BAS-210 0115

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Darwin Pipeline Duplication Project

Preliminary Documentation Report

October 2023

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REVIEW INTERVAL (MONTHS)		No Review Required
SAFETY CRITICAL DOCUMENT		NO

Acronyms and Abbreviations

Acronym	Definition
°C	Degrees Celsius
AFANT	Amateur Fishermen's Association of the Northern Territory
AIMS	Australian Institute of Marine Science
AIS	Automatic Identification System
ALA	Atlas of Living Australia
ALARP	As Low As Reasonably Practicable
AMSA	Australian Maritime Safety Authority
AOD	area of occupancy
AS	Australian Standard
ASS	Acid Sulphate Soil
AUV	Autonomous Underwater Vehicles
bbl	barrel
BHD	Backhoe dredger
BIAs	Biologically Important Areas
CEMP	Construction Environment Management Plan
CSD	Cutter Suction Dredges
dB	Decibel
dB re 1 µPa	decibels relative to one micropascal; the unit used to measure the intensity of an underwater sound
DAWE	Department of Agriculture, Water and Environment
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DENR	Department of Environment and Natural Resources
DEPWS	Department of Environment, Parks and Water Security
DLNG	Darwin Liquefied Natural Gas
DoEE	Department of Environment
DPD	Darwin Pipeline Duplication
DP	Dynamically positioned
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Cth)
e.g..	for example,

Acronym	Definition
EIS	Environmental Impact Statement
EN	Endangered
ENVID	Environmental Identification
EP	Environment Plan
EP Act	*Environment Protection Act 2019* (Northern Territory)
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FCGT	Flood, clean, gauge, testing
FPV	Fallpipe vessel
GA	Geoscience Australia
GEP	Gas Export Pipeline
GHG	Greenhouse Gas
h	hour
Ha	Hectare
HAT	Highest Astronomical Tide
HF	High Frequency
HFO	Heavy Fuel Oil
Hz	Hertz
IFO	Intermediate Fuel Oil
IMO	International Maritime Organization
IMR	Inspection, maintenance and repair
IMS	invasive marine species
ILT	In-line tee
IUCN	International Union for Conservation of Nature
km	Kilometre
KP	Kilometre Point
LAT	Lowest Astronomical Tide
LBL	Long base line
LNG	Liquefied Natural Gas
m	Metre

Acronym	Definition
m^2	square metre
m^3	cubic metre
M	Migratory species
Mg/L	Milligrams per litre
mm	Millimetre
Mm^3	Cubic megametre
m/s	Metres per second
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multi-beam echosounder
MDO	Marine Diesel Oil
MEG	Monoethylene glycol
MFE	Mass flow excavation
MNES	Matters of National Environmental Significance
MTPA	Million tonnes per annum
MSL	Mean Sea Level
NA	Not applicable
NEMP	Nearshore Environmental Monitoring Program
NOEC	No observed effect concentration
NSW	New South Wales
NT	Northern Territory
NT EPA	NT Environment Protection Authority
OEMP	Operations Environmental Management Plan
OFOV FME	Orientation field of view full moon equivalents
OPP	Offshore Project Proposal
PASS	Potential Acid Sulphate Soil
PC	Protection concentration, e.g. PC99 is 99% protection concentration, PC95 is 95% protection concentration etc.
pig	pipeline inspection gauge
PLET	Pipeline End Termination
PMST	Protected Matters Search Tool
POB	persons on board

Acronym	Definition
ppb	parts per billion
ppm	parts per million
PNEC	Predicted No-Effect Concentration
PTS	Permanent Threshold Shift
PWCNT	Power and Water Corporation Northern Territory
RFI	Request for Information
ROVs	Remotely Operated Vehicles
SBP	Sub-bottom profiler
SDV	Side dumped vessel
SEL	Sound exposure level
SEL_{24h}	24-hour sound exposure level
SER	Supplementary Environmental Report
SOPEP	Ship Oil Pollution Emergency Plan
SPL	Sound Pressure Level
SSS	Side scan sonar
TBD	To be decided
t	tonne
TPWC Act	*Territory Parks and Wildlife Conservation Act 1976* (Northern Territory)
TRH	Total Recoverable Hydrocarbons
TSHD	Trailing suction hopper dredger
TSDMMP	Trenching and Spoil Disposal Management and Monitoring Plan
TTS	Temporary Threshold Shift
USA	United States of America
USBL	Ultra-short base line
VU	Vulnerable
WA	Western Australia
WET	Whole of effluent testing
WDL	Waste Discharge Licence
WHO	World Health Organization

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Appendix 4 Safety Data Sheets for Proposed Chemicals
Appendix 5 Santos Chemical Approvals Procedure
Appendix 6 Effluent Testing Assessment Report
Appendix 7 Benthic Habitat Survey Report
Appendix 8 Sediment Dispersion Modelling Report
Appendix 9 Oil Spill Modelling
Appendix 10 Oil Pollution Emergency Plan
Appendix 11 Shipboard Oil Pollution Emergency Plan (confidential SOPEP has been provide to DCCEEW for review)
Appendix 12 Acid Sulphate Soils and Dewatering Management Plan (ASSDMP)
Appendix 13 Onshore Construction Environmental Management Plan (CEMP)
Appendix 14 Offshore Construction Environmental Management Plan (CEMP)
Appendix 15 Trenching and Soil Disposal Management and Monitoring Plan (TSDMMP)
Appendix 16 EPBC Protected Matters Report
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1 Document Purpose, Preamble and Cross Reference

1.1 Purpose

Santos NA Barossa Pty Ltd (Santos) has prepared this document in response to a request from the Department of Climate Change, Energy, the Environment and Water (DCCEEW) on 23 December 2022, to provide further information for the Darwin Pipeline Duplication (DPD) Project (the 'Project').

This follows the Referral controlled action assessment decision advised by DCCEEW to be undertaken using the preliminary documentation mechanism. The purpose of this document is to provide one document, called the Preliminary Documentation report, that includes the assessed Referral (Referral form – **Appendix 1**) and supporting information plus the further information requested. The Preliminary Documentation report includes:

- A comprehensive, updated description of the proposed activities.
- An environmental impact assessment of the proposed Project activities for Matters of National Environmental Significance (MNES) done in accordance with the Significant Impact Guidelines 1.1: Matters of National Environmental Significance (DoE, 2013), noting DCCEEW further information requirements for 'significant impact' to be addressed following DCCEEW guidelines (see **Section 1.2**) that further describe significant impact assessment.
- Further information on MNES as requested as part of the DCCEEW 23 December 2022 request.
- Updated mitigation measures to ensure the action will be taken to avoid or reduce any impact such that the residual impacts will not be significant.

In addition, this document considers relevant species recovery plans, threat abatement plans and management plans to inform the impact assessment and mitigation measures.

Where relevant this Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Preliminary Documentation report refers to the Northern Territory Environment Protection Authority (NT EPA) referral (BAS-201-0020) including specifically the Supplementary Environmental Report (**Appendix 2**).

1.2 Preamble

Following the EPBC Act Referral of the DPD Project (EPBC 2022/09372, **Appendix 1**), that was accepted on 7 November 2022, with a controlled action decision on 6 December 2022, the DCCEEW on 23 December 2022 submitted a request for further information (RFI) to Santos describing technical and non-technical information required in the preliminary documentation and the general structure, style and format of the required response (refer to **Appendix 3**). In the 6 December 2022 referral decision, it was stated that DCCEEW considers that the proposed action is likely to have a significant impact on the following matters protected by the EPBC Act:

- Listed threatened species and communities.
- Listed migratory species.
- Commonwealth marine area.

The further information required in this Preliminary Documentation report relates to these topics:

- Impacts to MNES from construction and operation activities.

+ Avoidance, mitigation, and management in relation to EPBC Act listed threatened and migratory turtles and EPBC Act listed migratory dolphins.
+ Proposed offsets where they apply.
+ Economic and social matters.
+ Ecologically sustainable development.
+ Environmental record.
+ Other approvals and conditions.
+ Relevant policies and publications.

The DCCEEW request to Santos on 23 December 2022 specifically refers to the need to provide evidence that the proposed action will not cause significant residual impact to EPBC Act listed threatened and migratory turtles and EPBC Act listed migratory dolphins.

Santos has provided in this report further information that shows the proposed action will not cause significant residual impact to the relevant turtle and dolphin species and the Commonwealth marine area.

The Preliminary Documentation report includes an assessment of residual impacts to marine turtles and dolphins against the Significant Impact Guidelines 1.1: Matters of National Environmental Significance (DoE, 2013). The Preliminary Documentation report therefore describes how the assessment against the significant impact criteria has considered whether the impact is ‘important, notable or of consequence having regard to its context or intensity’, and whether/how factors such as ‘sensitivity, value and quality of the environment, which is impacted, and the intensity, duration, magnitude and geographic extent of the impacts’ have been considered (DoE, 2013). Note that the MNES guidelines define ‘likely’ so that a significant impact is a real or not remote chance or possibility.

The document is structured as follows:

+ **Section 1**: Document purpose, preamble and cross reference – provides background to this document.
+ **Section 2**: Project description – provides a description of the key characteristics of the Project.
+ **Section 3**: Matters of National Environmental Significance – describes MNES relevant to the Project, the likelihood of threatened and migratory species occurring in the Project area and provides additional detail on threatened and migratory species identified as likely, or have potential, to occur within the Project area.
+ **Section 4**: Project impacts and risks – identifies and assesses potential Project impacts to MNES, including description of modelling studies undertaken to define the intensity, duration, magnitude and geographic extent of the impacts.
+ **Section 5**: Measures to avoid and reduce impacts – describes management measures to avoid and mitigate impacts and risks to listed threatened and migratory species and Commonwealth marine areas, considered in the assessment of impacts described in
+ **Section 6**: Residual Impact Assessment - assesses impacts for species which are likely, or have potential, to occur within the Project area, considering significant impact criteria described in MNES Significant Impact Guidelines 1.1. The assessment of impacts to Commonwealth marine areas considering these significant impact criteria is also described.

+ **Section 7**: Offsets – summarises the no significant impact outcome not requiring offsets.
+ **Section 8**: Economic and social matters – describes expected economic and social impacts of the Project including costs and benefits, employment opportunities, and Traditional Owner impacts.
+ **Section 9**: Stakeholder engagement – describes the stakeholder engagement open dialogue process that continues through the full project lifecycle, an essential process supporting environmental impact assessment as it provides affected and interested stakeholders with information about the Project's potential impacts and benefits.
+ **Section 10**: Ecologically sustainable development – describes how the Project is aligned with the principles of Ecologically Sustainable Development (ESD) as set out in section 3A of the EPBC Act, including in Project planning and design.
+ **Section 11**: Environmental record of proponent – describes the Santos environmental record to demonstrate a satisfactory record of responsible environmental management.
+ **Section 12**: Conclusion – summarises the outcomes of the significant impacts risk assessment required in the DCCEEW request for further information, fully documented in this Preliminary Documentation report.
+ **Section 13**: References – lists all references in this Preliminary Documentation report.

The work done by the persons involved in the preparation of the Preliminary Documentation report is listed in **Appendix 25**.

1.2.1 Residual Impact Assessment Approach

The Preliminary Documentation report includes an assessment of residual impacts to MNES including specific marine turtle and dolphin species, and the Commonwealth marine area against the Significant Impact Guidelines 1.1: Matters of National Environmental Significance (DoE, 2013). The process for undertaking the assessment in this Preliminary Documentation report is as follows:

1. Development of further information for turtle and dolphin species identified in the DCCEEW RFI (**Section 3.2** and **Section 3.3**).
2. An assessment of potential impacts to MNES species and the Commonwealth marine area from the planned and unplanned Project events is undertaken (**Section 4.2.1** to **Section 4.2.5.** This was previously provided in the Referral Supporting Information document and has been further developed), considering the significant impact criteria described in MNES Significant Impact Guidelines 1.1 (DoE, 2013).
3. Finalisation and implementation of an extended set of measures to avoid and mitigate impacts (**Section 5**).
4. The assessment against the DCCEEW significant impact criteria for each species is undertaken (e.g., **Table 6-2** - assessment of impacts to leatherback turtles against the significant impact criteria); these assessment tables are all included in **Section 6** and were previously provided in the Referral Supporting Information document. **Section 6.2**, **Section 6.3** and **Section 6.4** then specifically addresses the DCCEEW RFI relating to turtle species, dolphin species and the Commonwealth marine area respectively, in order to further detail that there is no residual significant risk to MNES after including the mitigation measures.

1.3 Request for Further Information

Table 1-1 provides a cross-reference showing the location of DCCEEW further information requested in this Preliminary Documentation report.

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Table 1-1 Preliminary documentation request for information (23 December 2022) from DCCEEW with summary response

Item	Request	Section and Response
Impacts to MNES		
1. Construction and Operation Activities		
The Department notes that construction activities will result in disturbance to the marine environment including in Commonwealth waters. The following additional information is required to determine the significance and acceptability of these disturbances:	+ The total (maximum) area (in hectares) of seafloor proposed to be trenched.	Where required for pipeline protection and stability the concrete coated pipeline will be trenched. Approximately 12.5 km will be trenched, all in NT waters, of the 123 km DPD total length. This is 1.25 ha of trenched area based on an average 10 m width. (**Section 2.2, Table 4-1**). Total (maximum) area of the pipeline footprint is approximately 131 ha of which 11.5 ha is in Commonwealth waters - refer to **Section 2.3.1, Section 4.2.1.1, Table 4-1**. Trenching and infrastructure footprints combined will impact less than 1% of the benthic habitats across Darwin Harbour and, more specifically, <0.18% of sponge or sponges/filterers/octocoral habitat, <0.12% of macroalgae habitat and approximately 0.12% of bare ground habitat found across Darwin Harbour. Therefore, the Project is unlikely to result in changes to the composition of benthic habitats across Darwin Harbour, nor have wider impacts on the marine fauna that rely on those habitats. Habitat mapping of the DPD pipeline in Commonwealth waters (**Figure 6-4**), where there is no trenching, shows the pipeline traverses the seabed mostly on bare ground habitat (approximately 80%), one 1-2 km patch of filter feeder habitat, one 1-2 km patch of burrower/crinoid

Item	Request	Section and Response
		habitat, and two small 100-200 m patches of filter feeder habitat. Two very small patches of hard coral habitat are avoided. The footprint of the 23 km Commonwealth waters section of the DPD pipeline is 11.5 ha.
Details of the following chemicals and materials proposed to be used:	+ FCGT / hydrotest chemicals (biocides, oxygen scavengers, dye, corrosion inhibitors) including Hydrosure, Roemex Hydro 3 and other potential similar alternatives that may be used, and a copy of Santos' chemical risk assessment process indicating interchangeability of products.	Commentary on the Santos chemical risk assessment process to be used in the Project area, including product interchangeability, is provided in **Section 2.6.1**2.6.1 Safety data sheets for chemicals and materials are provided in **Appendix 4**. The Santos Offshore Division Operations Chemical Approval Procedure (EA-91-II-10001) is provided to DCCEEW (**Appendix 5**). The procedure includes an evaluation of ecotoxicity thresholds and application of OCNS ratings, which may include establishment of alternative 'pseudo' rating that can be applied to the chemical in accordance with international standard protocols or guidelines (e.g., ISO test guidelines, OECD test guidelines, and OSPAR Guidelines), which allows for the assessment of interchangeability of chemicals.
	+ Fuels (marine diesel oil, marine gas oil), hydraulic fluids, lubricants.	Chemicals and materials proposed to be used including fuels, hydraulic fluids and lubricants, are detailed in **Section 2.6** and **Table 2-7**. Safety data sheets for chemicals and materials to be used are provided in **Appendix 4**.
	+ Composition of the grout to be used in the grout bags for span rectification.	Chemicals and materials proposed to be used, including grout mixture are detailed in **Section 2.6** and **Table 2-7**. The grout material is sand/aggregate and cement slurry with no chemical additives. Safety data sheets for

Item	Request	Section and Response
		chemicals and materials to be used are provided in **Appendix 4**.
	+ Other chemicals proposed or may potentially be disposed of to the sea which are 'Gold/Silver/ D or E rated through the Offshore Chemical Notification Scheme (OCNS), or PLONOR substance listed by OSPAR', including commentary that their environmental risk profile in the North Sea is applicable to marine waters in the project area. (e.g., vessel deck cleaning products and confirmation that they meet MARPOL Annex V, anti-fouling coatings, vessel fire training and fate of chemical used in firefighting systems, coatings for pipe welds).	Chemicals and materials proposed to be disposed to sea and their OCNS or other ratings are detailed in **Table 2-7**. Commentary on the Santos chemical risk assessment process to be used including risk profile in the Project area is provided in **Section 2.6.1**2.6.1 The environmental risk profile in the North Sea, where most of the chemical rating data is generated, is applicable to marine waters in the Project area, as the Santos/contractor chemical assessment process makes an evaluation of the receiving marine environment. Discharge of chemicals is restricted procedurally e.g., with regard to the potential discharge of firefighting chemicals from vessels, operational training with equipment will be up to the point of activating the discharge of foam but not an actual release.
	+ Information on the source of imported rock material to backfill trenches.	Information on the source of rock fill is provided in **Section 2.2.** Rock sourced from quarries located at Mt Bundey, NT (approximately 100 km southeast of Darwin) will be used to backfill the trench within nominated sections.
The following reports referenced in the referral package:	+ Whole of effluent testing (WET) assessment report for 'Hydrosure' as referenced in the dispersion modelling assessment reports. Wheatstone Project Offshore Facilities and Produced Formation Water Discharge Management Plan: Stage 1. Document No:	Refer to **Appendix 6**

Item	Request	Section and Response
	WS0-0000-HES-PLN-CVX-000-00101-000, Chevron Australia Pty Ltd (Chevron, 2015).	
	+ Complete copy (including all appendices) of 'Pipeline Benthic Survey Report – Barossa DPD' (RPS, 2002a) 6 September 2022, AU213002038.0012022a).	Refer to **Appendix 7**
	+ DPD Project trenching and spoil disposal sediment dispersion modelling (RPS, 2022c). Darwin Pipeline Duplication Sediment Dispersion Modelling. Document Number MAW1077J.001.	Refer to **Appendix 8**
	+ DPD Project oil spill modelling (RPS, 2022d). Darwin Pipeline Duplication Oil Spill Modelling. Document Number MAW1077J.002. Prepared for Santos Ltd by RPS, Robina, QLD.	Refer to **Appendix 9**
	+ INPEX Operations Australia Ltd (2014). Ichthys project – Gas Export pipeline: Dredging and spoil disposal management plan. Document no. F281-AH-PLN-10009, 454 pp.	As agreed with DCCEEW, a similar INPEX report is included in this Preliminary Documentation report reference list with a link to the full document – 'INPEX Operations Australia Pty Ltd. (2018). Ichthys project – Maintenance dredging and spoil disposal management plan. Report prepared by INPEX Operations Pty Ltd, Perth, WA, Australia.'
	+ Santos Offshore Division Operations Chemical Approval Procedure (EA-91-II-10001).	Provided to DCCEEW (refer to **Appendix 5**)

Item	Request	Section and Response
The department notes that several management plans are referenced in the referral package, which are pertinent to mitigating impacts to MNES. The department therefore requires the following management plans to assess the residual significance and acceptability of impacts to MNES. Please provide justification where management plans cannot be provided.	+ Oil Pollution Emergency Plan, Shipboard Oil Pollution and Emergency Plan (SOPEP) and / or Shipboard Marine Pollution Emergency Plan (SMPEP).	Santos DPD Oil Pollution Emergency Plan (OPEP) - refer to **Appendix 10** SOPEP/SMPEP – refer to **Appendix 11**. As agreed with DCCEEW, a SOPEP was included in this Preliminary Documentation report for initial assessment by DCCEEW on a confidential basis and is not included in the final PD report.
	+ Acid Sulfate Soils Management Plan.	Refer to **Appendix 12.**
	+ Construction Environmental Management Plan (CEMP).	Onshore and Offshore CEMPs - refer to **Appendix 13** and **Appendix 14.**
	+ Trenching, Spoil Disposal Management and Monitoring Plan (TSDMMP).	Refer to **Appendix 15.**
	+ Operations Environmental Management Plan (OEMP).	An Operations Environmental Management Plan (OEMP) for the operation of the DPD pipeline in NT waters will be submitted to NT Department of Industry Tourism and Trade (DITT) for approval prior to operations commencing in 2025. Similarly, a Production Operations Environment Plan (EP), covering operation of the DPD pipeline in Commonwealth waters, will be submitted for acceptance to NOPSEMA prior to commencement of operations. The DPD pipeline will also have an approved Safety Case and an approved Pipeline Management Plan to cover the operational phase prior to operations commencing. An OEMP for DPD pipeline operations has therefore not been provided with the PD for the following reasons:

Item	Request	Section and Response
		+ The OEMP has not yet been developed for submission since operations will not commence until 2025. Plans covering the management of environmental impacts and risks from the construction phase of the DPD Project, including Construction EMPs, a Trenching and Spoil Disposal Monitoring and Management Plan (TSDMMP), a Marine Megafauna Noise Management Plan (MMNMP) and an Oil Pollution Emergency Plan (OPEP) have been developed for assessment and approval, as required, given construction is expected to commence in Q2 2024. These documents have been provided with the PDR. The phasing of the development and approval of EPs/EMPs is considered standard for offshore pipeline projects. + NOPSEMA and DITT, as the relevant petroleum activity authorities, do not require Operations EPs/EMPs to be provided prior to construction. These are required to be provided and approved/accepted prior to commencement of operations in 2025 in-line with the approach taken by Santos. + The impacts and risks associated with the operational phase have been described in Environmental Impact Assessment documentation provided to the NT EPA and DCCEEW. The impacts and risk associated with the construction phase are considered greater than those for the operational phase. e.g., vessel numbers and activities will be significantly higher during construction since operational vessel activities will be relatively

Item	Request	Section and Response
		infrequent. Disturbance to seabed will be greater during construction, including greater direct disturbance and resultant water quality impacts from infrastructure installation (e.g. turbidity from trenching and spoil disposal). The environmental risk of a release from the pipeline is relatively low during operations given the pipeline will transfer dry gas only with no liquid hydrocarbon, this compares to the higher risk of vessel spills during the construction phase.
	+ Pipeline maintenance, cleaning and repair procedures and plans, and waste disposal plans.	There are no plans to perform operational pigging as this is a dry gas pipeline with no wax or other fluid slugs that need to be cleaned out. There is the potential to perform in-line inspection pigging of the pipeline if there has been an unplanned upset event (e.g., water ingress from damage, water ingress from a production upset). If the pipeline was pigged any debris would be collected in the pig receiver at DLNG where debris is stored, then disposed to prescribed waste facilities. Pipeline maintenance, cleaning and repair and waste management plans are currently being prepared and will be ready and in-place for the operational phase, and documented in EPs, PMPs and Safety Cases.
Avoidance, mitigation and management		
2. EPBC Act listed threatened and migratory turtles	The proposed action intersects biologically important areas and habitat critical to survival of the flatback turtle (*Natator depressus*). Additionally, the department considers that green turtle, olive ridley turtle and hawksbill turtle are likely to utilise the	Emphasis in this residual risk assessment section is given to the flatback turtle. The green turtle, olive ridley turtle and hawksbill turtle are likely to utilise the proposed Project area and the Project may affect these species during

Item	Request	Section and Response
	proposed action area. The department notes that the proposed action is likely to adversely affect these important areas through trenching, pipelay and spoil disposal activities. The proposed action also has potential to injure or displace marine turtles through acoustic disturbance or vessel collision associated with construction activities. The department therefore requires the following information to assess the residual significance and acceptability of impacts to EPBC-listed marine turtles: + Detail and justify all avoidance and mitigation measures proposed to reduce impacts to marine turtles and their habitats, for example: - Timing of construction activities, noting peak flatback turtle internesting period is June-September. - Avoidance of important habitat features. - Acoustic disturbance mitigation measures. - Collision mitigation measures. + Provide evidence that the proposed action will not cause significant residual impacts to threatened marine turtles or their habitat. - If significant residual impacts cannot be avoided and mitigated, please provide an offset proposal consistent with the EPBC Act Offsets policy. Information required regarding offsets is stated in section 4 of this table.	construction. As such, for these three turtle species the further information in **Section 3.2** and in the significant risk assessment tables referred to in **Section 6.2.1.1.1** are provided. **Section 6.2** focuses on residual risk to threatened species of marine turtles and their habitats. The conclusion reached in **Section 6.2** for each threatened marine turtle species and/or migratory marine turtle species is that the proposed action (i.e., the Project activities) does not trigger the criteria under the Significant Impact Guidelines 1.1 (DoE, 2013). Refer to **Section 5** for mitigation measures which reduce the residual risk to not significant; the outcomes of the Preliminary Documentation assessment are: + Irrespective whether Project construction activities overlap flatback turtle internesting periods or not, direct physical impacts of construction activities on flatback turtle habitat and benthic habitats are assessed as not significant following adoption of mitigation measures. + No significant deterioration of water quality during trenching, as modelled by dispersion of suspended sediment concentrations (SSC), was predicted within sensitive habitats such as hard coral, seagrass and mangroves, since these sensitive habitats are not present within Zones of Moderate Impact (ZoMI) or Zones of Influence (ZoIs) (**Section 4.2.1**).

Item	Request	Section and Response
		+ No protected or sensitive benthic habitats have been identified with the potential to be exposed to the dewatering plume in Commonwealth waters. The seabed in that location consists predominantly bare sediments or sparse filter feeders, with large sensitive banks and shoals too far away to be impacted. **Section 4.2.4** used predictive metocean modelling to determine ocean concentrations of the chemicals discharged at the PLET in Commonwealth waters. + Given the acoustic disturbance mitigation measures outlined in **Section 6.2.2.4**, residual underwater noise impacts (e.g. behavioural responses) that cannot be avoided from the Project to flatback turtles and other marine turtles are not predicted to be significant whether marine construction activities overlap the peak flatback turtle nesting season or not. + Residual significant impacts of Project construction vessel light spill on flatback turtles and other marine turtles are not predicted whether marine construction activities overlap the peak flatback turtle nesting season or not following adoption of light spill mitigation measures outlined in the light emissions section of **Table 5-1**. + Important habitats suitable for foraging flatback turtles and other marine turtle species are of very limited distribution within the Project area because these habitats are widespread, and the habitats

Item	Request	Section and Response
		disturbed are a small proportion of this total availability of habitat (**Section 6.2.2.3**). The physical presence of the exposed Project pipeline (laid on the seabed) and concrete mattresses at pipeline and telecommunication cable crossing locations, all provide new hard-bottom substrate, which will be colonised by benthic flora and fauna which could be foraged by flatback turtles. + Mitigation measures are considered adequate to reduce significant acoustic impacts to marine turtles, especially the 50-m radius exclusion zone around trenching (mitigation measure MA56 **Table 5-1**), which serves to avoid interaction with marine turtles that may be approaching the activity or construction vessel. + The precautionary mitigative measures (including mitigation measure MA54 **Table 5-1**) are considered appropriate and adequate for reducing Project vessel-marine turtle interactions and avoiding vessel strikes to marine turtles.
Avoidance, mitigation and management		
3. EPBC Act listed migratory dolphins	The proposed action intersects biologically important areas for the Australian snubfin dolphin (*Orcaella heinsohni*), Australian humpback dolphin (*Sousa sahulensis*), and spotted bottlenose dolphin (*Tursiops aduncus*). The department notes that the proposed action has potential to injure or displace these dolphins through acoustic disturbance or vessel collision	To assess the impact of construction and commissioning activities of the DPD project on migratory dolphin species, a detailed assessment has been undertaken, including noise, chemical and sediment plume modelling and the development of management actions to reduce the risks during various phases of the project. Refer to **Section 6.3**, specifically **Section 6.3.1** and **Section 6.3.2**. The conclusion

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	associated with construction activities. The department therefore requires the following information to assess the residual significance and acceptability of impacts to EPBC-listed inshore dolphins: + Detail and justify all avoidance and mitigation measures proposed to reduce impacts to inshore dolphins and their habitats, for example: - Avoidance of important habitat features. - Acoustic disturbance mitigation measures. - Collision mitigation measures. + Provide evidence that the proposed action will not cause significant residual impacts to migratory dolphins or their habitat. + If significant residual impacts cannot be avoided and mitigated, please provide an offset proposal consistent with the EPBC Act Offsets policy. Information required regarding offsets is stated in section 4 of this table.	reached in **Section 6.1** for each migratory dolphin species is that the proposed action (i.e., the Project activities) does not trigger the criteria under the Significant Impact Guidelines 1.1 (DoE, 2013). Refer to **Section 5** for mitigation measures which reduce the residual risk to not significant. The outcomes of the assessment are: + Since the Project pipeline is adjacent to and closely follows the main shipping lane to and from Darwin Harbour, it is most unlikely that any of the three dolphin species would breed within or close to this this shipping channel, and the proposed Project pipeline alignment. Therefore, the Project pipeline alignment is not expected to intercept or impact upon breeding habitat (**Section 6.3.2.2.1.2**). + While the broadscale MNES migratory dolphin BIAs within Darwin Harbour cannot be avoided, Project interception of dolphin breeding or shallow water calving areas within the BIAs is unlikely (**Section 6.3.2.2.1.3**). Overall, the DPD Project is assessed to not have direct significant residual impacts to dolphin breeding and calving habitats, as these habitats can be avoided. Potential indirect impacts can be adequately managed by applying Santos' multi-layered mitigation measures to reduce Project interactions with dolphins, avoid collisions, and limit underwater noise impacts by applying observation

Item	Request	Section and Response
		and exclusion zones around construction works and vessels. + **Section 4.2.1.1** has assessed that there are no unique or sensitive habitats along the Project pipeline route or the spoil disposal ground, and the habitats present are well represented in other locations, both within the harbour and regionally. This applies equally to the foraging habitats of the three migratory dolphin species. + With the evidence provided in **Section 6.3.2.2** no residual significant impacts on migratory dolphin foraging habitats are predicted within the Darwin Harbour BIAs. + The evidence provided in **Section 6.3.2.3.1** and the mitigation measures are considered adequate to reduce potential underwater noise disturbance to no residual significant impact to those migratory dolphins that approach and enter the 50-m radius Exclusion Zone around the trenching vessels. + The proposed mitigation measures to reduce vessel-dolphin interactions are also expected to avoid vessel-dolphin collisions. With the evidence provided in this **Section 6.3.2.4** including the existing commercial shipping and other maritime traffic in the Darwin Harbour region, it is considered unlikely that Project vessels from the proposed action would significantly increase the risk of impact to these species. The Project's proposed mitigation

Item	Request	Section and Response
		measures are considered adequate for avoiding dolphin strikes.
Proposed offsets		
4.	If there is likely to be a residual significant impact after all reasonable avoidance and mitigation measures have been applied, provide details of all compensatory measures (i.e., environmental offsets) proposed to compensate for any residual significant impacts on EPBC Act listed threatened species and/or migratory species, including: a. The type of offset(s) proposed. b. Extent to which the proposed offset actions correlate to, and adequately compensate for EPBC Act listed species. c. Suitability of the location of any proposed offset site for EPBC Act listed species, including evidence of the presence of, or usage by, relevant protected matter(s). d. Conservation gain to be achieved by the offset i.e., positive management strategies that improve the site or avert the future loss, degradation or damage of the protected matter(s). e. Time it will take to achieve the proposed conservation gain.	Based on the assessment of the potential impacts of the DPD project to MNES, in accordance with the Significant Impact Guidelines 1.1 (2013), no residual significant impact is predicted, and no offsets have been proposed or developed for the Project (Refer to **Section 67**).

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	f. Level of certainty that the proposed offset will be successful. Demonstrate how any proposed offset is consistent with the department's EPBC Act Environmental Offsets Policy and provide a completed offsets assessment guide (Excel spreadsheet available on the department's website) and justification for the figures used to complete the offsets assessment guide.	

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Economic and social matters		
5.	The preliminary documentation must provide information about the expected economic and social impacts of the proposed action (both positive and negative). This should include, but not necessarily be limited to, the following: a. Estimate of any anticipated economic costs and/or benefits (in AUD). b. Basis for any estimations of costs and/or benefits. c. Potential employment opportunities expected to be generated at each phase of the proposed action. d. Information regarding the impacts of the proposal on traditional owners/the local community/other parties impacted. e. Details of any public and/or traditional owner stakeholder consultation activities, including the outcomes of those consultations. f. Consideration of different scales of economic and/or social impacts where relevant (e.g., local versus national).	a. Estimate of any anticipated economic costs and/or benefits (in AUD) - **Section 8.2**. b. Basis for any estimations of costs and/or benefits - **Section 8**. c. Potential employment opportunities expected to be generated at each phase of the proposed action – **Section 8.3**. d. Information regarding the impacts of the proposal on traditional owners/the local community/other parties impacted – **Section 8.5**. e. **Section 8.5** and **Section 9.4** summarise that the Project has undertaken detailed consultation with traditional owners and is committed to continuing engagement and consultation with traditional owners throughout the DPD Project. Santos has assessed that any impacts of the DPD Project on indigenous cultural heritage can be appropriately managed and mitigated on the basis that: + Santos has obtained and will comply with the conditions of the AAPA certificate, outlined in this section. + Santos will avoid cultural heritage sites as described in mitigation measures MA18, MA20, MA25, MA26 (**Table 5-1**).

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		+ Santos will continue to engage with and consult traditional owners in project planning and throughout the implementation of the project. f. Consideration of different scales of economic and/or social impacts where relevant (e.g., local versus national) – **Table 8-1, Table 8-2**.
Ecologically sustainable development		
6.	The preliminary documentation must provide information about how the proposed action is consistent with the principles of ecologically sustainable development, as defined in the EPBC Act: a. Decision-making processes should effectively integrate both the long-term and short-term economic, environmental, social, and equitable considerations. b. The precautionary principle, which states that a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation where there are threats of serious or irreversible environmental damage. c. The principles of inter-generational equity, which states that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations.	Refer to **Section 10.**

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	d. The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. e. Improved valuation, pricing and incentive mechanisms should be promoted.	
Environmental record of person(s) proposing to take an action		
7.	The environmental record of the person proposing to take the action must be provided to demonstrate a satisfactory record of responsible environmental management. Therefore, the preliminary documentation must include details of any proceedings under a Commonwealth, state, or territory law for the protection of the environment or the conservation and sustainable use of natural resources against: a. The person proposing to take the action. b. For an action for which a person has applied for a permit, the person making the application.	Refer to **Section 11**.
Other approvals and conditions		
8.	The preliminary documentation must include information on any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action. This must include: a. A description of any approval that has been obtained or is required to be obtained from a state,	Refer to **Section 2.8** and **Section 5**.

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	territory or Commonwealth agency or authority (other than an approval under the EPBC Act), including any conditions that apply (or are reasonably expected to apply) to the action. b. A description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.	
Relevant policies and publications		
9.	Various policy statements and other publications that may be relevant to your assessment can be found on the department's website. Some key policies are summarised below: + Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012a). Marine bioregional plan for the North Marine Region. Prepared under the *Environment Protection and Biodiversity Conservation Act 1999*. Available from: http://www.environment.gov.au/topics/marine/marine-bioregional-plans/north. + Department of the Environment and Energy (2018). Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/marine-debris-2018.	This Preliminary Documentation report shows how the Project (the proposed action) is consistent with relevant recovery plans or threat abatement plans by assessing residual significant risk under the Significant Impact Guidelines 1.1: Matters of National Environmental Significance (DoE, 2013). The Preliminary Documentation report includes statements of whether the proposed action is consistent with any relevant recovery plans or threat abatement plans in **Section 6.2.3.2** and **Section 6.3.3.5**.

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	+ Department of the Environment and Energy (2017b). Recovery Plan for Marine Turtles in Australia. Available from: http://www.environment.gov.au/marine/publications/recovery-plan-marine-turtles-australia-2017. + Department of the Environment (2015a). Sawfish and River Sharks Multispecies Recovery Plan. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/sawfish-river-sharks-multispecies-recoveryplan. + Department of the Environment, Water, Heritage and the Arts (2008b). Approved Conservation Advice for Green Sawfish. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/68442-conservation-advice.pdf. + Department of the Environment (2014). Approved Conservation Advice for *Pristis pristis* (Largetooth Sawfish). Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/60756-conservation-advice.pdf. + Department of the Environment, Water, Heritage and the Arts (2009). Approved Conservation Advice for *Pristis clavata* (Dwarf Sawfish). Available from: http://www.environment.gov.au/biodiversity/thr	

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	eatened/species/pubs/68447-conservationadvice.pdf. + Department of the Environment and Energy (2020). National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds. Available from: https://www.dcceew.gov.au/environment/biodiversity/publications/national-light-pollution-guidelines-wildlife. + Department of the Environment and Water Resources (2007). Industry Guidelines on the Interaction between offshore seismic exploration and whales. Available from: https://www.dcceew.gov.au/. + Department of the Environment and Energy (2017d). Australian National Guidelines for Whale and Dolphin Watching. Available from: https://www.dcceew.gov.au/environment/marine/publications/australian-national-guidelines-whale-and-dolphinwatching-2017. The preliminary documentation must include a statement of whether the proposed action is inconsistent with any relevant recovery plans or threat abatement plans.	

2 Project Description

2.1 Overview

Santos is proposing to construct a subsea gas export pipeline between the offshore Barossa field and the existing Darwin Liquefied Natural Gas (DLNG) facility. The Darwin Pipeline Duplication (DPD) Project involves the construction of an approximately 123 km section of this pipeline, including 23 km of pipeline in Commonwealth waters and 100 km of pipeline in Northern Territory (NT) waters. Santos is the operator of the Barossa joint venture - Santos (Santos NA Barossa Pty Ltd) (50%), SK E&S (37.5%) and Jera (12.5%).

The DPD Project will be an extension of the approved Barossa Gas Export Pipeline (GEP) (**Figure 2-1**) and will be located generally parallel to Santos' existing Bayu-Undan to Darwin gas export pipeline. The Project pipeline will cross-over the Bayu-Undan to Darwin gas export pipeline at two locations to avoid encroachment into the Darwin Harbour shipping channel.

This section provides a description of the key characteristics of the Project, as summarised in **Table 2-1**.

The existing environment along the DPD pipeline corridor is described in the EPBC Act Referral (**Appendix 1** Section 3). Broadly, in Commonwealth waters the carbonate bank and terrace system of the Van Diemen rise is defined as a key ecological feature (KEF) considered important for its role in enhancing biodiversity and local productivity relative to its surroundings and for supporting relatively high species diversity. The KEF is 4.5 km from the Project area at its closest point and extends to the north of the Project area covering a large area of approximately 31,000 km^2.

In NT waters, the Project area runs through Darwin Harbour, which is a working port that supports commercial and recreational activities (e.g. fishing and boating). Some coastal areas within Darwin Harbour have relatively undisturbed natural features, in particular mangrove wetlands, and Darwin Port is listed on the Directory of Important Wetlands of Australia and an NT Site of Conservation Significance. The Project area does not overlap wetland areas and shoreline disturbance is within the existing DLNG facility footprint.

Section 3.2 and **Section 3.3** identify turtle and dolphin biological important areas that overlap the Project area.

Table 2-1 Key characteristics of the Project

Component	Description
Key Infrastructure	
Pipeline	+ The Project pipeline will be ~123 km in length (~100 km in NT waters and ~23 km in Commonwealth waters). + A proposed diameter transition from 26 inch to 34 inch ~60 km from the DLNG facility. Seabed disturbance will be within a 50 m disturbance corridor along the Project pipeline, with additional disturbance closer to shore due to vessel anchoring. + The Project pipeline will extend to the proposed pipeline beach valve location at the DLNG facility. The connection into the process plant is not included as part of the scope of this Preliminary Documentation

Component	Description
	report and has been discussed in the Supplementary Environmental Report (SER) (Appendix 2). + Since the EPBC Act Referral (Appendix 1) was first submitted, minor deviations including two pipeline crossings over the Bayu-Undan to Darwin gas export pipeline have been implemented after stakeholder consultation, to avoid encroachment into the Darwin harbour shipping channel along with a reduction in trenching of nominally 4 km of pipeline length.
Associated infrastructure/hardware	+ One Pipeline End Termination (PLET C) in Commonwealth waters (including PLET foundation with scour protection and protection structure). + Installation of a spool in Commonwealth waters (including mattresses with scour protection) between pipeline end termination (PLET B) on the GEP (approved under the in-force OPP and GEP EP) and PLET C. + In-line tee (ILT) in NT waters (including protection structure). + Subsea support structures (scour protection mattresses, power and telecommunication cable crossing, span rectification structures).
Key Activities	
Surveys	+ Onshore and offshore.
Pre-lay works	+ Pre-lay trenching. + Spoil disposal. + Pre-lay span rectification and foundation installation. + Pipeline crossings. + Cable crossings. + Onshore construction.
Installation and pre-commissioning	+ Installation: - Shore pull. - Pipelay activities. - In-line tee installation. - PLET installation. - Spool installation. - Trench back-fill with locally sourced rock. - Post-lay span rectification. - Installation of temporary subsea positioning systems. + Demobilisation at shore crossing. + Pre-commissioning: - Flood, clean, gauge and pressure testing (FCGT). - Dewatering.

Component	Description
	- Preconditioning. - Nitrogen packing. - Flushing and hydrostatic spool leak testing.
Operations	+ Transport of hydrocarbons (dry gas, no compression required). + Inspection, maintenance and repair activities (IMR).
Vessel, other equipment and helicopter operations	+ Vessels, helicopters and equipment entering the Project area including: - Pipelay vessels. - Supply vessels including pipe supply vessels. - Crew change vessels. - Marine survey vessels. - Construction vessels (ROV). - Anchor handling vessels. - Rock installation vessels. - Trenching and spoil disposal vessels. - Environmental monitoring vessels. - Inspection, maintenance and repair (IMR) vessels. - Remotely Operated Vehicles (ROVs)/ Autonomous Underwater Vehicles (AUVs). - Helicopters. - Vehicles, mobile plant and other onshore equipment. Nominally 34 vessels may be used, with an expected maximum of 21 vessels within the project area at any one time.
Construction Elements	
Duration	+ Construction to commence as early as Q1 2024. Construction activities will span a nominal cumulative period of 15 months in the field.
Operations Elements	
Pipeline product	+ Dry natural gas (water and hydrocarbon liquids removed on FPSO).
Operation life	+ First gas in first half of 2025 with operation approximately 25 years.
Decommissioning Elements	
Proposed de-commissioning	+ At end of Project life (>2050).

2.2 Project Pipeline

The Project pipeline will start at the DPD PLET near the existing Bayu-Undan to Darwin gas export pipeline in Commonwealth waters and end at the beach valve at the DLNG plant at Wickham Point in

Darwin Harbour (**Figure 2-1**). The Project pipeline will be located generally parallel (approximately 100 m) to the existing Bayu-Undan to Darwin gas export pipeline, to minimise potential environmental and social impact (**Figure 2-1**). The Project pipeline will cross-over the Bayu-Undan to Darwin gas export pipeline at two locations to avoid encroachment into the Darwin Harbour shipping channel.

The minor pipeline route change since the Referral (**Appendix 1**) has resulted in a reduction of nominally 4 km of trenching, with approximately 12.5 km of trenching now proposed, including pre-sweep areas for span rectification, within the Darwin Harbour with the remainder of the pipeline installed on the seabed. Rock sourced from the local Mt Bundey quarries will be used to backfill the trench within nominated sections.

Three options for the pipeline's route in the Darwin Harbour area were considered during the project design phase. These were onshore pipelines through Gunn Point or Cox Peninsula or a subsea pipeline through Darwin Harbour itself. Further analysis of the pipeline route options ruled out the onshore pipeline through the Cox Peninsula for reasons including environmental and cultural heritage constraints. A comparative assessment of potential environmental impacts from the three pipeline route options including the DPD Project is shown in Table 3-1 of the SER (**Appendix 2**). Santos also considered the option of not proceeding with the DPD Project and instead utilising the existing Bayu-Undan to Darwin Pipeline to transport gas from the Barossa gas field to DLNG. This option was not pursued because the potential to use the Bayu-Undan reservoir and the Bayu-Undan to Darwin gas pipeline to support a regional carbon capture and storage (CCS) opportunity would be lost.

Alternatives for Project pipeline routing were evaluated, considering the following criteria:

+ Proximity to the pre-disturbed Bayu-Undan to Darwin gas export pipeline and shore crossing.
+ Avoiding areas of environmental (including heritage) values and sensitivities.
+ Avoiding any seabed hazards.
+ Minimising long term integrity risks and/ or intervention requirements.
+ Minimising the number of pipeline crossings e.g., existing pipelines or communication cables.
+ Minimising encroachment on the Darwin Harbour shipping channel.
+ Minimising risk to other assets during construction.

2.3 Project Area

The DPD Project has three distinct sections:

+ Offshore waters including NT waters outside Darwin Harbour, where the proposed spoil disposal area is located, and the 23 km of pipeline in Commonwealth waters.
+ Darwin Harbour (waters within the Darwin Harbour Management Area).
+ Shore crossing and onshore location where the Project pipeline crosses the shoreline within the exiting DLNG disturbance footprint.

The locations for activities along the Project pipeline are described using 'kilometre points' (KP), where KP0 is the beginning of the Project pipeline from the PLET at the connection point with the Barossa GEP in Commonwealth waters. The infrastructure (Project pipeline route, PLET and spool) for the DPD Project within Commonwealth waters is shown in **Figure 2-2**.

At approximately KP23 the Commonwealth and NT waters boundary is crossed, at approximately KP93 Darwin Harbour is entered, and the Project pipeline terminates at the proposed pipeline beach valve location at KP122.69 within the DLNG facility disturbance envelope.

Specific to the purpose of the assessment of the proposed action, the Project area includes a 3,000 m radius defined around the DPD PLET, a 2,000 m buffer either side of the Project pipeline route with a reduced buffer in some sections to meet licence requirements and a 6.25 km^2 spoil disposal area with a 100 m buffer (**Figure 2-1**). The Project area includes the extent of all planned activities as described in **Section 2.4**, and encompasses activities of seabed preparation, trenching and spoil disposal, installation of the Project pipeline and associated infrastructure, onshore activities at the DLNG facility and support vessel movements in the immediate vicinity of the pipelay vessel (accounting for anchor handling activities, operational activities and decommissioning activities).

2.3.1 Project Area Disturbance

The total (maximum) area of the pipeline footprint is approximately 131 ha, approximately 12.5 km of pipeline within Darwin Harbour will be trenched to provide protection. Further information on pre-lay works including trenching is provided in **Section 2.4.2**. Most (95 ha) of this area will consist of sponge or sponges/filterers/octocoral habitat, 5 ha macroalgae habitat, with the remaining disturbed area (31 ha) classified as bare ground (**Figure 4-1** and **Figure 6-4**).

2.4 Project Schedule and Key Activities

Santos and partners undertook a final investment decision for the DPD Project in Q3 2022. Santos is targeting to have all DPD regulatory approvals in place by Q4 2023 to ensure construction activities do not delay Barossa first gas in the first half of 2025. A nominal DPD Project construction schedule is shown in **Figure 2-3**. The construction activities will span a nominal cumulative period of 15-months in the field. The actual construction sequence and schedule will be subject to regulatory approvals, vessel availability, operational issues, and weather. Santos has assessed in this Preliminary Documentation report the impacts of performing construction activities at any time throughout the year in order to respond to changes in the schedule.

Table 2-2 lists the Project activities and their locations as described in this section.

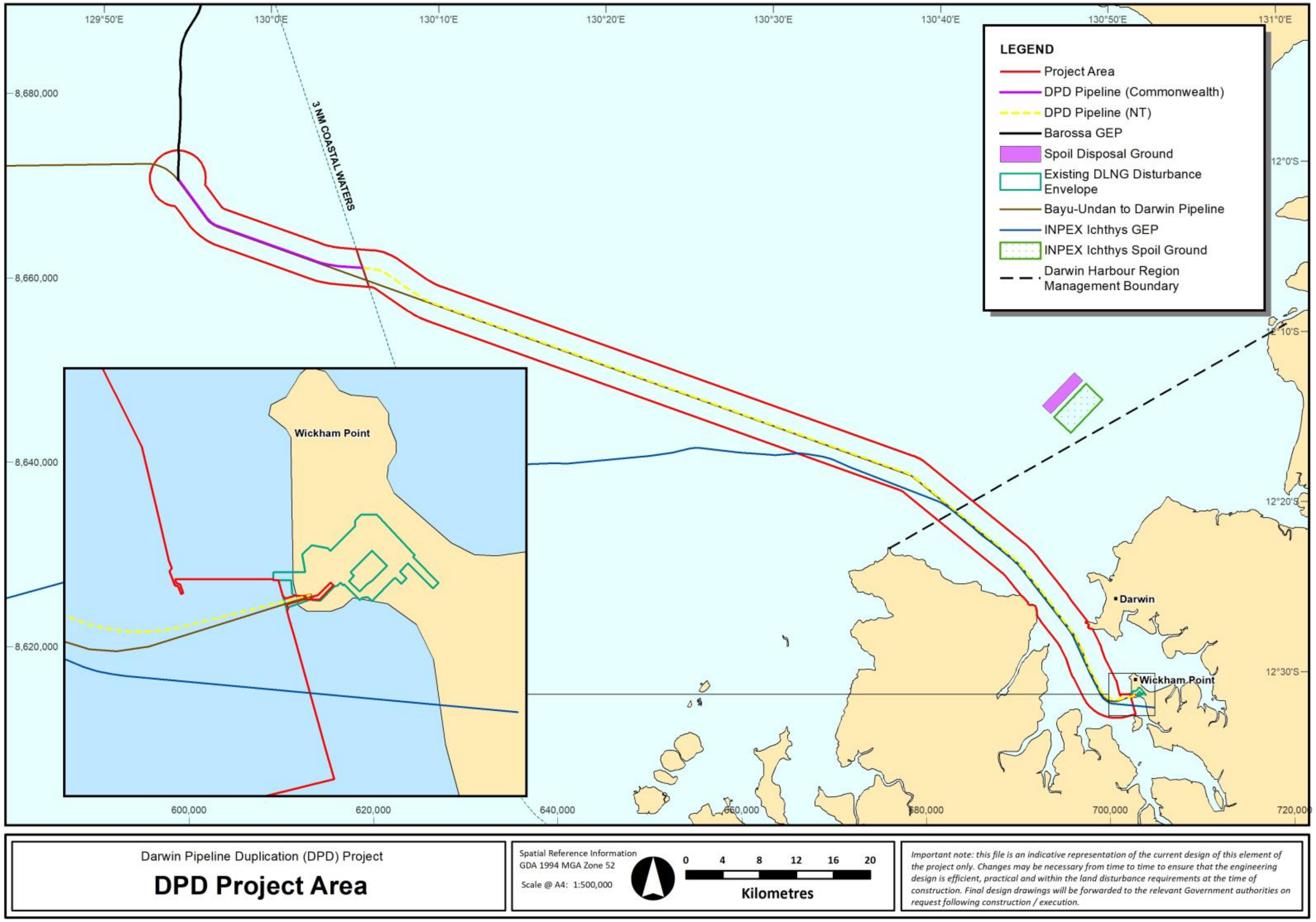


Figure 2-1 DPD Project area

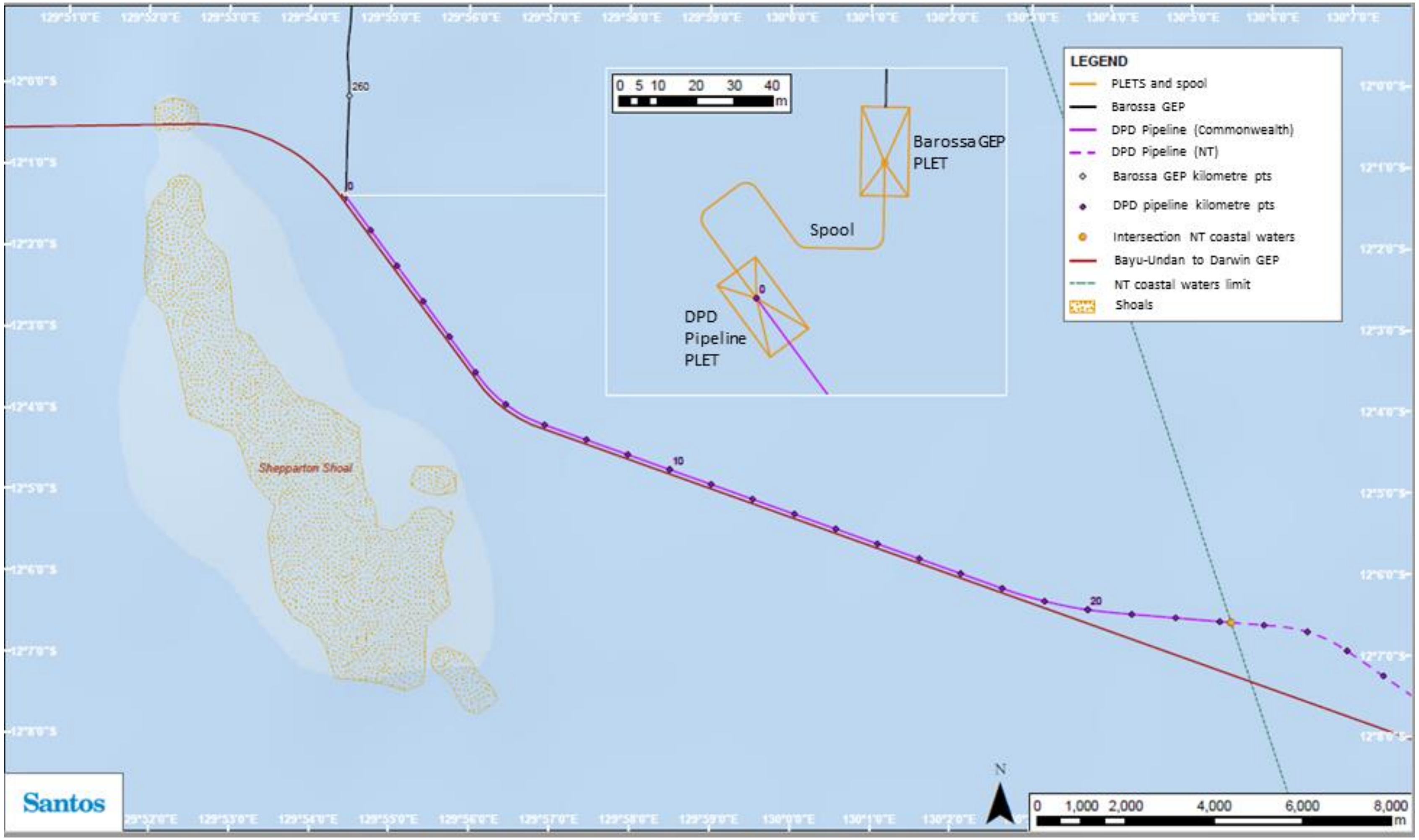


Figure 2-2 Commonwealth waters infrastructure

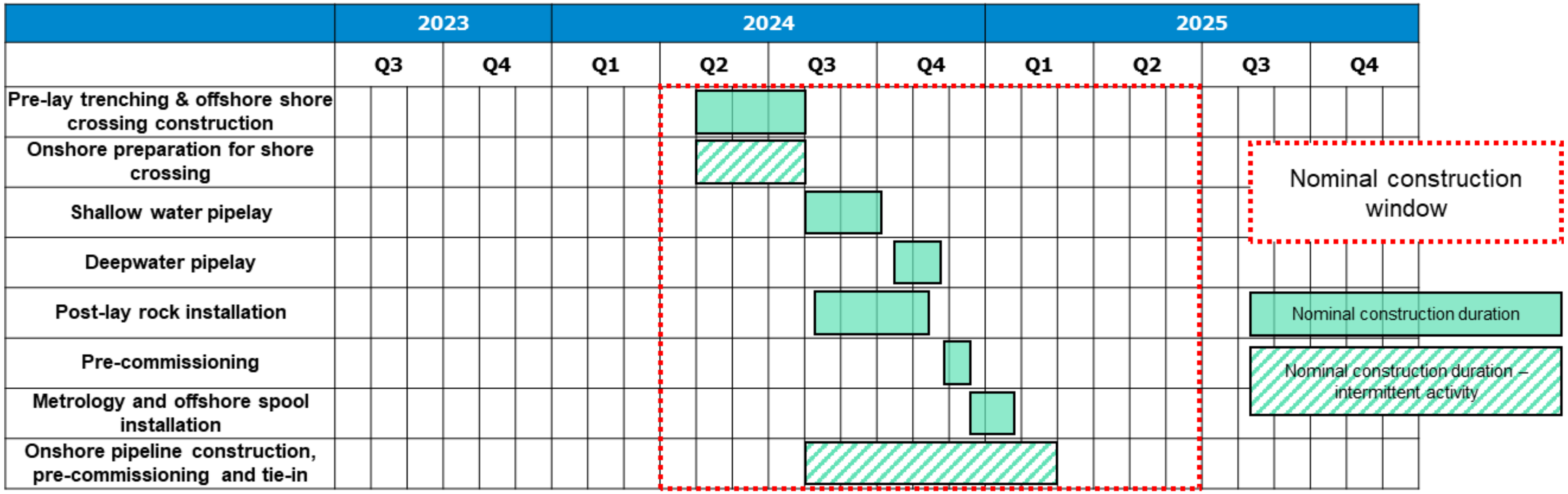


Figure 2-3 DPD Project execution schedule (indicative)

Table 2-2 Location of the different activities associated with the Project

Activity	Commonwealth waters	Offshore NT waters (includes spoil disposal ground)	Darwin Harbour	Onshore / shore crossing
Surveys				
Offshore surveying	Y	Y	Y	
Onshore surveying				Y
Pre-lay work				
Pre-lay trenching		Y	Y	Y
Spoil disposal		Y		
Pre-lay span rectification	Y	Y	Y	
Cable crossing			Y	
Onshore and shore crossing construction				Y
Pipeline installation and pre-commissioning				
Pipelay activities	Y	Y	Y	
ILT installation		Y		
PLET installation	Y			
Spool installation	Y			
Pipeline shore pull				Y
Trench back-fill		Y	Y	Y
Post-lay span rectification		Y	Y	
Pre-commissioning activities	Y	Unplanned	Unplanned	Y

Activity	Commonwealth waters	Offshore NT waters (includes spoil disposal ground)	Darwin Harbour	Onshore / shore crossing
Pipelay contingencies	Y	Y	Y	Y
Demobilisation at shore crossing				Y
Commissioning and operations				
Transport of hydrocarbons	Y	Y	Y	Y
Inspection, maintenance and repair	Y	Y	Y	Y
Decommissioning (> 2050)				
Pipeline	Y	Y	Y	Y
Subsea infrastructure	Y	Y	Y	
Onshore				Y
As-left / post surveys	Y	Y	Y	Y
Support operations				
Vessel	Y	Y	Y	
Helicopter	Y	Y	Y	
Remotely Operated Vehicles (ROV)/ Autonomous Underwater Vehicle (AUV)	Y	Y	Y	
Onshore plant and equipment				Y

2.4.1 Surveys

2.4.1.1 Offshore Surveys

Site surveys that will be undertaken at various stages throughout the construction and operation phases of the Project and will include:

+ Pre-lay surveys.
+ Surveys during and following pipeline trenching and installation.
+ Surveys during FCGT (contingency inspections during pressure testing).
+ Routine inspection surveys during operations.
+ Post decommissioning surveys.

Some routine surveys are excluded from the scope of this Preliminary Documentation report and the NT EPA referral and SER as they are additional surveys recently implemented post NT EPA referral and SER, and include low impact pre-construction surveys (including but are not limited to environment, heritage, geotechnical, geophysical and unexploded ordnance (UXO)) required to gather information for Project planning and approvals. Santos will continue to conduct low impact onshore and offshore site investigation works for Project planning and approval prior to the commencement of construction activities. These routine surveys include:

+ Environmental benthic habitat condition and water/sediment quality surveys (e.g., using remote operated vehicle, water/sediment sampling/monitoring equipment).
+ Underwater heritage surveys (e.g., using sonar equipment and remote operated vehicle) including recovery/movement of maritime heritage objects in accordance with Heritage Branch requirements.
+ Geophysical/ geotechnical surveys (e.g., using sonar, sub bottom profiler, sediment cores, onshore excavation equipment and cone penetration tests).
+ Unexploded ordinance (UXO) surveys and removal (e.g., using sonar, remote operated vehicles, divers, and magnetometer).

The results from these studies will further inform the baseline information on the existing environment and the potential impacts that may occur from the Project.

A pre-lay survey will be undertaken prior to commencement of Project pipeline installation and surveys will continue throughout the construction phase, to monitor the activity and evaluate progress of the installation. The pre-lay survey will include bathymetric and geophysical evaluations of the seabed to identify debris and other hazards along the proposed route prior to laying the Project pipeline, noting the initial site investigation did not identify any debris that would require removal prior to installation in offshore areas (RPS 2022a; **Appendix 7**).

As laid and cathodic protection surveys will be progressively undertaken throughout the installation phase and also during subsequent operations i.e., inspection, maintenance and repair activities. The data from these surveys will be used to determine the Project's pipeline position once laid, inform free-span rectification requirements and identify deviations from straightness. Surveys will use the same techniques as outlined above, as well as visual inspection using Remotely Operated Vehicles (ROVs) and cathodic protection equipment such as passive field gradient sensing equipment. Cathodic protection is an important control to prevent corrosion.

During operations, surveys will be undertaken as a part of ongoing inspection and maintenance. As-left surveys may also be conducted as part of future decommissioning activities.

Surveys will be undertaken either from dedicated survey vessels, or other support or installation vessels. ROVs or autonomous underwater vehicles (AUV) may be used during surveys, using visual or geophysical techniques, such as multi-beam echosounder (MBES) and side scan sonar (SSS).

Methods that will be used to undertake the offshore surveys include:

+ Geophysical surveys:
  - Geophysical marine survey methods for identifying debris, seabed features, buried assets (e.g., fibre optic cable) and obstructions are non-intrusive, and the equipment does not disturb the seabed. Survey methods will primarily include MBES. A MBES uses sound pulses to establish the seabed profile. Most modern MBES systems work by transmitting a broad acoustic pulse from a hull or pole mounted transducer. A sub-bottom profiler (SBP) also uses acoustics, although the acoustic pulse is transmitted from a towed surface or deep-sea source and collected by a receival array that is towed below the water surface.
  - Side scan sonar (SSS) identifies any sea floor debris and seabed profiles. SSS involves towing a set of transducers mounted on either side of a 'tow fish' approximately 10-20 m above the seabed, producing pulses at high frequencies.
+ Underwater acoustic positioning:
  - Installation of the Project pipeline requires accurate positioning on the seabed and therefore long base line (LBL) and/or ultra-short baseline (USBL) acoustic positioning may be required. USBL and LBL utilise transponders. Typically, for a USBL array, transponders are installed attached to subsea equipment and recovered once the equipment is correctly positioned on the seabed. For LBL, transponders are typically fixed to seabed frames which are deployed and then fully recovered once subsea equipment is correctly positioned.
  - LBL arrays could be required at the ILT and PLET location. The footprint on the seabed of a typical LBL transponder frame is less than 5 m^2 per frame. It is estimated that 6 LBL arrays per structure (inline tee and PLET) may be used, with a total area for each structure of up to ~50 m^2. LBL and USBL systems work by emitting short pulses of medium to high frequency sound. Transmissions are not continuous but consist of short 'chirps' with a duration that ranges from 3 to 40 milliseconds.
  - Units will be retrieved after installation of the structure.

2.4.1.2 Onshore Surveys

Onshore geophysical and geotechnical surveys will be undertaken prior to construction at the DLNG facility shore crossing location. These survey activities may include:

+ Geophysical, including seismic refraction and multi-channel analysis of surface wave surveys.
+ Geotechnical, including digging of test pits with an excavator; Piezocone penetration test testing and core sampling (i.e., to test for acid sulphate soils). These could extend to a few meters below the anticipated depth of the trench (i.e., 5 m).

Following decommissioning, surveys will be undertaken of the ground level (as-left survey).

2.4.2 Pre-lay Work

2.4.2.1 Pipeline Pre-lay Trenching

Pre-lay trenching of the seafloor and shoreline will be required for the following reasons:

+ Maximising pipeline stability.
+ Pipeline free span rectification.
+ Maintaining free water clearance between pipeline and vessel hulls within the Darwin Harbour shipping fairways.
+ Protection of the pipeline from anchor drag, vessel impact and grounding or other third-party impacts which may lead to pipeline damage.
+ Maintenance trenching if trenched areas accumulate sediments prior to pipelay.

2.4.2.1.1 Planned Trenching Operations

It is anticipated that approximately 12.5 km of trenching (including sand waves and pre sweep areas) will be required in sections within Darwin Harbour (~KP91.5 to KP121.6) and a further 300 m at the shore crossing up to the shore pull termination point (KP121.484 to KP122.690 respectively). Additional trenching between the shore-pull termination point and the beach valve (approximately 200 m) will be undertaken to facilitate laying of the onshore section of pipeline.

Trench design, including trench depth and presence/type of rockfill will vary across trenching locations dependent upon trench objectives. The DPD Project has optimised each trench length resulting in reduced trenching, and thereby reducing the extent of environmental impact from seabed disturbance and reducing potential turbidity effects from trenching. The trench designs have an approximate width of 3 m at the base but vary in width at the top of the trench, up to a maximum of ~40 m. Indictive trench designs are shown in **Figure 2-4** and **Figure 2-5**, however specifications may alter slightly as designs are finalised.

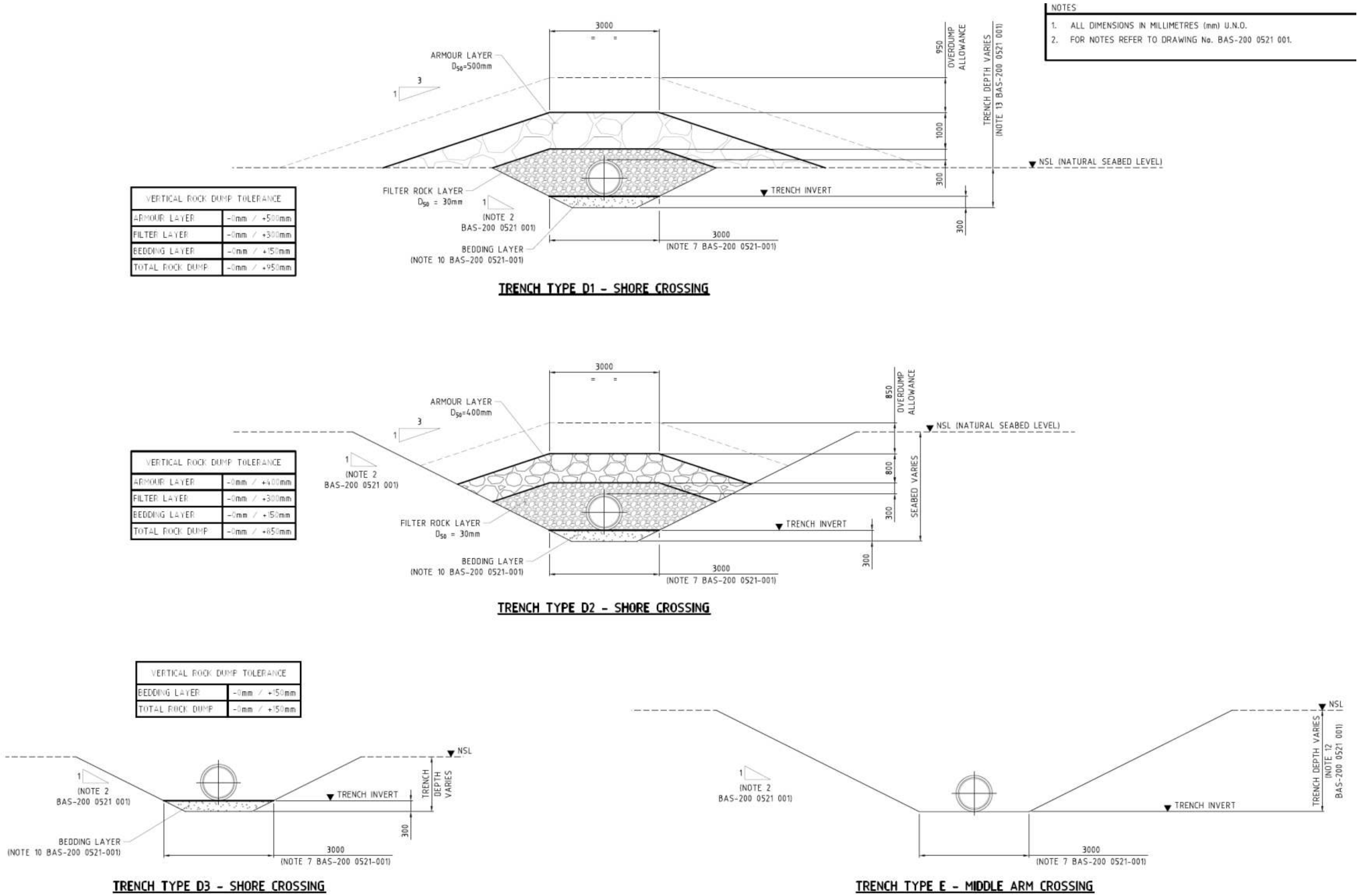


Figure 2-4 Indicative trench design – Middle Arm and shore crossing

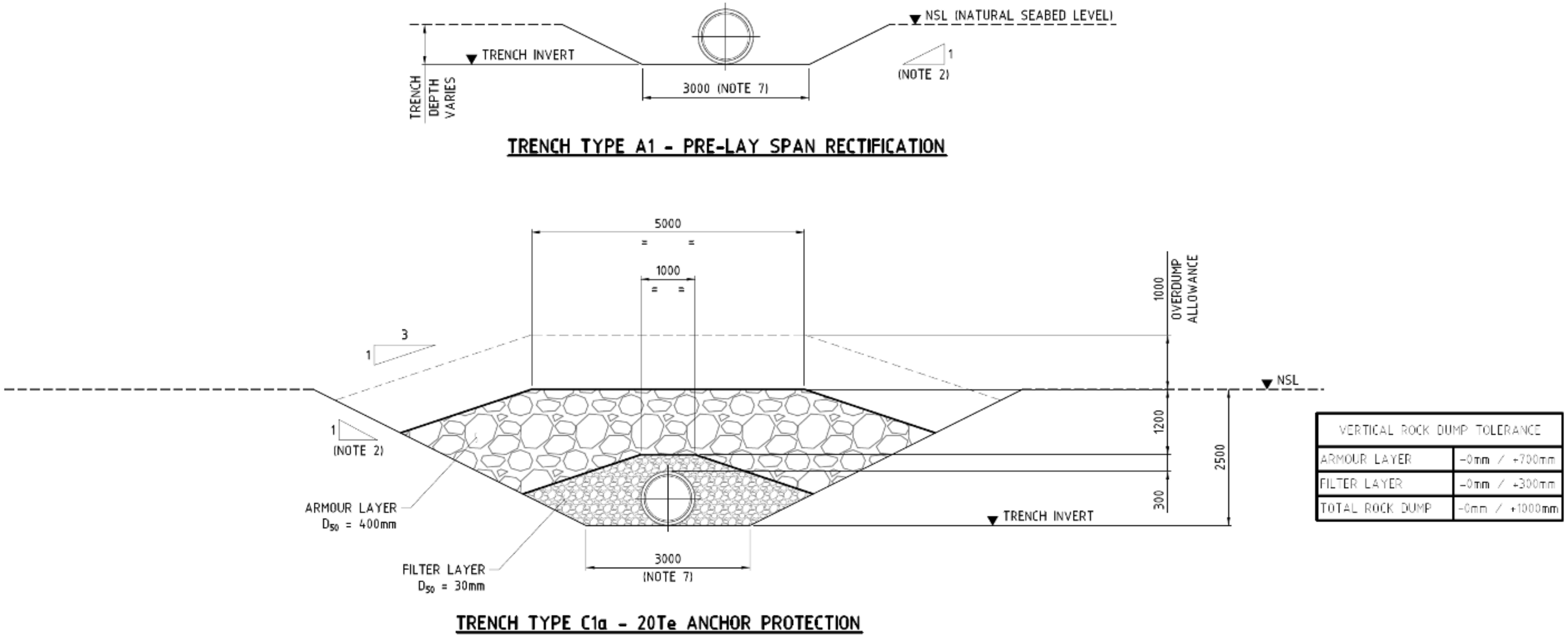


Figure 2-5 Indicative trench design – clearwater and anchor protection

The offshore trenching operations for the Project pipeline route in Darwin Harbour have been divided into eight sections, made up of four trenching zones, three pre-sweep areas and a sand waves area as outlined in **Table 2-3** and shown in **Figure 2-6.**

Table 2-3 Provisional outline of proposed trenching activities including trenching of shore crossing

Trenching Activity Areas	Trench Design	Location Start (KP)	Location End (KP)	Equipment	Approximate Material to be Trenched (m^3)
Trench Zone On-shore Shore pull termination point to beach valve	Onshore	~122.5	~122.7	Excavator	5,000
Trench Zone to shore pull termination point	D1	~122.4	~122.5	Excavator	5,000
Trench Zone 1	D2	~121.9	~122.4	BHD and Barge	17,000
Trench Zone 2	D3	~121.2	~121.9	BHD and Barge	6,000
Pre-sweep Area 1	N/A	~120.6	~121.2	TSHD	4,000
Trench Zone 3	E	~119.3	~120.7	TSHD and CSD	48,000
Pre-Sweep Area 2	N/A	~113.2	~116.4	TSHD	35,000
Pre-Sweep Area 3	N/A	~106.5	~106.8	TSHD	3,000
Trench Zone 4	C1A	~103.6	~106.6	TSHD and CSD	117,000
Sand Waves Area	N/A	~92.2	~94.4	TSHD	15,000
Total Volume					**255,000**

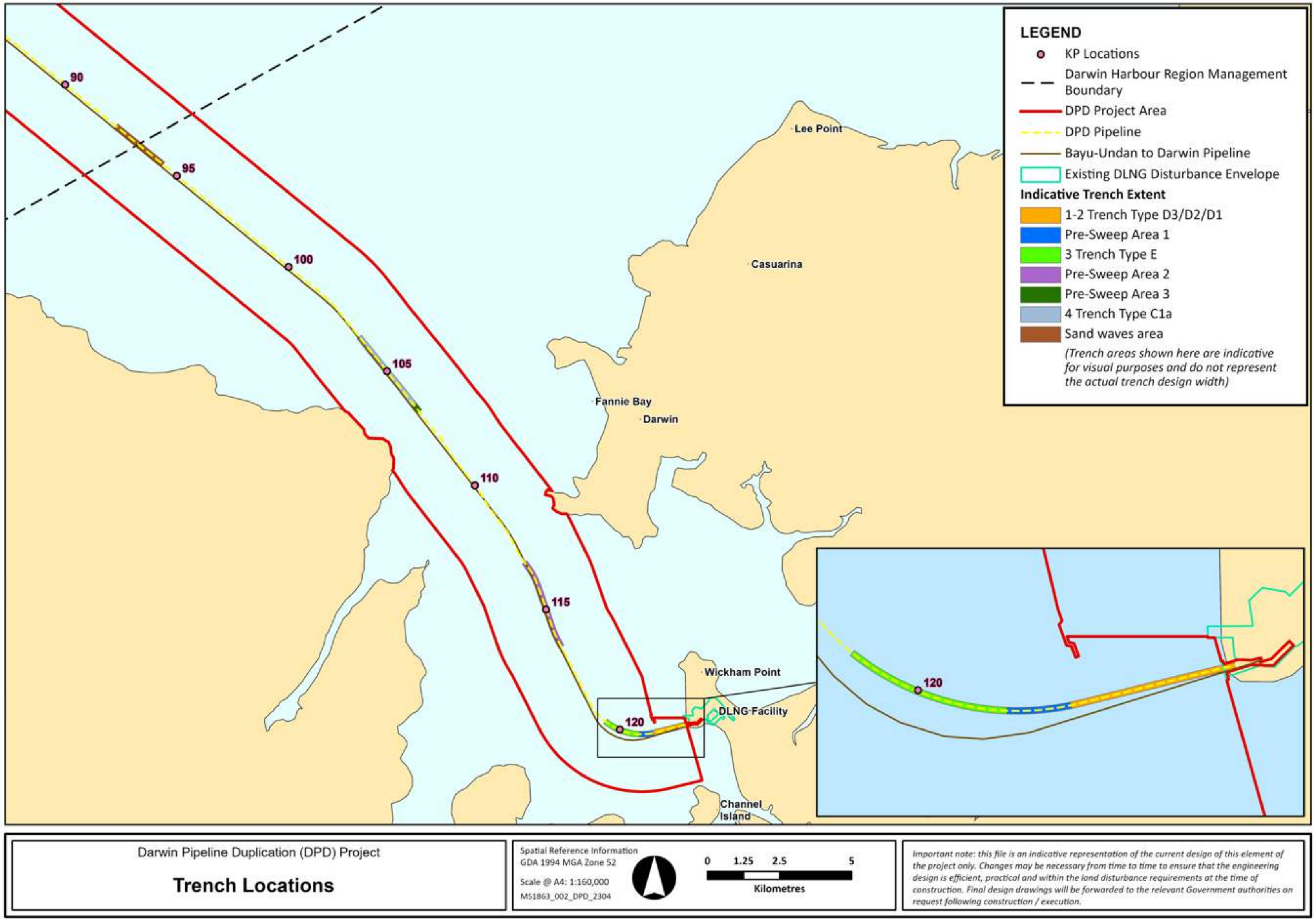


Figure 2-6 DPD Project trench locations

The three pre-sweep areas and single sand waves area only require sediments to be removed, while the seven trenching sections require the removal of both sediment and rock material. Two trench zones are located onshore up to the beach valve.

The trenching in Trench Zones 1 to 4 will be completed using a variety of trenching vessels (refer **Table 2-3**) which include a backhoe dredge (BHD), a trailing suction hopper dredge (TSHD) and a cutter suction dredge (CSD) (which is used to crush harder material). Pre-sweep sediment removal and sand wave rectification will occur is applicable areas (**Table 2-3**).

The BHD will be used for trenching in the shallow water sections, such as the shore crossing, while the CSD will be used to cut the harder material further offshore. For hard material in the shallow water section, the BHD Xcentric Ripper (preferred) or hydraulic hammer may be required for mechanical rock breaking. A TSHD is used to remove CSD rubble and soft sediments, such as in the pre-sweep and sand wave sections. An excavator will be used to carry out trenching activities onshore from the intertidal area through to the beach valve. Indicative quantities of each material type required to be trenched are provided in **Table 2-3**.

Material trenched by BHD, TSHD or CSD will be disposed of at a designated offshore spoil disposal ground. The designated spoil disposal ground for trenched material is located adjacent to the previous INPEX Ichthys spoil disposal ground to the north of Darwin Harbour, within Beagle Gulf, approximately 12 km north-west of Lee Point (refer **Figure 2-1**). In order to mitigate against acid sulfate soil risks, material removed within the inter-tidal zone by excavators will be placed near the low tide mark to keep material wet and there will be dispersion of this material with tidal movement. Trenched material within the onshore zone between the shore pull termination point and the beach valve will be stockpiled and used to backfill the trench once this section of Project pipeline has been installed.

Trenching and disposal operations are proposed to take place over an indicative six-week period, but potentially up to 12 weeks, with concurrent operations of the TSHD, CSD and BHD, and onshore excavators.

2.4.2.1.2 Trenching from Onshore

The route of the onshore Project pipeline section lies within the existing DLNG facility disturbance footprint and was cleared of native vegetation during construction of the Bayu-Undan to Darwin gas export pipeline. The vegetation that is present consists of naturally regenerated native grasses and weeds. The grasses and topsoil will be stripped, and the trench will be excavated to approximately 2.5 m deep and up to 3 m wide at the base. Santos is obtaining a variation to the existing DLNG Exceptional Development Permit for the DPD Project which will cover the work at the DLNG site, including the onshore trenching.

The onshore trenching works will be undertaken during wet and/or dry seasons. The trenching of the onshore works may require dewatering due to rainwater, if undertaken in the wet season. The management of the dewatering activities is detailed in the Onshore CEMP (**Appendix 13**). While considered unlikely, there may be some dewatering of groundwater required, and is included in the ASSDMP (**Appendix 12**) to ensure management of any acidic groundwater.

Excavated material from the trenches will be placed on the non-working side of the trench or stockpiled within the onshore Project area within the DLNG disturbance envelope for future reuse as backfill. Surplus material will be removed offsite. If any excavated material from onshore trenching is suspected to be potential acid sulfate soil, testing and treatment will be undertaken as per the ASSDMP (**Appendix 12**).

The construction works for the onshore trenching will be undertaken simultaneously with intertidal construction works. Therefore, trenching will initially be completed from the upstream weld of the beach valve location to the extent of the DPD site pad used for Project pipeline installation through the shore crossing (shore pull). This section will be approximately 130 m in length. Once the shore crossing facilities have been removed, the onshore trench will extend to the onshore termination point. This trench will be approximately 70 m in length and up to a maximum of 40 m wide. The onshore construction site and onshore trenching area can be seen in **Figure 2-7**.

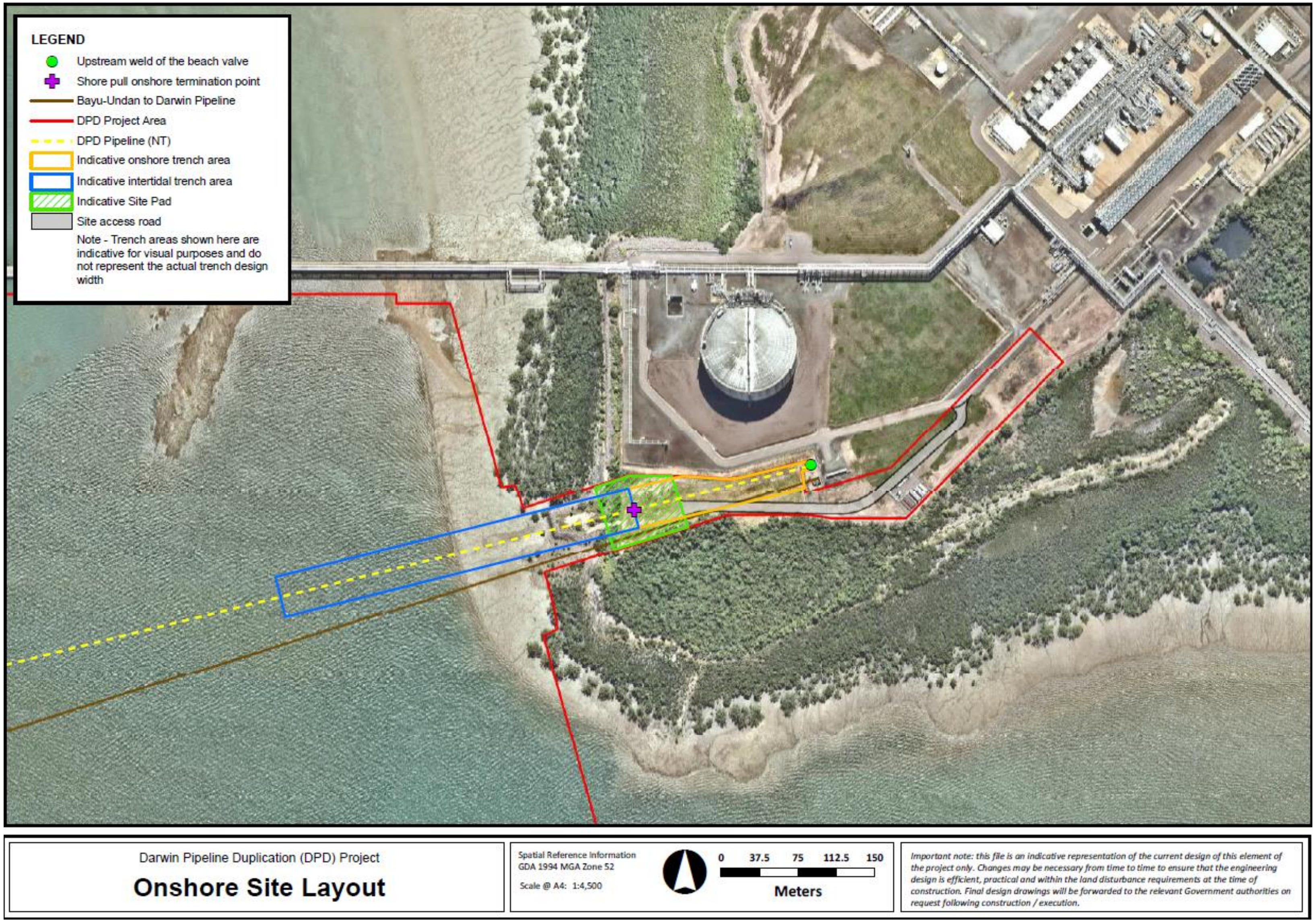


Figure 2-7 Shore crossing and onshore Project area

2.4.2.2 Spoil Disposal

All spoil disposals will be managed in accordance with the Trenching and Spoil Disposal Management and Monitoring Plan (TSDMMP), **Appendix 15**). The proposed trenching for the Project pipeline installation will require the disposal of an estimated 255,000 m^3 of spoil (**Table 2-3**, up to 245,000 m^3 for trenching including pre-sweep areas and 10,000 m^3 for onshore and shore pull works). However, a maximum volume of 500,000 m^3 has been accounted for potential over-trench and contingency trenching. Maintenance trenching may be required due to the mobility of the sediment within Darwin Harbour. Sediment mobility is difficult to determine, however conservative estimates indicate that up to 20% of the primary pipelaying campaign may need to undergo maintenance trenching, resulting in no more than 80,000 m^3 of additional trench material to be removed. The maintenance works are likely to be isolated pockets along the entire trench corridor that require clean-up to ensure the pipeline is installed and buried correctly. This would be completed over a short timeframe due to the likelihood of only soft material being present post wet season, with an expected time frame of no longer than two weeks. If maintenance trenching is required, this would likely occur at the end of the cyclone season around the months of April/May, following the primary trenching campaign.

The proposed spoil disposal ground for trenched material is located to the north of Darwin Harbour, within the Beagle Gulf, approximately 12 km north-west of Lee Point. This location has been selected with consideration of technical, environmental, cost and safety aspects and available information. The selected site is adjacent to the spoil disposal ground approved for use by INPEX for the Ichthys Gas Field Development Project (refer to **Figure 2-1**). The area of the spoil disposal ground is 6.25 km^2.

2.4.2.3 Pre-lay Span Rectification and Foundation Installation

Pre-lay span rectification will be required in some areas to reduce Project pipeline spanning. The use of a TSHD to rectify sand waves along with other sites outside of the planned trench zones by removal of sediment between KP92.2 and KP94.4 is detailed in **Table 2-3**. Additional areas may also require the use of the TSHD to prepare the benthic substrate prior to pipelay, and these will be assessed as works commence and progress. Pre-lay span rectification may also be performed using concrete mattresses, grout bags or mass flow excavation (MFE) subject to the seabed topography and benthic conditions.

An MFE tool works by accelerating a mass flow of water to blow away sediments within a localised area and can be used to accurately remove sediment high points and reduce pipeline spanning. MFE is an alternative to the installation of numerous concrete mattresses or grout bags. Where concrete mattresses or grout bags aim to support a spanning pipeline, the MFE will remove the span entirely limiting the exposure of the pipeline over its operational life and remove potential integrity concerns. The MFE tool would be deployed by a construction vessel using dynamic positioning and therefore no additional seabed disturbance due to the absence of anchoring is predicted other than within the localised area where the MFE operates.

The use of MFE has been identified as a potential method to reduce sediment high points at eight locations within two areas along the offshore Project pipeline route in NT waters. The first area is between KP51 to KP53 (consisting of four sites), approximately 40 km offshore from the Darwin Harbour boundary; the second area is between KP72 and KP81 (consisting of four sites), approximately 12 km from the Darwin Harbour boundary. At each location it is expected that typically less than 100 m of excavation, to a nominal width of 3 m at the bottom of the excavation, would be required along the pipeline route.

The use of MFE would occur during pre-lay activities and is expected to take an indicative 7-14 days to complete, with an estimated six hours of operation at each site.

The MFE tool will generate localised turbidity at the seabed during the excavation process. At the locations identified for MFE use, sediment characteristics, as identified by DPD Project sediment sampling (**Appendix 7**), indicate a high proportion of sand/gravel (70-90%), with a lesser contribution of fine sediments (silt/clay) (10-30%). Given the localised method and area of operation and the type of sediments observed at the excavation sites, turbidity created by the MFE tool is predicted to be localised and temporary. The lower fines content will also help mitigate large plume generation and limit turbidity.

The installation of concrete mattresses or grout bags may be used in addition to MFE where MFE proves unsuitable (e.g., if consolidated sediments are encountered that cannot be removed by MFE) or as an adjunct to MFE if there is residual spanning requiring further rectification. Each concrete mattress footprint is ~18 m^2 and may be installed in groups and stacked on top of each other to reach the desired height.

Post-lay span rectification, if required, is likely to be performed using grout bags aided by a remotely operated vehicle (ROV). The likely disturbance footprint, at each site, is approximately 25 m^2. Grout is an inert substance (sand/aggregate and cement slurry with no chemical additives) and will be used to fill the grout bags in-situ. Following grout bag filling, grout lines will be flushed resulting in small discharges of grout to the marine environment.

In addition to concrete mattresses for span rectification, for the in-line tee, a steel pre-lay foundation may be installed, complete with scour protection using mattresses or grout filled mats, with an approximate footprint of 375 m^2.

2.4.2.4 Cable Crossings

The Project pipeline will intersect with telecommunication and power cables at four locations within Darwin Harbour. The locations of the telecommunication and power cables are well known and are highlighted on maritime charts as 'no anchoring zones'. These locations are expected to be the crossing points however the cables are dynamically stable so they may shift slightly prior to the construction of the crossing. Telecommunications and power cables will be protected during pipelay operations using concrete mattresses if required. Supports either side of the individual cables will be provided as required to provide clearance between the Project pipeline and cables.

Detailed survey will be undertaken prior to any activities performed in the vicinity of the power and telecommunication routes. Furthermore, anchoring associated with pipelay activities in this area will include appropriate pull-on and pull-off separation distances to ensure no interaction with the cables present.

2.4.2.5 Pipeline Crossings

The Project pipeline crosses over the Bayu-Undan to Darwin gas export pipeline at two locations in order to avoid encroaching into the Darwin shipping channel. The crossing locations have been selected in regions where the Bayu-Undan to Darwin gas export pipeline is covered by a rock berm. The Project pipeline is supported by concrete mattresses over the crossings to manage spanning and to ensure a minimum separation between the Project pipeline and the Bayu-Undan to Darwin gas export pipeline rock berm. There is the potential to install nominally 30,000 tonnes of rock at the crossing locations subject to Project pipeline detailed design.

2.4.2.6 Onshore Construction

The Project pipeline is welded on the pipelay vessel and the proposed method of taking the pipeline ashore at the shore crossing is by shore-based winch. The onshore disturbance is located within the existing DLNG facility disturbance envelope, as shown in **Figure 2-7**.

The shore pull location and equipment layout has been designed to accommodate all contingency operations i.e., wet buckle dewatering.

Onshore construction includes:

+ Vegetation regrowth clearing.
+ Civil works and grading of the onshore shore pull site location, construction of a levelled lay-down area for the winch foundation.
+ Import of clean fill and rock.
+ Preparation of lay down areas, access roads, hardstand (geotextile and road base) and site fencing.
+ Installation of the winch spread, including winch pad, and holdback anchor.
+ Installation of bedding rock and or rollers for the shore pull.
+ Installation of facilities including offices, amenities, chemical and fuel storage, PASS storage and treatment.

The shore crossing location will be used for the flood, clean, gauge, testing (FCGT) scope once the Project pipeline has been fully installed. A hydrotest spread will be installed, with bulk chemical storage. Depending on the hydrotest concept selected, a bladder may need to be installed to temporarily store hydrotest water (i.e. an enclosed bladder within steel retaining wall). Hydrotesting the pipeline is to confirm its pressure integrity prior to commissioning and introducing hydrocarbons.

The total area of the shore crossing location (onshore) is approximately 3 Ha and is completely within the existing DLNG disturbance envelope.

Onshore, between the shore pull end point and the proposed beach valve location (a distance of approximately 200m), trenching will be continued, and pipeline installed through lowering by crane and welding of pipe lengths in-situ. Following pipeline installation and hydrostatic testing, the onshore trench will be filled. Further information regarding the onshore works for the DPD project are addressed in the Supplementary Environmental Report (SER) issued to the NT EPA May 2023 (**Appendix 2**) and the Onshore Construction Environmental Management Plan (CEMP) (**Appendix 13**).

2.4.3 Installation and Pre-commissioning

2.4.3.1 Pipelay Activities

The planned pipelay activities will commence with pipe welding in shallow water using an anchored nearshore pipelay barge. Consecutive joints will be welded onto the pull-in head, which will be pulled onshore to the onshore tie-in point using the preinstalled linear winch assembly detailed in **Section 2.4.2.6**. The base case methodology is for the pipelay to be carried out as a continuous program from nearshore to offshore and completed using the deep water pipelay vessel with laydown of the offshore Project pipeline PLET structure on the pre-installed foundation at pipeline KP0.

The Project pipeline will be laid using a continuous assembly pipe-welding installation method. This involves assembling single pipe joints (approximately 12 m in length) in a horizontal working plane onboard the pipelay vessel. The pipe joints are welded together, inspected and then the welded area is coated on-board the vessel before being lowered behind the pipelay vessel. The pipelay uses an 'S-lay' method (with the S notation referring to the shape of the pipeline catenary as it is lowered to the seabed). As the pipeline is lowered, it is supported on board the pipelay vessel using a curved steel structure fitted with rollers known as a 'stinger'.

Pipelay in shallow water will be conducted using an anchored pipelay barge, while pipelay in deeper water will be conducted using a dynamically positioned (DP) deep water pipelay vessel. KP91.5 is the nominated handover point between the anchored pipelay barge and deep water pipelay vessel in approximately 20 m of water, but the actual handover point where the deep water pipelay vessel will take over will depend on operational requirements.

The pipelay vessel that will be used is dependent on a range of factors including the availability of vessels, final pipeline parameters and water depth. Examples of pipelay vessels are shown in **Figure 2-8** and **Figure 2-9**.

In the Commonwealth and offshore NT waters (refer to **Section 2.3** for definition) where a deep-water DP pipelay vessel will be used, pipeline will be laid at approximately 2 km/day. The installation disturbance footprint will be limited to within a 50 m wide disturbance corridor.

Where the nearshore pipelay barge is used, anchoring will be required and the speed of pipelay will be reduced to ~300-400 m/day, depending on the coordination of other supporting activities.

For this extent, the footprint will include the 50 m disturbance corridor, plus the footprints required for vessel anchoring. It is estimated that each of the ten anchors has a footprint of ~10 m^2, including chain sweep. Between 10 – 20 anchor moves are expected each day, for a period conservatively estimated as 100 days.

When close to shore, pre-installed onshore anchors may be used by the nearshore pipelay barge. These would be within the proposed shore crossing (i.e. onshore) disturbance footprint (existing DLNG facility disturbance footprint). If onshore anchors are used, these anchors have a typical footprint of 5 m x 5 m with an additional 40 m^2 for anchor wire on the seabed.

Figure 2-8 Example of pipelaying vessel (deep water vessel)

Figure 2-9 Example of pipelaying vessel (nearshore pipelay barge)

A dead-man anchor may be used during a midline start up with the dynamically positioned pipelay vessel. The dead-man anchor will 'dig' into the seabed to provide stability for the dynamically positioned pipelay vessel during pipelay initiation.

The dead man anchor assembly is essentially a drag anchor connected to nominally 1,500 m of wire cable.

If required, the dead-man anchor shall be installed adjacent to the Project pipeline route and shall be removed on the completion of pipeline initiation.

The base case is for the Project pipeline to be sequentially laid, beginning at the shore crossing, moving through Darwin Harbour and progressing offshore through NT waters to the PLET in Commonwealth waters. For this to occur the last section of pipe laid by the shallow water pipelay barge will have a recovery head arrangement installed which will include a submersed pennant buoy, allowing this and the pipe to be recovered by the deep water pipelay vessel. Once retrieved the recovery head will be removed and recovered pipe welded to the new section of pipe to commence the deep-water pipelaying process. The base case handover point will be at KP91.5 in approximately 20 m of water, in this case the shallow water pipelay barge will have laid approximately 31 km of pipe and the deep-water pipelay vessel will lay approximately 69 km of pipe in NT waters and 23 km in Commonwealth waters.

An alternative to pipelaying sequentially from onshore to offshore may be to install the deep-water portion of the Project pipeline ahead of the shallow water portion, or to install both portions concurrently. In this scenario, the shallow water vessel would still commence at the shore crossing to facilitate the shore pull and an above water tie-in (AWTI) would be performed where the two sections of pipeline meet. The AWTI would occur using the shallow water pipelay barge and would involve recovery of pipeline end sections using davits and subsequent welding from a temporary work platform. This activity would involve the installation of buoyancy modules on the pipe tails to support the pipeline end sections and facilitate correct alignment for welding.

2.4.3.2 In-line Tee

The in-line tee (ILT) with integrated mudmat will be installed during the pipelay activities by the deep-water DP pipelay vessel. The ILT is welded into the Project pipeline onboard the pipelay vessel and is laid as part of normal pipelay. A protection structure, approximately 5 m high, would be installed post-pipelay by crane (guided by ROV) over the ILT assembly. Anti-scour protection in the form of concrete mattresses will also be installed and are included in the calculated seabed disturbance figures. The ILT allows for future expansion tie-ins.

2.4.3.3 Project Pipeline PLET Installation

The foundation for the Project pipeline PLET is pre-installed during pre-lay works (**Section 2.4.2.3**). The PLET is welded into the pipeline onboard the pipelay vessel and is laid as part of normal pipelay. The PLET will be installed utilising an in-line (s-lay) methodology where the PLET (excluding mattresses/mudmats and protection structures) will be introduced into the firing line where it is then welded into the pipe string. The PLET and pipeline are progressively lowered to the seabed as the vessel moves forwards until the PLET/pipeline assembly is landed onto the pre-installed foundation.

Following the PLET and spool installation, a PLET protection structure will be installed on the PLET foundation and will arch over PLET. The PLET protection structure may be wet parked (if required) adjacent to the PLET location. Once in place, the PLET protection structure does not add to the seabed disturbance footprint generated by the PLET foundation.

2.4.3.4 Spool Installation

The spool will be installed to connect two PLETs (**Figure 2-2**) (one PLET, the Barossa gas export pipeline (GEP) PLET, is out of scope for this RFI, as it is included in the *Barossa Gas Export Pipeline Installation Environment Plan (BAA-100 0329)* accepted by NOPSEMA on 9 March 2020). The spool is nominally 90 m long, 26-inch in diameter carbon steel pipeline. Concrete mattresses will be installed to support the spool (refer to **Section 2.4.2.3**). The positioning of the spool will be supported by a Long Base Line (LBL) acoustic positioning array to be installed around the PLETs. This may be in addition to the foundation installation array (depending on timing) and thus result in separate seabed disturbance. It will likely be installed pre-flooded with treated seawater. **Section 2.4.3.8** details the treated seawater chemical composition. Once the spool is positioned, the temporary caps will then be removed, and the spool connected to the PLETs, then flushed with monoethylene glycol (MEG). The nominal volumes discharged are listed in **Table 2-4**. The seabed footprint associated with installing the spool (including mattresses and LBL positioning (if required) is nominally 155 m^2.

2.4.3.5 Shore Pull

Shore-pull to bring the Project pipeline onshore within the DLNG disturbance footprint, will use a conventional winch operation. The arrangement for the shore-pull consists of a winch spread installed on a winch pad and attached to a hold back anchor located onshore.

The Project pipeline pull head on the shallow water pipelay vessel is connected to the winch using a pull wire and suitable rigging. The shore pull will be undertaken as follows:

- A large wire will be connected onto the front end of the pipeline via a pullhead. The large wire could be pulled out to the vessel from shore along the seabed using a smaller pull-wire, or conversely it could be pulled from the vessel to the shore subject to the selected installation methodology. In either scenario the wire will be pulled along the seabed within the pipeline route disturbance corridor.
- Pipeline will be assembled on the shallow water pipelay barge.
- Pipeline will be pulled ashore from the pipelay vessel using the winch spread located onshore through the pre-constructed trench to the target box.
- Pipeline will be winched up to shore pull onshore termination point, approximately 2 m above HAT which is the end of the shore pull.
- Pulling arrangement will allow for the shore-pull to be completed as a continuous operation, which may take approximately two weeks.

2.4.3.6 Trench Backfill

The primary method of maintaining Project pipeline stability on the seabed will be through the concrete weighted pipeline coating. However, it will also be necessary to install localised secondary stabilisation/protection for sections within Darwin Harbour where the concrete weighted coating alone is not considered sufficient to provide stability and/or protection. Secondary stabilisation/protection will be via rock placement using a fallpipe vessel (FPV); self-propelled DP vessels that are used to install rock (sourced onshore) on the seabed with support barges used to transport rock. A BHD shall also be used to install rock in shallow water at the shore crossing with the rock being brought alongside the BHD on barges or installed via machinery located onshore for areas in the intertidal zone not reachable by the BHD.

2.4.3.7 Post-lay Span Rectification

In order to provide Project pipeline stability, post-lay span rectification if required, is likely to be performed using grout bags with positioning aided by a ROV. The likely disturbance footprint for each occasion of post-lay span rectification is 25 m^2. Grout is an inert substance used to fill grout bags in-situ. Following grout bag filling, grout lines will be flushed resulting in small discharges of grout to the marine environment.

The actual locations for the placement of the grout bags will not be known until after the Project pipeline is laid and surveyed.

2.4.3.8 Pre-commissioning Activities

Once the pipeline is installed, pipeline inspection gauge (pig) launcher/receivers (PLRs) will be installed on the Project pipeline PLET and at the shore crossing for pre-commissioning activities (including flooding, cleaning, gauging, testing (FCGT), dewatering, leak testing, preconditioning and nitrogen packing) to be carried out to ensure the integrity of the infrastructure.

Key activities involved with FCGT will include:

- Pigging undertaken to clean and prepare pipeline using pipeline inspection gauges (pigs).
- Pig launcher/receivers are installed on the Commonwealth waters PLET and at the shore crossing.

+ Pigs are pushed using chemically treated seawater with water 'won' (extracted) from Darwin Harbour.
+ Water 'winning' (extraction) will be undertaken using screening /mesh designs at the end of the pump inlet that prevent entrapment or injury to marine fauna.

To dewater the pipeline, treated seawater will be discharged at the Project pipeline PLET, in Commonwealth waters, approximately 16 km west of the Commonwealth/NT waters boundary. In the marine environment, due to the corrosive nature of sea waters, maritime industries use and rely on a range of chemicals including corrosion inhibitors, biocides, and oxygen scavengers to protect the integrity of assets and infrastructure and prevent microbial growth.

The treated seawater is typically a mixture of biocides (to prevent biofouling and bacterial corrosion on the internal surfaces), an oxygen scavenger (to control corrosion of the pipeline) and a dye (for leak detection during a hydrostatic pressure test (hydrotest). The planned chemical for treating seawater is typically, a concentration of up to 550ppm of Hydrosure or Hydro 3 (or equivalent chemical). The chemical concentration of the hydrotest water will be dependent on the required preservation period, which is the period of time the pipeline will be left filled with the chemically treated seawater before being dewatered for tie-in and commissioning (or repair in the case of a wet buckle event).

The potential water quality impacts from discharges related to FCGT operations in Commonwealth waters are considered, modelled and assessed in **Section 4.2.4.2**).

Treated seawater will be used to separate each pig (during flooding) and will be discharged as each pig completes a run. A slug of filtered and chemically treated forewater will be injected ahead of the first pig to lubricate the polymer (typically polyurethane) sealing discs on the pig and control pig speed. There is potential that some debris remaining from Project pipeline installation activities within the pipeline may be discharged with this water.

A schematic of the pig flooding arrangement is presented in **Figure 2-10**, which shows five pigs, each pig separated by a 500 m treated sea water slugs, plus 500 m of forewater in front of the first pig. Treated seawater discharge volumes at the PLET during FCGT are summarised in **Table 2-4.** These reflect an over-pump contingency of up to an additional 10% of the total volume of the Project pipeline.

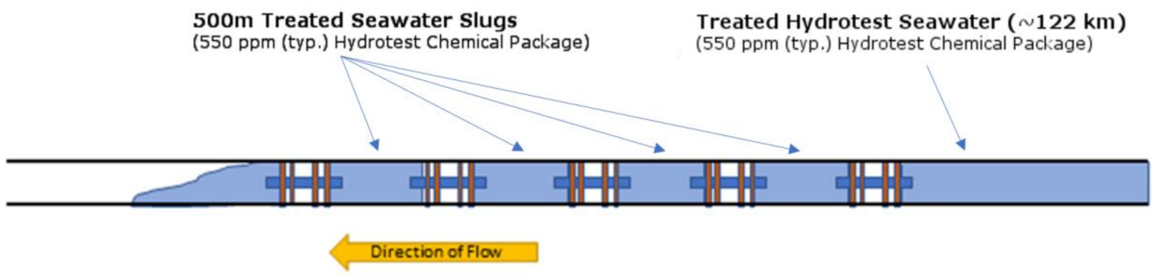


Figure 2-10 Schematic showing five pigs separated by 500 m

Once the pigging operations are completed and integrity tests met, the Project pipeline will be subjected to a hydrotest. An additional volume of treated seawater is pushed into the line to raise the pressure of the pipeline. The hydrotest pressure will be held for a period as per the relevant standard to test the pipeline integrity and ensure no leaks. There will be small, localised discharges at the PLET in Commonwealth waters as that infrastructure is tested and the GEP is depressurised.

The Project pipeline will then be dewatered using a train of dewatering pigs separated by MEG slugs. Approximately 1000 m^3 of MEG will be discharge at a final purity of >92%. MEG was selected as it effectively removes residual water from the pipeline in the drying phase of commissioning.

Dewatering discharge will be at the seabed through a diffuser attached to the Project pipeline PLET in Commonwealth waters (**Figure 2-1** and **Figure 2-2**).

The MEG could be discharged at the seabed or the surface, subject to the methodology adopted to sample the MEG in order to confirm that the Project pipeline has been correctly preconditioned.

A summary of discharges and emissions are listed in **Section 2.7.**

Table 2-4 Estimated Volumes of Discharge at the PLET During the FCGT

Pipe Diameter	26-inch Length (m)	34-inch Length (m)	Treated Seawater Discharge volume (m^3)		
			Pre-hydrotest*	Hydrotest	Dewatering
26/ 34-inch hybrid	61,800	60,684	4,183	2,000	50,117

**Pre-Hydrotest – (5 off 500 linear m slugs) +10% overpump*

Each of the discharges (**Table 2-8**) will occur at separate times at the DPD PLET.

The pig train should typically travel at a rate of 0.5 to 1.0 m/s for efficient dewatering and operation resulting in indicative discharge rates as presented in **Table 2-5.**

Table 2-5 Discharge rates [m^3/hr] at the PLET based on pig speed and pipeline diameter

Pipeline Size	Pig Speed	
	0.5 m/s	1.0 m/s
26-inch	543 m^3/hr	1086 m^3/hr
34-inch	934 m^3/hr	1867 m^3/hr

On completion of dewatering, the Project pipeline will be purged and packed with nitrogen, ready for hook up. All chemicals used in FCGT activities will be subject to Santos' chemical selection assessment process.

To provide water for the FCGT activities, flooding is planned to occur from onshore to the DPD PLET. Seawater will be extracted (water winning) from Darwin Harbour and with a screen on the pump intake to reduce the risk of harm to marine fauna. The proposed concept is that water winning will be via a pumping spread comprising four mesh-screened, submersible pumps supported on an anchored pontoon, with a water discharge manifold and hoses, power supply cables and a winch. It is anticipated that the pontoon and extraction hose will be positioned approximately 600 m from shore in approximately 15 m of water at lowest astronomical tide (LAT). Alternative, water winning may occur through a similar spread located along the DLNG jetty or jetty head.

The total volume of water required will be dependent upon the nature of the FCGT and any contingency requirements. Planned FCGT water winning requirements are expected to require approximately 56,000 m^3 of water. Pumping rates are expected to be approximately 9-16 m^3/minute and water winning for FCGT activities is expected to take place over approximately six days (not including any contingency activities).

Before chemical treatment, the water extracted will be filtered and regular backflushing will be required to ensure the effectiveness of the filters. The number of backflushes and volume of water associated with backflushing may vary depending upon the effectiveness of filters and the level of clogging by suspended solids.

Over a duration of approximately six days, approximately 580 backflush cycles are estimated, with each unit/cycle discharging 0.5 m^3 of backflush water, a total of 300 m^3 of backflush water is expected to be discharged.

Backflush water will have a higher suspended solids loading than water extracted (i.e., higher than ambient Darwin Harbour water suspended solid concentration). The concentration of total suspended solids (TSS) within backflush water will depend upon the ambient concentration within Darwin Harbour, which will vary with tidal state and season. Seawater during spring tides and over the wet season is expected to be more turbid (higher TSS concentration) than during neap tides and over the dry season.

Backflush water will be discharged onto the existing disturbed shore crossing construction site, where it will then drain into the intertidal area and solids will disperse with tidal movements. Where possible, and dependent on the progress of shore crossing rock installation at the time of FCGT activities, backflush water will be discharged onto installed rock, to baffle the flow of the discharged backflush water.

While the current planning is to dewater the entire Project pipeline in one activity as described above, if there is a failure in the pipeline during installation that requires remedial construction work on the pipeline, or if a pipeline wet buckle occurs during pipelay (a wet buckle is when there is a failure in the pipeline during installation which results in the ingress of raw/untreated seawater into the pipeline), contingency plans will be implemented (Refer to **Section 2.4.3.10**).

The preservation phase commences on completion of the nitrogen packing of the pipeline, until commissioning. This ensures the integrity of the infrastructure is maintained.

2.4.3.9 Demobilisation at Shore Crossing

Following the completion of shoreline construction activities (i.e., shore-pull and winch spread) and pre-commissioning activities, the Project pipeline will be left in the ground unburied at the beach valve location end until the tie-in is completed. Santos will install the remaining 800 m section of pipeline (including the beach valve and piping inside the DLNG facility) to the DLNG facility tie-in point. Alternatively, the onshore section of the pipeline may be installed in parallel with the offshore portion. These activities are further discussed in the Supplementary Environmental Report (**Appendix 2**), and the Onshore CEMP (**Appendix 13**).

2.4.3.10 Pipelay Contingencies

Whilst not anticipated, failures in the Project pipeline and the occurrence of wet buckling can occur during pipelay activities and in these situations, pipelay contingency activities will be required.

A 'wet buckle' event may occur during installation should the Project pipeline become buckled and fracture during pipelay, resulting in flooding of the pipeline with raw, untreated seawater. If this occurs, the raw seawater will need to be removed from the pipeline to prevent corrosion to the undamaged section of pipeline. To remove the raw seawater, a contingency pig is launched with filtered seawater to flush the pipeline, followed by a second contingency pig which is pushed with compressed dry air. The pipeline end is then recovered and pipelay can continue. Given only filtered seawater would be used to flush the pipeline, impact to the environment from this type of flushing is not expected.

In the event of an extended period before pipelay or rectification recommencement, the Project pipeline would be flushed with raw filtered seawater and then filled (from the DLNG facility end) with treated seawater to safely preserve the Project pipeline in the intervening period before pipelay is recommenced. If preservation is required, discharges will occur initially as over-pump of treated seawater and then through dewatering of the pipeline.

If modifications are required to the pipelay vessel or procedures that result in an extended period before pipelay can recommence, the pipeline will be flooded with treated seawater to safely preserve the pipeline until pipelay is recommenced. The pipeline will be dewatered immediately prior to pipelay recommencing in order to enable the pipeline to be recovered to the surface.

If a pig gets stuck or damaged in the DPD during pre-commissioning it will be forced out using a high seal pig, or a train of high seal pigs, resulting in a discharge at the PLET. If the stuck pig occurs during flooding, then the high seal pig(s) will be propelled with filtered and treated seawater to the same specification as the flooding train. If the stuck pig occurs during dewatering, then the high seal pigs may be separated by MEG and will be propelled with nitrogen. The process for propelling the high seal pigs and the associated discharges at the PLET will be similar to the processes and discharge volumes outlined in **Section 2.4.3**. In the unlikely event of a stuck pig the timing between discharges associated with the planned pre-commissioning activity and the contingency stuck pig activities shall be a week or more, as such there are no cumulative impacts as a result of the discharges.

2.4.4 Commissioning and Operations

The activities associated with the operations phase include:

+ Commissioning and transport of dry hydrocarbons through the pipeline.
+ Inspection, maintenance and repair of the installed infrastructure.

Operations and maintenance of the Project pipeline is expected to follow the same, or very similar management procedures and risk-based approach currently used by Santos to operate and manage the Bayu-Undan to Darwin gas export pipeline.

2.4.4.1 Transport of Hydrocarbons

The principal activity during operations of the Project pipeline will be the transportation of natural gas from offshore reservoirs to the DLNG facility. There will not be a separate control system for the pipeline and therefore valve discharges will not occur within NT jurisdiction.

For the Project pipeline construction and commissioning activities, MDO will be used on Project vessels rather than the more persistent intermediate or heavier fuel oils. Following best practice, conservative worst case spill volumes and exposure thresholds have been adopted for hydrocarbon spill modelling to inform risk assessment (**Appendix 9**). The fuel tank volumes on Project vessels are within the range of fuel and hydrocarbon storage tank volumes present on the large commercial vessels that regularly use Darwin Harbour (Darwin Port, 2022).

2.4.4.2 Inspection, Maintenance and Repair

Inspection, maintenance and repair (IMR) of subsea and onshore infrastructure will be undertaken to ensure that the integrity of the hydrocarbon system is maintained at acceptable standards. IMR activities will typically be vessel based, using ROV/AUV as required and may be scheduled or undertaken as a contingency.

Typical offshore IMR activities include but are not limited to:

+ Cathodic protection surveys.
+ General visual inspections.
+ Multibeam surveys (or similar) of the pipeline and infrastructure.
+ Anode replacement.
+ Cathodic protection system maintenance.
+ Wall thickness measurements (ultrasonic testing).
+ Inline inspections (including pigging - hazardous waste generated from pigging activities will be managed at the DLNG pig receiver).
+ Pipeline / spool repairs.
+ Span rectification and pipeline stabilisation, i.e. grout bags.
+ General subsea infrastructure servicing (includes leak testing).
+ Marine growth removal.
+ Removal of fishing nets or other marine debris.
+ Re-commissioning (similar to pre-commissioning discussed in **Section 2.4.3.8**).

In the unlikely event of Project pipeline failure, the pipeline may need to be repaired (clamp repair, or major repairs that require the replacement of a section of pipeline), which involves similar activities to decommissioning, and pre-commissioning (refer to **Section 2.4.5** and **Section 2.4.3.8**.

Typical onshore IMR activities include:

+ Cathodic protection surveys (visual, electrochemical potential survey).
+ General visual inspections for damage and missing items.
+ Wall thickness measurements (ultrasonic testing).

2.4.5 Decommissioning

At the end of the Project, it is expected that Project pipeline hydrocarbons will be displaced to the DLNG facility, and the pipeline will be flushed with either raw seawater, air or nitrogen. The Project pipeline, subsea infrastructure and associated facilities will then be decommissioned in accordance with regulatory requirements at that time.

Current industry best practice would be to leave the inert, stabilised Project pipeline in place. Furthermore, a Decommissioning Plan will be developed and will define closure objectives and agreed criteria, in consultation with relevant stakeholders (including Traditional Owners and relevant government agencies) prior to commencement of any decommissioning activities.

A decommissioning plan for DPD infrastructure will be developed closer to the end of field life (i.e. >2050) when it is expected that advancements in pipeline decommissioning will be made.

2.4.6 Summary of Vessel and Support Activities

Support activities associated with the DPD Project will be undertaken throughout all phases of the Project. Support activities are likely to include vessels, helicopters, ROVs, and onshore equipment, with varying requirements depending on the Project phase.

2.4.6.1 Vessel Activities

A number of vessels will be required to complete the proposed activities, including:

+ Marine survey vessels - to support pre-lay and post lay surveys of the Project pipeline, including trenching scope and spoil ground.
+ Environmental monitoring vessels – to conduct environmental monitoring during construction activities.
+ Pipelay vessels – A deep water pipelay vessel and a shallow water pipelay barge, to install the pipeline, ILT and Project pipeline PLET.
+ Anchor handling vessels to assist with nearshore pipelay barge anchoring.
+ Construction vessels – to support installation of structures (i.e. Project pipeline PLET foundations, spool, mattresses for scour protection, initiation site (if required), mechanical protection and stabilisation etc) and pre-commissioning activities.
+ Rock installation vessels – including fall pipe vessel, side dump vessels and non-propelled barges.
+ Trenching and spoil disposal vessels – including a CSD, TSHD, BHD and SHB.
+ Pipe supply vessels – to provide pipe to the pipelay vessel from general cargo vessel/s.
+ Supply vessels – to provide general support, crew transfers, material, fuel, chemicals and supplies to all offshore activities and backload material/ waste as required.
+ IMR vessels – to provide IMR support during Project pipeline operations.

Supply vessels are expected to operate from local regional ports (i.e. Darwin) to transport fuel, stores, waste and specialist supplies such as rock, pipe etc.

Pipe supply vessels will be supplied by General Cargo Vessel (GCVs) but not within the Project area.

Bunkering (re-fuelling) of the vessels may take place either at sea (i.e. if required for the pipelay vessel) or in port (support and other vessels).

Vessels will vary in length, draft and number of persons on board. They may anchor depending on water depth, with varying anchor requirement and disturbance footprints however, sensitive areas as marked on Project marine charts will be avoided for anchoring disturbance.

The expected requirements for vessels over different phases of the Project are presented in **Table 2-6.**

The greatest number of vessels will be required during the construction phase of the DPD Project. For trenching and spoil disposal activities, an expected 12 vessels will be involved, for deep water and shallow pipelay activities an expected six and seven vessels, respectively. For rock installation an expected nine vessels will be involved and for pre-commissioning an expected four vessels will be involved.

Darwin Harbour is an active port supporting commercial vessel operations including trade vessel (e.g. bulk cargo and materials, liquid natural gas (LNG), and livestock), oil and gas support vessels, defence vessels, fishing vessels and passenger vessels. Vessel movements within (intra-harbour) and in/out of Darwin Harbour (harbour visits) during DPD construction phase are not expected to add significantly to vessel traffic within the harbour on an annual basis. A comparison of expected intra- harbour and harbour visit movements with historical Darwin Harbour vessel movements is provided in **Figure 2-11**. This comparison only includes larger commercial vessel, smaller recreational and commercial vessels also add to the amount of harbour traffic.

During the operations phase, vessels will only be required for intermittent activities, with the frequency dependent on the IMR schedule.

Table 2-6 Expected support vessel requirements

Support Activity type	Construction			Commissioning and Operations*
	Survey	Pre-lay Works	Pipeline Installation and Pre-commissioning	
Survey vessel	✔	✔	✔	
Supply vessel		✔	✔	
Pipelay vessels (deep water and shallow water)			✔	
Construction vessels		✔	✔	
Rock placement vessels			✔	
Dredging vessels (CSD, TSHD, BHD, SHB)		✔		
Commissioning support vessel				✔
IMR vessels*			✔	✔

**Note if major repair is required during Project life, then similar vessels to construction may be required*

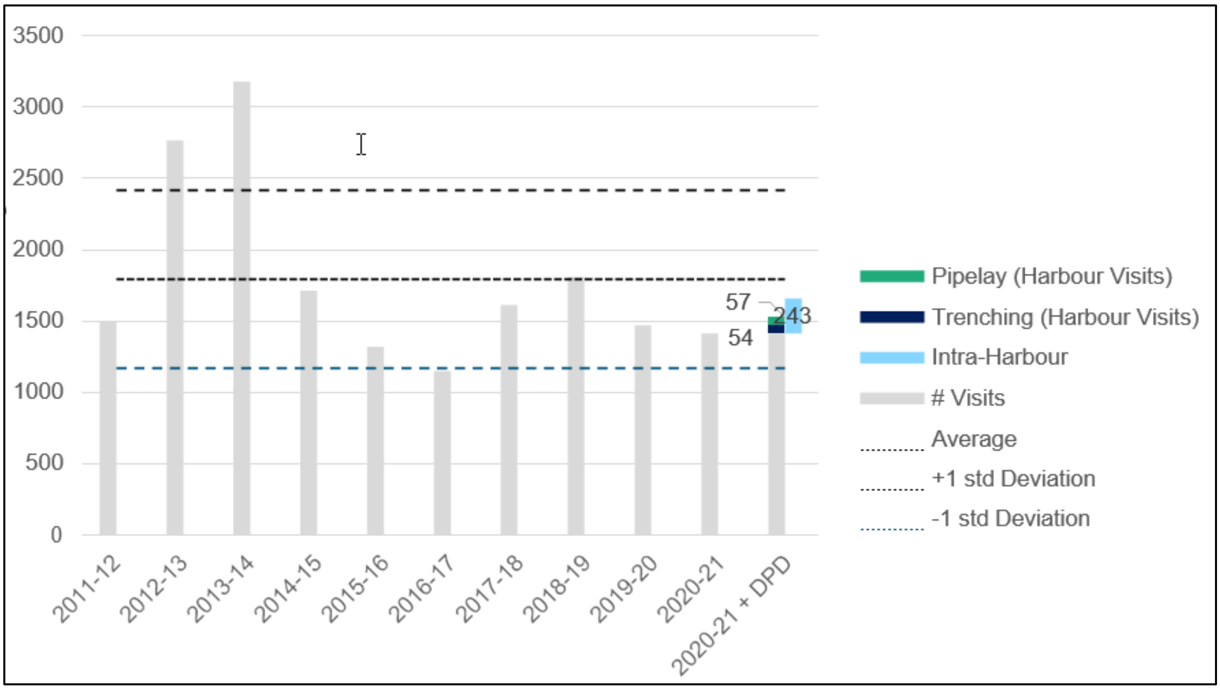


Figure 2-11 DPD Project vessel movements compared to historical Darwin Port trade vessel visit records (Darwin Port 2022)

2.4.6.2 Helicopter Activities

Helicopters will be used for transporting passengers and/or urgent freight to/from the pipelay vessel and construction vessel during offshore installation and pre-commissioning activities. They are also the preferred means of evacuating personnel in the event of an emergency for vessels with suitable and approved helidecks. Helicopter support will be principally supplied from Darwin Airport. Helicopter operations will be approximately three days per week, with typically two flights each day. Helicopters will operate during daylight hours unless in the event of an emergency.

2.4.6.3 ROV/AUV Activities

Throughout the Project, offshore activities will be supported by ROV. A ROV can be fitted with various tools and camera systems that can be used to capture permanent records of the operations and immediate surrounding environment. An AUV may also be used during IMR activities undertaken during operations.

2.4.6.4 Onshore Equipment

The types of equipment expected to be used include:

+ Light vehicles.
+ Mobile equipment such as excavators, graders, trucks, fuel trucks, etc.
+ Heavy equipment such as cranes.

2.5 Resource Requirements and Access

Other components required for the Project include:

+ Personnel for the construction period. Labour will be recruited from the domestic and local labour market where possible; this is subject to the contractors' resourcing requirements at the time. Accommodation may be provided for the workforce within the Darwin area.
+ Power may be supplied from onsite generators to support construction amenities and operation of equipment.
+ Water usage including for dust suppression, washdown facilities and ablutions supply will likely be sourced from mains water supply within the DLNG facility or provided as self-sufficient water through containerised water trucks.
+ Water required for FCGT activities will be extracted from Darwin Harbour.
+ Access to the shore crossing location (i.e., onshore site) will be via the existing DLNG access at the end of Middle Arm Peninsula into Wickham Point.
+ Crew and supply transfers to Project vessels will be via Darwin Port locations (vessel transfers) or Darwin Airport (helicopter transfers).
+ Loading of rock onto vessels will be via East Arm Wharf in Darwin Harbour.

2.6 Fuels, Chemicals and Materials

During the construction and commissioning phases, chemicals and fuel storage will be stored onsite within the shore crossing location and may include self-bunded fuel storage/tanks. Fuel trucks will likely be used to supply fuel to construction equipment including excavators, graders, cranes and generators. Hydrotest chemicals will also be stored onshore within a hydrotest spread (i.e., biocides, oxygen scavenger and dye).

2.6.1 Assessment of Fuels and Chemicals

Santos has a chemical approval process to ensure all chemicals (hazardous and non-hazardous) to be used at a Santos Offshore Division operating facility are approved for use prior to procurement and/or mobilisation to site. This process is included in the Santos Offshore Division Operations Chemical Approval Procedure (EA-91-II-10001) (**Appendix 5**). The Project contractor chemical selection and approval process aligns with key principles within the Santos Offshore Division Chemical Approval Procedure (EA-91-II-10001), including the requirement for Santos approved chemical risk assessment to be undertaken for chemicals discharged to the environment. The process for using chemicals is identified below:

+ **Chemical requests**: For chemicals planned to be discharged to the environment, the contractor will submit chemical application forms with safety data sheets (SDS) to Santos (unless already approved for Santos to use).
+ **Chemical environmental assessment trigger**: An environmental assessment is required for contractor chemicals planned to be discharge to environment. This assessment will be undertaken by Santos.

- **Chemical environmental assessment criteria**: Santos will approve chemicals planned to be discharge to the environment if they are:
  - Rated Gold/Silver (OCNS CHARM).
  - Rated D/E under OCNS (if not CHARM rated).
  - If not CHARM or OCNS rated, have an environmental risk assessment submitted by contractor and approved by Santos. The environmental risk assessment shall develop a residual risk rating based on:
    - Evaluation of the receiving marine environmental characteristics, values and sensitivities, and with regard to the nature and scale of the proposed chemical product to be discharged.
    - Review of alternative chemical products that are technically equivalent in the context of the requirements of the work.
    - Demonstration that the selected chemical represents the least hazardous option, whilst still meeting the technical requirements.
  - Evaluation of ecotoxicity thresholds and application of OCNS ratings, which may include:
    - Establishment of alternative 'pseudo' rating that can be applied to the chemical in accordance with international standard protocols or guidelines (e.g., International Organisation for Standardisation (ISO) test guidelines, Organisation for Economic Cooperation and Development (OECD) test guidelines, and OSPAR Guidelines), this allows for the assessment of interchangeability of chemicals; or
  - Use of alternative similar toxicity data if insufficient toxicity information is available on the non-rated chemicals.
- Maintaining register:
  - The contractor will maintain (and make available to Santos) their own register of chemicals, SDS, chemical application forms and risk assessment/risk rankings for chemicals that may be discharged to environment.

A list and information regarding proposed chemicals and materials that are proposed to be used within the Project area is provided in **Table 2-7**. Safety data sheets for these chemicals are provided in **Appendix 4**.

The environmental risk profile in the North Sea, where most of the chemical rating data is generated, is applicable to marine waters in the Project area, as the Santos/contractor chemical assessment process outlined above makes an evaluation of the receiving marine environment.

Discharge of chemicals is restricted procedurally e.g., with regard to the potential discharge of firefighting chemicals from vessels the Project shipping contractor ensures that there will be the requisite number of personnel trained in firefighting on board the vessels at all times covering all shifts and rotations. Vessel personnel are trained at an external provider in the use of firefighting techniques on board e.g., at ERGT facilities or similar in Australia. Once onboard there is a familiarisation and competency assessment provided by the vessel team to ensure that those people joining the vessel are able to operate the equipment. This will be up to the point of activating the discharge of foam but not an actual release of foam. The firefighting system will be checked prior to mobilization as part of the pre-mobilisation inspections, and during the campaign emergency response drills will be held. This approach also applies to the trenching vessels.

Table 2-7 Fuels, Chemicals and Materials

Chemical/ material type proposed	Purpose	Commonwealth Marine Area use	Discharge to environment	Product name	OCNS or other rating	Quantity Used	Quantity Discharged to the Environment
Flushing, cleaning, gauging, testing (FCGT) & dewatering/conditioning chemicals							
Biocide/ oxygen scavenger/ corrosion inhibitor package	Pipeline preservation	Yes	Yes	ChampionX Hydrosure HSUR43670A OR Roemex Hydro-3 or equivalent	GOLD rating OCNS (Previously called O3670R) GOLD rating OCNS	20 m^3	20 m^3 (included in 56,000 m^3 treated sea water and MEG discharge)
Monoethylene Glycol (MEG)	Dehydrating/dewatering and drying pipeline	Yes	Yes	Monoethylene Glycol (MEG)	E rating OCNS (and PLONOR)	1050 m^3	1050 m^3
Dye	Leak detection / visualisation	Yes	Yes	ChampionX MISC40003A OR Roemex RX-9022 or equivalent	GOLD rating OCNS GOLD rating OCNS	6 m^3	6 m^3 (included in 56,000 m^3 treated sea water and MEG discharge)
Fuels							
Marine diesel oil (MDO)/ Marine gas oil (low sulphur)	Vessel fuel	Yes	No	Marine Grade Diesel (G10)	N/A	Project duration	No discharge proposed
JET A-1	Aviation Turbine Fuel	Yes	No	Jet A-1	N/A	Project duration	No discharge proposed
Diesel	Stationary and mobile equipment and vehicles	No	No	DIST / HI FLOW Diesel / ADO / Automotive Gas	N/A	Project duration	No discharge proposed
Hydraulic fluids, lubricants and cleaning products							
Hydraulic fluid	Power ROV Equipment -Allseas[#] Vessels	Yes	No	Royal purple Synthetic Oil (Marine Hydraulic Oil)	N/A	<500 L	No discharge proposed
	Power cutting head Cutter Suction Dredge (CSD)	No	No	Mobil SHC 632	N/A	1000 L	No discharge proposed
	Power Backhoe Dredge (BHD) tools And Power Mass Flow Excavation (MFE) tools	No	No	Panolin HLP Synth 46 (Or equivalent)	N/A	1000 L	No discharge proposed
Grease /Lubricants	General equipment greasing	No	Yes	Mobile XHP 222	MARPOL listed	20 L per week	< 5 L /w

Chemical/ material type proposed	Purpose	Commonwealth Marine Area use	Discharge to environment	Product name	OCNS or other rating	Quantity Used	Quantity Discharged to the Environment
			from MARPOL regulated ship treated wastewater 15 ppm oil discharge.				
Detergents	Vessel Deck cleaning/washing and other incidental activities Allseas# Vessels	Yes	Yes	Vigor Heavy Duty Extraction Cleaner	MARPOL listed	10 L per week	1 L /w per vessel
		Yes	Yes	Unitor Gamazyme FC (Bio Cleaner)	N/A	10 L per week	No discharge proposed
		No	No	Unitor Enviroclean	N/A	-	No discharge proposed
Grouting products (post-lay)							
Grout material (sand/aggregate and cement slurry) – no chemical additives	Filling grout bags	Yes	Yes	Portland cement	OSPAR listed as PLONOR	100 tonnes	2 t (clearing grout lines)
Anti-fouling coating (AFC)							
Vessel AFC	Anti-fouling of Allseas# (Fortitude)	Yes	No – negligible amounts (but leaching/flaking could occur)	Hempel's Antifouling Globic 9000	N/A	25 L per week	No discharge proposed
	Anti-fouling coating	Yes	No – negligible amounts (but leaching/flaking could occur)	Sigma Ecofleet 290 Sigma - PPG Antifouling	N/A	-25 L per week	No discharge proposed
	Anti-fouling - Seawater Dispersant for Marine Systems - DEME Van Oord (DVO)	Yes	Yes	Bioguard plus - Unitor Biogard	N/A	25 L per week-	No discharge proposed
Vessel AFC	Vessels of opportunity*	Yes	No – negligible amounts (but leaching/flaking could occur)	Provided under contract arrangements	N/A	-	No discharge proposed
Pipe coatings							
Asphalt enamel	Pipe coatings / anti corrosion coating	Yes	No	Bitumax Bitumen Asphalt Enamel	N/A	1,587 m^3	No discharge proposed
				Bitumax Primer Type 1	N/A		
				Fibreglass Tissue Innerwrap - B 50-R8 Y (12”x1200’)	N/A		
				Phoenix Bitumen Outerwrap (Heavy Duty Outerwrap) (Type c)	N/A		
				Quakercoat® 141	N/A		

Chemical/ material type proposed	Purpose	Commonwealth Marine Area use	Discharge to environment	Product name	OCNS or other rating	Quantity Used	Quantity Discharged to the Environment
Concrete weight coating	Pipeline stability	Yes	No	Magna Dense - aggregate	N/A	16,600 m^3	No discharge proposed.
				Hydraulic Cement (Supramix)	N/A		
				High Density Polyethylene (HDPE) Plastic spacers	N/A		
				Polypropylene twine	N/A		
				Hard Drawn Steel wire (reinforcement)	N/A		
Fusion bonded Epoxy (FBE)	Component of Three-layer polypropylene (3LPP) for Pipeline coating anti corrosion coating	Yes	No	3M Scotchkote Fusion-bonded Epoxy Coating 6233P	N/A	1,000 kg FBE 5,000 kg PP	No discharge proposed
				3M Scotchkote Liquid-Epoxy Coating 323+ brush grade	N/A		
				Covalence PP-Meltstick Heat-shrinkable products for sealing and corrosion protection	N/A		
				BorcoatTM BB127E BorcoatTM BB108E	N/A		
High build Epoxy	External fusion bond epoxy for pipeline coating	Yes	No	Enviroline 124 – Epoxy Novalac	N/A	100 L	No discharge proposed
Internal flow coat (IFC)	Pipeline coating and curing	Yes	No	Hempel's Curing Agent 95830	N/A	25,0000 L (as applied IFC)	No discharge proposed
				Hempel's Hs Gas Pipe Coating 87831	N/A		
				Hempel's Thinner 08450	N/A		
				Taseto Silver	N/A	250 L	
Oil Spill Response/Firefighting							
Oil Spill Dispersant (OSD)	Ship Oil Pollution Emergency Plan (SOPEP)	Potentially – in response to a vessel spill	Emergency only	Seacare OSD	N/A	-	No discharge proposed
Firefighting foam	Vessel fire incident	Potentially – in response to a vessel fire	Emergency only	Solberg Re-Healing RF3 Foam	N/A	-	No discharge proposed

* Vessels of opportunity - Chemical use will be subject to Santos Offshore Division Operations Chemical Approval Procedure and Contractor Management arrangements.
# Allseas Marine Contactors Australia Pty Ltd

2.7 Summary of Discharges and Emissions

Construction and operation of the DPD Project will result in a number of discharges and emissions, as summarized in **Table 2-8** and **Table 2-9** below.

Table 2-8 Summary of Project activity planned marine discharges

Activity	Location	Discharge/waste type	Estimated total release volume (m^3)
FCGT	Commonwealth waters (vicinity of Project Pipeline PLET)	Treated seawater	7,650 to 6,000
Dewatering		Treated seawater	50,000
		MEG	1,000
Spool leak testing		Treated seawater	100
		MEG	50
Spoil disposal	Offshore NT waters (spoil disposal ground)	Spoil	255,000 and (up to 500,000)

Table 2-9 Summary of other typical Project discharges and emissions

Type	Description
Emissions	
Atmospheric emissions including GHGs (hydrocarbon combustion)	+ Emissions from Project vessels, vehicles, equipment and helicopters.
Noise emissions	+ Vessel activities (e.g. vessel engines, DP thrusters and other machinery). + Acoustic positioning systems. + ROV activities. + Helicopter activities.
Light emissions	+ Vessel navigation and safety lighting. + Spot lighting as needed. + ROV underwater lighting as needed.
Discharges	
Sewage and greywater	The volume of sewage and greywater directly relates to the POB number. Up to 30–40 L of sewage/greywater may be generated per person per day.
Deck drainage/run-off	Drainage water from activity vessels includes rainwater, seawater and washdown water. Such discharges may potentially contain small residual quantities of oil, grease and detergents if present or used on the decks.

Type	Description
Cooling water	Excess or unused heat in cooling water will be carried away from vessel and equipment components using seawater and returned to the sea with residual sodium hypochlorite.
Bilge water	Oily bilge water will be treated via an oily water filter system to achieve 15 mg/L after treatment, then discharged in compliance with regulatory requirements.
Brine (if a reverse osmosis unit is used for water treatment)	Brine generated from the water supply systems on vessels, where applicable, will be discharged to the ocean at a salinity of approximately 10% higher than sea water.
Putrescible food waste effluent	Putrescible waste discharge, where allowed under regulatory requirements, is estimated to be approximately 1 L of food waste per person per day.

2.8 Other Approvals and Conditions

Santos submitted a referral to the NT EPA under the NT Environment Protection Act 2019 (EP Act) for the DPD Project in the NT jurisdiction in January 2022. The EP Act environmental impact assessment process allows the NT EPA to consider the potential significant environmental impacts of a development proposal, and make recommendations to the Minister about the acceptability, or otherwise, of those potential environmental impacts. The NT EPA assessment is separate to the EPBC Act process and as such the project will not be assessed under a Bilateral Agreement.

The NT EPA Invited public comment on the referral until 15 February 2022. A total of 318 submissions were received during the public comment period.

The NT EPA provided a Notice of Decision and Statement of Reasons on 7 April 2022 determining that the DPD Project required assessment under the EP Act at a Tier 2 level of assessment – assessment by Supplementary Environmental Report (SER). A SER has been prepared and submitted to the EPA. The SER was put on public review from 24 May to 28 June 2023 (attached, **Appendix 2**).

Other approvals are required for construction of the DPD Project under Commonwealth and NT legislation include:

+ NOPSEMA's approval of an Environment Plan under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.
+ Pipeline licence from NOPTA for the 23km of the pipeline in Commonwealth waters.
+ NT Department of Infrastructure, Planning and Logistics (DIPL) – Development Permit (*Planning Act* 1999), and Occupational Licence (*Crown Lands Act* 1992).
+ NT DITT – Energy Division Consent to Construct and Consent to Test (*Energy Pipelines Act* 1981) and *Petroleum (Submerged Lands) Act* 1981). DPD Project EMPs are developed for submission and acceptance by DITT.

3 Matters of National Environmental Significance

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), an action will require approval from the Commonwealth Minister for the Environment if the action has, will have, or is likely to have, a significant impact on a MNES. A search of the Commonwealth Protected Matters Search Tool (PMST) (including a 5 km buffer) was undertaken in August 2022 and March 2023 to determine the presence of any MNES in the Project area, both of which returned the same results. A summary of the search results is provided in **Table 3-1**. The full PMST report is provided in **Appendix 16**.

Table 3-1 Summary of relevant MNES

MNES	Relevant	Description
World heritage properties	N	There are no world heritage properties close to the Project area
National heritage places	N	There are no national heritage places close to the Project area
Wetlands of International Importance (Ramsar)	N	There are no wetlands of international importance/Ramsar wetlands close to the Project area
Great Barrier Reef Marine Park	N	Not applicable as the marine park is off the coast of Queensland
Commonwealth marine area	Y	The Project area extends approximately 23 km into the Commonwealth marine area
Listed threatened ecological communities	N	There are no threatened ecological communities close to the Project area
Listed threatened species	Y	41 (birds - 13, mammals - 13, reptiles - 7, sharks - 8): Critically endangered - 4 Endangered - 12 Vulnerable - 24 Conservation dependent - 1
Listed migratory species	Y	75 (migratory marine birds - 7, migratory marine species - 28, migratory terrestrial species - 6, migratory wetland species - 34), a number of which are also listed as 'Threatened': Critically endangered - 3 Endangered - 6 Vulnerable - 11

3.1 Likelihood of Occurrence

A desktop assessment was undertaken during preparation of the Referral (**Appendix 1**) to determine the likelihood of the species listed in the PMST search results occurring within the Project area. The likelihood assessment considered the following information:

+ CDM Smith (2021). A targeted vegetation survey of the DLNG facility shore crossing was conducted in November 2021 by a qualified and experienced botanist. Given the shore crossing has been previously cleared, it is unlikely that protected fauna of MNES would be present in this area. If they are, then only vagrant individuals would be expected. **Figure 3-1** shows a view of the DLNG facility disturbance envelope.
+ CDM Smith (2021). Santos Darwin LNG Mangrove Monitoring 2021 Report 1001139. 26 December 2021. CDM Smith undertook a targeted vegetation survey of the shore crossing disturbance area conducted on 17 November 2021.
+ KBR (2018). Darwin Ship Lift Facility and Marine Industries Project – Notice of Intent, prepared for Northern Ship Support Pty Ltd.
+ AECOM (2021). AECOM 2021 Draft Environmental Impact Statement – Darwin Ship Lift, prepared for Department of Chief Minister and Cabinet.
+ Acer Vaughan Consulting Engineers and Consulting Environmental Engineers (1993), Draft Environmental Impact Statement: Darwin Port Expansion – East Arm, prepared for the NT Department of Transport & Works, Darwin, NT.
+ INPEX (2010b). Ichthys Gas Field Development Project: Draft Environmental Impact Statement, INPEX Browse, Ltd.
+ URS (2002). Darwin 10 MTPA LNG facility: public environmental report, report prepared for Phillips Petroleum Company Australia Pty Ltd, Darwin, NT.
+ Atlas of Living Australia, (https://ror.org/018n2ja79).
+ Jasco Applied Sciences (2016). Passive Acoustic Monitoring of Noise and Marine Mammals – Barossa Field.

Figure 3-1 View of existing cleared shore crossing looking west toward Darwin Harbour (Left) and mangroves in proximity of the shore crossing within the intertidal area of DLNG facility (Right)

The likelihood of occurrence assessment was based on documented records of the species within a 5-km radius of the Project area (sourced from publicly available information and previous studies of the area) and the species habitat requirements with respect to habitat features present within the vicinity of the Project area.

The criteria applied to define the likelihood of occurrence for terrestrial fauna is:

+ Unlikely: the Project area is not within the species' known distribution; and/or suitable habitat is not present within the Project area.
+ Potential: the Project area is within the species' known distribution and the Project area contains suitable habitat for the species, but the species has not been recorded within 5 km of the Project area.
+ Likely: the species has been recorded within 5 km of the Project area in the past 10 years, and the Project area contains suitable habitat for the species.
+ Known to occur: the species has been recorded (directly by commissioned surveys or from database records) within the Project area in the past 10 years.

The criteria applied to define the likelihood of occurrence for marine fauna is:

+ Unlikely: the species has not been recorded within Darwin Harbour or surrounding waters; and/or its current known distribution does not encompass Darwin Harbour, and surrounding water; and/or suitable habitat is generally lacking from the Project area.
+ Potential: the species has not been recorded within Darwin Harbour or surrounding waters, although species' distribution incorporates Darwin Harbour and surrounding waters; and potentially suitable habitat occurs in the Project area.
+ Likely: the species has been recorded within Darwin Harbour or surrounding waters in the past 10 years; and suitable habitat is present within the Project area.

+ Known to occur: the species has been recorded (directly by commissioned surveys or from database records) within the Project area in the past 10 years.

The species assessed as per the Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (DoE, 2013) self-assessment in **Section 5** (threatened species and ecological communities, and migratory species) are those species that are known to occur, considered likely to occur, or considered to have the potential to occur, as summarised in **Table 3-2**.

For the purposes of this assessment, Darwin Harbour is defined as the area within the Darwin Harbour Region Management Boundary (as illustrated in **Figure 4-2**).

Within this assessment, the terms 'habitat critical to the survival of a species' and 'biologically important areas' (BIAs) are used. These habitats and areas for marine turtles in Australia are defined in the Recovery Plan for Marine turtles in Australia (DoEE, 2017b), and for dolphins are defined in the Marine Bioregional Plan for the North Marine Region (DSEWPaC, 2012a).

Table 3-2 Likelihood of occurrence assessment

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
Threatened Species (Marine Reptiles)				
Flatback turtle	*Natator depressus*	VU/M	The Project area overlaps habitat critical to the survival of flatback turtles and a flatback turtle BIA (inter-nesting).	**Likely** - No important habitat (foraging or nesting) for the species occurs within the Project area. Individuals are likely to be sighted transiting through the area as they move through foraging areas.
Green turtle	*Chelonia mydas*	VU/M	The green turtle utilises Darwin Harbour regularly (Whiting 2003).	**Likely** - Species is known to occur in Darwin Harbour and surrounding waters.
Hawksbill turtle	*Eretmochelys imbricata*	VU/M	The hawksbill turtle utilises Darwin Harbour regularly (Whiting 2003).	**Likely** - Species is known to occur in Darwin Harbour and surrounding waters.
Leatherback turtle	*Dermochelys coriacea*	EN/M	The leatherback turtle is considered to be an oceanic species, which is unlikely to occur within Darwin Harbour (Whiting 2001). The species is likely to occur in oceanic waters outside Darwin Harbour.	**Potential** - Species unlikely to occur within Darwin Harbour, but potentially occurs in surrounding waters.
Loggerhead turtle	*Caretta Caretta*	EN/M	Loggerhead turtles are expected to be infrequent users of Darwin Harbour (Whiting 2003). The loggerhead turtle is more likely to occur in oceanic areas outside Darwin Harbour.	**Potential** - Species may occur within Darwin Harbour, but potentially occurs in surrounding waters.
Olive ridley turtle	*Lepidochelys olivacea*	EN/M	Habitat critical to the survival of olive ridley turtle and a BIA (inter-nesting) occurs to the north and south, respectively, of the Project area.	**Likely** - No important habitat (foraging or nesting) for the species occurs within the Project area. Individuals are likely to be sighted transiting through the area as they move through foraging areas.
Threatened Species (Terrestrial Reptile)				
Plains death adder	*Acanthophsis hawkei*	VU	Prefers flat, treeless, cracking soil riverine floodplains. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Whilst the species has been recorded within 5 km of the preferred route alignment for the Project area, there is no suitable habitat within the Project area.
Threatened Species (Terrestrial Mammals)				
Bare-rumped sheath-tailed bat	*Saccolaimus saccolaimus*	VU	Open Pandanus woodland fringing the eucalypt tall open forests. It roosts in tree hollows and caves. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat within the Project area.
Black-footed tree-rat	*Mesembriomys gouldii*	EN	Occurs in the Top End of the NT in tropical woodlands and open forests in coastal areas. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat within the Project area.
Brush-tailed rabbit-rat	*Conilurus penicillatus*	VU	The preferred habitat is eucalypt tall open forest, has been known to also occur on coastal grasslands with scattered large Casuarina equisetifolia trees, beaches, and stunted eucalypt woodlands on stony slopes. It shelters in tree hollows, hollow logs and, less frequently, in the crowns of pandanus or sand palms. This species has not been recorded within the Project area.	**Unlikely** - No suitable habitat is within the Project area.
Fawn antechinus	*Antechinus bellus*	VU	Occurs in savannah woodland and tall open forest of the Top End of the NT, shelters in tree hollows and fallen logs, shows a preference for areas exposed to cooler and less frequent fires. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat within the Project area.
Ghost bat	*Macroderma gigas*	VU	The distribution of this species is influenced by the availability of suitable caves and mines for roost sites. Daytime roosts may change seasonally. One of the largest known colonies occurs in a series of gold mine workings at Pine Creek in the NT.	**Unlikely** - No suitable habitat within the Project area.

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
Golden bandicoot	*Isoodon auratus*	VU	The golden bandicoot has historically occupied a range of habitats across the NT, although it favours heathland and shrubland habitats without greater tree cover. The species has declined significantly since European habitation, with the only population being on Marchinbar Island. A relocation program has also established populations on Raragala and Guluwuru islands.	**Unlikely** - As the species has disappeared from mainland distribution in the NT, it is unlikely to be affected by the project.
Nabarlek (Top End)	*Petrogale concinna*	EN	Nabarleks are restricted to rocky areas, especially on steep slopes, with large boulders, caves and crevices. They may move from these to forage in adjacent flat areas. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat within the Project area.
Northern brush-tailed possum	*Trichosurus vulpecula arnhemensis*	VU	Most records are from tall open forests dominated by Eucalyptus miniata and E. tetrodonta. The species is unlikely to be present in light of recent reductions in the species' range. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat within the Project area.
Northern brush-tailed phascogale	*Phascogale pirata*	VU	The northern brush-tailed phascogale is restricted to eucalypt forests in the top end of the NT. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species occurs in eucalypt forests which are not present close to the Project area.
Northern quoll	*Dasyurus hallucatus*	EN	This species formerly occurred across much of northern Australia, from south-eastern Queensland to the south-west Kimberley, with a disjunct population in the Pilbara. The most suitable habitats appear to be rocky areas. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Whilst the species has historically been recorded within 5 km of the Project area, there is no suitable habitat within the Project area.
Water mouse / false water rat	*Xeromys myoides*	VU	Mangrove forests, freshwater swamps and floodplain saline grasslands. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species has not been recorded within 5 km of the Project area and there is no suitable habitat within the Project area.
Threatened Species (Marine Mammal)				
Blue whale	*Balaenoptera musculus*	EN/M	The blue whale is found in every ocean except the arctic, with a range that extends from the periphery of drift-ice in polar seas to the tropics. It follows seasonal migration pattern between summering and wintering areas although some individuals may remain in certain areas year-round. The Project area does not contain any known feeding, breeding, calving, aggregation or migratory routes. The closest known record of pygmy blue whales is hundreds of kilometres north of the Project area.	**Unlikely** - Species is unlikely to occur within the Project area as its preferred habitat is open ocean.
Fin whale	*Balaenoptera physalus*	VU/M	The North Atlantic fin whale has an extensive distribution. In general, fin whales are more common north of approximately 30°N latitude, but considerable confusion arises about their occurrence south of 30°N latitude because of the difficulty in distinguishing fin whales from Bryde's whales. Fin whales are not known to occur, even infrequently, in the North Marine Region (DSEWPaC 2012b); however, the species is likely to occur in deeper offshore waters. The Project area does not contain any known feeding, breeding, calving, aggregation or migratory routes.	**Unlikely** - The species is unlikely to occur within the Project area as its preferred habitat is open ocean. It is seen to occur further offshore within Commonwealth waters.
Sei whale	*Balaenoptera borealis*	VU/M	Sei whales have been infrequently recorded in Australian waters. They typically occur within deeper offshore waters. The Project area does not contain any known feeding, breeding, calving, aggregation or migratory routes.	**Unlikely** - The species is unlikely to occur within the Project area as its preferred habitat is open ocean.
Threatened Species (Birds)				
Australian painted snipe	*Rostratula australis*	EN	Shallow, vegetated, freshwater swamps, claypans or inundated grassland. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat within the Project area.
Curlew sandpiper	*Calidris ferruginea*	CE/M	Fresh and brackish water, can include ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Whilst the species has been recorded within 5 km of the Project area, there is no suitable habitat within the Project area.

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
Eastern curlew	*Numenius madagascariensis*	CE/M	They are most common in mangrove areas but will also forage on intertidal flats and saltmarshes. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Whilst the species has been recorded within 5 km of the Project area, there is no suitable habitat within the Project area.
Gouldian finch	*Erythrura gouldiae*	EN	The species forages in open woodland with groundcover of Sorghum and other annual and perennial grasses. Nests in hollows in Eucalyptus tintinnans. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Whilst the species has been recorded within 5 km of the Project area, there is no suitable habitat within the Project area.
Great knot	*Calidris tenuirostris*	CE/M	Migratory species. In the NT, these birds settle on large sheltered intertidal mudflats and sandflats, especially in mangrove areas. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Whilst the species has been recorded within 5 km of the Project area, there is no suitable habitat within the Project area.
Greater sand plover	*Charadrius leschenaultii*	VU/M	In the NT, greater sand plovers have been recorded from most of the coastline. These birds forage along sandy beaches and sheltered mudflats and have been reported to occasionally also use inland saline wetlands, but always close to the coast. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Whilst the species has been recorded within 5 km of the Project area, there is no suitable habitat within the Project area.
Grey falcon	*Falco hypoleucos*	VU	Occurs in lightly timbered lowland plains, typically on inland drainage systems, where the average annual rainfall is less than 500 mm. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - This species has not been recorded within 5 km of the Project area and suitable habitat does not occur within the Project area.
Lesser sand plover	*Charadrius mongolus*	EN/M	Migratory species. In the NT the birds forage on sheltered mudflats, sandy beaches, estuaries and mangroves. They have also been reported to use inland saline wetlands occasionally, but always close to the coast. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Whilst the species has been recorded within 5 km of the Project area, there is no suitable habitat within the Project area.
Masked owl (mainland Top End)	*Tyto novaehollandiae kimberli*	VU	Occurs mainly in eucalypt tall open forests (especially those dominated by Darwin woollybutt Eucalyptus miniata and Darwin stringybark E. tetrodonta), but also roosts in monsoon rainforests, and forages in more open vegetation types, including grasslands. Although it may roost in dense foliage, it more typically roosts, and nests, in tree hollows. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat within the Project area.
Nunivak bar-tailed godwit, Western Alaskan bar-tailed godwit	*Limosa lapponica baueri*	VU	Widespread in coastal areas such as wetlands, however predominantly found in New Zealand during the breeding season. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat within the Project area.
Partridge pigeon	*Geophaps smithii*	VU	Occurs in open forest and woodland dominated by Eucalyptus tetrodonta and E. miniata with a structurally diverse understorey. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat within the Project area.
Red gosshawk	*Erythrotriorchis radiatus*	VU	Forest and woodland with a mosaic of vegetation types, including eucalypt woodland, open forest, gallery rainforest, swamp sclerophyll forest and rainforest margins. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat within the Project area.
Red knot	*Calidris canutus*	EN/M	Migratory species. In the NT, these birds settle on large sheltered intertidal mudflats and sandflats and are rarely encountered far from the coast. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Whilst the species has been recorded within 5 km of the Project area, there is no suitable habitat within the Project area.
Threatened Species (Sharks)				
Dwarf sawfish	*Pristis clavata*	VU/M	The species' Australian distribution is considered to extend north from Cairns around the Cape York Peninsula in QLD, across northern Australian waters to the Pilbara coast in Western Australia. The	**Unlikely** - The species is unlikely to occur in the Project area based on previous records.

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
			species usually inhabits shallow (2 to 3 m) coastal waters and estuarine habitats. The species does not utilise any purely freshwater areas, as its range is restricted to brackish and salt water. Dwarf sawfish are considered unlikely to occur in the Darwin Harbour area although an individual has been reported from Buffalo Creek (ALA 2022a) approximately 10 km east of the Project area.	
Freshwater sawfish	*Pristis pristis*	VU/M	The freshwater sawfish is a marine/estuarine species that spends its first 3 to 4 years in freshwater, then the larger mature animals tend to occur more often in coastal and offshore waters up to 25 m depth. In the NT, freshwater sawfish have been recorded from the Adelaide, Victoria, Daly, East Alligator, South Alligator, Goomadeer, Roper, McArthur, Wearyan and Robinson Rivers (DoE 2015a). The Project area does not contain key habitat resources for this species for foraging or breeding. The closest known record is over 20 km away from the Project area.	**Unlikely** - The species is unlikely to occur in the Project area based on previous records.
Great white shark	*Carcharodon carcharias*	VU/M	In Australia, great white sharks have been recorded from central QLD around the south coast to north-west WA but may occur further north on both coasts. It has been sighted in all coastal areas except in the NT.	**Unlikely** - The species is unlikely to occur within the Project area as its preferred habitat is not typically off the NT coast.
Green sawfish	*Pristis zijsron*	VU/M	The green sawfish was once widely distributed but it is now thought that northern Australia may be the last region where significant populations of green sawfish exist. They inhabit muddy bottom habitats and also enter estuaries where they can be found in shallow water. Individuals of this species have been recorded in the region e.g. reported from Buffalo Creek (ALA 2022b) approximately 10 km east of the Project area. The Project area does not contain key habitat resources for this species such as foraging or breeding.	**Unlikely** - The species is unlikely to occur in the Project area based on previous records.
Northern river shark	*Glyphis garricki*	EN	Since its discovery in 1986, only 36 specimens have been recorded. Little is known of the ecology of the northern river shark but it is probably restricted to shallow, brackish reaches of large rivers. This conclusion is based on the fact that it has not yet been caught in the coastal marine areas despite considerable fishing and collecting activity in these habitats. In the NT this species is only known within the Adelaide, East Alligator and South Alligator river systems. Individuals of this species of have been recorded in the broader Darwin area, although these records are located well away from the Project area in different habitat than what is found in the Project area. This species is not known in the Darwin Harbour area.	**Unlikely** - The species is unlikely to occur in the Project area based on previous records.
Scalloped hammerhead	*Sphyrna lewini*	Conservation Dependent	The scalloped hammerhead has a circum-global distribution in tropical and sub-tropical waters. The scalloped hammerhead shows strong genetic population structuring across ocean basins as it rarely ventures into or across deep ocean waters, but ranges quite widely over shallow coastal shelf waters. One individual of this species has been recorded in the Darwin Harbour region. The Project area does not contain key habitat resources for this species such as foraging or breeding.	**Unlikely** - The species is unlikely to occur in the Project area based on previous records and there is no suitable habitat within the Project.
Speartooth shark	*Glyphis glypis*	CE/M	Predominantly occurs within tidal rivers and estuaries within the NT. There are records in the Adelaide River which reflects is likely distribution in tidal rivers and estuaries. No individuals have been recorded in the Darwin Harbour region.	**Unlikely** - The species is unlikely to occur in the Project area based on previous records.
Whale shark	*Rhincodon typus*	VU/M	In Australia, the whale shark is most commonly seen in waters off northern WA, NT and QLD. The whale shark seasonally aggregates in coastal waters off Ningaloo Reef between March and July each year, at Christmas Island between December and January, and in the Coral Sea between November and December. The Project area does not contain any known feeding, breeding, aggregation or migratory routes.	**Unlikely** - The species is unlikely to occur within the Project area as its preferred habitat is open ocean.

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
Migratory (Marine Birds)				
Common noddy, brown noddy	*Anous stolidus*	M	A tropical seabird with worldwide distribution that breeds on tropical and subtropical inshore or oceanic islands, which have rocky cliffs and coral or sand beaches. It nests on the ground, in trees or shrubs, and on cliffs or man-made structures, such as docks and jetties. During the non-breeding season, this species will spend most of its time at sea and may roost on water, rocks, islets, flotsam and even the backs of sea turtles. The species may only be seen transiting the area but is unlikely to land onshore with no suitable foraging habitat present.	**Unlikely** - Species is unlikely to occur given the onshore component of the Project is located within the existing DLNG facility disturbance envelope and suitable habitat is not available.
Fork-tailed swift	*Apus pacificus*	M	This species spends most of the year relatively high in the air column, only coming down to near ground level at times of bad weather. Seen over open country from semi deserts to coasts, islands and sometimes over forests and cities. Species may be observed as an overhead visitor.	**Unlikely** - Species is aerial and unlikely to be found within the Project area.
Great frigatebird, greater frigatebird	*Fregata minor*	M	This species is a widespread seabird, with major colonies in the Indian Ocean, West and Central Pacific and Southern Atlantic. The species inhabits remote islands in tropical and sub-tropical seas, where it breeds in small bushes, mangroves and even on the ground. The species has not been recorded in the Darwin region in the last 30 years.	**Unlikely** - Species unlikely to occur in the Project area and limited suitable habitat is present in the Project area.
Lesser frigatebird, least frigatebird	*Fregata ariel*	M	This species is a widespread seabird, with major colonies in the Indian Ocean, West and Central Pacific and Southern Atlantic. The species inhabits remote islands in tropical and sub-tropical seas, where it breeds in small bushes, mangroves and even on the ground. Outside the breeding season it is sedentary, with immature and non-breeding individuals dispersing throughout tropical seas. The species has not been recorded in the Darwin region in the last 15 years. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Species unlikely to occur in the Project area and limited suitable habitat is present in the Project area.
Little tern	*Sternula albifrons*	M	Inhabits coastal waters, bays, inlets, saline or brackish lakes, salt fields and sewage ponds near the coast throughout northwest, north, east and southeast Australia. It can also be found further inland, sometimes up to several kilometres from the sea. The species has not been recorded in the Darwin region in the last 15 years. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Species unlikely to occur in the Project area and limited suitable habitat is present in the Project area.
Streaked shearwater	*Calonectris leucomelas*	M	This species is pelagic and abundant off the north coasts of Australia from November to May. Occurs on the west and east coasts in summer. Species is abundant off northern Australian coasts. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - Species unlikely to occur in the Project area and the Project area does not contain suitable habitat for the species.
White-tailed tropicbird	*Phaethon lepturus*	M	Tropicbirds are predominantly pelagic species, rarely coming to shore except to breed. The white-tailed tropicbird forages in warm waters and over long distances, moving up to 1500 km from breeding sites. The main breeding site is Christmas Island. Species may be observed as an overhead visitor.	**Unlikely** - Species unlikely to occur in the Project area and the Project area does not contain suitable habitat for the species.
Migratory (Marine Species)				
Australian snubfin dolphin	*Orcaella brevirostris*	M	The Project area intersects the Australian snubfin dolphin BIA for breeding. This species has been recorded within the Darwin Harbour.	**Likely** - Suitable habitat for the species is present. Individuals of the species have previously been recorded near Catalina Island, located to the east of the Project area.
Dugong	*Dugong dugon*	M	Generally occurs in wide, shallow, protected bays and mangrove channels that support extensive sea grass meadows. Reported to use shallow waters such as tidal sandbanks and estuaries for calving.	**Likely** - Suitable habitat for the species is present. The species is widely known from Darwin Harbour.

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
Australian humpback dolphin	*Sousa sahulensis1*	M	The Project area intersects the Australian humpback dolphin BIA for breeding. This species has been recorded within the Darwin Harbour.	**Likely** - Suitable habitat for the species is present. The species is widely known from Darwin Harbour.
Saltwater crocodile	*Crocodylus porosus*	M	The saltwater crocodile is commonly recorded in the Darwin Harbour. Nesting within Darwin Harbour is limited.	**Likely** - There is no important habitat for the species located within the Project area. Individuals of the species have been sighted on boat ramps near the Project area.
Spotted bottlenose dolphin	*Tursiops aduncus*	M	The Project area intersects the spotted bottlenose dolphin BIA for breeding. This species has been recorded within the Darwin Harbour.	**Likely** - Suitable habitat for the species is present. The species is widely known to occur within the Darwin Harbour.
Giant manta ray	*Mobula birostris*	M	This species is believed to have a wider distribution than the closely related reef manta ray and is more migratory in its behaviour. It appears to be a seasonal visitor to coastal and offshore sites and is commonly seen along productive coastlines with regular upwellings, as well as around oceanic islands, offshore pinnacles and seamounts. Sighted on the south coast of Bathurst Island but are not expected to be present in large numbers. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat is present within the Project area and the species is unlikely to occur in the Project area.
Bryde's whale	*Balaenoptera edeni*	M	Bryde's whale can be found in tropical and sub-tropical waters throughout the Atlantic, Pacific and Indian Oceans. There appear to be two distinct habitat preferences amongst Bryde's whales, with some populations, usually comprising smaller-bodied individuals, occurring in coastal waters, while other populations can be found in the open ocean, however all Bryde's whales have a preference for warmer water above 16.3°C. The Project area does not contain any known feeding, breeding, calving, aggregation or migratory routes.	**Unlikely** - No suitable habitat is present within the Project area and the species is unlikely to occur in the Project area.
Humpback whale	*Megaptera novaeangliae*	M	Australia has two distinct humpback whale populations which occur throughout all coastal waters surrounding Australia: east coast and west coast. Within the North Marine Region there are relatively few humpback whales known to travel north of their calving grounds located in Camden Sound (Jenner et al. 2001). No humpback whales were recorded during the 12 months of noise monitoring undertaken as part of the Barossa marine studies program (JASCO Applied Sciences 2016; McPherson et al. 2016). The Project area does not contain any known feeding, breeding, calving, aggregation or migratory routes.	**Unlikely** - The species is unlikely to occur within the Project area.
Killer whale, orca	*Orcinus orca*	M	The orca is found throughout all the world's oceans. The species occurs in virtually every marine region, from polar waters to the equator, and has even been known to enter bays, estuaries and rivers, as well as ice flows. However, it is most commonly recorded in coastal, temperate waters and in areas of high productivity. Its preferred habitat is open ocean. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area.
Longfin mako	*Isurus pacus*	M	Widely scattered records suggest that the longfin mako shark has a worldwide distribution in tropical and warm-temperate oceans; the extent of its range is difficult to determine due to confusion with the Shortfin Mako. Its preferred habitat is open ocean likely in Commonwealth waters outside the Project area. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area.

1 As per species SPRAT profile, the Australian humpback dolphin (Sousa sahulensis) was previously included with Indo-Pacific humpback dolphin (Sousa chinensis). Sousa sahulensis was elevated to a species in 2014 and is now used for humpback dolphins in the waters of the Sahul Shelf and northern Australia to southern New Guinea. Indo-Pacific humpback dolphin is now used to refer to humpback dolphins in the eastern Indian and western Pacific Oceans only. Therefore, humpback dolphins in this report are herein referred to under Australian humpback dolphin (Sousa sahulensis).

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
Narrow sawfish	*Anoxypristis cuspidata*	M	The narrow sawfish is found mainly in inshore coastal waters, to depths of around 40 m, where it is thought to spend most of its time on or near the bottom. It may also enter estuaries and river deltas and has been reported to move upstream into rivers in some areas, although its occurrence in freshwater has yet to be verified. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - No suitable habitat is present within the Project area.
Oceanic whitetip shark	*Carcharhinus longimanus*	M	The oceanic whitetip is found globally in deep, open oceans. Its preferred habitat is open ocean likely in the Commonwealth waters outside the Project area. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area.
Reef manta ray	*Mobula alfredi*	M	The reef manta ray is found in tropical and sub-tropical waters in the Pacific and Indian Oceans. However, within this widespread range its populations appear to be quite patchy. It is more commonly found in shallow inshore waters and typically occurs around coastal reefs, tropical island groups, atolls, bays and productive coastlines.	**Unlikely** - The species is unlikely to occur within the Project area and no suitable habitat is present within the Project area.
Shortfin mako	*Isurus oxyrinchus*	M	The shortfin mako inhabits offshore temperate and tropical seas worldwide. The closely related longfin mako shark is found in the Gulf Stream or warmer offshore waters (e.g., New Zealand and Maine). Its preferred habitat is open ocean likely in the Commonwealth waters outside the Project area. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area.
Migratory (Terrestrial/Wetland Birds)				
Asian dowitcher	*Limnodromus semipalmatus*	M	In the NT the Asian dowitcher is found in Darwin and Arnhem Land. The Asian dowitcher occurs in sheltered coastal environments, such as embayments, coastal lagoons, estuaries and tidal creeks. This species is known to frequent shallow water and exposed mudflats or sandflats.	**Potential** - Some species recorded close to the Project area. Potential habitat in Darwin Harbour.
Common sandpiper	*Actitis hypoleucos*	M	This species is found in shallow, pebbly, muddy or sandy edges of rivers and streams, coastal to far inland; dams, lakes, sewage ponds; margins of tidal rivers; waterways in mangroves or saltmarsh; mudflats; rocky or sandy beaches; and causeways, riverside lawns, drains and street gutters.	**Potential** - The Project area does not contain suitable habitat for nesting/roosting; however, there is suitable habitat for foraging on either side of the Project area which may result in this species traversing the Project area.
Grey plover	*Pluvialis squatarola*	M	Grey plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or saltlakes.	**Potential** - The Project area does not contain suitable habitat for nesting/roosting; however, there is suitable habitat for foraging on either side of the Project area which may result in this species traversing the Project area.
Oriental plover	*Charadrius veredus*	M	Oriental plovers usually forage among short grass or on hard stony bare ground but also on mudflats or among beach cast seaweed on beaches. Oriental plovers sometimes roost on soft wet mud or in shallow water of beaches and tidal mudflats. The species does not breed in Australia.	**Potential** - Some species recorded close to the Project area. Potential habitat in the Darwin Harbour and offshore of Wagait Beach.
Osprey	*Pandion haliaetus*	M	Treated as conspecific with P. cristatus. The osprey is thinly distributed around the coast of Australia where it forages for fish in fresh, brackish, or saline waters of rivers, lakes, estuaries and inshore coastal waters. Nests are usually located near a suitable area of foraging habitat and are a bulky structure made from piled sticks, often positioned in a tall dead tree or artificial structures such as telecommunication towers or poles. Breeding pairs defend breeding territory against other ospreys, and active nests are usually more than 1 km apart.	**Potential** - The Project area and surrounds contain suitable foraging habitat for the species. It is noted that there is an osprey nest on the DLNG site (atop an artificial pole).

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
Bar-tailed godwit	*Limosa lapponica*	M	The bar-tailed godwit has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Populations have also been recorded in the Top End, from Darwin and Melville Island, east to the Alligator River and Croker Island. The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. The species has been recorded in Darwin Harbour. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for this species.
Barn swallow	*Hirundo rustica*	M	This species is found sporadically throughout northern Australia during non-breeding season. The barn swallow is found in vegetated areas including farmland, sports grounds, native grasslands and airstrips as well as over open water such as billabongs, lagoons, creeks and sewage treatment plants. The closest known record is over 5 km from the Project area. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for this species.
Black-tailed godwit	*Limosa limosa*	M	The black-tailed godwit is found in all states and territories of Australia; however, it prefers coastal regions and the largest populations are found on the north coast between Darwin and Weipa. In Australia the black-tailed godwit has a primarily coastal habitat environment. The species is commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit; it is occasionally recorded on rocky coasts or coral islets. The species has been recorded in Darwin Harbour. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for this species.
Broad-billed sandpiper	*Limicola falcinellus*	M	This species is found in shallow, pebbly, muddy or sandy edges of rivers and streams, coastal to far inland; dams, lakes, sewage ponds; margins of tidal rivers; waterways in mangroves or saltmarsh; mudflats; rocky or sandy beaches; and causeways, riverside lawns, drains and street gutters. The closest known record is over 5 km from the Project area. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for this species.
Common greenshank	*Tringa nebularia*	M	This species is common throughout Australia from August until March, and is found in mudflats, estuaries, saltmarshes, margins of lakes, wetlands, clay pans, commercial salt fields, and sewage ponds. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Grey-tailed tattler	*Tringa brevipes*	M	Found in estuaries, tidal mudflats, mangroves, wave-washed rocks and reefs, shallow river margins, coastal or inland. In Australia, adults arrive in the north coast from late August to early September. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Grey wagtail	*Motacilla cinerea*	M	Found near running water, disused quarries, sandy rocky streams in escarpments and rainforests, sewage ponds, ploughed fields and airfields. Visitor to Australia from November to April. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Little curlew	*Numenius minutus*	M	The little curlew is most often found feeding in short, dry grassland and sedgeland, including dry floodplains and black soil plains, which have scattered, shallow freshwater pools or areas seasonally inundated. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
			The closest known record of this species is over 5 km from the Project area and was recorded 10 years ago. While the Project area does contain some attributes which are known to be utilised by this species (i.e. mudflats), they typically prefer to forage in short grasses which are not present at the site.	
Little ringed plover	*Charadrius dubius*	M	The species is associated with open plains; bare rolling country, often far from water; ploughed land; muddy or sandy wastes near inland swamps or tidal mudflats; bare clay pans; margins of coastal marshes; and grassy airfields, sports fields and lawns. They are a regular summer migrant to Australia from September to March. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Long-toed stint	*Calirdirs subminuta*	M	The long-toed stint breeds in Siberia during the Northern Hemisphere summer. It is a visitor to New Guinea and Australia and a vagrant to Sweden, South Africa, Melanesia, Hawaii, the northwestern USA and the vicinity of the Bering Sea. In its over-wintering range it visits a variety of wetland habitats including shallow freshwater or brackish areas, lakes, swamps, floodplains, marshes, lagoons, muddy shores and sewage ponds. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Marsh sandpiper	*Tringa stagnatilis*	M	This is a migratory species, with most birds wintering in Africa and India with fewer migrating to Southeast Asia and Australia. They prefer to winter on freshwater wetlands such as swamps and lakes and are usually seen singly or in small groups. These birds forage by probing in shallow water or on wet mud. They mainly eat insects, and similar small prey. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Oriental, Horsfield's cuckoo	*Cuculus optatus*	M	This species is treated as conspecific with C. saturatus (Himalayan cuckoo). It inhabits monsoon forests and rainforest edges; leafy trees in paddocks; and river flats, roadsides, mangroves and islands. The closest known record is over 5 km from the Project area. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for this species.
Oriental pratincole	*Glareola maldivarum*	M	This species usually inhabits open plains, floodplains or short grassland, often with extensive bare areas, and often occurs near terrestrial and artificial wetlands, especially around the margins. The species also occurs along the coast, inhabiting beaches, mudflats and islands, or around coastal lagoons. It does not breed in Australia. The closest known record is over 10 km from the Project area. This observation was recorded 15 years ago. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for this species.
Oriental reed-warbler	*Acrocephalus orientalis*	M	This is a rare migrant to coastal North and Eastern Australia, and is found in dense reeds, cumbungi, over and near water. It breeds mainly in reed beds and can also be found in marshes, paddy fields, grassland and scrub where it forages for insects and other invertebrates. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Pacific golden plover	*Pluvialis fulva*	M	This species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. It usually occurs on beaches, mudflats and sandflats in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks. The species is also sometimes recorded on islands, sand and coral cays and exposed reefs and rocks. Breeding occurs in dry areas of tundra away from the coast, usually on slopes of low hills, knolls or foothills vegetated with lichen and moss, or in bare, stony areas. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Pectoral sandpiper	*Calidris melanotos*	M	This species has patchy distribution around Australia's coastline. It is found in shallow fresh waters, often with low grass and other herbage; swamp margins, flooded pastures, sewage ponds; and occasionally tidal areas and saltmarshes. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for the species.

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
Pin-tailed snipe	*Gallinago stenura*	M	Pin-tailed snipe occurs most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. The species is also found in drier, more open wetlands such as clay pans in more arid parts of the species' range. It is also commonly seen at sewage ponds, but not normally in saline or inter-tidal wetlands. The closest known record is over 10 km from the Project area. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for the species.
Red-necked stint	*Calidris ruficollis*	M	This species is found in tidal mudflats, saltmarshes; sandy or shelly beaches; saline and freshwater wetlands, coastal and inland; salt fields and sewage ponds. The birds are often in dense flocks, feeding or roosting. The species spends the southern summer months in Australia and is found widely except in the arid inland. The closest known record is over 10 km from the Project area. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for the species.
Red-rumped swallow	*Cecropis daurica*	M	Migratory bird that spends the winter months in northern Australia. This species is found in open hilly country and mountains, river gorges, valleys and sea cliffs, as well as in cultivated areas and human habitations, including towns. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Ruddy turnstone	*Arenaria interpres*	M	This species winters on Australian coastlines and is found in tidal reefs and pools, weed covered rocks, pebbly shelly and sandy shores with stranded seaweed, mudflats, occasionally inland on shallow waters, sewage ponds, commercial salt fields, and open or ploughed ground. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Rufous fantail	*Rufous rufifrons*	M	The rufous fantail inhabits moist and moderately dense habitats. Within these areas, it has astonishingly large variations in habitat requirements. They can be found in eucalyptus forests, mangroves, rainforests and woodlands (usually near a river or swamp). Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Sanderling	*Calidris alba*	M	This species is found on broad ocean beaches of firm sand, depositing strands and heaps of seaweed; often near river mouths; and also inlets, tidal mudflats and coastal lagoons. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Sharp-tailed sandpiper	*Calidris acuminata*	M	The sharp-tailed sandpiper breeds in northern Siberia but migrates south to winter in Australia and New Zealand. In the non-breeding season, they can be found in tidal mudflats, saltmarshes, mangroves; shallow fresh, brackish or saline inland wetlands; floodwaters, irrigated pastures and crops; and sewage ponds and salt fields. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Swinhoe's snipe	*Gallinago megala*	M	This species is found on northern Australian coastlines. Non-breeding habitats include shallow freshwater wetlands of various kinds including paddy fields and sewage farms, with bare mud or shallow water for feeding, with nearby vegetation cover. The closest known record is over 10 km from the Project area. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for the species.
Terek sandpiper	*Xenus cinereus*	M	In Australia, the terek sandpiper has been recorded on coastal mudflats, lagoons, creeks and estuaries. Records indicate that the species favours muddy beaches near mangroves but may also be observed on rocky pools and coral reefs and occasionally up to 10 km inland around brackish pools. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.

Common Name	Scientific Name	EPBC Act Listing	Description/Habitat	Likelihood of Occurrence
Wandering tattler	*Tringa incana*	M	Non-breeding habitats include shallow freshwater wetlands of various kinds including paddy fields and sewage farms, with bare mud or shallow water for feeding, with nearby vegetation cover. Neither this species nor preferred habitat occur within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Whimbrel	*Numenius phaeopus*	M	This species is found in estuaries, mangroves, tidal flats, coral cays, exposed reefs, flooded paddocks, sewage ponds, bare grasslands, sports grounds and lawns. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Wood sandpiper	*Tringa glareola*	M	The wood sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees, especially melaleuca and river red gums *Eucalyptus camaldulensis* and often with fallen timber. They also frequent inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops. They are rarely found using brackish wetlands or dry stunted saltmarsh. Typically they do not use coastal flats, but are occasionally recorded in stony wetlands. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat.
Yellow wagtail	*Motacilla flava*	M	This species is a regular summer migrant to coastal Australia, especially Darwin to Broome, but also north-eastern Queensland from November to April. It is found in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lands. The closest known record is over 10 km from the Project area, and this observation was recorded 30 years ago. Neither this species nor preferred habitat occurs within the Project area.	**Unlikely** - The species is unlikely to occur within the Project area and the Project area does not contain suitable habitat for the species.

CE – Critically endangered

EN – Endangered

VU – Vulnerable

M – Migratory

3.2 Listed Threatened Species and Ecological Communities

This section focuses on threatened species of marine turtles, which provides additional information in response to the DCCEEW RFI Item 2 (EPBC Act listed threatened and migratory turtles) (see **Table 1-1** in **Section 1.3**); residual significant impact is specifically addressed in **Section 6.2.2**.

The PMST search identified 41 listed threatened species as occurring or potentially occurring within or nearby the Project area (**Appendix 16**). The likelihood of occurrence assessment (refer **Section 3.1**) identified six species of marine turtles having the potential or likely to occur within or nearby the Project area. These species are listed as threatened and migratory under the EPBC Act, as shown in **Table 3-3**.

No listed threatened ecological communities were recorded in the PMST search as occurring within the Project area.

Table 3-3 Listed threatened species

Common Name	Scientific Name	EPBC Act Status	Likelihood of Occurrence
Flatback turtle	*Natator depressus*	Vulnerable/Migratory	Likely
Olive ridley turtle	*Lepidochelys olivacea*	Endangered/Migratory	Likely
Green turtle	*Chelonia mydas*	Vulnerable/Migratory	Likely
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable/Migratory	Likely
Leatherback turtle	*Dermochelys coriacea*	Endangered/Migratory	Potential
Loggerhead turtle	*Caretta caretta*	Endangered/Migratory	Potential

The marine turtles listed in **Table 3-3** and their presence in the Project area and wider region are described below.

3.2.1 Flatback Turtle

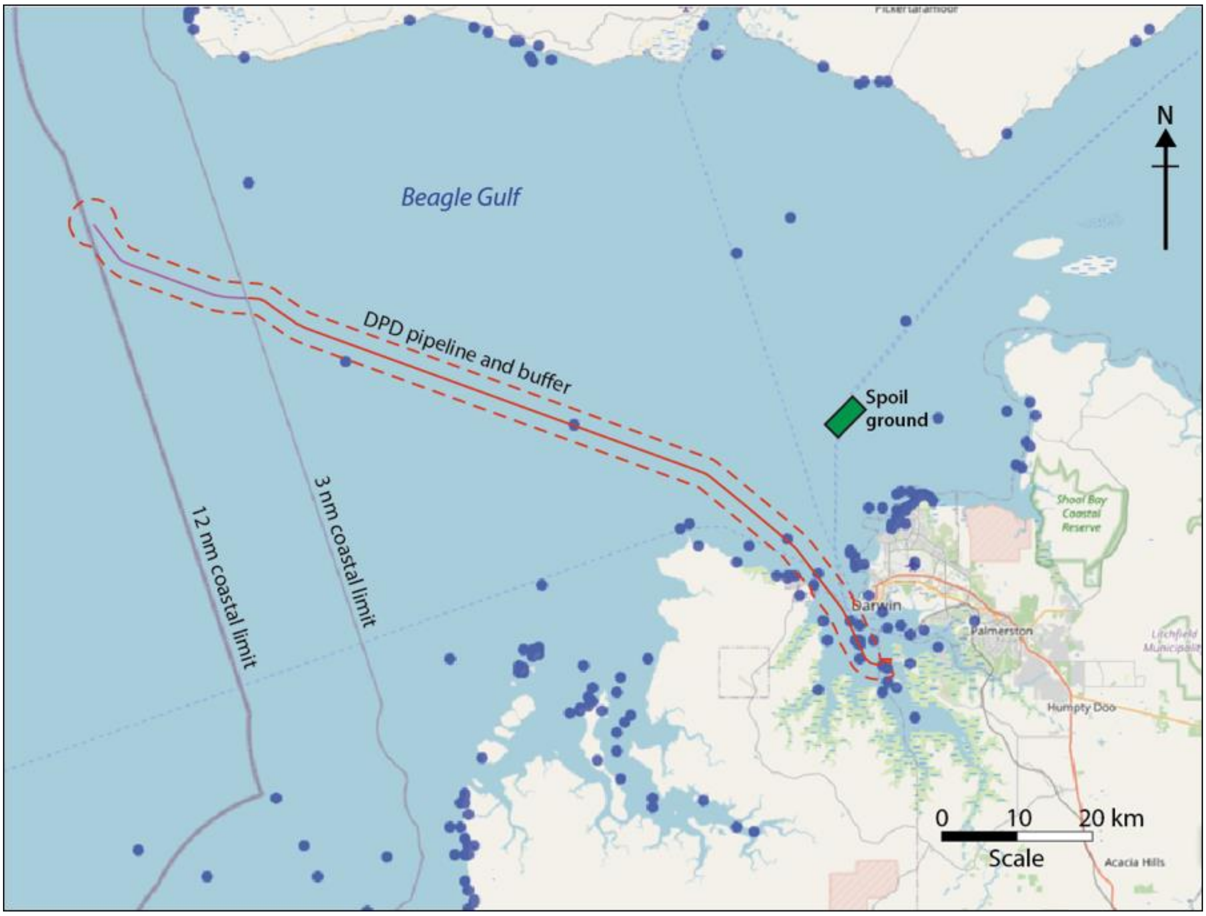
The flatback turtle (*Natator depressus*) is listed as vulnerable under the EPBC Act and data deficient under the TPWC Act 1976 (Northern Territory). This species is also listed as marine and migratory under the EPBC Act. There is no approved conservation advice or listing advice for this marine turtle species (DCCEEW, 2023). While there is no specific recovery plan for the flatback turtle, information on this species is provided in the Recovery Plan for Marine turtles: 2017-2027 (DoEE, 2017b).

Flatback turtles are large marine turtles which can grow up to 1.2 metres in length and are distributed throughout northern Australia, more specifically in Queensland, the Northern Territory and Western Australia (Limpus et al., 2020). The unique features of this turtle are its lack of an oceanic juvenile phase, it lays small clutches of eggs, and has an elevated breath-holding capacity. However, there are considerable gaps in knowledge regarding the species with its conservation status poorly understood (Limpus et al., 2020).

3.2.1.1 Distribution and Habitats

The flatback turtle is found only in the tropical waters of northern Australia and south coasts and islands of Papua New Guinea and Indonesia (Irian Jaya). This species is one of only two species of marine turtle without a global distribution.

Figure 3-2 shows the cumulative distribution of sighting records over 20 years within the Project area and wider region. Note also that satellite tracking of flatbacks from Western Australia shows they were found in deeper water ~100 km north-west of the Tiwi's (Pendoley Environmental, 2023).



Source: Atlas of Living Australia (CSIRO, 2023). BIA = Biological Important Areas.

Figure 3-2 Distribution of Flatback Turtle records in the Project area and wider region

Flatback turtles are the most widely spread nesting marine turtle species in the NT, nesting on a wide variety of beach types along the entire coastline. Despite this, there are no estimates of population size for the flatback turtle. In the NT, the flatback turtles prefer shallow, soft-bottom seabed and benthic habitats away from reefs with this habitat represented within the Project area. Unlike other marine turtle species, post-hatchling flatback turtles do not have an oceanic dispersal phase, this species remains within the relatively shallow waters of the Australian continental shelf (Salmon et al., 2009). In **Figure 3-2** the Project area intersects a BIA (internesting) for flatback turtles, which covers all of the Beagle Gulf including both the Darwin and Bynoe harbours. In addition, **Figure 3-3** shows the BIA (internesting) and 'nesting habitat critical to the survival of flatback turtles'.

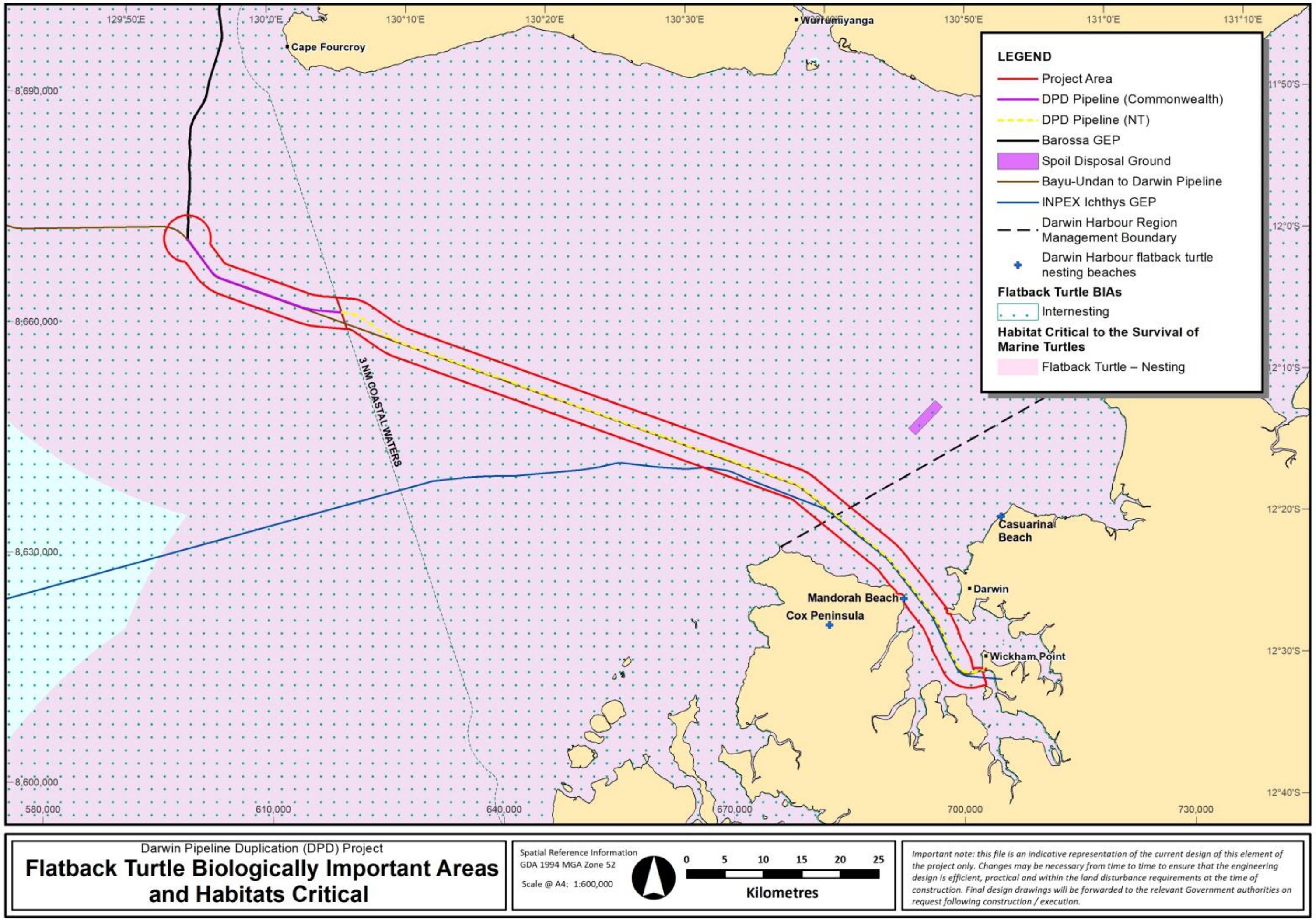


Figure 3-3 Flatback turtle biologically important areas and habitat critical to survival

The flatback turtle nesting habitat shown in **Figure 3-3** was mapped by consensus of a panel of experts in marine turtle biology (DoEE (2017b)) in accordance with the EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013) and defined as areas necessary for:

+ Activities such as foraging, breeding or dispersal.
+ Long-term maintenance of the species.
+ Maintaining genetic diversity and long-term evolutionary development.
+ Reintroduction of populations or recovery of the species.

Nesting habitat critical to the survival of flatback turtles includes at least 70 per cent of nesting for the stock (i.e., these marine areas are extensive).

3.2.1.2 Breeding Areas and Nesting Seasons

The flatback turtle nests on inshore islands and the mainland from Queensland to northern Western Australia. All known breeding sites of this species occur only in Australia. The largest nesting concentration of flatback turtles is in the north-eastern Gulf of Carpentaria and western Torres Strait. In the western NT (and possibly eastern Kimberley) there is a mid-winter peak nesting season and low-density summer nesting.

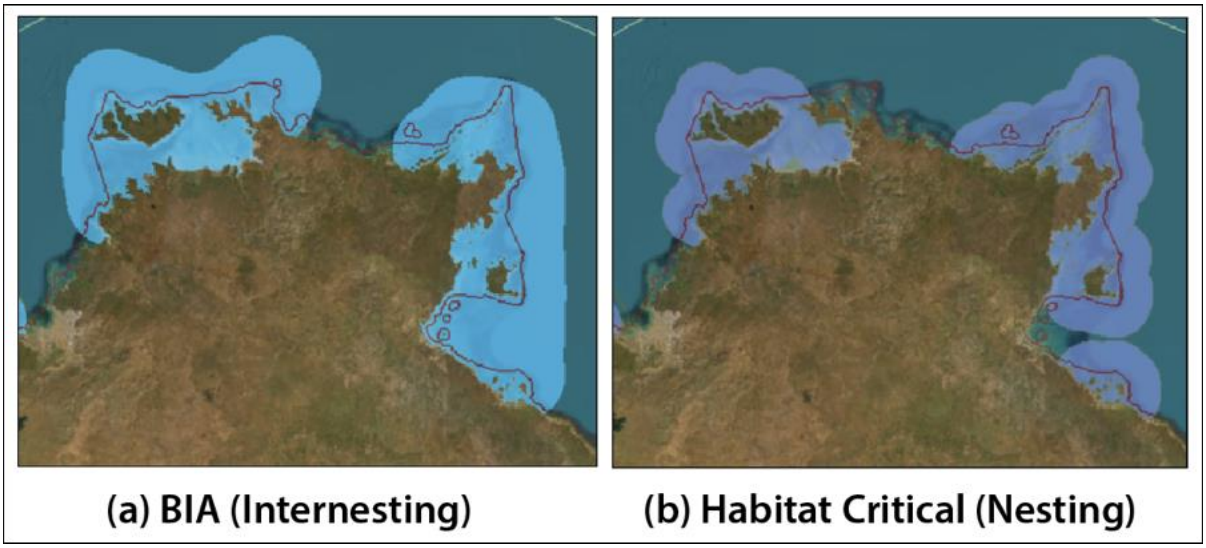
There are five stocks of flatback turtles currently described around Australia, which have been designated as the: eastern Queensland, Arafura Sea, Cape Domett, south-west Kimberley and Pilbara stocks (DoEE, 2017b). Flatback turtles occurring within the Project area and wider region belong to the Arafura Sea stock.

3.2.1.3 Northern Territory

The flatback turtle is considered the most widespread nesting turtle species in the NT and important nesting locations have been identified in various bioregions within the NT. Flatback turtles' nest on a wide variety of beach types along the entire NT coastline. Through surveys held between 1994 and 2004, Chatto and Baker (2008) identified 46 distinct areas within the NT that are either confirmed (18 sites) or inferred (a total of 28 sites) as highly likely to represent significant nesting areas for the flatback turtle. Most of these sites are located on islands to the east of Darwin such as the Arnhem Land rookeries, which include Cobourg Peninsula (e.g., Turtle Point) and the Greenhill, Field and McCluer islands. Significant nesting also occurs in Fog Bay and Perron Island to the southwest of Darwin, Bathurst and Melville islands (Tiwi Islands) to north of Darwin, and Bare Sand Island and Quail Island that are located near the mouth of Bynoe Harbour west of Darwin). These island nesting sites are considered more significant on a regional scale than those within Darwin Harbour such as Casuarina Beach (Chatto and Baker, 2008).

The peak nesting season for flatback turtles in the NT is reported to occur between June-September; however, a study undertaken by Chatto and Baker (2008) found that flatback turtle nesting predominantly occurred between May and October, but it was noted at Casuarina Beach that nesting was recorded in small numbers throughout the year.

There are very large areas of marine waters in the NT designated as BIA (internesting) and Habitat Critical (nesting) for flatback turtles, which are shown as largely overlapping in **Figure 3-4**.



Source: (a) Atlas of Living Australia (CSIRO, 2023).

Figure 3-4 Important Flatback Turtle BIA and Habitat Critical in the Northern Territory

3.2.1.3.1 Project Area

In general, nesting flatback turtles favour low energy beaches that are typically narrow with moderate grain size and a low to moderate beach slope, often shallow (underlain by rock platform or clay) and the beach approach obstructed by broad intertidal mud or limestone intertidal platforms (Pendoley, 2010). Marine turtle monitoring undertaken for the Ichthys project found that the mangroves and mudflats throughout the shorelines of Darwin Harbour do not provide suitable habitat for nesting turtles (INPEX Browse, 2010a).

The main flatback turtle nesting sites in Darwin Harbour are located within the outer harbour along Casuarina Beach, the nearest point of which is approximately 8.5 km east of the Project area and approximately 15 km south of the Project's proposed spoil ground. The Cox Peninsula northern beaches, including Wagait Beach and Mandorah Beach, are used infrequently for flatback turtle nesting, which border the Project area.

Chatto and Baker (2008) undertook a systemic and intensive turtle monitoring program at Casuarina Beach between 1997 and 2006, where they recorded a total of 107 marine turtle nests along an 8-km segment of the beach. The breakdown of the nests by species included those of flatback turtles (104 nests), olive ridley turtles (two nests) and green turtles (one nest). The number of nests recorded ranged from 7 to 20 each year, peaking between May and October, and confirms Casuarina Beach as a low-density nesting beach (Chatto and Baker 2008).

No systematic tagging or census surveys have been carried out on the Cox Peninsula northern beaches including the Wagait and Mandorah beaches. However, the Atlas of Living Australia (CSIRO, 2023) includes only one nest event among the nine records for the Cox Peninsula beaches, which suggests that they are used infrequently by flatback turtles.

The Project area unavoidably intersects the BIA (internesting) and the Habitat Critical (nesting) for flatback turtle within Darwin Harbour and the Beagle Gulf. (see **Figure 3-3**). Notwithstanding, the Project area represents a minute fraction of the Northern Territory-wide total areas of flatback turtle BIA (internesting) and Habitat Critical (nesting) shown in **Figure 3-4**.

3.2.1.4 Diet

The flatback turtle is a carnivorous reptile, feeding mostly on soft bodied prey such as sea cucumbers, soft corals, and jellyfish. They feed mainly in subtidal, soft-bottomed habitats. Based on surveys undertaken, there is potential foraging habitat (soft corals) within the Project area. Distribution of soft coral Alcyonaria ('alcyon') benthic habitat in the Commonwealth Marine Area is described in **Figure 6-4** and **Figure 4-1**.

3.2.1.5 Threatening Processes

The main threats to flatback turtles are associated with commercial and recreational fishing (e.g., entanglement in gill nets, longline and pot fishing, discarded nets), coastal infrastructure and development (including industrial, residential and tourism development), Indigenous harvest, feral animal predation, and climate change. Some specific threats, such as light pollution, may be associated with more than one of these broad categories.

3.2.2 Olive Ridley Turtle

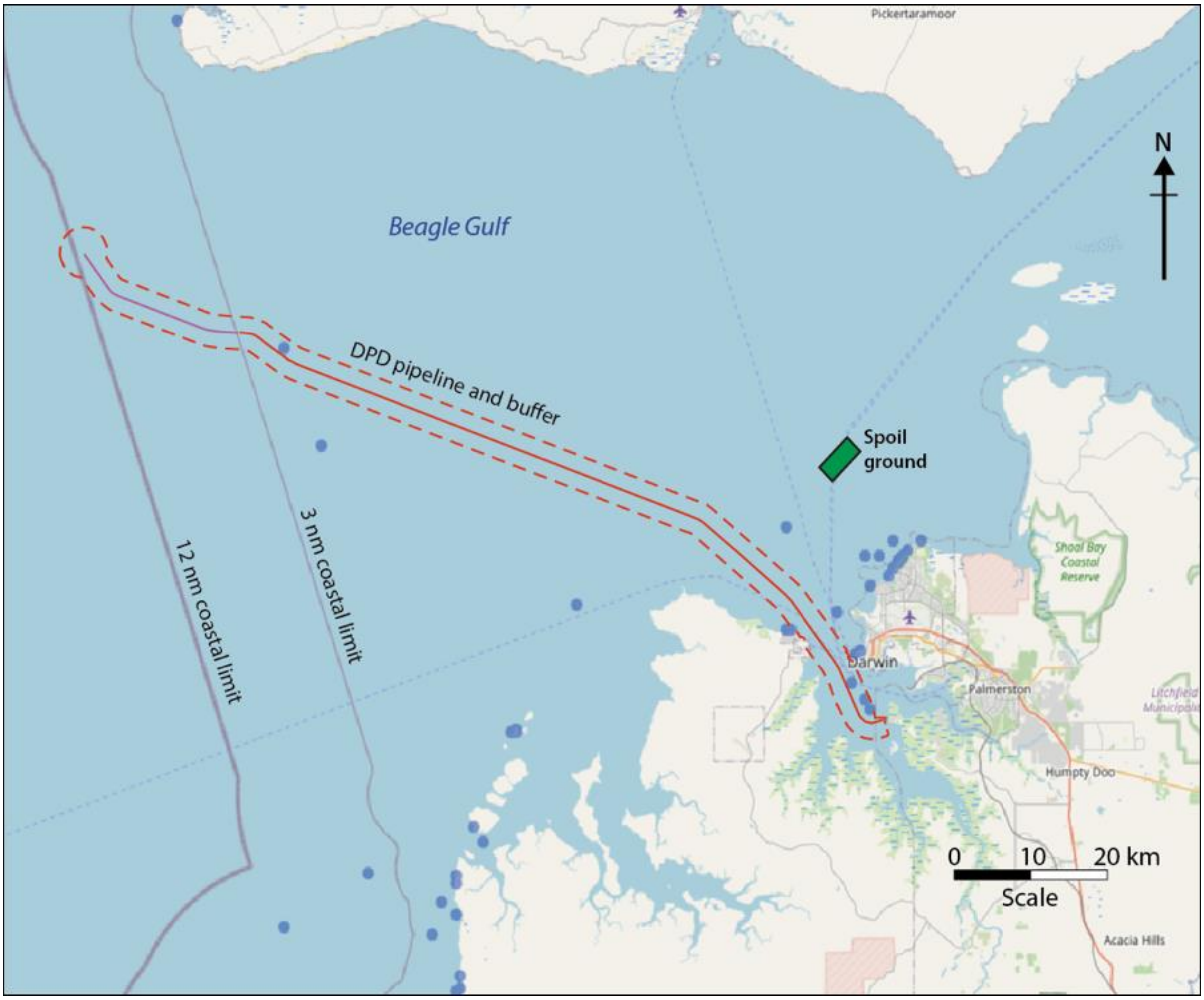
The olive ridley turtle (*Lepidochelys olivacea*) is listed as endangered under the EPBC Act and as vulnerable under the TPWC Act 1976 (Northern Territory). This species is also listed as marine and migratory under the EPBC Act. There is no approved conservation advice or listing advice for this marine turtle species (DCCEEW, 2023). While there is no specific recovery plan for the olive ridley turtle, information on this species is provided in the Recovery Plan for Marine turtles: 2017-2027 (DoEE, 2017b).

The olive ridley turtle is the second smallest of all seven species of marine turtles in the world, with adults ranging from 60-70 cm in length. Additionally, they are the most abundant marine turtle, with the global population estimated to be approximately 800,000 (Cáceres-Farias et al., 2022). This species derives its name from its heart shaped shell, skin or carapace which resembles a dark shade of olive green (Cáceres-Farias et al., 2022).

3.2.2.1 Distribution and Habitats

The olive ridley turtle has a worldwide tropical and subtropical distribution, including northern Australia. This marine turtle species typically occurs in shallow soft-bottom habitats of protected waters. In Australia, they occur along the coast from southern Queensland and the Great Barrier Reef, northwards to Torres Strait, and across to the Joseph Bonaparte Gulf in Western Australia. The current area of occurrence is estimated to exceed 10 million km^2.

Based on sighting records in the Atlas of Living Australia (CSIRO, 2023) **Figure 3-5** shows the known distribution of olive ridley turtles in the Project area and wider region. In addition, **Figure 3-6** shows the BIA (internesting) and nesting habitat critical to the survival of olive ridley turtles on the National Conservation Values Atlas (DCCEEW, 2023).



Source: Atlas of Living Australia (CSIRO, 2023) and National Conservation Values Atlas (DCCEEW, 2022c).

Figure 3-5 Distribution of Olive Ridley Turtles in the Project area and wider region

A substantial proportion of the immature and adult population forages over shallow water benthic habitats, though large juvenile and adult olive ridley turtles have been recorded foraging in both benthic and pelagic habitats. Foraging habitat can range from depths of several metres to over 100 m. There are no records of foraging behaviour of olive ridley turtles within Darwin Harbour and little in the outer region (Beagle Gulf), this is likely because foraging habitat is found in water depths usually greater than 10 m (Whiting et al., 2005).

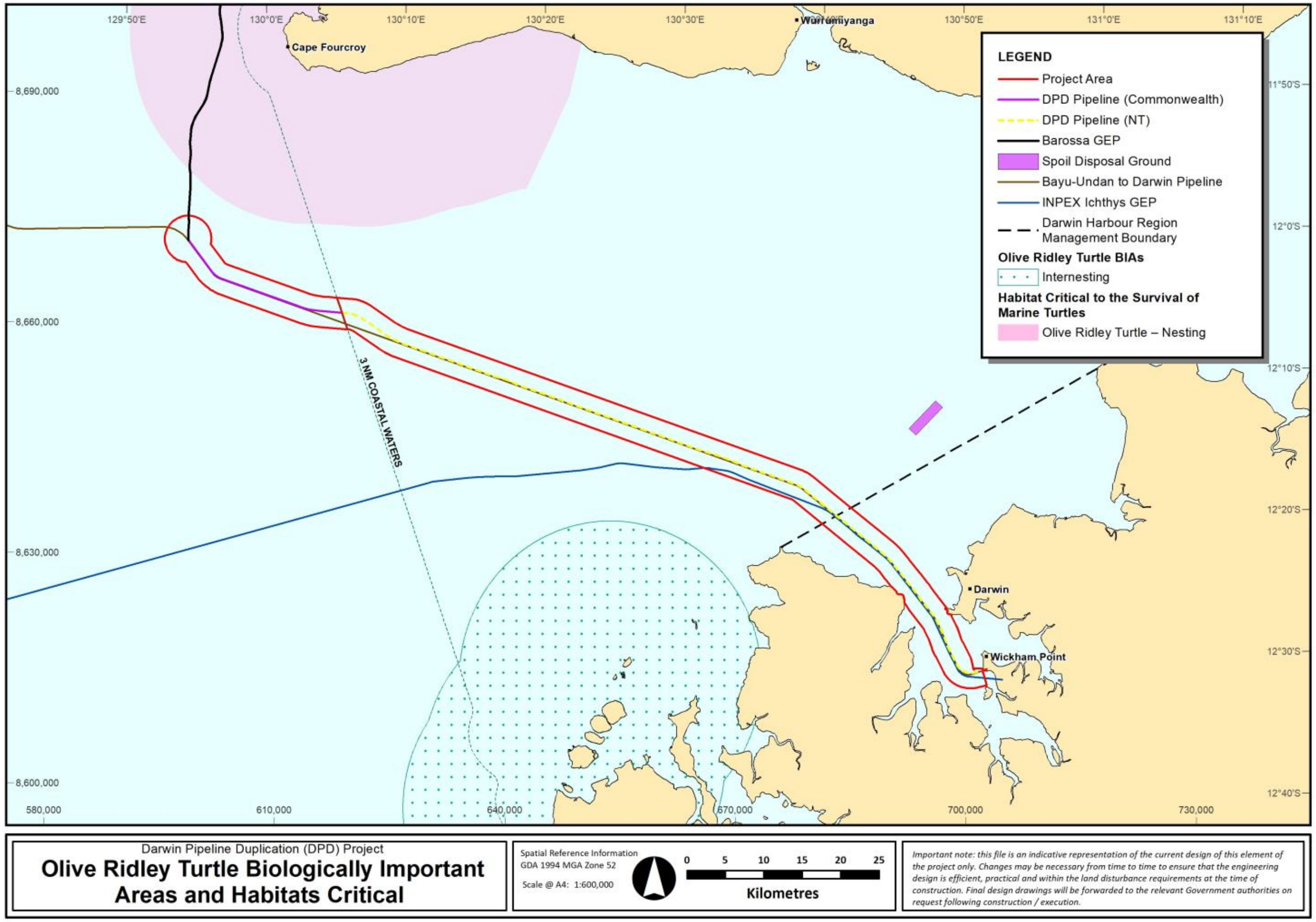


Figure 3-6 Olive Ridley Turtle biologically important areas and habitat critical

3.2.2.2 Breeding Areas and Nesting Seasons

The Project area does not intersect with a BIA or habitat critical to the survival of the species.

The olive ridley turtle is the most abundant of all marine turtles in the world, largely due to a few, but enormous, nesting aggregations found in Costa Rica, Mexico and India.

In Australia however, no large rookeries of olive ridley turtles have been recorded. Detailed information on the size of nesting and foraging populations is unknown although an estimate of the nesting population for Australia is 1,000–5,000 females annually.

In the NT, nesting occurs all year round, although most nesting occurs during the dry season from April to August. Hatchlings emerge from the nests about two months after laying (DoEE 2017b). A long-term study of nesting turtles in the NT (Chatto and Baker, 2008) found that olive ridley turtles were the second most widespread nesting species (after flatback turtles), though they were observed to nest in low numbers through much of their range. On some NT beaches however, such as along the northern coast of Bathurst and Melville islands, and some islands in north-eastern Arnhem Land, olive ridley turtles nest in nationally significant numbers (Chatto and Baker 2008).

The nearest nesting habitat critical to the survival of the olive ridley turtle is located 4.3 km to the north of the Project area (see **Figure 3-6**). The nearest BIA (internesting) for the Olive Ridley Turtle occurs in the southwest (i.e., around the Bare Sand, Quail and Indian islands near the mouth of Bynoe Harbour), which is located 9.5 km south of the Project area (see **Figure 3-6**). The sites within the BIA (internesting) at the mouth of Bynoe Harbour are not considered significant on a regional scale as infrequent nesting has been recorded (Chatto and Baker, 2008). The nearest olive ridley turtle BIA (foraging) located in Fog Bay is approximately 58 km southwest of the Project Area.

Olive ridley turtles are known to remain relatively close to nesting beaches during the nesting period (in comparison to post-nesting movements); tagged turtles remained within 48 km of the nesting beach in waters typically <30 m water depth, although the turtles moved considerable distances within this radius (up to 200 km) (Hamel et al., 2008).

Within Darwin Harbour, Casuarina Beach, Cox Peninsula northern beaches (including Wagait Beach) and Mandorah Beach are infrequently used for nesting. No nesting beaches or defined inter-nesting area are located within the Project area.

3.2.2.3 Diet

The Olive ridley turtle is carnivorous and is known to feed on shellfish, small crabs, molluscs, shrimp, tunicates, jellyfish and salps. Based on surveys, there is limited foraging habitat within the Project area (Chatto and Baker, 2008).

3.2.3 Green Turtle

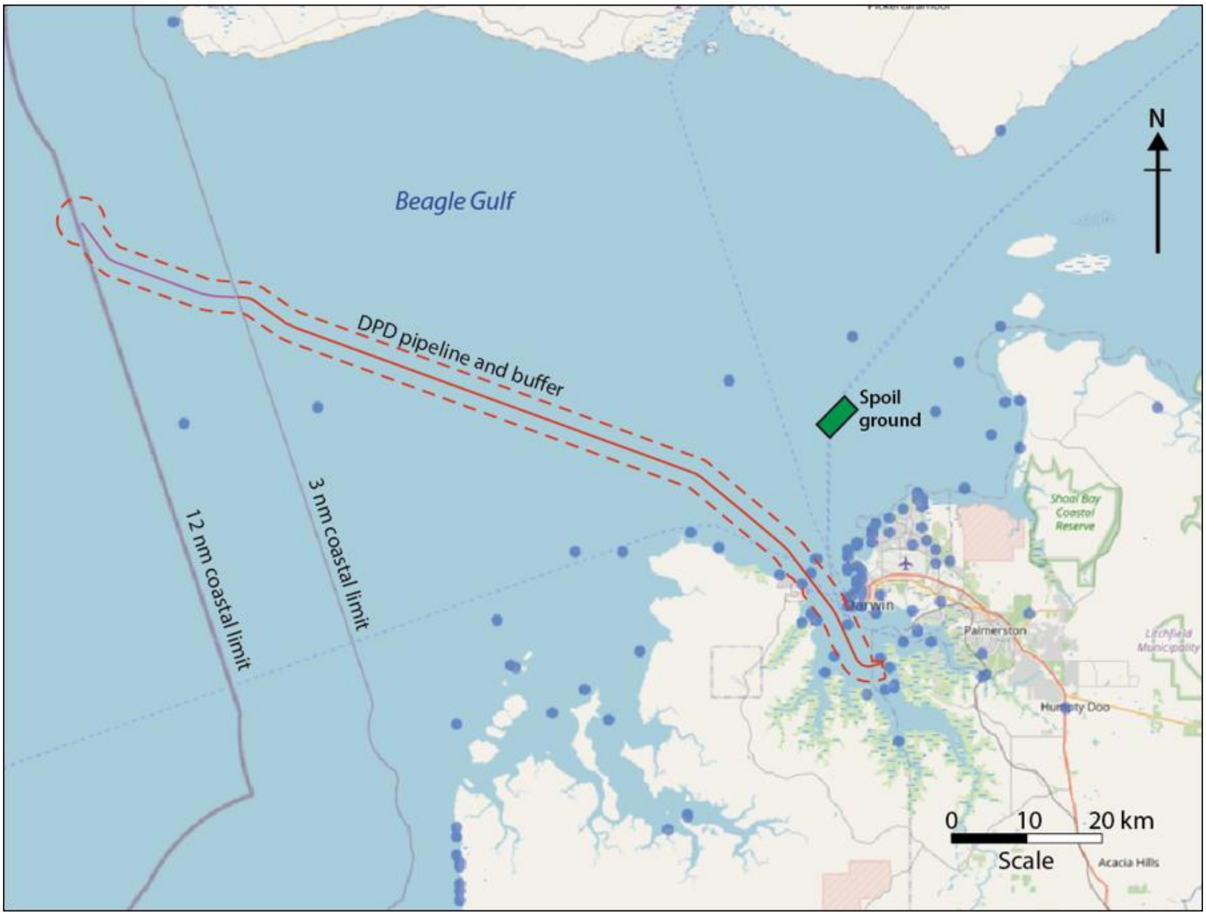
The green turtle (*Chelonia mydas*) is listed as vulnerable under the EPBC Act and near threatened under the TPWC Act 1976 (NT). This species is also listed as marine and migratory under the EPBC Act. There is no approved conservation advice or listing advice for this marine turtle species (DCCEEW, 2023). While there is no specific recovery plan for the green turtle, information on this species is provided in the Recovery Plan for Marine turtles: 2017-2027 (DoEE, 2017b).

The green turtle is a common species of marine turtle closely related to the flatback turtle. The species has a broad range extending throughout both tropical and subtropical seas globally (Jensen et al., 2019). Despite their large distribution, female Green turtles show strong natal homing (i.e., returning to their natal region to lay their eggs). The species is known for its olive-green shell and significant size with the species known to grow to lengths greater than 1 m (Jensen et al., 2019).

+ Distribution and Habitats

Green turtles are found in tropical and subtropical waters throughout the world, with the global population of green turtles estimated to be very large at approximately 2 million.

Based on sighting records in the Atlas of Living Australia (CSIRO, 2023), **Figure 3-7** shows the known distribution of green turtles in the Project area and wider region.



Source: Green Turtle sighting records are based on the Living Atlas of Australia (CSIRO, 2023)

Figure 3-7 Distribution of Green Turtles in the Project area and wider region

Green turtles spend their first five to ten years drifting on ocean currents (pelagic phase). They then settle in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitats or inshore seagrass beds. The shallow foraging habitat of adult green turtles contains seagrass beds or algae mat, which form a large component of their diet.

Green turtles' nest, forage and migrate across tropical northern Australia. The total Australian population of green turtles is estimated to be more than 70,000 individuals, distributed across seven regional populations. Furthermore, this species undergoes significant migration and can travel more than 2,600 km between their feeding and nesting grounds.

Aerial turtle surveys undertaken for the INPEX nearshore environmental monitoring program (NEMP) estimated a marine turtle population size of between 500 and 1,000 for the Darwin region (Buckee et al., 2014). Marine turtles were primarily observed in shallow waters (<10 m), with the highest densities recorded between East Point and Lee Point, and near Gunn Point (Cardno, 2015a). Marine turtles were also sighted throughout Darwin Harbour, although at lower densities. It is likely that most of marine turtles observed in Darwin Harbour during these surveys were green turtles, as they accounted for 74% of sightings during fine scale land-based observations (INPEX Browse, 2018). Based on surveys, the Project area is unlikely to have suitable rocky reef habitats or inshore seagrass bed habitats to support green turtles. Notwithstanding, green turtles may transit through the Project area.

3.2.3.1 Breeding Areas and Nesting Seasons

The green turtle has the most numerous and widely dispersed nesting sites of the seven turtle species known to nest in 80 countries. The largest green turtle nesting populations in the world are found at Tortuguero on the Caribbean coast of Costa Rica (about 30,000 females nest per season on average) and Raine Island on the Great Barrier Reef in Australia (peak nesting of up to 60,000 females).

In Australia, there are seven regional populations of green turtles that nest in different areas including the southern Great Barrier Reef, northern Great Barrier Reef, Coral Sea, Gulf of Carpentaria, and Western Australia's north-west shelf including the offshore Ashmore and Cartier Reefs and Scott Reef. The Gulf of Carpentaria has two main nesting areas including the Wellesley Island Group with major rookeries at Bountiful, Pisonia and Rocky Islands, and the Eastern Arnhem Land, Groote Eylandt, and Sir Edward Pellew Islands area. Nesting occurs year-round, with a mid-year peak in nesting activity.

In the NT, the key nesting and internesting areas (where females live between laying successive clutches in the same season) are the Cobourg Peninsula, between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land), Groote Island, offshore islands including Crocker Island, Goulburn Island, Sir Edward Pellew Islands, Bathurst and Melville Islands (Tiwi Island Group), Wessel and English Islands, and Rocky Island.

The nearest green turtle BIA (Internesting) is located around Cape Van Dieman on Melville Island, which is 75 km from the Project Area. The nearest BIA (foraging) is offshore to the west of Fog Bay, which is located about 120 km southwest of the Project area.

Within Darwin Harbour, green turtles are expected to infrequently use Casuarina Beach and Cox Peninsula northern beaches in the outer harbour and Mandorah Beach in the middle harbour for nesting. There are no nesting beaches or defined internesting areas in the Project area. There are also no designated habitats critical to the survival of green turtles in the Project area of wider Beagle Gulf. However, the nearest habitat critical (nesting) for this species is sited along the north coast of the Cobourg Peninsula, which is located about 185 km from the Project area.

3.2.3.2 Diet

Adult green turtles feed mainly on seagrass and algae, although they will occasionally eat other items including vegetative matter within and flowing to sea from mangroves. However, juvenile green turtles tend to be more carnivorous than the adult phase as they consume crustaceans, aquatic insects, and worms. During their pelagic phase (while drifting on ocean currents), young green turtles also eat plankton. Based on surveys, there is unlikely to be suitable foraging habitat for green turtles within the Project area.

3.2.3.3 Threatening Processes

In Australia, the main current threats to green turtles are disturbance (e.g., light disturbance) and habitat damage due to coastal development, by-catch from fisheries and shark control measures, predation on nests, boat strikes, entanglement in gill nets, ingestion of marine debris, and in some areas, indigenous harvesting. Potential threats include changes to the sea surface temperature, particularly changes to the Southern Oscillation Index, which determines breeding intervals, accidental events (e.g., oil spills), and feral predator invasions.

3.2.4 Hawksbill Turtle

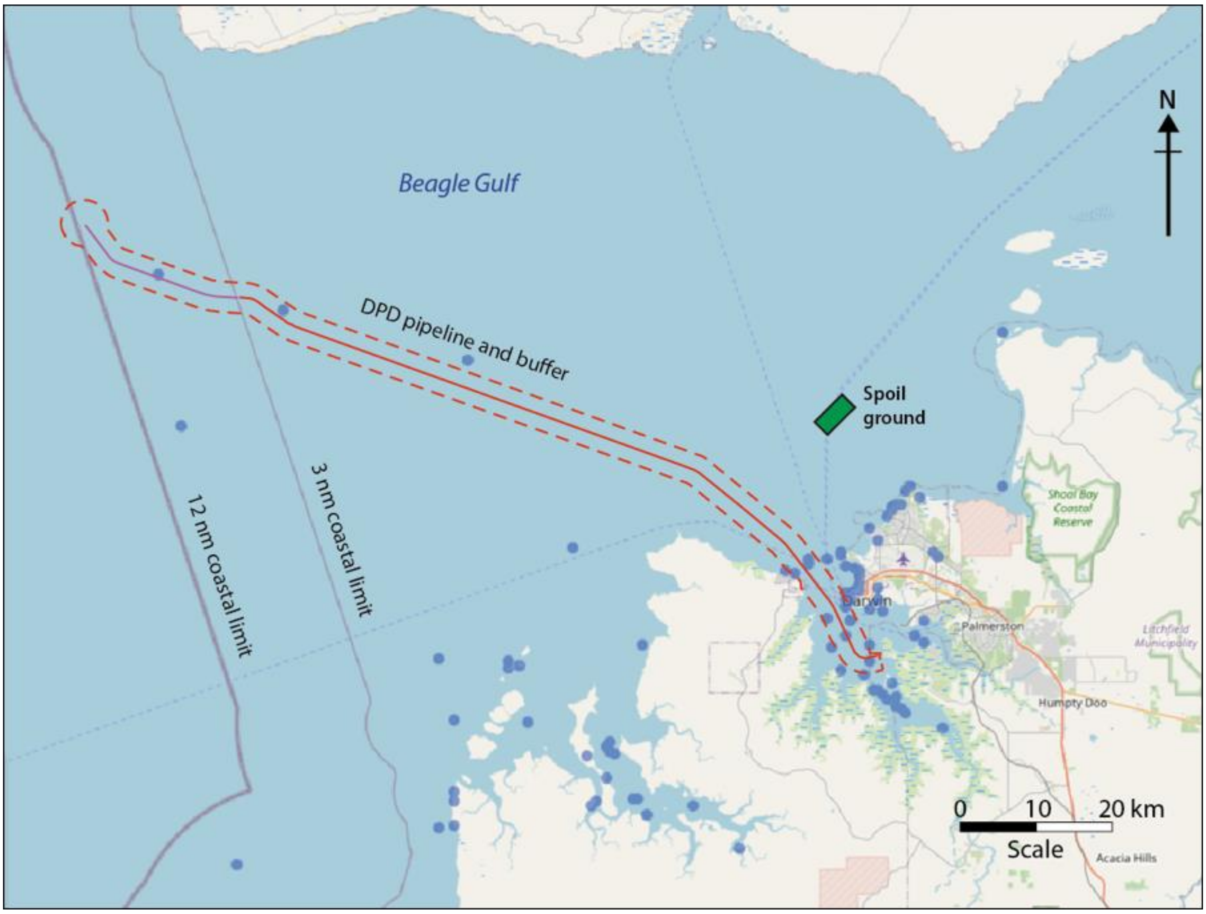
The hawksbill turtle (*Eretmochelys imbricata*) is listed as vulnerable under both the EPBC Act and the TPWC Act 1976 (Northern Territory). This species is also listed as marine and migratory under the EPBC Act. There is no approved conservation advice or listing advice for this marine turtle species (DCCEEW, 2023). While there is no specific recovery plan for the hawksbill turtle, information on this species is provided in the Recovery Plan for Marine Turtles: 2017-2027 (DoEE, 2017b).

The hawksbill turtle is known for its distinctive multicoloured shell and parrot-like beak. This species is smaller than the flatback turtle or green turtle, with a curved carapace length averaging 80 cm (Levasseur et al., 2020). However, much like the green turtle, the hawksbill turtle has strong natal origins, with breeding individuals known to return to their natal origins (Levasseur et al., 2020).

3.2.4.1 Distribution and Habitats

Hawksbill turtles are found in tropical, subtropical, and temperate waters in oceans all around the world. This species spends their first five to ten years drifting on ocean currents. During this pelagic (ocean-going) phase, they are often found in association with rafts of Sargassum (a floating marine plant that is also carried by currents). They then settle and forage in tropical tidal and sub-tidal coral and rocky reef habitats. Much like the green turtle, the hawksbill turtle undertake significant migrations and are known to migrate up to 2,400 km between foraging areas and nesting beaches.

In Australia, the main foraging areas extend along the east coast, including the Great Barrier Reef. Other foraging areas include Torres Strait and the archipelagos of the NT and WA, possibly as far south as Shark Bay or beyond in WA. Hawksbill turtles also forage at Christmas Island and the Cocos (Keeling) Islands. The current total population of hawksbill turtles in Australia is unknown. Based on over 20 years' sighting records in the database of the Atlas of Living Australia (CSIRO, 2023), **Figure 3-8** shows the distribution of hawksbill turtles in the Project area and wider region.



Source: Atlas of Living Australia (CSIRO, 2023); Project components (Santos).

Figure 3-8 Distribution of Hawksbill Turtles in the Project area and wider region

In **Figure 3-8**, hawksbill turtle clusters are present within Darwin Harbour including the Casuarina Coastal Reserve, as well as smaller clusters within Bynoe Harbour and around the Grose Islands Group and adjoining Roche Reef to the southwest of the Project area.

In the NT, hawksbill turtle abundance is concentrated around north-eastern Arnhem Land and Groote Eylandt in the Gulf of Carpentaria. Hawksbill turtles utilise Darwin Harbour regularly but occur in lower abundances compared to green turtles in the harbour (Whiting, 2001, 2003). Immature and adult hawksbill turtles have been reported in Darwin Harbour to use the rocky reef habitat at Channel Island but may also utilise other habitats within the harbour (Whiting, 2001).

Soft coral and sandy habitats are widely distributed in that part of the Project area within Darwin Harbour, thus provide suitable foraging habitat for hawksbill turtles.

3.2.4.2 Breeding Areas and Nesting Seasons

While scattered, low density nesting occurs throughout the tropics, only five geographic regions host more than 1,000 nesting females annually and located in Mexico, Seychelles, Indonesia and two regions in Australia. Australia supports the largest hawksbill turtle nesting aggregations worldwide with estimates of over 4,000 females nesting annually in Queensland, over 2,500 in the NT, and approximately 2,000 in Western Australia.

In the NT, most nesting occurs on islands rather than mainland beaches. The key NT nesting and internesting areas (where females live between laying successive clutches in the same season) include the Cobourg Peninsula, between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land), Groote Eylandt, Sir Edward Pellew Islands, and Wessel and English Islands. A globally important rookery occurs on an archipelago to the north-east of Groote Eylandt in the Gulf of Carpentaria.

Although hawksbill turtles breed throughout the year, the peak nesting period in Arnhem Land is between July and October. Within Darwin Harbour, hawksbill turtle nesting is not common. In addition, no hawksbill turtle nesting beaches or defined internesting areas are within the Project area.

3.2.4.3 Diet

Hawksbill turtles are omnivorous, eating a variety of animals and plants including poriferans (sponges), hydroids, cephalopods (octopus and squid), gastropods (marine snails), cnidarians (jellyfish), seagrass and algae. Sponges make up a major part of the diet. During their pelagic phase (while drifting on ocean currents), young hawksbill turtles eat plankton. Based on surveys, some foraging habitat is likely to occur within the Project area.

3.2.4.4 Threatening Processes

In Australia, the main current threats to hawksbill turtles are disturbance and habitat damage due to coastal development, by-catch from fisheries and shark control, predation on nests, boat strikes, entanglement (e.g., gill nets and longlines), ingestion of marine debris, and unsustainable levels of indigenous harvest in some areas. Potential threats include climate change, accidental events (e.g., oil spills) and feral predator invasions.

3.2.5 Leatherback Turtle

The leatherback turtle (*Dermochelys coriacea*) is listed as endangered under the EPBC Act and critically endangered under the TPWC Act 1976. (Northern Territory). This turtle species is also a listed marine species and migratory under the EPBC Act and has an approved conservation advice (DEWHA, 2008) and a listing advice (TSSC, 2009). While there is no specific recovery plan for the leatherback turtle, information on this species is provided in the Recovery Plan for Marine Turtles: 2017-2027 (DoEE, 2017b).

The leatherback turtle is an oceanic species with a worldwide distribution. This species is unique among the world's marine turtles as it does not have a bony carapace but instead is covered by a layer of leathery brown or black skin (Okuyama et al., 2021). Additionally, they are considerably larger than other turtles, with adult females having an average length of 1.6 metres and weighing upwards of a tonne. Leatherback turtles can also undertake behavioural thermoregulation, which enables them to respond to changes in sea temperature throughout their migration (Okuyama et al., 2021).

3.2.5.1 Distribution and Habitat

The leatherback turtle is a highly pelagic and oceanic species, with the widest global distribution of any marine turtle. This marine turtle species is found in tropical, subtropical, and temperate waters. In Australia, this species has been recorded foraging in coastal waters offshore of all Australian States.

Most leatherback turtles are commonly reported in coastal waters in central eastern Australia (from the Sunshine Coast in southern Queensland to the NSW central coast), southeast Australia (e.g., Tasmania, Victoria, and South Australia), and in the west (Western Australia. Leatherback turtles are regularly seen foraging in southern Australian waters and in particular, Bass Strait.

Most leatherback turtles within Australian waters are likely to be foraging migrants, from breeding and nesting populations in neighbouring countries such as Indonesia, Papua New Guinea, and the Solomon Islands (Limpus and McLachlan, 1990; INPEX, 2011). No estimates of the numbers of leatherback turtles that forage in Australian waters are available.

The Atlas of Living Australia (CSIRO, 2023) database did not show any leatherback turtle sightings in the Project area, Darwin Harbour or Beagle Gulf. The nearest sighting record (in 2010) was in eastern Van Dieman Gulf south of Morse Island, which is located about 185 km from the Project area.

No BIA for leatherback turtles is located within the Project area or wider region. The nearest BIA (internesting) along the northeast coast of the Cobourg Peninsula and Croker Island is located about 200 km from the Project area. Similarly, the nearest habitat critical to leatherback turtle survival is nesting habitat around northwest Cobourg Peninsula, and which is about 145 km from the Project area.

As an oceanic species, and due to the lack of suitable habitat, the species is unlikely to occur within the Darwin Harbour (Whiting, 2001).

3.2.5.2 Breeding Areas and Nesting Season

There is no historical evidence of a large nesting population of leatherback turtles in Australia (TSSC, 2009). Leatherback turtle nesting beaches are primarily located in tropical latitudes around the world. In Australia, no large rookeries have been recorded; however, scattered nesting has been reported in the Northern Territory, News South Wales, and Queensland.

In the NT, the only places where breeding has been reported are in Arnhem Land and include the Sir Edward Pellew Islands, Maningrida, Danger Point on Cobourg Peninsula, and Palm Bay on Croker Island. Tracks of Leatherback turtles are occasionally recorded on the northwest coast and Gulf of Carpentaria. Only very small numbers of nests are laid per year in the NT and thus, would only represent a minor contribution to the global population. Given what is known about the leatherback turtle in NT coastline and waters, this species is unlikely to use beaches within Darwin Harbour for nesting with no nesting beaches or defined internesting areas recorded in the Project area (Whiting, 2001).

3.2.5.3 Diet

The leatherback turtle is carnivorous and feeds mainly on gelatinous zooplankton, jellyfishes, and other soft-bodied pelagic invertebrates, which occur in greatest concentrations at the surface in areas of upwelling or convergence. Leatherback turtles have been recorded foraging and feeding in the coastal waters of all Australian States (Hamann et al., 2006). Based on the results of seabed and benthic surveys, there is unlikely to be suitable foraging habitat within the Project area to support the leatherback turtle.

3.2.5.4 Threatening Processes

Threats to leatherback turtles are predominantly anthropogenic and include incidental capture in commercial fisheries (e.g., as bycatch in pelagic longlining), ingestion of marine debris, and vessel strike occur in all open waters. Indigenous harvesting of adult leatherback turtles is carried out in Indonesia and Papua New Guinea waters, and eggs are harvested in Malaysia, Indonesia, Papua New Guinea, and

Thailand (Limpus, 1997). In Australia, the relative absence of nesting and the preference of leatherback turtles for offshore waters for foraging, renders them less susceptible to Indigenous harvesting and, as such, is not a significant threat.

3.2.6 Loggerhead Turtle

The loggerhead turtle (*Caretta caretta*) is listed as endangered under the EPBC Act and vulnerable under the TPWC Act 1976 (Northern Territory). This species is also listed as marine and migratory under the EPBC Act. There is no approved conservation advice or listing advice for this species (DCCEEW, 2023). While there is no specific recovery plan for this species, recovery of this and other marine turtle species are addressed in the Recovery Plan for Marine turtles: 2017-2027 (DoEE, 2017b).

Internationally, the Convention on the Conservation of Migratory Species of Wild Animals (CMS, 2014) unanimously agreed to and adopted an action plan entitled 'Single Species Action Plan for the loggerhead turtle (*Caretta caretta*) in the South Pacific Ocean'. Although not legally binding to signatory States of the Convention, which includes Australia, this agreement provided a framework for implementing management actions to address the decline of loggerhead turtles in the South Pacific. Aspects of this single species action plan were incorporated in the Australian Recovery Plan for Marine turtles in Australia (DoEE, 2017b).

3.2.6.1 Distribution and Habitat

The loggerhead turtle has a global distribution in tropical and warm temperate marine waters. In Australia, based on the annual percentage of nesting females, approximately 2 to 4% of the total global population of loggerhead turtles occurs in Australia. This species breeds primarily in the southern Great Barrier Reef and adjacent mainland in Queensland and on Dirk Hartog Island (Shark Bay) and Muiron Island (Northwest Cape) in Western Australia. The eastern and western subpopulations are genetically distinct. Loggerhead turtles that breed in Australia migrate to the Pacific Islands and southern Asia.

In the NT, the Atlas of Living Australia (CSIRO, 2023) lists only four records of loggerhead turtles in the wider region outside the Project Area including two records (1991) off Casuarina Beach with both between 8.5 and 12 km distance from the Project area, one record (1991) in Fog Bay (55 km distance), and one record (2015) of a dead loggerhead turtle at Stokes Hill Wharf (2 km distance) in Darwin Harbour. The one-off record of the dead loggerhead turtle in Darwin Harbour is not considered evidence of its presence in the harbour when alive, as this dead turtle may have been brought into the harbour by incoming tides.

Habitats within NT waters includes nearshore waters and the open sea of the Beagle Gulf, which is used by loggerhead turtles as they migrate through this area. Based on loggerhead turtle records in the Atlas of Living Australia (CSIRO, 2023) over a 23-year period (1991-2023), the nearshore waters and benthic environment adjacent to Casuarina Beach within the outer Darwin Harbour are occasionally visited by passing loggerhead turtles but a very low frequency. Overall, the likelihood of occurrence (refer **Table 3-2**) of loggerhead turtles in the Project area or wider region has been assessed as having the **Potential** to occur, however **Unlikely** may be more reasonable. While the species is highly unlikely to use beaches within Darwin Harbour for nesting, its occasional presence at Casuarina Beach (11 km from the Project area) and other sightings in Fog Bay (southwest of the Project area), suggests that loggerhead turtles may transit through the Project area.

3.2.6.2 Breeding Areas and Nesting Seasons

Individuals that forage in NT waters appear to originate from both the eastern and western breeding loggerhead turtle subpopulations. No mating or nesting of loggerhead turtles is known in the Anson–Beagle Bioregion (INPEX, 2011), which includes the Beagle Gulf and the Project area. This is confirmed by Chatto (1998) who noted that breeding had not been recorded in the NT up to 1998 within the Beagle Gulf, and that there are no known nesting beaches or defined internesting areas that provide habitat critical to loggerhead turtle survival.

3.2.6.3 Diet

Loggerhead turtles forage in subtidal and intertidal coral and rocky reefs and seagrass meadows in inshore waters, as well as in deeper soft-bottomed habitats. This species of marine turtle is carnivorous and feeds primarily on benthic invertebrates in benthic habitats ranging from shallow nearshore waters out to deeper waters up to 55 m depth. Typical diet items include gastropod molluscs and clams, and smaller amounts of jellyfish, starfish, corals, crabs, and fishes.

In their juvenile stage, Loggerhead turtles feed on algae, pelagic crustaceans, and molluscs. As they mature, juveniles change from a pelagic to benthic mode of feeding as they move into inshore waters and, consequently, their diet changes to consuming seabed fauna. Based on the results of seabed and benthic surveys, there is unlikely to be suitable habitat within the Project area to support a population of foraging loggerhead turtles.

3.2.6.4 Threatening Processes

Threatening processes affecting Loggerhead turtles currently includes increased predation of eggs by red foxes (*Vulpes vulpes*) and juvenile mortality from incidental capture in coastal otter-trawl fisheries and oceanic longline fisheries have led to observed declines in loggerhead turtle numbers (Chaloupka and Limpus, 2001). Loggerhead turtles are known to have a greater propensity than other sea turtles to consume baited longline hooks (Witzell, 1998), which makes them more vulnerable to longline fisheries.

In NT waters, the main anthropogenic cause of mortality has been attributed their incidental capture (bycatch) in prawn trawling nets (Poiner and Harris, 1996). This Commonwealth managed fishery has implemented and adopted measures to reduce bycatch of marine turtles (DoEE, 2017b). One such measure, the introduction of turtle exclusion devices (TEDs) into the Commonwealth prawn fishery in NT waters, is anticipated to have reduced the bycatch of loggerhead turtles.

3.2.7 Summary Descriptions of Marine Turtles

Table 3-4 presents a summary description of EPBC Act listed migratory marine turtles potentially occurring in the Project area.

Table 3-4 Summary description of EPBC Act-listed marine turtles potentially within the Project area

Species	Distribution and habitats	Breeding areas and nesting seasons	Diet
Flatback turtle	The flatback turtle is 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. There are no estimates of population size for the flatback turtle. They feed in the northern coastal regions of Australia, extending as far south as the Tropic of Capricorn. Their feeding grounds also extend to the Indonesian archipelago and the Papua New Guinea coast. Flatback turtles prefer shallow, soft-bottomed seabed habitats away from reefs. Post-hatchling flatback turtles do not have an oceanic dispersal phase, this species remains within the relatively shallow Australian continental shelf waters (Salmon et al. 2009). <u>Northern Territory</u> Flatback turtles are the most widely spread nesting marine turtle species in the NT, nesting on a wide variety of beach types around the entire coastline. <u>Project area</u> Flatback turtles prefer shallow, soft-bottomed seabed habitats away from reefs; being habitat represented within the Project area. As identified in **Figure 3-2**, the Project area intersects 'habitat critical to the survival of the flatback turtle species'. This habitat was mapped by consensus of a panel of experts in marine turtle biology and according to the EPBC Act Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (DoE 2013), is defined as areas necessary: + for activities such as foraging, breeding or dispersal. + for the long-term maintenance of the species. + to maintain genetic diversity and long-term evolutionary development. + for the reintroduction of populations or recovery of the species. Nesting habitat critical to the survival of Flatback turtles includes at least 70 per cent of nesting for the stock (i.e. these marine areas are extensive).	All known breeding sites of this species occur only in Australia. Flatback turtles nest on inshore islands and the mainland from Queensland to northern Western Australia. There are four major nesting areas in Australia, representing four genetic breeding stocks. The largest nesting concentration of flatback turtles is in the north-eastern Gulf of Carpentaria and western Torres Strait. In the western NT (and possibly eastern Kimberley) there is a mid-winter peak nesting season and low density summer nesting. <u>Northern Territory</u> The flatback turtle is considered the most widespread nesting turtle species in the NT and important nesting locations have been identified in various bioregions within the NT. Flatback turtles' nest on a wide variety of beach types around the entire coastline. Through surveys held between 1994 and 2004, Chatto and Baker (2008) have identified 46 distinct areas within the NT that are confirmed (a total of 18) or inferred as highly likely to represent (28 sites), significant nesting areas for the Flatback turtle. Most of these sites are on islands. Arnhem Land rookeries include Cobourg Peninsula and Greenhill Island, Field Island and McCluer Island. West of Darwin, significant nesting occurs in Fog Bay. Other significant sites include Turtle Point, North Perron Island and Bathurst and Melville Islands. Within the Darwin region most turtle nesting is associated with flatback turtles. The main nesting site in the Darwin Harbour is located at Casuarina Beach. This nesting site is located approximately 8 km east of the Project pipeline and approximately 15 km south of the Spoil Disposal Ground. The Cox Peninsula beaches and Mandorah Beach are infrequently used for nesting, which border the Project area. Monitoring undertaken for the Ichthys project found that the mangroves and mudflats throughout the shoreline of Darwin Harbour do not provide suitable habitat for nesting turtles (INPEX Browse 2010a). Other turtle nesting sites include Bare Sand Island and Quail Island, which are considered more significant on a regional scale than Casuarina Beach (Chatto and Baker 2008) and are located near the mouth of Bynoe Harbour (~50 km from Darwin). While peak nesting for flatback turtles in the NT is reported to occur between June-September, a study undertaken by Chatto and Baker (2008) found that flatback turtle nesting predominantly occurred between May and October; however, it was noted that at locations such as Casuarina Beach nesting was recorded in small numbers throughout the year. <u>Project area</u> Infrequently used nesting beaches at Wagait and Mandorah, although the Project area intersects an internesting BIA (**Figure 3-4**). The BIA (internesting) represents an extensive area extending south of the Daly River to Goulburn Islands in the north, inclusive of Bathurst and Melville islands (>800 km of coastline (see **Figure 3-4**).	The flatback turtle is carnivorous, feeding mostly on soft bodied prey such as sea cucumbers, soft corals and jellyfish. They feed mainly in subtidal, soft-bottomed habitats. <u>Project area</u> Based on surveys, there is foraging habitat (soft corals) within the Project area.

Species	Distribution and habitats	Breeding areas and nesting seasons	Diet
Olive ridley turtle	The olive ridley turtle has a worldwide tropical and subtropical distribution, including northern Australia. The turtle is the most numerous of all marine turtles in the world. <u>Northern Territory</u> The current area of occurrence is estimated to exceed 10 million km². Olive ridley turtles typically occur in shallow soft-bottom habitats of protected waters. In Australia, they occur along the coast from southern Queensland and the Great Barrier Reef, northwards to Torres Strait, and across to the Joseph Bonaparte Gulf in Western Australia. A 'habitat critical to the survival of the olive ridley species occurs around the south-western side of Bathurst Island, extending 20 km seaward and approximately 4.3 km north of the nearest point of the Project area. A substantial part of the immature and adult population of olive ridley turtles forage over shallow benthic habitats, though large juvenile and adult olive ridley turtles have been recorded in both benthic and pelagic foraging habitats. Foraging habitat can range from depths of several metres to over 100 m. There are no records of foraging behaviour of olive ridley turtles within Darwin Harbour and little in the outer region, this is likely because foraging habitat is located in water depths usually greater than 10 m (Whiting et al. 2005). <u>Project area</u> The Project area does not intersect with a BIA or habitat critical to the survival of the species. Olive ridley turtles typically occur in shallow soft-bottomed habitats of protected waters; being habitat represented within the Project area.	The olive ridley turtle is the most numerous of all marine turtles in the world, largely due to a few, but enormous, nesting aggregations found in Costa Rica, Mexico and India. <u>Northern Territory</u> No large rookeries of olive ridley turtles have been recorded in Australia. Detailed information on the size of nesting and foraging populations is unknown although an estimate of the nesting population for Australia is 1,000-5,000 females annually. Chatto and Baker's long-term study of nesting turtles in the NT (Chatto & Baker 2008) found that olive ridley turtles were the second most widespread nesting species (after Flatbacks) in the NT, though they nest in low numbers through much of their range. On some beaches, however, such as along the northern coast of Bathurst and Melville islands, and some islands in north-eastern Arnhem Land, they nest in nationally significant numbers (Chatto & Baker 2008). An olive ridley turtle BIA (internesting) area is located south-east of Darwin Harbour, approximately 10 km from the Project area (**Figure 3-6).** This BIA is near the turtle nesting sites of Bare Sand Island, Quail Island, and Indian Island, located near the mouth of Bynoe Harbour (~50 km from Darwin), however these sites are not considered significant on a regional scale with infrequent nesting recorded (Chatto and Baker 2008). Habitat critical to the survival of olive ridley turtle species (Nesting) encompasses nearshore waters along the north, west and east coasts of the Tiwi Islands. Internesting olive ridley turtles remain relatively close to nesting beaches during the nesting period (in comparison to post-nesting movements); tagged turtles remained within 48 km of the nesting beach in waters typically <30 m water depth, although the turtles moved considerable distances within this radius (up to 200 km) (Hamel et al. 2008). Within the Darwin Harbour, Casuarina Beach, Cox Peninsula Beaches and Mandorah Beach are infrequently used for nesting. In Northern Australia nesting occurs all year round, although most nesting occurs during the dry season from April to August. Hatchlings emerge from the nests about two months after laying (DoEE 2017b). <u>Project area</u> No nesting beaches or defined inter-nesting area.	The olive ridley turtle is carnivorous, known to feed on shellfish, small crabs, molluscs, shrimp, tunicates, jellyfish and salps. <u>Project area</u> Based on surveys, there is limited foraging habitat within the Project area.
Green turtle	Green turtles are found in tropical and subtropical waters throughout the world. The global population of green turtles is estimated to be very large (~2 million). Green turtles spend their first five to ten years drifting on ocean currents (pelagic phase). They then settle in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds. The shallow foraging habitat of adults contains seagrass beds or algae mats on which green turtles mainly feed. Green turtles can migrate more than 2,600 km between their feeding and nesting grounds. <u>Northern Territory</u> Green turtles nest, forage, and migrate across tropical northern Australia. The total Australian population of green turtles is estimated to be more than 70 000 individuals, distributed across seven regional populations. Aerial turtle surveys undertaken for the INPEX nearshore environmental monitoring program (NEMP) estimated a population size of between 500 and 1,000 for the Darwin	The green turtle has the most numerous and widely dispersed nesting sites of the seven turtle species, known to nest in 80 countries. The largest green turtle nesting populations in the world are found at Tortuguero on the Caribbean coast of Costa Rica (~30,000 females nest per season on average) and Raine Island on the Great Barrier Reef in Australia (peak nesting of up to 60,000 females). <u>Northern Territory</u> In Australia, there are seven regional populations of green turtles that nest in different areas: the southern Great Barrier Reef, the northern Great Barrier Reef, the Coral Sea, the Gulf of Carpentaria, Western Australia's north-west shelf, the Ashmore and Cartier Reefs and Scott Reef. The Gulf of Carpentaria has two main nesting areas, the Wellesley Island Group, with major rookeries at Bountiful, Pisonia and Rocky Islands, and the Eastern Arnhem Land, Groote Eylandt and Sir Edward Pellew Islands area. Nesting occurs year round, with a mid-year peak in nesting activity.	Adult green turtles eat mainly seagrass and algae, although they will occasionally eat other items including mangroves. Young turtles tend to be more carnivorous than adults. During their pelagic phase (while drifting on ocean currents), young green turtles also eat plankton. <u>Project area</u> Based on surveys, there is unlikely to be suitable habitat within the Project area.

Species	Distribution and habitats	Breeding areas and nesting seasons	Diet
	region (Buckee et al. 2014). Turtles were primarily observed in shallow waters (<10 m), with the highest densities recorded between East Point and Lee Point, and near Gunn Point (Cardno 2015a). Turtles were also sighted throughout Darwin Harbour, although at lower densities. It is likely that the majority of turtles observed in the harbour during these surveys were green turtles, as they accounted for 74% of sightings during fine scale land-based observations (INPEX Browse 2018). Project area Based on surveys, the Project area is unlikely to have suitable habitat being rocky reef habitat or inshore seagrass beds. Although green turtles may transit through the Project area.	The key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) are Coburg Peninsula, between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land), Groote Island, offshore islands including Crocker Island, Goulburn Island, Sir Edward Pellew Islands, Bathurst and Melville Islands, Wessel and English Islands, and Rocky Island. BIAs for green turtles occur on the north coast of the Tiwi Islands and in the vicinity of Cobourg Peninsula. Within Darwin Harbour, the green turtle is expected to infrequently use Casuarina Beach, Cox Peninsula Beaches and Mandorah Beach for nesting. Project area No nesting beaches or defined inter-nesting area.	
Hawksbill turtle	Hawksbill turtles are found in tropical, subtropical and temperate waters in all the oceans of the world. Hawksbill turtles spend their first five to ten years drifting on ocean currents. During this pelagic (ocean-going) phase, they are often found in association with rafts of Sargassum (a floating marine plant that is also carried by currents). They then settle and forage in tropical tidal and sub-tidal coral and rocky reef habitat. The hawksbilll turtle is known to migrate up to 2,400 km between foraging areas and nesting beaches. Northern Territory The total population of hawksbill turtles in Australia is unknown. In Australia the main feeding area extends along the east coast, including the Great Barrier Reef. Other feeding areas include Torres Strait and the archipelagos of the NT and WA, possibly as far south as Shark Bay or beyond. Hawksbill turtles also feed at Christmas Island and the Cocos (Keeling) Islands. In the NT, abundance is concentrated around north-eastern Arnhem Land and Groote Eylandt. The hawksbill Turtle utilises Darwin Harbour regularly but occur in lower abundances compared to the green turtle (Whiting, 2001, 2003). In the Darwin Harbour, immature and adult sized hawksbill turtles have been reported as using the rocky reef habitat at Channel Island but may also utilise other habitats (Whiting, 2001). Project area Soft coral and sandy habitats are widely present throughout the Project area within Darwin Harbour, therefore providing suitable foraging habitat for the hawksbill turtle.	Global nesting is mainly confined to tropical beaches. While scattered, low density nesting still occurs throughout the tropics, only five geographic regions host more than 1,000 nesting females annually: Mexico, Seychelles, Indonesia and two in Australia. Northern Territory Australia supports the largest hawksbill turtle nesting aggregations worldwide, with estimates of over 4,000 females nesting annually in Queensland, over 2,500 in the NT, and ~2,000 in Western Australia. In the NT, most nesting occurs on islands rather than mainland beaches. The key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) in the NT area: Coburg Peninsula, between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land), Groote Island, Sir Edward Pellew Islands, and Wessel and English Islands. A globally important rookery occurs on an archipelago to the north-east of Groote Eylandt. Although hawksbill turtles breed throughout the year, the peak nesting period in Arnhem Land is between July and October. Hawksbill turtle nesting is not common in Darwin Harbour. Project area No nesting beaches or defined internesting area.	The Australian stocks of hawksbill turtles are omnivorous, eating a variety of animals and plants including sponges, hydroids, cephalopods (octopus and squid), gastropods (marine snails), cnidarians (jellyfish), seagrass and algae. Sponges make up a major part of the diet. During their pelagic phase (while drifting on ocean currents), young Hawksbill turtles eat plankton. Project area Based on surveys, there is likely to be some foraging habitat within the Project area.
Leatherback turtle	The leatherback turtle has the widest global distribution of any reptile. The leatherback turtle is a pelagic feeder, found in tropical, subtropical and temperate waters throughout the world. Although this species has an unusually wide latitudinal range as adults can withstand cold (10 °C) water. It is a highly pelagic species, venturing close to shore mainly during the nesting season, and is capable of diving to several hundred metres.	Nesting beaches are primarily located in tropical latitudes around the world. Globally, the largest remaining nesting aggregations are found in Trinidad and Tobago, West-Indies (Northwest Atlantic) and Gabon, Africa (Southeast Atlantic). Australia No large rookeries have been recorded in Australia. Scattered nesting has been reported in Queensland, New South Wales and Arnhem Land.	The leatherback turtle is carnivorous and feeds mainly in the open ocean on jellyfish and other soft-bodied invertebrates. Soft-bodied creatures such as jellyfish and tunicates, occur in greatest concentrations at the surface in areas of upwelling or convergence. Project area

Species	Distribution and habitats	Breeding areas and nesting seasons	Diet
	Limited data indicates that leatherback turtles concentrate in areas where currents converge with steep bathymetric contours, presumably where food is more readily available. Australia Leatherback turtles are presumed to migrate to Australian waters from nesting populations in Indonesia, Papua New Guinea and the Solomon Islands (INPEX, 2010). The species has been recorded feeding in the coastal waters of all Australian States (Hamann et al. 2006). The species is most commonly reported from coastal waters in central eastern Australia (from the Sunshine Coast in southern Queensland to central NSW); south-east Australia (from Tasmania, Victoria and eastern South Australia) and in south-western Western Australia. It is regularly seen in southern Australian waters. The current area of occurrence in Australia is estimated to be ~6 million km². No estimates of the numbers of leatherback turtles that forage in Australian waters are available. As an oceanic species, the species is unlikely to occur within the Darwin Harbour (Whiting, 2001). Project area Based on surveys, there is unlikely to be suitable habitat.	Nesting sites have been found at Cobourg Peninsula, Manangrida and Croker Island in the NT. Only very small numbers of nests are laid per year in the NT and thus would only be a minor contributor to the global population. The species is unlikely to use beaches within the Darwin Harbour for nesting (Whiting 2001). Project area No nesting beaches or defined inter-nesting area.	Based on surveys, there is unlikely to be suitable habitat within the Project area.
Loggerhead turtle	The loggerhead turtle has a global distribution throughout tropical, sub-tropical and temperate waters. Loggerhead turtles forage in subtidal and intertidal coral and rocky reefs and seagrass meadows in inshore waters, as well as in deeper soft-bottomed habitats. Females can migrate up to 2,600 km from feeding areas to traditional nesting beaches. Australia In Australia, they occur in coral reefs, seagrass beds and muddy bays and estuaries in tropical and warm temperate waters off the coast of Queensland, NT, Western Australia and New South Wales. The current area of occurrence is estimated to be ~1.5 million km^2. In Australia, small loggerhead turtles live at or near the surface of the ocean and move with the ocean currents, with much of their feeding in the top 5 m of water, before recruiting to their chosen inshore or neritic feeding area. Loggerhead turtles are expected to be infrequent users of the Darwin Harbour (Whiting 2003). The loggerhead turtle is more likely to occur in oceanic areas outside the Darwin Harbour. Project area Based on surveys, there is unlikely to be suitable habitat.	Nesting is mainly concentrated on sub-tropical beaches with major aggregations occurring in Oman, eastern USA, southern Japan, Greece, Turkey, southern Queensland and Western Australia. Australia Based on the percentage of nesting females per year, approximately 2–4% of the total global population of loggerhead turtles occur in Australia, with the majority occurring in eastern and western Australia. The species is unlikely to use beaches within the Darwin Harbour for nesting. Project area No nesting beaches or defined inter-nesting area.	Loggerhead turtles are carnivorous, feeding primarily on benthic invertebrates in habitat ranging from nearshore to 55 m. Typical diet includes gastropod molluscs and clams, and smaller amounts of jellyfish, starfish, corals, crabs, and fish. In their juvenile stage, they feed on algae, pelagic crustaceans and molluscs. Once they move to the benthic foraging habitat their diet changes. Project area Based on surveys, there is unlikely to be suitable habitat within the Project area.

Sources:

DCCEEW (2022). Species Profile and Threats Database: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

DCCEEW (2022). Marine Species Conservation, Marine Turtles: https://www.awe.gov.au/environment/marine/marine-species/marine-turtles

NWA (2022). North West Atlas, Biological Important Areas (BIAs). https://northwestatlas.org/node/27496

NT EPA (2022). https://nt.gov.au/environment/animals/threatened-animals

3.2.8 Summary of Marine Turtle Presence

A summary of the likely nesting sites and likely locations for threatened marine turtles in the DPD Project area and surrounding areas is provided in **Table 3-5** below.

Table 3-5 Summary of likely location of MNES listed turtles

Turtle species	Likely Locations		Nesting Locations Frequency		
	Inside Darwin Harbour	Outside Darwin Harbour	Casuarina Beach	Cox Peninsula beaches and Mandorah Beach	Tiwi Islands
Flatback turtle	Frequent	Frequent	Frequent	Infrequent	Frequent
Olive ridley turtle	Infrequent	Infrequent	Infrequent	Infrequent	Frequent
Green turtle	Frequent	Infrequent	Infrequent	Infrequent	N/A
Hawksbill turtle	Frequent	Infrequent	Infrequent	Infrequent	N/A
Leatherback turtle	Unlikely	Infrequent	Unlikely	Unlikely	N/A
Loggerhead turtle	Infrequent	Infrequent	Unlikely	Unlikely	N/A

Sources: Chatto and Baker (2008); Whiting (2003); Whiting(2001); Buckee et al. (2014); INPEX Browse (2018); O2 Marine (2019).

3.3 Listed Migratory Species

This section focuses on listed species of migratory dolphins, and provides additional information in response to the DCCEEW RFI Item 3 (EPBC Act listed migratory dolphins) (see **Table 1-1** in **Section 1.3**); residual significant impacts are specifically addressed in **Section 6.3.2**.

The PMST report identified 75 listed migratory species as occurring, or as potentially occurring, within the vicinity of the Project area (**Appendix 16**). The likelihood of occurrence assessment (refer to **Table 3-2**) identified 18 migratory species as having the potential to or likely to occur within or nearby to, the Project area. Listed migratory terrestrial marine turtles (assessed in **Section 3.2**), Dugongs, Saltwater Crocodiles and the Osprey have been excluded from further consideration. There is commentary on Dugongs and Saltwater Crocodiles in **Section 4** and the Osprey in **Section 6,** the focus in this section is on the three dolphin species identified in the DCCEEW RFI.

Table 3-6 lists the migratory dolphin species occurring in the Project area that may potentially be impacted by the Project.

Table 3-6 Migratory dolphin species potentially occurring in the Project Area

Common Name	Scientific Name	EPBC Act Status	Likelihood of Occurrence
Australian snubfin dolphin	*Orcaella heinsohni*	Migratory	Potential
Australian humpback dolphin	*Sousa sahulensis*	Migratory	Likely
Spotted bottlenose dolphin	*Tursiops aduncus*	Migratory	Likely

The following sections describe the three inshore dolphin species in **Table 3-6** likely to be present in the Project area and wider region and provides additional information in response to the DCCEEW (2022) RFI Item 3 in **Table 1-1** and **Appendix 3**).

3.3.1 Australian Snubfin Dolphin

The Australian snubfin dolphin (*Orcaella heinsohni*) is listed as a cetacean and migratory but is not a listed threatened species under the EPBC Act. There is no approved conservation advice or listing advice for this species (DCCEEW, 2023). Since the species is not listed as threatened, there is no recovery plan for this species since the general purpose of recovery plans are to set out goals that need to be achieved to bring about a species' recovery and de-listing from the EPBC Act list of threatened species.

3.3.1.1 Distribution and Habitats

The Australian snubfin dolphin is a recently identified species which was previously combined with the Irrawaddy dolphin (Orcaella brevirostris) (DoE, 2019) and is considered endemic to Australia.

Australian snubfin dolphins primarily occur in shallow coastal and estuarine waters of the northern half of Australia, from approximately Broome on the west coast of Western Australia to the Brisbane River on the east coast of Queensland (Parra et al., 2002). Only a single record for the Australian snubfin dolphin exists outside Australia, which was located near Daru, Western Province, Papua New Guinea (Beasley et al., 2002).

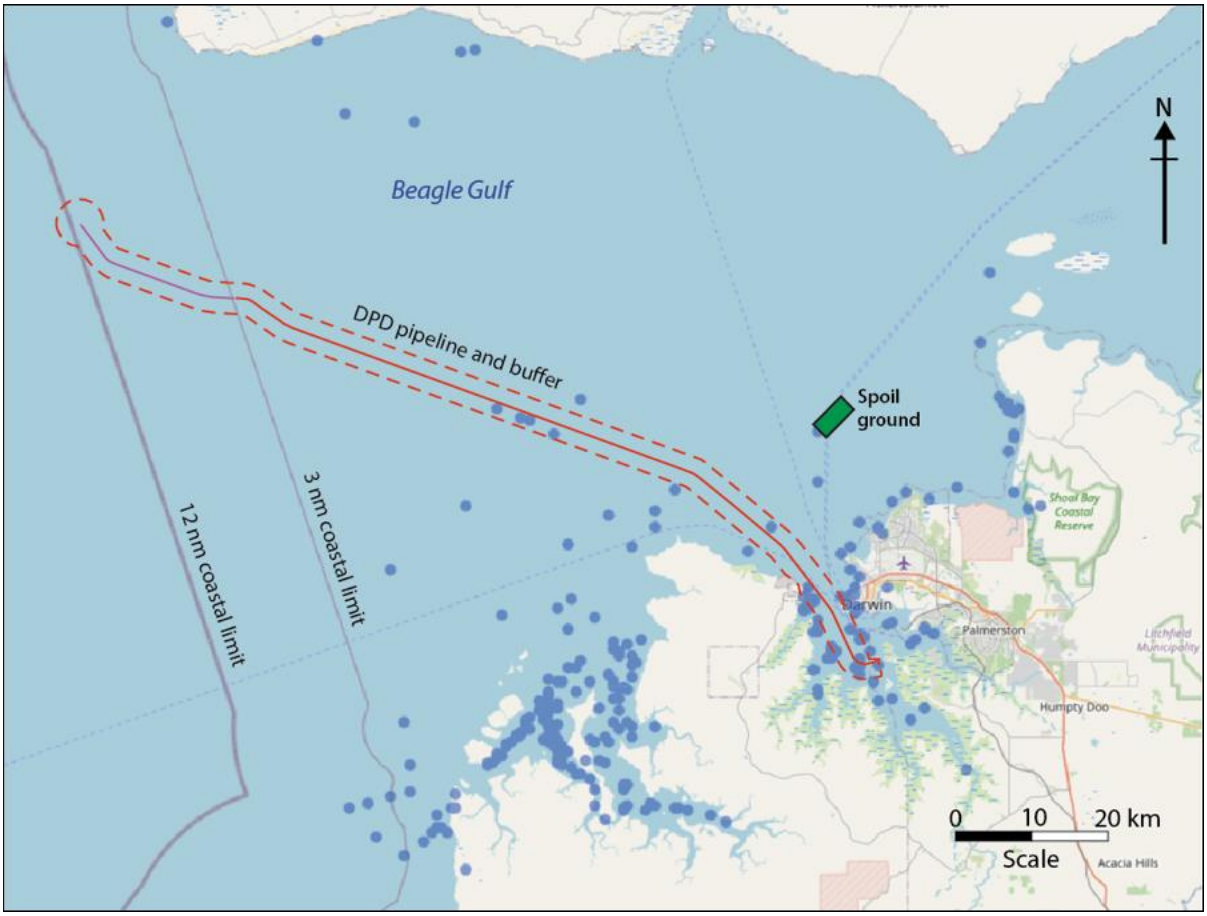
Within Australia, BIAs (breeding and calving) for the Australian snubfin dolphin have been designated along the Kimberley coastline in Western Australia and in Northern Territory coastal waters.

3.3.1.1.1 Northern Territory

The Australian snubfin dolphin is widely distributed across NT coastal waters with populations considered in a heathy state (Palmer et al., 2017). From aerial surveys undertaken in 2014 and 2015, the Australian snubfin dolphin was identified as having an area of occupancy (AOO) of 24,900 km^2 and was calculated to occupy 89% of NT coastal waters (Palmer et al., 2017). The highest densities of sightings were from the Pellew Islands, Groote Eylandt, English Company Islands / Arnhem Bay and Fog Bay (Palmer et al., 2017). These sites primarily on the east coast of NT, except for Fog Bay which lies to the southwest of Darwin.

3.3.1.1.2 Project Area

Based on the Atlas of Living Australia (CSIRO, 2023), **Figure 3-9** shows the distribution of Australian snubfin dolphins in the Project area and wider Darwin region and **Figure 3-10** shows a BIA (breeding and calving) for this species within Darwin Harbour.



Source: Atlas of Living Australia (CSIRO, 2023). Project components (Santos).

Figure 3-9 Distribution of Australian Snubfin Dolphins in the Darwin region

In **Figure 3-9**, there are sighting record clusters of Australian snubfin dolphins within both Darwin Harbour and Bynoe harbours, with other clusters in Shoal Bay and between the Grose Island Group and Indian Island to the west of Bynoe Harbour.

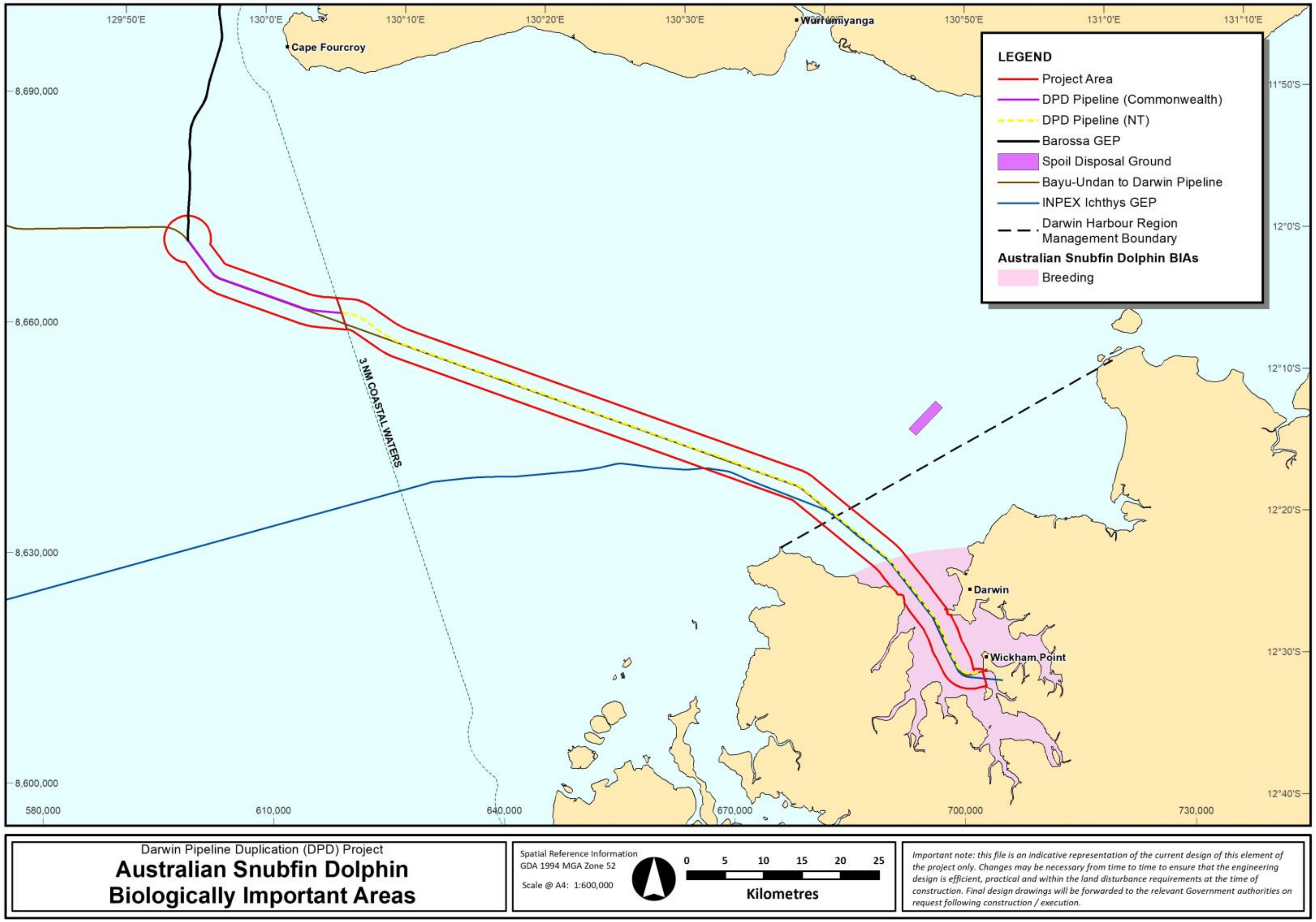
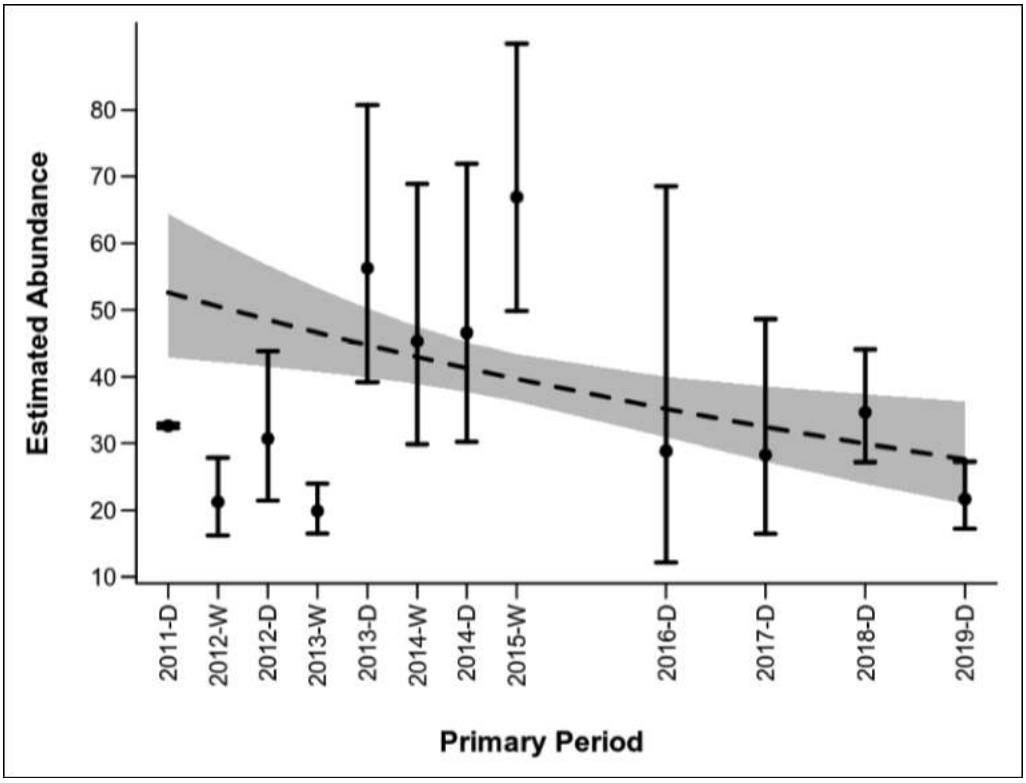


Figure 3-10 Biologically important areas (BIA) for Australian Snubfin Dolphins in Project area and Darwin region

The Australian snubfin dolphin has been monitored in the Darwin Harbour region (comprising Bynoe Harbour, Darwin Harbour and Shoal Bay) between 2011 and 2019 as part of the Coastal Dolphin Monitoring Program (Griffiths et al., 2020). This monitoring study found that populations of Australian snubfin dolphins , and the other coastal dolphin species, occur in small, highly mobile groups and exhibit movements in and out of Darwin harbour, including to the nearby Bynoe Harbour and Shoal Bay.

3.3.1.2 Population Estimates and Trends

Australian snubfin dolphins occur at low population densities that are similar to average densities across NT coastal waters and exhibit fluctuating temporary emigration across sites. **Figure 3-11** shows the estimated abundance and population trend of Australian snubfin dolphins in the Darwin region (i.e., combined Darwin Harbour, Bynoe Harbour, and Shoal Bay) over the period 2011–2019 (Griffiths et al., 2020).



Source: Griffiths et al. (2020). Population size estimates and 95% confidence intervals across the 12 primary sampling periods 2011-2019. Log-linear abundance trend estimates are overlayed (broken line) with 95% confidence interval (shaded area).

Figure 3-11 Populations of Australian Snubfin Dolphins in the Darwin region (2011-2019)

In **Figure 3-11**, the primary period (x-axis) refers to the mean date of the sampling period and whether the sampling was undertaken during the wet (W) or the dry (D) season. The results from the 2011 to 2019 monitoring program (Griffiths et al., 2020) highlight the small, mobile, and variable nature of coastal Australian snubfin dolphin populations in the Darwin region. This species has been shown to typically occur at low densities, exhibit substantial temporary emigration and have fluctuating population size. In **Figure 3-11**, there is an inferred overall downward trend in the population of Australian snubfin dolphins in the Darwin region over the period 2011-2019.

3.3.1.2.1 Population Size Estimates

The Australia snubfin dolphin population was small and highly variable over the 12 primary samples. There were insufficient data to estimate population size at each primary sample site; therefore, only a single estimate is reported for each primary sample. The single estimates were also used to determine a log-linear trend for this species.

The single population size estimate in the Darwin region (i.e., Darwin Harbour, Bynoe harbour and Shoal Bay) ranged from a minimum of 20 dolphins in 2013 to a maximum of 67 dolphins in 2015 (see **Figure 3-11**). During the last three sampling surveys (2017–2019), the population size estimates increased from 29 in 2017 to 35 in 2018 but dropped to 21 in 2019. However, the data is inadequate to discern trends at individual sites such as Darwin Harbour (Griffiths et al, 2020).

The Australian humpback dolphin has the highest temporary and permanent emigration rates of the three inshore dolphin species monitored, and this may be contributing to the variable pattern in abundance. It is likely that the sample area in this study (i.e., the Darwin region) forms only part of the range of the Australian snubfin dolphins that visit the area, and that their relative rates of usage of the Darwin region and areas elsewhere may vary widely over time (DENR, 2018).

3.3.1.2.2 Population Density Estimates

The average density of 0.04–0.11/km^2 for Australian snubfin dolphins in the Darwin region over the course of the 2011–2019 survey monitoring programs appears to be lower when compared to densities from multiple sites in WA (range 0.37–1.33/km^2) and QLD (range 0.37–1.37/km^2) (Griffiths et al., 2020).

Overall, the size of Australian snubfin dolphin population is small in the Darwin region, demonstrated the most variation in population size and has the highest level of temporary emigration. Over the 2011-2019 monitoring period, a significant negative trend in abundance was observed for Australian snubfin dolphins in the Darwin region. The reasons for the significant decline were not clear but may be related to population dynamics, environmental or anthropogenic factors (Griffiths et al., 2020).

3.3.1.3 Breeding Areas

The peak calving season for the Australian snubfin dolphin occurs in the months from October to April (Palmer, 2010). The proportion of calves sighted has varied considerably during monitoring years (DENR, 2019).

As noted in **Figure 3-10**, a BIA (breeding and calving) for the Australian snubfin dolphin is located within Darwin Harbour. In addition, other similar BIAs (breeding and calving) have been established elsewhere in the NT (e.g., at the mouths of the East and South Alligator rivers region and the northern coastline of the Cobourg Peninsula). Given the results of NT-wide surveys of the species showing wide distribution, occurrence within nearly all coastal waters and higher densities at sites not currently designated as BIAs (Palmer et al. 2017), there are potentially important breeding sites not currently recognised as potential BIAs.

3.3.1.4 Diet

The Australian snubfin dolphin is considered an opportunistic, generalist feeder that preys on a variety of schooling, bottom-dwelling and pelagic fishes, and cephalopods, which are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra, 2013).

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Within Darwin Harbour, foraging has been identified as the dominant behaviour for Australian snubfin dolphins, which is generally recorded in water depths ranging from 0.7 m to 25 m (Palmer, 2010). While foraging may occur in the Project area, there are no specific habitats that are considered unique or key for this species given its generalist feeding behaviour and wide use of coastal habitats for foraging.

3.3.2 Australian Humpback Dolphin

The Australian humpback dolphin (*Sousa sahulensis*) is listed as a cetacean and migratory but is not a listed threatened species under the EPBC Act. There is no approved conservation advice or listing advice, and no adopted or made recovery plan for this species (DCCEEW, 2023).

3.3.2.1 Distribution and Habitats

Australian humpback dolphins are found in tropical/subtropical waters of the Sahul Shelf from northern Australia to the southern waters of the island of New Guinea (Jefferson and Rosenbaum, 2014). In Australia, Australian humpback dolphins are thought to be widely distributed along the northern Australian coastline from approximately the QLD-NSW border to Shark Bay in western WA (Parra and Cagnazzi, 2016).

Along the mainland coast, Australian humpback dolphins are more likely to be found in relatively shallow and protected coastal habitats such as inlets, estuaries, major tidal rivers, shallow bays, inshore reefs, and coastal archipelagos, rather than in open stretches of coastline (Parra and Cagnazzi, 2016).

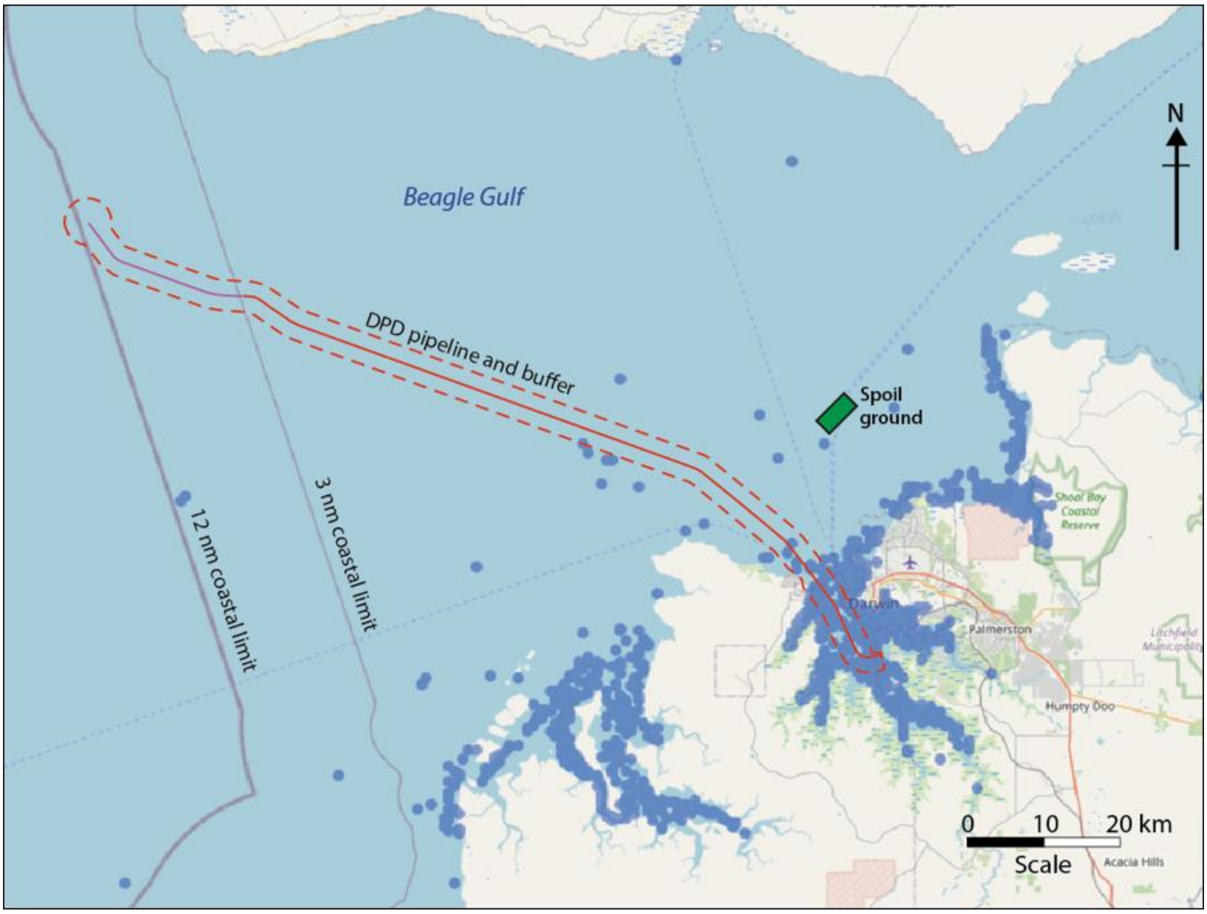
3.3.2.1.1 Northern Territory

Australian humpback dolphins are widely distributed across the NT with populations considered in a heathy state as per the findings of a conservation assessment by the NT DENR conducted in 2017 based on 2014/2015 surveys (Palmer et al., 2017). This species was identified as having an area of occupancy (AOO) of 16,900 km^2 as well as a calculated extent of occurrence of 88% of NT coastal waters (Palmer et al., 2017). The highest densities of Australian humpback dolphin sightings were from Groote Eylandt, English Company Islands, Kakadu National Park, Melville Island (Aspley Straight) (Palmer et al., 2017) which are located on northern and eastern coasts of NT.

3.3.2.1.2 Project area

Figure 3-12 shows the distribution of Australian humpback dolphins in the Darwin region, which includes the Project area, and is based on the sighting records from the Atlas of Living Australia (CSIRO, 2023).

The Project area overlaps the BIA (breeding, calving, foraging) for Australian humpback dolphins , which encompasses the whole of Darwin Harbour and the coastal waters of the northern Cox Peninsula before extending westwards for about 8 km towards Commonwealth marine waters to the west of Gilruth Point in northwest Cox Peninsula (see **Figure 3-13**).



Source: Atlas of Living Australia (CSIRO, 2023). Project components (Santos).

Figure 3-12 Distribution of Australian Humpback Dolphins in the Darwin region

Several BIAs (breeding, calving, foraging) and BIAs (foraging) for the Australian humpback dolphin occur along the Kimberley coast in Western Australia, in NT waters and from Cape York to Brisbane in Queensland (DSEWPaC, 2012). The largest BIA (foraging) at Napier Broome Bay on the Kimberley coast is about 420 km distance from the Project area.

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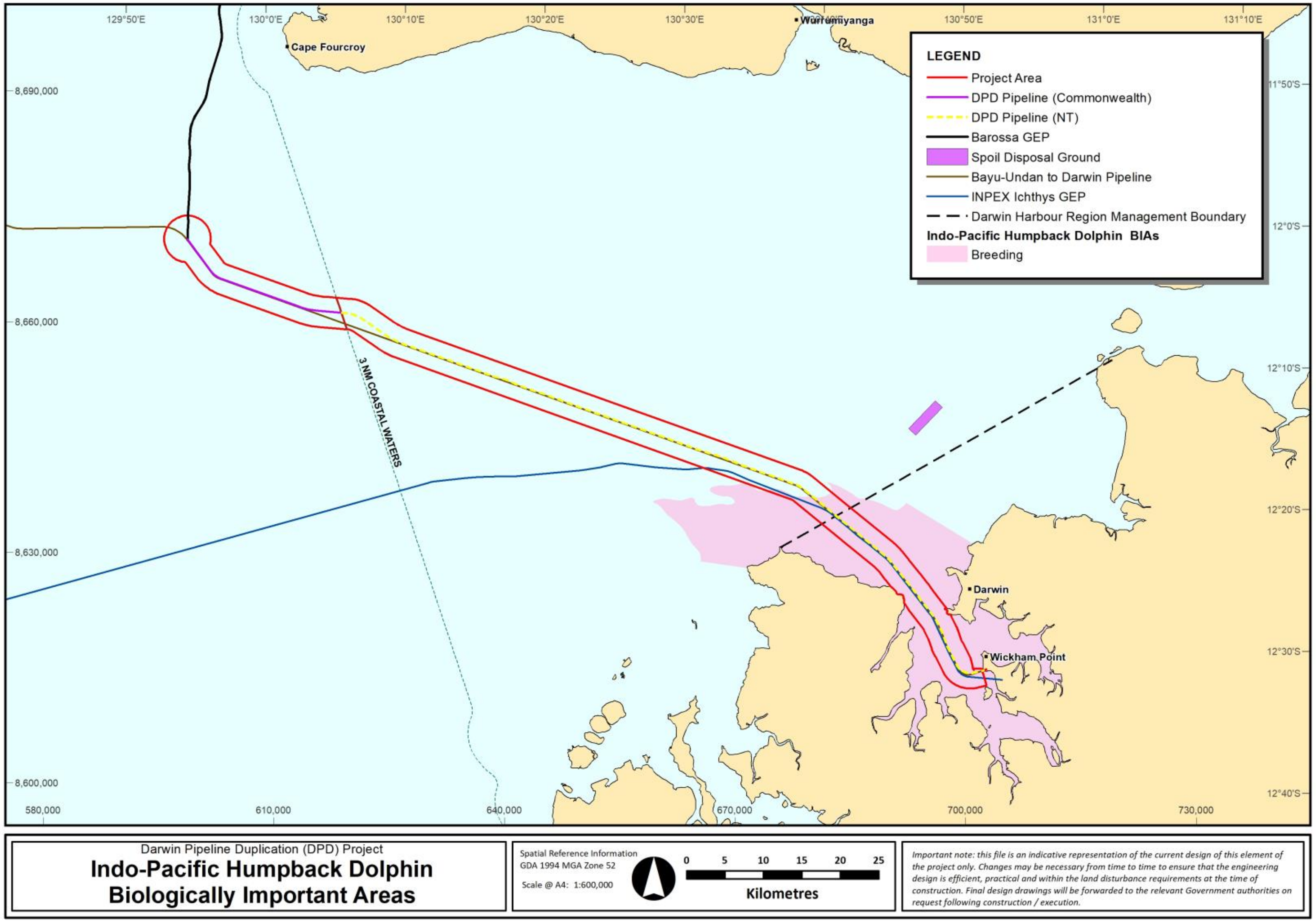


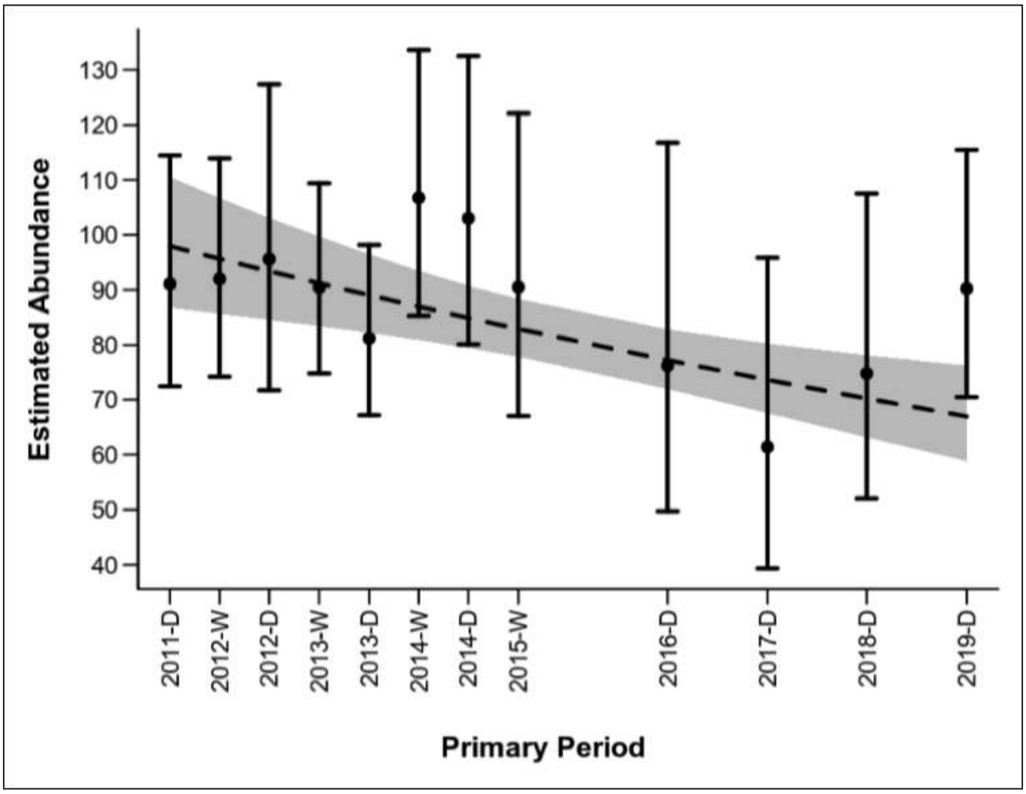
Figure 3-13 Biological important areas for Australian Humpback Dolphins

3.3.2.2 Population Density Estimates and Trends

This species had the highest temporary and permanent emigration rates of the three inshore dolphin species monitored, and this may be contributing to the variable pattern in abundance. It is likely that the sample area in this study (Darwin region) forms only part of the range of the Australian humpback dolphins that visit the area, and that their relative rates of usage of the study area and areas elsewhere may vary widely over time (DENR, 2018).

A study conducted by Palmer (2010) within the Darwin region over a 24-month period found that the most commonly sighted dolphin was the Australian humpback dolphin (284 records) followed by the spotted bottlenose dolphin (188) and the Australia snubfin dolphin (31).

Figure 3-14 shows the estimated abundance and population trend of Australian humpback dolphins in the Darwin region (i.e., combined Darwin Harbour, Bynoe Harbour, and Shoal Bay) over the period 2011–2019 (Griffiths et al., 2020).



Source: Griffiths et al. (2020). Population size estimates and 95% confidence intervals across the 12 primary sampling periods 2011-2019. Log-linear abundance trend estimates are overlayed (broken line) with 95% confidence interval (shaded area).

Figure 3-14 Population of Australian Humpback Dolphins in the Darwin Region (2011-2019)

3.3.2.2.1 Population size estimates

The population size estimates for Australian humpback dolphins in the Darwin region ranged from a minimum of 61 in 2017 to a maximum of 107 in 2014 (see **Figure 3-14**). The long-term log-linear abundance trend over the 2011-2019 period was significantly negative; however, during the last three sampling surveys (2017–2019), the population size estimates increased from 61 in 2017 through 75 in 2018 to 90 in 2019, which indicated an increasing but short-term trend.

The population size estimates of Australian humpback dolphins solely within the Darwin Harbour site of the Darwin region ranged from a minimum of 30 in 2017 to a maximum of 50 in 2012. However, during the latest three-year monitoring period (2017-2019), the population estimates increased from 30 in 2017 through 32 in 2018 to 39 in 2019, which may be inferred as a short-term increasing trend for this species that may be confirmed by further monitoring.

3.3.2.2.2 Population Density Estimates

The average density (0.05–0.09/km^2) of Australian dolphins in the Darwin region (Darwin Harbour, Bynoe Harbour and Shoal Bay) over the course of the 2011–2019 survey monitoring programs (Griffiths et al., 2020) appears to be lower when compared to densities from Cygnet Bay in WA (0.12–0.15/km^2) and from multiple sites in QLD (range 0.09–0.17/km^2).

Overall, the size of Australian humpback dolphin population was the largest of the three inshore dolphin species and Griffiths et al. (2020) were able to demonstrate movements among the three individual monitoring sites (i.e., Darwin Harbour, Bynoe Harbour and Shoal Bay) comprising the Darwin region monitoring area. For example, movements of Australian humpback dolphins between Darwin Harbour and Bynoe Harbour was highest with 34 recorded movements, movements between Darwin Harbour and Shoal Bay lower with five recorded movements, and only a single movement was observed between Shoal Bay and Bynoe Harbour. Population data were too low and inadequate to assess movements between the Darwin region sites for the other two inshore dolphin species.

3.3.2.3 Breeding Areas

Australian humpback dolphin BIAs (breeding, calving, foraging) have been designated in NT, within Darwin Harbour, Port Essington, Cobourg Peninsula, and the East and South Alligator rivers region. Given the results of NT-wide surveys of Australian humpback dolphins showing a wide distribution and occurrence within nearly all NT coastal and estuarine waters, with highest densities at sites not currently designated as BIAs (Palmer et al. 2017), there are potentially important breeding sites not currently recognised as BIAs.

In the Darwin Harbour BIA (breeding, calving, foraging), calving occurs in the months of October to April (Palmer, 2010).

3.3.2.4 Diet

The Australian humpback dolphin is considered an opportunistic, generalist feeder that preys on cephalopods and a variety of schooling bottom-dwelling and pelagic fishes. The habitats of these prey species are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra, 2013).

Within Darwin Harbour foraging has been identified as the dominant behaviour for Australian humpback dolphins, which is generally recorded in water depths ranging from 0.7 m to 25 m (Palmer, 2010). While foraging may occur within the Project area, there are no specific habitats that are considered unique or key for this species given its generalist feeding behaviour and wide use of coastal habitats for foraging.

3.3.3 Spotted Bottlenose Dolphin

The spotted bottlenose dolphin *(Tursiops aduncus*) is listed as migratory and as a listed cetacean under the EPBC Act. This species is not listed as threatened species under either the EPBC Act or the TPWC

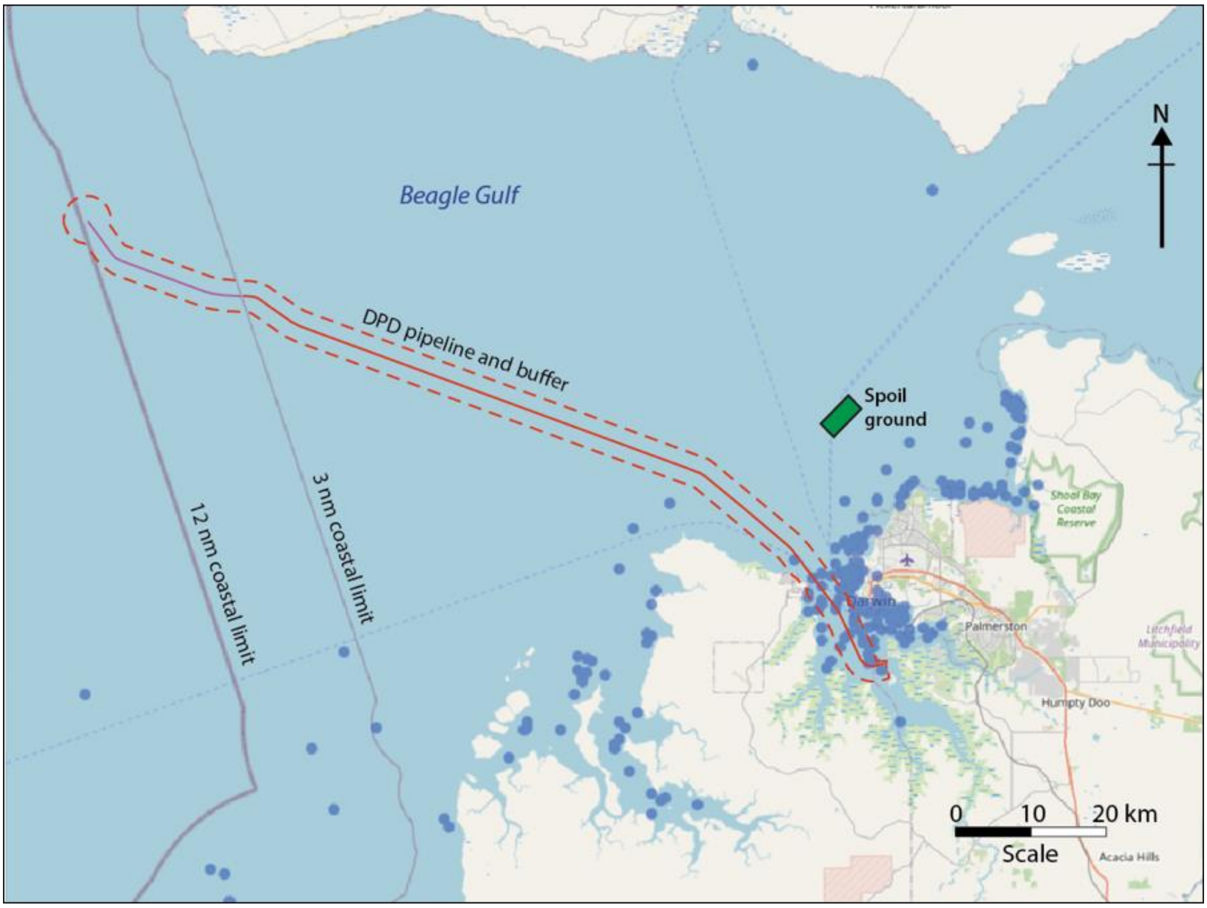
Act (Northern Territory). There is no approved conservation advice and no listing advice (DCCEEW, 2023). There is no recovery plan for this species as it is not listed as threatened under the EPBC Act.

3.3.3.1 Distribution and Habitats

In Australia, spotted bottlenose dolphins are distributed continuously around the mainland including estuarine and coastal waters of eastern, western, and northern Australia (Hale et al., 2000; Möller and Beheregaray, 2001; Ross and Cockcroft, 1990).

Figure 3-15 shows the distribution of spotted bottlenose dolphins in the Project area and wider region, which is based on sighting records in the Atlas of Living Australia (CSIRO, 2023).

In **Figure 3-15**, the distribution of spotted bottlenose dolphin sighting records within Darwin Harbour are highest within the middle and outer harbour. Darwin Harbour is designated as a BIA (breeding, calving, and foraging) for this species. The BIA (breeding and calving) for this species is shown in **Figure 3-16**.



Source: Sighting records based on the Atlas of Living Australia (CSIRO, 2023). Project pipeline proposed alignment and 4-km-wide buffer zone provided by Santos.

Figure 3-15 Distribution of Spotted Bottlenose Dolphins in the Darwin region

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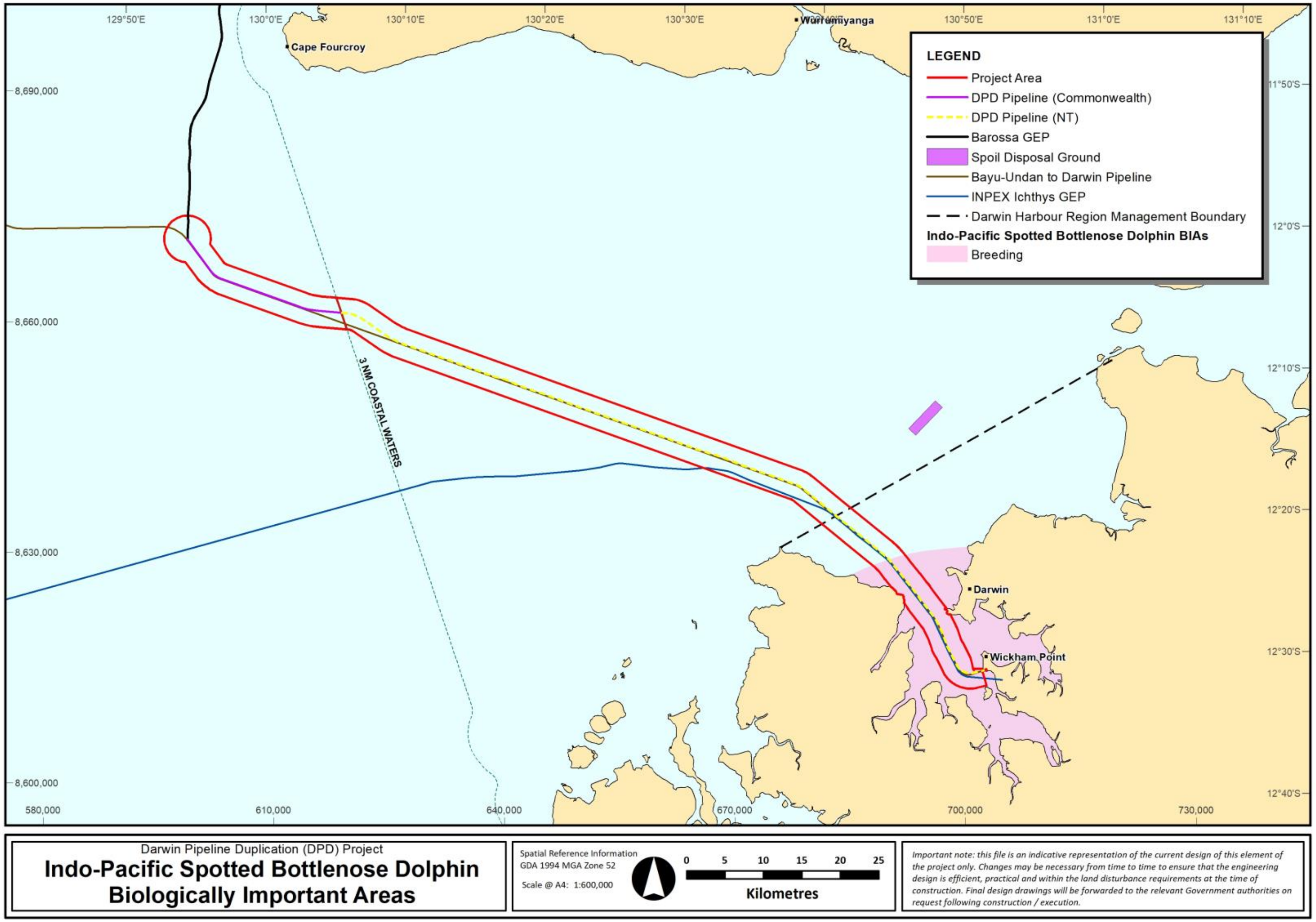


Figure 3-16 Biologically important areas for Spotted Bottlenose Dolphins

Spotted bottlenose dolphins were identified as having an area of occupancy (AOO) of 17,600 km^2 and occurred within 84% of NT coastal waters (Palmer et al. 2017). Spotted bottlenose dolphins are distributed widely across the NT waters with higher concentrations observed in Darwin and Bynoe Harbours, the Garig Gunak Barlu Marine Park (Cobourg Peninsula), and in the sea country of the Anindilyakwa Indigenous Protected Area (Groote Eylandt and Bickerton Island archipelago) in the Gulf of Carpentaria on the east coast of the NT. Palmer et al. (2017) observed that highest densities were recorded from Limmen Bight (Gulf of Carpentaria), Nhulunbuy and Caledon Bay (East Arnhem), Maningrida (West Arnhem), and Anson Bay, Cape Ford, and Fog Bay to the southwest of Darwin.

BIAs (breeding and foraging) for the spotted bottlenose dolphin have been established along the Kimberley Coast in WA and along the east coast of Australia from Cape York to past the NSW-Victorian border. In the NT, BIAs (breeding and calving) are located within Darwin Harbour and in the Garig Gunak Barlu National Park (Cobourg Peninsula). The Project area overlaps the Darwin Harbour BIA (breeding and calving) for the spotted bottlenose dolphin.

3.3.3.2 Population Density Estimates and Trends

Figure 3-17 shows the estimated abundance and population trend of spotted bottlenose dolphins in the Darwin region (i.e., combined Darwin Harbour, Bynoe Harbour, and Shoal Bay) over the period 2011–2019 (Griffiths et al., 2020).

In **Figure 3-17**, the primary period (x-axis) refers to the mean date of the sampling period and whether the sampling was undertaken during the wet (W) or the dry (D) season. The results from the 2011 to 2019 monitoring program (Griffiths et al., 2020) highlight the small, mobile, and variable nature of coastal spotted bottlenose dolphin populations in the Darwin region.

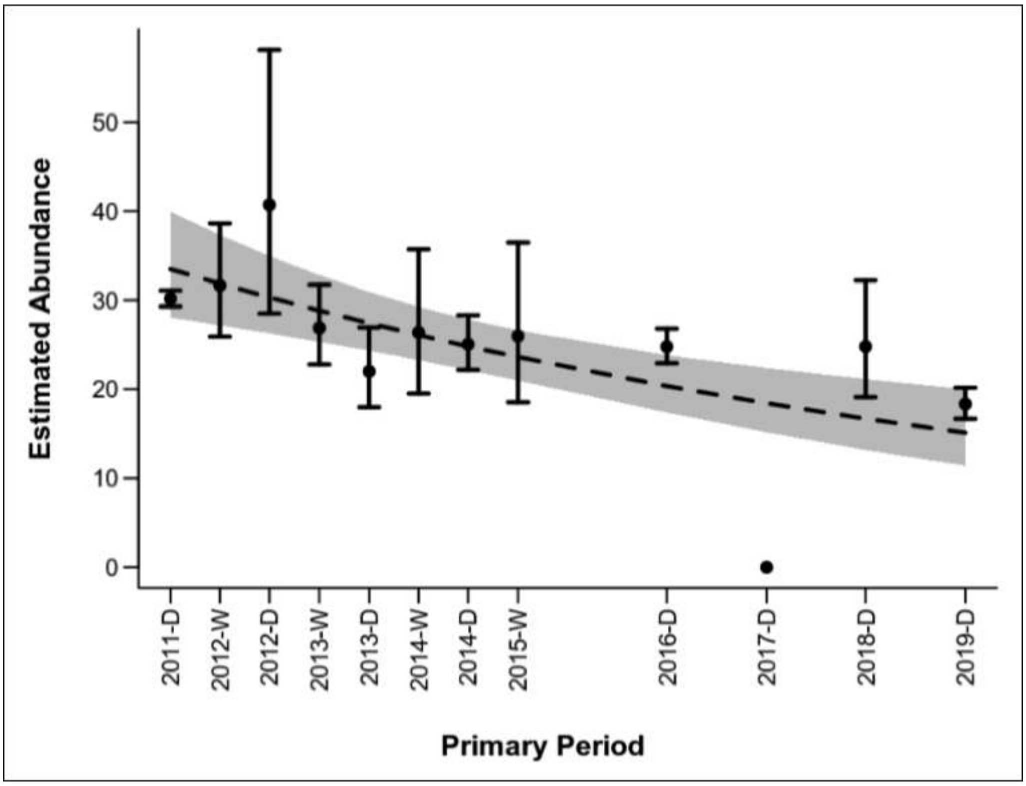
3.3.3.2.1 Population Size Estimates

The population size of spotted bottlenose dolphins ranged from a minimum of 0 in 2017 to a maximum of maximum of 41 in 2012. The long-term log-linear abundance trend over the full 2011-2019 monitoring period was significantly negative. During the last two sampling surveys (2018–2019), the population size estimate decreased from 25 in 2018 to 18 in 2018; however, there is insufficient data from two samplings to infer short-term downward trend.

3.3.3.2.2 Population Density Estimates

The average density of 0.02–0.03/km^2 for the spotted bottlenose dolphins in the Darwin region over the course of the 2011–2019 survey monitoring program (Griffiths et al., 2020) appears to be lower when compared to densities from Port Essington (0.10–0.46/km^2) in the Cobourg Peninsula (NT) and from multiple sites in WA (range 0.27–1.21/km^2).

Overall, the spotted bottlenose dolphin has the smallest population estimate of the three migratory dolphin species in the Darwin region and has demonstrated a high level of temporary emigration. Over the 2011-2019 monitoring period, a significant negative trend in abundance for the spotted bottlenose dolphins in the Darwin region. The reasons for the significant declines were not clear but may be related to population dynamics, environmental or anthropogenic factors (Griffiths et al., 2020).



Source: Griffiths et al. (2020). Population size estimates and 95% confidence intervals across the 12 primary sampling periods 2011-2019. Log-linear abundance trend estimates are overlayed (broken line) with 95% confidence interval (shaded area).

Figure 3-17 Population of Spotted Bottlenose Dolphins in the Darwin region (2011-2019)

3.3.3.3 Breeding Areas

In the NT, BIAs (breeding and calving) have been established within Darwin Harbour and at Cobourg Peninsula. In the Darwin Harbour BIA (breeding and calving), calving by the spotted bottlenose dolphin occurs in the months of October to April (Palmer, 2010). The proportion of dolphin calves sighted in the Darwin region has varied considerably over the years with calving rates increasing from 2017 to 2018, where over the previous years the rate has generally been low (DENR, 2019).

Given the results of NT-wide surveys of spotted bottlenose dolphins showing a wide distribution and occurrences within nearly all coastal waters and highest densities at sites not currently designated as BIAs (Palmer et al., 2017), there are potentially important breeding sites in the NT not currently recognised as potential BIAs.

3.3.3.4 Diet

The spotted bottlenose dolphin is considered an opportunistic and generalist feeder that preys on a variety of cephalopods and schooling pelagic and bottom-dwelling fishes, though fishes predominate in the diet. These prey items are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra, 2013).

Within the Darwin Harbour foraging has been identified as the dominant behaviour for dolphins, which is generally recorded in water depths ranging from 0.7 m to 25 m (Palmer, 2010). While foraging may occur in the Project area, there are no specific habitats that are considered key for this species given its generalist feeding behaviour and wide use of coastal habitats for foraging. However, potential

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Project and/ or third-party marine activities' impacts on spotted bottlenose dolphin prey availability may affect this species across its range within Darwin Harbour.

3.3.4 Summary Description of the Migratory Species

Table 3-7 provides summary descriptions of the Australian snubfin dolphin, Australian humpback dolphin, and the spotted bottlenose dolphin.

Table 3-7 Description of EPBC Act-listed migratory species potentially within the Project area

Species	Distribution and habitats	Breeding areas	Diet
Australian snubfin dolphin	The Australian snubfin dolphin (*Orcaella heinsohni*) is a recently identified species that was previously combined with the Irrawaddy dolphin (*Orcaella brevirostris*) (DoE, 2019) and is considered endemic to Australia occurring in shallow coastal and estuarine waters. Australian snubfin dolphins occur only in waters off the northern half of Australia, from approximately Broome on the west coast (WA) to the Brisbane River (QLD) on the east coast (Parra et al. 2002). Only a single record for the Australian snubfin dolphin exists outside Australia, and comes from Daru, Papua New Guinea (Beasley et al. 2002). Within Australia, Biologically Important Areas (BIA) for the Australian snubfin dolphin (breeding and calving or foraging) have been designated along the Kimberley coastline in Western Australia with BIA (breeding and calving) in NT waters. <u>Northern Territory</u> The Australian snubfin dolphin is widely distributed across NT coastal waters, with populations considered in a heathy state, as per the findings of a conservation assessment by the NT Department of Natural and Environmental Resources (DENR) (Palmer et al., 2017). From aerial surveys undertaken in 2014 and 2015, the Australian snubfin dolphin was identified as having an area of occupancy (AOO) of 24,900 km^2 and was calculated to occupy 89% of NT coastal waters (Palmer et al., 2017). The highest densities of sightings were recorded at the Pellew Islands, Groote Eylandt, English Company Islands / Arnhem Bay and Fog Bay (Palmer et al., 2017), these sites except the Fog Bay site are primarily on the east coast of NT. BIAs (breeding and calving) have been designated at Darwin Harbour, South Alligator River, East Alligator River and Coburg Peninsula (DSEWPaC 2012). <u>Project area</u> The Project area overlaps the Darwin Harbour BIA (breeding and calving) for Australian snubfin dolphins. This species has been monitored in the Darwin Harbour region (comprising Bynoe Harbour, Darwin Harbour and Shoal Bay) between 2011 and 2019 as part of the Coastal Dolphin Monitoring Program (Griffiths et al., 2019; 2020). This study found that populations of Australian snubfin dolphins occurred at low densities similar to average densities across NT coastal waters and exhibited fluctuating temporary emigration across sites. The study noted that over the monitoring period, population sizes fluctuated but showed a decline over time. The study was unable, however, to explain the reasons for year-to-year variation in abundances and the decline, citing potential factors as population dynamics, environmental factors, or anthropogenic factors.	<u>Northern Territory</u> For the three coastal dolphin species (including the Australian snubfin dolphin), calving occurs in the months of October to April (Palmer, 2010). BIAs (breeding, foraging) have been designated in NT, within Darwin Harbour, South Alligator River, East Alligator River and Cobourg Peninsula (DSEWPaC 2012). Given the results of NT-wide surveys of the species showing wide distribution, occurrence within nearly all coastal waters and highest densities at sites not currently designated as BIAs (Palmer et al. 2017), there are potentially important breeding sites not currently recognised as BIAs. <u>Project area</u> Calving in the Darwin Harbour BIA (breeding) occurs in the months of October to April (Palmer 2010). The proportion of Australian snubfin dolphin calves sighted has varied considerably during monitoring years (DENR, 2019).	The Australian snubfin dolphin is considered an opportunistic, generalist feeder which preys on a variety of schooling, bottom-dwelling and pelagic fish and cephalopods that are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra 2013) <u>Project area</u> Within Darwin Harbour, foraging has been identified as the dominant behaviour for Australian snubfin dolphins, which are generally recorded in water depths ranging from 0.7 m to 25 m (Palmer, 2010). While foraging may occur in the Project area, there are no specific areas that are considered unique or key foraging habitat for this species given its generalist feeding behaviour and wide use of coastal habitats for foraging.
Spotted bottlenose dolphin	Spotted bottlenose dolphins are found in tropical and sub-tropical coastal and shallow offshore waters of the Indian Ocean, Indo-Pacific Ocean region and the western Pacific Ocean (Möller & Beheregaray, 2001; Rice, 1998; Ross & Cockcroft, 1990; Wang et al., 1999). This species is distributed continuously around the Australian mainland and has been confirmed to occur in estuarine and coastal waters of eastern, western and northern Australia (Hale et al., 2000; Möller & Beheregaray, 2001; Ross & Cockcroft, 1990). BIAs for the species have been designated along the Kimberley Coast in WA, in NT waters and down the entire east coast of Australia from Cape York to past the NSW-Victorian border. <u>Northern Territory</u> Spotted bottlenose dolphins are widely distributed across the NT with populations considered in a heathy state as per the findings of a conservation assessment by the DENR based on 2014/2015 surveys (Palmer et al. 2017). The species was identified as having an area of occupancy (AOO) of 17,600 km^2 and occurred within 84% of NT coastal waters (Palmer et al. 2017). Highest densities were recorded from Limmen Bight, Nhulunbuy, Caledon Bay, Maningrida, Fog Bay, Anson Bay and Cape Ford (Palmer et al. 2017), these sites distributed across west, north and east coasts of NT.	<u>Northern Territory</u> For the three coastal dolphin species (including the spotted bottlenose dolphin), calving occurs in the months of October to April (Palmer 2010). BIAs (breeding, foraging) have been designated in NT, within Darwin Harbour and at Cobourg Peninsula (DSEWPaC 2012). Given the results of NT-wide surveys of spotted bottlenose dolphins showing wide distribution, occurrence within nearly all coastal waters and highest densities at sites not currently designated as BIAs (Palmer et al., 2017), there are potentially important breeding sites not currently recognised as BIAs. <u>Project area</u>	The spotted bottlenose dolphin is considered an opportunistic, generalist feeders which preys on a variety of schooling, bottom-dwelling and pelagic fish and cephalopods that are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra 2013) <u>Project area</u> Within Darwin Harbour, foraging has been identified as the dominant behaviour for spotted bottlenose dolphins, which are generally recorded in water depths ranging from 0.7 m to 25 m (Palmer, 2010). While foraging may occur in the Project area, there are no specific areas that are considered key foraging habitat for this species given its

Species	Distribution and habitats	Breeding areas	Diet
	BIAs (breeding and calving) have been identified for the spotted bottlenose dolphin in Darwin Harbour and at Cobourg Peninsula where foraging, feeding, breeding and provisioning of young takes place. (DSEWPaC 2012). <u>Project area</u> The Project area overlaps the Darwin Harbour BIA (breeding, calving) for this species. Spotted bottlenose dolphins have been monitored in the Darwin Harbour region (comprising Bynoe Harbour, Darwin Harbour and Shoal Bay) between 2011 and 2019 as per the Coastal Dolphin Monitoring Program (Griffiths et al., 2019; 2020). These studies found populations of this, and the other coastal dolphin species occurred at low densities similar to average densities across NT coastal waters and exhibited fluctuating temporary emigration across sites. The studies noted that over the monitoring period population sizes fluctuated but showed a decline over time. The study was unable, however, to explain the reasons for year-to-year variation in abundance and declines, citing potential factors as population dynamics, environmental factors, or anthropogenic factors.	Calving in the Darwin Harbour BIA (breeding) occurs in the months of October to April (Palmer, 2010). The proportion of spotted bottlenose dolphin calves sighted has varied considerably over the years with calving rates increasing from 2017 to 2018, whereas over the previous years, the calving rate has generally been low (DENR, 2019).	generalist feeding behaviour and wide use of coastal habitats for foraging.
Australian humpback dolphin	Australian humpback dolphins are found in tropical/subtropical waters of the Sahul Shelf from northern Australia to the southern waters of the island of New Guinea (Jefferson and Rosenbaum 2014). In Australia, humpback dolphins are thought to be widely distributed along the northern Australian coastline from approximately the Queensland-New South Wales border to western Shark Bay, Western Australia (Parra and Cagnazzi, 2016). Along the Australian coast, Australian humpback dolphins are more likely to be found in relatively shallow and protected coastal habitats such as inlets, estuaries, major tidal rivers, shallow bays, inshore reefs and coastal archipelagos, rather than in open stretches of coastline (Parra and Cagnazzi, 2016). BIAs (breeding, calving, foraging) for the Australian humpback dolphin occur along the Kimberley coast in Western Australia, in NT waters and along east coast of Queensland from Cape York to Brisbane (DSEWPaC 2012). <u>Northern Territory</u> Australian humpback dolphins are widely distributed across the NT with populations considered in a heathy state (Palmer et al., 2017). The Australian humpback dolphin was identified as having an area of occupancy (AOO) of 16,900 km^2 as well as a calculated extent of occurrence of 88% of NT coastal waters (Palmer et al. 2017). Palmer et al. (2017) noted that the highest densities of sightings were from Groote Eylandt, English Company Islands, Kakadu National Park, Melville Island (Aspley Strait), which are located on northern and eastern coasts of NT. BIAs (breeding, calving, foraging) have been designated for the Australian humpback dolphin in Darwin Harbour; Port Essington, Cobourg Peninsula; East Alligator River region and South Alligator River region (DSEWPaC, 2012). <u>Project area</u> The Project area overlaps the Darwin Harbour BIA (breeding, calving, foraging) for the Australian humpback dolphin. The species has been monitored in the Darwin Harbour region (comprising Bynoe Harbour, Darwin Harbour and Shoal Bay) between 2011 and 2019 as per the Coastal Dolphin Monitoring Program (Griffiths et al., 2020). This study found populations of this species occurred at low densities but similar to average densities across NT coastal waters and exhibited fluctuating temporary emigration across sites. The study noted that over the monitoring period population sizes fluctuated but showed a decline over time. The study was unable, however, to explain the reasons for year-to-year variation in abundance and declines, citing potential factors as population dynamics, environmental factors or anthropogenic factors.	BIAs for Australian humpback dolphin s (breeding, foraging) have been designated in NT, within Darwin Harbour; Port Essington, Cobourg Peninsula; East Alligator River region and South Alligator River region (DSEWPaC 2012). Given the results of NT-wide surveys of Australian humpback dolphins showing wide distribution, occurrence within nearly all coastal waters and highest densities at sites not currently designated as BIAs (Palmer et al. 2017), there are potentially important breeding sites not currently recognised as BIAs. <u>Project area</u> In the Darwin Harbour BIA, calving occurs in the months of October to April (Palmer 2010). The proportion of dolphin calves sighted has varied considerably over the years with calving rates increasing from 2017 to 2018 for the Australian humpback dolphins, where over the previous years the rate has generally been low (DENR, 2019).	The Australian humpback dolphin is considered an opportunistic, generalist feeder which preys on a variety of schooling, bottom dwelling and pelagic fish and cephalopods that are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra, 2013). <u>Project area</u> Within Darwin Harbour, foraging has been identified as the dominant behaviour for Australian humpback dolphins, which are generally recorded in water depths ranging from 0.7 m to 25 m (Palmer, 2010). While foraging may occur in the Project area, there are no specific areas that are considered unique or key foraging habitat for this species given its generalist feeding behaviour and wide use of coastal habitats for foraging.

4 Impact Assessment for Matters of National Environmental Significance

4.1 Initial Impact Assessment

This section identifies and assesses potential Project impacts to MNES. The MNES relevant to the Project are:

+ Listed threatened species.
+ Listed migratory species.
+ Commonwealth marine area.

Section 3 describes results of the desktop assessment undertaken to identify the threatened and migratory species that occur within the Project area. The following species are identified as likely, or have potential, to occur within the Project area (including 5 km buffer).

+ Listed threatened species:
  - Reptiles – flatback turtle (*Natator depressus*), olive ridley turtle (*Lepidochelys Olivacea*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriaceaand*), loggerhead turtle (*Caretta Caretta*).
+ Listed migratory species:
  - Marine mammals – dugong (*Dugong dugon*), Australian humpback dolphin (*Sousa sahulensis*), spotted bottlenose dolphin (*Tursiops aduncus*), Australian snubfin dolphin (*Orcaella brevirostris*).
+ Reptiles – saltwater crocodile (*Crocodylus porosus*).
+ Birds – osprey (*Pandion haliaetus*).

No listed threatened ecological communities are recorded as occurring within the Project area.

The following **Section 4.2** describes aspects of planned Project activities that may potentially impact the identified MNES species, their habitats and the Commonwealth marine environment. Unplanned events associated with the Project that may potentially occur are also identified.

Assessment of potential impacts to MNES species and the Commonwealth marine area from the identified planned and unplanned Project aspects includes standard management measures. Assessment is then undertaken (**Section 4.2.1 to Section 4.2.5**), considering the significant impact criteria described in MNES Significant Impact Guidelines 1.1 (DoE, 2013). **Table 5-1** consolidates the extended number of management measures that Santos will implement to avoid and reduce these impacts. **Section 6** considers the effectiveness of these measures and assesses the residual impacts that may arise following the successful implementation of management measures to avoid and mitigate impacts and risks described in **Section 5**.

A number of technical studies have been undertaken to inform the impact assessment and the development of control measures and management plans. These studies include:

+ Project pipeline route baseline habitat, sediment and water quality studies (RPS 2022a; **Appendix 7**).

- A quantitative risk assessment study of third-party impacts to the Project pipeline (Intecsea, 2021).
- PLET treated seawater and MEG discharge modelling (RPS, 2021; **Appendix 23**).
- DPD Project contingency treated seawater discharge modelling (RPS, 2022b; **Appendix 18**).
- DPD Project trenching and spoil disposal sediment dispersion modelling (RPS, 2022c; **Appendix 8**).
- Deepwater pipelay and construction vessel light modelling (Pendoley Environmental, 2022a, report number J06009 **Appendix 19**).
- DPD Project Darwin Harbour lighting technical note (Pendoley Environmental, 2022b; **Appendix 19** report number J06063).
- DPD Project underwater noise assessment (Talis Consultants, 2023; **Appendix 19**).
- DPD Project acoustic modelling for assessing marine fauna sound exposure (Connell et al., 2023; **Appendix 22**).
- DPD Project oil spill modelling (RPS, 2022d; **Appendix 9**).
- Underwater maritime heritage assessment (Cosmos Archaeology, 2022; **Appendix 20**).

In particular, the modelling studies of discharges and emissions have provided information upon the potential intensity, duration, magnitude and geographic extent of impacts on the identified sensitive values to inform whether an impact is 'significant'.

When evaluating the potential impacts from the DPD Project, consideration was also given to the extensive studies and monitoring conducted for similar projects in Darwin Harbour and in adjacent Commonwealth waters. In particular, the INPEX Ichthys Project has been utilised as a proxy to assess impacts on the basis that it involved similar work activities within the same area but on a greater spatial and temporal scale. INPEX's Ichthys nearshore environmental monitoring program is extensive and continues to be undertaken as part of the NT Government Darwin Harbour Integrated Marine Monitoring and Research Program. This monitoring data provides valuable insight into the natural environmental variability within Darwin Harbour and the effect of proposed Project activities on this environment.

As per the RFI request, the assessment of residual significant impact to individual species against the guideline significant impact criteria, and considering all Project aspects, is provided in **Section 6** Residual Impact Assessment.

4.2 Project Impacts and Risks

The following section provides an overview of the environmental impacts and risk assessment for the DPD project. The impacts are based on the description of the DPD project provided in **Section 2**, predominately the construction and commissioning phase.

Planned discharges associated with general vessel operations (e.g., bilge water discharges, engine exhaust, etc.) are regulated under the Australian Maritime Safety Authority (AMSA) Marine Orders and international conventions (MARPOL). The impacts associated with vessel discharges are considered minor, short term and the same as other commercial vessels operating within Darwin Harbour, associated shipping fairways and surrounds. **Section 5** describes the relevant management measures to avoid or reduce these impacts and are consistent with maritime regulations and standards.

Additionally, the use of marine vessels, helicopters and vehicles/equipment (onshore construction) and associated combustion of hydrocarbons (fuel oil - marine diesel oil) is unavoidable for this Project. This will result in short term combustion emissions of greenhouse gases (GHG), considered to be an insignificant contribution to the total current Australian GHG emissions. The impact (i.e., climate change) of GHG emissions from DPD Project sources is considered to be negligible and is not discussed further in this Preliminary Documentation report. Other than from the abovementioned GHG emission sources, there are no planned GHG emissions from pipeline operations (i.e., conveyance of natural gas) within the Project area. For completeness, it is noted that the NT EPA has requested Santos to outline scope 1, 2 and 3 greenhouse gas emissions associated with the DPD Project and the broader Barossa Development in the Supplementary Environmental Report (**Appendix 2**) prepared in accordance with the EP Act and *Environment Protection Regulations 2020* (NT).

Aspects of planned Project activities that may potentially impact MNES species, their associated habitats and the Commonwealth marine environment include:

+ Seabed disturbance.
+ Noise emissions.
+ Light emissions.
+ Treated seawater discharges.

Of the unplanned activities, the following aspects that may impact MNES species, their associated habitats and the Commonwealth marine environment include:

+ Introduction of invasive marine species.
+ Accidental marine fauna interaction.
+ Accidental marine diesel releases during bunkering or a vessel collision.
+ Accidental dry gas release from pipeline rupture during production operation.

An assessment of the planned and unplanned aspects that could have an impact to MNES during construction and operations is presented below. This assessment considers the potential threats to EPBC Act-listed fauna (marine mammals and marine reptiles) identified in **Section 3.2** and the Commonwealth marine environment, as relevant to activities within the Project area.

4.2.1 Seabed Disturbance

4.2.1.1 Direct Disturbance

The majority of the Project pipeline will be laid directly on the seabed; however, approximately 12.5 km of the proposed pipeline route within Darwin Harbour will require pre-lay trenching (**Figure 4-2**) (with associated disposal of sediment and an offshore spoil disposal ground) to install the pipeline. The installation of the Project pipeline will directly disturb, and in some areas remove and redistribute the seabed e.g., within trenching areas and spoil disposal ground. The trenching and the construction of two temporary rock causeways will also directly impact an intertidal area at the DLNG facility within the existing disturbance footprint.

Seabed disturbance will be within an approximate 50 m disturbance corridor along the Project pipeline route, with additional disturbance from vessel anchoring as required for the shallow water pipelay barge. Anchoring impacts (i.e., disturbance from anchors and chain) will be temporary and, except for contingency/ emergency events, will be restricted to within 900 m either side of the pipeline route where the nearshore pipelay barge is used (not in Commonwealth Waters).

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Benthic habitat directly below the trenched areas, the pipeline stabilisation and protection structures/measures (including span rectification structures and any engineered or rock backfill) will be lost as a result of direct impact from installation. However, the presence of the pipeline and rock installation will create hard surfaces that will be recolonised by benthic organisms and create new habitat. Benthic habitats within the spoil disposal ground will be partially smothered, and habitats contacted by vessel anchors will be temporarily disturbed.

There will be limited potential for seabed disturbance during operations. Activities that may potentially disturb the seabed during operations include vessel anchoring (if required) during Project pipeline inspections and any pipeline repairs. There is low likelihood that any Project pipeline rectification works will be required, and potential impacts would be similar for other projects such as Bayu-Undan to Darwin gas export pipeline and the Ichthys Project pipeline.

Based on benthic habitat mapping in the Darwin Harbour area (Galaiduk et al., 2019; Udyawer et al., 2021) and dedicated surveys along the Project pipeline route (RPS, 2023a; **Appendix 7**), the benthic habitats within the pipeline route and spoil disposal ground comprise soft sediments or hard substrate, supporting a filter feeding community (e.g., soft corals, sponges) ranging from sparse to medium density. This type of habitat is well represented in the Project area. Primary producer habitat, including seagrasses, hard corals and macroalgae are located away from the pipeline route in Darwin Harbour, typically in shallower waters (<10 m) closer to shorelines (Galaiduk et al., 2019, Udyawer et al., 2021, RPS, 2023a; **Appendix 7**) and therefore are not expected to be directly disturbed from pre-lay activities, laying of the pipeline or rock installation.

Project infrastructure footprints have been overlaid over a combined habitat mapping layer (provided by shallow water habitat maps from Udyawer et al. (2021) and deeper water habitat maps from Galaiduk et al. (2019) in **Figure 4-1**. Areas of impact have been calculated as a percentage of the total amount of each habitat predicted to be present in Darwin Harbour (**Table 4-1**).

Based on these calculations, trenching and infrastructure footprints combined will impact less than 1% of the benthic habitats across Darwin Harbour and, more specifically, <0.18% of sponge or sponges/filterers/octocoral habitat, <0.12% of macroalgae habitat and approximately 0.12% of bare ground habitat found across Darwin Harbour. Therefore, the Project is unlikely to result in changes to the composition of benthic habitats across Darwin Harbour, nor have wider impacts on the marine fauna that rely on those habitats.

There are no unique or sensitive habitats surveyed and/or predicted in the trenching, pre-sweep or sand wave zones. The habitats in these zones present are expansive across Darwin Harbour and well represented in other locations, both within the harbour and regionally. While habitats will be directly impacted by trenching activities, impacts will be over a comparatively small area compared to the extent of similar habitat in the immediate vicinity.

Overall, there are no unique, or sensitive habitats along the Project pipeline route and the habitats present are well represented in other locations, both within the harbour and regionally. While they will be directly impacted by placement of the pipeline, this infrastructure will itself provide additional habitat for marine species to colonise as has been observed along other gas pipelines. A recent study documented distinct fish assemblages associated with the existing Bayu-Undan to Darwin gas export pipeline that differed from the surrounding predominantly bare habitat fish assemblages (McLean et al., 2021). The fish assemblages observed on and around the pipeline were of higher diversity than those found off the pipeline (McLean et al., 2020). Sessile biota growing on the pipeline also included potential prey for marine turtles, such as soft corals and sponges. Sessile biota growing on the pipeline were observed to be present at much lower densities, or absent, from the habitats surrounding the pipeline (McLean et al., 2021).

The habitat present in the spoil disposal ground is predicted to be 91.8% low density sponge, filter feeder and octocoral habitat and 8.2% bare ground. There are no unique, or sensitive habitats and the habitats present are well represented regionally. While the habitats present will be directly impacted during the disposal of spoil, the spoil itself will provide similar habitat for marine species to colonise. No contaminants of concern were found in sediment along the Project pipeline route or at the potential spoil disposal ground, with elevated levels of arsenic considered to be naturally occurring. The sediment along the Project pipeline route is suitable for unconfined ocean disposal, as per the National Assessment Guidelines for Dredging (CoA, 2009a).

Habitat mapping of the DPD pipeline in Commonwealth waters (**Figure 6-4, Appendix 7**), where there is no trenching, shows the pipeline traverses the seabed mostly on bare ground habitat (approximately 80%), one 1-2 km patch of filter feeder habitat, one 1-2 km patch of burrower/crinoid habitat, and two small 100-200 m patches of filter feeder habitat. Two very small patches of hard coral habitat are avoided. The footprint of the 23 km Commonwealth waters section of the DPD pipeline is 11.5 ha.

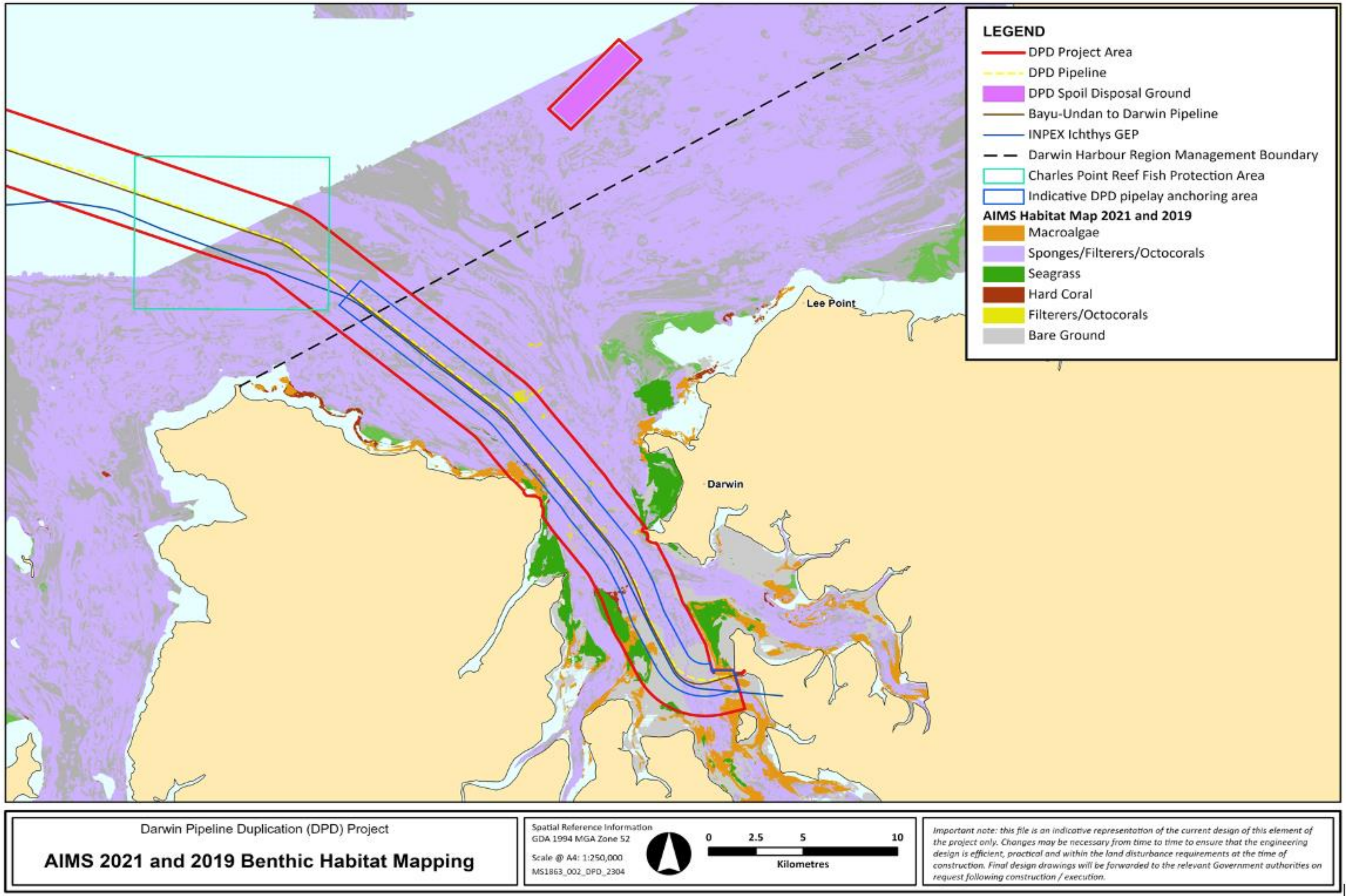

Figure 4-1 Project activities and infrastructure overlaid over mapped benthic habitat

Table 4-1 Summary of the areal overlap of Project infrastructure with different benthic habitats

Benthic Habitat	Trenching, pre-sweep and sand rectification zones (includes 20 m buffer (i.e., Zone of High Impact) 93.3 Ha			Pipeline installation in deep water (5 m wide footprint used) 29.2 Ha			Pipeline installation in Darwin Harbour (1 m wide footprint used) 0.94 Ha (excludes trenching zones)			Spoil ground 649.8 Ha	
Areal extent	Ha	as % of trenching area	as % of habitat in Darwin Harbour	Ha	as % of pipeline install footprint	as % of habitat in Darwin Harbour	Ha	as % of pipeline install footprint	as % of habitat in Darwin Harbour	Ha	as % of spoil ground area
Bare ground	26.7	28.80	0.12	3.13	37.7	0.014	0.33	35.4	0.0015	53.5	8.2
Hard coral	-	-	-	-	-	-	-	-	-	-	-
Seagrass	-	-	-	-	-	-	-	-	-	-	-
Macroalgae	4.97	5.30	0.115	-	-	-	-	-	-	-	-
Sponge or Sponges/Filterers/ Octocorals	60.75	65.10	0.157	5.17	62.3	0.013	0.61	64.6	0.0016	596.3	91.8

Note: Habitat areas are expressed as hectares (Ha) and as a percentage of the infrastructure area. Areas where there were no habitat data, e.g., beyond Darwin Harbour, are not presented.

4.2.1.2 Indirect Impacts

Pre-lay activities (in particular trenching and spoil disposal) will create turbidity as sediment particles of different sizes suspend in the water column. This has the potential to indirectly impact habitats through the settling of suspended particles (sedimentation), or by reducing the availability of light to photosynthetic biota on the seabed (hard corals, seagrasses, algae). Excessive sedimentation and/or prolonged reduction in light have the potential to cause mortality for these biota types. Importantly, the large tidal movements and strong currents in Darwin Harbour naturally generate high turbidity and sediment loads, particularly during spring tides, with spatial gradient observed in the harbour's water quality, with turbidity in the upper reaches higher than that of the outer harbour (ConocoPhillips, 2019). There is also an increase in turbidity during the wet season in Darwin harbour.

Sediment dispersion modelling has been undertaken of sediment suspended by trenching and disposal operations modelling (RPS, 2022c; **Appendix 8**). This peer-reviewed modelling was conducted in accordance with best practice guidance for sediment dispersion modelling in Western Australian Marine Science Institution (WAMSI) Dredging Science Node Guidance (Sun et al., 2016). There are inherent limitations to the accuracy of numerical models. The major sources of uncertainty for the sediment fate modelling are the modelled trenching methodology and sediment source inputs to the model. The results should be considered as indicative of the expected ranges in magnitude and distribution of suspended sediments and sedimentation, rather than an exact prediction (**Section 5.2, Appendix 8**). The sediment dispersion modelling predicted the evolution of the combined sediment plumes via current transport, dispersion, sinking and sedimentation, and allowed for the subsequent resuspension of settling sediments due to the erosive effects of currents and waves. Predicted seabed sedimentation was assessed against allowable exposure thresholds for sensitive receptors including mangrove, seagrass and hard coral habitats. These thresholds are based on the extensive environmental monitoring and thresholds established for the Ichthys Project EIS, and its capital and maintenance dredge management plans in Darwin Harbour (INPEX, 2010, 2011, 2014, 2018).

For the purpose of modelling, trenching operations were divided into eleven sections: seven trenching areas, three pre-sweep areas and the sand wave area (**Figure 4-2**). The three pre-sweep areas and the sand wave area only require sediments to be removed while the other seven trenching sections require removal of both sediment and rock material. The trenching in each of the seven trenching sections was assumed to be completed with either: a backhoe dredge (BHD); or a trailing suction hopper dredge (TSHD) conducting a pre-sweep to remove surface sediments, followed by a cutter suction dredge (CSD) crushing harder material, and a post-sweep with the TSHD to remove the CSD-crushed material. Trenching of the pre-sweep and sand wave sections is assumed to only require the TSHD.

Since the modelling was undertaken there has been a minor rerouting of the gas export Project pipeline at two locations in Darwin Harbour to avoid encroachment of the Darwin Harbour Navigation Channel. The change consists of rerouting the Project pipeline approximately 20 m closer to the Bayu-Undan to Darwin gas export pipeline in the outer harbour and approximately 135 m closer in the inner harbour, with the inclusion of two crossings over the Bayu-Undan to Darwin gas export pipeline. Rerouting the Project pipeline outside the shipping channel eliminates the requirement for trenching along these sections (since the pipeline is no longer required to be installed 1 m below the seabed, which is required if routed within the shipping channel). This change of alignment will reduce the length of required trenching section by 4 km, reducing the amount of dredged material to approximately 255,000 m^3 from that modelled (306,000 m^3). Given the removal of some trenching zones and the lesser expected spoil volume required to be disposed at the offshore spoil disposal ground, the modelling results and subsequent interpretation are considered to provide a conservative representation of effects and impacts from trenching and spoil disposal.

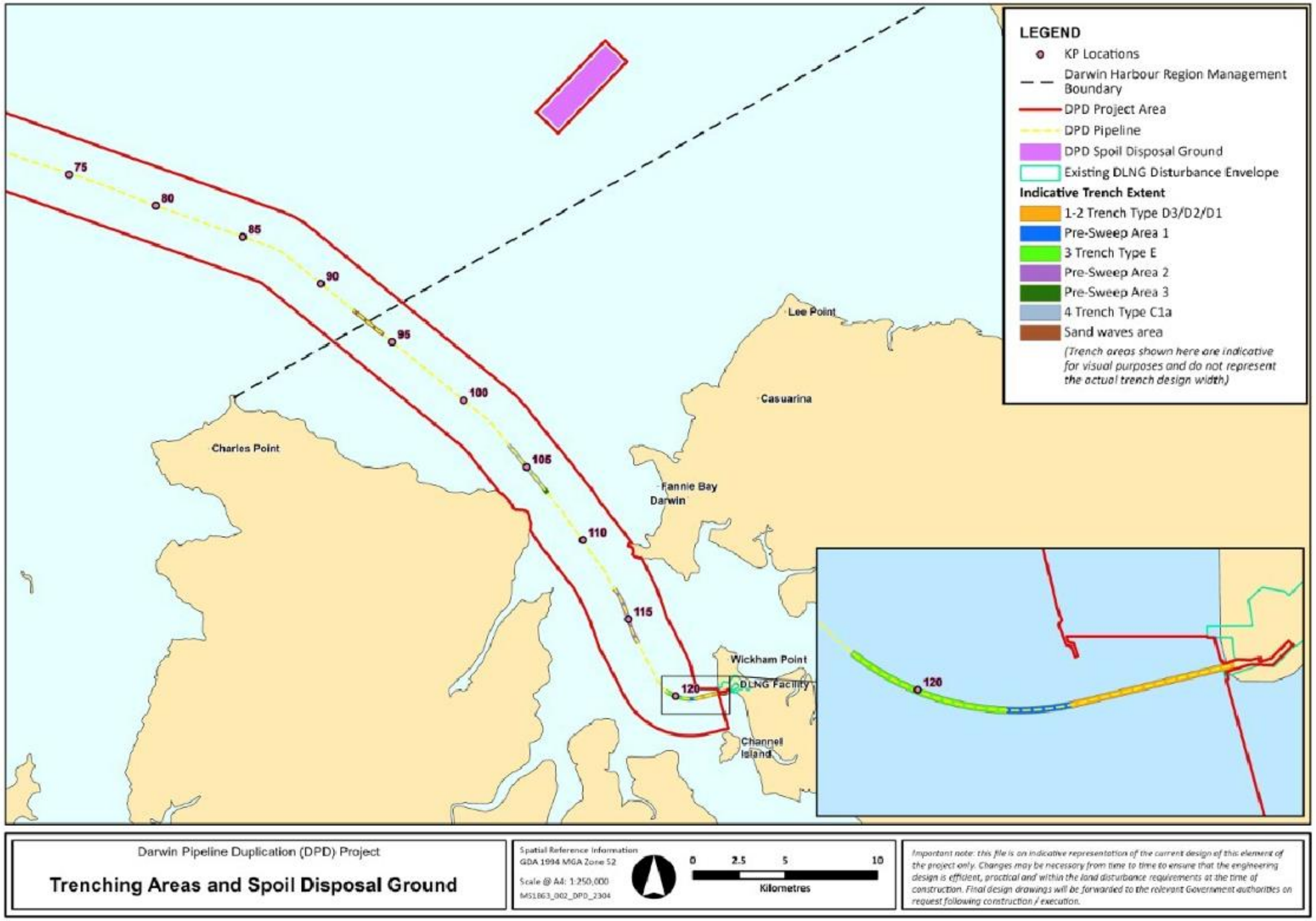

Figure 4-2 *Trenching areas and spoil disposal ground*

To model the Project pipeline route trenching and spoil disposal operations, a range of conditions were defined for the proposed operations, including trenching and disposal methods, production rates, and sediment/rock types and quantities. Two seasonal trenching and disposal scenarios were also simulated. Further details on modelling inputs and any assumptions made are described in RPS (2023), provided in **Appendix 7**.

Predictions of suspended sediment concentrations (SSC) and sedimentation were assessed against a series of water quality and sedimentation thresholds to categorise the modelled outcomes into management zones of influence and impact, defined with regard to environmental sensitivities in the study region (**Table 4-2**). The thresholds and the approach are based on the extensive environmental monitoring and threshold work established for the INPEX Ichthys Project, including its capital and maintenance dredge campaigns in Darwin Harbour (INPEX 2010; 2011; 2014; 2018).

Table 4-2 Tolerance limits for excess SSC and sedimentation (following INPEX, 2018)

Habitat	Trenching Impact Reporting Zone	Season	Suspended Sediment Concentrations (mg/L)	Sedimentation (mm)
Mangrove	Anywhere	All	N/A	50
Hard Coral	East Arm	Dry	11.9	15
		Wet	23.8	
	Middle Arm	Dry	12.4	15
		Wet	27.0	
	Mid Harbour	Dry	10.7	15
		Wet	28.4	
	Offshore	Dry	17.9	15
		Wet	64.2	
Seagrass	Anywhere	Dry	13.3	40
		Wet	60.6	

Following the approach applied by INPEX (2010; 2011; 2014; 2018), the following three impact zones have been adopted to assess modelling results:

+ **Zone of High Impact (ZoHI)** is where direct impact from trenching and disposal will occur, such as removal of substrate or smothering of substrate (INPEX, 2018). This zone includes the trench footprint and disposal area with a 20 m buffer extending outwards from these areas.
+ **Zone of Moderate Impact (ZoMI)** is defined as the area where sensitive receptor communities are predicted to be indirectly impacted by elevated suspended sediment concentrations (SSC) and sedimentation due to trenching and disposal activities (INPEX, 2018). Damage/mortality of sensitive receptor communities may occur, but the disturbed areas are considered to have good potential for recovery. Sensitive receptors are within the ZoMI if their respective ecological

tolerance limits for SSC are exceeded for 10% of the time or where the simulated sedimentation thickness exceeds their respective sedimentation tolerance limits at the end of the simulation.

+ **Zone of Influence (ZoI)** is defined as the area where sensitive receptor communities are predicted to be indirectly influenced by elevated SSC and sedimentation (INPEX, 2018). Sensitive receptor communities may, at some time experience detectable elevations in SSC and sedimentation (beyond expected background levels). However, no sublethal stress or mortality of benthic communities is expected to occur (INPEX, 2018).

The calculated extents of the defined management zones – ZoI and ZoMI – over the entire program of trenching and disposal operations for the winter/dry season scenario are presented in **Figure 4-3** and **Figure 4-4**, and for the summer/wet season scenario the extents are presented in **Figure 4-5** and **Figure** 4-6. From the figures it is evident that the predicted ZoMI for the trenching and disposal operations for both seasonal scenarios is restricted to the trenching and spoil disposal footprints, which are also within the ZoHI as defined above.

Management zones shown are the result of exceedance of the sedimentation thresholds only; no exceedance of the SSC thresholds occurred for both modelled seasonal scenarios.

The benthic habitats in the ZoI beyond the trenching footprint are a mix of bare sand, low density sponges/filterers/octocorals and sponge habitat. Consequently, the restricted spatial extent of SSC and the sediment above impact thresholds means that activities are not expected to impact benthic habitats, including sensitive habitats such as hard coral, seagrass and mangroves since they are not present in any of the modelled ZoMI/ZoIs.

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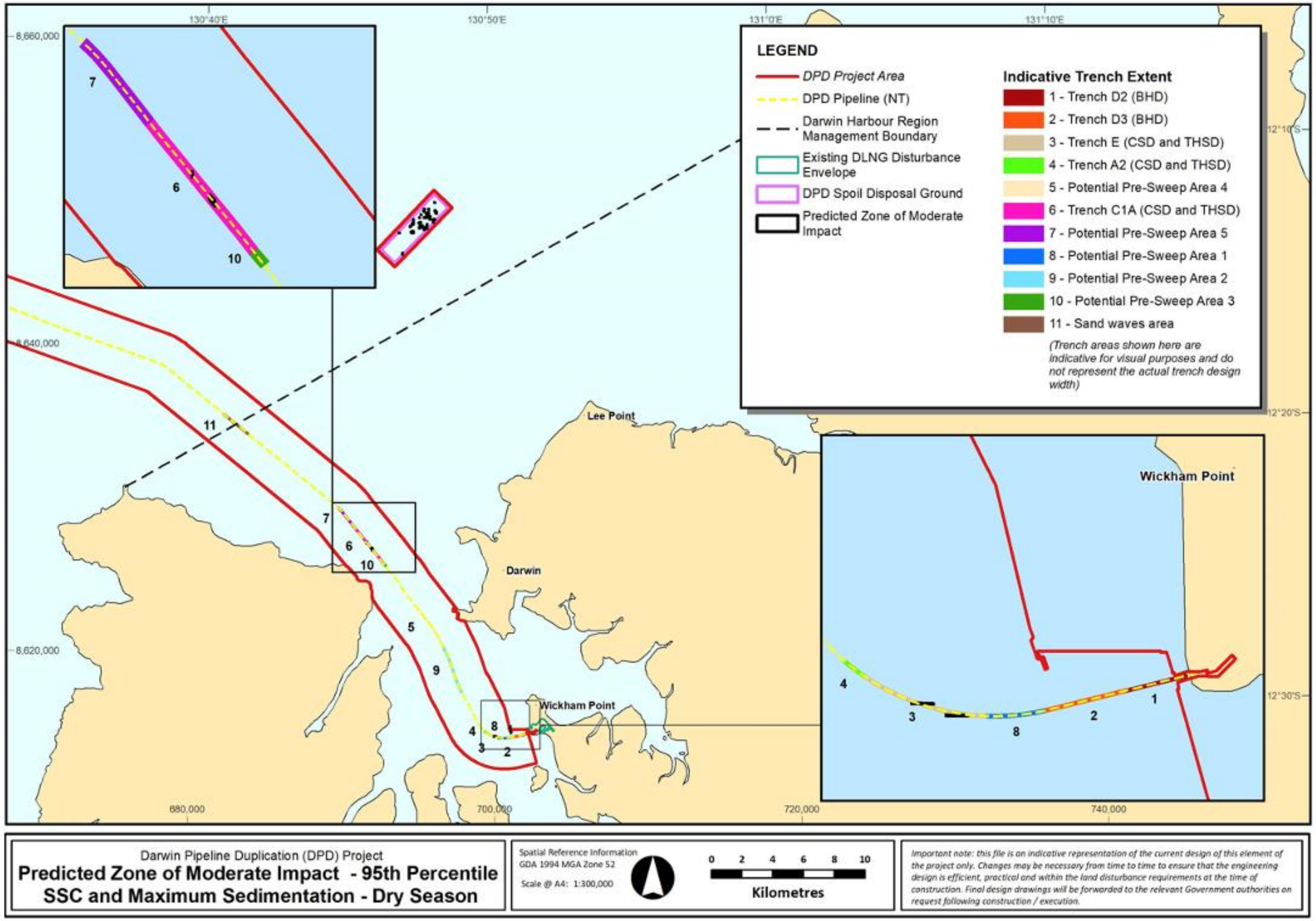


Figure 4-3 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds to the 95th percentile SSC and maximum sedimentation throughout the entire trenching programme transitioning into winter/dry season (1st April to 10th May 2019)

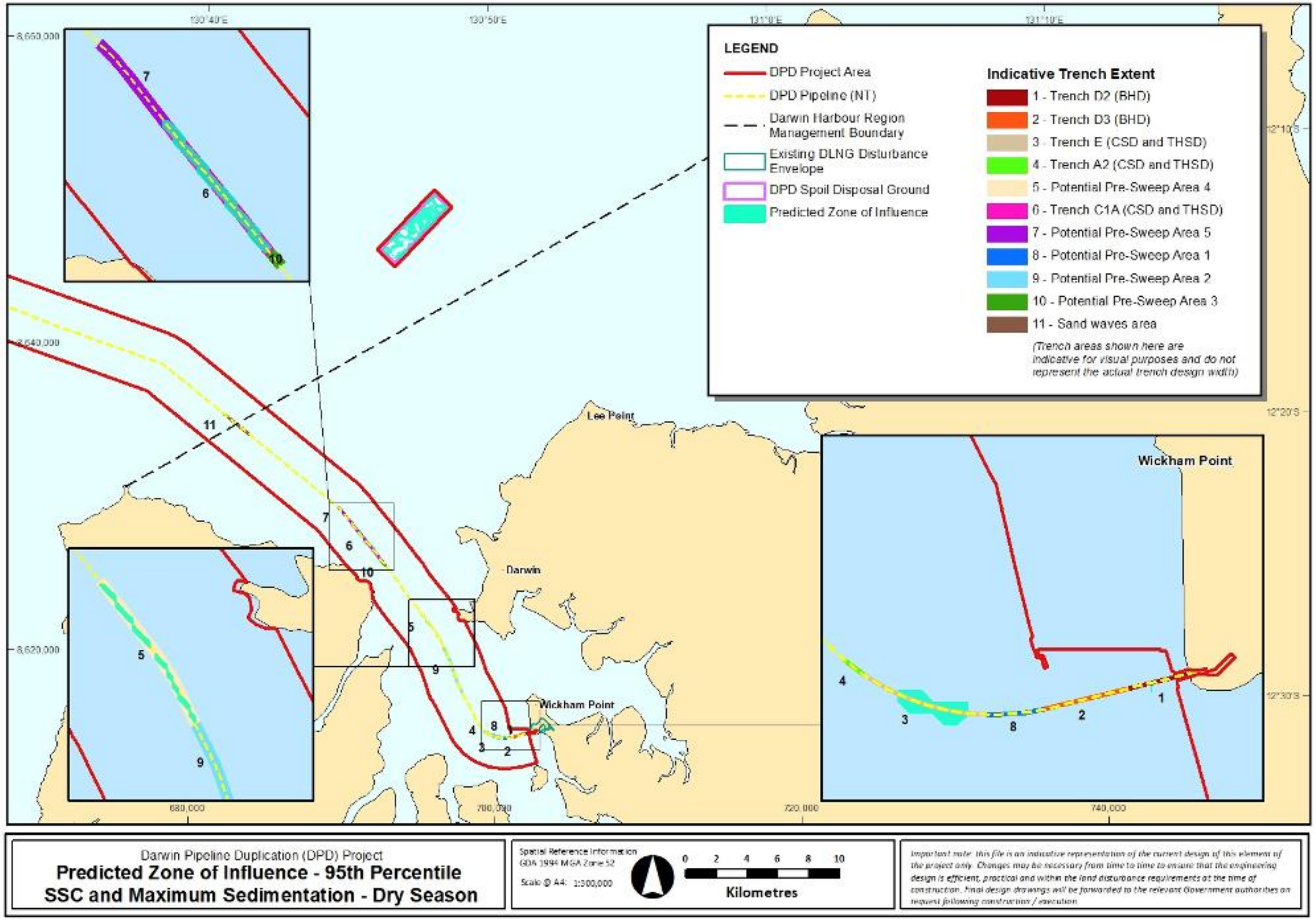


Figure 4-4 Predicted Zone of Influence following application of the appropriate spatial thresholds to the 95th percentile SSC and maximum sedimentation throughout the entire trenching programme transitioning into winter/dry season (1st April to 10th May 2019)

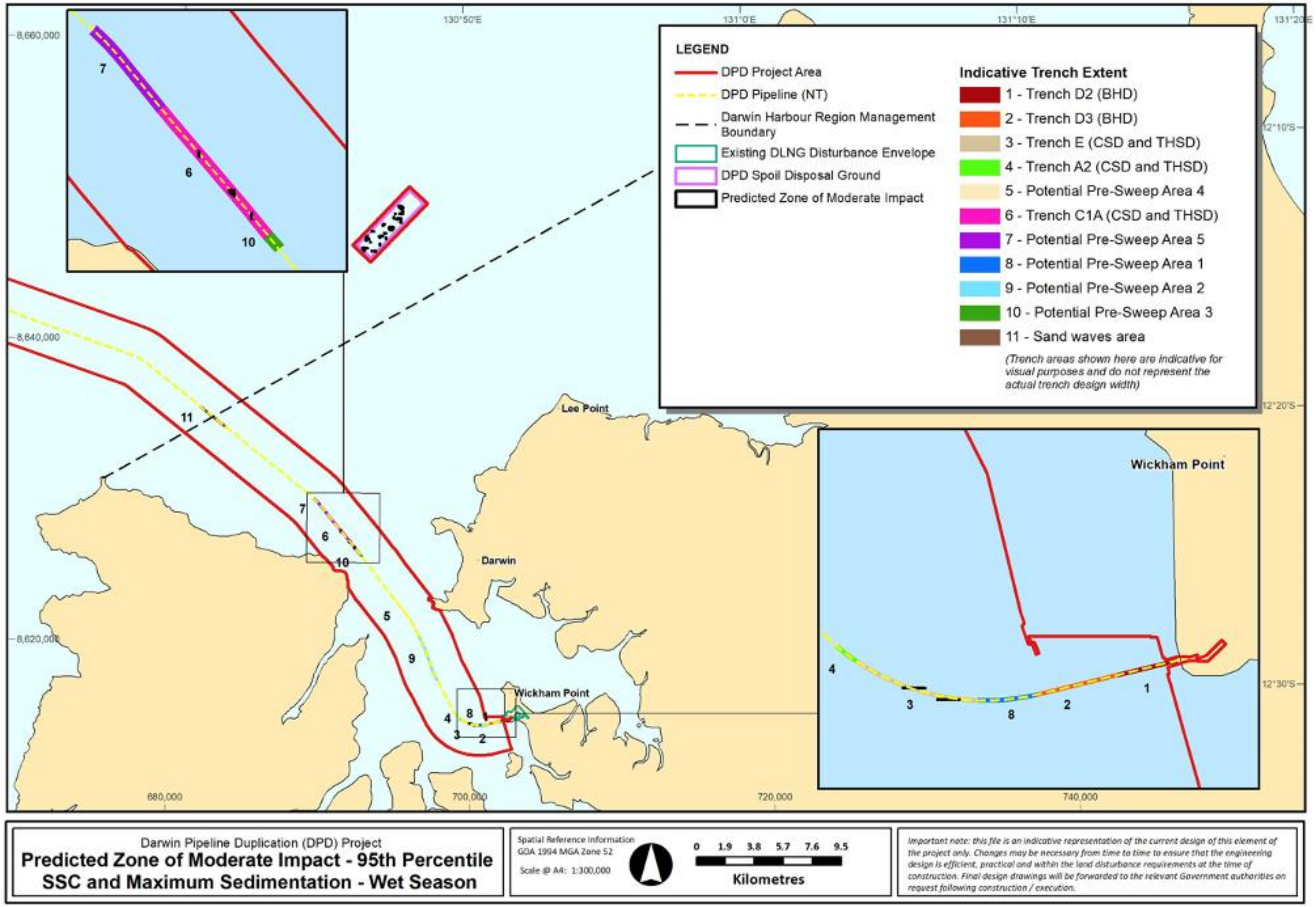


Figure 4-5 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds to the 95th percentile SSC and maximum sedimentation throughout the entire trenching programme transitioning into summer/wet season (1st October to 9th November 2019)

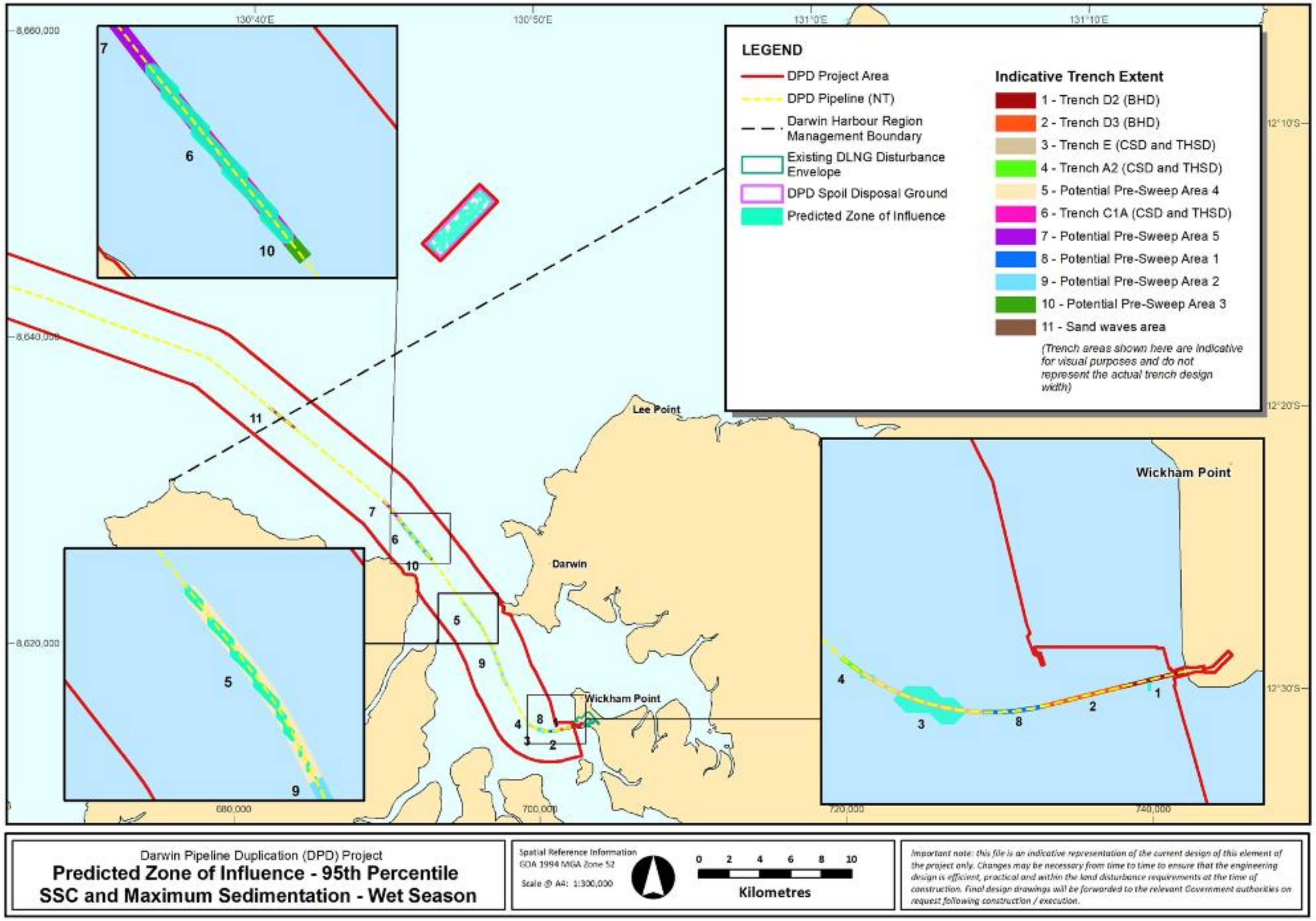


Figure 4-6 Predicted Zone of Influence following application of the appropriate spatial thresholds to the 95th percentile SSC and maximum sedimentation throughout the entire trenching programme transitioning into summer/wet season (1st October to 9th November 2019)

4.2.1.3 Significance of Impacts to MNES Species

Consideration of the above information on the potential intensity, duration, magnitude and geographic extent of impacts from seabed disturbance has been undertaken to assess whether there is a real chance or possibility that it will lead to a long-term decrease in the size of a population of the identified MNES species (significant impact criteria for listed threatened species described in MNES Significant Impact Guidelines 1.1 (DoE, 2013)). Also considered are other significant impact criteria, including whether the seabed disturbance will:

+ Reduce the area of occupancy of the species.
+ Fragment an existing population into two or more populations.
+ Adversely affect habitat critical to the survival of a species.
+ Disrupt the breeding cycle of a population.
+ Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

The following section describes the assessment of significant impact to MNES species due to seabed disturbance. Summary assessments of significant impacts to each individual species against all significant impact criteria in the guidelines, and considering all Project aspects, are also provided in **Section 6**.

4.2.1.3.1 Direct Disturbance

Disturbance to the seabed and benthic habitat is not expected to have any significant impact on MNES marine mammals (dolphins and dugongs) in the Project area. There are no unique or sensitive habitats surveyed and/or predicted in the trenching, pre-sweep or sand wave zones. The habitats in these zones present are expansive across Darwin Harbour and well represented in other locations, both within the harbour and regionally.

Dolphins have opportunistic, varied diets and there is no evidence from surveys conducted in the harbour and surrounding areas (Palmer, 2010; Brooks and Pollock, 2015) that these species preferentially target habitats along the Project pipeline route for foraging. Dugongs are known to occur in greatest abundance in shallow seagrass and algae habitats within Darwin Harbour and surrounding areas (Cardno, 2015a). Project pipeline installation activities for the DPD Project will not disturb these habitats.

Flatback, green and hawksbill turtles are the most common turtle species occurring in Darwin Harbour (**Table 3-2**) and can migrate over large distances between their feeding and nesting grounds. Most of these species forage in coral and rocky reef habitat and shallow inshore seagrass beds. As identified in **Table 4-1**, there are minimal such habitats within the trenching and infrastructure footprints, which occur widely elsewhere throughout Darwin Harbour. The Project is therefore unlikely to result in changes to the composition of benthic habitats across Darwin Harbour, nor have wider impacts on the marine fauna that rely on those habitats.

4.2.1.3.2 Indirect Impacts

Trenching and spoil disposal will temporarily increase turbidity and cause sedimentation in the local vicinity of trenching and spoil disposal footprints. However, based on the sediment dispersion modelling undertaken, impacts to dugong or turtle foraging habitat (e.g., seagrass habitat) are not expected since they are not present in any of the modelled ZoMI/ZoIs. Note, as stated in **Section 3.2.1** flatback turtles prefer shallow, soft-bottom seabed and benthic habitats away from reefs, with this habitat present within the Project area; this habitat is well represented elsewhere within Darwin Harbour.

Monitoring undertaken as part of construction activities for the Ichthys Project, including piling, dredging and spoil disposal activities, supports this assessment. The Ichthys monitoring program evaluated potential impacts from a scope of activities that was significantly larger than proposed for the DPD Project. The Ichthys Project was authorised to dredge and dispose of 16.1 Mm^3 of material to dredge a shipping channel and berthing area in East Arm which included dredging through the very hard substrate at Walker Shoal (INPEX, 2014). In comparison, a maximum volume of 500,000 m^3 (with an expected volume of approximately 255,000 m^3) will be trenched to install the Project pipeline, with the trenched material disposed immediately to the west of the Ichthys spoil disposal ground.

The Ichthys Project monitoring program did not detect any deleterious effects to turtle, dugong or dolphin distributions or population sizes in the Darwin region attributable to their dredging activities (Brooks and Pollock 2015; Cardno 2015a). Furthermore, seagrass monitoring did not indicate dredge-related turbidity impacts at seagrass sites known to support relatively high abundances of dugongs, with seasonal environmental factors considered the key drivers for seagrass growth and distribution at these sites (Cardno, 2015a, 2015b). Given the DPD Project is smaller in scale in comparison to the Ichthys Project, and will implement similar management measures, the proposed trenching, spoil disposal and construction activities are not expected to significantly impact listed marine mammal species.

A monitoring and management program, outlined in the Trenching and Spoil Disposal Monitoring and Management Plan (TSDMMP) (**Appendix 15**), will be in place to monitor turbidity and adapt management measures in response to triggers that provide an early warning sign of potential impacts to benthic habitat due to turbidity and sedimentation.

4.2.1.4 Significance of Impacts to the Commonwealth Marine Area

Significant impact criteria for the Commonwealth marine environment described in MNES Significant Impact Guidelines 1.1 (DoE, 2013) have been considered when assessing effects from seabed disturbance in Commonwealth waters. A description of the Project area within the Commonwealth marine environment is provided in **Section 6.4**. A summary assessment of significant impacts to the Commonwealth marine area against all significant impact criteria in the guidelines, and considering all Project aspects, is also provided in **Section 3.2**.

Within the Commonwealth marine area, seabed disturbance will occur from the laying of the Project pipeline and associated structures. There is no planned anchoring in the Commonwealth marine area, except as required for contingency/ emergency events, as Project vessels will utilise dynamic positioning in these waters. There will be no trenching in the Commonwealth marine area and turbidity effects from disturbance of sediment due to the laying of pipeline and associated structures is expected to be very minor and temporary in nature.

The habitat within the Commonwealth waters Project area (**Figure 6-4**) comprises bare sediments or sediment with a sparse biota of filter feeders (e.g., soft coral) and crinoids (Heyward et al., 2017, RPS, 2023a; **Appendix 7**). This type of habitat is ubiquitous for the region (Heyward et al., 2017) and therefore the disturbance to seabed is not expected to have any significant impact on the diversity of seabed habitats or ecosystem functioning on a broader scale. The installation of pipeline and associated structure will provide hard substrate which will likely be used as attachment point for biota (e.g., sessile filter feeders) and therefore may locally increase epibiota density.

The disturbance of seabed will not Impact the features of the Shepparton Shoal, approximately 3 km west of the pipeline at its closest point or the key ecological feature of Carbonate Bank and Terrace System of the Van Diemen Rise, which at its closest point is approximately 7.5 km east of the pipeline end.

4.2.2 Light Emissions

Project vessels will be working 24 hours/day and require external lighting to provide a safe working environment and to comply with relevant maritime navigation requirements at night. Light spill from project vessels has the potential to create localised impacts to marine fauna through behavioural disturbance such as attraction, disorientation and misorientation. Given light spill is a known threat to marine turtle behaviours such as nesting and hatchling orientation and the Project area intersects area designated as habitat critical for the flatback turtles, and flatback turtle BIAs, the assessment of impacts from light spill focuses primarily on marine turtles.

The Recovery Plan for Marine Turtles in Australia 2017–2027 (DoEE, 2017a) highlights artificial light as a threat to marine turtles. Specifically, the plan indicates that artificial light may reduce the overall reproductive output of a stock, and therefore recovery of the species, by:

+ Inhibiting nesting by females.
+ Disrupting hatchling orientation and sea-finding behaviour.
+ Creating pools of light that attract swimming hatchlings and increase their risk of predation.

As stated in the National Light Pollution Guidelines for Wildlife Including Marine turtles, Seabirds and Migratory Shorebirds (DoEE, 2020) most hatchling turtles emerge at night and must rapidly reach the ocean to avoid predation. Hatchlings locate the ocean using a combination of topographic and brightness cues, orienting towards the lower, brighter oceanic horizon and away from elevated darkened silhouettes of dunes and/or vegetation behind the beach. They can also find the sea using secondary cues such as beach slope. Sea finding behaviour may be disrupted by artificial lights which interfere with natural lighting and silhouettes. Artificial lighting may adversely affect hatchling sea finding behaviour in two ways: disorientation – where hatchlings crawl on circuitous paths; or misorientation – where they move in the wrong direction, possibly attracted to artificial lights. On land, movement of hatchlings in a direction other than the sea often leads to death from predation, exhaustion, dehydration, or being crushed by vehicles on roads.

4.2.2.1 Darwin Harbour Light Impact Assessment

Pendoley Environmental (2022b; **Appendix 19** report number J06063) provides a desktop assessment of project vessel lighting impacts to marine turtles in Darwin Harbour (including trenching, pipelay and other vessels). This report also includes a summary of available information on turtle nesting in Darwin Harbour and the significance of sites on a regional scale. In particular, the assessment focussed on potential impacts to flatback turtle nesting and hatching at Casuarina Beach and Cox Peninsula beaches (including Wagait beach), the closest known nesting beaches to Project activities. The assessment divided vessel activity into five scenarios/zones, representing different stages or types of Project activity (**Figure 4-7** and **Figure 4-8**). **Figure 4-7** illustrates that turtles using Casuarina and Wagait beaches will not have line-of-sight visibility of vessels within the harbour (Scenarios 1 and 2) and so are at little to no risk from exposure to vessel lighting in these areas. The outer harbour approach

(Scenario 4, **Figure 4-8**) and spoil disposal area (Scenario 5, **Figure 4-8**) are 10 to 20 km from potentially impacted beaches. Over that distance, vessel lights will produce a relatively small amount of sky glow, similar in appearance to the vessels that currently use the existing offshore vessel anchorage area (visible in **Figure 4-8** and labelled in **Figure 4-9**). Impacts on hatching turtles due to light from the vessel anchorage area are not known to occur and it is therefore unlikely project vessels will cause any such impact (Pendoley Environmental, 2022b; **Appendix 19** report number J06063).

The greatest risk of exposure was determined to occur when vessels are operating in the harbour mouth (Scenario 3, **Figure 4-8**) during the May to October nesting season peak. Vessels at this location will be approximately 12 km away from Casuarina Beach and 2 to 8 km from the Wagait and Mandorah beaches. However, the risk of impact was considered low due to the low number of turtles, nests and successfully emerged hatchlings on theses beaches, the short duration of trenching activities (i.e., expected to be limited to within one nesting season) and the large amount of urban light which is likely to mask vessel lighting rendering it indistinguishable from existing lighting. Project vessel lighting is likely to be indistinguishable from the large amount of light from Darwin and the harbour when viewed from Mandorah and Wagait beaches.

The assessment concluded overall that marine turtles that use Darwin Harbour beaches will be at low risk of impact from Project vessel lighting due to the relatively short duration of dredging and pipelay activities, and the amount of existing light pollution from Darwin Harbour and urban surrounds.

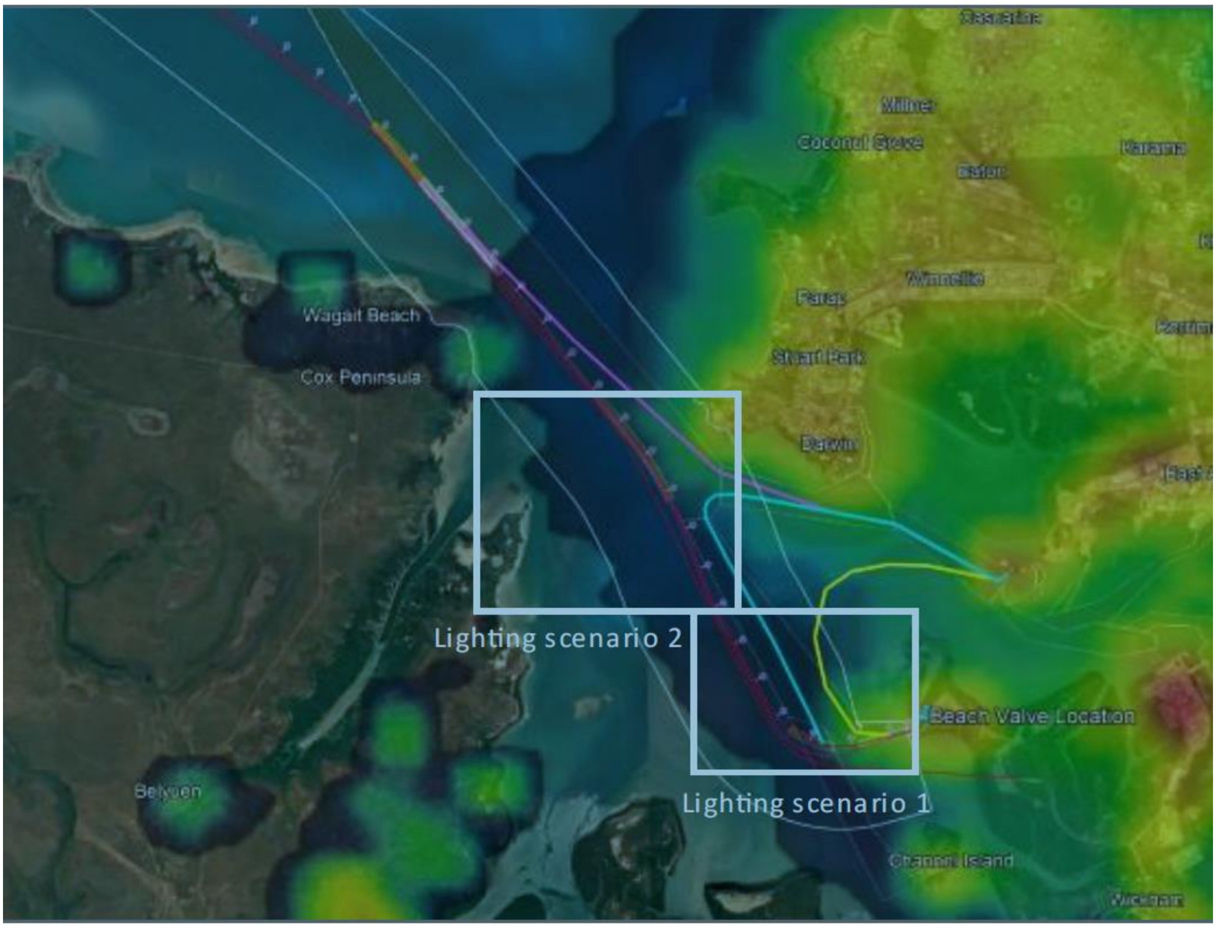


Figure 4-7 Vessel Presence Zones in Darwin Harbour

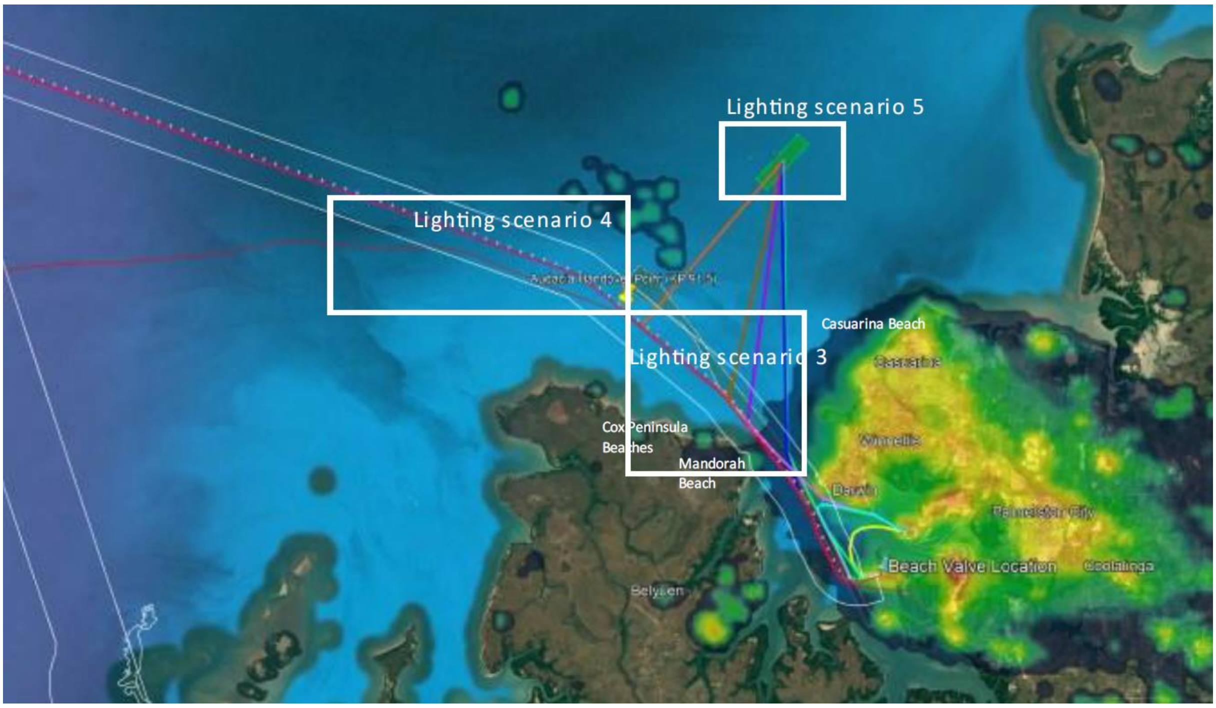
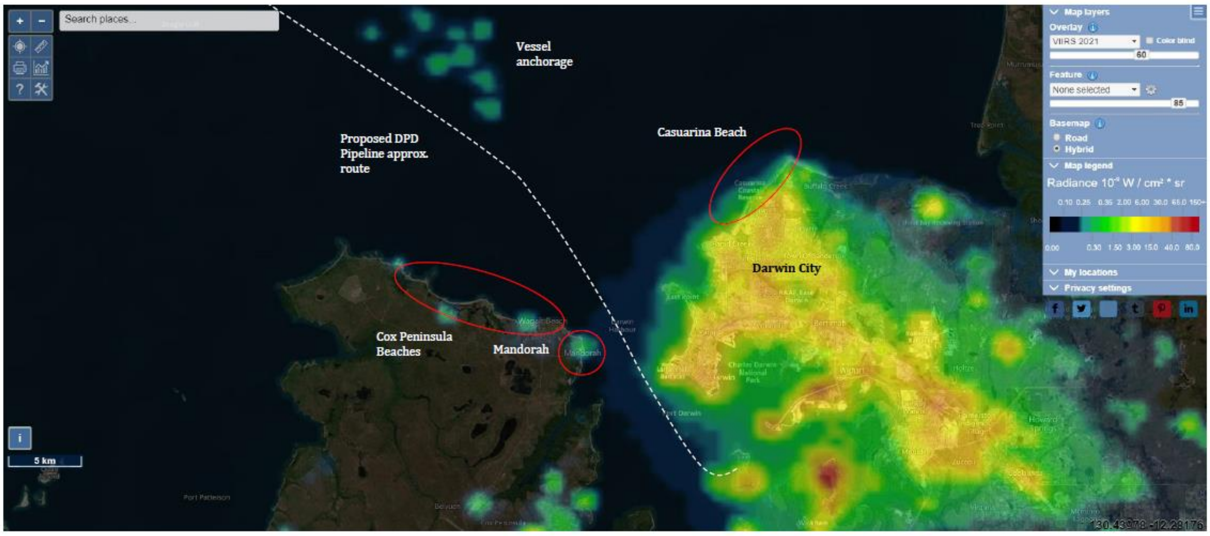


Figure 4-8 Vessel Presence Zones Approaching Darwin Harbour



Source: www.lightpollution.info, accessed 1 April 2022

Figure 4-9 2021 Visible infrared imaging radiometer suite map and Darwin Harbour turtle nesting beaches

4.2.2.2 Deepwater Pipelay and Construction Vessel Light Modelling Assessment

Light modelling has been conducted by Pendoley Environmental (2022a) (**Appendix 19** report number J06009) for the proposed offshore pipelay vessel (greatest level of light spill of project vessel fleet) and construction vessel as well as a cumulative assessment (combined light spill) of both vessels side-by-side. This scenario is not representative of vessels operating in Darwin Harbour (since a smaller shallow water pipelay barge will be used) but represents light spill associated with pipe laying and construction in Commonwealth waters. It provides information that can be used to assess potential impacts of light spill of the pipelay vessel to the closest regionally significant flatback turtle nesting site at Cape

Fourcroy on Tiwi Islands (approximately 25 km from the closest part of the Project area). ILLUMINA light modelling was undertaken for three scenarios associated with the project activities. The worst-case modelled light spill in Commonwealth waters is based on the combined offshore pipelay and construction vessels (Pendoley Environmental, 2022a, **Appendix 19** report number J06009) and identified that behavioural impacts are limited to approximately 4.5 km. Light spill from pipelay activities will therefore not impact Cape Fourcroy, which is also outside the 20 km buffer described in National Light Pollution Guidelines (DoEE, 2020).

4.2.2.3 Significance of Impacts to MNES species

This section describes the assessment of significant impact to MNES species from light emissions, considering significant impact criteria. Residual risk assessments of significant impacts to each individual species against all significant impact criteria in the guidelines, and considering all Project aspects, are provided in **Section 6**.

The assessment undertaken by Pendoley Environmental (2022b; **Appendix 19** report number J06063) has found that there is no discernible risk of Project vessel lighting in Darwin Harbour causing a significant impact to the Arafura Sea flatback turtle based on presently and publicly available data. This conclusion is based on the short-term nature of the Project, the low nesting effort on potential impact beaches, and their low reproductive value relative to other rookeries within the wider population.

With respect to light spill impacts from the deep water pipelay vessel and construction vessel working along deeper sections of the Project route to the PLET in Commonwealth waters, light spill is not expected to affect turtle nesting or hatchling survival at the regionally important beach at Cape Fourcroy on Tiwi Islands (approximately 25 km from offshore extent of the Project area). Light modelling conducted for the deep water pipelay vessel and construction vessel demonstrated that light spill at an intensity that could lead to turtle behavioural effects would be limited to within 4.5 km of the vessels, even when working side by side (Pendoley Environmental, 2022a, **Appendix 19** report number J06009).

Therefore, on the basis of the studies completed, it is well supported to conclude that there will be no significant impacts to turtle populations from Project vessel lighting anywhere within the Project area. Project vessel light spill to the marine environment will, however, be reduced as far as practicable as per control measures identified in **Section 5** while maintaining safety and navigational requirements for vessel lighting.

4.2.2.4 Significance of Impacts to Commonwealth Marine Area

This section describes the assessment of significant impact to the Commonwealth marine environment due to light emissions, considering significant impact criteria for the Commonwealth marine environment described in MNES Significant Impact Guidelines 1.1 (DoE, 2013). A summary assessment of significant impacts to the Commonwealth marine area considering all Project aspects is also provided in **Section 3.2.**

The worst-case potential impact from light spill in the Commonwealth marine area is behavioural disruption to marine turtles during the critical life-cycle phases of nesting and hatching. However, light spill modelling undertaken by Pendoley Environmental (2022a, **Appendix 19** report number J06009) shows that light spill will reduce to a level that is considered behaviourally insignificant to marine turtles within a worst-case distance of 4.5 km. The Project area is well offshore (approximately 25 km) from the closest significant flatback turtle nesting beaches at Cape Fourcroy and therefore significant impacts are not expected.

Other behavioural interactions with fauna in the Commonwealth marine environment include attraction of seabirds and fish to vessel light spill. Given the temporary nature of project activities and there being no aggregation areas or critical habitats for fish or birds nearby the Project area, such interactions are not expected to be significant on a population scale.

4.2.3 Underwater Noise

There will be a period of increased noise emissions during construction activities due to the operation of vessels and equipment, operation of survey and positioning equipment and from helicopters supporting the installation activity. Underwater noise emissions will be temporary and relatively short in duration as vessels move along the linear construction corridor. During operations, the only noise emissions will be from small support vessels and indistinguishable from any other vessel activity within and on the approach to Darwin Harbour. As such, noise emissions during operations are unlikely to have a significant impact on marine mammals.

Noise associated with pipelaying activities that could impact marine fauna includes noise generated by vessel thrusters, engines and propellers, as well as noise emitted onboard which is converted to underwater noise through the hull (i.e., from heavy machinery, pipe construction works). The main source of vessel noise will be from propellers or thrusters.

Helicopters will also generate noise, with the main source being the engines and the rotor blades. Strong underwater sounds are detectable for only brief periods when a helicopter is directly overhead during take-off and landing (Richardson et al., 1998).

Noise will also be generated during Project construction from trenching, installation activities (including span rectification), placement of the pipeline and stabilisation and protection structures (including mattresses and rock placement).

Underwater noise emissions have the potential to affect marine mammals as they use sound for a range of functions such as social interaction, foraging and orientation. Responses and effects depend on a number of factors, including distance from the sound source, water depth and bathymetry, the animal's hearing sensitivity, type and duration of sound exposure and the animal's activity at time of exposure. Broadly, the effects of sound on marine fauna can be categorised as:

+ Physiological impacts – Auditory threshold shift (temporary and permanent hearing loss) – marine fauna exposed to intense sound may experience a loss of hearing sensitivity, or even potentially mortal injury. Hearing loss may be in the form of a temporary threshold shift (TTS) from which an animal recovers within minutes or hours, or a permanent threshold shift (PTS) from which the animal does not recover.
+ Behavioural response – Behavioural impacts will depend on the audible frequency range of each potential receptor in relation to the frequency of the noise, as well as the intensity of the noise. Behavioural changes vary significantly and may include temporary avoidance, increased vigilance, reduction in foraging and reduced vocalisations.
+ Acoustic masking – Anthropogenic sounds may interfere with, or mask, biological signals, therefore reducing the communication and perceptual space of an individual.

Noise levels at which physiological impacts occur is dependent on whether the noise being generated is impulsive or non-impulsive. Impulsive noise is typically transient, brief, broadband and consists of high peak pressure with rapid rise time and rapid decay (NOAA, 2018). This noise source is associated with activities such as pile driving, seismic activities and underwater blasting. Non-impulsive noise can be broadband or narrowband, brief or prolonged, continuous or intermittent but typically does not have the high peak sound pressure with rapid rise time and decay. This type of noise source is associated with activities such as dredging, vessel noise, drilling and some construction activities.

4.2.3.1 Underwater Noise Modelling

4.2.3.1.1 Modelling Approach

Trenching activities, including rock breaking using hydraulic tools, will be the most significant source of Project underwater noise. These activities have been modelled to quantify noise emissions and marine fauna exposures to inform impact assessment and marine fauna noise management measures. This modelling approach is described below with the full technical reports presented in **Appendix 20** (Talis Consultants, 2023) and **Appendix 22** (Connell et al., 2023). Section 5.9 **Appendix 20** describes the limitations of the initial modelling undertaken including that reflection due to rough seabed surface, wave action and airborne noise are not accounted for in the model, and it is assumed there is negligible variation in sea temperature or salinity in the Project area water column.

Underwater noise modelling initially conducted for the Project (Talis Consultants, 2023; **Appendix 20**) considered dredging vessel noise emissions (trailing suction hopper dredge (TSHD), cutter suction dredge (CSD) and backhoe dredge (BHD)), vibratory hammer (sheet piling) noise emissions and hydraulic hammer (BHD rock breaking) noise emissions. Since completion of that modelling, further definition of the Project scope has been developed, including removal of the need to construct a cofferdam (and associated sheet piling). The vibratory hammer modelling results for sheet piling described in Talis Consultants (2023) (**Appendix 20**) have therefore not been presented below.

Further detail has also become available on the type and specification of rock breaking tools. **Appendix 22** (Connell et al., 2023) describes the additional modelling undertaken for rock breaking using an Xcentric Ripper (Xcentric Ripper XR-60) and a hydraulic hammer (Epiroc HB 10000). Use of a Xcentric Ripper tool is considered the base case option with a hydraulic hammer proposed as a contingency only.

Trenching scenarios have been modelled at three representative locations (**Figure 4-10**):

+ Location 1 - BHD excavating and rock breaking (Xcentric Ripper or hydraulic hammer) in an area of hard rock.
+ Location 2 - TSHD operating at a middle harbour trenching zone. This area is relatively close to Weed Reef compared to other trenching zones. Weed Reef is a known hard reef area supporting greater diversity of biota (including hard corals) and may support higher marine fauna abundance.
+ Location 3 - TSHD (alone) and TSHD/CSD (operating together) operating in an outer harbour trenching zone. This zone is relatively close to Cox Peninsula shallow water and shorelines, which support a higher diversity of biota and may support higher marine fauna abundance.

Project pipeline trenching and associated noise emissions will not be constant over a 24-hour period. As such, noise duration and cycle times for trenching activities were modelled as follows:

+ BHD noise – 4 hours of rock breaking modelled using an Xcentric Ripper (non-impulsive, continuous noise) and a hydraulic hammer (impulsive noise), 4 hours no noise (switching between rock breaking tool and excavating tool) and 4 hours digging (non-impulsive, continuous noise) over a

12-hour period and repeated (2 x 12-hour cycles per 24 hours) i.e., cumulative total of 8 hours each of rock breaking, digging and no noise.

+ TSHD noise – cycle times dependent on distance from spoil ground but nominally have been modelled as 3 hours dredging noise (non-impulsive noise), 2 hours transit to spoil ground and back (i.e., 'no noise' period) repeated over periods of 24 hours.
+ CSD noise – 10 hours cutting (non-impulsive noise), 2 hours downtime over 12 hours (2 x 12-hour cycles per 24 hour).
+ CSD + TSHD – cycles for TSHD and CSD were applied at the same trenching location to conservatively assess cumulative effects of these vessels if they were operating side by side.

Modelling of 24-hour sound exposure level (SEL_{24h}) was conducted for each scenario to provide a conservative determination of PTS and TTS ranges from the cumulative effect of noise to marine fauna of interest over a 24-hour period. This modelling method is considered industry leading practice and is a conservative method of estimating potential physiological effect ranges, as SEL_{24h} assumes the receptor (i.e., fauna) is stationary within the noise field of the noise source. In reality, the marine fauna of interest are highly mobile species which move naturally throughout the harbour and are capable of moving away from a noise source.

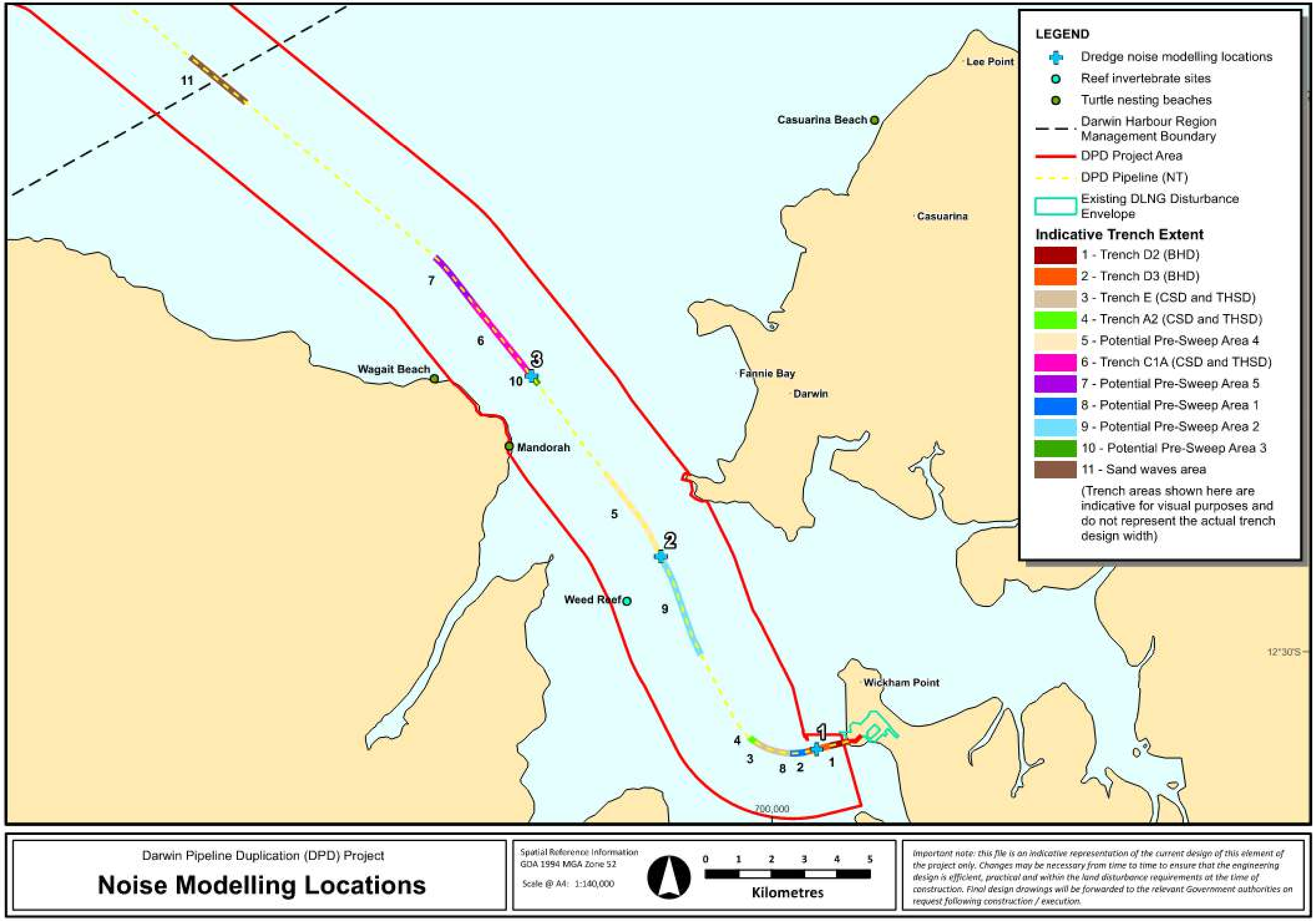


Figure 4-10 Location of modelled noise sources

SEL_{24h} modelling was conducted based on a mean sea level (MSL) over a 24-hour period to represent average water level throughout the daily tidal cycle. This was considered the most appropriate approach for SEL_{24h} modelling (in comparison to modelling over low or high tide water levels) since tide state varies significantly between low and high tide over a 24-hour period in Darwin Harbour (typically up to approximately a 6 m range) and low and high tides are not representative of water level over a duration of 24 hours (rather they represent extreme water levels present for short periods of time within a tidal cycle).

Modelling of sound pressure level (SPL), which represents an instantaneous level of noise (in contrast to SEL), has been used for determining behavioural impact ranges to fauna. For SPL modelling, modelling at high and low tide (as well as MSL) was considered appropriate to give the extremes (upper and lower ranges) in behavioural impact ranges. Highest astronomical tide (HAT) and lowest astronomical tide (LAT) were conservatively used as water levels to represent high and low tide states, respectively, although these extremes are rarely reached.

Further description of the modelling inputs, including bathymetry, seabed types and sound profiles and further description of the noise sources used is presented in **Appendix 20** (Talis Consultants, 2023) and **Appendix 22** (Connell et al., 2023).

4.2.3.1.2 Underwater Noise Modelling Thresholds

Threshold criteria associated with physiological impacts and behavioural responses for sensitive marine fauna have been derived from a number of sources (Finneran et al., 2017; McCauley et al. 2000a, 2000b; NMFS 2014; NOAA 2018; Popper et al., 2014; Southall et al., 2019), which are further described in **Appendix 20** (Talis Consultants, 2023) and **Appendix 22** (Connell et al., 2023). The thresholds used to assess modelling results and potential physiological impacts to marine fauna from PTS and TTS, as well as to assess potential behavioural effects, are shown in **Table 4-3**.

The only marine mammals likely to regularly occur in the waters of Darwin Harbour are dolphins (high frequency functional hearing category) and dugong and the noise effect threshold for these receptors are provided in **Table 4-3**.

Marine turtles are considered less sensitive to noise than marine mammals as they do not have an external hearing organ but can detect sound through bone-conducted vibration in the skull with their shell providing a receiving surface (Lenhardt et al., 1985). There are no known studies that have investigated the effects of noise on crocodiles so the thresholds for turtles shown in **Table 4-3** are considered applicable also for crocodiles.

Table 4-3 Noise impact thresholds for marine megafauna groups in Darwin Harbour

Marine fauna type	Marine hearing group	Hearing bandwidth	Noise type	SEL_{24h} (Weighted) dB (re 1µ Pa2.s)		SPL Possible Behavioural Disturbance dB (re 1µ Pa)
				TTS	PTS	
Dolphins	High frequency	150 Hz to 160 kHz	Non-Impulsive[†]	178	198	120
			Impulsive[†]	170	185	160
Dugong		100 Hz to 50 kHz	Non-Impulsive[†]	186	206	120

Marine fauna type	Marine hearing group	Hearing bandwidth	Noise type	SEL_{24h} (Weighted) dB (re 1µ Pa2.s)		SPL Possible Behavioural Disturbance dB (re 1µ Pa)
				TTS	PTS	
	Sirenians – low frequency		Impulsive†	175	190	160
Turtles (and crocodiles)	N/A	100 Hz to 2 kHz	Non-Impulsive†	200	220	Relative risk#
			Impulsive†	189	204	166

† Thresholds are derived from Southall et al. (2019); NOAA (2018); Finneran et al. (2017); McCauley et al. 2000 and Popper et al. (2014).

Relative risk levels of Low, Moderate and High have been developed by Popper et al. (2014) for behavioural effect on turtles exposed to non-impulsive noise. Risks are evaluated at three distances from the noise source defined in relative terms, i.e., Low risk – Near (N) (10s of metres), Moderate risk – Intermediate (I) (100s of metres) and High risk – Far (F) (1,000s of metres).

4.2.3.2 Underwater Noise Modelling Results

4.2.3.2.1 Physiological Impacts

Table 4-4 presents distances from noise source to meet physiological impact (i.e., TTS and PTS hearing impairment) thresholds (i.e., threshold ranges) for each fauna group for each modelled scenario. Figures showing threshold contours for various scenarios and fauna groups are provided in **Appendix 20** (Talis Consultants, 2023) and **Appendix 22** (Connell et al., 2023).

Table 4-4 Physiological response threshold ranges for each marine megafauna group for each modelled scenario/location at mean sea level

Marine fauna type	SEL 24 hour (Weighted) Threshold [dB re 1µ Pa².s]		Distance [m]	
	TTS	PTS	TTS	PTS
Location 1 – BHD digging (non-impulsive noise) (Talis Consultants, 2023; **Appendix 20**).				
Dolphins	178	198	145	<50
Dugongs	186	206	200	<50
Turtle	200	220	<50	<50
Location 1 – BHD rock breaking with Xcentric Ripper (non-impulsive noise) (Connell et al., 2023; **Appendix 22**)				
Dolphins	178	198	100	NR
Dugongs	186	206	70	NR
Turtle	200	220	40	NR

Marine fauna type	SEL 24 hour (Weighted) Threshold [dB re 1μ Pa².s]		Distance [m]	
	TTS	PTS	TTS	PTS
Location 1 – BHD rock breaking with hydraulic hammer (impulsive noise) (Connell et al., 2023; **Appendix 22**)				
Dolphins	170	185	1,830	130
Dugongs	175	190	2,500	160
Turtle	189	204	950	100
Location 2 – TSHD (non-impulsive noise) (Talis Consultants, 2023; **Appendix 20**)				
Dolphins	178	198	303	<50
Dugongs	186	206	170	<50
Turtle	200	220	131	<50
Location 3 – TSHD (non-impulsive noise) (Talis Consultants, 2023; **Appendix 20**)				
Dolphins	178	198	303	<50
Dugongs	186	206	200	<50
Turtle	200	220	120	<50
Location 3 – TSHD and CSD side-by-side (non-impulsive noise) (Talis Consultants, 2023; **Appendix 20**)				
Dolphins	178	198	350	<50
Dugongs	186	206	210	<50
Turtle	200	220	160	<50

NR = threshold was not reached

For all scenarios and fauna groups, PTS SEL_{24h} thresholds were met less than 50 m from the noise source with the exception of the BHD impulsive noise (hydraulic hammering) scenario where PTS threshold ranges were 130, 160 and 100 m for dolphins, dugongs and turtles, respectively. Given the mobility of these species, and the threshold ranges for behavioural response being greater than the PTS range for all species, it is unlikely that these species would remain within the predicted PTS ranges for a period of 24 hours. Permanent threshold shift (PTS) injury is therefore considered unlikely for dolphins, dugongs and turtles from Project trenching activities.

Modelled TTS SEL_{24h} threshold ranges for the non-impulsive noise sources of TSHD, CSD and BHD trenching, and the use of an Xcentric Ripper tool for rock breaking varied between 40 m and 350 m, and were highest for dolphins (100 to 350 m), followed by dugongs (70 to 210 m) and marine turtles (40 to 160 m). As with the PTS thresholds ranges, it is unlikely that these EPBC Act listed marine fauna would remain within these zones long enough (i.e., for 24 hours or greater) for TTS impacts to occur, and there are no known aggregation areas for these fauna within these zones. However, the application of observation and exclusion zones, monitored from trenching vessels, will be adopted to avoid TTS impacts (**Section 5**).

For the BHD hydraulic hammering impulsive noise scenario, TTS threshold ranges were significantly larger than those predicted for the other modelled scenarios; with threshold ranges for dolphins, dugongs and turtles predicted to be 1,830 m, 2,500 m and 950 m, respectively. Given the relatively large size of these ranges and the fact that behavioural response thresholds were predicted to be within these ranges, it is possible that dolphins, dugongs and turtles could remain within the threshold TTS ranges for a period of 24 hours and receive TTS impact, if management measures were not in place to prevent this from occurring. Further investigation was undertaken to determine the effect of reducing BHD hydraulic hammering time on TTS threshold ranges (Connell et al., 2023, **Appendix 22**). Reducing the hammering time to 2 hours (from 8 hours) reduced the threshold ranges for dolphins, dugongs and turtles to 670 m, 840 m and 380 m, respectively.

As described in **Section 4.2.3.1**, use of an Xcentric Ripper tool, which produces non-impulsive noise, is intended to be used for rock breaking from the BHD. Consideration of the use of a hydraulic hammer has been undertaken only as a contingency. Additional management controls will be implemented (over and above those proposed for other trenching activities) should a hydraulic hammer be used (**Section 5**). This includes monitoring of significantly larger observation and exclusion zones and restricting the time for hydraulic hammering.

4.2.3.2.2 Behavioural Responses

Table 4-5 presents modelling results for various sea levels (LAT, MSL and HAT) showing distance from noise source to be less than behavioural response SPL thresholds (i.e., threshold range) for each fauna group for each of the modelled scenarios.

Table 4-5 Behavioural response SPL threshold ranges for each fauna group for each modelled scenario at LAT, MSL and HAT

Receptor Type	Sound Pressure Level (SPL) Behavioural Threshold (dB re 1µ Pa)	Threshold Range (metres) at tidal state		
		LAT	MSL	HAT
Location 1 – BHD digging (non-impulsive noise) (Talis Consultants, 2023; **Appendix 20**)				
Dolphin	120	303	454	909
Dugong	120	303	454	909
Turtle	Risk[†]	Low	Low	Low
Location 1 – BHD rock breaking with Xcentric Ripper (non-impulsive noise) (Connell et al., 2023; **Appendix 22**)				
Dolphin	120	14,700	14,000	13,100
Dugong	120	14,700	14,000	13,100
Turtle	Risk[†]	-	-	-
Location 1 – BHD rock breaking with hydraulic hammer (impulsive noise) (Connell et al., 2023; **Appendix 22**)				
Dolphin	160	270	220	170
Dugong	160	270	220	170

Receptor Type	Sound Pressure Level (SPL) Behavioural Threshold (dB re 1µ Pa)	Threshold Range (metres) at tidal state		
		LAT	MSL	HAT
Turtle	166	90	60	60
Location 2 – TSHD (non-impulsive noise) (Talis Consultants, 2023; **Appendix 20**)				
Dolphin	120	1,450	1,667	20,000
Dugong	120	1,450	1,667	20,000
Turtle	Risk†	Low	Low	Moderate
Location 3 – TSHD (non-impulsive noise) (Talis Consultants, 2023; **Appendix 20**)				
Dolphin	120	1,515	2,273	17,878
Dugong	120	1,515	2,273	17,878
Turtle	Risk†	Low	Low	Moderate
Location 3 – TSHD and CSD side-by-side (non-impulsive noise) (Talis Consultants, 2023; **Appendix 20**)				
Dolphin	120	3,000	3,181	20,000
Dugong	120	3,000	3,181	20,000
Turtle	Risk†	Low	Low	Moderate

For behavioural response thresholds, ranges for marine mammals (dolphins and dugongs) varied from 100s of metres to 10s of kilometres for scenarios modelled at MSL with the highest range being for the Xcentric Ripper tool (14 km for both dolphins and dugongs). A quantitative threshold for marine turtles was only considered applicable for impulsive noise (i.e., BHD hydraulic hammer scenario). The range for this threshold at MSL was predicted to be 60 m.

In addition to ranges at MSL, quantitative behavioural threshold ranges were also modelled across LAT and HAT (**Table 4-5**). The effect of water level on threshold range distance was not consistent between modelling studies. Modelling undertaken by Talis Consultants (2023) (**Appendix 20**) predicted much larger threshold ranges for noise emissions during HAT compared to MSL and LAT, whereas modelling undertaken by Connell et al. (2023) (**Appendix 22**) predicted only minor differences under different tidal conditions.

Behavioural effect ranges for impulsive noise (BHD rock breaking) were predicted to be much lower than ranges for non-impulsive noise.

For turtles, behavioural responses from non-impulsive noise have been based on a risk score (from Popper et al., 2014) based on distance from noise source where effects may be observed (Talis Consultants, 2023; **Appendix 20**). With the exception of HAT for the TSHD scenario and TSHD and CSD working side-by-side scenario (both ranked as Moderate risk, i.e., possible effects up to 100s of metres), the risk score was ranked as Low (i.e., possible effects up to 10s of metres) under all tidal states.

4.2.3.3 Comparison to Existing Darwin Harbour Underwater Noise Environment

Based on the behavioural response threshold ranges, there is the potential for species of interest (dolphins, dugongs and turtles) to be affected by noise from dredging vessels on a scale of 100s to 1000s of metres. These ranges are expected to be on a similar scale to ranges for underwater noise emissions from large non-project commercial vessels that use Darwin Harbour on a daily basis, as they have similar noise source levels and operate in the same areas of the harbour. The modelled behavioural effect ranges for impulsive BHD hammering are lower i.e., in the range of 10s to 100s of metres.

The existing underwater noise environment within Darwin Harbour is influenced by noise from non-project commercial and recreational vessel traffic. Large commercial vessels, such as cargo ships, LNG tankers, cruise ships and offshore oil and gas vessels enter, exit and move around the harbour on a regular basis, as shown by vessel Automatic Identification System (AIS) screenshots (from the AIS Live program) provided in **Figure 4-11**. Vessel movements are concentrated along designated shipping channels and around berthing areas (**Figure 4-11**).The proposed Project pipeline route and associated trenching areas are adjacent to these shipping channels and within the area of high-density vessel traffic shown in **Figure 4-12**.

Indicative source levels for typical large commercial vessels using Darwin Harbour are provided in **Table 4-6** along with source levels from trenching vessels modelled for the DPD Project. Trenching vessels (BHD, CSD and TSHD) are expected to produce noise intensities similar to large commercial vessels that use Darwin Harbour on a daily basis, including cargo ships, LNG tankers, cruise ships and offshore oil and gas vessels (**Table 4-6**).

Considering the similarity in noise intensity and area of operation between existing Darwin Harbour commercial vessels and DPD Project trenching vessels, the DPD Project is not expected to create underwater noise that is greater in intensity in comparison to existing shipping noise. The Project will however provide a more constant noise source in areas of trenching activity, when compared to the typically transient nature of commercial vessel movements. Trenching will occur over an indicative 3-month period and will be 24 hours/day, notwithstanding periods of no trenching when disposing dredged material at the spoil ground and scheduled/unscheduled downtime. Given the existing noise environment, it is expected that marine fauna will have developed some level of acclimatisation to vessel noise over a range similar to that modelled for the DPD Project. Underwater noise measurements undertaken by INPEX and provided within the Ichthys Project EIS show measured background noise levels within East Arm (an area of high-density vessel traffic) of 150 to 170 dB re 1 $\mu Pa^2/Hz$ (INPEX, 2011). Background noise of this intensity would likely create a 'masking' effect to additional noise sources (e.g., DPD Project vessels) thereby reducing detection and fauna behavioural response threshold ranges.

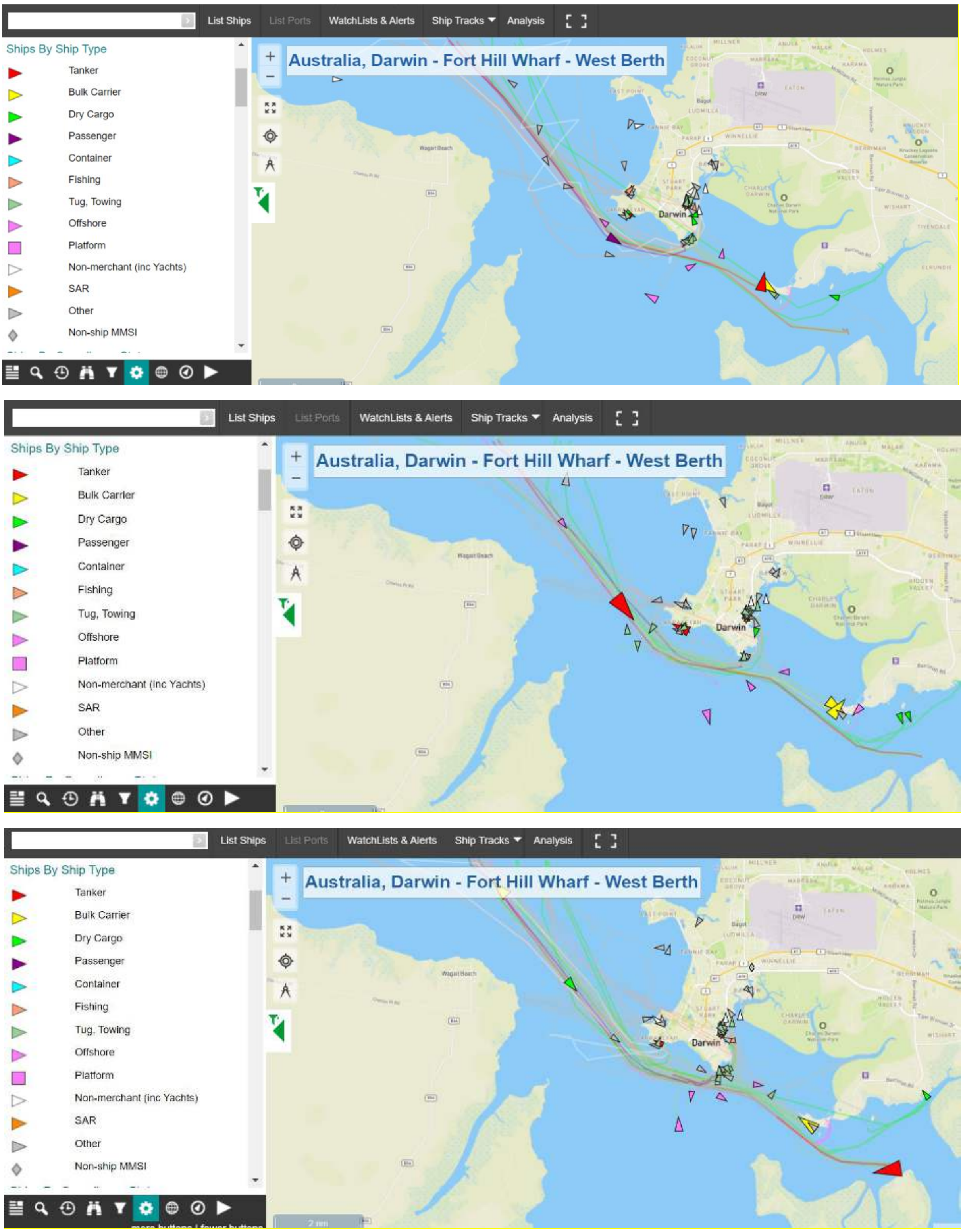


Figure 4-11 Vessel traffic by vessel type in Darwin Harbour on 6, 7 and 8 June 2022 from AIS data (AIS Live)

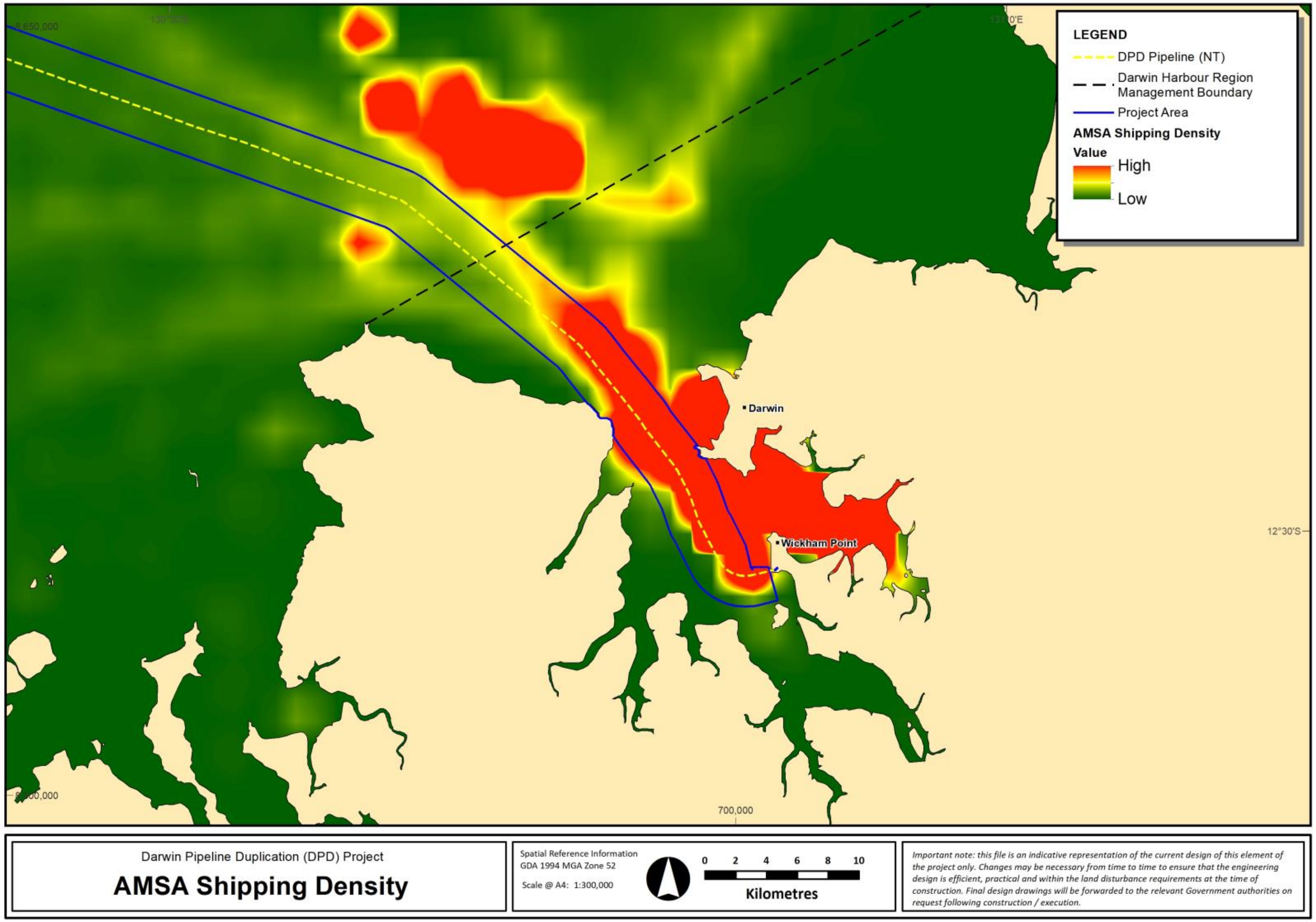


Figure 4-12 AMSA shipping density data for Darwin Harbour from January to May 2022

Table 4-6 Indicative noise levels from typical Darwin Harbour vessels and DPD Project trenching vessels

Vessel Type	Source Level (dB)	Frequency	Reference
Tanker and bulk carriers	180 to 186	Low (10 to 30 kHz)	INPEX (2011)
Offshore vessels (e.g., rig tender vessels)	177	Broadband	INPEX (2011)
Powerboats with 80 hp outboards (small recreational boats)	156 to 175	Broadband up to several kHz	INPEX (2011)
CSD	172 to 185	30 Hz to 20 kHz	Thomsen et al. (2009)
TSHD	184 to 188	30 Hz to 20 kHz	de Jong et al. (2010) Robinson et al. (2011)
BHD	175	30 Hz to 20 kHz	Reine et al. (2012)

4.2.3.4 Significance of Impacts to MNES species

This section describes the assessment of significant impact to MNES species due to noise emissions, considering significant impact criteria. Summary assessments of significant impacts to each individual species against all significant impact criteria in the guidelines, and considering all Project aspects, are also provided in **Section 3.2** and **Section 6**.

The potential for physiological impacts to EPBC Act listed marine megafauna (dolphins, dugong and turtles), in the form of PTS and TTS was determined through modelling of the highest underwater noise generating activities associated with the DPD Project, i.e., the operation of trenching vessels, including the use of rock breaking tools.

Predicted PTS SEL_{24h} threshold ranges for all species and modelled scenarios ranged from <50 m to 160 m. PTS impact within these ranges requires marine fauna to be within the range for 24 hours. Given the likely behavioural response to avoid the area prior to entering into a PTS zone, and the known mobility of these species, it is unlikely that these species would remain within these ranges for long enough for PTS injury to occur. Nevertheless, the monitoring of observation and exclusion zones around trenching vessels, and appropriate adaptive management measures to ceases trenching if fauna enter exclusion zones will be adopted for the Project to prevent potential impacts (**Section 5**) and have been included in the DPD Project Marine Megafauna Noise Management Plan (MMNMP) (**Appendix 23**).

For the non-impulsive noise sources of TSHD, CSD and BHD trenching, and the use of an Xcentric Ripper tool for rock breaking, modelled TTS SEL_{24h} threshold ranges varied between 40 m and 350 m. Threshold ranges were highest for dolphins (100 to 350 m), followed by dugongs (70 to 210 m) and marine turtles (40 to 160 m). As with the PTS thresholds ranges, it is unlikely that these EPBC Act listed marine fauna would remain within these ranges long enough (i.e., for 24 hours or greater) for TTS impacts to occur. Additionally, there are no known aggregation areas for these fauna within this vicinity of trenching areas. However, the application of observation and exclusion zones, monitored from trenching vessels, will be adopted to avoid TTS impacts.

Modelling undertaken for impulsive noise from use of a hydraulic hammer for rock breaking from the BHD predicted that PTS and TTS threshold ranges would be much larger than for trenching non-impulsive noise sources. In particular, the scale of hydraulic hammering TTS threshold ranges (in the order of kms) suggests that TTS impacts may occur to marine fauna remaining within these ranges for 24 hours or more. Avoidance of this impulsive noise source may not occur until marine fauna is well within the TTS range, given behavioural response threshold ranges are ≤270 m. As described in **Section 4.2.3.1**, use of an Xcentric Ripper tool, which produces non-impulsive noise, is intended to be used for rock breaking from the BHD. Consideration of the use of a hydraulic hammer has been undertaken only as a contingency. Additional management controls will be implemented (over and above those proposed for other trenching activities) should a hydraulic hammer be used (**Section 5** and **Appendix 23**). This includes monitoring of much larger observation and exclusion zones and restricting the time for hydraulic hammering.

Based on the modelled behavioural response threshold ranges, particularly the non-impulsive noise threshold ranges, there is the potential for species of interest (dolphins, dugongs and turtles) to be affected by noise from dredging vessels on a scale of 100s to 1000s of metres. These ranges are expected to be similar to those associated with noise emissions from large commercial vessels that use Darwin Harbour on a daily basis, as they have similar noise source levels and frequency bands and operate in the same areas (see **Section 4.2.3.3**). Given the existing noise environment, it is expected that marine fauna will have developed some level of acclimatisation to vessel noise over a range similar to that modelled for the Project trenching vessels. It is also likely that some masking of Project vessel noise above the marine mammal behavioural threshold of 120 dB re 1µ Pa would occur from other commercial vessels that transit Darwin Harbour. In support of this, ambient noise measurements taken by noise loggers in East Arm by Salgado-Kent et al. (2015) recorded that noise from transiting commercial vessels was frequently in the range of 130 to 140 dB re 1 µPa. Masking of Project vessel noise by other anthropogenic noise sources would be expected to diminish the range of behavioural effect ranges around Project vessels in areas and times where other vessels are active. While there may be a more prolonged exposure of marine fauna to noise above behavioural threshold levels from slow moving trenching vessels working in an activity area (i.e., a trenching zone) when compared to transiting commercial vessels, trenching activity is expected to be completed relatively quickly, within a period of two to three months across all trenching areas, and therefore any behavioural responses are considered temporary.

On the basis that physiological impacts (PTS and TTS) to EPBC Act listed marine fauna from Project underwater noise emissions will be avoided through the application of industry standard management controls described in **Section 5** and the MMNMP (**Appendix 23**), and behavioural responses will be temporary and on the same scale as from existing commercial vessel using Darwin Harbour, impacts to marine fauna from underwater noise emissions are considered to be minor.

MNES Significant Impact Guidelines 1.1 (DoE, 2013) defines a significant impact on a migratory species to be if there is a real chance or possibility that an action seriously disrupts the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Given the high mobility of the relevant EPBC Act listed marine megafauna (dolphins, dugong and turtles), the relatively small behavioural effect ranges relative to the total area of Darwin Harbour, the short duration of trenching activities and the implementation of appropriate management measures, the noise associated with DPD Project construction is not expected to create a serious disruption to the lifecycle of local populations of dugongs, dolphins and turtles using Darwin Harbour and surrounding NT waters.

4.2.3.5 Significance of Impacts to Commonwealth Marine Area

This section describes the assessment of significant impact to the Commonwealth marine environment due to noise emissions, considering significant impact criteria for the Commonwealth marine environment described in MNES Significant Impact Guidelines 1.1 (DoE, 2013). A summary assessment of significant impacts to the Commonwealth marine area considering all Project aspects is also provided in **Section 3.2** and **Section 6**.

Vessels operating in the Commonwealth waters part of the Project area will create noise through use of vessel thrusters (for dynamic positioning), other vessel equipment and through pipeline/seabed structure installation noise. No trenching will occur in this area. The potential for significant noise impacts within the Commonwealth marine area is considered to be lower than within NT waters or Darwin Harbour given that key MNES species susceptible to noise impacts (i.e., dugongs, dolphins and turtles) are expected to be less abundant and more transient in these waters. Furthermore, vessels are expected to spend considerably less time in this part of the Project area than in NT waters and Darwin Harbour where additional activities will occur (e.g., trenching, rock installation) and the pipelaying process will be slower.

4.2.4 Treated Seawater Discharges

Planned Project discharges that may impact water quality are detailed below. Impacts to water quality due to increased turbidity and suspended sediment from trenching and spoil disposal are addressed in **Section 4.2.1**.

4.2.4.1 Contingency Treated Seawater Discharge in NT waters

Treated seawater discharges within Darwin Harbour and NT waters are not planned, with treated seawater used for FCGT activities only planned to be discharged in Commonwealth waters at the PLET location (refer **Section 4.2.4.2**).

However, in the unlikely event of a wet buckle (i.e., failure of the pipeline during pipe laying), the pipeline may need to be preserved with treated seawater until such time that a repair can occur (refer **Section 2.4.3.10**). This seawater will need to be treated with a preservation chemical consisting of a biocide, corrosion inhibitor and oxygen scavenger to preserve the pipeline. For chemicals discharged to the environment, Santos preferentially selects for use those chemicals which are rated as Gold/Silver through the Offshore Chemical Notification Scheme (OCNS) Chemical Hazard and Risk Management (CHARM) or OCNS group rating of D/E (if not CHARM rated). A preservation chemical such as Roemex Hydro 3 dosed at a rate of 550 mg/L will be used to treat the seawater to be pumped into the pipeline. These chemicals are biodegradable with low potential for bioaccumulation.

This treated seawater would require subsequent discharge at the repair site. Such a contingency discharge has been modelled (RPS, 2022b; **Appendix 18**) considering the following release scenarios:

+ 600m^3 overfilling discharge (overflow release of treated seawater during pipeline filling).

- Pipeline dewatering, volume will depend upon length of pipeline being dewatered with the following three scenarios modelled:
  - 19,958 m^3 over 21.4 hours outside of Darwin Harbour.
  - 10,623 m^3 over 11.4 hours at Darwin Harbour mouth.
  - 4,400 m^3 over 4.7 hours in the inner harbour.

Model results of treated seawater dilutions were compared to no observable effect concentrations (NOEC) derived from laboratory ecotoxicology studies for Hydrosure 0-3670R (Chevron, 2015), following protocols recommended in ANZECC & ARMCANZ (2000). The NOEC values were established for various levels of aquatic species protection, including concentration thresholds that are expected to protect 80%, 90%, 95% and 99% of aquatic species. The 99% species protection concentration is suggested by ANZECC & ARMCANZ (2000) for development of environmental criterion for high conservation ecosystems or chemicals that tend to bioaccumulate.

The NOEC values for the varying species protection levels and the dilutions to achieve the concentration based on a dosage of 550 mg/L (ppm) Hydrosure are presented in **Table 4-7**.

Table 4-7 Dilutions of Hydrosure required to fall below NOEC values for varying species protection levels

Species protection level	NOEC threshold (mg/L) (from Chevron 2015)	Dilutions required to achieve the NOEC threshold based on Hydrosure dosing concentration of 550 mg/L
PC99%	0.06	1:9,167
PC95%	0.10	1:5,500
PC90%	0.15	1:3,667
PC80%	0.23	1:2,391

The modelling demonstrated rapid dilution and decreasing concentrations of the preservation chemical with increasing distance from the release location for all modelled scenarios (RPS, 2022b, **Appendix 18**). This resulted in concentrations not exceeding the conservative (protecting 99% of species) NOEC level of 0.06 mg/L for a period where effects would be expected to be observed (>48 hours).

Therefore, in the unlikely event of a wet buckle, release of treated seawater would only result in a localised and temporary effect on water quality around the discharge location, with aquatic species not expected to be adversely affected.

4.2.4.2 Planned Treated Seawater Discharge in Commonwealth Waters

Approximately 7,650 m^3 of seawater, treated with a preservation chemical such as Hydrosure, will be discharged at the Project Pipeline PLET during flooding, cleaning, gauging and testing (FCGT) associated with pipeline pre-commissioning activities (**Section 2.4.3.8**). On completion of FCGT, the flooded pipeline will be dewatered and conditioned with mono-ethylene glycol (MEG) and the pipeline will be packed with nitrogen. The dewatering activities will result in approximately 50,000 m^3 of treated seawater and approximately 1,000 m^3 of MEG separately discharged at the Project Pipeline PLET. In addition, nominal amounts of MEG and seawater will be discharged during the spool leak testing between the Project Pipeline PLET and the Barossa GEP PLET (see **Table 2-4**).

Monoethylene glycol (MEG) (CAS number 107-21-1) is a colourless, odourless, involatile, hygroscopic liquid. It is characterised by two hydroxyl groups, which contribute to its high water-solubility, hygroscopicity and reactivity with many organic compounds. MEG is on the OSPAR PLONOR (poses little to no risk to the environment) list and is therefore deemed safe to discharge to the marine environment. MEG is soluble in water, does not volatilise or undergo photodegradation, and is not adsorbed on to soil particles (Hook and Revill, 2016). Ethylene glycols biodegrade readily when released to the environment, and several strains of micro-organisms can use them as an energy source.

The dispersion and dilution of the discharge was modelled (RPS, 2021; **Appendix 23**) to predict the zone for any potential toxicological effects to aquatic biota. **Table 4-8** presents the modelling parameters applied at the PLET subsea discharge of the treated seawater volume. A 57,000 m^3 discharge was modelled over 35 hours (planned discharge volume is approximately 50,000 m^3).

Table 4-8 Summary of model parameters used in PLET seabed discharge modelling

Parameter	Value/design
Maximum discharge volume	57,000 m^3
Discharge duration	35 hours
Model run duration	3 days
Discharge depth (m)	3.5 m above the seafloor
Diffuser configuration	Three 4” ports spaced 4” apart and oriented 45° vertically upwards
Exit diffuser velocity (m/s)	21.3
Hydrotest water temperature (°C)	28.2 - same as ambient
Hydrotest water salinity (psu)	34.6 - same as ambient
Initial chemical treatment concentrations (biocide, oxygen scavenger, dye mixture)	550 mg/L

Model results of treated seawater dilutions were compared to NOECs for Hydrosure 0-3670R (Chevron, 2015), shown in **Table 4-7**. All results show that concentrations did not persist above NOECs for more than 48 hours (which is the typically exposure period used to determine the NOEC).

Modelling was also undertaken of the more conservative scenario showing the zones where exceedances of the NOECs occurred for a period of 12 hours. **Figure 4-13** shows the extent of these zones based on all 25 simulations of the stochastic modelling.

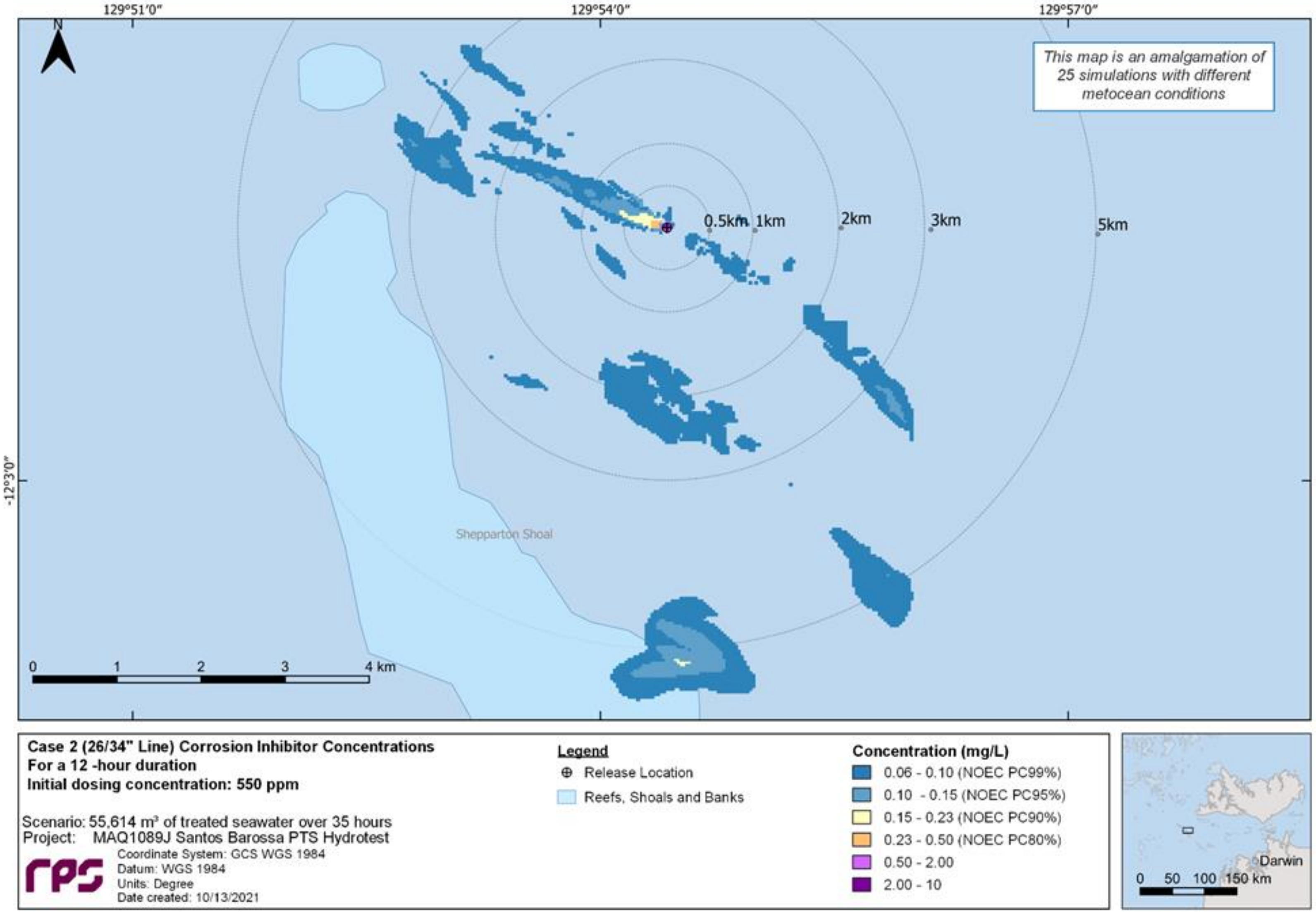


Figure 4-13 Maximum predicted Hydrosure concentrations assessed over a 12-hour continuous exposure period

The maximum distance from the release location to the PC99% of 0.06 mg/L was 7.23 km, and the maximum distance from the release location to the PC95% of 0.10 mg/L was 5.33 km. The maximum distance based on the PC80% (0.23 mg/L) did not exceed 0.2 km.

One run of the 25 simulations (under various metocean conditions) resulted in exposure to the shoulder of Shepparton Shoal south of the release location, representing a 4% probability of exposure at the NOEC PC90% concentration of 0.15 mg/L.

The modelled results are considered to be conservative given the modelled Hydrosure discharge concentration was set at the dosing concentration of 550 mg/L. In practice, the Hydrosure concentration will biodegrade over time during the hydrotest and reduce in concentration within the pipeline. It is therefore expected that discharge concentrations will be less than that modelled, and mixing and dilution to the NOEC PC90% (and other mixing zone boundaries) will occur closer to the discharge point than indicated by the modelling outputs.

Ethylene glycol (MEG) is readily biodegradable and has low toxicity to aquatic organisms (WHO, 2000). A substantial database on its toxicity to aquatic organisms is reported by WHO (2000), with a predicted no effect concentration (PNEC) of 859 mg/L. Assessment of the 1,000 m^3 neat MEG conditioning discharge at the PLET has been undertaken using this value. Modelling outputs for the hydrotest water discharge at the PLET (described above) show that dilutions of up to 10,000 occur at Shepparton Shoal (as represented by the dilutions required to meet the Hydrosure NOEC PC99%, see **Table 4-7**). This represents a MEG concentration in the order of 100 mg/L for the once-off discharge, which is well below the PNEC value of 859 mg/L. As shown in **Figure 4-13**, the zone to meet the Hydrosure PC80% is very small, with the maximum distance not exceeding 0.2 km. This zone represents a mixing zone boundary of about 2,400 dilutions (see **Table 4-7**). The MEG concentration at this boundary would therefore be approximately 420 mg/L, which is also well below the PNEC value of 859 mg/L. No significant impact to the marine environment from the release of MEG at the PLET is therefore expected.

4.2.4.3 Significance of Impacts to MNES Species

This section describes the assessment of significant impact to MNES species due to treated seawater discharges, considering significant impact criteria. Summary assessments of significant impacts to each individual species against all significant impact criteria in the guidelines, and considering all Project aspects, are also provided in **Section 6**.

Treated seawater discharges associated with contingency pipeline filling and dewatering associated with a wet buckle event, or planned FCGT and dewatering activities in Commonwealth waters at the PLET location, are not expected to impact MNES species (marine turtles, dolphins and dugongs). Treated seawater will rapidly dilute to levels that will not cause effects to these mobile species or any habitats on which they may forage (e.g., seagrass).

4.2.4.4 Significance of Impacts to Commonwealth Marine Area

This section describes the assessment of significant impact to the Commonwealth marine environment due to treated seawater discharges, considering significant impact criteria for the Commonwealth marine environment described in MNES Significant Impact Guidelines 1.1 (DoE, 2013). A summary assessment of significant impacts to the Commonwealth marine area considering all Project aspects is also provided in **Section 6**.

Plankton drifting past the PLET discharge location at the time of discharge may be exposed to concentrations of Hydrosure and MEG above that which could elicit an effect. However, dilution of the plume is rapid and the exposure concentration travelling with the organism will continually reduce. There may be effects to some individuals; however, plankton are widely distributed in the ocean and regenerate rapidly.

Sediments are unlikely to be impacted as the release will be through a diffuser, three to four metres above the seabed and orientated vertically upwards.

No protected or sensitive benthic habitats have been identified with the potential to be exposed to the dewatering plume. The seabed consists predominantly bare sediments or sparse filter feeders, with large sensitive banks and shoals too far away to be impacted. Shepparton shoal is 3 km from the PLET at its closest point and the dewatering discharge dispersion modelling shows adverse impacts to aquatic biota due to Hydrosure and MEG are unlikely to occur.

4.2.5 Unplanned Events

4.2.5.1 Unplanned Introduction of Invasive Marine Species

Ecosystem health may potentially be impacted from the introduction of an invasive marine species (IMS), especially within Darwin Harbour. The introduction of IMS may result in considerable modification of the environment through out-competing native species and modifying existing habitats. Such modifications may result in significant environmental impact, including decrease in biodiversity, reduction in coastal aesthetics and overall ecosystem health, potentially negatively impacting MNES species.

Vessels are the most common vector for the translocation of IMS in the marine environment. IMS can be introduced or spread when vessels are mobilised to the Project area, particularly if the vessels originate from international waters with similar water temperatures (i.e., south-east Asia). IMS may be present as biofouling (i.e., adult sessile organisms) on vessel hulls and submersible equipment, and in vessel ballast water (i.e., as larvae).

IMS risks are well known, and the Santos group has internal company procedures and complies with Commonwealth legislation and industry standards to minimise the risk of introducing IMS to Australian waters across all its offshore operations (see **Section 5**). Santos has for an extended period of time successfully applied these measures to its numerous offshore operations and considers the risk of introducing IMS to be low.

Summary assessments of significant impacts to each individual species and the Commonwealth marine area against all significant impact criteria in MNES Significant Impact Guidelines 1.1 (DoE, 2013), and considering all Project aspects, are also provided in **Section 6**. This includes specific consideration of any actions that may result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.

4.2.5.2 Unplanned Marine Fauna Interaction

The risk of vessel strike to marine fauna is inherent to movements of all vessel types and is recognised as a threat to marine species of MNES.

The impact from vessel interactions with marine fauna can be as minimal as temporary behavioural changes, ranging to severe impacts, such as injury or mortality resulting from vessel strike. The potential risk of a collision with marine fauna is directly related to the abundance of marine fauna and number of vessels in the Project area, and the actual likelihood of a collision occurring is also influenced by vessel speed. As presented in DoEE's (now DCCEEW) National Strategy for Reducing Vessel Strike on Cetaceans and Other Marine Megafauna (DoEE, 2017c), the majority of the reported vessel collisions have occurred along eastern or south-eastern Australia, with no reported incidences in NT waters. Additionally, a review of records of vessel collisions with marine megafauna reported a higher number of collisions with whale-watching boats, naval ships and container ships (DoEE, 2017c).

Vessel speed has been demonstrated to be a key factor in relation to collision with marine fauna, particularly cetaceans and turtles, with faster moving vessels posing a greater collision risk than slower vessels (Hazel et al. (2009); Jensen and Silber (2004); Laist et al. (2001); DoEE (2017c)). Laist et al. (2001) suggest the most severe and lethal injuries to cetaceans are caused by vessels travelling at 14 knots or faster.

Collisions with smaller cetaceans, such as dolphins, are very infrequent due to their high mobility allowing them to avoid vessels.

While dugongs may occur in the Project area, dugongs in the Darwin Harbour area spend most of their time in shallow tidal and subtidal seagrass meadows less than 10 m water depth away from Project activities (Cardno, 2015a).

Turtle/vessel interactions arising from increased vessel traffic is also recognised as one of several key impacts to marine turtles in the Recovery Plan for Marine turtles in Australia (DoEE, 2017a). In the recovery plan, vessel disturbance is identified as a risk to flatback turtles. The plan also notes that while a vessel strike can be fatal for an individual turtle, vessels strike (as a standalone threat) has not been shown to cause declines at a population or stock level and have considered vessel disturbance to be of minor consequence to turtle populations in the NT (DoEE, 2017b). In the recovery plan, vessel disturbance is identified as a risk to flatback turtles. Approved Conservation Advice for *Dermochelys coriacea* (leatherback turtle) (DEWHA, 2008) listed boat strike as a threat.

While Project vessels potentially present a risk to marine fauna, due to the slow speed of the pipelay vessel (<1 knot) it is considered to be effectively immobile and therefore presents a very low likelihood of vessel collision with marine fauna. Other Project vessels (e.g., construction, pipe support, rock placement, 'dredging', etc.) will also move at slow speeds and operate within Darwin Port speed limits. Vessels will be required to comply with Santos' marine fauna procedures which address the requirements of Part 8 of the EPBC Regulations 2000 and specific protocols for the observation and management of trenching operations within observation and exclusion zones. Santos considers the risk of adverse interactions with marine fauna to be low with these measures in place.

The likelihood of vessel strike will be no greater than for other vessels in Darwin Harbour and less so in deeper water including Commonwealth waters.

Trenching activities pose a higher risk to marine fauna, with TSHDs responsible for injuring or killing marine turtles near the seabed through interaction with dredging equipment. In comparison, CSDs and BHDs do not pose this risk as they lack the trailing dragheads found on TSHDs (Dickerson et al., 2004). There are operational aspects for using the TSHD that can reduce the risk of turtle interactions. Turtle 'tickler' chains that are designed to move turtles out of the way of the trenching will also be on the trailing arms of the TSHD. Given the avoidance behaviour that is likely to be displayed by marine fauna and the controls that will be implemented, interactions that lead to injury or death are considered unlikely during trenching activities.

4.2.5.3 Unplanned Marine Diesel Release

Of any potential spills associated with the Project, the accidental release of diesel from Project vessels (refuelling incident or vessel collision) is considered to have the greatest potential for impact to MNES. Other spills associated with vessel / ROV activities or onshore activities, such as minor spills of chemicals, fuels and hydraulic fluids, are considered to have a lower potential for MNES impact with the adoption of standard practices for prevention and mitigation, which are described in **Section 5**.

With management measures in place, the likelihood of a Project vessel incident resulting in a marine diesel spill (from vessel collision or refuelling spill) is considered to be low and not greater than other vessels using Darwin Harbour. Project vessel activities will be undertaken at slow speeds, lessening the potential and consequence for collision or grounding incidents and associated spills of diesel. Control measures will follow standard maritime practises as well as Project and Port of Darwin controls. As vessel-based activities are part of operations, the potential for an unplanned marine diesel release will remain during operations although, given operations support vessels are typically smaller than construction vessels, the maximum potential volume of diesel spills will be lower.

Studies and field observations suggest that cetaceans may be able to detect and avoid hydrocarbon slicks (Geraci and St Aubin, 1988). Cetaceans are vulnerable to the effects of surface hydrocarbons due to the need to surface and breathe. Direct contact with surface slicks and inhalation of vapours may irritate eyes, airways and lungs. Lethal or sub-lethal effects will depend on the concentration of the hydrocarbons and the duration of exposure. Potential impacts to dugongs are expected to be similar to cetaceans given their sensitivity to hydrocarbon exposure is likely to be similar.

Marine turtles are susceptible to the effects of hydrocarbon spills during all life stages (NOAA, 2014). They are in frequent contact with the sea surface and show little avoidance behaviour in response to the presence of surface hydrocarbons, which makes them vulnerable to coating and inhalation of toxic vapours.

Contact with surface slicks or entrained hydrocarbon can therefore result in hydrocarbon adherence to body surfaces (Gagnon and Rawson, 2010) causing irritation of mucous membranes in the nose, throat and eyes leading to inflammation and infection (NOAA, 2014). Oiling can also irritate and injure skin which is most evident on pliable areas such as the neck and flippers (Lutcavage et al., 1995).

Given spilled diesel is expected to disperse and weather rapidly under the ambient conditions in the marine environment, the potential for impacts to marine mammals would be expected to be concentrated around the release location. An Oil Pollution Emergency Plan (OPEP) for the Project will be in place that include Santos and Control Agency arrangements and response strategies (**Appendix 10**) informed by oil spill modelling results (RPS, 2022d; **Appendix 9**). OPEPs will include oiled wildlife response arrangements applicable for local wildlife, including MNES species.

4.2.5.4 Unplanned Dry Gas Release from Pipeline Rupture During Operations

A worst-case pipeline rupture during operations would result in a release of 'dry' gas to the environment which would move towards the surface forming a large plume in the water column and dispersing into the atmosphere. Consequently, the gas cloud may result in impacts to air-breathing fauna, such as marine mammals, with the worst-case outcome for animals in the immediate vicinity of the release being asphyxiation, potentially resulting in mortality. Given the dispersion of gas into the atmosphere, this potential effect would be highly localised to the release location and short term while the gas supply is being isolated.

In consideration of pipeline engineering and installation design (e.g., pipeline specifications including coating, trenching, rock armouring, etc.) and mitigation measures (e.g., pipeline isolation and spill response), the potential of a dry gas release from a pipeline rupture during operations impacting marine mammals is considered to be low.

4.3 Potential Cumulative Impacts from Planned Activities

An assessment of cumulative impacts from DPD Project activities and existing and proposed project activities that may overlap the DPD Project area in time and/or space has been undertaken. A detailed cumulative assessment of other existing activities and other proposed project activities is provided in Section 13 of the SER (**Appendix 2**) and is relevant to the DPD Project in NT waters. This section summarises the implementation and outcome of that assessment process and also assesses the potential for cumulative impacts of the DPD Project in Commonwealth waters.

4.3.1 Concurrent Barossa Project Activities

Cumulative impacts across the extent of the Barossa project and DPD Project activities have been assessed. There will be concurrent activities associated with DPD installation, Barossa Subsea, Umbilical, Riser and Flowline (SURF) installation and drilling and completion of the Barossa wells. However, the operational area for drilling and SURF activities is ~200 km distant from DPD Project area.

The Audacia deep water pipelay vessel will install the deeper water section of the DPD pipeline after the GEP installation is completed so there will not be concurrent DPD and GEP pipelay activities in Commonwealth waters and the deeper section of NT waters.

A one-off treated seawater discharge from the GEP will occur at the FPSO at a different time and ~200 km distant from the DPD PLET treated seawater discharge in Commonwealth waters.

There may be increased vessel transit through Darwin Harbour related to Barossa project and DPD Project concurrent activities that will occur outside the DPD Project area, with the potential for cumulative noise impacts. However, given the short duration of concurrent activities and the mobility of noise sensitive fauna species that may transit through the area, noise generated is predicted to attenuate below injury and disturbance thresholds. Therefore, cumulative noise effects are considered to be negligible, with no change to the overall assessment of no significant risk.

The overall extent of the Barossa and DPD project area minimises cumulative impact with SURF and drilling activities ~200 km distant from DPD. It is therefore assessed that there is no significant cumulative impact to the DPD Project from other Barossa project activities.

4.3.2 External Project Activities

There are a number of existing activities and proposed projects within Darwin Harbour and the wider region that have the potential to impact the environment, which have been evaluated as part of the cumulative impact assessment for the DPD Project in NT waters, as presented in the SER (**Appendix 2**). These include government and private infrastructure projects, Darwin Harbour dredging activities, and resource processing operations.

Relevant projects which may result in cumulative impacts as defined by searching the following databases:

+ NT EPA environmental impact assessment register.
+ NT EPA consultation hub (open and closed consultations).
+ Department of Chief Minister and Cabinet Major Projects.

+ Department of Planning, Infrastructure and Logistics list of government projects.

The full list and description of projects identified form this process is provided in Table 13-1 of the SER (**Appendix 2**).

Following an assessment of the potential for spatial and temporal overlap of these other projects with the DPD Project (refer Section 13.1.1 of the SER, **Appendix 2**), the following five projects were identified as having the greatest potential for overlap:

+ Department of Infrastructure, Planning and Logistics – Mandorah Marine Facilities.
+ Department of Defence – HMAS Coonawarra – Dredging and Dredged Material Management.
+ Department of Chief Minister and Cabinet – Darwin Ship Lift and Marine Industries Project.
+ INPEX – Ichthys Maintenance Dredging.
+ Australia-Asia Powerlink Australia Assets Pty Ltd – Australia-Asia Powerlink Project.

Since the identification of these projects was based on NT records, a review of the EPBC Act referral database was undertaken (past 5 years of records – 2018 to 2023) to determine if there were any potentially overlapping projects in Commonwealth waters, or relevant projects referred to the Commonwealth, they may have been missed in the assessment of NT records. This additional search did not identify any further projects.

With the exception of the Australia-Asia Powerlink Project, the identified projects are entirely based in Darwin Harbour and spatial overlap of activities and impacts with the DPD Project is considered to be confined to this area.

The Australia-Asia Powerlink Project involves subsea cabling that extends into Commonwealth waters, however the potential spatial interaction of activities with the DPD Project (potential crossing of cabling and pipeline) is within NT waters and therefore the greatest potential for cumulative impacts is within this jurisdiction.

A detailed assessment of the five additional projects was undertaken and provided in the SER (Sections 13.2 to 13.5, **Appendix 2**) considering cumulative impacts to water and sediment quality, marine habitats, and marine fauna. This concluded that there is a low potential for significant cumulative impacts, attributable in part to the limited spatial overlap of the DPD Project with other current and proposed projects, considering the nature and scale of their activities and impacts, and to the fact that the residual consequence of all the planned impacts from the DPD Project are no greater than minor.

Effects on water quality from Project trenching and spoil disposal, and pipeline FCGT and dewatering discharges, are expected to be short lived with water quality returning to within natural variability levels within short spatial ranges.

Should other proponents be considering similar activities over similar locations and time frames to Project activities, Santos will work with other proponents to consider the potential for cumulative impacts and mitigation to no significant impact. In particular, the potential for cumulative impacts with other Darwin Harbour dredging operations has been addressed within the TSDMMP for the DPD Project (**Appendix 15**) and the management and mitigation measures for trenching and disposal activities (**Table 5-1**) and the implementation of these measures will assist in reducing the adverse impacts that may result from the DPD Project and its interaction with other projects that may occur at the same timeframes or location.

In addition to the five external proposed projects, the impacts from existing Darwin Harbour users and activities and impacts and disturbance resulting from the previous construction and ongoing operation of the Bayu-Undan to Darwin pipeline and the Ichthys pipeline were also considered.

In terms of cumulative impacts associated with the existing gas export pipelines intersecting the DPD Project area, given the DPD pipeline route is close to the existing Bayu-Undan pipeline and Ichthys pipeline in Darwin Harbour and the linear disturbance footprint around the pipeline is narrow (approximately within 50 m) and away from significant benthic habitats and turtle nesting areas, potential cumulative impacts to marine mammals and reptiles from the cumulative disturbance to habitat is not considered to be significant.

Based on Project pipeline route surveys and existing benthic habitat mapping (Heyward et al., 2017; Galaiduk et al., 2019; Udyawer et al., 2021; RPS, 2022a **Appendix 7**) benthic habitats directly disturbed by the Project (e.g., pipelay) are considered to be well represented within the Darwin Harbour region as well as deeper waters of the Project area, including Commonwealth waters, and therefore the disturbance of seabed is not expected to add significantly to existing benthic habitat loss and disturbance from the Bayu-Undan and Ichthys pipelines.

There is the potential for cumulative impacts with respect to existing commercial vessel activities, this is expected to be greatest within the Darwin Harbour and immediately offshore where the DPD pipeline route is immediately adjacent to the shipping channel and commercial vessel activity is concentrated within the channel, wharves and anchorages. As the DPD pipeline route moves out of Darwin Harbour the shipping channel deviates further away from the pipeline route. Light and noise impacts from Project vessel activities are considered localised, relative to the distribution and movements of marine mammals and reptile species, and the incremental additional light and noise to existing vessel activities occurring in the vicinity of the DPD Project area, are not considered to present a significant cumulative impact (**Section 6.2.2.1** and **Section 6.3.2.1**).

5 Measures to Avoid and Reduce Impacts

5.1 Management Plans and Monitoring

Santos commits to implementing management actions during construction and operations to ensure impacts and risks to the receiving environment and sensitive receptors are acceptable and remain as low as reasonably practicable. As such, a number of management plans have been developed or are being developed for the Project, including:

+ Trenching, Spoil Disposal Management and Monitoring Plan (TSDMMP) (**Appendix 15**).
+ Acid Sulphate Soil and Dewatering Management Plan (ASSDMP) (**Appendix 12**).
+ Onshore Construction Environmental Management Plan (CEMP) (**Appendix 13**).
+ Offshore Construction Environmental Management Plan (CEMP) (**Appendix 14**).
+ Marine Megafauna Noise Management Plan (MMNMP) (**Appendix 23**).
+ Operations Environmental Management Plan (OEMP) (*being developed*).
+ Oil Pollution Emergency Plan (OPEP) (**Appendix 10**).

Plans will be assessed and approved, as applicable, under the following relevant NT and Commonwealth petroleum legislation:

+ *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.
+ *NT Petroleum (Submerged Lands) Act 1981*.
+ *NT Pipeline Energy Act 1981*.

A marine environmental monitoring program specific to construction activities will be implemented to validate the environmental assessment. The EMPs and monitoring results will be publicly available.

The management measures to avoid and mitigate impacts and risks from the DPD Project to listed threatened and migratory species and Commonwealth marine areas are presented in **Table 5-1**, and have been captured in the abovementioned environmental management plans (EMPs) as relevant. Controls have been informed by NT EPA and EPBC Act referral commitments and subsequent feedback and consultation with government and the public and have been reviewed through environmental impact identification (ENVID) workshops and EMP development. **Table 5-1** should be viewed as a consolidated list of measures to avoid and mitigate impacts of the DPD Project, which have been considered in the assessment of potential impacts described in **Section 6**.

Table 5-1 Avoidance, mitigation and monitoring measures applied to the relevant environmental aspects for the DPD Project

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
Seabed and Foraging Habitat disturbance	MA12	The pipeline route has been surveyed (geophysical and geotechnical) to evaluate seabed in conjunction with engineering design requirements. Trenching, stabilisation and freespan correction/ prevention will only be undertaken at identified areas (using standard positional accuracy measures used in the industry).	X	X	X
	MA20	In shallower waters, anchor exclusion areas will be implemented to avoid sensitive habitats and heritage sites.	X		X
	-	Placement of pipe to be based on subsea heritage and habitat assessment studies to enable the avoidance of designated sensitive benthic habitats, and heritage and culturally sensitive areas.	X	X	X
	MA28	Adaptive management process is defined within the Trenching and Spoil Disposal Management Plan (TSMMP) (**Appendix 15**). Environmental monitoring of water quality with management measures applied if water quality exceeds trigger levels.	X	X	X
	MA13	Overflow from the TSHD will be undertaken through the adaptive management processes. There will be an 'environmental valve', or 'green valve' where available (attached to O/F to reduce air entrained, to reduce billowing and facilitates sediment sinking) as standard which will be used as a first step to capture fine sediment from disposal at dredge.	X	X	X
	MA14/ MA15	Standard operating procedure for spoil disposal will be used. Spoil will not be disposed of in a single location, so will avoid developing a single large mound at the spoil disposal ground.	X	X	X

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
	MA17	Dynamically Positioned (DP) pipelay vessel will be used to install the pipeline in deeper waters. The DP vessel can be used in deeper water from KP23 (Territorial water boundary) to approx. KP91.5 where shallow water (<20 m) occurs and will not require anchoring.	X	X	X
	MA18	An Anchor Management Plan will be developed to allow safe anchoring of vessels undertaking pipelay, trenching and pile driving activities in the vicinity of nearshore heritage or sacred sites.	X	X	X
	MA19	Use of trained and competent anchor handling operators.	X	X	X
	MA22	Differential Global Positioning System (DGPS) for pipelay vessel to maintain accurate vessel position during installation.	X	X	X
	MA23	Checks prior to installation to confirm: + DGPS used to confirm ILT foundation structure position during installation. + Underwater positioning system (USBL/transponders) and ROV to confirm installation location and positioning of pipeline (within required location accuracy to reduce disturbance to the seabed).	X	X	X
	MA24	Installation plan developed and includes: + Requirement for trained and experienced vessel crews. + Trenching will be restricted to only areas where required.	X	X	X
	MA25/ MA26	Based on subsea heritage and habitat assessment studies, span-specific rectification plans developed that include:	X	X	X

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
		+ Pre-span method selection. + Real-time monitoring of span rectification. + Post-rectification inspections. + Permanent rock installation will be limited to only those pipeline sections requiring stabilisation and/or anchor protection.			
	MA29	Continuous monitoring of anchor wire tensions to prevent anchor drag on seabed. Additionally wire length measurement of the winch will be monitored. Based on experience this parameter is a good indicator to prevent anchor drag. These two parameters are monitored to act as mitigation to prevent anchor drag.	X	X	X
	MA28	Adaptive management process as defined within a Trenching and Spoil Disposal Management Plan (**Appendix 15**). Environmental monitoring of water quality with management measures applied if water quality exceeds trigger levels.	X	X	X

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
Contingency treated seawater discharge - from wet buckle scenario	MA71	Pipeline installation procedures to be prepared and followed.	X	X	X
	MA71	Shallow water pipelay barge has redundancy in its anchors for stability.	X	X	X
	MA71	Deep water pipelay vessel has redundancy in its station keeping abilities and operates in accordance with approved activity specific operating guidelines.	X	X	X
	MA72	Chemical selection procedure for all chemicals, including treated seawater discharged to the marine environment.	X	X	X
	MA73	Calibrated chemical dosing system in place to ensure accuracy.	X	X	X
	MA74	If contingency use and discharge of treated seawater is required, the lowest required concentration of treatment chemical will be evaluated and used (up to a maximum of 550 ppm) in order to meet pipeline preservation requirements.	X	X	X
	MA71	Maintenance requirements for pipelaying to minimise risk of operational failure.	X	X	X
	MA76	In the unlikely event that the pipeline requires contingency filling and subsequent dewatering of treated seawater in response to a wet buckle event and prolonged repair, water quality monitoring of the dewatering at the discharge location will be conducted to confirm the concentration and dispersion of treatment chemicals.			X
Noise emissions	-	Trenching extent is as small as practicable to achieve the required pipeline stability and protection.	X	X	

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
	MA49	Vessel inductions for all crew to address marine fauna risks and the required management controls.	X	X	X
	MA50	Vessels and helicopters to abide by Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000, which includes controls for minimising interactions with marine fauna.	X	X	X
	MA51	Personnel trained in marine fauna observation (MFO) present on pipelay, trenching and rock installation vessels during daylight hours, including one crew member with MFO training on the bridge at all times.	X	X	X
	MA52	All marine fauna interactions and observations to be appropriately recorded and reported to DEPWS/NT EPA and DCCEEW as required.	X	X	X
	MA54	Vessels will adhere to Port of Darwin vessel speed limits.	X	X	
	MA55	Vessel engines and Project equipment/machinery maintained as per planned maintenance system.	X	X	X
	MA56	Standard protocols for managing trenching vessel noise impacts included within the Marine Megafauna Noise Management Plan (**Appendix 23**).	X	X	
	MA56	Observation and shut-down zones for marine fauna have been developed based on noise modelling results and standard protocols. For trenching activities, excluding hydraulic hammering this includes:	X	X	

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
		An Observation Zone of 150 m and an Exclusion Zone of 50 m for marine mammals and turtles will be in place around trenching vessels (TSHD, CSD and BHD) for trenching activities. Observation Zone monitored for 10 minutes prior to commencing trenching during daylight hours only.			
	MA62	Soft start (ramp-up) of hydraulic tools by BHD, where practicable.	X	X	
	MA62	Soft start (ramp-up) of trenching equipment, where practicable, will apply to the CSD and TSHD.	X	X	
	MA56	Contingency hydraulic hammering management measures (not applicable for Xcentric Ripper tool).	X	X	
	-	Hydraulic hammering for no greater than 8 hrs over a 24-hr period.	X	X	
	-	No hydraulic hammering at night.	X	X	
	-	Increased Observation and Exclusion Zones for hydraulic hammering based on noise modelling results will be applied as follows: + If up to 8 hours of rock breaking is required, an increased Observation Zone of 2.5 km (marine mammals) and 1 km (turtle) will apply and an increased Exclusion Zone of 150 m for marine mammals and turtles will apply. + If up to 6 hours of rock breaking is required, an increased Observation Zone of 2 km (marine mammals) and 750 m (turtle) will apply and an increased Exclusion Zone of 100 m for marine mammals and turtles will apply.	X	X	

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Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
		+ If up to 4 hours of rock breaking is required, an increased Observation Zone of 1.5 km (marine mammals) and 750 m (turtle) will apply and an increased Exclusion Zone of 100 m for marine mammals and turtles will apply. + If up to 2 hours of rock breaking is required, an increased Observation Zone of 1 km (marine mammals) and 500 m (turtle) will apply and an increased Exclusion Zone of 50 m for marine mammals and turtles will apply.			
	-	A separate vessel with MFO onboard will be required to patrol the Observation Zone prior to and during hydraulic hammering.	X	X	
Light emissions	MA58	The pipelay vessel will have an enclosed pipe welding deck.	X	X	X
	MA61	Vessel searchlights will only be operated in an emergency situation.	X	X	X
	MA60	Housekeeping measures will be adopted, including requiring all crew to keep shutters on windows closed at night, to limit light emissions from vessels.	X	X	X
	MA59	Orient lights to area of direct work. Reduce overspill where practicable.	X	X	X
	MA62	Santos will document vessel light spill on Darwin Harbour turtle nesting beaches as part of the DPD Project's environmental monitoring program.	X	X	
Physical presence	MA11	Pipeline will not be laid in the vicinity of the Jewfish aggregation area within the Charles Point Wide RPA.			

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
	MA12	The pipeline route has been surveyed (geophysical and geotechnical) to evaluate seabed in conjunction with engineering design requirements. Trenching, stabilisation and freespan correction/ prevention will only be undertaken at identified areas (using standard positional accuracy measures used in the industry).	X	X	X
	MA10	Causeways will be temporary structures and will be removed following trenching and installation.			
	MA01	Intertidal and shoreline construction is in pre-disturbed area (DLNG footprint).			
	-	Minimise placement of rock berms and when placed, where practicable, the rock berms will be placed in trenches and will not protrude above natural seabed level.			
	-	All anchor pennant buoys will have lights and radar reflectors.	X	X	X
	-	The design of the pipeline has been performed to reduce risks from loss of containment events to ALARP for the life of the Project.	X	X	X
	-	Installation procedures shall be developed for all activities and will form the basis of constructability assessments and hazard workshops used to ensure all aspects of the works are conducted safely.			
	-	Key stakeholders will be invited to risk assessment workshops.			
	MA24	Company has engaged competent and skilled contractors with proven experience and capability to perform the installation activities.			

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
	-	All Project vessels shall undergo an extensive Santos Marine assessment and third-party Marine Warranty Survey prior to mobilisation.			
	-	All engineering and installation activities and designs will be verified and validated by independent third-party verification bodies, such as DNV and Marine Warranty Surveyors where applicable.			
	-	Installation, testing and operations shall be performed under a DITT accepted and independently validated Pipeline Management Plan.			
	MA101	Barges will have a 500 m exclusion zone for duration of construction activities.			
Hydrocarbon spill	MA102	No Intermediate Fuel Oil (IFO) and heavy Fuel Oil (HFO) will be used in the Project area.	X	X	X
	MA100	Vessel equipped and crewed in accordance with Australian maritime requirements.	X	X	X
	MA101	A Notice to Mariners will be issued for offshore works advising all major shipping traffic formally. In addition, pipelay vessels will have attendant vessels that may act as guard vessels for work within the harbour.	X	X	X
	MA96	Chemicals and hydrocarbons will be transferred and stored in accordance with standard maritime practices as per vessel SOPEP.	X	X	X
	MA99	Vessel-specific bunkering procedures and equipment consistent with Santos marine vessel vetting requirements including: + Use of bulk hoses that have quick connect 'dry break' couplings.	X	X	X

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
		+ Correct valve line-up. + Defined roles and responsibilities, and the specific requirement for bunkering to be completed by trained personnel only. + Visual inspection of hoses prior to bunkering to confirm they are in good condition. + Testing of the emergency shutdown mechanism on the transfer pumps. + Assessment of weather/sea state. + Maintenance of radio contact with Vessel during bunkering operations. + Bunkering checklist. + Visual monitoring during bunkering.			
	MA97	Spill clean-up kits available in all areas, including high risk areas	X	X	X
	MA103	Implement tiered spill response in the event of a hydrocarbon spill as outlined in an oil pollution emergency plan for DPD Project construction and operations.	X	X	X
	MA104	Oil spill tracking buoys will be made available on primary project vessel/s with Santos CSR/s and/or at local supply base for immediate deployment to assist with tracking of an oil spill.	X	X	X
		Operational and scientific monitoring to be undertaken in event of a hydrocarbon spill as outlined in the oil pollution emergency plan for DPD Project construction and operations (**Appendix 10**).	X	X	X
Dropped objects	-	Lifting and operational procedures in place and implemented.	X	X	

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
	MA75	Implementation of Santos approved standards and procedures for outboard lifts.	X	X	
	MA78	All lifting and winching equipment will undergo inspection, testing and certification as per applicable laws and applicable codes and Standards.	X	X	
	MA79	Dropped objects recovered where safe and practicable to do so.	X	X	
	MA80	Identification of no lift zones where relevant in proximity to subsea assets and infrastructure as documented in relevant lifting and operational procedure/s.	X	X	
	MA18/ MA20	Program anchor plots – avoid sites of significance or infrastructure.	X	X	
	-	Anchor handling controls – anchor deployment and recovery only in approved safe lifting zones.	X	X	
	MA82	Emergency response implemented to minimize potential for impacts in the event of a loss of containment from the Bayu-Undan to Darwin gas export pipeline or other gas pipeline as a result of a dropped object during DPD Project installation.	X	X	
Invasive marine species	MA84	Vessels equipped with effective anti-fouling coatings as required for class.	X	X	X
	MA85	Ballast water management will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) requirements (as applicable to class), *Australian Ballast Water Management Requirements and Biosecurity Act 2015*.	X	X	X

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
	MA86	Apply risk-based IMS management for vessels and immersible equipment – vessel and immersible equipment must be assessed as having a low risk of IMS prior to coming onto activity as per Santos IMS procedures.	X	X	X
	MA87	Vessels having suitable anti-fouling coating (marine growth prevention system) in accordance with the *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006*.	X	X	X
Marine fauna interactions	MA102	No intermediate fuel oil (IFO) or heavy fuel oil (HFO) will be used in the Project area.	X	X	
	MA49	Vessel inductions will address marine fauna risks and the required management controls.	X	X	
	MA50	Vessel movements will comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003), which ensures compliance with Part 8 of the EPBC Regulations 2000.	X	X	
	MA51	Personnel trained in marine fauna observation present on pipelay, trenching and rock installation vessels during daylight hours, including one crew member with MFO training on the bridge at all times.	X	X	
	MA56	An Observation Zone of 150 m and an Exclusion Zone of 50 m for marine mammals and turtles will be in place around trenching vessels (TSHD, CSD and BHD) for trenching activities.	X	X	X
	MA56	A Marine Fauna Observation and Management Protocol for Trenching Activities (included in a Trenching and Spoil Disposal Management and Monitoring Plan (TSDMMP)) will apply to the Observation and Exclusion Zones.	X	X	

Aspect	MA Reference	Management Measures	Listed Threatened & Migratory Turtles	Listed Threatened & Migratory Dolphins	Commonwealth Marine Areas
	MA89	Use of turtle ‘tickler’ chains on the trailing arms of the TSHD.	X	X	
	MA52	All marine fauna interactions and observations will be appropriately recorded and reported to relevant authorities.	X	X	X

6 Residual Impact Assessment

6.1 Significant Impact Criteria

The MNES Significant Impact Guidelines 1.1 outline criteria for assessing whether an action "will have, or is likely to have, a significant impact on a matter of national environmental significance" (DoE 2013) and these have formed the basis for assessment of impact against likely species (**Table 3-2**). **Section 1.2** describes how the significant impact guidelines provide criteria for the assessment of significant risk.

6.1.1 Threatened Species – Endangered

The likelihood of occurrence assessment (refer to **Section 3.1**) identified three endangered marine turtle species which are likely to, or have potential to, occur within the Project area, these being the olive ridley turtle, leatherback turtle and loggerhead turtle. An assessment of the proposed action against the Significant Impact Guidelines 1.1 (DoE, 2013) for these marine turtle species is provided in **Table 6-1, Table 6-2** and **Table 6-3**. Based on this assessment, it is concluded that the proposed action will not have a significant impact on threatened species listed as endangered under the EPBC Act after avoidance and mitigation measures are implemented.

6.1.2 Threatened Species – Vulnerable

The likelihood of occurrence assessment (refer to **Section 3.1**) identifies three vulnerable marine turtle species which are likely to occur within the Project area, being the flatback turtle, green turtle and hawksbill turtle. An assessment of the proposed action against the Significant Impact Guidelines 1.1 (DoE, 2013) is provided is **Table 6-4, Table 6-5** and **Table 6-6**. Based on this assessment, it is concluded that the proposed action will not have a significant impact on threatened species listed as vulnerable under the EPBC Act after avoidance and mitigation measures are implemented.

6.1.3 Migratory Species

The likelihood of occurrence assessment (refer to **Section 3.1**) identified six migratory species (excluding the marine turtles addressed above) which are likely to, or have potential to, occur within the Project area (these being saltwater crocodile, Australian snubfin dolphin, Australian humpback dolphin, spotted bottlenose dolphin, dugong and osprey[2]). An assessment of the proposed action against the Significant Impact Guidelines 1.1 (DoE, 2013) for the three dolphin migratory species is provided in **Table 6-7**. Based on the assessment for migratory dolphin species, it is concluded that the proposed action will not have a significant impact on the migratory dolphin species listed under the EPBC Act and identified in the RFI, after avoidance and mitigation measures are implemented.

6.1.4 Commonwealth Marine Area

The DPD Project area within Commonwealth waters varies in depth from ~30m to ~60m with the end of the Project pipeline in ~50m of water. Regional habitat modelling and mapping, including the Commonwealth waters Project area has been conducted by the Australian Institute of Marine Sciences (AIMS) (Heyward et al. 2017) and shows that the habitat in the Project area, as with the broader region,

[2] As described in Table 3-2, a number of additional migratory birds were assessed as having the potential to occur in the Project area. However, most of these birds would likely be transiting to suitable habitat located on either side of the Project area (i.e. shoreline crossing is within a disturbed area) and have therefore not been further considered.

is dominated by bare sand, filter feeders and burrowers/crinoids (**Figure 6-4**). Baseline surveys of the Project pipeline route, including the section in Commonwealth waters, have been undertaken by RPS (RPS, 2023a; **Appendix 7**). This survey, which included collection of benthic habitat imagery and sediment samples, confirmed the habitat categorisation by Heyward et al., 2017, with all sites along the Project pipeline route in Commonwealth waters classified as silty/shelly sand with very sparse to sparse biota (soft corals and crinoids).

A ~23 km section of the Project pipeline occurs within the Commonwealth marine area. An assessment of the proposed action against the Significant Impact Guidelines 1.1 (DoE, 2013) for the Commonwealth Marine Area is provided in **Table 6-8**. Based on this assessment, it is concluded that the proposed action will not trigger the significant impact criteria for a significant impact on the Commonwealth marine area after avoidance and mitigation measures are implemented. A summary of the Commonwealth marine area including potential impacts and risk is also included separately in **Section 6.4**.

Table 6-1 Assessment of impacts to Olive Ridley turtle (listed as endangered) against the significant impact criteria (turtles)

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
Lead to a long-term decrease in the size of a population	olive ridley turtle No	The olive ridley turtle has a worldwide tropical and subtropical distribution, including northern Australia. The turtle is the most numerous of all marine turtles in the world, with an extensive range across the NT. The Project area does not intersect habitat critical to the survival of or a BIA for the olive ridley turtle. Potential impacts to the olive ridley turtle may include injury or mortality from vessel collision and/or changes in behaviour such as avoidance of the area due to localised increases in underwater noise (for example as a result of trenching activities) and localised increases in light emissions. The Project vessel numbers and movements will be insignificant compared to the total number of vessel movements within the Darwin Harbour (i.e., Port of Darwin recorded 2,154 vessel visits in 2018-19). As such, given the large number of vessels already utilising Darwin Harbour regularly, the increase in vessel traffic from the Project is considered unlikely to result in a greater risk of vessel collision with this species than the current environment. Underwater noise emissions have the potential to affect marine fauna, including the olive ridley turtle, as described in **Section 3**. Installation activities will contribute to the underwater noise within the area. However, given the narrow operating area for the Project, it is considered that mobile animals such as turtles will be able to move away freely before any physical or behavioural changes occur. Impacts would likely only be temporary avoidance of the area. Marine turtles are sensitive to artificial light during nesting and hatching, as described in **Section 3**. As described above, given the Project does not intersect any critical breeding or nesting habitat for the olive ridley turtle and they are only considered to be transiting through the area, disturbance from artificial light is considered unlikely. Operational risks to marine turtles are considered no greater than installation risks. Given the location of critical habitat and nesting areas for the olive ridley turtle outside of the Project area and the successful implementation of management measures for similar types of projects in the area (i.e., Ichthys /GEP and Bayu-Undan to Darwin gas export pipeline), it is considered that potential impacts from construction and operational activities can be effectively minimised and if they occur, would be short term and highly localised. An approved monitoring program was undertaken as part of dredging and spoil disposal activities associated with the Ichthys Project, as conditioned in EPBC Act approval of that project (EPBC 2008/4208). The Ichthys monitoring program did not detect any deleterious effects to turtle distribution or population sizes in the Darwin region attributable to dredging and spoil disposal activities (Cardno 2015a). Given the proposed Project is smaller in scale in comparison to the Ichthys Project, and will implement management measures, including those within a TSDMMP, the proposed trenching, spoil disposal and installation activities associated with the Project do not to have a significant impact to olive ridley turtle distribution or population size.
Reduce the area of occupancy of the species	olive ridley turtle No	The Project area does not intersect habitat critical to the survival of or a BIA for the olive ridley turtle. Based on surveys, there is limited foraging habitat within the Project area. Impacts to olive ridley turtles as a result of the Project are expected to be temporary. The area of occupancy for the species may be reduced temporarily, however, as the olive ridley is widespread globally, this will only be a small area relative to the potentially available surrounding habitat.
Fragment an existing population into two or more populations	olive ridley turtle No	The Project does not trigger the significant impact criteria to result in fragmentation of an existing population into two or more populations as the species is considered highly mobile, migratory and widespread globally.
Adversely affect habitat critical to the survival of a species	olive ridley turtle No	The Project area does not contain sufficient foraging habitat for the olive ridley turtle and is not located within any habitat critical to the survival of the olive ridley turtle. Therefore, it is considered the Project does not trigger the significant impact criteria to adversely affect regional habitat critical to the survival of this species.
Disrupt the breeding cycle of a population	olive ridley turtle No	An olive ridley turtle BIA inter-nesting area is located south-east of Darwin Harbour, approximately 10 km from the Project area **(Figure 3-6).** This BIA is near the turtle nesting sites of Bare Sand Island, Quail Island and Indian Island, located near the mouth of Bynoe Harbour (~50 km from Darwin), however these sites are not considered significant on a regional scale with infrequent nesting recorded (Chatto and Baker, 2008). Within the Darwin Harbour, Casuarina Beach, Cox Peninsula Beaches and Mandorah Beach are infrequently used for nesting. On some NT beaches removed from the Project area, such as along the northern coast of Bathurst and Melville islands, and some islands in north-eastern Arnhem Land olive ridley turtles nest in nationally significant numbers (Chatto and Baker, 2008). The nesting critical habitat 4.5 km from the Project area on southwest Bathurst Island has low numbers. Due to infrequent nesting and widespread habitat availability globally, the Project does not trigger the significant impact criteria to disrupt the breeding cycle of a population of olive ridley turtle that may occur nearby to the Project area.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	olive ridley turtle No	Potential impacts to the olive ridley turtle may include injury or mortality from vessel collision and/or changes in behaviour such as avoidance of the area due to localised increases in underwater noise (for example as a result of trenching activities) and localised increases in light emissions. However, Project vessel numbers and movements will be insignificant compared to the total number of vessel movements within the Darwin Harbour and given the narrow operating area for the Project, it is considered that mobile animals such as turtles will be able to move away freely before any physical or behavioural changes occur.

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
		The Project does not trigger the significant impact criteria to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the olive ridley turtle species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	olive ridley turtle No	Santos will implement measures to reduce the risk of introducing invasive marine pest species, as described in **Section 5**. The Project does not trigger the significant impact criteria for invasive species that are harmful to marine turtles becoming established in the species' habitat.
Introduce disease that may cause the species to decline	olive ridley turtle No	Olive ridley turtles have been known to contract Fibropapillomatosis (FP), a tumour-causing disease notorious to occur in all sea turtles, resulting in tumours on the skin, including eyes and mouth, and can also form in internal organs. Turtles with FP can be surgically treated; however, survival rates are low. FP in sea turtles is associated with an infection by a herpes virus, however this knowledge is limited. It is thought that human disturbance on the environment and pollution may influence FP, however this is not confirmed. FP disease in olive ridley turtles have been recorded in Costa Rica, Mexico, Chile, India and the United States (Caceres-Farias et al., 2022). To date, within Australia there have been no recorded occurrences of turtles contracting diseases and pathogens (DoEE, 2017b). The Project does not trigger the significant impact criteria to introduce disease that may cause the olive ridley turtle species to decline.
Interfere with the recovery of the species	olive ridley turtle No	Specific objectives of the recovery plan for olive ridley turtles in the Northern Territory (DoEE, 2017b) are summarised below, along with consideration of applicability to the proposed action: + Liaise at a regional scale to address and reduce the source of marine debris in Australian waters – not applicable to the action. + Devise innovative methods for the early identification and intervention of ghost nets entering the Gulf of Carpentaria – not applicable to the action. + Support collection of tissue samples from stranded marine turtles – not applicable to the action. + Ensure clean-up activities are timed appropriately to coincide with on-shore peaks in marine debris (i.e., prior to wet season) – not applicable to the action. + Maintain and expand partnership arrangements for the collection of marine debris (both onshore and offshore) – not applicable to the action. + Quantify and model how changes in ambient temperatures (sand and water), sea level, frequency of extreme weather events, ocean circulation and acidification affect marine turtle nesting, sex ratios, hatching success, habitats, food availability and their ability adapt to these changes – not applicable to the action. + Identify and protect areas likely to provide refugia and range expansion – the Project does not interfere with habitat critical to survival or a BIA for the Olive Ridley turtle. + Ensure that spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to slow to recover habitats, e.g., seagrass meadows or corals – management measures to minimise spill risks and oil pollution will be provided in the OPEP covering Project activities in NT and Commonwealth waters. + Quantify the extent to which terrestrial predation effects this stock – not applicable to the action. + Establish a long-term monitoring program at an index beach to assess trends in nesting abundance and assess efficacy of management programs – not applicable to the action. Given the widespread distribution of the species globally, any potential impact on the olive ridley turtle is expected to be minor and construction impacts are temporary. Olive ridley turtles are mobile and migratory and have the ability to move freely at great extents. The Project does not trigger the significant impact criteria to interfere with the recovery of the olive ridley turtle.

Table 6-2 Assessment of impacts to Leatherback turtle (listed as endangered) against the significant impact criteria (turtles)

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
Lead to a long-term decrease in the size of a population	leatherback turtle No	The leatherback turtle has the widest global distribution of any reptile. As an oceanic species (pelagic feeder), the species is unlikely to occur within the Darwin Harbour (Whiting, 2001) and has no BIAs or habitat critical to the survival to leatherback turtle in Project area in Commonwealth waters. Therefore, significant impacts to this species are not predicted.
Reduce the area of occupancy of the species	leatherback turtle No	The species is unlikely to occur within the Darwin Harbour (Whiting, 2001) and there are no BIAs or habitat critical to the survival of Leatherback turtle within Project area in Commonwealth waters. Similarly, leatherback turtle nesting records have not been recorded within Northern Australia since 2011 (DoEE, 2017b). Due to the unlikelihood of occupancy within the Project area or immediate surrounds, the Project does not trigger the significant impact criteria to reduce the area of occupancy of the leatherback turtle.
Fragment an existing population into two or more populations	leatherback turtle No	As the leatherback turtle is not expected to occur within Darwin Harbour (Whiting, 2001) and there are no BIAs or habitat critical to the survival of leatherback turtle within Project area in Commonwealth waters, the Project does not trigger the significant impact criteria to fragment an existing population of the leatherback turtle into two or more populations.
Adversely affect habitat critical to the survival of a species	leatherback turtle No	The Project does not intersect and is not near habitat critical to the survival of the leatherback turtle, therefore it is considered that the Project does not trigger the significant impact criteria for regional habitat critical to the survival of this species.
Disrupt the breeding cycle of a population	leatherback turtle No	Nesting records have not been recorded within Northern Australia since 2011 (DoEE, 2017b). Based on the justification provided above, the Project does not trigger the significant impact criteria to disrupt the breeding cycle of a Leatherback turtle population.l
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	leatherback turtle No	Due to the unlikelihood of occurrence of this oceanic turtle species within Darwin Harbour, the Project does not trigger the significant impact criteria to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the leatherback turtle species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	leatherback turtle No	Santos will implement measures to reduce the risk of introducing invasive marine pest species, as described in **Section 5**. The Project does not trigger the significant impact criteria for invasive species that are harmful to marine turtles becoming established in the species' habitat
Introduce disease that may cause the species to decline	leatherback turtle No	Leatherback turtles may be subject to toxins as a result of anthropogenic disturbances and harbour in internal organs, potentially influencing diseases within internal organs. All seven sea turtles have been documented to be affected by Fibropapillomatosis (FP), a tumour-causing disease notorious to occur in all sea turtles, resulting in tumours on the skin, including eyes and mouth, and can also form in internal organs. Turtles with FP can be surgically treated; however, survival rates are low. FP in sea turtles is associated with an infection by a herpes virus, however this knowledge is limited. It is thought that human disturbance on the environment and pollution may influence FP, however this is not confirmed. The Project does not trigger the significant impact criteria to introduce disease that may cause the leatherback turtle species to decline.
Interfere with the recovery of the species	leatherback turtle No	Specific objectives of the recovery plan for Leatherback turtles nesting in Australia (DoEE, 2017b) are summarised below, along with consideration of applicability to the proposed action: + Liaise at a regional scale to address and reduce the source of marine debris – not applicable to this action. + Promote best practice bycatch mitigation and innovation in all Australian fisheries and continue to meet international obligations including conservation management measures under regional fisheries management organisations – not applicable to this action. + Determine genetic affiliations of leatherback turtles nesting in Australia – not applicable to this action. + Monitor nesting activity in historically known nesting areas – not applicable to this action. The Project does not trigger the significant impact criteria to interfere with the recovery of the leatherback turtle.

Table 6-3 Assessment of impacts to Loggerhead turtle (listed as endangered) against the significant impact criteria (turtles)

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
Lead to a long-term decrease in the size of a population	loggerhead turtle No	The loggerhead turtle is widespread throughout tropical, sub-tropical and temperate waters, with a global distribution. In Australia, the majority of the loggerhead turtle population is situated in either eastern or western Australia. Loggerhead turtles are expected to be infrequent users of the Darwin Harbour (Whiting, 2003) and are more likely to occur in oceanic areas outside Darwin Harbour. Similarly, no BIAs occur in the Project area Commonwealth waters. Surveys have been conducted and have concluded that there is unlikely to be suitable habitat within the Project area for the species. Due to the limited occurrence within the Project area, significant impacts to this species are not predicted.
Reduce the area of occupancy of the species	loggerhead turtle No	Loggerhead turtles are expected to be infrequent users of Darwin Harbour (Whiting, 2003) and is more likely to occur in oceanic areas outside the harbour. Similarly, no BIAs occur in the Project area Commonwealth waters and no suitable habitat exists within the Project area. Therefore, the Project does not trigger the significant impact criteria to reduce the area of occupancy of the loggerhead turtle.
Fragment an existing population into two or more populations	loggerhead turtle No	Due to limited occurrence within the Project area and the absence of suitable habitat within the Project area, the Project does not trigger the significant impact criteria to fragment an existing population of the loggerhead turtle into two or more populations.
Adversely affect habitat critical to the survival of a species	loggerhead turtle No	The Project does not intersect and is not near habitat critical to the survival of the loggerhead turtle.
Disrupt the breeding cycle of a population	loggerhead turtle No	Approximately 2 to 4% of the global population of nesting loggerhead turtles occurs in Australia, particularly in eastern and western Australia. The species is unlikely to nest on beaches within Darwin Harbour. Consequently, the Project does not trigger the significant impact criteria to disrupt the breeding cycle of a loggerhead turtle population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	loggerhead turtle No	There is no suitable habitat for the species within the Project area, and it is not expected to occur within Darwin Harbour. Therefore, the Project does not trigger the significant impact criteria to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the loggerhead turtle species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	loggerhead turtle No	Santos will implement measures to reduce the risk of introducing invasive marine pest species, as described in **Section 5.** The Project does not trigger the significant impact criteria for invasive species that are harmful to marine turtles becoming established in the species' habitat.
Introduce disease that may cause the species to decline	loggerhead turtle No	All seven sea turtles have been documented to be affected by Fibropapillomatosis (FP), a tumour-causing disease notorious to occur in all sea turtles, resulting in tumours on the skin, including eyes and mouth, and can also form in internal organs. Turtles with FP can be surgically treated; however, survival rates are low. FP in sea turtles is associated with an infection by a herpes virus, however this knowledge is limited. It is thought that human disturbance on the environment and pollution may influence FP, however this is not confirmed. The Project does not trigger the significant impact criteria to introduce disease that may cause the loggerhead turtle species to decline.
Interfere with the recovery of the species	loggerhead turtle No	Specific objectives of the recovery plan for loggerhead turtles within the South-west Pacific (DoEE, 2017b) are summarised below, along with consideration of applicability to the proposed action: + Implement the Single Species Action Plan for loggerhead turtles (Caretta caretta) in the South Pacific Ocean – not applicable to this action. + Quantify the impact of international fishery bycatch on this stock – not applicable to this action. + Assess the impacts of marine debris, particularly on post-hatchling life phase – not applicable to this action. + Manage artificial light from onshore and offshore sources to ensure that biologically important behaviour of nesting adults and dispersing hatchlings can continue – marine turtles that use Darwin Harbour beaches will be at low risk of impact from Project vessel lighting due to the relatively short duration of dredging and pipelay activities, and the amount of existing light pollution within Darwin Harbour and city.

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
		+ Understand changes in stock trends through monitoring of nesting beaches and demographics at key foraging areas to assess recruitment of juveniles from the pelagic life phase – not applicable to this action. + Understand changes in stock trends through monitoring of nesting beaches and demographics at key foraging areas to assess recruitment of juveniles from the pelagic life phase – not applicable to this action. The Project does not trigger the significant impact criteria to interfere with the recovery of the loggerhead turtle.

Table 6-4 Assessment of impacts to flatback turtle (listed as vulnerable) against the significant impact criteria (turtles)

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
Lead to a long-term decrease in the size of an important population of a species	Flatback turtle No	Flatback turtles are the most widely spread nesting marine turtle species in the NT, nesting on a wide variety of beach types around the entire coastline. Flatback turtles in the vicinity of Darwin Harbour and Tiwi Islands (including Casuarina/ Cox Peninsula/Mandorah/ Fourcroy Beaches) are part of the Arafura Sea genetic stock, considered the largest genetic stock within Australia. The IUCN Red List Assessment for the Arafura Sea genetic stock estimates approximately 18,000 nesting females which equates to approximately 30% of the global population for the species. In addition, the Arafura Sea genetic stock has the largest geographic breeding range of all flatback turtle subpopulations (genetic stock) extending along the northern Australian coastline from Cape York peninsula in Queensland to Cape Scott in the NT. The beaches in proximity to Darwin Harbour are very low in the regional importance status of the flatback turtle Arafura Sea genetic stock (Pendoley Environmental, 2022b; **Appendix 19** report number J06063). The flatback turtle has a BIA of inter-nesting habitat and habitat critical to the survival of the species intersecting the Project area**.** With an assumed inter-nesting distances of 60 km offshore, there are extensive BIAs across northern Australia. For example, the Project area intersects a BIA with a coastline (islands and mainland) stretching well over 800 km. The closest beaches to the Project area considered 'significant areas' for flatback turtle Nesting in the Anson Beagle and Tiwi Bioregions are Quail Island (located approximately 28 km from the Project area), Bare Sand Island (located approximately 29 km from the Project area) and Cape Fourcroy on Tiwi Islands (located approximately 25 km from the Project area). The National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020) states that a 20 km buffer (based on sky glow) to important habitat for turtles should be applied when considering possible impacts. The 'significant' areas for flatback turtle nesting are outside of the 20 km buffer recommended by DoEE (2020). Marine turtles are sensitive to artificial light during nesting and hatching. Light modelling undertaken for Project vessels indicates that the distance within which behavioural impacts to turtles could occur from light spill from vessel lighting would be approximately 4.5 km (Pendoley Environmental, 2022a, **Appendix 19** report number J06009) when two large offshore installation vessels are operating simultaneously. This is less than the distance of Project vessels to Casuarina Beach (8 km to the east of the Project area) which is considered the main nesting site for flatback turtles in Darwin Harbour. The closest significant nesting beach is at Cape Fourcroy (approximately 25 km from the Project area) which is outside of the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020) 20 km buffer to important habitat for turtles when considering possible impacts. There is no evidence, published or anecdotal, to suggest inter-nesting turtles are impacted by light from offshore vessels, and nothing in their biology would indicate this as a plausible threat (Pendoley Environmental, 2019; Witherington and Martin, 2003). It is therefore not expected that artificial light generated by the Project would cause an adverse impact on flatback turtles. Underwater noise emissions have the potential to affect marine fauna, including the flatback turtle as described in **Section 4.2.3** However, given the narrow operating area for the Project, it is considered that mobile animals such as turtles will be able to move away freely before any physical or significant behavioural changes occur. Impacts would likely only be temporary avoidance of the area. Potential impacts to the flatback turtle may include injury or mortality from vessel collision and/or changes in behaviour such as avoidance of the area due to localised increases in underwater noise as a result of trenching activities, and localised increases in light emissions. The Project vessel numbers and movements will be insignificant compared to the total number of vessel movements within the Darwin Harbour (i.e., Port of Darwin recorded 1,416 commercial vessel visits in 2020/2021). As such, given the large number of vessels already utilising Darwin Harbour regularly, the increase in vessel traffic from the Project is considered unlikely to result in a greater risk of vessel collision with this species than the current environment. Based on benthic habitat mapping in Darwin Harbour area (Galaiduk et al., 2019), including within the Project area, and dedicated surveys along the Project pipeline route (RPS 2022a); **Appendix 7**, the benthic habitats on the pipeline route are well represented and are not considered unique or critical foraging areas for marine turtles. Operations of the Project are unlikely to generate noise or light emissions that are a significant risk to marine fauna. Furthermore, the use of operations vessels would be minimal and unlikely to increase the risk of collision with turtles than the current environment (refer to **Section 5**). An approved monitoring program was undertaken as part of dredging and spoil disposal activities associated with the Ichthys project, as conditioned in EPBC Act approval of that project (EPBC 2008/4208). The Ichthys monitoring program did not detect any deleterious effects to turtle distribution or population sizes in the Darwin region attributable to dredging and spoil disposal activities (Cardno 2015a). Following the implementation of measures to avoid and mitigate disturbance to flatback turtles (**Section 5)**, consideration of residual impacts/risks from vessel noise and vessel collision **(Sections 6.2.2.2.4** and **6.2.2.2.5**), the temporary nature of construction activities and also considering the above assessment of significant nesting sites in the region, the Project does not trigger the significant impact criteria of leading to a long-term decrease in the size of an important population of a species.
Reduce the area of occupancy of an important population	Flatback turtle No	The flatback turtle is 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; however, there are currently no estimates on population sizes for the species within these regions. Flatback turtles nest on a wide variety of beach types around the NT coastline, with important nesting areas identified in various locations of the NT. Previous nesting assessments concluded that 46 distinct areas are known as significant nesting areas for the species. There is a nesting site located at Casuarina Beach, located approximately 8 km east of the Project Pipeline and approximately 15 km south of the spoil disposal ground. The Cox Peninsula beaches and Mandorah Beach, which border the Project area, are infrequently used for nesting. Pendoley 2022b (**Appendix 19** report number J06063) found that records over the last 30 years demonstrate the low importance of beaches surrounding Darwin Harbour to nesting turtles, including Wagait Beach and Mandorah on Cox Peninsula, and Casuarina Beach. No nesting beaches occur within the Project area, although the Project area intersects a BIA representing a 60 km inter-nesting area that extends south of the Daly River to the Goulburn Islands in the north (>800 km of coastline) (**Figure 3-3**).

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
		Following the implementation of measures to avoid and mitigate disturbance to flatback turtles (**Section 5),** consideration of residual impacts/risks from vessel noise and vessel collision **(Sections 6.2.2.2.4**and **6.2.2.2.5)** and also considering the above assessment of significant nesting sites in the region, the Project does not reduce the area of occupancy of an important population. Santos will implement measures to avoid and mitigate impacts to seabed habitats, as described in **Section 5. Sections 6.2.2.2.1, 6.2.2.2.2** and **6.2.3** outline that residual disturbance to seabed habitats potentially used by foraging flatback turtles will not be significant. Therefore, the Project does not reduce the area of occupancy used for foraging by an important population.
Fragment an existing important population into two or more populations	Flatback turtle No	The Project does not trigger the significant impact criteria to result in fragmentation of an existing population into two or more populations as the species is considered highly mobile, migratory and widespread within tropical waters of northern Australia, Papua New Guinea and Irian Jaya.
Adversely affect habitat critical to the survival of a species	Flatback turtle No	The Project intersects inter-nesting habitat of the flatback turtle (**Figure 3-3**). There are, however, no nesting beaches within the Project area and no significant flatback nesting beaches within 20 km of the Project area. The main nesting beach for flatback turtles in Darwin Harbour is Casuarina Beach, which is approximately 8 km east of the proposed Project pipeline, approximately 15 km south of the spoil disposal ground. The closest significant nesting beach is Cape Fourcroy located on Tiwi Islands approximately 25 km from the Project area. These 'significant' areas for flatback Turtle nesting are outside of the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE 2020) 20 km buffer to important habitat for turtles when considering possible impacts. The Project area intersects a very small proportion of the very large inter-nesting area, which extend 60 km offshore from the shoreline and stretching over 800 km of coastline. Following the implementation of measures to avoid and mitigate disturbance to flatback turtles (**Section 5),** consideration of residual impacts/risks from vessel noise and vessel collision **(Sections 6.2.2.2.3** and **6.2.2.2.5)** and also considering the above assessment of significant nesting sites in the region, the Project does not trigger the significant impact criteria to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Flatback turtle No	Within the NT, flatback turtles are the most widely spread nesting marine turtle species, with nesting occurrence along the entire NT coastline. Flatback turtles nest on a wide variety of beach types around the NT coastline, with important nesting areas identified in various locations of the NT. Previous nesting assessments concluded that 46 distinct areas are known as significant nesting areas for the species. There is a nesting site located at Casuarina Beach, located approximately 8 km east of the Project Pipeline and approximately 15 km south of the spoil disposal ground. The Cox Peninsula beaches and Mandorah Beach, which border the Project area, are infrequently used for nesting. Pendoley 2022b **(Appendix 19**, report number J06063) found that records over the last 30 years demonstrate the low importance of beaches surrounding Darwin Harbour to nesting turtles, including Wagait Beach and Mandorah on Cox Peninsula, and Casuarina Beach. No nesting beaches occur within the Project area, although the Project area intersects a BIA representing a 60 km inter-nesting area that extends south of the Daly River to the Goulburn Islands in the north (>800 km of coastline) (**Figure 3-3**). The flatback turtle has a wide nesting range in the NT and no significant nesting sites exist within the Project area. Following the implementation of measures to avoid and mitigate disturbance to flatback turtles (**Section 5**) and consideration of residual impacts/risks from vessel noise and vessel collision **(Sections 6.2.2.2.3** and **6.2.2.2.5),** the Project does not trigger the significant impact criteria to disrupt the breeding cycle of an important population of the flatback turtle.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Flatback turtle No	Santos will implement measures to avoid and mitigate impacts to seabed habitats, as described in **Section 5. Sections 6.2.2.2.1, 6.2.2.2.2** and **6.2.2.2.3** outline that residual disturbance to seabed habitats potentially used by foraging flatback turtles will not be significant. Therefore, the Project does not trigger the significant impact criteria to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the flatback turtle species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Flatback turtle No	Santos will implement measures to reduce the risk of introducing invasive marine pest species, as described in **Section 5**. The Project does not trigger the significant impact criteria for invasive species that are harmful to marine turtles becoming established in the species' habitat.
Introduce disease that may cause the species to decline	Flatback turtle No	All seven sea turtles have been documented to be affected by Fibropapillomatosis (FP), a tumour-causing disease notorious to occur in all sea turtles, resulting in tumours on the skin, including eyes and mouth, and can also form in internal organs. Turtles with FP can be surgically treated; however, survival rates are low. FP in sea turtles is associated with an infection by a herpes virus, however this knowledge is limited. It is thought that human disturbance on the environment and pollution may influence FP, however this is not confirmed. The Project does not trigger the significant impact criteria to introduce disease that may cause the flatback turtle species to decline.

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
Interfere substantially with the recovery of the species	Flatback turtle No	Specific objectives of the recovery plan for flatback turtles closest to the Project area (in the Arafura Sea) (DoEE, 2017b) are summarised below, along with consideration of applicability to the proposed action: + Support Indigenous and Torres Strait community programs to manage turtles and the implementation of their land and sea country management plans – management measures to minimise impacts will be provided covering Project activities in NT and Commonwealth waters. + Determine important flatback turtle foraging areas across northern Australia and compare marine debris hotspots foraging areas, post hatchling dispersal and migratory pathways to identify high priority mitigation areas – not applicable to this action. + Quantify predation of eggs and hatchlings by terrestrial predators and implement terrestrial predator management programs – not applicable to this action. + Continue long-term monitoring of index beaches to assess trends in nesting abundance – not applicable to this action. + The Project does not trigger the significant impact criteria to interfere with the recovery of the flatback turtle species.

Table 6-5 Assessment of impacts to Green turtle (listed as vulnerable) against the significant impact criteria (turtles)

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
Lead to a long-term decrease in the size of an important population of a species	Green turtle No	Green turtles are found in tropical and subtropical waters throughout the world, with the most numerous and widely dispersed nesting sites of the seven turtle species, known to nest in 80 countries. Green turtles inhabit areas of coral and rocky reefs and inshore seagrass and algal beds. Adult green turtles are herbivorous feeding primarily on seagrasses and algae, while juveniles are carnivorous (NRETAS, 2006a). The total Australian population of green turtles is estimated to be more than 70,000 individuals, distributed across seven regional populations. Aerial turtle surveys undertaken for the INPEX Ichthys Project estimated a population size of between 500 and 1,000 for the Darwin region (Buckee et al., 2014). Based on surveys, the Project area is unlikely to have suitable habitat of rocky reef or inshore seagrass beds, although green turtles may transit through the Project area. As noted above, underwater noise emissions have the potential to affect marine fauna, including turtles, as described in **Section 4.2.3**. However, given the narrow operating area for the Project, it is considered that mobile marine fauna such as turtles will be able to move away freely before any physical or behavioural changes occur. Impacts would likely only be temporary avoidance of the area. Marine turtles are sensitive to artificial light during nesting and hatching. Project modelling indicates that lighting effects will be localised and unlikely to affect any beaches where green turtles frequently nest (refer to **Section 4.2.3**). Project operations are unlikely to generate noise or light emissions of any significance to marine fauna. Furthermore, the use of operations vessels would be minimal and unlikely to increase the risk of collision with turtles than the current environment (refer to **Section 4.2.5**). An approved monitoring program was undertaken as part of dredging and spoil disposal activities associated with the Ichthys Project, as conditioned in EPBC Act approval of that project (EPBC 2008/4208). The Ichthys Project monitoring program did not detect any deleterious effects to turtle distribution or population sizes in the Darwin region attributable to dredging and spoil disposal activities (Cardno, 2015a). Given the proposed Project is smaller in scale in comparison to the Ichthys Project, and will implement management measures, including those within a TSDMMP (**Appendix 15**), the Project does not trigger the significant impact criteria to lead to a long-term decrease in the size of a population of the green turtle.
Reduce the area of occupancy of an important population	Green turtle No	Aerial turtle surveys undertaken for the INPEX Project estimated a green turtle population size of between 500 and 1,000 for the Darwin region (Buckee et al., 2014). BIAs for green turtles occur on the north coast of the Tiwi Islands and in the vicinity of Cobourg Peninsula. Green turtles spend their first five to ten years drifting on ocean currents (pelagic phase). They then settle in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds. The Project area does not have suitable habitat of rocky reef habitat or inshore seagrass beds for green turtles, although the species may transit through the Project area. The Project does not trigger the significant impact criteria to reduce the area of occupancy of the green turtle.
Fragment an existing important population into two or more populations	Green turtle No	Although the green turtle may transit through the Project area, it has been concluded that the Project area is unlikely to contain suitable habitat for the species. Therefore, the Project will not trigger the significant impact criteria to fragment an existing important population of green turtles into two or more populations.
Adversely affect habitat critical to the survival of a species	Green turtle No	The Project does not intersect and is not near habitat critical to the survival of the green turtle.
Disrupt the breeding cycle of an important population	Green turtle No	Green turtles are known to nest in 80 countries and therefore have the most numerous and widely dispersed nesting sites of the seven turtle species. The key nesting and inter-nesting areas in the Northern Territory include Coburg Peninsula, between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land), Groote Island, offshore islands including Crocker Island, Goulburn Island, Sir Edward Pellew Islands, Bathurst and Melville Islands, Wessel and English Islands, and Rocky Island. Within Darwin Harbour, the green turtle is expected to infrequently use Casuarina Beach, Cox Peninsula Beaches and Mandorah Beach for nesting. The Project area does not contain any known nesting beaches or defined inter-nesting areas. As the Project area does not intersect nesting beaches or 202 internesting areas, and the species nests globally, the Project will not trigger the significant impact criteria to disrupt the breeding cycle of an important population of the green turtle.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Green turtle No	Shallow foraging habitat of adult green turtles contain seagrass beds or algae mats. Green turtles can migrate more than 2,600 km between their feeding and nesting grounds. As the Project area is does not have suitable habitat of rocky reef or inshore seagrass beds the Project will not trigger the significant impact criteria to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the green turtle is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established	Green turtle No	Santos will implement measures to reduce the risk of introducing invasive marine pest species, as described in **Section 5.** The Project will not trigger the significant impact criteria for invasive species that are harmful to marine turtles becoming established in the species' habitat.

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
in the vulnerable species' habitat		
Introduce disease that may cause the species to decline	Green turtle No	All seven sea turtles have been documented to be affected by Fibropapillomatosis (FP), a tumour-causing disease notorious to occur in all sea turtles, resulting in tumours on the skin, including eyes and mouth, and can also form in internal organs. However, the disease is most commonly documented in green turtles and appears more severe within the species. turtles with FP can be surgically treated; however, survival rates are low. FP in sea turtles is associated with an infection by a herpes virus, however this knowledge is limited. It is also thought that human disturbance on the environment and pollution may influence FP, although this is not confirmed. The Project will not trigger the significant impact criteria to introduce disease that may cause the green turtle species to decline.
Interfere substantially with the recovery of the species	Green turtle No	Specific objectives of the recovery plan for green turtles within the Cobourg region (DoEE, 2017b) are summarised below, along with consideration of applicability to the proposed action: + Support the implementation of management plans and build capacity to undertake monitoring, education, and compliance management of marine turtles – the Project will incorporate management plans to ensure impacts to marine turtles are limited. + Understand the risk of entanglement for this stock – not applicable to this action. + Quantify predation of eggs and hatchlings by terrestrial predators – not applicable to this action. + Ensure that spill risk strategies include management for marine turtles and their habitats – management measures to minimise spill risks and oil pollution will be provided in the OPEP covering Project activities in NT and Commonwealth waters (**Appendix 10**). + Initiate long term monitoring of nesting turtle abundance at index beaches – not applicable to this action. The Project will not trigger the significant impact criteria to interfere with the recovery of the green turtle species.

Table 6-6 Assessment of impacts to Hawksbill turtle (listed as vulnerable) against the significant impact criteria (turtles)

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
Lead to a long-term decrease in the size of an important population of a species	Hawksbill turtle No	Hawksbill turtles are found in tropical, subtropical and temperate waters in all the oceans of the world. In the NT, most nesting occurs on islands rather than mainland beaches. The key nesting and inter-nesting areas in the NT are not close to the Project area (e.g., Groote Island > 400 km east) and there is a small nesting BIA on southern Coburg Peninsula 150 m east. The hawksbill turtle prefers rocky and coral reef habitats where it feeds on a wide variety of plants and animals including sponges, gastropods, seagrass and algae. Soft coral and sandy habitats are widely present throughout the Project area within Darwin Harbour, therefore providing suitable foraging habitat for the hawksbill turtle. The hawksbill turtle utilises Darwin Harbour regularly (Whiting, 2003). Hawksbill turtles In Darwin Harbour occur in lower abundances compared than the green turtle (Whiting, 2001). As noted above, underwater noise emissions have the potential to affect marine fauna, including the hawksbill turtle, as described in **Section 4.2.3**. However, given the narrow operating area for the Project, it is considered that mobile marine fauna such as turtles will be able to move away before any physical or significant behavioural changes occur. Impacts would likely only be temporary avoidance of the area. Marine turtles are sensitive to artificial light during nesting and hatching. Project modelling indicates that lighting effects will be localised and unlikely to affect any beaches where hawksbill turtles frequently nest (**Section 4.2.2**). Project operations are unlikely to generate noise or light emissions of any significance to marine fauna. Furthermore, the use of operations vessels would be minimal and unlikely to increase the risk of collision with turtles than the current environment (refer to **Section 4.2.5**). An approved monitoring program was undertaken as part of dredging and spoil disposal activities associated with the Ichthys Project, as conditioned in EPBC Act approval of that project (EPBC 2008/4208). The Ichthys Project monitoring program did not detect any deleterious effects to turtle distribution or population sizes in the Darwin region attributable to dredging and spoil disposal activities (Cardno, 2015a). Given the proposed Project is smaller in scale in comparison to the Ichthys Project, and will implement management measures, including those within a TSDMMP (**Appendix 15**), the Project will not trigger the significant impact criteria to lead to a long-term decrease in the size of a population of the hawksbill turtle.
Reduce the area of occupancy of an important population	Hawksbill turtle No	Hawksbill turtle population abundance In the NT is concentrated around north-eastern Arnhem Land and Groote Eylandt. The hawksbill turtle utilises Darwin Harbour regularly but occur in lower abundances compared to the green turtle (Whiting, 2001; 2003). In Darwin Harbour, immature and adult hawksbill turtles have been reported as using the rocky reef habitat at Channel Island but may also utilise other habitats (Whiting, 2001). The Project will not trigger the significant impact criteria to reduce the area of occupancy of the hawksbill turtle.
Fragment an existing important population into two or more populations	Hawksbill turtle No	The hawksbill turtle utilises Darwin Harbour frequently, although in low abundances compared to other turtle species. Impacts of the Project on the hawksbill turtle are expected to be temporary and given the narrow operating area for the Project, it is considered that mobile marine fauna such as turtles will be able to move away before any physical or behavioural changes occur. The Project will not trigger the significant impact criteria to fragment an existing important population of hawksbill turtles into two or more populations.
Adversely affect habitat critical to the survival of a species	Hawksbill turtle No	The Project does not intersect and is not near habitat critical to the survival of the hawksbill turtle.
Disrupt the breeding cycle of an important population	Hawksbill turtle No	Australia supports the largest hawksbill turtle nesting aggregations worldwide, with estimates of over 4,000 females nesting annually in Queensland, over 2,500 in the NT, and approximately 2,000 in Western Australia. In the NT, most nesting occurs on islands rather than mainland beaches, with key nesting and inter-nesting areas including Coburg Peninsula, between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land), Groote Island, Sir Edward Pellew Islands, and Wessel and English Islands. Although nesting occurs within the NT, hawksbill turtle nesting is not common in Darwin Harbour and there are no known nesting beaches or defined inter-nesting areas within the Project area. Therefore, the Project will not trigger the significant impact criteria to disrupt the breeding cycle of an important population of the hawksbill turtle.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Hawksbill turtle No	Hawksbill turtles spend their first five to ten years drifting on ocean currents. During this pelagic (ocean-going) phase, they are often found in association with rafts of Sargassum (a floating marine plant that is also carried by currents). Whereafter, they settle in soft coral and sandy habitats. These habitats are widely present throughout the Project area within Darwin Harbour and provides suitable foraging habitat for mature hawksbill turtle. The hawksbill turtle is known to migrate up to 2,400 km between foraging areas and nesting beaches, suggesting they are adaptable to find new resources if disruption occurs. The Project will not trigger the significant impact criteria to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the hawksbill turtle is likely to decline.

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Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Hawksbill turtle No	Santos will implement measures to reduce the risk of introducing invasive marine pest species, as described in **Section 5**. The Project will not trigger the significant impact criteria to invasive species that are harmful to marine turtles becoming established in the species' habitat.
Introduce disease that may cause the species to decline	Hawksbill turtle No	All seven sea turtles have been documented to be affected by Fibropapillomatosis (FP), a tumour-causing disease notorious to occur in all sea turtles, resulting in tumours on the skin, including eyes and mouth, and can also form in internal organs. Turtles with FP can be surgically treated; however, survival rates are low. FP in sea turtles is associated with an infection by a herpes virus, however this knowledge is limited. It is also thought that human disturbance on the environment and pollution may influence FP, although this is not confirmed. The Project is considered unlikely to introduce disease that may cause the hawksbill turtle species to decline.
Interfere substantially with the recovery of the species	Hawksbill turtle No	Specific objectives of the recovery plan for hawksbill turtles closest to the Project area (within north-east Arnhem Land) (DoEE, 2017b) are summarised below, along with consideration of applicability to the proposed action: + Liaise with countries throughout the region to address and reduce the source of marine debris in Australian waters – not applicable to this action. + Ensure clean-up activities are timed appropriately to coincide with on-shore peaks in marine debris (i.e., prior to wet season) – not applicable to this action. + Work on a regional scale to understand market supply chains and to reduce unsustainable harvest and illegal and unregulated trade – not applicable to this action. + Quantify and model how changes in ambient temperatures (sand and water), sea level, frequency of extreme weather events, ocean circulation and acidification affect marine turtle nesting, sex ratios, hatching success, habitats, food availability and their ability adapt to these changes – not applicable to this action. + Support communities in their management of terrestrial predators – not applicable to this action. + Support the implementation of management plans and build capacity to undertake monitoring, education, and compliance management of marine turtles – the Project will incorporate management plans to ensure impacts to marine turtles are limited. + Establish long-term monitoring programs at index beaches and key foraging areas to assess trends in nester abundance – not applicable to this action. The Project will not trigger the significant impact criteria to interfere with the recovery of the hawksbill turtle species.

Table 6-7 Assessment of impacts to migratory dolphin species against the significant impact criteria

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
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	Migratory Dolphins - Australian snubfin dolphin, Australian humpback dolphin, Indo-Pacific/spotted bottlenose dolphin No	The Project area intersects BIAs for the Australian snubfin dolphin, Australian humpback dolphin and the Indo-Pacific/spotted bottlenose dolphin, known to breed, calve and forage within Darwin Harbour (**Figure 3-10, Figure 3-13, Figure 3-16**). Australian snubfin dolphins are endemic to Australian shallow coastal and estuarine waters, from Broome (WA) to the Brisbane River (QLD). Within the NT, the Australian snubfin dolphin is widely distributed, with population numbers considered healthy and an area of occupancy estimated at 24,900 km^2 (89% of NT coastal waters). BIAs (breeding, foraging and resting) for the Australian snubfin dolphin have been designated along the Kimberley coastline, and within NT waters, including the Darwin Harbour, south Alligator River, east Alligator River and Coburg Peninsula. The Project area overlaps the BIA for Australian snubfin dolphin; however, studies have suggested the species occurs at low densities within Darwin Harbour. Spotted bottlenose dolphins are widely distributed across the NT, with populations considered in a healthy state, with an area of occupancy estimated at 17,600 km^2 (84% of NT coastal waters). The species occurs within tropical, subtropical coastal and shallow offshore waters of the Indian Ocean, Indo-Pacific Region and the western Pacific Ocean and is distributed continuously around the Australian mainland. BIAs for the spotted bottlenose dolphin have been designated along the Kimberley Coast (WA), in NT waters and down the entire east coast of Australia from Cape York to past the NSW-Victorian border. Within the NT, BIAs (foraging, provisioning of young, feeding and breeding) are located within Darwin Harbour and Cobourg Peninsula. The Project area overlaps the Darwin Harbour BIA for this species. However, previous studies suggest the species occurs at low densities within the Darwin Harbour. Australian humpback dolphins are distributed in tropical and subtropical waters of the Sahul Shelf from northern Australia to the southern waters of the island of New Guinea. In Australia, the species is widely distributed from QLD-NSW border, along the northern coastline and down to Shark Bay (WA). Within the NT, populations of the Australian humpback dolphin are considered at a healthy state, with an area of occupancy estimated at 16,900 km^2 (88% of NT coastal waters). BIAs (foraging, feeding and breeding) for the Indo-Pacific humpback dolphin occur along the Kimberley coast in WA, in NT waters and down the Queensland coast from Cape York to Brisbane. Within the NT, BIAs for the Australian humpback dolphin are located in Darwin Harbour; Port Essington, Cobourg Peninsula; East Alligator River region and South Alligator River region. The Project area overlaps the Darwin Harbour BIA for Indo-Pacific Humpback dolphins; however, previous studies suggest the species occurs at low densities within the Darwin Harbour. Direct impacts to migratory marine species, including interactions with vessels, have the potential to occur as a result of the proposed action. However, vessel collisions with smaller cetaceans such as dolphins are infrequent due to the mobility of these species which allows them to move out of the way. In addition, given existing commercial shipping and fishing activities occur in the area, it is considered unlikely that vessels from the proposed action would increase the risk of impact to these species. Project vessels will typically be slow moving or stationary when undertaking activities in the Project area and vessel strikes with marine fauna are not expected (see **Section 6**). Changes to dolphin behaviour could also occur due to underwater noise (and to a lesser extent lighting, for marine mammals) associated with pre-lay works (i.e., trenching), installation activities and vessels and/or equipment. However, given the nature of the construction works being short-term and temporary, and because noise emissions will be largely non-impulsive, significant impact criteria to species as a result of the proposed action are not triggered (see **Section 6**). An approved monitoring program was undertaken as part of construction activities, including piling, dredging and spoil disposal activities, associated with the Ichthys Project, as conditioned in EPBC Act approval of that project (EPBC 2008/4208). The Ichthys monitoring program did not detect any deleterious effects to dolphin distributions or population sizes in the Darwin region attributable to construction activities (Brooks and Pollock, 2015; Cardno, 2015a). Given the proposed Project is smaller in scale in comparison to the Ichthys Project, and will implement management measures, including those within a CEMP (**Appendix 13**) and a TSDMMP (**Appendix 15**), the proposed trenching, spoil disposal and installation activities associated with the Project do not trigger significant impact criteria dolphin species distributions or population sizes in the Darwin area. Seabed disturbance from pre-lay activities and pipeline laying is not expected to impact any known important foraging habitat for dolphins (**Section 6.3.2.2.1.3**), as informed by RPS (2022a; **Appendix 7**) and AIMS (Galaiduk et al., 2019) habitat mapping. While breeding and calving does occur in the region, including Darwin Harbour, the Project area and in particular the pipeline route, which is adjacent to an existing shipping channel, is unlikely to overlap any areas of particular importance to breeding and calving (refer **Section 6.3.2.2.1.1** and **6.3.2.2.1.2**). Given the Project measures in place to avoid and mitigate significant impacts to habitats (Section 5.1), and the assessment of dolphin breeding, calving and foraging habitats (**Section 6.3.2.2.1.1, 6.3.2.2.1.2** and **6.3.2.2.1.3**), the Project does not trigger the significant impact criteria to substantially modify (including by fragmenting, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for the three dolphin species.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Migratory Dolphins - Australian snubfin dolphin, Australian humpback dolphin, Indo-Pacific/spotted bottlenose dolphin No	Within the Project area, the only area considered to be 'important' habitat for migratory species including dolphins is within Darwin Harbour, as this is a BIA for all three described dolphin species: + Australian snubfin dolphin, Australian humpback dolphin and the Indo-Pacific spotted bottlenose dolphin. Santos will implement measures to reduce the risk of introducing invasive marine pest species, as described in **Section 5**. The Project will not trigger the significant impact criteria to invasive species that are harmful to marine mammals becoming established in the species' habitat.

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	Migratory Dolphins - Australian snubfin dolphin, Australian humpback dolphin, Indo-Pacific/spotted bottlenose dolphin No	As described above, there are BIAs (breeding) for the Australian snubfin dolphin, Australian humpback dolphin and the Indo-Pacific spotted bottlenose dolphin within Darwin Harbour. Calving in all three species occurs yearly, from October to April (Palmer, 2010). As this is an extended calving period, it is not practicable for the Project to avoid construction during this period within Darwin Harbour. However, there is no available evidence to suggest that the Project area or Darwin Harbour represents a critical breeding or calving area for marine mammals. Vessel activity will be largely confined to a linear corridor, with an approximate 50-m seabed disturbance corridor. Project vessels present a very low risk to marine mammals due to their slow speeds, and because they remain in one location for a short period of time. The area of the spoil disposal ground is ~6.25 km² (inclusive of a buffer area), which is located outside the defined BIAs for the three dolphin species. Potential direct impacts to the three dolphin species may include injury or mortality from vessel collision and/or slight changes in behaviour such as avoidance of the area due to localised increases in underwater noise (for example as a result of trenching activities) and localised increases in light emissions. However, Project vessel numbers and movements will be insignificant compared to the total number of vessel movements within the Darwin Harbour and given the Project vessels will be slow moving or stationary when undertaking activities, vessel strikes with marine fauna are not expected to occur. Following the implementation of collision avoidance measures (**Section 5.1**), considering the nature of work activities associated with the Project (i.e. slow moving or stationary vessels) and considering the context of existing vessel traffic in the harbour, the risk of vessel collisions with dolphins is not assessed as significant. Changes to dolphin behaviour may occur as a result of underwater noise during construction activities (particularly associated with pre-lay works i.e., trenching, and installation activities), however, construction activities will be short-term and temporary, with mostly non-impulsive noise emissions. Following the implementation of acoustic disturbance mitigation measures (**Section 5.1**) and considering the temporary nature of the highest noise emitting activities (trenching), the noise disturbance impacts from the DPD Project are not expected to be significant (refer **Section 6.3.2.3.1 and 6.3.2.3.2**). On the basis of the avoidance and mitigation measures that will be implemented (Section 5.1), and consideration of the residual impacts to dolphins from Project noise (**Section 6.3.2.3.1** and **6.3.2.3.2**) and to key habitats potentially disturbed by the Project (**Section 6.3.2.2.1.1, 6.3.2.2.1.2 and 6.3.2.2.1.3**), it is not considered that the Project will seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of migratory dolphins.

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Table 6-8 Assessment of impacts to Commonwealth marine area against the significant impact criteria

Significant Impact Criteria	Is the Proposed Action Likely to Trigger the Criteria	Assessment
Result in a known or potential pest species becoming established in the Commonwealth marine area	No	IMS risks are well known, and the Santos group has internal company procedures and complies with Commonwealth legislation and industry standards to minimise the risk of introducing IMS to Australian waters across all its offshore operations. Santos has for an extended period of time successfully applied these measures to its numerous offshore operations and consider the risk of introducing IMS to be low. Vessel activity in Commonwealth waters will be temporary only.
Modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results	No	Disturbance to seabed habitats from pipeline installation in Commonwealth waters will not result in disturbance to important habitat or impact to a substantial area of habitat. Within the Commonwealth marine area, seabed disturbance will occur from the laying of the pipeline and associated structures. There is no planned anchoring in the Commonwealth marine area as project vessels will utilise dynamic positioning in these waters. There will be no trenching in the Commonwealth marine area and turbidity effects from disturbance of sediment due to the laying of pipeline and associated structures is expected to be very minor and temporary in nature. The habitat within the Commonwealth waters Project area comprises bare sediments or sediment with a sparse biota of filter feeders (e.g., soft coral) and crinoids (Heyward et al., 2017; RPS, 2023a; **Appendix 7**). This type of habitat is ubiquitous for the region (Heyward et al., 2017) and therefore the disturbance to seabed is not expected to have any significant impact on the diversity of seabed habitats or ecosystem functioning on a broader scale.
Have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution	No	There are not considered to be any populations of cetaceans or other marine species that use the Commonwealth waters part of the Project area that would be significantly impacted by the project. MNES species have been identified and assessed and there are no key habitats nor areas supporting key-lifecycle activities within the Commonwealth waters Project area. MNES species would be expected to be transient only within the Project area. Impact to other marine species that may be local to the Commonwealth waters Project area, e.g., fish and invertebrates, are expected to be very localised and minor in nature.
Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity; social amenity or human health	No	There will be no substantial impact in water quality or air quality within the Commonwealth marine area. Water quality impacts will be primarily through short term discharge of treated seawater and MEG associated with pipeline pre-commissioning activities, modelling demonstrates that concentrations at levels where effects could be observed will be very short lived and localised in nature (**Section 4.2.4**).
Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected	No	Other than treated seawater and MEG discharges there will be no other planned chemical discharges associated with pipeline construction. The chemicals selected for use for the treatment of seawater have all be assessed and selected based environmental criteria. MEG is on the OSPAR PLONOR (poses little to no risk to the environment) list and is therefore deemed safe to discharge to the marine environment. The constitute components of the hydrotest chemical package do not persist or accumulate within the marine environment. The mixture is therefore considered biodegradable with negligible potential for bioaccumulation. Discharges of treated seawater will be temporary and through diffusers angled upwards reducing potential for seabed contact.
Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck	No	There are no heritage values that have been identified within the Commonwealth marine environment of the Project area.

6.2 Listed Threatened Species and Ecological Communities

6.2.1 Potential Significant Impacts

6.2.1.1 Comparison against Significant Impact Guidelines 1.1 criteria

The MNES Significant Impact Guidelines 1.1 (DoE, 2013) outline criteria for assessing whether an action "will have, or is likely to have, a significant impact on a matter of national environmental significance" have formed the basis for assessing impacts to the threatened and/or migratory marine turtle species assessed as either likely to occur, or having the potential to occur within the Project area (see **Table 3-2** for list of species).

The assessment includes the effect of reducing risk to the EPBC Act listed threatened and migratory turtles by the adoption of the 75 avoidance and mitigation measures that will be implemented by the Project (**Table 5-1**). Some of the mitigation measures are also included in the following commentary in **Section 6.2.2**.

Santos has a high level of commitment to take action to implement the mitigation measures. The avoidance, mitigation and monitoring measures proposed in **Table 5-1** are considered effective and appropriate to reduce potential impacts to a level where there is no significant risk. The measures to manage impacts and risks have been carried through to draft EMPs as relevant. Measures have been informed and selected by Referral (**Appendix 1**) commitments and subsequent feedback and consultation with government and the public and have been reviewed through ENVID workshops and during EMP development. The management measures table (**Table 5-1**) should be viewed as a consolidated list of measures to avoid or mitigate impacts of the DPD Project.

6.2.1.1.1 Project Area

The findings of the assessment of the Project against the MNES Significance Impact Guidelines 1.1 are presented in the following tables, which are relevant to marine turtles:

+ **Table 6-1** olive ridley turtle (listed as endangered).
+ **Table 6-2** leatherback turtle (listed as endangered).
+ **Table 6-3** loggerhead turtle (listed as endangered).
+ **Table 6-4** flatback turtle (listed as vulnerable).
+ **Table 6-5** green turtle (listed as vulnerable).
+ **Table 6-6** hawksbill turtle (listed as vulnerable).

The conclusions reached for each threatened marine turtle species and/or migratory marine turtle species in the abovementioned tables is that the proposed action (i.e., the Project activities) does not trigger the criteria under the Significance Impact Guidelines 1.1 (DoE, 2013).

6.2.1.2 Potential Significant Impact sources

This section identifies the key potential significant impacts and risks of the Project on marine turtles and their habitats.

The key potential significant impacts and risks of the Project to marine turtles are:

+ Seabed disturbance.
+ Water quality deterioration impacts.
+ Noise emissions.
+ Light emissions.
+ Vessel-marine turtle collisions.

Measures have been identified to mitigate and manage these potential significant impacts and the assessment of residual significant impacts assumes that these measures will have been successfully implemented.

6.2.2 Residual Significant Impacts

This section assesses the residual significant impacts of the Project to marine turtles and their habitats after Santos' mitigation and management measures have been implemented. The residual significant impacts of the Project to flatback turtles and their habitats is assessed, including the Santos mitigation and management measures implemented to reduce potential impacts.

As the RFI states, the Project intersects the BIA and habitat critical to survival of the flatback turtle, and therefore emphasis in this residual risk assessment section is given to the flatback turtle. The green turtle, olive ridley turtle and hawksbill turtle are also likely to utilise the proposed Project area and the Project may affect these species during construction and further information about these turtles is provided in **Section 3.2**, **Table 6-5**, **Table 6-1** and **Table 6-6**. The assessment also addresses the DCCEEW (2022) request for further information (RFI Item 2) as outlined in **Table 1-1** and in **Appendix 3** of this report.

6.2.2.1 DCCEEW Request for Information

DCCEEW (2022) notes that the proposed action intersects biologically important areas (BIAs) and habitat critical to survival of the flatback Turtle (*Natator depressus*). Additionally, DCCEEW (2022) also considers that the green turtle, olive ridley turtle and hawksbill turtle are likely to utilise the proposed Project area.

DCCEEW (2022) considers that the proposed action is likely to adversely affect these important areas through trenching, pipelay and spoil disposal activities, and that the proposed action has potential to injure or displace marine turtles through acoustic disturbance or vessel collision associated with construction activities. Therefore, DCCEEW (2022) has requested the following information for its assessment of the residual significance and acceptability of impacts to EPBC-listed marine turtles:

+ Detail and justify all avoidance and mitigation measures proposed to reduce impacts to marine turtles and their habitats, for example:
  - Timing of construction activities, noting peak flatback Turtle internesting period is June-September.
  - Avoidance of important habitat features.
  - Acoustic disturbance mitigation measures.
  - Collision mitigation measures.
+ Provide evidence that the proposed action will not cause significant residual impacts to threatened marine turtles or their habitat.

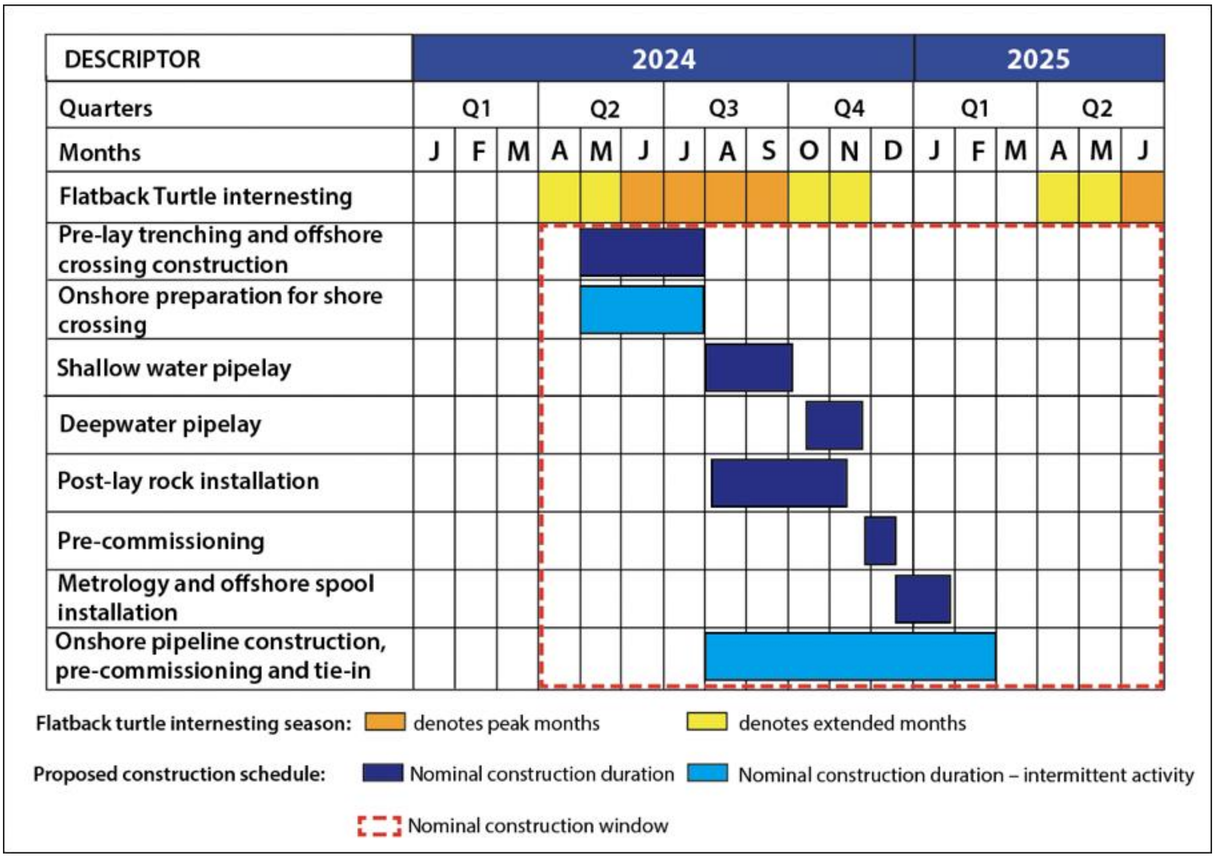
+ If significant residual impacts cannot be avoided and mitigated, please provide an offset proposal consistent with the EPBC Act. Note that the offsets policy and information required regarding offsets is given under RFI (Item 4) (see **Appendix 3**).

The following subsections address the abovementioned RFI (Item 2) topics, which come under the heading of Avoidance, Mitigation and Management in **Table 1-1.**

6.2.2.2 Timing of Construction Works and Impacts

In response to DCCEEW (2022) RFI (Item 2) request for further information on the timing of construction activities, noting that the peak flatback turtle internesting period is June to September each year, **Figure 6-1** shows the internesting period against the indicative construction schedule.

Santos is targeting to have all DPD regulatory approvals in place by Q1 2024 to ensure construction activities do not delay Barossa first gas in the first half of 2025. However, the sequence and duration of proposed construction activities shown in **Figure 6-1** may alter since activities are subject to regulatory approvals, vessel availability, operational issues, and weather. Notwithstanding, the sequence and durations of proposed construction activities outlined in **Figure 6-1** have been used as a basis for assessing residual impacts to flatback Turtle populations in NT State waters (Darwin Harbour and the Beagle Gulf) and in the Commonwealth marine area.



Source: Nominal construction schedule (Santos); Flatback Turtle internesting season (Scientific literature searches).

Figure 6-1 Timing of construction activities and peak Flatback Turtle internesting season

The following planned construction activities are most likely to overlap with the peak flatback turtle internesting season based on the indicative schedule:

+ Pre-lay trenching (indicatively 13 weeks duration) and offshore crossing construction (indicatively 2 weeks duration) overlaps the peak season in June and July.
+ Onshore preparation for shore crossing (indicatively 12 weeks' duration) intermittently overlaps the peak internesting months of June and July.
+ Shallow water pipelay (indicatively 8 weeks duration) overlaps the internesting months of August and September.
+ Post-lay rock installation (indicatively 13 weeks duration) overlaps the peak internesting period in August and September.
+ Onshore pipeline construction, pre-commissioning, and tie-in (indicatively 30 weeks duration) intermittently overlaps the peak internesting period in August and September.

The following planned construction activities are less likely to overlap with the flatback turtle internesting seasons based on the indicative schedule:

+ Pre-commissioning (indicatively 3 weeks duration) in December.
+ Metrology and offshore spool installation (indicatively 6 weeks duration) is scheduled from mid-December through January, which lies outside the peak internesting season.

As noted above, any adjustment to the construction schedule could alter the overlap with the peak flatback turtle internesting seasons. When assessing impacts of the Project to flatback turtles, the assessment of residual impacts in previous sections of this report have been revisited to also assess a worst case of construction activities overlapping peak seasons. The principal potential Project construction impact pathways to flatback turtles are:

+ Disturbance to seabed habitats.
+ Water quality deterioration impacts.
+ Underwater noise impacts.
+ Lighting impacts.
+ Vessel-turtle collision impacts.

The residual impact findings of construction activities to flatback turtles are summarised below with notes on the implications to their internesting populations.

6.2.2.2.1 Disturbance to Seabed and Benthic Habitats

Section 4.2.1 assessed the Project's direct disturbance to seabed and benthic habitats of marine turtles in Darwin Harbour. Flatback turtles are a common turtle species occurring in Darwin Harbour (**Figure** 3-2) and can migrate over large distances between their feeding and nesting grounds. The flatback turtle has a preference for shallow, soft-bottom seabed and benthic habitats away from reefs. As identified in **Table 4-1** there are such habitats within the pre-lay trenching and infrastructure footprints, which occur widely elsewhere throughout Darwin Harbour. The project bare ground habitat impacted is 0.0015 per cent of that habitat in Darwin Harbour (**Table 4-1**). It was concluded that the Project construction activities were unlikely to result in changes to the composition of benthic habitats across Darwin Harbour, nor have wider impacts on flatback turtles that rely on those habitats.

Irrespective whether Project construction activities overlap flatback turtle internesting periods or not, direct physical impacts of construction activities on flatback turtle habitat and benthic habitats are assessed as not significant.

6.2.2.2.2 Water Quality Deterioration Impacts to Flatback Turtles

Section 4.2.1 (Seabed Disturbance) used predictions of suspended sediment concentrations (SSCs) that were assessed against a series of water quality thresholds to categorise the modelled outcomes into management 'zones of influence and impact', which were defined with regard to the environmental sensitivities in the study region in **Table 4-2**.

The results of the sediment dispersion modelling study indicated that indirect impacts of construction activities to seabed and benthic habitats from water quality deterioration was localised due to the restricted spatial extent of zones of influence and impact predicted SSCs. No significant deterioration of water quality as measured by SSC was predicted within sensitive habitats such as hard coral, seagrass and mangroves, since these sensitive habitats were not present within Zones of Moderate Impact (ZoMI) or Zones of Influence (ZoIs) (see **Section 4.2.1** for definitions of these zones of influence).

Irrespective of whether Project construction activities overlap flatback turtle internesting periods or not, the indirect impacts of construction activities on flatback turtle habitat foraging are assessed as not significant.

Section 4.2.4 (Treated Seawater Discharges) used predictive metocean modelling to determine ocean concentrations of the chemicals discharged at the PLET in Commonwealth waters. An assessment was made of significant impact to the Commonwealth marine environment due to treated seawater discharges, considering significant impact criteria for the Commonwealth marine environment described in MNES Significant Impact Guidelines 1.1 (DoE, 2013).

Plankton drifting past the PLET discharge location at the time of discharge may be exposed to concentrations of Hydrosure and MEG above that which could elicit an effect. However, dilution of the plume is rapid and the exposure concentration travelling with the organism will continually reduce. There may be effects to some individuals; however, plankton are widely distributed in the ocean and regenerate rapidly.

Sediments are unlikely to be impacted as the release will be through a diffuser, three to four metres above the seabed and orientated vertically upwards.

No protected or sensitive benthic habitats have been identified with the potential to be exposed to the dewatering plume. The seabed consists predominantly bare sediments or sparse filter feeders, with large sensitive banks and shoals too far away to be impacted. Shepparton shoal is 3 km from the PLET at its closest point and the dewatering discharge dispersion modelling shows adverse impacts to aquatic biota due to Hydrosure and MEG are unlikely to occur with no significant impact.

6.2.2.2.3 Underwater Noise Impacts to Flatback Turtles

Section 4.2.3.1 assessed the impacts of underwater noise on marine turtles including flatback turtles.

The underwater noise modelling used impulsive and/or non-impulsive noise permanent threshold shift (PTS) and temporary threshold shift (TTS) acoustic threshold criteria for flatback turtles and other marine turtles, which can be used for assessing acoustic damage and/or physiological impacts to marine turtles. The acoustic threshold criteria were based on a cumulative Sound Exposure Level (SEL) over a 24-hour exposure period (SEL24h), where exceedance of the threshold may indicate a potential acoustic impact. However, the SEL24h threshold is based on the critical assumption that a marine turtle would remain stationary, or at a constant exposure range from a Project noise source, during an entire 24-hour period, which is an unlikely scenario.

The results of the modelling and assessment of acoustic impacts to marine turtles are summarised as follows:

+ Irreversible permanent hearing loss or tissue damage impacts:
  - In all underwater noise modelling scenarios, PTS SEL_{24h} thresholds for flatback turtles were only exceeded within a radius of 50 m from the noise source except for the backhoe dredger (hydraulic hammering) scenario (see below). Given the mobility of flatback turtles and other marine turtles, it is unlikely that flatback turtles would remain within the predicted PTS ranges for a period of 24 hours as they would detect the noise gradient surrounding the underwater noise source and would be expected to move away from the noise source. Therefore, irreversible permanent hearing loss (as measured by PTS onset) or tissue injury is considered unlikely for flatback turtles from most of the Project's marine construction activities, including the construction vessels employed.
  - Underwater noise from the backhoe dredger during hydraulic hammering is considered impulsive noise. The PTS SEL_{24h} threshold criteria for flatback turtles was exceeded within a radius of 100 m from the noise source, which still represents a small impact zone within which flatback turtles are unlikely to remain for 24 hours. Given their high mobility, flatback turtles and other marine turtles are expected to move away from this underwater impulsive noise source, so exposure times would be expected to be much less than 24 hours, even if management measures to reduce exposure were not applied. Therefore, irreversible permanent hearing loss (as measured by PTS onset) or tissue injury is considered unlikely for flatback turtles from hydraulic hammering activities.
+ Temporary reversible hearing loss impacts:
  - Modelled TTS SEL_{24h} threshold ranges for the non-impulsive, (i.e., continuous) noise generated by pre-lay trenching, including the use of an Xcentric Ripper tool for rock breaking, varied between radii of 40 m and 160 m for Flatback turtles. As was the case for the abovementioned PTS SEL_{24h} thresholds ranges, it is unlikely that flatback turtles would remain within the TTS zones long enough (i.e., for 24 hours or greater) for TTS onset impacts to occur. There are no known aggregation areas for flatback turtles within this range where pipe-lay trenching activities would occur. (see **Figure 4-10**).
  - In the case of the BHD hydraulic hammering impulsive noise scenario, the modelled TTS SEL_{24h} threshold ranges were significantly larger than that predicted for the other modelled scenarios with a TTS onset range for the flatback Turtle and other marine turtles predicted to be a radius of 950 m. Given the relatively large size of this range, it is possible that flatback turtles could remain within the TTS onset ranges for a period of 24 hours and be exposed to TTS onset impact, if management measures were not in place to prevent this from occurring. Further investigation undertaken to determine the effect of reducing BHD hydraulic hammering time on TTS SEL_{24h} threshold ranges (Connell et al., 2023; **Appendix 22**) revealed that by reducing the hammering time to 2 hours (from 8 hours), this management measure would reduce the TTS range for marine turtles including flatback turtles to 380 m. Note that hydraulic hammering (impulsive noise source) is only included in the acoustic modelling as an alternative option to

the preferred use of an Xcentric Ripper tool for rock breaking (i.e., a non-impulsive noise source) that has a predicted low TTS onset range radius of only 40 m.

+ Underwater noise impacts on flatback Turtle behaviour
  - Modelling of sound pressure level (SPL), which represents an instantaneous level of noise (in contrast to SEL that is measured over a cumulative period), has been used for determining behavioural impact ranges to sea turtles. An SPL behavioural threshold of 166 dB re 1 μPa_{rms} for marine turtles was only considered applicable for impulsive noise (i.e., BHD hydraulic hammer scenario). The range for this threshold at MSL was predicted to be 60 m. In the case of non-impulsive noise emissions typical of all other marine construction activities and/or associated construction vessels, a relative risk level of **Low** was predicted for sea turtle behaviour impacts. This represents a very small area surrounding a marine construction site (e.g., dredging, trenching, or ripper tool) or a construction vessel in which non-impulsive noise would induce a change in marine turtle behaviour. In this case a flatback turtle would be expected to move away from or not approach the non-impulsive noise sound field around the site or vessel.

Irreversible acoustic damage impacts (as measured by PTS onset) to flatback turtles or other marine turtles are not predicted to occur. In addition, behavioural impacts to flatback turtles are expected to be short-lived and persist only for the duration of the marine construction activities being carried out. Given their natural high mobility and ability to sense underwater noise gradients, flatback turtles are unlikely to approach an active Project underwater noise source if the intensity of the underwater noise is discomforting to their hearing system.

Project vessels (e.g., the pipelay vessel, dredgers, and smaller tender vessels) transiting to and from ports within Darwin Harbour will generate underwater noise, and nearby or approaching flatback turtles are anticipated to move away from the transiting vessels' noise sources. In the case of active marine construction within a particular area such as a trenching site, flatback turtle are expected to sense that these sites represent 'fixed' or stationary underwater noise location.

Overall and given the acoustic disturbance mitigation measures outlined in **Section 6.2.2.4** below, residual underwater noise impacts of the Project to flatback turtles and other marine turtles are not predicted whether marine construction activities overlap the peak flatback turtle nesting season or not.

6.2.2.2.4 Lighting Impacts to Flatback Turtles

Project construction vessels will be working 24 hours/day and require external lighting at night-time to provide a safe working environment as well as navigation lighting to comply with relevant maritime navigation requirements at night. The Recovery Plan for Marine Turtles in Australia 2017–2027 (DoEE, 2017b) highlights artificial light as a threat to marine turtles. This has been recognised in the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020).

Section 4.2.2 assessed the impacts of Project light emissions from vessels on marine turtles. In shallow water areas, Pendoley Environmental (2022b; **Appendix 19** report number J06063) concluded that there was no discernible risk of Project vessel lighting in Darwin Harbour causing a significant impact to the flatback turtle based on presently and publicly available data, as well as the masking effects of the predominant light spill from the city of Darwin and adjacent urbanised areas. This conclusion was based on the short-term nature of the Project, the low nesting effort on potential impact beaches, and their low reproductive value relative to other rookeries within the wider population.

In the deeper water areas (e.g., Beagle Gulf) and considering the worst-case modelled pipelay and construction vessels, Pendoley Environmental (2022a, **Appendix 19** report number J06009) assessed behavioural impacts of light spill on flatback turtles were likely to be limited to approximately 4.5 km. Therefore, light spill from offshore pipelay activities is not predicted to impact Cape Fourcroy and the southwest coast of Bathurst Island, which is designated as nesting 'habitat critical to the survival of flatback turtles' and this island shoreline also outside the 20 km buffer described in National Light Pollution Guidelines (DoEE, 2020).

In addition, various light spill mitigation measures will be put in place by Santos as outlined under 'light emissions' in **Table 5-1** to reduce lighting impacts on marine fauna and seabirds. Examples include shielding, where practicable, and/or orienting operational lights (excluding navigational lighting) on vessels to limit light spill to the environment, as well as housekeeping measures (e.g., keeping shutters on windows closed at night).

Overall, residual impacts of Project construction vessel light spill on flatback turtles and other marine turtles are not predicted whether marine construction activities overlap the peak flatback turtle nesting season or not.

6.2.2.2.5 Conclusions on Project Timing

Based on the above summary assessments of the residual impacts of habitat disturbance, changes to water quality, underwater noise and light spill to flatback turtles, it is concluded that the issue raised by DCCEEW (2022) of the timing of construction activities (noting peak flatback turtle internesting period is June-September) may be allayed as all the predicted residual significant impacts of Project marine construction activities are assessed to be not significant whether these activities coincide with peak flatback turtle internesting season or not. Furthermore, the additional avoidance, mitigation and monitoring protocols listed in **Table 5-1** have been developed to reduce potential impacts to marine turtles (including flatback turtles) and their habitats.

6.2.2.3 Avoidance of Important Habitat Features

The Project's proposed pipeline route has been surveyed (geophysical and geotechnical) to evaluate seabed suitability for pipe-lay in conjunction with engineering design requirements, and benthic surveys have also been carried out to evaluate the presence of high value seabed habitats along the route.

Most of the pipeline will be laid directly on the seabed; however, approximately 12.5 km of the proposed pipeline route within Darwin Harbour will require pre-lay trenching (with associated disposal of sediment at an offshore spoil disposal ground) to install the pipeline.

The installation of the Project pipeline will directly disturb, and in some areas remove and redistribute the seabed e.g., within trenching areas and spoil disposal ground. Seabed trenching, stabilisation, pre-sweep, and freespan correction/ prevention will only be undertaken at specific identified areas where this is required to meet pipeline integrity and safety requirements, thereby minimising seabed disturbance as far as possible.

Areas of key habitat for benthic primary producers such as seagrasses, hard corals and macroalgae are located away from the Project pipeline route in Darwin Harbour, typically in shallower waters (<10 m) and closer to shorelines (Galaiduk et al., 2019, Udyawer et al., 2021, RPS, 2023a; **Appendix 7**). Seagrass and hard coral habitats are not predicted to be directly disturbed from pre-lay activities, laying of the Project pipeline or rock installation while the area of disturbed seabed supporting macroalgae is small relative to the total area of this habitat within Darwin Harbour (0.115%, **Table 4-1**).

Section 4.2.1 assessed impacts of the Project construction phase on seabed habitats and benthic communities. The main findings are:

+ Based on benthic habitat mapping in the Darwin Harbour area (Galaiduk et al., 2019; Udyawer et al., 2021) and dedicated surveys along the Project pipeline route (RPS, 2023a; **Appendix 7**), the benthic habitats within the pipeline route and spoil disposal ground comprise predominantly soft sediments or hard substrate, supporting a filter feeding community (e.g., soft corals, sponges) ranging from sparse to medium density. This type of habitat is well represented in the Project area, within Darwin Harbour and in the region.
+ While habitats will be directly impacted by pre-lay trenching and pipelay activities, impacts will be over a comparatively small area compared to the extent of similar habitat in Darwin Harbour and the region (see **Table 4-1**, **Figure 4-1**) .

Based on the findings in **Section 4.2.1**, trenching and infrastructure footprints combined will impact less than 1% of the benthic habitats across Darwin Harbour and, more specifically, <0.15% of sponge or sponges/filterers/octocoral habitat, approximately 0.01% of macroalgae habitat and <0.05% of bare ground habitat found across Darwin Harbour. Therefore, the Project will not result in significant changes to the composition of benthic habitats across Darwin Harbour, nor have wider impacts on the marine turtles that forage within these habitats.

Overall, important habitats suitable for foraging flatback turtles and other marine turtle species are of very limited distribution within the Project area. However, the physical presence of the exposed Project pipeline (laid on the seabed) and concrete mattresses at pipeline and telecommunication cable crossing locations, all provide new hard-bottom substrate, which will be colonised by benthic flora and fauna. These developing sessile benthic communities (e.g., such as soft corals and sponges) are likely to include potential prey for flatback turtles.

6.2.2.4 Acoustic Disturbance Mitigation Measures

Acoustic disturbance mitigation measures are outlined in **Table 5-1** and they are summarised below:

+ Trenching extent is as small as practicable to achieve the required pipeline stability and protection, thereby minimising the use of trenching vessels and associated noise emissions.
+ Standard protocols have been included within the Marine Megafauna Noise Management Plan (MMNMP) (**Appendix 23**) including:
  - Vessel inductions for all crew to address marine fauna risks and the required management controls.
  - A requirement that there are personnel trained in marine fauna observation present on pipelay, trenching and rock installation vessels.
  - Soft start (ramp-up) for rock breaking (Xcentric Ripper or hydraulic hammer) by BHD, where practicable.
  - Soft start (ramp -up) for trenching equipment, where practicable, will apply to the CSD and TSHD.

+ Observation and shut-down zones for marine megafauna have been developed based on noise modelling results and standard protocols and include:
  - An observation zone of 150 m and an exclusion zone of 50 m for marine mammals and turtles will be in place around trenching vessels (TSHD, CSD and BHD) for trenching activities.
  - Observation zone monitored for 10 minutes prior to commencing trenching during daylight only.
+ Vessels will adhere to Port of Darwin vessel speed limits.

The above mitigation measures are considered adequate to reduce acoustic impacts to marine turtles, especially the 50-m radius exclusion zone around trenching, which serves to avoid interaction with marine turtles that may be approaching the activity or construction vessel. Santos contracted construction vessels will abide by speed limit restrictions within Darwin Harbour, which serve to reduce underwater noise levels (engine and propeller noise) and also reduces the radial distances at which marine turtles' behaviour may be disrupted.

6.2.2.5 Collision Mitigation Measures

The risk of vessel strike on marine turtles is inherent to movements of all construction vessels and is recognised as a threat to EPBC Act listed of threatened and migratory marine turtle species. The potential risk of a collision with marine fauna is directly related to the abundance of marine fauna and number of vessels in the Project area, and the actual likelihood of a collision occurring is also influenced by vessel speed. Vessel/marine turtle interactions arising from increased vessel traffic is also recognised as one of several key impacts to marine turtles in the Recovery Plan for Marine Turtles in Australia (DoEE, 2017b). This recovery plan has identified vessel disturbance as a particular risk to flatback turtles.

Vessel speed has been demonstrated to be a key factor in relation to collision with marine fauna, particularly cetaceans and turtles, with faster moving vessels posing a greater collision risk than slower vessels (DoEE, 2017b). Santos contracted construction vessels will abide by speed limit restrictions within Darwin Harbour, which serves to reduce the potential for vessel strikes on marine turtles. Outside Darwin Harbour and within the Beagle Gulf, where the Project vessels (e.g., offshore supply vessels, crew boats, TSHD etc.) that will transit between Darwin port and other activity locations outside the port, take avoidance action when marine turtles are observed at the surface ahead of the ship. While such transits need not follow same speed limits as required within Darwin Harbour, the onus is on the deck officers to be vigilant by scanning ahead of their vessels for marine turtle presence, as well as other megafauna. **Table 5-1** lists management measures that serve to reduce collision risk to marine turtle, and are summarised below:

+ Vessel inductions will address marine fauna risks and the required management controls.
+ Personnel trained in marine fauna observation will be present on pipelay, trenching and rock installation vessels during daylight hours, including one crew member with MFO training will be stationed on the bridge of each vessel at all times.
+ An Observation Zone of 150 m and an Exclusion Zone of 50 m for marine mammals and marine turtles will be in place around trenching vessels (TSHD, CSD and BHD) for trenching activities.

The above collision mitigation measures are anticipated to significantly assist in reducing the potential for vessel strikes to marine turtles, whether the timing of marine construction activities coincides with peak turtle nesting season or not. Note that the main flatback turtle nesting beaches within Darwin Harbour is located at Casuarina Beach, which is located about 8 km from the Project area. While flatback turtle nesting is known to also occurs at Cox Peninsula northern beaches including Mandorah Beach, these beaches are reported as supporting a relatively insignificant nesting effort (Chatto, 1998; Chatto and Baker, 2008).

Overall, the above precautionary mitigative measures are considered appropriate and adequate for reducing Project vessel-marine turtle interactions and avoiding vessel strikes to marine turtles. No additional managed measures are proposed to reduce vessel/marine turtle collisions.

6.2.3 Threats and Management Plans

This section summarises identified generic and specific threats to marine turtles and management plans applicable and/or relevant to marine turtles, which may serve to reduce potential threats specific to the Project.

6.2.3.1 Threats to Marine Turtles

Based on a review of the abovementioned plans, marine turtles face a number of threats associated with the following broad categories of human activity in the NT and Commonwealth marine areas:

+ Bycatch in commercial and recreational fisheries.
+ Coastal infrastructure and development, including.
    - Underwater noise pollution.
    - Light pollution.
    - Habitat degradation.
    - Vessel strike.
    - Marine debris entanglement.
+ Chemical and terrestrial discharges.
+ Animal predation.
+ Seismic surveys and other noise sources.
+ Indigenous harvest.
+ Diseases and pathogens.
+ Climate change and variability.

In the Project area, the key threats to flatback turtles and other marine turtle species from the proposed marine construction activities include:

+ Seabed disturbance – assessed in **Section 4.2.1**.
+ Lighting impacts – assessed in **Section 4.2.2**
+ Underwater noise impacts – assessed in **Section 4.2.3**.
+ Treated seawater discharge at PLET – assessed in **Section 4.2.4**.
+ Water quality impacts (treated seawater discharge) – assessed in **Section 4.2.4**.
+ Vessel strikes (collisions) – assessed in **Section 4.2.5.2**.

6.2.3.2 Management Plans

There are various management plans, advice, policies and guidelines relevant to marine turtles, including:

+ Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008a).
+ National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020).
+ Recovery Plan for Marine Turtles in Australia (DoEE, 2017b).
+ Threat abatement plan for predation, habitat degradation, competition, and disease transmission by feral pigs (Sus scrofa) (DoEE 2017a).
+ Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018).
+ Threat abatement plan for predation by feral cats (DoE, 2015b).
+ Threat abatement plan for predation by the European red fox (DEWHA, 2008c).
+ Marine bioregional plan for the North Marine Region (DSEWPaC, 2012).
+ Sustainable Harvest of Marine Turtles and Dugongs in Australia – A National Partnership Approach (NRMMC, 2005).
+ Northern Prawn Fishery Bycatch Strategy (NFP, 2020).

The Project is not inconsistent with the above threat abatement plans. The Recovery Plan does not recognise any of the nesting beaches within Darwin Harbour as significant nesting sites for the Arafura Sea genetic stock.

6.2.3.3 Management Strategies

The 75 controls to manage and mitigate impacts and risks to the EPBC Act listed threatened and migratory turtles are presented in **Table 5-1**, some of which are included in the **Section 6.2.2** commentary above. These were discussed and reviewed as part of the environmental identification (ENVID) workshops and subsequent work to develop the environmental management plans (EMPs). The ENVID workshop controls were informed by commitments made in the initial referral to the NT EPA (BAA-201 0003). The management and mitigation table in **Section 5** should be viewed as a consolidated list of mitigation measures to avoid, reduce, or mitigate impacts of the Project to marine turtles and their habitats.

6.3 Listed Migratory Species

6.3.1 Potential Significant Impacts

6.3.1.1 Comparison Against Significant Impact Guideline 1.1 Criteria

The MNES Significant Impact Guidelines 1.1 (DoE, 2013) outline criteria for assessing whether an action "will have, or is likely to have, a significant impact on a matter of national environmental significance" and have formed the basis for assessing impacts to the migratory inshore dolphin species assessed as likely to occur within the Project area (see **Table 3-2** for a list of the three migratory dolphin species).

The assessment includes the effect of reducing risk to the EPBC Act listed migratory inshore dolphin species by the adoption of the 74 avoidance and mitigation measures that will be implemented by the Project (**Table 5-1**). Some of the mitigation measures are also included in the following commentary in **Section 6.3.2**. There is further baseline information on each dolphin species in **Section 3.3**.

Santos has a high level of commitment to take action to implement the mitigation measures. The avoidance, mitigation and monitoring measures proposed in **Table 5-1** are considered effective and appropriate to reduce potential impacts to a level where there is no significant risk. The measures to manage impacts and risks have been carried through to draft EMPs as relevant. Measures have been informed and selected by Referral (**Appendix 1**) commitments and subsequent feedback and consultation with government and the public and have been reviewed through ENVID workshops and during EMP development. The management measures table (**Table 5-1**) should be viewed as a consolidated list of measures to avoid or mitigate impacts of the DPD Project.

6.3.1.1.1 Project Area

The findings of the assessment of the Project against the MNES Significance Impact Guidelines 1.1 are presented in **Section 6.1** under the following table, which is relevant to migratory dolphins:

+ **Table 6-7** – Assessment of impacts to migratory dolphin species against the significant impact criteria.

The conclusions reached in **Section 6.1** for each migratory dolphin species in the abovementioned table is that the proposed action (i.e., the Project activities), including mitigation measures, does not trigger the criteria under the Significant Impact Guidelines 1.1 (DoE, 2013).

6.3.1.2 Potential Significant Impact Sources

This section identifies the key potential significant impacts of the Project on migratory dolphins and their habitats.

The key potential significant impacts of the Project to inshore migratory dolphins include:

+ Seabed disturbance impacts to benthic foraging habitats.
+ Underwater noise impacts.
+ Light spill impacts.
+ Vessel strike impacts (collisions).

Measures have been identified to mitigate and manage these potential significant impacts and the assessment of residual significant impacts assumes that these measures will be fully implemented. There is little benefit to be gained in assessing potential impacts of the Project to the three inshore migratory dolphin species and their habitats prior to the implementation of Santos' mitigation and management measures. Therefore, the focus of this report has been to assess the residual significant impacts of the Project to inshore migratory dolphins and their habitats after Santos' mitigation and management measures have been implemented, which is presented in **Section 6.3.2** below.

6.3.2 Residual Significance Impacts

This section assesses the residual significant impacts of the Project on the three MNES migratory dolphin species and their habitats and assumes that Santos' mitigation and management measures have been implemented to reduce potential impacts. The assessment addresses the DCCEEW (2022) request for further information (RFI Item 3) on MNES migratory dolphins and presents conclusions on whether residual significant impacts can be avoided or adequately mitigated by pro-active management measures.

6.3.2.1 DCCEEW Request for Information

This section provides additional information in response to the DCCEEW (2022d) Request for Information (RFI) on EPBC Act listed migratory dolphins (see RFI Item 3 in **Table 1-1** in **Section 1.3**, and **Appendix 3**). The relevant DCCEEW RFI text under the DCCEEW heading of "Avoidance, mitigation, and management" is quoted below:

The proposed action intersects biologically important areas (BIAs) for the Australian Snubfin Dolphin (Orcaella heinsohni), Australian Humpback Dolphin (Sousa sahulensis), and Spotted Bottlenose Dolphin (Tursiops aduncus). The department notes that the proposed action has potential to injure or displace these dolphins through acoustic disturbance or vessel collision associated with construction activities. The department therefore requires the following information to assess the residual significance and acceptability of impacts to EPBC-listed inshore dolphins:

+ *Detail and justify all avoidance and mitigation measures proposed to reduce impacts to inshore dolphins and their habitats, for example:*
    - *Avoidance of important habitat features.*
    - *Acoustic disturbance mitigation measures.*
    - *Collision mitigation measures.*
+ *Provide evidence that the proposed action will not cause significant residual impacts to migratory dolphins or their habitat.*

If significant residual impacts cannot be avoided and mitigated, please provide an offset proposal consistent with the EPBC Act Offsets policy. Information required regarding offsets is stated in section 4 of this table.

Responses to the DCCEEW RFI Item 3 and additional information is provided in the following sections. There is also further baseline information on each dolphin species in **Section 3.3**.

6.3.2.2 Avoidance of Important Habitat Features

6.3.2.2.1 Biologically Important Areas (BIA) for Dolphins

MNES migratory dolphin BIAs cannot be avoided by the Project's proposed marine construction activities and associated construction vessels, as is the case for existing port developments and maritime traffic within Darwin Harbour.

The following migratory dolphin BIAs are present in the Project area:

+ Australian snubfin dolphin BIA (breeding and calving) – an approximate 20-km long section of the Project pipeline intersects this BIA, which is shown in **Figure 3-10**.
+ Australian humpback dolphin BIA (breeding, calving, foraging) – an approximate 33-km long section of the Project pipeline intersects this BIA, which is shown in **Figure 3-13**.

+ Spotted bottlenose dolphin BIA (breading and calving) – an approximate 20-km long section of the DPD pipeline intersects this BIA, which is shown in **Figure 3-16**.

The longer extension of the Project pipeline within the Australian humpback dolphin BIA (breeding, calving, foraging) reflects the extension of the BIA into the outer Darwin Harbour and westwards along the northern coast of the Cox Peninsula.

6.3.2.2.1.1 Breeding Habitat

The exact locations of breeding habitats within the BIA (breeding and calving) in Darwin Harbour are not known. Breeding may take place in shallow or deeper water habitats, while calving probably occurs in shallow water habitats although there are no supporting studies/reports of calving behaviour of the three dolphin species in the Darwin Harbour region. The three dolphin species are therefore most unlikely to calve in the deeper waters of the Project's alignment. Calving areas in very shallow waters would serve to protect dolphin calves from predators, which is also a common reason for other marine fauna nursery areas (e.g., fishes).

Since the Project pipeline is adjacent to and closely follows the main shipping lane to and from Darwin Harbour, it is most unlikely that any of the three dolphin species would breed within or close to this this shipping channel, and the proposed Project pipeline alignment. Therefore, the Project pipeline alignment is not expected to intercept or impact upon breeding habitat.

6.3.2.2.1.2 Calving Habitat

The exact locations of calving habitats within the BIA (breeding and calving) in Darwin Harbour are not known. However, calving habitats are generally found in shallow sheltered waters and embayments, which are not intercepted by the Project pipeline alignment, except for a small section of the Project pipeline that traverses a shallow water area near landfall. The shallow water section is close to shipping lanes and maritime traffic and, as such, is not considered to be a likely or suitable calving area.

Data that is available is based on Palmer (2010) and the following calf distributions have been identified within Darwin Harbour, mostly on the eastern side with small numbers on the western side:

+ Snubfin dolphin calf sightings-
    - Palmer (2010) recorded three calf sightings along the western side of Darwin Harbour with one north of Mandorah, one south of Mandorah (both within the Project area), one at the mouth of Woods Inlet, and one sighting along the eastern side of Darwin Harbour (northern Fannie Bay).
+ Australian humpback dolphin calf sightings-
    - Palmer (2010) recorded no calves on the western side of Darwin Harbour. All calf sightings were recorded along the eastern side of Darwin Harbour with 7 sightings in Fannie Bay, 5 sightings in Frances Bay, and 4 sightings along the Darwin port frontage.
+ Spotted bottlenose dolphin calf sightings-
    - Palmer (2010) recorded 4 calf sightings along the western coast of Darwin Harbour and 12 sightings along the eastern side of Darwin Harbour (mainly between Frances Bay and East Arm).

In the case of foraging habitats within Darwin Harbour, these are found both in shallow waters (e.g. seagrasses, macroalgae, and mangrove habitats) and deeper water habitats that provide benthic food sources (e.g., sponges, other macroinvertebrates, and fishes). While the Project's proposed pipeline route does not pass through seagrass or mangrove habitats, it does intercept other benthic habitat types (e.g., soft corals, sponge communities) that are important to those inshore dolphin species that forage within these habitat types (see **Section 6.3.2.2.1.3** below).

While the broadscale MNES migratory dolphin BIAs within Darwin Harbour cannot be avoided, Project interception of dolphin breeding or shallow water calving areas within the BIAs is unlikely. Overall, the DPD Project is assessed to not have direct significant residual impacts to dolphin breeding and calving habitats, as these habitats can be avoided. Potential indirect impacts can be adequately managed by applying Santos' multi-layered mitigation measures to reduce Project interactions with dolphins, avoid collisions, and limit underwater noise impacts by applying observation and safety zones around construction works and vessels.

6.3.2.2.1.3 Foraging Habitats

Santos completed benthic habitat surveys along the proposed pipeline route, dredge spoil disposal ground and surrounding areas in both 2021 and 2022 to verify the benthic habitat present in areas where impacts to benthic habitat may occur (RPS, 2023a, **Appendix 7**). A video transect survey was conducted between 6 and 10 June 2022 with the objective of expanding the benthic habitat survey data along the proposed pipeline route, including within the Charles Point Wide Reef Fish Protection Area, and to ground-truth areas of potential sensitive habitat adjacent to the pipeline route (as predicted by the AIMS 2021 and 2019 habitat mapping).

The results from the abovementioned benthic habitat surveys showed that selected sites that were predicted as suitable for macroalgae, seagrass and/or hard coral by AIMS (2021) mapping typically did not show presence of these benthic community types. For example, where the AIMS mapping predicted areas near Mandorah as being potential hard coral and potential seagrass habitat, the areas were in fact observed to be bare sand and sand waves habitat.

To inform the impact assessment of Project activities, Santos combined the shallow water habitat maps from the AIMS 2021 report (Udyawer et. al., 2021) with the deeper water habitat maps from the 2019 report (Galaiduk et al., 2019) to a single, combined habitat mapping layer, which is shown in **Figure 6-2** (also shown in **Section 4.2.1**).

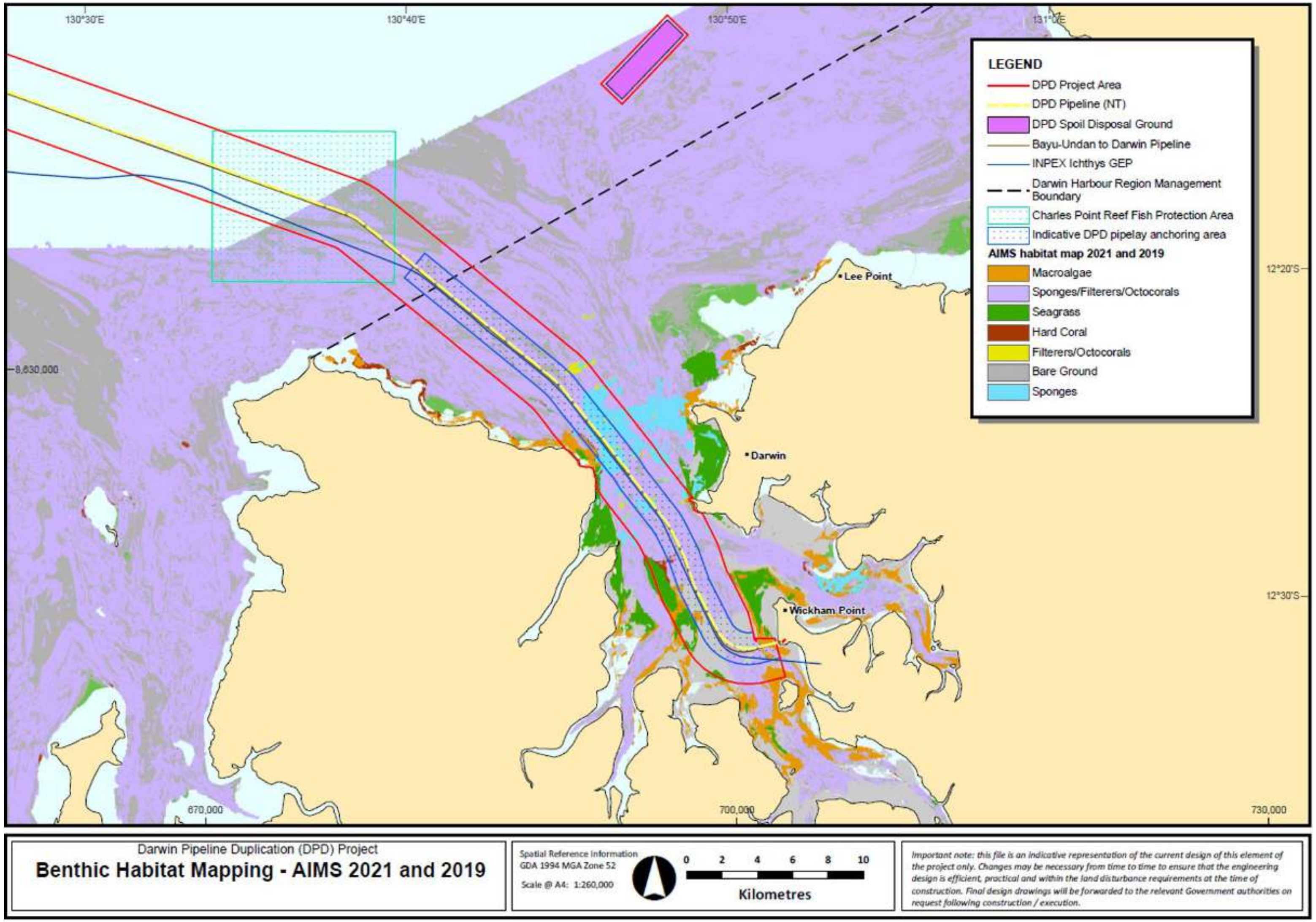


Figure 6-2 Benthic habitat mapping – AIMS 2021 and 2019

In **Figure 6-2**, the proposed Project pipeline route within Darwin Harbour between landfall and the Darwin Harbour Regional Boundary (dashed line) is 69 km. The route unavoidably passes through three seabed benthic habitat types, as detailed in **Table 4-1.**

Given that the small width (**Table 4-1**) and area of direct seabed disturbance along the proposed pipeline route, residual impacts on these broadscale seabed habitat types are assessed to be negligible, given the much larger areas of non-impacted broadscale seabed habitat types available to foraging inshore dolphins.

All three inshore dolphin species are considered as opportunistic and generalist feeders (Parra, 2013) and may therefore prey on benthic food resources within these broadscale habitats that occur throughout the wider Darwin Harbour area during the Project's proposed construction activities. While the three species of coastal dolphins have some degree of foraging spatial and space overlap, the broadscale habitats used for foraging also varies geographically within the wider Darwin Harbour area and occur at different distances from the Project's proposed marine construction activities, as summarised below:

+ Australian snubfin dolphins.
  - This species generally inhabits relatively shallow and protected coastal habitats such as inlets, estuaries, major tidal rivers, shallow bays, inshore reefs, and coastal archipelagos, rather than in open stretches of coastline (Parra and Cagnazzi, 2016) and, often in association with mangrove systems close to creeks and river mouths (Beasley et al., 2012).
  - Most sightings occur in depths up to 10 m with a preference of water depths around 5 m deep close to river and creek mouths and upstream in some tidal rivers (Palmer, 2009; Parra, 2006; Parra et al. 2006a). However, a comprehensive understanding of the spatial ecology, regional distribution, and environmental preferences of Australian snubfin dolphins is still lacking (Bouchet et al., 2021).
  - During the period 2008 to 2010 (Palmer, 2010), this species was observed to be primarily found along the west coast of Darwin Harbour (e.g., Woods Inlet, 3.5 km from the Project alignment) and within Bynoe Harbour (30 km from the Project's proposed alignment). Foraging habitat includes estuarine inlets, sands, mudbanks, seagrasses and rocky reefs.
  - The Australian snubfin dolphin is considered an opportunistic, generalist feeder that preys on a variety of schooling, bottom-dwelling and pelagic fishes, and cephalopods, which are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra, 2013)
  - The foraging habitats of the Australian snubfin dolphins are generally found closer to shore and/or inflowing rivers where mangroves are present, which are used less by the Australian humpback and spotted bottlenose dolphins whose foraging habitats are in deeper waters and further offshore, respectively.
  - While foraging may occur in the Project area, there are no specific habitats that are considered unique or key for the Australian snubfin dolphin given its generalist feeding behaviour and wide use of shallow coastal habitats for foraging.
+ Australian humpback dolphins.
  - Australian humpback dolphins are more likely to be found in relatively shallow and protected coastal habitats such as inlets, estuaries, major tidal rivers, shallow bays, inshore reefs, and

coastal archipelagos, rather than in open stretches of coastline (Parra and Cagnazzi, 2016). This coastal dolphin species occurs mostly in shallow waters up to 10 km from the coast and 20 km from the nearest river mouth, and they have been seen 55 km offshore in shallow water.

- During the two-year period 2008 to 2010, this species was not observed along the western side of Darwin Harbour where Australian snubfin dolphins predominated (see above) but was observed along the eastern side of the harbour at Frances Bay and the East Arm of the harbour (Palmer, 2010). **Figure 3-9** shows the cumulative sighting records within the wider Darwin Harbour area, which indicates that the species is likely to forage in most shallow areas of the harbour.
- The Australian humpback dolphin is considered an opportunistic, generalist feeder that preys on cephalopods and a variety of schooling bottom-dwelling and pelagic fishes. The habitats of these prey species are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra, 2013).
- While foraging may occur within the Project area, there are no specific habitats that are considered unique or key for this species given its generalist feeding behaviour and wide use of coastal habitats for foraging.

+ Spotted bottlenose dolphins.
  - This species tends to occur in deeper and more open waters of the continental shelf (<200 m deep) but primarily in shallow coastal waters (typically <50 m deep) fringing the coastline, reefs, and offshore islands.
  - During the two-year period between 2008 and 2010 (Palmer, 2010), this species was not found foraging within the western side of Darwin Harbour but was found to forage along the eastern side of the harbour mainly at Fannie Bay with some foraging sightings in Frances Bay. Fannie Bay and Frances Bay are located approximately 3 km and 5 km from the nearest Project alignment. **Figure 3-15** shows the cumulative sighting records for this species in Darwin Harbour and indicates a continuing preference for the eastern side of the harbour. Outside Darwin Harbour, an important foraging area for this species was inner Shoal Bay (30 km from the Project area) at Hope Inlet and the mouth of the Howard River, which represented a combined foraging area not accessed by Australia snubfin and Australian humpback dolphins (Palmer, 2010).
  - The spotted bottlenose dolphin is considered an opportunistic and generalist feeder that preys on a variety of cephalopods and schooling pelagic and bottom-dwelling fishes, though fishes predominate in the diet. These prey items are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra, 2013).
  - While foraging may occur in the Project area, there are no specific habitats that are considered key for the spotted bottlenose dolphin given its generalist feeding behaviour and wide use of coastal habitats for foraging.

Based on the results of a ground-truthing video transect survey conducted between 6th and 10th June 2022 (RPS, 2022), **Figure 6-3** shows the distribution of micro-scale habitat sites predicted to be suitable for rarer high-value biota habitat types (e.g., macroalgae, hard corals and seagrass) within Darwin Harbour. The survey focussed on those ground-truthing sites that were closest to the proposed pipeline route and therefore, had the greatest potential to be influenced by Project construction activities, including trenching.

In **Figure 6-3**, in addition to the survey's ground-truthing sites along the proposed route, it is anticipated that if comparable line surveys were to be undertaken along similar linear at various distances either side of the pipeline route and within the buffer zone. In other words, there is likely to be a plethora of such high-value microscale habitat types within the broad-scale mapping units that are also shown by AIMS (2021) in **Figure 6-3**.

Section 4.2.1.1 has assessed that there are no unique or sensitive habitats along the Project pipeline route or the spoil disposal ground, and the habitats present are well represented in other locations, both within the harbour and regionally. This applies equally to the foraging habitats of the three migratory dolphin species.

With the evidence provided in this section no residual significant impacts on migratory dolphin foraging habitats are predicted within the Darwin Harbour BIAs.

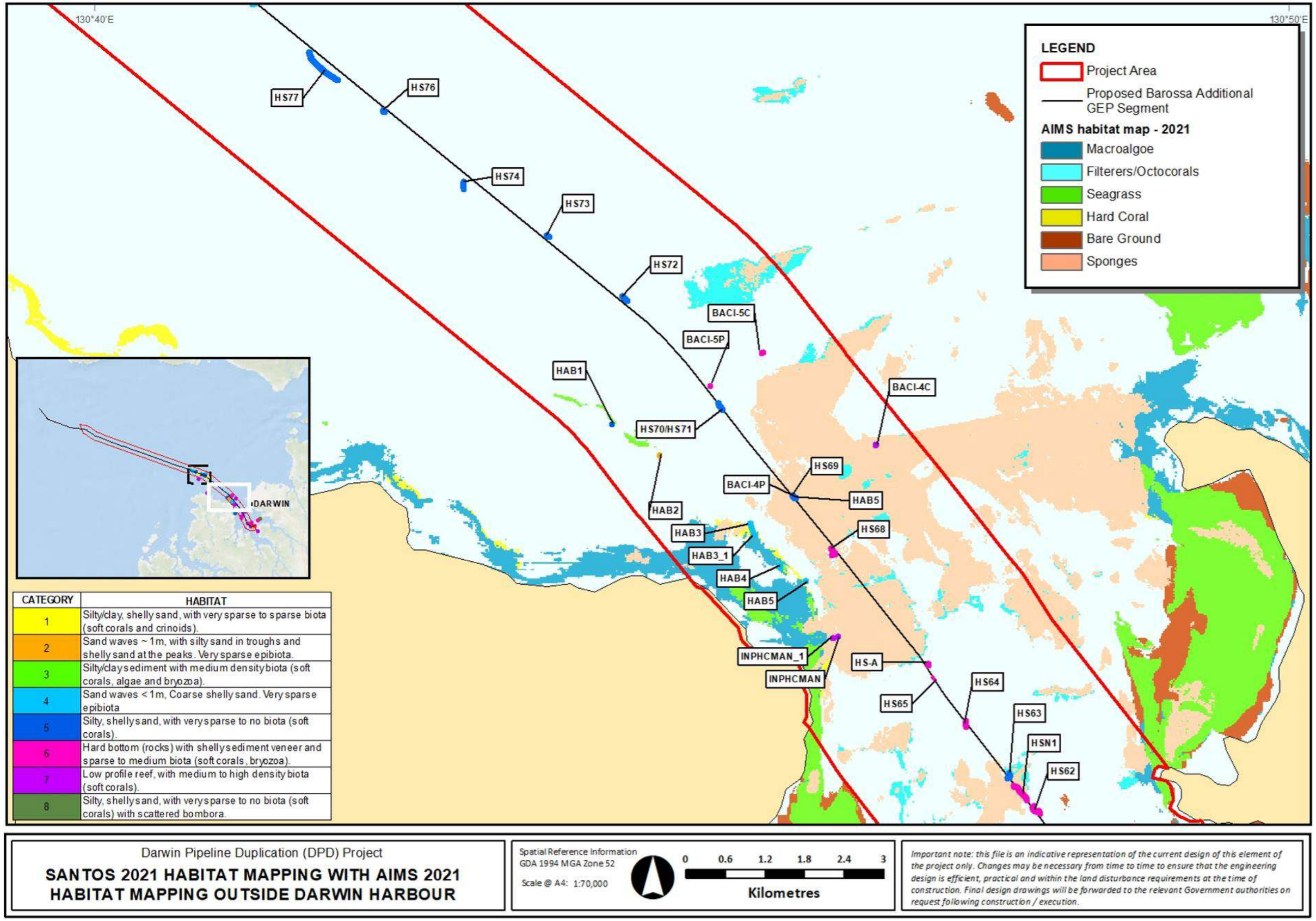


Figure 6-3 Specific microscale habitat sites within broadscale habitat type

6.3.2.3 Adequacy of Acoustic Disturbance Mitigation Measures

Santos has a suite of avoidance, mitigation, and management measures to reduce the Project's potential acoustic impacts to MNES migratory dolphins, which are summarised in **Table 5-1** in **Section 5**. Different acoustic disturbance mitigation measures will be applied to reduce acoustic disturbance to marine megafauna from the Project's static or very slow-moving marine construction activities (e.g., trenching) and from Project vessels in transit or moving between sites in the field.

6.3.2.3.1 Acoustic Disturbance Mitigation Measures for Marine Construction Activities

The key acoustic disturbance mitigation measures for marine construction activities are:

+ Observation and shut-down zones for marine megafauna (which includes dolphins) have been developed based on Project noise modelling results and standard protocols and include:
  - An Observation Zone of 150 m and an Exclusion Zone of 50 m for marine mammals (including dolphins) and turtles will be in place around trenching vessels (TSHD, CSD and BHD) for trenching activities.
  - Trenching cannot commence if fauna are within or heading into the Exclusion Zone as described in **Appendix 23** and **Section 5**: Marine megafauna observation are adaptive management protocol for routine construction operations including the use of Xcentric Ripper tool.
+ Standard Protocols have been included within the Marine Megafauna Noise Management Plan (MMNMP) (**Appendix 23**) including a requirement that the personnel are inducted in marine fauna observation present on pipelay, trenching and rock installation vessels, with at least one trained Marine Mammal Observer (MMO) being present onboard these vessels.
+ A Marine Fauna Observation and Management Protocol for Trenching Activities will apply to the Observation and Exclusion Zone (refer **Appendix 23** and **Section 5**).
  - A soft start (ramp-up) of hydraulic hammering (rock breaking) by BHD will apply.
  - A soft start (ramp-up) of trenching equipment, where practicable, will apply to the CSD and TSHD.
  - Hydraulic hammering for no greater than 8 hrs over a 24-hr period.
  - No hydraulic hammering at night.
+ Personnel trained in marine fauna observation (MFO) present on pipelay, trenching and rock installation vessels during daylight hours including one crew member with MFO training on the bridge at all times.
+ Project vessels and helicopters will adhere to the requirements of the EPBC Regulations 2000 Part 8 Division 8.1 Interacting with cetaceans (note this requirement does not apply to the pipeline installation vessel when it is installing the pipeline).
+ All marine fauna interaction and observations within the Project area will be appropriately recorded and reported to relevant authorities.

The deepwater pipelay vessel will be positioning using dynamic positioning (DP) control when laying pipe. The deepwater vessel does not adopt the protocol as it cannot safely shut down thrusters quickly with pipe attached. In addition, the very slow speed of pipelaying would essentially be a static underwater noise source to which dolphins are less aversive than would be the case for a fast-moving vessel.

In the case of the Project's marine construction activities such as trenching, these such operations will be concentrated in particular areas (see **Figure 2-6** in **Section 2.4.2.2**) within the middle and outer compartments of Darwin Harbour. In this case, rather than the transient underwater noise generated by a Project vessel in transit, the underwater noise from trenching is continuous for the duration of trenching activity. In addition, as trenching is essentially concentrated in one area at a time, this represents a stationary and persistent underwater noise for the duration of the trenching activity. As such, potential impacts on inshore dolphins are reduced as cetaceans in general (including inshore dolphins) show less aversion or avoidance behaviour to a static or slowly moving source (e.g., pipelay vessel or dredger). This has been confirmed by:

+ Studies have shown that cetaceans show less aversion or avoidance behaviour to stationary vessels or marine construction activities (Richardson et al, 1995).
+ Noise sources that are continual and do not move favour marine animals readily acclimating to them (Duncan and McCauley, 2008).
+ Studies have established that cetaceans engage in avoidance behaviour when surface vessels move toward them (Richardson et al., 1995).

In terms of dolphins entering the 50-m Exclusion Zone around the dredgers, the shut-down procedures require active trenching to cease until the dolphins have moved out of this zone. However, the dredgers would still be required to maintain station using their thrusters and DP control; therefore, the dredgers will continue to represent a static underwater noise source to which dolphins a less aversive.

The evidence provided in this section and the abovementioned mitigation measures are considered adequate to reduce potential underwater noise disturbance to no residual significant impact to those migratory dolphins that approach and enter the 50-m radius Exclusion Zone around the trenching vessels.

6.3.2.3.2 Acoustic Disturbance Mitigation Measures for Vessel Movements

The key acoustic disturbance mitigation measures for Project vessel transit and other in-field vessel movements are:

+ Vessels transiting or moving within the Darwin Port limits (**Figure 2-1**) will adhere to Port of Darwin vessel speed limits.
+ In the absence of Northern Territory marine mammal watching guidelines, Project vessels underway or approaching individual or groups of migratory dolphins will adhere to the recommended vessel approach distance requirements of Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000 as referred to in the MMNMP (**Appendix 23**), which include the following vessel approach guidelines:
  - No approach zone is 50 m of an adult dolphin (vessels must not enter this zone).
  - Caution zone is 150 m of an adult dolphin (vessels must reduce speed in this zone to less than 6 knots).
  - Caution zone is 150 m of a dolphin calf (vessels must not enter this zone).

- Vessel inductions for vessels entering the Project area will address marine fauna risks and the required management controls.
- Vessels abide by Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000, which includes controls for minimising interactions with marine fauna.
- Vessel engines and Project equipment/machinery maintained as per planned maintenance system.
- Additional mitigative measures for managing vessel activity in proximity to dolphins include:
  - Care should be taken such that no dolphin should be separated from a group or a mother from her calf or that a group be dispersed.
  - Under no circumstances should dolphins be driven, or their movements blocked by vessels.
  - If dolphins approach the vessel or bowride, maintain a slow, steady speed without changing course.

Note that the Project's 'Exclusion Zone' and 'Observation Zone' are of equivalent meaning as the respective 'no approach' and 'caution zone' of the national guidelines for whale and dolphin watching (DoEE, 2017d).

6.3.2.3.2.1 Conclusion on adequacy of acoustic disturbance mitigative measures

While the level of noise expected from temporary and intermittent marine construction activities has the potential to cause physical injury to marine mammals, all three MNES migratory dolphin species are expected to demonstrate avoidance behaviour if noise levels approach those that could cause pathological effects.

The potential for acoustic physiological injuries and behavioural impacts to migratory dolphins will be managed through the Santos group's procedures for interacting with marine fauna under Santos' Marine Megafauna Noise Management Plan (MMNMP) (**Appendix 23**). In addition, transiting or other vessels between site or in-field vessel movements abide by the national guidelines for speed restrictions and manoeuvring in vicinity of dolphins (DoEE, 2017d).

Overall, the Project's proposed mitigation and management measures to reduce acoustic impacts to MNES migratory dolphins are considered adequate and fit for purpose, such as Santos' application of a 50-m radius Exclusion Zone around trenching vessels to trigger a shut-down for dolphins. For example, in the EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales: Industry guidelines (DEWR, 2007), the guidelines apply to whales but do not apply to encounters with the smaller dolphins and porpoises.

With the evidence provided in this section including, the sparse distribution of migratory dolphins within Darwin Harbour and the outer harbour region, where marine construction activities (e.g., trenching) and vessel transits are proposed, the likelihood of marine construction activity or vessel interaction with MNES listed migratory dolphins is anticipated to be low.

6.3.2.4 Adequacy of Collision Mitigation Measures

Direct impacts to MNES listed migratory dolphin species, including interactions with vessels, have the potential to occur during Project vessel activities. In general, vessel collisions with smaller cetaceans such as dolphins are infrequent due to the mobility of these species, which allows them to move out of the way. Notwithstanding, Santos has developed various collision mitigation measures which, when implemented, are anticipated to reduce potential vessel-dolphin interactions and collision impacts.

Project vessels used during the proposed marine construction activities such as trenching pipelaying, and rock placement, will predominantly be static (i.e., avoids collisions) or very slow moving and considered to be effectively immobile and therefore present a very low likelihood of vessel collision with dolphins. The principal risk of vessel-dolphin collisions arises mainly through vessel movements at higher speeds (e.g., transiting between port and the marine construction sites or undertaking other in-field manoeuvres). Therefore, the collision mitigation measures summarised below, apply only to vessels underway and at higher speeds.

Table 5-1 lists collision mitigation measures relevant to vessel movements at speed, which are summarised below:

+ Vessel inductions will address marine fauna risks and the required management controls.
+ Vessel movements will comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA 91 11 00003), which ensures compliance with Part 8 of the EPBC Regulations 2000.

In addition, the acoustic disturbance mitigation measures for vessel movements outlined in **Section 6.3.2.3.2** above, also serve to greatly reduce the potential for vessel-dolphin interactions and avoid collisions. In the case where dolphins choose bowride along a fast-moving Project support vessel or crew boat, it is generally accepted to maintain a slower, steady speed without changing course during such encounters.

There are existing vessel safety procedures that will benefit migratory dolphins through a reduction in the potential for vessel strikes, such as bridge personnel assigned to stand watch continuously when moving through the water (i.e., when the vessel is underway). Watch personnel undertake scanning procedures to detect anomalies ahead of the vessel such as a floating or partially submerged object, a piece of debris, or surface disturbance.

Santos' proposed mitigation measures that include trained MFO personnel to attend if required the main marine construction vessels (e.g., pipelay, dredgers, rock dumping vessels) and induct personnel on other support vessels (as well as the skippers) in dolphin awareness ahead of the vessels is expected to enhance dolphin sightings, and to take aversive or other appropriate action to avoid potential collisions.

Overall, the proposed mitigation measures to reduce vessel-dolphin interactions are also expected to avoid vessel-dolphin collisions. With the evidence provided in this section including the existing commercial shipping and other maritime traffic in the Darwin Harbour region, it is considered unlikely that Project vessels from the proposed action would significantly increase the risk of impact to these species. The Project's proposed mitigation measures are considered adequate for avoiding dolphin strikes.

6.3.3 Threats and Management Plans

This section summarises identified generic and specific threats to the three MNES migratory dolphin species and management plans applicable and/or relevant to marine turtles, which may serve to reduce potential threats specific to the Project.

6.3.3.1 Threats to Inshore Migratory Dolphins

Threatening processes that may impact on migratory dolphins are described below including those potentially attributable to the Project.

Beasley et al. (2012) circulated a questionnaire to Australian researchers, seeking expert opinion on the threats faced by tropical inshore dolphins. The results broadly (and non-mutually exclusively) include:

+ Habitat loss and degradation through coastal development.
+ Disturbance from increasing shipping and boating activity.
+ The proliferation of underwater noise from anthropogenic sources.
+ Wildlife tourism targeting tropical inshore dolphins.
+ Depletion of food resources through commercial and recreational fishing.
+ Catchment run-off (including nutrients and metal contaminants).
+ Bycatch in a variety of fishing gear, such as gillnets, trawl nets and purse-seines, as well as incidental capture in shark nets set for bather protection.
+ Climate change, including both gradual ocean warming and acidification, as well as more frequent and intense extreme weather events.

The latter three are loosely equivalent to the anthropogenic threats ranked as the greatest to marine ecosystems by Halpern et al. (2007), which are point-source organic pollution, demersal destructive fishing, and increasing sea temperature.

The Species Profile and Threats (SPRAT) database (DCCEEW, 2023), identified the key threats to EPBC Act listed migratory dolphins in tropical Australia as:

+ Habitat destruction and degradation.
+ Pollution of habitat.
+ Fishing - commercial and recreational.
+ Interaction with vessels.
+ Seismic surveys and other noise sources.
+ Diseases and pathogens.
+ Climate change and variability.
+ Vessel collision.

The above Australia-wide generic threatening processes to migratory dolphins varies somewhat when considering the three migratory dolphin species in the NT, and which are summarised below.

6.3.3.2 Threats to Australian Snubfin Dolphin

Past and current threats to Australian snubfin dolphins include habitat destruction and degradation, incidental capture in gillnets, traditional hunting by Indigenous Australian communities, and live capture for oceanariums (Bannister et al., 1996). The calving interval of Australian snubfin dolphins is unknown, however, as per most Delphinidae, it is expected to be approximately one calf born per two to three years. This low reproductive rate could result in a slow population recovery from any threatening processes.

In the Project area and wider region, the inshore distribution of Australian snubfin dolphins leads to the high probability of physical interactions with vessels and exposure to underwater noise generated by passing vessels and marine construction activities. Australian snubfin dolphins can be expected to exhibit vessel avoidance behaviour, potentially negatively affecting their extent of occupancy and life history, as per other nearshore dolphins (Bedjer et al., 2006).

6.3.3.3 Threats to Australian Humpback Dolphin

The Australian humpback dolphin is threatened by habitat loss and degradation, by-catch in fisheries, water pollution, underwater noise, floods, vessel traffic, overfishing of prey resources and wildlife tourism (Parra and Cagnazzi, 2016). In the Darwin region, habitat loss or degradation, underwater noise (marine construction and vessels), and loss or degradation of benthic and demersal food resources represent potential threats to this species.

In the Project area, the inshore distribution of Australian humpback dolphins leads to the high probability of physical interactions with vessels and exposure to underwater noise generated the Project's marine construction activities and vessels employed for this purpose. In general, while Australian humpback dolphins can be expected to exhibit vessel avoidance behaviour, potentially negatively affecting their extent of occupancy and life history, these dolphins are known to approach vessels, as do spotted bottlenose dolphins.

6.3.3.4 Threats to Spotted Bottlenose Dolphins

Past and current threats to spotted bottlenose dolphins include habitat destruction and degradation, incidental capture in gillnets, traditional hunting by Indigenous Australian communities, and live capture for oceanariums (Bannister et al., 1996).

Based on one of the best-studied cetacean populations of Indo-Pacific bottlenose dolphins (*Tursiops* sp.) of Shark Bay, Australia, Bedjer et al. (2006) documented a long-term response to vessels used in dolphin-watching tourism. Given their substantial presence and proximity to the dolphins, tour vessels were considered the primary contributor to declining dolphin abundance. Engine size and consequent underwater noise were indicated as the source of disturbance to the dolphins.

In the Project area, the inshore distribution of spotted bottlenose dolphins leads to the high probability of physical interactions with vessels and exposure to underwater noise generated the Project's marine construction activities and vessels employed for this purpose. While behavioural disturbance from loud underwater noise surrounding ships and larger vessels may be expected to disturb spotted bottlenose dolphins, this species is also known to approach vessels in transit (e.g., bow riding), and habituate (desensitise) to vessels' underwater noise fields.

6.3.3.5 Management Plans

Management plans, strategies, policies, and guidelines etc. that may be required to be implemented and/ or followed to reduce potential threats to inshore dolphin species include:

+ Marine bioregional plan for the North Marine Region (DSEWPaC, 2012).

+ National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (DoEE 2017c).
+ Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018).
+ Matters of National Environmental Significance, Significant impact guideline 1.1 (DoE, 2013).
+ Australian National Guidelines for Whale and Dolphin Watching (DoEE, 2017d).

Other relevant polices and guidelines include:

+ Relevant Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) related recovery plans, conservation advice and management plans.
+ National Strategy for Reducing Vessel Strike on Cetaceans and Other Marine Megafauna (DoEE 2017c).
+ Guidelines for the environmental assessment of marine dredging in the Northern Territory (NT EPA, 2013).
+ National system for the prevention and management of marine pest incursions (DAFF 2010).
+ Darwin Harbour Water Quality Protection Plan (DLRM, 2014).
+ Anti-fouling and in-water cleaning guidelines (DENZMPI, 2015).
+ Developing an integrated long-term monitoring program for Darwin Harbour. Anthropogenic Pressures on Darwin Harbour: The Darwin Harbour Integrated Marine Monitoring and Research Program (IMMRP) Long-term Monitoring Plan Version 1 (Radke and Fortune, 2020).

The Project is not inconsistent with the above plans and guidelines, and the proposed action will not cause significant residual impacts.

6.3.3.6 Management Strategies

The 74 controls to manage and mitigate impacts and risks to the EPBC Act threatened migratory dolphin species and their habitat are presented in **Table 5-1**, some of which are included in the **Section 6.3.2.3.1** and **Section 6.3.2.3.2** commentary above. These were discussed and reviewed as part of the environmental identification (ENVID) workshops and subsequent work to develop the environmental management plans (EMPs). The ENVID workshop controls were informed by commitments made in the initial referral to the NT EPA (BAA-201 0003). The management and mitigation table in **Section 5** should be viewed as a consolidated list of mitigation measures to avoid, reduce, or mitigate impacts of the Project to marine turtles and their habitats.

6.4 Commonwealth Marine Area

The DPD Project area within Commonwealth waters varies in depth from ~30m to ~60m with the end of the Project pipeline in ~50m of water. Regional habitat modelling and mapping, including the Commonwealth waters Project area has been conducted by the Australian Institute of Marine Sciences (AIMS) (Heyward et al. 2017) and shows that the habitat in the Project area, as with the broader region, is dominated by bare sand, filter feeders and burrowers/crinoids (**Figure 6-4**). Baseline surveys of the Project pipeline route, including the section in Commonwealth waters, have been undertaken by RPS (RPS, 2023a; **Appendix 7**). This survey, which included collection of benthic habitat imagery and sediment samples, confirmed the habitat categorisation by Heyward et al., 2017, with all sites along the Project pipeline route in Commonwealth waters classified as silty/shelly sand with very sparse to sparse biota (soft corals and crinoids).

The Project area is located immediately to the east of Shepparton Shoal, which is a raised seabed feature with a depth up to 30m, and habitat mapping shows similar benthic habitat categorisation as surrounding areas (**Figure 6-4**). The Project pipeline route was re-aligned during the preliminary engineering design to avoid Shepparton Shoal disturbance with the pipeline end ~3km from this feature at its closest point (**Figure 6-4**).

A key ecological feature of “Carbonate Bank and Terrace System of the Van Diemen Rise” at its closest point is ~4.5km east of the Project area in Commonwealth waters. This feature covers a large area (approximately 31,278 km^2) predominantly to the north of the Project area and is characterised by terrace, banks, channels and valleys (DSEWPaC, 2012a).

Activities with the potential to reduce water quality within the Commonwealth marine environment will be undertaken in the pre-commissioning and construction phases of the Project. Sediment disturbance is one likely result of these activities, with associated impacts capable of influencing water quality in Commonwealth waters, where approximately 23 km of the Project pipeline is being installed. Further, under the EPBC Act Significant Impact Guidelines 1.1 (Doe, 2013), any action that will or is likely to have significant impact on Commonwealth marine areas, even if undertaken in water of Northern Territory jurisdiction, is a prohibited action. Sediment and seabed disturbance has been addressed in **Section 4.2.1.4**, where residual impacts, considering the influence of the Project mitigation measures (**Table 5-1**), are described as minor and temporary to the Commonwealth marine area, and that seabed disturbance will not have significant impact to existing seabed habitat, diversity, or function. Seabed disturbance will not impact Shepparton Shoal, or the Carbonate Bank and Terrace System of the Van Diemen Rise within the Commonwealth marine area. Seabed disturbance is also summarised in **Table 6-8.**

Chemical discharge is also addressed in **Section 4.2.4.4** as another impact of pre-commissioning and construction activities with the potential to impact water quality in the Commonwealth marine environment. Treated seawater and MEG discharges are the only chemical discharges planned. Treated seawater discharges will be temporary and directed at an upwards angle to minimise seabed contact ad maximise dilution. MEG poses little environmental risk, as it is biodegradable and has negligible bioaccumulation potential. Modelling of PLET seawater discharge is outlined in **Section 4.2.4.2**, with toxicological effects to marine organisms from discharge modelled and reported in **Appendix 17**. No residual impacts, considering the influence of the Project mitigation measures (**Table 5-1**), from the discharge at the PLET are expected for the Commonwealth marine area (also summarised in **Table 6-8**).

The further information provided in the this Preliminary Documentation report in response to item 1 of the DCCEEW Information Request about Project chemical usage and discharge (**Section 2.6.1**, **Table** 2-7, **Appendix 4**) shows that the impacts of the Project on the Commonwealth marine area will be acceptable, also considering the influence of the Project mitigation measures (**Table 5-1**).

Cultural heritage is an aspect of the Commonwealth marine environment. Santos has made an assessment of the impacts of the Project on cultural heritage, including the 23 km section of pipeline in Commonwealth waters, in **Section 8.5** and **Section 8.6** that indicates that with a continuation of ongoing consultation and monitoring that the Commonwealth marine area significant impact criteria will not be triggered considering the influence of the Project mitigation measures (**Table 5-1**).

The proposed action, including avoidance and mitigation measures, will not trigger a significant impact on the Commonwealth marine area.

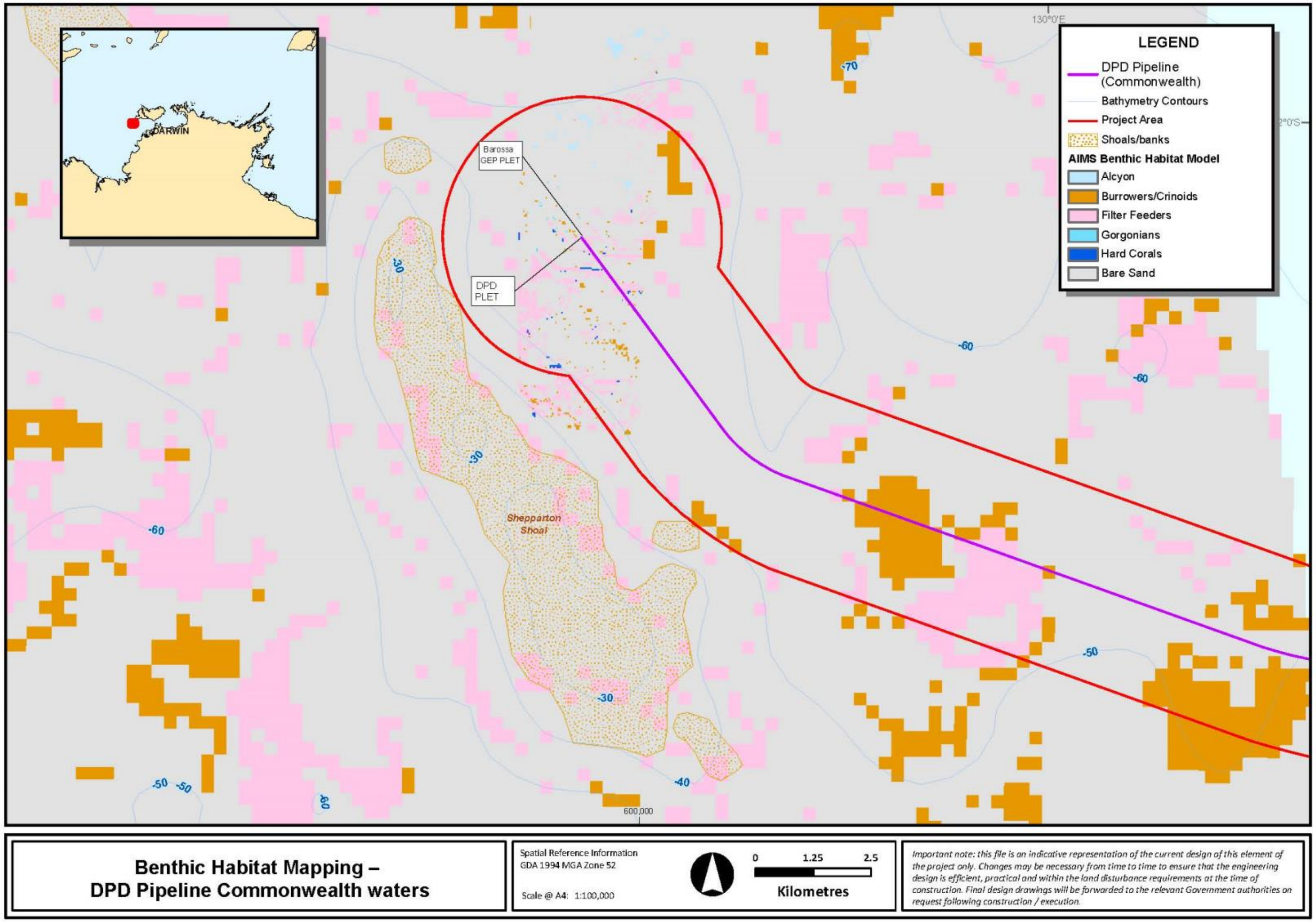


Figure 6-4 Project area benthic habitat in Commonwealth waters

7 Offsets

Items 2, 3 and of the RFI require Santos to provide evidence that the proposed action will not cause significant residual impact to:

+ Threatened marine turtles or their habitat.
+ Migratory dolphins or their habitat.

Section 6 Residual Impact Assessment of this Preliminary Documentation report has demonstrated that the proposed action will not cause significant residual impact to the following:

+ Listed threatened species and communities, including threatened marine turtles or their habitat.
+ Listed migratory species, including migratory dolphins or their habitat.
+ Commonwealth marine areas.

Therefore Santos does not propose to provide any offsets, which is consistent with the EPBC Act Offsets policy (DSEWPC, 2012) impact assessment process.

The DCCEEW EPBC Act Offsets Policy (DSEWPC, 2012) states that 'avoidance and mitigation measures are the primary strategies for managing the potential significant impact of a proposed action. They directly reduce the scale and intensity of the potential impacts of a proposed action. Offsets do not reduce the likely impacts of a proposed action, but instead compensate for any residual significant impact. Avoidance of impacts on protected matters may be achieved through comprehensive planning and suitable site selection.' Santos has developed suitable avoidance and mitigation measures (**Section 5**) so that significant impact is not triggered, and offsets are not required e.g., 75 controls to manage and mitigate impacts and risks to the EPBC Act listed threatened and migratory turtles will be implemented (**Table 5-1**).

8 Economic and Social Matters

8.1 DPD Project Overview

The DPD Project is part of the Barossa Development and will operate in association with the DLNG Life Extension and potentially the proposed Bayu-Undan Carbon Capture and Storage (CCS) project.

The Barossa Development is one of the largest investments in the LNG sector in Australia for almost a decade and signifies Santos' ongoing commitment to the development of the Northern Territory. It will be an important gas project for Australia, providing jobs, increasing exports and building relationships with investors and gas customers in Asia who have depended on Australia for their energy security for decades.

The potential for the Barossa Development to stimulate socioeconomic activity in the Northern Territory is significant, including the opportunity for the Northern Territory to host one of the first major common user CCS projects in Australia.

The Santos group is the leading Australian oil and gas exploration and production company in the Northern Territory, with a significant presence onshore and offshore. The Santos group's presence in the Northern Territory stretches back many years, having been the major supplier of gas to the local market and the only Australian company in Darwin LNG.

The Barossa Development and Darwin Pipeline Duplication will enable continued Darwin LNG operations for another 20 years and allow for repurposing of the existing Bayu-Undan to Darwin Gas Export Pipeline to facilitate CCS options, subject to regulatory approvals.

The Bayu-Undan CCS project under investigation by Santos could become a low-cost, large-scale, commercial project storing CO_2 from future NT and Australian developments as well as an enabler for future zero emissions clean fuels projects.

8.2 Socioeconomic Impacts

It is anticipated that the DPD Project, the Barossa Development, DLNG Life Extension and the potential Bayu-Undan CCS project, subject to all regulatory approvals, will have a number of socioeconomic impacts at varying scales (i.e. local, regional and national, RFI 5f) with respect to the socioeconomic activities that occur within the Project area as summarised in **Table 8-1** and **Table 8-2** below. Overall, the socioeconomic impacts associated with the Project are anticipated to be positive, with identified possible negative socioeconomic impacts likely to be short-term and of low magnitude.

Socioeconomic responses and impacts raised for onshore and NT waters during the NT EPA public submission process are provided in a comprehensive summary in the DPD Project SER Table 5-1 (**Appendix 2**). Further indigenous socioeconomic responses and impacts are outlined in **Section 8.5** and **Section 9.4** for the Preliminary Documentation report Project area.

Additionally, an assessment of residual impacts and risks to socioeconomic factors of the DPD Project from the NT EPA assessment process is summarised in **Table 8-3**. Impacts from planned events were assessed as having Negligible or Minor impact, while unplanned events were assessed as presenting a Low or Very Low risk to Community and Economy.

Estimates of the Australian dollar value of costs and benefits related to the Project (RFI item 5a) include:

+ The DPD Project represents a commitment in excess of $900 million to preserve the CCS opportunity.

+ Combined with life extension works required at DLNG, Santos estimates the creation of 800 construction jobs, 180 long-term operational jobs and approximately $2.5 billion in local spend. Santos also anticipates indirect jobs created for every direct job involved in the project as well as positive impacts on the broader economy.
+ DLNG operations currently employ approximately 250 people and generate approximately $100 million annually in supply and service business opportunities. In addition to regular operations, DLNG also undertakes a major maintenance program every two years, with approximately 600 people employed and up to $50 million injected into the local economy.

The information in **Section 8** including other sections referenced provides a response to RFI Item 5: Economic and social matters requested (**Appendix 3**). The estimation of costs/benefits (RFI item 5b) associated with the DPD Project is based on the NT EPA guidelines for the preparation of an economic and social impact assessment (NT EPA, 2013) which recommends including information such as project contribution to the NT and Australian economy and contribution to employment and training. Santos estimates are based on past expenditure from DLNG experience.

Developed management measures and controls to manage impacts and risks to Community and Economy have been carried through to draft EMPs as relevant. The measures proposed are considered effective and appropriate to reduce potential impacts to Community and Economy to a level that is considered acceptable.

Controls have been informed by referral commitments and subsequent feedback and consultation with the government and the public and have been reviewed through ENVID workshops and during EMP development. The management measures listed within these identified documents should be viewed as a consolidated list of mitigation measures to avoid or mitigate impact of the DPD project.

Table 8-1 Summary of socioeconomic activities that occur within the project area

Value/ sensitivity	Description
Commercial fisheries – Commonwealth	The Northern Prawn Fishery is the only active Commonwealth managed fishery overlapping the Project Area. There are three other inactive or low operating (less than five vessels active in the fishery each year since 2005) Commonwealth managed fisheries overlapping the Project Area: Southern Bluefin Tuna Fishery, Western Tuna and Billfish Fishery and the Western Skipjack Tuna Fishery (DAWE, 2020c; DAFF, 2022).
Commercial fisheries – NT	There are five NT managed fisheries that intersect the Project Area: Coastal Line, Demersal, Offshore Net and Line, Spanish Mackerel, and Aquarium Fishery.
Recreational fishing	Recreational fishing does occur within the Project Area. The Darwin Harbour/Surrounds fishing zone supporting 63% of total fishing effort within the Greater Darwin Area (Matthews et al. 2019).
Traditional fishing	Traditional Australian Indigenous fishing in NT waters predominately occurs within inshore tidal waters. Approximately 55% of NT's coastline is owned by Traditional Aboriginal Owner groups in the Northern Land Council region (NLC, 2022).
Shipping	The closest major commercial port to the Project Area is Darwin. The Darwin Port Corporation serves multiple shipping and cargo markets, including cruise and naval vessels, livestock exports, dry bulk ore, offshore oil and gas rig services, and container and general cargo. The Australian Maritime Safety Authority (AMSA) shipping routes close to the Project Area.
Tourism	Within Darwin Harbour common tourism/recreational activities include fishing, boating, scuba-diving, sailing, water-skiing, and beach use.
Defence	The Project Area intersects a Central Defence Practice Area of the Darwin Air Weapons Range (AWR), a maritime military zone administered by the Department of Defence. The Project Area is also nearby to the Australian Exercise Area (NAXA) Defence Training Area approximately 3km to the South
Petroleum industry	Several offshore petroleum projects are in operation and there is considerable exploration activity within the NMR; however, only the existing INPEX Ichthys and Santos Bayu-Undan to Darwin gas export pipelines overlap with the Project Area.
Aboriginal heritage	There are four registered/recorded sacred sites within Darwin Harbour within or adjacent to the Project Area: three rocky areas and shoals on the western side of the Harbour and an underwater sand and rock bar outside the mouth of the Harbour, north of Cox Peninsula. Santos has received an Authority Certificate from the AAPA for the DPD Project (Authority Certificate C2022/098) and will abide by conditions of the certificate.
Maritime heritage	Five historic shipwrecks listed under the Underwater Cultural Heritage Act 2018 (Commonwealth) are overlapped by the Project Area: I-124 Japanese Submarine (1942) 800 m radial protection zone, Yu Han 22 unlisted protection zone, Song Saigon (1982) unlisted protection zone, Mauna Loa USAT (1942) 100 m radial protection zone and Meigs USAT (1942) unlisted protection zone (DCCEEW, 2022b). Santos has undertaken maritime heritage surveys within the Project Area to determine the presence of additional maritime heritage objects and will apply measures to ensure these are not impacted.

Source: Section 5.6.1 – Table 5-7 Santos Offshore Pipeline Construction Environment Management Plan (CEMP)

Table 8-2 Potential socioeconomic impacts on the local, regional and national levels

Scale of Impact	Positive Socioeconomic Impacts	Negative Socioeconomic Impacts
Local	+ A residential workforce policy requires DLNG staff to live in Darwin, injecting local jobs and global expertise into the region. + Santos' supply base for all its NT offshore activities is located in Darwin. The project will involve an increased number of personnel needing to transit through Darwin, particularly during the offshore installation phase, which may result in increased local spend. + Santos estimates the creation of 800 construction jobs, 180 long-term operational jobs and approximately $2.5 billion in local spend (including life extension works at DLNG). + Santos anticipates indirect jobs created for every direct job involved in the project as well as positive impacts on the broader economy. + The proposed Project pipeline and armour rock installation will provide new habitat for marine species which could potentially have a positive impact on fish populations and tourism activities within the area.	+ Santos' supply base for all its NT offshore activities is located in Darwin. The project will involve an increased number of personnel needing to transit through Darwin putting pressure on transport infrastructure particularly during the offshore installation phase, which also leads to an increase in local spend. + It is anticipated there will be an increased demand for short-term accommodation potentially impacting tourism accommodation availability at peak times. This would be mitigated through Darwin's existing expansion and planned future facilities. Onshore accommodation requirements will be planned well in advance in consultation with local facilities.
Regional	+ The DPD and associated projects have significant potential to stimulate economic activity in the Northern Territory, including providing the opportunity for the NT to host one of the first major common user CCS projects in Australia. + The DPD and associated projects will provide opportunities for NT-based companies to support project logistics supply chains via the offshore and onshore movement of personnel and equipment by air and sea and all associated activities such as fuel and water supply, catering and the supply and movement of equipment and materials.	+ Cumulative socioeconomic impacts may arise as higher levels of vessel and small aircraft movements between Darwin and offshore and higher passenger levels at Darwin airport putting pressure on transport infrastructure. In view of the number of vessel and passenger movements involved, the cumulative impact is anticipated to be minor.
National	+ Significant revenues will be transferred to the Federal Government in the form of company tax and income taxation payments. + The DPD and associated projects are important for the nation, enhancing jobs, exports and relationships with investors and export gas customers in Asia who have depended on Australia for their energy security for decades.	

8.3 Potential Employment Opportunities

Combined, the DPD Project, the Barossa project, DLNG Life Extension and potential Bayu-Undan CCS Project, subject to all regulatory approvals, will promote sustainable economic development and employment growth in the NT and Timor-Leste, while building momentum for a whole-of-region carbon reduction solution.

During the construction phase of the DPD Project, it is projected that several hundred personnel will be working on the Project (RFI item 5c), with the majority of these being accommodated on two large offshore vessels, avoiding the need for development of major support infrastructure in Darwin or significant pressure on existing facilities.

The majority of opportunities for NT-based companies will occur within the Project's logistics chain and the offshore and onshore movement of personnel and equipment by air and sea and all associated activities such as fuel and water supply, catering and the supply and movement of equipment and materials from Santos' supply base in Darwin.

The Barossa project will extend the life of the DLNG facility which has been a significant employer and user of goods and services in northern Australia for the past decade. Combined with DLNG life extension works, Santos estimates the creation of 800 construction jobs and 180 long-term operational jobs. Indirect jobs can also be expected to be created for every direct job involved in the project as well as positive impacts on the broader economy.

As an indicator of the operational phase which is expected to last for approximately 20 years, the existing Bayu-Undan and Darwin LNG operations has supported more than 1,300 jobs across Australia and Timor-Leste. On average about 150 of the personnel work on the Bayu-Undan offshore facility are located in Timor-Leste waters. However, Santos' commitment to Darwin's ongoing development will include the requirement that the Barossa FPSO operational workforce will be based in the NT.

As the operator of DLNG, Santos is committed to training and employing a residential workforce with numerous programs to develop local skills, including early career traineeships, graduate programs, and operations pathways. A residential workforce policy requires DLNG staff to live in Darwin, injecting local jobs and global expertise into the region. This is supported by Santos Darwin Operations Trainee Academy (DOCTA) program, which trains NT residents with skills in related trades to be LNG plant operators. The Wickham Point Deed Reference Group Liaison Committee has requested that Larrakia Rangers (within Larrakia Nation) be involved in environmental monitoring for the Project and Santos has approached Larrakia Rangers who have agreed (**Section 9.4**).

8.4 Potential Impacts on the Local Community

8.4.1 Physical Presence (Impact to Other Users)

8.4.1.1 Project Activities

Increased vessel movements and the presence of dredges within the Darwin Harbour during the construction of the DPD Project has the potential to temporarily change the visual amenity of the harbour during construction and may also impact the visual amenity of the surrounding areas, as was raised during the NT EPA referral consultation process, especially in relation to the popular Mindil Beach Sunset Market. While the DPD Project activities are expected to increase vessel traffic by 3-5%, it is not expected to significantly change the visual amenity of the harbour given the current volume and range of commercial vessels already present. The proposed vessels are similar in size to cargo vessels that already frequent the harbour. The use of dredges is an existing activity in the Darwin Harbour used for other projects. The installation of linear infrastructure has been undertaken for other operations Bayu-Undan and Ichthys pipeline installation, and the vessels that Santos are proposing are smaller in scale that what have previously been used.

Santos has conducted a quantitative risk assessment (Intescea,2021) which included assessment of current marine traffic, with an addendum to cover future traffic growth based on the DIPL proposed port expansion. Engagement has been undertaken with DIPL and DEPWS to describe the potential impacts of the DPD Project's vessels on other port users, and Santos will continue to liaise with other infrastructure users and proponents to create opportunities to share resources and minimise potential impacts to port users. Santos and all contractors for the DPD Project have robust systems in place to risk assess and manage the proposed construction activities and vessels (see **Table 5-1**). Santos' engagements with DIPL included modification of the pipeline route and trenching design to avoid encroachment into the Darwin harbour navigation channel and provision for the potential of future dredging by DIPL in the middle arm channel.

The presence of the vessels and the safety exclusion zones around the vessels may temporarily displace other users of the harbour from the areas they prefer to visit and use. This impact is unavoidable, and the Project pipeline route and spoil disposal location has been determined based on the engineering requirements to construct a stable and protected pipeline (informed by geophysical and geotechnical studies), and with consideration of other users, including engagement with the Harbourmaster.

During planning for the INPEX Ichthys LNG project, a Recreational Fishing and Fish Health Monitoring Program (RFFHMP) was undertaken to detect potential changes in patterns of recreational fishing and catch rates, as well as reports of ill-health in key recreationally targeted fish species. The study aimed to investigate whether any changes were observed as a result of dredging and construction activities associated with the Ichthys project (Cardno, 2013). The RFFHMP involved seasonal fishery-dependent recreational fishing surveys (Access Point Surveys (APS)) as well as fishery-independent fish sampling and fish health assessments at two locations potentially affected by construction: Darwin Harbour Inner (DI), Darwin Outer (DO), and two control locations (Bynoe Harbour (BH) and Adelaide River (AR)).

As part of the RFFHMP, recreational fishing sampling was undertaken during the Access Point Surveys Monitoring Program (APSMP) prior to the commencement of dredging, periodically throughout the dredging and post dredging. Data collected during the dredging phase and post-dredging phase sampling seasons were compared against data collected pre-dredging to detect potential changes in recreational fishing parameters investigated. Access Point Surveys conducted during multiple sampling seasons have facilitated temporal and spatial comparisons of standardised recreational fisher parameters.

This assessment identified that most fishing effort reported by parties returning to boat ramps occurred at fishing sites within the location into which they launched, indicated by grids as shown in **Figure 8-1** (Cardno, 2013).

According to the Recreational Fishing Monitoring Program Post-dredging Report (Cardno, 2015a), the majority of the fishers interviewed during the APSMP reported that their catch averages had either remained the same or increased over the past 12 months or few years. Similarly, during the post-dredging and dredging phase sampling seasons no evidence was recorded to indicate any influence of Project dredging or construction activities on fisher targeting behaviour, catches or catch rates, fish health, besides the usual changes in fisher targeting due to climatic conditions and seasonality (Cardno, 2015b).

Santos has been continuing to engage with stakeholders following submission of the NT EPA referral to discuss topics raised during the public consultation period, including AFANT and NT DITT – Fisheries. Prior to the referral submission, Santos engaged with AFANT on 27 October 2021 where AFANT was concerned about impact of planned activities on recreational fishing in Harbour which is already subject to many pressures as a result of varied and similar conflicting uses. AFANT also advised that Santos needs to explain how the scale of its project will be different to INPEX Ichthys Project. On 7 February 2022, Santos had a meeting with AFANT to update on the referral submission and to further discuss issues and concerns raised by AFANT at the previous meeting held in October 2021. AFANT agreed that the DPD Project was a significantly smaller and different project to Ichthys and was pleased that trenching would not be occurring in the Charles Point RPA and spoil disposal would not occur within the INPEX spoil disposal area, which had now become a recreational fishing site. A meeting was held on 18 March 2022 to provide an update regarding submission of the NT-EPA referral and outcomes of discussions held with NT-DITT - Fisheries. Subsequent meetings were held on 5 July 2022 to discuss progress on preparation of SER and how Santos will be responding to issues raised in AFANT's submission to the Referral and AFANT's views of current and potential fish and habitat research in Darwin Harbour, and then on 10 November 2022 to provide update on project approvals and the proposed schedule of works in Darwin Harbour with particular focus on progress of environmental studies as related to issues previously raised by AFANT in its Referral submission.

NT Seafood Council (NTSC), which represents commercial fishing licence-holders, confirmed that commercial fishers do not operate within the harbour, however, there are some fishing activities within other NT waters jurisdictions. NTSC's two main requests were for Santos to not disturb the jewfish aggregation area within the Charles Point RFA and to mitigate against fishing gear being snagged around the pipeline.

Santos has held meetings with NT DITT - Fisheries to provide an update on the referral submission and to further discuss the Department's views on range of environmental factors addressed in the referral documentation. The Department's initial view was that the Project pipeline installation's local impact was unlikely to have any broader consequences for fisheries. On a subsequent meeting, held on 15 March 2022, the NT DITT - Fisheries agreed that pipelines were generally beneficial to recreational fishing activities. It also did not see the DPD Project causing problems for mud crab migration.

The DPD Project will not disturb the jewfish aggregation area within the Charles Point RPA and control measures (**Table 5-1**) will be implemented to minimise impacts to local commercial and recreational fishing.

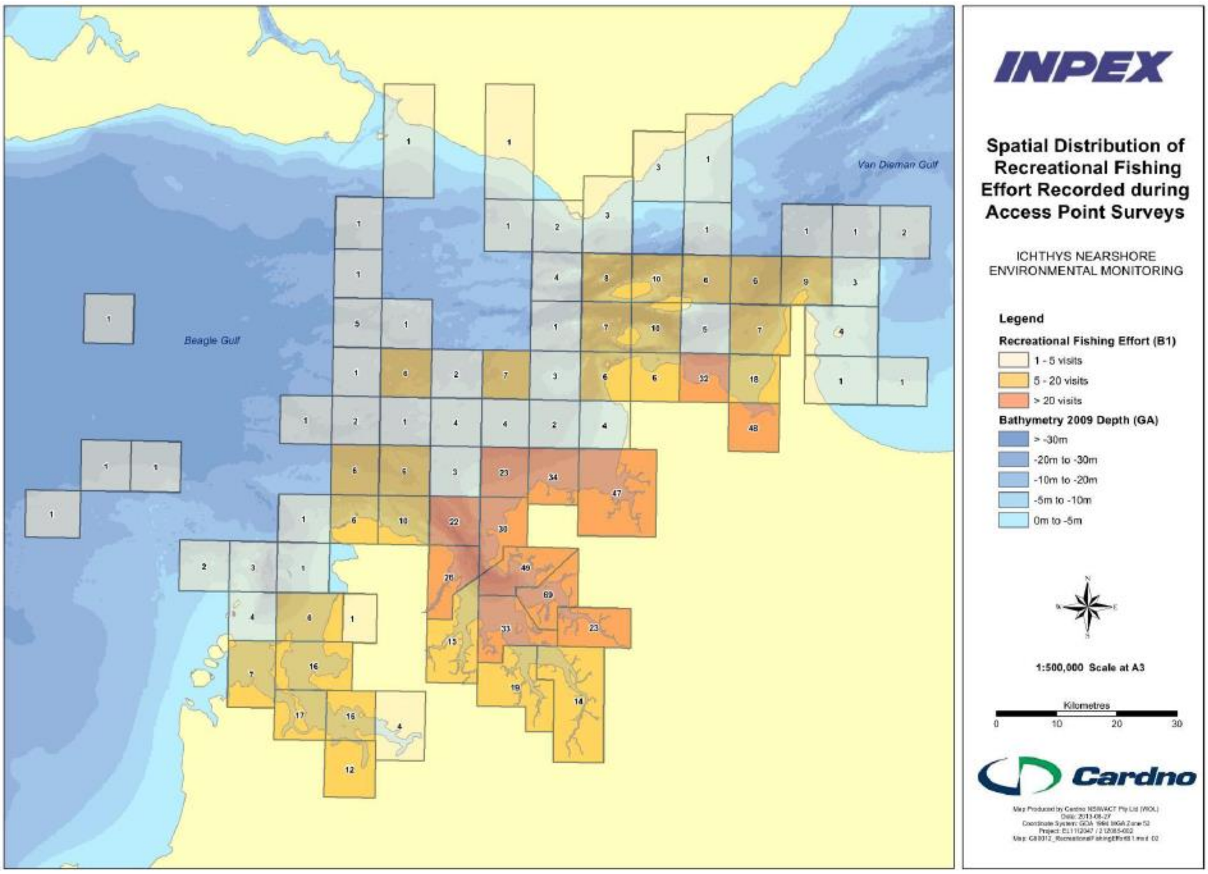


Figure 8-1 Frequency of reported visits by APS interviewees to fish area grids (from Cardno, 2013)

Project vessels will move slowly along the Project pipeline route during construction so displacement of other users from any one area would be temporary and localised to only where the vessels were working on the pipeline route and at the spoil disposal grounds at any particular time. This is not considered to present a significant impact.

The presence of activity vessels has the potential to cause temporary disruption to commercial shipping. However, given all shipping vessels and activity vessels are required to comply with the Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) and associated Marine Orders, it is expected navigational and communicative aids are sufficient to preventing any negative interactions beyond basic avoidance during DPD Project construction phase.

Anchoring operations with the Darwin Harbour navigation channel shall be managed in consultation with the Darwin Port, the Darwin Harbourmaster and other key stakeholders. The frequency and extent of anchoring will be less than what was undertaken on the previous Darwin Harbour pipelay campaigns due to the shallow water pipelay barge being smaller than what was used for the Bayu-Undan and Ichthys pipeline project. Preliminary assessments indicate that approximately 1150 anchor movements will be undertaken during the DPD pipelay campaign, with only half of these being located towards the navigation channel. The proposed anchor pattern for the shallow water pipelay barge is smaller than that for previous projects', and the anchor suspension catenaries are typically 100-200 m from the vessel.

Marine notices shall be in pace for the duration of the works, and Darwin Port and DIPL will be consulted throughout the relevant DPD Project construction risk assessments.

The movements of DPD Project vessels are not considered to significantly add to the annual movements of vessels in and out of the harbour or within the harbour. Any increase to the annual average of vessel movements within the harbour will be limited to a short-term project construction phase. Moreover, whilst interactions between vessels engaged for other Santos Project activities are unlikely, a simultaneous operations (SIMOPS) procedure will be implemented to control and manage any concurrent SIMOPS activities.

8.4.1.2 Project Infrastructure

The installation and ongoing presence of the Project pipeline and other project infrastructure (such as stabilisation structures and rock backfill) is not considered likely to significantly impact other users in the area. A detailed quantitative risk assessment (Intecsea, 2021) has been performed to assess the risk of damage to the Project pipeline by third parties. Data from the Marine Traffic website (marinetraffic.com) was used to examine vessel movement and behaviour along the proposed Project pipeline route. The impact frequencies were calculated and assessed for the typical shipping impact scenarios such as vessel sinking, and anchor drop and drag (refer **Section 8.4.1.6**). It was determined that pleasure craft, such as sailing vessels and yachts, were unlikely to rupture or cause any major damage to the pipeline.

The quantitative risk assessment concluded that three zones were at risk from third party activities, and the design of the Project pipeline has incorporated additional protection where the pipeline wall thickness and concrete weight coating alone is not sufficient to maintain its integrity. The proposed pipeline and armour rock installation will provide new habitat for marine species which could potentially positively impact fish populations and tourism activities within the area. Similarly, while DPD Project activities at the spoil disposal ground may temporarily displace fishing activities, the deposition of spoil may increase seabed structure and fish abundance at the spoil disposal grounds.

Given the shore crossing and onshore activities are in an area which has previously been disturbed from construction of the Bayu-Undan to Darwin pipeline and DLNG facility; has no public access; no residential housing or tourist attractions present (the closest is approximately 6 km away), the trenching activities at the shore crossing and construction of the temporary causeways are unlikely to impact other users and these structures will be removed following construction.

In developing the onshore road Traffic Impact Assessment, existing transport conditions were reviewed, informed via a combination of desktop reviews, site visit, crash/traffic data analysis and review of relevant policies and legislation.

Traffic associated with Project logistics was assessed, accounting for a very minor proportion of traffic on the local road network in 2024 and where the available capacity of a road has been exceeded, it is not a result of Project traffic. The modelling results indicate additional traffic movements generated by the construction of the Project in 2024 would result in negligible impacts on intersection capacity and performance and no road upgrades are anticipated to be required to accommodate Project-related traffic.

8.4.1.3 Seabed Disturbance

The trenching activities will result in temporarily increased suspended sediment which may result in a visible plume that could impact visual amenity and dissuade the use of the area in the harbour and at the spoil disposal ground. Given that there will be restricted access near the trenching vessel and given the suspended sediment concentrations above SSC and sedimentation thresholds will remain largely within the trenching footprint, the impact to visual amenity from trenching activities will be temporary and localised to where the vessels are operating.

In terms of the potential for trenching activities to impact fish and therefore fishing activities, the Recreational Fishing and Fish Health Monitoring Program (RFFHMP) did not find any evidence of fish health issues prior to, during and post INPEX Ichthys LNG project dredging activities. Field based observations and extensive laboratory examination of finfish and crab species during the RFFHMP did not reveal any areas of particular concern regarding the types of externally visible abnormalities or health problems associated with the prevalence and intensity of parasitic and histopathological infections (Cardno, 2015c). For finfish frequently examined within the laboratory, particularly golden snapper, barramundi and gold-spotted rock cod, the prevalence and intensity of infections were generally similar between the post-dredging, dredging and pre-dredging sampling seasons and among locations. Variability in the prevalence and intensity of infection was evident for some parasites, however there was no indication that the health parameters monitored during the RFFHMP substantially changed in the short, medium, and long term since the completion of Ichthys LNG project dredging activities compared to the pre-dredge data. Rather, infections recorded within finfish species were within 'natural' occurrences through habitat, food sources and dietary preferences (Arthur, 1997), and there was no evidence to suggest changes in finfish and crab characteristics and health parameters were related to Project dredging or construction activities.

Indirect impacts to fish and therefore fishing and recreational activities have also been considered. **Section 4.2.1** details the impact assessment undertaken on how seabed disturbance could impact benthic habitats and marine fauna, and also considers the importance of the habitats for fish.

Based on that assessment, impacts to marine fauna as a result of seabed disturbance and disturbance to benthic habitats is not considered to be significant. The presence of the pipeline stretches of rock backfill and increased topographic complexity at the spoil disposal ground is expected to increase topographic complexity of the seabed and provide additional habitat to fish and other marine fauna. Subsequently, this may result in greater fish abundance and diversity, particularly in areas of low topographic complexity (e.g., flat sand habitats), as has been found when fish assemblages on and off the Bayu-Undan to Darwin gas export pipeline have been compared (McLean et al., 2020).

8.4.1.4 Noise Emissions

Section 4.2.3 presents the impact assessment for potential impacts to marine fauna from noise emissions as a result of DPD Project activities. The control measures that will be implemented to reduce the risk of interactions and impacts are presented in **Table 5-1**.

As there are a number of tour operators whose businesses are dependent on the presence of wildlife in Darwin Harbour, any significant impact to marine fauna could indirectly impact community and economy. Based on the impact assessment that the potential for the noise emissions from the DPD Project activities to impact marine fauna is considered to be not significant, it is considered unlikely that community and economy could be significantly impacted.

+ Consultation has occurred with a range of stakeholders including Tourism NT and Top End Tourism, the organisation representing marine-based tour operators in Darwin Harbour, and relevant government agencies. The stakeholders have advised Santos that the main impact will be caused by pipe-lay vessel activities potentially displacing tourism activities for some periods of time (SER Table 5-1, **Appendix 2**).

+ Consultation on the potential impact to benthic habitats such as weed reef, which is regarded by Traditional Owners and eco tour operators as a primary location for dugongs in Darwin harbour was undertaken. No specific issues with weed reef have been raised during any of these consultations and No tourist operators, raised this issue through the submission process (SER Table 5-1, **Appendix 2**).

The noise levels generated from construction activities will be below the NT EPA nuisance thresholds of 35 dB (NT EPA, 2018), within 320 m of the construction vessels. The nearest residential area of the DPD Project is approximately 1.5 km from the construction activities. Additionally, major vessels that will be used for the DPD Project will have exclusion zones imposed (expected to be 500 m).

Noise impacts to the residential and other on-land receptors, was assessed using the formula that calculates the sound attenuation over distance for a point source (this is the Inverse Square Law[3]). It is anticipated that the noise levels on the decks of the construction vessels will result in negligible impacts to residential communities.

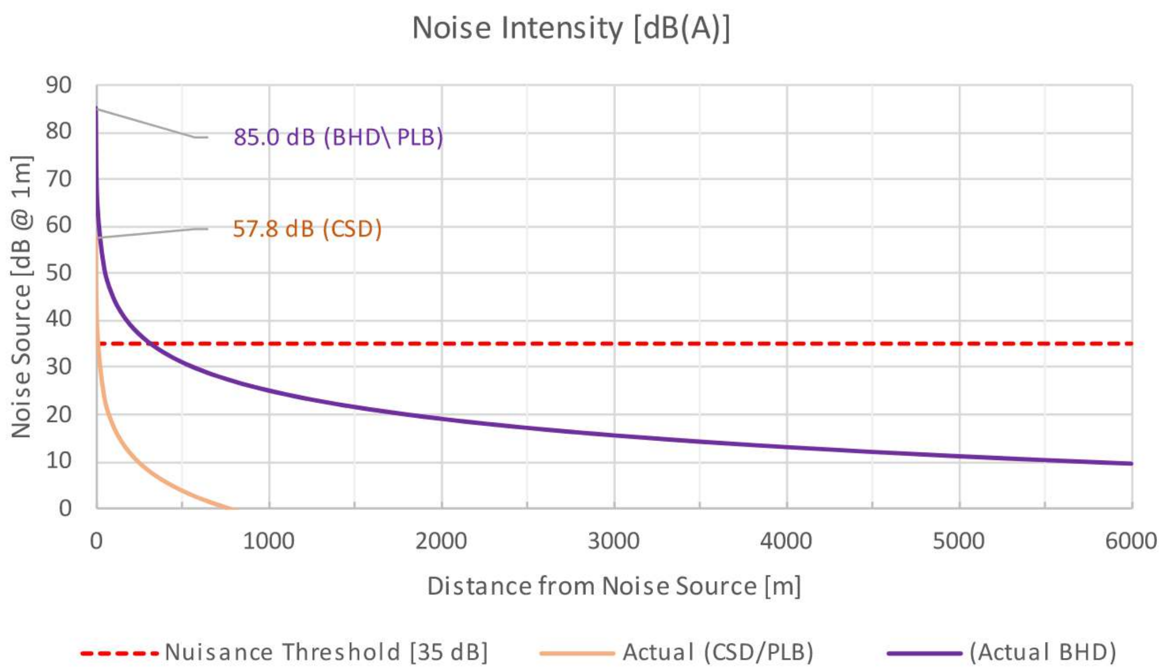


Figure 8-2 Noise attenuation from construction vessels

[3] Lp(R2) = Lp(R1) - 20·Log10(R2/R1)

Where:

Lp(R1) = Known sound pressure level at the first location (typically measured data or equipment vendor data)

Lp(R2) = Unknown sound pressure level at the second location

R1 = Distance from the noise source to location of known sound pressure level

R2 = Distance from noise source to the second location

Noise associated with the trenching activities has the potential to impact other users. However, as the nearest sensitive residential, tourist and/or commercial area to the onshore infrastructure of the DPD Project is located approximately 6 km north (Stokes Hill Wharf) and 6 km east (East Arm), it is unlikely to have any impact to the economic and social matters within the Darwin Harbour and surrounds.

8.4.1.5 Treated Seawater Discharge

As presented in **Section 2.4.3** and **Section 2.7** should treated seawater need to be used to preserve the Project pipeline and then be discharged to the environment as a contingency action following an unlikely wet buckle scenario, no exceedance of the NOEC 99% species protection levels are predicted over a 48-hour period and consequently, no significant impact to either the marine environmental quality, nor marine ecosystem is expected from this dewatering activity. The only impact related to the contingency discharge of treated seawater may be through temporary visual amenity (if a dye is used as part of the seawater treatment chemical package) and temporary exclusion of the area during the discharge.

8.4.1.6 Ground Disturbance (Onshore)

Ground disturbance associated with the onshore construction activities, including trenching for the shore pull and onshore site facilities will all occur in the area previously disturbed during construction of the Bayu-Undan to Darwin gas export pipeline and DLNG facility and within the DLNG facility disturbance footprint. The nearest sensitive residential, tourist and/or commercial area to the onshore infrastructure of the DPD Project is located approximately 6 km north (Stokes Hill Wharf) and 6 km east (East Arm). No residential and commercial receptors are present near the onshore site. Negligible impacts to the community and economy is predicted from onshore construction activities within the DLNG disturbance footprint.

Given the onshore construction will require equipment and additional personnel to be on site, there will be additional traffic to support the DPD Project. Impact to traffic associated with the transport of rock from Mt Bundey to the project area (East Arm Wharf and the DLNG facility) has been assessed within a Traffic Impact Assessment (**Appendix 24**). The NT DIPL – Transport and Civil Services Division has advised that the Traffic Impact Assessment meets their requirements as raised in their submission on the DPD Project referral. onshore construction impact and risk assessment outcomes Impacts are identified and assessed in the DPD Project Onshore Construction EMP (CEMP), 2023 (**Appendix 13**).

8.4.1.7 Dropped Objects Dry Gas Release

The only credible scenario where a dropped object event has the potential to have a significant impact on community and economy is if a dropped object ruptured the Bayu-Undan to Darwin gas export pipeline, or the Project pipeline (once in operation) resulting in the release of dry gas. During the quantitative risk assessment (Intecsea, 2021), the pipeline between KP 104 and KP 106 was identified as requiring additional protection from a 21.5 tonne anchor drop and drag. The rock protection has been designed to ensure the anchor fluke cannot penetrate through to the pipeline.

Two other areas were identified to pose a risk to the Project pipeline from anchoring. These are located between KP 106- KP 108; and KP 112 – KP 115. It was determined that this area of the Project pipeline may be susceptible to damage from a 5-6 tonne anchor drop and drag from smaller vessels. The stresses imposed by a dragged anchor in this region have been modelled and have been shown not to result in a pipeline loss of containment.

Table 5-1 (Seabed and Foraging Habitat Disturbance section) has the anchoring mitigation measures that apply during pipeline installation.

In terms of potential impacts to other users, during DPD Project activities, other users will be restricted from the area where any lifting activity would occur by way of vessel exclusion zones and consequently, no impact to other users is likely.

8.4.1.8 Invasive Marine Species

As presented in **Section 4.2.5** vessels are the most common vector for the translocation of IMS in the marine environment and the introduction of IMS could impact the marine environment with subsequent impact to the community and economy. Impacts could include decreasing biodiversity (from the reduction or loss of native marine species) and loss of fishing resources and IMS have resulted in direct impacts to ports and shipping activities in other parts of the world. IMS has previously been found in Darwin Harbour, e.g., the black-striped false mussel which resulted in the closure and quarantine of all Port of Darwin marinas before it was successfully eradicated.

Darwin Harbour is a commercial port where large commercial vessels, such as cargo ships, LNG tankers, cruise ships and offshore oil and gas vessels enter, exit and move around the harbour on a regular basis. DPD Project activities are not considered to have any higher risk of introducing IMS into the area than regular activities within the harbour and the proposed controls are considered effective and appropriate to reduce the risk of introducing IMS and no significant impact to the community and economy is expected.

8.4.1.9 Marine Fauna Interaction

Section 4.2.5 presents the impact assessment for marine fauna interactions as a result of DPD Project activities and the control measures that will be implemented to reduce the risk of interactions and impacts are presented in **Table 5-1**.

As there are a number of tour operators whose business is dependent on the presence of wildlife in Darwin Harbour, any significant impact to marine fauna could indirectly impact community and economy. Based on the impact assessment that the potential for the DPD Project activities to impact marine fauna is considered not significant, it is considered the community and economy would not be significantly impacted.

8.4.1.10 Hydrocarbon Spill – Marine Diesel Oil

8.4.1.10.1 Impact on Recreational Fishing and Tourism

Darwin Harbour and surrounding waters support a range of commercial and recreational maritime uses, including fishing, tourism and recreational shipping/boating activities. Limited tourism and recreational activities occur in the more distant offshore waters of the Project area.

Any impacts to receptors that provide nature-based recreational tourism features (e.g., popular target recreational fishing species such as barramundi or black jewfish) may cause a subsequent negative impact to recreation and tourism activities. There is the potential for temporary closure of all recreational activities due to the risk to public health and safety. Similar impacts arising from the shoreline accumulation of hydrocarbons will add a visual impact and potentially restricted access to shorelines. There is also potential for impacts to the wider service industry (hotels, restaurants and their supply chain) and local communities in terms of economic loss as a result of spill impacts to tourism.

8.4.1.10.2 Impact on Commercial Fishing

Within the area that may potentially be impacted by spills of marine diesel oil (i.e., moderate exposure zones) the Commonwealth managed Northern Prawn Fishery and the NT managed Coastal Line, Spanish Mackerel, Aquarium and Offshore Net and Line Fisheries are likely to be active.

There is the potential for hydrocarbons to temporarily disrupt fishing activities if the surface or entrained hydrocarbons moves through fishing areas. It is possible that there could be accumulation of oil in fish tissues to the extent that could result in hydrocarbon tainting of fish flesh. Connell and Miller (1981) compiled a summary of studies listing the exposure value concentrations at which tainting occurred for hydrocarbons. The results contained in their review indicate that tainting of fish occurs when fish are exposed to ambient concentrations of 4 to 300 ppm (4,000 to 300,000 ppb) of hydrocarbons in the water, for durations of 24 hours or more, with response to phenols and naphthenic acids being the strongest. Given the volume of MDO that could potentially be released, it is possible impacts could be detected to fisheries on a stock level, although it is more likely natural variation in fish abundance would be on a greater scale than any impacts attributable to a hydrocarbon spill. This would most likely be the case for fisheries species that utilise waters in close proximity to the spill, such as the Charles Point Wide RFPA, and could also occur through direct impacts to fish or to fish habitats (for example, seagrass, coral reef, mangrove habitats).

8.4.1.10.3 Impact on Shipping and Ports

At the approach to Darwin Harbour, and within the harbour itself, several notable shipping traffic lanes converge to create a high-density shipping traffic area where hydrocarbons from an unplanned release of MDO may spread.

In the event of a large spill of MDO (e.g. Scenario 1: 700 m^3 outside the harbour or Scenario 4: 300 m^3 inside the harbour), an exclusion zone may be established around the spill affected area. This could result in exclusion of other users such as shipping vessels. Any exclusion zone established would be limited to the immediate vicinity of the release point, and due to the rapid weathering of marine diesel would only be in place for days after release, therefore physical displacement to vessels is unlikely to be a significant impact. An OPEP will be in place for the Project (**Appendix 10**).

8.5 Potential Indigenous Cultural Heritage Impacts

The Darwin region was traditionally occupied by the Larrakia people, whose country runs from Cox Peninsula in the west to Gunn Point in the north, Adelaide River in the east and down to the Manton Dam area southwards (Larrakia Nation, 2023). The waters of Darwin Harbour, Bynoe Harbour, Shoal Bay, Adam Bay, and parts of Beagle Gulf also form part of Larrakia country (Cosmos Archaeology, 2022). The Larrakia people maintain an innate connection to the land and sea in the region.

This section provides a response to RFI item 5d as does **Section 9.4**. Cultural, spiritual and heritage sites of significance are located throughout the region where traditional harvesting remains an important practice (DHAC, 2020). Offshore from Darwin Harbour, the waters around the Tiwi Islands (including Bathurst Island, Melville Island and the Vernon Island) similarly hold a spiritual connection, and a source of food and wellbeing, for the Tiwi people (Tiwi Land Council, 2021).

Cultural heritage and sacred sites in the Northern Territory are protected by the Heritage Act (2011) and the Northern Territory Aboriginal Sacred Sites Act 1989 respectively. The purpose of the Heritage Act (2011) is to provide for the conservation of the Territory's cultural and natural heritage, whereby the significance of a place or object includes its aesthetic, historical, scientific and social significance. Sacred sites are places within the landscape that have a special meaning or significance under Indigenous traditions, including hills, rocks, waterholes, trees, plains, lakes, billabongs (AAPA, 2022). There are many sacred sites within Darwin Harbour and the surrounding waters. In coastal and sea areas, sacred sites may include features which lie both above and below the water (AAPA, 2022).

The Aboriginal Areas Protection Authority (AAPA) is an independent statutory authority established under the Northern Territory Aboriginal Sacred Sites Act 1989 (AAPA, 2022). AAPA is responsible for overseeing the protection of Aboriginal sacred sites on land and sea across the whole of Australia's Northern Territory. AAPA protects Aboriginal sacred sites through:

+ Sacred site avoidance surveys and issuing of Authority Certificates for any proposals of development.
+ The provision of information to the public about existing sacred sites data through abstracts of Authority records and access to the Registers maintained by the Authority.
+ The registration of Aboriginal sacred sites (AAPA, 2022).

Authority Certificates are based on consultations between AAPA and custodians and provide clear instructions on what can and cannot be done in and around sacred sites (AAPA, 2022). An Authority Certificate provides a statutory indemnity against prosecution in relation to the works or uses covered by the Certificate, provided the applicant complies with any conditions imposed to protect sacred sites (AAPA, 2022). Certificates are voluntary and are considered to provide an effective risk management tool for developers and act as site protection measures for custodians (AAPA, 2022).

Santos has applied for and received an Authority Certificate (C2022-098), from AAPA on 23 December 2022 (in relation to RFI 5e), which covers seabed disturbance in Subject Land areas from DLNG at Wickham Point to the boundary of Territory and Commonwealth waters and inclusive of the offshore spoil disposal area. **Figure 8-3** shows Subject Land areas within the Darwin Harbour section. The certificate identified that the registered sacred site 5073-105 overlaps the Subject Land area and that a restricted works area (RWA 1) shall apply within which no work or damage can occur.

Santos has submitted an application for an additional Authority Certificate to cover additional small areas of disturbance outside the current certificate (C2022-098), associated with nearshore pipelay barge anchoring, water quality logger installation (for monitoring water quality during trenching and spoil disposal operations) and onshore disturbance within the existing DLNG Facility disturbance footprint.

Santos will ensure that the conditions of AAPA Authority Certificates and requirements of the NT Aboriginal Sacred Sites Act 1989 and the Heritage Act (2011) will be made known to Project contractors and will be followed.

Additional to the AAPA sacred site assessment in NT jurisdiction, and the maritime heritage assessment presented in **Appendix 21** (and relevant to comments raised by National Indigenous Australians Association) (refer **Table 9-2**), Santos will undertake ongoing consultation and engagement with Traditional Owners in relation to Indigenous cultural values and heritage within the DPD Project area. Santos will also prepare and implement a Cultural Heritage Management Plan which will incorporate and build upon management measures identified through consultation with Indigenous stakeholders on the sacred site / restricted works area identified from the AAPA Authority Certificate (C2022/98). The Cultural Heritage Management Plan will also include cultural heritage induction procedures for site personnel, procedures for anchoring and the establishment of anchor exclusion zones, and detail of how compliance will be monitored. Santos expects the preparation and implementation of a Cultural Heritage Management Plan for the DPD Project addressing these matters will be a requirement of the conditions of any environmental approval granted by the Northern Territory EPA under the Environment Protection Act 2019. While those conditions will only relate to the portion of the DPD Project within Northern Territory waters, Santos will extend the scope of the Cultural Heritage Management Plan to include the portion of pipeline in Commonwealth waters.

A significant program of heritage site identification, classification, and protection / removal was undertaken for the Santos DLNG facility, and the DPD Project will remain within the previously surveyed and cleared envelope. There are no registered or recorded sacred sites within the DLNG facility, and the potential to encounter previously unidentified heritage sites is very low.

In terms of unplanned impacts form an unplanned fuel spill incident, the outputs from oil spill modelling, both in Darwin Harbour and NT/Commonwealth waters, have been used to determine the potential spatial extent of impacts, which indicates the potential for impacts to cultural heritage areas/sacred sites and sensitive environmental locations (**Appendix 10**). Spill response planning conducted for the Barossa Project has included the identification of the environmental and socioeconomic sensitivity of coastal locations on Tiwi Islands (Jacobs, 2019) and the Net Environmental Benefit Analysis (NEBA), also referred to Spill Impact Mitigation Assessment (SIMA), within the DPD Project OPEP (**Appendix 10**) specifically recognises Indigenous cultural heritage values in spill response planning.

Consultation conducted to date on the Barossa Project with Tiwi Island and Croker Island clan members (**Section 9.4**) has included detail about Barossa Project spill scenarios and spill response avoidance and mitigation measures. Through this consultation, agreement for spill notification processes has been made as well as agreement to provide rapid response test kits and associated training to Tiwi Island Rangers Groups (Section 5.4.2 of **Appendix 10**).

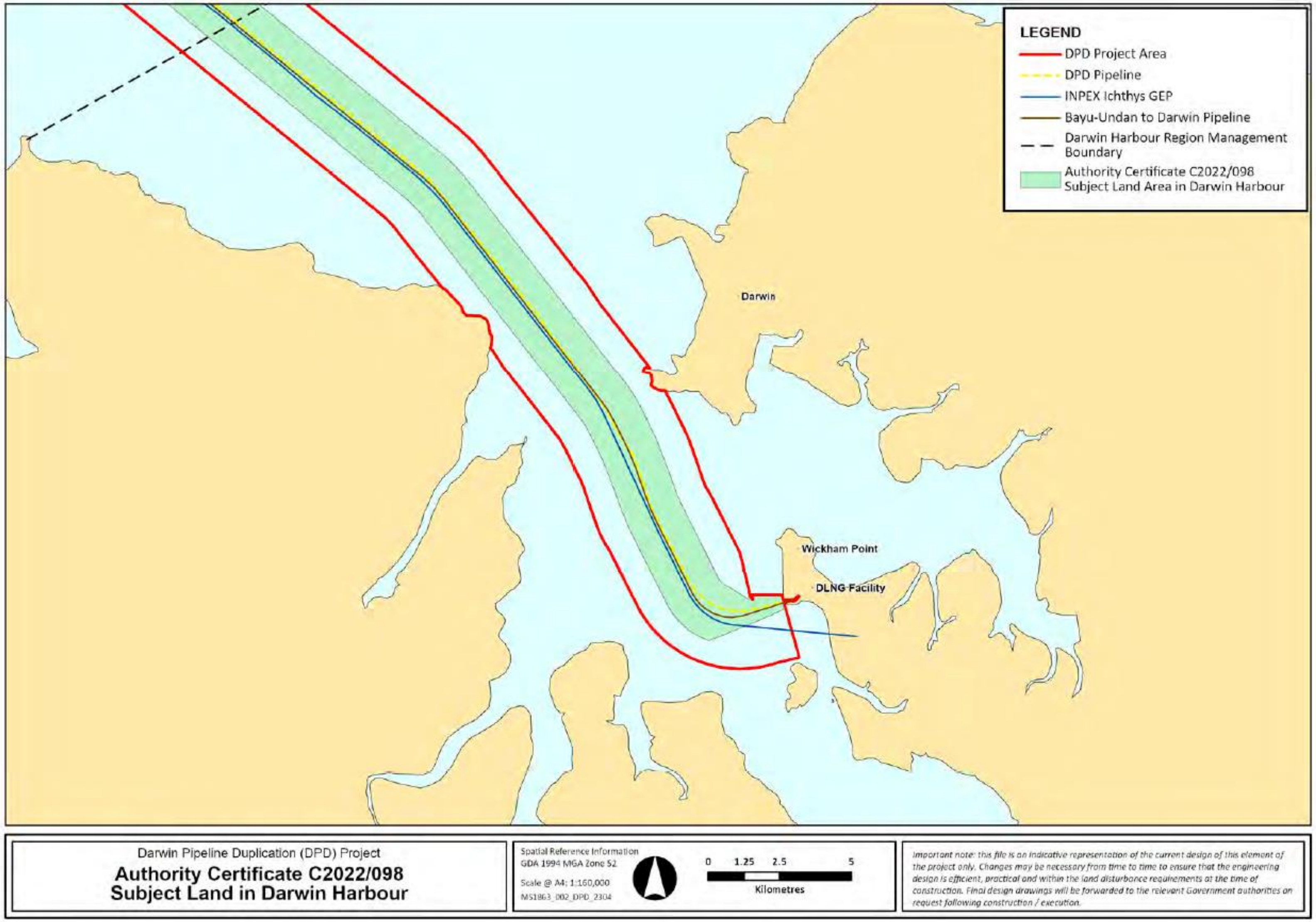


Figure 8-3 Authority Certificate C2022/098 Subject Land in Darwin Harbour

8.6 Potential Maritime Heritage Impacts

Santos engaged Cosmos Archaeology to undertake a maritime archaeological heritage assessment (MAHA) (**Appendix 21**), with summary results of the assessment presented here. An Archaeological Scope of Works prepared by the Heritage Branch of the NT Department of Territory Families, Housing and Communities, in November 2021, informed the Cosmos Archaeology assessment. The MAHA study area consisted of a pipeline corridor along the entire route and a wider anchoring corridor (900 m either side of the pipeline route) along the pipeline route within which anchoring by the shallow water pipelay vessel is proposed to occur. This was to ensure that the seabed disturbing activities of pipelay, trenching and temporary anchoring were covered.

Following finalisation of the DPD pipeline route, Cosmos Archaeology reviewed the MAHA and found that the revised route did not result in any changed recommendations in the original report, other than that one site (Target MA_007; a metal structure that is possibly wreckage) no longer required further impact assessment due to it being sufficiently far enough away from the revised route to be avoided (Cosmos Archaeology, 2023; **Appendix 21**).

Cosmos Archaeology identified 17 known shipwrecks within the MAHA study area. These are shown in the SER (**Appendix 2**, Table 11-3 and Figure 11-5). The closest shipwreck to the DPD Project pipeline route is the USAT Mauna Loa.

Cosmos Archaeology noted 29 known but unlocated shipwrecks, and 25 known but unlocated aircraft wrecks were recorded to have sunk within the vicinity of the MAHA study area and could potentially occur within the Project area (**Appendix 21**). This is based on historical accounts and general indication of where the wreck may be located. The location data for these wrecks provided by heritage inventories and historical records are not always accurate, due to movement on the seabed, or how the data was captured at the time.

8.7 Environmental Management and Mitigation

The controls and management measures outlined in **Table 5-1** have been identified through the environmental risk assessment process and lead to a reduction in possible community impacts.

Impacts from planned events to the community and economy were assessed in the SER as having Negligible or Minor impact, while unplanned events were assessed as presenting a Low or Very Low risk to community and economy (**Table 8-3**).

Table 8-3 Residual impact risk rating for the local community and economy

Aspect	Potential impact	Residual impacts and risks rating
Planned events[1]		
Physical presence (impacts to other users)	Physical presence of the pipeline and work vessels during the construction phase could potentially result in temporary visual impact to local residents and visitors, impact on commercial and recreational tourism and fishing and also impact commercial shipping due to increased number of vessels and associated exclusion zones.	Minor

Aspect	Potential impact	Residual impacts and risks rating
Seabed disturbance	Disturbance of seabed during trenching and spoil disposal activities resulting in temporarily increased suspended sediment. This may result in a visible plume that could impact visual amenity and dissuade the use of the area in the harbour and at the spoil disposal ground.	Minor
Noise emissions	Underwater noise impacts to key marine species that support commercial and recreation activities has the potential to impact these activities. Airborne noise from Project vessels has the potential to pose a nuisance to other users of Darwin Harbour and its shorelines.	Minor
Contingency treated seawater discharge	Contingency dewatering (e.g., a wet buckle event) to the marine environment from planned treated seawater may present an aesthetic impact to other users within the harbour, if a dye were to be used.	Minor
Ground disturbance (onshore)	A trench is required to be dug to allow the shore pull of the pipeline from offshore to onshore. This will be undertaken in a previously disturbed area and within the DLNG footprint.	Negligible
Unplanned events[2]		
Dropped objects – dry gas release	A dropped object has the potential to rupture the existing Bayu-Undan to Darwin gas export pipeline during DPD Project construction, or the Project pipeline (once operating) and result in dry gas release. This has the potential to impact other users in the harbour. Consequence assessment: Minor Likelihood assessment: Unlikely	Very Low
Invasive marine species	The introduction of IMS could decrease biodiversity (from the reduction or loss of native marine species) and loss of fishing resources which could impact the Community and Economy. Consequence assessment: Major Likelihood assessment: Unlikely	Low

Aspect	Potential impact	Residual impacts and risks rating
Marine fauna interaction	Vessel interactions with marine fauna (e.g., vessel disturbance or interaction with trenching equipment) may result in behavioural impacts, physical injury to, or the death of the fauna involved. There is the potential that this could have flow on impacts to the community and economic activities (e.g., tourism). Consequence assessment: Minor Likelihood assessment: Possible	Very Low
Hydrocarbon spill – marine diesel oil	Hydrocarbon spills have the potential to cause an adverse impact to recreational and commercial fishing and other tourism activities as a result of temporary closure of fishing and tourism areas as well as contamination of fish and damage to habitats and wildlife. The worst case MDO spill associated with the activity was determined to be from vessel collision and fuel tank rupture. Consequence assessment: Moderate Likelihood assessment: Unlikely	Low

[1] All planned events have been rated as if they will occur, therefore only the activity's consequence (ranging from negligible to critical) has been considered for the risk assessment.

[2] The assessment of the unplanned events considered both the likelihood and the consequence of an activity, and therefore the residual risk rating has been calculated using Santos' Risk Management process and risk matrix.

9 Stakeholder Engagement

The stakeholder engagement approach taken is in accordance with Santos' corporate standards and practices and align with the International Association for Public Participation's (IAP2) Quality Assurance Standard for Community and Stakeholder Engagement (IAP2 2015).

9.1 Engagement Objectives

Stakeholder engagement is an open dialogue that continues through the full project lifecycle. It is an essential process supporting environmental impact assessment as it provides affected and interested stakeholders with information about the Project's potential impacts and benefits.

It supports the identification of issues, addresses community concerns and expectations on decisions that may affect them and aids better decision-making and outcomes.

The objectives of the engagement strategy used for the DPD Project are to:

+ Maintain an ongoing dialogue with stakeholders, keeping them informed of the Project details and impacts.
+ Update stakeholders on changes to the Project during each stage of engagement.
+ Notify stakeholders of commitments being made by Santos as part of the Project approval process.
+ Encourage stakeholders to provide comments and raise issues or concerns about the Project.
+ Respond to stakeholder comments through the formal assessment process and directly as required.
+ Continue to build on existing stakeholder relationships and trust to inform Santos' longer term-activities and community involvement.

9.2 Identified Stakeholders

The Santos group has a long-standing presence in Darwin and the NT and has developed close relationships with a wide range of government, industry and community stakeholders. As Operator of the existing DLNG facility and the Bayu-Undan to Darwin gas export pipeline, Santos already has a strong understanding of the stakeholders and issues involved with developing and operating similar infrastructure.

Table 9-1 below lists the stakeholders currently identified for the Project have who been engaged directly or Santos has received and responded to formal submissions from them. Stakeholders were initially identified based on Santos' knowledge and history of engagement in the Darwin area, their activities within the Project's footprint area, potential to be positively or negatively impacted by the Project or their general interest in the type of project.

This list is updated as the Project progresses, recognising that as more project documents are released for public comment, further stakeholder groups may be identified. The list represents consultation up to Preliminary Documentation report submission as stakeholder engagement is an ongoing process.

Table 9-1 Stakeholder Engagement and Outcomes

Sector	Stakeholder Group	Engagement and Outcomes
Commonwealth Government Regulators / Agencies	National Offshore Petroleum Safety and Environment Management Authority	Santos has engaged with NOPSEMA on Barossa project Environment Plan submissions in Commonwealth waters, including discussion of the proposed DPD Project Environment Plan for Commonwealth waters. Additionally, Santos has discussed the process for applying for a pipeline licence variation for the proposed DPD pipeline section within Commonwealth Waters (engagement through NOPTA). Santos also advised the intention to submit application for new pipeline licences in NT Waters to the NT DITT.
	Australian Communications and Media Authority	Santos has engaged with ACMA on Barossa project Environment Plan submissions in Commonwealth waters, including discussion of the proposed DPD Project Environment Plan for Commonwealth waters. Additionally, Santos has engaged with ACMA on the application pipeline licence variation for the proposed DPD pipeline section within Commonwealth Waters. ACMA has encouraged Santos to engage with operators and/or potential operators of subsea cables in the vicinity of activities and with the Australian Hydrographic Office (AHO) to assist with identifying cable locations. Engagement by Santos with operators/potential operators is ongoing (see Infrastructure Operators entry below in this table).
	Australian Fisheries Management Authority	Santos has engaged with AFMA on Barossa project Environment Plan submissions in Commonwealth waters, including discussion of the proposed DPD Project Environment Plan for Commonwealth waters. Additionally, Santos has engaged with AFMA on the pipeline licence application variation for the proposed DPD pipeline section within Commonwealth waters. Santos has followed AFMA consultation guidelines for the petroleum industry and consulted directly with commercial fishing representative organisations (see separate entries below in this table).
	Australian Hydrographic Office	Santos has engaged with AHO on Barossa project Environment Plan submissions in Commonwealth waters, including discussion of the proposed DPD Project Environment Plan for Commonwealth waters. Additionally, Santos has engaged with AHO on the application pipeline licence variation for the proposed DPD pipeline section within Commonwealth Waters. General advice has been provided by AHO on notifications required to be made by vessels prior to

Sector	Stakeholder Group	Engagement and Outcomes
		operations, notifications that should be made to AMSA and vessel navigation and anti-collision measures. This advice has been given with respect to other elements of the Barossa project and is considered to apply equally to the DPD Project. Santos will advise AHO as required prior to DPD Project commencement.
	Australian Marine Safety Authority	Santos has engaged with AMSA on Barossa project Environment Plan submissions in Commonwealth waters, including discussion of the proposed DPD Project Environment Plan for Commonwealth waters. Additionally, Santos has engaged with AMSA on the pipeline licence application variation for the proposed DPD pipeline section within Commonwealth waters. General advice has been provided by AMSA on notifications required to be made by vessels prior to operations, notifications that should be made to AHO and vessel navigation and anti-collision measures. This advice has been given with respect to other elements of the Barossa project and is considered to apply equally to the DPD Project. Santos will advise AMSA as required prior to DPD Project commencement.
	Department of Climate Change, Energy, the Environment and Water (formerly Department of Agriculture, Water and the Environment)	Santos has engaged with DCCEEW throughout the EPBC Act Referral process and proceeding through to the Preliminary Documentation assessment process.
	Department of Climate Change, Energy, the Environment & Water - Parks Australia	Discussion on intent to submit a referral to DCCEEW on the DPD Project for assessment under the EPBC Act.
	Department of Defence – Navy/Australian Border Force/Maritime Border Command	Santos has engaged with the Department of Defence (Navy), ABF and MBC on Barossa project Environment Plan submissions in Commonwealth waters. Additionally, Santos has engaged with the Department, ABF and MBC on the pipeline licence application variation for the proposed DPD pipeline section within Commonwealth Waters. The Department has provided Santos with

Sector	Stakeholder Group	Engagement and Outcomes
		information on naval exercise areas and activities occurring in NT waters and ongoing engagement occurs ABF/MBC operations primarily occur in Commonwealth waters.
	Department of Defence (Navy) - HMAS Coonawarra, Darwin	Santos has been providing updates to Department of Defence (Navy) on the DPD Project and its environmental approval requirements. HMAS Coonawarra engagement has occurred regarding proposed DPD Project trenching and HMAS Coonawarra dredging activities; this has included a discussion of proposed schedules and the potential for cumulative impacts. Based on discussions to date, concurrent dredging/trenching activities appears unlikely. Santos has also discussed potential anchoring of some vessels within a corridor that traverses two areas of Naval Waters and potential concurrent DPD Project operations during Naval exercises held annually. Discission on timing of activities are ongoing.
	Department of Agriculture, Fisheries & Forestry	Santos has engaged with DAFF on Barossa project Environment Plan submissions in Commonwealth waters, including discussion of the proposed DPD Project Environment Plan for Commonwealth waters. DAFF responses have provided generic links to information on biosecurity management requirements which are considered relevant to the DPD Project.
	Department of Industry, Science and Resources	Santos has engaged with DISR on Barossa project Environment Plan submissions in Commonwealth waters, including discussion of the proposed DPD Project Environment Plan for Commonwealth waters.
	National Indigenous Australians Agency	NIAA has provided a submission on the DPD Project EPBC Act Referral. **Table 9-2** provides a response to NIAA comments within the submission and Santos will continue to follow-up with NIAA to discuss these comments further. Santos met with NIAA representatives 26 September 2023 to provide an update on the status of the DPD Preliminary Documentation report including an overview of Santos consultation to date with indigenous persons and associations, our approach for ongoing consultation and our commitment to developing a Cultural Heritage Management Plan for the DPD works. NIAA did not raise any specific concerns and seemed satisfied with Santos' approach and commitment to ongoing indigenous consultation and planned use of the Larrakia Rangers organisation to perform specific works. NIAA requested they be provided a copy of the Preliminary

Sector	Stakeholder Group	Engagement and Outcomes
		Documentation report when it becomes available. Santos will continue to update NIAA on progress of the indigenous engagement program.
NT Government Regulators / Agencies	Aboriginal Areas Protection Authority	The Aboriginal Areas Protection Authority (AAPA) is an independent statutory authority established under the NT Aboriginal Sacred Sites Act. The Authority is responsible for overseeing the protection of Aboriginal sacred sites on land and sea across the whole of Australia's Northern Territory. Project proponents within the Northern Territory may apply to the Authority for an Authority Certificate to cover their proposed activities. Certificates are based on consultations with custodians and provide clear instructions on what can and cannot be done in and around sacred sites. An Authority Certificate provides a statutory indemnity against prosecution in relation to the works or uses covered by the Certificate, provided the applicant complies with any conditions imposed to protect sacred sites. Santos applied to AAPA for an Authority Certificate to cover seabed disturbance activities within the DPD Project area (specifically an appropriately 1 km buffer around the pipeline route, the spoil disposal ground and the onshore disturbance area within the DLNG facility, and received an AAPA Authority Certificate (C2022/098) for the DPD Project in December 2022. Santos has communicated its AAPA application to Indigenous stakeholder groups, including the Wickham Point Deed Reference Group, the Northern Land Council and Larrakia Nation. Additional to the Subject Land Areas covered by Authority Certificate C2022/098, Santos has identified additional small areas of seabed disturbance associated with pipelay vessel anchoring, additional onshore disturbance areas within the DLNG Facility and areas where the seabed will be disturbed by the installation of water quality logging equipment required for DPD Project environmental monitoring. Santos has liaised with AAPA on these additional subject land areas and has submitted an additional Authority Certificate request to cover disturbance within these areas. AAPA provided a submission on the DPD Project EPA referral which was responded to within the DPD Project SER (refer Table 5-1 of **Appendix 2**).
	Department of Environment, Parks and Water Security	Santos has been in regular contact with DEPWS-Environmental Assessment Division (DEPWS-EAD) (which provides administrative services to the NT EPA) with respect to assessment of the

Sector	Stakeholder Group	Engagement and Outcomes
		DPD Project under the NT EP Act. Santos presented on the DPD Project SER at a NT Government Environmental Assessment Forum (EAF) chaired by DEPWS-EAD. Santos has met with representatives from DEPWS-EAD and DEPWS-Flora and Fauna Division (DEPWS-FFD) to discuss the preliminary environmental monitoring approach for DPD Project trenching and spoil disposal activities. DEPWS-FFD has made a formal submission on the DPD Project Referral to the NT EPA and subsequent Supplementary Environmental Report (SER). Santos' response to DEPWS-FFD submission on the Referral is provided within the SER (refer Table 5-1 of **Appendix 2**). Santos will continue to engage with DEPWS-EAD and FFD on regulatory / environmental monitoring requirements for the DPD Project.
	Department of Chief Minister and Cabinet	The Department of Chief Minister and Cabinet (DCMC) has made a submission on the DPD Project Referral to the NT EPA requesting information on workforce composition and how local employment and procurement opportunities will be maximised. Further, DCMC has highlighted the need for Santos to protect existing commercial and recreational shipping in Darwin Harbour, general harbour users and the offshore commercial fisheries in and adjoining the Project area. Santos has addressed DCMC comments in the DPD Project SER (refer **Table 5-1** of **Appendix 2**).
	Department of Industry, Tourism and Trade (Fisheries)	Santos initially met with the Department of Industry Tourism and Trade (DITT) – Fisheries to discuss the intention to submit a referral to the NT EPA for the DPD Project in NT Waters. Initial response from the Department was that there were unlikely to be major concerns related to commercial fishing or fish sustainability. The department requested that the route does not pass over or close to a jewfish aggregation area within the Charles Point Reef Fish Protection Area (CPRFPA), that artificial reef areas are not impacted by the project and that Santos consult with the Amateur Fisherman's Association of the NT (AFANT) to gain recreational fishing sector views. Following the meeting, Santos provided further information on the proposed pipeline route through the CPRFPA and has included mitigation measure so that the DPD Project will not disturb the jewfish aggregation area within the CPRFPA (the DPD route is approximately 2.5 km away from the aggregation area). Santos specifically undertook ROV work at the fish

Sector	Stakeholder Group	Engagement and Outcomes
		aggregation area within the CPRFPA following Fisheries engagement and has provided this video data to Fisheries, along with other data along the pipeline route and within the CPRFPA. DITT-Fisheries provided a submission on the DPD Project NT EPA referral which has been addressed in the SER (refer Table 5-1 of **Appendix 2**).
	Department of Industry, Tourism and Trade (Fisheries/Darwin Aquaculture Centre)	Santos has presented to the Department of Fisheries and other users of the Darwin Aquaculture Centre on the DPD Project, including the outcomes of sediment dispersion modelling for planned trenching in closest proximity to Channel Island, and the potential for impacts to the DAC seawater intake supply. DAC users expressed concern on the potential for trenching to mobilise and transport contaminants (in particular heavy metals) to the DAC and the potential for these to impact aquaculture species through the DAC seawater pump intake. Santos considered the potential for impacts from heavy metals in trenched sediments (refer to Section 8.5.1.6 SER, **Appendix 2**). In response to DAC concerns, Santos has agreed to monitor for metals at DAC which has been included within the environmental monitoring program proposed for trenching and spoil disposal (**Appendix 15** in the TSDMMP, **Appendix 2**).
	Department of Industry, Tourism and Trade (Energy)	Santos has met with the Department of Industry, Tourism and Trade (DITT) – Mining and Energy Division to discuss the DPD Project and approval requirements under NT petroleum legislation, including the Pipeline Licence, Pipeline Management Plans and Environmental Management Plans. DITT – Mining and Energy Division advised that it was important to discuss the project with the Aboriginal Areas Protection Authority (AAPA). Santos has provided the department with an update on AAPA Clearance Certification process and discussed whether there are any other requirements related to Native Title consultation. Department advised it was not aware of any issues that would trigger additional legislative requirements and consultation than Santos was already progressing for NT waters. Santos will continue to engage with DITT – Mining and Energy Division with respect to assessment and approval of its Pipeline Licence application, Pipeline Management Plans and Environmental Management Plans.

Sector	Stakeholder Group	Engagement and Outcomes
	Department of Industry, Tourism and Trade (Tourism)	DITT – Tourism provided a submission on the DPD Project NT EPA referral noting the potential for DPD Project impacts on tourism. Santos has addressed this within the SER (refer Table 5-1 of **Appendix 2**) noting that the DPD Project is located within a maritime and logistics precinct and will be visible from public recreational places. DITT – Tourism also suggested that Santos make contact with Darwin Harbour tourism operators during planning and construction phases. Consultation has occurred with a range of stakeholders including Tourism NT and Top End Tourism, the organisation representing marine-based tour operators in Darwin Harbour, and other relevant government agencies. The stakeholders have advised Santos that the main impact will be caused by pipe-lay vessel activities potentially displacing tourism activities for some periods of time. The stakeholders acknowledge that the timeframe and scale of impacts is less in comparison to the Ichthys pipeline vessel-based activities and associated onshore construction activities. They have advised the key requirement of Santos will be to communicate as early in the process as possible, to provide regular communications during the activities and to provide a contact person who can coordinate immediate responses to any issues or concerns raised.
	Department of Infrastructure, Planning & Logistics (Harbour Master)	Engagement has been undertaken with the DIPL Harbour Master to describe the potential impacts of the DPD Project's vessels and installed infrastructure on other port users. The Harbour Master provided a submission on the DPD Project NT EPA Referral which Santos has addressed in the DPD Project SER (refer Table 5-1 of **Appendix 2**). Consultation with DIPL through 2022 into 2023 has focussed on options to mitigate the potential for third-party interactions with the DPD pipeline to ensure the DPD pipeline does not limit future plans for the shipping channel. Santos undertook a quantitative risk assessment (QRA) of the pipeline route to inform protection requirements (i.e. trenching and rock armour) and provided this to DIPL including an update based on comments made by DIPL's independent reviewer (Royal Haskoning). In consultation with the Harbour Master, Santos has rerouted a 4 km section of the DPD pipeline to move the route fully outside of the shipping channel. Santos also increased the depth and length of trenching across middle arm channel through consultation with the Harbour Master.

Sector	Stakeholder Group	Engagement and Outcomes
	Department of Infrastructure, Planning & Logistics (Planning)	Santos has consulted with DIPL – Planning to understand development permit requirements for onshore and Darwin Harbour sections of the DPD pipeline route. Applications for development permits have been progressed based on these discussions. DIPL – Planning provided a submission on the DPD Project NT EPA Referral which Santos addressed in the DPD Project SER (refer Table 5-1 of **Appendix 2**).
	Department of Infrastructure, Planning & Logistics (Middle Arm Sustainable Development Precinct Project)	Santos has met with DIPL regarding the proposed Middle Arm Sustainable Development Precinct Project to share information, including indicative timeframes and plans for activities in Darwin Harbour and current/planned environmental studies.
	Department of Infrastructure, Planning & Logistics (Darwin Shiplift Project)	Santos has met with DIPL regarding the proposed Shiplift Project to share information, including indicative timeframes and plans for activities in Darwin Harbour (including dredging) and current/planned environmental studies. Santos has liaised with DIPL (Shiplift Project) on the potential for spoil reuse to support Shiplift construction and has provided technical data for evaluation.
	Department of Infrastructure, Planning & Logistics (Mandorah Marine Facilities Project)	Santos has met with DIPL regarding the proposed Mandorah Marine Facilities Project to share information, including indicative timeframes for activities in Darwin Harbour (including dredging) and current/planned environmental studies. Given the relatively close proximity of dredging areas for Mandorah and DPD, Santos will continue to liaise with DIPL on the project to determined potential for concurrent operations as both projects progress closer to construction activity windows and look for potential mitigation measures to reduce potential for cumulative impacts if required.
	Department of Infrastructure, Planning & Logistics (Transport and Civil Services)	DIPL – Transport and Civil Services provided a submission on the DPD Project NT EPA referral requesting Santos conduct a Traffic Impact Statement for land logistics activities supporting the DPD Project construction activities (including traffic associated with the transport of rock from Mt Bundey to the Project area, as well as movement of equipment and personnel to the Project area). Santos met with DPIL to understand requirements and commissioned a Traffic Impact Assessment

Sector	Stakeholder Group	Engagement and Outcomes
		(**Appendix 24**). The Traffic Impact Assessment was provided to the Transport and Civil Services Division who advised that it met their requirements.
	Department of Territory Families, Housing and Communities (Heritage)	Santos undertook a Maritime Archaeological Heritage Assessment, as per an Archaeological Scope of Works provided by the Department of Territory Families, Housing and Communities (DTFHC) – Heritage Branch. The assessment was undertaken by a Maritime Archaeologist informed by geophysical data from the Project area and a marine survey conducted in June 2022 by ROV to collect visual data of potential heritage sites. The maritime archaeological heritage assessment (**Appendix 21**) has been provided to the DTFHC – Heritage Branch. The DTFHC provided a submission on the DPD Project NT EPA referral which has been addressed in the DPD Project SER (refer Table 5-1 of **Appendix 2**).
	NT Environment Protection Authority	Santos has provided an overview to the NT EPA on the DPD Project and how it relates to other Santos activities and projects in the Darwin area. Engagement with the NT EPA throughout the NT EP Act assessment process, in terms of the submission and assessment of the DPD Project NT EPA referral and the SER, has been undertaken through the DEPWS-Environmental Assessment Division, which provides administrative services to the NT EPA.
	NT Power and Water Corporation	Santos has met with the NT Power and Water Corporation (PWC) to discuss the DPD Project in both NT and Commonwealth waters. Discussions have focused on the status of power and communications cables and crossings. Santos and PWC have shared detailed information to discuss the status of power and communications cables and crossings that will be required and may be required in the future. Detailed survey will be undertaken prior to any activities performed in the vicinity of the power and telecommunication routes. Furthermore, anchoring associated with DPD pipelay activities in the vicinity of power and telecommunication cables will include appropriate pull-on and pull-off separation distances to ensure no interaction with the cables present. Santos will liaise with PWC on the outcomes of surveys in the vicinity of power and telecommunication routes as requested by the PWC in their submission to the DPD Project SER.

Sector	Stakeholder Group	Engagement and Outcomes
	Tourism NT	Santos has met with Tourism NT to discuss DPD Project activities and stakeholder consultation undertaken with other users of Darwin Harbour and surrounds. Tourism NT assisted Santos with further identification of stakeholders, including Tourism Top End which represents charter boat operators along with the NT Guided Fishing Industry Association. Tourism NT advised that communication prior to and during the activities was critical and offered to assist by passing on communication via its monthly newsletter. Santos has also discussed logistics requirements during activities in 2024 with Tourism NT and the DPD pipeline installation contractor, and potential assistance that Tourism NT can provide for consultation with relevant organisations.
NT Local Government	Darwin City Council	Santos has notified Darwin City Council of rock haulage (truck movements) between Mt Bundey quarry and Darwin Port for stockpiling in preparation for commencement of DPD Project construction activities.
	Litchfield Council	Santos has notified Litchfield Council of rock haulage (truck movements) between Mt Bundey quarry and Darwin Port for stockpiling in preparation for commencement of DPD Project construction activities.
	Palmerston Council	Santos has notified Palmerston Council of rock haulage (truck movements) between Mt Bundey quarry and Darwin Port for stockpiling in preparation for commencement of DPD Project construction activities.
Indigenous Groups / Representative Bodies	Aboriginal Areas Protection Authority (also noted as agency above)	Refer entry under NT Government Regulators / Agencies.
	Larrakia Nation (including Larrakia Sea Rangers)	Larrakia Nation is the peak Larrakia body and provides services to Larrakia people including outreach services, community services and the Larrakia Land and the Sea Rangers program. Santos has met with Larrakia Nation to discuss the DPD Project, Santos' AAPA Authority Certificate application process, and consultation undertaken with other representative organisations/groups, including the Wickham Point Deed Reference Group, the Tiwi Land Council and the Northern Land Council. Santos and its environmental contractors have started

Sector	Stakeholder Group	Engagement and Outcomes
		discussions with Larrakia Sea Rangers to provide environmental monitoring services during DPD Project construction activities.
	Northern Land Council	The Northern Land Council (NLC) consults with traditional landowners and other Aboriginal peoples with an interest in affected land. The NLC is a signatory to the Wickham Point Deed. Santos has met with the NLC to discuss the DPD Project and associated stakeholder and regulatory consultation conducted with AAPA, the WPDRG and TLC. The NLC has provided a submission on the DPD Project SER providing feedback on Aboriginal community engagement and cultural heritage assessment including the response to NIAA outlined in **Table 9-2**.
	Tiwi Land Council	The Tiwi Land Council (TLC) represents all Tiwi people in the protection of land, sea and environment and supports sustainable economic development to improve Tiwi lives through employment, income, education and health opportunities. Santos has met with the TLC to discuss the broader Barossa project and the DPD Project in Commonwealth and NT waters, associated regulatory approval processes, ongoing consultation with Tiwi clan groups and potential areas for collaboration on environmental projects with relevance to the DPD section in Commonwealth Waters. The Santos response includes considering assistance with the removal of ghost nets, feral pests and turtle monitoring that are ongoing focusses for Tiwi Land and Sea Rangers.
	Tiwi Land-owner Groups (Jikilaruwu, Wurankuwu and Malawu)	Santos has met with the Tiwi land-owner groups of Jikilaruwu, Malawu and Wurankuwu to discuss Barossa project activities and potential areas for collaboration on environmental projects, some of which will also have relevance to the section of the DPD in Commonwealth waters. Through this consultation, the Santos response has been to establish spill notification processes as well as agreement to provide rapid response test kits and associated training to Tiwi Island Rangers Groups.
	Croker Island community members	Santos has met with Croker Island community members to provide an overview of the Barossa Project activities and key impacts, risks and management measures associated with the Barossa project. Santos' response includes establishing Croker Island notification processes for

Sector	Stakeholder Group	Engagement and Outcomes
		unplanned spills associated with the Barossa Project, which are also of relevance to the DPD Project. Further consultation with the Croker Island community will be undertaken.
	Wickham Point Deed Reference Group – Larrakia Liaison Committee	The Wickham Point Deed Reference Group (WPDRG) was set up to strengthen the dialogue between Santos and the Larrakia people and support delivery of the parties commitments under the Wickham Point Deed, entered into between Darwin LNG and the NLC on 29 April 1999. The Larrakia Liaison Committee (LLC) has been set up under the deed and its functions include making recommendations to Santos for various matters such as environmental, cultural heritage, employment and business opportunities. The WPDRG comprises Santos and Larrakia representatives reflecting a position for a representative from each Larrakia family. The LLC represents a long running dialogue between Santos and Larrakia representatives and meets quarterly. The DPD Project, associated environmental approvals, impacts/risks and management measures, indigenous consultation and the AAPA Authority Certificate process has been discussed at the LLC. Santos response has been to implement the LLC advice on measures to manage DPD construction activities in the vicinity of a sacred site within Darwin Harbour as recognised on Authority Certificate C2022/098 and suggestions for involving Larrakia Rangers in environmental monitoring work.
	National Indigenous Australians Agency	Refer entry under Commonwealth Government Regulators / Agencies.
Academic and Research Organisations	Australian Marine Science Association (NT Branch)	AMSA-NT provided a submission on the DPD Project SER to the NT EPA, outside of the formal public submission window. Santos agreed to receive the submission directly and will consider the technical advice in the finalisation of its environmental management and monitoring plans.
	Australian Institute of Marine Science (also a DHAC member)	The DPD Project sediment dispersion modelling approach, including use of source terms, and the technical report were reviewed by a subject matter expert from AIMS.
	Charles Darwin University (also a DHAC member)	A meeting was held with a CDU researcher to discuss issues related to presence and potential impacts on turtles in Darwin Harbour and NT Waters generally.

Sector	Stakeholder Group	Engagement and Outcomes
Environmental Group Representatives	Environment Centre NT (also a DHAC member)	Santos has engaged with ECNT on Barossa project Environment Plan submissions in Commonwealth waters, including discussion of the proposed DPD Project Environment Plan for Commonwealth waters. ECNT has provided feedback that it considered that approvals should be assessed based on the entire Barossa project, i.e., from extraction at Barossa field right through treatment at DLNG, re-use of Bayu-Darwin pipeline and potential CCS at Bayu-Undan. ECNT provided a submission on the DPD Project NT EPA Referral which Santos responded to in the DPD Project SER (refer Table 5-1 of **Appendix 2**). ECNT made raised a number of issues to the EPBC Act Referral which are included in **Table 9-2** together with Santos' responses.
	The Australia Institute	The Australia Institute provided a submission on the DPD Project NT EPA referral with concerns primarily around Barossa project GHG emissions which Santos responded to in the DPD Project SER (refer Table 5-1 of **Appendix 2**).
	Australian Conservation Foundation	The Australian Conservation Foundation provided a submission on the DPD Project NT EPA referral with concerns primarily around Barossa project GHG emissions which Santos responded to in the DPD Project SER (refer Table 5-1 of **Appendix 2**).
	Australian Parents for Climate Action Darwin and NT	The Australian Parents for Climate Action Darwin and NT provided a submission on the DPD Project NT EPA referral with concerns primarily around Barossa project GHG emissions which Santos responded to in the DPD Project SER (refer Table 5-1 of **Appendix 2**).
	Central Australian Frack Free Alliance	The Central Australian Frack Free Alliance provided a submission on the DPD Project NT EPA referral with concerns primarily around Barossa project GHG emissions which Santos responded to in the DPD Project SER (refer Table 5-1 of **Appendix 2**).
	Doctors for the Environment Australia	Doctors for the Environment Australia provided a submission on the DPD Project NT EPA referral with concerns primarily around Barossa project GHG emissions which Santos responded to in the DPD Project SER (refer Table 5-1 of **Appendix 2**).

Sector	Stakeholder Group	Engagement and Outcomes
	Institute for Energy Economics and Financial Analysis	The Institute for Energy Economics and Financial Analysis provided a submission on the DPD Project NT EPA referral with concerns primarily around Barossa project GHG emissions which Santos responded to in the DPD Project SER (refer Table 5-1 of **Appendix 2**).
	Jubilee Australia Research Centre	The Jubilee Australia Research Centre provided a submission on the DPD Project NT EPA referral with concerns primarily around Barossa project GHG emissions which Santos responded to in the DPD Project SER (refer Table 5-1 of **Appendix 2**).
	La'o Hamutuk - Timor-Leste Institute for Development Monitoring and Analysis	La'o Hamutuk provided a submission on the DPD Project NT EPA referral with concerns primarily around Barossa project GHG emissions which Santos responded to in the DPD Project SER (refer Table 5-1 of **Appendix 2**).
	Territory Natural Resource Management (as a member of DHAC)	Refer to the entry for Darwin Harbour Advisory Committee (DHAC).
	Landcare NT (as a member of DHAC)	Refer to the entry for Darwin Harbour Advisory Committee (DHAC).
Fishing Representative Bodies and Operators	Amateur Fishermen's Association of the NT (also as DHAC member)	Santos has met with AFANT to provide information on the DPD Project and environmental approvals process. Discussions have been primarily around potential Project impacts to recreational fishing activities and the effect of the Project construction activity on fish habitat, both in terms of habitat loss and potential habitat creation. Concerns were also raised with respect to potential impacts to mud crab migration and to potential impacts to fish habitat within the Charles Point Wide Reef Fish Protection Area. Santos is discussing support for a potential study into the benefits of artificial habitats, including pipeline infrastructure, in the Darwin Harbour. Santos met with NT DITT - Fisheries who agreed that pipelines were generally beneficial to recreational fishing activities, and they did not see the DPD Project causing problems for mud crab migration. AFANT provided a submission on the DPD Project NT EPA referral which Santos responded to in the DPD Project SER (refer Table 5-1 of **Appendix 2**).

Sector	Stakeholder Group	Engagement and Outcomes
	NT Seafood Council	NTSC, which represents commercial fishing licence-holders, did not make a submission to the NT EPA referral or the EPBC Act Referral. NTSC confirmed that commercial fishers do not operate within the harbour, however, there is some fishing activity within other NT waters jurisdiction. NTSC's two main requests were for Santos to not disturb the jewfish aggregation area within the CPRFPA and to mitigate against fishing gear being snagged around the pipeline. The Santos response is the inclusion of the mitigation measure MA11 - pipeline will not be laid in the vicinity of the Jewfish aggregation area within the Charles Point Wide RPA (**Table 5-1**). The large diameter cylindrical pipeline is inherently snag free, without any appurtenances that can snag trawling gear. The Pipeline End Termination structure (PLET) at the end of the DPD and the In-Line Tee (ILT positioned nominally pipeline mid-length) structures are covered by snag resistant protection frames.
	Northern Prawn Fishing Industry (NPFI) Pty Ltd	NPFI, which represents commercial fishing licence-holders, did not make a submission to the NT EPA referral or the EPBC Act Referral. NPFI licence holders only operate within Commonwealth waters, but some are based in Darwin. A meeting was held with a NPFI Darwin-based representative to discuss the DPD pipeline in Commonwealth Waters and intention to submit a referral to the NT EPA for the DPD section in NT Waters. Initial view of NPFI was that there will not be any major concerns, however Santos was requested to provide further specific information on the proposed pipeline route and spoil disposal area plus the other subsea infrastructure required in the additional Commonwealth waters area so any potential impacts on commercial fishing grounds in Commonwealth waters and a Sea Gear Trial area in NT Waters can be considered. In response, Santos provided the requested information.
	Paspaley Pearling Company (also as Darwin Aquaculture Centre user)	Santos has had discussions with Paspaley Pearls about Project vessel activities in the vicinity of pearl lease areas and at the request of Paspaley Pearls. The Santos response has instructed contractor vessels to avoid these areas when transiting to the Project area (e.g. supply vessels transferring pipe to pipelay vessels).
Other Community Organisations	Darwin Harbour Advisory Committee (DHAC)	Santos has met with DHAC to introduce and provide updates to the committee on the DPD Project and the NT and Commonwealth environmental approvals process. At the request of DHAC, Santos has provided a presentation on Santos' proposed future greenhouse gas

Sector	Stakeholder Group	Engagement and Outcomes
		emissions management through Carbon Capture and Storage (CCS) and specifically the potential Bayu-Undan CCS Project. DHAC has provided comments that a Before After Control Impact Study of the proposed pipeline value as habitat would be useful for future decommissioning approach. The Santos response has been to incorporate baseline habitat value into its environmental monitoring design to enable future assessment of pipeline habitat value.
Tourism Representative Bodies and Operators	NT Guided Fishing Industry Association	Santos met with the NT Guided Fishing Industry Association to discuss the DPD Project and approval process. The Association, which represents ~70 guided fishing/charter boat operations, provided initial advice that another pipeline was welcome for fish attraction and artificial habitat creation and there should not be any major issues provided installation/trenching was of a relatively short duration and did not occur over known fishing locations or the artificial reefs. The Santos response to these issues is that the DPD pipelay will occur over 3.5 months following 3 months pre-lay trenching and offshore shore crossing construction (**Figure 2-3**) and does not occur over known guided fishing locations or the artificial reefs. The mitigation measure MA11 implemented - pipeline will not be laid in the vicinity of the Jewfish aggregation area within the Charles Point Wide RPA (**Table 5-1**) will be implemented. Following the meeting, Santos provided further information on the proposed pipeline route.
	Sea Darwin (also a DHAC member)	Santos engaged with Sea Darwin to discuss the DPD Project, environmental approvals process and other stakeholder consultations undertaken with tourism bodies. The business owner/operator reiterated the importance of communication and need to liaise with Tourism NT and Top End Tourism. Santos' response has been to engage with Tourism NT and Top End Tourism for effective engagement with tourism operators.
Infrastructure Operators	BW Digital	Santos has shared DPD Project information with BW Digital to understand future work requirements (proposed subsea telecommunications cable system to Darwin) and any potential requirements for coordination with DPD Project. Engagement will be ongoing.

Sector	Stakeholder Group	Engagement and Outcomes
	Inligo Network	Santos has shared DPD Project information with Inligo Network to understand future work requirements (proposed subsea telecommunications cable system to Darwin) and any potential requirements for coordination with DPD Project. Engagement will be ongoing.
	Darwin Port	Santos has met with Darwin Port to discuss progress of all aspects of DPD planning as related to port operations, including future communication with key contracting companies for marine, wharf and road activities. Darwin Port advised that its preference will be for Santos to consult and communicate directly with all relevant stakeholders and keep the Port regularly informed. Consultation with the Darwin Harbour Advisory Committee was recommended. The Port will advise Santos if any briefings are required via its ongoing Port User Group consultation process.
	NT Ports and Marine	Santos has engaged with NT Ports and Marine on Barossa project Environment Plan submissions in Commonwealth waters, including discussion of the proposed DPD Project Environment Plan for Commonwealth waters. Additionally, Santos has discussed the process for applying for a pipeline licence variation for the proposed DPD pipeline section within Commonwealth waters (engagement through NOPTA). Santos also advised the intention to submit application for new pipeline licences in NT waters.
	NT Power and Water	Refer entry under NT Government Regulators / Agencies.
	Sun Cable	Santos has met with the Sun Cable Project (which includes proposed subsea power cable between Darwin and Singapore) to discuss the DPD Project, regulatory approvals, indicative activity schedules and potential future crossovers of pipelines/cables. Engagement with Sun Cable is ongoing.
	Telstra	Santos has shared DPD Project information with Telstra (who operates subsea communications cables in Darwin Harbour) to understand future work requirements and any potential requirements for coordination with DPD Project activities. Engagement with Telstra is ongoing.
	Vocus	Santos has shared DPD Project information with BW Digital to understand future work requirements (proposed subsea telecommunications cable system to Darwin) and any potential requirements for coordination with DPD Project. Engagement with Vocus is ongoing.

Sector	Stakeholder Group	Engagement and Outcomes
Energy Industry	Australian Marine Oil Spill Centre	Santos has engaged with AMOSC (Santos primary spill response services provider) together with other NT Government Departments with respect to oil spill response arrangements in NT waters and clarifying cross jurisdictional arrangements.
	Eni Australia	Santos has engaged with Eni with respect to the re-routing of the proposed DPD pipeline route, which involves crossing of the existing Bayu-Undan pipeline and bringing the DPD route into an area under assessment by Eni for potential pipeline routing.
	INPEX	Santos has regularly engaged with INPEX with respect to the DPD Project activities and approvals process. This has included sharing information on activities within Darwin Harbour, in particular DPD activities with the potential to interact with the Ichthys pipeline and trenching/dredging activities both companies are planning in 2024. Santos has engaged with INPEX with respect to environmental monitoring activities undertaken for the Ichthys project which has assisted Santos with the planning of environmental management and monitoring for the DPD Project.

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9.3 Engagement Undertaken

Stakeholder engagement has been undertaken from Project inception and will continue over the life-cycle of the Project, with more than 130 meetings held with stakeholders between October 2021 and August 2023 made up of 110 meetings concerning the DPD Project and 20 meetings concerning the Barossa project more broadly that included the DPD Project.

In addition to proactive meetings held, stakeholder feedback on the DPD Project has occurred through formal public and Government submission processes under the NT EP Act and the Commonwealth EPBC Act. This includes public/Government submissions received on the NT EPA Referral and Supplementary Environmental Report (SER) during submission periods of 18 January to 15 February 2022 and 24 May to 28 June 2023, respectively, and public/Government submissions received on the EPBC Act Referral between 7 and 21 November 2022.

A total of 318 submissions were received in response to the publication of the NT EPA Referral which included group public submissions by 284 individuals with the same wording. This included submissions from environmental organisations, researchers, volunteer groups, individuals (some submissions representing multiple people), and from multiple government agencies.

Issues raised in formal public/Government submissions on the NT EPA Referral and SER for activities onshore and in NT waters can be broadly summarised under the following themes:

+ Increasing GHG/air emissions from the DPD Project and associated Barossa Development and impacts to climate change.
+ Feasibility of Carbon Capture and Storage (CCS).
+ Impacts to the marine ecosystem and supporting evidence used to assess impacts, including:
  - Benthic habitats (including seagrass and hard coral habitats).
  - Protected marine megafauna (including dolphins, dugongs and turtles).
  - Fish and fisheries.
  - Mangroves.
+ Impacts to coastal processes and marine environmental quality, associated with trenching and rock placement.
+ Assessment of potential impacts to cultural heritage.
+ Industrialisation of Darwin Harbour and cumulative impacts.
+ Reliance on INPEX Ichthys data and the lack of evidence around long-term impacts.
+ Santos' engagement with potentially affected communities and request for further details on Santos' stakeholder planning.
+ Impacts to recreational fishers (including use of the spoil ground) and existing shipping traffic.
+ Impacts to the broader community including job security, tourism and overall health impacts.

Issues raised from the NT EPA Referral submissions have been specifically addressed in the Table 5.1 of the SER (**Appendix 2**), referencing applicable sections of the SER and technical appendices.

Additional to submissions received on the NT EPA Referral and SER a total of seven submissions were received on the EPBC Act Referral including four submissions by Commonwealth/NT Ministers (or delegates) invited by DCCEEW to comment on the Referral and three submissions by the public in response to the published Referral. Issues from these submissions are summarised in **Section 9.5**.

9.4 Traditional Owner Consultation

Santos has undertaken engagement with Traditional Owners on the DPD Project from Project inception which will be ongoing through the Project life-cycle. The key component of Santos' consultation with Traditional Owners in the Darwin area is consultation undertaken through the Wickham Point Deed Reference Group (WPDRG) which includes Larrakia representatives, reflecting a position for a representative from each Larrakia family group. Santos coordinates quarterly meetings with the WPDRG through the Larrakia Liaison Committee, the functions of which are set out in the Wickham Point Deed and include making recommendations to Santos on various matters such as environmental, cultural heritage, employment and business opportunities. The Wickham Point Deed was entered into between Darwin LNG and the Northern Land Council on 29 April 1999 and the Larrakia Liaison Committee represents a long-running dialogue between Santos and Larrakia Traditional Owners.

Santos has discussed the DPD Project with the WPDRG Larrakia Liaison Committee on multiple occasions from November 2021 onwards, including Project activities, approval requirements, impacts and risks, the AAPA Authority Certificate process and proposed management measures. The Liaison Committee requested that Larrakia Rangers (within Larrakia Nation) be involved in environmental monitoring, including marine fauna monitoring, for the Project. Santos has approached Larrakia Rangers, who have agreed to be involved with this work and this arrangement will progress as monitoring scopes are finalised.

Santos has met on a number of occasions with the Northern Land Council on the DPD Project from October 2021 onwards to discuss the Project approvals, AAPA Authority Certificate application and applicable Project stakeholders and will continue to discuss ongoing cultural heritage requirements and Traditional Owner consultation including the liaison with the NIAA and development of a cultural heritage management plan.

Santos has met regularly with Tiwi Land Council from October 2022 onwards to discuss Barossa project activities and potential areas for collaboration on environmental projects, some of which also have relevance to the section of the DPD in Commonwealth waters. Removal of ghost nets, feral pests and turtle monitoring are an ongoing focus for Tiwi Land and Sea Rangers and provide opportunities for Santos' consideration of support to the Tiwi community. Initial meetings focused on organisation of further Clan Group meetings to discuss installation of the pipeline and how information is provided. Santos also advised that it resubmitted the DPD EPBC Act Referral (**Appendix 1**) to DCCEEW that now includes the 23 km section in Commonwealth waters south of the Tiwi Islands. Santos has directly engaged with Tiwi landowner Clan Groups Jikilaruwu, Wurrumiyanga and Malawu to discuss the Barossa project more broadly, as part of the ongoing Barossa project engagement process.

Tiwi Islands Clan Groups and Traditional Owners have participated in an extensive engagement program with Santos from January 2023 to July 2023 for the Barossa Drilling and Completions EP. Consultation activities were conducted in person, primarily through discussions or presentations. Written consultation materials were also made available or supplied. Santos used visual aids, maps, videos, animations to present information regarding the activity and the project more generally. Santos attended the Tiwi Islands and held community engagement sessions in Milikapiti, Pirlangimpi and Wurrumiyanga to seek feedback from the clan members as to how they would like to be consulted. Santos representatives remained on the Tiwi Islands on 9 and 10 February 2023 and were available to answer questions regarding the Barossa project and proposed activities (including risks and impacts), the consultation process and consultation preferences, and to receive any feedback. Santos then held initial clan consultation sessions with Tiwi Islands clans at Milikapiti, Pirlangimpi and Wurrumiyanga. Information regarding Barossa Drilling and Completions EP and the project more generally was communicated to clan members and feedback was sought. One session was held for each clan group, however other clan group members attended some meetings with the approval of the clan trustee. In total, approximately 756 clan members attended these sessions. Follow up clan consultation sessions with the Tiwi Islands clans were held and a total of approximately 820 clan members attended these sessions. Santos held final consultation sessions with Tiwi Islands clans in June 2023 with 679 clan members attending these sessions. Some of the issues raised and responses from Santos in relation to the broader Barossa project are of relevance to the DPD Project e.g., response to spill incidents that may occur near Tiwi Islands. From this consultation, spill notification processes and the provision of rapid response test equipment and training to Tiwi Ranger Groups has been agreed, which Santos will also apply to the DPD Project.

Consultation with Croker Island clan group members has occurred on the overall Barossa Project and on drilling and subsea installation activities. Further consultation is planned to cover other activities, including the DPD Project. Consultation to date has outlined Barossa Project impacts and risks and associated control measures. A notification protocol in the event of Barossa Project spills has been established for the Croker Island, and will also be applied in relation to the DPD Project.

Santos has met with the NT's two tourism umbrella organisations, Tourism NT and Top End Tourism, to discuss the DPD Referral to NT EPA and stakeholder consultation undertaken to date with other users of Darwin Harbour and surrounds. Top End Tourism represents charter boat operators and both organisations have established relationships with Larrakia and Tiwi indigenous organisations.

In summary, Santos has undertaken detailed consultation and is committed to continuing engagement and consultation with Traditional Owners throughout the DPD Project and comply with the intent of the DCCEEW indigenous engagement guidelines (DCCEEW, 2023b).

9.5 EPBC Act Referral Submissions

Comments raised in the seven submissions (comments received from three public submissions were assessed in one set of comments by DCCEEW under ECNT) on the EPBC Act Referral (as summarised in DCCEEW Statement of Reasons, **Appendix 1**), and Santos' responses are summarised in **Table 9-2**.

Table 9-2 EPBC Act Referral Comments

Submitter	Comment	Santos Action
Commonwealth Government Ministry for Defence	Responded on 23 November 2022, requesting ongoing engagement and consultation as the project progresses to ensure there are no conflicting activities with Defence Estate or Naval Waters.	Santos has been engaging with Defence on the DPD Project and will continue to do so to ensure there are no conflicting activities.
Geoscience Australia responded on behalf of the Minister for Resources	Responded on 21 November 2022 noting the nature of the proposed action, concurred with the proponent's view that the proposed action is not a nuclear action, nor a coal seam gas or coal mining project.	Comment noted. No action from Santos required.
National Indigenous Australians Agency (NIAA)	Responded on behalf of the Minister for Indigenous Australians on 23 November 2022 noting the following: 1. While the Native Title determination incorporating part of the project area found there to be no Native Title, this determination does not encompass the entirety of the Darwin Harbour, meaning that Native Title rights and interests may still existing beyond the determination area. We therefore recommend the proponent seek advice from the NT Government regarding any future act processes which may apply to the project under the Native Title Act 1993. 2. Santos has engaged with a number of Traditional Owner groups and First Nations representative organisations in the Darwin area and Tiwi Islands. The NIAA stated their understanding that Traditional Owner groups affected by the proposed project have concerns about its potential impacts, including impacts on the ocean environment, hunting areas and	Santos actions, completed and proposed, relevant to NIAA comments are as follows: 1. Santos considers that it is sufficiently informed on processes under the Native Title Act 1993 and will comply with any future act processes applicable to this project. 2. Santos has engaged with Tiwi and Darwin area Traditional Owners on the Project, including engagement on Project activities, Project impacts and cultural heritage assessments undertaken . Traditional Owner engagement is ongoing and is further detailed in **Section 9.4**. Gwalwa Daraniki Association and the Larrakia Development Corporation are among a number of Traditional Owner organisations in the Darwin area. Santos has included these two groups on its stakeholder list and commits to engaging with these groups. 3. Santos has engaged with Traditional Owners as per **Section 9.4** and will continue to engage through the life-cycle of the DPD Project. Santos is aware of Dhawura

Submitter	Comment	Santos Action
	cultural heritage. NIAA note the need for thorough and sensitive consultation with Traditional Owners about this Project while the legal proceedings about the Barossa Development are active, as well as post-decision. We further recommend that Santos ensure it has consulted with all relevant Traditional Owner groups including the Gwalwa Daraniki Association and the Larrakia Development Corporation. 3. NIAA recommends that the proponent ensure they have engaged with the relevant Traditional Owners and First Nations stakeholders who have interests in or may be affected by a proposed development, including through potential cultural, social, and economic impacts. This engagement should be ongoing for the entirety of a project's operational lifetime and decommissioning. NIAA recommends the proponent consider Dhawura Ngilan: A Vision for Aboriginal and Torres Strait Islander Heritage in Australia and the Best Practice Standards in Indigenous Cultural Heritage Management and Legislation as a guide to future consultation with First Nations stakeholders. 4. The NIAA stated they are unsure whether the previous cultural heritage assessment was conducted with Traditional Owners and covered all offshore areas in the current project area. Given the time that has elapsed since the previous cultural heritage assessment, NIAA advised the proponent to undertake a new First Nations cultural heritage survey	Ngilan: A Vision for Aboriginal and Torres Strait Islander Heritage in Australia and the Best Practice Standards in Indigenous Cultural Heritage Management and Legislation (Heritage Chairs of Australia and New Zealand, 2020) and will consider the information within where applicable. 4. Indigenous cultural heritage assessments conducted relevant to the DPD Project include an assessment of sacred sites within the Project area in NT jurisdiction, undertaken by the Aboriginal Areas Protection Authority (AAPA) at the request of Santos, which resulted in the issuance of an Authority Certificate (C2022-098). AAPA conducted this assessment in consultation with relevant Traditional Owners. Santos will undertake ongoing consultation and engagement with Traditional Owners in relation to Indigenous cultural values and heritage within the DPD Project area. Further, Santos will prepare and implement a Cultural Heritage Management Plan for the DPD Project which will incorporate and build upon management measures identified through consultation with Indigenous stakeholders on the sacred site / restricted works area identified from the AAPA Authority Certificate (C2022/98). 5. Santos has been consulting with the Wickham Point Deed Reference Group through the Larrakia Liaison Committee on cultural heritage management measures with respect to a sacred site in Darwin Harbour which has an associated Restricted Works Area (RWA) as outlined on AAPA Authority Certificate (C2022-098). This consultation has resulted in agreed cultural heritage measures for

Submitter	Comment	Santos Action
	of the entire project area with Traditional Owner participation. Further, that cultural heritage assessment should incorporate the offshore portions of the project area and address tangible and intangible values. Intangible values may include culturally significant species, ecological communities, biogeographic features and song lines. 5. The NIAA further recommended that the proponent collaborate with the Traditional Owners to develop a Cultural Heritage Management Plan (CHMP) to formalise agreed measures for cultural heritage management and impact mitigation, and jointly agreed protocols addressing the identification, protection and management of both tangible and intangible cultural values that may be revealed during project construction and operations. NIAA suggests that the CHMP also include cultural awareness training to ensure that all workers on the site are apprised of the importance of cultural heritage values within the landscape and can take steps to ensure their protection. 6. The NIAA recommended the proponent engage with Supply Nation to deliver project-related services and to connect with the local Community Development Program providers, Ironbark Aboriginal Corporation and Tiwi Islands Training & Employment Pty Ltd, to connect to First Nations jobseekers	works in the vicinity of this RWA, and more broadly within the Project area, including requirements for Larrakia involvement in the development of induction material for DPD Project contractors. Santos will develop a Cultural Heritage Management Plan for DPD Project construction activities which will include these management measures. Santos is planning to involve Larrakia Rangers in monitoring of marine fauna (turtles, dolphins, dugongs) in Darwin Harbour to assist with the management of Project construction activities and ensure protection of these species from significant Project impacts. Santos will develop an Unidentified Finds Protocol. 6. Santos has partnered with the Industry Capability Network NT (ICN NT) to assist with Australian vendor identification and raise awareness of the Project. Santos supports indigenous economic opportunities including employment, training, education and enterprise opportunities. Santos is committed to building and maintaining mutually beneficial relationships with Indigenous communities, as reflected in its Local Industry, Community and Indigenous Participation Policy.

Submitter	Comment	Santos Action
Chairperson of the NT EPA for the Northern Territory Minister for Environment, Climate Change and Water Security.	An earlier response to the original Referral noted potential impacts to migratory marine megafauna and listed threatened and migratory marine turtles. Potential impact pathways identified in this comment included vessel traffic, dredging operations, pile driving and associated underwater noise, and light pollution. The following mitigation measures were recommended: + Implementation of vessel speed limits during the construction and operation phase. + Marine megafauna observation zones and exclusion zones. + That the observation period for marine megafauna prior to commencing dredging and pile driving is 20 minutes and that the observer is solely dedicated to the task of sighting and recording marine megafauna interactions prior to, and during, dredging and pile driving operations. + Lighting specifications follow the National Light Pollution Guidelines for Wildlife Including Marine turtles, Seabirds and Migratory Shorebirds (2020).	Santos recognises the potential impact pathways to migratory marine megafauna and listed/migratory marine turtles, including vessel traffic, trenching operations, underwater noise and light spill (refer **Section 4**). There is no pile driving proposed for the DPD Project. Mitigation measures relevant to these impact pathways are included in **Section 5** and include: + Vessel speed restrictions. + Marine Megafauna Observation and Exclusion Zones. + Marine megafauna observations prior to and during trenching operations. + Light spill mitigation measures on Project vessels.
The Environment Centre NT (ECNT)	ECNT submitted their view that the Department should consider all impacts from the larger action, including in assessing the impacts from scope 1, 2 and 3 Greenhouse Gas emissions, and impacts to the Great Barrier Reef Marine Park, and World and National Heritage (including Kakadu National Park and Uluru-Kata Tjuta National Park). ECNT raised the following additional concerns:	Santos provides the following response to concerns raised by ECNT: + Santos does not agree that information in the EPBC Act Referral was inaccurate with respect to benthic habitats (including hard corals) within Darwin Harbour. The latest habitat mapping of Darwin Harbour conducted by Australian Institute of Marine Science (Udyawer et al.,

Santos

Submitter	Comment	Santos Action
	+ The information provided in the Referral is inaccurate and de-emphasises important environmental values associated with Darwin Harbour, including the extent of hard coral habitat. + Information provided in the Ichthys monitoring program, which was relied on in the Referral for determining impacts of project activities on marine ecosystems, may be inadequate to assess impacts on marine turtles and migratory mammals because the report is out-dated and lacking in information. + A significant increase in underwater noise and increased shipping traffic may have an impact on the Australian Humpback, Australian Snubfin and Spotted Bottlenose dolphins within Darwin Harbour. + Impacts on some threatened and migratory species that have been recorded in Darwin Harbour, were not considered in the Referral, including: - Large tooth (Freshwater) sawfish (*Pristis pristis Indo-West Pacific subpopulation*) – vulnerable, migratory. - Green sawfish (*Pristis zijsron*) – vulnerable, migratory. - Dwarf sawfish (*Pristis clavata*) – vulnerable, migratory. - False killer whales (Pseudorca crassidens) – cetacean.	2021) has been used and ground-truthed by surveys conducted by Santos (refer **Section 4.2.1**). + Impact predictions to marine turtles and migratory mammals have been informed by studies undertaken specifically by Santos for the DPD Project (refer **Section 4.1**), including underwater noise modelling, and do not rely on conclusions from Ichthys monitoring alone. Nevertheless, given the type and location of activities conducted during the Ichthys project, results from that monitoring program are considered a valid source of information to inform the DPD Project impact assessment. + DPD Project underwater noise and vessel interaction impacts are detailed in **Sections 4.2.3** and **4.2.5.2**. Underwater noise modelling specifically considered impacts to dolphin species within Darwin Harbour. + EPBC Act threatened and migratory species identified from the Protected Matters Search Tool (PMST) have been assessed for likelihood of occurrence within the Project area. This was included in the Referral, and also in **Section 3.1** of this report, and includes the following threatened and migratory species: - Large tooth (Freshwater) sawfish (*Pristis pristis* Indo-West Pacific subpopulation) – vulnerable, migratory. - Green sawfish (*Pristis zijsron*) – vulnerable, migratory. - Dwarf sawfish (*Pristis clavata*) – vulnerable, migratory.

Submitter	Comment	Santos Action
	- Dwarf spinner dolphins (*Stenella longirostris roseiventris*) – cetacean. - Humpback whale (*Megaptera novaeangliae*) – migratory, cetacean. + Pre-lay activities (including trenching and pipelay) may impact Commonwealth waters.	- Humpback whale (*Megaptera novaeangliae*) – migratory, cetacean. + The following species have not been specifically included in the likelihood of occurrence assessment as they are not listed as threatened or migratory under the EPBC Act and therefore not considered MNES: - False killer whales (*Pseudorca crassidens*) – cetacean. - Dwarf spinner dolphins (*Stenella longirostris roseiventris*) – cetacean. + Pre-lay trenching will not occur in Commonwealth waters and impacts are not predicted to extend into Commonwealth waters. Impacts to the Commonwealth marine area from pipelay activities are detailed in **Section 6.4**.

* These Santos actions are imminent but have not yet started.

10 Ecologically Sustainable Development

The Project has been considered against the principles of Ecologically Sustainable Development (ESD) as set out in section 3A of the EPBC Act. As required under the EPBC Act the principles of ESD have been considered in the Project planning and design. A description of how the Project is aligned with these principles is provided in **Table 10-1**. To ensure the Project aligns with these principles, details of the key management actions proposed or already applied in the Project planning and design phase are provided.

Table 10-1 Principles of Ecological Sustainable Development Addressed

Principle	Details	Relevant key Management Actions	Demonstration of Alignment
Decision-making principle	+ Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.	Santos will continue to consult with relevant persons throughout the key stages of the Project life cycle.	+ As part of the planning and design Santos has considered short-term and long-term economic, environmental, social and equitable issues, with the strategic objective to create an opportunity for a positive contribution. + Costs through temporary environmental disturbance and increased marine traffic within the Darwin Harbour have been weighed against short-term (during planning and construction) and long-term (during operations) local economic benefits and design to minimise impacts. + The Project provides an opportunity for re-purposing the Bayu-Undan to Darwin gas export pipeline by transferring carbon dioxide into the Bayu-Undan underground geological formations for permanent storage. CCS can help to reduce the Santos group's (Northern Territory) GHG emissions. + Various stakeholders were directly contacted to seek input on the Project (refer to **Section 9.2,** and **Section 9.4** for First Nations consultation).
Precautionary Principle	+ A lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation where there are threats of serious or irreversible environmental damage.	The EPBC Act Referral and this Preliminary Documentation MNES risk assessment demonstrates no residual significant impact with the implemented mitigation measures.	+ Santos considered various route options for the Project pipeline and carried out risk assessments to evaluate the feasibility and practicality of these route options. The location and siting of the Project pipeline from the offshore connection point to the onshore termination point at the DLNG facility has undergone considerable consultation with stakeholders, and regulating authorities. The Project pipeline has been re-designed to avoid interference with existing pipeline routes (i.e. Bayu-Undan and Ichthys pipelines), key sensitive habitats and breeding grounds, and areas of maritime heritage. The pipeline route has been further redesigned, with the alternate route set to avoid the Darwin Harbour Channel and reduce trenching (see **Section 2.2**). + Santos completed additional survey work to validate specific locations where there was uncertainty and where potential impacts may occur, including benthic habitat survey and maritime heritage assessment. Santos also engaged a Subject Matter Expert (SME), Dr Kelly Pendoley of Pendoley Environmental, to further review the likely presence of conservation significant turtles within and nearby to the Project. Dr Pendoley also reviewed a number of vessel lighting scenarios for the Project to determine whether they would pose a potential significant impact to nesting turtles. Santos additionally engaged David Balloch of EnviroGulf Consulting, a SME for review of the Darwin Harbour dolphin impact assessment. + A risk assessment has been developed for the Project which carefully identifies and evaluates MNES risks (refer to **Section 1.2.1**). + In instances where there was uncertainty around baseline information utilised as part of the referral assessment (i.e. AIMS benthic habitat data and maritime heritage assessment) Santos completed additional survey work to validate specific locations where there was uncertainty and where potential impacts may occur. Santos also completed a range of modelling studies to further understand the potential direct and indirect impacts from the Project e.g., sediment dispersion modelling from trenching has identified a zone of influence (**Figure 4-4**). + The Project has reduced any potential impacts to no significant residual risk by the implementation of mitigation measures **Table 5-1**.
Principle of intragenerational equity	+ The present generation should ensure that the health, diversity and productivity of the environment is	The Implementation of the management measures presented in the Preliminary Documentation report (**Table 5-1**) and actions proposed in the draft	+ Santos is committed to ensuring the Project will not adversely impact on future generations and aims to provide opportunities for future generations.

Principle	Details	Relevant key Management Actions	Demonstration of Alignment
	maintained or enhanced for the benefit of future generations.	management plans should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	+ The Project would provide an opportunity for Barossa and other third-party users to bring gas to DLNG to support ongoing DLNG operation to meet energy demand and continue to support local jobs and the economy. + The underlying premise of the DPD Project is to utilise pre-existing corridors and infrastructure to the maximum extent possible. The spoil ground has been selected to be directly adjacent to the Ichthys spoil ground. The DPD Project proposes to use rock as backfill for pipeline stabilisation from the local Mt Bundey quarries. + The onshore component of the DPD Project is contained to the shore crossing and connection into DLNG, following the existing corridor and within a pre-existing industrial land use, separated from sensitive land uses. + A balance is required between meeting the short term needs of the current generation, while acting through initiatives such as the International Paris Agreement to preserve the environment for the benefit of future generations. + Santos is committed to developing carbon solutions that can be utilised to generate carbon credits to offset the emissions of the Santos group and its customers. This includes the expansion of high-quality nature-based solutions and the development of new technologies such as direct air capture. The Santos group already generates Australian carbon credit units (ACCU) from nature-based projects and continues to evaluate further opportunities. As well, the potential Bayu-Undan CCS project if it proceeds, would reduce NT GHG emissions.
Principle of conservation of biological diversity and ecological integrity	+ Biological diversity and ecological integrity should be conserved and maintained and should be a fundamental consideration in decision-making.	Santos completed a range of Project-specific modelling studies to further assess Project activities where significant impacts have potential to occur. These included sediment plume modelling, hydrocarbon spill modelling, underwater noise modelling and treated seawater modelling. The results of these modelling studies have enabled relevant, and effective management and monitoring strategies to be developed to reduce these impacts to not significant.	+ The Project has been designed with consideration and commitment to ensuring the protection and conservation of biological diversity and integrity. + Decisions during the planning and assessment of the Project have been made with the consideration of relevant information obtained from a variety of sources and professionals in appropriate fields. In all cases where a known source of direct field verified data is available, this has been used in preference of desktop data. + As per above, Santos completed additional survey work to validate specific locations where there was uncertainty and where potential impacts may occur, including benthic habitat survey and maritime heritage assessment. Santos also engaged a Subject Matter Expert (SME), Dr Kelly Pendoley of Pendoley Environmental, to further review the likely presence of conservation significant turtles within and nearby to the Project. Dr Pendoley also reviewed a number of vessel light scenarios for the Project to determine whether they would pose a potential significant impact to nesting turtles. + The Project is effectively a pipeline duplication with the offshore and nearshore components following the Bayu-Undan to Darwin gas export pipeline and the Ichthys pipeline corridor. The onshore section of the Project is contained wholly within the existing DLNG disturbance envelope. + This consideration and commitment to the Project alignment has minimised the potential risks and impacts ensuring the protection and conservation of biological diversity and integrity. + Santos is committed to avoid the disturbance of threatened fauna species where possible. Avoidance and mitigation measures are outlined in **Section 5.** + The Project provides an opportunity for re-purposing the Bayu-Undan to Darwin gas export pipeline by transferring carbon dioxide into the Bayu-Undan underground geological formations for permanent storage. CCS can help to reduce Santos' GHG emissions.

Principle	Details	Relevant key Management Actions	Demonstration of Alignment
Principle of improved valuation, pricing and incentive mechanisms should be promoted	+ Improved valuation, pricing and incentive mechanisms should be promoted.		+ The Project supports the extension of the DLNG facility, creates a new asset and preserves the Bayu-Undan to Darwin gas export pipeline for potential future re-use opportunities including CCS. + The Project will positively contribute to the Northern Territory economy during construction and ongoing operations phases, without causing significant environmental or social impacts. + As a long-term operator in Northern Australia, Santos has a well-established system for the management of wastes and discharges and assumes full responsibility for these aspects. + The generation of some waste during construction and operations is unavoidable, however, Santos has committed to minimising waste where possible and recycling, reusing and treating waste appropriately. + The costs for all waste management, disposal and monitoring (where required) will be borne by Santos. + Supply chain management is inherently imbedded into the Santos group management system. The Santos group management system ensures the appropriate selection of vendors and suppliers. + Procurement of goods and services through the proposed Project provides the value-based continuity of supply of gas to DLNG, while creating opportunity for CCS. + The achievement of environmental goals is reflected in the core strategic imperative of the Project. Specifically, to create opportunity for the Bayu-Undan to Darwin gas export pipeline to be re-purposed for CCS, Santos is aiming to plan and execute the Project as efficiently as possible in order to eliminate waste and reduce environmental and social impacts. + Environmental requirements are embedded in the Santos group's contract/procurement processes to responsibly incentivise our contractors to make sure environmental objectives are considered in conjunction with commercial objectives and ensure cost-effective environmental management.

11 Environmental Record of Proponent

The Santos group maintains commitment to environmental and social responsibility. This involves the reporting of environmental performance and incidents, as outlined below.

11.1 Environmental Performance Summary

The Santos group environmental performance has been summarised in their most recent Sustainability Report from 2023, as outlined below (Santos Limited, 2023):

- Moomba Carbon Capture and Storage (CCS) project 40% complete and on track for 2024 start-up.
- >70% of waste generated in Australia reused, recycled or treated.
- Received final approval from the Queensland Government for the Mount Tabor biodiversity offset project (>5,000 hectares), formalising our partnership with Traditional Owners, the Bidjara people from eastern Queensland.
- First biodiversity stewardship site secured in New South Wales covering 390 hectares.
- 251 cultural heritage assessments delivered across Australian operations.
- A$64.7 million spent supporting Indigenous suppliers across Australia and Alaska, and landowner companies and landowner groups in PNG.
- 20% increase in our Aboriginal and Torres Strait Islander permanent workforce in Australia.
- Completed two background methane surveys in New South Wales and across the Cooper Basin, 13 out of the 18 surveys now complete.
- Continued support for the Australian Institute of Marine Science (AIMS) for research into species behaviour, feeding patterns, growth and migration of the whale shark.

11.2 Recent Environmental Awards

The Santos group has been rewarded for their environmental record on numerous occasions in recent years:

- 2022 PNG Chamber of Mines and Petroleum Industry Award for outstanding environmental or climate change initiative (PNG Biomass Carbon Abatement Project). This initiative has planted approximately four million trees, as of Santos' Climate Change Report 2023. The Santos group has made a $50 million final investment decision to support three to four more decades of nature-based carbon capture, providing habitat and increasing species diversity of underutilised land (Santos, 2023).
- 2021 Australian Petroleum Production and Exploration Association (APPEA) Environment Company Excellence Award for 2020 including – the Santos group partnered with Traditional Owners and the Nature Foundation to establish the first large-scale significant environmental benefit offset project in the South Australian Channel Country region known as the Gidgealpa Offset Property (GOP).
- 2021 APPEA Environmental Project Excellence Award (North West Shoals to Shore Research Program).
- 2021 Australian Pipelines and Gas Association Environment Award (Santos Moomba Carbon Capture and Storage Project).

+ 2020 APPEA Environmental Project Excellence Award (Shearwater fledgling interactions with gas plant operations).
+ 2019 APPEA Environmental Project Excellence Award (Varanus Island flare management).
+ 2019 SA Project Management Achievement Award in the category of Sustainability Projects (solar beam pump initiative).
+ 2019 APPEA Environment Project Excellence Award (Zero Waste Well).

11.3 List of Environmental Incidents

The Santos group reports incidents and spills in their Sustainability Reports. Data from the 2023 Report include hydrocarbon (HC) spills and produced formation water (PFW) spills (Santos Limited, 2023).

+ Number of HC releases >1 bbl*: 5.
+ Volume of HC released, for releases >1 bbl*: 28 m^3.
+ Number of PFW releases**: 94.
+ Volume PFW released**: 191 m^3.
+ Prosecutions: 0.
+ Penalty notices received from regulators: 1.
+ Administrative notices received from regulators: 2.
+ Fines received from regulators (A$): 13,785.

*Releases of hydrocarbons to the environment greater than 1 barrel (or 0.16m^3).

**Counts and volumes of PFW spills captures any spill with a volume of greater than 1 L (or 0.001m^3).

It is the nature of the oil and gas industry to ensure safety and responsibility is held in high regard. Incident prevention is paramount in the industry, as is implementing and maintaining incident response processes. This is essential for safe and sustainable development and leads to continued improvement of social frameworks and environmental practices.

11.4 Legal Proceedings

Santos NA Barossa Pty Ltd was the was Second Respondent in Federal Court proceedings (Tipakalippa v National Offshore Petroleum Safety and Environmental Management Authority (No 2) [2022] (https://www.judgments.fedcourt.gov.au/judgments/Judgments/fca/single/2022/2022fca1121) concerning NOPSEMA's acceptance of an environment plan under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*. Santos NA Barossa Pty Ltd's appeal of the decision in these proceedings (Santos NA Barossa Pty Ltd v Tipakalippa [2022] was dismissed on 2 December 2022 (https://www.judgments.fedcourt.gov.au/judgments/Judgments/fca/full/2022/2022fcafc0193). This was not a compliance action but is identified for completeness).

Also reported in the Referral for the Project, under Commonwealth, State or Territory law for the protection of the environment and/or conservation and sustainable use of resources, Santos group has recorded the following proceedings: July 2018, Santos group received a $68,000 fine from the Queensland Department of Environment and Science for the unauthorised release of hydrocarbons to land. June 2013, Santos NSW (Eastern) Pty Ltd pleaded guilty in the NSW Land and Environment Court for proceedings relating to breaches of the NSW Petroleum (Onshore) Act 1991 for past reporting failures in the Pilliga forest. Santos NS (Eastern) Pty Ltd was fined $52,500. Santos group discloses all environmental regulatory fines and infringement notices within its publicly available annual reports.

12 Conclusion

Based on the impact assessment presented within this document, and application of significant impact criteria (DoE, 2013), the proposed action is considered unlikely to result in a significant residual impact to MNES. These criteria consider whether the impact is 'important, notable or of consequence having regard to its context or intensity', and whether/how factors such as 'sensitivity, value and quality of the environment, which is impacted, and the intensity, duration, magnitude and geographic extent of the impacts' have been considered.

The Preliminary Documentation report addresses all the request for further information items identified by DCCEEW as described in **Section 1.2** and summarised in **Table 1-1**.

Twelve MNES species were identified as having the potential for impact from the Project, covering two MNES categories – threatened species and migratory species. All species are well represented outside of the Project area.

Direct interactions with MNES species are considered most likely during a temporary installation phase (expected to be 15 months) with ongoing operational activities associated with the Project pipeline expected to have a very low level of interaction.

All MNES species with the potential to be impacted by the proposed action are mobile species including turtles, dolphins and dugongs, and it is expected that these species will avoid temporary disturbance caused by localised Project activities.

Turtle and dolphin species have been identified by DCCEEW in the request for further information for further significant impact assessment that is addressed in this Preliminary Documentation report. Where BIAs and habitats for MNES species have been identified that overlap the Project area, the behaviours within these areas will not be significantly impacted by the Project. Benthic habitats with the Project area, as defined by surveys, are well represented elsewhere and are not considered to be locally significant.

The Project is effectively a pipeline duplication within an existing pipeline route (nominally within 100 m of the Bayu-Undan to Darwin gas export pipeline including two crossovers of that pipeline) and a 'brownfields' industrial precinct (i.e., DLNG). Given the proposed location, the narrow linear pipeline corridor (i.e., notional 40 m pipeline disturbance footprint mostly within an existing pipeline corridor with additional disturbance closer to shore due to vessel anchoring), proximity of the spoil disposal ground to an existing and much larger spoil ground, potential impacts to marine and coastal habitats and the Commonwealth marine area are expected to be localised and are reduced to no significant residual impact after avoidance and mitigation measure have been applied.

Given the onshore area of the proposed action is wholly within the existing DLNG facility disturbance envelope, significant impacts to terrestrial species are not triggered.

The natural environment and its potential for impact are well understood within Darwin Harbour and surrounds, with extensive Ichthys baseline and monitoring data supplemented by Santos' pipeline environmental survey and modelling data. Monitoring undertaken as part of installation activities on the Ichthys project, a condition of the EPBC Act approval for that project (EPBC 2008/4208), did not detect any deleterious effects to MNES (including turtles and dolphins) in the Darwin region attributable to construction activities (Brooks and Pollock, 2015; Cardno, 2015). Given the proposed Project is smaller in scale than the Ichthys project and will implement management measures consistent with those applied by other pipeline Projects in the area, the proposed trenching, spoil disposal and construction activities associated with the Project are not expected to lead to a significant impact to MNES in the Darwin area. The dewatering activities in Commonwealth waters are considered to have negligible impacts to MNES.

The proposed action will be managed to avoid impacts where possible, and where unavoidable, impacts will be managed through the implementation of a suite of mitigation measures. Santos commits to implementing construction and operations environmental management plans to ensure impacts and risks to the receiving environment are reduced to ALARP and to an acceptable level. A marine environmental monitoring program will be implemented to validate the environmental assessment and ensure that impacts are within acceptable limits. The environmental management plans and monitoring results will be publicly available.

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Appendix 1 DPD EPBC Act Referral

Appendix 2 Supplementary Environmental Report

Appendix 3 DCCEEW Request for Information

Appendix 4 Safety Data Sheets for Proposed Chemicals

Appendix 5 Santos Chemical Approvals Procedure

Appendix 6 Effluent Testing Assessment Report

Appendix 7 Benthic Habitat Survey Report

Appendix 8 Sediment Dispersion Modelling Report

Appendix 9 Oil Spill Modelling

Appendix 10 Oil Pollution Emergency Plan

Appendix 11 Shipboard Oil Pollution Emergency Plan (confidential SOPEP has been provide to DCCEEW for review)

Appendix 12 Acid Sulphate Soils and Dewatering Management Plan (ASSDMP)

Appendix 13 Onshore Construction Environmental Management Plan (CEMP)

Appendix 14 Offshore Construction Environmental Management Plan (CEMP)

Appendix 15 Trenching and Soil Disposal Management and Monitoring Plan (TSDMMP)

Appendix 16 EPBC Protected Matters Report

Appendix 17 PLET Treated Seawater and MEG Discharge Modelling Report

Appendix 18 Treated Seawater Contingency Discharge Modelling

Appendix 19 Lighting Technical Notes

Appendix 20 Underwater Noise Modelling Report (Talis consultants, 2023)

Appendix 21 Maritime Archaeological Heritage Assessment

Appendix 22 Noise Modelling Report (Connell 2023)

Appendix 23 Marine Megafauna Noise Management Plan (MMNMP)

Appendix 24 Traffic Management Plan

Appendix 25 Persons preparing Preliminary Documentation Report