Bonaparte Carbon Capture and Storage (CCS) Project – Referral Report

RECORD OF AMENDMENT

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Terms, abbreviations and acronyms

Term, abbreviation or acronym	Meaning
°	degrees
°C	degrees Celsius
%	percent
3D	three-dimensional
4D	four-dimensional
AAPA	Aboriginal Areas Protection Authority
AAQ NEPM	Ambient Air Quality National Environment Protection Measure
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABWM	Australian Ballast Water Management
AFMA	Australian Fisheries Management Authority (Cwlth)
AFZ	Australian fishing zone
ALA	atlas of living Australia
ALARP	as low as reasonably practicable
ALRA	*Aboriginal Land Rights (Northern Territory) Act 1976*
AMP	Australian marine park
AMSA	Australian Maritime Safety Authority (Cwlth)
ANZECC	Australia and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines 2018
ARMCANZ	Agriculture and Resources Management Council of Australia and New Zealand
ASS	acid sulphate soils
AUCHD	Australasian Underwater Cultural Heritage Database

Term, abbreviation or acronym	Meaning
AUV	autonomous underwater vehicle
BHD	backhoe dredger
BIA	biologically important area
BOM	Bureau of Meteorology
BOP	blow-out preventor
BTEX	benzene, toluene, ethylbenzene and xylenes
CCA	*Climate Change Act 2022*
CCES	CO_2 compression and export system
CCS	carbon capture and storage
CLV	cable lay vessel
CO	carbon monoxide
CO_2	carbon dioxide
CSD	cutter suction dredger
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTH / Cwlth	Commonwealth
dB	decibel
DLNG	Darwin LNG
DLRM	Department of Land Resource Management
DNP	Director of National Parks (Cwlth)
DO	dissolved oxygen
DoSF	Declaration of Identified Greenhouse Gas Storage Formation
DP	dynamic positioning
DPIRD	Department of Primary Industries and Regional Development (Western Australia)

Term, abbreviation or acronym	Meaning
DSDMP	dredging and spoil disposal management plan
EAA	East Asian-Australasian
EcOz	EcOz environmental consultants
EEZ	exclusive economic zone
EIA	environmental impact assessment
EP	environment plan
EP Act	*Environmental Protection Act 2019*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
EPBC Regulations	Environment Protection and Biodiversity Conservation Regulations 2000 (Cwlth)
ERAs	environmentally relevant activities
ERM	Environmental Resources Management Australia Pty Ltd
ESD	ecological sustainable development
FFPV	flexible fall pipe vessel
g	grams
g/L	grams per litre
GEP	gas export pipeline
GGIS	greenhouse gas injection and storage
GHG	greenhouse gas
GPS	global positioning system
Gt	gross tonnage
ha	hectares
HDD	horizontal directional drilling
HILs	health investigation levels

Term, abbreviation or acronym	Meaning
HWM	high water mark
Hz	hertz
IBA	important bird area
IEA	International Energy Agency
IECA	International Erosion Control Association 2008 guidelines
ILNG	Ichthys liquefied natural gas
IMO	International Maritime Organization
IMR	inspection, maintenance and repair
IMS	invasive marine species
in^3	cubic inch
INPEX	INPEX Operations Australia Pty Ltd
INPEX Australia	Australian subsidiaries of INPEX Corporation including INPEX Browse E&P Pty Ltd
IPA	Indigenous protected area
ISO	International Standards Organisation
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
JV	joint venture
KEF	key ecological feature
kHz	kilohertz
km	kilometre
km^2	square kilometre
km/h	kilometres per hour
L	litre
LAT	lowest astronomical tide

Term, abbreviation or acronym	Meaning
LBL	long baseline
LNG	liquefied natural gas
m	metre
m^2	square metres
m^3	cubic metres
m/s	metres per second
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973/1978
MASDP	Middle Arm Sustainable Development Precinct
MBES	multibeam echo sounders
MDO	marine diesel oil
MEG	monoethylene glycol
MFE	mass flow excavation
MFO	Marine Fauna Observer
mg/L	milligrams per litre
MGO	marine gas oil
MHWS	mean high water spring
mL	millilitre
MLWN	mean low water neap
mm	millimetre
MMV	measurement, monitoring and verification
MNES	Matters of National Environmental Significance
MODU	jack-up rig or moored semi-submersible mobile offshore drilling unit
MP	marine park
MPI	Ministry for Primary Industries

Term, abbreviation or acronym	Meaning
MSL	mean sea level
MSS	marine seismic survey
MSV	multi-purpose support vehicle
MT	million tonnes
mtpa	million tonnes per annum
NAXA	North Australian Exercise Area
NGER	National Greenhouse and Energy Reporting
NGER Act	*National Greenhouse and Energy Reporting Act 2007* (Cwlth)
NIAA	National Indigenous Australians Agency
NIW	nationally important wetlands
NLC	Northern Land Council
nm	nautical miles
NMR	north marine region
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NO_X	nitrogen oxides
NO_2	nitrogen dioxide
NPF	Northern Prawn Fishery
NPI	national pollutant inventory
NR	natural resources
NSW	New South Wales
NT	Northern Territory
NT DAF	Northern Territory Department of Agriculture and Fisheries

Term, abbreviation or acronym	Meaning
NT DEPW	Northern Territory Department of Environment, Parks and Water
NT DPIR	Northern Territory Department of Primary Industries and Resources
NT EPA (NT EP Act)	*Northern Territory Environment Protection Act 2019*
NTG	Northern Territory government
NTSC	Northern Territory Seafood Council
NTU	nephelometric turbidity unit
NUI	normally unattended installation
NWCS	North-west cable system
O_3	ozone
OCP	organochlorine pesticide
ODA	onshore development area
OPEP	oil pollution emergency plan
OPGGS Act	*Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cwlth)
OPGGS (E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cwlth)
OPP	organophosphate pesticide
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PDA	pipeline development area
PFAS	perfluoroalkyl and polyfluoroalkyl substances
PM_{10} and $PM_{2.5}$	particulate matter less than 10microns
PMST	Protected Matters Search Tool
ppt	parts per thousand

Term, abbreviation or acronym	Meaning
PTS	permanent threshold shift
Ramsar Convention	The Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the Ramsar Convention)
RFPA	Reef Fish Protected Area
RFSU	ready for start-up
ROV	remotely operated vehicle
S	south
SBT	southern bluefin tuna
SHB	split hopper barges
SO_2	sulphur dioxide
SOPEP	shipboard oil pollution emergency plan
SOWER	Southern Ocean whale and ecosystem research
SPFO	subsea power and fibre optic
SPL	sound pressure level
SPRAT	species profile and threats
SSDV	side stone dump vessel
SSS	side scan sonar
SQGV	sediment quality guideline value
Tn	tonne
TBT	tributyltin
TEC	threatened ecological community
TLC	Tiwi Land Council
TP	total phosphorus
TPH	total petroleum hydrocarbons
TPWC	Territory Parks and Wildlife Conservation

Term, abbreviation or acronym	Meaning
TPWC Act	*Territory Parks and Wildlife Conservation Act 1976* (NT)
TRH	total recoverable hydrocarbons
TSHD	trailing suction hopper dredger
TSSC	threatened species scientific committee
TTS	temporary threshold shift
TWP	Territory Wildlife Park
USAT	United States Army transport
USBL	ultra short baseline
UXO	unexploded ordinance
VOCs	volatile organic compounds
WA	Western Australia
WOMP	well operations management plan
WoNS	weeds of national significance
WTBF	Western Tuna and Billfish Fishery
WWIA	working with Indigenous Australians
µS	microSiemens

EXECUTIVE SUMMARY

Proposal description

INPEX Corporation and its subsidiaries are actively working to decarbonise their operations and deliver a stable supply of diverse and clean energy sources. Carbon capture and storage (CCS) is a safe and proven emissions reduction technology that can be applied to liquefied natural gas (LNG) production to capture naturally occurring carbon dioxide (CO_2) from the hydrocarbon reservoir stream.

INPEX Operations Australia Pty Ltd (INPEX) is the Operator of the Bonaparte CCS Assessment Joint Venture (JV) on behalf of INPEX Browse E&P Pty Ltd, TotalEnergies CCS Australia Pty Ltd and Woodside Energy Ltd. As Operator, INPEX is exploring the opportunity to develop sequestration infrastructure, including an offshore pipeline and subsea facilities for the transport of CO_2 from an onshore inlet station on Middle Arm, through Darwin Harbour, to a saline aquifer in the Petrel Sub-Basin, which is located within the greenhouse gas (GHG) assessment permit area G-7-AP Project (refer to Figure ES-1)

The proposed action that would be assessed as part of this referral submission includes the components of the Project that sit within the Northern Territory jurisdiction (onshore and in Northern Territory waters), including the onshore inlet station, CO_2 transport pipeline and subsea power and fibre optic (SPFO) cable that extend to the limits of Northern Territory coastal waters. A referral under the EPBC Act has also been prepared (in parallel) in relation to the entire Project (including Commonwealth waters).

The following infrastructure is proposed to be installed for the Project:

- An onshore inlet station that would receive, amalgamate, filter, and meter CO_2 for export via the CO_2 pipeline and would include provisions for potential booster pumping equipment.
- CO_2 transport pipeline and subsea power and fibre optic cables (SPFO) located between the onshore inlet station (NT) and boundary of the Northern Territory waters.

Activities required to be undertaken to support the proposed Project include:

- geophysical and geotechnical surveys of the CO_2 transport pipeline and subsea infrastructure
- pre-lay and post-lay surveys of the CO_2 transport pipeline, subsea infrastructure and onshore infrastructure
- site establishment and construction of an onshore inlet station.
- shore crossing trench and shore-pull preparations for CO_2 transport pipeline and cables
- dredging (trenching) within Darwin Harbour and spoil disposal activities at existing spoil grounds in the Beagle Gulf
- pre-lay span rectification, foundation installation and cable crossings
- pipelay
- rock armouring of pipeline within Darwin Harbour
- SPFO cable(s) installation
- flooding, cleaning and gauging and testing - mechanical completion of CO_2 transport pipeline
- pre-commissioning including dewatering, drying (mono ethylene glycol (MEG) and air discharges) and preservation with nitrogen of the CO_2 transport pipeline

- commissioning
- CO_2 transport pipeline first fill with CO_2.
- start-up operations
- decommissioning and abandonment.

Environmental assessment and management

An assessment of the potential impacts of the proposed Project on the Northern Territory Environment Protection Authority (NT EPA) environmental factors identified nine of the listed 14 environmental factors may be impacted (Table ES-1).

A systematic risk assessment process was adopted for the environmental management of the activities required under this proposal. This process aligns with INPEX's Environmental Policy, which requires the identification of environmental hazards and risks associated with business activities, and management of these to levels that are 'as low as reasonably practicable' (ALARP). Environmental management frameworks have been developed and are proposed to be implemented to manage potential impacts to ALARP; and include a suite of management actions/controls. A summary of proposed management actions/controls applicable to each of the nine environmental factors is provided in Table ES-1.

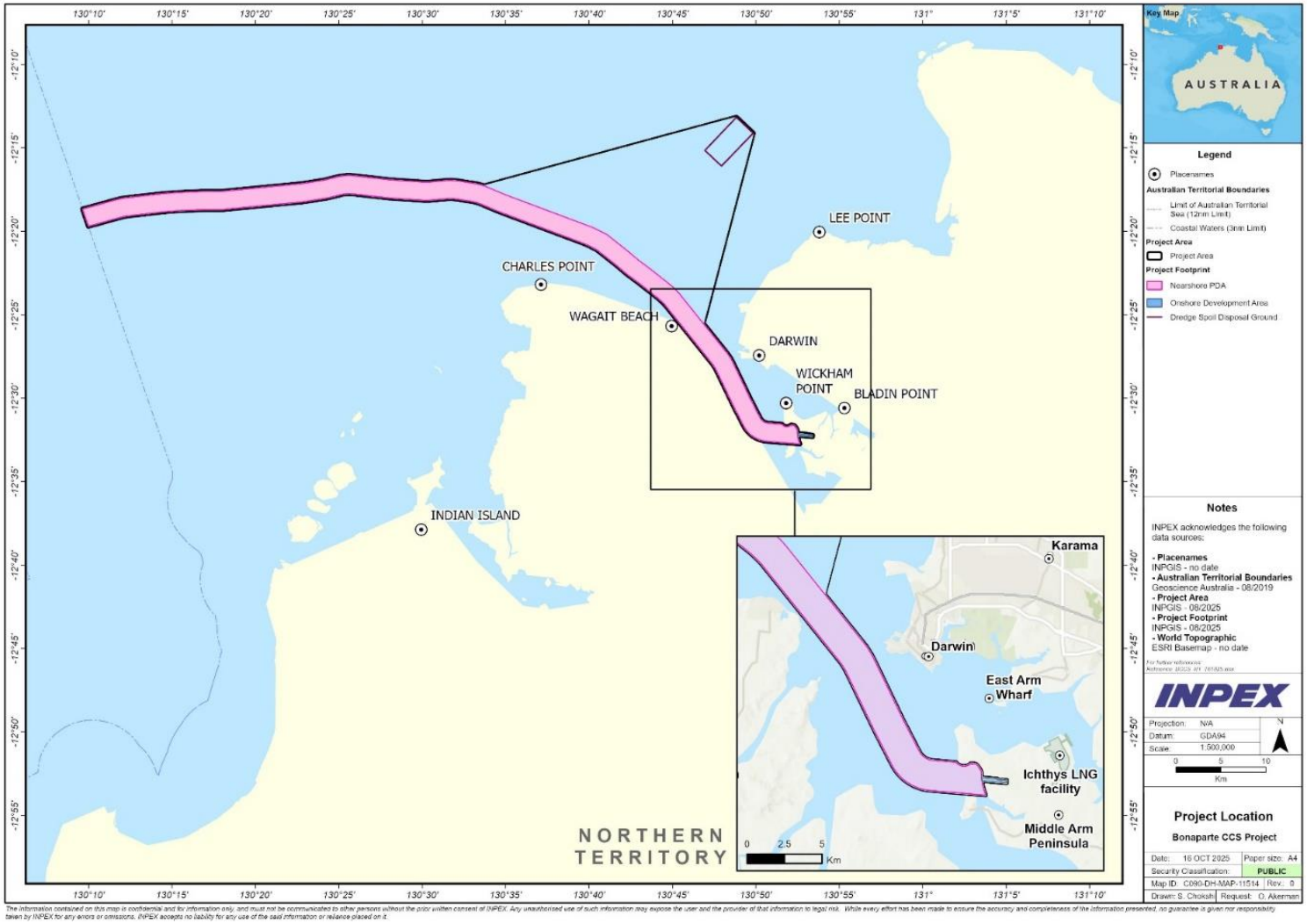


Figure ES-1: Location of proposed activities

Table ES-1: Environmental factors potentially impacted by proposed activities

NT EPA factor	Environmental values and sensitivities	Potential impact	Key management controls
Land – terrestrial environmental quality	Quality of soils, including chemical, physical, biological and aesthetic qualities that support life	General management and mitigation measures for potential impacts on the terrestrial environmental quality: • A construction environmental management plan (CEMP) would be developed and implemented. The CEMP would include management measures for the following: - vegetation clearing, earthworks and rehabilitation - introduction of weed and pests - dust, erosion and sediment control - surface water runoff and drainage - onshore spill prevention and response - waste management - chemical selection and approval.	
		Impacts to land and soils due to acid sulphate soils (ASS) disturbance	• Undertake geophysical and geotechnical surveys to inform presence and extent of ASS/PASS within the nearshore pipeline development area and onshore development area. • Development and implementation of an acid sulphate soils management plan. • Disposal management of ASS include neutralising and re-covering with clean fill or disposing off site and excavated ASS material may be disposed of at the offshore disposal ground.
		Impacts to land and soils due to soil erosion and sedimentation	• Mangroves would be cleared in a way that minimises disturbance of the root system (such as cutting off the mangroves at root level or pushing the vegetation over). • Weed infestation would be quantified prior to any vegetation clearing in areas weeds are anticipated in the onshore development area. • Cleared vegetation would be mulched and stockpiled on site boundaries (outside the intertidal zone) or off site. Where possible, the mulch would be used for both rehabilitation and soil stabilisation to prevent erosion. • Temporarily disturbed areas within the onshore development area would be revegetated and rehabilitated following completion of construction activities. • Large-scale vegetation clearing would be undertaken preferentially in dry season conditions to avoid potential erosion risks associated with monsoon rains in the wet season. • Erosion risks would be managed in accordance with a site-specific erosion and sediment control plan. • Erosion protection infrastructure would be installed to ensure that sediment is contained within the site boundaries as far as possible. • If soil erosion is evident, exposed surfaces would be stabilised using appropriate management techniques. • Clearing would not exceed the area designated.
		Impacts to the quality and integrity of land and soils due to unplanned hydrocarbon/ chemical	• An emergency response plan would be developed and implemented. • The *Dangerous Goods Act 1998* (NT) would be complied with. • Chemicals and hazardous substances used during construction would be selected and managed to minimise potential adverse environmental impact associated with their transport, transfer, storage, use and disposal. • Spill kits would be available, maintained and accessible locations within work areas. • During construction, appropriate temporary containment facilities (e.g. bunding) would be utilised for the storage of chemicals, fuels and hazardous wastes. • Personnel who routinely handle hazardous materials or wastes would receive training in handling, transporting and storing hazardous materials or wastes, and spill clean-up techniques and practices. • Safety Data Sheets would be available to aid in the identification of appropriate spill clean-up and disposal methods.
		Impacts to the quality and integrity of land and soils due to unplanned CO_2 release	• The CO_2 transport pipeline would be designed to protect against threats to integrity including impact, corrosion, running ductile fracture and embrittlement. Design codes and material specifications would be compliant with the relevant Australian and international standards for transporting CO_2. • Testing would be undertaken prior to commissioning to confirm integrity of the CO_2 transport pipeline.

NT EPA factor	Environmental values and sensitivities	Potential impact	Key management controls
			• IMR activities would be conducted throughout operations, including monitoring the transport pipeline corrosion protection system, to manage the integrity of subsea infrastructure. • Compliance with obtained pipeline licences in accordance with the *Energy Pipelines Act* and PLSA (subject to amendment of legislation).
Land – terrestrial ecosystems	Migratory, threatened and habitat for significant fauna species, including shorebirds utilising mangrove and woodland communities within the Project area.	General management and mitigation measures for potential impacts on the terrestrial ecosystems: • Siting of the pipeline and other infrastructure would predominantly be within previously disturbed areas and areas zoned for Utilities. • A construction environmental management plan (CEMP) would be developed and implemented. The CEMP would include management measures for the following: - vegetation clearing, earthworks and rehabilitation - introduction of weed and pests - dust, erosion and sediment control - surface water runoff and drainage - onshore spill prevention and response - waste management - chemical selection and approval.	
		Impacts on terrestrial ecosystems from vegetation removal, habitat loss and fragmentation	• The vegetation clearing footprint for the onshore development area (ODA) and nearshore Pipeline Development Area (PDA) would be minimised during the design phase, subject to constructability and safety considerations. • Areas to be cleared would be clearly identified prior to work commencing. Clearing boundaries would be marked in the field and on-site plans and register of clearing activities will be maintained. • Mangroves would be cleared in a way that minimises disturbance of the root system (such as cutting off the mangroves at root level or pushing the vegetation over). • Cleared vegetation would be mulched and stockpiled on site boundaries (outside the intertidal zone) or off site. Where possible, the mulch would be used for both rehabilitation and soil stabilisation to prevent erosion. • Temporarily disturbed areas within the ODA would be revegetated and rehabilitated following completion of construction activities.
		Impacts on terrestrial ecosystems from light emissions	• Lighting during construction and operations at the ODA would be limited to the minimum to meet personnel safety requirements. • Construction of the onshore infrastructure would primarily be conducted during daylight hours, where practicable.
		Impacts on terrestrial ecosystems from noise and vibration emissions	• Compliance with the requirements of the: - *Waste Management and Pollution Control Act 1998* (NT) - *Work Health and Safety (National Uniform Legislation) Act 2011* (NT) - National code of practice for noise management and protection of hearing at work [NOHSC: 2009 (2004)] (Commonwealth of Australia 2004). • Traffic management plan. • Construction works limited to daytime where practicable. • Community notifications and hotline for feedback.
		Impacts on terrestrial ecosystems from improper waste management	• During construction appropriate temporary containment facilities would be available for storing wastes. • All waste storage receptacles (e.g. skips and bins) would have covers and be fit for purpose and in good condition. • A suitably licenced waste contractor would be engaged for waste disposal.
		Impacts on terrestrial ecosystems from unplanned discharges of hydrocarbons or chemicals	See Land – terrestrial environmental quality

NT EPA factor	Environmental values and sensitivities	Potential impact	Key management controls
		Impacts on terrestrial ecosystems from the unplanned introduction of weeds, pest and pathogens	• Machinery used for earthmoving and vegetation clearing would be cleaned and inspected prior to commencement of work to remove any foreign material. • Topsoil containing high densities of weed seeds would not be used in rehabilitation. • Weed infestation would be quantified prior to any vegetation clearing in areas weeds are anticipated in the onshore development area.
		Impacts on terrestrial ecosystems due to changes in bushfire risk	• Fire-fighting equipment would be available at the work sites. • Designated smoking areas would be assigned. • Hot work procedures would be implemented for cutting, welding and any other work considered to have a high potential to start a fire. Smoke detection in equipment rooms. • Power generator enclosures would be equipped with fire and gas detection.
		Impacts on terrestrial ecosystems as a result of injury or entrapment of fauna	• Clearing activities would be undertaken in such a manner to allow animals to move into adjacent surrounding vegetation. • "High-risk" entrapment areas would have sloping egress ramps to prevent fauna entrapment. • Regular monitoring of construction areas would be undertaken to identify any trapped fauna, and any required removal would be completed by a suitably qualified wildlife handler. • Vehicle speed limits within construction areas would be enforced.
		Impacts on terrestrial ecosystems due to an unplanned CO_2 release	See Land – terrestrial environmental quality
Sea – coastal processes	Mangrove ecosystems and coastal morphology. Coastal processes in Darwin Harbour include wave action, tidal action, longshore drift, cyclones, surface water drainage and sea level rise.	Physical presence of infrastructure changes local geophysical and hydrological processes.	• Temporary structures required for construction of the pipeline would be removed following installation. • The ODA would be reinstated to match the existing topography following installation of the pipeline. • Erosion risks would be managed in accordance with a site-specific erosion and sediment control plan.
		Seabed disturbance during trenching activities changes seabed topography and sedimentation.	• Geophysical and geotechnical pre-lay surveys would be undertaken to inform the final pipeline route, seabed intervention requirements and identify protruding seabed features that may need to be avoided. • Sediment transport modelling would be undertaken to inform a sediment transport impact assessment to understand the potential extent of excess suspended sediment concentrations and sediment deposition that may result during dredging and spoil disposal activities. • A dredging and spoil disposal management plan (DSDMP) would be developed following formal risk assessment.
		Onshore site preparation, trenching and pipelay activities cause temporary changes in geophysical and hydrological processes.	See above, Sea – coastal processes potential impact "physical presence of infrastructure changes local geophysical and hydrological processes."
Sea – marine environmental quality	Quality of the marine waters, sediment and biota. Ecosystem health condition.	Sedimentation and turbidity impacts from seabed disturbance	• Geophysical and geotechnical pre-lay surveys would be undertaken to inform the final pipeline route, seabed intervention requirements and identify protruding seabed features that may need to be avoided. • Sediment transport modelling would be undertaken to inform a sediment transport impact assessment to understand the potential extent of excess suspended sediment concentrations and sediment deposition that may result during dredging and spoil disposal activities. • A dredging and spoil disposal management plan (DSDMP) would be developed following formal risk assessment. • Dredging vessels would be equipped with navigational aids to maintain dredging within permitted footprint. • Trenching and management of acid sulfate soil will follow the '*Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management*' (Water Quality Australia 2018).
		Water quality impacts from vessel discharges	• Project vessels would comply with the *Marine Pollution Act 1999* (Northern Territory), Marine Pollution Regulations (Northern Territory) and Darwin Port requirements, specifically: - Marine Order 94 (marine pollution prevention - packaged harmful substances).

NT EPA factor	Environmental values and sensitivities	Potential impact	Key management controls
			- Marine Order 95 (pollution prevention – garbage), as appropriate to class. - Marine Order 96 (pollution prevention – sewage), as appropriate to class. • A waste management plan would be developed with consideration of the threat abatement plan for the impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (DoEE 2018). • Chemicals and hazardous substances used during construction would be selected and managed to minimise potential adverse environmental impact associated with their transport, transfer, storage, use and disposal.
		Water quality impacts from subsea discharges and accidental hydrocarbon release	• Project vessels would comply with the requirements of: - the *Navigation Act 2012* (Cwlth). - the *Marine Pollution Act 1999* (NT). - relevant marine orders. • project vessels would have a Ship Oil Pollution Emergency Plan (SOPEP) (as appropriate to vessel class). • Bunkering procedures would be developed and implemented if bunkering at sea is required. • Safety exclusion zones would be established around Project construction/installation vessels, and these would be communicated to marine users. • compliance with vessel speed restrictions applied within Darwin Harbour. • Spill kits would be available on-board vessels. • Hydrocarbon spill modelling would be undertaken to inform an assessment of potential impacts and to inform if additional management measures are required. • A chemical selection and approval process would be developed.
		Unplanned CO_2 release	• The CO_2 transport pipeline would be designed to protect against threats to integrity including impact, corrosion, running ductile fracture and embrittlement. Design codes and material specifications would be compliant with the relevant Australian and international standards for transporting CO_2. • The CO_2 transport pipeline would be trenched and rock armouring installed within sections of Darwin Harbour to protect the pipeline from external impact. • Testing would be undertaken prior to commissioning to confirm integrity of the CO_2 transport pipeline. • IMR activities would be conducted throughout operations, including monitoring the CO_2 transport pipeline corrosion protection system. • Compliance with obtained pipeline licences in accordance with the *Energy Pipelines Act* and PLSA (subject to amendment of legislation).
Sea – marine ecosystems	Critical marine and coastal fauna habitat for nesting, breeding or foraging; seagrass meadows, sponge gardens, coral reefs; mangrove communities and salt marshes; marine and migratory species; ecological functions and processes.	Impacts on marine ecosystems from seabed disturbance	• Geophysical and geotechnical pre-lay surveys would be undertaken to inform the final pipeline route, seabed intervention requirements and identify protruding seabed features that may need to be avoided. • Sediment transport modelling would be undertaken to inform a sediment transport impact assessment to understand the potential extent of excess suspended sediment concentrations and sediment deposition that may result during dredging and spoil disposal activities. • A dredging and spoil disposal management plan (DSDMP) would be developed following formal risk assessment. • Dredging vessels would be equipped with navigational aids to maintain dredging within permitted footprint. • Trenching and management of acid sulfate soil would follow the '*Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management*' (Water Quality Australia 2018). • Procedures would be developed and implemented for the following activities: - pipeline installation - buckle and recovery - anchoring management - cable installation. • Infrastructure would be placed on the seabed within the design footprint using positioning technology.

NT EPA factor	Environmental values and sensitivities	Potential impact	Key management controls
			• Monitoring and maintenance of subsea infrastructure would be undertaken to manage any scour or pipeline movement to within integrity envelope.
		Impacts on marine ecosystems from underwater noise	• Vessel contractors would comply with relevant requirements of the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05) Interacting with cetaceans.
		Impacts on marine ecosystems from light emissions	• Vessel lighting would be limited to the minimum required for navigational and safety requirements, with the exception of emergency events. • Vessel personnel would receive an induction/training to inform them of the requirements to minimise external artificial lighting. • Consideration would be given to the National Light Pollution Guidelines for Wildlife 2023, as relevant to Project activities.
		Impacts on marine ecosystems from routine vessel discharges	See Sea – marine environmental quality
		Impacts on marine ecosystems from unplanned loss of hazardous or non-hazardous waste	See Sea – marine environmental quality
		Impacts on marine ecosystems, including benthic habitats, from unplanned seabed disturbance	See above, Sea – marine ecosystems "potential impact on marine ecosystems from seabed disturbance".
		Impacts on marine ecosystems from unplanned introduction and establishment of IMS	• Project vessels would have an antifouling coating applied that is in accordance with the prescriptions of the International Convention on the Control of Harmful Anti-fouling systems on ships, 2001, and the *Protection of the Sea (Harmful Antifouling Systems) Act 2006* (Cwlth). • Project vessels would comply with the requirements of the *Biosecurity Act 2015* (Cwlth). • Project vessels would have an approved ballast water management plan and valid ballast water management certificate, unless an exemption applies or is obtained. • Project vessels operating within Australian seas would manage ballast water discharge using one of the following approved methods of management (DAWE 2020): - An approved ballast water management system. - Ballast water exchange conducted in an acceptable area. - Use of low-risk ballast water (e.g. fresh potable water, water taken up on the high seas, water taken up and discharged within the same place). - Retention of high-risk ballast water on board the vessel. - Discharge to an approved ballast water reception facility. • A biofouling risk assessment would be undertaken by a suitably qualified biofouling inspector for all international vessels, and mitigation measures commensurate to the risk would be implemented, as appropriate.
		Impacts on marine ecosystems from unplanned marine fauna interaction	• Project vessels would operate in accordance with EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05). • Project vessels would comply with Darwin Harbour speed restrictions. • Procedures would be developed and implemented during dredging to for reduce risk of marine fauna entrainment.
		Impacts on marine ecosystems from unplanned hydrocarbon release (vessel collision)	See Sea – marine environmental quality
		Impacts on marine ecosystems from unplanned CO_2 release	See Sea – marine environmental quality

NT EPA factor	Environmental values and sensitivities	Potential impact	Key management controls
Air – air quality	The nearest sensitive receptors are the residential areas of Palmerston, approximately 8 km to the north-east of the onshore inlet station at the nearest point. Other sensitive receptors to construction-related dust emissions include the surrounding vegetation, including sensitive mangrove communities.	Air quality impacts from fugitive dust emissions and diesel particulate during construction	• A construction environmental management plan (CEMP) would be developed and implemented. The CEMP would include management measures to manage generation of dust during clearing and earthworks, including: - revegetation of exposed areas as soon as practicable - covering of soil stockpiles as soon as practicable - application of dust suppression/binding agents to exposed stockpiles • use of water carts during dry and windy conditions. • Vessels (as applicable to vessel and engine size, type and class) would comply with the air emission, ODS, and energy efficiency requirements of Marine Order 97 including sulfur content of fuel oil. • Construction equipment and vehicles would be maintained in accordance with manufacturer specifications and turned off when not in use. • Implementation of an INPEX Australia contractor emissions reduction program to assist contractors to identify and implement areas where they can reduce emissions.
		Air quality impacts associated with operational venting during operations	• Development of specific plans, including exclusion zones, for temporary onshore vent stacks for planned venting at the inlet station. • Development of standard operating procedures (SOPs) for depressurisation including pigging activities.
		Air quality impacts associated with an unplanned CO_2 release	• See Land – terrestrial environmental quality
People – community and economy	Commercial fisheries, defence areas, shipping, tourism, recreational activities and existing infrastructure for petroleum and telecommunications.	Impacts on community and economy due to physical presence – disruption to other marine users	• Vessels to adhere to the navigation safety requirements including the *Navigation Act 2012* and subsequent Marine Orders. • Establishment of safety/exclusion zones around construction and installation vessels (e.g. SWLB) as required. • Ongoing notifications/consultation with stakeholders, such as a notice to mariners. • Should cable crossings be required, crossing supports such as mattresses or rock berms would be installed over the existing infrastructure. • Consultation with Department of Defence regarding planned military exercises. • Establishment of an agreement with Department of Defence for activities within the NAXA.
People – culture and heritage.	The Project area is within the traditional country of the Larrakia people who are recognised as the Traditional Owners and custodians of the Darwin region and whose cultural places were and still are located throughout Darwin Harbour and the greater Darwin city area. The waters of Darwin Harbour, Bynoe Harbour, Shoal Bay, and the Project area contains known heritage sites.	General management and mitigation measures for potential impacts on culture and heritage: • Develop and implement a Heritage Management Plan for activities in onshore development area and Nearshore pipeline development area. • Undertake ongoing consultation with Larrakia to inform Aboriginal heritage management measures. • Implementation of the following additional management measures onshore to reduce and minimise impacts on cultural and heritage values: - consultation with Larrakia people and organisations, including Larrakia Development Corporation, Larrakia Nation Aboriginal Corporation, Gwalwa Daraniki Association and the INPEX Larrakia Advisory Committee, during planning of geotechnical surveys and construction works - planning pre-construction surveys, in consultation with Larrakia people and their representatives - site protection measures, such as flagging/fencing off any heritage sites within proximity of the proposed impacts areas to avoid damage to sites during works (as determined in consultation with Larrakia representatives) - implementation of a chance find procedure during ground disturbance activities - contractor and work site cultural heritage inductions for all employees and contractors to point out importance of sites to Larrakia and the legislative protection of the sites.	
		Impacts on maritime heritage from seabed disturbance	• Geophysical and geotechnical pre-lay surveys would be undertaken to inform final pipeline route and seabed intervention requirements. • Geophysical survey data would be analysed to identify any archaeological/heritage values within the Nearshore pipeline development area. Analysis undertaken by a qualified maritime archaeologist in accordance with the s3.6 of DCCEW guidelines - Accessing and Managing Impacts to Underwater Cultural Heritage in Australian Waters • Maritime cultural heritage would be avoided through pipeline routing. • AAPA Authority Certificates would be obtained that cover the area of works within NT, and the conditions of obtained certificates would be complied with.

NT EPA factor	Environmental values and sensitivities	Potential impact	Key management controls
			• Location data for all maritime heritage sites (including any applicable protection zones) and restricted works areas identified on AAPA Authority Certificates, would be provided to vessel contractors for inclusion in vessel navigation systems. • Exclusion zones and restricted works area requirements of registered sites, including anchoring exclusion zones would be included in Anchor Management Plans. • An unexpected maritime archaeology chance finds protocol with stop work and notification procedures would be implemented during construction and installation activities.
		Disturbance of onshore sacred sites, cultural and heritage	• Areas to be cleared would be clearly identified prior to work commencing. Clearing boundaries would be marked in the field and on-site plans and register of clearing activities would be maintained.
People – human health	The Project area is in close proximity to coastal communities of Darwin Harbour, including Bladin Point, Cox Peninsula and Darwin city centre.	Impacts on community and economy due accidental CO_2 leak	• See Sea – marine environmental quality

Stakeholder engagement

Pre-referral stakeholder consultation for the proposed Bonaparte CCS Project was undertaken to obtain advice on appropriateness of the proposed management controls within the referral and obtain advice on requirement notifications and ongoing engagement requirements for the Bonaparte CCS Project Stakeholder Engagement Plan. Once the proposed project activities have commenced, ongoing engagement would be undertaken to:

- respond to stakeholder requests for information about project activities, including management of feedback or any concerns
- provide sufficient notice to key stakeholders prior to the commencement of upgrades, construction and commissioning works to ensure effective communication of the timing of works, and the associated safety and environmental measures
- proactively provide information throughout the proposed activities above, to support safety outcomes and manage potential community impacts and;
- provide confirmation of completion of the proposed activities above to communicate final results and acknowledge the community's support.

Conclusion

Based on the systematic risk assessment process, the residual risk for the majority of potential impacts associated with the proposed activities are considered low. Where potential impacts have a residual risk of "moderate", they are presented in Table ES-2.

Table ES-2: Summary of potential impacts with residual risk moderate

Potential impact	Consequence	Likelihood	Residual risk
Sedimentation and turbidity impacts from seabed disturbance	Minor	Possible	Moderate
Impacts on marine environmental quality from accidental hydrocarbon release	Moderate	Highly Unlikely	Moderate
Impacts on marine ecosystems from seabed disturbance	Minor	Possible	Moderate
Impacts on marine ecosystems from unplanned introduction and establishment of IMS	Significant	Remote	Moderate
Impacts on marine ecosystems from unplanned hydrocarbon release (vessel collision)	Moderate	Highly Unlikely	Moderate

Potential impact	Consequence	Likelihood	Residual risk
Impacts on maritime heritage from seabed disturbance	Moderate	Highly unlikely	Moderate
Disturbance of onshore sacred sites, cultural and heritage	Moderate	Highly unlikely	Moderate
Impacts on community and economy due accidental CO_2 leak	Significant	Highly unlikely	Moderate

1 INTRODUCTION

The vision for carbon, capture and storage (CCS) in the Darwin area is for the development of a high-capacity hub (The Northern Territory Low Emissions Hub) that would support carbon dioxide (CO_2) sequestration from the two existing Liquefied Natural Gas (LNG) plants and new industries in the proposed Middle Arm Precinct.

INPEX Corporation and its subsidiaries are actively working to decarbonise their operations and deliver a stable supply of diverse and clean energy sources. CCS is a safe and proven emissions reduction technology that can be applied to LNG production and other CO_2 emitting industries (International Energy Agency 2021).

INPEX Operations Australia Pty Ltd (INPEX), is the Operator of the Bonaparte CCS Assessment Joint Venture (JV) on behalf of INPEX Browse E&P Pty Ltd, TotalEnergies CCS Australia Pty Ltd and Woodside Energy Ltd. As Operator, INPEX is exploring the opportunity to develop sequestration infrastructure, including an offshore pipeline and subsea facilities for the transport of CO_2 from an onshore inlet station on Middle Arm to a saline aquifer in the Petrel sub-basin, which is located within the greenhouse gas (GHG) assessment permit area G-7-AP (Figure 1-1). The geological storage formation (approximately 2,000 metres (m) below the seabed) in G-7-AP has been assessed to have large scale CO_2 storage characteristics. Appraisal data and subsurface modelling support an assessment that G-7-AP may have the capacity to store in excess of 300 million tonnes (MT) of CO_2, subject to further validation and regulatory approvals. The proposed transport facility would be designed to allow for sequestration to be performed at up to 10 MT per annum (mtpa).

The proposed Bonaparte CCS Project (the Project) would include a CO_2 transport pipeline extending from the onshore inlet station on Middle Arm, through Darwin Harbour, that links to the proposed manifold and injection well locations in G-7-AP (Figure 1-1). The Project is planned to be developed in phases, with the initial phase developing capacity to sequester at a rate of up to 8 mtpa and subsequent phase(s) planned to increase the capacity up to approximately 10 mtpa. The Project facilities are proposed to be designed for an operational life of approximately 30 years.

Third-party CO_2 sources are intended to be received from potential customers in the region through commercial agreements, including reservoir CO_2 from Ichthys LNG (ILNG) onshore facility. The Bonaparte CCS Project has an aspiration for future expansion to service anticipated CO_2 storage demand from across the Asia Pacific region.

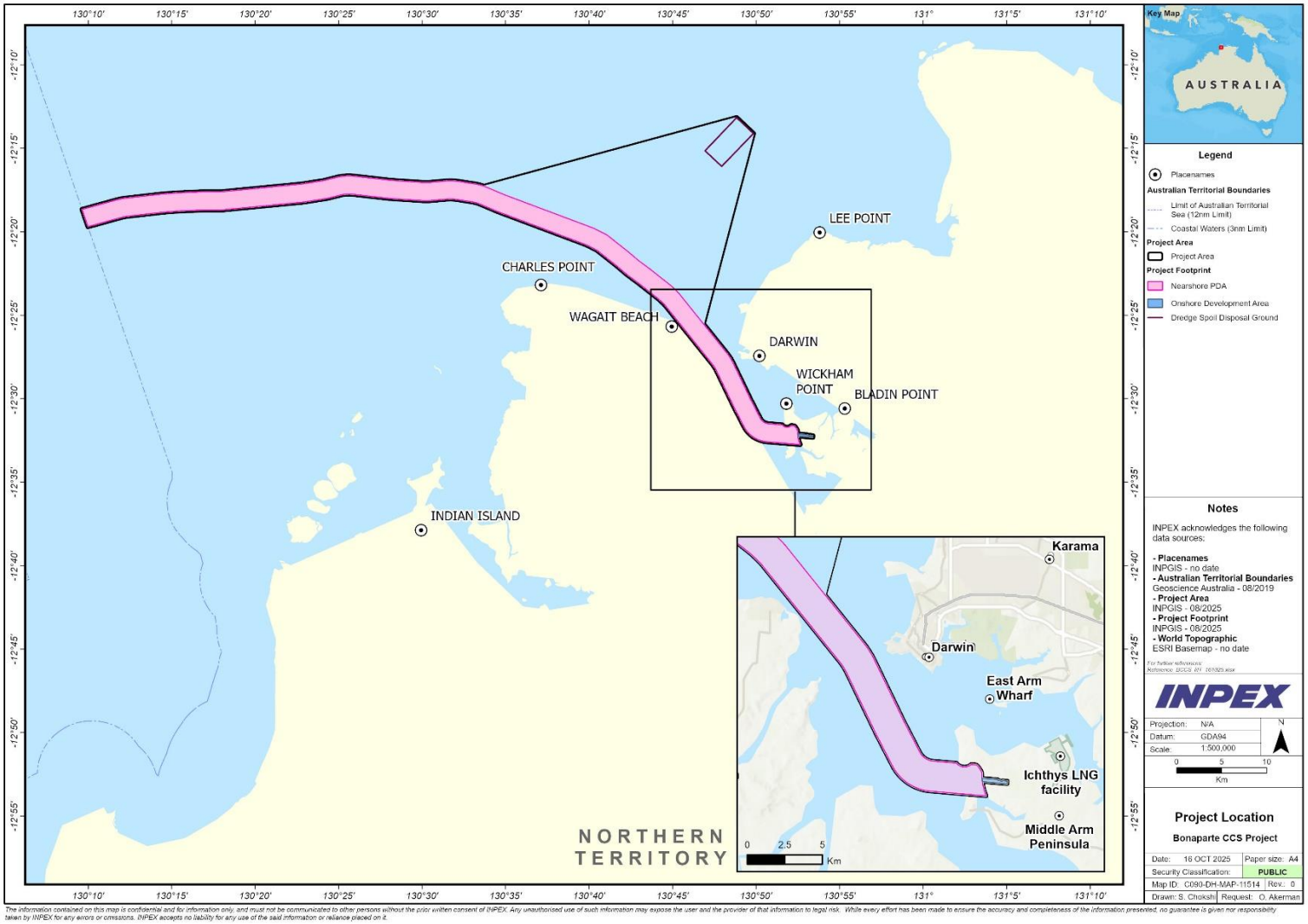


Figure 1-1: Overview of Project area

1.1 Background and Project justification

CCS is expected to play a key role in the transition to a low carbon society globally (International Energy Agency 2020; IPCC 2022). Under the International Energy Agency's updated net zero emissions scenarios, 1.2 gigatonnes of carbon dioxide (CO_2) needs to be sequestered by 2030 using CCS technologies (International Energy Agency 2022). The proposed location of the onshore inlet station is within close proximity to a number of heavy industry facilities at the Middle Arm Precinct and therefore presents a viable pathway for decarbonisation within the hard-to-abate sector. The Middle Arm Precinct has been master planned with a strategic environmental assessment currently underway under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) and the *Environment Protection Act 2019* (Northern Territory) via an Environmental Impact Statement.

Initial screening for the location of the storage formation for the Project was based on Geoscience Australia's assessment of CO_2 storage potential of the Petrel sub-basin (Consoli et al. 2013). The selected storage formation is within the G-7-AP permit area of the Petrel sub-basin in the Joseph Bonaparte Gulf. Suitability of the formation for CO_2 sequestration has been established through evaluation of three-dimensional (3D) seismic survey data and data from appraisal wells. The appraisal program included measurements and analysis for injectivity, CO_2 solubility in reservoir formation brine, routine core analysis, special core analysis and seal capacity. Key factors supporting the suitability of the storage formation for CO_2 storage are outlined in Section 3.2.

1.2 Purpose of this document

INPEX is referring the Project as a proposed action under the Northern Territory *Environment Protection Act 2019* (EP Act) through this referral submission.

This Referral Report provides the Northern Territory Environment Protection Authority (NT EPA) with the information required to determine if the proposed action that requires assessment under Section 48 of the EP Act and if so, the level of assessment that would be applied.

The purpose of this EP Act referral supporting information is to provide:

- a description of the components of the proposed Project and the activities to be undertaken;
- a description of the local and regional physical, ecological and socio-economic environmental context of the Project;
- a high-level assessment of Northern Territory EPA Environmental Factors and Values; and
- management and mitigation measures proposed to reduce potential adverse impacts to MNES and other protected matters under the EPBC Act.

The proposed action that would be assessed as part of this referral submission includes the components of the Project that sit within the Northern Territory jurisdiction (onshore and in Northern Territory waters), including the onshore inlet station, CO_2 transport pipeline and subsea power and fibre optic (SPFO) cable that extend to the limits of Northern Territory coastal waters. A referral under the EPBC Act has also been prepared (in parallel) in relation to the entire Project (including Commonwealth waters).

1.3 Overview of the proposed action

A high-level summary of the Project is provided in Table 1-1, with a detailed description is provided in Section 3.

Table 1-1: Summary of the Project

Element	Details
Location	Works and activities associated with the action would occur within the Middle Arm Peninsula terrestrial, shoreline and nearshore areas, adjacent and overlapping with the existing Ichthys gas export pipeline (GEP) beach valve precinct and GEP shore crossing areas, Darwin Harbour nearshore areas and Northern Territory waters.
Schedule	Works are expected to commence in 2028. Works would progressively occur until completed; provisionally estimated to be end Q2 2031.
Activities	• Construction and commissioning of an up to 22-inch carbon steel CO_2 transport pipeline extending ~90 km between the onshore inlet station and boundary of the Northern Territory waters. The total length of the CO_2 transport pipeline is approximately 260 km between the onshore inlet station and the sequestration site in the G-7-AP permit area in Commonwealth waters. • Construction and commissioning of an SPFO cable extending ~90 km between the onshore inlet station and boundary of the Northern Territory waters, adjacent to the CO_2 transport pipeline along the entire route, with an approximately 50 to 100 m offset. The total length of the SPFO cable is approximately 260 km between the onshore inlet station and the sequestration site in the G-7-AP permit area in Commonwealth waters. To provide redundancy, a back-up cable may also be installed in the shore crossing from the onshore inlet station into Darwin Harbour. • Activities supporting the construction and commissioning of the CO_2 transport pipeline and SPFO cable(s) include: - geophysical and geotechnical surveys of the CO_2 transport pipeline and subsea infrastructure. - Pre-lay and post-lay surveys of the CO_2 transport pipeline, subsea infrastructure and onshore infrastructure. - shore crossing trench and shore-pull preparation for CO_2 transport pipeline and cables - dredging (trenching) within Darwin Harbour and spoil disposal activities at existing spoil grounds in the Beagle Gulf - pre-lay span rectification, foundation installation and cable crossings - pipelay - rock armouring of pipeline within Darwin Harbour - SPFO cable(s) installation - flooding, cleaning and gauging and testing - mechanical completion of CO_2 transport pipeline - pre-commissioning including dewatering, drying (mono ethylene glycol (MEG) and air discharges) and preservation with nitrogen of the CO_2 transport pipeline - commissioning - CO_2 transport pipeline first fill with CO_2. - start-up operations. • Site establishment and construction of the onshore inlet station, to be situated in available land in cadastral Section 1896, adjacent to the existing Ichthys GEP beach valve station, on the west side of Wickham Point Road.

Element	Details
	• Connection of the CO_2 transport pipeline with the onshore pipelines coming from the CO_2 sources at the onshore inlet station. The onshore inlet station would include facilities and equipment to filter, and fiscally meter the CO_2 stream, including monitoring of key CO_2 stream components. • Operations, including transport of CO_2 and measurement, monitoring and verification (MMV) and inspection, maintenance and repair (IMR) of the CO_2 transport pipeline, cables and onshore station infrastructure. • Decommissioning and abandonment.
Battery limits	The 'battery limits' of the Northern Territory scope for the Project during construction, commissioning, operation and decommissioning commence at the onshore inlet station and extend to limit of the Northern Territory coastal waters.

1.4 Relationship with other proposed actions

Ichthys CCS Project

INPEX on behalf of Ichthys LNG Pty Ltd, is proposing to develop a buried onshore pipeline system between Ichthys LNG facility and the inlet to potential CO_2 sequestration projects. Furthermore, it will operate capture, dehydration and compression facilities within Ichthys LNG facility as part of an integrated CCS system (Figure 1-2).

The proposed onshore pipeline system would be comprised of two sections. The first section would extend from the Ichthys LNG facility boundary on Bladin Point to the proposed Bonaparte CCS Project onshore inlet station. The subsequent section would extend from the Bonaparte CCS Project onshore inlet station to a proposed CCS tie in/inlet station located adjacent to the Darwin LNG facility on Wickham Point.

In addition to the pipeline system on Middle Arm, the proposal includes the hot commissioning of the Ichthys LNG facility CCES and upgraded AGRUs, and the operations of the integrated CCS system to the point of custody transfer at a CCS sequestration project CO_2 onshore inlet station within the region.

A referral application supporting this project is planned to be submitted in Quarter 4 2025.

The submission of separate referrals for the respective Ichthys Carbon Capture and Storage Project and Bonaparte Carbon Capture and Storage Project is appropriate because:

- the Projects are owned by different JVs and would be managed separately by those JV's
- commercial agreements must be formed between the two Projects and are unlikely to be exclusive for either JV
- there are clear geographical boundaries between the Projects (i.e. between the interconnector pipelines and the inlet station tie-in valves)
- between the two referrals, all significant impacts of the two proposed actions are, or would be assessed; and
- both referrals have considered the cumulative impacts of the proposed actions.

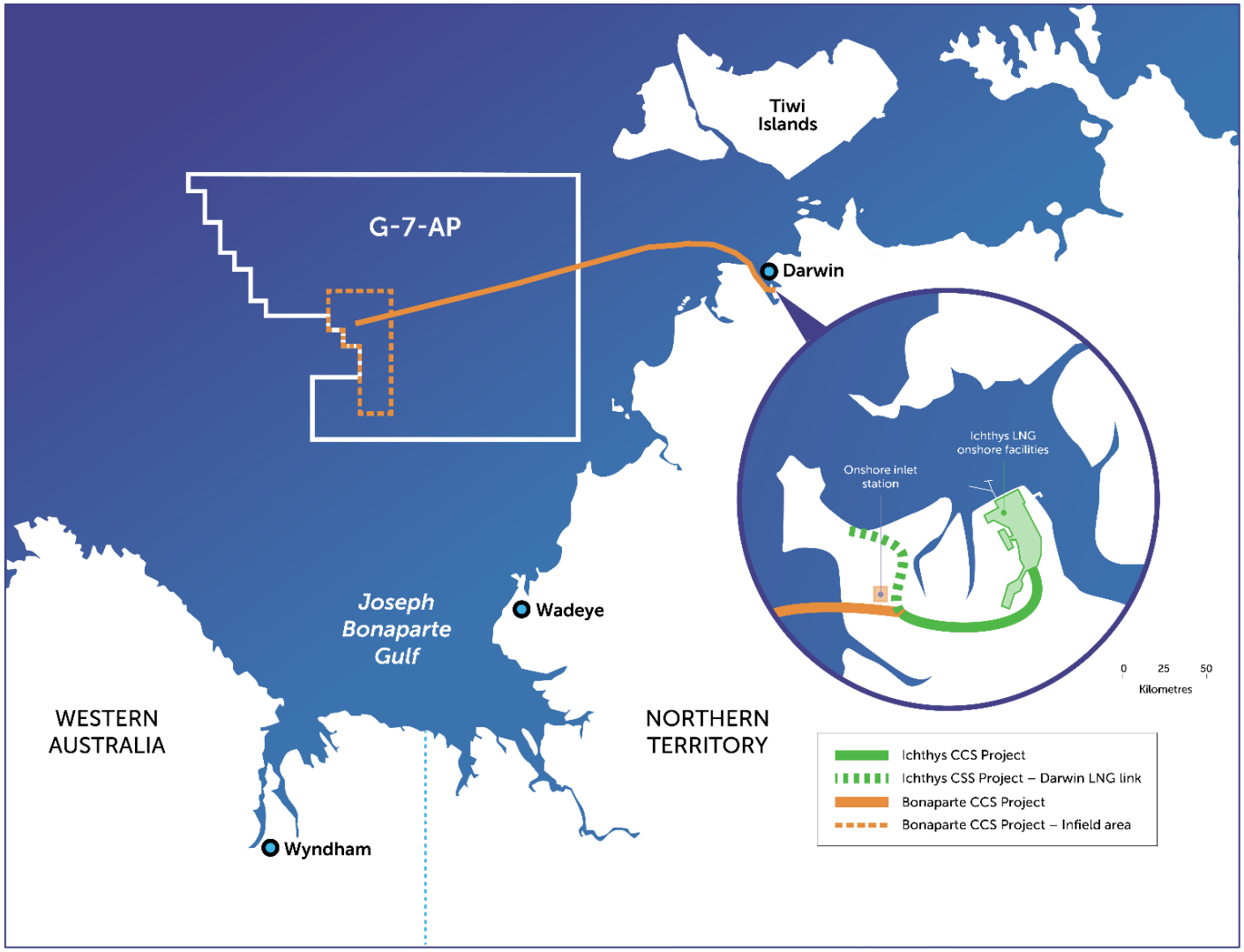


Figure 1-2: Ichthys and Bonaparte CCS projects

1.5 Proponent details

INPEX Operations Australia Pty Ltd (INPEX), a wholly owned subsidiary of INPEX Corporation, is the proponent and operator for the Project on behalf of the Bonaparte CCS joint venture parties.

The addresses of INPEX offices in Australia are as follows:

Perth office	Darwin office
Level 22, ENEX 100 100 St Georges Terrace Perth WA 6000	Level 8, Mitchell Centre 59 Mitchell Street. Darwin NT 0800

1.6 Publication statement

This Referral Report has been prepared by suitably qualified persons as outlined in Table 1-2.

Table 1-2: Suitably qualified persons involved in the preparation of the referral and impact assessment

Name	Experience
Bethan Parnum	Bethan Parnum is a Consulting Director with 20 years' experience, specialising in marine ecology, impact assessment and regulatory approvals for offshore industries. Bethan has worked on a range of large-scale project developments in project management and technical advisory roles. She is experienced in environmental approvals under Commonwealth and State/Territory legislation, including for projects in the Joseph Bonaparte Gulf.
Glenn Murray	Glenn has 15 years' experience in environmental impact assessment and project approvals, including consulting and regulatory roles for major projects across the energy, water, transport and mining sectors. Beyond his technical expertise, Glenn has considerable project management experience, including proponent-side approvals management roles. He has recent government regulatory experience as a Senior Impact Assessor for the Victorian Department of Transport and Planning, including contributions to Victorian government regulatory planning policy for new energy projects.

2 LEGISLATION

A summary of all relevant Northern Territory legislation is provided in Table 2-1. A summary of relevant Commonwealth legislation is provided in Table 2-2.

Table 2-1: Summary of relevant Northern Territory legislation

Legislation	Relevance
Dangerous Goods Act 1998 and Dangerous Goods Regulations 2017	The *Dangerous Goods Act 1998* is aimed at protecting the safety, health, and welfare of people and the environment. The Act establishes duties for the safe handling, storage, and transport of dangerous goods, outlines the responsibilities of manufacturers, handlers, and transporters, and specifies offences related to dangerous goods. The Act provides powers to appointed officers to enforce the Act, including issuing prohibition and improvement notices, and details the legal framework for prosecutions and appeals related to dangerous goods incidents The associated Dangerous Goods Regulations 2017 provide detailed requirements for the classification, packaging, labelling, and transport of dangerous goods.
Energy Pipelines Act 1981	The *Energy Pipelines Act 1981* regulates the construction, operation, and maintenance of pipelines used for conveying hydrocarbons for energy production. The Act does not currently cover CO_2 pipelines; however, they might be considered under the Act's provisions if they are used for energy-related purposes such as enhanced oil recovery or CCS projects. The Act outlines requirements for permits, licenses, and registration, as well as standards for construction, operation, and maintenance. The Act also addresses environmental offenses related to pipeline activities. Due to the proposed high operating pressure, line size and precedence in other States, a pipeline licence under the Act is expected to be required for the Project to construct and operate the CO_2 transport pipeline.
Environmental Protection Act 2019 (EP Act)	The (EP Act) aims to promote ecological sustainable development, manage significant disturbances through an environmental approval process, provide for broader community involvement and recognise the importance of participation of Aboriginal people and communities in environmental decisions. Under the Act, the NT EPA regulates the environment impact assessment process to identify potential environmental impacts of development proposals. Relevant environmental protection policies developed under the Act require consideration by the Project.
Fisheries Act 1988	The *Fisheries Act 1988* governs the management and conservation of fisheries resources. This Act ensures the sustainable use and management of fishery resources and establishes a system for issuing licenses and permits for fishing activities. This Act sets out regulations for fishing practices and compliance requirements, aims to protect the marine environment and biodiversity, and provides powers for enforcement and penalties for non-compliance. The aspects of this Act relevant to the Project will be related to the conservation of fisheries resources and the protection of aquatic habitats.

Legislation	Relevance
Heritage Act 2011	The *Heritage Act 2011* is aimed at protecting and conserving the NT's cultural and natural heritage. This Act establishes a register of heritage places and objects to ensure their protection and creates a Heritage Council responsible for advising on heritage matters and making decisions about the inclusion of places and objects in the register. This Act provides measures for the protection and conservation these features, including restrictions on alterations and demolitions and requires permits for activities that may affect heritage places or objects, and ensuring that any changes are managed appropriately, or establishing enforcement and offence provisions. Given the known presence of a number of Aboriginal heritage sites within and adjacent to the onshore and nearshore Project area, the Act applies to the Project (see Section 4.4) In addition, an unexpected finds procedure will be developed by the Project.
Marine Act 1981	The *Marine Act 1981* regulates shipping and maritime activities. This act establishes rules for the safe operation of vessels within the NT and appoints shipping inspections with powers to enforce the Act. The Act also creates a tribunal to hear and determine appeals related to maritime matters, sets standards for the safety and manning of vessels, including crew qualifications and accommodations, provides for the licensing of commercial operations and certification of vessels, regulates the provision and maintenance of navigational aids, and establishes specifies offences and penalties for non-compliance with the Act. Project vessels operating in NT waters will be required to adhere to the requirements of this Act to ensure marine incident reporting and other related matters is conducted.
Marine Pollution Act 1999	The overall purpose of the *Marine Pollution Act 1999* is to protect the NT's marine and coastal environment by minimising intentional and negligent discharges of ship-sourced pollutants into coastal waters. This Act implements provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL), addresses pollution from oil, noxious liquid substances in bulk, packaged harmful substances, sewage, and garbage, establishes a duty to report incidents involving polluting substances, provides for the appointment of officers with powers to enforce the Act, including issuing prohibition and improvement notices, and specifies offences and penalties for non-compliance, including provisions for damage and compensation. Project vessels operating in NT waters will be required to adhere to the Act, to prevent harmful discharges of pollutants, like oil, noxious substances, and garbage, into coastal waters, which can damage ecosystems, harm marine life, and hinder human activities.
Northern Territory Aboriginal Scared Sites Act 1989	The *Northern Territory Aboriginal Sacred Sites Act 1989* is designed to protect and manage Aboriginal sacred sites in the NT. This Act ensures the preservation and protection of Aboriginal sacred sites, establishes a system for issuing permits for entry onto sacred sites, creates the Aboriginal Areas Protection Authority (AAPA) to oversee the protection of sacred sites and manage the permit system, aims to balance the preservation of Aboriginal cultural traditions with the economic, cultural, and social aspirations of all people in the Territory, and provides enforcement mechanisms and penalties for unauthorised entry or damage to sacred sites.

Legislation	Relevance
	INPEX has been issued an AAPA Authority certificate for the onshore areas where Project activities will occur (Authority Certificate C2011/166) and the offshore dredge spoil area (Authority Certificate C2012/138). An application in progress for the nearshore PDA.
Petroleum (Submerged Lands) Act 1981	The *Petroleum (Submerged Lands) Act 1981* regulates petroleum exploration and production in the submerged lands of the NT. The Act outlines the process for obtaining permits and licences for petroleum exploration and production in submerged lands as well as specifying the rights and obligations of permit and licence holders, including the conditions for exploration, retention leases, and production licences. The Project applies to any company or individual involved in offshore petroleum activities to ensure legal operation and to protect the marine environment. The Act details the application, granting, and renewal processes relevant to the Project, and sets standards for environmental protection and safety during petroleum operations, including provisions for managing environmental impacts.
Planning Act 1999	The *Planning Act 1999* regulates how land in the NT can be developed and used. It establishes the framework for planning schemes, the Development Consent Authority, and the Planning Commission. The Act outlines how land in the NT can be developed and used, including procedures for subdivisions, consolidations, and development applications. The Project is required to comply with the Act where development activities are undertaken, as the Act provides a framework for how land can be used and developed and outlines the processes for obtaining the necessary approvals.
Ports Management Act 2015	The *Ports Management Act 2015* governs the control, management, and operation of ports. This Act establishes the process for declaring designated ports and appointing port operators. It defines the functions and responsibilities of port operators, including dredging, hydrographic surveys, and record-keeping. The Act also appoints regional harbourmasters and outlines their duties, such as promulgating depths and under keel clearances. The Act provides powers for directing and controlling vessels within designated ports, including the removal of wrecks and handling of dangerous goods. The Project is required to comply with the Act to ensure the safe, efficient, and effective management of ports and related activities. This includes adherence to regulations regarding port operations, environmental protection, and the safety of vessels and personnel within designated port areas.
Public and Environmental Health Act 2011	The *Public and Environmental Health Act 2011* establishes a framework for managing public and environmental health in the NT, including the appointment of a Chief Health Officer and the regulation of public health risk activities. It also outlines measures to address public health nuisances and emergency situations. The Act often complements Work Health and Safety (WHS) legislation, ensuring that businesses and individuals are meeting their obligations to protect workers and the public. The Project is required to comply with the Act to minimise the of risk or harm to the public and the environment.

Legislation	Relevance
Territory Parks and Wildlife Conservation Act 1976 (TPWC Act)	The TPWC Act focuses on the establishment and management of parks and reserves, as well as the study, protection, conservation, and sustainable use of wildlife within the NT. It establishes the Territory Parks and Wildlife Commission and outlines its functions, including the management of parks, reserves, and wildlife. The Project is required to comply with the Act to ensure the protection, conservation, and sustainable use of wildlife and natural resources within parks and reserves in the NT.
Waste Management and Pollution Control Act 1998 and Waste Management and Pollution Control (Administration) Regulations 1998	The *Waste Management and Pollution Control Act 1998* (WMPC Act) is aimed at protecting, and where practical to restore and enhance the quality of the NT environment by preventing pollution, reducing the likelihood of pollution occurring, effectively responding to pollution, avoiding and reducing the generation of waste, increasing the re-use and re-cycling of waste, and effectively managing waste disposal. This Act encourages ecologically sustainable development and facilitates the implementation of national environment protection measures made under the *National Environment Protection Council (Northern Territory) Act 1994*. The Waste Management and Pollution Control (Administration) Regulations 1998 supports the Waste Management and Pollution Control Act 1998 by providing detailed administrative procedures. These regulations specify types of wastes classified as "listed wastes" for regulatory purposes, details the licensing requirements for companies handling listed wastes, including collection, transport, storage, treatment, recycling, and disposal, implements a system for tracking the movement of listed wastes to ensure proper management and compliance, and establishes requirements for compliance reporting and record-keeping by licensed companies. This Act's regulations apply to activities that could potentially cause pollution or generate waste, and therefore, the Project is required to comply with the Act to protect the environment and public health by regulating waste management and pollution control activities.
Water Act 1992	The *Water Act 1992* provides for the investigation, allocation, use, control, protection, management and administration of water resources, including extraction of ground water, wastewater management and water pollution. Under the Act waste discharge licences are required where an activity could affect a declared beneficial use of a water resource. A waste discharge licence may be required for the Project if wastewater associated with pre-commissioning activities is required to be discharged to Darwin Harbour.

Table 2-2: Summary of relevant Commonwealth legislation

Legislation	Relevance
Aboriginal Land Rights (Northern Territory) Act 1976	The *Aboriginal Land Rights (Northern Territory) Act 1976* provides the basis for Aboriginal people in the NT to claim rights to land based on traditional occupation. The Act allows Aboriginal people to claim land where traditional ownership can be proven. This was the first law in Australia to legally recognize the Aboriginal system of land ownership. Land granted under this Act is held as inalienable freehold title, meaning it cannot be sold, mortgaged, or otherwise disposed of. The Act established Land Councils to assist Aboriginal people in claiming land and managing their land rights, playing a crucial role in representing Aboriginal interests.
Australian Maritime Safety Authority Act 1990 (AMSA Act)	The main objectives of the AMSA Act are the promotion of maritime safety and the protection of the marine environment. The Act also sets out the processes and procedures for combating marine pollution particularly oil spills. Project vessels will be required to comply with this Act to minimise and respond to potential spill events that may occur during modification and operational activities.
Biosecurity Act 2015	The *Biosecurity Act 2015* manages biosecurity risks in Australia, in particular diseases and pests that may cause harm to human, animal or plant health or the environment. This Act sets out requirements on goods, aircraft, and vessels from overseas that enter Australian territory and implements the Ballast Water Convention, regulating ballast water of certain vessels. Project vessels will be required to comply with the Act by implementing control measures that reduce the likelihood of the introduction of invasive marine pests (IMS).
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The Project is being referred under the EPBC Act for a decision as to whether it is a 'controlled action' for potential significant impacts to MNES. All Project activities will need to comply with the requirements of the EPBC Act; irrespective of location or jurisdiction (i.e. Commonwealth or coastal waters).
Environment Protection (Sea Dumping) Act 1981 (Sea Dumping Act)	The *Sea Dumping Act 1981* regulates the disposal of CO_2 via carbon capture and sequestration at sea and implements the London Protocol permitting requirements in Australian waters. A sea dumping permit is a permit that is required for the placement of controlled material (as defined in the Sea Dumping Act) in Australian waters, including the injection of CO_2 streams into sub-seabed geological formation. A sea dumping permit will be required for the Project to load and store CO_2 in the sub-seabed geological formation, including a Long-Term Management Plan.
Fisheries Management Act 1991	The *Fisheries Management Act 1991* is largely responsible for the management of Australian fisheries in Commonwealth waters. The Act sets out the legislative basis for statutory fishing rights, licences, permits and fisheries management plans. The Act applies to the Project where it overlaps with Commonwealth managed areas, including commercial, recreational, and Indigenous fishers is present.

Legislation	Relevance
National Greenhouse Gas and Energy Reporting Act 2007 (NGER Act)	The NGER Act establishes a national framework mandating corporations meeting specific thresholds to report their GHG emissions, energy production and energy consumption. It requires certain corporations to report on their emissions and energy usage to the Clean Energy Regulator (CER). The Act aims to inform government policy, public awareness, and international reporting obligations related to GHG emissions. This reporting is crucial for informing government policy, supporting Australia's international reporting obligations, and raising public awareness about corporate environmental impact. It will apply to the Project if it meets the Act's specific thresholds of GHG emissions or energy consumption/production.
Navigation Act 2012	The *Navigation Act 2012* is legislation which covers international ship and seafarer safety, actions of seafarers in Commonwealth waters and protects the marine environment where it relates to shipping. This Act also gives effect to international conventions for maritime issues where Australia is a signatory. Project vessels will be required to adhere to the requirements of this Act.
Native Title Act 1993 (NT Act)	The *Native Title Act 1993* recognises the rights and interests of Aboriginal peoples and Torres Strait Islanders to traditional lands and waters. It establishes procedures to be followed so that future acts (proposed actions/developments) can be validly done. The Project is committed to early consultation with any relevant and interested First Nation's groups to ensure their rights and interests are considered.
Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act)	The OPGGS Act and its regulations provide a framework for all offshore petroleum exploration, production, recovery, and environmental matters for offshore GHG activities within Commonwealth waters (between 3 and 200 nm from shore). The OPGGS Act is supported by regulations and directions that cover safety, diving, integrity, petroleum resource management and environmental management. Under the Act, a GHG injection licence is required where a titleholder seeks to inject or store (on a permanent basis or otherwise) a substance into the seabed or subsoil of an offshore area. In accordance with the OPGGS Act and regulations, the Project will require the following: • GHG assessment permit • declaration of identified GHG storage formation (DoSF) • access authorities • pipeline licence • infrastructure licence • injection licence • site plan (including a CO_2 monitoring plan) • accepted safety cases • accepted environment plans (EPs) • well operation management plan • site closing certificate

Legislation	Relevance
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011	The related OPGGS regulations states that, a Well Operations Management Plan (WOMP) is required for any well activity prior to commencement of the activity and the activity must be conducted in accordance with the WOMP in force. The WOMP must provide a description of the control measures in place that ensure that risks to the integrity of the well will be reduced to as low as reasonably practicable (ALARP) throughout the life of the well, including periods when the well is suspended (i.e. not operational but not permanently abandoned), and that a description of the performance standards for those control measures are also described and appropriate. Additionally, a description of the planned performance outcomes and criteria against which performance is to be measured will also be included. Further, the WOMP will include a description of the monitoring, audit and well integrity assurance processes that will be implemented to ensure the performance outcomes and performance standards are met throughout the life of the well, including periods when the well is suspended. A WOMP will be submitted to National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for approval before activities commence.
Offshore Petroleum and Greenhouse Gas Storage (Greenhouse Gas Injection and Storage) Regulations 2023 (OPGGS (GGIS) Regulations)	The related OPGGS (GGIS) Regulations ensure the fundamental suitability for CO_2 storage sites via a declaration of identified GHG storage formation. The application for declaration of identified GHG storage formation provides a mechanism for the transition from a GHG assessment permit to a GHG holding lease or GHG injection licence. This is an important step in establishing the technical viability of the GHG Storage Formation. The process is administered by the National Offshore Petroleum Titles Administrator (NOPTA), with advice from other agencies as required, and the Declaration is made by the Responsible Commonwealth Minister. A GHG injection licence is required where a titleholder seeks to inject or store (on a permanent basis or otherwise) a substance into the seabed or subsoil of an offshore area. The Project is required to obtain and comply with the injection licence and the site plan which will be in place prior to CO_2 injection activities.
Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023 (OPGGS (E) Regulations)	The related OPGGS (E) Regulations ensure that any petroleum or GHG storage activity is consistent with ecological sustainable development (ESD) principles and is carried out in such a way that the environmental impacts and risks of the activity are reduced to ALARP and are of an acceptable level. Under the OPGGS (E) Regulations, the titleholder of a GHG storage activity must not carry out that activity unless an accepted EP is in force for the activity. The EP must describe the activity, the receiving environment, environmental aspects and assess potential environmental impacts. In addition, an EP must contain appropriate risk-based environmental performance outcomes and standards, and an implementation strategy. It must also provide criteria for determining whether the outcomes and standards are met. In addition, under the OPGGS (E) Regulations, an oil pollution emergency plan (OPEP) is required as part of the EP's implementation strategy.

Legislation	Relevance
	Activities in Commonwealth waters requiring an individual, accepted EP (inclusive of OPEP) for the proposed Project may include (but are not limited to): drilling and completions; installation and commissioning; operations and maintenance (including monitoring); and decommissioning. EPs for each relevant activity will be submitted to NOPSEMA for acceptance prior to the commencement of activities.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983	The *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* along with the *Navigation Act 2012* implements into domestic law Australia's obligation under MARPOL 73/78. The obligations include the prevention of accidental and operational marine environment pollution from shipping and relate to pollution by oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air emissions. Project vessels will be required to adhere to the requirements of this Act.
Submarine Cables and Pipelines Protection Act 1963	The *Submarine Cables and Pipelines Protection Act 1963* is an Australian law that aims to protect submarine cables and pipelines, including those carrying telecommunications, oil, and gas. The Act addresses the breaking or injury of these cables and pipelines, particularly those beneath the high seas, by making it an offense to do so wilfully or through culpable negligence. The Act applies to the Project where this is potential to cause damage to underwater infrastructure.
Underwater Cultural Heritage Act 2018	The *Underwater Cultural Heritage Act 2018* is an Australian law that protects underwater cultural heritage sites and associated artefacts. It replaced the *Historic Shipwrecks Act 1976*, broadening protection to include sunken aircraft and other types of underwater heritage, as well as Aboriginal and Torres Strait Islander underwater cultural heritage in Commonwealth waters. The Act aims to protect these sites in-situ and prevent unpermitted artefact recovery. This Act requires the Project to have a permit to enter and utilise areas within a protected zone and sets out obligations if unknown cultural heritage sites are encountered. The Project is required to undertake appropriate investigations to understand the presence of underwater cultural heritage within the Project area and potential impacts upon it.

3 PROJECT DESCRIPTION

3.1 Project overview

The proposed Project has the potential to sequester CO_2 to an offshore geological carbon storage site within the G-7-AP permit area over a period of approximately 30 years. The G-7-AP permit area is located west of Darwin in the Petrel sub-basin, within the Joseph Bonaparte Gulf. CO_2 would be transported via a pipeline of up to 22-inch diameter from the onshore inlet station on Middle Arm to the injection area in the G-7-AP permit area. The CO_2 emissions which the Project is proposed to sequester are those arising from a range of industrial facilities in the region.

Development of the infrastructure proposed in this referral is planned to be performed in phases. The initial development is planned to consist of infrastructure that provides the ability to transport and sequester CO_2 at a rate of up to 8 mtpa. Subsequent development phase(s) are planned to increase the annual capacity of the system to a total of approximately 10 mtpa. Considering the 30-year design life of the proposed transport and injection facilities, the project facilities have the potential to sequester up to a total of 300 MT of CO_2.

Key components of the proposed Project are summarised in Table 3-1 with reference to which components fall under NT jurisdiction. The Project area is presented in Figure 1-1.

Table 3-1: Key components of the proposed Project

Project component	Description	Relevance to Northern Territory referral scope
Wells	Up to six injection wells drilled in phases, including wellheads and Christmas trees (four planned wells and two contingency wells).	Out of scope – located in Commonwealth waters.
Other infield subsea infrastructure	One subsea manifold with provision for temporary subsea pig receiver. Infield pipelines and associated connection structures, spools and jumpers connecting the injection wells to the manifold and CO_2 transport pipeline.	Out of scope – located in Commonwealth waters.
CO_2 transport pipeline	An up to 22-inch diameter carbon steel CO_2 transport pipeline with a total length of approximately 260 km between the onshore inlet station and the storage formation in the G-7-AP permit area.	In scope (component within NT waters). Onshore development area Pipeline development area
Subsea power and fibre optic cables	A SPFO is proposed to be installed adjacent to the CO_2 transport pipeline along the entire route, with an approximately 50 to 100 m offset. The cable would terminate in multiple subsea nodes, which would facilitate connection to each of the injection wells via distribution structures and additional infield cables.	In scope (component within NT waters).

Project component	Description	Relevance to Northern Territory referral scope
	To provide redundancy, a back-up cable may also be installed from the onshore inlet station, through the shore crossing and within Darwin Harbour.	
Onshore infrastructure	Onshore inlet station located on Middle Arm Peninsula next to the existing Ichthys GEP beach valve precinct; the station would receive, amalgamate, filter, and meter CO_2 from customers for export via the CO_2 transport pipeline. The onshore inlet station would include provisions for potential future booster pumps.	In scope. Onshore development area

3.2 Suitability of geological storage formation

The geological storage formation is composed of a permeable formation into which CO_2 is intended to be injected and stored as well as a geological formation that will act as a baffle and seal to contain the CO_2.

The suitability of the storage formation for CO_2 sequestration has been established through evaluation of 3D seismic survey data and data from appraisal wells. The appraisal program included measurements and analysis for injectivity, CO_2 solubility in reservoir formation brine, routine core analysis, special core analysis and seal capacity.

Key factors supporting the suitability of the storage formation for CO_2 storage are as follows:

- High CO_2 injectivity and storage capacity:
  - the injection formation has been confirmed to have high injectivity, meaning it can accept high rates of CO_2 injection.
  - storage capacity in excess of the volume proposed to be sequestered throughout the life of the Project.
- Migration-assisted storage mechanism:
  - the storage mechanism for the proposed storage formation is migration assisted storage.
  - CO_2 is proposed to be injected into a downdip location within the permit area, and it is then expected to migrate vertically until it encounters a pre-identified barrier, after which it would move up-dip under a cap rock seal.
- Effective sealing formation:
  - the Wangarlu Formation (part of the Bathurst Island Group) acts as a regionally competent top seal, preventing CO_2 from escaping upward.
- CO_2 plume behaviour:
  - during the plume migration a large fraction of CO_2 would dissolve in the formation brine.
  - when injection finishes, microscopic trapping would occur as brine re-imbibes the pore space occupied by CO_2. The remaining CO_2 would reach capillary-gravity equilibrium, halting further migration and ensuring permanent storage.

3.3 Carbon dioxide stream

The CO_2 stream for sequestration is proposed to be supplied by multiple third parties under commercial agreements with the Project and the exact sources are anticipated to change over the Project's lifetime. The exact composition of the gases to be sequestered will be dependent on the CO_2 sources and their respective processing facilities but will be required to meet a specification, including limits on incidental associated substances (IAS) at the onshore inlet station and be subject to composition monitoring (Section 3.7.4).

In accordance with the London Protocol, the CO_2 streams proposed to be sequestered would consist overwhelmingly of CO_2, specifically they would be comprised of 95 percent CO_2 (as a minimum) in line with the accepted definition (ISO 27913). The stream may also contain other IAS derived from the source material and the third-party capture and sequestration processes.

The sequestration of the CO_2 for permanent storage, would require a sea dumping permit (SDP) under the Sea Dumping Act (Section 2). The Department of Climate Change, the Environment and Water (DCCEEW) has issued an Interim National Action List (INAL), and a Final National Action List is currently in preparation. During the preparation of a sea dumping permit, INPEX would consider the specific requirements of these and other guidelines and comply with the relevant legislation governing CO_2 composition.

3.4 Project schedule

Subject to receipt of all relevant regulatory and project approvals, the indicative timeframe for the proposed Project is as follows:

- commencement of onshore site works in 2028
- ready for start-up (RFSU) / ready for injection and commencement of operations to occur in 2031
- operational lifespan of approximately 30 years, followed by ongoing plume monitoring and decommissioning activities.

Further details of indicative timings for Project activities (including those outside NT jurisdiction) are presented in Table 3-2.

Table 3-2: Bonaparte CCS Project indicative schedule

Activity	2028				2029				2030				2031			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Site establishment & onshore inlet station																
Shore crossing trench and preparation																
Near-shore trenching and rock armouring																
Power & control cable installation																
Pipelay (near-shore & offshore)																
Drilling of injection wells																
Installation, mechanical completion & Pre-commissioning Activities (G-7-AP)																
Commissioning and first fill																
Ready for Injection																

3.5 Project area

The "Project Area" extends over 250 km east to west from the onshore inlet station to the G-7-AP permit area and crosses Northern Territory and Commonwealth jurisdictions. The Project area within the scope of this referral covers the area from the onshore inlet station (adjacent to the existing Ichthys gas export pipeline (GEP) beach valve precinct) on the Middle Arm Peninsula in Darwin, about 90 km from east to west to the Northern Territory waters boundary (Figure 1-1).

The "Project footprint" describes the area where disturbance (i.e. ground disturbance, clearing, etc) would occur. The Project footprint is discussed in terms of the following smaller areas:

- Onshore development area (ODA) – the area encompasses the onshore inlet station footprint and the corridor of the onshore portion of the CO_2 transport pipeline (approximately 1.2 kilometres) and cabling, which extends from the onshore inlet station to the low water mark (LWM) in Darwin Harbour.
- Pipeline development area (PDA) – the area encompassing the CO_2 transport pipeline corridor commencing from the LWM in Darwin Harbour through to the infield development area, covering the potential pipeline routes currently under investigation. Given the large span of the PDA and the segregation of activities specific to certain regions, the PDA discussion is further split in this referral into the nearshore PDA and the offshore PDA (refer to Figure 1-1). The SPFO cable(s) would also run through the PDA.
- Dredge spoil disposal ground (DSDG) – the area is located to the north of Darwin Harbour, within the Beagle Gulf, approximately 12 km north-west of Lee Point.

Details of Project infrastructure within the Project area are presented in Table 3-1 and further described in Section 3.6.

3.5.1 Onshore development area

The ODA comprises of the Project including the onshore component of the CO_2 transport pipeline (up to the LWM) and onshore inlet station footprint (Figure 3-1), covering a total area of approximately 29 hectares (ha).

The proposed onshore inlet station footprint encompasses approximately 4 ha on the western side of Wickham Point Road, within cadastral Section 1896. This area includes the onshore inlet station, which is proposed to be situated adjacent to the existing Ichthys GEP beach valve precinct and occupy approximately 1.5 ha of permanent infrastructure. The station design includes provision for installation of pressure booster pumps within its boundaries. In addition to the permanent infrastructure, approximately 2.5 ha will be used for temporary construction laydown and associated activities.

The ODA includes construction corridors for the CO_2 transport pipeline, SPFO cables(s) and the shore crossing area as well as the immediate hinterland area between the onshore inlet station and the nearshore PDA, covering an area of approximately 25 ha. The temporary construction footprint could affect a corridor up to 200 m wide, depending on the respective installation methodology and is planned run in parallel to the existing Ichthys GEP. The onshore pipeline development is likely to be offset from the existing Ichthys GEP corridor to manage safety concerns with working near a pressurised gas pipeline.

The ODA also encompasses temporary areas that may be used for acid sulfate soil treatment, equipment laydown, etc.

The final footprint and alignment of the ODA will be refined during the design and approvals phase, taking into account geotechnical and cultural heritage investigations, minimisation of environmental and heritage impacts, and safety considerations near existing infrastructure. All temporary use areas will be reinstated following the completion of construction activities.

Project infrastructure within the ODA is described in Section 3.6.1.

Figure 3-1: Bonaparte CCS Project ODA

3.5.2 Dredge spoil disposal ground

The DSDG is located to the north of Darwin Harbour, within the Beagle Gulf, approximately 12 km north-west of Lee Point (Figure 1-1). It is located approximately 14 km from the nearshore pipeline development area (at its closest point) in water depths between 15 m and 20 m below LAT (lowest astronomical tide).

The DSDG covers an area of 12.5 km^2 (5 km by 2.5 km). Based on review of the post-Ichthys Project capital dredging hydrographic survey of the DSDG in mid-2014, the remaining capacity is calculated to be approximately 7 Mm^3.

3.5.3 Pipeline development area

The PDA spans east to west from the pipeline shore crossing at the LWM in Darwin Harbour to the NT waters boundary. The nearshore PDA (as defined below) includes a two km wide pipeline installation area, incorporating a corridor one km either side of the pipeline centreline. The corridor is to accommodate the movements and activities of construction vessels used for pipeline trenching, pipelay, cable lay, rock armouring and other activities.

Key criteria used in determining the pipeline route include:

- to avoid significant seabed features and obstructions, such as scarps, reefs and areas of significant seabed undulation
- to minimise disturbance to potentially environmentally sensitive areas
- to avoid sensitive heritage areas
- to avoid existing infrastructure such as the Ichthys GEP, Bayu-Undan GEP and Barossa Darwin pipeline duplication.

The final route will be selected following consideration of environmental, cultural, technical and regulatory factors to minimise impacts and optimise constructability.

Project infrastructure within the PDA is described in Section 3.6.2.

Nearshore PDA

The nearshore PDA extends from the LWM to the limit of NT coastal waters, crossing through Darwin Harbour and the Beagle gulf. Water depths in this area range from 0 to 43 m.

The CO_2 transport pipeline and SPFO cable would follow the existing Ichthys GEP within the nearshore PDA and would be positioned outside of the main Darwin Port shipping channel. The CO_2 transport pipeline would be offset by approximately 70 to 100 m from the Ichthys GEP on the south-west side within Darwin Harbour and would be offset by up to 200 m outside the harbour.

Dredging would occur within the nearshore PDA to support pipelay and cable lay activities (refer to Section 3.7.2). Dredged spoil would be transported to an existing offshore disposal ground, located in the Beagle gulf outside Darwin Harbour (refer to Figure 1-1).

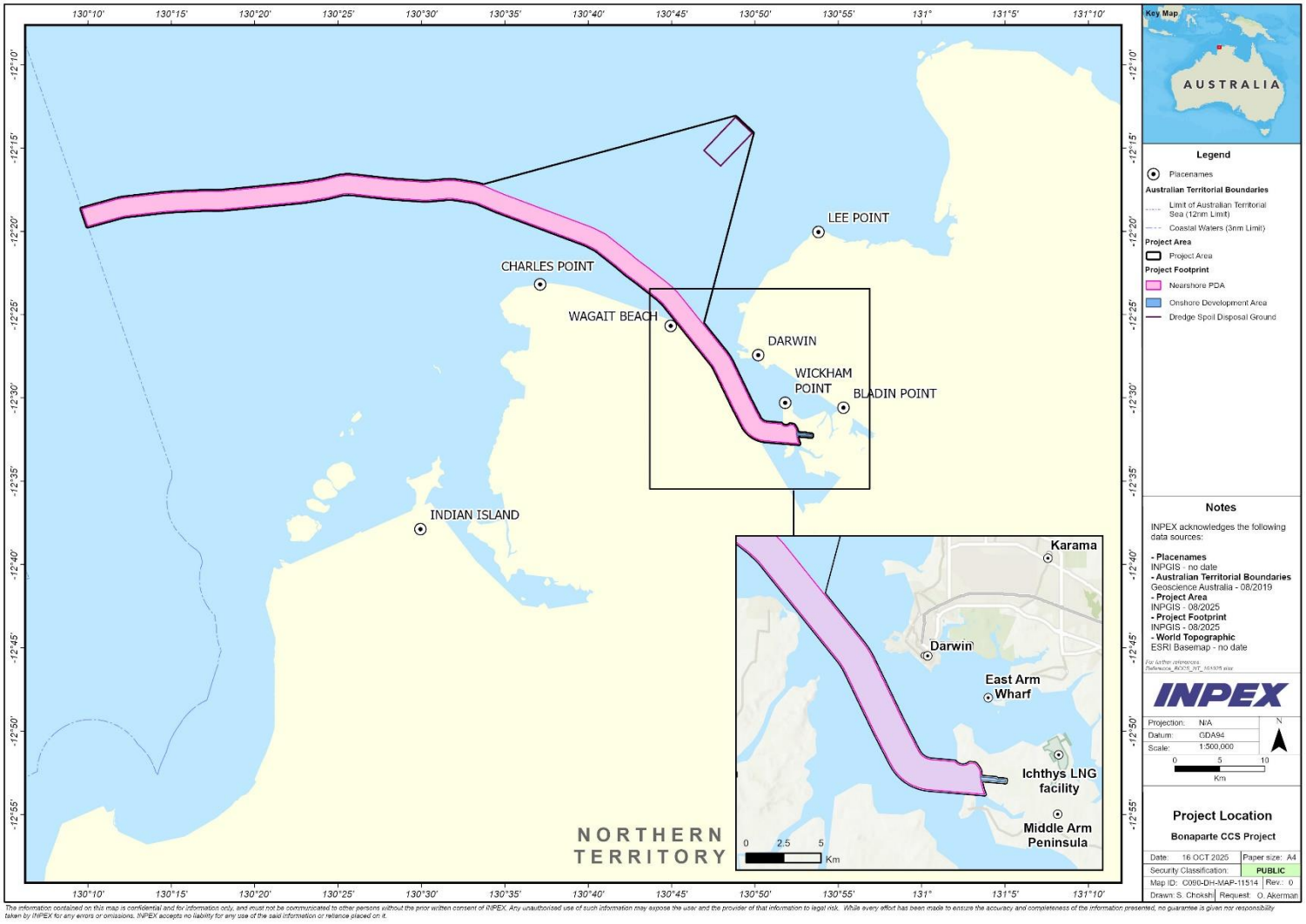


Figure 3-2: Nearshore PDA location

3.6 Project infrastructure

3.6.1 Onshore inlet station

The onshore inlet station is proposed to be located on Middle Arm Peninsula adjacent to the existing Ichthys GEP beach valve precinct; and would amalgamate, filter, and meter CO_2 for transport via the CO_2 transport pipeline.

Facilities planned at the onshore inlet station include the following equipment and infrastructure:

- pig launcher/receiver
- fiscal metering skid
- filtration skid
- manifold piping and valves
- local equipment room
- lighting, closed-circuit television and security fencing
- future booster pumps and associated infrastructure.

The Project also requires additional infrastructure to support the functioning of the onshore inlet station. The support infrastructure is proposed to be located on Middle Arm Peninsula and consists of the following:

- control and safety system hardware including an operator control station, proposed to be located at the existing Ichthys LNG facility

Alternate locations for the operator control station are also under investigation.

3.6.2 CO_2 transport pipeline

The CO_2 transport pipeline is proposed to extend from the onshore inlet station and traverse through NT and Commonwealth waters, to the offshore sequestration site in the G-7-AP permit area.

The proposed CO_2 transport pipeline would be up to 22-inch diameter and designed to transport CO_2 in dense phase. The pipeline would be constructed from individual sections of carbon steel pipe welded together in a continuous process on the pipelay vessel. The pipeline is planned to be routed from the onshore inlet station on Middle Arm, initially to the south and then to the west of the existing Ichthys GEP through Darwin Harbour as shown in Figure 1-1. The pipeline would then be routed west towards the Bonaparte CCS injection site, covered here to the limit of the NT waters.

While this referral only includes the pipeline to the NT waters boundary, the pipeline would continue offshore and terminate infield at a subsea manifold. The pipeline would have facilities at either end to support periodic inline inspection pigging.

3.6.3 SPFO cable

An SPFO cable is proposed to provide power and control functionality for the Bonaparte subsea injection facilities. The cable is proposed to be installed adjacent to the CO_2 transport pipeline along the entire route, with a 50 to 100 m offset. The cable may be contained inside a conduit through the shore crossing area to provide protection. To provide redundancy, a back-up cable and conduit may also be installed from the onshore inlet station through the shore crossing into Darwin Harbour parallel and slightly offset to the primary cable.

Seabed intervention and pipeline stabilisation activities related to installation of the CO_2 transport pipeline and SPFO are described in Section 3.7.2.

3.7 Key Project activities

This section provides a description of the key activities for the Project across the Project area and Project phases.

3.7.1 Geotechnical and geophysical surveys

Survey activities, including geotechnical, geophysical and metocean, may be carried out prior to, during and after infrastructure installation activities to support the construction and operation phases. Surveys would collect data to gather information on:

- soil conditions onshore and offshore
- seabed and near seabed geomorphology
- debris/obstacles
- infrastructure positioning.

Survey activities may be undertaken either from a dedicated survey vessel or from the construction vessels themselves.

Depending on survey objectives, activities may include geophysical survey methods, such as multibeam echo sounders (MBES), side scan sonar (SSS), sub-bottom profilers (SBP), pipe trackers, and magnetometer, and may utilise underwater acoustic positioning. For MBES, SBP and SSS, sound waves are transmitted from a transducer mounted on either a remotely operated vehicle (ROV), autonomous underwater vehicle (AUV), or the hull of a vessel. The survey activities may also include metocean data acquisition and geotechnical survey methods, such as cone penetration tests, box core and bucket grab samples, core drills down to 30 to 45 m.

3.7.2 Construction and installation activities

Onshore development area

Interface with Ichthys LNG operations and construction

The proposed activities within the ODA would be performed in close proximity to existing Ichthys LNG infrastructure. Furthermore, it is anticipated that, subject to securing regulatory approvals, the Ichthys CCS Project (refer Section 1.4) may be required to perform activities in close proximity to Bonaparte CCS Project activities. In addition to securing land access from the relevant authorities for all permanent infrastructure and temporary construction related activities, the Bonaparte CCS Project will coordinate all of its activities with Ichthys LNG and the Ichthys CCS Project to ensure that the Project is clearly delineated from non-Project activities at all times.

Information that is proposed to be shared with relevant stakeholders of the Project to ensure clear delineation of the Project and to prevent conflict with non-Project activities includes the following:

- location and details of all Project infrastructure
- extent of all temporary and construction related activities
- construction methodology & sequence and measure that will be implemented to protect existing infrastructure
- activities conflict avoidance & SIMOP measures

- project work plan/schedule constraints
- site establishment and construction of the onshore inlet station.

Onshore inlet station

The onshore inlet station would require civil works, including grading, filling, general earthworks and construction of fencing and short sections of access road within the onshore development area. These activities would include some vegetation clearing for the area and would be subject to the detailed design and construction sequence planning. Construction activities would also include areas for treatment of ASS and laying temporary matting.

Construction and installation of the required infrastructure within the onshore inlet station would include pipeline, piping, manifolds, valves, filtration instrumentation, equipment room, power supply, communications equipment, fencing, and security items. All infrastructure associated with the onshore inlet station will be constructed within the defined ODA.

The onshore inlet station area may also provide for potential future installation of booster pumping facilities.

All construction and preparation works would avoid restricted work areas identified on Authority Certificates issued by the AAPA and any heritage protection zones.

A large portion of the onshore inlet station is located within a previously cleared and subsequently rehabilitated area. Remnant vegetation clearing beyond the original clearing would likely be required. Post construction, equipment would be removed from all temporary construction areas before rehabilitation of the natural environment.

Onshore pipeline

The pipeline shore crossing of salt flat and mangrove area would be similar to the previously installed Ichthys GEP shore crossing, transversing four key habitats including tidal flat/mangroves, salt mud flats and hinterland/woodlands. The construction of the shore crossing for the CO_2 transport pipeline would use:

- open trench excavation design for the hinterland/woodlands
- open trench or a sheet piled cofferdam trench through the salt flat area
- sheet piled cofferdam trench through mangrove and some tidal flat section
- intertidal trenching with land-based excavators and near shore dredging using sea-based dredging equipment through the remaining tidal flat area through the low water mark.

The construction would occur within an approximately 25 to 50 m wide temporary construction corridor, which may widen in areas up to 200 m to facilitate access, soil treatment and temporary work areas and would be dependent on-site conditions and chosen construction methods. Where possible existing cleared and previously rehabilitated areas would be utilised; however additional mangrove habitat may be cleared with the final area dependent on the temporary construction corridor chosen.

A typical cofferdam within the temporary construction corridor is around 6 to 10 m wide and excavated up to two metres below natural ground level deep. Cross-sectional width of the open cut trench would vary depending on the site-specific soil conditions.

Given the shore crossing area may encounter ASS, trenching is also considered the only viable method to effectively segregate and treat the soils before disposal or reuse as trench backfill. Designated areas within the existing Ichthys GEP corridor and cadastral boundary of Section 1896 would be used for topsoil storage, ASS treatment and access roads. Excavated soil treated for ASS would be transported to the soil treatment pad. PASS may also be disposed of offshore at the existing DSDG in Beagle Gulf using the same method as the Ichthys GEP project.

Horizontal directional drilling (HDD) or a trenched conduit may be used for the SPFO cable shore crossing, with the preferred construction method subject to further evaluation. The shore crossing cable would be pulled through the conduit from an offshore shallow water cable lay vessel (CLV) or barge through to the inlet station using a winch.

The pipeline would be pulled onshore from a moored shallow water lay barge using an onshore pulling system such as a linear winch and cable storage system. The shore pull consists of the length of pipeline installed (pulled) from the lay barge, when moored close to the shore crossing, to the onshore inlet station. The shore pull is currently estimated to be required on a minimum pipeline length of 2.2 km. The lay barge welds the pipe string and as each pipe joint is completed, it is pulled ashore via a cable and winch.

Where possible existing cleared areas would be utilised, with the footprint being dependent on the final construction parameters chosen.

Post pipe laying the trenches would be backfilled with treated and/or uncontaminated soil and then naturally rehabilitated.

Nearshore pipeline development area

Key activities within this area include nearshore pipelay, nearshore cable lay and trenching and also specifically within Darwin Harbour includes dredging, cable crossings and rock armouring. More information on these activities is provided below.

Dredging

Dredging would be required through the harbour section for pipeline protection, with the extent and depth to be further developed in later Project phases. Dredging would be conducted to create a trench along sections of the pipeline route within Darwin Harbour to protect and stabilise the pipe. Dredging may also be required for pipelay, and cable lay access to the shore-pull location.

The scope of dredging would be largely defined by the level of protection required along the route. A formal risk assessment would determine the risks and areas requiring protection. It is estimated the Project dredge volume would be between 600,000 and 900,000 m^3 for the pipeline and subsea power and fibre optic cable. Trenching is likely to occur prior to pipelay; post-lay trenching of the pipeline is not considered a technically feasible alternative in the harbour due to the extensive presence of rock. Given the phyllite rock that is present along most of the harbour route, a combination of trailing suction hopper dredger (TSHD) and backhoe dredger (BHD) would be required. The TSHD would be used to remove the surface sediment overlay, while the BHD would be used to perform the bulk of the dredging. A cutter suction dredger (CSD) may also be needed if significant quantities of rock require removing in deeper sections. Split hopper barges (SHBs) and auxiliary vessels (e.g. anchor handlers) may also be required to support dredging and spoil disposal activities.

Dependant on the duration between the main dredging campaign and the pipelay activity, a pre-lay dredging sweep of the trench may be required to remove accumulated sediments.

Dredge spoil would be disposed of at an existing DSDG used by Ichthys LNG in the Beagle Gulf. Seabed surveys would be completed prior to and following dredging and disposal to confirm depth profiles.

Survey

Survey vessels may be used to perform pre-lay and post-lay survey of the pipeline and cable routes in the PDA (Refer to Section 3.7.1). In addition, vessels performing construction works would use underwater acoustic positioning for obtaining accurate positioning of subsea infrastructure on the seabed during installation using ultra short baseline (USBL) or long baseline (LBL) acoustic positioning.

Pre-lay span rectification, foundation installation and cable crossings

Seabed rectification methods such as jetting, leveling and filling may be conducted prior to laying the pipeline on the seabed. This would ensure a stable/flat foundation for the pipeline.

There is currently one live telecommunication cable, and an additional four subsea cables proposed to be in close proximity to the Project area, these are currently in planning and development phases (see Section 4.5.7). There are several abandoned cables that cross the proposed CO_2 transport pipeline and SPFO cable routes near the Darwin Harbour mouth. These cables are at or close to the seabed surface. A previously used crossing method in the region, considered a likely choice for the pipeline, has been the use of flexible concrete mat supports. The crossing support would be a pre-lay installation activity, with concrete mattresses stacked to create the supports. The support height and spacing would be developed in detailed design. Prior to mat installation, a detailed survey would be performed to confirm and mark the location of the live cables. The SPFO cable crossing is subject to design and may require mattresses or other protection applied.

Nearshore pipelay

This activity, from the shore crossing to the NT coastal waters limit, would include laying approximately 90 km of pipeline.

The construction of the ~35 km long shallow water pipeline section (<20 m water depth) would be performed by a shallow water pipelay vessel positioned via an anchor spread. The remainder of the pipeline section the NT coastal waters limit could be installed by either an anchored pipelay vessel or a dynamic positioning (DP) pipelay vessel.

The nearshore pipelay operations would include the following:

- Once the pipe pull to shore is completed (from the shore-pull component of the pipelay activity) then pipelay vessel would commence lay away.
- The pipelay vessel would progress along the prescribed route laying pipe.
- Periodically as the pipelay vessel moves along the pipeline route, anchors are recovered and relocated to allow the next section to be laid.
- The pipeline would be temporarily terminated with a temporary laydown head and laid on the seabed using a winch to allow for changeover to the offshore DP pipelay vessel (discussed below). The location of the changeover is to be confirmed and may occur inside NT coastal waters.

Key constraints during pipelay will be the handling of vessel anchors with other existing pipelines in close proximity (e.g. Ichthys GEP, Santos Bayu-Undan pipeline, and Santos Barossa pipeline) and working within the harbour near active commercial shipping and recreational vessels as well as heritage (cultural and maritime) sites.

Nearshore cable-lay

It is anticipated the SPFO cable would be installed using specialised telecommunications cable installation equipment and vessels. Typically, the cable would be ploughed or jetted into the seabed for protection and the section within Darwin Harbour may also be covered with rock armour. The nearshore cable lay operations include the following:

- A shallow water CLV, or barge would lay the cable from the shore crossing through the harbour along the prescribed lay route.
- The shallow water vessel or barge would lay down the cable with a temporary head at a predetermined location suitable for the deepwater CLV.
- Deepwater CLV would recover the cable and connect to the deepwater cable section, then continue cable lay along the prescribed route.
- At a pre-determined location and depth, a cable plough would be deployed.
- The cable installation with ploughing would continue, with the cable laid into the plough trench out to the NT coastal waters boundary.

Rock armouring

Rock armouring would be required along the pipeline route in Darwin Harbour to avoid damage to the pipeline from dropped and dragged commercial or recreational vessel anchors. Rock armouring of the SPFO cables(s) may also be required. All rock would be installed after completion of the nearshore pipelay scope. The quantity of rock required would be dependent on the protection requirements and the trenching philosophy adopted (in trench or on seabed surface). It is estimated to be a quantity of up to approximately 600,000 m³ (equivalent to 1,000,000 T of rock). Rock is likely to be supplied from a regional quarry.

A side stone dump vessel (SSDV), flexible fall pipe vessel (FFPV) and BHD (for shallow water sites) may be used for this scope. Vessel selection would be determined based on vessel availability and preferred execution strategy.

Additionally, concrete weight coating may be used as the primary stabilisation method along sections of the CO_2 transport pipeline where it is necessary.

3.7.3 Mechanical completion, pre-commissioning and commissioning

Mechanical completion

Once installed, the onshore inlet station and CO_2 transport pipeline would be subject to mechanical completion testing to verify the integrity of the system. The main activities to be performed are as follows:

- Onshore inlet station:
  - cleaning and flushing of the piping and valves to remove construction debris
  - pressure testing to verify integrity of the infrastructure post installation.
- CO_2 transport pipeline:
  - flooding of the pipeline from the onshore inlet station with treated seawater
  - cleaning of the pipeline (via pigging) to remove any potential construction debris
  - gauging (via pigging) to confirm the absence of pipeline deformation and damage
  - pressure testing to verify integrity of the pipeline system post installation.

Water sourcing alternatives for the pipeline flooding and hydrotest would be subject to a future evaluation and selection study. One anticipated option involves drawing seawater from Darwin Harbour, specifically from the shallow waters near the shore crossing, using a floating pumping facility. The seawater would then be transferred via a temporary pipeline to an onshore filtration and treatment facility before being introduced into the CO_2 transport pipeline.

Pre-commissioning

Following successful completion of integrity testing, the onshore inlet station; CO_2 transport pipeline and infield infrastructure will be subject to pre-commissioning and commissioning activities as follows:

Onshore inlet station:

Pre-commissioning of the onshore inlet station comprises the following key activities:

- remove the hydrotest fluid in the piping and valves via low point drains
- vacuum dry and preserve the onshore inlet station with nitrogen in preparation for subsequent introduction of CO_2.

CO_2 transport pipeline:

Pre-commissioning of the CO2 transport pipeline comprises the following key activities:

- dewatering of the pipeline from the onshore inlet station to the offshore end to remove treated seawater (discharge is outside the scope of this referral)
- drying of the pipeline to eliminate residual water and prevent potential corrosion during product filling operation
- inerting the pipeline using nitrogen for preservation
- pipeline filling with CO_2 from the onshore inlet station, during which the nitrogen within the pipeline will be discharged at the seabed from the subsea pig receiver (discharge is outside the scope of this referral)
- increase pressure of CO_2 within the pipeline to achieve the target pressure for CO_2 transport in dense phase.

Commissioning, first fill and start-up

Commissioning of infrastructure would be conducted in a planned and structured manner. This would include the operational functionality verification of all sensors/instrumentation, valves, chokes and control system elements in readiness for first fill and commencement of sequestration.

CO_2 is planned to be sourced from Ichthys LNG for the commissioning first fill activity. The CO_2 transport pipeline first fill would utilise a series of pigs to allow the conditioning of the pipeline to CO_2 and allow displacement of the preservation nitrogen, or treated seawater, to be vented to sea at the subsea pig receiver (outside the scope of this referral). The first fill process is expected to take approximately two to four weeks.

On completion of the transition from the CO_2 transport pipeline to dense phase CO_2, injection shall commence via the injection wells into the storage formation and injection rates will be progressively ramped-up until the target injection rate is achieved.

3.7.4 Operational activities

Operation of the Project would involve:

- amalgamation, CO_2 metering and impurities filtration and monitoring at the onshore inlet station
- transport of compressed CO_2 via pipeline to the offshore CO_2 storage site
- overall system measurement, monitoring and verification (i.e. leak monitoring)
- management and optimisation of CO_2 injection rates and overall system stability
- IMR activities, including the use of ROVs or divers (in shallow water) from support vessels and periodic pipeline inspections via pigging.
- execution of routine onshore maintenance activities.

Once operational, the CO_2 transport pipeline and all elements of the CCS injection system would be monitored and operated via an integrated control system.

Onshore inlet station

The onshore inlet station includes piping, valves, and instrumentation required to connect the CO_2 transport pipeline with the onshore pipelines which originate from the CO_2 sources. The onshore inlet station would include facilities and equipment to filter, and fiscally meter the CO_2 stream, including monitoring of key CO_2 stream components. There would also be a pig launcher with a local vent, sized for launching pigs into the CO_2 transport pipeline. A local equipment room would also be located within the onshore inlet station area to provide for power management and controls equipment for both the offshore facilities and the onshore inlet station. In addition, operation of the onshore inlet station would include instrumentation, lighting and security elements, as required.

During the operational phase CO_2 would be filtered and fiscally metered and key components monitored at the onshore inlet station. During launch and receipt of pigs for inspection purposes or during upset conditions there would be some localised venting of CO_2. The volume of release would be equivalent to the volume of the pig trap. There may also be venting of CO_2 resulting from periodic maintenance activities of the onshore inlet station equipment, such as metering and filtering units. The maintenance activities may require depressurisation of the units and associated piping with the vented volumes limited to the local piping volumes.

Future booster pumping facilities or pipelines from other CO_2 sources, may require depressurisation and venting of CO_2 from limited sections of piping within the onshore inlet station. The onshore inlet station is also one of the potential locations being considered for a temporary venting stack should it be necessary in the future to perform a contingency de-inventorying of the CO_2 transport pipeline (with up to 60,000 T CO_2 vented).

Inspection, maintenance and repair

The subsea and onshore facility design would include provision for the flushing, purging, venting, leak testing and reinstatement of equipment as required in support of the maintenance and inspection regime for specific equipment and systems.

Inspection activities would be conducted in accordance with a risk-based inspection (RBI) schedule. Maintenance and repair activities would be conducted based on the results of inspection and monitoring. IMR activities for subsea infrastructure may include visual inspections, side scan sonar/multibeam sonar, non-destructive testing, pigging activities (including in-line inspection), cathodic protection system monitoring, debris and marine growth removal, sediment relocation, flushing, installation of sleeves/clamps, installation of grout bags or concrete mattresses, and leak and pressure testing and environmental surveys or sampling.

Subsea pipeline in-line inspection would occur approximately every five years along the whole offshore pipeline (NT and Commonwealth waters) with the majority of activities confined to Commonwealth waters. Depending on the early findings/results frequency of inspection would be adjusted accordingly.

IMR for the subsea infrastructure (excluding in-line inspection) is expected to be performed over a period of approximately 10 days per year. However, this would be optimised into campaigns as required to reduce frequency requirements to multiple years. Detailed RBI programs during detailed design would target reducing both the magnitude of scope as well as frequency.

Routine IMR activities for the associated onshore infrastructure would be conducted to ensure the operability and integrity of the facilities is sustained. The maintenance activities will be clearly defined in line with INPEX and regulatory standards and scheduled within the maintenance and inspection system. This may include, but is not limited to visual inspection, electrical safety checks, calibration, filter changes, integrity testing, security checks and manufacturer prescribed maintenance activities at the onshore inlet station equipment. Detailed maintenance and inspection activities would be further developed during detailed design.

Contingency activities

Contingency activities in the event of an unplanned or emergency scenario include:

- Pipeline damage during installation: contingency dewatering of the CO_2 transport pipeline or infield pipelines in the event of damage. Seawater will be treated with the same chemicals as for the FCGT process and the discharge could occur at any point along the pipeline route.
- Receipt of off-specification CO_2: this scenario would result in isolation of the supply of off-specification CO_2 from entering the CO_2 transport pipeline at the onshore inlet station.
- Pigging of the CO_2 transport pipeline: in the scenario where off-specification CO_2 has reached the transport pipeline and is judged to present a risk to the pipeline integrity, a pigging run may be used to push off-specification elements out of the pipeline.
- Blowdown venting/ de-inventory of the CO_2 transport pipeline: while there are no planned scenarios which would require venting of the pipeline, design consideration would be given to performing venting of the pipeline at the onshore inlet station and /or the Ichthys LNG facility in a contingency situation.
- Deployment of a communications buoy and power backup system in the event of a risk of loss, or loss of functionality of the SPFO cable.

Contingency activities would be managed in coordinated approach with the CO_2 source providers as required.

Decommissioning activities

At the end of the proposed Project life, the facilities would be decommissioned in accordance with good practice and in compliance with relevant Commonwealth and NT legislation. Post-closure period expectations and obligations, including ongoing plume monitoring, would be defined through subsequent approvals and with relevant regulators.

Decommissioning would involve removal of equipment from the Project area in accordance with an approved decommissioning and abandonment plan.

Given the expected life of the Project and the possible developments in technology that may occur between now and the time of decommissioning, it is not possible to fully scope the decommissioning strategy that would be employed.

3.8 Feasible alternatives considered

Several potentially feasible project design alternatives have been considered during the early engineering phase of the Project. These concepts represent the project alternatives that have been assessed against economic, health, safety, environmental and strategic criteria to optimise value and align with the overall Project objectives (Table 3-3).

Table 3-3: Bonaparte CCS Project alternatives

Feasible project concept alternatives	Evaluation
Pipeline and cable routing	*Darwin Harbour* Alternative pipeline/cable routes within Darwin Harbour were considered but deemed unfeasible due to existing infrastructure and environmental sensitivities. *Shore crossing* No alternative shore crossing locations have been considered given the pipeline/cable would utilise an area adjacent to the existing Ichthys GEP beach valve precinct on Middle Arm.
Shore crossing design	The construction of the pipeline shore crossing would use an open trench excavation design. Horizontal direction drilling was assessed as a shore crossing option but was considered high risk due to the length and pipeline size required; however, may be viable for the SPFO installation.
No development	Without the Project, third-party CO_2 generating industries in Darwin may continue to emit CO_2 to atmosphere, given there are currently no other approved or sanctioned CCS projects in the region. The Project is justified for the reasons provided in Section 1.1. The Project also represents additional employment opportunities and economic investment in the region.

4 EXISTING ENVIRONMENT

This section provides a description of the environment relevant to the onshore and nearshore PDA within Northern Territory waters and the ODA on Middle Arm Peninsula (Section 3.5).

An EPBC Protected Matters Search Tool (PMST) report was generated on the 13 May 2025 with a 20 km buffer surrounding the Project Area to determine the presence of MNES within or adjacent to the Project Area (refer Appendix A). Outputs of this have been described within the subsequent sections, as applicable.

4.1 Regional context

The PDA runs in an east-west orientation, originating at the onshore inlet station on Middle Arm Peninsula crossing Darwin Harbour before reaching the Northern Territory coastal waters boundary. The CO_2 transport pipeline would be offset by approximately 70 to 100 m from the Ichthys GEP on the south-west side within Darwin Harbour and would be offset by up to 200 m outside the harbour.

The ODA is located on the Middle Arm Peninsula in Darwin Harbour (Figure 3-1) between the proposed onshore inlet station near Wickham Point to the western border of the shore crossing area (Figure 3-1 and Figure 3-2). Middle Arm Peninsula lies within the Litchfield Council region. The ODA covers land zoned under the Northern Territory planning scheme as future development. Surrounding land is mostly zoned as conservation, development and main road.

The nearshore PDA is in proximity to coastal communities of Darwin Harbour, including Bladin Point, Cox Peninsula and Darwin city centre. The Darwin coastal region is of mixed land use and urban development, in an area of high shipping traffic and industrial sector infrastructure.

The socio-economic values of the top end region of the Northern Territory are influenced by people living along the adjacent coastline who rely on the sea, directly or indirectly (CoA 2015). The remainder of the Northern Territory population is concentrated around inland centres of Alice Springs and Katherine (Northern Territory Government [NTG] 2024a). The lack of dense coastal settlements and subsequent low levels of marine resource use denotes relatively low human pressures in the region (DSEWPaC 2012a). The most intensive use of Darwin Harbour is commercial shipping, recreational boating/fishing, tourism and naval activities. Indigenous occupation of coastal areas dates back as far as 60,000 years (CoA 2015). The region supports commercial fishing, recreational fishing, marine tourism, offshore oil and gas production, defence activities, shipping transport and port activities (CoA 2015). Recently, the Joseph Bonaparte Gulf region has become the focus of potential carbon capture and storage and offshore renewable energy proposals (Geoscience Australia 2016).

4.1.1 Bioregion

Based on the Interim Biogeographic Regionalisation for Australia Version 7, the ODA and surrounding areas are within the Darwin Coastal bioregion (Australian Government 2022). The Darwin Coastal bioregion comprises gently undulating plains on lateritised Cretaceous sandstones and siltstones; sandy and loamy red and yellow earths and siliceous sands from near the mouth of the Victoria River to just west of Cobourg Peninsula.

The most notable vegetation feature of the bioregion is the extensive and diverse floodplain environment associated with the lower reaches of the many large river systems. There are also substantial areas of mangroves (see Section 4.3.2), rainforest and other riparian vegetation fringing the rivers. Inland from the coast, the dominant vegetation type is eucalypt tall open forest, typically dominated by Darwin woollybutt (Eucalyptus miniata) and Darwin stringybark (E. tetrodonta) (Baker et al. 2005).

4.1.2 Protected areas

This section identifies protected areas that overlap or are located within proximity of the Project area.

Indigenous Protected Areas

No Indigenous Protected Areas (IPAs) as defined in the Australia's National Reserve System occur in proximity to the Project area.

Australian Marine Parks

There are no Australian Marine Parks (AMPs) in proximity to the Project area. The nearest AMP to the Project area is Oceanic Shoals AMP, located 88 km north-west of the nearshore PDA.

Northern Territory Protected Areas

The Northern Territory Parks and Wildlife Commission are responsible for the conservation care, control and management of parks and reserves in the Northern Territory.

No State/Territory protected areas overlap the Project area. There are a number of State/Territory parks in the region (refer to Table 4-1 and Figure 4-1). It is noted that the Channel Island Leprosarium and Reefs (100 m south of the nearshore PDA) have been declared and are protected under the Heritage Act 2011 (Northern Territory) for their unique position and species diversity in a large ria (drowned river valley) system characterised by stressors (high turbidity, currents, sedimentation and depressions in salinity) that are not normally considered conducive to coral growth or presence (TFHC 2021).

The nearshore PDA overlaps the Charles Point Wide Reef Fish Protected Area (RFPA), intended to prevent the overfishing of golden snapper, black jewfish and other vulnerable reef species. The nearshore PDA is also in proximity to Lorna Shoals RFPA, also established to reduce the impact of ongoing catch and allow rejuvenation of stocks (NTG 2024b). No fishing activities are permitted within RFPAs.

Table 4-1: Protected areas and IUCN categories in proximity to the Project area

Protected area	IUCN category	Distance and direction from Project area
Casuarina Coastal Reserve	V (Protected landscape or seascape)	15 km north of ODA
Charles Darwin NP	V (Protected landscape or seascape)	6 km north of ODA
Holmes Jungle Nature Park	V (Protected landscape or seascape)	12 km north-east of ODA

Protected area	IUCN category	Distance and direction from Project area
Knuckey Lagoons Conservation Reserve	IV (Habitat or species management area)	9 km north-east of ODA
Howard Spring Nature Park	V (Protected landscape or seascape)	14 km east-northeast of ODA
Howard Spring Hunting Reserve	VI (Protected area with sustainable use of natural resources)	16 km east-northeast of ODA

Figure 4-1: Northern Territory protected areas in proximity to the Project area

Nationally important wetlands

Australia is signatory to the Convention on Wetlands of International Importance (the Ramsar Convention), which aims to halt the worldwide loss of wetlands and to conserve those that remain. As a member country, Australia nominates to place wetlands on the List of Wetlands of International Importance (Ramsar wetlands) if those sites are representative, rare or unique, or are important for conserving biological diversity. Australia currently has 65 listed Ramsar sites, two of which are in the Northern Territory (Cobourg Peninsula and Kakadu National Park). Ramsar sites are protected under the EPBC Act. As a key part of their commitment to recognising Australia's most important wetlands, all State, Territory and Commonwealth governments have jointly compiled a list of nationally important wetlands (NIW).

The PMST tool identified that Port Darwin NIW overlaps the nearshore PDA (Table 4-2, Figure 4-2). There are no Ramsar sites located in close proximity to the Project area, the nearest site being Kakadu National Park, located approximately 108 km east of the PDA at the closest point.

Table 4-2: Nationally important wetlands in the proximity to the Project area

Port Darwin	Overlaps	Identified as a NIW, Port Darwin comprises of the entire embayment of Port Darwin and encompasses over 48,000 ha, including at least 16,000 ha of mangroves (DCCEEW 1993). The site is characterised by a megascale embayment, with macroscale and microscale islands, fringing reefs and subtidal coral platforms. Port Darwin is a major nursery area for estuarine and offshore fish and crustaceans and supports a variety of seabirds and migratory shorebirds that breed, roost and stop-over in the wetland. The mangroves of this site are the most extensive and species-rich of any Northern Territory embayment, supporting at least 36 species of flora, including several Northern Territory endemics (DCCEEW 1993).
Finniss Floodplain and Fog Bay Systems	38 km south-west	The Finniss Floodplain and Fog Bay System is an example of a beach-fringed curved bay with continuous intertidal mudflats (DAWE 2022). The site is a major breeding area for magpie goose (Anseranas semipalmata) and during the dry season acts as a refuge area for water birds. It is also a migration stop-over area for shorebirds and a major breeding area for saltwater crocodile (DAWE 2022). There are extensive paperbark swamps and small areas of samphire near the estuaries and the south-west part of Fog Bay. This site is recognised as an important bird area (IBA) with the intertidal mudflats of Fog Bay reported to support many species of shorebird and waterbird colonies (Birdlife International 2022). The Finniss Floodplain and Fog Bay System is approximately 38 km south-west of the Project area.

Adelaide River Floodplain System	18 km east	Located south-east of Darwin Harbour, Adelaide River Floodplain System is a NIW comprising of several swamps, lakes, lagoons and intertidal mudflats and is continuous with the Mary River Floodplain to the north-east (DCCEEW 2019). The site is a major breeding area for magpie goose (A. semipalmata) and saltwater crocodiles (C. porosus) as well as a major dry season refuge area for waterbirds and migration stop-over for shorebirds (DCCEEW 2019). Vegetation in the wetland is characterised by areas of mangrove, samphire, melaleuca open-forest and mixed sedgeland over most of the site (DCCEEW 2019).

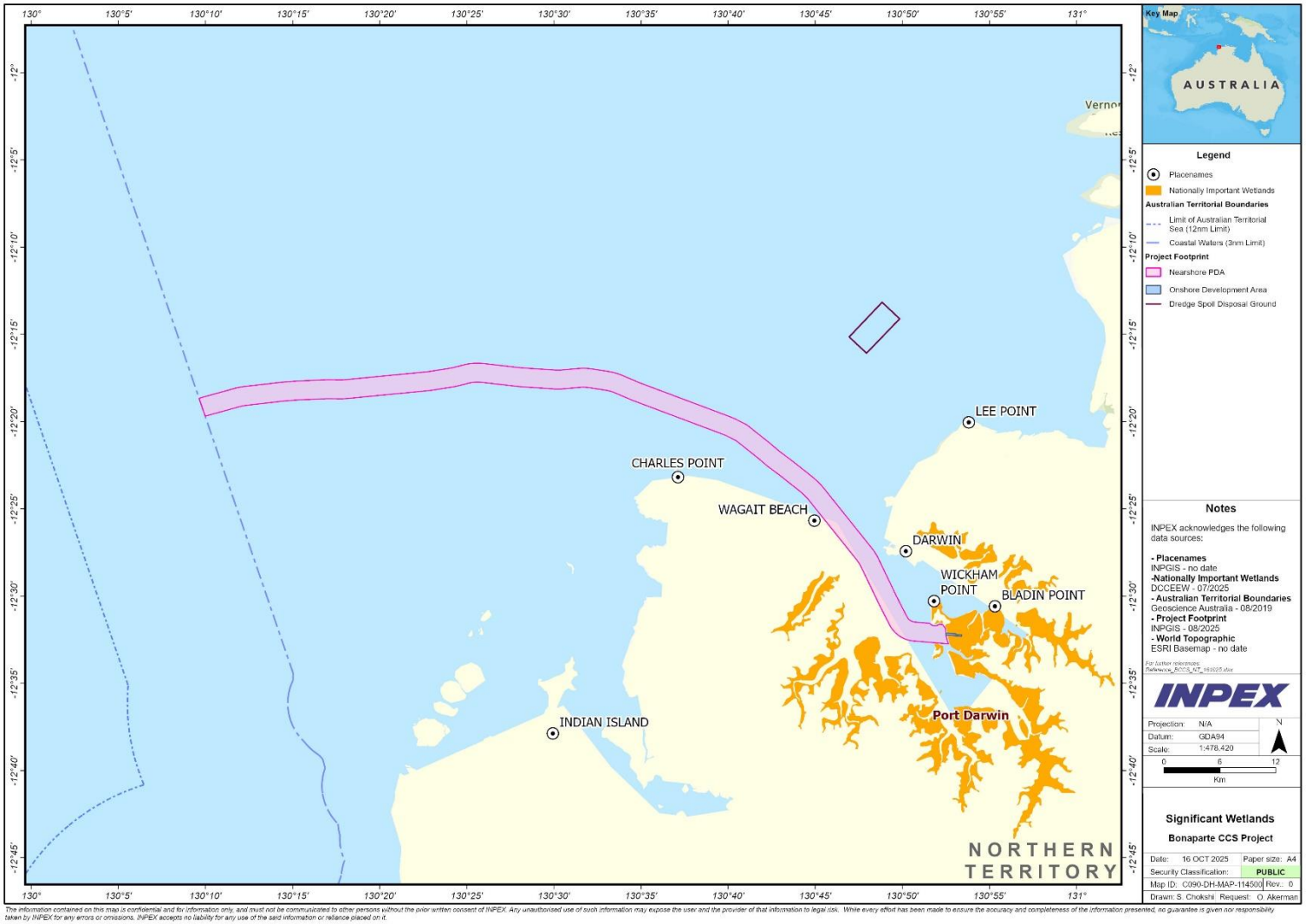


Figure 4-2: Nationally important wetlands overlapping the Project area

4.2 Physical environment

4.2.1 Climate and meteorology

The Project area lies in the monsoonal tropics of northern Australia, which has two distinct seasons - a hot wet season from November to April and a warm dry season from May to October. April and October are transitional months between the wet and dry seasons. Darwin has a mean annual rainfall of 1,724 mm, with rain falling on an average of 113 days (mainly in the wet season). Rainfall varies seasonally, with average monthly rainfall of 1.1 mm in July and 431.3 mm in January. The mean annual evaporation rate is 2,444 mm. The average monthly conditions for Darwin are presented in Table 4-3.

During the wet season, which has an official start date of 1 November each year, prevailing winds are westerly and west-north-westerly. Winds in the dry season, which has an official start date of 1 May each year, vary from south-easterly to northerly. Wind roses for Darwin are shown in Figure 4-3.

The area is subject to tropical low-pressure systems and cyclones, particularly from November to April. Tropical cyclones bring strong winds, heavy/squally rainfall, local flooding and storm surges. Damage from cyclones can occur up to 50 km inland from the coast.

Table 4-3: Average monthly weather conditions for Darwin (BOM 2022)

Month	Average maximum temperature (°C)	Average minimum temperature (°C)	Average monthly rainfall (mm)	Average relative humidity (9 am; %)	Average relative humidity (3 pm; %)	Month
January	31.8	24.9	431.3	81	70	January
February	31.5	24.8	369.0	83	72	February
March	32.0	24.6	310.8	82	67	March
April	32.8	24.1	101.7	74	52	April
May	32.1	22.2	20.4	65	43	May
June	30.7	20.0	1.8	60	38	June
July	30.7	19.3	1.1	60	37	July
August	31.5	20.3	4.6	64	40	August
September	32.7	23.0	16.53	68	47	September
October	33.3	24.9	71.2	69	52	October
November	33.4	25.3	143.2	72	58	November
December	32.7	25.3	252.0	76	65	December
January	31.8	24.9	431.3	81	70	January

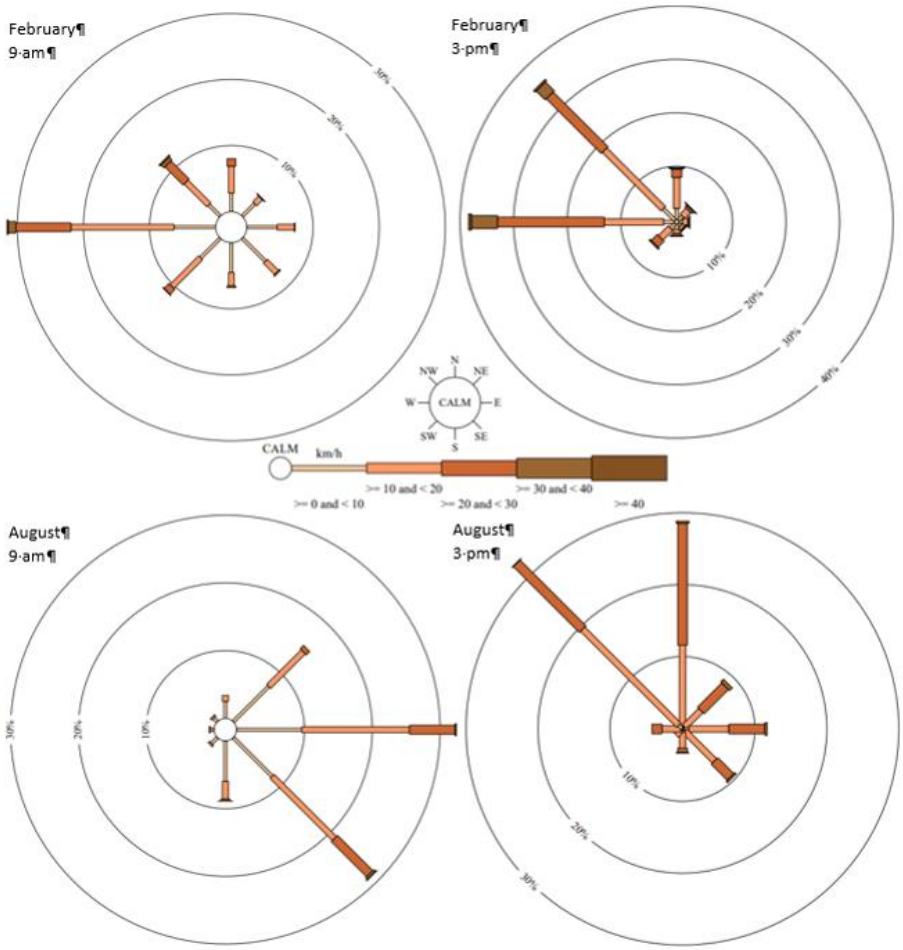


Figure 4-3: Wet season (February) and dry season (August) indicative wind roses for the Darwin area (BOM 2022)

4.2.2 Air quality

Air quality in the offshore environment of the nearshore PDA is generally high given the distance from urban and industrial pollution sources.

Ambient air quality in the ODA (part of the Darwin airshed) is influenced by several sources, including biogenic sources (soil, natural and agricultural vegetation), smoke from bushfires, vehicles and industrial sources. Generally, the concentrations of nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and photochemical oxidants (as measured by ozone, O_3) in the Darwin airshed are relatively low. Particulate levels in the Darwin airshed vary seasonally due to annual backburning and bushfires; the 2024 Darwin Harbour Integrated Report Card [DHIRC] (2024) reported that 94 per cent of days in the dry season were below the $PM_{2.5}$ good air quality indicator, compared to only 39 per cent of days in the wet season.

The nearest sensitive receptors for air quality from the Project area are the residential areas of Palmerston (11 km north-east).

The Ambient Air Quality National Environment Protection Measure (AAQ NEPM) specifies maximum acceptable ground-level concentrations for a range of common parameters relevant to airsheds across Australia.

Northern Territory EPA report annually on ambient air quality in the Darwin region, using monitoring data from three designated ambient air quality monitoring stations located at Palmerston, Winnellie and Frances Bay (previously Stokes Hill). The most recent annual report is the Northern Territory Ambient Air Quality Monitoring Report 2023 (v1, NT EPA 2024). The six NEPM air pollutants monitored for ambient air quality are: SO_2, NO_2, carbon monoxide (CO), O_3 and particulate matter (PM_{10} and $PM_{2.5}$).

The 2023 report found that ambient air quality complies with the NEPM for SO_2, NO_2, CO and O_3.

There were a number of exceedances of short-term standards for PM_{10} and $PM_{2.5}$. All exceedances were associated with exceptional events such as bushfire smoke. $PM_{2.5}$ exceeded the 1-year average $PM_{2.5}$ standard at all three monitoring stations.

4.2.3 Bathymetry and seabed morphology

The water depth of the nearshore PDA ranges from 0 m LAT to 43 m at the Northern Territory coastal waters boundary. Bathymetry data have been collected as part of several studies completed within Darwin Harbour to form an understanding and characterisation of seabed features.

The coastal morphology of the Darwin region is dominated by estuarine and rocky intertidal environments, with extensive mangrove communities and mud flats found in the inner Harbour. Darwin Harbour is a large ria (drowned river valley) system flanked by shoreline platforms and subtidal flats (Nicholas et al. 2019; Siwabessy et al. 2016) and covers an area of approximately 500 km2. It has three main components (East Arm, West Arm and Middle Arm) that merge into a single unit, along with the smaller Woods Inlet, before opening into the Beagle Gulf to the north (INPEX 2010).

The main natural channel for the Port of Darwin is approximately 15 to 30 m deep, with a maximum depth of 42 m (Figure 4-4) (INPEX 2010; Nicholas et al. 2019). The channel favours the eastern side of the harbour, with broader shallower areas occurring on the western side. The channel continues into East Arm, towards Bladin Point, at water depths of more than 15 m below LAT and leads into the Projects access channel and turning basin, which was dredged to 13.5 m below LAT. A deeper channel extends into Middle Arm, up to the western side of Channel Island (INPEX 2010; Nicholas et al. 2019). While parts of the channel seabed are comprised of bedrock, most areas of Darwin Harbour are dominated by unconsolidated sediment forming a range of features including mud flats, ripples and sub-aqueous dunes (Nicholas et al. 2019). Elongate sand bodies are present seaward of Darwin Harbour and are suggestive of ongoing sediment transport out of Darwin Harbour (Nicholas et al. 2019). Freshwater inflow from the Elizabeth River into the East Arm and the Blackmore and Darwin rivers into the Middle Arm generally occurs between January and April, when estuarine conditions prevail in all areas (Hanley 1988).

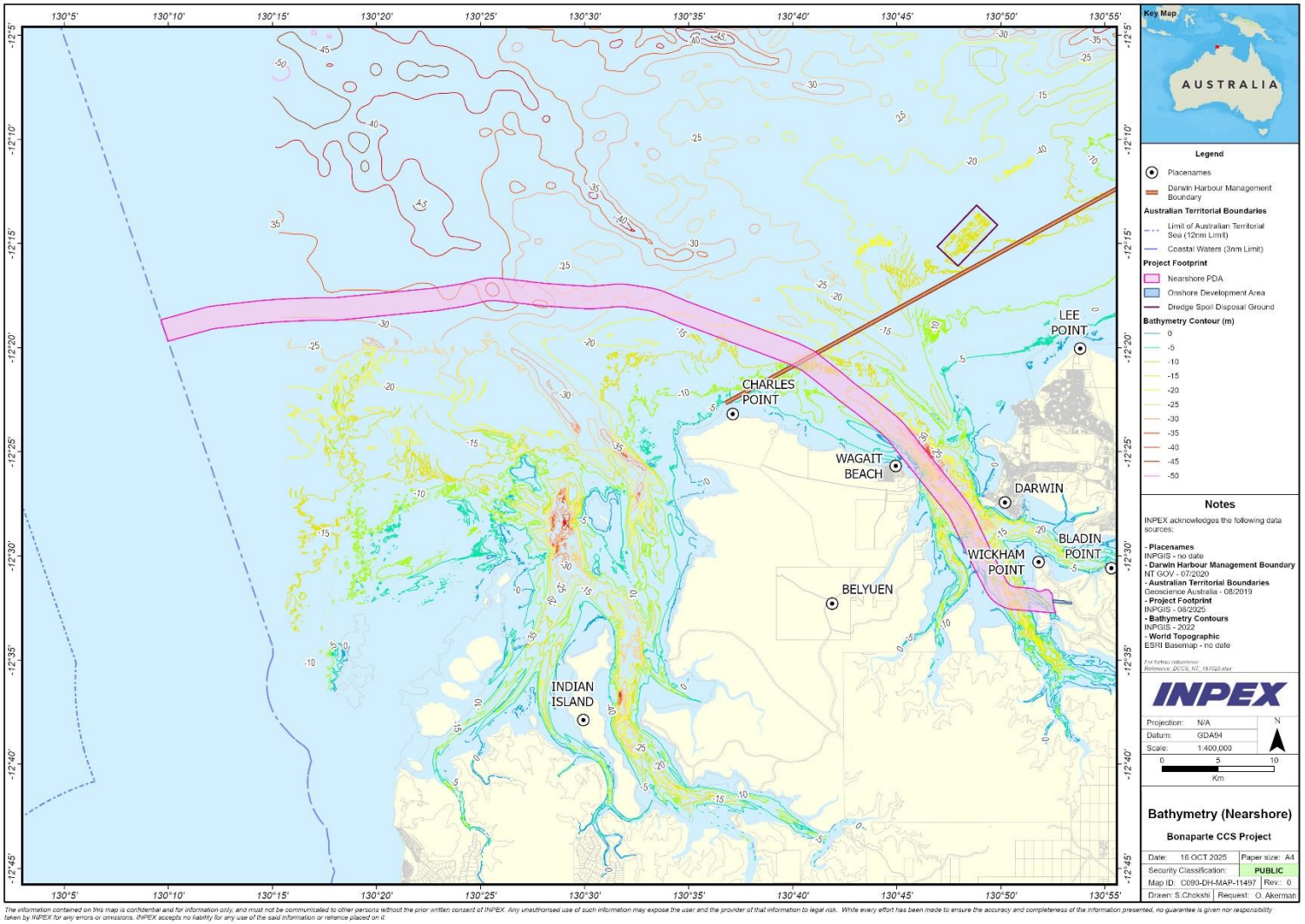


Figure 4-4: Bathymetry of the nearshore PDA

4.2.4 Oceanography

The Darwin region marine environment encompasses the open ocean of the Beagle Gulf and the estuarine-dominated Darwin Harbour. Tidal forces have the greatest control over the sea level and water currents in Darwin Harbour.

Darwin Harbour is classed as a macro-tidal estuary, with maximum tidal range reaching 7.8 m (Padovan 2003; Li 2013). The Darwin region experiences a semidiurnal tidal cycle (i.e. two highs and two lows per day) with a slight diurnal inequality between the successive tides (INPEX 2010). The daily tidal range is characterised by a pronounced variation in magnitude, repeating approximately every 15 days (spring-neap tide cycle). The average daily tidal range is ~6 m during the spring phase and ~3 m during neap phase of the tidal cycle (Cardno 2014). There is also considerable annual variability, with the largest spring tides typically occurring in March and September/October.

Tidal excursions range from 8 to 15 km during spring tides and 2 to 8 km during neap tides (Hanley and Caswell 1995; Semeniuk 1985). Within East Arm, model results show large tidal ranges produce strong currents that peak at 1.5 to 2.0 ms−1 during spring tides (HRW 2013).

4.2.5 Water quality

Darwin Harbour is a naturally turbid environment due to the large tidal ranges and associated currents (see Section 4.2.4), with clearest water occurring during neap tides while the spring tides are associated with increased turbidity due to increased current velocities.

During the wet season, monsoonal troughs and tropical cyclones (events) significantly influence water quality, in particular turbidity. These events increase metocean conditions (wind and waves) which suspend sediments resulting in high turbidity levels (>150 nephelometric turbidity unit (NTU) daily average) in coastal waters outside the harbour, while waters within the harbour are typically sheltered. If these events coincide with spring tides, the tidal currents can affect the highly turbid coastal waters into the harbour resulting in increased turbidity (>100 NTU daily average) (Cardno 2015a; URS 2009). Turbidity inside the harbour would also be increased by sediment loading from surface runoff associated with increased rainfall during such events.

Conversely, metocean conditions in the dry season are relatively benign, with water quality primarily driven by tides. As a result, clearer waters are measured inside and outside the harbour, with turbidity typically between 1 and 7 NTU (median daily average).

Water temperature typically varies from 24 °C in the dry season to over 30 °C in the wet season. However, the timing, duration and frequency of wet season events can significantly influence water temperature causing declines of 2 °C to 4 °C. The rainfall associated with these events can also drive fluctuations in salinity within Darwin Harbour.

Salinity within Darwin Harbour is generally slightly lower in the wet season when compared to the dry season due to rainfall; however, in either season there can be strong local gradients in salinity. During the wet season, salinity can range from approximately 30 to 35 parts per thousand (ppt) in the mid-Harbour down to near 0 ppt further up rivers (Makarynska and Makarynska 2019), where there are significant freshwater inflows. During the dry season, a lack of rainfall and increased evaporation can lead to salinities between 35 and 40 ppt in upstream waters where there is limited tidal flushing (Cardno 2014; Makarynska and Makarynska 2019).

Dissolved oxygen in Darwin Harbour typically ranges from 74 to 96 per cent (mean 84 per cent), with no seasonal effects (INPEX 2011; Padovan 1997).

A seasonal summary of mean water quality is provided in Table 4-4.

Table 4-4: Water quality near Bladin Point

Parameter	Dry season	Wet season
Temperature	24.5 °C*	30.6 °C*
Salinity	35.5 ppt*	29 ppt*
Dissolved oxygen	93.3% of saturation*	87.8% of saturation*
pH	7.91†	7.77†

*URS (2009) mean values

†AEC Environmental (2017) median values

The *Water Act 1992* (Northern Territory) defines several beneficial uses for water bodies in the Northern Territory. Beneficial uses describe how a community values and uses a water resource. These are then used to set water quality objectives relevant to the beneficial uses declared for a particular water body. The declared beneficial uses for the Darwin Harbour Region – High Water Mark and Darwin Harbour Region – Natural Waterways are as follows:

- aquaculture: water for commercial production of aquatic animals, including related research
- environment: water to maintain the health of aquatic ecosystems
- cultural: water to meet aesthetic, recreational and cultural needs.

4.2.6 Sediment quality

Numerous sediment quality surveys have been undertaken in Darwin Harbour (Royal Haskoning DHV 2022; Cardno 2022; Radke et al. 2019, 2020a, 2020b, 2021, 2023, 2024; AECOM 2020; INPEX 2019, 2020, 2021, 2023; GHD 2019; Munksgaard et al. 2013; URS 2009; Fortune 2006). Results from published monitoring studies in East Arm have found the sediment to be primarily comprised of sand with varying amounts of gravel, silt and clay, depending on the sample location (e.g. intertidal areas or channels). Sampling of deposited material within the jetty pockets adjacent to Ichthys facilities was found to be predominantly silts and clay (INPEX 2016, 2019, 2020, 2023).

Analysis of potential inorganic contaminants in Darwin Harbour such as metals (including metalloids) found that arsenic concentrations commonly exceed the Australian and New Zealand Guidelines (ANZG 2018) sediment quality guideline value (SQGV) of 20 mg/kg. However, these high concentrations have been attributed to local geology (weathering of arsenic rich coastal substrata) rather than anthropogenic sources (Fortune 2006). Furthermore, previous bioavailability testing has indicated that only a small proportion is bioavailable indicating that it is unlikely to be toxic in the marine environment.

A range of other metals (e.g. antimony, chromium, copper, lead, mercury, nickel and silver) have also been recorded to infrequently exceed SQGVs; however, their mean concentrations have always remained below SQGVs. Exceedances are typically associated with individual samples or samples collected adjacent to urbanised or developed areas.

Until recently few sediment sampling programs have analysed samples for other contaminants such as organic compounds. Sediment sampling to inform dredging activities at Coonawarra (GHD 2019), Mandorah (Cardno 2022), the proposed ship lift in East Arm (AECOM 2020) and Middle Arm Sustainable Development Precinct (Royal Haskoning DHV 2022) have all included various analysis of organics. However, the most recent comprehensive surveys were undertaken by the Northern Territory Government in 2019, 2020 and 2023 (Radke et al. 2023, 2021, 2020a, 2020b), as part of the Ichthys LNG Darwin Harbour Integrated Marine Monitoring and Research Program environmental offset. These surveys cover the entire Darwin Harbour extent and include tributyltin (TBT), per- and polyfluoroalkyl substances (PFASs), polychlorinated biphenyls (PCBs), organophosphate pesticides (OPPs), organochlorine pesticide (OCPs), polycyclic aromatic hydrocarbons (PAHs), total recoverable hydrocarbons (TRHs) and benzene, toluene, ethylbenzene and xylenes (BTEX). INPEX (2023) also tested the MOF berth pockets for organics, total petroleum hydrocarbons (TPH), total recoverable hydrocarbons (TRH), PAH, BTEX.

4.2.7 Geology and geomorphology

The ODA is underlain by Early Proterozoic and Burrell Creek Formation rocks, with some Cretaceous Darwin Formation rocks along the shoreline. Soils over half of the site are very gravelly, massive earths that range in depth from shallow (<0.25 m) to moderately deep (0.25 to <0.5 m) (Fogarty et al. 1984).

The following soil families have been identified at Bladin Point: Bladin (red, fine sandy clay loam); Hotham (brown, massive, fine sandy loam with medium gravel); Koolpinyah (yellow sandy loam over sandy clay loam); Mullalgah (deep, peaty soils on marine sediments); Euro (hydrosols on intertidal flats); Maand (poorly drained marine muds); and Rinamatta (siliceous sands).

The Mullalgah, Euro, Maand and Rinamatta soil families contain varying levels of ASS. Geotechnical investigations for Ichthys LNG construction phase identified areas of ASS within Ichthys LNG footprint, within 4 km of the ODA (JKC 2014; Coffey 2014). In addition to areas of ASS, geotechnical investigations also reported soils with natural non sulphuric acidity (pH levels as 3.4 to 6.8); natural acidity formed through hydrolysis reactions where the anions are leached and replaced with hydrogen soils.

There are currently no beneficial uses or soil quality objectives for land legislated by the Northern Territory Government. INPEX will refer to the relevant Health Investigation Levels (HILs) [D (commercial/industrial land)] as described by the National Environment Protection (Assessment of Site Contamination) Measure for the Project land [ID category for the pipeline route and crossing] as this aligns with the Litchfield Council land use zoning of Industrial Development.

4.3 Biological environment

4.3.1 Marine

Benthic habitats and communities

Darwin Harbour benthic habitats mapped by INPEX subcontractors during the development of the Ichthys EIS and capital dredging project within the PDA in Darwin Harbour are presented in Figure 4-5.

Darwin Harbour has a complex assemblage of marine habitats and there are large differences in the extent, diversity and significance of the associated biological communities.

Coral

Hard coral communities in Darwin Harbour are located in the lower intertidal (less than 1 m above LAT) to upper subtidal zone, down to approximately 5 to 10 m below LAT (INPEX 2010). In waters deeper than approximately 5 m below LAT, hard coral communities diffuse into sparsely distributed soft coral and sponge-dominated filter feeder communities. All three of these communities are restricted to areas of hard substrate, where they can gain a holdfast on exposed rock or hard substrate under a thin veneer of benthic sediment. Coral communities in Darwin Harbour are unique as they are exposed to fluctuations in salinity and higher levels of turbidity and sedimentation that would not normally be associated with coral communities. Corals living in the lower intertidal zone may also be exposed during extreme spring low tides that typically occur in the late dry to early wet season (September to December), making them vulnerable to potential desiccation and freshwater impacts if low tides coincide with heavy rainfall events (INPEX 2010). The coral community at Channel Island has been declared and is protected under the *Heritage Act 2011* (Northern Territory) for its unique position and species diversity in a large ria (drowned river valley) system characterised by stressors (high turbidity, currents, sedimentation and depressions in salinity) that are not normally considered conducive to coral growth or presence (DTFHC 2021).

A total of 123 species of corals have been recorded in Darwin Harbour (Wolstenholme et al. 1997). Coral spawning is not known to have been observed in Darwin Harbour, although many of the species found reproduce by spawning elsewhere in the Indo-Pacific Region. Spawning in the NT aquarium has been observed around the full moon of October to November (TWP 2006). Coral gravidity assessments indicated that *Faviidae* colonies may have an autumn (April/May) spawning window in Darwin Harbour (Cardno 2015b).

Seagrass

Seagrass monitoring undertaken for the Ichthys Nearshore Environmental Monitoring Plan identified large seagrass beds along the Darwin coastal region between Fannie Bay and Lee Point, and smaller isolated patches at Woods Inlet and off Charles Point along the Cox Peninsula (Cardno 2015c). No seagrass beds were identified within Darwin Harbour itself during the monitoring program, although other environmental surveys have identified isolated sparse patches of seagrass at Weed Reef and Wickham Point (INPEX 2010; Streten 2022). Coastal shallow water seagrass habitats are generally rare in the region, accounting for only 11.5 km or 0.2 per cent of the total coastline surveyed by Duke et al. (2010). The regionally dominant genera in Australia are *Halophila* and *Halodule*.

Macroalgae

Macroalgae dominated communities in Darwin Harbour are often located on platform crests and in the intertidal–subtidal interface zone, generally a few metres either side of the low water mark and often in association with coral or sponge dominated communities. Known localities of these communities are East Point Reef and Weed Reef (Smit 2003). Marine habitat investigations by URS (INPEX 2010) recorded a sparse though diverse macroalgal community on the rubble covered pavement at Weed Reef, which included browns (Sargassum and Padina spp.), foliose reds (*Laurencia* spp.), greens (*Caulerpa*, *Ulva* and *Udotea* spp.) and calcareous greens (*Halimeda* spp.) (INPEX 2010).

Algal composition is highly seasonal and seems to be regulated by the amount of time the community is exposed during spring low tides and other factors such as rise in water temperature. During the build-up season (October to December) when water temperatures rise to over 30 °C and the tidal range is at its largest, exposing the lower intertidal zone, the larger macroalgae die back and turf algae dominates. During the earlier dry season, when the tidal range is not so extreme, the larger macroalgae are more abundant (INPEX 2010).

Soft-bottom benthos

Soft substrates, which make up the largest habitat within Darwin Harbour, consist mainly of muds and fine sand and are found in front of (i.e. seaward of) mangroves and in intertidal and subtidal areas between the hard substrates and the main drainage channels.

Intertidal and subtidal soft substrates support a range of marine invertebrates that live buried within and on the surface of the sediments, respectively referred to as infauna and epifauna. Infaunal assemblages vary largely depending on the type of sediment they are associated with but generally contain a variety of burrowing organisms such as polychaete worms, amphipod crustaceans, bivalve and gastropod molluscs, and nemerteans and nematodes. These animals are an important source of food for wading birds and fish that live in the harbour and help in nutrient cycling. The species richness and abundance of these assemblages is likely to vary both annually and seasonally (Metcalfe and Glasby 2008), likely related to the intensity of the monsoon season and recruitment success (Cardno 2014). The epifauna found in this habitat included hydroids, occasional soft corals (gorgonians, *Pennatulacea*, *Junceella* and *Alcyoniidae*), *Bryozoa* (lace coral), sea urchins and sea stars (RPS 2021).

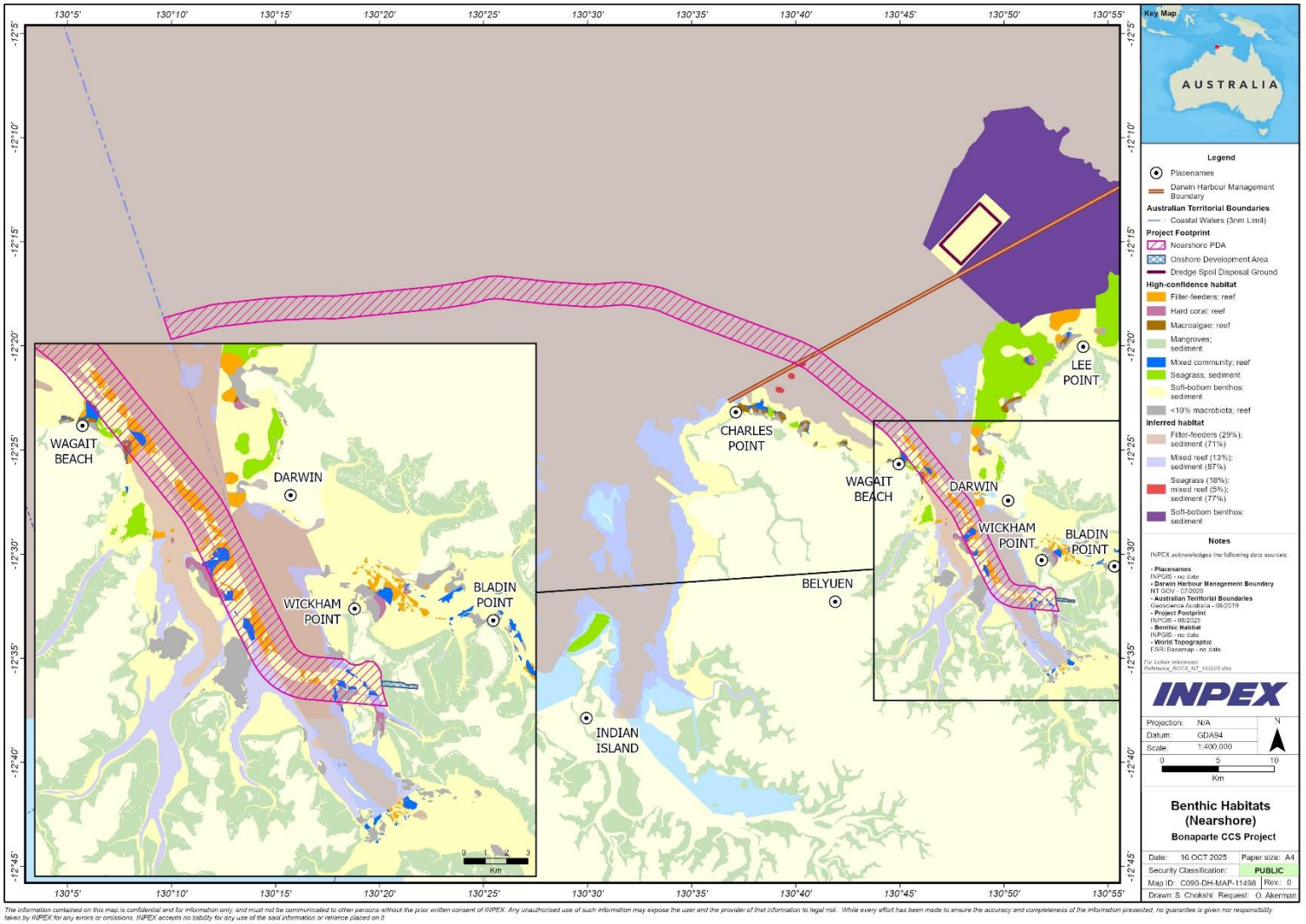


Figure 4-5: Benthic habitats of the nearshore PDA

Marine fauna

There are a number of threatened fauna species, listed under both the Commonwealth EPBC Act and the TPWC Act, which may be present in the nearshore PDA. Threatened and Migratory marine fauna species identified by the PMST as occurring within the nearshore PDA are presented in Section 4.3.4.

4.3.2 Terrestrial

Middle Arm Peninsula has been subject to extensive terrestrial vegetation, flora and fauna surveys over the past two decades, such that the terrestrial ecological values of the peninsula are well described. The relevant survey information has been reviewed and summarised in the following sections.

Flora and ecological communities

The ODA lies within the Darwin Coastal Bioregion, which is characterised by mangroves, monsoon vine forest and tall open eucalypt forest. Much of the ODA has been previously cleared during the construction of the Ichthys GEP, however mangrove rehabilitation efforts have been undertaken in the area since 2014 to revegetate the 1.6 ha clearing (EcoScience NT 2017).

A ground-truth vegetation survey of the ODA was undertaken in December 2023 by EcOz Environmental Consultants (EcOz) to verify existing vegetation mapping of the area.

In total, there are four vegetation systems within the ODA (Figure 4-6): melaleuca forest, salt flats, mangrove communities and monsoon vine forest. The mangrove communities were the dominant vegetation community within the Project area, which included the following community types:

- *Sonneratia* woodland
- shoreline forest
- *Avicienna*/*Ceriops* open forest
- mixed hinterland closed forest.

There are no EPBC Act listed Threatened Ecological Communities (TECs) were identified in the PMST search in the vicinity of the ODA. "Significant Vegetation" is a term applied in the Northern Territory Planning Scheme 2020 and supported by NT Guidelines for targeted surveys of threatened and significant plant species The mangrove communities and the monsoon vine forest within the ODA are considered to have high conservation value in Darwin Harbour for biological and cultural reasons, and as such are Significant Vegetation. Significant Vegetation types recorded on Middle Arm Peninsula include:

- mangrove communities
- monsoon vine forest / vine thicket
- wetlands
- riparian vegetation
- sandsheet heath
- old-growth forest supporting large, hollow-bearing trees.

Figure 4-6: Vegetation communities of the onshore development area

Mangroves

Whilst there are no listed TECs within or adjacent to the Project area, the mangrove communities in the ODA are considered to have high conservation value in Darwin Harbour for biological and cultural reasons, and as such are considered significant vegetation. The distribution of mangrove communities in Darwin Harbour is presented in Figure 4-7. Mangrove communities are protected in the Northern Territory through a combination of Northern Territory legislation and Commonwealth laws due to their critical ecological roles in coastal protection, biodiversity, and carbon storage.

Protection under Northern Territory legislation:

- *Territory Parks and Wildlife Conservation Act 1976* (Northern Territory)
  - provides protection to marine and coastal ecosystems, including mangrove forests, especially when they serve as habitats for protected wildlife.
- *Planning Act 1999* (Northern Territory)
  - mangrove areas in the Northern Territory are often classified under Conservation or Coastal Protection zones in land use plans
  - Development Consent is required for activities affecting these areas, ensuring that mangrove clearing or disturbance is minimized and properly assessed.

Protection Under Commonwealth Legislation:

- EPBC Act
  - while mangroves themselves may not be individually listed, they are protected as part of habitats critical to species listed under the Act (e.g. migratory birds, marine turtles).

Mangrove communities are important to the ecological health of Darwin Harbour and provide food and shelter for a wide range of animals (e.g. nursery grounds for juvenile fish and crabs). Mangroves in the Darwin Harbour area constitute approximately 44 per cent of the mangrove communities in the Darwin Coastal Bioregion and about 5 per cent of the total mangrove area of the Northern Territory, with 80 per cent of these mangroves found in the "inner" Harbour between Sadgroves Creek and Mandorah (INPEX 2010). Recent habitat mapping (Brocklehurst and Edmeades 2018) using high resolution aerial imagery between Charles Point and Gunn Point has reported mangrove extent as 26,729 ha with an additional 4,846.8 ha of salt flats. Darwin Harbour is also recognised for its mangrove diversity, containing 36 of the 50 known mangrove species worldwide.

In Darwin Harbour there are four key mangrove assemblages distributed along the tidal profile as illustrated in Figure 4-7 (Cardno 2014). The seaward assemblage grows between 3 and 4 m LAT (typically between mean low water neaps (MLWN) and mean sea level (MSL)) and experiences tidal inundation twice every day at high tide. It is most commonly found adjacent to the open Harbour next to expansive mud flats rather than in riverine or creek system settings. It is dominated by open woodland of mature Sonneratia alba trees and in many places an understorey of the river mangrove *Aegiceras corniculatum* (Cardno 2014).

The tidal creek assemblage is typically found between MSL and mean high water neaps (MHWN) and is inundated at least once every day. This assemblage is dominated by *Rhizophora stylosa* and is found throughout Darwin Harbour often fringing creeks that lack a seaward assemblage (Cardno 2014). Adjacent to the tidal creek assemblage, is the tidal flat assemblage (typically located between MHWN and mean high water springs (MHWS)) is only inundated during spring high tide and as such and contains hyper saline salt flats. The tidal flats support a low closed but patchy forest dominated by Ceriops australis, while

the surrounding the salt flats typically occupied by the most salt tolerant species Avicennia marina (Cardno 2014).

At the landward edge of the mangroves, above the MHWS, lies the generally narrow Hinterland Margin assemblage, which is inundated only a few times a year during the highest spring tides. This assemblage is commonly dominated by C. australis; however, contains a greater variety of mangrove species than in other assemblages, including *Lumnitzera racemosa* and varieties of the deciduous *Excoecaria* sp.

Harbour-wide mangrove health monitoring using remote sensing (normalised difference vegetation index) as part of the National Environment Management Plan showed a distinct seasonality in mangrove condition. Mangroves are typically healthiest in the late wet (February to April) to early dry (May to July) season and most stressed in the late dry (August to October) to early wet (November to January) season (Datt and Staben 2020; Cardno 2015d). This seasonality in mangrove condition is likely to be linked to the effects of increased wet season rainfall and lower evaporation and inversely low rainfall and higher evaporation during the dry season, along with other seasonal changes in temperature, light regime and salinity (Cardno 2015d).

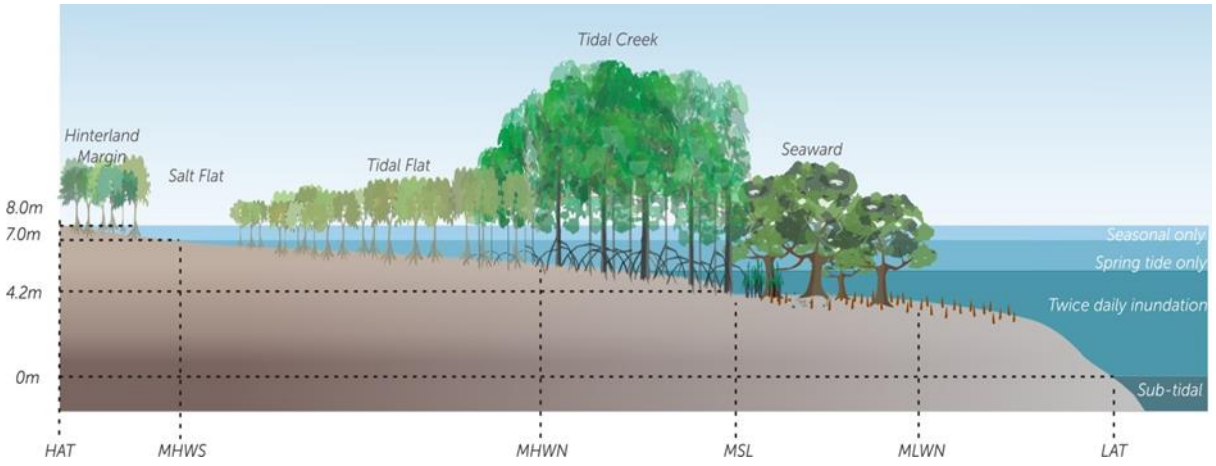


Figure 4-7: Major mangrove assemblages of Darwin Harbour and their position in the tidal profile (adapted from Brockelhurst and Edmeades 1996) (Cardno 2014)

Mangrove mapping by Brocklehurst et al (2018) indicates that the mangrove communities present adjacent to the PDA include the following species:

- *Rhizophora stylosa*/*Camptostemon schultzii* low to mid closed-forest/open-forest (shoreline forest and tidal creek forest)
- *Rhizophora stylosa*/*Bruguiera* spp./*Ceriops* spp. low closed-forest/low open-forest (transition zone)
- *Ceriops tagal* low closed-forest/low open-forest (tidal flats)
- mixed species low closed-forest (hinterland)
- Ceriops tagal low closed-forest/open-forest (hinterland)
- *Avicennia marina*/*Ceriops* spp. low open-forest/low closed-forest
- mixed species low open-forest/low closed-forest and
- *Sonneratia alba* low woodland/low open forest.

Mangrove ecosystems are included in several marine parks and coastal reserves in the Northern Territory, offering them area-based protection through management plans that regulate activities with the Charles Darwin National Park (which protects mangrove environments in Darwin Harbour) located to the north of the project.

Figure 4-8: Mangrove communities of Darwin Harbour

Weeds

Some species of introduced flora are declared to be weeds under the Northern Territory *Weeds Management Act 2001* because of the environmental and/or economic harm they can cause. Class A weeds are to be eradicated by landowners and occupiers. Class B weeds must have their growth and spread controlled by landowners and occupiers.

The remaining introduced flora species are referred to as environmental weeds. The Commonwealth Government has also categorised some species as Weeds of National Significance (WoNS). WoNS are a significant problem in the Northern Territory and pose multiple threats to the savanna woodlands, resulting in intense wildfires and tree canopy destruction. Weed distribution is often related to environmental disturbances caused by the construction of roads and tracks and feral animals.

Annual weed surveys have been undertaken by INPEX on Middle Arm Peninsula for environmental monitoring compliance. Weed surveys undertaken in and around Ichthys LNG between November 2018 and May 2023 recorded the following weed species (Table 4-5), some of which are listed as declared weeds under the *Weeds Management Act 2001*.

Table 4-5: Weed species recorded on Middle Arm Peninsula

Common Name	Scientific Name	WoNS[1]	*Weeds Management Act 2001* (NT) Class[2]
Gamba Grass	*Andropogon gayanus*	Yes	B
Hyptis	*Mesosphaerum suaveolens*	-	B
Lantana	*Lantana camera*	Yes	B
Annual mission grass	*Cenchrus pedicellatus*	No	-
Perennial mission grass	*Cenchrus polystachios*	No	B
Sida - Flannel weed	*Sida cordifolia*	No	B
Stylo - Caribbean	*Stylosanthes hamata*	No	-
Lion's tail	*Leonotis nepetifolia*	No	B
Barnyard grass	*Echinochloa colona*	No	C
Mimosa	*Mimosa pigra*	Yes	A
Sicklepod	*Senna obtusifolia*	No	B
Wild passionfruit	*Passiflora foetida*	No	-

1 Weeds of National Significance (WoNS) are weeds identified as a threat to Australian environments based on their invasiveness, potential for spread, and socioeconomic and environmental impacts; There are currently 20 species listed as WoNS.

2 Weeds under the *Weeds Management Act 2001* (NT) may be declared within the following classes, defined as Class A (To be eradicated), Class B (Growth and spread to be prevented), Class C (Not to be introduced to the Territory), Class D (Not to be spread by the actions of persons) or Unclassified (Declared but not classed as above). All Class A and B weeds are also considered to be Class C weeds.

4.3.3 Fauna and habitat

There are a number of threatened fauna species, listed under both the Commonwealth EPBC Act and the TPWC Act, which may be present in the ODA. Threatened and migratory terrestrial fauna species identified by the PMST as occurring within the ODA are presented in Section 4.3.4.

Past fauna surveys for the ILNG EIS at Bladin Point (~2 km north-west) recorded 148 vertebrate species, including nine mammal species, 106 bird species, 22 reptile species and 11 frog species (GHD 2009) were recorded. The ODA transects areas of saltpans, which are known to be important roosting habitat for threatened shorebirds (refer to Section 4.3.4).

No trees within the ODA met the threshold for large, hollow-bearing trees to support hollow-dependent native fauna species. However, the surveyed corridor transects suitable mangrove habitat for Mitchell's water monitor (EcOz 2023, refer to Section 4.3.4).

A survey of biting insects at Bladin Point found that biting midges were much more abundant than mosquitoes (Department of Health and Families 2009a). The most common biting midge recorded was Culicoides ornatus (mangrove biting midge) and the most common mosquito species recorded was Aedes vigilax (northern salt marsh mosquito).

Introduced terrestrial fauna species recorded in the area include the cane toad Rhinella marina, feral pigs (*Sus scrofa)*, cats (*Felis catus*), black rat (*Rattus rattus*) and insect pest species (AEC Environmental 2014). The cane toad is the most widely occurring pest species recorded on Bladin Point and Middle Arm Peninsula. Feral cats were recorded in December 2013 (AEC Environmental 2014). The tracks of dogs or dingoes were also recorded in December 2013; however, no animals were sighted (AEC Environmental 2014).

4.3.4 Threatened and migratory species

There are a number of threatened fauna and flora species, listed under both the Commonwealth EPBC Act and the *Territory Parks and Wildlife Conservation Act 2001* (Northern Territory) (TPWC Act), which may be present in the Project area.

A search of the EPBC Protected Matters Search Tool (PMST) for Matters of National environmental significance (MNES) was conducted for the ODA and PDA with a 20 km buffer applied. The report is attached as Appendix A. A likelihood of occurrence assessment (Appendix B) has been undertaken to determine the species taken through to the Preliminary Assessment of Potential Significant Impacts on MNES, presented in Section 7.

The PMST search revealed a combined total of 103 "listed threatened and migratory" species comprising 13 terrestrial birds, seven sea birds, 35 shore birds, one amphibian, 14 fish, sharks and rays, seven marine reptiles, four terrestrial reptiles, nine marine mammals, ten terrestrial mammals, and three plants (Table 4-6). Descriptions of threatened species with a likelihood of occurring within the Project area ('May', 'Likely', and 'Known' to occur) have been provided in the relevant subsections below.

A combined total of 34 species listed under the TPWC Act have been identified, including five terrestrial birds, eight shore birds, one amphibian, five fish, sharks and rays, three marine reptiles, three terrestrial reptiles, six terrestrial mammals, and three plants.

The summary of the Listed Threatened and Migratory species within the Project area or within the 20 km buffer are provided in Table 4-6. A likelihood of occurrence assessment (Appendix B) has been undertaken to determine the species taken through to the Preliminary Assessment of Potential Significant Impacts on MNES, presented in Section 7.2.

Table 4-6: Listed Threatened and Migratory species (EPBC and TPWC Act) predicted to occur within the Project area or within the 20 km buffer

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Land birds						
Alligator Rivers yellow chat	*Epthianura crocea tunneyi*	E	-	E	Species or species habitat may occur within area	Unlikely to occur
Barn swallow	*Hirundo rustica*	-	✓	-	Species or species habitat known to occur within area	May occur
Fork-tailed swift	*Apus pacificus*	-	✓	-	Species or species habitat likely to occur within area	Likely to occur
Gouldian finch	*Erythrura gouldiae*	E	-	V	Species or species habitat known to occur within area	
Grey falcon	*Falco hypoleucos*	V	-	V	May occur	
Grey wagtail	*Motacilla cinerea*	-	✓	-	Species or species habitat known to occur within area	Unlikely to occur
Masked owl (northern)	*Tyto novaehollandiae kimberli*	V	-	V	Species or species habitat known to occur within area	May occur
Oriental cuckoo	*Cuculus optatus*	-	✓	-	Species or species habitat likely to occur within area	Unlikely to occur
Osprey	*Pandion haliaetus*	-	✓	-	Breeding known to occur within area	Known to occur

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Partridge pigeon (eastern)	*Geophaps smithii smithii*	V	-	-	Species or species habitat known to occur within area	Unlikely to occur
Red goshawk	*Erythrotriorchis radiatus*	E	-	V	Species or species habitat known to occur within area	Unlikely to occur
Red-rumped swallow	*Cecropis daurica*	-	✓	-	Species or species habitat known to occur within area	May occur
Yellow wagtail	*Motacilla flava*	-	✓	-	Species or species habitat known to occur within area	May occur
Seabirds						
Common noddy	*Anous stolidus*	-	✓	-	Species or species habitat likely to occur within area	Known to occur
Great frigatebird	*Fregata minor*	-	✓	-	Species or species habitat known to occur within area	May occur
Lesser frigatebird	*Fregata ariel*	-	✓	-	Species or species habitat known to occur within area	Known to occur
Little tern	*Sternula albifrons*	V	✓	-	Species or species habitat likely to occur within area	Known to occur
Red-tailed tropicbird (Indian Ocean)	*Phaethon rubricauda westralis*	E	-	-	Species or species habitat may occur within area	Unlikely to occur

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Streaked shearwater	*Calonectris leucomelas*	-	✓	-	Species or species habitat known to occur within area	Known to occur
White-tailed tropicbird	*Phaethon lepturus*	-	✓	-	Species or species habitat may occur within area	Unlikely to occur
Shorebirds						
Asian dowitcher	*Limnodromus semipalmatus*	V	✓	-	Species or species habitat known to occur within area	Likely to occur
Australian painted snipe	*Rostratula australis*	E	-	E	Species or species habitat known to occur within area	Likely to occur
Bar-tailed godwit	*Limosa lapponica*	-	✓	-	Species or species habitat known to occur within area	Known to occur
Black-tailed godwit	*Limosa limosa*	E	✓	-	Roosting known to occur within area	Likely to occur
Broad-billed sandpiper	*Limicola falcinellus*	-	✓	-	Roosting known to occur within area	May occur
Common greenshank	*Tringa nebularia*	E	✓	-	Species or species habitat known to occur within area	Known to occur
Common sandpiper	*Actitis hypoleucos*	-	✓	-	Species or species habitat known to occur within area	Known to occur

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Curlew sandpiper	*Calidris ferruginea*	CE	✓	CE	Species or species habitat known to occur within area	Likely to occur
Eastern curlew	*Numenius madagascariensis*	CE	✓	CE	Species or species habitat known to occur within area	Known to occur
Great knot	*Calidris tenuirostris*	V	✓	CE	Roosting known to occur within area	Known to occur
Greater sand plover	*Charadrius leschenaultii*	V	✓	V	Species or species habitat known to occur within area	Likely to occur
Grey plover	*Pluvialis squatarola*	V	✓	-	Roosting known to occur within area	Known to occur
Grey-tailed tattler	*Tringa brevipes*	-	✓	-	Roosting known to occur within area	Known to occur
Lesser sand plover	*Charadrius mongolus*	E	✓	E	Roosting known to occur within area	Likely to occur
Little curlew	*Numenius minutus*	-	✓	-	Roosting known to occur within area	Known to occur
Little ringed plover	*Charadrius dubius*	-	✓	-	Roosting known to occur within area	May occur
Long-toed stint	*Calidris subminuta*	-	✓	-	Roosting known to occur within area	May occur

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Marsh sandpiper	*Tringa stagnatilis*	-	✓	-	Roosting known to occur within area	Known to occur
Nunivak bar-tailed godwit	*Limosa lapponica baueri*	E	-	V	Species or species habitat known to occur within area	Likely to occur
Oriental plover	*Charadrius veredus*	-	✓	-	Roosting known to occur within area	Likely to occur
Oriental pratincole	*Glareola maldivarum*	-	✓	-	Roosting known to occur within area	Likely to occur
Oriental reed-warbler	*Acrocephalus orientalis*	-	✓	-	Species or species habitat may occur within area	May occur
Pacific golden plover	*Pluvialis fulva*	-	✓	-	Roosting known to occur within area	Known to occur
Pectoral sandpiper	*Calidris melanotos*	-	✓	-	Species or species habitat known to occur within area	Likely to occur
Pin-tailed snipe	*Gallinago stenura*	-	✓	-	Roosting likely to occur within area	Unlikely to occur
Red knot	*Calidris canutus*	V	✓	E	Species or species habitat known to occur within area	Likely to occur
Red-necked stint	*Calidris ruficollis*	-	✓	-	Roosting known to occur within area	Likely to occur

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Ruddy turnstone	*Arenaria interpres*	V	✓	-	Roosting known to occur within area	Known to occur
Sanderling	*Calidris alba*	-	✓	-	Roosting known to occur within area	Known to occur
Sharp-tailed sandpiper	*Calidris acuminata*	V	✓	-	Roosting known to occur within area	Known to occur
Swinhoe's snipe	*Gallinago megala*	-	✓	-	Roosting known to occur within area	Likely to occur
Terek sandpiper	*Xenus cinereus*	V	✓	-	Roosting known to occur within area	Known to occur
Wandering tattler	*Tringa incana*	-	✓	-	Roosting known to occur within area	Unlikely to occur
Whimbrel	*Numenius phaeopus*	-	✓	-	Roosting known to occur within area	Known to occur
Wood sandpiper	*Tringa glareola*	-	✓	-	Roosting known to occur within area	Likely to occur
Amphibians						
Howard river toadlet	*Uperoleia daviesae*	V	-	V	Species or species habitat known to occur within area	Unlikely to occur
Fish, sharks and rays						

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Dwarf sawfish	*Pristis clavata*	V	✓	V	Species or species habitat known to occur within area	Likely to occur
Freshwater sawfish	*Pristis pristis*	E	✓	V	Species or species habitat likely to occur within area	May occur
Giant manta ray	*Mobula birostris*	-	✓	-	Species or species habitat may occur within area	May occur
Green sawfish	*Pristis zijsron*	V	✓	V	Species or species habitat known to occur within area	Likely to occur
Grey nurse shark	*Carcharias taurus*	-	✓	-	Species or species habitat may occur within area	Likely to occur
Longfin mako	*Isurus paucus*	-	✓	-	Species or species habitat likely to occur within area	May occur
Narrow sawfish	*Anoxypristis cuspidata*	-	✓	-	Species or species habitat likely to occur within area	Likely to occur
Northern river shark	*Glyphis garricki*	E	-	E	Species or species habitat may occur within area	May occur
Oceanic whitetip shark	*Carcharhinus longimanus*	-	✓	-	Species or species habitat may occur within area	May occur
Reef manta ray	*Mobula alfredi*	-	✓	-	Species or species habitat may occur within area	May occur

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Shortfin mako	*Isurus oxyrinchus*	-	✓	-	Species or species habitat likely to occur within area	May occur
Speartooth shark	*Glyphis glyphis*	CE	-	V	Species or species habitat may occur within area	May occur
Whale shark	*Rhincodon typus*	V	✓	-	Species or species habitat may occur within area	May occur
White shark	*Carcharodon carcharias*	V	✓	-	Species or species habitat may occur within area	Unlikely to occur
Marine reptiles						
Flatback turtle	*Natator depressus*	V	☐	-	Breeding known to occur within area	Known to occur
Green turtle	*Chelonia mydas*	V	✓	-	Breeding known to occur within area	Known to occur
Hawksbill turtle	*Eretmochelys imbricata*	V	✓	V	Species or species habitat known to occur within area	Known to occur
Leatherback turtle	*Dermochelys coriacea*	E	✓	CE	Breeding likely to occur within area	May occur
Loggerhead turtle	*Caretta caretta*	E	✓	V	Foraging, feeding or related behaviour known to occur within area	Likely to occur

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Olive ridley turtle	*Lepidochelys olivacea*	E	✓	-	Breeding known to occur within area	Likely to occur
Salt-water crocodile	*Crocodylus porosus*	-	✓	-	Species or species habitat likely to occur within area	Known to occur
Terrestrial reptiles						
Merten's water monitor	*Varanus mertensi*	E	-	V	Species or species habitat known to occur within area	Unlikely to occur
Mitchell's water monitor	*Varanus mitchelli*	CE	-	V	Species or species habitat known to occur within area	May occur
Northern blue-tongued skink	*Tiliqua scincoides intermedia*	CE	-	-	Species or species habitat known to occur within area	May occur
Plains death adder	*Acanthophis hawkei*	V	-	V	Species or species habitat known to occur within area	Unlikely to occur
Marine mammals						
Australian humpback dolphin	*Sousa sahulensis*	V	✓	-	Breeding known to occur within area	Known to occur
Australian snubfin dolphin	*Orcaella heinsohni*	V	✓	-	Breeding known to occur within area	Known to occur

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Blue whale	*Balaenoptera musculus*	V	✓	-	Species or species habitat may occur within area	May occur
Bryde's whale	*Balaenoptera edeni*	-	✓	-	Species or species habitat may occur within area	May occur
Dugong	*Dugong dugon*	-	✓	-	Species or species habitat known to occur within area	Known to occur
Fin whale	*Balaenoptera physalus*	V	✓	-	Species or species habitat may occur within area	May occur
Humpback whale	*Megaptera novaeangliae*	-	✓	-	Species or species habitat likely to occur within area	Likely to occur
Killer whale	*Orcinus orca*	-	✓	-	Species or species habitat may occur within area	Likely to occur
Sei whale	*Balaenoptera borealis*	E	✓	-	Species or species habitat may occur within area	May occur
Spotted bottlenose dolphin	*Tursiops aduncus* (Arafura/Timor Sea populations)	-	✓	-	Species or species habitat known to occur within area	Known to occur

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Terrestrial mammals						
Bare-rumped sheath-tailed bat	*Saccolaimus saccolaimus nudicluniatus*	V	-	-	Species or species habitat known to occur within area	Likely to occur
Black-footed tree-rat (Kimberley and mainland Northern Territory)	*Mesembriomys gouldii gouldii*	E	-	E	Species or species habitat known to occur within area	Likely to occur
Brush-tailed rabbit-rat	*Conilurus penicillatus*	V	-	E	Species or species habitat may occur within area	Unlikely to occur
Fawn antechinus	*Antechinus bellus*	V	-	E	Species or species habitat known to occur within area	Unlikely to occur
Ghost bat	*Macroderma gigas*	V	-	-	Species or species habitat likely to occur within area	Unlikely to occur
Nabarlek (Top End)	*Petrogale concinna canescens*	E	-	E	Species or species habitat likely to occur within area	Unlikely to occur
Northern brushtail possum	*Trichosurus vulpecula arnhemensis*	V	-	-	Species or species habitat known to occur within area	Known to occur
Northern brush-tailed phascogale	*Phascogale pirata*	V	-	E	Species or species habitat likely to occur within area	Unlikely to occur

Common Name	Scientific Name	EPBC Act Status*		TPWC Act Status*	PMST Result†	Likelihood of Occurrence
		Threatened	Migratory			
Northern quoll	*Dasyurus hallucatus*	E	-	CE	Species or species habitat known to occur within area	Unlikely to occur
Water mouse	*Xeromys myoides*	V	-	-	Species or species habitat likely to occur within area	Unlikely to occur
Plants						
A triggerplant	*Stylidium ensatum*	E	-	E	Species or species habitat known to occur within area	Unlikely to occur
N/A (herb)	*Typhonium taylorii*	E	-	E	Species or species habitat likely to occur within area	May occur
N/A (subshrub)	*Atalaya brevialata*	CE	-	CE	Species or species habitat known to occur within area	Unlikely to occur

* CE = critically endangered, E = endangered, V = vulnerable

† PMST results derived from ODA for terrestrial species and nearshore PDA for marine species. PMST results for shorebirds did not differ between onshore and nearshore PDAs.

Avifauna

Threatened and migratory avifauna with the potential to occur within the Project area have been divided into seabirds, shorebirds and land birds in the following subsections.

There are no BIAs for avifauna within the Project area. The nearest BIA for avifauna is the lesser crested tern breeding BIA, located approximately 109 km north of the nearshore PDA. A description of individual avifauna species with the potential to occur within the Project area is presented in the likelihood of occurrence assessment (Appendix B). In addition to seven species of seabirds, the search of the EPBC Act Protected Matters database identified 36 species of shorebirds potentially present within the Project area. These species may migrate through the Project area to wetland habitats on the mainland and/or larger coastal islands (DoEE 2017b).

The Project area is located within what is known as the East Asian-Australasian (EAA) Flyway an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters. 'Flyway' is the term used to describe a geographic region that supports a group of populations of migratory waterbirds throughout their annual cycle. There are 54 species of migratory shorebirds that are known to specifically follow migration paths within the EAA Flyway (Bamford et al. 2008). Migratory shorebird species are mostly present in Australia during the non-breeding period, from as early as August to as late as April/May each year. After arrival in Australia at the end of long migrations, they disperse throughout the country to a wide variety of habitats including coastal wetlands, mudflats, reefs and sandy beaches (DoEE 2017b).

Targeted shorebird survey data available from 2018 to 2022 from the Middle Arm Peninsula and surrounds were compiled as part of the Middle Arm Sustainable Development Precinct (MASDP) environmental assessment (EcOz 2023).

The shorebird habitat availability and distribution within the Middle Arm Peninsula is relatively well understood (EcOz 2023). The Middle Arm Peninsula is surrounded by an extensive intertidal zone, with previous targeted surveys showing that shorebirds are distributed throughout this zone at low tide in a manner that does not indicate strong preferential use of available foraging habitat (EcOz 2023).

Twelve shorebird species have been recorded within the Middle Arm Peninsula. Of the 12 species recorded, seven migratory shorebird species are currently listed under the EPBC Act or TPWC Act, including (EcOz 2023):

- far eastern curlew (critically endangered)
- bar-tailed godwit (endangered)
- common greenshank (endangered)
- greater sand plover (vulnerable)
- grey plover (vulnerable)
- sharp-tailed sandpiper (vulnerable)
- terek sandpiper (vulnerable).

Shorebird count data for Middle Arm between 2018 and 2022 is presented in Figure 4-9.

Figure 4-9: Migratory shorebird count data for Middle Arm between 2018 and 2022

The intertidal areas along Middle Arm from Lightning Creek to the north-west of the Peninsula – including Cossack Creek – represent one of three key foraging sites within Darwin Harbour (EcOz 2023). Large congregations of shorebirds have been recorded during low tide aerial surveys on the intertidal mudflat between the Bladin Point (Ichthys LNG) and the Darwin LNG plant (Lilleyman et al. 2020 in EcOz 2023). However, survey records show that areas immediately surrounding Ichthys LNG are not core habitat in context to surrounding areas of the Middle Arm Peninsula.

The saltpans (used as roost sites) surrounding Ichthys LNG are not used by the shorebirds and fewer shorebirds have been observed within the intertidal foraging habitat in comparison the surrounding Middle Arm Peninsula.

The threatened shorebird species that have been observed within close proximity (less than 1 km) of the existing Ichthys LNG facility (far eastern curlew, common greenshank, greater sand plover, and terek sandpiper) have also been observed in greater numbers in other areas of the Darwin Harbour.

Mammals – Marine

Marine mammals that could potentially use or pass through the Project area are identified in Table 4-7 and the locations to the closest marine mammal BIAs are presented in Figure 4-10. Three BIAs for marine mammals were identified as occurring within the nearshore PDA and are presented in Table 4-7.

The coastal waters of the Joseph Bonaparte Gulf and Darwin Harbour are BIAs for coastal dolphin species, including Australian humpback dolphin, Australian snubfin dolphin and spotted bottlenose dolphin. The BIAs are within the nearshore PDA; and these species represent important populations in region. These species are described further below.

Species with a likelihood of occurring within the Project area have been described further in the following subsections.

Table 4-7: Marine mammal BIAs within the Project area

Species	BIA	Location	Presence
Australian snubfin dolphin	Breeding	Darwin Harbour	Known to occur
Australian humpback dolphin	Breeding	Darwin Harbour	Known to occur
Spotted bottlenose dolphin	Breeding	Darwin Harbour	Known to occur

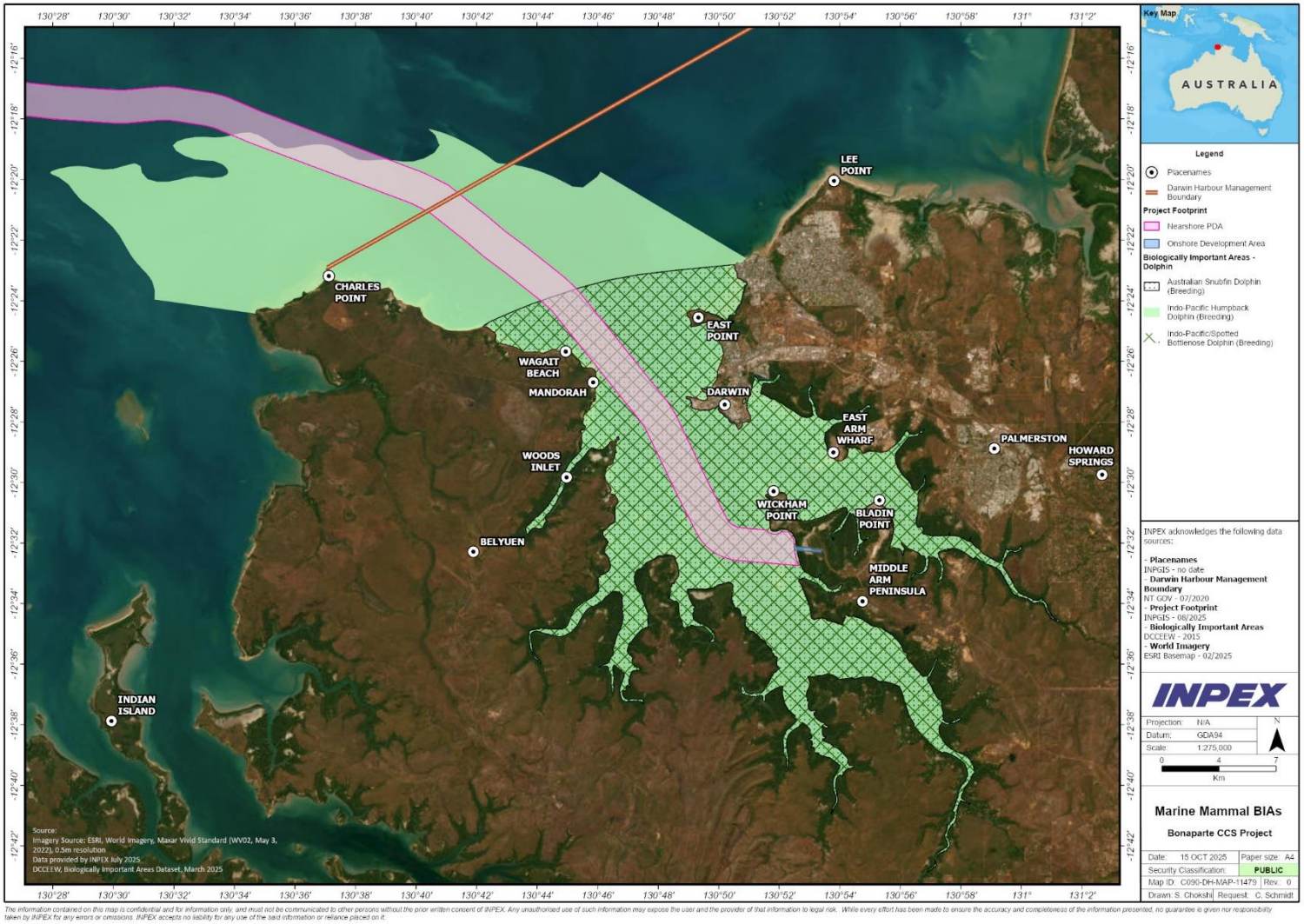


Figure 4-10: Marine mammal BIAs overlapping the nearshore PDA

Australian snubfin dolphin

The Australian snubfin dolphin (*Orcaella heinsohni*) is listed as Migratory and Vulnerable under the EPBC Act. A BIA for the species overlaps the nearshore PDA within Darwin Harbour, where breeding is known to occur between December to April (DCCEEW 2024a). The Australian snubfin dolphin, formerly known as the Irrawaddy dolphin, occurs only in waters off the northern half of Australia, from approximately Broome on the west coast to the Brisbane River on the east coast (Paterson et al. 1998; Parra et al. 2002). Within Australia, the species occurs almost exclusively in protected shallow coastal waters, close to river and creek mouths, with occasional vagrants venturing upstream in river systems (Parra 2006; Parra and Corkeron 2001; Parra et al. 2002). Mangrove and seagrass habitats often support large fish populations and are therefore considered an important habitat for the species (Robertson and Duke 1987; Heithaus 2004; Bloomfield and Gillanders 2005).

An attempt to determine the abundance of Australian snubfin dolphins in the western Gulf of Carpentaria estimated a population of about 1,000 individuals, and the regional population in north-east Queensland is also estimated to be in the thousands (Freeland and Bayliss 1989; Parra 2006). Given the species' distribution and area of suitable shallow habitat, it is unlikely that the species population exceeds 10,000 mature individuals (Peddemors & Harcourt 2006, pers. comm.). There is no known global population size, however the large expanses of shallow water on the Sahul Shelf suggests that it may be possible for Australian snubfin dolphins to range between northern Australia and the Sahul Island of eastern Indonesia and Papua New Guinea. Data suggests that the species exists as a metapopulation of small, spatially structured local populations with limited geneflow between them (Brown et al. 2014, 2016; Brooks et al. 2017).

The species has displayed evidence of connectivity and movement (observed high rates of temporary emigration) between local sites, including Darwin Harbour, Bynoe Harbour and Shoal Bay in the Northern Territory (Brooks et al. 2017). Boat-based surveys have been undertaken in the coastal waters of Darwin Harbour and Port Essington, finding that Australian snubfin dolphins were widely and unevenly distributed throughout the Northern Territory (Palmer et al. 2014). The biological features (slow to reach sexual maturity and low reproductive output) and ecological characteristics (high degree of habitat overlap with anthropogenic activities) of the Australian snubfin dolphin render the species particularly vulnerable to threats such as fisheries bycatch or entanglement, vessel strikes and habitat degradation.

An important population of a species is that which is necessary for a species' long-term survival and recovery such as: key source populations either for breeding or dispersal, populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species range. Within the Darwin region, Bynoe Harbour, Darwin Harbour and Shoal Bay, and the Northern Territory are areas of important populations of the Australian snubfin dolphin and Australian humpback dolphins (DCCEEW 2025c).

Australian humpback dolphin

The Australian humpback dolphin (*Sousa sahulensis*) is currently listed as Migratory and Vulnerable under the EPBC Act. A BIA for the Australian humpback dolphin overlaps the nearshore PDA within Darwin Harbour, where breeding is known to occur (DCCEEW 2024b). Breeding and calving occurs year-round in the Northern Territory, with the gestation period lasting 10 to 12 months (Berta 2015). The Australian humpback dolphin is distributed along remote stretches of coastline within the inshore tropical/subtropical waters of the Sahul Shelf from northern Australia to the southern waters of the island of New Guinea (Jefferson and Rosenbaum 2014; Parra et al. 2017).

Australian humpback dolphins are a cryptic species that are typically found within 20 km of the coast, with preference for shallow, often turbid, inshore waters, embayments and estuaries (Parra et al. 2004; Parra et al. 2006b; Beasley et al. 2016; Meager et al. 2018; Hunt et al. 2020). The species also utilises reef, seagrass flats, mangroves and dredged channel habitat within coastal waters throughout its range (Parra 2006; Meager et al. 2018; Hunt et al. 2020). Several locations in the Darwin region are considered important populations of Australian humpback dolphins, including Darwin Harbour, Bynoe Harbour and Shoal Bay. The species does not appear to undergo large-scale seasonal migrations, however seasonal shifts in abundance have been observed (Parra and Cagnazzi 2016).

There have been no dedicated wide-scale surveys throughout the species' northern Australian distribution, and therefore there is no current wide-range estimate on the population of Australian humpback dolphins (Parra and Cagnazzi 2016). Estimates of abundance for Australian humpback dolphins in the Northern Territory show a total population size of 86 to 99 in the Darwin region (Bynoe Harbour, Darwin Harbour and Shoal Bay), 48 to 207 in Port Essington, and 1,753 in Coastal waters of the Northern Territory (including locations mentioned above) and therefore the total number of mature individuals across their range is unlikely to exceed 1,000 (DCCEEW 2025d).

The biological features (slow to reach sexual maturity and low reproductive output) and ecological characteristics (high degree of habitat overlap with anthropogenic activities) of the Australian humpback dolphin render the species particularly vulnerable to threats such as habitat loss, fisheries interactions, vessel strikes, pollution and climate change. The key threats to Australian humpback dolphins are fisheries bycatch and entanglement and habitat degradation (DCCEEW 2023a). A non-lethal skin disease has been observed on inshore dolphins of Darwin Harbour, considered indicative of declining water quality and susceptibility to anthropogenic or environmental pressures (Palmer and Peterson 2014).

Spotted bottlenose dolphin

The spotted bottlenose dolphin (Tursiops aduncus) is listed as migratory under the EPBC Act. A BIA for the spotted bottlenose dolphin overlaps the nearshore PDA within Darwin Harbour, where breeding is known to occur (DCCEEW 2024c). In the Northern Territory of Australia, spotted bottlenose dolphins can breed year-round, but mating and calving often peak during spring and summer, with a gestation period of about 12 months (DCCEEW 2024c). The spotted bottlenose dolphin (or Indian Ocean bottlenose dolphin) is found in tropical and sub-tropical coastal and shallow offshore waters of the Indian Ocean, Indo-Pacific Region and the western Pacific Ocean (Möller and Beheregaray 2001; Rice 1998; Ross and Cockcroft 1990; Wang et al. 1999). In Australia, spotted bottlenose dolphins are distributed widely around the Australian mainland and known to occur in four main regions around Australia, including Arafura/Timor Seas. Spotted bottlenose dolphins are found in coastal lagoons and enclosed bays with mangrove forests and seagrass beds but are also found in open coastal waters around islands and coastal cliffs associated with rock or coral reefs (Palmer 2009; Parra et al. 2006a, 2006b; Thiele 2008). The species usually occurs in depths of up to 20 metres, but it has been sighted up to 55 km offshore in shallow water (Corkeron et al. 1997; Jefferson 2000 in DSEWPaC 2011a).

The global population size of spotted bottlenose dolphins is not known; however, it is likely that this species is common in inshore and nearshore waters of eastern, western and northern Australia (Ross 2006). Local population estimates range from 102 individuals in Jervis Bay up to 2,400 individuals in Shark Bay, however the species is understudied in the Northern Territory (Preen et al. 1997). Several species of coastal dolphins, including T. aduncus, were studied in Darwin Harbour from 2007 to 2010 using transects and opportunistic sightings (Palmer 2010). A total of 252 individual spotted bottlenose dolphins were observed in schools ranging from one to seven and sighted in depths ranging from 3.3 m to 20 m (Palmer 2010).

Spotted bottlenose dolphins have a low reproductive rate and high calf mortality, making population recovery for this species a slow process in consideration of their susceptibility to anthropogenic and environmental pressures (Connor et al. 2000; Mann et al. 2000). The key threats to Spotted bottlenose dolphins include indirect by-catch, fisheries entanglements, tourism, habitat degradation and overfishing (Shaughnessy et al. 2003; Bedjer et al. 2006; Ross 2006). The species is known to forage in deeper water where fisheries operate and is therefore at a greater risk of direct or indirect impacts from fisheries operating in these areas (Parra and Jedensjo 2009).

Blue whale

The blue whale is listed as endangered under the EPBC Act. The blue whale (*Balaenoptera musculus*) has four subspecies, two of which occur within Australian waters (Rice 1998), these include:

- Antarctic blue whale (*B. m. intermedia*) or 'true' blue whale
- pygmy blue whale (*B. m. brevicauda*).

The following information is relevant to the blue whale at the species level (B. musculus), unless stated otherwise. Blue whale sightings in Australian waters are widespread, and it is likely that the whales occur around the continent at various times of the year. However, much of the Australian continental shelf and coastal waters have no particular significance to the whales and are used only for migration and opportunistic feeding. The only known areas of significance to the blue whale are feeding areas around the southern continental shelf, notably the Perth Canyon, in Western Australia (WA), and the Bonney Upwelling and adjacent upwelling areas of South Australia and Victoria (DEH 2005a). From November to December, the pygmy blue whale occupies the western area of the Bonney Upwelling system in the Eastern Great Australian Bight and next to Kangaroo Island canyons (DoE 2015).

In addition to whaling records (Branch et al. 2007), most of the current knowledge of blue whale distribution within Australian waters has been derived from long-term passive acoustic monitoring (Samaran et al. 2013). Antarctic blue whale calls have been detected year-round suggesting some individuals may not leave Antarctica (Samaran et al. 2010). In comparison, the pygmy blue whale has a more widespread distribution, found throughout the Indian Ocean and usually north of 54°S (Branch et al. 2009) at lower latitudes, with individuals migrating between Australian waters and Indonesia along the Western Australian coastline (Branch et al. 2007; Double et al. 2014).

The distribution of each subspecies varies and is not fully understood (Double et al. 2014). The Antarctic blue whale tends to remain at higher latitudes and migrate to lower latitudes for feeding, breeding and calving during the Australian summer (Branch 2007; Woinarski et al. 2014). The pygmy blue whale is known to aggregate each year during the summer off southern Australia due to seasonal upwellings that concentrate high densities of prey (Attard et al. 2010; Gill et al. 2011). Outside of the recognised feeding areas, possible foraging areas for the pygmy blue whale include the greater region around the Perth Canyon, off Exmouth and Scott Reef in Western Australia, in Bass Strait off Victoria and diving and presumably feeding at depth off the West coast of Tasmania (P. Gill pers. Comm., cited in DoE 2015). Evidence for feeding is based on limited direct observations or through indirect evidence, such as the occurrence of krill in close proximity of whales, or satellite tagged whales showing circling tracks. Further feeding grounds may be identified in the future.

While breeding areas have not yet been identified, it is likely that they occur in tropical areas of high localised biological production, as, unlike the humpback whale (*Megaptera novaeangliae*) and southern right whale (*Eubalaena australis*), the blue whale has a thin blubber layer, which implies that they cannot fast during the winter season. Satellite tagging has confirmed that the pygmy blue whale feeds off the Perth Canyon and head north in March/April to potential breeding grounds in Indonesian waters by June (Double et al. 2014).

Blue whale sexual maturity is reached at 7 to 10 years of age. The Antarctic blue whale breeds around June to July each year with calving in April to May the following year (Branch 2008). The Antarctic blue whale gestation is around 10 to 11 months (Branch 2008). The calves are weaned in summer feeding grounds at approximately seven months old and 16 m long. Mean calving interval for the Antarctic blue whale is 2.5 years (Taylor et al. 2007) and 2.6 years for the pygmy blue whale (Branch 2008). It is unknown whether reproduction of the blue whale varies between the subspecies.

Sei whale

The sei whale (*Balaenoptera borealis*) is listed as vulnerable under the EPBC Act. Sei whales have been infrequently recorded in Australian waters (Bannister et al. 1996). The similarity in appearance of sei whales and Bryde's whales (*Balaenoptera edeni*) has resulted in confusion about distributional limits and frequency of occurrence, particularly in warmer waters (>20 °C) where Bryde's whales are more common.

Sei whales have been sighted 20 to 60 km offshore on the continental shelf in the Bonney Upwelling (Miller et al. 2012) where opportunistic feeding has been observed between November and May (Gill et al. 2015). Sei whales were reported 200 nm south-west of Port Lincoln in December 1995 and a concentration of sei whales was reported at the western end of Bass Strait (Kato et al. 1996). Surveys passing through Commonwealth waters during the 2001 to 2002 and 2002 to 2003 International Whaling Commission (IWC) Southern Ocean Whale and Ecosystem Research (SOWER) cruises found a small number of sei whales, including cows with calves, about 40 km south of Hobart, Tasmania (Ensor et al. 2002). Seven sei whales were seen apparently feeding about 65 km south of Tasmania in January 1993, and a sei whale was seen close inshore off the Tasman Peninsula, south-east Tasmania, in June 1996 (Gill 2004, pers. comm.).

The Australian Antarctic waters are important feeding grounds for sei whales, as are temperate, cool waters (Horwood 1987). Sei whales feed intensively between the Antarctic and subtropical convergences and mature animals may also feed in higher latitudes. This species has been sighted between November to May (upwelling season) during aerial surveys conducted between 2002 to 2013 in South Australia (Gill et al. 2015). Sei whale feeding was observed during these aerial surveys, which is one of the first documented records of sei whale feeding in Australian waters, suggesting that the region may be used for opportunistic feeing (Gill et al. 2015).

Breeding occurs in tropical and subtropical waters. The age of first reproduction is around 9 to 10 years, and the inter-birth interval is 2.5 years (Taylor et al. 2007). The main breeding season is in winter (April to August) in the Southern Hemisphere and November to March in the Northern Hemisphere, with gestation between 10.5 to 12.5 months in the Southern Hemisphere (Horwood 1987). Calves are generally weaned in seven months (Horwood 2009).

Fin whale

The fin whale (*Balaenoptera physalus*) is listed as vulnerable under the EPBC Act. Fin whales have been observed during aerial surveys in South Australian waters between November and May (Gill et al. 2015); however, fin whale distribution in Australian waters is known primarily from stranding events and whaling records. Fin whales have been sighted inshore in the proximity of the Bonney Upwelling, Victoria, in the summer and autumn months during aerial surveys (Gill 2002). Fin whale acoustics have been heard off the Rottnest Trench, Western Australia, between January and April 2000 (McCauley et al. 2000).

The Australian Antarctic waters are important feeding grounds for fin whales. Sightings of fin whales feeding in the Bonney Upwelling area indicate that this area is also a potentially important feeding ground (Morrice et al. 2004). There are no known mating or calving areas in Australian waters. The sighting of a cow and calf in the Bonney Upwelling in April 2000 and the stranding of two fin whale calves in South Australia suggest that this area may be important to the species' reproduction, perhaps as a provisioning area for mothers with calves (Morrice et al. 2004). Fin whales in the Bonney Upwelling are sometimes seen in the vicinity of the endangered blue whale and vulnerable sei whale, both of which are listed under the EPBC Act. It is uncertain whether these threatened species are competitors or associates of the fin whale.

Breeding in the Southern Hemisphere occurs between May to July (Aguilar 2009). Gestation lasts around 11 months with calves being born at around 6 to 7 m long (Aguilar 2009). The mean calving interval is two to three years (Agler et al. 1993; Laws 1961). This low rate of reproduction has implications for the ability of a population to recover. The location of breeding grounds is unknown (Thiele 2004, pers. comm.). Weaning occurs around 6 to 7 months and is followed by a resting period of six months when mating then takes place (Aguilar 2009).

Omura's whale

The Omura's whale (*Balaenoptera omurai*) is listed as migratory under the EPBC Act, however, was not identified in the EPBC PMST. Omura's whale is a relatively recently described species, found to be distinct from similar species, Bryde's whales, sei whale and the larger fin whale (Wada et al. 2003; Cerchio et al. 2019). The Omura's whale is widely distributed in primarily tropical and warm-temperate locations, between 35°S and 35°N (Cerchio et al. 2019).

The Omura's whale is one of the most recently described species of baleen whale. Initially known only from stranding and whaling specimens, it has now been identified in all ocean basins excluding the central and eastern Pacific. Unlike most baleen whales that migrate between the poles and the equator seasonally, the Omura's whale is known to inhabit tropical to sub-tropical waters year-round. In Australian waters, there remain fewer than 30 confirmed visual sightings over the past decade. However, based on acoustic records, the Omura's whale has been detected off areas of the north-west coast of Australia year-round. The study made by Browne, Erbe, and McCauley (2024) utilises passive acoustic recordings from 41 locations around Australia from 2005 to 2023 to assess the distribution and seasonality of the Omura's whale. The seasonal presence of Omura's whale vocalisations varied by location, with higher presence at lower latitudes. Vocalisations were detected year-round in the Joseph Bonaparte Gulf in the Timor Sea, and near Browse Island and Scott Reef, in the Kimberley region. In the Pilbara region, acoustic presence mostly peaked from February to April, and no acoustic presence was consistently observed from July to September across all sites. The most southerly occurrence of Omura's whale vocalisations was recorded off the North-West Cape in the Gascoyne region. Vocalisations similar but not identical to those of the Omura's whale were detected in the Great Barrier Reef.

Generally, baleen whales undertake annual seasonal migrations between the poles and the equator. Summer months are spent feeding in productive, high-latitude waters and winter months in warmer, low-latitude waters for breeding and calving (Corkeron and Connor 1999; Geijer et al. 2016). However, some species of baleen whale have been found to inhabit tropical to sub-tropical waters year-round, such as the Omura's, Bryde's and Rice's (*B. ricei*) whales (Cerchio et al. 2019; Geijer et al. 2016; Best 2001). They may move towards and away from the equator or inshore and offshore but do not embark on large-scale migrations covering many tens of degrees of latitude (Geijer et al., 2016). Given that Omura's whale vocalisations were detected year-round in parts of Australia, they are likely to be feeding and breeding within the same habitat areas, like the Omura's whale population off north-west Madagascar (Cerchio et al., 2015). There have been separate sightings of an Omura's whale feeding and of an adult-and-calf pair as well as stranding of a sub-adult off the Ningaloo coast, so there are varying age demographics of the species and feeding opportunities in the same region (Aviation 2018; Sutton et al. 2019). Currently, it is not known what the Omura's whale feeds in Australian waters. Field studies would be required to confirm if Omura's whales are in fact feeding and breeding within the same habitats or if they use distinct habitats across the tropical waters of Australia to undertake these events.

Additionally, McPherson et al. (2017) examined recordings from the Pilbara, west Kimberley, Browse Basin and Timor Sea for the period 2010 to 2015. The Joseph Bonaparte Gulf was not included in the study. Water depths at the recording stations ranged from 130 m to 500 m. In the Timor Sea, to the north of the Joseph Bonaparte Gulf, Omura's whales were detected year-round, but more commonly between April and September, with a peak in the winter months of June and July. Based on the recordings, the whales seem to enter and leave the Timor Sea from the south-west, leaving the area by the start of November (McPherson et al. 2016, 2017). Fewer calls were detected in the Timor Sea between October and March (McPherson et al. 2017). Conversely, there were fewer detections in the Pilbara, west Kimberley and Browse Basin between May and December (McPherson et al. 2017). The results indicate presence across north-west Australian continental shelf, with potential seasonal movements across the region; however, McPherson et al. (2017) state that more data and analysis are needed to understand coastal/oceanic basin movements and population structure. Given the year-round detection of potential Omura's whale vocalisations in the Joseph Bonaparte Gulf and across north-western Australia, the Omura's whale may be encountered within the Project area.

Humpback whale

Humpback whales (*Megaptera novaeangilae*) are listed as Migratory with both east coast and west coast populations in Australian waters making their annual migrations between breeding areas in tropical waters along the coasts to feeding areas in the Antarctic (DCCEEW 2025c). Recent records in NT waters suggest a regular southward migration each year around October along the western NT coast and have been reported in Kakadu National Park.

Breeding areas include the Great Barrier Reef for the east coast population, with some individuals reaching New Caledonia (Garrigue et al. 2000), and Camden Sound and Ashmore Reef for the west coast population (Jenner et al. 2001). Migratory routes are typically within 20 km of the coast in waters less than 200m deep, although some west coast whales deviate offshore between Exmouth and Shark Bay.

The humpback whale is a large baleen whale; females generally measure 1-1.5 metres longer than males and colouration varies slightly between Northern and Southern hemisphere populations (Baker et al. 1990). The dorsal fin is distinctive as they have a hump on the leading edge, giving them the humpback name (DCCEEW 2025c).

Humpback whales reach sexual maturity between the age of four and eight and their lifespan is at least 48 years (Corkeron & Connor 1999). Gestation lasts 11–12 months, and lactation continues for 10–12 months, calves may begin independent feeding at six months (Clapham 2000). The average calving interval ranges from one to five years (Barlow & Clapham 1997). Migration timing varies by sex and reproductive status, with lactating females and calves migrating first, followed by immature individuals, mature males, and pregnant females (Brown et al. 1995; Paton 2006).

Globally, humpback whale populations are highly fragmented. Temporal differences in migration prevent interaction between Northern and Southern Hemisphere groups. Within hemispheres, strong matrilineal site fidelity limits genetic exchange (Baker et al. 1990; Palsboll et al. 1995). Australia's east and west coast populations are considered genetically distinct, with long-term gene flow estimated at only a few females per generation (Baker et al. 1998). Song analysis has revealed connections between these populations and others in New Zealand, New Caledonia, and the Pacific Islands (Noad et al. 2000; Gill & Burton 1995; Helweg et al. 1998). Species habitat is known to occur within the project area so there is potential for this species to interact with facilities offshore.

Dugong

The dugong (*Dugong dugon*) is the only extant species in the family Dugongidae and one of four species in the order Sirenia and is listed as migratory (DCCEEW 2025). It is most closely related to the extinct Steller's sea cow (*Hydrodamalis gigas*) (Marsh et al. 2002). No subspecies of dugong is currently recognised. Despite recent population declines, Australian dugongs maintain high genetic diversity. Microsatellite DNA markers have shown low but significant regional differentiation in southern Queensland, even with frequent movement between locations (Cope et al. 2015; Seddon et al. 2014)

Dugongs are large, herbivorous marine mammals with paddle-like forelimbs and a broad flat tail. Adults can reach lengths of up to 3.3 metres and weigh as much as 570 kilograms (Jefferson et al. 2008). Dugongs have small ear openings, nostrils positioned near the top of the snout and surface to breathe. Mature males and some older females develop tusks, although these do not protrude.

Dugongs primarily occupy tidal and subtidal seagrass meadows. Key habitats in Western Australia include Shark Bay, Ningaloo, Exmouth Gulf, the Pilbara coast, Eighty Mile Beach, and the Kimberley Coast (Brown et al. 2014). In the Northern Territory, dugongs are found along the coast from Daly River to Millingimbi, including Melville and Vernon Islands and the Darwin region. In the Gulf of Carpentaria, important habitats include the Sir Edward Pellew Islands, Limmen Bight River mouth, and waters between Blue Mud Bay and Groote Eylandt (Grech et al. 2011; Marsh et al. 2008).

Dugongs are seagrass specialists, and their distribution closely aligns with tropical and subtropical seagrass meadows. These meadows are low in nutrients, and subject to frequent disturbance (Carruthers et al. 2002). Dugongs feed primarily on seagrass with high below-ground biomass which are often more abundant than the above-sand leaves (de Longh et al. 2007; Masini et al. 2001). Seagrass habitats occur in tidal rivers, coastal zones, reefs, and deepwater areas. Most seagrasses are found in shallow waters up to 25 metres deep. Dugong feeding aggregations are common in wide, shallow bays, mangrove channels, and sheltered offshore areas. In the Torres Strait, dugongs are frequently seen more than 10km from land, feeding in Australia's largest seagrass bed (Carter et al. 2014). Dugongs also use estuarine creeks and have been tracked several kilometres upstream (Marsh & Rathbun 1990).

Dugongs may use specific habitats for predator avoidance and reproduction. For example, they rest on sandbank edges in Moreton Bay and deeper waters in Shark Bay to avoid sharks (Wirsing et al. 2007). Shallow waters such as tidal sandbanks and estuaries are used for calving (Marsh et al. 2011). Species and species habitat is known to occur within the project area so there is potential for interaction with facilities.

Killer whale/Orca

The Killer whale or Orca (Delphinus orca) is listed as migratory. Killer whales are the largest members of the dolphin family, identified by their striking black, white, and grey coloration. Males and females differ in size and fin shape, with males reaching up to 9.8 m and over 4000 kg, and females up to 9.2 m and 3100 kg (Dahlheim & Heyning 1999). Their social structure is complex, typically forming pods of fewer than 30 adult males, females, and juveniles, with a clear social hierarchy (Dahlheim & Heyning 1999). Male killer whales reach sexual maturity at around 16 years, females at about 10 and a lifespan of about 40 years (Dahlheim & Heyning 1999). Matrilineal pods form the core social unit, often spanning two or three generations. These groups are largely endogamous and differ in morphology, genetics, and cultural behaviours such as prey selection and vocal dialects (Rice 1998).

Killer whales are globally distributed apex predators with a highly varied diet that changes seasonally and regionally. Although the diet of Australian Killer Whales is not well documented, they have been observed attacking dolphins, young Humpback Whales, Blue Whales, Sperm Whales, Dugongs, and Australian Sea Lions (Bannister et al. 1996). In Antarctic waters, stomach content analysis from 362 specimens revealed a diet consisting of fish, Minke Whales, pinnipeds, and squid (Bannister et al. 1996). Killer Whales may travel 125–200 km per day while foraging, often following the movements of their prey (Dahlheim & Heynin 1999). Their foraging behaviour is highly specialised and culturally influenced, with documented cases of coordinated attacks on sperm whales and dolphins, as well as pack hunting humpback and minke whales (Ross 2006).

Killer whales have been recorded year-round in all coastal states and territories of Australia (Morrice 2004), but there are three regions where they are most commonly sighted: Australia's southeast; the southwest Bremer Sub-basin and a lesser-known summer group at the northwest Ningaloo Reef (Hutchings et al. 2025). The presence of the tropical form in the Northern Territory is apparent, but where these animals originate from and whether they are from the same northwest group is yet to be confirmed (Hutchings et al. 2025). Killer Whales prefer oceanic, pelagic habitats and are often seen near seal colonies. Their transient nature makes habitat categorisation difficult, but their movements are often linked to prey availability and behavioural needs (Similae et al. 2002). There is some suitable habitat within the project area so interaction with this species is likely.

Bryde's whale

Bryde's whales (*Balaenoptera edeni*) are listed as Migratory and are among the smaller baleen whales, closely resembling Sei whales but distinguishable by their dark grey back and white stomach (Kato 2002). Females are generally larger than males, with a size difference of about 0.5-0.6 m at full maturity (Kato 2002). Bryde's Whales are typically solitary or found in pairs, with larger groupings of up to 23 individuals being loosely associated, often during feeding (Martin 1990).

Bryde's whales inhabit temperate to tropical waters and have been recorded in all states except the Northern Territory (DEW 2007). Some specimens have shown intermediate characteristics between Bryde's and Sei Whales, adding to identification challenges (Bannister et al. 1996). Additionally, there are smaller coastal forms and larger oceanic forms of Bryde's whale that have distinct preferences for foraging in those habitats.

Bryde's whales are found year-round in tropical and temperate waters shallower than 200 m, moving along the coast in response to prey availability (Best et al.1984). Bryde's whales primarily forage in the upper ocean layers and can be considered pelagic (Best et al. 1984). The inshore whales appear to reside in areas with abundant shoaling fish, while the offshore whales undertake seasonal migrations between tropical and subtropical regions (Best 1977). Bryde's whales may live for over 50 years (Bannister et al. 1996). Age at sexual maturity is estimated between seven and nine years (Kato 2002). Inshore Bryde's whales appear to breed year-round, and offshore whales breed during winter (Kato 2002). Their reproductive cycle spans two years, 11-12 months gestation, six months lactation, and a six-month resting period (Kato 2002).

Bryde's whales are opportunistic feeders, consuming a wide range of prey depending on availability (Kato 2002). The inshore whales primarily feed on schooling fish while offshore whales target small crustaceans and cephalopods (Kawamura 1980). Despite differences in diet, there are no notable distinctions in baleen plate structure between the habitat preferences, suggesting that dietary variation is due to preference rather than physical limitation (Best 1977). There is some species habitat in the project area, and this species may occur.

Mammals – Terrestrial

Terrestrial mammals that could potentially occur within the Project area are identified in Table 4-6. Species with a likelihood of occurring within the Project area have been described further in the subsections below (Appendix B).

Bare-rumped Sheath-tailed Bat

The bare-rumped sheath-tailed bat is widely distributed across Oceania, Southeast Asia and South Asia (Bonaccorso 1998; Brosset 1962; Nowak and Paradiso 1983). In Australia, the bare-rumped sheath-tailed inhabits northeastern Queensland, the Northern Territory and the Kimberley in Western Australia (Milne et al. 2009). Within the Northern Territory, the bare-rumped sheath-tailed bat is typically found in the floodplain area of Kakadu National Park. In Australia, habitat preference for this species is typically eucalypt forests and woodlands in near-coastal areas (Friend and Braithwaite 1986; Dennis 2012). Not much is known about the roosting habitat of the bare-rumped sheath-tailed bat, however a small number of confirmed roost sites in Australia have been confirmed, all of which located in tree hollows (Churchill 1998; Compton and Johnson 1983). Similarly, little is known about reproduction and gestation of this species; however, females are known to give birth to a single young between December to April in the Northern Territory (Churchill 1998; Compton and Johnson 1983).

Black-footed Tree-rat (Kimberley and mainland Northern Territory)

The black-footed tree-rat (Kimberley and mainland Northern Territory) is restricted to forests and woodlands in the north Kimberley in Western Australia and mainland Northern Territory. It occurs mostly in lowland open forests and woodlands dominated by eucalyptus species (Friend 1987).

In the Northen Territory, this species has been located in Kakadu National Park, Litchfield National Park, Gunak Gurig Barlu National Park, Charles Darwin National Park, Berry Springs Nature Park and Manton Dam Recreation Area (Woinarski et al. 2014; NTG 2021b). The black-footed tree-rat is a nocturnal species that predominantly dens in tree hollows, but occasionally in dense foliage or in buildings (Woinarski et al. 2014). Foraging occurs both on the ground and in trees, and individuals can forage more than 500 m from roost sites (Friend et al. 1992). Breeding may occur throughout the year, but in the Northern Territory peaks in August to September (Friend 1987). Litter size is between one and three young, with a known gestation period of approximately 43 days (Crichton 1969).

Northern Brushtail Possum

The Northern brushtail possum has a patchy distribution ranging from the Kimberley in Western Australia to the Gulf of Carpentaria in the Northern Territory but is predominantly found in the Northern territory (McKenzie 1981; Morris et al. 2008). This marsupial is nocturnal and semi-arboreal, occurring mostly in tall eucalypt forests with large hollow-bearing trees but has also been recorded in some mangrove communities and rainforests. (Kerle 1985; Friend and Taylor 1985; Woinarski et al. 2011). The Northern brushtail possum has no distinct breeding season (Kerle and Howe 1992). Sexual maturity is achieved at around 12 to 15 months, and longevity is presumed to be up to ten years (Kerle and Howe 1992).

Reptiles – Marine

The EPBC Act Protected Matters database search identified salt-water crocodiles (*Crocodylus porosus*) and six species of marine turtle that may occur within the Project area (Table 4-8): the green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), leatherback turtle (*Dermochelys coriacea*), flatback turtle (*Natator depressus*), hawksbill turtle (*Eretmochelys imbricate*) and olive ridley turtle (*Lepidochelys olivacea*). Both a BIA and habitat critical to survival for flatback turtles overlap the Project area (Table 4-8 and Table 4-9; Figure 4-11).

Satellite tracking data reviewed in recent studies (Ferreira et al. 2020; Thums et al. 2021) concluded that, although the spatial extent of marine turtle internesting areas (habitat critical to survival) was adequately covered by the defined internesting buffers and therefore afforded an appropriate level of protection, it was not the same for foraging areas. The spatial extents of foraging BIAs are considered to potentially underestimate the distribution of foraging turtles.

An internesting BIA for flatback turtles overlaps with the nearshore PDA near Melville Island and Cobourg Peninsula, as well as a habitat critical to the survival of marine turtles for nesting flatback turtles overlapping the nearshore PDA. The nearest known nesting sites for flatback turtles are located at Mandorah (500 m west of nearshore PDA) and Casuarina Beach (18 km north of nearshore PDA).

Threatened marine reptile species with a likelihood of occurring within the Project area are described further in the following subsections.

Table 4-8: Marine reptile BIAs within the nearshore PDA

Species	BIA	Location	Presence
Flatback turtle	Internesting	Melville Island, Cobourg Peninsula	Likely to occur

Table 4-9: Habitat critical to the survival of marine reptiles within the nearshore PDA

Species	Behaviour	Season	Presence
Flatback turtle	Nesting	August to September	Known to occur

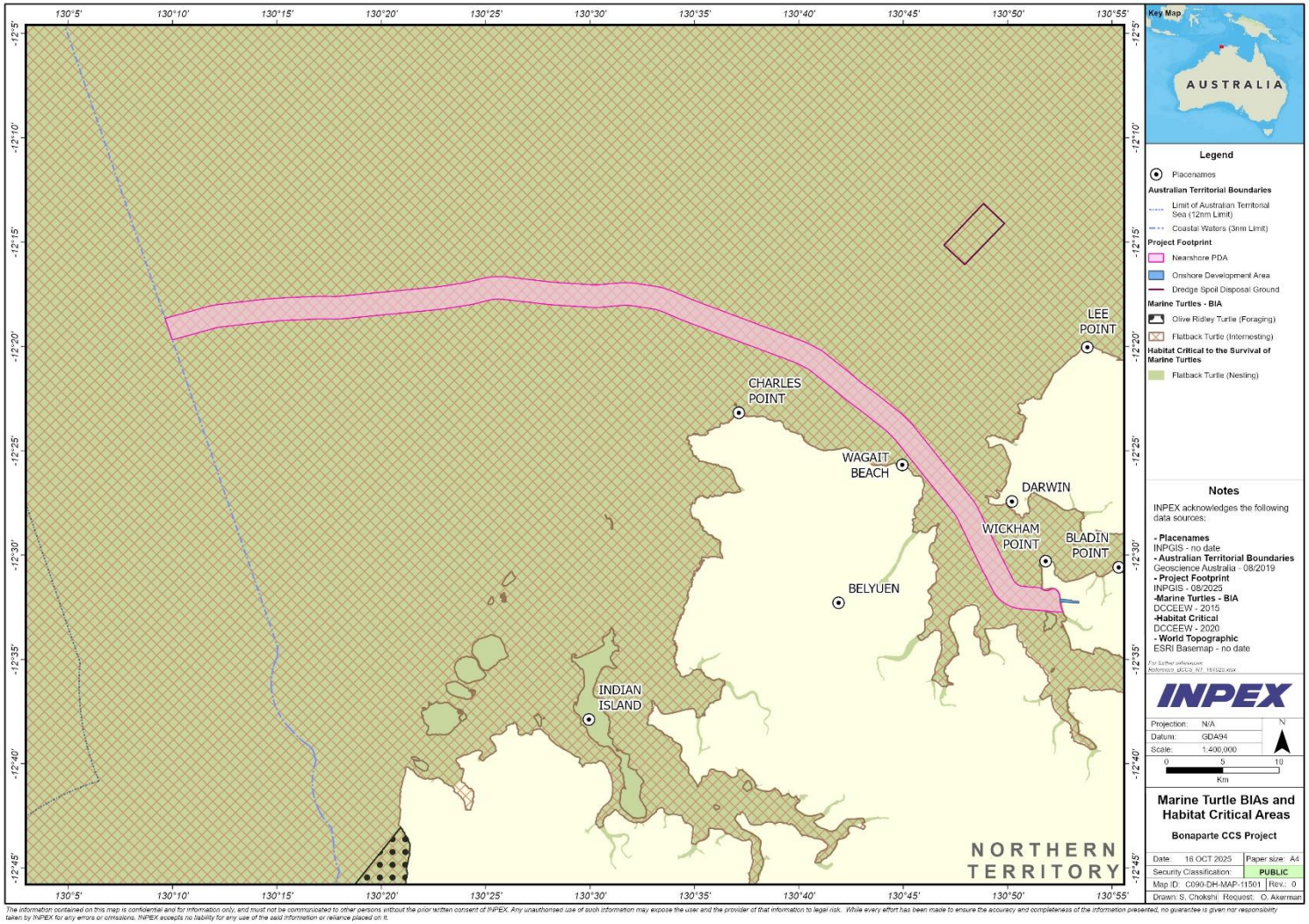


Figure 4-11: Marine reptile BIAs overlapping the Project area

Flatback turtle

Flatback turtles are listed as Vulnerable and Migratory under the EPBC Act. A BIA for flatback turtles overlaps the PDA (nearshore and offshore), where nesting is likely to occur. Habitat Critical to the Survival of the flatback turtle also overlaps the pipeline development area (nearshore and offshore), where nesting is known to occur (DCCEEW 2024d).

Flatback turtles are found only in the tropical waters of northern Australia, Papua New Guinea and Irian Jaya and is one of only two species of sea turtle without a global distribution (Spring 1982; Zangerl et al. 1988). Five genetic stocks are recognised, including eastern Queensland, Arafura Sea, Cape Dommett, south-west Kimberley and Pilbara. In the Northern Territory, flatback turtles are the most widely spread nesting turtle species, utilising a wide variety of beach types around the entire coastline (Chatto and Baker 2008).

Flatback turtles are known to nest in Darwin Harbour along Casuarina Beach, located 18 km north of the nearshore PDA and Mandorah, located 500 m west of the nearshore PDA (Chatto and Baker 2008). Bare Sand Island (25 km south of nearshore PDA) and Quail Islands (24 km south of nearshore PDA) outside of Bynoe Harbour are also known flatback turtle nesting sites, with Bare Sand Island recognised as a significant nesting location (Chatto and Baker 2008).

Notable nesting sites in proximity to the Project area include Cobourg Peninsula (170 km north-east of PDA), Melville Island (52 km north-east of PDA), Fog Bay (60 km south-west of PDA) and Turtle Point (193 km south of IDA) (Guinea and Whiting 1999).

Flatback turtles forage across the Australian continental shelf and into continental waters off Indonesia and Papua New Guinea, feeding in turbid, shallow inshore waters from 10 m to 40 m in depth (Robins 1995). Flatback turtles require sandy beaches with sand temperatures between 25 and 33 for successful incubation as well as areas free of light pollution to prevent adverse behaviours (i.e. disorientation of nesting females and hatchlings) (Limpus 1995; Walker 1994).

There are no estimates of population size for flatback turtles, however their nesting distribution has been well surveyed in northern Australia. Aerial and vehicle surveys were conducted in eight defined "bioregions" of the Northern Territory, recording over 1600 flatback turtle nests on island beaches, compared to just under 200 nests on mainland beaches (Chatto and Baker, 2008). Nesting has been observed to occur year-round, however peaks from June to September in the Arafura Sea region (DCCEEW 2017).

There are a number of threats to flatback turtles associated with human activity, including entanglement in marine debris, interactions with fishing equipment, terrestrial predation and light pollution (Northern Territory Department of Environment, Parks and Water [NT DEPW] 2021). Flatback turtles are presumed to be slow growing, taking decades to reach breeding age. The strong nest site fidelity shown by the flatback turtle also makes this species susceptible to hazards of nest site disturbance and decreased suitability of the site over time through pressures such as feral predators, human interference of changes in beach morphology (Limpus 2007).

Green turtle

Green turtles are listed as Vulnerable and migratory under the EPBC Act. The nearest BIA for green turtles is located 77 km south-west of the nearshore PDA, where foraging is known to occur (DCCEEW 2024e). Green turtles occur in tropical and sub-tropical waters throughout the world, capable of migrating over 2600 km between foraging and nesting sites (DCCEEW 2008).

In Australia, green turtles nest, forage and migrate across tropical northern Australia with a large number of key nesting grounds in the Northern Territory, mostly occurring from the western end of Melville Island to near the border of Queensland (DEH 2005b; DEWHA 2008a). Green turtles spend their first five to ten years drifting on ocean currents, later settling in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rock reef habitat or inshore seagrass beds (Musick and Limpus 1997). In the Northern Territory, green turtles nest mainly on wide beaches backed by large dune systems (Chatto 1998).

The Australian population of green turtles is estimated to be more than 70,000 individuals across seven regional populations (DoE 2025). The number of green turtles that come ashore to nest each year fluctuates depending greatly on sea temperatures (DEH 2005b).

Individuals tagged in the Kimberley and Great Barrier Reef have been recaptured in the Top End and southern Gulf of Carpentaria (Kennett et al. 2004). No turtle nesting sites are known to occur within Darwin Harbour, with the closest nesting site located at Casuarina Beach. Only small numbers of green turtles have been observed nesting in the Darwin region, however green turtles regularly inhabit the area, accounting for 74 per cent of turtle sightings during fine scale observations (INPEX Browse Ltd 2018).

In Australia, the main current threats to green turtles are light disturbance, habitat degradation, fisheries by-catch, nest predation, vessel strikes, entanglement and ingestion of marine debris (DEHWA 2008).

Olive ridley turtle

Olive ridley turtles are listed as Endangered and Migratory under the EPBC Act. The nearest BIA for olive ridley turtles is located 77 km south-west of the nearshore PDA, where foraging is known to occur (DCCEEW 2024f). Olive ridley turtles occur in tropical and sub-tropical waters across the world, migrating up to 2600 km between foraging and nesting sites (Whiting et al. 2005). A substantial portion of the Australian population of olive ridley turtles forage over the shallow benthic habitats of the continental shelf from northern Western Australia to south-east Queensland, however, have also been found to forage in pelagic habitats up to 100 m in depth (Limpus, 2008). Low densities of olive ridley turtle nests have been recorded in the Northern Territory, including Cobourg Peninsula and offshore islands (Chatto 1998; Chatto and Baker 2008). Adult females nest on sandy beaches, where hatchlings later disperse in offshore currents for a pelagic phase of unknown length (Musick and Limpus 1997).

The olive ridley turtle is the most numerous of all marine turtles in the world, however their population is unknown in Australia. Based on the number of nesting sites, there is an estimated 500 to 1000 breeding females annually in Australia (DSEWPaC 2011b). Areas identified as significant nesting areas for olive ridley turtles are concentrated around the Tiwi Islands (Chatto and Baker 2008). Olive ridley turtles tracked from these nesting sites migrated up to 1050 km and stayed within waters of the continental shelf (Whiting et al. 2005).

The key threats to olive ridley turtles are fisheries by-catch or entanglement, coastal development, feral animal predation and climate change (DCCEEW 2024f). Longevity, slow growth and delayed sexual reproduction are all life history traits of olive ridley turtles that hinder efforts to identify population trends and also act to prevent fast population recovery.

Loggerhead turtles

In Australia, there are two unique breeding populations of loggerhead turtles. The eastern Australian population nests on the southern Great Barrier Reef and adjacent mainland Queensland coastal areas. Major nesting areas for the Western Australian population include Muiron Islands, Ningaloo Coast and islands near Shark Bay (Department of the Environment and Energy (DoEE), 2017a).

Satellite tagging of nesting female loggerhead turtles from the Ningaloo/Pilbara coast have shown dispersal north-west as far as Indonesia and southern Borneo, north-east as far as the Tiwi Islands and south as far as the Great Australian Bight (Waayers et al. 2015; Whiting et al. 2008). Loggerhead turtle breeding in Western Australia reportedly occurs between November to May (DoEE 2017a). Loggerhead turtles are known to forage around the pinnacles of the Bonaparte Basin and the carbonate bank and terrace system of the Sahul Shelf KEFs with a foraging BIA located approximately 210 km west of the nearshore PDA.

Hawksbill turtle

Major nesting of hawksbill turtles in Australia occurs at Varanus Island and Rosemary Island in Western Australia (Pendoley 2005), and in the northern Great Barrier Reef and Torres Strait (Dobbs et al. 1999; Limpus et al. 1989), Queensland. The key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) in the Northern Territory are (DEH 2005b): Coburg Peninsula, Between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land), Groote Island, Sir Edward Pellew Islands, and Wessel and English Islands.

The total population of hawksbill turtles in Australia is unknown. However, Australia supports the largest hawksbill turtle nesting aggregations worldwide, with estimates of over 4000 females nesting annually in Queensland, over 2500 in the Northern Territory, and ~2000 in Western Australia (Miller et al. 1995; Meylan and Donnelly 1999; Limpus 1997; Limpus et al. 2000 all cited in Hoenner et al. 2016). Hawksbill turtles occur in the following marine reserves (DEH 2005b). These reserves are managed to protect feeding grounds, nesting grounds and inter-nesting habitat (where females occur during non-breeding times) for marine turtles in Australia, including the hawksbill turtle: Kakadu National Park, Gurig Gunalc Barlu National Park, Coburg Marine Park, and Dhimurru Indigenous Protected Area.

The hawksbill turtle migrates up to 2400 km between foraging areas and nesting beaches (Miller et al. 1998). Breeding male and female hawksbills move from their feeding grounds to areas near nesting beaches for mating. The males then return to their feeding grounds, and the females come up onto the beach to lay their eggs, usually on several different nights (Robins et al. 2002). Nesting occurs in the northern Great Barrier Reef and the Torres Strait between January and April (Dobbs et al. 1999; Loop et al. 1995); in the Northern Territory during the second half of the year (Chatto 1997, 1998); and in Western Australia, all year with a peak between October and January (Robinson 1990, cited in Limpus 1995).

Leatherback turtle

The leatherback turtle is a pelagic feeder, found in tropical, subtropical and temperate waters throughout the world (Marquez 1990). Large body size, high metabolism, a thick adipose tissue layer and regulation of blood flow (Spotila et al. 1997) allow them to utilise cold water foraging areas unlike other sea turtle species. For this reason, this species is regularly found in the high latitudes of all oceans including the South Pacific Ocean in the waters offshore from New South Wales (NSW), Victoria, Tasmania and Western Australia (Benson et al. 2011; Limpus and MacLachlan 1979, 1994). It has been recorded feeding in the coastal waters of all Australian States (Hamann et al. 2006).

Foraging behaviour has been reasonably well studied in the northern Pacific and Atlantic Oceans (Eckert et al. 1989; Houghton et al. 2006) - for example in the north-east Atlantic Ocean 22 per cent of leatherback turtle distribution can be explained by "hot spots" of jelly fish abundance. Various authors have described foraging area distribution in Australia. The species is reported to forage year-round in Australia and is most commonly reported from coastal waters in central eastern Australia (from the Sunshine Coast in southern Queensland to central New South Wales); south-east Australia (from Tasmania, Victoria and eastern South Australia) and in south-western Western Australia (Bone 1998; Hamann et al. 2006; Limpus and MacLachlan 1979).

This species makes reproductive migrations from foraging areas to nesting beaches (Lazell 1980). No major nesting has been recorded in Australia, although scattered isolated nesting (one to three nests per annum) occurs in southern Queensland (Limpus and MacLachlan 1979, 1994; Limpus et al. 1984) and the Northern Territory (Hamann et al. 2006; Limpus and MacLachlan 1994). Nesting sites have been found at Cobourg Peninsula, Manangrida and Croker Island (Chatto 1998) in the Northern Territory though the only confirmed nesting of leatherbacks during Chatto and Baker's (2008) survey between 1991 and 2004 was at Danger Point, Cobourg Peninsula. Regardless, only very small numbers of nests are laid per year in the Northern Territory and thus would only be a minor contributor to the global population (Hamann et al. 2006). Some nesting has occurred in northern New South Wales near Ballina (Tarvey 1993). However, no nesting has occurred in Queensland or New South Wales since 1996 (Hamann et al. 2006). Nesting in Western Australia is still unknown or unconfirmed (Prince 1994).

Salt-water crocodile

Saltwater crocodiles (Crocodylus porosus) are regularly encountered in Darwin Harbour and are known to migrate there from surrounding areas. The species is a large generally solitary reptile that inhabits a wide variety of salt, brackish and freshwater environments, including coastal rivers and swamps in northern Australia, sometimes extending inland along major drainage systems. They are considered a significant concern for public safety, as they are large and potentially dangerous, and swimming in Darwin Harbour and nearshore coastal waters is not advised. The Northern Territory government manages the crocodile population by removing crocodiles from the harbour.

The Saltwater crocodile is listed as Marine and Migratory and is the largest living reptile and the largest crocodile species. Males typically reach 5m in length and weigh over 450kg, females are smaller, averaging 3m and up to 150kg. Some individuals may exceed 7m and 1000kg (Cogger 1996). Adults have a broad snout and a muscular tail used for swimming. Their coloration ranges from grey to dark brown with a pale underside. Juveniles are tan with black stripes and spots. Adults are believed to have the strongest bite force of any living animal (Cogger 1996; Erickson et al. 2012).

Preferred nesting habitats are elevated freshwater swamps typically away from tidal influence (Webb et al. 1987). In the Northern Territory, nests are often located on northwest riverbanks exposed to midday sun (Magnusson 1980). Nesting occurs during the wet season, peaking between January and February, with courtship beginning 4–6 weeks prior (Webb et al. 1987). Males establish territories and mate with multiple females through elaborate courtship behaviours (Grigg & Gans 1993). Salt-water crocodiles are mound nesters, laying one clutch of 52-60 eggs per season (Cogger 2014). Incubation lasts 65-114 days with the female guarding the nest. Nest temperature determines hatchling sex: males develop between 31–33 ºC, while females dominate outside this range (Magnusson 1982). After hatching, the mother transports hatchlings to water. Hatchlings are guarded by the mother for up to two months (Magnusson 1980). Saltwater crocodiles can live beyond 70 years (Webb et al. 1984).

Saltwater crocodiles are opportunistic carnivores. Juveniles feed on insects and crustaceans, while larger individuals consume mammals. Diet varies by habitat: in saline mangroves, crabs dominate; in freshwater swamps, insects and small mammals are more common (Taylor 1979). Crocodiles use both active hunting and ambush strategies (Cooper & Jenkins 1993). They are known to ingest rocks and stones, possibly aiding digestion or buoyancy control.

Saltwater crocodiles inhabit coastal waters, estuaries, lakes, swamps, and inland marshes across northern Australia. Their range extends from Rockhampton in Queensland through the Northern Territory to King Sound in Western Australia and further south (Miller 1993; McNamara & Wyre 1993). In the Northern Territory, they are found in numerous river systems including the Mary, Daly, and Alligator Rivers (Fukuda et al. 2007). They can occur up to 150km inland and tolerate highly saline conditions (Webb et al. 1983). There are many records across the project area and suitable habitat within and adjacent to the project area, therefore, this species is likely to occur.

Reptiles - Terrestrial

Terrestrial reptiles and amphibians that could potentially occur within the Project area are identified in Table 4-6. Species with a likelihood of occurring within the Project area have been described further in the subsections below (Appendix B).

Mitchell's Water Monitor

Mitchell's water monitor is endemic to north Western Australia, the Northern Territory, and north-west Queensland (Wilson and Knowles 1988). This species inhabits freshwater and saline wetlands, including rivers, creeks, swamps and mangroves, and is both arboreal and semi-aquatic, moving between trees and the water for habitation (Shine 1986; de Laive et al. 2021; Wilson and Swan 2021). Habitat choice and diet for Micthell's water monitor has been found to correlate to seasonality, with populations in the Magella catchment of the Northern Territory found to have diet dominated by fish in the wet season, whereas in the dry season, Mitchell's water monitor predominantly feeds of terrestrial invertebrates (Shine 1986). Nesting sites are unknown, but this species has been found to develop eggs late into the wet season and early in the dry season (April to June) (Shine 1986).

Northern Blue-Tongue Skink

The northern blue-tongue skink occurs from north Western Australia, the Northern Territory and north-west Queensland (Shea 1992). Northern blue-tongued skinks are predominantly found in grass and shrublands, typically dominated by white currant bush, native jasmine, wild grape and acacia species (Price-Rees et al. 2013). This species avoids open ground and can be found in patches of habitat that provide shaded, cool and damp conditions (Shine 2017; Price-Rees et al. 2013). In the Northern Territory, the Northern blue-tongue skink has been recorded in open forest environments with native grasses (Price-Rees et al. 2013). The northern blue-tongue skink births live young in clutches of up to ten at the start of the wet season (December to January) (Shea 1992).

Fish, sharks and rays

Fish, shark and ray species that could potentially use or pass through the Project area are identified in Table 4-6. There are no BIAs for fishes and sharks within the Project area. Fish, sharks, and ray species with a likelihood to occur within the Project area have been described further in the sections below (Appendix B).

Darwin Harbour, which the nearshore PDA traverses, supports an abundance of both resident benthic and transient pelagic fish species with 415 species documented (Larson and Williams 1997). Of all these species, barramundi (Lates calcarifer) is the most targeted species by recreational anglers and accounts for 26 per cent of total catch in the Northern Territory, although in Darwin Harbour it only accounts for 5 per cent of total catch (Cardno 2015e; INPEX 2010). Golden snapper (*Lutjanus johnii*) are the second most targeted species, while jewfish (*Protonibea diacanthus*) are also commonly targeted by anglers in Darwin Harbour (Cardno 2015e). Darwin Harbour is protected from commercial gill netting, providing a valuable sportfishing area for residents and tourists (Northern Territory Government 2024). Mangroves in the area are a valuable habitat for fish communities in Darwin Harbour, providing nursery and spawning grounds as well as holding recreational value (Santos 2021).

Whale shark

Whale sharks (*Rhincodon typus*) are large filter-feeders that can be observed foraging in the vicinity of oil and gas platforms (Hoffmayer, Franks & Shelley 2005; Weir 2010; Robinson et al. 2013; Todd et al. 2020). Distributed throughout the world's tropical and warm-temperate seas (Compagno 2001; Sequeira et al. 2012), these sharks display migratory movements spanning 1000's km (Hearn et al. 2021). Although whale sharks spend significant portions of time in oceanic seascapes, they migrate to and from seasonal aggregations in coastal waters across the globe (Sequeira et al. 2013). In Australia, whale sharks are present year-round along West Australia's North-West (Norman, Reynolds, and Morgan 2016) but aggregate in large numbers between April and September (Meekan et al. 2006). Satellite telemetry has been used to describe the movement patterns of whale sharks from the north-west of Australia, documenting migrations through Australia's largest oil and gas producing fields (North-West Shelf Project; Acil Tasman Ltd 2009) and into the oceanic seascapes of the East-Indian Ocean (Wilson et al. 2006; Sleeman et al. 2010; Norman, Reynolds & Morgan 2016; Reynolds et al. 2017, 2022).

In Australia, the whale shark is known from New South Wales, Queensland, Northern Territory, Western Australia and occasionally Victoria and South Australia, but it is most commonly seen in waters off northern Western Australia, Northern Territory and Queensland (Compagno 1984; Last & Stevens 1994). Ningaloo Reef, off the West Australian coast, is the main known aggregation site of whale sharks in Australian waters. Taylor (1996) suggests that this aggregation is due to seasonal concentrations of krill and other zooplankton, which are a food source for the whale shark. Detailed and informal surveys carried out in both 1991 and 1992 demonstrated that whale sharks congregate off Ningaloo Reef (Western Australia) from March to July, when the coral undergoes mass spawning. The number of whale sharks reaches a peak about two weeks after this coral spawning (DEH 2005c; Taylor 1996).

The whale shark is an oceanic and coastal, tropical to warm-temperate pelagic shark. It is often seen far offshore but also comes close inshore and sometimes enters lagoons of coral atolls. The whale shark is generally encountered close to or at the surface, as single individuals or occasionally in schools or aggregations of up to hundreds of sharks (Compagno 1984). Whale sharks are generally found in areas where the surface temperature is 21 to 25 °C, preferably with cold water of 17 °C or less upwelling into it, and salinity of 34 to 34.5 parts per thousand (ppt) (Pogonoski et al. 2002). In Ningaloo Marine Park waters (Western Australia), sightings are most common in water temperatures around 27 °C (DEH 2005c).

Data on the lifespan of the whale shark is limited. Taylor (1994) indicates that based on the late age of sexual maturity, estimated at around 30 years of age, the whale shark may be one of the longest living animals in the world, with an estimated lifespan of over 100 years. Whale sharks have been observed feeding passively by swimming forward with mouth agape and feeding actively by opening their mouths and sucking in prey. Whale sharks have also been reported hanging vertically in the water while feeding (Colman 1997); often it assumes a vertical position in schools of baitfish and opens its mouth so the baitfish can be sucked in (Compagno 1984). The species feeds at or close to the surface (Compagno 1984).

Sawfish

Four species of sawfish (freshwater, narrow, dwarf and green sawfish) were identified in the EPBC Act Protected Matters database search (Appendix A). While sawfish are identified as being found within the Project area, due to their ecology (generally estuarine rather than open ocean species) it is expected that they would only be present near the nearshore PDA.

The narrow sawfish (*Anoxypristis cuspidata*), dwarf sawfish (*Pristis clavata*), freshwater sawfish (*Pristis microdon*) and green sawfish (*Pristis zijsron*) occur mainly in inshore coastal waters and riverine environments of tropical northern Australia (DEWHA, 2008b).

There are no data available on the range and occurrence of the dwarf sawfish prior to European settlement in northern Australia. Since European settlement, the species' Australian distribution has previously been considered to extend north from Cairns around the Cape York Peninsula in Queensland, across northern Australian waters to the Pilbara coast in Western Australia (Last and Stevens 1994; McAuley et al. 2005; Stevens et al. 2008). The dwarf sawfish usually inhabits shallow (2 to 3 m) coastal waters and estuarine habitats. A study in north-western Western Australia found that estuarine habitats are used as nursery areas by dwarf sawfish, with immature juveniles remaining in these areas up until three years of age (Thorburn et al. 2007). Peverell (2005) found that dwarf sawfish may move into marine waters after the wet, and during the wet season enter estuarine or more fresh waters to breed. Peverell's (2005) observations on reproductive staging and the capture of neonate specimens suggest that pupping occurred through the wet season until the beginning of the dry season in May. Adults are known to seasonally migrate back into inshore waters (Peverell 2007), although it is unclear how far offshore the adults travel, as captures in offshore surveys are very uncommon.

The narrow sawfish was historically distributed across a broad swathe of the Indo-Pacific Ocean. Its southern limit is the northern Australian states of Western Australia, the Northern Territory, and Queensland (ALA n.d.). At present, it is known to exist only in the eastern Arabian Sea, parts of South Asia and Australia and Papua New Guinea. The narrow sawfish is bentho-pelagic and is found at depths of about 100 meters (330 feet) (ALA n.d.). The narrow sawfish prefers soft bottom-substrates, such as sand, mud, or seagrass, to rocky or coraline habitats. It can tolerate low salinity levels and is found in inshore waters, including bays and estuaries. The narrow sawfish is euryhaline, meaning it can tolerate a wide range of salinity and move between estuarine and marine environments. It undergoes an ontogenetic shift in habitat. Larger individuals are commonly found offshore, whereas smaller individuals are found inshore. Females are also more likely to be found offshore (ALA n.d.).

In Australian waters, green sawfish have historically been recorded in the coastal waters off Broome, Western Australia, around northern Australia and down the east coast as far as Jervis Bay, New South Wales (Stevens et al. 2005). It has been recorded in inshore marine waters, estuaries, river mouths, embankments and along sandy and muddy beaches but the species does not penetrate into freshwater (Peverell et al. 2004; Stevens et al. 2005; Thorburn et al. 2004). Stevens (2005) reported that this species was frequently found in shallow water (<1m) to offshore trawl grounds in over 70 m of water (Stevens et al. 2005). Little is known about their historical distribution in Western Australia and the Northern Territory, although given these areas are less populated than the east coast, it is likely that sawfish have not undergone declines of the same magnitude (Stevens et al. 2005). Sawfish return seasonally to inshore coastal waters adjacent to the northern Australian region to breed and pup. The Commonwealth Scientific Industrial Research Organisation and Fisheries agencies in Western Australia, Northern Territory and Queensland have recorded pupping in January (McAuley 2003, pers. comm., cited in Peverell 2005). This very scant dataset suggests pupping may occur during the wet season (Peverell 2005).

The freshwater sawfish may potentially occur in all large rivers of northern Australia from the Fitzroy River, Western Australia, to the western side of Cape York Peninsula, Queensland. It is mainly confined to the main channels of large rivers (Allen 2000 pers. comm.). The species is known from several drainages of northern Australia including the Adelaide River, Victoria River and Daly River of the Northern Territory; and also recorded from the McArthur River, Northern Territory (Merrick & Schmida 1984). In northern Australia, this species appears to be confined to freshwater drainages and the upper reaches of estuaries, occasionally being found as far as 400 km from the sea (Thorburn et al. 2007; Whitty et al. 2008). There are few reports of adult individuals at sea, with only a few records of fish greater than 3 m in total length from the Pilbara coast, and one individual from Cape Naturaliste (south-western Australia) (Chidlow 2007 cited in Whitty et al. 2008). Merrick and Schmida (1984) noted that no detailed studies had been made on the reproduction of the freshwater sawfish. The species possibly breeds in fresh water (Allen 1991). In the Mitchell River on western Cape York Peninsula, Queensland, spawning generally occurs at the beginning of the wet season in November or December (Allen 1991). In the Fitzroy River, Western Australia, pupping is correlated to higher water levels in the late wet season (Whitty et al. 2008).

Nearshore environments found in the Project area provide protection for shallow shelf habitats that are important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish. The range of sawfish species overlaps with popular recreational fishing locations in some parts of the north marine region (NMR) (DSEWPaC 2012b) and adjacent areas. Observations of dead discarded sawfish species from recreational fishing highlights that mortality occurs as a direct result of capture and discarding (DSEWPaC 2012b).

Northern river shark

The northern river shark is a very rare species found in northern Australia and Papua New Guinea. Northern river sharks are elasmobranchs capable of living in and moving between freshwater and seawater. The species utilises rivers, tidal sections of large tropical estuarine systems, macrotidal embayments, inshore and offshore marine habitats (Pillans et al. 2009). Adults have been recorded only in marine environments, whereas neonates, juveniles and subadults have been recorded in freshwater, estuarine, and marine environments (Pillans et al. 2009). The small amount of data available indicates a preference for highly turbid (secchi depth = 3 to 70 cm), tidally influenced waters with fine muddy substrate (Stevens et al. 2005). The presence of animals well offshore suggests northern river sharks undertake movements away from rivers and estuaries and are therefore likely to move between river systems. However, the extent to which this occurs, and the distances moved, is unknown.

Within the Northern Territory, northern river sharks have been recorded from the highly turbid lower reaches (salinity between 2 and 10) of the Adelaide River, Daly River and the South and East Alligator Rivers (Field et al. 2008). In northern Australia, a single female was recorded with 9 pups and free-swimming young have been found in October, which suggests they give birth in October (Pillans et al. 2010). Little else is known of the biology.

White shark

Great white sharks are not typically found in Northern Territory waters but can be found from close inshore around rocky reefs, surf beaches and shallow coastal bays to outer continental shelf and slope areas (Pogonoski et al. 2002 in DEWHA 2009). They also make open ocean excursions and can cross ocean basins (for instance from South Africa to the western coast of Australia and from the eastern coast of Australia to New Zealand). Great white sharks are often found in regions with high prey density, such as pinniped colonies (DEWHA 2009).

Great white sharks are widely, but not evenly, distributed in Australian waters. Areas where observations are more frequent include waters in and around some Fur Seal and Sea Lion colonies such as the Neptune Islands (South Australia); areas of the Great Australian Bight as well as the Recherche Archipelago and the islands off the lower west coast of Western Australia (Environment Australia 2002; Malcolm et al. 2001). Juveniles appear to aggregate seasonally in certain key areas including the 90 Mile Beach area of eastern Victoria and the coastal region between Newcastle and Forster in New South Wales (Bruce and Bradford 2008). Other areas, such as the Portland region of western Victoria and the coast off the Goolwa region of South Australia, are also reportedly visited by juvenile great white sharks. The great white shark moves seasonally along the south and east Australian coasts, moving northerly along the coast during autumn and winter and returning to southern Australian waters by early summer (Bruce et al. 2006).

Juveniles appear to aggregate seasonally in certain key areas including the 90 Mile Beach area of eastern Victoria and the coastal region between Newcastle and Forster in New South Wales (Bruce and Bradford 2008). Other areas such as the Portland region of western Victoria and the coast off the Goolwa region of South Australia are frequented by juvenile great white sharks at times (DEWHA 2009). The Port Stephens region is a major aggregation sites off eastern Australia. Bruce and Bradford (2008) established that juvenile great white sharks aggregate in the area in mid-September to mid-December, moving then to Bass Strait. The locations of pupping areas in Australia are unknown (DEWHA 2009) though neonate great white sharks have been taken as bycatch in the western region of the Great Australian Bight and Bass Strait (DEWHA 2009).

Reproduction in great white sharks is poorly documented, largely because there have been few opportunities to study pregnant females (Francis 1996). Great white sharks often occur singly or in pairs but can be found around food sources (such as sea lion (*Neophoca cinerea*) colonies) in feeding aggregations. Schooling does not apparently occur (Compagno 1984). A dominance hierarchy has been described, in which smaller great white sharks avoid larger individuals when feeding (Strong et al. pers. comm in Klimley and Anderson 1996).

Speartooth shark

The speartooth shark is only found in river catchments in the Northern Territory and Queensland, and in southern coastal areas of Papua New Guinea (Stevens et al. 2005; Compagno et al. 2008; White et al. 2015). Genetic analysis shows minimal genetic exchange between these catchments, resulting in largely distinct populations (Feutry et al. 2014). In the Northern Territory, the speartooth shark is known to occur in the van Diemen Gulf, including the Adelaide River, Alligator Rivers and Murganella Creek (Steven et al. 2005). Within the Adelaide River, Pillans et al. (2005) observed cyclic upstream and downstream movement patterns that correlated with ebb and flood tides.

Juvenile speartooth sharks prefer turbid tidal rivers (Pillans et al. 2009) and it is inferred that this species may be restricted to freshwater and brackish areas of rivers (Pillans et al. 2005), but habitat use, and movement remains largely unknown. Additionally, no sexually mature adult speartooth sharks have been recorded, and nothing is known of the timing and locations for reproduction (White et al. 2015), however, it is presumed that adults occupy a separate habitat to juveniles and may migrate inshore to breed (Stevens et al. 2005).

Grey nurse shark

The Grey nurse shark (*Carcharias taurus*) is a listed migratory and widespread species found worldwide in tropical to temperate coastal waters (Environment Australia 2002). In Australia, there are two distinct populations, the east coast population, predominately found in southern Queensland and coastal NSW, and the west coast population, where this species has been found from south Western Australia to the North West Shelf (Environment Australia 2002). Evidence and captures outside of these populations have occurred in Northern Territory waters and around northern western Australia, with an individual sampled from Northern Territory as related to the west coast population (Krause S and Stow A, 2025). The east coast population is classified as critically endangered, while the west coast population is listed as vulnerable (EPBC Act 1999; EPBC Regulations 2000). Grey Nurse Sharks are typically found hovering near the seabed in deep sandy-bottomed gutters or rocky caves, often around inshore rocky reefs and islands (Pollard et al. 1996). They inhabit sub-tropical to cool temperate waters around continental landmasses (Last & Stevens 1994). This species is generally found at depths between 15 and 40 m but can reach depths of 200m on the continental shelf. Grey nurse sharks generally occur as solitary individuals or in small groups, with larger aggregations grouping for mating (Environment Australia 2002). Darwin Harbour was a known locality of the Grey Nurse Shark pre-2000 (NT Gov, 2024). There is some suitable habitat in the project are so this species may occur.

The Grey Nurse shark has a large, stout body with grey to grey-brown dorsal colouring and a pale underside. Juveniles may display reddish or brownish spots on the tail and posterior body (Last & Stevens 1994; Pollard et al. 1996). It features a conical snout and similarly sized first and second dorsal fins. The caudal fin is asymmetrical. Individuals can grow up to 360cm in total length and are thought to be more active at night (Pollard et al. 1996). They are usually solitary or in small groups of fewer than 20 individuals. Aggregations of five or more sharks are considered significant (Otway & Parker 2000). Larger aggregations are rare and typically linked to feeding or mating behaviour. Seasonal movements along the east coast appear to be influenced by water temperature, with males more common in southern Queensland between July and October (Otway & Parker 2000).

The diet of adult Grey Nurse sharks includes bony fish, other sharks and rays, squid, crabs, and lobsters (Compagno 1984). Cooperative feeding has been observed, where sharks concentrate schooling prey before feeding (Compagno 1984). Grey Nurse sharks have a slow growth rate and reach sexual maturity at 4-6 years (Last & Stevens, 1994). Mating scars observed in March and April suggest reproductive activity during this period (Otway & Parker 1999). Females reproduce biennially and have a maximum of two pups per litter (Smith & Pollard 1999). Embryos consume siblings and unfertilised eggs in the uterus, with gestation lasting 9-12 months (Last & Stevens 1994).

Scalloped Hammerhead Shark

The Scalloped hammerheads (*Sphyrna lewini)* is listed as Conservation Dependent (Threatened Species Scientific Committee (TSSC) 2018). It is olive, bronze, or brownish-grey dorsally and pale underneath, with dusky or dark markings on the pectoral fin tips and tail in juveniles (Last & Stevens 2009). A distinctive feature of the species is its hammer-shaped head with indentations that enhance sensory capabilities, including detection of electrical fields and environmental changes (TSSC 2018).

Scalloped hammerheads are coastal pelagic sharks, found in temperate and tropical waters, preferring continental shelves rarely crossing deep ocean basins, resulting in strong genetic structuring across ocean regions (Chin et al. 2017). In Australia, their range extends from Wollongong in New South Wales, around the northern coast, and south to Geographe Bay in Western Australia, though sightings south of the Houtman Abrolhos Islands are rare.

Scalloped hammerheads exhibit variation in age and size at maturity depending on water temperature. Maximum age estimates range from 30-55 years, depending on region (Drew et al. 2015). Reproduction involves live birth, with pupping year-round along the east coast of Australia and gestation lasting 9-10 months (Stevens & Lyle, 1989). Litter sizes vary widely from 13-41 (Noriega et al. 2011). There is one record of a Scalloped hammerhead in the project area and some suitable foraging sites so this species may occur.

Reef Manta Ray

The Reef Manta Ray (*Mobula alfredi*) is a large pelagic ray found in tropical and subtropical waters of the Indo-Pacific. It is listed as Migratory and occurs across northern Australia in a wide range from Coffs Harbour, New South Wales to Shark Bay, Western Australia (Armstrong et al. 2020). The reef manta ray is mainly found inshore around coral and rocky reefs from the surface to a depth of 432m (Marshall et al. 2019). Their distribution is influenced by factors like water temperature and plankton availability (Marshall et al. 2011).

Reef Manta Rays can grow up to 5.5m in disc width (wing tip to wing tip) but generally observed between 3-3.5m and are estimated to have a maximum lifespan of 45-50 years (ALA 2025; Marshall et al. 2019). Reef Manta rays have a dark dorsal side with two lighter areas on top of the head that form a "Y" shape. The ventral surface is white and sometimes features dark spots that can be used to identify individuals (ALA 2025). There are no ALA records of Reef Manta Rays or suitable habitat in the project area, so this species is unlikely to occur (ALA 2025).

Giant Manta Ray

The Giant Manta Ray (*Mobula birostris*) is a large ray that is highly mobile and globally distributed throughout tropical to temperate pelagic waters. This species is listed as Migratory and occurs across northern Australia from Montague Island, New South Wales to Shark Bay, Western Australia (Kyne et al. 2021). This species is mainly pelagic and can be found from the surface to a depth of 1000m. It primarily inhabits open ocean environments, but also frequents coastal areas, particularly where there are aggregations of plankton (Kyne et al. 2021).

Giant Manta ray maximum size is approximately 7m disc width and have a maximum lifespan of 45 years. They have a dark dorsal side and a white ventral side with two white areas on the top of their head that form a "T" shape. There are no ALA records of Giant Manta Rays or suitable habitat in the project area, so this species is unlikely to occur (ALA 2025).

Longfin Mako

The Longfin Mako (*Isurus paucus*) is a large bodied shark that is widely distributed throughout global tropical and sub-tropical waters. This species is listed as Migratory and in Australia, is found from Geraldton, Western Australia across the top end and down to Port Stevens, New South Wales. The Longfin Mako prefers tropical, epipelagic waters, feeding on small schooling bony fishes and cephalopods. This species is the second largest in its family after the Great White and is distinguishable by its dark blue-grey black colouration and dusky mottling on the pectoral fins (ALA 2025). The Longfin Mako is aplacental viviparous and generally has a litter size of two but may be as many as eight (ALA 2025). There are no ALA records of this species within the project area though there is some suitable habitat, therefore, this species may occur.

Shortfin Mako

The Shortfin Mako (*Isurus oxyrinchus*) is listed as Migratory and is a large bodied, highly mobile, pelagic shark that is widespread throughout tropical and temperate waters of all oceans. The species comprises three known subpopulations: Atlantic, Eastern North Pacific, and Indo-West Pacific. The Indo-West Pacific subpopulation occurs from the western Indian Ocean across to the eastern Pacific Ocean. It is found throughout Australian waters, with the exception of the Arafura Sea, Torres Strait, and Gulf of Carpentaria. The Shortfin Mako is found in pelagic and continental shelf waters, occurring from the surface to depths of 500m. There are no ALA records of this species within the project area though there is some suitable habitat, therefore, this species may occur.

The Shortfin Mako is the fastest known shark species and has been recorded travelling at up to 74km/h in short bursts. This species can grow up to 4.4m in length, weigh up to 600kg and have a lifespan of approximately 30 years (ALA 2025). It is distinguishable by its electric blue and white countershading, including a distinct line of demarcation between the colours on the body ALA 2025). Shortfin Mako travel extensively for foraging and/or breeding opportunities. They are polyandrous and have a 15-18 month gestation period.

Oceanic Whitetip Shark

The Oceanic Whitetip Shark (*Carcharhinus longimanus*) is listed as Migratory and is a widespread pelagic species. In Australian waters, it is found in from Cape Leeuwin, Western Australia across the Northern Territory, down the east coast to Sydney, New South Wales. It has not been recorded within the Gulf of Carpentaria or the Arafura Sea, preferring pelagic waters.

This species is typically solitary though can gather in large numbers at food concentrations. Also known as the Brown Shark, this species is identifiable by its grey-bronze dorsal side and white ventral side. Additionally, as the name suggests, most of its fins have white tips. The Oceanic Whitetip usually measures between 3-4m in length and weigh up to 150kg. This species is viviparous with a gestation period of 9-12 months and a lifespan of approximately 22 years.

There are no ALA records of this species within the project area though there is some suitable habitat, therefore, this species may occur.

Plants

No plants listed under the EPBC Act have been assessed as known to occur, likely to occur or may occur in the Project area. Three plants were identified in the PMST search: *Atalaya brevialata*, *Stylidium ensatum*, and *Typhonium taylorii*. A ground-truth vegetation survey of the ODA was undertaken in December 2023 by EcOz Environmental Consultants (EcOz) to verify existing vegetation mapping of the area and identify suitable habitat for the threatened flora species, *Cycas armstrongii* and *Typhonium paetermissum* / *Typhonium* sp. Cox Peninsula. All three species have been assessed as unlikely to occur in the Project area, due to limited or no habitat presence, and surveys conducted by the Department of Land Resource Management (DLRM 2016) and EcOz (2023).

4.4 Cultural environment

4.4.1 Cultural heritage

Traditional Owners

Aboriginal and Torres Strait Islander peoples' continuing connection to country is recognised in Australia under both State/Territory and Commonwealth legislation. At a national level, the *Native Title Act 1993* (Cwlth) establishes Native Title, which recognises, under Australian common law, pre-existing Indigenous rights and interests according to traditional laws and customs. Native Title is different from land rights as it is not a grant or right created by governments (CoA 2023). Aboriginal land in the Northern Territory is defined by the *Aboriginal Land Rights (Northern Territory) Act 1976* (Cwlth), which affords Traditional Owners sovereign rights to country. In some instances, where Native Title exists it may extend over land and sea (generally out to 3 nm).

It has been established that human presence in the Northern Territory dates back 65,000 years, and continuous occupation of the Tiwi Islands of at least 6,000 years, pending further archaeological investigation (Burns 1994). Archaeological sites and evidence, including shell mounds and rock art, found throughout Darwin and Middle Arm Peninsular in the harbour provides evidence for Aboriginal occupation of this area over time and throughout landscape changes (O'Brien et al. 2025).

The Larrakia people are recognised as Traditional Owners and custodians of the Darwin region, including Middle Arm Peninsula, whose country stretches from Finnis River in the West to Adelaide River in the east, and inland along the Charlotte River. Both historic and present cultural places are located throughout Darwin Harbour, and the Larrakia people continue to maintain culture and uphold links to the land and sea country (Earth Sea Heritage Survey 2024).

Additionally, throughout the 1700s to 1900s, fleets of Indonesian fisher people and traders, known as the Macassan Traders, traversed through the Timor Sea, along the Tiwi Islands and along the Cobourg Peninsula on the north Australian coastline (O'Brien et al. 2025). Macassan artifacts have been found on beaches within the Darwin region, including a cast iron swivel gun collected on the shoreline of Darwin Harbour in 1908, however, there are no historical accounts that the Macassan Traders travelled into Darwin Harbour (O'Brien et al. 2025).

Two Aboriginal land councils represent Aboriginal communities in the region of the proposed Project: The Northern Land Council (NLC) and Tiwi Land Council (TLC) in the Northern Territory. The NLC is responsible for assisting Aboriginal Peoples in the Top End to manage traditional land and protect sites of significance, and to promote economic interests by advocating for Traditional Owners on Land Trust and Native Title lands (Earth Sea Heritage Survey 2024). The TLC is responsible for Tiwi Island compliance with the Aboriginal Land Rights (Northern Territory) Act 1976 (ALRA) and in ensuring activities on

the Tiwi Islands are undertaken only after consultation with the relevant clan group(s) and Traditional Owners. There are also a number of Prescribed Bodies Corporates that represent Aboriginal peoples in the Northern Territory.

Culture and connection to country

Aboriginal and Torres Strait Islander peoples have passed down their culture through generations over the past 65,000 years. Historically, Aboriginal people lived in small family groups and were semi-nomadic, with each family group living in a defined territory, systematically moving across a defined area following seasonal changes. Aboriginal people built semi-permanent dwellings; as a nomadic society emphasis was on relationships to family, group and country. Membership within each family or language group was based on birthright, shared language, and cultural obligations and responsibilities. Groups had their own distinct history and culture and at certain times, family groups would come together for social, ceremonial and trade purposes (Working with Indigenous Australians [WWIA] 2023).

According to Aboriginal beliefs, the physical environment of each local area was created and shaped by the actions of spiritual ancestors who travelled across the landscape (WWIA 2023). Songlines are tied to the Australian landscape and provide important knowledge, cultural values and wisdom. Songlines trace the journeys of ancestral spirits as they created the land, animals and lore, and are integral to Aboriginal spirituality and connectedness to country.

Unlike elsewhere in Australia, Aboriginal groups in northern Australia had several centuries of contact with foreign visitors before the arrival of Europeans (National Oceans Office 2004). Many coastal and island regions in Western Australia and the NT were the scene of complex patterns of interaction, trade and exchange with outsiders including Macassan trepangers from Sulawesi from the late 1600s until early 1900s, European mariners from the mid-1600s, and Japanese pearl divers after European arrival (McCarthy et al. 2022).

Evidence of visits and interactions between Macassan and Aboriginal people include the remains of stone fireplaces and smoke houses, tamarind trees planted by Macassan people and fragments of earthenware and porcelain. Although not necessarily marine based, Aboriginal and Macassan archaeological places are important to Aboriginal people as part of their continuing culture and identity.

Sea country and submerged historic landscapes

Over the 65,000 years of Aboriginal occupation of Australia, sea levels have fluctuated, rising from a peak low of -120 m at around 21,000 years ago relative to present levels, which resulted in the inundation of vast areas of the continental shelf (Ward et al. 2022; Figure 4-12). Aboriginal and Torres Strait Islander peoples have been sustainably using and managing their sea country for tens of thousands of years, in some cases since before rising sea levels created these marine environments (DNP 2018b).

Sea country (or saltwater country) refers to the areas of the sea that Aboriginal and Torres Strait Islander peoples are particularly affiliated with. It is an estate of sea as well as land, containing sacred sites and inhabited by ancestral beings, existing in both the physical and spiritual world. Sea country is valued for Aboriginal and Torres Strait Islander cultural identities, health and wellbeing (DNP 2018a, 2018b).

Types of sites in the Northern Territory that may preserve on the seabed include:

1. stone tool scatters, like those on Murujuga
2. engraved rock art
3. shell mounds and middens

4. fish traps and weirs
5. burials.

The current lack of known submerged Aboriginal archaeological sites in the Northern Territory is due to the lack of detailed investigation and studies regarding geomorphology, sea level modelling, wind, tide and wave action, sediment deposition and scouring (O'Brien et al. 2025).

There is a considerable body of literature describing the complexity of the cultural, spiritual, ceremonial, territorial and economic connection between Aboriginal and Torres Strait Islander peoples and the sea.

Although limited baseline surveys of submerged archaeology have been undertaken in Australia to date, submerged archaeological landscapes have recently been identified in Western Australia through combined evidence of terrestrial ecology, coastal and marine geomorphology and sea-level studies (Benjamin et al. 2020; McCarthy et al. 2022). As some of the oldest dated terrestrial sites have been found in the Northern Territory, there is a potential for the existence of submerged landscapes with associated Aboriginal heritage values to exist throughout the previously submerged areas of the continental shelf where strong cultural connections between Traditional Owners and the sea exist (McCarthy et al. 2022). Such relationships and the connections with sea country transcends the landscape/seascape divide and the sea is not only a physical and temporal space, but also a mental map of ancestral journeys and rituals to nurture and pass on to future generations (Ward et al. 2022).

Many AMPs are of important cultural significance with fishing, hunting and the maintenance of Aboriginal heritage through ritual and stories are considered to be important uses of nearshore and adjacent areas (DNP 2018a).

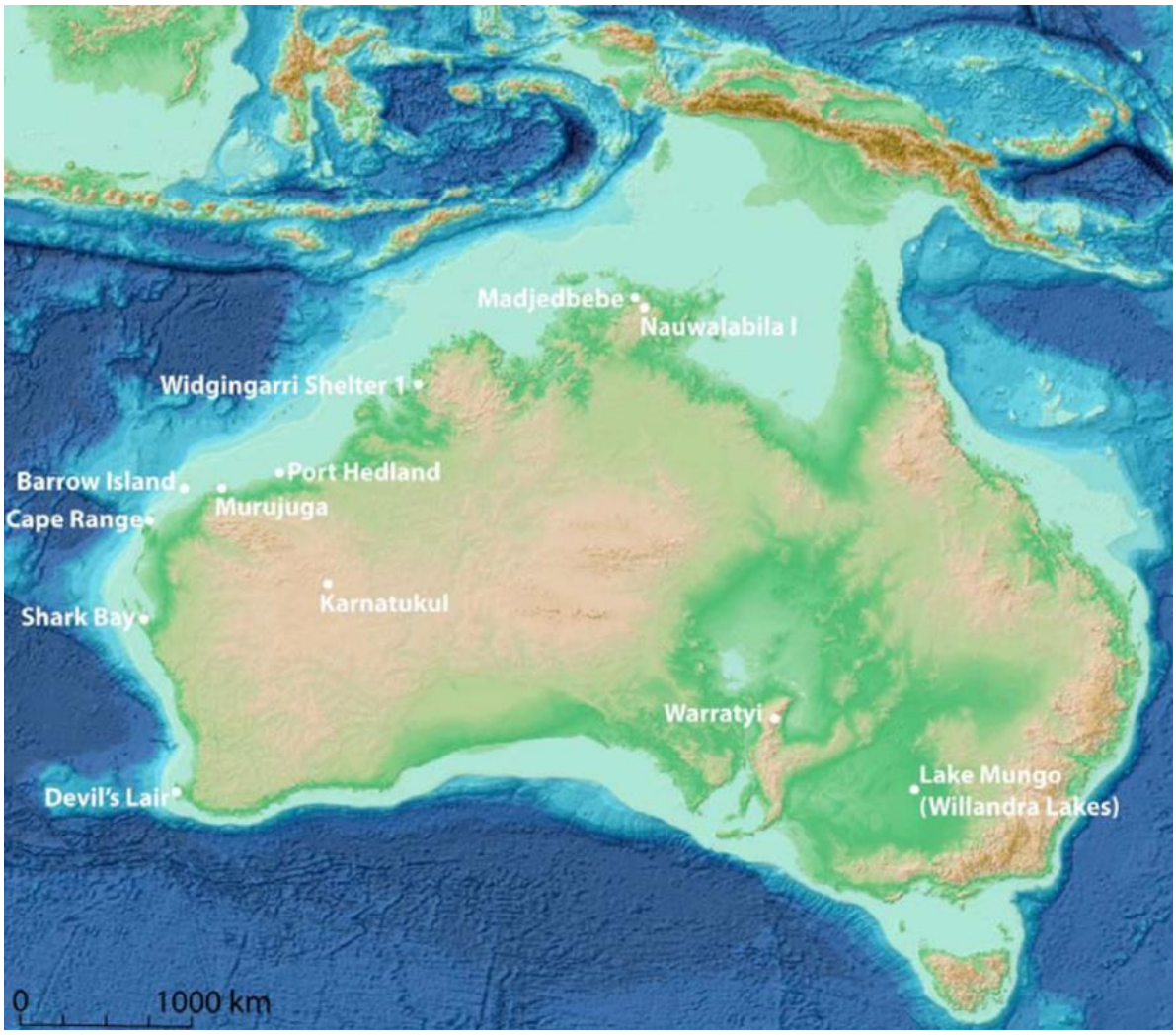


Figure 4-12: Map of Australian historic coastline (O'Brien et al. 2025)

Aboriginal sacred sites and other recognised heritage places

During heritage surveys undertaken to support the construction of the Ichthys LNG facility, a number of Aboriginal heritage sites were identified within and adjacent to the ODA. Following consultation with the Larrakia Heritage Management Executive Committee and Northern Territory Heritage Branch actions were taken to protect and manage heritage places. Additional surveys are planned to be conducted by qualified Larrakia cultural heritage monitors to assist with pipeline design; route selection and geotechnical investigation works. Project surveys are planned to be conducted in late 2025 and continue during project execution.

Since the 1980's, over 30 terrestrial and maritime related heritage studies have been undertaken at Middle Arm (Earth Sea Heritage Survey 2024). These studies identified several archaeological features, including shell mounds on Channel Island and on Coastal areas of Darwin Harbour (Bourke 1994, 1996), petroglyphs at Middle Arm (Bourke and Mulvaney, 2003), skeletal remains at Middle Arm (Richardson 1996) and shell middens at Wickam Point (Crassweller 2002).A search of the Aboriginal Areas Protection Authority interactive map of 'Regions of Sacred Sites in the Northern Territory, identified a number of registered sacred sites within the region (AAPA 2023). These sites are protected under the Northern Territory Aboriginal Sacred Sites Act 1989 (Northern Territory). Some sites located directly on the coast or on offshore islands that have values associated with plant

resources, water sources, hunting places/camps and spiritual and cultural history may be affected in the event of an emergency condition.

The Kenbi Rangers have shared information on land use and access on the Cox Peninsula and Bynoe Harbour with INPEX which included the location of sacred sites. None of the sites on the Cox Peninsula fall within the Project area.

INPEX has been issued an AAPA Authority certificate for the onshore areas where Project activities will occur (Authority Certificate C2011/166) and also for the offshore dredge spoil area (Authority Certificate C2012/138). An application is in progress for the nearshore PDA.

Aboriginal seasonal calendars

Aboriginal and Torres Strait Islander peoples have developed an understanding of the Australian environment over many thousands of years (BOM 2023; CSIRO 2022). Aboriginal knowledge of the seasons is highly localised and unique to each Aboriginal group. As such, the number of seasons recognised in an annual cycle, the length of each season, and how they are locally defined and understood, differs a lot depending on where the seasonal knowledge of Country has developed (CSIRO 2022).

Within specific seasons certain activities occur; these include customary activities such as ceremonies and burn offs. Resource availability is also influenced by season such as the flowering of certain plants, identifying when eggs are available for collection or specific bird calls which indicate that yams are ready to eat (BOM 2023).

Some examples of specific traditional activities that may occur in the region that are influenced by season include:

- On the Tiwi Islands, turtles are collected whenever possible, although Jamutakari (wet season; December to February) seems to be the most fruitful time (TLC 2023). Crested terns also lay eggs towards the end of Jamutakari which are collected for food (TLC 2023).
- Gulumoerrgin (Larrakia) seasonal calendar shows that turtle eggs are collected during Mayilema (March to April), green sea turtles are hunter throughout the year, except when they are mating and laying eggs, dugong hunting occurs during Dinidjanggama (June to July) and cockles collected during Gurrulwa (August; Williams, et al. 2012).

Traditional use of resources

Traditional fishing occurs along the majority of the Kimberley and Northern Territory coastline. The practice of traditional fishing includes harvesting turtles, dugong, fish and other marine life (DCCEEW 2023b), with traditional fishing methods consisting of the use of lines, hand collection, nets and spears (National Oceans Office 2004).

A search of the National Indigenous Australians Agency (NIAA) interactive map confirmed there were no Indigenous protected areas (IPAs) within the Project area (NIAA 2023) However, non-designated areas along the Northern Territory coastline are used for traditional fishing with approximately 55 per cent % of the Northern Territory coastline owned by Traditional Aboriginal Owner groups. These areas support a range of economies and livelihoods and contain many iconic fishing areas (Northern Land Council [NLC] 2021).

A National Recreational and Indigenous Fishing Survey undertaken in 2000 reported that the greatest fishing effort focused on saltwater environments, including estuarine, coastal, inshore (less than 5 km from the coast) and offshore (greater than 5 km from the coast) with line fishing and hand gathering being the two most common fishing methods (National Oceans Office 2004). Data collected during the survey in 2000, showed that offshore fishing

activities represented only 2 per cent % of total indigenous fishing effort with inshore (49 per cent), coastal (23 per cent), rivers (16 per cent) and lakes/dams (10 per cent) being more common (National Oceans Office 2004).

Several Aboriginal groups have responsibility for managing sea country where they have deep spiritual connections to offshore landscapes and harvest marine resources for food and cultural purposes. Fish are a staple food source, and fishing a form of cultural expression, connecting people to their country modelled on tradition and based in traditional law (DNP 2018a).

4.4.2 Heritage places

A search of the Australian Heritage Database determined there are three registered places of heritage significance in the vicinity of the Project area:

- Channel Island Reefs
- Channel Island Leprosarium
- Darwin Harbour Wetlands.

Additionally, a search of the Northern Territory Heritage Register determined one place with a permanent heritage declaration under the Northern Territory *Heritage Act 2011* in the vicinity of the nearshore PDA: the Channel Island Leprosarium and Reefs (Refer to Figure 4-13).

Channel Island is approximately 200 m south of the nearshore PDA. The Channel Island Leprosarium was a quarantine station from 1884, converted into a Leprosarium in 1930. It is both a culturally and socially significant site providing a view on enforced isolation of diseased people in the Northern Territory (Earth Sea Heritage Survey 2024). The Channel Island Reef is biologically significant, hosting a diverse coral community in an area characterised by conditions typically unfavourable for coral growth, including strong currents, high turbidity, fine muddy sediment and low salinity (Earth Sea Heritage Survey 2024). The Darwin Harbour Wetlands are listed as indicative, meaning that there is no heritage protection in place.

4.4.3 Maritime heritage

A search of the Australian National Shipwrecks Database (DCCEEW 2024g) determined that the Project area overlaps five existing shipwreck sites. An additional four shipwrecks are within 500 m of the nearshore PDA (Figure 4-14). These include:

- Ellengowan (declared area)
- Dieman
- Mandorah Queen
- Mauna Loa United States Army Transport (USAT) (declared area)
- Medkhanun 3
- Meigs USAT (declared area)
- John Holland Barge
- Yu Han 22.

Both the Northern Territory *Heritage Act 2011* and *Underwater Cultural Heritage Act 2018* prohibit interference or disturbance with declared protection zones without obtaining a permit (NTG 2025a).

The Ellengowan is the oldest known shipwreck in Darwin Harbour and is one of the earliest examples of shipping associated with European settlement in the area. It is a unique example of nineteenth-century maritime history in the territory and is the only known Norwegian-built iron steamer in Australian waters. Its significance to maritime archaeology is consequently rated highly (DNREA 2008).

There are also currently two sites in Darwin Harbour that have 'closed waters' controls over them by order of the regional harbourmaster - the Booya and Catalina 6. These areas can't be entered without permission of the Heritage Branch; however, they do not overlap the nearshore PDA.

Additionally, there is the potential for Project activities to encounter unlocated shipwrecks not documented in historical records, which may include aboriginal, Macassan or early colonial wrecks inclusive of aircrafts, as well as potential remnants of historical quarantine and naval anchorages.

Six historical maritime infrastructure installations are found within the nearshore PDA, which include three sections of the 1871 Darwin to Java subsea telegraph cables (protected under the Northern Territory *Heritage Act 2011*), an anti-submarine boom net installation from World War II, and two groups of World War II indicator loops. Despite potential overlap, the World War II remains are not protected under Territory or Commonwealth heritage legislation and may be relocated (O'Brien et al. 2025).

4.4.4 Historic heritage

Archaeological surveys undertaken to support the Ichthys LNG Development Project identified World War II objects on Bladin Point. Objects found within the vicinity of Ichthys LNG were deemed to not be of heritage value and were removed following consultation with the Northern Territory Heritage Branch. There are no known World War II heritage sites within where Project activities are planned to be undertaken.

Figure 4-13: National and Commonwealth Heritage places in proximity to the nearshore PDA

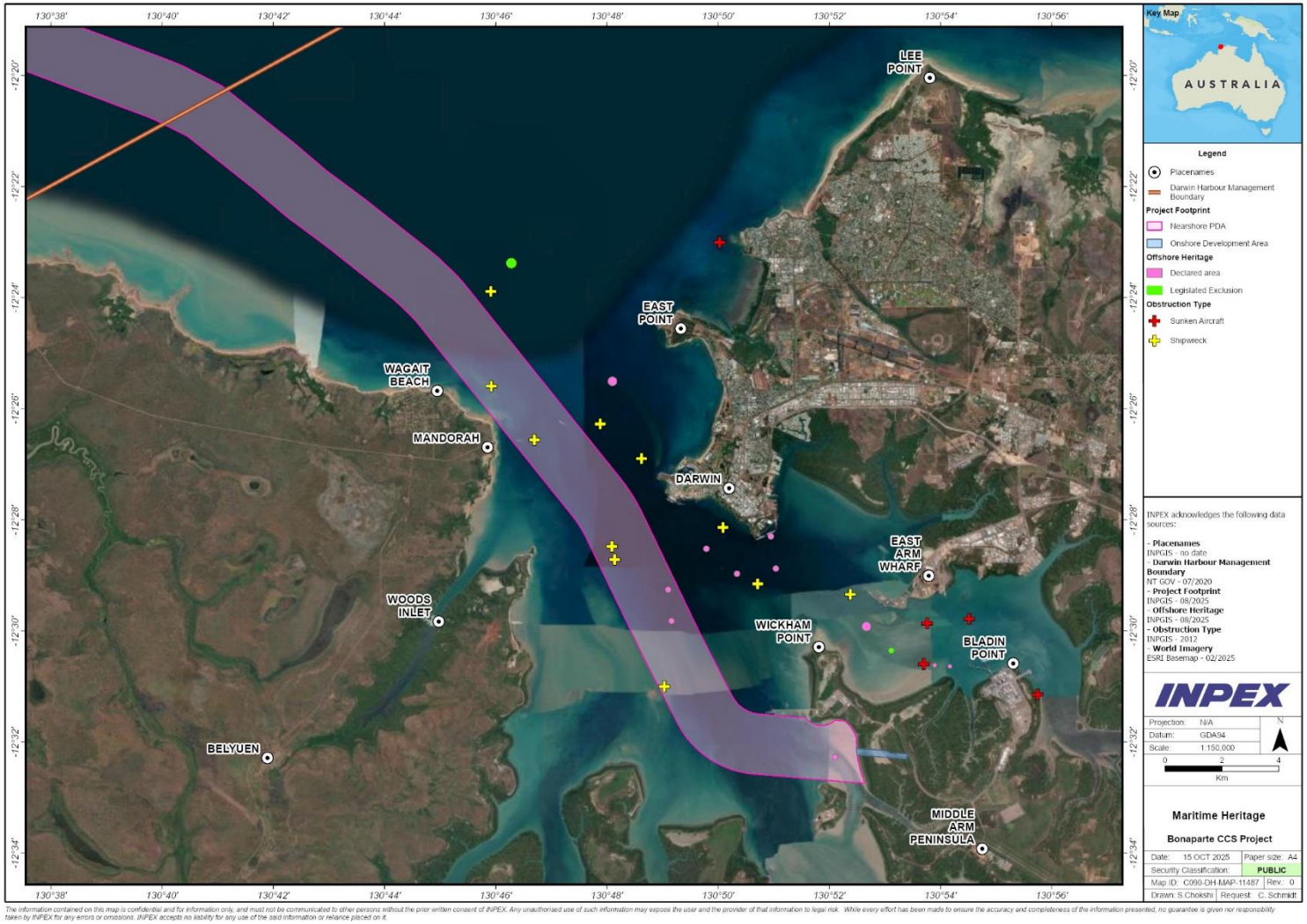


Figure 4-14: Maritime heritage overlapping or in proximity to the nearshore PDA

4.5 Socio-economic environment

4.5.1 Existing land use and infrastructure

The Project area is located within the Middle Arm Precinct, which provides an area for transmission of utilities, particularly gas. Current land uses of Middle Arm Peninsula in the vicinity of the Project area are presented in Table 4-10.

Wickham Point Road and Channel Island Road are public access roads providing entry to the industrial premises, with associated parallel utility corridors.

Table 4-10: Current land uses of Middle Arm Peninsula in proximity to the Project area

Land use	Operator/owner	Distance from the Project area
Ichthys LNG	INPEX	4 km north-east of ODA
Ichthys GEP	INPEX	Directly adjacent to nearshore PDA
Darwin LNG	Santos	200 m north of nearshore PDA
Bayu Undan GEP	Santos	Directly adjacent to nearshore PDA
Channel Island Power Station	Territory Generation	1 km south of nearshore PDA
Weddel Power Station	Territory Generation	8 km south-east of ODA
Bladin Village	Trepang Services Pty Ltd	4 km south-east of ODA
Darwin Aquaculture Centre	Northern Territory Government	1 km south of nearshore PDA

4.5.2 Commercial fisheries

The AFMA manages Australian Commonwealth fisheries within the Australian Fishing Zone (AFZ). AFMA carry out objectives that are listed in the *Fisheries Administration Act 1991* and the *Fisheries Management Act 1991*. Northern Territory fisheries are managed by the Northern Territory Department of Agriculture and Fisheries (Northern Territory DAF). Wild harvest fisheries are managed under the Northern Territory *Fisheries Act 1988* and Fisheries Regulations 1992.

Commonwealth managed fisheries

The following Commonwealth Fisheries management areas overlap the Project area:

- Northern Prawn Fishery
- Western Skipjack Tuna Fishery
- Southern Bluefin Tuna Fishery
- Western Tuna and Billfish Fishery

Northern Prawn Fishery

The Northern Prawn Fishery (NPF) stretches from the Joseph Bonaparte Gulf, across the Top End, to the Gulf of Carpentaria. Otter trawl gear is used, with most vessels now employing quad rigs comprising four trawl nets. The main target species are white banana prawn (*Fenneropenaeus merguiensis*), redleg banana prawn (*Fenneropenaeus indicus*), and tiger prawns, both brown tiger prawn (Penaeus esculentus) and grooved tiger prawn (*Penaeus semisulcatus*). By-product species include blue endeavour prawn (*Metapenaeus endeavouri*), red endeavour prawn (*Metapenaeus ensis*), deep-water scampi (*Metanephrops sibogae*), bugs (*Ibacus peronii*) and saucer scallop (*Ylistrum balloti* or *Amusium pleuronectes*).

The Northern Prawn Fishery has historically been active in the Project area, based on the fishing effort data, and is described further in Table 4-11.

Western Skipjack Tuna Fishery

The Western Skipjack Tuna Fishery covers the waters surrounding Northern Territory out to 200 nm from the coast. The fishery targets the skipjack tuna (Katsuwonus pelamis) and primarily employs purse seine fishing methods, with some minor pole and line and longline fishing. The fishery is currently inactive, with no Australian vessels since 2009; as confirmed by the Australian Bureau of Agricultural and Resource Economics (ABARES) of fishing effort data.

Southern Bluefin Tuna Fishery

The Southern Bluefin Tuna (SBT) Fishery covers Australian waters out to 200 nm from the coast and includes the whole Australian exclusive economic zone (EEZ). The Fishery targets a single, migratory stock of southern bluefin tuna (*Thunnus maccoyii*) that spawns in the north-east Indian Ocean and migrates throughout the temperate southern oceans, including a southbound migration past Western Australia.

There are 84 statutory fishing right owners in the fishery. This fishery is managed under a quota system to ensure the species is not subject to overfishing. The fishery employs both longlining (east coast of Australia) and purse seine net fishing (Great Australian Bight) methods, with the majority of fishing in Australia by purse-seine.

Commercial fishers mainly use the purse seine fishing method to catch southern bluefin tuna between December and February each year, with the fish being towed closer inshore and transferred to permanent floating pontoons. Since 2011, most fishing has occurred in the east of the Great Australian Bight, closer to Port Lincoln, resulting in shorter towing distances to bring the fish to aquaculture farms for growing before harvest (Patterson et al. 2021). The major landing port is Port Lincoln in South Australia (AFMA 2022a). All current SBT longline effort occurs on the east coast of Australia and around Tasmania. Longline fishing for SBT generally starts from May to October. Over 1323 tonnes (Tn) of SBT were caught on longline in 2023 (Butler et al. 2024). No fishing effort has occurred within or adjacent to the Project area from review of the ABARES data spanning 2010 to 2023.

Western Tuna and Billfish Fishery

The Western Tuna and Billfish Fishery (WTBF) management area encompasses the entire Australian EEZ, extending from the Gulf of Carpentaria westward to the South Australia-Victoria border. The key target species include bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), broadbill swordfish (*Xiphias gladius*) and striped marlin (*Tetrapturus audax*). Some albacore tuna (*Thunnus alalunga*) is also taken. The Fishery employs longline fishing methods; primarily pelagic longline with some minor-line fishing.

Spawning of yellowfin tuna occurs throughout the year in tropical waters and seasonally in subtropical waters. Yellowfin tuna spawn in surface waters within 10° of the equator (including the Coral Sea) when temperatures exceed 24 to 26 °C with the main spawning season between November to April. The peak spawning period in the southern hemisphere occurs in summer (AFMA 2023; Ministry for Primary Industries [MPI] 2023) this is supported by anecdotal evidence provided to INPEX from Tuna Australia that peak spawning occurs between December and February. Therefore, it is understood that tuna species, such as yellowfin tuna may occur in the Project area. In recent years, fishing effort has concentrated off south-west Western Australia (Patterson et al. 2021) with no fishing occurring near the Project area from the review ABARES data spanning 2010 to 2023 (Butler et al. 2024). In the fishery there are currently 93 vessels with statutory fishing rights (confirmed by Tuna Australia). The WTBF is a productive fishery with a long history of sustained fishing effort until the early 2000's. At its peak, there were up to 6 million hooks set per year by up to 50 active boats. However, since 2005 fewer than 5 vessels have been active in the fishery each year (Patterson et al. 2021). Tuna Australia informed INPEX that a consortium of WTBF concession owners aim to fish key north-west grounds from late 2023 however are unlikely to be adjacent to the Project area.

Northern Territory managed fisheries

A number of Northern Territory Fishery management areas overlap with the Project area. These include:

- Coastal Line Fishery (West)
- Offshore Net Line Fishery
- Spanish Mackerel Fishery
- Coastal Net Fishery
- Trepang Fishery
- Aquarium Fishery.

Northern Territory fishing effort data (Type 1) for the period 2020 to 2023 provided by the Northern Territory DAF demonstrates that the main fisheries that operate in the Project area are the Northern Territory Offshore Net and Line Fishery Northern Territory Spanish Mackerel Fishery.

The Northern Territory Aquarium Fishery, Northern Territory Barramundi Fishery and Northern Territory Coastal Net and Line fisheries have also reported relatively low-level fishing effort in grid blocks that overlap or lie directly adjacent to the Project area.

Further review of Global Fishing Watch automatic identification system (AIS) and vessel monitoring system data also confirmed that fishing vessels consistently operate in the Project area which supports the fishing effort data for the period 2020 to 2023 provided by Northern Territory DAF.

The Northern Territory-managed fisheries that have historically been active in the Project area based on the fishing effort data are described further in Table 4-11.

Table 4-11: Commonwealth and Northern Territory managed fisheries with potential to interact with the Project

Fishery	Management area	Gear type and use	Target species	Summary of Fishing Activities	Summary of Historical Fishing Effort
Commonwealth					
Northern Prawn Fishery	The Northern Prawn Fishery extends from the Joseph Bonaparte Gulf across the top end to the Gulf of Carpentaria (AFMA 2022b).	The Northern Prawn Fishery uses otter trawl gear. Most vessels have transitioned from using twin gear to using a more efficient quad rig comprising four trawl nets.	• White banana prawn • Redleg banana prawn • Tiger prawns (brown and grooved) • By-product species include endeavour prawns, deep-water scampi, bugs and saucer scallops.	The Northern Prawn Fishery operates during two seasons. The first season is from 1 April to 15 June, and during this time banana prawns are mainly caught. In the second season (1 August to 1 December) tiger prawns are predominantly caught. During this second season, trawling is banned during daylight hours. Either season has the potential to end early if catch rates fall below pre-set trigger levels. Closures in between these seasons protect / allow recovery of the stocks (Patterson et al. 2021).	Based on the ABARES 2014 to 2024 data (Butler et al. 2024): There is consistent overlap of low fishing intensity (< 0.1 days/km^2) with the nearshore PDA in the Beagle Gulf/north-werst of Darwin Harbour (Refer to Figure 4-15).
Northern Territory					
Northern Territory Barramundi Fishery	Commercial fishing for barramundi is allowed from the high-water mark (HWM) to 3 nm seaward of the low water mark. The fishing area is restricted to waters seaward from the coast, river mouths and legislated closed lines.	Gill nets (those set in open sea must have minimum mesh size of 150 mm, those set-in rivers must have minimum mesh size of 175 mm).	• Barramundi • King threadfin	There are currently 14 issued licences (NTG 2025b) and in 2017, the reported catch was 703.8 Tn, including, barramundi (55.8%), king threadfin (42.2%), with 1% byproduct of black jewfish and sharks (NT DPIR 2019). According to the Northern Territory Seafood Council (NTSC), many areas are excluded from the fishery defined by fishery closure lines, protection zones and various National Parks and Marine Parks (NTSC 2025)	Historic fishing effort data (2020 to 2023) provided by the Northern Territory DAF (2020 to 2023; 10 nm blocks) indicates that fishing effort has been recorded in the Nearshore PDA (Figure 4-16). The nearshore PDA overlaps with one 10 nm block with low fishing intensity data recorded, albeit on a confidential basis regarding number of days fished. There are greater numbers of 10 nm blocks fished to the south of the Project area near Daly River (Figure 4-16)
Northern Territory Offshore Net and Line Fishery	The Offshore Net and Line Fishery extends from the low water mark to the outer boundary of the AFZ (200 nm offshore) (NTG 2025c).	Demersal long lines, pelagic long lines, longlines and pelagic nets.	• Grey mackerel • Black-tip shark	The fleet operates with an average of 10 vessels per year, and the fishery harvested 632 Tn in 2018 to 2019, including grey mackerel (510 Tn) and combined finfish (58 Tn) (NTG 2025c).	Historic fishing effort data provided by the Northern Territory DAF (2020 to 2023; 10 nm fishing blocks) indicates that fishing effort has been recorded in the nearshore PDA (Figure 4-17). The nearshore PDA overlaps with three 10 nm blocks with low fishing intensity data recorded, albeit on a confidential basis regarding number of days fished. The nearshore PDA also overlaps one 10 nm block with 1 to 25 days fished between 2020 and 2023 (Figure 4-17).
Northern Territory Spanish Mackerel Fishery	The Northern Territory Spanish Mackerel Fishery extends from the HWM to the outer boundary of the AFZ (200 nm offshore) (NTG 2025d).	Commercial fishers operate using a mothership and up to two dories. It is common for fishers to troll two to four lines behind a dory and up to eight lines from a mothership using trolled lures or baited lines.	• Spanish mackerel	The Spanish Mackerel Fishery is a limited entry fishery and is limited to 15 licences (NTG 2025d). Total catch in 2019 to 2020 was approximately 375 Tn (NT DAF 2021a). The fishing season is all year. Fishing generally takes place around reefs, headlands and shoals. Majority of catch occurs off the western and eastern mainland coasts and near islands including Bathurst Island, Groote Eylandt and the Wessel Islands.	Historic fishing effort data provided by the Northern Territory DAF (2020 to 2023; 10 nm fishing blocks) indicates that fishing effort has been recorded in the nearshore PDA (Figure 4-18). The nearshore PDA overlaps with eight 10 nm block with low fishing intensity data recorded, albeit on a confidential basis regarding number of days fished. The nearshore PDA also overlaps one 10 nm block with 1 to 25 days fished between 2020 and 2023 (Figure 4-18).

Fishery	Management area	Gear type and use	Target species	Summary of Fishing Activities	Summary of Historical Fishing Effort
Northern Territory Aquarium Fishery	The Northern Territory Aquarium Fishery covers freshwater, estuarine and marine habitats to the outer boundary of the AFZ (200 nm offshore) (NTG 2025e).	Diving. Collection via hand-held equipment, including nets (barrier, cast, scoop, drag and skimmer) and hand pumps. Freshwater pots are also permitted.	• Rainbowfish • Catfish • Scats • Invertebrates including hermit crabs, snails, whelks and hard and soft corals and aquatic plants.	The fishery has traditionally focused on freshwater fish, but in recent years some operators have been transitioning into the collection of marine fish. The fishing season is all year. There are 11 licences in the Aquarium Fishery and in 2018 to 2019 there were 7 licences actively collecting marine species (NT DPIR 2019). Harvesting usually takes place in depths less than 10 m, and occasionally in depths up to 30 m (NT DPIR 2019). Freshwater and estuarine species are generally collected between the Adelaide and Daly rivers, while most marine species are collected within 100 km of Nhulunbuy and Darwin (NTG 2025e).	Historic fishing effort data provided by Northern Territory DAF 2020 to 2023; 10 nm fishing blocks) indicates that fishing effort has been recorded in the nearshore PDA (Figure 4-19). The nearshore PDA overlaps with two 10 nm blocks with low fishing intensity data recorded, albeit on a confidential basis regarding number of days fished. There are greater numbers of 10 nm blocks fished to the north-east of the nearshore PDA between the Tiwi Islands and mainland Northern Territory (Figure 4-19).
Northern Territory Coastal Line Fishery	The Northern Territory Coastal Line Fishery operates along the Northern Territory coast between the HWM and 15 nm out from the low water mark. Special restrictions apply in the western zone. The western zone extends from the Western Australian border to Vashon Head on Cobourg Peninsula, in the Northern Territory. Access is restricted from reef protection areas and around registered Aboriginal sacred sites and protected areas (NTG 2025f).	Vertical lines, cast nets, scoop nets or gaffs can be used from the high-water mark out to 15 nm from the low water mark. Drop lines and up to 5 fish traps can be used from 2 to 15 nm out from the low water mark. Up to 5 hooks per vertical line and up to 40 hooks per drop line.	• Black jewfish • Golden snapper	There are currently 52 issued active licences (NTG 2025f) and in 2017, the reported catch was 172 Tn, mostly consisting of black jewfish (98%) and holden snapper (0.45%) with byproduct made up of blue salmon and cods.	Historic fishing effort data provided by the Northern Territory DAF (2020 to 2023; 10 nm fishing blocks) indicates that fishing effort has been recorded in the nearshore PDA (Figure 4-20). The nearshore PDA overlaps with one 10 km block with low fishing intensity recorded, albeit on a confidential basis regarding number of days fished. There are greater numbers of 10 nm blocks fished in areas to the north and south of the PDA, including 10 nm with up to 100 days fished from 2020 to 2023 (Figure 4-20).

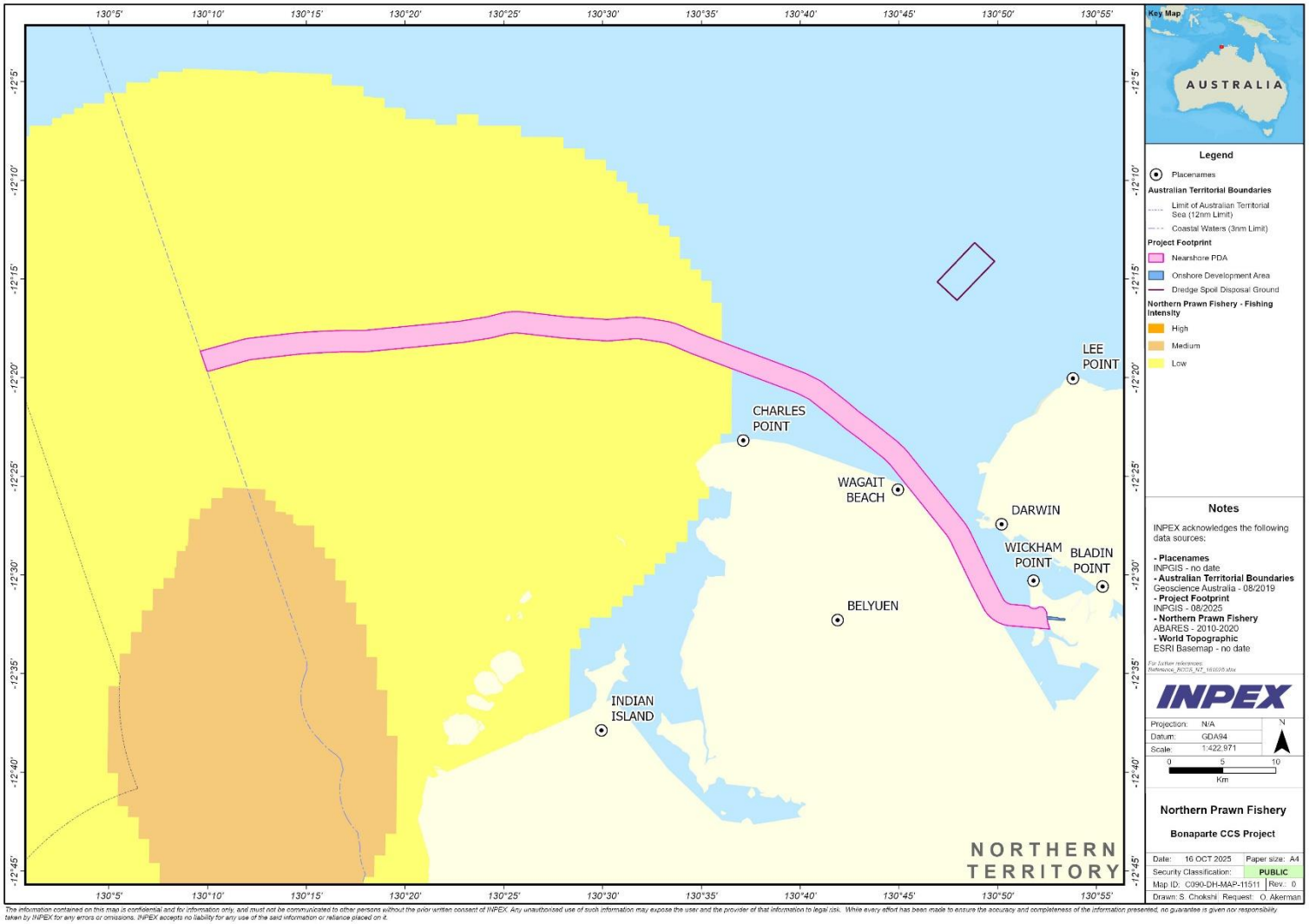


Figure 4-15: Northern Prawn Fishery fishing effort overlapping the nearshore PDA

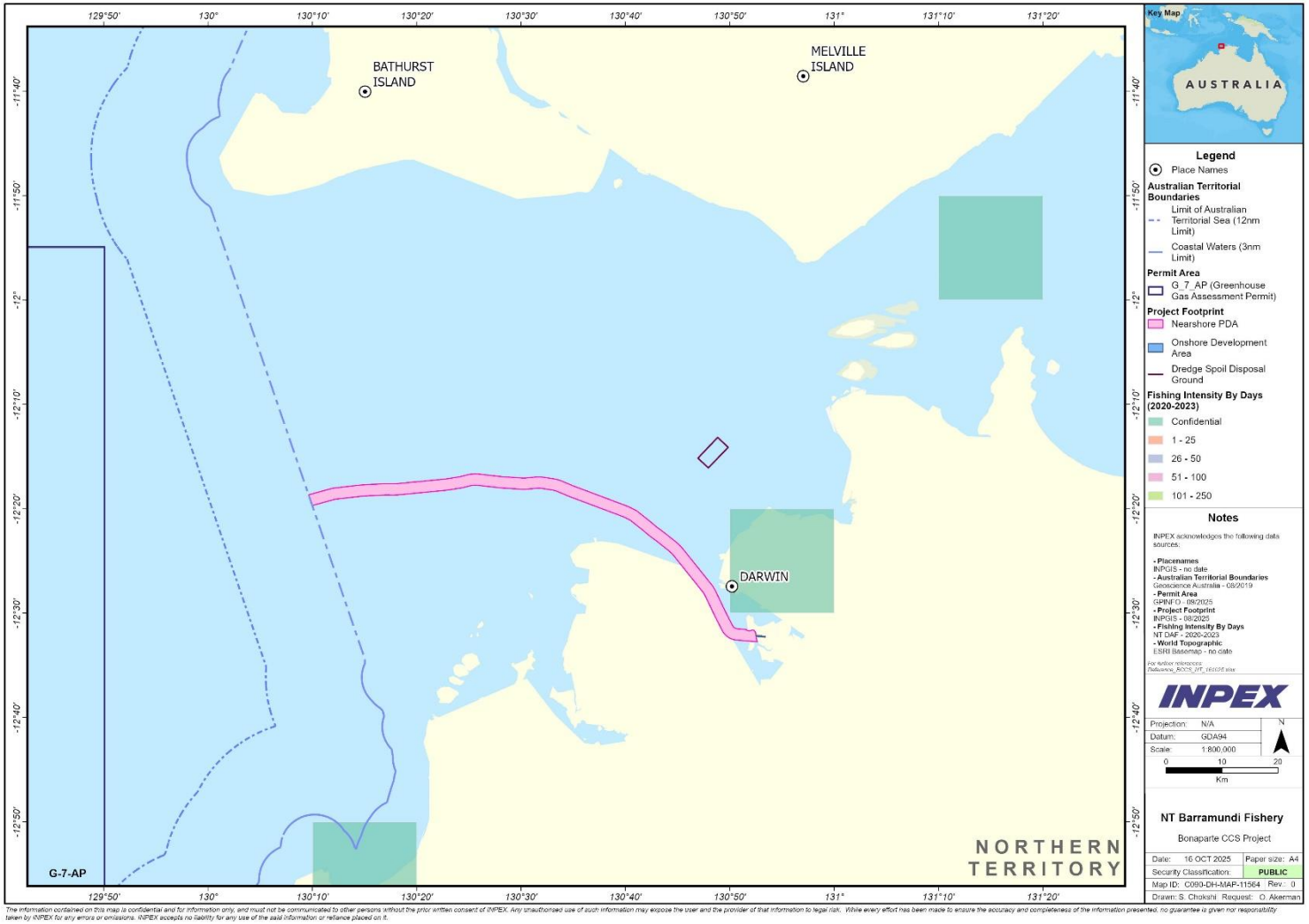


Figure 4-16: Northern Territory Barramundi Fishery fishing effort overlapping the Project area

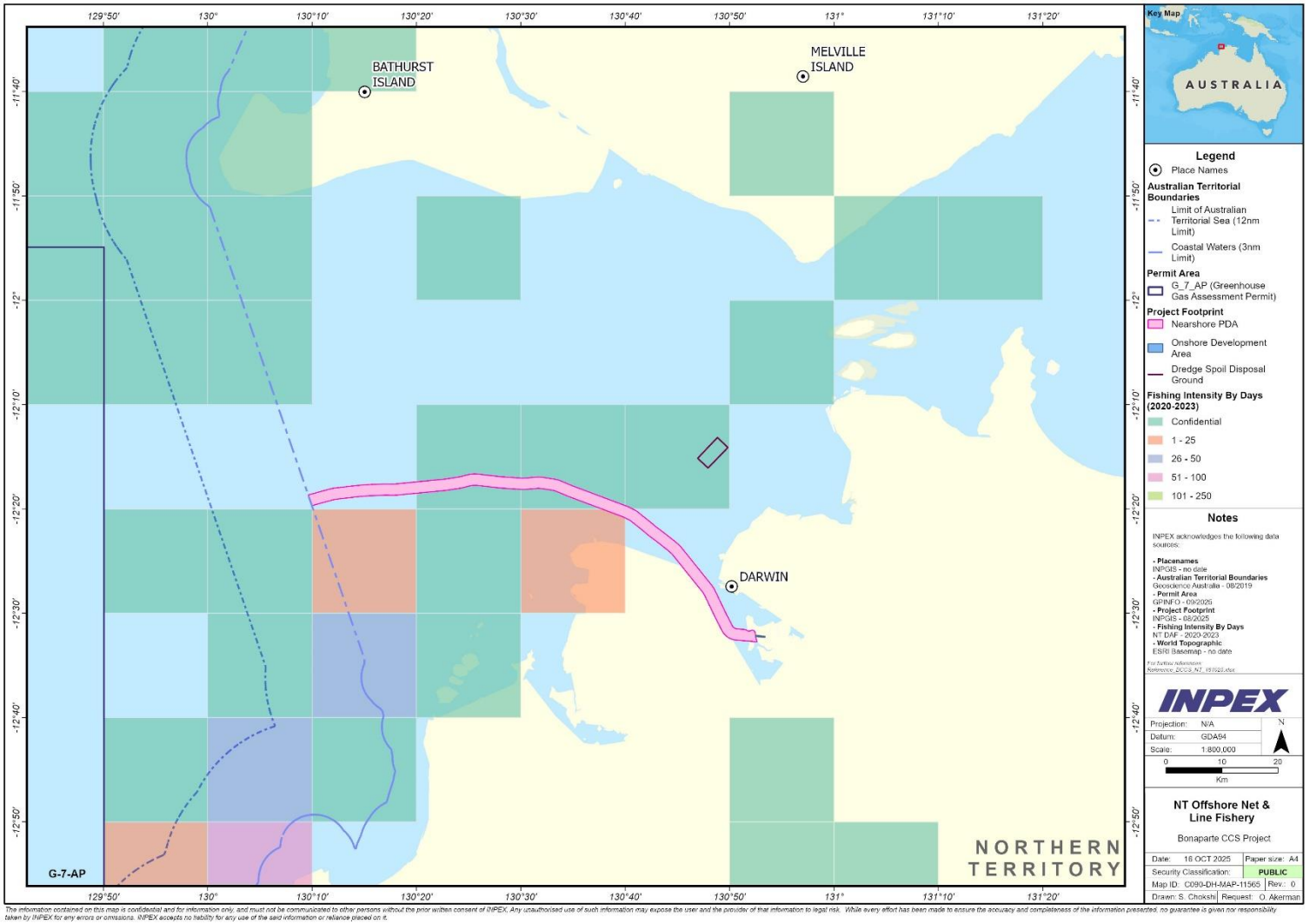


Figure 4-17: Northern Territory Offshore Net and Line Fishery fishing effort overlapping the Project area

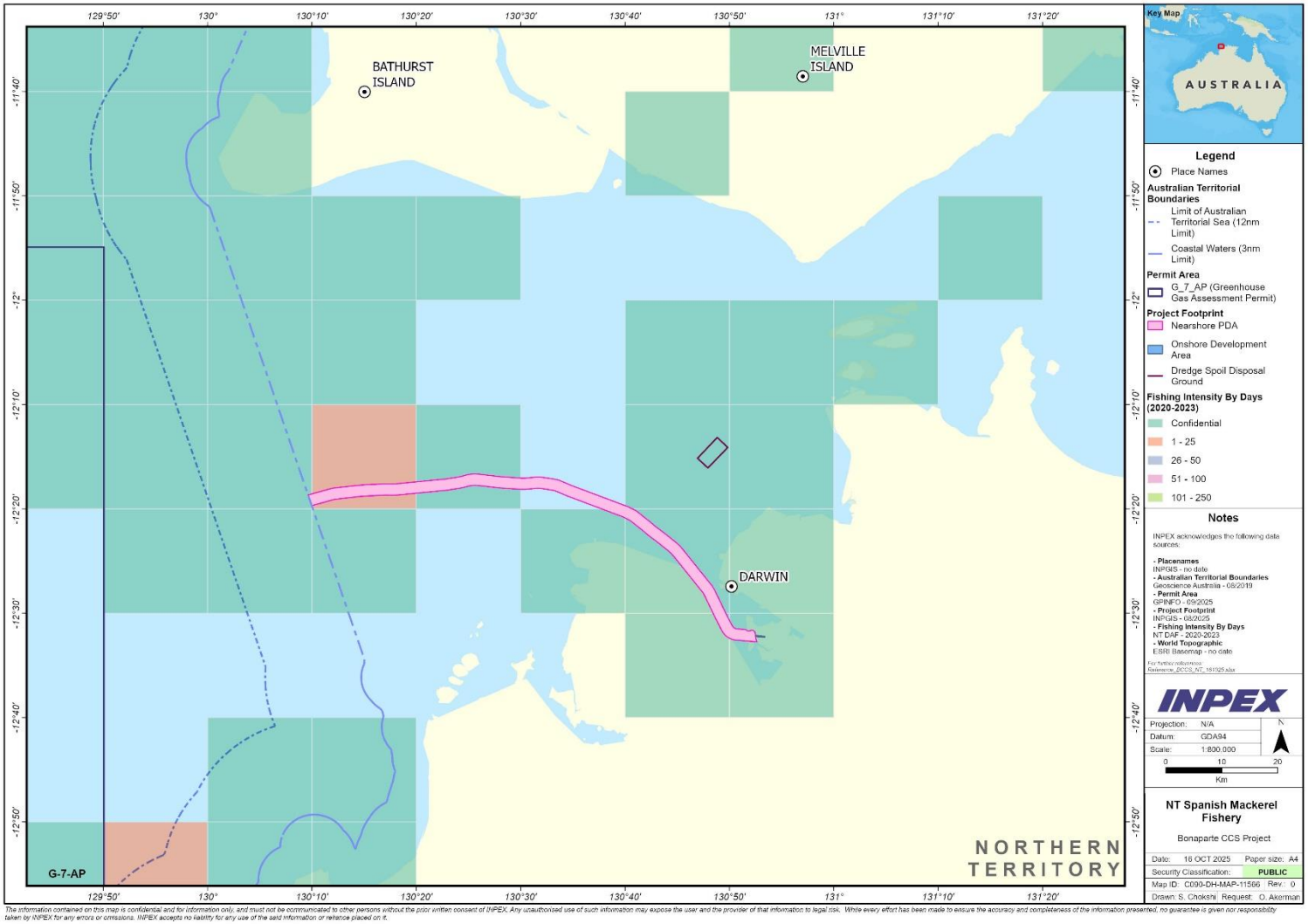


Figure 4-18: Northern Territory Spanish Mackerel Fishery fishing effort overlapping the Project area

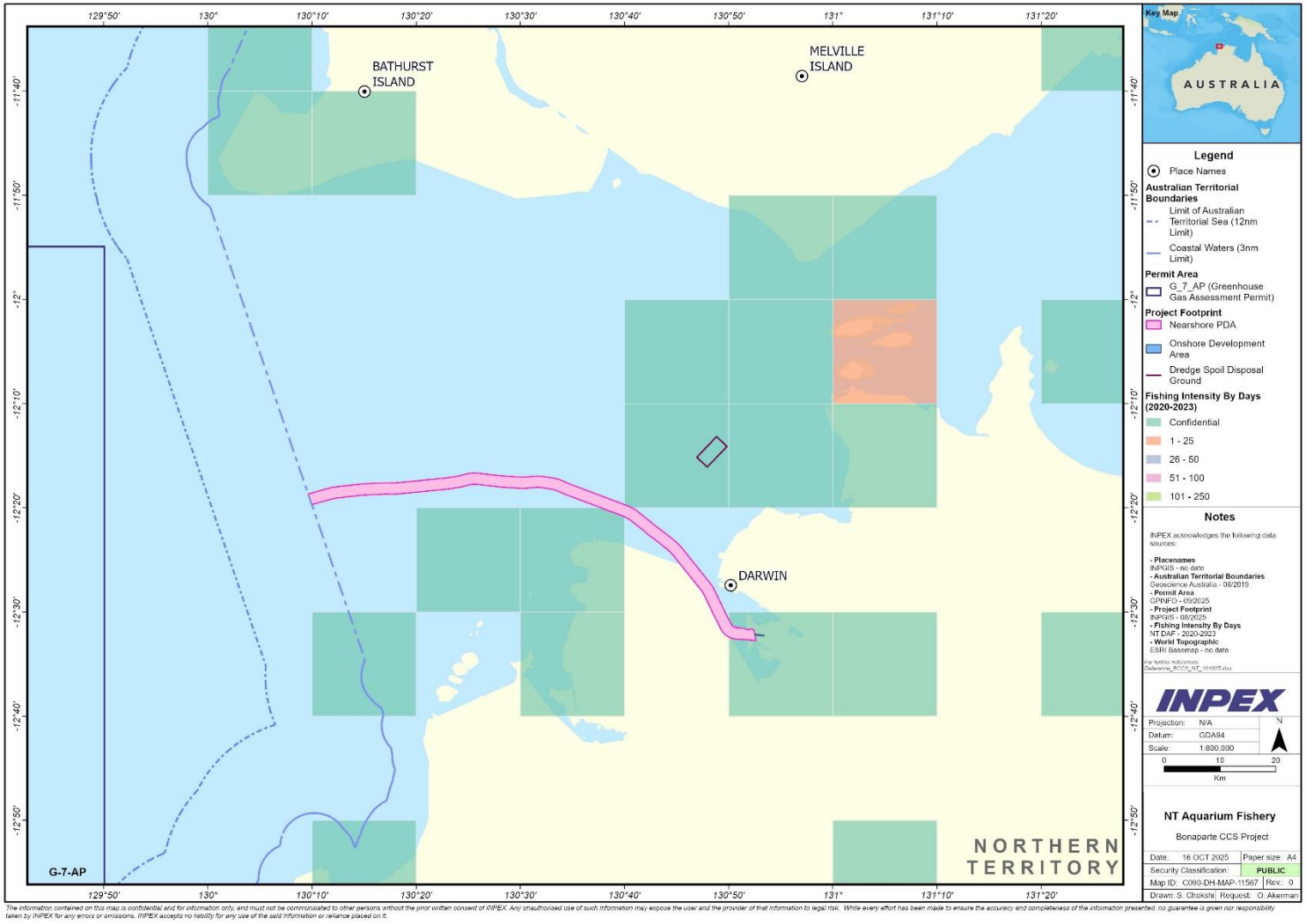


Figure 4-19: Northern Territory Aquarium Fishery fishing effort overlapping the Project area

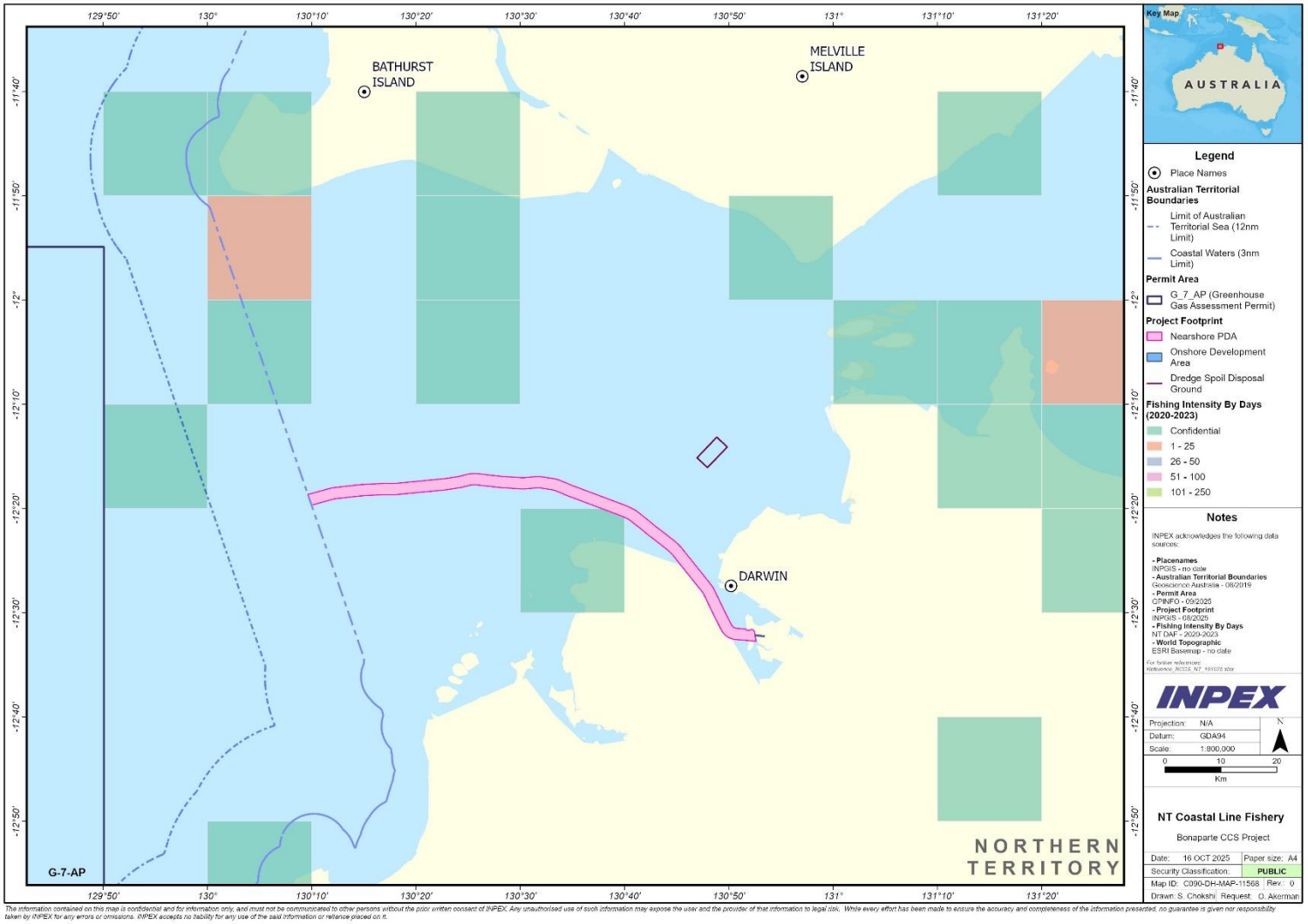


Figure 4-20: Northern Territory Coastal Line Fishery fishing effort overlapping the Project area

4.5.3 Defence areas and UXOs

The ODA does not overlap any defence areas or unexploded ordinance (UXO), however there are several defence training areas and bases in the Darwin area, including:

- Larrakeyah Barracks (9 km north-west of the ODA)
- Robertson Barracks (10 km north-east of the ODA)
- Naval base HMAS Coonawarra (9 km north-west of the ODA)
- Defence Establishment Berrimah (8 km north of the ODA)
- RAAF Base Darwin (11 km north of the ODA)

A search on National Map (DCA, 2021) was undertaken and identified that the nearshore PDA intersects the North Australian Exercise Area (NAXA) Defence Training Area (Figure 4-21). Two shipwrecks (USAT Mauna Loa and USAT Meigs, see Section 4.4.3) with known ordinance payloads exist within Darwin Harbour and are within close proximity to the proposed pipeline route. Due to the number undiscovered wrecks that may exist within Darwin Harbour and the extensive bombing of Darwin which occurred during World War II, there is the potential for undiscovered UXOs to exist throughout the nearshore PDA.

Australian Border Force and Australian Defence Force vessels undertake civil and maritime surveillance within the region with the primary purpose of monitoring the passage of illegal entry vessels and illegal fishing activity within these areas.

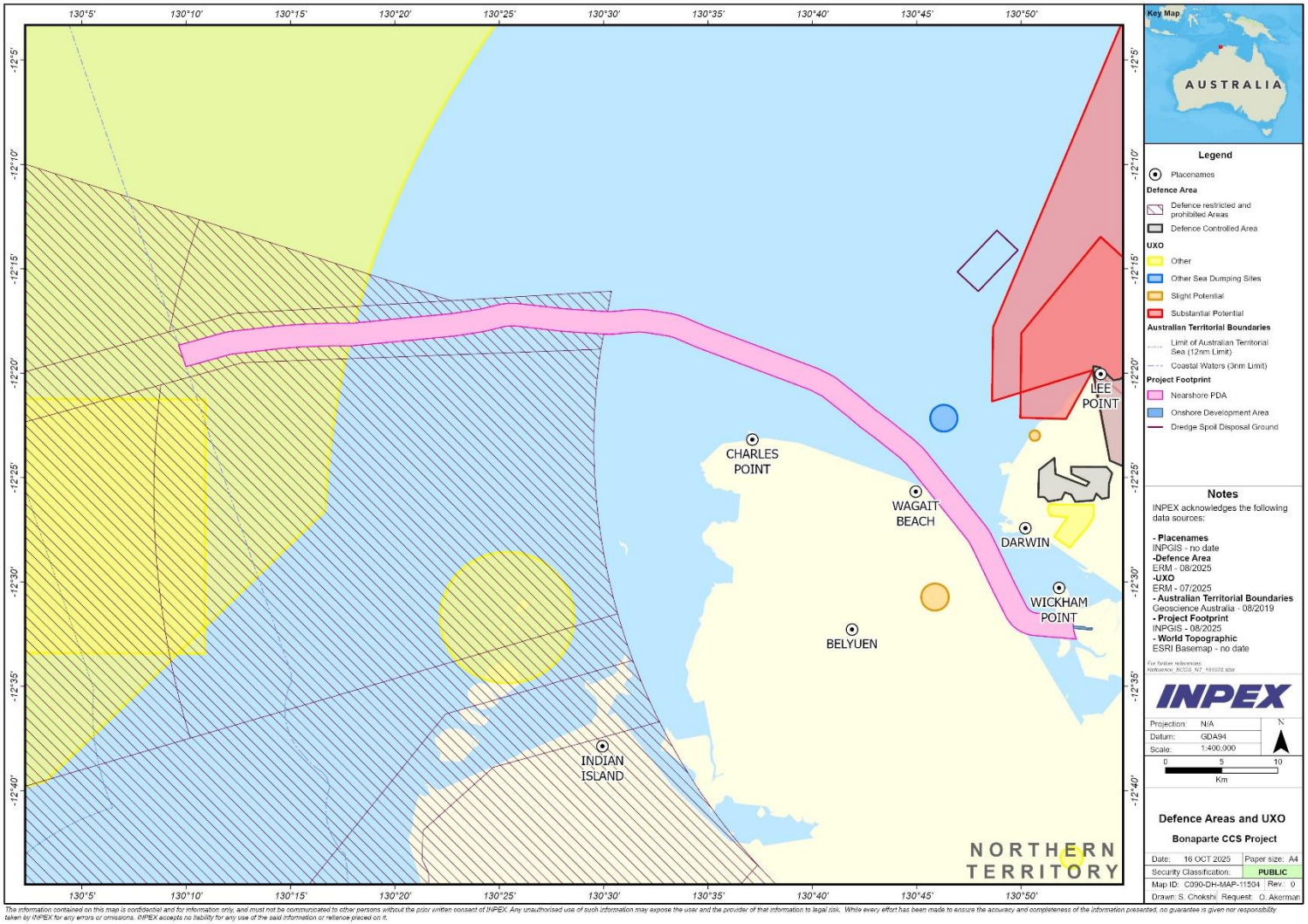


Figure 4-21: Defence prohibited areas, defence practice areas and potential UXO overlapping or in proximity to Project area

4.5.4 Shipping

Vessel traffic data from the AMSA Marine Traffic Database (AMSA 2025) for the Project area from January to May 2025 is shown in Figure 4-22, which shows the Project area intersects areas of high shipping traffic.

The Port of Darwin recorded 2,440 vessel visits in 2023 to 2024 (Darwin Port Authority, 2024) with traffic in the Port typically influenced by number of the well-established industrial and commercial facilities that receive a wide range of maritime traffic.

Although Darwin Port remains the primary active port in the region, there is small-scale port activity at the Tiwi Islands. Port Melville is located on Melville Island (122 km north of Darwin) and the wharf infrastructure at Port Melville was constructed in 2013.

The main supply bases for vessels supporting the petroleum activity are in Darwin. As all vessels have the potential to act as vectors for marine pests to Darwin Port, a brief description of the current and historical IMS status of this port is provided in the following sub-section.

Darwin Port

Darwin Port, located in Darwin Harbour in the Northern Territory, is a major service centre for the mining and energy sectors. Darwin Port operations consist of marine traffic of non-commercial vessels (e.g. recreational anglers) and trading vessels, including commercial ships carrying cargo and passengers, industry vessels such as supply vessels and anchor handling supply vessels, tankers and bulk-cargo vessels.

A number of targeted marine pest monitoring programs have been executed in Darwin Port since 2010 (Cardno and Golder Associates 2015, Golder Associates 2010), and through the course of these programs the following IMS have been detected; however, none of these are listed as noxious species by the NTG: *Magallana gigas* (presence of one shell valve) and *Caulerpa racemosa var. lamourouxii* (Golder Associates 2010), *Amphibalanus amphitrite* (barnacle), *Bugula neritina* (bryozoan) and the ascidians *Botryllus schlosseri*, *Botrylloides leachi* and *Didemnum perlucidum* (Cardno and Golder Associates 2015). While M. gigas was detected during a survey, as this was based on the presence of one shell valve, Golders Associates (2010) determined it was likely to be a discarded shell from oysters imported and purchased for human consumption and therefore its presence did not confirm this species had established in Darwin Port. *C. racemosa var. lamourouxii* is common in tropical and warm temperate seas and has previously been recorded in warmer waters in Australia including Darwin Harbour (Golders Associates 2010).

A marine pest monitoring program managed by Northern Territory Aquatic Biosecurity officers is currently ongoing. Artificial settlement units are located throughout Darwin Port, including on the INPEX ILNG and liquified petroleum gas jetties. These settlement units are photographed monthly and collected, replaced and analysed every four months.

In addition to monitoring program outcomes, in 1999 an outbreak of black stripped mussels was recorded in three Darwin Port marinas. Following, a national response to the outbreak this species was successfully eradicated from invaded locations (Ferguson 2000).

In summary, numerous IMS monitoring studies have been undertaken at Darwin Port with IMS identified. Therefore, Darwin Port is considered to be an operationally active environment rather than a pristine environment.

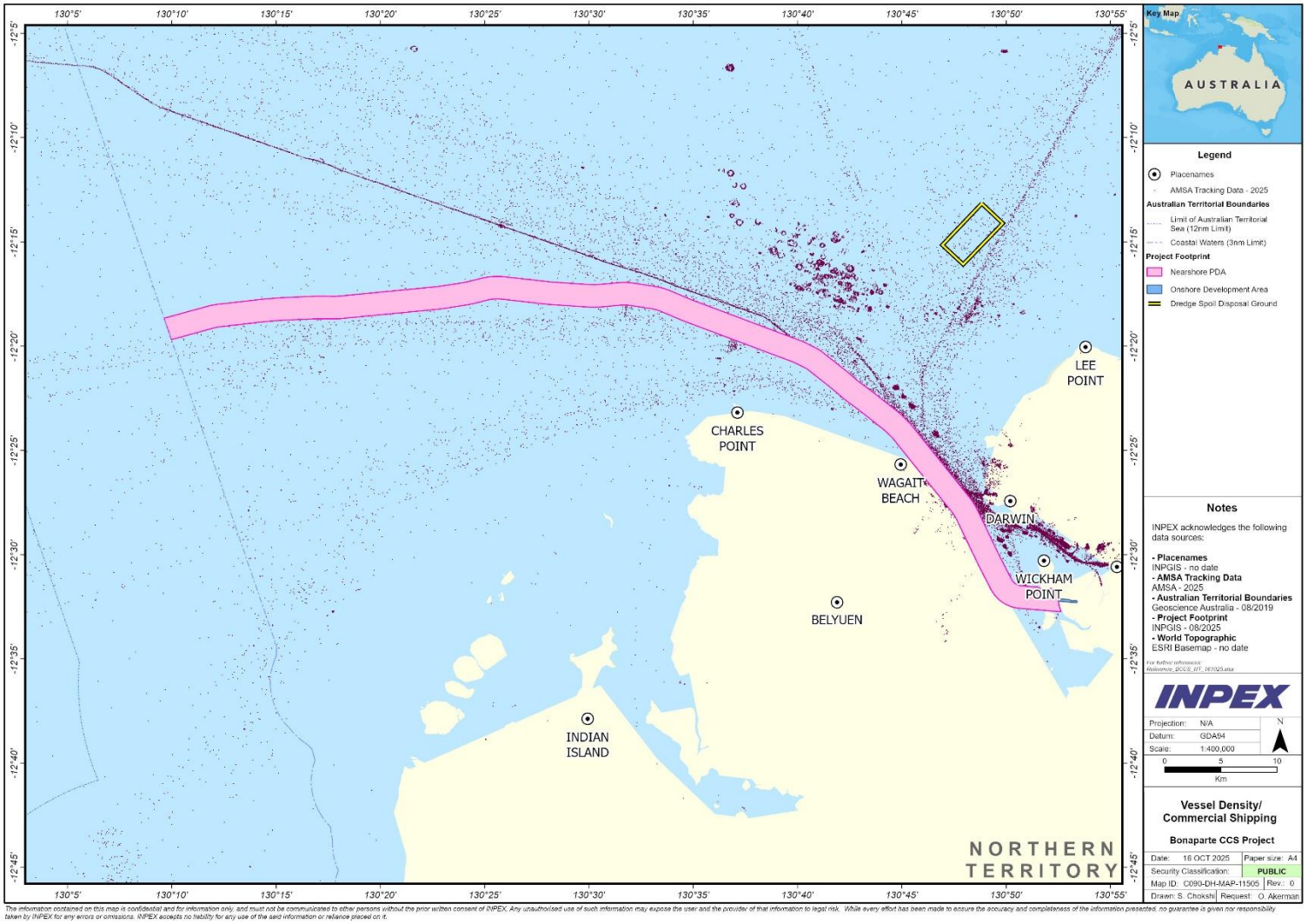


Figure 4-22: Vessel tracking data for the Project area (AMSA 2025)

4.5.5 Petroleum infrastructure

The INPEX Ichthys GEP, Bayu Undan GEP and Darwin pipeline duplication lie directly adjacent to the nearshore PDA within Darwin Harbour. The ODA is in proximity to existing industries on Middle Arm Peninsula, notably the Ichthys LNG and Darwin LNG plants and their associated infrastructure. Oil and gas infrastructure in proximity to the Project area are listed in Table 4-12.

Table 4-12: Oil and gas infrastructure in proximity to Project area

Facility/Asset	Type	Operator (s)	Distance from the Project area
Ichthys LNG	LNG Plant	Ichthys LNG Pty Ltd	4 km north-east of ODA
Ichthys GEP	Gas export pipeline	Ichthys LNG Pty Ltd	Directly adjacent to onshore and nearshore PDA
Bayu Undan	Gas export pipeline	Santos NA Darwin Pipeline Pty Ltd	Directly adjacent to nearshore PDA
Barossa	Gas export pipeline	Santos NA Barossa Pty Ltd	Directly adjacent to nearshore PDA (under construction)
Darwin LNG	LNG Plant	Santos	200 m north of nearshore PDA

4.5.6 Tourism and recreational activities

In addition to providing a base for major port operations in the Northern Territory, Darwin Harbour supports a range of commercial and recreational maritime uses, including fisheries, tourism and recreational shipping/boating activities. Fishing tourism is important to the Northern Territory's economy and there are several fishing clubs that utilise Darwin Harbour.

The water surrounding Middle Arm Peninsula is used for recreational fishing, sailing and general boating. However, tour boats in Darwin tend to avoid the Middle Arm because of navigational hazards in the shallow nearshore waters (URS 2002). Most recreational and tourism activities in the region occur predominantly in State/Territory waters adjacent to population centres, such as Darwin. Tourism in the region typically peaks during the dry season (May to October), which includes activities such as recreational fishing, diving, snorkelling, wildlife watching and boating (DEWHA 2008b). Fish species commonly targeted in Darwin Harbour by recreational fishers include snapper, mud crab, barramundi, small bait fish and some game fish. Boat ramps in proximity to the nearshore PDA include Channel Island, Palmerston and East Arm (Errity et al. 2022). Surveys over an eight-month period recorded up to a total of 56,370 hours of fishing effort in the Middle Arm "fishing region" and 44,509 hours in the East Arm "fishing region," consisting mostly of snapper and mullet (Errity et al. 2022).

4.5.7 Telecommunications

The North-West Cable System (NWCS) overlaps with approximately 11 km of the nearshore PDA within Darwin Harbour (Figure 4-23). The NWCS is a purpose-built, submarine fibre cable system designed to serve Australia's onshore and offshore resources industry. The NWCS has been providing connectivity (high-speed data and voice communication services) to INPEX's Ichthys facility since 2017 when the NWCS became operational.

An additional four subsea cables are proposed and may be located in proximity to the Project area: Project Waterworth, Hawaiki Nui 1, Bosun and the Asia Connect Cable System (TeleGeography 2025). As these cables are currently in the planning and development phases; appropriate consultation would be conducted for the Project as part of the next phase of the detailed EIA.

Figure 4-23: Telecommunication cables overlapping the Project area

5 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

The assessment for this report has been undertaken in accordance with the following guidance material:

- Environmental impact assessment (EIA) and environmental approval under the *Environment Protection Act 2019* (v.3, NT EPA 2025a)
- Referring a proposal to the Northern Territory EPA (v.3, NT EPA 2022)
- Northern Territory EPA Environmental factors and objectives (v.4, NT EPA 2025b)
- Guidelines for assessment of impacts on terrestrial biodiversity (v.2, NT EPA 2013a)
- Guidelines for the preparation of an economic and social impact assessment (v.2, NT EPA 2013b)
- Guidelines for the environmental assessment of marine dredging in the Northern Territory (v.2, NT EPA 2013c)
- Stakeholder Engagement and Consultation (NT EPA 2021)
- A Stormwater Strategy for the Darwin Harbour Region (NT EPA 2014)
- Prevent Pollution from Building Sites (NT EPA 2015).

The approach and methods used to develop this report included:

1. Desktop review of available information from existing reports and relevant databases, to provide a description of the existing environment relevant to the Project area, as presented in Section 4.
2. A likelihood of occurrence assessment for threatened and migratory species to verify the presence or absence of environmental values and sensitivities that have the potential to be significantly impacted by the proposal (detailed in Section 4.3.4 and Appendix B).
3. An environmental hazard identification (ENVID) workshop was held to identify and agree upon the potential environmental risks arising from construction, commissioning, operation and decommissioning of the Project. Environmental risks were assessed in accordance with the INPEX Environmental Policy, as described in Section 5.3.
4. Potential environmental impacts were screened against the 14 Northern Territory EPA Environmental Factors outlined in the Northern Territory EPA Environmental factors and objectives (NT EPA 2025b), as presented in Section 6 and Appendix C.
5. Preliminary assessment of the potential impacts of the proposal and the significance of the impacts with regard to the Northern Territory EPA objectives for each environmental factor, as presented in Section 6.
6. The potential for significant impacts on Matters of National Environmental Significance (MNES) protected under the EPBC Act, were also assessed, and a summary is presented in Section 7.
7. A proposed program of investigations and consultation was developed, as presented in Section 8.

5.1 Desktop review

A desktop review was conducted to inform the description of the existing environment in and around the Project area, and was informed by the following publicly available data sources:

- species recovery plans, conservation management plans and threatened species scientific committee (TSSC) approved conservation advice
- peer reviewed scientific papers
- previous environmental studies within or in proximity to the Project area, including INPEX technical reports relevant to the footprint area
- publications and resources from relevant organisations, including:
- Australian Fisheries Management Authority (AFMA)
- Geoscience Australia
- Birdlife Australia
- databases, including:
- Seamap Australia
- Australasian Underwater Cultural Heritage (AUCHD)
- Protected Matters Search Tool (PMST) (DCCEEW 2025a)
- Species Profile and Threats Database (DCCEEW).
- Atlas of Living Australia (ALA)
- Flora Atlas – Nature Resources (NR) Maps
- Fauna Atlas – NR Maps.

The 2025 EPA draft guidelines for the assessment of impacts on terrestrial biodiversity (NT EPA 2025c), recommend a desktop review search radius of 20 km outside the proposal area, even where extensive field studies have already been undertaken.

Therefore, a conservative 20 km buffer was applied to the PMST for the Project areas within this referral to ensure alignment with the draft guidelines.

In addition, existing INPEX commissioned studies and reports have been used to inform the assessment:

- EcOZ: Bladin Point Pipeline Corridor – Ecology Survey Report 2023
- Earth Sea Heritage Surveys: INPEX Cultural Heritage Desktop Study: Carbon Capture and Storage Pipeline Project, 2024
- Ichthys Gas Field Development Project Draft EIS, including Appendix 16 – Onshore flora and fauna study.

5.2 Likelihood of occurrence assessment

The likelihood of occurrence was assessed for threatened and migratory species identified from the PMST report to further identify those that could potentially interact with Project infrastructure or activities within the Project area. For this assessment, the Project area was divided into the onshore development area (ODA) and pipeline development area (PDA) (Section 3).

The assessment identified key habitats that support resident and migratory species within the Project area and matched the habitat requirements and reported occurrence for each species based on the following sources of information:

- PMST report
- Altas of Living Australia (ALA)
- publicly available peer-reviewed literature

- conservation advice and recovery plans via DCCEEW species profile and threats (SPRAT) database
- Northern Territory Parks and Wildlife Conservation (TPWC) Act species status
- existing Project related technical reports.
- The primary source of information was the PMST, which has a varied granularity in terms of cell sizes overlapping the Project area. These can be considered as buffer areas from the project boundary, including:
- 1 km cell resolution: coastal areas including Middle Arm, Darwin Harbour and <30 km from the coast
- 32 km cell resolution: offshore areas >30 km from the coast.

The following criteria was used to define the likelihood of occurrence for each species based on the above searches:

- **Known to occur** – species that have been reported to occur based on ALA records or actual surveys within the Project area in the last 30 years.
- **Likely to occur** – species that have not been reported to occur in the Project area but known to occur within the local area (within 20 km of Project area) based on nearby Biologically Important Area's (BIA) and/or important habitat requirements (e.g. breeding, foraging, roosting) within the species known distribution.
- **May occur** – species that have not been reported to occur in the Project area, have a broader distribution, utilise a variety of habitats across the region and may transit the Project area.
- **Unlikely to occur** – species that have not been reported to occur in the Project area and not likely to occur within the Project area due to the lack of suitable habitat and their known distribution does not overlap with the Project area.

The species taken through to the preliminary assessment of potential impacts in Section 6 are those species that are known to occur or considered likely to occur or may occur as summarised in Section 4.3.4 of this referral.

5.3 Environmental risk assessment

A systematic risk assessment process has been adopted for the environmental management of construction, commissioning and operating activities. The risk assessment process has been developed in line with Australian Standard AS/NZS ISO 31000:2018, risk management principles and guidelines.

This process aligns with INPEX's Environmental Policy, which requires the identification of environmental hazards and risks associated with our business, and management of these to levels that are ALARP.

An environmental aspect register was generated as a result of a project wide environmental hazard identification and risk assessment workshop. The workshop involved environmental, compliance, health, safety, emergency response, drilling and engineering personnel.

The following sections provide an overview of the risk assessment process.

5.3.1 Risk assessment process

For the purposes of the risk assessment, an environmental aspect is defined as a feature or characteristic of the proposed Project activities that has the potential to affect the environment. Following the identification of activities, which could result in a particular environmental aspect, the potential environmental impacts associated with each aspect were identified. For each source of environmental risk, control measures were then identified for evaluation. Where the level of risk reduction achieved by these control measures was determined to be grossly disproportionate to the "cost" of implementing them, the control measure was not included, and the risk was considered to be managed to ALARP.

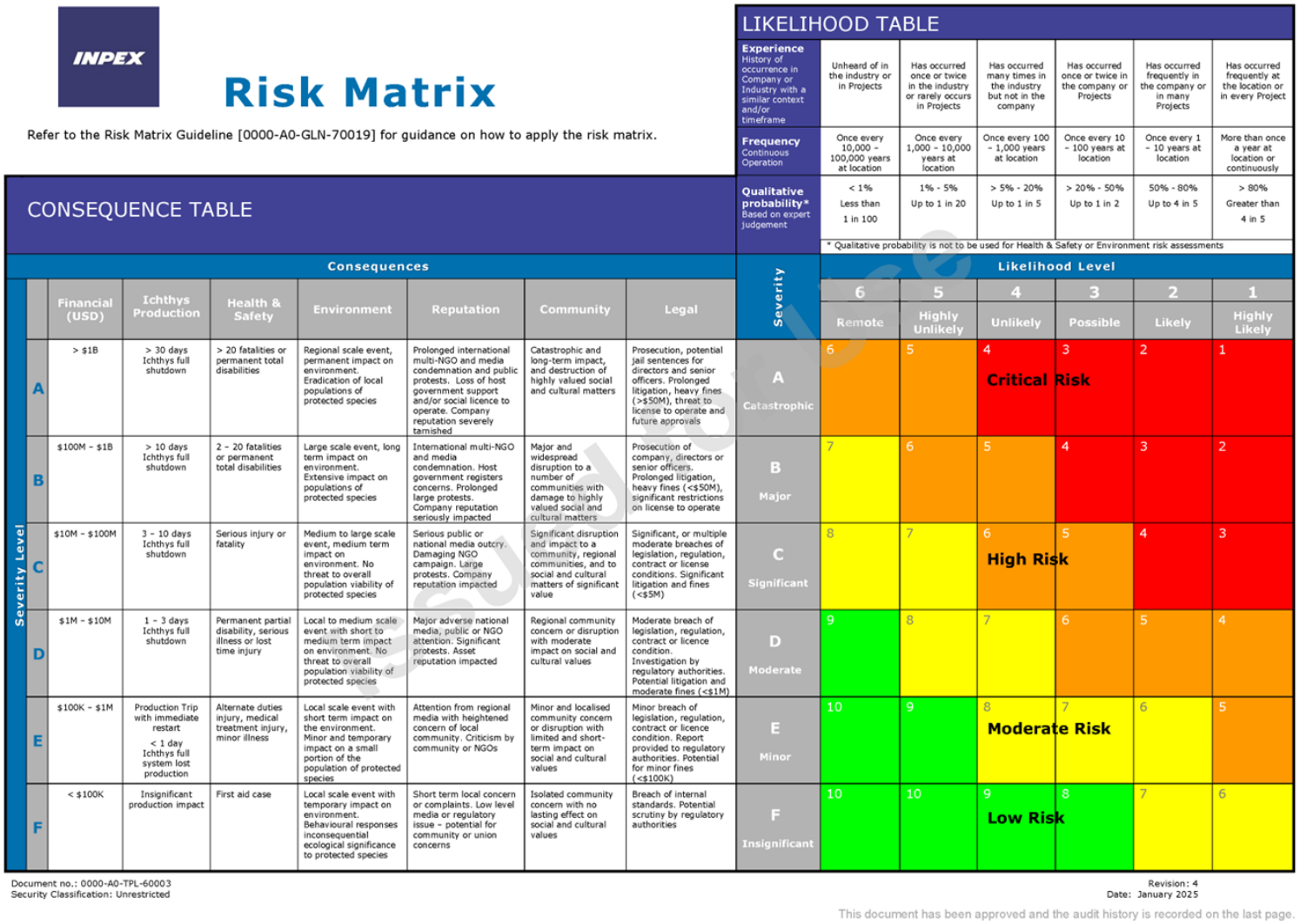
The consequence and likelihood of each impact was then assessed to determine the residual risk that remained after controls to be implemented were taken into consideration.

The consequence is defined as an outcome or impact from an event occurring. For the purposes of the assessment, the consequence level applied was based on the credible worst-case scenario and assumed no control measures were in place.

The likelihood can be described as the level of probability that, or the frequency with which, the described consequence would impact upon the environment. When determining the likelihood of a consequence occurring, any proposed control measures identified to mitigate the potential impact were taken into account.

The risk matrix used to determine the risk of impact from the Project is provided in Figure 5-1.

The outcomes of the risk assessment as they relate to Northern Territory EPA environmental factors and values and cumulative impacts, are presented in Section 6.



INPEX

Risk Matrix

Refer to the Risk Matrix Guideline [0000-A0-GLN-70019] for guidance on how to apply the risk matrix.

CONSEQUENCE TABLE

Severity Level	Financial (USD)	Ichthys Production	Health & Safety	Environment	Reputation	Community	Legal
A	> $1B	> 30 days Ichthys full shutdown	> 20 fatalities or permanent total disabilities	Regional scale event, permanent impact on environment. Eradication of local populations of protected species	Prolonged international multi-NGO and media condemnation and public protests. Loss of host government support and/or social licence to operate. Company reputation severely tarnished	Catastrophic and long-term impact, and destruction of highly valued social and cultural matters	Prosecution, potential jail sentences for directors and senior officers. Prolonged litigation, heavy fines (>$50M), threat to license to operate and future approvals
B	$100M - $1B	> 10 days Ichthys full shutdown	2 - 20 fatalities or permanent total disabilities	Large scale event, long term impact on environment. Extensive impact on populations of protected species	International multi-NGO and media condemnation. Host government registers concerns. Prolonged large protests. Company reputation seriously impacted	Major and widespread disruption to a number of communities with damage to highly valued social and cultural matters	Prosecution of company, directors or senior officers. Prolonged litigation, heavy fines (<$50M), significant restrictions on license to operate
C	$10M - $100M	3 - 10 days Ichthys full shutdown	Serious injury or fatality	Medium to large scale event, medium term impact on environment. No threat to overall population viability of protected species	Serious public or national media outcry. Damaging NGO campaign. Large protests. Company reputation impacted	Significant disruption and impact to a community, regional communities, and to social and cultural matters of significant value	Significant, or multiple moderate breaches of legislation, regulation, contract or license conditions. Significant litigation and fines (<$5M)
D	$1M - $10M	1 - 3 days Ichthys full shutdown	Permanent partial disability, serious illness or lost time injury	Local to medium scale event with short to medium term impact on environment. No threat to overall population viability of protected species	Major adverse national media, public or NGO attention. Significant protests. Asset reputation impacted	Regional community concern or disruption with moderate impact on social and cultural values	Moderate breach of legislation, regulation, contract or licence condition. Investigation by regulatory authorities. Potential litigation and moderate fines (<$1M)
E	$100K - $1M	Production Trip with immediate restart < 1 day Ichthys full system lost production	Alternate duties injury, medical treatment injury, minor illness	Local scale event with short term impact on the environment. Minor and temporary impact on a small portion of the population of protected species	Attention from regional media with heightened concern of local community. Criticism by community or NGOs	Minor and localised community concern or disruption with limited and short-term impact on social and cultural values	Minor breach of legislation, regulation, contract or licence condition. Report provided to regulatory authorities. Potential for minor fines (<$100K)
F	< $100K	Insignificant production impact	First aid case	Local scale event with temporary impact on environment. Behavioural responses inconsequential ecological significance to protected species	Short term local concern or complaints. Low level media or regulatory issue - potential for community or union concerns	Isolated community concern with no lasting effect on social and cultural values	Breach of internal standards. Potential scrutiny by regulatory authorities

LIKELIHOOD TABLE

Experience History of occurrence in Company or Industry with a similar context and/or timeframe	Unheard of in the industry or in Projects	Has occurred once or twice in the industry or rarely occurs in Projects	Has occurred many times in the industry but not in the company	Has occurred once or twice in the company or Projects	Has occurred frequently in the company or in many Projects	Has occurred frequently at the location or in every Project
Frequency Continuous Operation	Once every 10,000 - 100,000 years at location	Once every 1,000 - 10,000 years at location	Once every 100 - 1,000 years at location	Once every 10 - 100 years at location	Once every 1 - 10 years at location	More than once a year at location or continuously
Qualitative probability* Based on expert judgement	< 1% Less than 1 in 100	1% - 5% Up to 1 in 20	> 5% - 20% Up to 1 in 5	> 20% - 50% Up to 1 in 2	50% - 80% Up to 4 in 5	> 80% Greater than 4 in 5

* Qualitative probability is not to be used for Health & Safety or Environment risk assessments

Severity	Likelihood Level 6 Remote	5 Highly Unlikely	4 Unlikely	3 Possible	2 Likely	1 Highly Likely
A Catastrophic	6	5	4 **Critical Risk**	3	2	1
B Major	7	6	5	4	3	2
C Significant	8	7	6 **High Risk**	5	4	3
D Moderate	9	8	7	6	5	4
E Minor	10	9	8 **Moderate Risk**	7	6	5
F Insignificant	10	10	9 **Low Risk**	8	7	6

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Figure 5-1: INPEX risk matrix

5.4 Preliminary assessment

The preliminary impact assessment discussed in Section 6 included the following steps:

- Screening of project activities and potential impacts against the Northern Territory's environmental objectives, consistent with Northern Territory EPA Environmental factors and objectives (NT EPA 2025b).
- Identification of potential impacts and key mitigation measures – potential impacts associated with Project activities during all project stages are identified and summarised, and key mitigations are included. Potential impacts to environmental values, associated mitigation methods and risk assessment outcomes resulting from the Project activities were evaluated using the INPEX risk assessment process (Section 5.3).
- Preliminary assessment of potential impacts on Northern Territory environmental factors against the Northern Territory's environmental objectives, consistent with Northern Territory EPA Environmental factors and objectives (NT EPA 2025b).

5.5 Proposed program of investigations

A proposed program of investigations to be undertaken to improve understanding of the baseline environmental conditions, as well as impact assessment studies, is provided in Section 8. The outcomes of these studies would inform a more detailed EIA and identify the specific mitigation and monitoring that would be required to manage impacts from the Project.

6 NT EPA ENVIRONMENTAL FACTORS AND VALUES ASSESSMENT

The Northern Territory EPA has identified 14 environmental factors categorised under five themes of Land, Water, Sea, Air and People. These environmental factors are broad divisions of the environment that may be impacted by a proposed action and provide for a systematic approach for organising information for the purpose of environmental impact assessment (Northern Territory EPA 2021a).

The following sections provide the outcomes of the preliminary assessment of potential impacts Project activities may have on NT EPA environmental factors and values.

6.1 Outcomes of preliminary assessment

To determine if the proposal could impact on any environmental factors identified by the Northern Territory EPA, a preliminary screening (Refer to Table 6-1 and Appendix C) and assessment was undertaken. This assessment was informed by information presented in Section 4 on the existing environment. Outcomes of the preliminary assessment are presented in the following sections.

In summary, the preliminary assessment found that the proposal has the potential for significant impacts on the following environmental factors:

- land – Terrestrial Environmental Quality
- land – Terrestrial Ecosystems
- sea – Coastal Processes
- sea – Marine Environmental Quality
- sea – Marine Ecosystems
- air – Air Quality
- people – Community and economy
- people – Cultural and heritage; and
- people - Human health.

A detailed assessment of the potential impacts and their significance, and proposed controls to manage and mitigate these is provided in the following sub-sections.

Table 6-1: Screening and assessment overview against Northern Territory EPA environmental factors and objectives

Factor	Objective	Potential to be impacted (Yes/No/Uncertain/Not applicable)	Rationale
Land			
Landforms	Conserve the variety and integrity of distinctive physical landforms	N/A	The Project will not impact on the integrity of existing terrestrial landforms. The Project disturbance footprint is mostly located in previously disturbed areas or co-located with existing infrastructure within land designated for Utilities and Development. Therefore, this EPA environmental factor is not considered relevant and is not considered further in this referral.
Terrestrial environmental quality	Protect the quality and integrity of land and soils so that environmental values are supported and maintained	Yes	The Project is not anticipated to significantly impact on the quality and integrity of terrestrial land and soils. Most of the Project footprint was previously cleared of vegetation during the construction of Ichthys GEP, which was approved as part of the Ichthys LNG Development Project. However potential acid sulphate soils (PASS) or ASS are known to exist in the Project area. Further details on potential impacts and management are provided in Section 6.1.4.
Terrestrial ecosystems	Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning	Yes	Construction activities are mostly limited to the previously disturbed envelope for the GEP on land zoned for Development and for Utilities (within land parcel 1896). The ODA crosses mangrove communities, Melaleuca forest and Monsoon Vine Forest. Native vegetation removal is likely to be required. Further details on potential impacts and management are provided in Section 6.1.5.
Water			
Hydrological processes	Protect the hydrological regimes of groundwater and surface water so that environmental including ecological health, land uses and the welfare and amenity of people are maintained	No	The proposed action is not anticipated to significantly impact on hydrological regimes of groundwater or surface water, as no freshwater surface water or groundwater features, are identified in or downstream of the proposed development footprint. The surface water runoff and groundwater aquifer underlying the proposed development footprint has the potential to interact with marine ecosystems, see assessment statement for the Factors under Theme – Sea. Therefore, this EPA environmental factor is not considered further in this referral.
Inland water environmental quality	Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained	No	The proposed action is not anticipated to impact on the quality of groundwater or surface water, as no freshwater surface water or groundwater features, are identified in or downstream of the proposed development footprint. The surface water runoff and groundwater aquifer underlying the proposed development footprint has the potential to interact with marine ecosystems. Therefore, this EPA environmental factor is not considered further in this referral.
Aquatic ecosystems	Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning	No	The proposed action is not anticipated to impact on freshwater aquatic ecosystems as no freshwater aquatic ecosystems are present within or downstream of the proposed development footprint. Therefore, this EPA environmental factor is not considered further in this referral.
Sea			
Coastal processes	Protect the geophysical and hydrological processes that shape coastal morphology so that the environmental values of the coast are maintained	Uncertain	There is a potential for the shoreline crossing activities and chosen infrastructure to impact hydrodynamics. As the majority of the proposed activity is within the previous disturbance corridor for the GEP, including the previous shoreline crossing, the proposed action is not expected to impact on geophysical and hydrological processes that shape coastal morphology. Further details on potential impacts and management are provided in Section 6.1.1.

Factor	Objective	Potential to be impacted (Yes/No/Uncertain/Not applicable)	Rationale
Marine environmental quality	Protect the quality and productivity of water, sediment and biota so that environmental values are maintained	Yes	Proposed project shoreline crossing and nearshore activities have the potential to impact quality and productivity of water, sediment and biota. Further details on potential impacts and management are provided in Section 6.1.2
Marine ecosystems	Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning	Yes	Proposed project shoreline crossing and nearshore activities could interact with marine habitats and environmental values. Further details on potential impacts and management are provided in Section 6.1.3
Air			
Air quality	Protect air quality and minimise emissions and their impact so that environmental values are maintained	Yes	The proposed action may have a temporary impact on air quality in within the Project area and the surrounds. Construction air emissions such as dust and equipment/vehicle exhaust are not predicted to be significant and are readily manageable. Dust will be generated during onshore stockpiling and marine loadout of rock for placement on the pipeline. Standard dust control management measures will be implemented. Air emissions within Darwin Harbour and Offshore Northern Territory waters will be caused predominately by vessels, more specifically from engine exhausts. Any emissions as a result of vessel operations will be temporary and highly localised. Further details on potential impacts and management are provided in Section 6.1.6.
Atmospheric processes	Minimise greenhouse gas emissions so as to contribute to the Northern Territory Government's goal of achieving net zero greenhouse gas emissions by 2050	No	The proposed action is not anticipated to contribute significantly to greenhouse gas emissions in the Northern Territory. Greenhouse gas emissions associated with the activity are limited to the operation of a construction machinery and any crew support vessel/s. Any emissions as a result of vessel operations and/ or construction machinery will be temporary and highly localised. Other potential GHG emissions relate to pre-commissioning and commissioning activities, are considered to be incidental, relatively small scale and short term. The Project is considered to support a net reduction in greenhouse gas emissions in the Northern Territory. Therefore, this EPA environmental factor is not considered further in this referral.
People			
Community and economy	Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians	Yes	The Project may impact communities and the economy through planned activities like physical presence, noise, and air emissions, as well as unplanned events such as waste management issues, unplanned discharges and introduced marine species. Affected local values include recreational and commercial fishing, aquaculture, charter boat operations and other port activities. These values could be directly impacted via Project activities (e.g., physical presence of vessels and infrastructure) or indirectly impacted as a result of the Project activities impacting other environmental values, including seabed disturbance (e.g., trenching and dredging), pipelay activities, noise emissions and unplanned activities (e.g., spills, introduction of invasive marine species, fauna interaction, etc.). Further details on potential impacts and management are provided in Section 6.1.7.
Culture and heritage	Protect culture and heritage	Uncertain	The proposed action is not anticipated to significantly impact culture and heritage. Middle Arm Peninsula is located within the traditional country of the Larrakia people. There are no known cultural or heritage sites (including sacred sites) within the Project area. Construction activities would largely occur within an existing pipeline corridor. Potential impacts to unknown cultural heritage places, if encountered, would be managed in line with best practice and applicable regulations and guidelines. Further details on potential impacts and management are provided in Section 6.1.8.

Factor	Objective	Potential to be impacted (Yes/No/Uncertain/Not applicable)	Rationale
Human health	Protect the health of the Northern Territory population	Uncertain	A potential CO_2 transport pipeline leak or rupture (subsea or onshore) and potential discharge of CO_2 from a leak or rupture at the onshore inlet station have the potential to impact on human health if not managed appropriately For a pipeline CO_2 leak with release to the atmosphere or an onshore leak, impacts may occur from the resultant atmospheric plume. If the leak is occurring along the transport pipeline in the nearshore environment, as CO_2 is denser than air, it could quickly displace oxygen, leading to potential number of direct human health impacts. Further details on potential impacts and management are provided in Section 6.1.9.

6.1.1 Sea – Coastal processes

NT EPA environmental objective:
Protect the geophysical and hydrological processes that shape coastal morphology so that the environmental values of the coast are maintained.

Relevant policy and guidelines

The following key conventions, legislation, policy and guidelines are relevant:

- The Coastal and Marine Management Strategy 2019 to 2029
- Darwin Harbour Regional Plan of Management
- National Assessment Guidelines for Dredging (NAGD; Commonwealth of Australia 2009)
- Guidelines for Environmental Assessment of Marine Dredging in the Northern Territory (Northern Territory EPA 2013)
- Darwin Harbour Strategy 2020 to 2025 (Darwin Harbour Advisory Committee 2020).

Environmental context

The physical and biological marine and coastal environment are described in Sections 4.2 and 4.3. Relevant environmental values in the Project area include mangrove ecosystems and coastal morphology. Coastal processes in Darwin Harbour include wave action, tidal action, longshore drift, cyclones, surface water drainage and sea level rise.

Potential impacts

The following activities have the potential to impact on coastal geophysical and hydrological processes through seabed disturbance and physical presence of infrastructure if not managed appropriately:

- Construction works for the shoreline crossing.
- Dredging within Darwin Harbour and spoil disposal activities at existing spoil grounds in Beagle Gulf.
- Pipeline and cable installation activities, including trenching, backfill and rock armouring.
- Pre-lay span rectification, foundation installation and cable crossings.
- Physical presence of the pipeline.

The potential impacts associated with these activities include:

- Temporary changes in hydrodynamic processes resulting in impacts to intertidal mangrove areas.
- Temporary changes in hydrodynamic processes resulting in impacts from increased erosion and sedimentation affecting coastal and benthic habitats.

Seabed disturbance

Construction activities for the CO_2 transport pipeline/ SPFO cable would require seabed disturbance for trenching, dredging, site preparation, backfill and rock armouring. The open trench excavation design for the shoreline crossing would modify the current shoreline. These changes to the existing conditions have the potential to change the existing local hydrodynamic conditions. Hydrodynamic modelling was previously undertaken for the Ichthys Gas Field Development Project EIS (2010) in relation to potential changes to hydrodynamic processes as a result of pipeline installation and dredging activities (among other activities such as the influences of dredging navigation channels and shipping berths).

The modelling study predicted no significant changes in wave energy or direction beyond the dredging footprint, with no indication of any increase in bank erosion or sediment transport within East Arm. While the study focused on activities within East Arm, it assessed activities with a much higher potential for impacts on coastal processes than the current Project.

Santos recently assessed impacts on coastal processes for the nearby Santos Darwin Pipeline Duplication supplementary environment report (Santos 2023), north of the proposed shoreline crossing point. As discussed in that report, recent shoreline movement analysis by Geoscience Australia (2020) suggests there has been no significant change in the coastline between 1988 and 2020, suggesting there have been no significant changes in coastal processes in the area as a result of the construction of other recent projects (including the Ichthys GEP and Bayu-Undan to Darwin pipeline).

While excavation activities and trenching would temporarily modify currents along the shoreline, this is not expected to have a significant impact. Any impacts on currents would be temporary during these activities. Construction of the shoreline crossing trench could increase erosion and runoff into the harbour. Any impacts would be temporary during pipeline installation.

Physical presence of infrastructure

The physical presence of infrastructure, including the pipeline, has the potential to alter hydrological processes. Based on other recent, similar projects in the area for Ichthys and Santos, pipeline and infrastructure presence is not expected to result in significant changes to coastal processes, including hydrodynamics or sedimentation. Impacts can be reduced further via the implementation of management measures outlined in the following section.

Management

To meet the Northern Territory EPA objective for coastal processes, the management controls presented in Table 6-2 will be implemented to minimise/mitigate any potential impacts to geophysical and hydrological processes.

Table 6-2: Coastal processes - principal management and mitigation

Aspect	Principal management / mitigation
Seabed disturbance	• Geophysical and geotechnical pre-lay surveys would be undertaken to inform the final pipeline route, seabed intervention requirements and identify protruding seabed features that may need to be avoided.

Aspect	Principal management / mitigation
	• Sediment transport modelling would be undertaken to inform a sediment transport impact assessment to understand the potential extent of excess suspended sediment concentrations and sediment deposition that may result during dredging and spoil disposal activities. • A dredging and spoil disposal management plan (DSDMP) to be developed following formal risk assessment.
Physical presence of infrastructure	• Temporary structures required for construction of the pipeline would be removed following installation. • The ODA would be reinstated to match the existing topography following installation of the pipeline. • Erosion risks would be managed in accordance with a site-specific erosion and sediment control plan.

Residual risk statement

Given the proposed mitigation measures to be implemented, the expected residual impact associated with coastal processes is considered low (refer to Table 6-3).

Table 6-3: Coastal processes – residual risk

Potential impact	Consequence	Likelihood	Residual risk
Physical presence of infrastructure changes local geophysical and hydrological processes.	Insignificant	Unlikely	Low
Seabed disturbance during trenching activities changes seabed topography and sedimentation.	Insignificant	Possible	Low
Onshore site preparation, trenching and pipelay activities cause temporary changes in geophysical and hydrological processes.	Insignificant	Possible	Low

6.1.2 Sea – Marine environmental quality

NT EPA environmental objective:
Protect the quality and productivity of water, sediment and biota so that environmental values are maintained.

Relevant policy and guidelines

The following key conventions, legislation, policy and guidelines are relevant:

- International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 thereto (MARPOL 73/78)
- *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth)

- *Environment Protection and Biodiversity Conservation Act 1999* (Cth)
- *Dangerous Goods Act 1998* (Northern Territory)
- *Environment Protection Act 2019* (Northern Territory)
- *Fisheries Act 1988* (Northern Territory)
- *Waste Management and Pollution Control Act 1998* (Northern Territory)
- *Water Act 1992* (Northern Territory)
- *Marine Pollution Act 1999* (Northern Territory)
- Australian and New Zealand guidelines for fresh and marine water quality (ANZG 2018)
- National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ 2000)
- National Assessment Guidelines for Dredging (NAGD; Commonwealth of Australia 2009)
- Guidelines for Environmental Assessment of Marine Dredging in the Northern Territory (Northern Territory EPA 2013)
- Guidelines for the dredging of ASS sediments and associated dredge spoil management (Water Quality Australia 2018)
- Threat Abatement Plan for the impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (DoEE 2018)
- Declaration of Beneficial Uses and Objectives, Darwin Harbour Region, Northern Territory Government Gazette No. G27, 7 July 2010.
- Water Quality Objectives for the Darwin Harbour Region – Background document (NRETAS 2010)
- Darwin Harbour Water Quality Protection Plan (DLRM 2014)
- A Stormwater Strategy for the Darwin Harbour Region (Northern Territory EPA 2014)

Environmental context

Marine water quality and sediment quality are described in Section 4.2. Environmental values of relevance to the Project include marine water quality and sediment quality within the nearshore PDA, including Darwin Harbour.

Potential impacts

The following activities have the potential to impact on marine environmental quality if not managed appropriately:

- Seabed disturbance associated with dredging, trenching, pipelay, cable lay, cable crossings and sheet piling for the shore crossing.
- Shoreline crossing activities, including potential disturbance of coastal ASS.
- Routine and unplanned vessel discharges.
- Treated seawater discharge in the event of a pipeline wet buckle (if applicable).
- Unplanned discharge of waste or equipment.
- Unplanned hydrocarbon releases from vessels.
- Unplanned CO_2 release from a pipeline leak during operations.

Potential impacts associated with these activities include:

- Seabed disturbance activities in the nearshore PDA, including anchoring, dredging and trenching, causing increased turbidity and sedimentation resulting in reduced water quality and indirect impacts to sensitive receptors (e.g., coral, seagrass and mangrove habitat).
- Sediment disturbance from construction activities in the ODA, including exposure of ASS resulting in localised pollution of marine water.
- Waste and liquid discharges may result in localised water quality impacts.
- Water quality impacts from site run-off due to shore crossing activities.
- Localised and temporary impacts on water quality and/or sediment quality due to unplanned hydrocarbon releases or unplanned CO_2 pipeline leaks.

Seabed disturbance

A temporary reduction in water quality is likely to occur where turbid plumes from intermittent seabed disturbance associated with Project activities are generated (i.e. dredging, equipment placement, backfill, infrastructure installation, vessel movements in shallow waters, pipelay and cable lay, any other interaction with the sea floor). Shallow regions of the nearshore PDA would experience a greater reduction in water quality due to the type of activities and sediment disturbance occurring at or near the surface. Reductions in water quality are expected to last from hours to days depending on particle size and oceanographic conditions. Sediments can be resuspended by successive tidal currents to travel long distances before settling. Sediment deposition is likely to be naturally reworked into surface sediment layers through bioturbation. The localised and temporary displacement of sediment and subsequent sediment deposition would not result in any lasting change to particle size distribution or the physio-chemical composition of sediment.

It is possible that contaminated sediments, if present, may be disturbed and distributed during dredging operations. As described in Section 4.2.6, a range of metals (e.g. antimony, chromium, copper, lead, mercury, nickel and silver) have been recorded to infrequently exceed SQGVs from monitoring in Darwin Harbour; however, mean concentrations have remained below SQGVs.

Detailed assessment of the potential impacts on water quality and sediment quality is proposed to be undertaken, including hydrodynamic and sediment transport modelling.

Disturbance of coastal ASS for the shoreline crossing may also result in a temporary reduction in water quality resulting in acidification and higher heavy metals.

Vessel discharges

Routine vessel discharges would include:

- sewage, grey water and food waste,
- deck drainage, bilge and firefighting foam, and
- cooling water.

Impacts from routine and non-routine discharges from the vessels on water quality would have a negligible effect due to the transient nature of vessels, with little continuous discharge in a stationary location. Furthermore, routine and non-routine vessel discharges occur in a localised mixing zone, with a high level of dilution into the open water marine environment of the Project area. Therefore, there is not likely to be any lasting effect on water quality, and any potential impacts would be insignificant.

No routine vessel discharges would occur within 3 nautical miles of the Northern Territory shoreline, including Darwin Harbour.

Subsea discharges

Contingency discharge of treated seawater may occur in the event of dewatering from a wet buckle during installation of the CO_2 transport pipeline. Seawater would be treated with the same chemicals such as biocides, oxygen scavenger and corrosion inhibitors. The discharge could occur at any point along the pipeline route. Dewatering discharges would be highly localised and rapidly dispersed depending on oceanographic conditions. As such, the discharge is expected to result in a temporary decline in water and sediment quality around the discharge location, with no lasting effect predicted.

Unplanned hydrocarbon release

Several potential accidental loss of hydrocarbon containment events have the potential to occur as a result of the Project, including:

- minor spills associated with safe storage, handling and transfer of hydrocarbons and chemicals on vessels
- loss of hydrocarbon fuels during bunkering of vessels
- loss of hydrocarbons resulting from a vessel collision

The volume of a spill from a vessel collision is considered to provide a worst-case scenario; however, the actual volume would depend on the size of the vessel and fuel tank capacity.

Large hydrocarbon spills have the potential to result in impacts at a local and/or regional scale. Specific predictive modelling would be undertaken for the potential loss of containment events to inform an assessment of potential impacts.

Unplanned CO_2 release

There is potential for a CO_2 release from the CO_2 transport pipeline. A release would occur in the unlikely event of a leak or rupture of the pipeline resulting from damage to the integrity of the infrastructure.

The location, water depth and size of the pipeline rupture would influence the extent to which CO_2 would dissolve in surrounding seawater or be released to the atmosphere. When CO_2 is released in the water column, a plume is formed which may rise to the surface and release into the atmosphere. However, as CO_2 can quickly saturate water, the flux of gaseous CO_2 emerging at the sea surface can be much lower than the CO_2 release rate, since CO_2 is in part absorbed into the water column (Jones et al., 2015; Huser et al., 2016; Tamburini et al. 2024). Factors influencing the rate of dissolution and dispersion include water temperature, pressure, tide, topography, release rate and weather-related factors such as winds and currents (Jones et al. 2015).

Tamburini et al. (2024) modelled a range of CO_2 release scenarios for a leak simulation in water depths of 10 to 80 m to predict the fate of a submarine plume and the atmospheric dispersion of surfacing gas. The study found that in extremely shallow water the threshold distances of the gas cloud dispersing in the air can be higher for CO_2 than for natural gas. However, when considering greater water depths, the release of CO_2 to the atmosphere is strongly attenuated by the dissolution of CO_2 in the water column.

Environmental impacts in the marine environment associated with an unplanned release of CO_2 would primarily result from an increase in dissolved CO_2 concentration in the water column and an associated decrease in pH (Lian et al. 2022). Potential impacts would depend on the magnitude of seawater acidification and the spatial and temporal extent of any potentially harmful pH reductions exceeding a site-specific natural variability, which marine biota would be adapted to (Vielstädte et al. 2019). It is noted that the CO_2 stream exported to the storage formation would contain incidental associated substances (as managed by the Interim National Action List[1] for Offshore CO_2 Sequestration). These incidental substances are expected to rapidly distribute and mix within the water column and fall below threshold concentrations very quickly in the event of a leak.

Changes in water quality would be localised and temporary.

Detailed assessment of leak scenarios from the CO_2 transport pipeline, including modelling of CO_2 dispersion, will be conducted to inform an assessment of potential impacts.

Management

To meet the Northern Territory EPA environmental objective for marine environmental quality, the management controls presented in Table 6-4 will be implemented to minimise/mitigate any potential impacts to water, sediment and biota quality.

Table 6-4: Marine environmental quality - principal management and mitigation

Aspect	Principal management / mitigation
Sediment disturbance	• Geophysical and geotechnical pre-lay surveys would be undertaken to inform the final pipeline route, seabed intervention requirements and identify protruding seabed features that may need to be avoided. • Sediment transport modelling would be undertaken to inform a sediment transport impact assessment to understand the potential extent of excess suspended sediment concentrations and sediment deposition that may result during dredging and spoil disposal activities. • A dredging and spoil disposal management plan (DSDMP) to be developed following formal risk assessment. • Dredging vessels would be equipped with navigational aids to maintain dredging within permitted footprint. • Trenching and management of acid sulfate soil will follow the '*Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management*' (Water Quality Australia 2018).
Waste management and vessel discharges	• Project vessels would comply with the *Marine Pollution Act 1999* (Northern Territory), Marine Pollution Regulations (Northern Territory) and Darwin Port requirements, specifically: - Marine Order 94 (marine pollution prevention - packaged harmful substances). - Marine Order 95 (pollution prevention – garbage), as appropriate to class. - Marine Order 96 (pollution prevention – sewage), as appropriate to class.

[1] Final National Action List is currently in preparation

Aspect	Principal management / mitigation
	• A waste management plan would be developed with consideration of the threat abatement plan for the impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (DoEE 2018). • Chemicals and hazardous substances used during construction would be selected and managed to minimise potential adverse environmental impact associated with their transport, transfer, storage, use and disposal.
Accidental hydrocarbon and chemical discharge	• Project vessels would comply with the requirements of: - the *Navigation Act 2012* (Cwlth). - the *Marine Pollution Act 1999* (NT). - relevant marine orders. • project vessels will have a Ship Oil Pollution Emergency Plan (SOPEP) (as appropriate to vessel class). • Bunkering procedures would be developed and implemented if bunkering at sea is required. • Safety exclusion zones would be established around Project construction/installation vessels, and these would be communicated to marine users. • compliance with vessel speed restrictions applied within Darwin Harbour. • Spill kits would be available on-board vessels. • Hydrocarbon spill modelling would be undertaken to inform an assessment of potential impacts and to inform if additional management measures are required. • A chemical selection and approval process would be developed.
Unplanned CO_2 release	• The CO_2 transport pipeline would be designed to protect against threats to integrity including impact, corrosion, running ductile fracture and embrittlement. Design codes and material specifications would be compliant with the relevant Australian and international standards for transporting CO_2. • The CO_2 transport pipeline would be trenched and rock armouring installed within sections of Darwin Harbour to protect the pipeline from external impact. • Testing would be undertaken prior to commissioning to confirm integrity of the CO_2 transport pipeline. • IMR activities would be conducted throughout operations, including monitoring the CO_2 transport pipeline corrosion protection system. • Compliance with obtained pipeline licences in accordance with the Energy Pipelines Act and PLSA (subject to amendment of legislation, refer to Section 2).

Residual risk statement

Given the proposed mitigation measures to be implemented, the expected residual impact associated with marine environmental quality is considered low to moderate (refer to Table 6-5).

Table 6-5: Marine environmental quality – residual risk

Potential impact	Consequence	Likelihood	Residual risk
Sedimentation and turbidity impacts from seabed disturbance	Minor	Possible	Moderate
Water quality impacts from vessel discharges	Insignificant	Highly unlikely	Low
Water quality impacts from subsea discharges	Insignificant	Possible	Low
Accidental hydrocarbon release	Moderate	Highly Unlikely	Moderate
Unplanned CO_2 release	Minor	Highly Unlikely	Low

6.1.3 Sea – marine ecosystems

NT EPA environmental objective:
Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

Relevant policy and guidelines

The following key conventions, legislation, policy and guidelines are relevant:

- Guidelines for the Control and Management of Ships' Biofouling to Minimize the transfer of Invasive Aquatic Species (IMO 2012)
- International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004 (IMO 2009)
- International Convention on the Control of Harmful Anti-fouling Systems on Ships
- *Biosecurity Act 2015* (Cwlth)
- EPBC Act (Cwlth)
- *Marine Pollution Act 1999* and Marine Pollution Regulations 2023 (Northern Territory)
- *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* (Cwlth)
- *Fisheries Act 1988* (Northern Territory)
- TPWC Act (Northern Territory)
- Australian Ballast Water Management Requirements. Version 8. (ABWM Requirements; DAWE 2020)
- National Biofouling Management Guidance for Non-trading Vessels (MPSC 2018)
- Australian National Guidelines for Whale and Dolphin Watching 2017 (Commonwealth of Australia 2017)
- EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05) Interacting with cetaceans
- National Light Pollution Guidelines for Wildlife (DCCEEW 2023c)
- Marine orders 91, 94, 95 and 96.

Environmental context

Marine ecosystems, including benthic habitat and pelagic environment (including marine fauna) are described in Section 4.3. Environmental values of relevance to the Project include critical marine and coastal fauna habitat for nesting, breeding or foraging; seagrass meadows, sponge gardens, coral reefs; mangrove communities and salt marshes; marine and migratory species; ecological functions and processes.

Potential impacts

The following activities have the potential to impact on protected marine fauna and marine habitats in the nearshore PDA, if not managed appropriately:

- seabed disturbance associated with dredging, trenching, pipelay and cable lay activities.
- underwater noise from geophysical surveys, construction activities, and vessel operations
- light emissions from vessel activities and in the ODA
- Routine and unplanned vessel discharges
- unplanned introduction of invasive marine species
- unplanned marine fauna interaction
- unplanned discharge of waste or equipment
- unplanned hydrocarbon releases from vessels
- unplanned CO_2 release from a pipeline leak during operations
- unplanned discharge of waste or equipment.

These activities have potential for a significant impact to marine ecosystems, particularly the following values:

- marine mammals, including dolphin species with breeding BIAs in Darwin Harbour
- marine reptiles, including the flatback turtle with an internesting BIA and habitat critical to the survival of a species in Darwin Harbour
- fishes and sharks
- Intertidal and benthic habitats
- seabirds and migratory shorebirds.

Seabed disturbance

The nearshore PDA is characterised by epifaunal communities which are typical of a soft substrate habitat type consisting of silty, shelly sand, with sparse biota (RPS 2021). The regions surrounding the nearshore PDA within Darwin Harbour are characterised by complex assemblages of marine habitats that range in diversity and significance (as described in Section 4.3.1).

Dredging, spoil disposal, pipe lay, cable lay and backfill activities would alter the seabed habitats over which the activities occur, resulting in epifauna and infauna community changes throughout the nearshore PDA. This would be most evident in Darwin Harbour where dredging activities are proposed.

Seabed disturbance may result in direct impact to benthic communities within the footprint of seabed intervention and infrastructure installation. Indirect disturbance from turbidity plumes may also result in clogging and damage to the feeding and breathing apparatus of filter feeding organisms (Parr et al. 1998) and smothering when displaced sediments settle. It is possible that activities would produce a slight alteration of the local habitat and community structure. However, benthic habitats and communities are expected to recover quickly, and no long-term changes to the ecosystem are expected.

Seabed disturbance from activities such as dropped objects have the potential to alter or smother benthic habitats and communities, with impacts varying by size of the object, water depth and prevailing currents.

The Northern Prawn Fishery, Southern Bluefin Tuna Fishery and Western Tuna and Billfish Fishery are potentially active in the Project area and a number of commercially significant fish stocks, considered as key indicator species, may be present. Recreational fishing also occurs in the nearshore PDA. Disturbance to seabed habitats from the activity is not expected to affect fish spawning habitats due to the short-term nature of the activity, similarly, as tuna spawning is reported to occur in offshore surface waters, no impacts to spawning is expected.

The nearshore PDA overlaps breeding BIAs for Australian snubfin, Australian humpback and spotted bottlenose dolphins (Darwin Harbour). Seabed disturbance and associated reductions in water quality (e.g. increases in turbidity) associated with dredging and pipe/cable lay may indirectly impact marine mammals in the nearshore PDA. However, activities would be occurring in a busy port environment and would be short-term in nature, progressing along the pipeline route, and are not expected to have any lasting effect on coastal dolphin behaviour or habitat utilisation.

The nearshore PDA and part of the offshore PDA extends through the flatback turtle internesting BIA and habitat critical to the survival of the species. The Recovery Plan for Marine Turtles in Australia (DoEE 2017a) identifies habitat modification from infrastructure/coastal development as a threat to the stock of flatback turtles in the region of the Project area. Seabed disturbance in the nearshore PDA has the potential to effect habitat critical during construction/installation and decommissioning activities, however due to the localised and short-term nature of benthic disturbance, Darwin Harbour having naturally high turbidity, and portions of the site being previously disturbed, no lasting effects to habitat critical are expected.

The potential impacts of increased turbidity and sedimentation resulting from seabed disturbance would be assessed in detail, including a dredging and spoil disposal / sediment impact assessment and consideration of cumulative impacts from other activities in Darwin Harbour.

Underwater noise

Underwater noise would be generated by activities in Darwin Harbour, including:

- vessel activities
- vessel positioning transponders
- geophysical surveying instruments.

Routine sound emissions from the sources described above have the potential to result in the following impact(s):

- a change in ambient noise
- a change in fauna behaviour
- injury and/or mortality to fauna.

The particular environmental receptors with the potential to be impacted by underwater noise emissions from project activities are:

- transient, threatened/migratory species (marine mammals, turtles and sharks)
- fish including commercial species
- other marine users.

Elevated underwater noise can affect marine fauna, including cetaceans, marine turtles, fish, sharks and rays, in three main ways (Richardson et al. 1995; Simmonds et al. 2004):

- by causing direct physical effects on hearing or other organs. Hearing loss may be temporary (temporary threshold shift [TTS]; referred to as auditory fatigue), or auditory injury, which includes permanent threshold shift (PTS) and other forms of hearing damage
- by masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey)
- through disturbance leading to behavioural changes or displacement from important areas (e.g. BIAs).

Marine mammals and especially cetaceans rely on sound for important life functions including socialising, detecting predators and prey, navigation and reproduction. There is a paucity of data regarding responses of marine reptiles to underwater noise sources. However, turtles have been shown to respond to low frequency sound, with indications that they have the highest hearing sensitivity in the frequency range 100 to 700 Hz (Bartol and Musick 2003). Fish may use sound to communicate, locate prey, detect predators, and as a cue for orientation (McCauley and Cato 2000), perceiving sound through the ears and the lateral line, which are sensitive to vibration. Different fish may detect the pressure and particle acceleration components of sound to varying degrees. Fish with a swim bladder or other gas volume connected directly to the inner ear (e.g. herrings, sardines, pilchards, shads) can detect both sound pressure as well as particle motion and are susceptible to barotrauma. Fish with no swim bladder (e.g. sharks, mackerels) or with no direct connection between the swim bladder and inner ear (e.g. demersal snappers and emperors) are less sensitive to changes in sound pressure (Popper et al. 2014).

Vessel-based activities would occur within the nearshore PDA at various times during the different phases of the Project, with higher levels of vessel activity during the construction and commissioning, and decommissioning phases. Vessel/construction noise and noise from geophysical surveys has the potential to result in a change in ambient noise conditions and in localised disturbance to marine fauna, including the potential to impact inshore dolphin species in their BIAs in the nearshore PDA (Darwin Harbour). Impacts could include temporary behavioural effects on small numbers of individuals. Impairment to hearing is considered unlikely given the type of noise sources and management measures that will be in place.

The potential impacts of underwater noise would be assessed in detail, including underwater noise modelling with consideration of cumulative noise.

Light emissions

Light emissions are relevant to all phases of the Project; the potential impacts are dependent on a number of factors such as specifications and activity duration. Light emissions would be highest during the construction phase due to the presence of onshore construction works and multiple vessels.

Lighting is required for the safe operation of the project vessels and cannot reasonably be eliminated. In the ODA, temporary lighting would be required onshore during construction activities for the onshore inlet station and pipeline and may be visible from the shoreline. Once the Project is operational, there would be no ongoing light emissions except occasional vessels during IMR, MMV and survey activities. Light emissions during decommissioning would also be temporary and minor (limited to lighting from decommissioning vessels).

Light emissions may impact on existing environmental values in the Project area and surrounds. Impacts need to be considered in the context of all existing light sources within and adjacent to the Project area, including high vessel traffic within the Port of Darwin and multiple existing onshore sources of light, e.g., the LNG plant at Bladin Point.

Fauna within the Project area that may be affected includes marine turtles, pelagic fish and zooplankton, resident and migratory seabirds and shorebirds and transient cetacean species.

Behavioural changes reported in marine turtles exposed to increases in artificial lighting can include disorientation and interference during nesting (Pendoley 2005; CoA 2023). The effect of light emissions resulting in disruption to turtle orientation and behaviour has been observed from up to 18 km away (CoA 2023) and the National Light Pollution Guidelines for Wildlife (CoA 2023) recommends that a 20 km buffer for assessment of impacts be considered around important habitat for turtles.

Foraging turtles may be present in the Project area year-round, with nesting and internesting turtles present in the PDA during nesting seasons. Therefore, there is a potential for marine turtles to be impacted by light emissions associated with the Project. Significant exposure or changes in ambient light levels are not expected to affect the behaviour of the adult turtle population as adult turtles undertaking internesting, migration, mating or foraging activities do not use light cues to guide these behaviours (Witherington and Martin 2003).

Given the proximity to the nesting beaches, light emissions may impact hatchlings, causing them to be disorientated by light emissions from the ODA or vessels within the PDA. The nearest nesting beach is Mandorah, located 500 m west of the nearshore PDA. Onshore lighting and vessel lighting during construction would result in a small incremental increase in existing artificial light sources and is not expected to impact hatchlings on nesting beaches. Once in the water, and in the absence of wave cues, swimming hatchlings have been shown to orient towards light cues and in some cases, wave cues were overridden by light cues (Thums et al. 2013, 2016). Consequently, there is potential for hatchlings at sea to be attracted to light emissions from project vessels. Given the temporary nature of the project vessels in the PDA, impacts to hatchling dispersal behaviour is not expected to be significant and would not impact turtle populations, nor recovery.

Artificial light can attract and disorient seabirds, disrupt foraging and potentially causing collision with infrastructure (CoA 2023). Where there is important habitat for seabirds within 20 km of a project, the National Light Pollution Guidelines for Wildlife (CoA 2023) recommends that consideration be given as to whether light is likely to have an effect on those birds. Given the existing levels of artificial light adjacent to the ODA, the temporary nature of lighting for construction works and the low level of lighting required at the inlet station during operations, impacts are expected to be limited.

Cetaceans, fish and planktonic organisms are not expected to be impacted by above surface light emissions. Lighting from the presence of vessels may result in the localised aggregation of fish below the vessel. However, these aggregations of fish are considered localised and temporary and any long-term changes to fish species composition or abundance is considered highly unlikely.

Vessel discharges

Routine vessel discharges would include:

- sewage, grey water and food waste,
- deck drainage, bilge and firefighting foam, and
- cooling water.

Impacts from routine discharges from the vessels on marine fauna would be negligible due to the transient nature of vessels, with little continuous discharge in a stationary location. Furthermore, routine vessel discharges occur in a localised mixing zone, with a high level of dilution into the open water marine environment of the Project area. Therefore, there is not likely to be any lasting effect on marine fauna and any potential impacts would be insignificant.

Unplanned introduction and establishment of invasive marine species

Invasive marine species (IMS) are non-native marine plants or animals that have been introduced into a region beyond their natural range and have the ability to survive, reproduce and establish founder populations. IMS are widely recognised as one of the most significant threats to marine ecosystems worldwide. Shallow coastal marine environments, in particular, are thought to be amongst the most heavily invaded ecosystems, which largely reflects the accidental transport of IMS by international shipping to marinas and ports where the preferred artificial hard structures are commonly found.

The key pathways for introduction of IMS to the Project area is within biofouling on external surfaces of vessels and within internal niche areas and systems, and through vessel's ballast water. IMS could also be present as biofouling on immersible equipment (survey equipment, ROV, TSHD drag head etc.) and could be translocated to the Project area and transferred directly to the seafloor or subsea structures where they could establish. IMS propagules may also be transferred via natural dispersion.

The introduction and establishment of IMS into the marine environment may result in impacts to benthic communities and associated receptors dependent on these, including fishing, due to changes to the structure of benthic habitats and native marine organisms through predation and/or competition for resources, leading to a change in ecological function.

The Project area passes through Darwin Port, a major service centre for the mining and energy sectors. The risk of introducing IMS is expected to be greater for vessels and activities occurring in Darwin Harbour (nearshore PDA) due to the density of vessel traffic and shallow waters containing hard substrate in the area. The high frequency of vessels visits from a range of destinations, and habitat preference for IMS (artificial substrate, disturbed habitats, shallow coastal waters) have resulted in Darwin Port having a confirmed presence of certain IMS, and therefore ongoing marine pest monitoring programs. IMS originating from Darwin Port may present a potential impact to the activity itself and sensitive habitats that has the potential to result in medium to large scale impacts to benthic communities.

The risk of introducing or invasive marine species would be managed in accordance with standard procedures.

Unplanned marine fauna interaction (vessel collision and dredging)

Vessel movements during all phases of the proposed Project have the potential to cause injury or mortality to marine fauna as a result of accidental collisions. During construction and installation activities, project vessels would include barges, survey vessels, installation dredging and pipelay vessels. During operations project vessels would include IMR vessels.

The type and number of vessels in the Project area (and transiting to and from the Project area) at any one time, and the duration of presence, would differ depending on the Project phase. Vessel presence is expected to be greatest for short-term project phases (i.e. construction and installation), with the longer-term operational phase requiring fewer vessels.

Dredging and trenching activities within the nearshore PDA have the potential to entrain fish and protected marine fauna such as marine turtles, through the unintentional removal of organisms by the suction field created by the TSHD. Entrainment rates depend on a number of factors, including depth, dredger type, speed, and strength of suction field. The TSHD would sail slowly, typically at 1 to 1.5 m/s during dredging activities.

Vessels in the Project area have the potential to interact with EPBC and TPWC-listed threatened species. This may result in injury or death of marine fauna from a vessel strike or entanglement/entrainment from the use of equipment.

The risk of impacts from unplanned marine fauna interactions would be managed in accordance with standard procedures.

Unplanned hydrocarbon release

A vessel collision and subsequent surface release of MDO/MGO has the potential to result in changes to water quality and impacts to marine flora and fauna through surface, entrained, dissolved, and shoreline hydrocarbon exposure as follows:

- Ecological:
  - impacts to plankton
  - impacts to benthic habitat and communities
  - injury or mortality to EPBC-listed species (seabirds and migratory shorebirds, fish, marine mammals, marine reptiles)
- impacts to BIAs, KEFs, AMPs, Territory marine parks/nature reserves.

Upon release to the marine environment hydrocarbons would disperse through natural physical oceanic processes, such as currents, tides and waves, and photochemical and biological degradation. Therefore, any surface expression is expected to weather and dissipate with time. Exposure to entrained and dissolved hydrocarbons is typically limited to the upper water column (up to approximately 20 m depth for entrained oil and 60 m depth for dissolved aromatic hydrocarbons). Shoreline accumulation may occur depending on the location and extent of a spill plume.

Foraging turtles green, olive ridley, flatback and loggerhead turtles may be present in the Project area year-round, with nesting and internesting flatback turtles present in the nearshore PDA during nesting seasons (Section 4.3.4). The nearshore PDA overlaps breeding BIAs for three coastal dolphin species. A number of other marine mammal species may also occur in the region of the Project area, with individuals potentially impacted by an MDO/MGO spill. Potential impacts may include behavioural impacts (e.g. avoidance of impacted areas), sub-lethal biological effects (e.g. skin irritation, irritation from ingestion or inhalation, reproductive failure) and lethal impact may occur depending on the size and location of a spill.

Other protected species that may occasionally transit through the area and may potentially be exposed to an MDO/MGO spill include sea snakes, shark and ray species. Should sharks or rays be present in the region of the Project area during a spill, direct impacts may occur if foraging within surface slicks or in the upper 20 to 30 m of the water column.

The Project area is located within the EAA Flyway, an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters. However, there are no BIAs for marine avifauna that overlap the Project area. The closest outer boundary of a marine avifauna BIA is 110 km north from the Project area at the closest point. No Ramsar sites overlap the Project area; the closest nationally important wetland (Kakadu National Park) is located over 100 km from the Project area. This site provides important habitat for marine avifauna including migratory species which could be expected to be encountered in low numbers as they may transit through the Project area.

The risk of impacts from unplanned hydrocarbon releases would be managed in accordance with standard procedures. Potential impacts would be assessed in detail, including through hydrocarbon spill modelling to inform any additional management measures.

Unplanned CO_2 release

An unplanned CO_2 release from the CO_2 transport pipeline in Darwin Harbour could result in a submarine gaseous plume, high concentrations of dissolved CO_2 and a release to atmosphere.

CO_2 plumes can affect benthic communities, reducing pH and impairing nutrient cycling, both of which can lead to hypoxia in localised areas. As many benthic organisms, such as corals and sponges, are sessile, hypoxic conditions can lead to impaired settlement, reduced recruit survival, and mortality. The localised reduction in pH (acidification) can particularly affect organisms with calcium carbonate shells, such as corals (Huser et al. 2016; Orr et al. 2005) and benthic invertebrates (Fabry et al., 2008). A reduction in pH around benthic sediments may also increase the bioavailability of metals and substances, which in turn can result in sediment toxicity and mortality of benthic fauna (Roberts et al. 2017; Rodriguez-Romero et al. 2014). Darwin Harbour is characterised by complex assemblages of marine habitats and associated diverse biological communities. Coral, sponge, macroalgal and small patches of seagrass communities are known to be present in or directly adjacent to the Project area. In the event of a CO_2 leakage from the section of pipeline in Darwin Harbour, it is likely that these organisms would be directly impacted. However, impacts would be short-term as CO_2 dissolves and disperses or is released to the atmosphere.

The specific impact pH reduction and an increase in CO_2 (partial pressure of CO_2) as a result CO_2 dispersal into the water column may have on marine life is species dependent, and dependent on the dispersal and longevity of the leak. Many marine species are not sensitive to hypercapnia (increase CO_2 in the bloodstream) as a result of short-term moderate CO_2 increases (Fabry et al. 2008); however, effects of a large-scale CO_2 release (such as from a pipeline rupture) are likely to be both more acute and more severe. In the case of a rapid, high-volume CO_2 release, especially in an area with poor mixing, the gas can dissolve into the surrounding water quickly, creating a localized area of oxygen displacement and acidification. Mobile organisms, like fish and marine mammals, are more able move away, however behaviour may be altered as a result of environmental change, and long-term exposure may interfere with metabolic processes and reproduction capabilities (Portner et al. 2005).

Rapid change in CO_2 concentration and pH in both water and sediment pore-water may lead to the loss of localised benthic communities and habitats or changes to benthic community structure. Beyond this, impacts are expected to be minor with no lasting effects. Potential impacts to listed threatened and migratory species include potential injury or mortality due to shock from the sudden drop in temperature and / or exposure to sudden changes in CO_2 concentration and pH in the water in the vicinity of a large-scale CO_2 leak.

Due to the shallow water depth, a CO_2 pipeline release would likely reach the surface within Darwin Harbour. If released to atmosphere in high concentrations (>5%), CO_2 poses a risk to human health and life (Rusin and Stolecka, 2014; IPCC 2005) and other fauna such as marine turtles, mammals and seabirds. As CO_2 is denser than air, it can quickly displace oxygen, leading to altered cognitive function, loss of consciousness, and asphyxiation which can result in mortality. However, impacts are expected to be restricted to those individuals in immediate proximity to the release, and as such impacts at the species level are not anticipated.

Detailed assessment of leak scenarios from the CO_2 transport pipeline, including modelling of CO_2 dispersion, will be conducted to inform an assessment of potential impacts.

Management

To meet the Northern Territory EPA environmental objective for marine ecosystems, the management controls presented in Table 6-6 would be implemented to minimise/mitigate any potential impacts.

Table 6-6: Marine ecosystems - principal management and mitigation

Aspect	Principal management / mitigation
Sediment disturbance	• Geophysical and geotechnical pre-lay surveys would be undertaken to inform the final pipeline route, seabed intervention requirements and identify protruding seabed features that may need to be avoided. • Sediment transport modelling would be undertaken to inform a sediment transport impact assessment to understand the potential extent of excess suspended sediment concentrations and sediment deposition that may result during dredging and spoil disposal activities. • A dredging and spoil disposal management plan (DSDMP) would be developed following formal risk assessment. • Dredging vessels would be equipped with navigational aids to maintain dredging within permitted footprint. • Trenching and management of acid sulfate soil will follow the '*Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management*' (Water Quality Australia 2018). • Procedures would be developed and implemented for the following activities: - pipeline installation - buckle and recovery - anchoring management - cable installation. • Infrastructure would be placed on the seabed within the design footprint using positioning technology. • Monitoring and maintenance of subsea infrastructure would be undertaken to manage any scour or pipeline movement to within integrity envelope.
Underwater noise	• Vessel contractors will comply with relevant requirements of the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05) Interacting with cetaceans.

Aspect	Principal management / mitigation
Light emissions	• Vessel lighting would be limited to the minimum required for navigational and safety requirements, with the exception of emergency events. • Vessel personnel will receive an induction/training to inform them of the requirements to minimise external artificial lighting. • Consideration would be given to the National Light Pollution Guidelines for Wildlife 2023, as relevant to Project activities.
Waste management and vessel discharges	• Project vessels would comply with the *Marine Pollution Act 1999* (Northern Territory), Marine Pollution Regulations (Northern Territory) and Darwin Port requirements, specifically: - Marine Order 94 (marine pollution prevention - packaged harmful substances). - Marine Order 95 (pollution prevention – garbage), as appropriate to class. - Marine Order 96 (pollution prevention – sewage), as appropriate to class. • A waste management plan would be developed with consideration of the threat abatement plan for the impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (DoEE 2018). • Chemicals and hazardous substances used during construction would be selected and managed to minimise potential adverse environmental impact associated with their transport, transfer, storage, use and disposal.
Unplanned introduction and establishment of IMS	• Project vessels would have an antifouling coating applied that is in accordance with the prescriptions of the International Convention on the Control of Harmful Anti-fouling systems on ships, 2001, and the *Protection of the Sea (Harmful Antifouling Systems) Act 2006* (Cwlth). • Project vessels would comply with the requirements of the *Biosecurity Act 2015* (Cwlth). • Project vessels would have an approved ballast water management plan and valid ballast water management certificate, unless an exemption applies or is obtained. • Project vessels operating within Australian seas would manage ballast water discharge using one of the following approved methods of management (DAWE 2020): - An approved ballast water management system. - Ballast water exchange conducted in an acceptable area. - Use of low-risk ballast water (e.g. fresh potable water, water taken up on the high seas, water taken up and discharged within the same place). - Retention of high-risk ballast water on board the vessel. - Discharge to an approved ballast water reception facility. • A biofouling risk assessment would be undertaken by a suitably qualified biofouling inspector for all international vessels, and mitigation measures commensurate to the risk would be implemented, as appropriate.

Aspect	Principal management / mitigation
Unplanned marine fauna interactions	• Project vessels would operate in accordance with EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05). • Project vessels would comply with Darwin Harbour speed restrictions. • Procedures would be developed and implemented during dredging to for reduce risk of marine fauna entrainment.
Accidental hydrocarbon and chemical discharge	• Project vessels would comply with the requirements of: - the *Navigation Act 2012* (Cwlth). - the *Marine Pollution Act 1999* (NT). - relevant marine orders. • project vessels will have a SOPEP (as appropriate to vessel class). • Bunkering procedures would be developed and implemented if bunkering at sea is required. • Safety exclusion zones would be established around Project construction/installation vessels, and these would be communicated to marine users. • Compliance with vessel speed restrictions applied within Darwin Harbour. • Spill kits would be available on-board vessels. • Hydrocarbon spill modelling would be undertaken to inform an assessment of potential impacts and to inform if additional management measures are required. • A chemical selection and approval process would be developed.
Unplanned CO_2 release	• The CO_2 transport pipeline would be designed to protect against threats to integrity including impact, corrosion, running ductile fracture and embrittlement. Design codes and material specifications would be compliant with the relevant Australian and international standards for transporting CO_2. • The CO_2 transport pipeline would be trenched and rock armouring installed within sections of Darwin Harbour to protect the pipeline from external impact. • Testing would be undertaken prior to commissioning to confirm integrity of the CO_2 transport pipeline. • IMR activities would be conducted throughout operations, including monitoring the CO_2 transport pipeline corrosion protection system. • Compliance with obtained pipeline licences in accordance with the Energy Pipelines Act and PLSA (subject to amendment of legislation, refer to Section 2).

Residual risk statement

Given the proposed mitigation measures to be implemented, the expected residual impact associated with marine ecosystems is considered low to moderate (refer to Table 6-7).

Table 6-7: Marine ecosystems – residual risk

Potential impact	Consequence	Likelihood	Residual risk
Impacts on marine ecosystems from seabed disturbance	Minor	Possible	Moderate
Impacts on marine ecosystems from underwater noise	Insignificant	Possible	Low
Impacts on marine ecosystems from light emissions	Insignificant	Unlikely	Low
Impacts on marine ecosystems from routine vessel discharges	Insignificant	Possible	Low
Impacts on marine ecosystems from unplanned loss of hazardous or non-hazardous waste	Insignificant	Possible	Low
Impacts on marine ecosystems, including benthic habitats, from unplanned seabed disturbance	Insignificant	Possible	Low
Impacts on marine ecosystems from unplanned introduction and establishment of IMS	Significant	Remote	Moderate
Impacts on marine ecosystems from unplanned marine fauna interaction	Minor	Highly Unlikely	Low
Impacts on marine ecosystems from unplanned hydrocarbon release (vessel collision)	Moderate	Highly Unlikely	Moderate
Impacts on marine ecosystems from unplanned CO_2 release	Minor	Highly Unlikely	Low

6.1.4 Land – Terrestrial environmental quality

NT EPA environmental objective:
Protect the quality and integrity of land and soils so that environmental values are supported and maintained.

Relevant policy and guidelines

The following key conventions, legislation, policy and guidelines are relevant:

- *Waste Management and Pollution Control Act 1998 Act* (NT)
- *Dangerous Goods Act 1998* (NT)
- Guideline for the Preparation of an Environmental Management Plan (Northern Territory EPA 2015)

- Erosion and sediment control plans for rural development (DLRM n.d.)
- IECA Best Practice Erosion and Sediment Control Guidelines (IECA 2008)
- National Acid Sulfate Soils Sampling and Identification Methods Manual (Sullivan et al. 2018)
- National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments (National Guidance; Shand et al. 2018)
- National Strategy for the Management of Coastal Acid Sulfate Soils (National Working Party on Acid Sulfate Soils 2000)
- Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines Version 5.1 (Dear et al. 2024).

Environmental context

The geology and soils of the terrestrial environment are described in Section 4.2.7. The Project area contains areas of ASS and potential ASS, and geotechnical investigations in the area have also reported acidic soils with natural non sulphuric acidity.

Potential impacts

The Project has the potential to result in impacts to land soils through soil erosion, exposure of ASS and unplanned spills due to the following aspects of the construction phase:

- clearing of vegetation
- erosion of cleared areas
- direct disturbance of landforms and soils from earthworks during construction
- increase in surface-water runoff, including potential for acidic runoff
- alteration of surface-water drainage direction and volumes
- sedimentation of mangrove areas around the PDA, leading to smothering of pneumatophores and reduced plant growth or death
- unplanned leaks of hazardous materials leading to potential contamination of soils, surface water and groundwater.

Vegetation clearance and earthworks

Vegetation clearing and earthworks is required within the ODA, including clearing of both native and mangrove vegetation.

The total area cleared within the ODA would be determined and refined during the project design and approvals process and depend on the final construction methodology chosen, with a large portion only planned as temporary clearance to support construction works followed by rehabilitation. It is estimated up to 25 m wide corridor through the crossing would remain cleared through operations, an estimated area of 4 ha.

Erosion and run-off

The mangrove forest at the shoreline acts as a sediment trap for erosion. However, in areas where the mangroves habitat is completely cleared, soil erosion from the onshore disturbance could reach the nearshore marine environment.

Erosion and the subsequent release of sediment can result in a reduction in nearshore water quality due to increased sediment load from turbid surface-water runoff. High levels of water turbidity may result in increased sedimentation on intertidal and benthic habitats, and reduced levels of light availability in the marine environment, which may adversely impact habitats of listed marine species. Erosion risk is dependent on the likelihood and intensity of expected rainfall, the estimated rate of soil loss and the anticipated disturbance period.

The shore crossing pipeline and cable construction works would be designed to minimise construction footprint to minimise soil disturbance. The risk that the erosion hazard results in environmental harm was assessed for the existing GEP Project pipeline route adjacent to the proposed CO_2 transport pipeline according to International Erosion Control Association (IECA) 2008 guidelines. An erosion risk was only identified for the area of the site above the HAT (i.e., the woodland area) given:

- a very low to low hazard exists for land-based disturbance activities which within the dry season between May and September
- a high to extreme hazard exists for land-based disturbance activities within the wet season between October and April.

Therefore, the potential risks of erosion are limited to the areas near the inlet station during the wet season. These potential erosion risks would be managed in accordance with a site-specific erosion and sediment and control plan.

Sediment deposition

During mangrove clearing, sediment dispersion may occur outside the footprint depending on sediment type and hydrodynamic conditions during activities.

Clearing activities would result in the release of fine sediment particles (silts and clays), which can remain suspended in the water column under moderate to high current speeds and cause turbid plumes. They can be resuspended by successive tidal currents to travel long distances before settling.

Sediment deposition is likely to be naturally reworked into surface sediment layers through bioturbation. The localised and temporary displacement of sediment and subsequent sediment deposition would not result in any lasting change to particle size distribution or the physio-chemical composition of sediment. As such, no lasting changes to sediment quality is expected to occur in the intertidal area.

Exposure of Acid sulfate soils

ASS are naturally formed soils, sediments, and peats that contain iron sulfides, mainly in the form of pyrite (Sammut et al. 1996). Acid sulfate soils have the potential to occur within the shore crossing area and may become an environmental issue when the soil is exposed to oxygen for a prolonged period of time. This exposure can be caused in the following ways:

- removal of vegetation in the intertidal zone resulting in exposure and disturbance of surface soils
- excavation of the trench resulting in:
  - exposure of the excavated trench base and trench batters / walls to air
  - drawdown of the groundwater table from trenching activities
  - exposure of excavated material to air.

Surface water that has been exposed to ASS may be more acidic and have higher heavy metal concentrations. If discharged off site, this water may have detrimental effects on pH levels and heavy metal concentrations of surrounding surface water.

Topsoil may be disturbed when clearing machinery traverse from the woodland to the mangrove area and through the mangrove area. Although the likelihood of ASS presence in the topsoil in the salt flat area is relatively low, there is a risk of prolonged exposure of disturbed topsoil to the air in this area during the vegetation clearance period. Potentially disturbed topsoil in the mangrove area, which is located below mean sea level, would be inundated daily by tides which would neutralise any acid released from disturbed soils.

Excavation of the trench below the groundwater table could contribute to groundwater from nearby soil to drain into the trench. Drainage of groundwater creates a depression of the groundwater table near the trench and some oxygen from the overlying soil and atmosphere would be drawn into the soil. Any ASS adjacent to the trench may become oxidised and generate acid. Release of acids and heavy metals may result in potential contamination of surface water and groundwater.

Oxidation may occur over weeks or months following ASS disturbance. Given activities in the shore crossing area may encounter ASS, trenching would allow for segregation and treatment prior to disposal. Additional detailed chemical testing of ASS would be conducted on site during FEED and prior to construction.

Water Quality

A temporary reduction in water quality is likely to occur in the form of turbid plumes from intermittent disturbance associated with removing mangroves along the onshore pipeline route. Sources of impact on water quality include erosion, ASS and dust. The potential risks of erosion are limited to the areas near the inlet station during the wet season. Potential erosion risks would be managed in accordance with a site-specific erosion and sediment control plan.

Unplanned hydrocarbon/chemical release

While measures to prevent the release of hydrocarbons/chemicals into the environment would be in place at all times, there is potential for spills and leaks on land to occur through accidents and/or failure of equipment as a result of the Project, including:

- minor spills associated with safe storage, handling and transfer of hydrocarbons and chemicals storage
- loss of hydrocarbons and chemicals during refuelling of vehicles and plant/equipment
- loss of hydraulic fluid to ground (constructions equipment)

The potential impact from an accidental spill or leak is dependent on the location of the event and the type and volumes of materials released.

The potential terrestrial environmental impacts include contamination of soils, surface water and groundwater resulting from leaks and spills of such materials. Secondary impacts relating to potential contact of flora, vegetation and fauna with discharges.

Mangroves are known to be particularly susceptible to pollution from hydrocarbon spills. Mangrove communities are also important to the ecological health of their surrounds and provide food and shelter for a wide range of animals.

Due to the limited spatial extent of a hydrocarbon/chemical from a spill to land and the limited window for exposure, impacts to any receptor are not expected.

Unplanned CO_2 release

No impacts are expected on terrestrial environmental quality (i.e. quality of soils, processes). Impacts may result to terrestrial ecosystems as a result of unplanned CO_2 release.

Management

To meet the Northern Territory EPA objective for terrestrial environmental quality, the management controls presented in Table 6-8 would be implemented to minimise/mitigate any potential impacts to the quality and integrity of land and soil.

Table 6-8: Terrestrial environmental quality - principal management and mitigation

Aspect	Principal management / mitigation
General	• A construction environmental management plan (CEMP) would be developed and implemented. The CEMP would include management measures for the following: - vegetation clearing, earthworks and rehabilitation - introduction of weed and pests - dust, erosion and sediment control - surface water runoff and drainage - onshore spill prevention and response - waste management - chemical selection and approval.
Vegetation clearing and surface water management	• Mangroves would be cleared in a way that minimises disturbance of the root system (such as cutting off the mangroves at root level or pushing the vegetation over). • Weed infestation would be quantified prior to any vegetation clearing in areas weeds are anticipated in the ODA • Cleared vegetation would be mulched and stockpiled on site boundaries (outside the intertidal zone) or off site. Where possible, the mulch would be used for both rehabilitation and soil stabilisation to prevent erosion. • Temporarily disturbed areas within the ODA would be revegetated and rehabilitated following completion of construction activities. • Large-scale vegetation clearing would be undertaken preferentially in dry season conditions to avoid potential erosion risks associated with monsoon rains in the wet season. • Erosion risks would be managed in accordance with a site-specific erosion and sediment control plan. • Erosion protection infrastructure would be installed to ensure that sediment is contained within the site boundaries as far as possible. • If soil erosion is evident, exposed surfaces would be stabilised using appropriate management techniques. • Clearing would not exceed the area designated
Ground disturbance works (acid sulfate soils)	• Undertake geophysical and geotechnical surveys to inform presence and extent of ASS/PASS within the nearshore PDA and ODA.

Aspect	Principal management / mitigation
	• Development and implementation of an acid sulphate soils management plan. • Disposal management of ASS include neutralising and re-covering with clean fill or disposing off site and excavated ASS material may be disposed of at the offshore disposal ground.
Unplanned hydrocarbon/chemical release	• An emergency response plan would be developed and implemented. • Chemicals and hazardous substances used during construction would be selected and managed to minimise potential adverse environmental impact associated with their transport, transfer, storage, use and disposal. • Spill kits would be available, maintained and accessible locations within work areas. • During construction, appropriate temporary containment facilities (e.g. bunding) would be utilised for the storage of chemicals, fuels and hazardous wastes. • Personnel who routinely handle hazardous materials or wastes would receive training in handling, transporting and storing hazardous materials or wastes, and spill clean-up techniques and practices. • Safety Data Sheets would be available to aid in the identification of appropriate spill clean-up and disposal methods.
Unplanned CO_2 release	• The CO_2 transport pipeline would be designed to protect against threats to integrity including impact, corrosion, running ductile fracture and embrittlement. Design codes and material specifications would be compliant with the relevant Australian and international standards for transporting CO_2. • Testing would be undertaken prior to commissioning to confirm integrity of the CO_2 transport pipeline. • IMR activities would be conducted throughout operations, including monitoring the transport pipeline corrosion protection system, to manage the integrity of subsea infrastructure. • Compliance with obtained pipeline licences in accordance with the Energy Pipelines Act and PLSA (subject to amendment of legislation, refer to Section 2).

Residual risk statement

Given the proposed mitigation measures to be implemented, the expected residual impact associated with terrestrial environmental quality is considered low (refer to Table 6-9).

Table 6-9: Terrestrial environmental quality – residual risk

Potential impact	Consequence	Likelihood	Residual risk
Impacts to land and soils due to ASS disturbance	Minor	Highly unlikely	Low
Impacts to land and soils due to soil erosion and sedimentation	Insignificant	Highly unlikely	Low

Potential impact	Consequence	Likelihood	Residual risk
Impacts to the quality and integrity of land and soils due to unplanned hydrocarbon/ chemical releases	Minor	Highly unlikely	Low

6.1.5 Land – Terrestrial ecosystems

NT EPA environmental objective:
Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

Relevant policy and guidelines

The following key conventions, legislation, policy and guidelines are relevant:

- EPBC Act (Cth) (EPBC Act)
- *Biosecurity Act 2015* (Cth)
- TPWC Act (NT)
- *Weeds Management Act 2001* (Northern Territory)
- Guidelines for Assessment of Impacts on Terrestrial Biodiversity (Northern Territory EPA 2013)
- Preparation of an Environmental Management Plan (Northern Territory EPA 2015)
- Environmental impact assessment and environmental approval under the Environment Protection Act 2019: environmental impact assessment guidance (Northern Territory EPA 2025)
- Land Clearing Guidelines, Northern Territory Planning Scheme (Department of the Environment, Parks and Water Security 2024)
- Australian Weeds Strategy 2017-2027 (DAWR 2017)
- National Light Pollution Guidelines for Wildlife (DCCEEW 2023c).

Environmental context

The terrestrial ecosystem is described in Section 4.3.2. Relevant environmental values of the Project area include mangrove and woodland communities, and habitat for significant and migratory fauna species, including shorebirds.

Potential impacts

The following activities have the potential to impact on terrestrial habitats if not managed appropriately:

- direct loss of flora/native vegetation and ecological communities from clearance of mangrove and woodland vegetation for construction of pipeline and other onshore infrastructure, and for ongoing maintenance, as required for easements.
- impacts and disturbances to habitat for EPBC Act and TPWC Act listed threatened or migratory species.

- fragmentation of vegetation communities, including sensitive vegetation such as mangrove communities.
- indirect disturbance or degradation to flora and native vegetation, e.g., from erosion, dust, disturbance of ASS, etc.
- impacts on vegetation or fauna through the introduction of, or increase in, invasive weed species and pathogens due to construction, operation, or maintenance activities
- introduction of, or increase in, pest animal species due to construction, operating, maintenance activities, or edge effects from disturbed areas
- indirect impacts on vegetation communities from the 'edge effect', where the clearing of vegetation creates an exposed boundary of the retained vegetation, creating opportunities for weed incursion and modified micro-climates (such as greater sunlight or wind exposure)
- impacts on avifauna, terrestrial reptiles and mammals from light emissions during construction activities
- impacts on avifauna, terrestrial reptiles and mammals from noise and vibration emissions during construction and operation of the inlet station and booster pumps (future phase)
- accidental entrapment or injury to terrestrial fauna, where fauna may become entrapped in trenches or other construction activities, or may be injured in the vegetation removal process or by vehicle strike
- improper management of wastes may result in pollution and contamination of the terrestrial environment
- impacts on terrestrial vegetation from unplanned discharges of hydrocarbons or chemicals during the commissioning phase
- changes in bushfire risk (fire frequency and intensity) due to vegetation clearing for Project infrastructure
- unplanned fire events construction activities including machinery, sparks, and hot works.

Vegetation clearing and earthworks

The area for the pipeline would lie within an about 200 m wide corridor from the inlet station to the LWM, a distance of approximately 1.5 km. The width of clearing along the construction corridor is expected to vary between 25 to 50 m, which may widen in areas to up to 200 m, dependent on-site conditions, to facilitate access and chosen construction methods. A wider clearance area is generally expected in the hinterland/woodland area which includes temporary areas to support shore pulls of the pipeline and cable, and pre-commissioning operations. The area cleared within the salt flat and mangrove areas would allow for trenching vehicles and equipment. The total area cleared within the ODA would be determined and refined during the project design and approvals process and depend on the final construction methodology chosen, with a large portion only planned as temporary clearance to support construction works followed by rehabilitation.

The mangrove communities in the ODA are considered to have high conservation value in Darwin Harbour for biological and cultural reasons, and as such are considered Significant Vegetation. The mangrove vegetation cleared at the cofferdam section of the shore crossing pipeline route would be dependent on the final construction parameters chosen. The route also runs parallel with the tidal flow, allowing diurnal tidal processes to continue supporting in the surrounding forest. Given the vast area of shoreline vegetation (predominantly mangroves) on Middle Arm coupled with a rehabilitation program post-construction, the effects on the mangrove community would be temporary and unlikely to result in long-term effects to mangroves forests and shoreline habitats.

Clearing of vegetation will not result in permanent habitat fragmentation or isolation of populations of species. Temporary cleared areas required during construction would be rehabilitated.

Light emissions

Light would be emitted from project vessels and from temporary lighting onshore during construction activities. The existing context for the onshore environment includes multiple existing onshore sources of light, including East Arm Wharf, the Darwin LNG plant at Wickham Point, the Ichthys LNG plant at Bladin Point and lower intensity lighting from residential and urban areas throughout the northern and eastern shores of Darwin Harbour.

Light emissions can affect fauna in two main ways:

- Behaviour: Many organisms are adapted to natural levels of lighting and the natural changes associated with the day and night cycle as well as the night-time phase of the moon. Artificial lighting has the potential to create a constant level of light at night that can override these natural levels and cycles.
- Orientation: Organisms such as marine turtles and marine avifauna may also use lighting from natural sources to orient themselves in a certain direction at night. In instances where an artificial light source is brighter than a natural source, the artificial light may act to override natural cues, leading to disorientation or mis-orientation.

Marine fauna within the Project area includes marine reptiles, resident and migratory seabirds and shorebirds, pelagic fish and zooplankton, and transient marine mammal species. Terrestrial fauna that may be affected by light emissions include mammals, birds, reptiles and amphibians.

Artificial light can disrupt the natural day-night cycle of terrestrial birds, potentially leading to disorientation during migration and changes in foraging and mating behaviours. Many species rely on natural light cues for navigation and timing of biological processes. It also increases the risk of predation and collisions with lit structures. Given the existing levels of artificial light adjacent to the ODA, the temporary nature of lighting for construction works and the low level of lighting required at the inlet station during operations, impacts are expected to be limited.

Potential impacts to terrestrial mammals associated with artificial lighting from construction / operational activities include an increased risk of predation, decrease in food consumption, impact to foraging patterns, disruption to dispersal patters for taxa, disruption to circadian rhythms and avoidance from the Project area (habitat displacement).

Given the existing levels of artificial light adjacent to the ODA, the temporary nature of lighting for construction works and the low level of lighting required at the inlet station during operations, it is unlikely that the artificial light would significantly impact terrestrial mammals.

Artificial light from construction activities has the potential to impact various terrestrial reptiles and amphibians. These potential impacts include disruption to circadian rhythms, disrupting sleep patterns, interference with reproduction via reducing breeding season or breeding call activity, increased risk of predation, and habitat avoidance. Although artificial light can cause various potential impacts to reptile and amphibian taxa, the impact from the Project would not be significant, due to the existing levels of artificial light adjacent to the ODA, the temporary nature of lighting for construction works and the low level of lighting required at the inlet station during operations.

Airborne noise and vibration

Airborne noise and vibration from activities associated with the project could result in the following potential impacts on terrestrial reptiles, amphibians, mammals and avifauna:

- Habitat displacement of various reptiles and amphibians that usually inhabit in proximity to the proposed pipeline corridor.
- Foraging and dispersal patterns, thereby changing where they are present.
- Changes in reproduction patterns, potentially impacting population dynamics.
- Additional or elevated stress for taxa, being on high alert constantly.
- Impacted vocal production and perception of acoustic communication between taxa.
- Potentially impacting a species ability to predate upon other species due to increased noise or vibration levels.

Airborne noise and vibration can also have the potential to impact to marine reptiles (turtles and crocodiles) in the nearshore or onshore environment.

While there are numerous potential impacts that could arise due to the construction of the project, the area already experiences some noise disturbance (although minimal) from the ongoing operation of nearby industry. It is unlikely that the construction noise associated with the proposed pipeline and onshore inlet station would significantly impact species listed above nor human health.

Introduced weeds, pests and pathogens

Project activities also have the potential to introduce new terrestrial species of plants and animals into the Middle Arm Peninsula area from the mobilisation of clearing and excavation vehicles. The introduction and establishment of invasive species and weeds can change the floristic structure of a vegetation community, reducing the diversity and ecological value of that area. Encroachment of invasive species and weeds can also reduce the area of native vegetation, by out-competing the native species.

Flora species, and particularly threatened flora species, have the potential to be impacted by weeds. Loss of habitat due to weed encroachment and change in floristic structure can reduce the range of occupancy of flora species. Native flora is often out-competed by more aggressive weed species, limiting the space and resources available for the establishment and persistence of native species.

It is considered that the risk of weed spread due to transport by vehicles or earthmoving equipment can be effectively managed by visual inspections and cleaning activities prior to the mobilisation of equipment to site. The risk of weed related impacts is considered low.

The introduction of invasive pests can have a deleterious effect on native species through competition for food and habitat and by predation. Pest animals recorded on Middle Arm Peninsula include the cane toad (Bufo marinus), feral pigs (Sus scrofa) and the black rat (Rattus rattus). Cane toads are widespread throughout the Darwin region and impact heavily on native reptile and mammal populations.

Fauna species, and particularly threatened fauna species, have the potential to be impacted by invasive species. Loss of habitat due to weed encroachment and change in floristic structure can reduce the range of occupancy of fauna species. Fauna species are also vulnerable to predation, particularly by invasive species such as feral cats and feral pigs, both of which have been recorded on Middle Arm Peninsula.

Bushfire

The key environmental impacts and risks due to fire events include loss and/or degradation of vegetation and fauna habitat, and injury/death of fauna due to fire in surrounding vegetation. A number of conservation significant terrestrial fauna species have been recorded in the onshore development area. The habitat types associated with these species are considered to be well represented within the locality and in the wider region.

Waste management

Given the likely small volumes of hazardous and solid wastes, and the occasional nature of the event, only insignificant changes to the terrestrial receptors would be expected. Significant impacts are unlikely to occur at an individual level and would not occur at a population level, nor result in the decrease of the quality of the habitat such that the extent of these species is likely to decline.

Unplanned discharges

Unplanned discharges accidentally discharged to the terrestrial environment may lead to the contamination of soil and groundwater as well as causing secondary impacts relating to potential contact of fauna with discharges. This may result in injury or mortality to fauna, either through contamination or physical injury depending on the nature of the waste.

Significant impacts are unlikely to occur at an individual level and are not expected to occur at a population level, nor result in the decrease of the quality of the habitat such that the extent of these species is likely to decline

Unplanned CO_2 release

An atmospheric CO_2 plume may result from an unplanned CO_2 release from the onshore inlet station or the buried or above ground components of the CO_2 transport pipeline. As CO_2 is denser than air, it can quickly displace oxygen. For human health an exposure limit of 40,000 ppm (the industry standard exposure concentration for 'immediately dangerous to life or health') is considered to represent the level at which multiple fatalities can occur.

The extent of impacts of a CO_2 release on the respiratory system of fauna such as mammals, birds, reptiles and some amphibians are expected to be similar to that of the zones presented for human exposure. Small mammals, reptiles, and burrowing animals are particularly vulnerable to CO_2 accumulation near the ground or underground. High concentrations can lead to disorientation, loss of consciousness or death due to asphyxiation. Sub-lethal CO_2 exposure may cause stress responses, including altered foraging behaviour and reduced reproductive success.

Elevated CO_2 concentrations in the soil from a buried pipeline leak can displace oxygen, leading to hypoxic conditions that impair root respiration and ultimately cause reduced plant growth and potential mortality (Lake and Lomax 2019). The severity of plant response varies with soil type. Sandy soils, for example, allow faster CO_2 diffusion, potentially reducing localised toxicity, while clay-rich soils may trap CO_2 longer, exacerbating root stress. A pipeline rupture would also result in very low temperatures (sub-zero). This is likely to be significant for all vegetation types as a result of sudden exposure beyond the normal temperature range and may result in structural impacts to stomata and cell membranes of vegetation in the immediate vicinity of a CO_2 leak. An atmospheric plume is expected to rapidly disperse, and impacts are expected to be highly localised.

Detailed assessment of leak scenarios, including modelling of CO_2 dispersion, will be conducted to inform an assessment of potential impacts.

Injury or entrapment of terrestrial fauna

Vehicle movements, vegetation clearing and major earthworks, such as the onshore trenching, may pose potential risks to terrestrial fauna such as removal of habitat causing displacement, potential injury due to physical interactions with vehicles or equipment and entrapment within trenches. Given similar representative habitat is available on Middle Arm, vegetation clearing and earthworks are unlikely to result in significant disturbance to fauna or long-term impacts on faunal communities in the area.

Open trenches and excavation sites created during pipeline construction can act as unintentional traps for terrestrial fauna. Animals such as reptiles, amphibians, small mammals, and ground-dwelling birds may fall into these structures while foraging or migrating, becoming unable to escape due to the steep and slippery sides.

Vehicle strikes pose an increased risk to terrestrial fauna during the construction phase, as machinery and vehicles operate in and traverse natural habitats with increased frequency. Particularly, wildlife may be struck while attempting to cross access roads or construction zones. This risk is higher during high-risk times such as dawn and dusk, when many species are most active.

The improper management of food scraps and/or workforce personnel encouraging fauna to the ODA may lead to fauna behavioural change.

Management

To meet the Northern Territory EPA objective for terrestrial ecosystems, the management controls presented in Table 6-10 would be implemented to minimise/mitigate potential impacts on terrestrial ecosystems.

Table 6-10: Terrestrial ecosystems - principal management and mitigation

Aspect	Principal management / mitigation
General	• Siting of the pipeline and other infrastructure would predominantly be within previously disturbed areas and areas zoned for Utilities. • A construction environmental management plan (CEMP) would be developed and implemented. The CEMP would include management measures for the following: - vegetation clearing, earthworks and rehabilitation - introduction of weed and pests - dust, erosion and sediment control

Aspect	Principal management / mitigation
	- surface water runoff and drainage - onshore spill prevention and response - waste management - chemical selection and approval.
Vegetation clearing	• The vegetation clearing footprint for the ODA and nearshore PDA would be minimised during the design phase, subject to constructability and safety considerations. • Areas to be cleared would be clearly identified prior to work commencing. Clearing boundaries would be marked in the field and on-site plans and register of clearing activities will be maintained. • Mangroves would be cleared in a way that minimises disturbance of the root system (such as cutting off the mangroves at root level or pushing the vegetation over). • Cleared vegetation would be mulched and stockpiled on site boundaries (outside the intertidal zone) or off site. Where possible, the mulch would be used for both rehabilitation and soil stabilisation to prevent erosion. • Temporarily disturbed areas within the ODA would be revegetated and rehabilitated following completion of construction activities.
Light emissions	• Lighting during construction and operations at the ODA would be limited to the minimum to meet personnel safety requirements. • Construction of the onshore infrastructure would primarily be conducted during daylight hours, where practicable.
Airborne noise and vibration	• Compliance with the requirements of the: - *Waste Management and Pollution Control Act 1998* (NT) - *Work Health and Safety (National Uniform Legislation) Act 2011* (NT) - National code of practice for noise management and protection of hearing at work [NOHSC: 2009 (2004)] (Commonwealth of Australia 2004). • Traffic management plan. • Construction works limited to daytime where practicable. • Community notifications and hotline for feedback.
Introduction of weeds, pests or pathogens	• Machinery used for earthmoving and vegetation clearing would be cleaned and inspected prior to commencement of work to remove any foreign material. • Topsoil containing high densities of weed seeds would not be used in rehabilitation. • Weed infestation would be quantified prior to any vegetation clearing in areas weeds are anticipated in the ODA
Accidental bushfire	• Fire-fighting equipment would be available at the work sites. • Designated smoking areas would be assigned.

Aspect	Principal management / mitigation
	• Hot work procedures would be implemented for cutting, welding and any other work considered to have a high potential to start a fire. Smoke detection in equipment rooms. • Power generator enclosures would be equipped with fire and gas detection.
Waste management	• During construction appropriate temporary containment facilities would be available for storing wastes. • All waste storage receptacles (e.g. skips and bins) would have covers and be fit for purpose and in good condition. • A suitably licenced waste contractor would be engaged for waste disposal.
Unplanned hydrocarbon/chemical release	• An emergency response plan would be developed and implemented as required. • The *Dangerous Goods Act 1998* (NT) would be complied with. • Chemicals and hazardous substances used during construction would be selected and managed to minimise potential adverse environmental impact associated with their transport, transfer, storage, use and disposal. • Spill kits would be available, maintained and accessible locations within the ODA and nearshore PDA. • During construction, appropriate temporary containment facilities (e.g. bunding) would be utilised for the storage of chemicals, fuels and hazardous wastes. • Personnel who routinely handle hazardous materials or wastes would receive training in handling, transporting and storing hazardous materials or wastes, and spill clean-up techniques and practices. • Safety Data Sheets would be available to aid in the identification of appropriate spill clean-up and disposal methods.
Unplanned CO_2 release	• The CO_2 transport pipeline would be designed to protect against threats to integrity including impact, corrosion, running ductile fracture and embrittlement. Design codes and material specifications would be compliant with the relevant Australian and international standards for transporting CO_2. • Testing would be undertaken prior to commissioning to confirm integrity of the CO_2 transport pipeline. • IMR activities would be conducted throughout operations, including monitoring the transport pipeline corrosion protection system, to manage the integrity of subsea infrastructure. • Compliance with obtained pipeline licences in accordance with the Energy Pipelines Act and PLSA (subject to amendment of legislation, refer to Section 2).
Injury or entrapment of terrestrial fauna	• Clearing activities would be undertaken in such a manner to allow animals to move into adjacent surrounding vegetation. • "High-risk" entrapment areas would have sloping egress ramps to prevent fauna entrapment. • Regular monitoring of construction areas would be undertaken to identify any trapped fauna, and any required removal would be completed by a suitably qualified wildlife handler.

Aspect	Principal management / mitigation
	• Vehicle speed limits within construction areas would be enforced.

Residual risk statement

Given the proposed mitigation measures to be implemented, the expected residual impact associated with terrestrial ecosystem is considered low (refer to Table 6-11).

Table 6-11: Terrestrial ecosystems – residual risk

Potential impact	Consequence	Likelihood	Residual risk
Impacts on terrestrial ecosystems from vegetation removal, habitat loss and fragmentation	Minor	Highly unlikely	Low
Impacts on terrestrial ecosystems from light emissions	Insignificant	Possible	Low
Impacts on terrestrial ecosystems from noise and vibration emissions	Insignificant	Possible	Low
Impacts on terrestrial ecosystems from improper waste management	Insignificant	Highly unlikely	Low
Impacts on terrestrial ecosystems from unplanned discharges of hydrocarbons or chemicals	Insignificant	Highly Unlikely	Low
Impacts on terrestrial ecosystems from the unplanned introduction of weeds, pest and pathogens	Minor	Highly Unlikely	Low
Impacts on terrestrial ecosystems due to changes in bushfire risk	Minor	Highly Unlikely	Low
Impacts on terrestrial ecosystems as a result of injury or entrapment of fauna	Insignificant	Possible	Low
Impacts on terrestrial ecosystems due to an unplanned CO_2 release	Moderate	Remote	Low

6.1.6 Air – Air quality

NT EPA environmental objective:
Protect air quality and minimise emissions and their impact so that environmental values are maintained.

Relevant policy and guidelines

The following key conventions, legislation, policy and guidelines are relevant:

- *Waste Management and Pollution Control Act 1998*
- National Environment Protection (Ambient Air Quality) Measure 1997
- National Environment Protection (Air Toxics) Measure 2004
- Guideline: Recommended Land Use Separation Distances (Northern Territory EPA 2017)
- Environment Protection (National Pollutant Inventory) Objective 2004 (Northern Territory)

Environmental context

Local air quality is described in Section 4.2.2. The nearest sensitive receptors are the residential areas of Palmerston, approximately 8 km to the north-east of the onshore inlet station at the nearest point. Other sensitive receptors to construction-related dust emissions include the surrounding vegetation, including sensitive mangrove communities.

Potential impacts

The following activities have the potential to impact on air quality if not managed appropriately:

- hydrocarbon combustion to operate the vessels and vehicles
- fugitive dust emissions during construction activities
- emissions of fine particulate matter from diesel combustion associated with the operation of vessels, vehicles and construction equipment.
- operational venting of CO_2 from the onshore inlet station during either maintenance activities, launch and receipt of PIGs (for inspection purposes) or during the connection of future booster pumping facilities or onshore pipelines. The volume to be vented would be equivalent to the volume of the PIG trap, or that of local piping/equipment
- Unplanned CO_2 release from the onshore inlet station or CO_2 transport pipeline.

Potential impacts associated with these activities include:

- construction phase: temporary and localised reduction in ambient air quality due to dust and particulate matter resulting impacts to amenity and vegetation
- operations phase: temporary and localised reduction in ambient air quality due to operational venting
- an unplanned leak of CO_2 into the atmosphere would contribute to GHG emissions. However, as a stand-alone event, the highly unlikely event of a loss of CO_2 containment would not result in a measurable change to atmospheric CO_2 levels and

would be negligible compared to the CO_2 removed from the atmosphere overall by the Project.

Atmospheric emissions from the Project would contribute to overall GHG concentrations and have the potential to result in localised changes in air quality and subsequent exposure of receptors to air pollutants.

A detailed assessment of atmospheric emissions will be conducted to inform an assessment of potential impacts on air quality.

Management

To meet the Northern Territory EPA environmental objective for air quality, the management controls presented in Table 6-12 would be implemented to minimise emissions and mitigate any potential impacts.

Table 6-12: Air quality - principal management and mitigation

Aspect	Principal management / mitigation
Dust generated during construction activities	• A construction environmental management plan (CEMP) would be developed and implemented. The CEMP would include management measures to manage generation of dust during clearing and earthworks, including: - revegetation of exposed areas as soon as practicable - covering of soil stockpiles as soon as practicable - application of dust suppression/binding agents to exposed stockpiles - use of water carts during dry and windy conditions.
Vessel, vehicle and construction equipment emissions	• Vessels (as applicable to vessel and engine size, type and class) would comply with the air emission, ODS, and energy efficiency requirements of Marine Order 97 including sulfur content of fuel oil. • Construction equipment and vehicles would be maintained in accordance with manufacturer specifications and turned off when not in use. • Implementation of an INPEX Australia contractor emissions reduction program to assist contractors to identify and implement areas where they can reduce emissions.
Operational venting	• Development of specific plans, including exclusion zones, for temporary onshore vent stacks for planned venting at the inlet station. • Development of standard operating procedures (SOPs) for depressurisation including pigging activities.
Unplanned CO_2 release	• The CO_2 transport pipeline would be designed to protect against threats to integrity including impact, corrosion, running ductile fracture and embrittlement. Design codes and material specifications would be compliant with the relevant Australian and international standards for transporting CO_2. • Testing would be undertaken prior to commissioning to confirm integrity of the CO_2 transport pipeline.

Aspect	Principal management / mitigation
	• IMR activities would be conducted throughout operations, including monitoring the transport pipeline corrosion protection system, to manage the integrity of subsea infrastructure. • Compliance with obtained pipeline licences in accordance with the Energy Pipelines Act and PLSA (subject to amendment of legislation, refer to Section 2).

Residual risk statement

Given the proposed mitigation measures to be implemented, the expected residual impact associated with air quality is considered low (refer to Table 6-13).

Table 6-13: Air quality – residual risk

Potential impact	Consequence	Likelihood	Residual risk
Air quality impacts from fugitive dust emissions and diesel particulate during construction	Insignificant	Possible	Low
Air quality impacts associated with operational venting during operations	Insignificant	Unlikely	Low
Air quality impacts associated with an unplanned CO_2 release	Moderate	Remote	Low

6.1.7 People – Community and economy

NT EPA environmental objective:
Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.

Relevant policy and guidelines

The following key conventions, legislation, policy and guidelines are relevant:

- EPBC Act (Cth)
- *Navigation Act 2012* (Cth)
- *Marine Act 1981* (Northern Territory)
- *Ports Management Act 2015* (Northern Territory)
- Darwin Harbour Strategy 2020-2025 (DHAC 2020)
- Guidelines for the preparation of an economic and social impact assessment (NT EPA 2013)

Environmental context

The socio-economic environment is described in Section 4.5 and includes commercial fisheries, defence areas, shipping, tourism, recreational activities and existing infrastructure for petroleum and telecommunications.

Potential impacts

The following activities have the potential to impact on the community and economy if not managed appropriately:

- vessel operations
- construction and operation of subsea infrastructure.

These activities have potential to impact on other marine users, including the following:

- commercial shipping
- commercial fishing
- recreational fishing
- defence
- existing petroleum and telecommunications infrastructure.

The physical presence of vessels in the PDA has the potential to cause disruption to other marine users, including shipping operators and fisheries through the reduction of space available to conduct shipping and fisheries activities in the area. A safety exclusion zone would be implemented around some construction/installation vessels as required (e.g. SWLB).

The type and number of vessels in the PDA at any one time, and the duration of presence, would differ depending on the Project phase. Vessel presence is expected to be greatest for short-term project phases (i.e. construction/installation), with the longer-term operational phase requiring significantly fewer vessels. Vessel physical presence and movement close to Darwin Harbour is limited to activities along the pipeline route and the cycling of dredging and spoil disposal between the PDA and spoil ground. These activities would be conducted over a period of months, and vessels would be continually moving. Vessels would be operating at low speeds within the PDA and would display navigational lighting and external lighting on a 24-hour basis, as required for safe operations.

Other marine users in the vicinity of the PDA may be impacted by vessel presence due to the loss of navigable space available to conduct their activities. The implications of such disruptions include changes to sailing routes and journey times, or reduced ability to fish in an area. The worst-case consequence from a loss of access to an area could result in economic losses and/or potential reduction in employment levels.

A review of AMSA's vessel traffic data for the PDA in 2024 confirmed the presence of major shipping lanes within the PDA (Section 4.5.4). Therefore, heavy vessel traffic would occur in some parts of the Project area.

There are several Commonwealth and State/Northern Territory managed fisheries overlap the Project area (Section 4.5.2). Of the Commonwealth fisheries, the Northern Prawn Fishery (currently active), Western Skipjack Tuna Fishery (inactive since 2009), Southern Bluefin Tuna Fishery (no fishing effort within project area between 2010 to 2023), and Western Tuna and Billfish Fishery (no fishing effort within project area between 2010 to 2023) overlap the Project area. There are also a number of Northern Territory -managed fisheries with fishing effort identified in the PDA. These include the Northern Territory-managed Demersal, Barramundi, Offshore Net and Line, Spanish Mackerel, Aquarium, Coastal Net and Coastal Line Fisheries (see Section 4.5.2).

Project activities in the PDA would take place intermittently over a period of approximately 18 months for dredging and pipelay. During this period, vessels would be continually moving and operating within a small spatial footprint. The presence of vessels and exclusion zones around the anchor spread for the SWLB (if required) would be limited to specific areas of the PDA at any one time. Therefore, fishing vessels would not be excluded from the entire PDA for the total duration of the Project. Furthermore, the PDA comprises a relatively small area when compared to the extent of the individual fishery boundaries. As such, displacement of commercial fisheries due to activities in the Project area are not expected to impact commercial fishing activities or the economic viability of the fisheries.

Recreational fishing occurs in Darwin Harbour; and over 100,000 hours of fishing effort was recorded in waters surrounding the Project area over an eight-month period (refer to Section 4.5.6). Other fishing activities such as Aboriginal traditional use of resources are known to occur along the Northern Territory and Western Australian coastlines during certain times of the year where resource availability may be influenced by the season. Potential impacts to tourism and recreational activities would likely be a minor interference (i.e. navigational hazard) and temporary, localised displacement/avoidance. Interactions in the PDA would be limited to the duration of construction activities and occasional IMR activities during operation of the Project.

As described in Section 4.5.3, the Project area overlaps defence exercise and training areas, such as NAXA. Access to NAXA may be restricted to all vessels and aircraft during planned military exercises, which will be established through consultation with Defence. Defence has previously requested that INPEX provide as much advance notice as possible for any planned activities by INPEX or contractors in the NAXA (approximately five to six weeks' notice). Disruption to Defence activities from the proposed activities would be of a minor impact.

A number of oil and gas pipelines and cables are located in proximity to the CO_2 transport pipeline. Separation distances will be implemented for pipelines and cables will be avoided. Should cable crossings be required, crossing supports such as mattresses or rock berms will be installed over the existing infrastructure.

Management

To meet the Northern Territory EPA environmental objective for community and economy, the management controls presented in Table 6-14 would be implemented to minimise and mitigate any potential impacts.

Table 6-14: Community and economy - principal management and mitigation

Aspect	Principal management / mitigation
Vessel presence and activities	• Vessels to adhere to the navigation safety requirements including the *Navigation Act 2012* and subsequent Marine Orders. • Establishment of safety/exclusion zones around construction and installation vessels (e.g. SWLB) as required. • Ongoing notifications/consultation with stakeholders, such as a notice to mariners. • Should cable crossings be required, crossing supports such as mattresses or rock berms would be installed over the existing infrastructure. • Consultation with Department of Defence regarding planned military exercises. • Establishment of an agreement with Department of Defence for activities within the NAXA.

Residual risk statement

Given the proposed mitigation measures to be implemented, the expected residual impact associated with community is considered low (refer to Table 6-15).

Table 6-15: Community and economy – residual risk

Potential impact	Consequence	Likelihood	Residual risk
Impacts on community and economy due to physical presence – disruption to other marine users	Minor	Highly unlikely	Low

6.1.8 People – Culture and heritage

NT EPA environmental objective:
Protect culture and heritage.

Relevant policy and guidelines

The following key conventions, legislation, policy and guidelines are relevant:

- *Environment Protection and Biodiversity Conservation Act 1999* (Cth)
- *Underwater Cultural Heritage Act 2018* (Cth)
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth)
- *Aboriginal Land Rights (Northern Territory) Act 1976* (Cth)
- *Native Title Act 1993* (Cth)
- *Heritage Act 2011* (Northern Territory)
- *Northern Territory Aboriginal Sacred Sites Act 1989* (Northern Territory)
- Convention on the Protection of Underwater Cultural Heritage (UNESCO 2001)
- United States of America *Sunken Military Craft Act 2004*
- Assessing and Managing Impacts to Underwater Cultural Heritage in Australian Waters (Cth)

Environmental context

The cultural environment is described in Section 4.4. Darwin Harbour contains a variety of historic, spiritual and heritage values that are significant to the people of the Northern Territory and Australia. Darwin Harbour and adjacent coastal waters also hold significant maritime and World War II heritage values including numerous wreck sites.

The ODA falls within the traditional country of the Larrakia people who are recognised as the Traditional Owners and custodians of the Darwin region and whose cultural places were and still are located throughout Darwin Harbour and the greater Darwin city area. The waters of Darwin Harbour, Bynoe Harbour, Shoal Bay, ODA contains known heritage sites.

Potential impacts

Construction activities within the ODA and nearshore PDA have the potential to impact on culture and heritage. In particular, the following activities may impact on protected heritage and sacred sites if not management appropriately:

- Darwin Harbour
  - seabed disturbance for pipelay and cable lay, including trenching and dredging
  - associated vessel movements and anchoring
- Onshore
  - construction activities, including site establishment works, vegetation clearance, earthworks and excavation.

Dredging would be required in Darwin Harbour for pipeline protection. Direct removal of the seabed is expected within the footprint of dredging. The construction of the shallow water pipeline section in coastal waters would be performed by a shallow water pipelay vessel positioned via an anchor spread.

Temporary seabed disturbance is anticipated during setting, moving and recovery of the lay barge anchors and mooring equipment as well as buckle and recovery pipeline activities.

Pipelay and cable lay will result in temporary seabed disturbance which could result in:

- the disturbance or damage to heritage sites resulting from anchoring on or in proximity to shipwrecks; and
- damage to previously unidentified heritage objects.

Five shipwrecks (three of which are protected) are overlapped by the nearshore PDA within Darwin Harbour. Vessel propeller wash from Project vessels may result in sediment scouring resulting in damage to maritime heritage.

The placement of infrastructure and associated seabed activities is yet to be confirmed and would be designed to avoid impacts to known maritime and cultural heritage from Project activities.

The ODA contains known heritage sites; therefore, the Project area may hold both cultural features and heritage values as described in Section 4.4, particularly in regard to Sea Country, with cultural and environmental values intrinsically linked.

Ground disturbance and vegetation clearance activities for the shoreline crossing and onshore pipeline installation have the potential to disturb and potentially destroy known heritage sites and previously unidentified heritage sites. Potential impacts include damage to declared heritage sites, previously unrecorded heritage sites and loss of cultural values.

Management

To meet the Northern Territory EPA environmental objective for culture and heritage, the management controls presented in Table 6-16 would be implemented to minimise/mitigate any potential impacts to protected heritage and sacred sites and previously unidentified heritage objects.

Table 6-16: Culture and heritage - principal management and mitigation

Aspect	Principal management / mitigation
General	• Develop and implement a Heritage Management Plan for activities in ODA and Nearshore PDA. • Undertake ongoing consultation with Larrakia to inform Aboriginal heritage management measures. • Implementation of the following additional management measures onshore to reduce and minimise impacts on cultural and heritage values:

Aspect	Principal management / mitigation
	- consultation with Larrakia people and organisations, including Larrakia Development Corporation, Larrakia Nation Aboriginal Corporation, Gwalwa Daraniki Association and the INPEX Larrakia Advisory Committee, during planning of geotechnical surveys and construction works - planning pre-construction surveys, in consultation with Larrakia people and their representatives - site protection measures, such as flagging/fencing off any heritage sites within proximity of the proposed impacts areas to avoid damage to sites during works (as determined in consultation with Larrakia representatives) - implementation of a chance find procedure during ground disturbance activities - contractor and work site cultural heritage inductions for all employees and contractors to point out importance of sites to Larrakia and the legislative protection of the sites.
Nearshore pipeline route selection and pipeline installation activities	• Geophysical and geotechnical pre-lay surveys would be undertaken to inform final pipeline route and seabed intervention requirements. • Geophysical survey data would be analysed to identify any archaeological/heritage values within the Nearshore PDA. Analysis undertaken by a qualified maritime archaeologist in accordance with the s3.6 of DCCEW guidelines - Accessing and Managing Impacts to Underwater Cultural Heritage in Australian Waters • Maritime cultural heritage would be avoided through pipeline routing. • AAPA Authority Certificates would be obtained that cover the area of works within NT, and the conditions of obtained certificates would be complied with. • Location data for all maritime heritage sites (including any applicable protection zones) and restricted works areas identified on AAPA Authority Certificates, would be provided to vessel contractors for inclusion in vessel navigation systems. • Exclusion zones and restricted works area requirements of registered sites, including anchoring exclusion zones would be included in Anchor Management Plans. • An unexpected maritime archaeology chance finds protocol with stop work and notification procedures would be implemented during construction and installation activities.
Vegetation clearing, ground disturbance and onshore construction activities	• Areas to be cleared would be clearly identified prior to work commencing. Clearing boundaries would be marked in the field and on-site plans and register of clearing activities would be maintained.

Residual risk statement

Given the proposed mitigation measures to be implemented during construction activities, the expected residual impact associated with culture and heritage is considered moderate (refer to Table 6-17).

Table 6-17: Culture and heritage – residual risk

Potential impact	Consequence	Likelihood	Residual risk
Impacts on maritime heritage from seabed disturbance	Moderate	Highly unlikely	Moderate
Disturbance of onshore sacred sites, cultural and heritage	Moderate	Highly unlikely	Moderate

6.1.9 People – Human health

NT EPA environmental objective:
Protect the health of the Northern Territory population.

Relevant policy and guidelines

The following key conventions, legislation, policy and guidelines are relevant:

- *Public and Environmental Health Act 2011* (Northern Territory).
- *Work Health and Safety (National Uniform Legislation) Act 2011* (Northern Territory).

Environmental context

The socio-economic environment is described in Section 4.5. The ODA is located on the Middle Arm Peninsula in Darwin Harbour. The nearshore PDA is in proximity to coastal communities of Darwin Harbour, including Bladin Point, Cox Peninsula and Darwin city centre.

Potential impacts

The following activities have the potential to impact on human health if not managed appropriately:

- CO_2 transport pipeline leak or rupture (subsea or onshore).
- A discharge of CO_2 from a leak or rupture at the onshore inlet station.

For a pipeline CO_2 leak with release to the atmosphere or an onshore leak, impacts may occur from the resultant atmospheric plume. As CO_2 is denser than air, it can quickly displace oxygen, leading to altered cognitive function, loss of consciousness, and asphyxiation which can result in mortality. If the leak was to occur from the CO_2 transport pipeline in the nearshore environment (Darwin Harbour) and the plume was to reach the surface, or from the onshore component of the pipeline, human health may be impacted.

For human health an exposure limit of 40,000 ppm (the industry standard exposure concentration for 'immediately dangerous to life or health') is considered to represent the level at which multiple fatalities can occur. Detailed assessment of leak scenarios from the CO_2 transport pipeline, including modelling of CO_2 dispersion, will be conducted to inform an assessment of potential impacts.

Management

To meet the Northern Territory EPA environmental objective for human health, the management controls presented in Table 6-18 would be implemented to minimise and mitigate any potential impacts.

Table 6-18: Human health - principal management and mitigation

Aspect	Principal management / mitigation
Unplanned CO_2 release	• The CO_2 transport pipeline would be designed to protect against threats to integrity including impact, corrosion, running ductile fracture and embrittlement. Design codes and material specifications would be compliant with the relevant Australian and international standards for transporting CO_2. • The CO_2 transport pipeline would be trenched and rock armouring installed within sections of Darwin Harbour to protect the pipeline from external impact. • Testing would be undertaken prior to commissioning to confirm integrity of the CO_2 transport pipeline. • IMR activities would be conducted throughout operations, including monitoring the CO_2 transport pipeline corrosion protection system. • Compliance with obtained pipeline licences in accordance with the Energy Pipelines Act and PLSA (subject to amendment of legislation, refer to Section 2).

Residual risk statement

Given the proposed mitigation measures to be implemented, the expected residual impact associated with community is considered moderate (refer to Table 6-19).

Table 6-19: Human health – residual risk

Potential impact	Consequence	Likelihood	Residual risk
Impacts on community and economy due accidental CO_2 leak	Significant	Highly unlikely	Moderate

6.1.10 Cumulative impacts

In the case of construction occurring concurrently with other developments in the area, potential cumulative impacts include:

- construction disturbance and amenity impacts (e.g. traffic, air quality, noise and light emissions)
- turbidity and sedimentation from seabed disturbance and pipelay activities
- underwater noise impacts on marine fauna
- disturbance of intertidal mudflats providing habitat for shorebirds
- direct removal of mangrove and woodland vegetation
- social, economic and cultural impacts onshore and offshore
- interaction with other marine users.

Post-construction, there are likely to be cumulative impacts to the community and environmental values related to land use changes and industrialisation of the Darwin Harbour environment due to the presence of infrastructure for this Project and other existing and potential developments in the area.

Relevant projects

Northern Territory EPA's guidance on referring a proposal to the Northern Territory EPA (NT EPA 2022) guides proponents to describe potential cumulative impacts of a proposal taking into account the combined impact of the action or proposal and other actions, including those that are currently under assessment or have already been approved.

Projects of relevance for the consideration of cumulative impacts include:

- Ichthys CCS
- Ichthys LNG maintenance dredging campaigns
- MASDP enabling works
- Darwin Ship Lift and Marine Industries Project
- Mandorah Marine Facilities
- HMAS Coonawarra
- Australia-Asia Powerlink.

Cumulative impacts would be considered in greater detail as part of the assessment process for the Project.

7 COMMONWEALTH MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Under the EPBC Act an action requires approval from the minister if it has, would have, or is likely to have, a significant impact on a matter of national environmental significance. A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity.

The Matters of National Environmental Significance - Significant Impact Guidelines 1.1 (Significant Impact Guidelines) are designed to assist any person who proposes to take an action to decide whether or not they should submit a referral to the DCCEEW for a decision by the Australian Government Environment Minister (the minister) on whether assessment and approval is required under the EPBC Act.

The purpose of this section is to provide an overview of the assessment of significance undertaken for the Project, as submitted separately under the EPBC Act. This assessment has been developed in alignment with the significant impact guidelines.

7.1 Matters of National Environmental Significance

The PMST search for MNES was conducted for the Project area on 13 May 2025.

According to the draft guidelines for the assessment of impacts on terrestrial biodiversity (Northern Territory EPA 2025c), when conducting database searches, proponents are to ensure the search radius is large enough to assess the potential impacts. The guidelines state that the search radius should be at least 20 km outside the proposal area, even for locations where extensive field studies have already been reported. Therefore, a 20 km buffer was applied to the PMST search for the Project areas defined in this document. The PMST results are provided in Table 7-1 and Appendix A.

Table 7-1: Summary of relevant MNES

Matters of National Environmental Significance	Relevant	Description
World heritage properties	N	There are no world heritage properties within the Project area
National heritage places	N	There are no national heritage places within the Project area
Wetlands of International Importance (Ramsar)	N	There are no wetlands of international important / Ramsar wetlands within the Project area
Great Barrier Reef Marine Park	N	Not applicable
Commonwealth marine areas	N	Not applicable (outside scope of this referral)
Listed threatened ecological communities	N	There are no listed threatened ecological communities within the Project area
Listed threatened species	Y	There are 59 threatened species within the Project area
Listed migratory species	Y	There are 75 migratory species within the Project area

7.2 Preliminary assessment of potential significant impacts on MNES

The following sections, provide an overview of the preliminary assessment of potential significant impacts on terrestrial MNES.

The PMST search conducted on 12 May 2025 (see Appendix A) revealed a combined total of 103 "listed threatened and migratory" species comprising 13 terrestrial birds, seven sea birds, 35 shore birds, one amphibian, 14 fish, sharks and rays, seven marine reptiles, four terrestrial reptiles, nine marine mammals, ten terrestrial mammals, and three plants.

The summary of the Listed Threatened and Migratory species predicted to occur within the Project area or within the 20 km buffer are provided in Section 4.3.4.

Descriptions of threatened species with a likelihood of occurrence of 'May', 'Likely', and 'Known' have been provided in Section 4.3.4. A likelihood of occurrence assessment (Appendix B) has been undertaken to determine the species taken through to the Preliminary Assessment of Potential Significant Impacts on MNES, with a summary presented in the following sections.

To assist in assessing whether a significant impact to MNES is likely to occur, the guidelines provide a set of significant impact criteria unique to each MNES group. The assessment presented in the tables below, utilise these criteria.

Each significant impact criterion is assessed as 'Potential for significant impact', 'Unlikely to have significant impact' or 'No significant impact'. Project aspects are assessed as having 'Potential for significant impact' if a significant impact is either likely or there is currently uncertainty about the Project or the potential impacts that prevents it from being determined as 'Unlikely to have significant impact' or 'No significant impact'.

7.2.1 Listed threatened species

The likelihood of occurrence assessment identified 35 threatened species as 'known to occur', 15 threatened species as 'likely to occur' and 32 threatened species as 'may occur' within the Project area.

A summarised assessment of potential impacts and risks from the Project against the significant impact criteria for these species is presented below. The detailed significant impact assessment is provided in the Bonaparte CCS Project EPBC Referral Supporting Information Document (ERM 2025).

Marine reptiles

Six (6) threatened marine reptile species were identified as 'May', 'Likely', or 'Known' to occur within the nearshore PDA (see Section 4.3.4). Of these species, three (3) are listed as endangered, and three (3) are listed as vulnerable. A summary of the significant impact assessment is provided in Table 7-2.

Table 7-2: Summary of the preliminary assessment of potential impacts to MNES - Threatened marine reptile species

Significant Impact Criteria	Assessment of Significant Impact
An action is likely to have a significant impact on a Threatened species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population.	*Unlikely to have a significant impact*

Significant Impact Criteria	Assessment of Significant Impact
Reduce the area of occupancy of the species.	*Unlikely to have a significant impact*
Fragment an existing population into two or more populations.	*No significant impact*
Adversely affect habitat critical to the survival of a species.	*Unlikely to have a significant impact*
Disrupt the breeding cycle of a population.	*Unlikely to have a significant impact*
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	*Unlikely to have a significant impact*
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat.	*No significant impact*
Introduce disease that may cause the species to decline.	*No significant impact*
Interfere with the recovery of the species.	*Unlikely to have a significant impact*

Terrestrial reptiles

Two (2) threatened terrestrial reptile species were identified as 'May', 'Likely', or 'Known' to occur within the ODA (see Section 4.3.4). Both species are listed as critically endangered. A summary of the significant impact assessment is provided in Table 7-3.

Table 7-3: Summary of the preliminary assessment of potential impacts to MNES - Threatened terrestrial reptile species

Significant Impact Criteria	Assessment of Significant Impact
An action is likely to have a significant impact on a Threatened species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population.	*Unlikely to have a significant impact*
Reduce the area of occupancy of the species.	*Unlikely to have a significant impact*
Fragment an existing population into two or more populations.	*Unlikely to have a significant impact*

Significant Impact Criteria	Assessment of Significant Impact
Adversely affect habitat critical to the survival of a species.	*Unlikely to have a significant impact*
Disrupt the breeding cycle of a population.	*Unlikely to have a significant impact*
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	*Unlikely to have a significant impact*
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat.	*Unlikely to have a significant impact*
Introduce disease that may cause the species to decline.	*No significant impact*
Interfere with the recovery of the species.	*Unlikely to have a significant impact*

Marine Mammals

Four (4) threatened marine mammal species were identified as 'May', 'Likely', or 'Known' to occur within the nearshore PDA (see Section 4.3.4). All of these species are listed as vulnerable. A summary of the significant impact assessment is provided in Table 7-4.

Table 7-4: Summary of the preliminary assessment of potential impacts to MNES - Threatened marine mammal species

Significant Impact Criteria	Assessment of Significant Impact
An action is likely to have a significant impact on a Threatened species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population.	*Unlikely to have a significant impact*
Reduce the area of occupancy of the species.	*Unlikely to have a significant impact*
Fragment an existing population into two or more populations.	*Unlikely to have a significant impact*
Adversely affect habitat critical to the survival of a species.	*No significant impact*

Significant Impact Criteria	Assessment of Significant Impact
Disrupt the breeding cycle of a population.	*Unlikely to have a significant impact*
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	*Unlikely to have a significant impact*
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat.	*No significant impact*
Introduce disease that may cause the species to decline.	*No significant impact*
Interfere with the recovery of the species.	*Unlikely to have a significant impact*

Terrestrial mammals

Three (3) threatened terrestrial mammal species were identified as 'May', 'Likely', or 'Known' to occur within the ODA (see Section 4.3.4). Of these species, one (1) is listed as endangered, and two (2) are listed as vulnerable. A summary of the significant impact assessment is provided in Table 7-5.

Table 7-5: Summary of the preliminary assessment of potential impacts to MNES - Threatened terrestrial mammal species

Significant Impact Criteria	Assessment of Significant Impact
An action is likely to have a significant impact on a Threatened species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population.	*Unlikely to have a significant impact*
Reduce the area of occupancy of the species.	*Unlikely to have a significant impact*
Fragment an existing population into two or more populations.	*Unlikely to have a significant impact*
Adversely affect habitat critical to the survival of a species.	*Unlikely to have a significant impact*
Disrupt the breeding cycle of a population.	*Unlikely to have a significant impact*

Significant Impact Criteria	Assessment of Significant Impact
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	*Unlikely to have a significant impact*
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat.	*Unlikely to have a significant impact*
Introduce disease that may cause the species to decline.	*No significant impact*
Interfere with the recovery of the species.	*Unlikely to have a significant impact*

Avifauna

Seabirds and shorebirds

16 threatened seabird and shorebird species were identified as 'May', 'Likely', or 'Known' to occur within the nearshore PDA (see section 4.3.4). Of these species, two (2) are listed as critically endangered, five (5) are listed as endangered, and nine (9) are listed as vulnerable. A summary of the significant impact assessment is provided in Table 7-6.

Table 7-6: Summary of the preliminary assessment of potential impacts to MNES - Threatened seabird and shorebird species

Significant Impact Criteria	Assessment of Significant Impact
An action is likely to have a significant impact on a Threatened species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population.	*Unlikely to have a significant impact*
Reduce the area of occupancy of the species.	*Unlikely to have a significant impact*
Fragment an existing population into two or more populations.	*Unlikely to have a significant impact*
Adversely affect habitat critical to the survival of a species.	*Unlikely to have a significant impact*
Disrupt the breeding cycle of a population.	*Unlikely to have a significant impact*

Significant Impact Criteria	Assessment of Significant Impact
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	*Unlikely to have a significant impact*
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat.	*Unlikely to have a significant impact*
Introduce disease that may cause the species to decline.	*No significant impact*
Interfere with the recovery of the species.	*Unlikely to have a significant impact*

Land birds

One (1) threatened land bird species was identified as 'May', 'Likely', or 'Known' to occur within the ODA (see Section 4.3.4). The species is listed as vulnerable. A summary of the significant impact assessment is provided in Table 7-7.

Table 7-7: Summary of the preliminary assessment of potential impacts to MNES - Threatened land bird species

Significant Impact Criteria	Assessment of Significant Impact
An action is likely to have a significant impact on a Threatened species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population.	*Unlikely to have a significant impact*
Reduce the area of occupancy of the species.	*Unlikely to have a significant impact*
Fragment an existing population into two or more populations.	*Unlikely to have a significant impact*
Adversely affect habitat critical to the survival of a species.	*Unlikely to have a significant impact*
Disrupt the breeding cycle of a population.	*Unlikely to have a significant impact*
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	*Unlikely to have a significant impact*

Significant Impact Criteria	Assessment of Significant Impact
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat.	*Unlikely to have a significant impact*
Introduce disease that may cause the species to decline.	*Unlikely to have a significant impact*
Interfere with the recovery of the species.	*Unlikely to have a significant impact*

Fish, sharks and rays

Six (6) threatened fish, shark, and ray species were identified as 'May', 'Likely', or 'Known' to occur within the nearshore PDA (see section 4.3.4). Of these species, one (1) is listed as critically endangered, two (2) are listed as endangered, and three (3) are listed as vulnerable. A summary of the significant impact assessment is provided in Table 7-8.

Table 7-8: Summary of the preliminary assessment of potential impacts to MNES - Threatened fish, shark and ray species

Significant Impact Criteria	Assessment of Significant Impact
An action is likely to have a significant impact on a Threatened species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population.	*Unlikely to have a significant impact*
Reduce the area of occupancy of the species.	*Unlikely to have a significant impact*
Fragment an existing population into two or more populations.	*Unlikely to have a significant impact*
Adversely affect habitat critical to the survival of a species.	*Unlikely to have a significant impact*
Disrupt the breeding cycle of a population.	*Unlikely to have a significant impact*
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	*Unlikely to have a significant impact*

Significant Impact Criteria	Assessment of Significant Impact
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat.	*No significant impact*
Introduce disease that may cause the species to decline.	*No significant impact*
Interfere with the recovery of the species.	*Unlikely to have a significant impact*

Plants

No plants listed under the EPBC Act have been assessed as 'known to occur', 'likely to occur' or 'may occur' in the ODA (). Three plants were identified in the PMST search: *Atalaya brevialata*, *Stylidium ensatum*, and *Typhonium taylorii*. All three species have been assessed as unlikely to occur in the Project area, due to limited or no habitat presence, and surveys conducted by the DLRM (2016) and EcOz (2023).

7.2.2 Listed migratory species

The PMST search conducted on 12 May 2025 identified a total of 70 migratory species within the Project area. The likelihood of occurrence assessment identified 34 migratory species as 'known to occur', 11 migratory species as 'likely to occur', and 24 species as 'may occur' within the Project area (see section 4.3.4).

A summarised assessment of potential impacts and risks from the Project against the significant impact criteria for these species is presented below (Table 7-9).

Table 7-9: Summary of the preliminary assessment of potential impacts to MNES - Migratory Species

Significant Impact Criteria	Assessment of Significant Impact
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	*Unlikely to have a significant impact*
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	*Unlikely to have a significant impact*
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	*Unlikely to have a significant impact*

8 PROPOSED PROGRAM OF INVESTIGATIONS

INPEX plans to conduct further investigations to support the detailed EIA process. A gap analysis would be conducted to determine additional environmental baseline studies required to inform a detailed evaluation of impacts and risks and future monitoring. An outline of indicative assessments are identified in Table 8-1.

Table 8-1: Indicative desktop assessments to support detailed EIA

Study	Study Objectives	Potential Methods Being Considered
Dredging and spoil disposal / sediment transport impact assessment	• Characterisation of the materials to be dredged • Dredge and spoil disposal options assessment • Understand potential extent of excess suspended sediment concentrations and sediment deposition as a result of dredging and spoil disposal activities. • Evaluate potential impacts on sensitive receptors (e.g. benthic communities).	• Sediment sampling • Numerical hydrodynamic and sediment transport modelling – excess suspended sediment concentrations and sediment deposition.
CO_2 release modelling	• Evaluate the fate and effect of unplanned CO_2 leaks from the Project infrastructure.	• Numerical/quantitative modelling - credible CO_2 leak scenarios
Hydrocarbon spill modelling	• Evaluate the fate and effect of unplanned and accidental marine-related hydrocarbon spills during the Project. • Results would inform spill preparedness and emergency response arrangements.	• Numerical/quantitative modelling – credible hydrocarbon spill scenarios
Social impact assessment	• Identification of socio-economic uses within the marine environment. • Assessment of potential social impacts.	• Stakeholder consultation • Desktop assessment
Cultural heritage assessment	• Identify tangible and intangible cultural heritage within the Project area and surrounds through consultation, desktop assessment and field surveys. • Development of a Cultural Heritage Management Plan.	• First nations consultation • Underwater and terrestrial cultural heritage investigations as per DCCEEW 2024 Guidelines (including desktop assessment and field surveys)

9 CONSULTATION

INPEX believes effective stakeholder engagement is essential in maximising the safety of INPEX and Contractor personnel, and the community; and in establishing, building and maintaining community support and trust. INPEX works closely with identified stakeholders to provide integrated, timely and effective information to the community and provide mechanisms for feedback and response.

INPEX's approach to integrated stakeholder engagement is based on five key principles:

- regular personal contact with priority stakeholders
- consistent, timely, coordinated and responsive communication across all stakeholder groups
- upfront communication about issues and impacts
- easily accessible information
- ongoing monitoring and improvement.

INPEX has prepared a stakeholder engagement plan to support Bonaparte Carbon Capture and Storage project activities. The Plan has been prepared to meet the regulatory requirements for consultation under the Northern Territory EP Act, and subordinate legislation.

Section 43 of the EP Act (NT) outlines the general duty of proponents and includes specific requirements for stakeholder consultation. Specifically, the EP Act requires the following:

A proponent of an action has the following general duties under an environmental impact assessment process:

a. To provide communities that may be affected by a proposed action with information and opportunities for consultation to assist each community's understanding of the proposed action and its potential impacts and benefits;

b. To consult with affected communities, including Aboriginal communities, in a culturally appropriate manner; and

c. To seek and document community knowledge and understanding (including scientific and traditional knowledge and understanding) of the natural and cultural values of areas that may be impacted by the proposed action.

In addition to the EP Act requirements, the NT EPA *Stakeholder Engagement and Consultation: Environmental Impact Assessment Guidance for Proponents* (SEC) outlines the expectations of the NT EPA with regards to stakeholder consultation. The SEC outlines that proponents are responsible for undertaking stakeholder consultation from the earliest stage of the environmental impact assessment process, and that stakeholder consultation would continue throughout the life of an activity.

9.1 Overview of process

An overview of INPEX's approach to stakeholder consultation is presented in the following sections. A full description of the approach is provided in the Bonaparte Carbon Capture and Storage Project Stakeholder Engagement Plan (Appendix D), which has been provided separately to the NT EPA as a standalone document.

9.1.1 Stakeholder mapping

INPEX has undertaken a stakeholder mapping exercise to identify relevant stakeholders and ensure they are engaged in the most effective manner with targeted and responsive engagement activities for the purposes of the Project.

Stakeholders were screened to establish if their functions or activities could be potentially impacted as result of either overlap with the Project Area or as a result of Project activities. Where there was no perceived effect on a stakeholder's functions or activities the stakeholder was not considered further.

It is acknowledged that through the process of consulting with identified stakeholders, additional stakeholders may be brought to INPEX's attention.

9.1.2 Timing

Timing of stakeholder engagement would be implemented during the following key stages, as follows:

- pre-referral engagement - the purpose of the engagement was to:
  - obtain advice on appropriateness of proposed management controls
  - obtain advice on required notifications and ongoing engagement requirements
- ongoing engagement – the purpose of this engagement is to:
  - respond to stakeholder requests for information about project activities, including management of feedback or any concerns
  - provide sufficient notice to key stakeholders prior to the commencement of upgrades, construction and commissioning works to ensure effective communication of the timing of works, and the associated safety and environmental measures
  - proactively provide information throughout the proposed activities above, to support safety outcomes and manage potential community impacts and;
  - provide confirmation of completion of the proposed activities above to communicate final results and acknowledge the community's support.

9.1.3 Engagement tools

A range of tools are used to target and engage with stakeholder groups in an appropriate manner. INPEX considers industry best practice standards and codes of conduct in designing project specific engagement. These tools build on the successful activities employed by INPEX in the Northern Territory since 2009 and are informed by stakeholder needs and requirements. INPEX will continue to maintain and develop and strengthen stakeholder relationships when required given the long-term operational life of the Project.

Engagement tools may include formal briefings with stakeholders, community public information forums, advertising and media (including social media), fact sheets, INPEX website, INPEX 1800 community feedback line, INPEX community enquiries email account project specific email account.

9.2 Stakeholder consultation – Pre-referral

The complete stakeholder register, outlining stakeholders who were consulted during the pre-referral stage and any relevant information that was provided to them for consideration, is presented in Appendix E. Where feedback was received a summary of this and how it has been addressed in the Referral Report is provided in Table 9-1.

Table 9-1: Summary material matters raised

Stakeholder	Summary of material stakeholder feedback	Summary of INPEX response or actions
Wagait shire council	Requested consideration of the potential impacts on ferry routes during construction of the proposed pipeline.	Consultation with Wagait shire council is ongoing and will consider any potential impacts during construction.
Land development corporation (LDC)	LDC assisted INPEX to arrange a series of Larrakia family meetings. Feedback was Larrakia families would like to remain informed and gave INPEX feedback on how to continue consultation with the as the project progresses.	INPEX will incorporate feedback into the design of ongoing consultation activities to be implemented under the Stakeholder engagement plan (Appendix E).
Department of Logistics and Infrastructure - Regional Harbourmaster	Requested a harbour activity schedule and outlined expectations for ongoing engagement/updates.	INPEX provided key activity timeframes and consultation is ongoing.
Northern prawn fishing industry (NPFI)	Requested a shape file of the proposed pipeline route.	INPEX completed the risk assessment using recent data available and provided NPFI a summary of the content described in Section 4.5.2 including the shape files of the proposed pipeline route figures showing potential overlap with NPFI fishery.
Department of Defence (DoD) -Northern command	DoD provided feedback on the proposed pipeline route options presented to them including the proposed potential location of in-field infrastructure in relation to the Northern Australian Exercise Area (NAXA).	INPEX has considered alternative pipeline routes within the referral and how to reduce the overlap of the Project footprint with the NAXA. Consultation with DoD is ongoing.

9.3 Stakeholder consultation - ongoing

Stakeholder engagement is planned to be undertaken throughout the life of the Project and is described in the Bonaparte Carbon Capture and Storage Stakeholder Engagement Plan (Appendix D).

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APPENDIX A: PROTECTED MATTERS SEARCH RESULTS

Submitted as a separate appendix to the NT EPA.

APPENDIX B: LIKELIHOOD OF OCCURRENCE ASSESSMENT

Submitted as a separate appendix to the NT EPA.

APPENDIX C: PRELIMINARY ASSSESSMENT OF POTENTIAL IMPACTS ON NORTHERN TERRITORY ENVIRONMENTAL FACTORS OR VALUES

The purpose of the preliminary assessment is to determine whether the Project has the potential for significant environmental impact under the EP Act. A significant environmental impact is defined by Section 11 of the EP Act as:
An impact of major consequence having regard to:

- The context and intensity of the impact
- The sensitivity, value and quality of the environment impacted on, and the duration, magnitude and geographic extent of the impact.

The preliminary assessment was undertaken using the pre-screening tool provided in the *Guideline – Referring a Proposal to the NT EPA* (Referring a proposal to the NT EPA). Each of the NT EPA identified environmental factors/objectives were assessed in context of the specific questions outlined in the NT EPA guidance document (refer Figure 10-1).

The outcomes of the preliminary assessment are presented in Table 10-1.

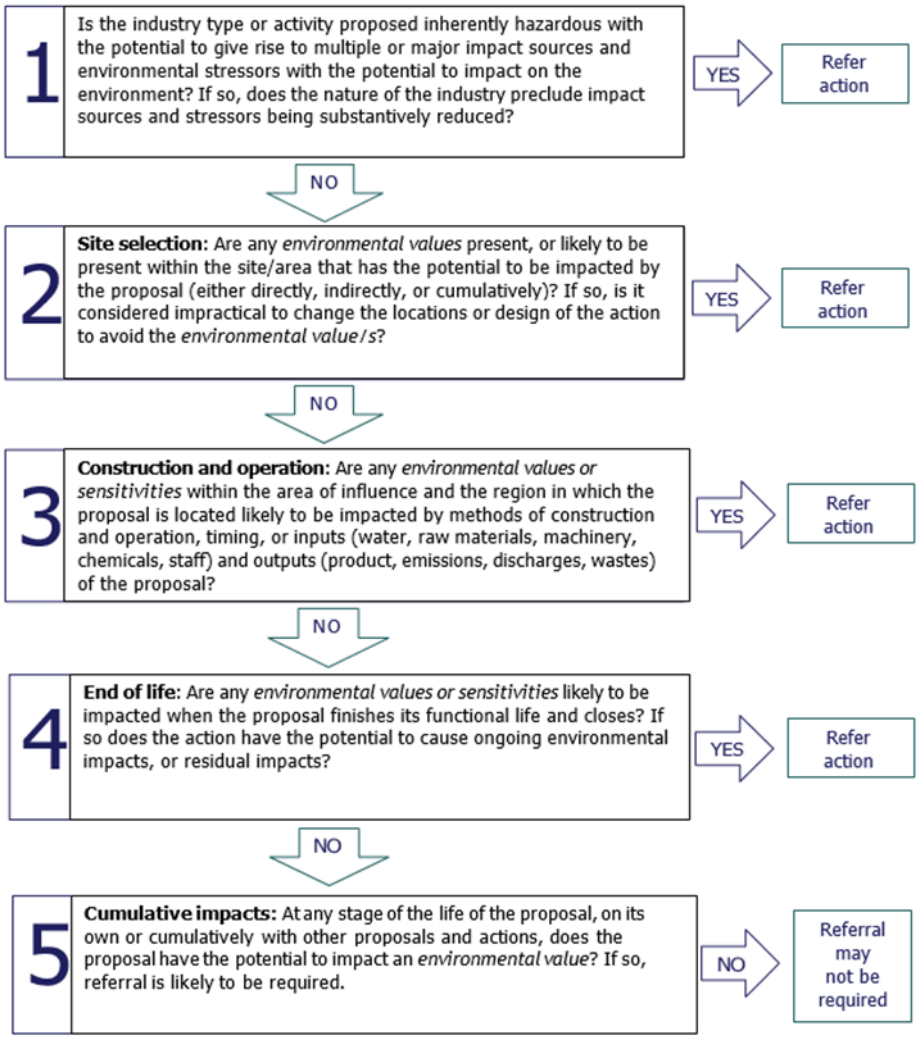

Figure 10-1: Preliminary assessment screening questions

Table 10-1: NT EPA environmental factor and values preliminary assessment

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)	Q2	Q3	Q4	Q5
Is the industry type or activity proposed inherently hazardous with the potential to give rise to multiple or major impact sources and environmental stressors with the potential to impact on the environment?					Yes ☐ No ☒				
If so, does the nature of the industry preclude impact sources and stressors being substantively reduced?					Yes ☐ No ☒				
Land	Landforms	Conserve the variety and integrity of distinctive physical landforms.	• distinctive features in the landscape, either geological or anthropogenic • subterranean karstic terrain and faults • craters, gorges, ranges, caves, massifs, escarpments, plateaus • monuments • tourism related to landform	Not applicable.	Yes No Uncertain Not applicable	☐ ☐ ☐ ☒	☐ ☐ ☐ ☒	☐ ☐ ☐ ☒	☐ ☐ ☐ ☒
	The Project will not impact on the integrity of existing terrestrial landforms. The Project disturbance footprint is mostly located in previously disturbed areas or co-located with existing infrastructure within land designated for Utilities and Development.								
	Terrestrial environmental quality	Protect the quality and integrity of land and soils so that environmental values are supported and maintained.	• high quality soils, including chemical, physical, biological and aesthetic qualities that support life • the biological processes that depend on soil quality	Refer to Section 4.2.7 and Section 4.3.2.	Yes No Uncertain Not applicable	☐ ☒ ☐ ☐	☐ ☐ ☒ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐
	Assessment statement: The Project is not anticipated to significantly impact on the quality and integrity of terrestrial land and soils. Most of the Project footprint was previously cleared of vegetation during the construction of Ichthys GEP, which was approved as part of the Ichthys LNG Development Project. However potential acid sulphate soils (PASS) or ASS are known to exist in the Project area. If encountered the following controls will be incorporated within the Construction Environmental Management Plan (CEMP): • In accordance with International Erosion Control Association (IECA) Best Practice Erosion Control Guidelines (BPESC) Guidelines (IECA 2008), INPEX will implement an erosion and sediment control plan (ESCP) that has been endorsed by a certified professional. Should PASS or ASS be encountered during trenching and excavation activities. The following controls will be in place: • The transportation, storage and handling of hazardous and polluting substances managed in accordance with the appropriate Australian Standards and the Waste Management Pollution Control Act.								
	Terrestrial ecosystems	Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	• sensitive or significant' vegetation or buffers (as defined in the NT Land Clearing Guidelines) • listed threatened species and their habitat (NT and Commonwealth) • listed migratory species and their habitat (Commonwealth) • listed threatened ecological communities (Commonwealth) • locally endemic species or species with restricted habitat • locally endemic or restricted species and their habitat • species that are data deficient with unknown protection status • protected area or reserve, including Indigenous Protected Area • biosecurity	Refer to Sections 4.3.2, 4.3.3 and 4.3.4.	Yes No Uncertain Not applicable	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)				
						Q2	Q3	Q4	Q5
			• high quality biological and functional diversity, integrity and services						
	Assessment statement: Construction activities are mostly limited to the previously disturbed envelope for the GEP on land zoned for Development and for Utilities (within land parcel 1896). The ODA crosses mangrove communities, Melaleuca forest and Monsoon Vine Forest. Native vegetation removal is likely to be required. A ground-truth vegetation survey of the pipeline corridor (between the mudflats and inlet station) was undertaken in December 2023 to verify existing vegetation mapping of the corridor and identify suitable habitat for threatened flora species with the potential to occur within the footprint. The survey found that the northern portion of the corridor consisted of regrowth, while the southern side was previously undisturbed and included Melaleuca dominated forest. No threatened flora species were identified within the ODA. Suitable habitat for a number of listed threatened fauna species (e.g., black-footed tree-rat, northern brushtail possum, bare-rumped sheathtail bat, Mitchell's water monitor, and some shorebird species) is known to occur in the area; however, this is well represented on Middle Arm and within the broader area.								
Water	Hydrological processes	Protect the hydrological regimes of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	• the supply and quantity of water in surface water features including rivers, lakes, wetlands, swamps, creeks, billabongs, intermittent streams, floodplains, mangroves and drainage lines • the supply and quantity of water in groundwater features including aquifers, aquitards and water tables • declared beneficial uses • present and future uses, and users of water • current or potential water supplies, including regional scale aquifers • culturally important water features or other features affected by water level	Refer to Section 4.3.2.	Yes No Uncertain Not applicable	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐
	Assessment statement: The proposed action is not anticipated to significantly impact on hydrological regimes of groundwater or surface water, as no freshwater surface water or groundwater features, are identified in or downstream of the proposed development footprint. The surface water runoff and groundwater aquifer underlying the proposed development footprint has the potential to interact with marine ecosystems, see assessment statement for the Factors under Theme – Sea.								
	Inland water environmental quality	Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	• the quality of water in surface water features including rivers, lakes, wetlands, swamps, creeks, billabongs, intermittent streams, floodplains, mangroves and drainage lines • the quality of water in groundwater features including aquifers and water tables • declared beneficial uses • present and future uses and users of water • current or potential water supplies, including regional scale aquifers • potability / drinkability • culturally important water features	Refer to Section 4.2.6.	Yes No Uncertain Not applicable	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐
	Assessment statement: The proposed action is not anticipated to impact on the quality of groundwater or surface water, as no freshwater surface water or groundwater features, are identified in or downstream of the proposed development footprint. The surface water runoff and groundwater aquifer underlying the proposed development footprint has the potential to interact with marine ecosystems.								

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)				
						Q2	Q3	Q4	Q5
	Aquatic ecosystems	Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	• threatened species • the health of the biota in inland waterways • the habitats that support the lifecycle of aquatic biota • groundwater dependent ecosystems • Ramsar wetlands • high quality biological and functional diversity, integrity and services	Not applicable	Yes No Uncertain Not applicable	☐ ☐ ☐ ☒	☐ ☐ ☐ ☒	☐ ☐ ☐ ☒	☐ ☐ ☐ ☒
	Assessment statement: The proposed action is not anticipated to impact on freshwater aquatic ecosystems as no freshwater aquatic ecosystems are present within or downstream of the proposed development footprint.								
Sea	Coastal processes	Protect the geophysical and hydrological processes that shape coastal morphology so that the environmental values of the coast are maintained.	• processes that support marine ecosystems such as coral reefs and mangroves • processes that support coastal morphology such as beaches, rock bars, and sandbars • tidal creeks, deltas and river mouths • storm surge protection • unique coastal landforms	Refer to Section 4.2.5.	Yes No Uncertain Not applicable	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐
	Assessment statement: There is a potential for the pipeline shore crossing activities and chosen infrastructure to impact hydrodynamics. This has been discussed as part of the environmental hazard identification workshop for the Project. As the majority of the proposed activity is within the previous disturbance corridor for the GEP, including the previous shore crossing, the proposed action is not expected to impact on geophysical and hydrological processes that shape coastal morphology. Sediment transport modelling will be undertaken to confirm these findings.								
	Marine environmental quality	Protect the quality and productivity of water, sediment and biota so that environmental values are maintained.	• quality of the water, sediment and biota • physical parameters that support fishing and aquaculture • physical parameters that support recreation and aesthetics • industrial water supply • cultural and spiritual values	Refer to Sections 4.2.5 and 4.2.6.	Yes No Uncertain Not applicable	☐ ☒ ☐ ☐	☒ ☐ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐
	Assessment statement: Proposed project shoreline crossing and nearshore activities have the potential to impact quality and productivity of water, sediment and biota.								
	Marine ecosystems	Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	• conservation significant marine and coastal fauna and critical habitat such as nesting, breeding or foraging habitat • conservation significant marine and coastal benthos (seagrass meadows, sponge gardens, coral reefs, mangrove communities and salt marshes) • ecological functions and processes • high quality biological and functional diversity, integrity and services	Refer to Sections 4.3.1 and 4.3.4.	Yes No Uncertain Not applicable	☐ ☒ ☐ ☐	☒ ☐ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐
	Assessment statement:								

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)	Q2	Q3	Q4	Q5
	Proposed project shoreline crossing and nearshore activities could interact with marine habitats and environmental values.								
Air	Air quality	Protect air quality and minimise emissions and their impact so that environmental values are maintained.	• ambient air quality in the local airshed • the chemical, physical and biological characteristics of quality air • the biological processes that depend on the air quality	Refer to Section 4.2.2.	Yes No Uncertain Not applicable	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐
	Assessment statement: The proposed action may have a temporary impact on air quality in within the Project area and the surrounds. Construction air emissions such as dust and equipment/vehicle exhaust are not predicted to be significant and are readily manageable. Dust would be generated during onshore stockpiling and marine loadout of rock for placement on the pipeline. Standard dust control management measures would be implemented. Air emissions within Darwin Harbour and Offshore Northern Territory waters will be caused predominately by vessels, more specifically from engine exhausts. Any emissions as a result of vessel operations will be temporary and highly localised. The Project is considered to support a net reduction in greenhouse gas emissions in the Northern Territory.								
	Atmospheric processes	Minimise greenhouse gas emissions so as to contribute to the NT Government's goal of achieving net zero greenhouse gas emissions by 2050.	• a contribution to the NT's greenhouse gas emissions through nearing or reaching emission thresholds for: - industrial projects of 100 000 $tCO_{2\text{-}e}$ scope 1 emissions per year not counting emissions generated from land clearing - land use projects of 500 000 $tCO_{2\text{-}e}$ scope 1 emissions from single or cumulative land clearing actions		Yes No Uncertain Not applicable	☐ ☐ ☐ ☒	☐ ☐ ☐ ☒	☐ ☐ ☐ ☒	☐ ☐ ☐ ☒
	Assessment statement: The proposed action is not anticipated to contribute significantly to greenhouse gas emissions in the Northern Territory. Greenhouse gas emissions associated with the activity are limited to the operation of a construction machinery and any crew support vessel/s. Any emissions as a result of vessel operations and/ or construction machinery will be temporary and highly localised. Other potential GHG emissions relate to pre-commissioning and commissioning activities, are considered to be incidental, relatively small scale and short term. The Project is considered to support a net reduction in greenhouse gas emissions in the Northern Territory.								
People	Community and economy	Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.	• communities, towns and suburbs where people live • community aspirations for liveable environment and healthy lifestyles: - affordable access to food, water, electricity, transport and communication networks. - good amenity – air quality, noise, aesthetics - access to social infrastructure and services including transport and logistics - access to natural resources including bush food - recreational use of the natural or built environment (e.g. fishing, cycling, sports, picnics) - species of social, cultural, livelihood and or economic importance (terrestrial, aquatic and marine biota) • participation in jobs, businesses and education • existing industries such as agriculture, pastoralism, tourism, fisheries	Refer to Section 4.5.	Yes No Uncertain Not applicable	☐ ☒ ☐ ☐	☐ ☐ ☒ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)				
						Q2	Q3	Q4	Q5
			• vulnerable sectors of the community						
	Assessment statement: The Project may impact communities and the economy through planned activities like physical presence, noise, and air emissions, as well as unplanned events such as waste management issues, unplanned discharges and introduced marine species. Affected local values include recreational and commercial fishing, aquaculture, charter boat operations and other port activities. These values could be directly impacted via Project activities (e.g., physical presence of vessels and infrastructure) or indirectly impacted as a result of the Project activities impacting other environmental values, including seabed disturbance (e.g., trenching and dredging), pipelay activities, noise emissions and unplanned activities (e.g., spills, introduction of invasive marine species, fauna interaction, etc.). Similar Project activities were recently assessed for the Santos Darwin Pipeline Duplication project's Supplementary Environmental Report and found the potential impacts to be low or negligible. With the implementation of management measures to be adopted to avoid and minimise environmental impacts, significant impacts on community and economy are not expected. While adverse impacts on the community and economy are not expected, the Project is expected to generate positive benefits for the economy and welfare of Territorians. Therefore, a net benefit is expected for this environmental factor.								
	Culture and heritage	Protect sacred sites, culture and heritage.	• Aboriginal cultural values • sacred sites • the Territory's natural and built heritage • declared heritage places and objects protected under the *Heritage Act 2011* (NT) such as: - any Aboriginal or Macassan archaeological place or object (coastal mounds and middens, rock art, stone arrangements, quarries, artefacts, graves, burial sites and ancestral remains) - underwater cultural heritage (isolated objects, shipwrecks, plane wrecks, - underwater cables and evidence of Aboriginal occupation prior to sea level rise) - built heritage (colonial buildings and other historic buildings) - defence structures (defensive positions and airfields) - natural features (meteorite impact sites, palaeontological sites, springs, trees) - world heritage • underwater cultural heritage protected under the *Underwater Cultural Heritage Act 2018* (Cwth) • Aboriginal rights and interests, including right of access	Refer to Section 4.4.	Yes No Uncertain Not applicable	☐ ☒ ☐ ☐	☐ ☐ ☒ ☐	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐
	Assessment statement: The proposed action is not anticipated to significantly impact culture and heritage. Middle Arm Peninsula is located within the traditional country of the Larrakia people. There are no known cultural or heritage sites (including sacred sites) within the Project area. Construction activities would largely occur within an existing pipeline corridor. Potential impacts to unknown cultural heritage places, if encountered, would be managed via the following control measures: • Cultural Heritage Surveys, a chance finds procedure, reporting of any potential cultural heritage finds to relevant stakeholders and authorities, and involving cultural heritage monitors during construction. Five historic shipwrecks are overlapped by the nearshore PDA within Darwin Harbour. As per the Commonwealth Underwater Cultural Heritage Act 2018, adequate mitigation measures will be in place to ensure there is no interaction or disturbance to any underwater cultural heritage feature within the nearshore PDA. The nearshore PDA is also following the route of current subsurface infrastructure.								
	Human health	Protect the health of the Northern Territory population.	• drinking water • air quality • bush tucker	Not applicable	Yes No Uncertain	☐ ☐ ☐	☒ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)				
						Q2	Q3	Q4	Q5
			• radiological limits • biting insects		Not applicable	☒	☐	☒	☒
	Assessment statement: The following activities have the potential to impact on human health if not managed appropriately: • CO_2 transport pipeline leak or rupture (subsea or onshore). • A discharge of CO_2 from a leak or rupture at the onshore inlet station. For a pipeline CO_2 leak with release to the atmosphere or an onshore leak, impacts may occur from the resultant atmospheric plume. If the leak is occurring along the transport pipeline in the nearshore environment, as CO_2 is denser than air, it could quickly displace oxygen, leading to potential number of direct human health impacts.								

APPENDIX D: BCCS PROJECT STAKEHOLDER ENGAGEMENT PLAN

Submitted as a separate appendix to the NT EPA.

APPENDIX E: PRE-REFERRAL CONSULTATION

Submitted as a separate appendix to the NT EPA.