# Environmental Review Document

## Learmonth Pipeline Fabrication Facility

Assessment No. 2208

Issue: Sept 2019

# Learmonth Pipeline Fabrication Facility
# APFAC017
# Environmental Review Document

Date: 10 September 2019

Author: Subsea 7

Assessment Number: 2208

## REVISION RECORD SHEET

| Revision | Issue Date | Purpose | Description of revision(s) | Authorisation |
|---|---|---|---|---|
| A | 01.03.2019 | Client Review | Initial Draft | S. Shute (MBS Environmental) |
| 0 | 17.04.2019 | EPA Review | Final Draft | S. Shute (MBS Environmental) T. Radic (Subsea 7) |
| 1 | 8.07.2019 | EPA Review | Final Draft | S. Shute (MBS Environmental) T. Radic (Subsea 7) |
| 2 | 10.09.2019 | Public Review | Final | S. Shute (MBS Environmental) D. Knox (Subsea 7) |

# Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on the environmental review for this proposal.

Subsea 7 proposes to construct and operate a new pipeline fabrication facility adjacent to the western shoreline of Exmouth Gulf, at Learmonth, approximately 35 km south of the Exmouth townsite. The proposed facility will allow the construction and launching of pipeline Bundles for the offshore oil and gas industry. The Environmental Review Document (ERD) has been prepared in accordance with the EPA's Procedures Manual (Part IV Divisions 1 and 2). The ERD is the report by the proponent on their environmental review that describes this proposal and its likely effects on the environment.

The ERD is available for a public review period of 8 weeks from 2 October 2019, closing on 30 November 2019.

Information on the proposal from the public may assist the EPA to prepare an assessment report in which it will make recommendations on the proposal to the Minister for Environment.

## Why write a submission?

The EPA seeks information that will inform the EPA's consideration of the likely effect of the proposal, if implemented, on the environment. This may include relevant new information that is not in the ERD, such as alternative courses of action or approaches.

In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information.

Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992*.

## Why not join a group?

It may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

## Developing a submission

You may agree or disagree with, or comment on information in the ERD.

When making comments on specific elements in the ERD:

- Clearly state your point of view and give reasons for your conclusions.
- Reference the source of your information, where applicable.
- Suggest alternatives to improve the outcomes on the environment.

**What to include in your submission**

Include the following in your submission to make it easier for the EPA to consider your submission:

- Your contact details – name and address.
- Date of your submission
- Whether you want your contact details to be confidential.
- Summary of your submission, if your submission is long.
- List points so that issues raised are clear, preferably by environmental factor.
- Refer each point to the page, section and if possible, paragraph of the ERD.
- Attach any reference material, if applicable. Make sure your information is accurate.

The closing date for public submissions is: 30 November 2019

The EPA prefers submissions to be made electronically via the EPA's Consultation Hub at https://consultation.epa.wa.gov.au.

Alternatively submissions can be:

- posted to: Chairman, Environmental Protection Authority, Locked Bag 10, Joondalup, WA 6919, or
- delivered to: the Environmental Protection Authority, Prime House, 8 Davidson Terrace, Joondalup WA 6027.

If you have any questions on how to make a submission, please contact the EPA Services at the Department of Water and Environmental Regulation on 6364 7000 or learmonthpipelineconsult@epa.wa.gov.au.

# Scoping Checklist

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| Regional Context and Integrating Issues | | |
| 1. | Provide information regarding the selection process for the proposal site and tow route, including an examination of the alternative options considered and the environmental constraints and values at risk for each alternative option, to demonstrate that the proposal site and tow route has been selected to avoid and minimise impacts. | Section 2.4.8, p. 38 |
| 2. | Discuss the regional and cumulative impacts of other existing or reasonably foreseeable development in the vicinity of the proposal with the potential to impact the same receptors and environmental values. | Section 2.5.8, p. 59 |
| 3. | Provide details of proposed care and maintenance, and decommissioning and closure of the proposal. Provide details of the potential risks and impacts to environmental values, and details of mitigation and management measures to ensure that the impacts are not greater than predicted. | Section 2.3.9, p. 31 |
| EPA Factor 1 – BCH | | |
| 4. | Characterise the environment by designing and conducting a benthic communities and habitat survey to accurately map the spatial extent of benthic habitats. Based on the findings of the surveys, produce geo referenced maps showing the extent and distribution of the different benthic communities and habitats across the defined Local Assessment Unit (LAU) offshore of Heron Point, including all potential launch disturbance areas. Geo-referenced maps of benthic communities and habitats should also be provided for the bundle parking area, and those areas potentially affected by the towing activities within the Exmouth Gulf, Ningaloo Marine Park/Ningaloo Coast World Heritage Property/Ningaloo Coast World Heritage Place and present these at the appropriate scale. Surveys should be conducted to a standard such that the results can be used as a baseline for future quantitative monitoring. This characterisation should also identify any critical windows of environmental sensitivity for benthic communities, particularly corals. | Section 5.1.3, p. 83 |
| 5. | Assess the values and significance of benthic communities and habitats within the proposal area, and adjacent areas, and describe these values in a local and regional context. This assessment must also specifically address the values and significance of benthic communities and habitats which are: potentially affected by towing activities within the Exmouth Gulf, Ningaloo Marine Park Ningaloo Coast World Heritage Property/Ningaloo Coast World Heritage Place, and Muiron Islands Marine Management Area; important for significant marine fauna | Section 5.1.3.2 & 5.4.3, p. 89 & 167 |

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| | (in particular *Dugong dugon* and *marine turtles*); and important for supporting commercial and recreational fisheries (including aquarium fisheries). | |
| 6. | Identify elements of the proposal that may potentially affect benthic communities and habitat, including both direct and indirect impacts, and for both construction and operation. This should include impacts in the event of an accidental spill or incident; and damage to or loss of control of the pipeline bundle during launch and towing activities. | Section 5.1.3.4, p. 92 |
| 7. | Predict the residual impacts from the proposal, both direct and indirect, on benthic communities and habitat after demonstrating how the mitigation hierarchy has been applied. Impact predictions are to:<br><br>(a) Include the likely extent, severity and duration of direct and indirect impacts of the proposal on benthic communities and habitats. Predictions for both construction and operational impacts are to include the most likely worst case, and the most likely best-case loss scenarios.<br><br>(b) Address any irreversible loss of, or serious damage to, benthic communities and habitat, in the context of Technical Guidance – Protection of Benthic Communities and Habitats, December 2016 including an appropriately defined local assessment unit and an assessment of the significance of any loss, including cumulative loss.<br><br>(c) Include a risk assessment identifying potential impacts to benthic communities and habitat: that provides habitat for conservation significant or locally important marine fauna; that provides habitat for commercial and recreational fisheries; and that may be potentially affected by towing activities within the Exmouth Gulf, Ningaloo Marine Park Ningaloo Coast World Heritage Property/Ningaloo Coast World Heritage Place and Muiron Islands Marine Management Area. This risk assessment should include consideration of accidental spills or incidents, including damage to or loss of control of the pipeline bundle during launch and towing activities. | Section 5.1.6, p. 92 |
| 8. | Include details of the monitoring and management to occur during and after construction of the proposal, and during ongoing operations to demonstrate that residual impacts are not greater than predicted at the launch site, bundle parking area and along the tow path. | Section 5.1.7, p. 125 |
| 9. | Describe the likely consequences for the ecological integrity and biological diversity of the benthic communities and habitats that the identified impacts may have and include a description of the likely impact any changes may have on other dependent factors. | Section 5.1.6.11, p. 116<br><br>Section 5.4.7, p. 228 |
| 10. | Determine and quantify any significant residual impacts | Section 5.1.7, p. 125 |

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| | by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the *WA Environmental Offset Guidelines* (2014). | |
| 11. | Where significant residual impacts remain, propose an appropriate offset package that is consistent with the *WA Environmental Offsets Policy and Guidelines and where residual impacts relate to EPBC Act-listed threatened and/or migratory species the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Spatial data defining the areas of significant residual impacts should be provided. | Section 8, p. 425 |
| EPA Factor 2 – Coastal Processes | | |
| 12. | Characterise the environment by describing the current coastal processes in the proximity to the proposal. This is to include, but not be limited to,<br><br>(a) conducting a detailed analysis of existing long-shore sediment movements and variability over at least 20 years to estimate erosional and depositional patterns including for cross-shore processes;<br><br>(b) conduct an analysis of cross-shore processes and variability over at least 20 years;<br><br>(c) spatially quantify the coastal morphology by presenting beach profiles and aerial imagery or a more detailed representation (e.g. unmanned aerial vehicle survey); and<br><br>(d) characterise erosion and inundation provided by extreme events, particularly the potential effects of severe tropical cyclones.<br><br>The characterisation is to consider all temporal scales including seasonal, inter-annual and episodic. The spatial scale must be adequate to address all coastal processes and patterns likely to be affected as a result of the proposal. Characterisation should extend beyond the limits of where impacts may potentially occur to provide a baseline for subsequent evaluation. | Section 5.2.3, p. 137 |
| 13. | Identify elements of the proposal that may potentially affect coastal processes, including both direct and indirect impacts and for both construction and operation. | Section 5.2.4, p. 141 |
| 14. | Predict the residual impacts from the proposal, both direct and indirect, after outlining any avoidance, mitigation and management options that will be applied. Impact predictions are to:<br><br>(a) Be provided at a sufficient scale to address all impacts resulting from the proposal to both up and down coastal processes as well as onshore-offshore processes. | Section 5.2.7, p. 145 |

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| | (b) Be informed by monitoring previously undertaken in the local area.<br><br>(c) Predict near-field responses to the proposed coastal facilities, including anticipated updrift and downdrift coastal change. Information should include forecast changes to beach morphology over the intended service life of the facility (e.g. predicted beach profiles).<br><br>(d) Determine changes to local current and wave climate, long-shore sediment movements and erosional and deposition patterns (including cross-shore processes).<br><br>(e) Consider and assess the cumulative effects from and to any other approved or reasonably foreseeable coastal developments.<br><br>(f) Be for both the short and long-term (100 year planning horizon or planning horizon relevant to the service life of the facility); be provided for best, most likely and worst case scenarios; and consider the likely impacts of climate change within the service life of the facility.<br><br>(g) Address the frequency, volume and potential environmental impacts of sand bypassing/backpassing adjacent to the proposal.<br><br>(h) Address the requirements of State Planning Policy 2.6, particularly with regard to setback and coastal risk management. | |
| 15. | Identify management and mitigation measures to ensure residual impacts are not greater than predicted. | Section 5.2.7, p. 145 |
| 16. | Outline the proposed ongoing governance arrangements for the management of coastal processes including the roles and responsibilities for sand bypassing/backpassing requirements where required. | Section 5.2.7, p. 145 |
| 17. | Include details of monitoring and management that will apply during construction and operation to demonstrate and ensure that residual impacts to coastal processes are not greater than predicted. | Section 5.2.7, p. 145 |
| 18. | Identify the proposed service life of the facility and anticipated service life of the facility and anticipated process of decommissioning. Include details of mitigation, monitoring, and management that will apply during and after decommissioning. | Section 2.3.9, p. 31<br><br>Attachment 3 |
| EPA Factor 3 – Marine Environmental Quality | | |
| 19. | Conduct monitoring as necessary to characterise the existing marine environmental quality (baseline water and sediment quality) in the area potentially affected by the proposal. The characterisation needs to be informed by an assessment of threats and pressures to marine | Section 5.3.3, p. 151 |

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| | environmental values, both ecological and social. The characterisation is to inform the environmental quality monitoring and management plans required in 24. | |
| 20. | Provide an Environmental Quality Plan (EQP) that spatially defines the Environmental Values (EVs), Environmental Quality Objectives (EQOs) and Levels of Ecological Protection (LEPs) that apply to the area. The EQP shall be consistent with *Technical Guidance: Protecting the quality of Western Australia's marine environment*, December 2016 and have regard for the *Pilbara Coastal Water Quality Outcomes: Environmental Values and Environmental Quality Objectives*, Map 6 (Department of Environment, 2006). | Attachment 3 |
| 21. | Identify elements, activities and potential inputs of the proposal that may potentially affect marine environmental quality, for both construction and operation. | Section 5.3.4, p. 154 |
| 22. | Describe the marine system and the cause and effect pathways of each element, activity or input from the proposal on marine environmental quality. | Section 5.3.6, p. 155 |
| 23. | Predict the extent, severity and duration of any impacts from the proposal, after outlining any avoidance and mitigation options that will be applied. Impact predictions are to be presented in the context of the EQP for:<br><br>(a) Construction of coastal infrastructure<br><br>Predicted impacts should also be presented spatially as an overlay to the EQP to identify where the EVs, EQOs and LEPs may not be achieved during construction.<br><br>(b) Operation/maintenance of fabrication site<br><br>Predicted impacts should also be presented spatially as an overlay to the EQP to identify where the EVs, EQOs and LEPs may not be achieved during operations/maintenance of the fabrication site.<br><br>(c) During bundle launch, bundle parking and towing<br><br>Predicted impacts should include an assessment of risk from increased turbidity during bundle launch, including from dragging of bundle ballast chains, spills, accidents and collisions during towing activities (under a range of scenarios) particularly when towing occurs in the Ningaloo Marine Park/Ningaloo Coast World Heritage Property/Ningaloo Coast World Heritage Place and adjacent to the Muiron Islands Marine Management Area.<br><br>Predicted impacts should also be presented spatially as an overlay to the EQP to identify where the EVs, EQOs and Leap's may not be achieved during bundle launch, | Section 5.3.6, p. 155<br>Attachment 3 |

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| | bundle parking and towing. | |
| 24. | Identify management and mitigation measures to ensure residual impacts are not greater than predicted. The PER is to include:<br><br>(a) A Marine Construction Monitoring and Management Plan (MCMMP) that includes the protocols and procedures for monitoring of key environmental quality indicators (e.g. turbidity, light attenuation coefficient, visual records etc.) and management of environmental quality (e.g. silt curtains, pre-washing of material for launchway etc.) to ensure that the construction of the proposal achieves the proposed EQOs/LEPs defined in the EQP.<br><br>(b) Include details of the monitoring and management to occur during and after construction of the proposal, and during ongoing operations (bundle launch, bundle parking and towing) to demonstrate that residual impacts to water quality are not greater than predicted.<br><br>(c) A Marine Emergency Response Plan that includes procedures to be implemented during operations which specifically address measures to be implemented in the event of an accidental spill or incident, including damage to or loss of control of the pipeline bundle during launch and towing activities. | Section 5.3.7, p. 161<br>Attachment 3 |
| EPA Factor 4 – Marine Fauna | | |
| 25. | Identify and assess the values and significance of marine faunal assemblages within the proposal area (including the Exmouth Gulf area and area of the Ningaloo Marine Park/Ningaloo Coast World Heritage Property/Ningaloo Coast World Heritage Place and Muiron Islands Marine Management Area that is potentially affected by the operation of the proposal) and describe these values in a local, regional, and State context. For listed species, this must include information on the abundance, distribution, ecology, and habitat preferences, together with baseline information and mapping of local and regional occurrences. | Section 5.4.3, p. 167 |
| 26. | Identify critical windows of environmental sensitivity for marine fauna in the proximity of the proposal area, including conservation significant or locally important marine fauna (including migratory coastal birds) and species important to commercial and recreational fisheries in the proposal area and immediate adjacent area. | Section 5.4.3, p. 167 |
| 27. | Describe the presence of marine fauna in the proximity of the proposal area, including marine mammals, other conservation significant or locally important marine fauna (including migratory coastal birds) and species important to commercial and recreational fisheries in the proximity to the proposal area, and document any known uses of | Section 5.4.3, p. 167 |

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| | the area by them (e.g. foraging, migrating, calving and nursing, spawning, roosting and nesting etc.). For listed species, this must include:<br><br>(a) a population size and importance of the population from a local and regional perspective; and<br><br>(b) information on conservation value of each habitat type (e.g. breeding, migration, feeding, resting, internesting) from a local and regional perspective, including the percentage representation of each habitat site in relation to its local and regional extent. | |
| 28. | Identify the construction and operational elements of the proposal that may affect conservation significant or locally important marine fauna and marine fauna habitat, including from increased turbidity during bundle launch and dragging of bundle ballast chains. | Section 5.4.4, p. 208 |
| 29. | Describe and assess the potential direct and indirect impacts that may result from construction and operation of the proposal to marine mammals, other conservation significant or locally important marine fauna (including migratory coastal birds) and species important to commercial and recreational fisheries and their habitat. | Section 5.4.6, p. 208 |
| 30. | Identify any significant gaps in knowledge for conservation significant or locally important marine fauna in the proposal area and assess the importance and/or significance of those gaps with respect to identifying and managing impacts of the proposal, and where required conduct investigations to address these critical knowledge gaps. | Section 5.4.5, p. 208 |
| 31. | Identify any known marine pests or pathogens in the area that is potentially affected by the operation of the proposal, and/or adjacent waters. Conduct a risk assessment to identify whether the proposed activities are likely to introduce or extend the range of introduced marine pests or pathogens. Identify the control measures by which these may be avoided/mitigated. Based on the outcomes of the risk assessment determine in consultation with EPA Services and the Department of Primary Industries and Regional Development whether a there is a need to design and conduct a baseline survey in accordance with the guidelines provided by the Australian National System for the Prevention of Marine Pest Incursions. | Section 5.4.3.8, p. 206<br>Attachment 2 |
| 32. | Identify measures to mitigate adverse impacts on marine fauna in the proximity of the proposal area (including the tow area), including marine mammals, other conservation significant or locally important marine fauna (including migratory coastal birds) and species important to commercial and recreational fisheries and their habitat. This is to include management and monitoring protocols for introduced marine organisms during construction and | Section 5.4.7, p. 227 |

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| | operation and protocols to reduce the impacts to marine fauna during construction and operation to ensure that residual impacts to marine fauna are not greater than predicted. This should include procedures to be implemented in the event of an accidental spill or incident, including damage to or loss of control of the pipeline bundle during launch and towing activities. | |
| 33. | Predict the residual impacts from the proposal, both direct and indirect, after outlining any avoidance and mitigation options that will be applied. Impact predictions, should consider both short and long-term impacts, how the proposal may change marine fauna patterns of use and cumulative impacts. This should include an assessment of the risk posed to any listed species as a result of the proposal. | Section 5.4.7, p. 227 |
| 34. | Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the *WA Environmental Offsets Guidelines* (2014). | Section 8, p. 425 |
| 35. | Where significant residual impacts remain, propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines *and where residual impacts relate to EPBC Act-listed threatened and/or migratory species the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Spatial data defining the area of significant residual impacts should also be provided. | Section 8, p. 425 |
| EPA Factor 5 – Flora and Vegetation | | |
| 36. | Identify and characterise the flora and vegetation of areas that may be directly or indirectly impacted by the proposal in accordance with Technical Guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment*, December 2016. Demonstrate how surveys are relevant, representative and demonstrate consistency with current EPA policy and guidance set out below. Include a summary of survey findings in accordance with relevant guidelines set out below. | Section 5.5.3, p. 241 |
| 37. | Identify and describe the vegetation and significant flora species present and likely to be present within the Development Envelope, and any areas that may be indirectly impacted by the proposal beyond the Development Envelope. Include an analysis of the significance of flora and vegetation in local, regional and State contexts as appropriate in accordance with the relevant guidance set out below. | Section 5.5.3, p. 241 |
| 38. | Provide a map depicting the recorded locations of the significant flora, ecological communities and significant vegetation in relation to the Development Envelope in accordance with the relevant guidelines set out below. | Section 5.5.3, p. 241 |
| 39. | Assess the potential direct and indirect impacts of the construction and operational elements of the proposal on | Section 5.5.6, p. 249 |

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| | identified environmental values. Include a quantitative assessment of levels of impact on significant flora, listed ecological communities and all vegetation units. Describe and assess the extent of any cumulative impacts within local, regional and State contexts as appropriate. | |
| 40. | Describe and justify any proposed mitigation to reduce the potential impacts of construction and operation of the proposal. Include any proposed management and/or monitoring plans that will be implemented pre- and post-construction to ensure residual impacts are not greater than predicted. | Section 5.5.7, p. 259 |
| 41. | Identify, describe and quantify the potential residual impacts (direct, indirect and cumulative) that may occur following implementation of the proposed after considering and applying avoidance and minimisation measures. | Section 5.5.7, p. 259 |
| 42. | Determine the significance of any significant residual impacts on the identified environmental values by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the *WA Environmental Offsets Guidelines* (2014). Provide spatial data defining the area of significant residual impacts. | Section 8, p. 425<br><br>Attachment 2 |
| 43. | Where significant residual impacts remain, propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines *and where residual impacts relate to EPBC Act-listed threatened and/or migratory species the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy.* | Section 8, p. 425 |
| EPA Factor 6 – Subterranean Fauna | | |
| 44. | In accordance with EPA guidance:<br><br>(a) conduct a desktop study, incorporating existing regional subterranean fauna surveys and databases; and<br><br>(b) undertake surveys to identify and characterise subterranean fauna and subterranean fauna habitat at a local and regional scale that may be impacted directly and indirectly by the implementation of the proposal. This should include sampling inside and outside the impact areas and consider cumulative impacts. | Section 5.6.3, p. 266 |
| 45. | Provide figure(s) showing the extent of subterranean fauna habitat in relation to the proposal and species distributions. | Section 5.6.3, p. 266 |
| 46. | Describe and assess the extent of direct, indirect and cumulative impacts as a result of implementation of the proposal during both construction and operations to subterranean fauna, taking into consideration the significance of subterranean fauna and subterranean fauna habitat. | Section 5.6.6, p. 271 |
| 47. | Predict the residual impacts from the proposal on | Section 5.6.7, p. 275 |

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| | subterranean fauna after considering and applying avoidance and minimisation measures. | |
| 48. | Identify management measures for the proposal to ensure residual impacts to subterranean fauna are not greater than predicted. | Section 5.6.7, p. 275 |
| 49. | Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the *WA Environmental Offsets Guidelines* (2014). | Section 8, p. 425 |
| 50. | Where significant residual impacts remain, propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines *and where residual impacts relate to EPBC Act-listed threatened and/or migratory species the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Spatial data defining the area of significant residual impacts should also be provided. | Section 8, p. 425 |
| EPA Factor 7 – Terrestrial Fauna | | |
| 51. | In accordance with the requirements of EPA Guidance:<br><br>(a) conduct a desktop study, incorporating existing regional terrestrial fauna surveys and databases.<br><br>(b) undertake terrestrial fauna surveys, to identify and characterise terrestrial fauna and fauna habitat, at a local and regional scale, that may be impacted directly and indirectly by the implementation of the proposal. This should include sampling inside and outside the impact areas and consider cumulative impacts. For listed species, this must include information on:<br>• the abundance, distribution, ecology, and habitat preferences, together with baseline information and mapping of local and regional occurrences.<br>• a population size and importance of the population from a local and regional perspective.<br>• information on conservation value of each habitat type (e.g. breeding, migration, feeding, resting, internesting) from a local and regional perspective, including the percentage representation of each habitat site in relation to its local and regional extent. | Section 5.7.3, p. 280<br><br>Attachment 2 |
| 52. | Describe the values and significance of fauna and fauna habitat that maybe impacted directly and indirectly by implementation of the proposal during both construction and operations and describe the significance of these values in a local and regional context. | Section 5.7.3, p. 280 |
| 53. | Provide a map illustrating the known recorded locations of conservation significant species, short-range endemic invertebrate species or other significant fauna and fauna habitat in relation to the proposal. | Section 5.7.3, p. 280 |

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| 54. | Describe and assess the extent of direct and indirect impacts as a result of implementation of the proposal during both construction and operations to terrestrial fauna taking into consideration cumulative impacts and the significance of fauna and fauna habitat. This should include an assessment of the risk posed to any listed species as a result of the proposal. | Section 5.7.6, p. 283 |
| 55. | Predict the residual impacts to terrestrial fauna after considering and applying avoidance and minimisation measures. | Section 5.7.7, p. 289 |
| 56. | Discuss proposed management, monitoring and mitigation methods to be implemented to ensure residual impacts (direct and indirect) are not greater than predicted. | Section 5.7.7, p. 289 |
| 57. | Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the *WA Environmental Offsets Guidelines* (2014). | Section 8, p. 425 |
| 58. | Where significant residual impacts remain, propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines *and where residual impacts relate to EPBC Act-listed threatened and/or migratory species the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Spatial data defining the area of significant residual impacts should also be provided. | Section 8, p. 425 |
| EPA Factor 8 – Inland Waters | | |
| 59. | Characterise the baseline hydrological and hydrogeological regimes and water quality and quantity, both in a local and regional context, including, but not limited to, water levels including the fluctuation of the aquifer system in response to tides and storm events, water chemistry, presence of acid sulphate soils, stream flows, flood patterns, spatial characteristics of the fresh/saline groundwater interface, aquifer characteristics, and recharge potential. | Section 5.8.3.4, p. 298 |
| 60. | Identify the location of abstraction bores for water requirements and identify and discuss any associated impacts of groundwater abstraction including from drawdown. | Section 5.8.3.4, p. 298 |
| 61. | Provide a detailed description of the design and location of the proposal with the potential to impact surface and ground water, including the extent of discharges and/or reinjection, and the disturbance of acid sulphate soils, if present. | Section 5.8.6, p. 303 |
| 62. | Undertake hydrological investigations to determine the effects of any proposed surface discharge, reinjection and modified drainage will have on the surface and ground water quality and quantity of the likely direct and indirect impact areas taking into account cyclonic conditions, | Section 5.8.6, p. 303<br><br>Attachment 2 |

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| | cumulative impacts and a range of climatic scenarios including probable maximum precipitation. | |
| 63. | Predict the residual impacts on hydrological processes and inland waters environmental quality, for direct, indirect and cumulative impacts, after considering avoidance and minimisation measures. | Section 5.8.7, p. 310 |
| 64. | Identify management, mitigation, and monitoring methods to be implemented for the proposal to ensure residual impacts are not greater than predicted. | Section 5.8.7, p. 310 |
| 65. | Where significant residual impacts remain, and relate to MNES, propose an appropriate offsets package that is consistent with the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Spatial data defining the area of significant residual impacts should also be provided. | Section 8, p. 425 |
| EPA Factor 9 – Social Surroundings | | |
| 66. | Characterise the heritage and cultural values of the proposal area, including for the Ningaloo Coast World Heritage Property and the Ningaloo Coast World Heritage Place, and any other areas that may be indirectly impacted to identify sites of significance and their relevance within a wider regional context. | Section 5.9.3, p. 316 |
| 67. | Conduct appropriate Aboriginal heritage surveys to identify Aboriginal sites, values, and/or cultural associations. | Section 5.9.3, p. 316<br><br>Attachment 2 |
| 68. | Conduct appropriate consultation to identify concerns in regard to environmental impacts as they affect heritage matters. | Section 5.9.3, p. 316 |
| 69. | Provide a detailed description and figure(s) of the proposed disturbance and impacts to heritage sites, values, and/or cultural associations, including for the Ningaloo Coast World Heritage Property/Ningaloo Coast World Heritage Place associated with the proposal. | Section 5.9.5, p. 344 |
| 70. | Assess the impacts on heritage sites, values and/or cultural associations, including for the Ningaloo Coast World Heritage Property and the Ningaloo Coast World Heritage Place, associated with the implementation of the proposal, including those resulting from changes to the environment which may impact on cultural and heritage significance or values. | Section 5.9.5, p. 344 |
| 71. | Predict the residual impacts on heritage sites, values and/or cultural associations, for direct, indirect and cumulative impacts after considering the mitigation hierarchy. | Section 5.9.7, p. 359 |
| 72. | Outline the mitigation and management measures to ensure impacts to heritage sites, values, and/or cultural associations (direct and indirect) are minimised, and not greater than predicted. | Section 5.9.7, p. 359 |
| 73. | Characterise the environment by providing a description of the visual landscape character and scenic quality values and provide maps of the visual landscape units | Section 5.9.3, p. 316 |

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| | that may potentially be visually affected. This should include, but not be limited to: landforms; vegetation; and waterways/bodies and can be undertaken by way of three-dimensional modelling and/or photographs. | |
| 74. | Characterise the current, and any other reasonably foreseeable, land and recreation uses and amenity values (including for visual, noise, odour, and dust) of the proposal area. | Section 5.9.3, p. 316 |
| 75. | Identify and discuss the potential sources and impacts of noise, dust, light-spill and alteration to landscape from the proposal. | Section 5.9.5, p. 344 |
| 76. | Design and undertake a visual impact assessment (VIA) for before, during construction, after construction, during operations, and after closure and decommissioning, to assess the impacts of the proposal on visual amenity in accordance with the Western Australian Planning Commission (2007) *Visual Landscape Planning in Western Australia: a manual for evaluation, assessment, siting and design*. | Section 5.9.5, p. 344<br>Attachment 2 |
| 77. | The VIA will identify and describe the aspects of the proposal that may potentially affect the visual landscape character and scenic quality values both temporarily and permanently, using agreed (by the EPA) reference and vantage points of surrounding areas and use area's viewer positions and perceptions. | Attachment 2 |
| 78. | Predict the residual amenity impacts from the proposal on the landscape, land and recreation use and amenity values (including visual, noise, odour, and dust) after considering and applying avoidance and minimisation measures. Impact predictions are to include, but not be limited to:<br><br>(a) The likely extent, severity, and duration of the impacts.<br><br>(b) Simulations/modelling of the predicted residual impacts from the proposal, including changes to the landscape from the agreed reference and vantage points. Include the cumulative impacts on amenity (visual, noise, odour, and dust) from the proposal and other currently approved developments. | Section 5.9.7, p. 359 |
| 79. | Review the social implications of the proposal to planned activities within Ningaloo Marine Park, in the context of the stated objectives of each of the relevant social values outlined in the Management Plan for Ningaloo Marine Park and Muiron Islands Marine Management Area. | Section 5.9.5, p. 344 |
| 80. | Identify management and mitigation measures for the proposal to ensure residual impacts to land and recreation uses, and amenity (including visual, noise, odour, and dust) are not greater than predicted. | Section 5.9.7, p. 359 |
| 81. | Conduct appropriate consultation to identify the potential impacts the proposal will have on the economic | Section 5.9.5, p. 344 |

| Task No. | Required Work | Section & Page No. |
|---|---|---|
| | surroundings of people affected by the proposal (related to the physical area involved in the proposal), including in relation to tourism, commercial fishing, and recreational fishing operations/business. | |
| 82. | Identify and discuss the potential impacts to the economic surroundings of the people referred to in scope 81 above. The discussion must include consideration of the mitigation hierarchy. | Section 5.9.5, p. 344 |
| 83. | Identify management and mitigation measures for the proposal to ensure impacts to economic surroundings are not greater than predicted. | Section 5.9.7, p. 359 |
| 84. | Where significant residual impacts remain, and relate to MNES, propose an appropriate offsets package that is consistent with the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Spatial data defining the area of significant residual impacts should also be provided. | Section 8, p. 425 |
| Other Factors or Matters – Terrestrial Environmental Quality | | |
| | Provide details of chemical and diesel storage, and power generation and management measures, including contingencies in the event of a spill, to ensure that contamination of land does not occur. | Section 2.3 & 6.1.7, p. 17 & 369 |
| | Provide details on the presence of acid sulphate soils within the proposal area, and if present details of proposed management measures to be implemented during construction to minimise impacts to terrestrial environmental quality. | Section 6.1.3 & 6.1.7, p. 365 & 369 |

Table ES 1: Work Required in Accordance with the Environmental Scoping Document (EPA 2018a)

# Executive Summary

## INTRODUCTION, BACKGROUND, AND CONTEXT

This Environmental Review Document (ERD) has been prepared by Subsea 7 Australia Contracting Pty Ltd (Subsea 7) for the Learmonth Pipeline Fabrication Facility (the Proposal).

The Proposal will involve the production of pipeline Bundles, used in the development of offshore gas fields, which co-locate a number of services within a single pipeline, which is constructed onshore before being launched and towed offshore to the field under development. Bundle technology represents an alternative to the conventional development of an offshore gas field. Subsea 7 currently operates the only other existing Bundle site in Wick, Scotland.

Numerous alternative sites were assessed for suitability as a Bundle construction and launch site, both within Western Australia and globally, with the environmental, planning, social and engineering constraints considered. Key physical site requirements include a 10 km long, and relatively flat, onshore area for the Bundle tracks, an adjacent medium gradient shore crossing and relatively sheltered nearshore environment. A number of sites in the North West region of Western Australia were considered, with two short-listed; Anketell Point (Karratha) and Learmonth (Exmouth). Further and more detailed environmental opportunity and constraints analysis, and studies including bathymetry surveys, were undertaken. These indicated that the Anketell site was unsuitable for Bundle fabrication and launch and thus Learmonth was determined to be the only feasible site.

Subsea 7 referred the original Proposal to the Western Australian Environmental Protection Authority (EPA) on 23 October 2017. On 20 November 2017, the EPA determined the original Proposal required formal assessment with the level of assessment set as Public Environmental Review (PER), with an eight-week public review period (Assessment number 2136). An Environmental Scoping Document (ESD) was prepared by the EPA to define the form, content, timing and procedure of the Environmental Review Document (ERD). A draft ESD was published for public comment by the EPA on 14 February 2018, with the final, approved, ESD published on 18 April 2018. Subsequently Subsea 7 submitted a request to make changes to the Proposal under section 43A of the *Environmental Protection Act 1986* (EP Act). The proposed amendments included:

- Amendment of the Proposal title from the 'Learmonth Bundle Site' to the 'Learmonth Pipeline Fabrication Facility'.
- Extension of the onshore Development Envelope adjacent to the Minilya-Exmouth Road to ensure a safe alignment of the site access road.
- Inclusion of the proposed production bores and associated water supply pipeline within the Development Envelope.
- Slight modification of the tow route and definition of an Offshore Operations Area to describe the maximum area (or envelope) within which launch and tow operations will occur.
- Definition of an Offshore Operations Area (Off bottom tow) within which Bundle ballast chains, which hang below the Bundle, will be in contact with the seabed. This area represents an envelope within which any and all disturbance associated with Bundle launches, over the life of the facility, may occur.

- A slight realignment of the 'Bundle laydown area' (now termed the Bundle parking area) to align with the revised tow route.
- Change to a 'Surface tow' method through Ningaloo Marine Park and the definition of an Offshore Operations Area (Surface tow) representing an envelope within which all Bundle tows, over the life of the facility, will occur.

Following initial discussions between Subsea 7 and the EPA, Subsea 7 requested that the EPA terminate its assessment of the Proposal.

Subsea 7 referred an amended Proposal to the EPA on 16 May 2019. On 29 May 2019, the EPA determined the Proposal required formal assessment with the level of assessment set as PER, with an eight-week public review period (Assessment number 2208). An Environmental Scoping Document (ESD) was prepared by the EPA to define the form, content, timing and procedure of the Environmental Review Document (ERD) (this document). A final, approved, ESD was published on 8 July 2019 (Appendix 1). The ESD outlines the preliminary key environmental factors, other environmental factors or matters and work requirements for completion of the ERD.

The ERD has been prepared to fulfil the requirements for assessment of the Proposal at a level of PER pursuant to Part IV of the Western Australian *Environmental Protection Act 1986* (EP Act). It has been prepared in accordance with the EP Act Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA 2016a), the Guidelines for Preparing an Environmental Review Document (EPA 2018b) and to the requirements of the ESD.

The Proposal was referred to the Department of the Environment and Energy (DoEE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 18 October 2017. On 24 February 2018, the Proposal was deemed a Controlled Action. On 1 July 2019 the DoEE accepted a variation to the Proposal to allow assessment of the amended Proposal through an accredited assessment under the EP Act, with the ERD (this document) addressing the potential impacts to the relevant controlling provisions.

## OVERVIEW OF THE PROPOSAL

The Proposal is to construct and operate a new pipeline fabrication facility adjacent to the western shoreline of Exmouth Gulf, at Learmonth, approximately 35 km south of the Exmouth townsite (ES Figure 1). The proposed facility will allow the construction and launching of pipeline Bundles for the offshore oil and gas industry.

The Proposal includes the construction of a fabrication shed, where the Bundles will be constructed, a storage area where the Bundle materials will be stored prior to use, and two approximately 10 km long Bundle tracks along which each Bundle will be constructed and then launched (ES Figure 2). A Bundle launchway, crossing the beach and extending 380 m (measured from the dune line) into the nearshore subtidal area, will facilitate the launch of each bundle (ES Figure 3).

A Summary of the Proposal is provided in ES Table 1.

| Summary of Proposal | |
|---|---|
| Proposal Title | Learmonth Pipeline Fabrication Facility |
| Proponent Name | Subsea 7 Australia Contracting (Subsea 7) |
| Short Description | The proposal is to construct and operate an onshore pipeline fabrication facility at Lots 233 and 1586 to the east of Minilya-Exmouth Road, Learmonth, approximately 35 km south of the Exmouth town site.<br><br>The onshore pipeline bundle fabrication site and associated infrastructure includes two bundle tracks (approximately 10 km in length) along which the Bundles will be constructed and launched from a Bundle launchway that crosses the beach and extends into the subtidal zone at Heron Point in the Exmouth Gulf. Once launched the Bundles will be towed along a pre-determined route between two tugs at a controlled depth to the Bundle Parking area within which tow reconfiguration will occur before continuing offshore. |

ES Table 1: Summary of Proposal

The Key Characteristics of the Proposal are provided in ES Table 2.

| Physical Elements | | |
|---|---|---|
| Element | Location | Proposed Extent |
| Bundle fabrication facility and associated infrastructure including:<br>• Fabrication site (including site offices, staff facilities, lunchroom, storage area and car park).<br>• Two Bundle Tracks.<br>• Launchway facilities | Within the onshore Development Envelope as shown in ES Figure 2 | Clearing and disturbance of up to 176 ha of vegetation within a 452 ha Development Envelope |

| Physical Elements | | |
|---|---|---|
| Element | Location | Proposed Extent |
| area.<br>• Access roads.<br>• Spray field.<br>• Drainage sump.<br>• Hydro testing water pond.<br>• Groundwater production bores and supply pipeline.<br>• Miscellaneous (Drains, access tracks, earthworks areas). | | |
| Bundle Launchway | Within Exmouth Gulf as shown in ES Figure 3 | Direct disturbance of up to 1 ha of seabed (measured from mean high water) within a 4,164 ha Offshore Operations Area (Off bottom tow) |
| Offshore Operations Area (Off bottom tow) | Within Exmouth Gulf as shown in ES Figure 3 | Direct disturbance of up to 1,450 ha of seabed (per Bundle launch) within a 4,164 ha Offshore Operations Area (Off bottom tow) |
| Offshore Operations Area (Bundle Parking area) | Within Exmouth Gulf as shown in ES Figure 3 | Direct disturbance of up to 368 ha of seabed within a 2,426 ha Offshore Operations Area (Parking area) |
| Offshore Operations Area (Surface tow) | Within Exmouth Gulf and Ningaloo Marine Park, Ningaloo Coast World Heritage Property/Ningaloo Coast World Heritage Place as shown in ES Figure 3 | No ground or seabed disturbance to the extent of State Waters |

| Operational Elements | | |
|---|---|---|
| Element | Location | Proposed Extent |
| Groundwater abstraction | Learmonth (onshore) | Abstraction of up to 12 ML/annum for potable and hydrotest water |

| Operational Elements | | |
|---|---|---|
| Element | Location | Proposed Extent |
| Bundle launch and tow | Within Exmouth Gulf and Ningaloo Marine Park, Ningaloo Coast World Heritage Property/Ningaloo Coast World Heritage Place as shown in ES Figure 3 | Maximum of three Bundle launches per annum. |

ES Table 2: Proposal Key Characteristics

To launch a Bundle, the Towhead on the offshore end of the Bundle is connected to a tug (the 'Leading Tug') via a long towline. The tug then slowly heads offshore, pulling the Bundle along the track and into the ocean. Following launch, the Bundle will be towed slowly (≤ 2 knots[1]) offshore along the tow route (ES Figure 3). The Bundle will be in 'Off bottom tow', meaning that the Bundle (including towheads) will be clear of the seabed. The lower links of the long Bundle chains will be in contact with the seabed in this mode.

On arrival at the Bundle Parking area (ES Figure 3), the Bundle will be stopped and various checks and reconfiguration of the subsequent Surface tow completed. The Bundle may remain within this area for up to 24 hours to allow for all checks and reconfiguration to be completed, and to allow for the 'Surface tow' out of Exmouth Gulf to be aligned with optimal wind and current conditions.

On exit from the Bundle Parking area the tow vessels will increase the tow speed to 5-6 knots (up to a maximum of 8 knots)[2]. Hydrodynamic forces acting on the ballast chains produce a lift component and the Bundle will rise to the surface in a controlled manner. In this 'Surface tow' configuration the Bundle lies right at the surface, ensuring maximum clearance from the seabed within Ningaloo Marine Park (ES Figure 3).

Once the bundle and tow fleet exit the Exmouth Gulf and enter deeper waters, the Bundle tow speed will be reduced slightly, and the tension from the trailing tug reduced, to allow the Bundle to be lowered through the water column to sit at mid-depth through the water column. The actual depth varies pending the Bundle tow characteristics and the environmental conditions at the time, but is typically in the region of 50 m water depth. Once this depth is reached, and the Bundle is stable, the tow has entered 'Controlled Depth Tow Method' (CDTM) which will continue until the Bundle reaches the installation location.

To provide clarity regarding the tow route, and allowing for minor changes in the exact towpath (which may occur under varying environmental conditions), an Offshore Operations Area has been defined (ES Figure 3). This described the maximum area (or envelope) within which launch and tow operations will occur.

[1] Two knots is equivalent to 3.7 km/hour, well below average walking speed of 5-6 km/hour (City of Belmont 2019).
[2] Eight knots is equivalent to approximately 15 km/hour. A speed limit of 8 knots is commonly set for the safe operation of motor vessels within restricted waters (e.g. mooring areas, shallow waters or adjacent to a wharf or jetty within the Swan River) (Department of Transport 2019). In Exmouth Gulf, adjacent to the proposed tow route, no speed limits apply as these waters represent unrestricted, open waters.


Scale: 1:400000
Aerial Photo: ESRI Satellite
Original Size: A4
Grid: GDA 94 / MGA Zone 50

Notes: Location of proposed Bundle Site.

Subsea 7 Pipeline Fabrication Facility

subsea 7

ES Figure 1: Location of Proposal (Development Envelope)

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Scale: 1:60000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

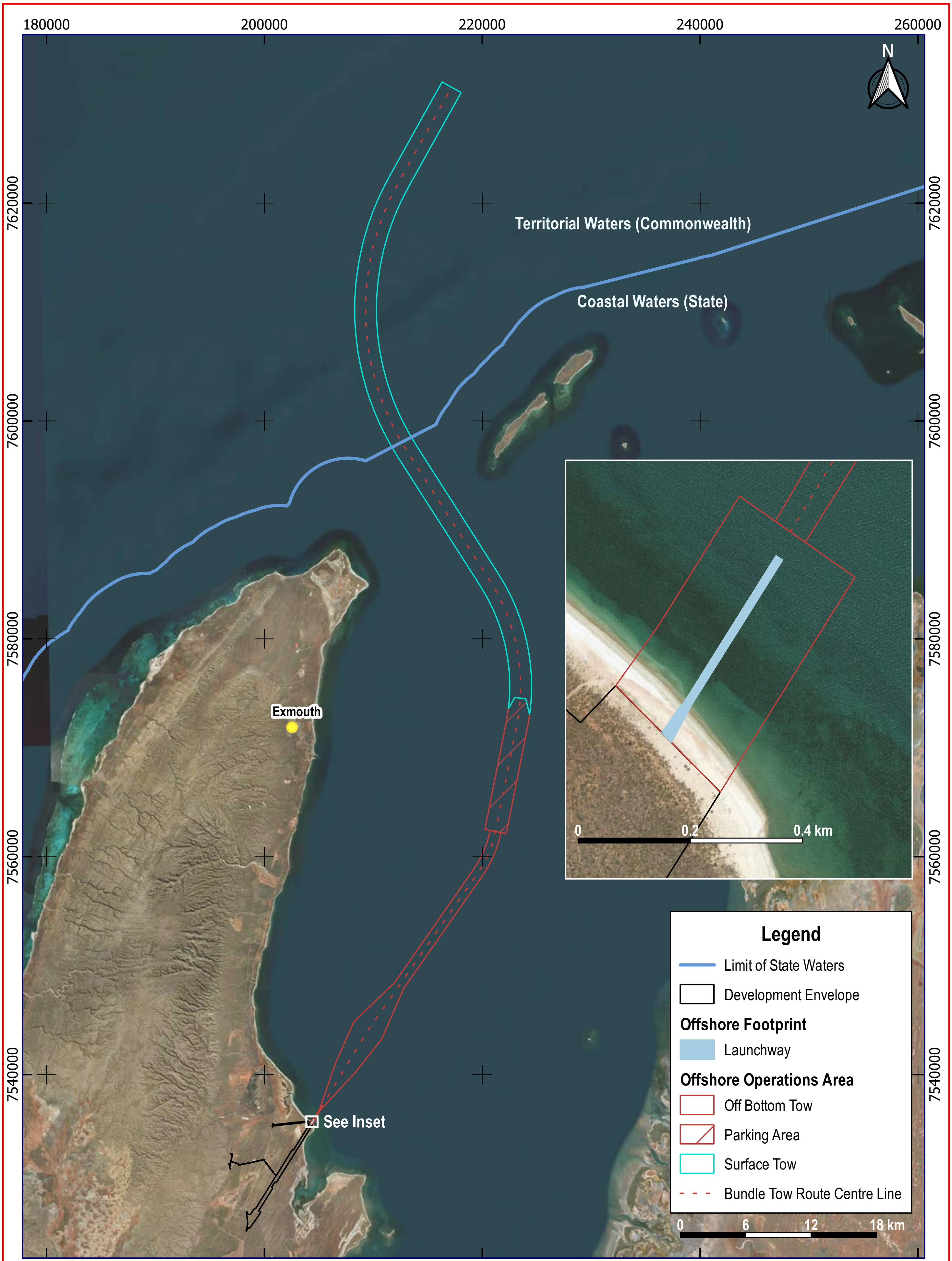
Notes: Data sourced from Subsea 7 (2018).

Subsea 7 Pipeline Fabrication Facility

subsea 7

ES Figure 2: Development Envelope and indicative Development Footprint

W:\Subsea 7\GIS\Infrastructure Map.qgs 27/06/2019




Scale: 1:450000
Aerial Photo: ESRI Satellite
Original Size: A4
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Subsea 7 (2018).

Subsea 7 Pipeline Fabrication Facility

subsea 7

ES Figure 3: Offshore Operations Area and Indicative Tow Route

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Bundle technology represents significant innovation compared to standard offshore field development technology, with numerous safety, performance, cost and environmental benefits. To quantify some of the environmental benefits of the use of Bundle technology, Subsea 7 completed an assessment of the offshore operations associated the most recent conventional project delivered by Subsea 7 from Exmouth Gulf (development of the Van Gogh field), and then modelled the offshore operations that would have occurred had the project used Bundle technology. The duration and magnitude of offshore and inshore (Exmouth Gulf) vessel operations were significantly reduced for the Bundle project compared to the conventional project. For the primary construction vessel, the 'Toisa Proteus', for example, offshore time was reduced by 81%, and time in Exmouth Gulf by 75% under the Bundle solution. Other advantages to a Bundle project in addition to the reduced vessel operations include a greater ability for local and domestic vessel operators to be involved as smaller and more locally available vessels can be used, and fuel consumption and greenhouse gas emissions are reduced.

## SUMMARY OF POTENTIAL IMPACTS, PROPOSED MITIGATION, AND OUTCOMES

ES Table 3 provides a summary of potential impacts, proposed mitigation measures, and predicted outcomes relevant to each environmental factor.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Key Environmental Factor: Benthic Communities and Habitats (BCH) | | |
| EPA Objective | To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained. | |
| Potential Impact | Mitigation Measures | Predicted Outcome |
| Direct loss of BCH during launchway construction | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill).<br>• Use of pre-cast concrete panels will reduce seabed disturbance.<br>Measures to rehabilitate:<br>• NA | Habitats within the launchway footprint are well represented elsewhere and the predicted losses represent a small proportion of the habitat present within the Heron Point LAU, as follows:<br>• Soft sediment – direct loss of 0.2 ha (0.0%) of mapped habitat.<br>• Reef with macroalgae – direct loss of 0.3 ha (0.1%) of mapped habitat.<br>The biological diversity and ecological integrity of BCH will be maintained.<br><br>Monitoring<br>Habitat mapping of BCH adjacent to launchway within one year of construction being completed (refer to the Marine Construction Monitoring and Management Plan (MCMMP) in Attachment 3). |
| Indirect loss or degradation of BCH due to turbidity created during launchway construction | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill) thus reducing seabed disturbance and duration of construction.<br>• Use of pre-cast concrete panels will reduce | Construction of the Bundle launchway is estimated to take up to six months. Elevated turbidity is expected to be limited to the immediate surrounds (<50 m) of the work site. The adjacent habitats are expected to be tolerant of short-term pulses in turbidity and suspended sediment. Potential reversible impacts could occur as follows:<br>• Soft sediment 2.0 ha (0.0%) of mapped habitat. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | seabed disturbance and duration of construction.<br>• Construction material to be screened and washed to remove 'fines' (particles <63 µm in diameter).<br>• Silt curtains deployed as required to contain sediment plume.<br>• Suspension of turbidity-generating construction activity as required.<br>Measures to rehabilitate:<br>• NA | • Reef with macroalgae 2.5 ha (0.7%) of mapped habitat.<br>The biological diversity and ecological integrity of BCH will be maintained.<br><br><u>Monitoring</u><br>Monitoring of water quality adjacent to launchway (refer to the MCMMP in Attachment 3).<br><br>Quantitative survey of BCH adjacent to launchway before construction, and within one year of construction being completed (refer to the Marine Construction Monitoring and Management Plan (MCMMP) in Attachment 3). |
| Direct loss of BCH during Bundle launch and tow | Measures to avoid:<br>• Surface tow operations within Ningaloo Marine Park to avoid impacts to BCH.<br>Measures to minimise:<br>• All launch and tow operations will occur within the nominated Offshore Operations Area to minimise cumulative impacts to BCH.<br>• Bundle tethered to 'Leading Tug' and 'Trailing Tug' at all times, including within Parking area, to ensure minimal lateral movement of Bundle.<br>• Chains arranged and connected to the Bundle provide lateral stability during the initial launch and off-bottom tow to ensure operations remain within the Offshore Operations Area. | An average of two Bundle launches will occur per year with a maximum of three. Soft sediment communities are expected to rapidly recover from what will be a short-term, periodic, superficial physical disturbance of the top sediment layer.<br><br>Direct impacts to Reef with microalgae and Reef with macroalgae and filter feeder habitats will be limited to a narrow corridor adjacent to the end of the launchway. These habitats are well represented to the north and south of the launchway alignment.<br><br>On the basis of the 'realistic worst case' scenario, predicted BCH impacts as a result of a Bundle launch are as follows:<br>• Soft sediment (1815.8 ha).<br>• Reef with macroalgae and filter feeders (1.5 ha). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• NA | • Soft sediment with filter feeders (0.4 ha).<br><br>Localised loss will not result in significant impacts on biological diversity or ecological integrity of the local or regional ecosystem. |
| Indirect loss or degradation of BCH during Bundle launch and tow | Measures to avoid:<br>• A maximum of three launches per year, for a nominal duration of two days per launch, is unlikely to lead to indirect impacts to BCH.<br>Measures to minimise:<br>• NA<br>Measures to rehabilitate:<br>• NA | An average of two Bundle launches will occur per year with a maximum of three.<br><br>It is expected that the macroalgae and filter feeders on reefs adjacent to the inshore section of tow route will be tolerant of isolated, short-term, 'pulses' of elevated turbidity (as occur naturally) and as such will not be significantly impacted. Thus, the area of potential elevated turbidity has been deemed a Zone of Influence (ZoI), where no impacts to BCH are expected.<br><br>Biological diversity and ecological integrity of BCH will be maintained.<br><br><u>Monitoring</u><br>Water quality monitoring adjacent to sensitive BCH outside of the Offshore Operation Area during initial Bundle launch to validate sediment fate modelling predictions (refer Marine Operational Environmental Monitoring Plan (MOEMP) in Attachment 3).<br><br>Quantitative survey of BCH within and outside of the Offshore Operation Area before and following initial Bundle launch to validate impact predictions (refer Marine Operational Environmental Monitoring Plan (MOEMP) in Attachment 3). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Direct loss of BCH during Bundle tow in the event of a loss of control of the Bundle | Measures to avoid:<br>• Weather forecast/seasonal data reviewed to inform launch schedule to avoid tow in adverse conditions.<br>• Weather forecast monitored ahead of launch operations and launch window defined to avoid tow in adverse conditions.<br>• Defined limiting weather criteria.<br>• Bundle tethered to 'Leading Tug' and 'Trailing Tug' at all times, including within Parking area.<br>• High specification tow vessels used for launch operations.<br>• Secondary system/redundancy design in Bundle monitoring system.<br>• Tow vessels to be equipped with 'Dynamic Positioning' (DP) systems, with a suitable level of system redundancy.<br>• Full tow vessel position monitoring system verification prior to leaving Bundle Parking area.<br>• Secondary tow vessel position keeping system in place for passage through Ningaloo Marine Park.<br>• Vessel Assurance Suitability Surveys conducted prior to commencement of operations.<br>• Notice to mariners supporting information | Given the controls in place during each Bundle launch, the risk of a loss of control of a Bundle, leading to an impact to BCH beyond the defined Offshore Operations Area (Off bottom tow) is considered negligible (refer Marine Emergency Response Plan (Attachment 3)).<br><br>Biological diversity and ecological integrity of BCH will be maintained.<br><br><u>Monitoring</u><br>In the event of a loss of control of the Bundle leading to seabed contact outside the Offshore Operation Area (Off bottom tow) or Offshore Operation Area (Parking area), habitat mapping of BCH adjacent to site(s) of contact within one month. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | issued prior to tow to inform local vessels of operations.<br>• Guard vessel to monitor/enforce exclusion zones.<br>• Each vessel operating in adherence to International Regulations for Preventing Collisions at Sea (COLREGs).<br>• Vessel intervention if required (as described in guard vessel procedure for engaging 3rd party vessels).<br>• Visual monitoring of Bundle on surface (surface buoys and lights).<br>• Timing of Surface tow through Ningaloo Marine Park chosen to coincide with benign sea, tidal and weather conditions.<br>Measures to minimise:<br>• Community engagement and announcements locally.<br>• Broadcasting on VHF as required.<br>Measures to rehabilitate:<br>• NA. | |
| Indirect loss of BCH during Bundle tow in the event of a loss of control of the Bundle or support vessel (e.g. from | Measures to avoid:<br>• Bundle fully pressure tested and leak tested prior to launch.<br>• Ongoing monitoring of Bundle pressures prior to and during launch.<br>• Weather forecast/seasonal data reviewed to | Given the controls in place during each Bundle launch, the risk of a loss of control of a Bundle, and of a resulting chemical leak or spill and an impact to BCH, is considered negligible (refer Marine Emergency Response Plan (Attachment 3)).<br><br>Biological diversity and ecological integrity of BCH will |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| physical contact or a chemical spill) | inform launch schedule.<br>• Weather forecast monitored ahead of launch operations and launch window defined.<br>• Weather conditions monitored during launch operations.<br>• Defined limiting weather criteria.<br>• High specification tow vessels used for launch operations.<br>• System confirmation check completed prior to departing Parking area.<br>• Secondary system/redundancy design in bundle monitoring system.<br>• Tow vessels to be equipped with 'Dynamic Positioning' (DP) systems, with a suitable level of system redundancy.<br>• Full tow vessel position monitoring system verification prior to leaving Bundle Parking area.<br>• Secondary tow vessel position keeping system in place for passage through Ningaloo Marine Park.<br>• Vessel Assurance Suitability Surveys conducted prior to commencement of operations.<br>• Notice to mariners supporting information issued prior to tow to inform local vessels of operations.<br>• Guard vessel to monitor/enforce exclusion | be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | zones.<br>• Each vessel operating in adherence to International Regulations for Preventing Collisions at Sea (COLREGs)<br>• Vessel intervention if required (as described in guard vessel procedure for engaging 3rd party vessels).<br>• Community engagement and announcements locally.<br>• Broadcasting on VHF as required.<br>• Visual monitoring of Bundle on surface (surface buoys and lights).<br>• Timing of Surface tow through Ningaloo Marine Park chosen to coincide with benign sea, tidal and weather conditions.<br>Measures to minimise:<br>• Bundle carrier pipe does not contain any hydrocarbons (filled with inert nitrogen gas plus solid corrosion inhibitors).<br>• Any chemical to be used within flow lines must have:<br>o An OCNS Hazard Quotient rating of Gold, Silver, E or D and have no substitution or product warning; or<br>o Further assessment is to be undertaken to ensure the environmental risk is ALARP. | |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• Each vessel equipped with a vessel specific Shipboard Oil Pollution Emergency Plan (SOPEP) or equivalent and will follow response actions to incidental pollution in accordance with the vessel's emergency plan.<br>• Emergency Response Plan (Attachment 3). | |
| Indirect loss of BCH due to altered water flows and sediment movement as a result of the presence of the launchway | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>• Periodic bypassing of sand during launchway maintenance to limit sand accumulation to the north of the launchway and associated sand depletion to the south of the launchway.<br>Measures to rehabilitate:<br>• Management of onshore sediment accretion via monitoring and, when management triggers are exceeded, sand bypassing. | Due to its relatively small size and low elevation of the launchway relative to the seabed, the launchway is not expected to have any significant impact on the local wave or current conditions at or adjacent to the site.<br><br>Sediment accretion is predicted to occur adjacent to the north side of the launchway, across existing beach sands and across intertidal pavement reef habitat. This pavement reef habitat does not support any macroalgae or fauna, and the biological diversity and ecological integrity of BCH will not be affected.<br><br>Biological diversity and ecological integrity of BCH will be maintained.<br><br><u>Monitoring</u><br>The following monitoring is proposed:<br>• Survey of beach profiles adjacent to launchway (annual).<br>• Inspections, including photographic monitoring of shoreline adjacent to launchway (annual).<br>• Shoreline mapping (every 3-6 years). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Impacts to BCH as a result of removal of the launchway | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Silt curtains deployed during turbidity-generating construction activities (refer MCMMP).<br>• Suspension of turbidity-generating construction activity in the event elevated turbidity is recorded beyond the ZoMI (refer MCMMP).<br>Measures to rehabilitate:<br>• NA | No permanent impacts to BCH expected.<br><br>Elevated turbidity is expected to be limited to the immediate surrounds (<50 m) of the work site. Potential reversible impacts to BCH could occur as follows:<br>• Soft sediment (2.0 ha or < 0.1% of mapped habitat).<br>Reef with macroalgae (2.5 ha or 0.7% of mapped habitat).<br>Biological diversity and ecological integrity of BCH will be maintained. |
| **Key Environmental Factor: Coastal Processes** | | |
| EPA Objective | To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected. | |
| **Potential Impact** | **Mitigation Measures** | **Predicted Outcome** |
| Direct impact to sediment transport leading to seabed, beach or dune erosion on downdrift side of launchway | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>• Periodic bypassing of sand during launchway maintenance to limit sand accumulation to the north of the launchway and associated sand depletion to the south of the launchway. | It is predicted that sand would accumulate along the northern side of the launchway, above the low tide mark, until sediment on the beach berm starts to move across the structure. Due to the temporary reduction in sand migrating to the shoreline to the south, some narrowing or possible loss of the small perched beach formations to the south of the launchway could occur.<br><br>Given the relatively slow rates of sediment transport, the proposed monitoring program, and the implementation of sand bypassing in the event that |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• Management of onshore sediment accretion (north of launchway) and depletion (south of launchway) via monitoring and sand bypassing.<br><br>Note: Governance Arrangements<br>During construction and operations, Subsea 7 will be responsible for the implementation of the nominated monitoring and mitigation measures.<br><br>For three years post closure Subsea 7 will be responsible for the implementation of the nominated monitoring and mitigation measures. After this time, if the monitoring of shoreline position demonstrates a stable shoreline (in comparison to adjacent unimpacted sections of shoreline), Subsea 7's monitoring and mitigation commitments will cease. | trigger values are exceeded, the geophysical processes that shape coastal morphology will be maintained so that the environmental values of the coast are protected.<br><br><u>Monitoring</u><br>The following monitoring is proposed:<br>• Survey of beach profiles adjacent to launchway (annual).<br>• Inspections, including photographic monitoring of shoreline adjacent to launchway (annual).<br>• Shoreline mapping (every 3-6 years). |
| Indirect impacts to coastal morphology by altered wave climate, water flows and sediment movement as a result of the presence of the launchway | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>• Periodic bypassing of sand during launchway maintenance to limit sand accumulation to the north of the launchway and associated sand depletion to the south of the launchway. | Due to its relatively small size and low elevation of the launchway relative to the seabed, the launchway is not expected to have any significant impact on the local wave or current conditions. Thus no significant indirect impacts to coastal morphology as a result of altered wave climate, water flows and sediment movement following launchway construction are expected.<br><br>The geophysical processes that shape coastal morphology will be maintained so that the environmental values of the coast are protected. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• Management of onshore sediment accretion (north of launchway) and depletion (south of launchway) via monitoring and sand bypassing. | <u>Monitoring</u><br>The following monitoring is proposed:<br>• Survey of beach profiles adjacent to launchway (annual).<br>• Inspections, including photographic monitoring of shoreline adjacent to launchway (annual).<br>• Shoreline mapping (every 3-6 years). |
| Altered wave overwash and drainage due to launchway leads to dune instability during extreme flooding events | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>• Stabilisation of cut embankments.<br>Measures to rehabilitate:<br>• Management of onshore sediment accretion via monitoring and sand bypassing.<br>• Reinstatement of the dune following any significant re-profiling following an extreme weather event. | The construction of the launchway will necessitate a cut through the dune system. The construction of the launchway will reduce the elevation of the coastal dune in this area from approximately 5 mAHD down to an elevation of around 2.5 mAHD at the foundation level. Such a reduction in the elevation could result in a localised increase in erosion risk and inundation vulnerability. For more severe events, or those that cause more rapid fluctuations in sea level, the ingress of seawater through the launchway cut could occur, potentially resulting in scour of the adjoining area.<br><br>With the commitment to reinstate the dune structure following any significant re-profiling of the dune system, it is considered that the environmental values of the coast will be protected.<br><br><u>Monitoring</u><br>Inspections, including photographic monitoring, of the shoreline and dunes adjacent to the launchway will be undertaken annually. |
| Permanent change to water flows and sediment | Measures to avoid:<br>• Full removal of the launchway will occur. | At the end of the service life of the facility, decommissioning will be completed including full removal of the launchway and reinstatement of the dune system will occur. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| movement as a result of the presence of the launchway post closure | Measures to rehabilitate:<br>• Management of onshore sediment accretion via monitoring and sand bypassing. | The geophysical processes that shape coastal morphology will be maintained so that the environmental values of the coast are protected.<br><br><u>Monitoring</u><br>Annual monitoring of the shoreline position for a period of three years to monitor recovery of pre-development beach alignment. |
| Key Environmental Factor: Marine Environmental Quality | | |
| EPA Objective | To maintain the quality of water, sediment and biota so that environmental values are protected. | |
| Potential Impact | Mitigation Measures | Predicted Outcome |
| Temporary impacts to water quality through the release of fines, nutrients or contaminants from sediments during launchway construction | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill) thus reducing seabed disturbance and duration of construction.<br>• Use of pre-cast concrete panels will reduce seabed disturbance and duration of construction.<br>• Construction methods to minimise the disturbance of sediments.<br>• Silt curtains deployed to ensure environmental objectives are achieved.<br>• Construction occurs during single shift allowing time for settling and or dissipation of fines. | Construction of the Bundle launchway is estimated to take up to six months. Elevated turbidity is expected to be limited to the immediate surrounds (<50 m) of the work site. Sediments do not contain elevated concentrations of nutrients or contaminants. Any changes in marine water quality as a result of the project are likely to affect an extremely small area. The magnitude of such changes is considered likely to be consistent with short-term increases in suspended solids associated with natural processes such as large storms.<br><br>Implementation of management measures during construction will ensure that the quality of marine water, sediment and biota will be maintained and the EQOs will be met.<br><br><u>Monitoring</u><br>Twice daily (during works: approximately 10am and 2pm) visual monitoring during construction.<br>In the event of persistent turbidity, assessment of |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• Suspension of turbidity-generating construction activity in the event a persistent turbidity plume is observed beyond the silt curtain(s). | water quality at the 50 m boundary (refer to Attachment 3). |
| Temporary impacts to water quality (turbidity) due to release of fines from construction materials (quarry rock) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Construction material to be screened and washed to remove 'fines' (particles <63 µm in diameter).<br>• Silt curtains deployed as required to ensure environmental objectives are achieved.<br>Measures to rehabilitate:<br>• Suspension of turbidity-generating construction activity in the event a persistent turbidity plume is observed beyond the silt curtain(s). | Rock fill (expected to be hard rock) will be screened and washed prior to use, resulting in minimal turbidity release. Any changes in turbidity as a result of the project will be short-term and are likely to affect an extremely small area. The magnitude of such changes are considered likely to be consistent with short-term increases in turbidity associated with natural processes such as large storms or the regular strong wind events experienced in the area.<br><br>Implementation of management measures during construction will ensure that the quality of water, sediment and biota will be maintained and the EQOs will be met. |
| Temporary impacts to water quality during Bundle launch and tow due to chains on the seabed | Measures to avoid:<br>• No more than three launches per year will occur.<br>Measures to minimise:<br>• NA<br>Measures to rehabilitate:<br>• NA | An average of two Bundle launches may occur per year with a maximum of three. Water quality impacts will be minor, local, and of short duration.<br><br>The quality of water, sediment and biota will not be significantly impacted and the environmental quality outcomes (EQOs) will be met.<br><br><u>Monitoring</u><br>Given the short-term nature of the predicted turbidity, no formal monitoring is proposed, although a visual |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | assessment (likely aerial) will be undertaken during the first Bundle launch). |
| Impacts to water and/or sediment quality in the event of a loss of control of the Bundle or support vessel (e.g. from a chemical spill) | Measures to avoid:<br>• Bundle fully pressure tested and leak tested prior to launch.<br>• Ongoing monitoring of Bundle pressures prior to and during launch.<br>• Weather forecast/seasonal data reviewed to inform launch schedule.<br>• Weather forecast monitored ahead of launch operations and launch window defined.<br>• Weather conditions monitored during launch operations.<br>• Defined limiting weather criteria.<br>• High specification tow vessels for launch operations.<br>• System confirmation check completed prior to departing Parking area.<br>• Secondary system/redundancy design in bundle monitoring system.<br>• Lead tow vessels to be equipped with 'Dynamic Positioning' (DP) systems, with a suitable level of system redundancy.<br>• Full tow vessel position monitoring system verification prior to leaving Bundle Parking area.<br>• Secondary tow vessel position keeping system in place for passage through Ningaloo Marine | Given the control measures to be implemented to prevent a loss of control of the Bundle or support vessel, any such incident is extremely unlikely.<br><br>Further, given the inherent strength of the carrier pipe (the outside casing of the Bundle), the lack of liquid chemicals within the carrier pipe, the release of a chemical, leading to an impact to marine environmental quality, is extremely unlikely.<br><br>The quality of water, sediment and biota will not be significantly impacted and the EQOs will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
| --- | --- | --- |
| | Park.<br>• Vessel Assurance Suitability Surveys conducted prior to commencement of operations.<br>• Notice to mariners supporting information issued prior to tow to inform local vessels of operations.<br>• Guard vessel to monitor/enforce exclusion zones.<br>• Each vessel operating in adherence to International Regulations for Preventing Collisions at Sea (COLREGs)<br>• Vessel intervention if required (as described in guard vessel procedure for engaging 3rd party vessels).<br>• Community engagement and announcements locally.<br>• Broadcasting on VHF as required.<br>• Visual monitoring of bundle on surface (surface buoys and lights).<br>• Timing of Surface tow through Ningaloo Marine Park chosen to coincide with benign sea, tidal and weather conditions.<br>Measures to minimise:<br>• Bundle carrier pipe does not contain any hydrocarbons (filled with inert nitrogen gas plus solid corrosion inhibitors). | |

<table>
<tr><th>Potential Impact</th><th>Mitigation Measures</th><th>Predicted Outcome</th></tr>
<tr><td></td><td><ul><li>Any chemical to be used within flow lines must have:<ul><li>An offshore chemical notification scheme (OCNS) Hazard Quotient rating of Gold, Silver, E or D have no substitution or product warning; or</li><li>Further assessment to ensure the environmental risk is ALARP.</li></ul></li></ul>Measures to rehabilitate:<ul><li>Each vessel equipped with a vessel specific Shipboard Oil Pollution Emergency Plan (SOPEP) or equivalent and will follow response actions to incidental pollution in accordance with the vessel’s emergency plan.</li></ul></td><td></td></tr>
<tr><td colspan="3">Key Environmental Factor: Marine Fauna</td></tr>
<tr><td>EPA Objective</td><td colspan="2">To protect marine fauna so that biological diversity and ecological integrity are maintained.</td></tr>
<tr><th>Potential Impact</th><th>Mitigation Measures</th><th>Predicted Outcome</th></tr>
<tr><td>Loss or degradation of BCH representing marine fauna habitat (e.g. foraging habitat) due to launchway construction</td><td>Measures to avoid:<ul><li>NA</li></ul>Measures to minimise:<ul><li>Launchway designed to minimise footprint (including extent of rock fill) thus reducing seabed disturbance and duration of construction.</li><li>Use of pre-cast concrete panels will reduce seabed disturbance and duration of construction.</li></ul></td><td>Habitats within the launchway footprint are well represented elsewhere and the predicted losses represent a small proportion of the habitat present within the Heron Point LAU, as follows:<ul><li>Soft sediment – direct loss of 0.2 ha (0.0%) of mapped habitat, indirect impact to 2.0 ha (0.0%) of mapped habitat.</li><li>Reef with macroalgae – direct loss of 0.3 ha (0.1%) of mapped habitat, indirect impact to 2.5 ha (0.7%) of mapped habitat.</li></ul></td></tr>
</table>

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | • Construction material to be screened and washed to remove 'fines' (particles <63 µm in diameter).<br>• Silt curtains will be deployed during construction to minimise impacts to water quality beyond 50 m from the construction area.<br>• Suspension of turbidity-generating construction activity (refer MCMMP in Attachment 3).<br>Measures to rehabilitate:<br>• NA | Construction of the Bundle launchway is estimated to take up to 6 months. Elevated turbidity is expected to be limited to the immediate surrounds (<50 m) of the work site. The adjacent habitats are expected to be tolerant of short-term pulses in turbidity and suspended sediment.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained.<br><br><u>Monitoring</u><br>Habitat mapping of BCH adjacent to launchway within one year of construction being completed. |
| Temporary behavioural responses of marine fauna due to noise or light spill during construction phase | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Shrouded or directional lighting as well as motion-sensor or timed lighting will be used and placed such that the majority of light is focused on the working areas and not out to sea.<br>• Deployment of silt curtains around active construction areas to assist in preventing marine fauna from entering these areas.<br>• Use of a Marine Fauna Observer (MFO) during marine construction activities to ensure no listed marine fauna enter within a 'marine fauna exclusion zone' of 50 m surrounding active construction (e.g. placement of rock fill, placement of pre-cast slabs). Works will be | Given the management measures, no significant impacts to marine fauna are expected.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | suspended in the event an animal enters this zone during active construction.<br>Measures to rehabilitate:<br>• NA | |
| Introduction of introduced marine pests (IMP) via construction vessels | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Adoption of the Department of Agriculture and Water Resources (DAWR) 'Quick Domestic Ballast Water (DBW) Risk Assessment Tool (DAWR 2018).<br>• Adoption of the DPIRD on-line 'Vessel Check' decision support tool and the adoption of appropriate biofouling management requirements.<br>Measures to rehabilitate:<br>• NA | Given the management measures no significant impacts to marine fauna are expected.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |
| Temporary behavioural response of marine fauna due to changes in marine water quality | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill) thus reducing seabed disturbance and duration of construction.<br>• Use of pre-cast concrete panels will reduce seabed disturbance and duration of | Construction of the Bundle launchway is estimated to take up to six months. Elevated turbidity is expected to be limited to the immediate surrounds (<50 m) of the work site.<br><br>Water quality impacts during a Bundle launch will be minor, local, and of short duration.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | construction.<br>• Construction methods selected to minimise disturbance of sediments.<br>• Silt curtains will be deployed during construction to minimise impacts to water quality beyond 50 m from the construction area.<br>• A maximum of three launches per year, for a duration of nominally two days per launch.<br>• No launches during period of peak usage of Exmouth Gulf by Humpback whales.<br>Measures to rehabilitate:<br>• Suspension of turbidity-generating construction activity in the event a persistent turbidity plume is observed beyond the silt curtain(s). | |
| Reduction in commercial and recreational fishing species due to loss of habitat and/or changes in marine water quality (construction and operations) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill) thus reducing seabed disturbance and duration of construction.<br>• Use of pre-cast concrete panels will reduce seabed disturbance and duration of construction.<br>• Construction material to be screened and washed to remove 'fines' (particles <63 µm in | The local fish and invertebrate species, and the habitats they rely on, are expected to be tolerant of occasional short-term pulses in turbidity and suspended sediment during a Bundle launch.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | diameter).<br>• Silt curtains will be deployed as required to ensure environmental objectives are achieved.<br>• Suspension of turbidity-generating construction activity (refer MCMMP in Attachment 3).<br>• Launch and tow operations will only occur within the nominated Offshore Operation Area to minimise impacts to nearshore BCH.<br>• Bundle remains tethered to 'Leading Tug' and 'Trailing Tug' at all times, including within Parking area, to ensure minimal lateral movement of Bundle.<br>Measures to rehabilitate:<br>• Maximum of three launches per year to allow soft sediment habitats to recover from any superficial physical disturbance between launches. | |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Loss or degradation of BCH representing marine fauna habitat (e.g. foraging habitat) during Bundle launch and tow | Measures to avoid:<br>• Bundle engineering completed to increase buoyancy of towheads.<br>• A maximum of three launches per year, for a duration of up to two days per launch, is unlikely to lead to indirect impacts to BCH.<br>Measures to minimise:<br>• NA<br>Measures to rehabilitate:<br>• NA | During Bundle launch impacts to water quality will be short-term and local.<br><br>The adjacent habitats are expected to be tolerant of occasional short-term pulses in turbidity and suspended sediment during a Bundle launch, such that no measurable impacts will occur.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |
| Temporary behavioural response of marine fauna due to noise or light spill during Bundle launch and tow | Measures to avoid:<br>• No launches during period of peak usage of Exmouth Gulf by Humpback whales.<br>Measures to minimise:<br>• Lighting design during bundle launches will be a continuation of lighting management measures implemented during fabrication operations and will take account of measures proven to reduce the risk of impact on marine fauna such as shrouded or directional lighting.<br>Measures to rehabilitate:<br>• NA | Negligible risk of a significant impact from underwater noise given the short-term and low-level nature of underwater noise associated with a Bundle launch, and the low frequency of launches.<br><br>A significant impact from light spill is unlikely given the absence of turtle nesting within Exmouth Gulf, the short duration and low frequency of launches and the measures to minimise light spill. |
| Direct impact (strike or entanglement) during Bundle launch and tow | Measures to avoid:<br>• No Bundle launches during period of main Humpback whale usage of Exmouth Gulf.<br>• Specific training on marine fauna observation | Low risk of a significant impact (i.e. direct physical interaction) to marine fauna.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
| --- | --- | --- |
| | and avoidance provided to vessel crews.<br>• MFO on board lead support vessel and key support vessels, to identify marine fauna within 500 m ahead of tow, to allow avoidance measures to be implemented. Avoidance measures may include a change to the Off bottom tow speed, delay to the start of the Surface tow component of a tow or a slight change to the tow route (within the 2 km wide Surface tow envelope).<br>• Adherence to Marine Fauna Management Plan (MFMP).<br>• Ability to suspend transit if required to avoid collision.<br>• Tow vessels and Bundle launch speeds low during launch (≤ 2 knots) and tow (≤ 8 knots).<br>• Use of a 'spotter plane' during any Bundle launches undertaken between March and July to identify location of any Whale sharks within Ningaloo Marine Park and allow avoidance.<br>Measures to minimise:<br>• NA<br>Measures to rehabilitate:<br>• Any fauna injuries and/or deaths will be reported and a register maintained.<br>• Injured fauna will be taken to the Exmouth office of the Department of Biodiversity, Conservation and Attractions (DBCA), or to | Monitoring<br>Visual monitoring by MFOs during Bundle launches. Recording of any strikes or entanglement. Any vessel strikes with cetaceans will be reported in the National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Exmouth Wildlife Care Group, for assessment/rehabilitation. | |
| Introduction of introduced marine pests (IMP) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Adoption of the Department of Agriculture and Water Resources (DAWR) 'Quick Domestic Ballast Water (DBW) Risk Assessment Tool (DAWR 2018).<br>• Adoption of the Department of Primary Industries and Regional Development (DPIRD) on-line 'Vessel Check' decision support tool and the adoption of appropriate biofouling management requirements.<br>Measures to rehabilitate:<br>• NA | Given the management measures no significant impacts to marine fauna are expected.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |
| Loss or alteration of coastal habitat as a result of changes to coastal processes or hydrodynamic/ hydrological regimes | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>Measures to rehabilitate:<br>• Management of onshore sediment accretion via monitoring and sand bypassing. | Loss of coastal habitat, such as roosting or foraging habitat for migratory birds, could occur as a result of changes to coastal processes leading to altered erosion or accretion patterns. The shoreline at Heron Point adjacent to the launchway was not found to represent key foraging or roosting habitat. Significant changes to the beach profile adjacent to the launchway, leading to a loss of marine fauna habitat, are not expected. Monitoring and mitigation will ensure no significant changes to coastal habitat.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | <u>Monitoring</u><br>The following monitoring is proposed:<br>• Survey of beach profiles adjacent to launchway (annual).<br>• Inspections, including photographic monitoring of shoreline adjacent to launchway (annual).<br>• Shoreline mapping (every 3-6 years). |
| Leak or spill of chemicals (including hydrocarbons) associated with launch and tow activities, accidental collisions and loss of control of pipeline Bundle during launch, laydown, towing, or ship groundings. Impacting marine fauna health | Measures to avoid:<br>• Bundle fully pressure tested and leak tested prior to launch.<br>• Ongoing monitoring of Bundle pressures prior to and during launch.<br>• Weather forecast/seasonal data reviewed to inform launch schedule.<br>• Weather forecast monitored ahead of launch operations and launch window defined.<br>• Defined limiting weather criteria.<br>• High specification tow vessels used for launch operations.<br>• System confirmation check completed prior to departing Parking area.<br>• Secondary system/redundancy design in bundle monitoring system.<br>• Tow vessels to be equipped with 'Dynamic Positioning' (DP) systems, with a suitable level of system redundancy.<br>• Full tow vessel position monitoring system | Given the inherent strength of the carrier pipe (the outside casing of the Bundle), the lack of liquid chemicals within the annulus and the control measures to be implemented to prevent a loss of control of the Bundle or support vessel (refer Marine Emergency Response Plan (Attachment 3)), the likelihood of a chemical leak or spill leading to an impact on marine fauna health is considered negligible.<br><br>Standard 'operating over water' management measures will be employed during the construction of the launchway to prevent spills of chemicals into the marine environment.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | verification prior to leaving Bundle Parking area.<br>• Secondary tow vessel position keeping system in place for passage through Ningaloo Marine Park.<br>• Vessel Assurance Suitability Surveys conducted prior to commencement of operations.<br>• Notice to mariners supporting information issued prior to tow to inform local vessels of operations.<br>• Guard vessel to monitor/enforce exclusion zones.<br>• Each vessel operating in adherence to International Regulations for Preventing Collisions at Sea (COLREGs)<br>• Vessel intervention if required (as described in guard vessel procedure for engaging 3rd party vessels).<br>• Community engagement and announcements locally.<br>• Broadcasting on VHF as required.<br>• Visual monitoring of bundle on surface (surface buoys and lights).<br>• Timing of Surface tow through Ningaloo Marine Park chosen to coincide with benign sea, tidal and weather conditions.<br>• Standard 'operating over water' management | |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | measures will be employed during the construction of the launchway.<br><br>Measures to minimise:<br>• Bundle carrier pipe does not contain any hydrocarbons).<br>• Any chemical to be used within flow lines must have:<br>o An OCNS Hazard Quotient rating of Gold, Silver, E or D have no substitution or product warning; or<br>o Further assessment to ensure the environmental risk is ALARP.<br><br>Measures to rehabilitate:<br>• Each vessel equipped with a vessel specific Shipboard Oil Pollution Emergency Plan (SOPEP) or equivalent and will follow response actions to incidental pollution in accordance with the vessel's emergency plan.<br>• Thorough clean-up of environment in the event of a leak or spill. | |
| **Key Environmental Factor: Flora and Vegetation** | | |
| EPA Objective | To protect flora and vegetation so that biological diversity and ecological integrity are maintained. | |
| **Potential Impact** | **Mitigation Measures** | **Predicted Outcome** |
| Direct loss of native vegetation and significant | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used | The proposed clearing is of communities that are common and widespread with all 10 vegetation communities directly impacted by the Proposal being |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| flora species during clearing for onshore infrastructure | wherever possible to minimise total ground disturbance.<br><br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>• Where practicable, land clearing will be undertaken progressively with the amount of active disturbance minimised.<br>• The site induction program will provide written and verbal information on protection of vegetation, conservation significant flora and ground disturbance authorisation procedures.<br>Measures to rehabilitate:<br>• Compacted areas will be ripped on the contour to remove soil compaction.<br>• Cleared vegetation and topsoil material will be retained for use in rehabilitation.<br>• Rehabilitation will be undertaken on disturbed construction areas (e.g. directional drilling sites, adjacent to access road) as they become available. | well represented outside of the Development Envelope.<br><br>Limited removal of individuals of Priority species *Corchorus congener* (P3) will occur as a result of implementation of the Proposal. *Corchorus congener* is known to occur widely in the Development Envelope and more broadly across the Learmonth area.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained.<br><br><u>Monitoring</u><br>Inspections/survey to confirm no clearing beyond Development Envelope. |
| Indirect loss or degradation of native vegetation due to dust emissions | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground | Dust emissions during construction will be short-term in nature and the potential impact area will be localised (<50 m from source). Flora and vegetation in areas adjacent to land clearing activities is locally |

| Potential Impact | Mitigation Measures | Predicted Outcome |
| --- | --- | --- |
| | disturbance.<br>• Vehicles and equipment will keep to designated roads and tracks.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Water cart used during clearing to prevent significant dust emissions.<br>• Topsoil will be stored in designated locations and respread over rehabilitated areas to act as a seed source.<br>• Cleared vegetation will be stored for subsequent respread over rehabilitation areas to protect the soil from erosion.<br>Measures to rehabilitate:<br>• Progressive rehabilitation will be undertaken on impacted areas (as required). | and regionally common.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Indirect loss or degradation of native vegetation due to the introduction or spread of weeds | Measures to avoid:<br>• Earth moving machinery will be cleaned of soil and vegetation prior to entering or leaving the Development Envelope.<br>• No weed affected soil, mulch or fill will be brought into the Development Envelope.<br>• During operations, vehicles and equipment will keep to designated roads and tracks. | Increased presence of weeds, (species and abundance) may affect flora and vegetation; however these impacts will result in localised and incidental effects on the health, abundance and structure of vegetation communities, all of which are well represented locally and in the region.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to minimise:<br>• A weed hygiene system will be developed and implemented during the construction phase to avoid the establishment of new populations within the Development Envelope.<br><br>Measures to rehabilitate:<br>• Weed control to be implemented within rehabilitation areas as required. | |
| Fragmentation of native vegetation during clearing for onshore infrastructure | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>Measures to minimise:<br>• Clearing activities will be managed to ensure clearing is strictly limited to that necessary for construction.<br>Measures to rehabilitate:<br>• Rehabilitation will be undertaken on disturbed construction areas (e.g. directional drilling sites, adjacent to access road) as they become available. | Fragmentation may affect flora and vegetation; however these impacts will result in localised and incidental effects on the health, abundance and structure of vegetation communities, all of which are well represented in the region.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Indirect loss or degradation of native vegetation due to changes in surface water | Measures to avoid:<br>• Where necessary, suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns. | Modification to surface water flows are considered to be minor at a local scale and as such are unlikely to affect the survival of, or reduce the condition of, vegetation within or adjacent to the Development Envelope. Vegetation communities within the Development Envelope are locally and regionally |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| flows or quality | Measures to minimise:<br>• Project design has considered the local surface water flow paths and location of drainage lines with the aim of minimising changes to natural flows.<br>• Hazardous materials will be stored in accordance with relevant Australian Standards.<br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas.<br>• Upon closure reinstatement of the natural flow paths will occur after removal of the project infrastructure. | widespread and are resilient to both drought and short-term inundation associated with seasonal rainfall events.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation, and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Indirect loss or degradation of native vegetation due to changes in groundwater flows or quality | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Groundwater abstraction will be no more than 12 ML/annum at abstraction rates of 0.3 L/s in individual bores.<br>• Hazardous materials will be stored in accordance with relevant Australian Standards.<br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas. | It is not expected that changes in groundwater levels that may result from abstraction of groundwater will impact flora and vegetation. No GDE communities have been identified in the Development Envelope.<br><br>No changes in groundwater quality are anticipated to result from development and implementation of the Proposal.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation, and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Loss or degradation of native vegetation due to leak or spill of chemicals (including hydrocarbons) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Hazardous materials will be stored in accordance with relevant Australian Standards.<br>• Refuelling will occur on concrete or HDPE-lined pads to contain any drips and spills. The pads will drain to a sump to allow removal of collected material.<br>• Spill kits will be located at strategic locations throughout the project area and employees trained in their use.<br>• Spills will be cleaned up and contaminated soils will either be treated in situ or removed from site by a licensed third party.<br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas. | Leaks or spills have potential to cause adverse impacts to flora and vegetation, however these impacts will result in localised and incidental effects on the health, abundance and structure of vegetation communities, all of which are well represented in the region.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Indirect loss or degradation of fauna habitat due to changes in fire regimes | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Development to be conducted in accordance with appropriate BAL specifications/conditions.<br>• Vehicle traffic will be confined to defined roads and tracks (except during active clearing).<br>• Firefighting equipment will be located on site | Mitigation measures will minimise the risk of Proposal-related fires. The Proposal-specific impacts on local fire regimes are not anticipated to adversely impact the environment given the open structure of the vegetation and locally and regionally common nature of fauna habitats within the Development Envelope.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | and in project vehicles.<br>• Project personnel will be trained in fire response.<br>• A Hot Work Permit system will be developed and implemented.<br>• The project site induction will include information on the prevention and management of fires.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available. | |
| Indirect impacts to native fauna as a result of introduction or increase of feral animals | Measures to avoid:<br>• Lidded bins.<br>• Regular removal of waste by a licenced contractor.<br>Measures to minimise:<br>• Access control measures implemented to sources of water (e.g. fencing, or the use of sealed bladders, covers, etc.).<br>Measures to rehabilitate:<br>• A feral animal control program will be implemented if populations of feral animals noticeably increase. | It is not considered likely that development and operation of the Proposal will result in introduction of new feral animal species to the area or an increase in abundance of feral animals. It is anticipated that the proposed controls will be effective and will prevent an increase in diversity and abundance of feral animals.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Loss or alteration of coastal habitat as a result of changes to coastal processes or hydrodynamic/ hydrological regimes | Addressed under marine fauna as related to migratory bird habitat. | |
| **Key Environmental Factor: Subterranean Fauna** | | |
| EPA Objective | To protect subterranean fauna so that biological diversity and ecological integrity are maintained. | |
| Potential Impact | Mitigation Measures | Predicted Outcome |
| Direct loss of individuals or habitat (including Directory of Important Wetlands in Australia Cape Range Subterranean Waterways – WA006) during construction of onshore infrastructure | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Ground excavation will be kept to a minimum (expected to be limited to cuts through the tops of dunes and minor excavations during the construction of surface water drainage infrastructure).<br>Measures to rehabilitate:<br>• Rehabilitation will be undertaken on disturbed construction areas (e.g. directional drilling sites, adjacent to access road) as they become available. | Subterranean fauna habitat was not recorded in proximity to the fabrication shed, sprayfield or the majority of the Bundle tracks. Excavations associated with the construction of the Proposal will be shallow (up to 1 m) and are predominantly within areas not supporting stygofauna. No troglofauna habitat was recorded within the main Development Envelope but may be present at the borefield.<br><br>The EPA objective for Subterranean Fauna will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Loss of individuals or habitat due to leak or spill of chemicals (including hydrocarbons) which result in groundwater contamination | Measures to avoid:<br>• Hazardous materials will be stored, in or adjacent to the fabrication shed, in accordance with relevant Australian Standards and Dangerous Goods Storage regulations.<br>• Chemical storage and handling procedures to prevent leaks or spills.<br>Measures to minimise:<br>• Refuelling to occur on concrete or HDPE-lined pads to contain any drips and spills. The pads will drain to a sump to allow removal of collected material.<br>• Spill kits will be located at strategic locations throughout the project area and employees trained in their use.<br>• Employees and contractors will be trained in use of spill kits.<br>• Spills will be cleaned up and contaminated soils will be removed from site by a licensed third party.<br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas. | Considering the application of standard industry practices for chemical storage and handling, and the absence of stygofauna or troglofauna habitat in proximity to the fabrication shed, the risk of impacts to subterranean fauna is considered low.<br><br>The quality of groundwater will be maintained and the EPA objective for Subterranean Fauna will be met. |
| Indirect loss of individuals or habitat due to presence of onshore infrastructure | Measures to avoid:<br>• Where necessary, suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns. | After installation of surface water drainage measures, surface water flow patterns are expected to remain similar to baseline flow patterns. Therefore significant impacts to surface water infiltration patterns are not expected. Subterranean fauna habitat was not recorded in proximity to the fabrication shed, |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| impacting surface water infiltration | Measures to minimise:<br>• Project design has considered the location of drainage lines with the aim of minimising changes to natural flows.<br>Measures to rehabilitate:<br>• Upon closure the reinstatement of the natural flow paths after removal of project infrastructure. | sprayfield or the majority of the Bundle tracks.<br><br>The EPA objective for Subterranean Fauna will be met. |
| Indirect loss of individuals or habitat due to changes to groundwater flows or quality (including from groundwater abstraction, or discharges of treated wastewater) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Minimise water abstraction through the storage and re-use of hydrotest water.<br>• Water storages will be lined to minimise seepage.<br>• Low abstraction rates to reduce the likelihood of groundwater drawdown.<br>Measures to rehabilitate:<br>• NA. | Under the most conservative (worst-case) scenario, modelling predicts a maximum drawdown in the immediate location of the production bores of 1.15 m after 10 years of continuous abstraction, assuming no recharge occurs. Changes to localised groundwater levels are not predicted to significantly impact stygofauna habitat. The EPA objective for Subterranean Fauna will be met.<br><br><u>Monitoring</u><br>Regular (quarterly) monitoring of groundwater quality (including salinity) and levels, in accordance with abstraction licence conditions |
| **Key Environmental Factor: Terrestrial Fauna** | | |
| EPA Objective | To protect terrestrial fauna so that biological diversity and ecological integrity are maintained. | |
| **Potential Impact** | **Mitigation Measures** | **Predicted Outcome** |
| Direct loss of native fauna due to vehicle strike during | Measures to avoid:<br>• NA | Fauna injury or mortality due to vehicle strikes may occur during construction and operations. Implementation of management measures will reduce the likelihood of vehicle strike. Given fauna species of |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| construction and operations | Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Where practicable, land clearing will be undertaken progressively with the amount of active disturbance minimised.<br>• A fauna relocation team will be present to assist in recovery and relocation of any native fauna displaced during land clearing.<br>• Vehicle traffic will be confined to defined roads and tracks (except during active clearing).<br>• Speed limits will be implemented and enforced to minimise fauna mortality due to vehicle strike.<br>• The site induction program will provide information on fauna of conservation significance, including their appearance and habitats.<br>Measures to rehabilitate:<br>• Vertebrate fauna injuries and/or deaths will be reported and a register maintained.<br>• Injured vertebrate fauna will be taken to the Exmouth office of DBCA, or to Exmouth Wildlife Care Group, for assessment/ rehabilitation. | conservation significance are all migratory or marine bird species, the likelihood of interaction with vehicles is considered low.<br><br>Given the proposed management measures, a significant impact on the biological diversity and ecological integrity of terrestrial fauna is not predicted. |
| Direct loss of native fauna due to entrapment within water | Measures to avoid:<br>• NA | Given the short construction period (approximately 6 weeks), the small diameter of the pipe (≤ 150 mm) and resultant small size of the trench required, and the use of existing tracks, fauna entrapment is not |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| pipeline trench | Measures to minimise:<br>• Fauna shelters (e.g. hessian bags) placed every 50 m or less in open trench.<br>• Open sections of trench inspected in the morning, within three hours of sunrise, and immediately before pipe laying and backfilling. Any entrapped fauna retrieved and released.<br>• Trench inspections, and fauna retrieval and release, by a suitably trained fauna handler.<br>• Trench backfilled (to at least cover pipe) as soon as practicable after pipe laying.<br>• Retrieved fauna released into suitable habitat near point of rescue, at appropriate distance from trench, as soon as practicable, except where they need to be held for treatment (dehydration, hypothermia, etc.), or are a nocturnal species best released in the evening.<br>Measures to rehabilitate:<br>• Fauna unfit for release referred to the Exmouth office of DBCA, or to Exmouth Wildlife Care Group, for assessment/ rehabilitation. | expected to be a significant risk to local fauna populations.<br><br>Following the implementation of the proposed management measures, a significant impact on the biological diversity and ecological integrity of terrestrial fauna is not expected. |
| Direct loss of fauna habitat during clearing for onshore infrastructure | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance. | The fauna habitats identified within the Development Envelope are associated with vegetation communities that are well represented locally and regionally.<br><br>The six conservation significant fauna identified in the Development Envelope are marine and migratory bird species that use coastal habitat. Similar and better |

| Potential Impact | Mitigation Measures | Predicted Outcome |
| --- | --- | --- |
| | Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>• Where practicable, land clearing will be undertaken progressively with the amount of active disturbance minimised.<br>• The site induction program will provide information of fauna of conservation significance, their appearance and habitats.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available.<br>• Topsoil will be appropriately stored and respread over rehabilitated areas to act as a seed source.<br>• Cleared vegetation will be appropriately stored and respread over rehabilitated areas to protect the soil from erosion and provide habitat for fauna. | quality coastal habitat is locally and regionally widespread and direct impacts as a result of the Proposal are small. This is discussed further in Section 5.4.5.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained.<br><br><u>Monitoring</u><br>Inspections/survey to confirm no clearing beyond Development Envelope. |
| Indirect loss or degradation of fauna habitat due to dust emissions | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>Measures to minimise:<br>• Water carts will be utilised for dust | Potential short-term impacts during construction are considered unlikely to significantly affect habitat condition or result in loss of habitat.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | suppression during construction.<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>•<br>Measures to rehabilitate:<br>• Disturbed or degraded areas will be rehabilitated. | |
| Indirect loss or degradation of fauna habitat due to introduction or spread of weeds | Measures to avoid:<br>• Earth moving machinery will be cleaned of soil and vegetation prior to entering or leaving the Development Envelope.<br>• No weed affected soil, mulch or fill will be brought into the Development Envelope.<br>• During operations, vehicles and equipment will keep to designated roads and tracks.<br>Measures to minimise:<br>• A weed hygiene system will be developed and implemented during the construction phase to avoid the establishment of new populations within the Development Envelope.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available.<br>• Conduct weed control in rehabilitation areas. | Increased presence of weeds (species and abundance) may affect fauna habitat. However, given the proposed management measures these impacts will not result in significant impacts on the health, abundance and structure of vegetation communities.<br><br>Subsea 7 considers that the potential impacts to fauna habitat can be managed such that there are no significant residual impacts to terrestrial fauna habitat and the biological diversity and ecological integrity of fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Fragmentation of fauna habitat due to presence of onshore infrastructure | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>Measures to minimise:<br>• Clearing activities will be managed to ensure clearing is strictly limited to that necessary for operations.<br>• Stock fencing to be installed around site boundary that will allow native fauna to cross site.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available. | The potential for habitat fragmentation is most likely to occur where there is limited extent of a fauna habitat supporting a population of breeding fauna species or where a particular species is limited to that specific habitat. Fauna habitats in the Development Envelope are well represented locally and regionally and do not support species of conservation significance that are restricted.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained. |
| Indirect loss or degradation of fauna habitat due to changes in surface water flows or changes in groundwater levels or quality | Measures to avoid:<br>• Project infrastructure and associated surface water management infrastructure has considered existing conditions and has been designed to minimise impacts to surface drainage patterns.<br>Measures to minimise:<br>• Monitoring of groundwater levels and quality as required under the licence to abstract groundwater (under 5C of the *Rights in Water and Irrigation Act 1914*).<br>Measures to rehabilitate:<br>• Rehabilitation of areas impacted by changes to | Long-term losses of fauna habitat or changes in the biological diversity and ecological integrity of fauna habitat are not expected to result from localised changes in surface water flows.<br><br>Given the absence of GDE within the Development Envelope and locally and regionally widespread nature of fauna habitats within the Development Envelope, localised changes to groundwater levels and or quality are not considered likely to have significant changes on the biological diversity and ecological integrity of fauna habitats.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | surface water flows or quality. | maintained. |
| Indirect loss or degradation of fauna habitat due to changes in fire regimes | Measures to avoid:<br>• NA.<br>Measures to minimise:<br>• Development to be conducted in accordance with appropriate BAL specifications/conditions.<br>• Vehicle traffic will be confined to defined roads and tracks (except during active clearing).<br>• Firefighting equipment will be located on site and in project vehicles.<br>• Project personnel will be trained in fire response.<br>• A Hot Work Permit system will be developed and implemented.<br>• The project site induction will include information on the prevention and management of fires.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available. | Mitigation measures will minimise the risk of Proposal-related fires. The Proposal-specific impacts on local fire regimes are not anticipated to adversely impact the environment given the open structure of the vegetation and locally and regionally common nature of fauna habitats within the Development Envelope.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained. |
| Indirect impacts to native fauna as a result of introduction or increase of feral animals | Measures to avoid:<br>• Lidded bins.<br>• Regular removal of waste by a licenced contractor.<br>Measures to minimise:<br>• Access control measures implemented to | It is not considered likely that development and operation of the Proposal will result in introduction of new feral animal species to the area or an increase in abundance of feral animals. It is anticipated that the proposed controls will be effective and will prevent an increase in diversity and abundance of feral animals.<br><br>Based on the above, the biological diversity and |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | sources of water (e.g. fencing, or the use of sealed bladders, covers, etc.).<br>Measures to rehabilitate:<br>• A feral animal control program will be implemented if populations of feral animals noticeably increase. | ecological integrity of terrestrial fauna will be maintained. |
| Loss or alteration of coastal habitat as a result of changes to coastal processes or hydrodynamic/ hydrological regimes | Addressed within Section 5.4.6.11 as related to migratory bird habitat. | |
| **Key Environmental Factor: Inland Waters** | | |
| EPA Objective | To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. | |
| **Potential Impact** | **Mitigation Measures** | **Predicted Outcome** |
| Changes to surface water flow patterns due to the presence of infrastructure | Measures to avoid:<br>• Where necessary, suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns.<br>Measures to minimise:<br>• Project design has considered the location of drainage lines with the aim of minimising changes to natural flows.<br>Measures to rehabilitate:<br>• Upon closure the reinstatement of the natural | After installation of surface water drainage measures, surface water flow patterns are expected to remain similar to baseline flow patterns, and changes to flow velocities are not expected to alter the natural scour characteristics of the catchment.<br><br>The hydrological regimes will be maintained after implementation of the Proposal so that environmental values are protected consistent with the EPA objective for Inland Waters. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | flow paths after removal of the project infrastructure. | |
| Impact to surface water quality due to exposure of soils (risk of erosion and elevated suspended solids) | Measures to avoid:<br>• Where necessary, suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns.<br>• Project design has considered the location of drainage lines with the aim of minimising changes to natural flows.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>• Where practicable, land clearing will be undertaken progressively with the amount of active disturbance minimised.<br>• Use of erosion control measures, such as surface treatments (compaction, hydromulch) of disturbed areas to minimise soil erosion.<br>Measures to rehabilitate:<br>• Rehabilitation will be undertaken on disturbed construction areas (e.g. directional drilling sites, adjacent to access road) as they become available.<br>• Upon closure the reinstatement of the natural flow paths after removal of the project infrastructure. | Significant impacts to surface water quality from erosion during construction and operations are not expected as no significant changes to surface water flow velocities have been predicted.<br><br>The quality of surface water will be maintained so that environmental values are protected and the EPA objective for Inland Waters will be achieved. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Impact to surface water and groundwater quality due to treated wastewater discharge | Measures to avoid:<br>• WWTP designed and located consistent with regulatory requirements relevant to the protection of water quality.<br>• Treatment of greywater will be provided by an advanced system (such as a Wise Water system) to ensure a high recovery of nutrients.<br>• Location of sprayfield chosen to avoid defined drainage channels.<br>Measures to minimise:<br>• All blackwater will be tankered offsite.<br>• Spray field appropriately sized to promote nutrient update by vegetation and soil.<br>Measures to rehabilitate:<br>• NA. | No significant impact to surface or groundwater quality is expected as a result of the discharge of treated wastewater.<br><br>The quality of surface and groundwater will be maintained so that environmental values are protected and the EPA objective for Inland Waters will be met. |
| Impact to groundwater levels due to groundwater abstraction | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Minimise water abstraction through the storage and re-use of hydrotest water.<br>• Water storages will be lined to minimise seepage.<br>• Low abstraction rates to reduce the likelihood of groundwater drawdown. | Under the most conservative (worst-case) scenario, modelling predicts a maximum drawdown in the immediate location of the production bores of 1.15 m after 10 years of continuous abstraction, assuming no recharge occurs. Changes to localised groundwater levels are not predicted to adversely impact on beneficial uses. Local hydrological regimes will be maintained and the EPA objective for Inland Waters will be met.<br><br><u>Monitoring</u><br>Regular (quarterly) monitoring of groundwater quality (including salinity) and levels, in accordance with |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• NA. | abstraction licence conditions. |
| Impact to surface water and groundwater quality due to leak or spill of chemicals (including hydrocarbons) | Measures to avoid:<br>• Hazardous materials will be stored in accordance with relevant Australian Standards and Dangerous Goods Storage regulations.<br>• Chemical storage and handling procedures to prevent leaks or spills.<br>Measures to minimise:<br>• Refuelling to occur on concrete or HDPE-lined pads to contain any drips and spills. The pads will drain to a sump to allow removal of collected material.<br>• Spill kits will be located at strategic locations throughout the project area and employees trained in their use.<br>• Employees and contractors will be trained in use of spill kits.<br>• Spills will be cleaned up and contaminated soils will be removed from site by a licensed third party.<br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas. | Considering the application of standard industry practices for storage and handling, the risk of contamination of surface and groundwaters is considered low.<br><br>The quality of surface and groundwater will be maintained so that environmental values are protected and the EPA objective for Inland Waters will be met. |

| Key Environmental Factor: Social Surroundings | | |
|---|---|---|
| EPA Objective | To protect social surroundings from significant harm. | |
| Potential Impact | Mitigation Measures | Predicted Outcome |
| Disturbance to Aboriginal heritage places and/or cultural associations during construction | Measures to avoid:<br>• Heritage surveys completed to allow any significant heritage sites to be mapped and avoided.<br>Measures to minimise:<br>• Cultural awareness training for the workforce.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>• The site induction program will provide written and verbal information on cultural and heritage awareness.<br>• Heritage monitors during clearing and construction activities. The quantity and extent of monitoring activities will be agreed on a case by case basis for each clearing or excavation operation.<br>• If artefacts are located, all work will be stopped until appropriate assessment has been completed and approval to remove/disturb is obtained.<br>• Approved Indigenous Land Use Agreement (ILUA) to be obtained and adhered to.<br>• Cultural Heritage Management Plan to be developed and implemented.<br>• Providing Culture Awareness training to workforce. | Given that no sites or cultural places of significance were identified during the heritage surveys, significant impacts to Aboriginal Heritage are not expected.<br><br>The proposed management measures will ensure the EPA objective for Social Surroundings will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• NA | |
| Impacts to the social values (e.g. aesthetics and active use) of the Proposal area during construction | Measures to avoid:<br>• Access to Heron Point and the Bay of Rest will be maintained.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the Proposal.<br>• Minimisation of disturbance to dunes and other elevated vantage points within the Development Envelope.<br>• Appropriate management of noise, dust and light emissions.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available. | Given the maintenance of access to Heron Point and the Bay of Rest, and the management of potential aesthetic and amenity impacts associated with noise, dust and light, it is considered that the EPA objective for Social Surroundings will be met. |
| Changes to surface water flow patterns and/or coastal processes which may impact on Aboriginal heritage places | Measures to avoid:<br>• Heritage survey completed to allow any significant heritage sites to be mapped and impacts avoided.<br>• Where necessary, suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns.<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed. | Given that no Aboriginal sites of places of significance were identified, and the proposed management of surface water flows and coastal processes, it is considered that the EPA objective for Social Surroundings will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | • Project design has considered the location of drainage lines with the aim of minimising changes to natural flows.<br>• Management of onshore sediment accretion via monitoring and sand bypassing.<br>• Cultural Heritage Management Plan to be developed and implemented.<br>Measures to rehabilitate:<br>• Upon closure the reinstatement of the natural flow paths after removal of the project infrastructure. | |
| Permanent constraint on access and traditional cultural activities | Measures to avoid:<br>• Access to Heron Point and the Bay of Rest will be maintained.<br>• Subsea 7 commits to ensuring that the Gnulli will be welcome visitors into the Development Envelope and that access will not be unreasonably refused.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the Proposal.<br>• Cultural Heritage Management Plan to be developed and implemented.<br>• Approved Indigenous Land Use Agreement (ILUA) to be obtained and adhered to.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they | Given that the site does not contain any culturally significant areas used for customary practices, and that access to Heron Point and the Bay of Rest will be maintained, impacts are considered minimal. The EPA Objective for Social Surroundings will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
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| | become available. | |
| Impacts to the heritage values of the Ningaloo Coast World Heritage Property and the Ningaloo Coast World Heritage Place | Measures to avoid:<br>• Surface tow to avoid interaction with the seabed within the Ningaloo Coast World Heritage Property (also referred to as the World Heritage Area) and the Ningaloo Coast World Heritage Place.<br>Measures to minimise:<br>• Limit on the number of Bundle launches (average of two, up to a maximum of three, per year).<br>• No launches during period of peak usage of Exmouth Gulf by Humpback whales (August to October).<br>• Local stakeholder engagement team in place to receive continuous feedback from local community groups.<br>Measures to rehabilitate:<br>• NA | Given the short-term nature of the tow operations through the Ningaloo Coast WHA, the Bundle tow operation is not likely to have any significant impacts on the natural beauty and aesthetic importance of the area, or on the important and significant natural habitats. There will be no contact with the seabed in this area and therefore no impacts to BCH. The likelihood of a marine fauna strike is low due to the numerous control measures that will be implemented.<br><br>The heritage values of the Ningaloo Coast World Heritage Area and the Ningaloo Coast World Heritage Place are unlikely to be impacted as a result of the Proposal. |
| Impacts to amenity values (including visual landscape, scenic and visual aesthetic values and recreational tourism) in a | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Limit on the number of Bundle launches (average of two, up to a maximum of three, per year).<br>• Public notification prior to Bundle tow | A Bundle tow will traverse Ningaloo Marine Park for a duration of approximately four hours per launch, with no residual effect following this period. A maximum of three Bundles will be launched per year.<br><br>Impacts to amenity values will not be significant and the EPA objective for Social Surroundings will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| marine park | operations.<br>• No launches during period of peak usage of Exmouth Gulf by Humpback whales (August to October).<br>• Local stakeholder engagement team in place to receive continuous feedback from local community groups.<br>Measures to rehabilitate:<br>• NA | |
| Impacts to the social values (e.g. aesthetics or active use) of the Proposal area during operations | Measures to avoid:<br>• Access to Heron Point and the Bay of Rest will be maintained.<br>Measures to minimise:<br>• Limit on the number of Bundle launches (average of two, up to a maximum of three, per year).<br>• Public notifications prior to and during a Bundle launch.<br>• Local stakeholder engagement team in place to receive continuous feedback from local community groups.<br>Measures to rehabilitate:<br>• NA | The Bundle and tow/support vessels will only be visible from Vlamingh Head Lighthouse for approximately 18 hours 21 minutes per tow. The Bundle tow will only occur within the WHA for a total of three hours 48 mins.<br><br>Third party vessels will be able to navigate, and utilise, the area outside of the exclusion zone, during a Bundle launch and tow.<br><br>Impacts to social values will not be significant and the EPA objective for Social Surroundings will be met. |
| Impacts to commercial fishing and recreational | Measures to avoid:<br>• Public notifications prior to and during a Bundle launch. | Commercial fishing operators will have advanced notice of a Bundle launch and will be able to schedule activities to avoid the Bundle tow route (as required). The Exmouth Gulf prawn fishery occurs across |

| Potential Impact | Mitigation Measures | Predicted Outcome |
| --- | --- | --- |
| fishing operations/ businesses and tourism activities in the Proposal area | • Local stakeholder engagement team in place to receive continuous feedback from local operators.<br>Measures to minimise:<br>• Limit on the number of Bundle launches (average of two, up to a maximum of three, per year).<br>• Preferential use of local vessels to support Bundle launches.<br>Measures to rehabilitate:<br>• NA | approximately 300 square nautical miles, so the area affected during a Bundle launch is negligible.<br><br>Recreational tour operators will be able to navigate, and utilise, the area outside of the exclusion zone during a Bundle launch and tow.<br><br>Impacts to commercial fishing and recreational fishing operations/businesses and tourism activities will not be significant. Therefore, the EPA objective for Social Surroundings will be met. |
| Other Environmental Factors or Matters: Terrestrial Environmental Quality | | |
| EPA Objective | To maintain the quality of land and soils so that environmental values are protected. | |
| Potential Impact | Mitigation Measures | Predicted Outcome |
| Impact to soil, surface water or groundwater quality following the exposure or disturbance of acid sulphate soils | Measures to avoid:<br>• None (no ASS recorded).<br>Measures to minimise:<br>• Minimise the extent and depth of excavations.<br>Measures to rehabilitate:<br>• In the event of any ASS disturbance undertake treatment (e.g. lime dosing) and post-treatment testing. | Given no ASS were identified within the Development Envelope, the Proposal will not cause impacts associated with their disturbance.<br><br>The EPA objective for terrestrial environmental quality will be met. |
| Impacts to soil, surface water or groundwater quality due to | Measures to avoid:<br>• None (no ASS recorded) | No significant impact to terrestrial environmental quality is expected.<br><br>The EPA objective for terrestrial environmental quality |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| leaks or spills | Measures to minimise:<br>• Implement appropriate chemical transport, storage and handling procedures.<br>• Chemical and hydrocarbon storage vessels will be bunded.<br>• Staff will be trained in refuelling procedures and the handling and management of chemicals.<br>• Oil spill kits and equipment will be available on site.<br>Measures to rehabilitate:<br>• In the event of a leak or spill the contamination will be contained and contaminated material removed for offsite disposal at a licenced facility. | will be met. |

ES Table 3: Summary of Potential Impacts, Proposed Mitigation, and Outcomes

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# TABLES

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# 1. INTRODUCTION

## 1.1 PURPOSE AND SCOPE

This Environmental Review Document (ERD) has been prepared by Subsea 7 Australia Contracting Pty Ltd (Subsea 7) for the Learmonth Pipeline Fabrication Facility (the Proposal). The Proposal is to construct and operate a new pipeline fabrication facility adjacent to the western shoreline of Exmouth Gulf, at Learmonth, approximately 35 km south of the Exmouth townsite. The proposed facility will allow construction and launching of pipeline Bundles for the offshore oil and gas industry. A pipeline Bundle, used in development of offshore gas fields, co-locates a number of services within a single pipeline, which is constructed onshore before being launched and towed offshore to the field under development.

The Proposal includes the construction of a fabrication shed, where the Bundles will be constructed, a storage area where the Bundle materials will be stored prior to use, and two approximately 10 km long Bundle tracks along which each Bundle will be constructed and then launched. A Bundle launchway, crossing the beach and extending into the shallow subtidal area, will facilitate the launch of each Bundle.

Subsea 7 referred the original Proposal to the Western Australian Environmental Protection Authority (EPA) on 23 October 2017. On 20 November 2017, the EPA determined the original Proposal required formal assessment with the level of assessment set as Public Environmental Review (PER), with an eight-week public review period (Assessment number 2136). An Environmental Scoping Document (ESD) was prepared by the EPA to define the form, content, timing and procedure of the Environmental Review Document (ERD). A draft ESD was published for public comment by the EPA on 14 February 2018, with the final, approved, ESD published on 18 April 2018. Subsequently Subsea 7 submitted a request to make changes to the Proposal under section 43A of the *Environmental Protection Act 1986* (EP Act). Following initial discussions between Subsea 7 and the EPA, Subsea 7 requested that the EPA terminate its assessment of the Proposal.

Subsea 7 referred an amended Proposal to the EPA on 16 May 2019. On 29 May 2019, the EPA determined the Proposal required formal assessment with the level of assessment set as PER, with an eight-week public review period (Assessment number 2208). An Environmental Scoping Document (ESD) was prepared by the EPA to define the form, content, timing and procedure of the Environmental Review Document (ERD). A final, approved, ESD was published on 8 July 2019 (Appendix 1). The ESD outlines the preliminary key environmental factors, other environmental factors or matters and work requirements for completion of the ERD.

The ERD (this document) has been prepared to fulfil the requirements for assessment of the Proposal at a level of PER pursuant to Part IV of the Western Australian *Environmental Protection Act 1986* (EP Act). It has been prepared in accordance with the EP Act Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA 2016a), the Guidelines for Preparing an Environmental Review Document (EPA 2018b) and to the requirements of the ESD.

The Proposal was referred to the Department of the Environment and Energy (DoEE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 18 October 2017. On 24 February 2018, the Proposal was deemed a Controlled Action. On 1 July 2019 the DoEE accepted a variation to the Proposal to allow assessment of the amended Proposal through an accredited assessment under the EP Act, with the ERD (this document) addressing the potential impacts to the relevant controlling provisions.

## 1.2 PROPONENT

Subsea 7 is a world-leading seabed-to-surface engineering, construction and services contractor to the offshore energy industry. Subsea 7 operates throughout the world, delivering high-quality services built on the core strengths of engineering, project management, supply chain and vessel management, supported by their commitment to invest in people, technology and assets worldwide.

In all their major operating locations, they aim to build local businesses founded on local leadership. Subsea 7 develops high-quality personnel to deliver responsive support to their clients, contribute to local economies and communities and support regional supply chains. Subsea 7 has operated in Australia and New Zealand for the past 40 years working with all major oil and gas operators and has an office based in Perth with about 70 permanent employees. Subsea 7 has been involved in the majority of major oil and gas developments in Australia, including the Chevron operated Gorgon Project and Woodside operated Pluto Project.

The proponent can be contacted at:

Subsea 7 Australia Contracting Pty Ltd (Subsea 7) (ABN 005 288 406)
15-17 William Street
Perth
Western Australia

The key contact for the project is:

David Knox
Project Manager
Email: Subsea7communications.australia@subsea7.com

## 1.3 ENVIRONMENTAL IMPACT ASSESSMENT AND PROCESS

### 1.3.1 Overview

As outlined in Section 1.1, the Proposal was referred to the EPA under Section 38 of the EP Act, and the EPA set the level of assessment for the project at Public Environmental Review (PER) with an eight-week public review period.

At a Commonwealth level, it was determined that the Proposal constitutes a controlled action under the EPBC Act, with assessment by 'accredited assessment' under the EP Act required, for the following controlling provisions:

- World Heritage Properties (Sections 12 & 15A).
- National Heritage Places (Sections 15B & 15C).
- Listed Threatened species and communities (Sections 18 & 18A).
- Listed Migratory Species (Sections 20 & 20A).
- Commonwealth Marine Areas (Sections 23 & 24A).

Under an 'accredited assessment', a single document (the ERD, this document) is prepared and assessed by the EPA. Following publication of an EPA Report, separate approvals are then granted under the EP Act (by the WA Minister for Environment) and under the EPBC Act (by the Federal Environment Minister).

The ERD will be made available for eight weeks, during which time the public may make submissions to the EPA regarding the Proposal.

### 1.3.2 EPA Assessment Process

Procedural requirements for environmental assessment prescribed under the EP Act are set out in the Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA 2016a).

Following the EPA determination that the Proposal required formal assessment, the formal assessment process needs to be completed (refer Figure 1-1). Following preparation of the Environmental Review Document (ERD, this document) (Step 2 in Figure 1-1), and the completion of the subsequent public review period (Step 3 in Figure 1-1), the EPA will provide copies of public submissions (with the names of private individuals removed) to Subsea 7. Subsea 7 is then required to prepare a summary of the key issues and matters raised in the submissions and respond to the satisfaction of the EPA.

The EPA will then complete the assessment of the Proposal (Step 4 in Figure 1-1), taking into account the ERD document, public submissions, Subsea 7's response to submissions, and advice obtained from any other persons it considers appropriate, and then submit an assessment report (EPA Report) to the WA Minister for Environment and Federal Environment Minister.

The report to each of the ministers will address the environmental factors and MNES relevant to the Proposal, conditions and procedures to which the implementation of the Proposal should be subject, and any other recommendations the EPA considers appropriate.

Key dates associated with the State assessment thus far are as follows:

- Proposal referred to the Western Australian Environmental Protection Authority (EPA) on 23 October 2017.
- The EPA determined the original Proposal (Assessment number 2136) required formal assessment with the level of assessment set as Public Environmental Review (PER), with an eight-week public review period, on 20 November 2017.
- A draft ESD was published for public comment by the EPA on 14 February 2018.
- Final, approved, ESD published on 18 April 2018.
- A request for a Change to Proposal under Section 43A of the EP Act submitted to the EPA on 13 February 2019 and published for public review on 28 February 2019. The proposed amendments included:
    - Amendment of the Proposal title from the 'Learmonth Bundle Site' to the 'Learmonth Pipeline Fabrication Facility'.
    - Extension of the onshore Development Envelope adjacent to the Minilya-Exmouth Road to ensure a safe alignment of the site access road.
    - Inclusion of the proposed production bores and associated water supply pipeline within the Development Envelope.
    - Slight modification of the tow route and definition of an Offshore Operations Area to describe the maximum area (or envelope) within which launch and tow operations will occur.
    - Definition of an Offshore Operations Area (Off bottom tow) within which Bundle ballast chains, which hang below the Bundle, will be in contact with

the seabed. This area represents an envelope within which any and all disturbance associated with Bundle launches, over the life of the facility, may occur.

    - A slight realignment of the 'Bundle laydown area' (now termed the Bundle parking area) to align with the revised tow route.
    - Change to a 'Surface tow' method through Ningaloo Marine Park and the definition of an Offshore Operations Area (Surface tow) representing an envelope within which all Bundle tows, over the life of the facility, will occur.

- Subsea 7 subsequently requested a termination of the EPA's assessment. An amended Proposal was referred under the EP Act on 16 May 2019.
- The EPA determined the amended Proposal (Assessment number 2208) required formal assessment with the level of assessment set as PER, with an eight-week public review period, on 29 May 2019.
- Final, approved, ESD published on 8 July 2019.

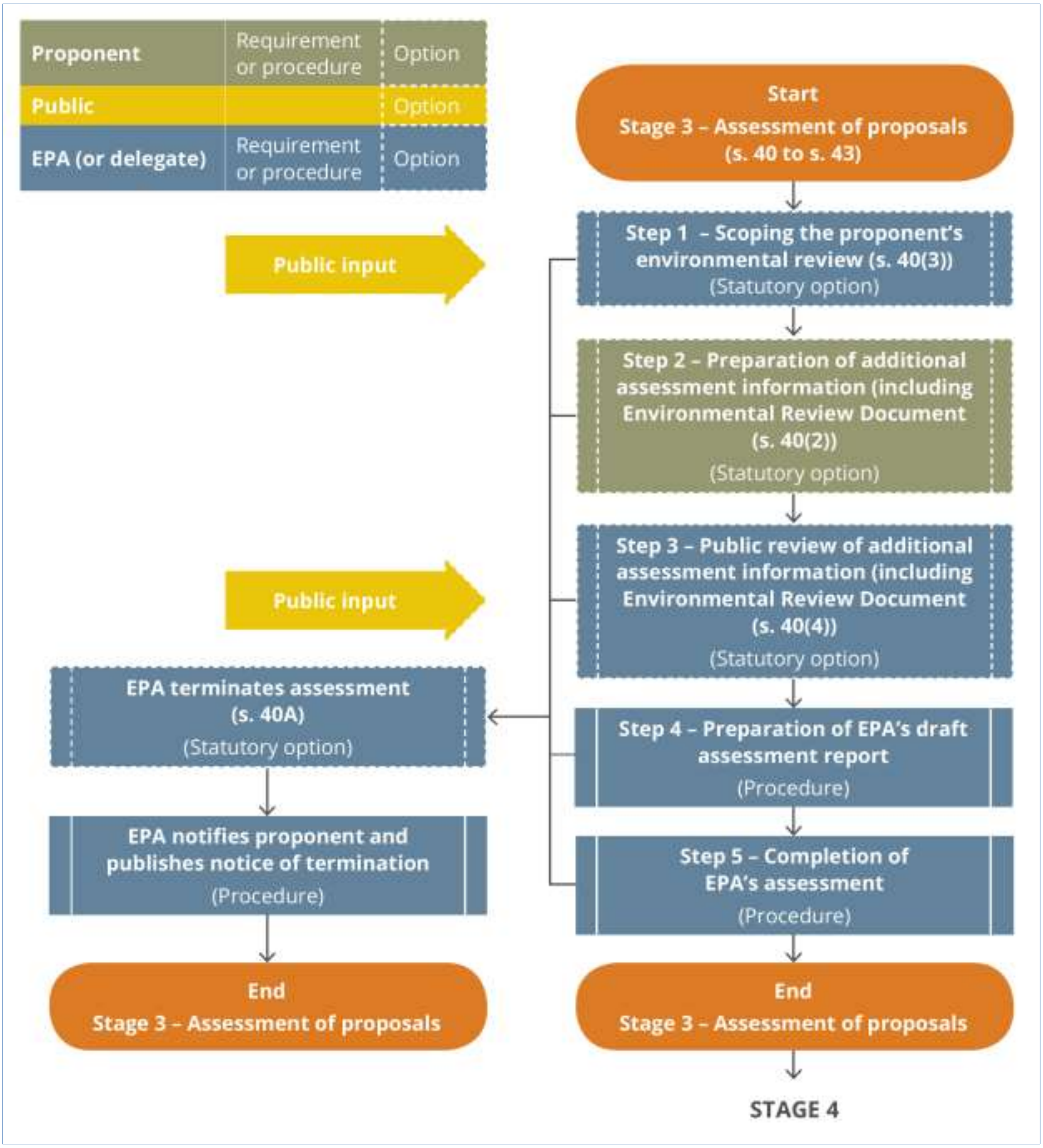


Figure 1-1: Flowchart of EPA Assessment Process (Source EPA 2016b)

### 1.3.3 State Approval Process

The WA Minister for Environment will publish and circulate the EPA Report as soon as reasonably able to do so. In accordance with section 100(2) of the EP Act, any person may lodge an appeal with the Minister for Environment against the contents or recommendations of the EPA Report within 14 days of the publication of the report. Once any appeals have been considered and determined by the Minister, the Minister then consults with the relevant Decision-Making Authorities (in this case the Minister for Water, Minister for

Planning, Minister for Aboriginal Affairs, and the Chief Executive Officer of the Shire of Exmouth) before deciding whether the Proposal can proceed and issuing a 'Statement that the Proposal may be implemented' (Ministerial Statement), which includes conditions of approval under the EP Act. The Minister's decision and the conditions set can be appealed by the proponent (only) within 14 days of release.

### 1.3.4 Commonwealth Approval Process

The Federal Environment Minister (or delegate) will review the EPA Report and decide whether the Proposal can proceed, before issuing a formal approval, including conditions of approval, under the EPBC Act.

## 1.4 OTHER APPROVALS AND REGULATION

In addition to assessment of the Proposal under Part IV of the EP Act and under the EPBC Act, a range of other environmental assessments and authorisations will be required for implementation of the Proposal. Additional environmental approvals likely to be required are summarised in Table 1-1.

| Proposal Activities | Land tenure/ access | Approval Required | Legislation regulating the activity |
|---|---|---|---|
| Taking or disturbing flora or fauna | Pastoral Lease | Permit to Take | *Biodiversity Conservation Act 2016* |
| Land access and ground disturbance in areas of indigenous cultural heritage significance | Pastoral Lease | Section 18 approval(s) | *Aboriginal Heritage Act 1972* (WA) |
| Construction of water abstraction bores | Pastoral Lease | 26D licence | *Rights in Water & Irrigation Act 1914* |
| Abstraction of groundwater | Pastoral Lease | 5C licence | *Rights in Water & Irrigation Act 1914* |
| Construction of fabrication facility and associated waste treatment and management facilities | Pastoral Lease | Planning consent, building approvals (Shire of Exmouth) | • *Building Act 2011*<br>• *Planning and Development Act 2005*<br>• *Health Act 1911*<br>• Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974 |
| Storage of Dangerous Goods | Pastoral Lease | Dangerous Goods Licence for storage of amounts above manifest quantities | • *Dangerous Goods Act 2004*<br>• *Dangerous Goods Safety Storage and Handling (Non Explosives) Regulations 2007* |
| An offshore petroleum or greenhouse gas activity (i.e. offshore installation/operation of a Bundle) | Commonwealth and State waters | Environment Plan | *Offshore Petroleum and Greenhouse Gas Storage Act 2006* |

Table 1-1: Other Approvals and Legislation Relevant to the Proposal

## 1.5 STRUCTURE OF THE ERD (THIS DOCUMENT)

### 1.5.1 Environmental Impact Assessment

The environmental impact assessment has been divided into sections relating to each of the preliminary key environmental factors, other environmental factors or matters, and matters of national environmental significance, as follows:

- Benthic Communities and Habitats (Section 5.1).
- Coastal Processes (Section 5.2).
- Marine Environmental Quality (Section 5.3).
- Marine Fauna (Section 5.4).
- Flora and Vegetation (Section 5.5).
- Subterranean Fauna (Section 5.6).
- Terrestrial Fauna (Section 5.7).
- Inland Waters (Section 5.8).
- Social Surroundings (Section 5.9).
- Other Environmental Factors or Matters: Terrestrial Environmental Quality (Section 6.1).
- Matters of National Environmental Significance (Section 7).
- Offsets (Section 8).
- Holistic Impact Assessment (Section 9).

For each of the impact assessment sections (Section 5.1 to 6.1), a standard structure has been used to describe the factor, its value, potential impacts, mitigation and predicted outcome, as follows:

- EPA Objective (statement of the EPA's objective for each factor).
- Policy and Guidance (provides an overview of relevant policy and guidance and how this has been taken into account in the design of the Proposal and/or the completion of technical studies and environmental impact assessment).
- Receiving Environment (provides an overview of studies undertaken and a description of the existing environment).
- Potential Impacts (provides an overview of the potential impacts to the factor as a result of the Proposal).
- Assessment of Impacts (discusses in detail the potential environmental impacts and their significance within the context of the knowledge provided by the studies undertaken).
- Mitigation and Predicted Outcome (provides a high-level discussion of Subsea 7's proposed approach to avoiding and managing its impacts and, taking into account the proposed mitigation, a summary of the predicted outcome for the environmental factor within the context of the relevant objective(s)). Monitoring to demonstrate that residual impacts are not greater than predicted will also be described.

The 'integrating issues', as presented in Table 4 of the ESD, are addressed under the most relevant section (e.g. site selection under Section 2.4, regional, and cumulative impacts under Sections 5.1.6.11, 5.3.6.5, 5.4.6.11, 5.5.6.8, 5.7.6.11, and 5.8.6.6, and proposed care and maintenance, decommissioning and closure under Sections 2.3.9, 5.1.6.10, and 5.2.6.4).

### 1.5.2 Changes in EPA Guidance Between the Original Assessment (2136) and Current Assessment (2208)

The original ESD referenced the 'Statement of Environmental Principles, Factors and Objectives' (EPA 2016c). This guidance was updated to Version 2.0 in 2018 (EPA 2018c).

The change of relevance to the Proposal was the combination of two environmental factors, Inland Waters Environmental Quality and Hydrological Processes, into one environmental factor, Inland Waters. This change has been reflected in the ERD for the amended Proposal (this document).

### 1.5.3 Supporting Studies

A number of technical studies (both desktop and field studies) have been undertaken specifically for this Proposal to:

- Provide a comprehensive understanding of the receiving environment.
- Support the assessment of potential impacts resulting from the Proposal.
- Inform the development of mitigation measures and environmental management plans.

An overview of the technical studies undertaken for this Proposal is provided in Table 1-2.

| Title | Date | Author | Refer |
|---|---|---|---|
| Proposal Development | | | |
| Site Selection | April 2019 | Subsea 7 | Attachment 2A |
| Site Selection Peer Review | April 2019 | Teal Solutions | |
| Benthic Communities and Habitats | | | |
| Learmonth Habitat Surveys | February 2017 | 360 Environmental | Attachment 2B |
| Exmouth Gulf Benthic Communities and Habitat survey report | October 2018 | MBS Environmental | Attachment 2C |
| Coastal Processes | | | |
| Subsea 7 Bundle Facility Shoreline Movement Assessment | October 2017 | MP Rogers | Attachment 2D |
| Coastal Processes Assessment | February 2019 | MP Rogers | Attachment 2E |
| Coastal Processes Peer Review | April 2019 | Teal Solutions | |
| Marine Environmental Quality | | | |
| Learmonth Bundle Launch Site Baseline Water and Sediment Quality Assessment | February 2017 | 360 Environmental | Attachment 2F |
| Learmonth Hydrodynamic Survey Field Report | August 2018 | GHD | Attachment 2G |
| Learmonth Sediment Dispersion Modelling Report | March 2019 | RPS | Attachment 2H |
| Marine Fauna | | | |
| Subsea 7 Learmonth Bundle Site Invasive Marine Species and Pathogen Desktop Risk Assessment | Sept 2018 | Biofouling Solutions | Attachment 2I |
| Exmouth Gulf aerial humpback whale | January | Lyn Irvine | Attachment 2J |

| Title | Date | Author | Refer |
|---|---|---|---|
| survey (southern migration) | 2019 | | |
| Migratory bird surveys report | February 2019 | Western Wildlife | Attachment 2K |
| Flora and Vegetation | | | |
| Detailed Flora, Vegetation and Targeted Survey | October 2018 | 360 Environmental | Attachment 2L |
| Subterranean Fauna | | | |
| Desktop Assessment of Subterranean Fauna for the Learmonth Bundle Project | August 2017 | Invertebrate Solutions | Attachment 2M |
| Review of subterranean fauna at Learmonth Bundle Project | October 2017 | Bennelongia | Attachment 2N |
| Subsea 7 Pipeline Fabrication Facility Stygofauna Survey | Sept 2019 | Bennelongia | Attachment 2O |
| Terrestrial Fauna | | | |
| Learmonth Level 1 Fauna Survey | October 2018 | 360 Environmental | Attachment 2P |
| Desktop Assessment of Short Range Endemic Invertebrates for the Learmonth Bundle Project | September 2017 | Invertebrate Solutions | Attachment 2Q |
| Inland Waters Environmental Quality | | | |
| Bundle Fabrication Facility Surface and Groundwater Investigation | March 2019 | GHD | Attachment 2R |
| Social Surroundings | | | |
| Landscape and Visual Impact Assessment | June 2019 | 360 Environmental | Attachment 2S |
| Landscape and Visual Impact Assessment Peer Review | June 2019 | GHD | |
| Social Impact Assessment | May 2019 | 360 Environmental | Attachment 2T |
| Terrestrial Environmental Quality | | | |
| Acid Sulphate Soils Survey Report | October 2018 | MBS Environmental | Attachment 2U |

Table 1-2: Overview of Supporting Studies

The majority of the technical studies undertaken for this Proposal were completed prior to the amendment of the Proposal. The proposed location of onshore and offshore infrastructure and activities has not changed since the completion of the technical studies. However, the Development Envelope and Development Footprint have been slightly amended, as follows:

- The Onshore Development Envelope and Development Footprint have been truncated at the mean high water mark in response to stakeholder comments regarding the clear differentiation of onshore versus offshore elements/disturbance.
- The Offshore Operations Area (Surface tow) runs offshore from the mean high water mark and therefore includes the launchway footprint.

While the majority of the technical studies reflect the original Development Envelope and Development Footprint, the changes to the Development Envelope and Development Footprint are not considered to have any material impact to the validity of the outcomes of the technical studies.

#### 1.5.3.1 Environmental Management Plans

A number of environmental management plans (EMPs) have been prepared to guide the construction and/or operation of the Proposal to minimise the risk (likelihood and consequence) of adverse environmental impacts, as follows:

- Marine Construction Monitoring and Management Plan (Attachment 3A).
- Marine Fauna Management Plan (Attachment 3B).
- Environmental Quality Plan (Attachment 3C).
- Marine Emergency Response Plan (Attachment 3D).
- Decommissioning and Closure Plan (Attachment 3E).
- Marine Operational Environmental Monitoring Plan (Attachment 3F).

# 2. THE PROPOSAL

## 2.1 BACKGROUND

The Proposal is located adjacent to the western shoreline of Exmouth Gulf, at Learmonth, to the east of Minilya-Exmouth Road, approximately 35 km south of the Exmouth townsite and 2.5 km south east of the RAAF Learmonth base (Figure 2-1).

The Proposal is to construct and operate a new pipeline fabrication facility, in order to produce pipeline Bundles for the offshore oil and gas industry. A pipeline Bundle, used in the development of offshore gas fields, co-locates a number of services within a single pipeline, which is constructed onshore before being launched and towed offshore to the field development. Pipeline Bundles have been installed in a variety of configurations for both greenfield and brownfield developments, and are a proven technology with over 84 Bundles installed by Subsea 7, with the vast majority coming from the existing site in Scotland.

The Proposal includes construction of a fabrication shed, where the Bundles will be constructed, a storage area where the Bundle materials will be stored prior to use, and two approximately 10 km long Bundle tracks (Plate 2-1) along which each Bundle will be constructed and then launched. A Bundle launchway, crossing the beach and extending into the shallow subtidal area, will facilitate the launch of each Bundle.

The launch operations involve pulling the Bundle along the launchway by way of anchor handling tugs. Once the Bundle is off the launchway, it is towed to a designated Parking area, which has sufficient water depth to confirm the submerged weight of the Bundle. Once the final trim and configuration of the Bundle is confirmed, it is towed to the offshore installation site using Subsea 7′s Controlled Depth Tow Method (CDTM).


Scale: 1:400000
Aerial Photo: ESRI Satellite
Original Size: A4
Grid: GDA 94 / MGA Zone 50

Notes: Location of proposed Bundle Site.

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 2-1: Location of Proposal

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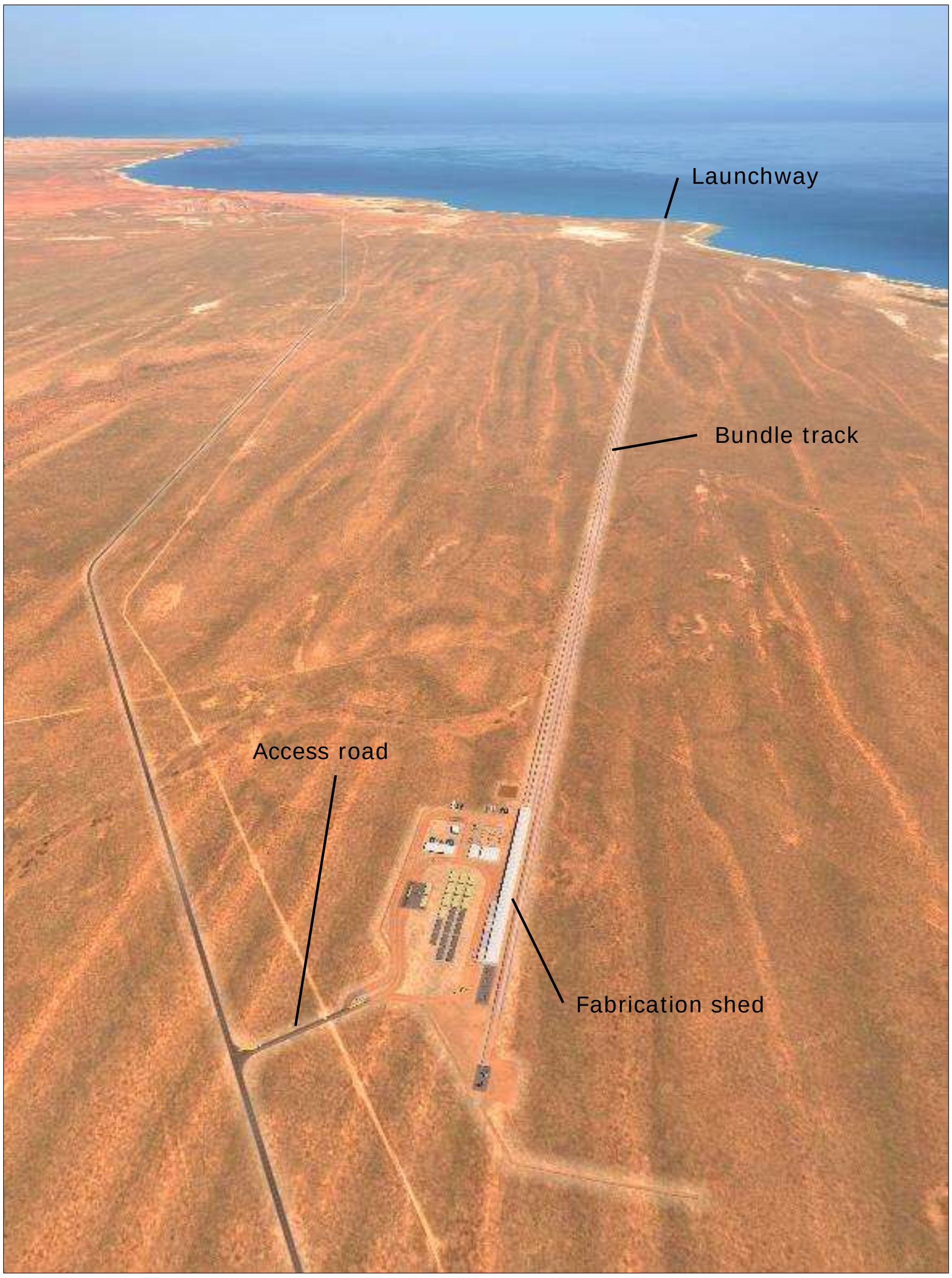


Plate 2-1: Conceptual Site Layout for the Proposal

## 2.2 EXISTING FACILITY IN SCOTLAND

Subsea 7 currently operates the only other existing Bundle site in Wick, Scotland (Figure 2-2). The site is located approximately six miles north of the town of Wick, Caithness, and extends from the shoreline at Sinclair's Bay landward in an east-west orientation.

### 2.2.1 Site History

The Wick Fabrication Site was established in 1978 and is situated to service offshore installations in the North Sea and the Norwegian Sea. The site consists of a 7.8 km Bundle track that covers an area of approximately 30 ha. This track consists of four separate railway tracks, with a combined length of 27,200 m, which is used for movement of pipes and pipeline Bundles. The site contains three fabrication sheds utilised for the welding, fabrication and testing of pipeline Bundles. The launchway used at the Wick site is 240 m long.

The longest pipeline towed from this site was 7.6 km and the heaviest structure/manifold assembly was approximately 550 tonnes. A total of 81 Bundles have been fabricated and launched at the Wick site between 1978 and 2018, with no significant environmental incidents in this time.

### 2.2.2 Environment Governance

Subsea 7's priority is to protect the Health, Safety and Security of everyone involved in or affected by their activities while minimising impact on the environment wherever it operates. Subsea 7's Health Safety Environment and Quality Policy Statement is provided in Attachment 5.

Subsea 7 is acutely aware of the responsibility that comes with proposing a development in Exmouth Gulf and is committed to ensuring no significant environmental impacts. The existing site in Wick is situated beside a European Site of Special Scientific Interest (SSSI), which has been established to conserve the wildlife and ecology of the area. Subsea 7 has ensured its activities do not impact the SSSI and regularly participates in activities to support this intiative (Attachment 4). This indicates Subsea 7's commitment to minimising impacts on the environment, and establishes a track record of having done so in sensitive areas.

Subsea 7 has been actively involved in environmental initiatives at the Wick site over a number of years (refer Attachment 4), including:

- Tern Relocation Program: Subsea 7 had a large involvement in the Tern Relocation Project at Wick.
- Dune Stabilisation: Subsea 7 worked collaboratively with universities and scientists, assisting in studies and projects regarding stabilisation of sand dunes.
- Beach Cleans: Personnel and equipment used at the Wick Fabrication Site regularly assist in beach clean ups along the Wick coast.
- Local Employment: At present, 95% of the workforce at the Wick site is locally based.
- Apprenticeship Program: Subsea 7 has developed a successful apprenticeship scheme at the Wick site to develop skills within the local community.

- Social Engagement: A performance recognition scheme has been in place at Wick for approximately 20 years, whereby contributions are made to charities and local organisations as a result of strong performance of the site.

### 2.2.3 Wick Stakeholder Feedback and Support

Subsea 7's Bundle site in Wick has become a valued and integral part of the Wick community, employment market, and economic landscape. As part of the stakeholder consultation effort for the Proposal, feedback has been sought from relevant local equivalents of the local shire / council, and various enterprise networks or development commissions in Wick, Scotland. The response that was received was overwhelmingly positive, reflecting the very positive contribution and benefit from Subsea 7's long-term presence in Wick.

In Attachment 4, three letters from Scotland are included to indicate the perception of Subsea 7 in the local community, including:

- The Highland Council.
- The Highland and Islands Enterprise.
- The Caithness Chamber of Commerce.

Common themes from the feedback include:

- Subsea 7's commitment to operating responsibility in an area of environmental significance (Wick being in a European SSSI).
- The drive to employ locally.
- The commitment to the provision of training and opportunities to youth and local community members.
- Subsea 7's engagement with the local supply chain.
- Subsea 7's willingness to continually engage with local stakeholders, including visitors and tourists, to ensure that they are considered in the operations at the site.
- The flow on benefits of Subsea 7's presence in Wick (such as the re-opening of the far north rail line, regeneration of Wick Harbour, local employment, and opportunities for other local businesses).


Scale: 1:120000
Aerial Photo: ESRI Satellite
Original Size: A4
GRID: OSGB36 / EPSG 27700

Notes: Exisitng Subsea 7 Bundle Fabrication Site.

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 2-2
Existing Bundle Site in Wick, Scotland

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## 2.3 PROPOSAL DESCRIPTION

### 2.3.1 Key Characteristics

The Key Characteristics of the Proposal are provided in Table 2-1.

| Summary of Proposal | |
|---|---|
| Proposal Title | Learmonth Pipeline Fabrication Facility |
| Proponent Name | Subsea 7 Australia Contracting (Subsea 7) |
| Short Description | The proposal is to construct and operate an onshore pipeline fabrication facility at Lots 233 and 1586 to the east of Minilya-Exmouth Road, Learmonth, approximately 35 km south of the Exmouth town site.<br><br>The onshore pipeline bundle fabrication site and associated infrastructure includes two bundle tracks (approximately 10 km in length) along which the Bundles will be constructed and launched from a Bundle launchway that crosses the beach and extends into the subtidal zone at Heron Point in the Exmouth Gulf. Once launched the Bundles will be towed along a pre-determined route between two tugs at a controlled depth to the Bundle Parking area within which tow reconfiguration will occur before continuing offshore. |

| Physical Elements | | |
|---|---|---|
| Element | Location | Proposed Extent |
| Bundle fabrication facility and associated infrastructure including:<br>• Fabrication site (including site offices, staff facilities, lunch room, storage area and car park).<br>• Two Bundle Tracks.<br>• Launchway facilities area.<br>• Access roads.<br>• Spray field.<br>• Drainage sump.<br>• Hydro testing water pond.<br>• Groundwater production bores and supply pipeline.<br>• Miscellaneous (Drains, access tracks, | Within the onshore Development Envelope as shown in Figure 2-3 | Clearing and disturbance of up to 176 ha of vegetation within a 452 ha Development Envelope |

| Physical Elements | | |
|---|---|---|
| Element | Location | Proposed Extent |
| earthworks areas). | | |
| Bundle Launchway | Within Exmouth Gulf as shown in Figure 2-4 | Direct disturbance of up to 1 ha of seabed (measured from mean high water) within a 4,164 ha Offshore Operations Area (Off bottom tow) |
| Offshore Operations Area (Off bottom tow) | Within Exmouth Gulf as shown in Figure 2-4 | Direct disturbance of up to 1,450 ha of seabed (per Bundle launch) within a 4,164 ha Offshore Operations Area (Off bottom tow) |
| Offshore Operations Area (Bundle Parking area) | Within Exmouth Gulf as shown in Figure 2-4 | Direct disturbance of up to 368 ha of seabed within a 2,426 ha Offshore Operations Area (Parking area) |
| Offshore Operations Area (Surface tow) | Within Exmouth Gulf and Ningaloo Marine Park, Ningaloo Coast World Heritage Property/Ningaloo Coast World Heritage Place as shown in Figure 2-4 | No ground or seabed disturbance to the extent of State Waters |
| Operational Elements | | |
| Element | Location | Proposed Extent |
| Groundwater abstraction | Learmonth (onshore) | Abstraction of up to 12 ML/annum for potable and hydrotest water |
| Bundle launch and tow | Within Exmouth Gulf and Ningaloo Marine Park, Ningaloo Coast World Heritage Property/Ningaloo Coast World Heritage Place as shown in Figure 2-4 | Maximum of three Bundle launches per annum. |

Table 2-1: Proposal Key Characteristics


Scale: 1:60000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Subsea 7 (2018).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 2-3: Development Envelope and Development Footprint

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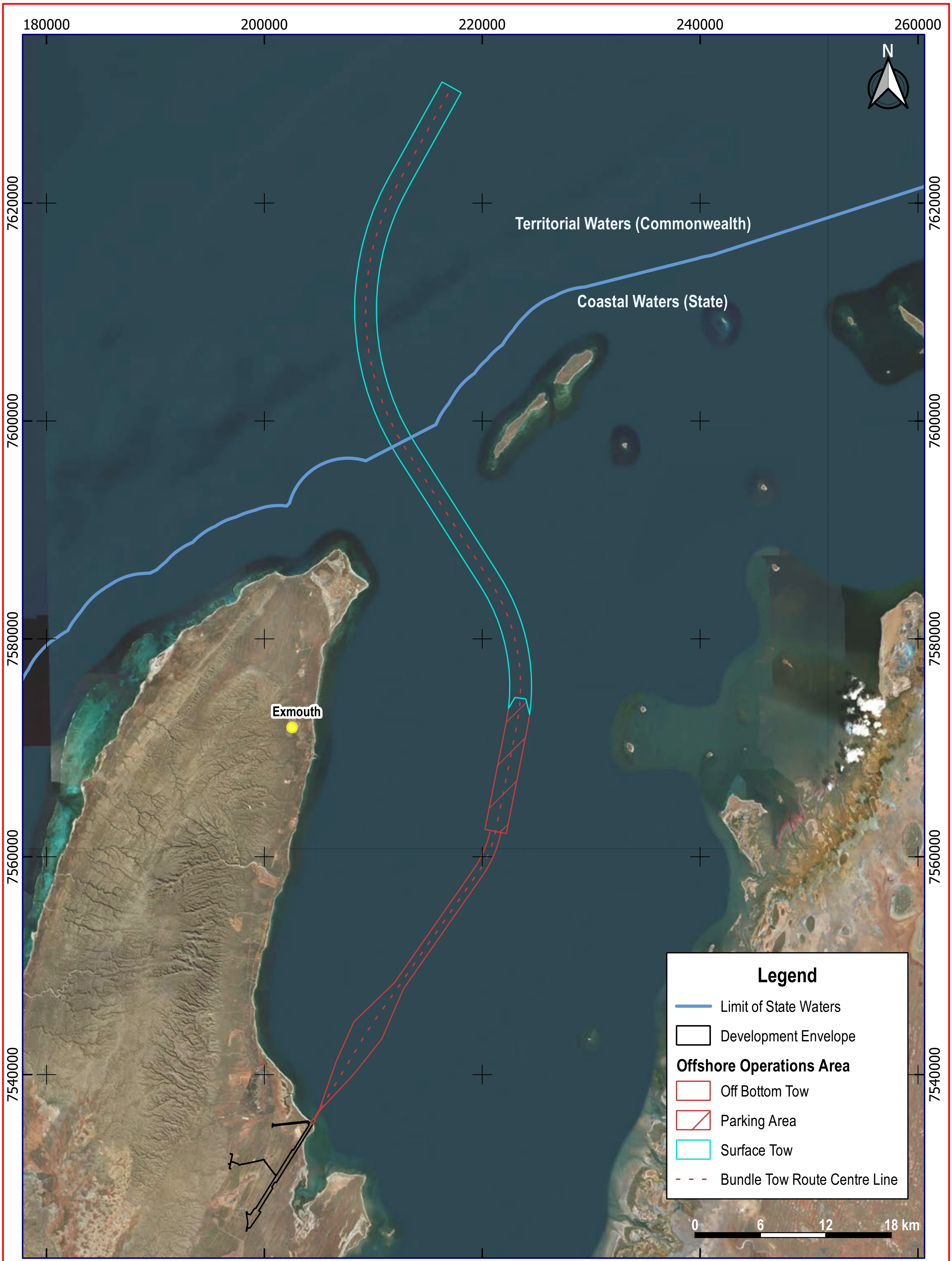


Scale: 1:450000
Aerial Photo: ESRI Satellite
Original Size: A4
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Subsea 7 (2018).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 2-4: Offshore Operations Area and Indicative Tow Route

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### 2.3.2 Water Source

Subsea 7 completed a broad investigation into water supply options. From this investigation, groundwater bores were identified where the water is of sufficient quality that the initially proposed reverse osmosis (RO) water treatment plant is not required. This has a major positive impact (reduction) to the required water abstraction volumes due to the removal of any inefficiency associated with water treatment (can be 30-40%).

Groundwater abstraction of up to 12 ML/annum will occur, under a 5C licence under the *Rights in Water and Irrigation Act 1914*. Three groundwater production bores will be installed to provide the required potable water and hydro-test water (Figure 2-3). Investigation into current groundwater licences for the area indicated that only 2% of the total aquifer allocation is currently allocated.

A PVC pipeline of ≤ 150 mm diameter will be installed to transfer water from the three production bores to the main Development Envelope. The pipeline alignment will follow existing tracks, running south east, before running beneath Minilya-Exmouth Road and along another section of existing track into the Development Envelope (Figure 2-3). The pipeline will be installed either on the surface or sub-surface (up to approximately 0.3 m below the soil surface via trenching). The section running beneath the Minilya-Exmouth Road will be installed by directional drilling.

### 2.3.3 Wastewater Treatment and Discharge

All blackwater will be tankered to the Water Corporation's Exmouth Wastewater Treatment Plant (WWTP) for treatment. Grey water (from showers and wash basins) will be treated on site within a small WWTP. An estimated maximum grey water volume of 6,560 L/day (or 2,394 kL/year based on the site operating year-round) will require treatment prior to disposal via surface irrigation within the nominated sprayfield (Figure 2-3). Treatment of grey water will be provided by an advanced system (such as a Wise Water system) to ensure a high recovery of nutrients.

### 2.3.4 Lighting

The construction and operational phases of the Proposal require artificial light sources to enable tasks to be completed safely and efficiently during dark hours in accordance with occupational health and safety requirements.

It is intended that the fabrication facility will operate on a 12-hour day shift basis, with occasional 24-hour operations (during Bundle launch, or during occasional peak fabrication times where the delivery schedule requires it). Permanent (timed) lighting would be required for the following infrastructure:

- Gatehouse security.
- Car parks.
- Mechanical workshop area (sufficient for forklift use).
- General storage yard area.
- Pedestrian pathways.

### 2.3.5 Bundle Site Workforce

Based on two upcoming third party projects that could be executed with Subsea 7's Bundle technology, the following workforce would be required onsite:

- Up to 120 people required on site for the build phase of a Bundle (duration of 6 to 12 months for the build, test and then launch of a Bundle); and

- Over the total duration of the build, test and launch, the average number of personnel on site may be in the vicinity of 70-80 personnel.

The proposed Bundle site represents a sustainable and long-term employment opportunity for a locally based workforce. Subsea 7 notes that as each Bundle is uniquely designed to meet the specific client's requirements. Each build phase requires some differences in the number of personnel that are required, and the duration for which they are required. Being project-based work, the employment opportunities on the site ultimately depend on the uptake of the concept by operators and clients.

When there are no live projects at the Bundle site, the site would be run in a care and maintenance mode, with a small workforce on site maintaining the readiness of the site to be able to ramp up when a new project be awarded.

### 2.3.6 Bundles

#### 2.3.6.1 Bundle Construction

A Bundle pipeline contains multiple pipes within a single carrier pipe (Plate 2-2). The inner pipes (flowlines) and cables will be installed for specific purposes such as hydrocarbon transfer, water, electrical or hydraulic control systems, telecommunications, or service chemicals.

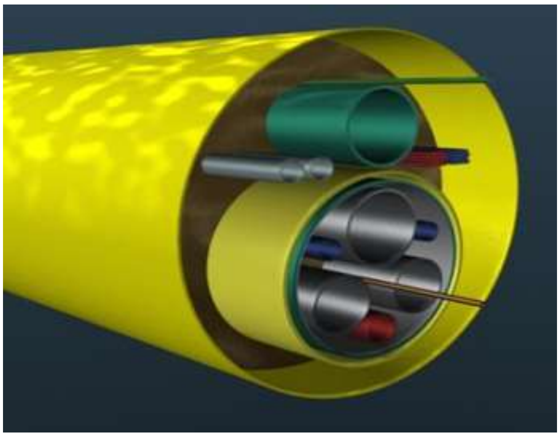

Plate 2-2: Pipeline Bundle Cross-section

The outer structural pipe (carrier pipe) can range from 60 cm to 152 cm in diameter, and each end is terminated by an end structure (towhead). These towhead structures incorporate many functions from simple valve arrangements to complex processing and control systems.

Bundles can integrate up to nine (9) fluid lines, with fluid line diameters ranging from 5 cm to 80 cm depending on the application. The lines are typically installed empty, with some small bore fluid lines installed with corrosion inhibitor or treated seawater. A large variety of material can be used for fluid lines in Bundle systems, including carbon steel, corrosion resistant alloys (e.g. Duplex, SuperDuplex, Stainless Steel), metallurgically bonded clad pipe, mechanically lined pipe, or internally plastic lined pipe.

A Bundle pipeline would be progressively manufactured until completed as one, up to 10 km long, segment and moved out from the manufacturing facility along the track towards the launch area.

For those pipes that will need to contain fluids, hydrostatic pressure testing (hydrotesting) is required to ensure pipe integrity. Hydrotesting is conducted using onsite water (sourced from groundwater). Pipeline testing will be completed as per industry standards for the type of service line, with test durations up to 24 hours. On completion of the hydrotest, the lines will be depressurised at a pre-determined rate.

The Bundle pipeline is then towed out by boat and submerged. Once at its designated location, the Bundle is installed on the sea floor to connect with other pipe segments or infrastructure. Each pipe segment would contribute to an integrated pipeline network laid on the sea floor for various uses and functions for the oil and gas industry.

While the manufacturing of Bundles is based on customer demand, it is estimated that two launches could occur, on average, per annum. In the event that several smaller Bundles are built in quick succession, there is potential for a maximum of three Bundle launches in a 12 month period.

#### 2.3.6.2 Bundle Chemicals

There will be no antifoulants within the paint used on the Bundles, which is an epoxy product. The chemicals contained within epoxy are all tightly bound within the dry and hardened product such that loss into the surrounding seawater is negligible.

For small diameter flowlines within the Bundle, fluids will be present in the lines during Bundle tow and installation. All flowlines, and the surrounding carrier pipe, are sealed prior to Bundle launch.

Selection of Bundle transport and installation contents is performed in consultation with the field operator and the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) to confirm compatibility with existing infrastructure, and ensure environmental impacts and risks associated with any chemicals are managed to a level that is acceptable and ALARP. The field operator is required to submit a field development Environment Plan for approval as part of Environment Regulations administered by NOPSEMA.

The indicative Bundle pipe contents during tow and installation operations are summarised in Table 2-2.

NOPSEMA recognises several international management systems have been established to assess the environmental performance of chemical products to inform the chemical selection process (NOPSEMA 2018). The Offshore Chemical Notification Scheme (OCNS), managed by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) in the United Kingdom, is one of the predominant management systems. The OCNS provides a framework and updated register which ranks the environmental performance of chemicals used in offshore petroleum activities.

| Line Function | Pipe Contents | Approximate Volume[3] | Purpose |
|---|---|---|---|
| Carrier Pipe | Inert Gas & Seawater Treatment | 6,400 $m^3$ | Inert gas reduces the submerged weight of the Bundle during transport and installation.<br>This is typically nitrogen gas at 50 bar internal pressure.<br>Installed as solids within a dissolvable package, seawater treatment chemicals prevent corrosion or biological growth inside the pipe[4]. Typical seawater treatment chemicals include;<br>• Hydrosure O-3670R at 500 ppm concentration<br>• Roemex RX-5254 |
| Production | Inert Gas | 2,500 $m^3$ | Inert gas reduces the submerged weight of the Bundle during transport and installation.<br>This is typically nitrogen gas at various internal pressures. |
| Utility | Hydrate Inhibitor | 300 $m^3$ | Hydrate inhibitors are used to prevent formation of hydrates in the pipe during production. Typical hydrate inhibitors include:<br>• Mono Ethylene Glycol (MEG)<br>• Methanol |
| Control | Hydraulic Control Fluid | 10 $m^3$ | Hydraulic control fluid is used to apply hydraulic pressure to hydraulic control systems. Typical hydraulic control fluids include;<br>• Oceanic HW443<br>• Transaqua HT2 |

Table 2-2: Indicative Bundle Chemicals

[3] Volume is based on a Bundle length of 10 km.
[4] These chemicals take effect after the carrier pipe is flooded with seawater, after Bundle installation.

Chemicals are ranked by the Chemical Hazard Assessment and Risk Management (CHARM) mathematical model to produce a Hazard Quotient (HQ), which uses toxicity, biodegradation, and bioaccumulation data provided by suppliers. The chemicals are assigned a colour banding, as illustrated in Figure 2-5.

| Minimum HQ value | Maximum HQ value | Colour banding | |
|---|---|---|---|
| >0 | <1 | Gold | |
| ≥1 | <30 | Silver | |
| ≥30 | <100 | White | Lowest hazard |
| ≥100 | <300 | Blue | Highest hazard |
| ≥300 | <1000 | Orange | |
| ≥1000 | | Purple | |

Figure 2-5: CHARM Hazard Quotient Ranking (source CEFAS 2018)

Products not amenable to the CHARM model (i.e. inorganic substances, hydraulic fluids etc.) are not assigned a colour banding, but assigned a OCNS grouping, A–E based on the persistence, bioaccumulation, and toxicity (PBT) test data, refer to Figure 2-6. Group A products are considered to have the greatest hazard potential and Group E the least.

| Initial grouping | A | B | C | D | E |
|---|---|---|---|---|---|
| Result for aquatic-toxicity data (ppm) | <1 | >1-10 | >10-100 | >100-1,000 | >1,000 |
| Result for sediment-toxicity data (ppm) | <10 | >10-100 | >100-1,000 | >1,000-10,000 | >10,000 |

Figure 2-6: OCNS Initial Grouping for Non-CHARM Chemicals (source CEFAS 2018)

For the typical Bundle chemicals listed in Table 2-2, the published OCNS groupings are shown in Table 2-3. The low hazard rankings of these chemicals are defined by applying the CHARM/Non-CHARM assessment criteria to the chemical toxicity, biodegradation and bioaccumulation test data.

| Chemical | Use | Colour Banding | OCNS Group |
|---|---|---|---|
| Hydrosure O-3670R at 500 ppm | Combined Biocide, Oxygen Scavenger, Corrosion Inhibitor | GOLD | |
| Roemex RX-5254 | Combined Biocide, Oxygen Scavenger, Corrosion Inhibitor | GOLD | |
| MEG | Hydrate inhibitor | | E |
| Methanol | Hydrate inhibitor | | E |
| HW443 | Hydraulic control fluid | | D |
| Transaqua HT2 | Hydraulic control fluid | | D |

Table 2-3: ONCS Rankings of Bundle Chemicals

To control chemicals selected for use within the Bundle during tow and installation operations, Subsea 7 has deemed that chemicals that have an OCNS Hazard Quotient corresponding to ratings of Gold, Silver, E or D on the OCNS Ranked List of Notified Chemicals, and have no substitution or product warning, do not require further assessment, as they do not represent a significant risk to the environment. This is in line with the chemical selection standards of most offshore field operators. Should a field operator have a more stringent chemical selection process, this will take precedence.

Chemicals not meeting the criteria above (i.e. OCNS Hazard Quotient white, blue, orange, purple, A, B, C or have product/substitution warning), or those that are not on the OCNS Ranked List of Notified Chemicals, will require further assessment to understand the potential environmental impacts of a leak or spill into the marine environment. This assessment will be documented and will include:

- Assessment of the toxicity and biodegradation of the chemical in the marine environment and any other environmental issues or potential risks.
- Investigation of potential alternatives for the chemical, with preference for options that are on the OCNS Ranked List of Notified Chemicals with OCNS Hazard Quotient of Gold, Silver, or are Group E or D with no substitution or product warning.
- Justification of the selected chemical.
- Further risk reduction measures (i.e. specific controls on the use of the chemical).
- Determination of whether the environmental risk is ALARP.

#### 2.3.7 Bundle Launch

A Bundle launchway, crossing the beach and extending 380 m (measured from the dune line) into the nearshore subtidal area, will facilitate the launch of each Bundle.

To launch a Bundle, the towhead on the offshore end of the Bundle is connected to a tug (the 'Leading Tug') via a long towline. The tug then slowly (≤ 2 knots) heads offshore, pulling the Bundle along the track and into the ocean (Plate 2-3). The onshore end of the Bundle is connected to another line which is slowly unwound from an onshore winch, until the Bundle reaches sufficient water depth for connection to another tug (the 'Trailing Tug').

Plate 2-3: Bundle Launch (Wick, Scotland)

The Bundle rolls down the track, which extends across the beach and into the shallow subtidal area. As the Bundle towheads (both lead and trailing towheads) enter the water and gain depth, they will become buoyant as the structure and floatation devices enter the water.

Ballast chains are attached at intervals along the length of the Bundle to provide stability control during the launch and lift during the offshore Controlled Depth Tow Method (CDTM) tow out to the production field. Each Bundle is custom designed and built, so chain dimensions may vary. Typically, the ballast chains that hang beneath the Bundle vary between short and long lengths, alternating in a short-long-short-long configuration. The typical chain size used is 76 mm diameter chain. Short lengths are typically 10-12 links (3-4 m) and long chain lengths are typically 18-20 links (5-6 m). The long chain lengths are typically spaced at 20 m intervals along the Bundle. The longer Bundle chain lengths will have some contact (4-5 links touching the seabed) along the length of the tow route out to the Bundle Parking area (approximately 30 km).

### 2.3.8 Bundle Tow

#### 2.3.8.1 Tow Fleet

A key advantage of the Bundle technology is that smaller domestic support vessels can be used in-lieu of large international pipelay and construction vessels. A typical vessel fleet for a Bundle tow would consist of the following vessels:

- 1 x Command Vessel.
- 2 x Lead Tugs (Anchor Handling Tugs).
- 1 x Trail Tug.

- 1 x Work Vessel.
- 1 x Project Support Boat.
- 2 x Guard Vessels.

#### 2.3.8.2 Off Bottom Tow

Following launch, the Bundle will be towed slowly (nominally at 2-3 knots, up to a maximum of 5 knots) offshore along the tow route (Figure 2-4). The Bundle will be in 'Off bottom tow', meaning that the Bundle (including towheads) will be clear of the seabed. The lower links of the long Bundle chains will be in contact with the seabed in this mode (Plate 2-4).

On arrival at the Bundle Parking area (Figure 2-4), the Bundle will be stopped and various checks and reconfiguration for the subsequent Surface tow completed. The Bundle may remain within this area for nominally up to 24 hours to allow for all checks and reconfiguration to be completed, and to allow for the Surface tow out of Exmouth Gulf to be aligned with optimal environmental conditions.

#### 2.3.8.3 Surface Tow

On exit from the Bundle Parking area the tow vessels will increase the tow speed to 5-6 knots (up to a possible maximum of 8 knots[5]). Hydrodynamic forces acting on the ballast chains produce a lift component and the Bundle will rise to the surface in a controlled manner. In this 'Surface tow' configuration the Bundle lies right at the surface, ensuring maximum clearance from the seabed within Ningaloo Marine Park (Plate 2-5). The trailing tug provides back-tension during tow, as required.

#### 2.3.8.4 Controlled Depth Tow Method

Once the Bundle and tow fleet exit the Exmouth Gulf and enter deeper waters, the Bundle tow speed will be reduced slightly (to 3-4 knots), and the tension from the trailing tug reduced, to allow the Bundle to be lowered to sit at mid-depth in the water column. The actual depth varies pending the Bundle tow characteristics, and the environmental conditions at the time, but is typically in the region of 50 m water depth. Once this depth is reached, and the Bundle is stable, the tow has entered 'Controlled Depth Tow Method' (CDTM) which will continue until the Bundle reaches the installation location.

The CDTM was developed by Subsea 7 and involves transportation of a pipeline Bundle configuration suspended between two tow vessels (Plate 2-6).

On arrival at the installation location the Bundle is manoeuvred into location, lowered to the seabed, and the carrier pipe flooded with seawater in its final position.

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[5] Speed through water.

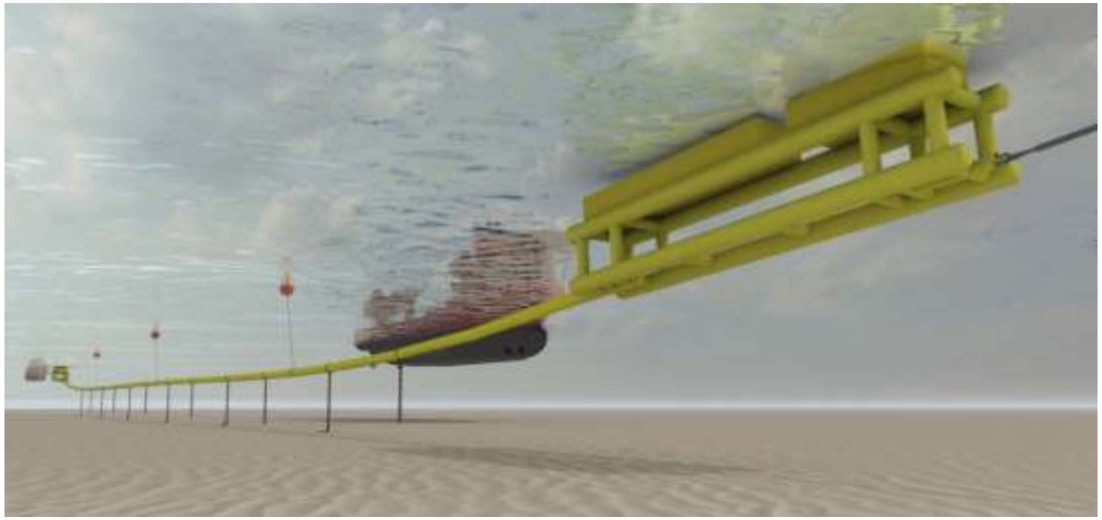

Plate 2-4: Bundle Tow Arrangement – Off Bottom Tow

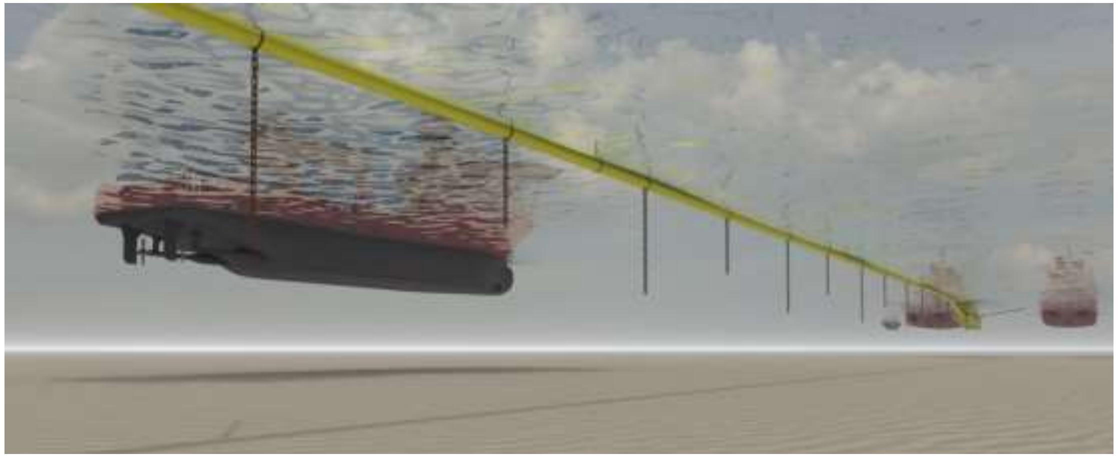

Plate 2-5: Bundle Tow Arrangement – Surface Tow

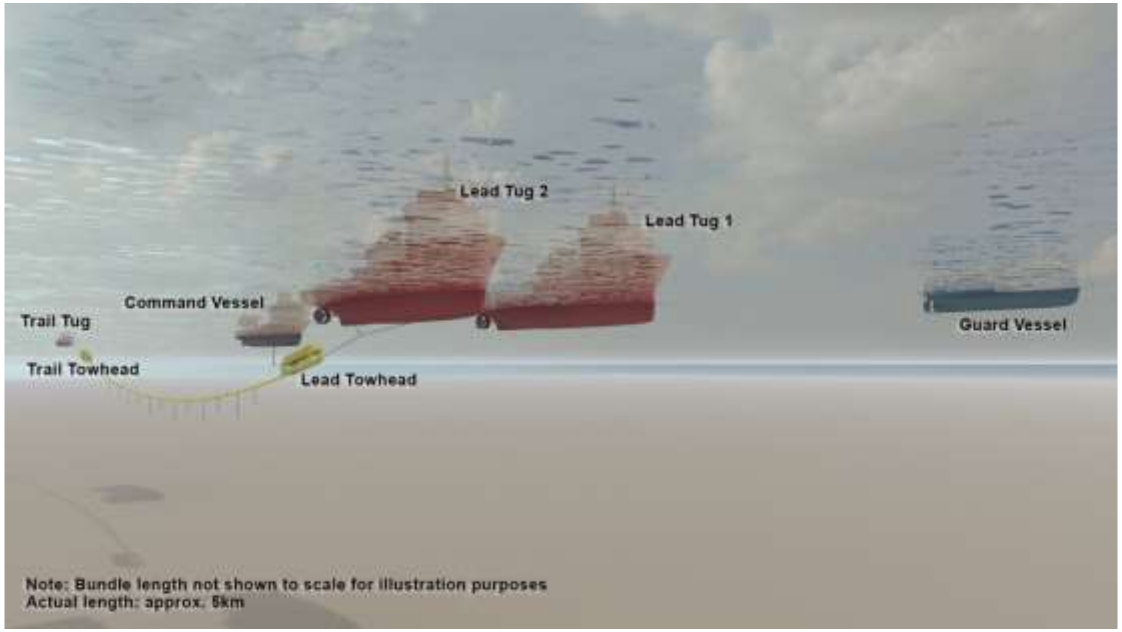


Plate 2-6: Bundle Tow Arrangement – CDTM

#### 2.3.9 Care and Maintenance, Decommissioning, and Closure

During periods between Bundle projects a reduced onsite workforce would be retained to maintain the site in preparation for the next project and undertake required monitoring and reporting. This workforce is likely to include:

- Fabrication Manager.
- Mechanics.
- Electrician.
- Handyman.
- Administration Officer.
- Cleaner.
- Site Workers.
- Stores and Logistics Personnel.
- Water Cart Operator.

Activities to be completed during decommissioning and closure at the end of the life of the site are outlined in the Decommissioning and Closure Plan (Attachment 3).

### 2.4 JUSTIFICATION

The Learmonth Pipeline Fabrication Facility is proposed as a means to meet the market's needs for pipeline fabrication for the offshore oil and gas industry, but with an innovative approach that provides an overall environmental, technical, economic and local benefit in comparison to the existing pipeline delivery methods. The sections below provide further information regarding:

- The need and justification for the Proposal.
- Alternative technologies to the Proposal.
- Site selection.
- Proposal optimisation to minimise environmental impacts.

#### 2.4.1 Value Proposition

Prior to discussing the detailed justifications for the Proposal, the overall value proposition for pipeline Bundle technology, in comparison to conventional pipeline fabrication and installation solutions, is presented in Table 2-4.

| Method | Enviro. Impact | Cost | Execution Risk | Technical / Innovation | Local Content | Regional Benefit |
|---|---|---|---|---|---|---|
| Offshore Construction | Higher | $$$ | !!! | ✓✓ | ✓ | ✓ |
| Bundles | Lower | $$ | ! | ✓✓✓ | ✓✓✓ | ✓✓✓ |

Table 2-4: Value Proposition for Bundle Technology in Comparison to Conventional Pipeline Installation

Pipeline Bundles represent an alternative to conventional pipeline fabrication and installation methodologies that have been utilised extensively in Australia's offshore oil and gas industry. This alternative cannot replace conventional solutions entirely, however, for a significant proportion of the future demand for offshore pipelines in the North West Shelf, Bundle technology represents an opportunity to realise:

- A net overall reduction in environmental impact.
- A reduction in the development cost.
- A reduction in the execution risk.
- Increased opportunities to implement technology improvements.
- Significantly increased local content and local industry participation.
- Benefits to regional WA.

### 2.4.2 Environmental Impact

This ERD provides an in-depth assessment specifically of the environmental impact of the Proposal. What is also relevant to consider is the potential change in environmental impact associated with the adoption of Bundle technology. Offshore pipelines have been extensively installed in Australia to support oil and gas production. Conventionally, these pipelines are installed with the use of offshore pipelay vessels that effectively fabricate the pipeline on board the vessel, and progressively lower the pipeline to the seabed. Comparing the impacts to the environment from these methods to those from Bundle technology reveals that conventional methods:

- Require a significantly greater deployment of large installation vessels. These vessels are rarely resident in Australia, and require mobilisation from other oil and gas centres around the world, which involves extensive inter-continental transits.
- Require the support of multiple support vessels throughout the installation campaign. Typically, a pipelay asset may be supported by at least one bulk carrier vessel, in addition to multiple pipe support vessels (PSVs) to ferry pipe joints between the bulk carrier and the offshore installation.
- Require significantly greater time on the water for the installation operations, as the pipeline is welded onboard the vessel.
- Require a significantly greater seabed footprint for the numerous pipelines that are required for a development.
- Present a greater environmental risk during commissioning operations as the pipelines can only be tested after installation (in water) where the environment cannot be controlled.
- Provide limited capability to re-use a facility and therefore limit cumulative impacts associated with development. Pipeline Bundles allow for the re-use of one facility to fabricate and deliver pipelines to any location on the North West Shelf.

These benefits to Bundle technology result in net improvements (reductions) in impacts to, for example:

- Benthic communities and habitat.
- Marine environmental quality.
- Marine fauna.
- Air quality.

### 2.4.3 Development Cost, Schedule Flexibility and Execution Risk

The use of Bundles offers a significantly greater schedule flexibility compared with conventional pipelay, as the bulk of the work is transferred to a controlled onshore environment and can be performed in advance of the offshore operations. The required in-field duration is reduced, meaning the Bundle installation can more flexibly work around drilling or other simultaneous operations. The result is a considerable reduction of risk, and the ability to predict with a greater degree of accuracy the execution of the work. This results in a higher predictability for the project, a lower risk profile, and often a lower cost base.

Bundles are able to be deployed in weather that exceeds the limiting sea states for conventional pipelay operations. Further, as production manifolds and riser bases are integrated into the Bundle system, there are significantly less installation activities.

Bundles also represent potential development cost benefits associated with pipeline installation as:

- Bundle technology removes the requirement for the mobilisation of expensive pipelaying assets from other regions of the world, and instead allows the use of more cost effective local assets. Pipeline tie-backs are characterised by relatively short pipelines. This is one reason why Bundles are particularly suitable for pipeline tie-backs.
- Technical and engineering benefits of Bundles often translate to a more cost effective approach.
- The reduced duration of offshore operations results in a reduction in logistics costs associated with supporting an extensive offshore operation (supply vessels, food and waste management, material logistics).
- The unit cost of labour for offshore operations is higher than the same labour utilised for onshore operations. Moving work onshore therefore reduces the costs.
- Bundle solutions also represent the potential for reduced social and environmental impacts associated with offshore developments. For example, removing the need to mobilise personnel for extended periods of time offshore has an associated social benefit. An associated reduction in the fuel consumption of multiple offshore vessels is also realised.

### 2.4.4 Innovation

Bundle technology represents significant innovation compared to standard offshore field development technology, with numerous safety, performance, cost, and environmental benefits.

Bundle technology aligns with the Government of Western Australia's announcement to establish an LNG Jobs Taskforce (in March 2018). The taskforce will focus on harnessing the job opportunities the LNG industry can provide to the WA community, including new technology, education and maintenance services. Bundle technology specifically meets the target of utilising innovative technology to generate job opportunities within the LNG industry. The technical benefits of Bundles (Section 2.4.4.2) and the innovation projects that utilise Bundle technology are particularly beneficial for gas production, delivering a true fit with the aim of the LNG taskforce.

#### 2.4.4.1 Pipeline Bundle Technology

Fluid lines within a pipeline Bundle are often developed with thermal insulation installed. For high performance thermal insulation, fluid lines can also be developed as dry pipe-in-pipe systems, or active heating systems such as hot water or electrical heat traced flowlines (EHTF).

Control systems are regularly incorporated within pipeline Bundles, therefore removing the requirement for separate umbilical lay and burial operations. Hydraulic control tubes, electrical cables, and optical fibre cables are clamped to the fluid lines and protected by the carrier pipe. The inclusion of the complete control system allows the system to be fully tested onshore prior to installation.

The Bundle end structure, or towhead, can consist of either very simple pull-heads with isolation valves installed, to complex manifold structures. The towheads are designed specifically for each field development incorporating a number of features, which include High-Integrity Pressure Protection Systems (HIPPS), multi-slot tie-ins, riser bases, and removable modules. Typically, the leading towhead (constructed on the seaward end of the Bundle) is larger than the trailing towhead (Subsea 7 2014).

#### 2.4.4.2 Advantages of Bundle Technology

The technical advantages of Bundle technology are as follows:

- Pipe Integrity.

  The Bundle carrier pipe sustains the majority of the installation and operational loads, reducing the risk of damage to the flowlines that would transfer the production fluid. The axial stress, bending moments and fatigue loads experienced during installation are sustained by the carrier pipe, which also prevents buckling during operations. Bundles have reduced expansion loads as thermal expansion is permitted along the full length of the bundle. The towheads are capable of moving in a longitudinal direction; as a result, buckle initiation is not required for the flowlines. This allows for a simplified connecting spool design, which benefits the spool fabrication, transportation and installation scopes.

  The onshore fabrication aspects of the Bundle system are a significant improvement to the use of conventional pipelay vessels. By providing a controlled environment for welding and non-destructive testing activities, higher quality control and production efficiencies improve the overall end product.

- On-Bottom Stability.

  Once the carrier pipe is flooded after installation, the carrier pipe and installation aids provide the necessary on-bottom stability to ensure the pipeline remains within the design corridor for the life of the installation. This removes the need for extensive trenching or rock-dumping activities that can increase the environmental impacts, or concrete mattress/culvert installation that increases the amount of subsea infrastructure.

- Protection.

  The carrier pipe provides physical protection from dropped objects (as per industry standards) as well as fishing gear protection. This also works to remove additional trenching, concrete mattress or culvert installation that is typically utilised to provide this protection.

- Thermal Performance.

  Due to the nature of most Australian offshore field developments, thermal performance is a key design factor in pipeline design, to ensure flow assurance requirements can be maintained, and the fields can be operated safely. A Bundle can be constructed with low cost dry insulation materials or pipe-in-pipe designs, for passive thermal insulation of flowlines. Active heating systems can also be developed within the Bundle that include systems such as hot water or electrical heat traced flowlines (EHTF). Thermal performance reduces the required pipeline diameters and field service lines in order to develop high temperature and high-pressure fields without risk of hydrate development and other production irregularities.

- System Testing & Commissioning.

  Unlike offshore pipelay installations, a Bundle is tested and the integrity is verified onshore, in advance of any offshore operations. This removes the need to test the pipeline offshore, where the operation is more challenging, and typically requires venting the test fluid to the marine environment. The test medium (groundwater) used for Bundle hydrotesting will be recycled where possible and used for subsequent hydrotests.

#### 2.4.4.3 Developments in Bundle Technology

Bundles are the optimal platform for developing and introducing new technologies into the subsea industry. Numerous technology firsts have been achieved in Bundles leading to significant cost savings and reduction in environmental risk. Examples of new technologies that were developed using Bundles as a platform are outlined below.

Bubi® mechanically lined pipe was first introduced to the Subsea industry on the BP Cyrus field in 1995 within a pipeline Bundle. Following this introduction the technology is now widespread in the industry and is used extensively in individual pipelay and riser projects. The corrosion resistant liner material reduces the corrosion risk, and therefore environmental risk, and ultimately provides cost savings to projects.

Swagelining polymer lining technology was first used in the BP Machar bundle project in 2008. This technology provides an HDPE liner inside water injection pipelines that historically corrode quickly. The polymer liner prevents corrosion and reduces overall cost, whilst increasing integrity. The technology is now commonplace and polymer lined water injection pipelines are now the base case technical solution in most field developments. Directly related to the polymer lined pipe is a new joining system Linerbridge® that will have its first subsea use in a Bundle system in 2019. Following successful implementation within the Bundle, Linerbridge® will expand the installation methods that can be used for polymer-lined pipe, particularly by reducing cost and enabling installation by S-Lay.

Pipeline Bundles are a fantastic platform for first use of technology due to the ability to fully commission and strength test the system onshore. Future developments that will be introduced over the coming years are:

- Expanded use of composites.

  Still largely new to the subsea industry, composites are a focus area, with a number of key components presently being tested (including long-term submersed ageing trials). Ultimately, this will reduce the weight of the subsea system, reduce cost and reduce the overall quantity of materials used on projects, therefore enhancing sustainability and opening up the opportunities for re-use of systems. The development and acceptance of composites in the industry is key as weight drives savings in all areas from reduced buoyancy requirements to smaller vessels with smaller cranes that have a lower environmental footprint.

- Fibre optic condition monitoring systems.

  Utilising the Bundle platform for development, fibre optic condition monitoring systems enable accurate measurement of installation stresses and operating conditions. The technology enables the reduction of risk through live condition monitoring and actual installation stress measurement that could allow increased installation weather windows, or extensions to service life. Ultimately this could lead to a reduction in design conservatism and therefore a reduction in material use and project cost.

Pipeline Bundles continue to enable new technologies to be implemented and trialled in a reduced risk environment. The inner flowlines within the cross section are protected during the installation operation and are not subjected to high installation services or plastic bending that occur with conventional installation techniques.

Overall, Bundle technology represents a significant opportunity for local industry and engineering in Western Australia to be positioned at the forefront of innovative subsea technology development, and provides a means for innovation to drive long-term sustainable opportunities.

#### 2.4.5 Local Industry Content and Employment

In April 2001, Commonwealth, State and Territory Ministers signed an Australian Industry Participation Framework that is aimed at maximising and encouraging local industry participation in major Australian projects. A Bundle site in Australia would represent a step change in local industry participation for the offshore oil and gas industry, and is completely aligned with the intent of the framework.

At present, the greater majority of offshore pipelines are installed by highly specialised, temporarily mobilised, construction vessels. Very little of the installed infrastructure is built locally. A Bundle site would transfer much of the work that is performed to a local footprint, achieving a significant change in the local contribution to these projects.

Subsea 7 has a large number of new technologies currently under development that are based on Bundle solutions. Having a site based in Australia enables these technologies to be deployed here, assisting to future proof the industry and extend Australia's technology capability.

Subsea 7's goal is to establish a local workforce to work on the Bundle site. This is what Subsea 7 has achieved at its Wick site in Scotland, and the commitment is to repeat this concept in Western Australia. At present in Wick, approximately 95% of the workforce is locally based. Where it is not possible to obtain local employees for particular roles, the workforce may be sourced from elsewhere. Over time, as the necessary skill set is developed, it is envisaged that the large majority of roles will be performed by local employees.

To give an indication of the workforce for a Proposal, Subsea 7 has modelled the workforce requirements for two potential projects for the Learmonth site. The results of this modelling indicated that:

- Up to 120 people may be required on site for the build phase of a Bundle.
- The total duration required for the build, test and then launch for a Bundle may be between 8 to 12 months.

- The average number of personnel on site may be in the vicinity of 70-80.
- A number of roles are required for the operation of a Bundle site including:
  - Pipe welders.
  - Trades apprentices.
  - Equipment operators (e.g. forklifts, cranes, trucks).
  - Riggers.
  - Mechanics.
  - Electricians.
  - Site supervision and foremen.
  - Site management, engineering, administration, cleaning, and support staff, etc.

This list of roles is not exhaustive, and there is a very wide range of roles required during the Bundle build and launch operations.

#### 2.4.6 Regional Economic Benefits

The Bundle site provides an opportunity for many local businesses to work directly with Subsea 7. Many indirect benefits would also flow on to the community.

An Economic Impact Assessment produced for the Project estimates that the Project will directly contribute $162.6 million to State income over the study period, averaging $4.5 million per annum, under a baseline level of activity at the site. This level of activity is in turn expected to generate a further $453 million indirectly to WA income (an average of $12.6 million per annum), resulting in a total contribution of $615.6 million over the project period at an average of $17.1 million per annum. Over half ($9.3 million per annum) is estimated to flow through to the Gascoyne Region (ACIL Allen 2018).

#### 2.4.7 Regional Community Benefits

Subsea 7's aim is to become a contributing member of the Exmouth community. This has been achieved in Wick, and the same level of commitment to achieving this goal is proposed for Exmouth. As an example, a performance recognition scheme has been in place at Wick for 20 years, whereby donations are made to charities and local organisations as a result of strong performance of the Bundle site. To date, £220,000 (GBP) has been donated in total.

This development is not aimed at a single project but rather an ongoing operation that is able to meet the needs of the market in the long-term. The site in Wick, Scotland, is entering its 41st year of operation, with multiple generations of local families now having both direct and indirect involvement in the site. If successful, the Learmonth facility would represent one of the largest employers of local labour in Exmouth, with the prospect to offer sustainable opportunities to regional businesses and community members.

#### 2.4.8 Alternatives Considered and Optimisation

##### 2.4.8.1 No Development Case

Bundle technology represents an alternative to the conventional development of an offshore gas field. To quantify the benefits of the use of Bundle technology, Subsea 7 completed an assessment of the offshore operations associated the most recent conventional project delivered by Subsea 7 from Exmouth Gulf, and then modelled the offshore operations that would have occurred had the project used Bundle technology.

The chosen project, the development of the Van Gogh field, was located in the Exmouth sub-basin, approximately 50 km north of Exmouth, with field infrastructure consisting of subsea wells, flowlines, umbilicals, structures, risers and moorings, all connecting into the Floating Production Storage and Offloading (FPSO) vessel the 'Ningaloo Vision'. The project consisted of seven production, gas injection, and water injection flexible flowlines, connecting production manifolds to riser pipeline bases beneath the FPSO. Had this project been completed using Bundle technology, two Bundles would have been needed to replace the seven flowlines and associated manifolds.

The primary construction vessel for the project was the 132 m 'Toisa Proteus'. All subsea infrastructure was deployed from this vessel over an 8 month period. Due to the lack of large port infrastructure in Exmouth, the subsea products were stored on heavy lift cargo vessels (the largest being 153 m in length) that were anchored in Exmouth Gulf for the duration of the project. Other vessels included tugs, cargo barges, and light supply vessels.

The results of the assessment and modelling are presented in Table 2-5. The duration and magnitude of offshore and inshore (Exmouth Gulf) vessel operations are significantly reduced for the Bundle project compared to the conventional project.

| Vessel Type | Operation Requirement (days) | |
|---|---|---|
| | Conventional Project | Bundle Project (2 Bundles) |
| Exmouth Gulf | | |
| Toisa Proteus | 15.6 | 3.9 |
| Heavy Lift Vessel1 | 68.0 | 0 |
| Heavy Lift Vessel2 | 7.3 | 0 |
| Bundle Lead Tug | 0 | 3.9 |
| Bundle Trail Tug | 0 | 3.9 |
| Work Vessel | 0 | 6.7 |
| Personnel Transfer | 0 | 6.7 |
| Guard Vessel | 0 | 4.0 |
| Total | 90.9 | 28.9 |
| Offshore | | |
| Toisa Proteus | 50.1 | 9.6 |
| HLV1 | 0 | 0 |
| HLV2 | 0 | 0 |
| Bundle Lead Tug | 0 | 5.3 |
| Bundle Trail Tug | 0 | 4.5 |
| Work Vessel | 0 | 0 |
| Personnel Transfer | 0 | 0 |
| Guard Vessel | 0 | 3.6 |
| Total | 50.1 | 23.0 |

Table 2-5: Vessel Operations Associated with a Conventional versus Bundle Technology Delivery of the Van Gogh Project

For the primary construction vessel the 'Toisa Proteus', offshore time is reduced by 81%, and time in the Exmouth Gulf by 75%. Also, as there is no requirement for the heavy lift cargo vessels during manifold and flowline installation, 83 days of heavy vessel time in the Exmouth Gulf is avoided with a Bundle solution.

This case study demonstrates that offshore vessel operations associated with offshore gas field development can be considerably reduced by the use of Bundle technology. Other advantages to a Bundle project, in addition to the reduced vessel operations, include a greater ability for local and domestic vessel operators to be involved as smaller and more widespread vessels can be used, and a reduction in fuel consumption and greenhouse gas emissions. The continued adoption of the 'no development' case is to forgo the efficiency gains and commensurate reductions in environmental risk offered by Bundle technology.

#### 2.4.8.2 Site Selection

Numerous alternative sites were assessed for suitability as a Bundle construction and launch site, with the environmental, planning, social and engineering constraints considered.

The project requires a 10 km long Bundle track, with adjacent medium gradient shore crossing. The site profile needs to be gentle enough to ensure uniform load distribution from the ground to the Bundle via Bundle support systems during assembly, testing and launch.

This is not the first time that Australia would have used Bundle technology, with previous Bundle fabrication and deployments occurring from two temporary facilities:

- Gnoorea Point, approximately 60 km from Karratha (Western Australia), was previously used as a temporary facility to build and deploy Bundles for two projects during the 1990s.
- McGauran's Beach, approximately 21 km from Woodside (Victoria) and within the McLoughlin's Beach – Seaspray Coastal Reserve, was previously used for a single Bundle deployment in 1996.

Bundle technology and design has developed and progressed significantly since this time, and these improvements have changed the site requirements to support the technology.

Subsea 7 undertook an initial screening to identify potential sites within the North West region of Western Australia that may be suitable for a fabrication facility. This initial screening was based on three elements (Attachment 2A):

- Maximum towing distance of a Bundle.
- Open water tow operations.
- Proximity to existing towns and infrastructure.

Ten potential sites for the proposed Bundle fabrication facility were identified (Figure 2-7):

- Browse SIA (Browse LNG Precinct).
- Boodarie SIA.
- Anketell Point.
- Burrup SIA.
- Maitland SIA.
- Gnoorea Point (Mardie Station).
- Cape Preston East.
- Ashburton North SIA.
- Learmonth.
- Exmouth.

Risk assessments and environmental opportunity and constraints tools were then used to assess the suitability of each site. The assessment for each site consisted of a consideration of the following six factors (refer Table 2-6 and Attachment 2A):

- Marine conditions and suitability.
- Terrestrial conditions and suitability.
- Land tenure.
- Local infrastructure.
- Heritage values.
- Environmental values.

Each factor was assessed using a 'traffic light' system of Green (Suitable), Amber (More information required) or Red (Unsuitable) (refer Attachment 2A).

Following this analysis, three potential sites were identified as appropriate for further assessment (Table 2-6):

- Anketell Point.
- Gnoorea Point (Mardie Station).
- Learmonth.

Following a site inspection of these sites, preliminary stakeholder engagement and further desktop assessment, Gnoorea Point was ruled out due to unsuitable land tenure, unfavourable marine and terrestrial conditions and the risk to environmental values (Table 2-7, Attachment 2A).

Further and more detailed environmental opportunity and constraints analysis, and studies including bathymetry surveys, were undertaken for the remaining sites; Anketell Point and Learmonth. These indicated that Anketell Point was unsuitable for Bundle fabrication and launch and thus Learmonth was determined to be the only feasible site (Table 2-8, Attachment 2A).


Scale: 1:3700000
Original Size: A4
Grid: GDA 94 MGA Zone 50

0 50 100 150 km

Notes: Data sourced from Subsea 7 (2018).

Subsea 7 Pipeline Fabrication Facility

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Figure 2-7: Alternative Sites Considered

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| Site | Marine Conditions | Terrestrial Conditions | Land Tenure | Local Infrastructure | Heritage Values | Environmental Values | Progress to Next Stage of Assessment |
|---|---|---|---|---|---|---|---|
| Browse SIA | | | | | | | No |
| Boodarie SIA | | | | | | | No |
| Anketell Point | | | | | | | Yes |
| Burrup SIA | | | | | | | No |
| Maitland SIA | | | | | | | No |
| Gnoorea Point | | | | | | | Yes |
| Cape Preston East | | | | | | | No |
| Ashburton North SIA | | | | | | | No |
| Learmonth | | | | | | | Yes |
| Exmouth | | | | | | | No |

Table 2-6: Summary of Initial Desktop Assessment Outcomes

| Site | Marine Conditions | Terrestrial Conditions | Land Tenure | Local Infrastructure | Heritage Values | Environmental Values | Progress to Next Stage of Assessment |
|---|---|---|---|---|---|---|---|
| Anketell Point | | | | | | | Yes |
| Gnoorea Point | | | | | | | No |
| Learmonth | | | | | | | Yes |

Table 2-7: Summary of Site Inspection and Further Assessment Outcomes

| Site | Marine Conditions | Terrestrial Conditions | Land Tenure | Local Infrastructure | Heritage Values | Environmental Values | Site Selected for Development |
|---|---|---|---|---|---|---|---|
| Anketell Point | | | | | | | No |
| Learmonth | | | | | | | Yes |

Table 2-8: Site Investigation and Detailed Assessment Outcomes

#### 2.4.8.3 Facility Design

The Development footprint was designed to minimise development at the seaward end of the site and to minimise adverse aesthetic impacts to users of the beaches and inshore waters of Exmouth Gulf. This included location of the proposed fabrication shed at the south western extent of the site, furthest from the shoreline.

The original Proposal included an approximately 750 m long interface with the Minilya-Exmouth Road to allow for flexibility in the final alignment of the site access road. Advice was received from Main Roads WA (MRWA) in July 2018 that, for safety reasons, the site access road should join the Minilya-Exmouth Road at a slightly different location (either slightly to the north or slightly to the south) due to the bend in the road. In liaison with MRWA, the Development Envelope was slightly extended to the north (further from the bend and beyond the slight dip in the road associated with the creekline) and to the south (further from the bend) to ensure that the Development Envelope allows for a safe alignment of the site access road (Figure 2-3). The final alignment of the site access road will be determined following completion of detailed road engineering.

#### 2.4.8.4 Water Source

The installation and operation of a Reverse Osmosis (RO) plant was initially proposed to treat groundwater to the quality required to provide the required potable water and hydro-test water. It was estimated that the RO plant would produce 17 kL/day of wastewater during active operations on site, with a total dissolved solids (TDS) content of up to 1300 mg/L (for reference seawater has a TDS of approximately 35,000 mg/L).

Since the original referral of the Proposal under the EP Act (in 2017), substantial additional studies have been completed to investigate potential water source options. These studies have resulted in the identification of a 'fresh' (salinity (as TDS) of less than 1120 mg/L) groundwater source, to be abstracted from three bores (refer Figure 2-3). Water quality is expected to be such that water treatment will not be required prior to use, and as such no RO plant or associated wastewater stream will be required. An associated reduction in the required groundwater abstraction volume from 16 ML/annum to 12 ML/annum has been achieved.

#### 2.4.8.5 Bundle Launch and Tow Method

Since the original referral (in 2017), Subsea 7 has performed extensive launch and tow engineering studies to define a locally appropriate Bundle launch methodology that is sensitive to the characteristics of the Learmonth site, to address the feedback received through stakeholder engagement and to continue the research required ahead of site development. Some key aims of the engineering included:

- Investigation of opportunities to increase buoyancy of the Bundle towheads and therefore reduce/eliminate seabed interaction.
- Modelling of vessel operations within Exmouth Gulf during a Bundle launch and tow.
- Use of site-specific current data obtained since the referral to model in detail the towpath of Bundles, under different oceanographic conditions, during launch and tow.

The fundamental objective was to develop a robust Bundle launch and tow methodology, building on the knowledge obtained from 40 years of operations in the North Sea, but adapted to suit the very specific conditions in Exmouth Gulf. As a result of this engineering, the width of the Offshore Operations Area at the end of the launchway has been reduced since the original referral of the Proposal.

A launch methodology has been developed for the Learmonth site that minimises the potential for 'indirect' impacts such as seabed erosion from tug thrusters. The site-specific methodology provides for two options depending upon the size (and weight) of the Bundle and the forces required for launch (Table 2-9).

| Scenario | Pull Force Delivery Method | Rationale |
|---|---|---|
| Lighter Bundles | Vessel propulsion, approx. 50-100 Te[6] range | Adequate under keel clearance for vessel to apply low pull force with minor/negligible impact to seabed. |
| Heavier Bundles | Combination of vessel propulsion (50-100 Te range) + Vessel Winching | Vessel propulsion to be limited to a level such that there is no significant impact to seabed.<br><br>Remaining required force delivered by vessel winch, with vessel position maintained by a combination of propulsion and anchor spread (consisting of length of ballast chain laid on seabed within Off bottom tow area). |

Table 2-9: Options for Bundle Launch to Minimise Seabed Disturbance

The proposed options mitigate the risk of impact to the seabed, as follows:

- Avoidance of large vessel propulsion forces mitigates the risk of seabed erosion.
- Avoiding the use of drag anchors that require embedment and proof loading to be effective and can cause the disturbance of soft sediment to a significant depth. The use of ballast chain as an alternative leads to surface disturbance only.
- Ballast chain footprint will be minimal and will be contained within the Off bottom tow area.

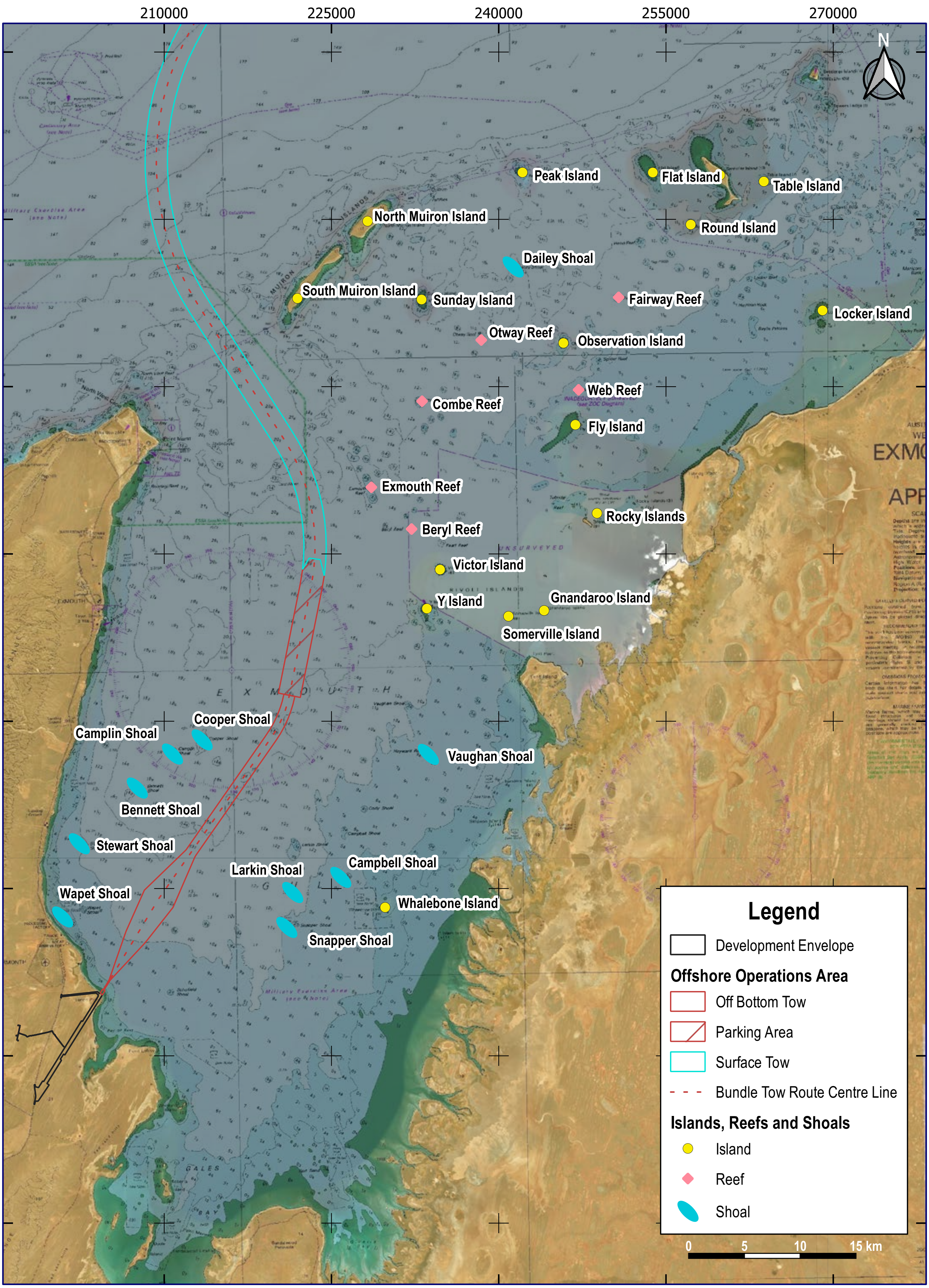
#### 2.4.8.6 Bundle Tow Route

A tow route passing to the east of the Muiron Islands, and avoiding Ningaloo Marine Park, was considered. It was determined that this option was not feasible, and presented a greater risk of a significant environmental impact, given:

- The reefs and shoals south and east of the Muiron Islands (refer Figure 2-8) are distributed such that there is no route which would be navigable by a Bundle tow fleet.
- The tidal movement around these reef and shoal features is more erratic and faster moving and would cause challenging and unpredictable deflections in the Bundle under tow.

[6] The vessel propulsion force is an indicative range. The actual force that is required is specific to the Bundle being launched. As every Bundle is different in some way, the force required will also be different. The limiting propulsion is heavily dependent on the vessel being utilised for the launching operation, and the particular draft condition, trim, and loading of the vessel at the time. Project-specific analysis and risk assessment are conducted for every Bundle launch to determine these requirements and limits, and then select the appropriate pull force delivery method.

- Given the shallow water depths to the east of the Muiron Islands a surface tow could not be conducted, so additional direct impacts to BCH would occur.
- The area currently designated for surface tow between the tip of the North west cape and the Muiron Islands is widely used as a transit area by commercial vessels and recreational fishing vessels alike, so Subsea 7's proposed operation does not represent a change to the type of activity currently undertaken.




Scale: 1:450000
Aerial Photo: ESRI Satellite
Original Size: A4
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from DBCA (2018) and Commonwealth of Australia (2018).

Subsea 7 Pipeline Fabrication Facility

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Figure 2-8: Location of Islands and Shoals in Exmouth Gulf

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## 2.5 LOCAL AND REGIONAL CONTEXT

### 2.5.1 Climate

The climate of the region is hot semi-arid with hot summers and mild winters. Climate data from 1945 to 2017 was obtained from the Learmonth Airport Station located approximately 1.5 km north west of the Development Envelope (Figure 2-9). The annual mean maximum temperature is 31.9°C and the annual mean minimum temperature is 17.7°C. The mean annual rainfall was recorded at 260.7 mm (BoM 2017).

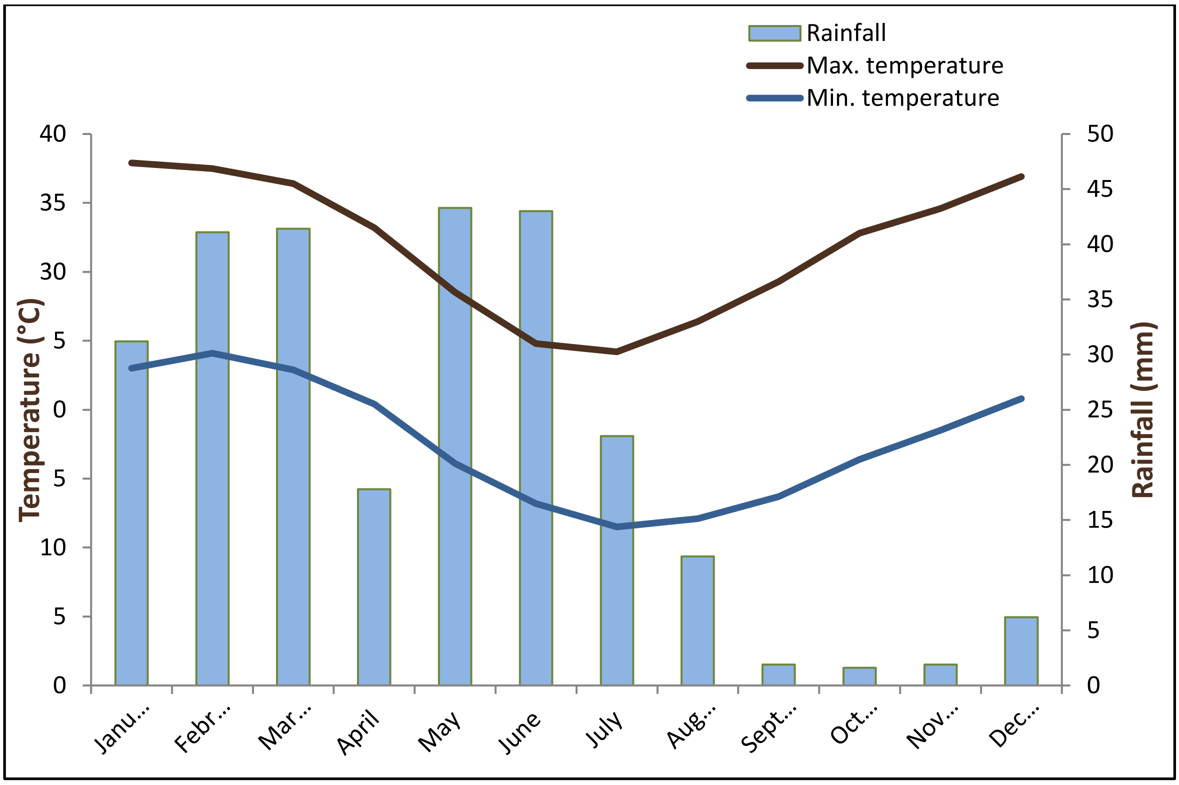



Figure 2-9: Climate Statistics for Learmonth Airport Station 1945-2017 (BoM 2017)

A general south or south westerly wind regime predominates for much of the year. Winds from the north easterly quadrant are common during afternoons in both summer and winter. However, winds may vary considerably due to the influence of afternoon sea breezes in the warmer months. These sea breezes are generally south to south westerly on the western side of North West Cape and typically either south westerly or north easterly on the Exmouth Gulf side.

The annual rainfall for the Exmouth Gulf region is highly variable with an annual average of 260 mm. Peak rainfall occurs from January to March (associated with the passage of tropical cyclones) and between May and June (associated with tropical cloud bands originating to the north west). The heaviest rainfall is generally associated with tropical cyclones and can cause extensive flooding in the area – tropical cyclones are responsible for 20–40% of the annual input of freshwater into Exmouth Gulf (Wyrwoll 1993). Tropical cyclones affect the North West Cape area about once every two years on average. A severe cyclone will impact the area approximately once every 25 years, with severe tropical cyclones having occurred in 1945, 1953, 1964 (Tropical Cyclone Katie) and 1999 (Tropical Cyclone Vance). Tropical Cyclone Vance was registered as a Category 5 cyclone and was the most intense tropical cyclone ever recorded to cross the Australian coast (Bureau of

Meteorology 2000). The eye of this cyclone passed down Exmouth Gulf, about 25 km to the east of Exmouth and 80 km to the west of Onslow. During this cyclone, the highest ever wind gust recorded on the Australian mainland of 267 km/h was recorded at Learmonth Airport on 22 March 1999. Tropical Cyclone Vance also resulted in approximately 200-300 mm of rainfall to the east and south of Exmouth with consequent flooding of these areas (Blandford & Associates and Oceanica 2005).

### 2.5.2 Geographical and Physical

#### 2.5.2.1 Surface Geology and Soils

Surface geology was mapped at a scale of 1:100 000 and identified three surface geology profiles within the Heron Point area (GSWA 2008):

- Dunes 38496: Dunes, sandplain with dunes and swales; may include numerous interdune claypans; residual and Aeolian sand with minor silt and clay; Aeolian red quartz sand, clay and silt in places gypsiferous; yellow hummocky sand.
- Estuarine and delta deposits 38489: Coastal silt and evaporate deposits; estuarine, lagoonal, and lacustrine deposits.
- Colluvium 38491: Colluvium, sheetwash, talus: gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and Aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite.

Department of Agriculture and Food WA (DAFWA) Soil Subsystems mapping indicates that the Littoral System and the Cardabia System occur in the Heron Point area (DAFWA 2012):

- Littoral System: Bare coastal mudflats (unvegetated), samphire flats, sandy islands, coastal dunes and beaches, supporting samphire low shrublands, sparse *Acacia* shrublands and mangrove forests.
- Carbadia System: Undulating sandy plains with linear dunes, minor limestone plains and low rises, supporting mainly soft spinifex hummock grasslands with scattered acacia shrublands and mangrove forests.

Review of the 'Yanrey-Ningaloo' (Learmonth) 1:250, 000 geological maps indicates the geology of the Development Envelope mainly comprises of longitudinal network dunes and residual sandplains comprised of red brown to yellow quartz sand (GHD 2017).

#### 2.5.2.2 Surface Water

A defined watercourse intersects the Development Envelope approximately 2 km from the proposed fabrication shed. The watercourse has an upper catchment extending approximately 10 km to the west of the site, with a catchment area of 1,689 ha (refer Section 5.8.3).

A smaller catchment (approximately 155 ha) lies to the south of the Development Envelope (refer Section 5.8.3).

Areas along the Bundle track/road corridor (approximately 2 km on the approach to the launchway), and the majority of the access track, are located in the supratidal flats and do not appear to have any external drainage (refer Section 5.8.3).

#### 2.5.2.3 Marine

Exmouth Gulf marks the start of the shallow Pilbara coastal waters region. The shallow protected waters of Exmouth Gulf provide a contrast to the waters of Ningaloo Reef that, outside the reef line, are exposed to the open ocean and rapidly drop off into waters approximately 1,000 m deep.

The deeper waters outside the Gulf are stratified in temperature while the waters inside the Gulf are vertically well mixed, more turbid and higher in chlorophyll-a (Verspecht 2002).

The tidal circulation in the Exmouth Gulf has been predicted by Massel *et al*. (1997) and APASA (2005). Tidal circulation along the deeper waters of the western margin are primarily orientated north-south, while tidal migrations along the eastern margin are more complex, being steered by local topography (Oceanica 2006).

During the flood tide, transport occurs in one direction over a distance of approximately 4 km before the flow stops and starts to reverse as the ebb tide commences. Thus there is little possibility of direct (i.e. in a single cycle) transfer by the tides of any material or nutrient from the south or east coasts to the North West Cape area and Ningaloo Reef. This has implications for the connection between the Gulf and Ningaloo, in that at best the Gulf could provide organic and suspended sediments to waters offshore; however, the dominant south and south westerly wind direction will tend to move waters north east out of the Gulf (Oceanica 2006).

Deployment of current measurement instruments off Heron Point for two tidal cycles (spring and neaps) in May/June 2018 indicated that the predominant currents flowed to the north (ebb tide) and south (flood tide), with speeds of up to approximately 0.5 m/s (GHD 2018a) (Figure 2-10).

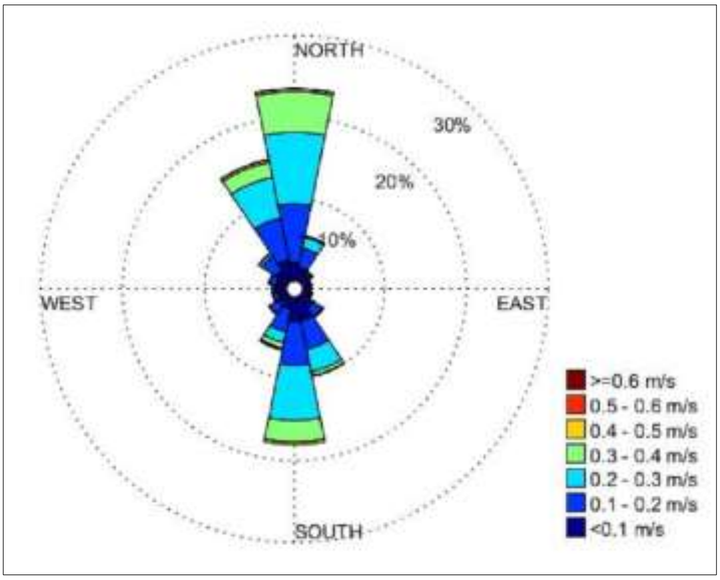



Figure 2-10: Current Speed and Direction Recorded off Heron Point in May/June 2018 (duration indicated as % of time occurring throughout monitoring period) (from GHD 2018)

### 2.5.3 Land Tenure

The Development Envelope is located partially on Lot 233 (P219618) and Lot 1586 (P72986), which are subject to the Exmouth Gulf Pastoral Lease accessed from Minilya-Exmouth Road. The Development Envelope is approximately 35 km south of the Exmouth townsite. The land is zoned as 'Rural' under the Shire of Exmouth Local Planning

Scheme No. 4. The Site is subject to the 'Exmouth Gulf' Pastoral Lease, which has a term of 39 years, 3 months, 1 day, as of 1 July 2015.

On 10 October 2017, the (then) Commissioner of the Shire of Exmouth adopted Scheme Amendment 32 to the (now revoked) Town Planning Scheme No. 3 (TPS 3) for the purposes of rezoning part of Lot 233 Minilya-Exmouth Road and part of Lot 1586 Minilya-Exmouth Road, Learmonth, from 'Pastoral' to 'Special Use No. 9' zone, and amending the scheme map accordingly. The amendment was referred to the Western Australian Planning Commission (WAPC) and on 30 January 2018, WAPC advised that Amendment 32 was suitable for advertising. The amendment was referred to the EPA, which requested further information that would be contained within an ERD.

During 2018 the Shire of Exmouth finalised its draft Local Planning Strategy and draft Local Planning Scheme No. 4 (LPS 4) with modifications required by the WAPC. The Local Planning Strategy (final, as modified) has been approved by the WAPC and the Minister for Planning has approved the LPS 4. The previous Scheme Amendment 32 has fallen away as the TPS 3 has been revoked.

Under the LPS 4, the Development Envelope is zoned as 'Rural'. Subsea 7 has resubmitted a Scheme Amendment Request to rezone the area from 'Rural' to 'Special Use' under LPS 4. As a result, the intended amendment to TPS 3 via Scheme Amendment 32, has been reconfigured to relate to LPS 4. A Special Use zone is still proposed for the purposes of rezoning the Development Envelope. The EPA determined that the proposed amendment to LPS 4 required formal assessment under Part IV of the EP Act. An Environmental Review process is underway and a separate impact assessment document has been prepared to fulfil the assessment requirements (under Assessment number 2209) under Section 48A of the EP Act.

#### 2.5.4 Native Title

One registered Native Title claim exists across the Proposal area; Gnulli WC1997/028 (DAA 2017). The Gnulli Native Title claim covers approximately 82,708 km$^2$ of land and sea in the Yamatji Region. It lies in the Shires of Ashburton, Carnarvon, Exmouth and Upper Gascoyne. The claim is currently in the process of determination.

As part of stakeholder engagement for the Proposal, Subsea 7 has engaged regularly with Gnulli, through their representatives the Yamatji Marlpa Aboriginal Corporation (YMAC), since mid-2017. Subsea 7's first attendance at the Gnulli Working Group meeting occurred in August of 2017, and Subsea 7 has remained a regular attendee at the Working Group's meetings since this first engagement.

Subsea 7 remains committed to recognising the rights, history and heritage of the Traditional Owners, with the aim of forming long-term and mutually beneficial relationships. Together, the Gnulli and Subsea 7 have achieved a number of milestones over the period of engagement:

- The parties have performed heritage surveys on the site with input and leadership from the Traditional Owners.
- The Traditional Owners have provided education, assistance and monitoring during environmental investigations associated with the subterranean fauna drilling program, maintaining an onsite presence throughout the work.
- The Gnulli Working Group and Subsea 7 have performed site visits together on the land, to enable all parties to better understand one another.

These activities have contributed to increasing Subsea 7's cultural awareness of the Gnulli people's relationship with the land. This engagement has fostered a positive working relationship, whereby the Proposal can be discussed and understood at all levels, together with the potential for impact, to ensure an appropriate final Proposal design. Subsea 7 is committed to entering into a mutually beneficial agreement with the Gnulli people, and continues to progress this in consultation with the Gnulli and YMAC.

### 2.5.5 Environmental Values

The conservation values of Exmouth Gulf are recognised in several State government publications, policies and guidelines:

- In 1975, the Conservation Through Reserves Committee recognised its conservation significance and recommended that a series of studies on biophysical characteristics of the tidal and supra-tidal flats of Exmouth Gulf be conducted.
- The fringe of arid zone mangroves along the east coast of Exmouth Gulf is recognised as being of 'regional significance' in EPA Guidance Statement No. 1 (EPA 2001) (Figure 2-11).
- The mangroves along the south western end of Exmouth Gulf are described in EPA Guidance Statement 1 (EPA 2001) as 'Area 1: Bay of Rest' and are classified as being of 'Very High' importance (Figure 2-11). For Guideline 1 areas, the EPA expects that '*no development should take place that would adversely affect the mangrove habitat, the ecological function of these areas and the maintenance of ecological processes which sustain the mangrove habitats*' (EPA 2001).
- The salt flats, mangrove creeks and inshore waters were recommended for reservation in the report '*A Representative Marine Reserve System for Western Australia*' by the Marine Parks and Reserves Selection Working Group referred to as the Wilson Report (CALM 1994) (Figure 2-11).
- The coastal waters along the east coast of Exmouth Gulf have been recommended for the 'maximum' level of ecological protection in the Department of Environment document *Pilbara Coastal Water Quality Consultation Outcomes* (DoE 2006) (Figure 2-11). The objectives for 'maximum' water quality protection are that there be no contamination and no detectable change from natural variation in water quality.
- Humpback whales are listed as Species of Special Conservation Interest under the Biodiversity Conservation Act 2016 (BC Act), Dugong are listed as Species in need of Special Protection under the BC Act, and both Green and Hawksbill turtles are listed as Vulnerable under the BC Act. Other specially protected and migratory species regularly use the area.
- To protect the ecosystem services and recreational enjoyment that are provided along the east coast and south of Exmouth Gulf, the coastal waters have been a permanent nursery closure area for prawn trawling since 1983, and were recommended as a 'Fish Habitat Protection Area' in the draft Fisheries Environmental Management Plan for the Gascoyne Region (Shaw 2002) (Figure 2-11).
- Consolidating this body of complementary policy instruments and guidelines, the Ningaloo Coast Regional Strategy Carnarvon to Exmouth, was endorsed by the WA Government and released by the WAPC in 2004 (WAPC 2004). The strategy recommends that the southern and south eastern mangrove areas of Exmouth Gulf and adjacent coastal waters become marine protected areas, consistent with the findings of the Wilson Report (CALM 1994).

The conservation values of Exmouth Gulf are also recognised at the Commonwealth government level (Figure 2-12):

- Two Nationally Important Wetlands, listed in the 'Directory of Important Wetlands in Australia' as wetland 'Cape Range Subterranean Waterways – WA006' and 'Exmouth Gulf East Wetlands – WA007' occur in proximity to the Project site.
- The Ningaloo Coast World Heritage Area and National Heritage Place.
- The Ningaloo Marine Park (as described in Australian Marine Parks North-west Marine Parks Network Management Plan) (Director of National Parks 2018).

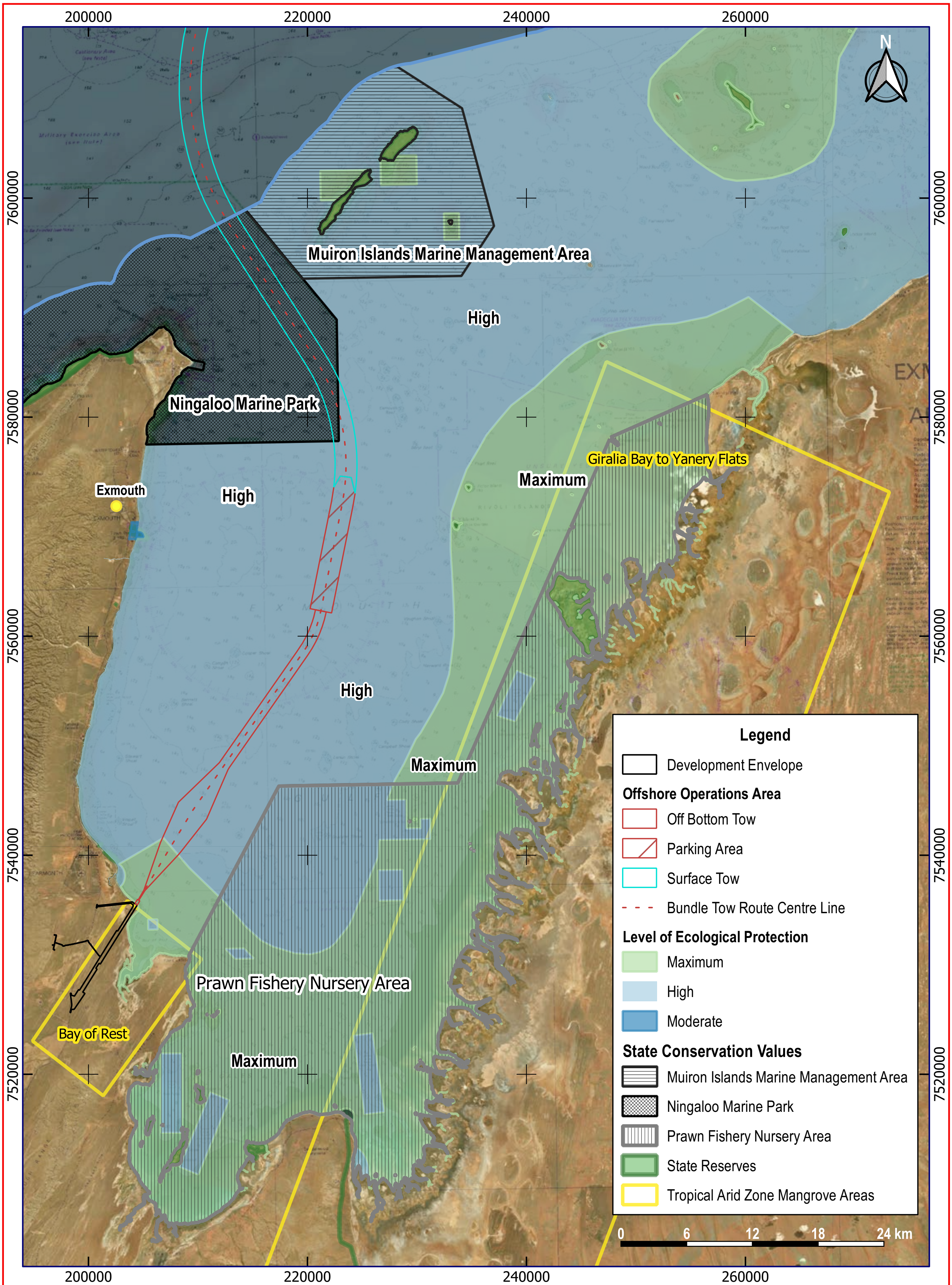
The Commonwealth Ningaloo Marine Park stretches approximately 300 km along the west coast of the Cape Range Peninsula, and is adjacent to the Western Australian Ningaloo Marine Park. The park covers an area of 2,435 $km^2$ and a water depth range of 30 m to more than 500 m. The Marine Park was originally proclaimed under the *National Parks and Wildlife Conservation Act 1975* on 20 May 1987 as the Ningaloo Marine Park (Commonwealth Waters), and was proclaimed under the EPBC Act on 14 December 2013 and renamed Ningaloo Marine Park on 9 October 2017. The park is assigned IUCN category IV and includes two zones assigned under this plan: National Park Zone (II) (an area approximately 40 km north of Coral Bay) and Recreational Use Zone (IV) (the remainder of the park) (Director of National Parks 2018).

The Commonwealth Ningaloo Marine Park is significant because it contains habitats, species and ecological communities associated with the Central Western Shelf Transition, Central Western Transition, Northwest Province, and Northwest Shelf Province. It includes three key ecological features:

- Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula (valued for unique seafloor features with ecological properties of regional significance).
- Commonwealth waters adjacent to Ningaloo Reef (valued for high productivity and aggregations of marine life).
- Continental slope demersal fish communities (valued for high levels of endemism and diversity).

The Marine Park provides connectivity between deeper offshore waters of the shelf break and coastal waters of the adjacent Western Australian Ningaloo Marine Park. It includes some of the most diverse continental slope habitats in Australia, in particular the continental slope area between North West Cape and the Montebello Trough. Canyons in the park are important for their role in sustaining the nutrient conditions that support the high diversity of Ningaloo Reef. The Marine Park is located in a transition zone between tropical and temperate waters and sustains tropical and temperate plants and animals, with many species at the limits of their distributions (Director of National Parks 2018). The Marine Park supports a range of species including species listed as Threatened, Migratory, Marine or Cetacean under the EPBC Act. Biologically important areas within the region include (Figure 2-13):

- A migratory pathway for Humpback whales.
- Nesting and internesting habitat for marine turtles.
- Breeding, calving and nursing habitat for Dugong.
- Foraging habitat for Whale sharks.




Scale: 1:450000
Aerial Photo: ESRI Satellite
Original Size: A4
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from EPA (2018, 2011), Commonwealth of Australia (2018), and DBCA (2018). Maximum level of Ecological Protection areas are the same as those identified by CALM as 'Recommended for Reservation (1994).'

Subsea 7 Pipeline Fabrication Facility

Figure 2-11: Conservation Values of Exmouth Gulf Recognised in State Publications

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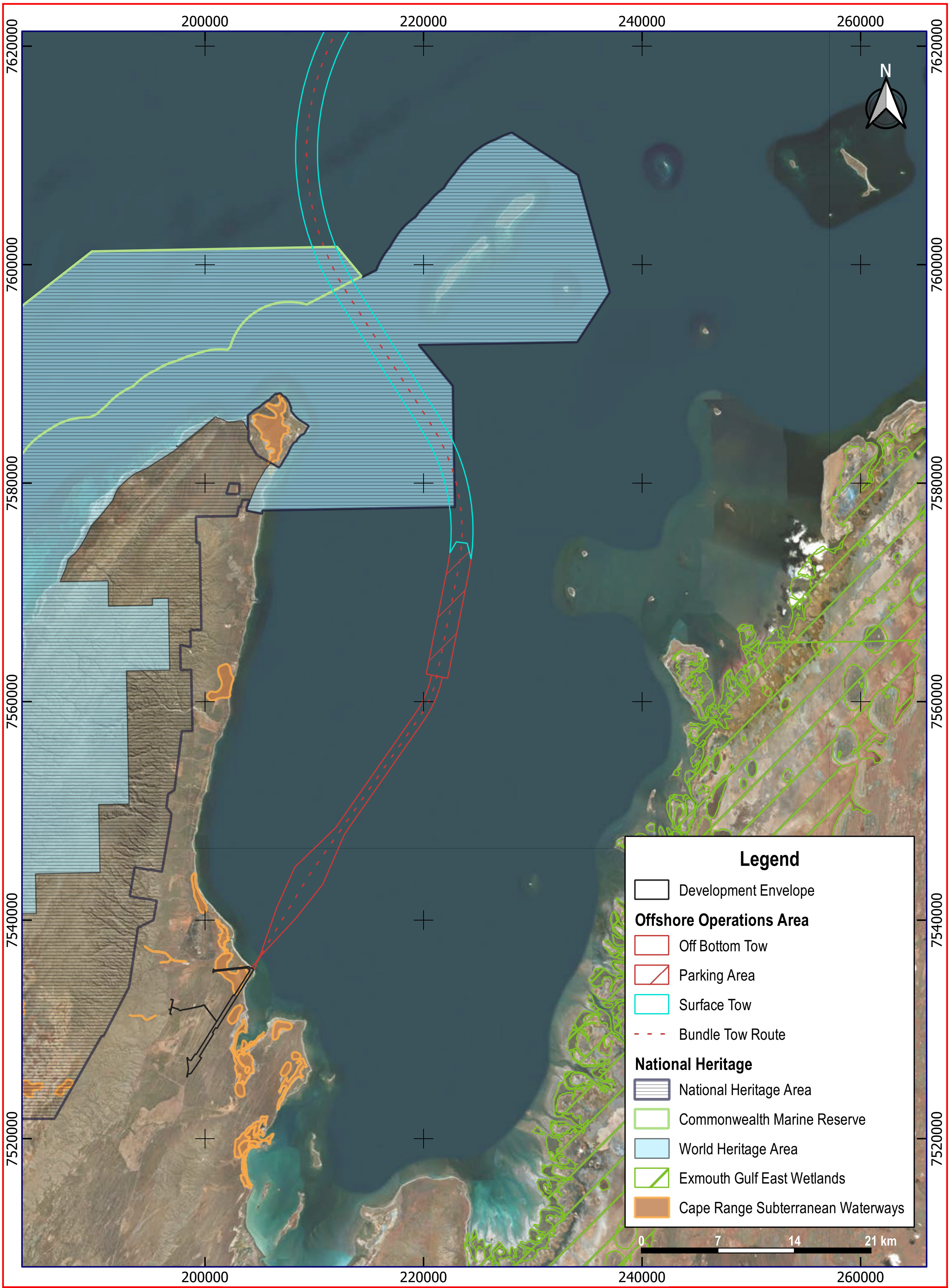


Scale: 1:450000
Aerial Photo: ESRI Satellite
Original Size: A4
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Commonwealth of Australia (2013 and 2018).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 2-12: Conservation Values of Exmouth Gulf Recognised at the Commonwealth Level

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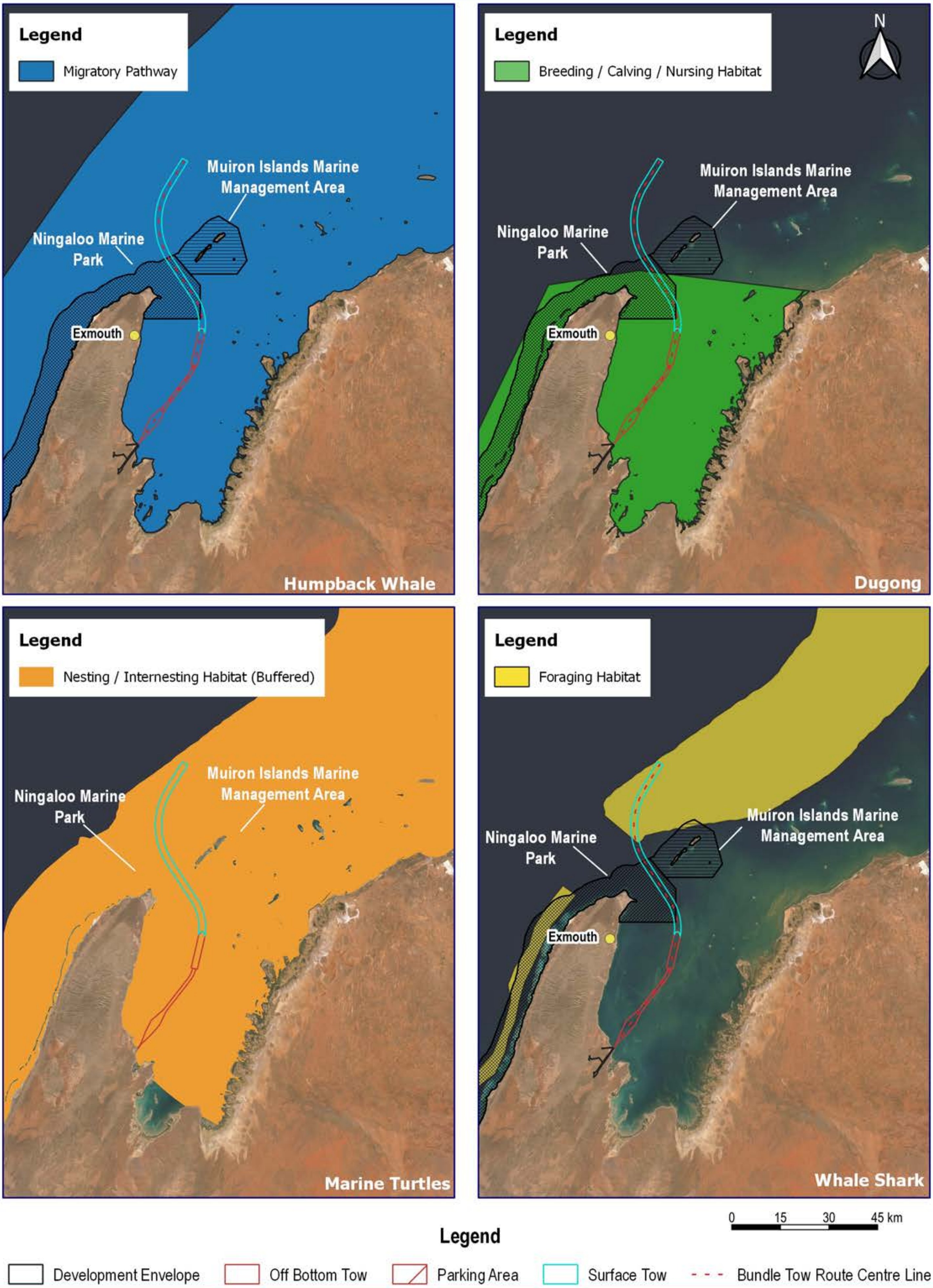


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Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94

Notes: Data sourced from DoEE (2015).

Subsea 7 Pipeline Fabrication Facility

Figure 2-13: Biologically Important Areas for Humpback Whale, Dugong, Marine Turtles and the Whale Shark Within Exmouth Gulf and Ningaloo Marine Park

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### 2.5.6 Social Surroundings

The Gascoyne covers an area of approximately 138,000 $km^2$ representing about 5.5% of WA (DPIRD 2019). The Gascoyne is made up of four local government areas – Carnarvon, Exmouth, Shark Bay, and Upper Gascoyne. The Gascoyne is known as WA's food bowl with 84% of the land covered by Pastoral Leases and home to WA's biggest prawn fishery in Shark Bay (DPIRD & Gascoyne Development Commission [GDC] 2018).

In 2016, the Gascoyne population was 9,485; the lowest estimated resident population of all the regions in WA (ABS 2016b, GDC 2017). Of the population, 52.7% were male and 47.3% were female. Aboriginal and/or Torres Strait Islander people made up 13.4% of the population, which is significantly higher than the 3.1% that makes up the WA population.

The Shire of Exmouth is situated 1,270 km north of Perth and covers an area of 650,300 ha. Over the past decade the population within the Shire of Exmouth has increased by approximately 32% (2,063 persons in 2006 to 2,728 in 2016) (ABS 2006; 2016a). Every year, during the cooler winter months (May–August), the resident population in Exmouth triples due to an influx of holiday-makers (Shire of Exmouth 2018).

Tourism is now the largest industry and major economic contributor in the Shire with hospitality, accommodation and retail also accounting for a large proportion of Exmouth's economy and job market (SGS Economics & Planning [SGS] 2012, ABS 2016a). Other key industries include fishing, aquaculture, pastoralism and mining. A key finding from the public consultation process in the Shire of Exmouth's Strategic Community Plan 2030 was the need for greater fulltime employment opportunities. The community would also like to see a stronger and more diverse local economy enabling year-long employment opportunities (Shire of Exmouth 2018).

### 2.5.7 Heritage

#### 2.5.7.1 Ningaloo Coast World Heritage Area

The Ningaloo Coast World Heritage Area (Reference 1369) was inscribed on the World Heritage List on 1 November 2011 under the following criteria:

- Criterion (vii) contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
- Criterion (x) contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing Threatened species of outstanding universal value from the point of view of science or conservation.

The adopted boundary includes the Ningaloo Marine Park (Commonwealth Waters), Ningaloo Marine Park (State Waters) and the Muiron Islands Marine Management Area (including the Muiron Islands), Jurabi Coastal Park, Bundegi Coastal Park, Cape Range National Park and Learmonth Air Weapons Range (Figure 2-12).

Key threats identified (UNESCO 2011) include:

- Future bombing activities within the Learmonth Air Weapons Range Facility, which may pose a threat to the Bundera sinkhole.
- Increasing tourism potentially leading to damage to vegetation, illegal fishing, sewage and waste disposal and disturbance to wildlife.
- Increased water demand leading to water abstraction with potential effects on the groundwater systems.

- Fire, historically part of local indigenous management, is a potential threat to the terrestrial vegetation.
- Offshore hydrocarbon extraction in the region potentially increasing the risk of pollution and disturbance.
- Sea level rises and increases in seawater temperatures associated with climate change.
- Invasive alien species, primarily foxes, cats, goats, and weeds (on land) and some marine species.

#### 2.5.7.2 Ningaloo Coast National Heritage Place

The Ningaloo Coast National Heritage Place covers approximately 710,000 ha, comprising Ningaloo Marine Park, Muiron Islands Marine Management Area (including the Muiron Islands), Jurabi Coastal Park, Bundegi Coastal Park, Cape Range National Park, Learmonth Air Weapons Range and portions of Exmouth, Ningaloo, Cardabia, Warroora, Gnaraloo, and Quobba Pastoral Leases (Figure 2-12).

The National Heritage Place was listed under the following criteria:

- Criterion (a): the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history.
- Criterion (b): the place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history.
- Criterion (c): the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history.
- Criterion (d): the place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of (i) a class of Australia's natural or cultural places; or (ii) a class of Australia's natural or cultural environments.
- Criterion (f): the place has outstanding heritage value to the nation because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.

### 2.5.8 Other Nearby Projects or Proposals

#### 2.5.8.1 Exmouth Gulf Prawn Fishery

Summary

Prawn trawling commenced in 1963 targeting schooling Banana prawns (*Penaeus merguiensis*) during daylight hours (Penn *et al*. 1997). As the catch of Banana prawns declined over the ensuing four years, the trawl fleet transferred effort to night time fishing on King (*Penaeus latisulcatus*), Tiger (*Penaeus esculentus*) and Endeavour prawns (*Metapenaeus endeavouri*). Annual nominal effort in the fishery gradually increased to about 50,000 hours trawled in the late 1970's to the early 1980's when a maximum of 23 trawlers operated in the fishery. In 1985, the number of trawlers was reduced to 17, to 16 in 1990, another boat was removed in 1998 and in 2000 two more were removed bringing the total to 13 (Kangas *et al*. 2006a).

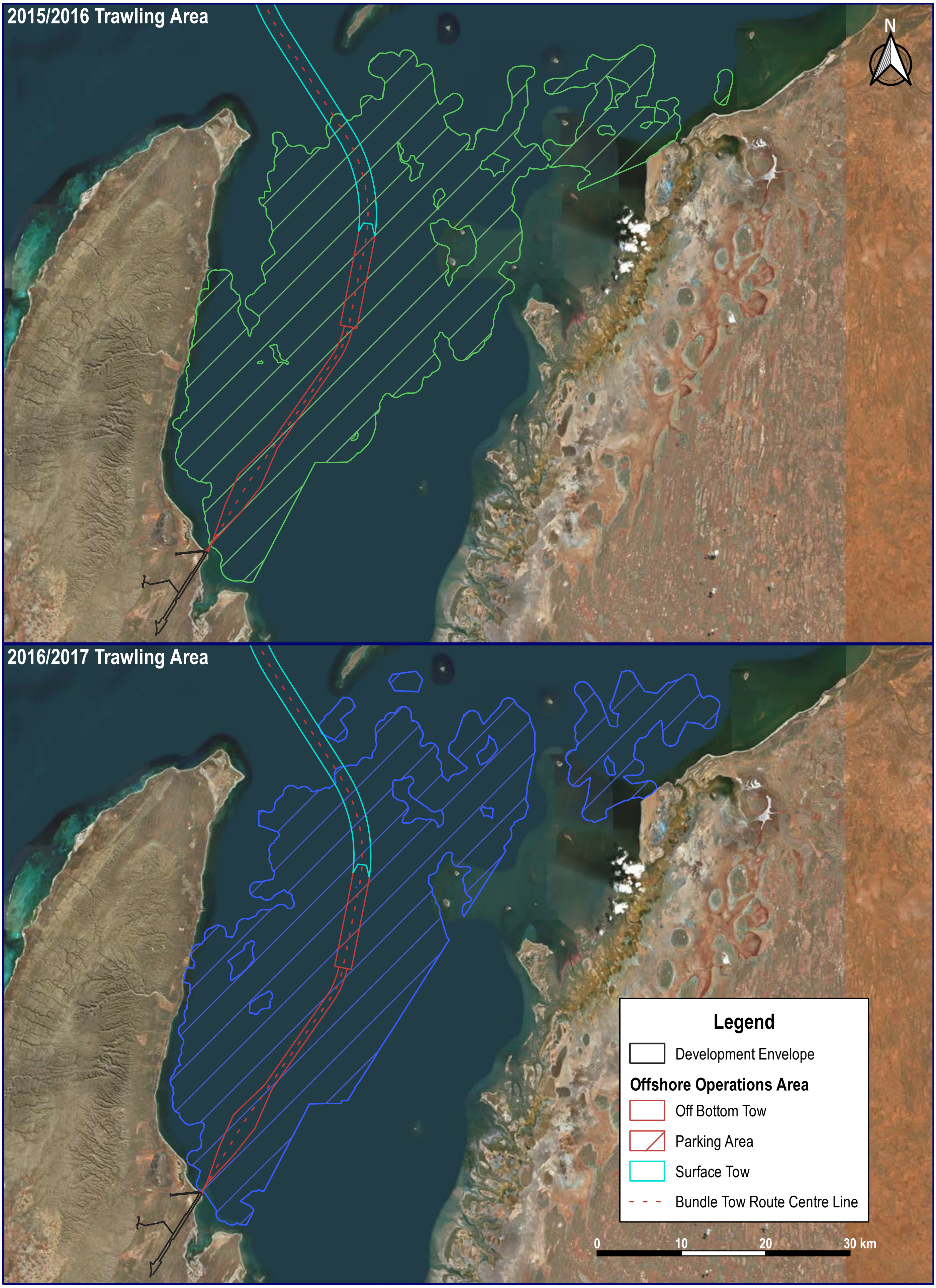
The Exmouth Gulf Prawn Fishery is one of the largest trawl fisheries in WA and has had catches ranging from 771 to 1,456 tonnes per year over the past 11 years (since 2006). The commercial catch for 2016 was a total of 822 tonnes. Banana, Tiger, and Endeavour prawns were all below the designated accepted annual catch limits (Gaughan and Santoro 2018).

During the open season, trawling is only permitted between 17:00 hours and 08:00 hours except when Banana prawns are available, when daylight trawling can occur. Trawl duration in this fishery is generally between one and three hours. Trawling ceases for 3 to 5 days around the period of the full moon each month when prawns tend to bury themselves in sediment making trawling less economical. The average trawl speed is 3.5 to 4 knots (Kangas *et al*. 2006a).

The Offshore Operations Area overlaps with the area currently trawled (Figure 2-14).

The trawling grounds comprise mud and sand habitats, and therefore the physical impact of the trawl gear has limited impact. The overall environmental effect is considered to be low due to the habitat type and control measures in place (Kangas *et al*. 2015). A study by Kangas *et al*. (2006a) reported that no major detrimental ecological impacts were identified as a result of the ongoing prawn fishery, although some evidence of lower faunal abundance at heavily trawled sites was recorded. It was also reported that some species such as the Large-scaled lizardfish (*Saurida undosquamis*), the Asymmetrical goatfish (*Upeneus asymmetricus*), the Hair-finned leatherjacket (*Paramonacanthus choirocephalus*), commercial prawn species, and Portunid crabs, preferred the disturbed, low-relief, soft sediment habitats modified by trawling.

In 2016, a total of 325 square nautical miles (28.5%) of the trawlable grounds were fished. This is in line with the set performance measures for habitat impact relating to the spatial extent of the licenced trawling area (SoF 2017).

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Original Size: A4

Notes: Data sourced from DPIRD (2018) and Subsea 7 (2018).

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Figure 2-14: Exmouth Gulf Prawn Fishery – Areas Fished (2015/2016 and 2016/2017)

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Regional Impacts

In the early days of trawling in Exmouth Gulf, the grounds were unknown and echo-sounding and navigation devices were very primitive. Suitable areas for trawling were discovered by trawling the seabed. In some areas, a technique called 'breaking the ground' was employed where chains would be strung between trawlers and dragged, to remove obstacles for the nets. The effects of the early trawling practices are unknown, but are likely to have caused significant habitat modification towards soft substrates (RPS 2004). Impacts of trawling are likely to be often underestimated because there are no documented examples where pre-trawling communities are described and quantified for comparison to post-trawl communities at the same location (Hobday *et al*. 2006). Prawns are one of the groups that are apparently facilitated by moderate levels of trawling (Cushing 1984).

The Department of Fisheries (2002) conducted an assessment into the sustainability of the fishery, which was reviewed by the Department of Environment and Heritage (2002). The assessment considered the potential impact on the mud and sand habitats in Exmouth Gulf, as a result of the prawn trawling operations, unlikely to have had even a minor consequence. Of the area that is permitted to be trawled, approximately 35% is actually trawled due to the targeting of known favourable grounds. Furthermore, 28% of the area is permanently closed to trawling. Studies of actual impacts from prawn trawling suggest only minimal impacts to infaunal communities. After forty years of trawling in Exmouth Gulf, the areas that are the subject of ongoing trawling activity are likely to have become stable habitats. Visual observation of these areas has encountered mostly bare sands with virtually no epibenthos, and very limited motile organisms present (RPS 2004, MBS Environmental 2018a).

#### 2.5.8.2 Exmouth Artificial Reef 'King Reef'

Summary

An artificial reef has been constructed using a mix of steel towers salvaged from decommissioned offshore oil and gas facilities and purpose-made concrete sections. The reef lies to the north east of Exmouth Marina (Figure 2-15), covers approximately 0.8 ha and was put in place in August 2018.

Regional Impacts

Negligible impact to BCH is considered to have occurred at a local and regional scale given the small footprint of the artificial reef (0.8 ha) within an area of soft sediment.

#### 2.5.8.3 Exmouth Marina

Summary

In March 1991, the EPA formally assessed a proposal by the Department of Transport for an inland marina, residential subdivision and quarry. Environmental approval was issued on 20 January 1992. The Department of Transport proposed some changes to the project in 1995, including a re-design of the marina from an inshore harbour basin to a smaller offshore harbour basin and deferral of the residential component. Environmental approval was issued by the Minister on 11 March 1996 (Ministerial Statement 406).

On 3 December 1996, a proposal to construct an inland marina, resort and residential/canal development, as a land-backed extension to the Exmouth Boat Harbour, was referred to the EPA by LandCorp. This was treated as a new proposal and was assessed at a level of PER. The EPA concluded that the proposal could be managed in a manner to avoid an unacceptable impact on the environment. Approval was granted, via Ministerial Statement 474, in April 1998.

Construction of Exmouth Boat Harbour was completed in 1997. In 2016-2017 additional dredging and construction of a heavy lift facility within the harbour was undertaken. The current footprint is shown in Figure 2-15.

Regional Impacts

The marina footprint is approximately 87 ha onshore and 37 ha offshore. It is likely that the nearshore habitats impacted during construction of the rock walls and deepening of the harbour were consistent with those found immediately adjacent to the site i.e. soft sediment. Benthic Primary Producer Habitat (BPPH) (now termed Benthic Communities and Habitat) were not a key environmental factor during the EPA's assessment of the project (EPA 1997c).

The native vegetation within the onshore footprint is likely to have been consistent with the vegetation types found broadly across the region. The EPA (1997c) noted that:

- '*The coastal dunes between the proposed marina site and the Exmouth Gulf form a distinct vegetation zone. A number of pioneer species as Spinifex longifolius, Salsola kali, Cakile maritima, Ipomea brasiliensis, and Tetragonia decumbens occur in the foredune/primary dune with Ptilotus spp., Atriplex isatidea, Olearia axillaris, Scaevola crassifolia and Euphorbia sp. in the swales. These plants are important as they trap sediments and protect the dunes from wind erosion. Existing foredunes are badly degraded in places due to uncontrolled access. Weed invasion has also occurred in a number of areas*'.
- '*In contrast with the coastal areas of the Cape Range peninsula, the coastal dunes within the site are in moderate to very poor condition due to disturbance of the vegetation by activities such as pony/horse riding, camel rides, 4-wheel driving and uncontrolled pedestrian access to the beach. Weeds such as Buffel grass have also been introduced to the coastal dunes, and the weeds are now common on the coastal plain*'.

#### 2.5.8.4 Cape Seafarms Project

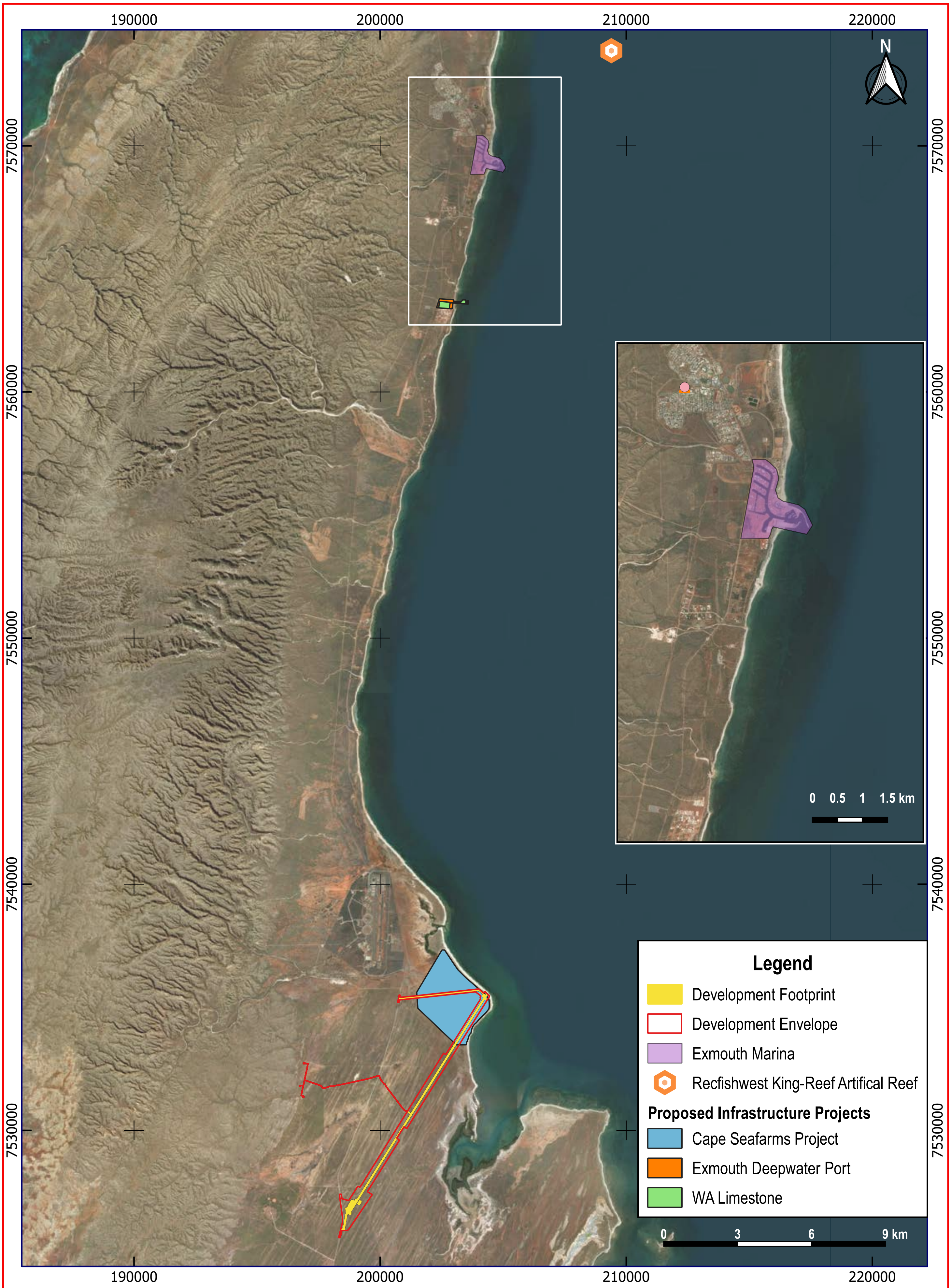
Summary

Cape Seafarms Pty Ltd proposed to develop a 120 ha onshore prawn farm at Heron Point including a total footprint of 250 ha (Figure 2-15). The proposal was referred to the EPA and was assessed via a Consultative Environmental Review (CER) (EPA 1997a).

The project was recommended for approval by the EPA and was approved, via Ministerial Statement 456, on 27 August 1997. Initial earthworks were undertaken, but the project has since been abandoned.

Regional Impacts

An examination of aerial imagery suggests that approximately 170 ha of the onshore footprint were disturbed by initial earthworks. It is assumed that the flora species and vegetation associations across this area are similar to those recorded within the Development Envelope. No Declared Rare or Priority listed flora were found in the project area and all species are described as common in the Exmouth area and in most coastal regions of the north west of Western Australia (EPA 1997a). No marine impacts have occurred as a result of this project.




Scale: 1:200000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data representing indicative existing and proposed infrastructure developed by MBS Environmental (2018).

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Figure 2-15: Location of Existing or Reasonably Foreseeable Developments in the Vicinity of the Proposal

W:\Subsea 7\GIS\Infrastructure Map.qgs 29/08/2019

#### 2.5.8.5 WA Limestone

Summary

Whitecrest Enterprises Pty Ltd proposed to construct and operate a barge loading facility south of Mowbowra Creek, to the south of Exmouth Marina within Exmouth Gulf. The facility was proposed for export of limestone mined from the nearby Whitecrest Limestone Mine.

The Exmouth Limestone Project Barge Loading Facility proposal was described in a CER document (Halpern Glick Maunsell 1997). EPA Bulletin 871, recommended approval of the proposal, with conditions, was published in November 1997. Ministerial Statement 465 was published on 19 January 1998.

The proposal included a 650 m rockfill causeway, including a reclaimed offshore storage area, an onshore laydown/plant area (Figure 2-15) and a haul road from the proposed Whitecrest Mine to the barge loading facility. Under proposed maximum quarry production rates (1 mtpa), a shipment would leave Exmouth Gulf every two weeks.

A future proposal to develop a larger shipping facility, including a dredged shipping approach, was envisaged, but was not considered as a part of the EPA's assessment.

Regional Impacts

The direct impacts to BCH were predicted to be as follows (EPA 1997b):

- Rocky shores (0.06 ha).
- Intertidal limestone pavement (1.0 ha).
- Subtidal limestone pavement (1.0 ha).
- Seafloor (supporting holothurians, echinoids, molluscs and prawns) (4.2 ha).

These habitats were mapped to the north and south of the infrastructure footprint, are expected to be widely represented along the western shore of Exmouth Gulf, and are similar to the habitats recorded at Heron Point extending north to Learmonth Jetty. Thus impacts were not considered significant at a local scale.

An onshore footprint of 20.6 ha was expected as a result of the project (based on the estimated footprint presented in Figure 2-15). To date the project has not been implemented.

#### 2.5.8.6 Exmouth Deepwater Port

Summary

Several groups are investigating the prospect of a deep-water port to service larger vessels, including cruise ships, defence and resources sector vessels. Visiting cruise ships are currently anchored offshore within Exmouth Gulf for a few hours and passengers are brought ashore for sightseeing and shopping, if the weather allows.

The Shire of Exmouth secured funding from the Gascoyne Development Commission to investigate the development of the proposed terminal. Two potential sites were being looked at, the first immediately to the south of Exmouth Marina, the second to the south of Mowbowra Creek (Figure 2-15). Mowbowra Creek is the same location as the proposed Exmouth Limestone Project Barge Loading Facility. Only one of the proposals would occur at this site.

Regional Impacts

The project, based on the estimated footprint presented in Figure 2-15, would result in the loss of 13.2 ha of native vegetation onshore and of 1.8 ha of nearshore soft sediment habitat offshore.

#### 2.5.8.7 General Recreational and Commercial Vessel Operations

Summary

Currently extensive vessel activity occurs within Exmouth Gulf as a result of the Exmouth Gulf Prawn Fishery (13 boats) (Section 2.5.8.1), charter fishing and tour operators, recreational fishers and commercial operations (including those associated with oil and gas projects (refer Section 2.4.8.1)).

There are 15 tour operators, licensed to operate within the Ningaloo Marine Park, undertaking Whale shark and Humpback whale swim tours. All operations occur within Ningaloo Marine Park, with the majority to the west of the North West Cape and within the northern portion of Ningaloo Marine Park. There are also 5-10 whale-watching operators who operate within Exmouth Gulf (Hogstrom, A. pers comm. 2019).

Regional Impacts

Current recreational and commercial vessel traffic in Exmouth Gulf poses a risk of direct (e.g. vessel collision) and indirect (e.g. underwater noise) impacts to marine fauna. Currently the soundscape in Exmouth Gulf is mainly dominated by biological sounds from wave action, Humpback whales and snapping shrimp, with a low noise contribution from shipping, boating and other anthropogenic activities (Bejder *et al*. 2019). Increased development within or adjacent to Exmouth Gulf would see an increase in marine traffic and a concomitant increase in anthropogenic noise within Humpback whale breeding/resting habitat, with the potential for increased risk of ship strikes and acoustic disturbance to resting and nursing mother and calf whales (Bejder *et al*. 2019).

A recent project attempted to quantify the current risk from shipping to large marine fauna around Australia by combining vessel data (density, speed and noise levels) with species distribution/habitat models to produce fine-scale relative spatial risk profiles (Peel *et al*. 2019). The modelled total relative risk of vessel strike on Humpback whales across the whole of Exmouth Gulf was greatest as a result of vessels under 80 m in length (compared to vessels greater than 80 m in length, vessels travelling at greater than 15 knots and recreational vessels). However, the highest risk identified was in the area adjacent to Exmouth marina, from vessels travelling at greater than 15 knots.

# 3. STAKEHOLDER ENGAGEMENT

## 3.1 INTRODUCTION

This section provides a summary of consultation undertaken and the feedback received to date. In many instances, the comments and advice received are beyond the environmental scope of this ERD. Subsea 7 has included these matters in the summary to provide a full and balanced account of the consultation outcomes and stakeholder sentiment. Subsea 7's programme of consultation is ongoing and provides a forum for engagement on environmental and non-environmental matters that extends the opportunities presented in the formal environment impact assessment process.

## 3.2 KEY STAKEHOLDERS

A number of meetings and briefings on the Proposal have been held with the local community, local, State and Federal government agencies, other industry participants, non-government organisations, Traditional Owner groups and the pastoralist. Key stakeholders are considered to include:

- Jane Lefroy and Phil Kendrick (Pastoralist).
- Shire of Exmouth.
- Department of Jobs, Tourism, Science and Innovation (DJTSI).
- Department of Premier and Cabinet (DPC).
- Department of Water and Environmental Regulation (DWER) including the Environmental Protection Authority (EPA) Service Unit.
- Exmouth Community Reference Group.
- Exmouth Chamber of Commerce and Industry.
- Gascoyne Development Commission – Exmouth Branch.
- Department of Planning, Lands and Heritage (DPLH).
- Gnulli Working Group (Traditional Owners).
- YMAC – Native Title Representative Body.
- Exmouth Community.
- Cape Conservation Group (CCG).
- Department of Biodiversity Conservation and Attractions (DBCA).
- Department of Transport (DoT).
- Department of the Environment and Energy (DoEE).
- Kailis Group.

In addition to the key stakeholders identified above, Subsea 7 has taken the approach, since the Proposal was made public, to endeavour to reasonably respond or engage with any interested person or group that has expressed an interest in the Proposal. This has resulted in engagement with a wide range of parties. The full stakeholder engagement record/matrix is contained in Attachment 2T.

## 3.3 STAKEHOLDER ENGAGEMENT PROCESS

The format and frequency of communications with stakeholders and decision-makers has been related to the nature of matters under discussion and the rate of progress of the Proposal definition and technical studies.

A broad cross-section of community and service organisations local to Exmouth, including conservation groups, has also been contacted regarding the Proposal. The subjects of discussion have varied through the range of stakeholders, and valuable input has been gained for development of the environmental investigation programmes and design of the Proposal.

The method of consultation employed by Subsea 7 has varied depending on the forum, subject matter and purpose. The main forms of communication can be categorised as:

- Broad project briefings and presentations.
- Stakeholder workshops.
- Stakeholder meetings and discussions, including those undertaken on Subsea 7's behalf by consultants (e.g. specific environmental technical study methods and approach).
- Written communications and the distribution of project updates.
- Telephone discussions.

In addition to Subsea 7-led stakeholder engagement, formal public consultation processes have occurred associated with the State and Commonwealth environmental assessment processes including:

- Subsea 7's initial referral of the original Proposal to the EPA under Section 38 of the EP Act was advertised for public consultation between 14 and 28 February 2018.
- Subsea 7's referral to the DoEE was advertised for public consultation on 31 October 2018, in accordance with the EPBC Act.
- The Native Vegetation Clearing Permit required for the minimal land clearing associated with the commencement of the subterranean fauna investigations, required under the ESD, was issued for public comment between 7 and 28 February 2018. This consultation included the provision of all contemporary flora and vegetation survey reports, thus representing another form of public consultation in connection with the Proposal.
- The release of the ESD for public comment, for a two-week period between 14 and 28 February 2018, provided opportunity for public input on the scope of the technical studies required to support the environmental impact assessment (as presented within this document).
- The request to change the Proposal under Section 43A of the EP Act was advertised for public review between 1 and 15 March 2019.
- Subsea 7's referral of the amended Proposal to the EPA under Section 38 of the EP Act was advertised for public consultation between 20 and 26 May 2019.
- The public release of this ERD, for an eight-week period, will provide a further opportunity for stakeholder review and involvement in planning for the Proposal.

It is noted that a number of these consultation periods are not legislative or mandatory, but have been conducted to ensure the fullness of public consultation is maintained for this Proposal.

Engagement with the Gnulli people, who hold a Native Title claim over an area that includes the Proposal Envelope, will be maintained through the Heritage and Indigenous Land Use Agreement (ILUA) process. Subsea 7 has established an open and consultative process with the Gnulli Group, where engagement has been performed in the form of:

- Regular attendance and presentations at the Gnulli Working Group meetings.
- Multiple site visits with members of the Gnulli Group.
- Multiple heritage surveys performed with members of the Gnulli Group.
- Ongoing and regular engagement with YMAC, acting as representatives of the Gnulli Group in the Native Title claim.

Where relevant, feedback and outcomes from the engagement with the Gnulli have been incorporated into this ERD.

## 3.4 CONSULTATION OUTCOMES

Consultation was successful in improving stakeholder awareness of the Proposal, in obtaining feedback for consideration in project design and in identifying opportunities for environmental and social initiatives.

Table 3-1 presents a summary of the feedback provided by stakeholders to date. Note that this is not intended to be an exhaustive record of all questions and queries that were received during stakeholder engagement, but is intended to summarise themes of feedback received, and how these has been implemented or addressed.

| Stakeholders | Feedback Received | Incorporation of Feedback |
|---|---|---|
| • Cape Conservation Group.<br>• Protect Ningaloo Campaign.<br>• Conservation Council WA.<br>• Exmouth Community.<br>• Local Businesses, particularly Tourism Operators.<br>• DWER.<br>• DoEE. | Whale Interaction in Exmouth Gulf – concern was raised regarding the potential for whale interactions in Exmouth Gulf, particularly during the Southern Whale Migration. | Subsea 7, in advance of performing any public consultation or stakeholder engagement, mandated that no Bundle launch and tow operations would occur during the peak of the southern whale migration and occupation of Exmouth Gulf.<br><br>During the conduct of the environmental investigations, a contemporary study of the Humpback whale migration was commissioned by Subsea 7, to inform the proposed no-launch period. This period is now proposed as a 3-month window encompassing the months of August, September and October.<br><br>As part of the impact assessment, research has also been commissioned to understand the potential reduction in marine use of the Exmouth Gulf by vessels directly connected to the offshore construction industry. This has shown that there are potentially large reductions in offshore vessel operations following the adoption of Bundle technology. |
| • Exmouth Community.<br>• Local Business, Charter Operators, Aquarium Specimen Collectors.<br>• Exmouth Council and Shire. | Access – stakeholder feedback identified the following areas as important to the public, and required that access be maintained:<br>• Heron Point.<br>• Bay of Rest. | The following has been included in the Proposal to ensure access is maintained:<br>• Launchway crossing to maintain beach access.<br>• Development of alternative access tracks from Minilya-Exmouth Road to the Bay of Rest. |

| Stakeholders | Feedback Received | Incorporation of Feedback |
| --- | --- | --- |
| Exmouth Community | Road Traffic – initial presentations to the Exmouth community identified a concern about increased traffic flow on the Minilya-Exmouth Road heading into Exmouth. | Subsea 7 commissioned a full survey of transit routes, as well as a traffic study to understand the potential impacts. This included engagement with Main Roads WA MRWA).<br><br>The outcome of the study was that the traffic related to the operation of the Bundle facility would have a relatively minor impact to the numbers of vehicles that are utilising those roads. As an example, using July as an example (the peak period of travel based on MRWA data) the Minilya-Exmouth Road (north of Burkett Road) would experience an increase from 733 vehicles per day to 759 vehicles per day. The proportion of heavy vehicle movements would increase from 17.1% to 17.8% with the additional movements. This is based on a 2017 MRWA dataset.<br><br>Given this outcome, MRWA feedback was that these are considered to be small changes that do not require a redevelopment (e.g. passing lanes) of the Minilya-Exmouth Road. The study did include a recommendation to ensure right turns into the Bundle site can be made safely without impacting traffic (e.g. add a right turn road widening), which has been incorporated into the Proposal. |
| Exmouth Community | Employment – ensuring employment opportunities are available for local community members | A number of measures are proposed to ensure that employment opportunities exist for local personnel:<br>• The site does not include any accommodation facilities. Therefore, all personnel working at the site will be required to reside in the Exmouth town.<br>• Subsea 7's global track record for similar site operations shows a strong culture of local employment. For example, the only other Bundle facility in the world, based in Wick, Scotland, has a 100% local management team and typically has a 95% local workforce.<br>• Subsea 7's Proposal includes for the establishment of development schemes (such as apprenticeship schemes) to ensure that local personnel are adequately trained for work on the site.<br>• In March 2019, Subsea 7 employed its first member of the Bundle Site Team (Site Manager), with this role being sourced from the local community. |

| Stakeholders | Feedback Received | Incorporation of Feedback |
|---|---|---|
| • Exmouth Community.<br>• Local Businesses. | Local content and business opportunities – businesses have often questioned the opportunities that would be available during site construction and operation | Subsea 7 remains committed to supporting local businesses, and has regularly acknowledged the Proposal's reliance on the local supply chain for the Proposal to be viable. In response to this feedback:<br>• Subsea 7 arranged an information session and presentation, made by both Subsea 7 and their engineering consultancy (GHD), with an open invitation to all local businesses and members of the Exmouth community.<br>• Information regarding the typical packages and work scopes required during construction and operation has been communicated.<br>• Information regarding supplier qualification requirements for Subsea 7 and GHD has been communicated, including recommendations to seek appropriate partnerships or close any gaps to ensure suitability to bid for the work.<br>• Key contacts within Subsea 7 and GHD have been provided to enable local businesses to commence communications and seek feedback well in advance of any onsite operations.<br>• A commitment to set and be held to targets regarding local content has been made. |
| Gnulli Group | Potential impact to the 'Dinner Time Tree' | In performing the heritage survey of the Development Envelope in February 2019, the survey group identified a particular tree as the 'Dinner Time Tree', and communicated a preference for this tree to remain unimpacted by the site development.<br><br>This feedback has been welcomed, and Subsea 7 remains committed to ensuring that this tree remains unimpacted.<br><br>Subsea 7 will continue to work with the Gnulli group to identify opportunities for cultural awareness development, potentially involving this tree. |
| Cape Conservation Group and local Sea Shepherd Member | Personnel logistics and transportation – the suggestion was made that utilising buses for the transportation of the work force to the site would be more environmentally sustainable than individuals driving themselves | This feedback was well received. Since this discussion, Subsea 7 has based Proposal planning around utilising a bus service to transport the work force to and from the site.<br><br>Not only would this represent an environmentally preferred approach, this would also represent a business opportunity for the local community. |
| Cape Conservation Group and local Sea Shepherd Member | Light spill and management – in this discussion, the potential for light spill from the Bundle site operations, and its potential impact, was raised | In response to this feedback, Subsea 7 has confirmed that the vast majority of site operations and construction activity would be performed during daylight hours, thereby limiting the lighting requirements for the site.<br><br>To address the potential impact of light spill, mitigating measures have been proposed as part of this ERD, which can include timed and directional lighting. |

| Stakeholders | Feedback Received | Incorporation of Feedback |
|---|---|---|
| • Cape Conservation Group and local Sea Shepherd Members.<br>• Exmouth Community. | Power supply – interested stakeholders queried whether or not there would be an option to utilise renewable energy to power the site | As a result of receiving this feedback, Subsea 7 amended the site basis of design to propose that general site power for activities such as general lighting, office and ablutions power and general power outlets will all be supplied by solar power (when available). |
| • Cape Conservation Group.<br>• Protect Ningaloo Campaign.<br>• Conservation Council WA.<br>• Exmouth Community.<br>• Fishing Charter Business. | Towhead launching – during engagement, feedback was received expressing concern regarding the potential for towheads to impact the seabed during launch | Subsea 7 performed a 12 month engineering study with Bundle experts from their centre of excellence in Aberdeen, and driven by a highly respected Bundle Towmaster, to develop a specific launch and tow methodology for Bundles in Exmouth Gulf. As a result of the study, the potential for interaction between the towheads and seabed has been reduced, as well as the potential for seabed interaction from the launch tow tugs. Subsea 7's target is that towheads do not touch the seabed. |
| • Cape Conservation Group.<br>• Protect Ningaloo Campaign.<br>• Conservation Council WA.<br>• Ningaloo Coast World Heritage Committee.<br>• Exmouth Community.<br>• DWER.<br>• DoEE. | Potential impact to Ningaloo Reef – during stakeholder engagement, regular feedback was received that highlighted the importance of the Ningaloo marine area, noting that the Proposal included marine operations in the Ningaloo Marine Park | Initial feedback to stakeholders regarding this concern highlighted that the operations inside the Ningaloo Marine Park were limited to vessel movements and towing operations, which are already undertaken safely and regularly for other operations and developments.<br><br>To address the Bundle tow specifically, Subsea 7 commissioned an extensive engineering study to consider the tow of a Bundle through the Ningaloo Marine Park. The tow methodology was subsequently amended slightly to incorporate a 'Surface tow' method for a Bundle when in the Ningaloo Marine Park. The 'Surface tow' method increases the clearance between Bundle chains and the seabed, and therefore further reduces the low risk of potential impact. |
| • DWER | Groundwater abstraction rate – to ensure water abstraction does not affect groundwater levels, the use of multiple bores, and a limit on the extraction rate, was proposed. | Upon receipt of this feedback, the water sourcing strategy for the site was updated to include the use of three (3) separate water bores, each with a limited extraction rate. Modelling shows that extraction will be limited to only 0.14 L/s per bore, which Subsea 7 considers to be a low extraction rate. |

| Stakeholders | Feedback Received | Incorporation of Feedback |
|---|---|---|
| • Gnulli Group.<br>• Cape Conservation Group.<br>• Protect Ningaloo Campaign.<br>• Conservation Council WA. | Groundwater abstraction volume – feedback was received raising concern regarding the volume of proposed water extraction | To address this feedback, Subsea 7 completed a broad investigation into water supply options. From this investigation, water bore locations were identified where the water quality is of sufficient quality that the initially proposed reverse osmosis (RO) water treatment plant is not required. This has a major positive impact (reduction) to the water abstraction volumes due to the removal of any inefficiency associated with water treatment (can be 30-40%).<br><br>Further investigation into current groundwater licences for the area indicated that only 2% of the total aquifer allocation is currently allocated. |
| • Cape Conservation Group.<br>• Protect Ningaloo Campaign.<br>• Conservation Council WA.<br>• Exmouth Community.<br>• Fishing Charter Business. | Visual impact at the beach – concern has been raised that the site may impact the visual amenity of the beach at Heron Point. | Subsea 7's Proposal has been developed to minimise any permanent infrastructure at the beach/Heron Point end of the Development Envelope. In contrast to the site at Wick, the Proposal includes only minimal infrastructure at the seaward end of the site (the launchway, hydrotest water pond and launchway facilities area (a clear and flat area with no permanent structures)). The vast majority of infrastructure has been located adjacent to Minilya-Exmouth Road, where it is in keeping with nearby facilities (i.e. RAAF Learmonth).<br><br>Further, Subsea 7 has developed a design for the launchway that targets the lowest profile possible, to ensure its visibility is minimised. The structure would be considerably smaller than the nearby Learmonth jetty. A Visual Impact Assessment has been performed, which demonstrates the limited/minimal impact to the visual amenity. |
| • Cape Conservation Group.<br>• Protect Ningaloo Campaign.<br>• Conservation Council WA.<br>• Exmouth Community.<br>• Fishing Charter Business. | Visual impact of fabrication site – concern has been raised that the site may impact the visual amenity at the fabrication end of the site (i.e. fabrication shed visible from Minilya-Exmouth Road). | In response to the concern regarding visual impact due to the fabrication shed, a Visual Impact Assessment has been performed and independently peer reviewed. This assessment demonstrates the limited/minimal impact to the visual amenity.<br><br>In general, the infrastructure proposed at the fabrication site is considered to be in keeping with that in the near vicinity (i.e. RAAF Learmonth). Subsea 7 is committed to building infrastructure that is no higher than is necessary to support the intended operations. |

| Stakeholders | Feedback Received | Incorporation of Feedback |
|---|---|---|
| • Cape Conservation Group.<br>• Protect Ningaloo Campaign.<br>• Conservation Council WA.<br>• Shire of Exmouth.<br>• Exmouth Community.<br>• Jock Clough. | Gulf industrialisation – in general, opposition to the Proposal has voiced concern regarding the potential for the Proposal to lead to a general 'industrialisation' of Exmouth Gulf. | Subsea 7 has approached the Proposal with a planning strategy that considers the regional context. Subsea 7's scheme amendment request proposes a Special Use Zone. This recognises that the Proposal and associated technology is unique (only one other site exists in the world of its type). The re-zoning request concerns only the Development Envelope for this Proposal. The remainder of the nearby area would remain largely zoned for pastoralism, and cannot be developed without further extensive planning and environmental approval processes.<br><br>The Proposal also provides opportunity to reduce some aspects of 'industrialisation' of Exmouth Gulf, by transferring pipeline installation operations from predominantly marine-based activities, to predominantly land-based activities, providing a net reduction in marine operations within Exmouth Gulf. |
| • Cape Conservation Group.<br>• Protect Ningaloo Campaign.<br>• Conservation Council WA.<br>• Exmouth Community. | Leaks/spills in Exmouth Gulf – concern has been raised regarding the potential for leaks or spills to occur as a result of Bundle towing operations. | General concern has been raised regarding the potential for leaks or spills to occur in Exmouth Gulf during Bundle launch and tow operations.<br><br>There was a general misunderstanding of the contents of the Bundles. The initial response has been to clarify that the pipelines do not contain hydrocarbons.<br><br>A full, detailed assessment of the risk potential and consequences of a leak/spill has been undertaken and the outcomes included in the ERD. |
| MRWA | Site access – feedback was received that the proposed location of the site access road may present a road safety hazard. | Following collaboration and discussion between Subsea 7, GHD (engineering consultancy) and MRWA, two alternative locations for the site access road have been identified and are under consideration for the site. The final selection will be performed during the detailed design phase, but the opportunity to incorporate either has been captured in the ERD, ensuring that this feedback is accounted for. |
| • Recfishwest.<br>• Local Flyfishing Business.<br>• Exmouth Community. | Marine access to the Bay of Rest, Muiron Islands, etc. – concern was raised that access to areas such as the Bay of Rest and the Muiron Islands would be impacted by site operations. | In all cases, access will be maintained to these areas of value.<br><br>Upon receipt of this feedback, Subsea 7 has endeavoured to understand the different marine access options that are utilised by water users. It is understood that users wishing to access the Bay of Rest often launch from the beach adjacent to the Bay of Rest. This access would not be impacted by Bundle site operations. Access to the Muiron Islands will also be maintained, though for a short period during a Bundle launch (~6 hours) a detour around the Bundle tow route (and associated exclusion zone) may be required. |

Table 3-1: Summary of Feedback Provided by Stakeholders Between November 2016 and December 2018

## 3.5 SECTION 43A CHANGE TO PROPOSAL (UNDER ASSESSMENT NUMBER 2136)

On 28 February 2019 the EPA published Subsea 7's request to change the Proposal under Section 43A of the EP Act. The consultation period closed on 15 March 2019.

A total of 2,321 comments were received during the public comment period, with the vast majority being brief, pro forma type, responses. All of these responses were considered by the EPA during the consideration of the request to change the Proposal. Subsea 7 subsequently requested the termination of the assessment to allow a new referral to be submitted. Table 3-2 identifies a selection of the key issues raised during the public review period for the Section 43A process, and provides Subsea 7's responses.

| Feedback Topic | Subsea 7 Response |
|---|---|
| Numerous submissions called for a full assessment of the Proposal and challenged the level of work presented in the S43A documentation | It is noted that the S43A only provided information that was relevant to the specific updates, not the overall Proposal. The S43A documentation provided the following, as required by the EPA:<br>• Details of the proposed change.<br>• Statement of the significance of the change.<br>• Rationale for the change.<br>The documentation was not intended to represent a full environmental impact assessment (EIA) of the Proposal. Rather, the documentation was prepared to support Subsea 7's conclusion that the proposed changes to the Proposal are unlikely to significantly increase any impact that the Proposal may have on the environment.<br><br>The full EIA is presented in the PER (this document). |
| Industrialisation of the Gulf | Numerous submissions referenced the Proposal as a 'gateway' project, which will lead to a subsequent increase in development and marine operations in the area.<br><br>The Exmouth township was founded on the defence industry (both naval and air force defence), in combination with the fishing industry. Pastoralism has also been present throughout this time. Industry has been present in Exmouth Gulf for some time, and continues to be so today, so it is inaccurate to label this Proposal a gateway project.<br><br>Exmouth Gulf is currently regularly utilised for commercial marine operations, as the majority of residents would realise. The Proposal represents an opportunity for the volume of marine operations in Exmouth Gulf, associated with offshore developments, to be reduced (refer Section 2.4.8.1).<br><br>Subsea 7's approach for the proposed re-zoning of the site, under the Exmouth local planning scheme, was to request a Special Use Zone to ensure that the site is only able to be utilised for this Proposal. The re-zoning request applies only to the land that is required for this Proposal and would not facilitate other industrial developments. |

| Feedback Topic | Subsea 7 Response |
|---|---|
| Seabed disturbance due to Bundle chains | Following the original referral of the Proposal to the EPA (refer Section 1.3.2) additional Bundle launch and tow engineering work was completed which determined that some of the ballast chains which hang below the Bundle, forming a component of the Controlled Depth Tow Method (CDTM), will be in contact with the seabed out to the Bundle Parking area. This change was promptly communicated to stakeholders (including to the EPA in July 2018 and to the Exmouth community on 24 October 2019 (refer Attachment 2T).<br><br>Seabed disturbance due to the ballast chains will occur within a narrow corridor and this disturbance has been clearly described, and is assessed, within the PER (this document).<br><br>Various submissions stated that the chains would disturb the full Offshore Operations Area. To clarify, the Offshore Operations Area covers the potential disturbance from multiple Bundle launches, based on the modelling of various Bundle lengths being launched under varied environmental conditions. In keeping with EPA guidelines, the worst-case scenario is presented and assessed. |
| Seabed disturbance due to Bundle towheads | Design studies were undertaken to increase the buoyancy of the Bundle towheads, to facilitate the early floatation of the towheads and provide a reduction in seabed interaction adjacent to Heron Point. The continued assertion that the towheads will skid along the seabed for a distance of over 1.5 km is incorrect. |
| Offshore Operations Area and chain footprint | EPA guidance (EPA 2017) states that the following spatial data should be defined:<br>• Development envelope: the maximum area within which the proposal footprint will be located.<br>• Development footprint: the location where the physical proposal elements occur.<br>To align with EPA guidance, and to reflect the revised seabed disturbance area, the Offshore Operations Area (representing an offshore 'development envelope') has been defined to cover the maximum area within which the chain footprint will be located. The chain footprint associated with several differing Bundle launch scenarios is also presented. Submissions suggesting that the entire Offshore Operations Area, or Development Envelope, will be disturbed are incorrect. |
| Loss of access to Heron Point or the Bay of Rest | Subsea 7 first learnt of the community's concern regarding continued access to Heron Point or the Bay of Rest in August 2017. In response, Subsea 7 revised the design of the launchway to allow for a vehicle crossing. This was presented to the Exmouth community on 24 October 2019 (refer Attachment 2T). The continued assertion that access will be prevented is wholly incorrect.<br><br>Further, Subsea 7 proposes to provide alternative access tracks to ensure access is maintained to Heron Point or the Bay of Rest (Figure 5-56). The continued accessibility of these areas remains of paramount importance and Subsea 7 is committed to ensuring access is maintained. |

| Feedback Topic | Subsea 7 Response |
|---|---|
| Numerous submissions referenced 'biodiverse' or 'structurally complex' BCH within the Offshore Operations Area | Several surveys have confirmed that the majority of BCH within the Offshore Operations Area is composed of low relief (flat) soft sediment (mud) habitat. This habitat does not represent 'biodiverse' or 'structurally complex' habitat.<br><br>The majority of disturbance will occur in an area that is already utilised by the fishing industry, with no cumulative impact to BCH expected. |
| Exmouth Gulf as 'nursery' and 'engine room' of Ningaloo | Benthic communities play important roles in maintaining the integrity of marine ecosystems and the supply of ecological services. There is strong evidence that benthic communities are important for the maintenance of biological diversity by providing structurally complex and diverse habitat, refuge for vulnerable life stages and a varied and increased food supply. In Western Australia it is the benthic primary producer communities that form the foundation of many of our coastal food webs, which in turn support productive and economically-important fisheries (EPA 2016e).<br><br>Algal mat and mangrove habitats are widely reported as being important in nutrient recycling and primary production. Mangroves are also recognised as contributing to coastal protection and in representing nursery habitat for juvenile fish. The algal mat and mangroves habitats along the southern and eastern shores of Exmouth Gulf are extensive and their values well recognised (refer Section 2.5.5). The Proposal will not have any impact on algal mat or mangrove habitats.<br><br>Hydrodynamic modelling (Massel *et al*. 1997) has shown that the tidal movement of water within Exmouth Gulf is predominantly north-south, with the tidal excursion length (the distance a parcel of water travels before the tide turns) being less than 5 km. This is too short to allow significant quantities of water to leave the Gulf on any one tide. Only a localised area of Exmouth Gulf exchanges directly with the Ningaloo region, with the remainder of the water in Exmouth Gulf tending to move north east towards the Onslow region. Thus while some habitats within Exmouth Gulf may represent foraging or nursery habitat for species that may subsequently travel to Ningaloo Reef or the Onslow area, Exmouth Gulf is not thought to significantly contribute to the productivity of Ningaloo Reef. |

Table 3-2: Key Issues Raised on Section 43A Change to Proposal Application

# 4. KEY ENVIRONMENTAL PRINCIPLES AND FACTORS

## 4.1 PRINCIPLES OF THE EP ACT

Part I, section 4A of the EP Act sets out five core principles by which protection of the environment is to be achieved in Western Australia. The principles are further elaborated on in the EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2018c).

These principles and the manner in which Subsea 7 has sought to apply them in the design and planned implementation of the Proposal are described in Table 4-1.

| Principle | Consideration of Principle in Proposal |
|---|---|
| *The Precautionary Principle*<br><br>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.<br><br>In the application of the precautionary principle, decision should be guided by:<br>• Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and<br>• An assessment of the risk-weighted consequences of various options. | Subsea 7 has undertaken comprehensive environmental studies on aspects of the Proposal that may impact the environment, including BCH, terrestrial flora and fauna, coastal processes and marine fauna. These studies are described under the relevant preliminary key environmental factor, within the 'receiving environment' section.<br><br>The Proposal design has, as much as practicable, taken into account the outcomes of the environmental technical studies, in consultation with the relevant agencies. Project design was amended to minimise the risk of serious or irreversible impacts and appropriate management measures have been adopted to minimise residual impacts.<br><br>Management and mitigation measures to minimise potential environmental impacts during construction and operations will be addressed through an overarching Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP). Specific key management plans have been developed as components of this ERD (refer Attachment 3). |
| *The Principle of intergenerational equity*<br><br>The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. | Subsea 7 commits to manage environmental impacts within their control, such that the risks of adverse impacts are minimised and the quality of the environment is maintained or enhanced wherever possible. |

| Principle | Consideration of Principle in Proposal |
| --- | --- |
| *The Principle of the conservation of biological diversity and ecological integrity*<br><br>Conservation of biological diversity and ecological integrity should be a fundamental consideration. | Impacts to BCH will be minimal when assessed at the worst case and will not impact the biological diversity and ecological integrity of the Heron Point area or wider region.<br><br>Impacts to marine fauna will be managed through the implementation of the MFMP (Attachment 3) to maintain the biological diversity and abundance of marine fauna in Exmouth Gulf.<br><br>Impacts to terrestrial vegetation, flora and fauna are not expected to be significant, or pose a risk of loss of biological diversity and ecological integrity. |
| *Principles relating to improved valuation, pricing and incentive mechanisms*<br><br>Environmental factors should be included in the valuation of assets and services<br><br>The *polluter pays* principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement.<br><br>The user of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes.<br><br>Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems. | Where possible, Subsea 7 will employ appropriately trained local personnel and source local goods and services.<br><br>Subsea 7 will ensure leading best practice standards during construction and operations to minimise emissions and discharges as far as possible and ensure negative legacies are not created.<br><br>Subsea 7 recognises the need to provide sufficient capital and operating funds to ensure environmental management measures are implemented throughout the project life. Provision has also been made for costs associated with closure and decommissioning and these costs form part of the cost of production. Where practicable Subsea 7 will source goods and services that have the least environmental impact. |

| Principle | Consideration of Principle in Proposal |
|---|---|
| *The principle of waste minimisation*<br><br>All reasonable and practicable measures should be undertaken to minimise the generation of waste and its discharge into the environment. | All reasonable and practicable measures to minimise the generation of waste and its discharge to the environment will be taken. Waste generated from the Proposal will be minimised through the implementation of the hierarchy of waste controls; avoid, re-use, recycle, recover and dispose. Waste avoidance and minimisation objectives will be outlined in the CEMP and OEMP. |

Table 4-1: Principles of the EP Act

## 4.2 PRELIMINARY KEY ENVIRONMENTAL FACTORS

The following preliminary key environmental factors require assessment, as identified within the ESD (Attachment 1):

- Benthic Communities and Habitats.
- Coastal Processes.
- Marine Environmental Quality.
- Marine Fauna.
- Flora and Vegetation.
- Subterranean Fauna.
- Terrestrial Fauna.
- Inland Waters.
- Social Surroundings.
- Other Environmental Factors or Matters: Terrestrial Environmental Quality (not considered a key environmental factor, but to be addressed).

# 5. PRELIMINARY KEY ENVIRONMENTAL FACTORS

## 5.1 KEY ENVIRONMENTAL FACTOR 1 – BENTHIC COMMUNITIES AND HABITAT

### 5.1.1 EPA Objective

To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.

In the context of this objective, 'Ecological integrity' is the composition, structure, function and processes of ecosystems, and the natural variation of these elements. The objective for this factor recognises that marine benthic communities are important components of almost all marine ecosystems, and are fundamental to the maintenance of ecological integrity and biological diversity of the marine environment as a whole.

### 5.1.2 Policy and Guidance

Subsea 7 has taken into consideration relevant policy and guidance in the design of the Proposal, the completion of the environmental impact assessment and through the development of this ERD.

A summary of the policy and guidance relevant to BCH, and how Subsea 7 has considered these, is presented in Table 5-1.

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Statement of Environmental Principles, Factors and Objectives (EPA 2016c, 2018c) | Referred to in the identification and assessment of Preliminary Key Environmental Factors. |
| Environmental Factor Guideline – Benthic Communities and Habitats (EPA 2016d) | This guidance was consulted in the consideration of potential direct and indirect impacts to Benthic Communities and Habitat (BCH) as a result of the Proposal, and in the development of options to avoid or mitigate impacts.<br><br>The guidance states that '*When assessing potential impacts on benthic communities and habitats, the EPA is mainly concerned with changes that are likely to significantly impact on biological diversity and ecological integrity. The EPA is therefore mainly focused on the extent, severity and duration of the impact(s) and hence whether any consequent losses to benthic communities or their habitats are temporary or permanent.*' |
| Technical Guidance – Protection of Benthic Communities and Habitats (EPA 2016e) | This guidance was consulted in the development of local assessment units (LAUs) for the assessment of potential impacts to BCH, the characterisation of the BCH present within the LAUs, and in the calculation of cumulative impacts. |
| Technical Guidance Environmental Impact Assessment of Marine Dredging (EPA 2016v) | This guidance was referenced in the definition of the zones of impact associated with launchway construction and Bundle launch and tow. |

| Policy/Guidance | Consideration for Proposal |
|---|---|
| WA Environmental Offsets Policy (Government of Western Australia 2011) | These policies were considered as part of the determination of the need for offsets. |
| WA Environmental Offsets Guidelines (Government of Western Australia 2014) | |
| *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy (DSEWPAC 2012a) | |
| Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005 – 2015 (MPRA and CALM 2005) | This management plan was reviewed during the assessment of BCH within the Ningaloo Marine Park and Muiron Islands Marine Management Area. |

Table 5-1: Key Policy and Guidance Relevant to BCH

### 5.1.3 Receiving Environment

#### 5.1.3.1 Regional Benthic Communities and Habitats

Benthic communities and habitats (BCH) play important roles in maintaining the integrity of marine ecosystems and the ecological services they supply. There is strong evidence that the presence of benthic communities can be important for the maintenance of biodiversity through provision of structurally complex and diverse habitat, provision of refuge, and increased food supply. Some of these complex habitats are important recruitment and nursery areas for many marine fauna species and may also provide essential food resources for large marine mammals, such as dugongs and turtles. Benthic primary producer habitats form the foundation of many marine food webs that, in turn, support productive and economically important fisheries (EPA 2016d).

A number of marine studies have previously been undertaken within the region (Exmouth Gulf and adjacent areas around the Muiron Islands) in the period 1994 to 2015, as outlined in Table 5-2. Subsea 7 has augmented the information available as a result of these previous studies by commissioning additional, Proposal-specific studies, to ensure a comprehensive level of information is available to support completion of the environmental impact assessment.

The Proposal-specific studies, as listed in Table 5-2, were undertaken by various technical specialists, and are included in full within Attachment 2. They are also referred to, as appropriate, in the assessment of potential impacts and proposed management measures.

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| Regional Studies | | |
| 1994 | McCook *et al*. | Seagrass communities in Exmouth Gulf, Western Australia: a preliminary survey |
| 1996 | Hutchins *et al*. | Marine Biological Survey of the Muiron Islands and the Eastern Shore of Exmouth Gulf |
| 1999 | Loneragan *et al*. | Developing techniques for enhancing prawn fisheries, with a focus on Brown tiger prawns (*Penaeus esculentus*) in Exmouth Gulf |

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| 2003 | Bancroft | Broad-scale regional marine habitats of selected areas in Western Australia |
| 2006 | CSIRO | Ecosystem characterisation of Australia's North West Shelf |
| 2006-2007 | Kobryn *et al*. | Ningaloo Reef: Shallow Marine Habitats Mapped Using a Hyperspectral Sensor |
| 2013-2015 | Vanderklift *et al*. | Natural dynamics: understanding natural dynamics of seagrasses in north-western Australia |
| 2018 | Oceanwise | Exmouth Gulf, north western Australia: A review of environmental and economic values and baseline scientific survey of the south western region |
| Project-specific Studies | | |
| 2016 | 360 Environmental | Survey of benthic habitats off Heron Point |
| 2017 | 360 Environmental | Survey of benthic habitats within the Heron Point Local Assessment Unit (LAU) |
| 2017 | 360 Environmental | Survey of benthic habitats within the 'Bundle Laydown Area' |
| 2018 | MBS Environmental | Exmouth Gulf Benthic Communities and Habitat survey report (Attachment 2C) |

Table 5-2: Overview of Local and Regional BCH Studies

Various attempts have been made to map benthic habitats across the wider Exmouth Gulf, and particularly within the Ningaloo Marine Park (Bancroft 2003, Oceanica 2008, Kobryn *et al*. 2013); however, the naturally elevated turbidity has made reliable classification of benthic habitats from remote imagery difficult (Kobryn, H. pers comm. 2018). Numerous surveys have targeted subtidal benthic habitats in the Exmouth Gulf, including McCook *et al*. (1995), Hutchins *et al*. (1996) and Loneragan *et al*. (2003). McCook *et al*. (1995) published the first survey of seagrass communities of the east coast of the Gulf.

<u>Seagrasses</u>

It is widely recognised that a number of seagrass species (including *Cymodocea angustata, Cymodocea serrulata, Halodule uninervis, Halophila ovalis, Halophila spinulosa, Syringodium isoetifolium* and *Thalassodendron ciliatum*) occur within Exmouth Gulf, predominantly along the eastern and southern margins (McCook *et al*. (1995), Hutchins *et al*. (1996) and Loneragan *et al*. (2003)). A key driver of seagrass distribution is the amount of sunlight within the wavelengths necessary for photosynthesis (photosynthetically active radiation (or PAR)) reaching the seabed, which is affected by seabed depth and water clarity. Seagrasses were rare or absent below 5 m depth (McCook *et al*. 1995).

From August 2013 to March 2015 (18 months), surveys of seagrass abundance were undertaken in the Exmouth Gulf region under the Western Australian Marine Science Institution (WAMSI) Dredging Science Node Project 5.3 (Vanderklift *et al*. 2016). The locations surveyed (South Muiron Island, Bundegi and Exmouth Gulf) encompassed a range of water clarity from clear to turbid. The Bundegi site was located approximately 40 km north of the Development Envelope and the Exmouth Gulf sites (G1 and G2) were located approximately 25 km east of the Development Envelope. At the Exmouth Gulf sites five seagrass species were recorded; *Halodule uninervis*, *Halophila ovalis*, *Halophila spinulosa*, *Syringodium isoetifolium* and *Cymodocea angustata*. At Bundegi, two species were recorded; *H. ovalis* and *H. uninervis*. Bundegi and Exmouth Gulf had similar trends in cover, which tended to be highest in late summer (March 2015) and lowest in winter, though the peak density of different species varied from November (*H. ovalis*) to March (*H. spinulosa*) (Vanderklift *et al*. 2016).

The levels of photosynthetically active radiation (or PAR) near the seafloor were lowest at the Exmouth Gulf sites, with a maximum in summer (December) and a minimum in winter (June). To provide a biologically meaningful reference point for these measurements, the PAR was compared against reported values for the onset of saturating light intensities for photosynthesis in *H. uninervis* (Ek). At light intensities above Ek the plants will not be light-limited. For *H. uninervis*, reported Ek values span a wide range, from approximately 50 to 300 μmol $m^{-2}s^{-1}$ (Campbell *et al*. 2007, Lee *et al*. 2007, Collier *et al*. 2012, Ow *et al*. 2015). At the Exmouth Gulf sites PAR did not exceed 300 μmol $m^{-2}s^{-1}$ on approximately 30 days of the 529 day study (or 0.1% of the time) and light intensity failed to exceed 9 μmol $m^{-2}d^{-1}$ on 23 occasions. Six of these lasted for more than nine days and the longest event lasted for 31 days, indicating that seagrasses at these sites are naturally subject to long durations of low light levels (Vanderklift *et al*. 2016). In proximity to the Development Envelope a small area of sparse seagrass (*H. uninervis* and *H. ovalis*) has been recorded (Attachment 2B).

Macroalgae

Algae including Sargassum, Dictyopteris, Padina, Caulerpa, and Halimeda have been recorded within Exmouth Gulf and across the Dampier Archipelago to the north (Huisman and Borowitzka 2003) (Attachment 2B). In terms of biomass (abundance), macroalgal communities in the Dampier Archipelago vary seasonally, but also show marked variation interannually when comparing within seasons (Chittleborough, 1983). Peak macroalgal biomass in Exmouth Gulf is expected to similarly occur during summer.

Soft Sediment

Limited information is available on the extent and type of soft sediment that covers a large part of the central seabed in Exmouth Gulf, or its associated fauna. Additionally, no published surveys have covered the benthic regions where commercial trawling is carried out. It is reported in Kangas *et al*. (2006a) that an Apache Energy study reported that soft sediment regions above (i.e. shallower than) 20 m depth outside commercial trawl areas have extensive invertebrate communities, of which the most abundant are echinoderms including sand dollars, Diadema urchins, heart urchins, and crinoids.

Filter Feeders

Well developed filter feeder communities (those communities comprising species such as sponges, tunicates and cnidarians other than hermatypic corals) occur in the northern part of Exmouth Gulf around North West Cape and the Muiron Islands (CALM 2005). A survey of the filter feeding communities adjacent to North West Cape (Bancroft 2003) found that the greatest density and diversity of filter feeding communities occurred in the waters adjacent to tip of the North West Cape. Surveys by the Australian Institute of Marine Science (AIMS) during 2004 in depths between 20 m and 200 m have recorded extensive areas of filter feeding communities in Ningaloo Marine Park and the Muiron Islands Marine Management Area (CALM 2005).

The channel between the Muiron Islands and North West Cape was reported to have only a thin veneer of coarse sediment overlying limestone pavement. This area was reportedly rich in gorgonians, sea whips, bryozoans, some hard corals, crinoids, ascidians and hydroids, but few fish species were recorded (Kangas *et al*. 2006a).

The Department of Conservation and Land Management (CALM, now the Department of Biodiversity Conservation and Attractions) (1994) noted that the invertebrate fauna along the western shore of Exmouth Gulf was diverse and abundant, with an area of hard substrate to the north of the Bay of Rest supporting extensive soft corals and sponges.

Corals

Ningaloo Reef is the largest fringing barrier coral reef, and the second largest coral reef system, in Australia. The most diverse coral communities in the reserves (Ningaloo Marine Park and the Muiron Island Marine Management Area) are in the relatively clear water, high energy environment of the fringing barrier reef and low energy lagoonal areas to the west of North West Cape. The reserves are characterised by a high diversity of hard corals with at least 217 species representing 54 genera of hermatypic (reef building) corals recorded to date. All 15 families of hermatypic corals are represented in the reserves, however species diversity and community structure vary with environmental conditions such as exposure to wave action, currents, depth and water clarity. Natural events that impact on coral communities include cyclones, extreme low tide events, anoxic conditions resulting from coral spawning, bleaching and predation by the gastropod, *Drupella cornus* (CALM 2005).

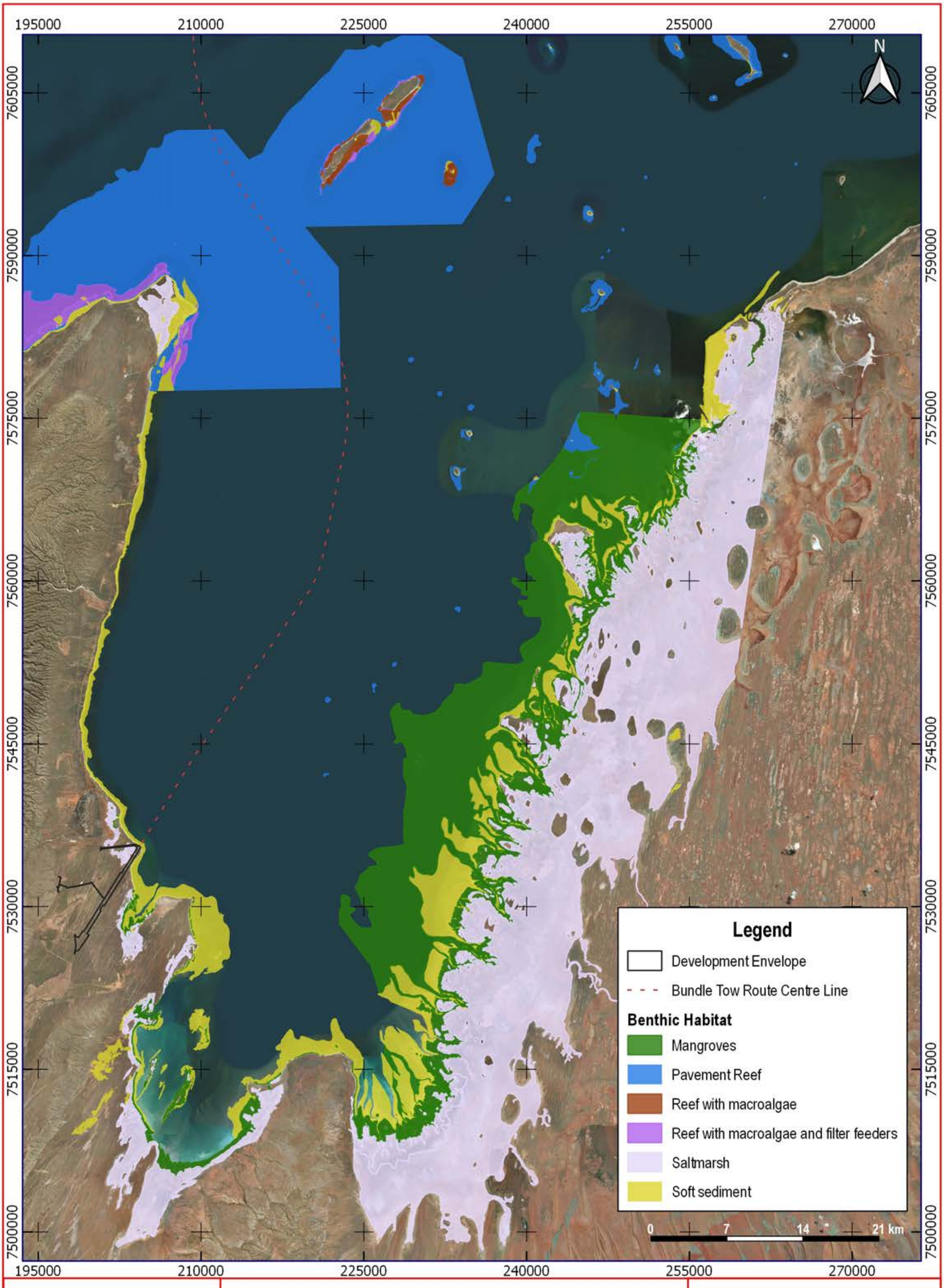
Coral reefs within the Exmouth Gulf are incipient, being submerged reefs that lack defined reef flat zones, unlike the Ningaloo Reef on the western side of the Cape Range Peninsula. This morphology reflects the low energy conditions within the Gulf and the higher turbidity which affects coral community composition (Twiggs and Collins 2010, Fitzpatrick *et al*. 2019). Within the Proposal's Offshore Operations Area coral cover was low and restricted to BCH types 'Pavement reef with filter feeders' and 'Pavement reef with macroalgae and filter feeders' (Attachment 2C). Coral cover was slightly higher offshore at Wapet, Stewart, Bennett and Cooper shoals (Figure 2-8, Attachment 2C). Cooper Shoal had the greatest abundance of corals.

Large-scale mass-spawning events have been reported among corals on WA reefs in the autumn period involving synchronous spawning by up to 24 coral species from a wide range of genera and families (Simpson 1988, Babcock *et al*. 1994). Some of the most abundant species of coral, including species of *Porites*, *Pavona* and *Turbinaria*, have been found to not participate in the mass spawning events and their patterns of reproduction remain uncertain (Stoddart and Gilmour 2005). More recent research on some WA coastal and offshore reefs has confirmed a smaller multispecific spawning period involving fewer species and colonies occurring during late spring or early summer (Rosser and Gilmour 2008, Gilmour *et al*. 2009, Rosser and Baird 2009). Between the release of gametes into the water by adult corals and the growth of newly settled coral spat lie three stages of development: fertilisation and embryonic development, larval growth, and settlement and metamorphosis. The natural percentage survival at each of these stages is likely to be very low and influenced by a wide range of physical (e.g. wind, waves, salinity) and biological (e.g. predator abundance) factors (Gilmour 1999).

Habitat Mapping

Regional habitat types recorded along the western margin of Exmouth Gulf and within the Ningaloo Marine Park were as follows (Bancroft 2003, SeaMap 2017) (refer Figure 5-1):

- Biota present.
- Consolidated hard substrate.
- Coral biota.
- Hard substrata.
- Invertebrates.
- Macroalgae.
- Mangroves.
- Pavement.
- Saltmarsh.
- Sand.
- Soft substrata.




| | | |
|---|---|---|
| Scale: 1:450000<br>Original Size: A4<br>Aerial Photo: ESRI Satellite<br>Grid: GDA 94 / MGA Zone 50 | Notes: Data sourced from Bancroft (2003) and SeaMap (2017).<br><br>Subsea 7 Pipeline Fabrication Facility | subsea 7<br><br>Figure 5-1: Regional BCH Mapping in Exmouth Gulf |

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#### 5.1.3.2 Local Benthic Communities and Habitats

Intertidal and subtidal habitats off Heron Point were surveyed in December 2016 (Attachment 2B). A follow-up survey, to map all BCH off Heron Point, was completed in May/June 2017. Three intertidal BCH types were recorded (refer Table 1 in Attachment 2B):

- Fine sand (Fine sand within upper littoral zone).
- Pavement reef (Unvegetated pavement reef within the upper littoral zone).
- Reef with macroalgae:
    - Pavement reef within the mid-littoral zone with mud veneer and sparse macroalgae (*Sargassum* sp.).
    - Pavement reef within the lower-littoral zone with macroalgae (*Halimeda* sp., *Padina* sp., *Sargassum* sp.) and occasional hard corals (*Turbinaria* spp.) and soft corals (*Lobophytum* spp.)

The intertidal habitats surveyed at Heron Point are consistent with those known for the broader area, being described as '*largely algal-dominated with the benthos including macroalgae (Sargassum, Padina, Halimeda and Dictyota) and turf algae. In some areas, non-reef-building corals occur on exposed reef surfaces, including minor corymbose and tabulate Acropora and domal Favid corals*' (Fitzpatrick *et al*. 2019).

Mangroves were recorded within the Bay of Rest (Attachment 2C). Six subtidal BCH types were recorded off Heron Point (Figure 5-2, Attachment 2B, and Attachment 2C):

- Soft sediment (Mud and sand dominated habitats with sparse turf algae).
- Soft sediment with turf algae (Mud and sand dominated habitats with turf algae/ microphytobenthos (MPB)).
- Seagrass (Mud and sand dominated habitats with sparse *H. uninervis* and *H. ovalis*).
- Soft sediment with filter feeders (Soft sediment veneer overlying low relief reef. Sparse cover of filter feeders (sponges and soft corals)).
- Reef with macroalgae (Low relief reef with macroalgae (brown)).
- Reef with macroalgae and filter feeders (Low relief reef with macroalgae (brown) and filter feeders (sponges, soft corals, hard corals)).

A towed video survey of the original Bundle laydown area (now termed the Parking area) was completed in September 2017. This survey was augmented by the completion of 114 towed video transects across the Offshore Operations Area including along the proposed tow route within the Ningaloo Marine Park. Unvegetated habitats were recorded across the entire Bundle Parking area (Attachment 2C). Within Ningaloo Marine Park, within the Surface tow area, three BCH types were recorded (Attachment 2C):

- Soft sediment.
- Pavement Reef with filter feeders.
- Pavement reef with macroalgae and filter feeders.

To facilitate the development of a consolidated map of BCH within Exmouth Gulf, the Bancroft (2003) and SeaMap (2017) data were reclassified to align with the BCH classifications developed for the Proposal (Figure 5-2).

Mangroves

Within the Bay of Rest several mangrove species were recorded; Grey Mangrove (*Avicenna marina*), Stilted Mangrove (*Rhizophora stylosa*) and Club mangrove (*Aegialitis annulata*) (Attachment 2B).

Soft Sediment Communities

Multi-Dimensional Scaling (MDS) and dendrogram analysis of subtidal infauna samples collected from sites off Heron Point indicated that no site was clearly different from the rest, nor were any sites particularly similar to each other. The inshore sites at Heron Point (IS-1 and IS-2) were around 38% similar and sites IS-7 and IS-11 (both ~3.5 km offshore) were approximately 60% similar (Attachment 2B).

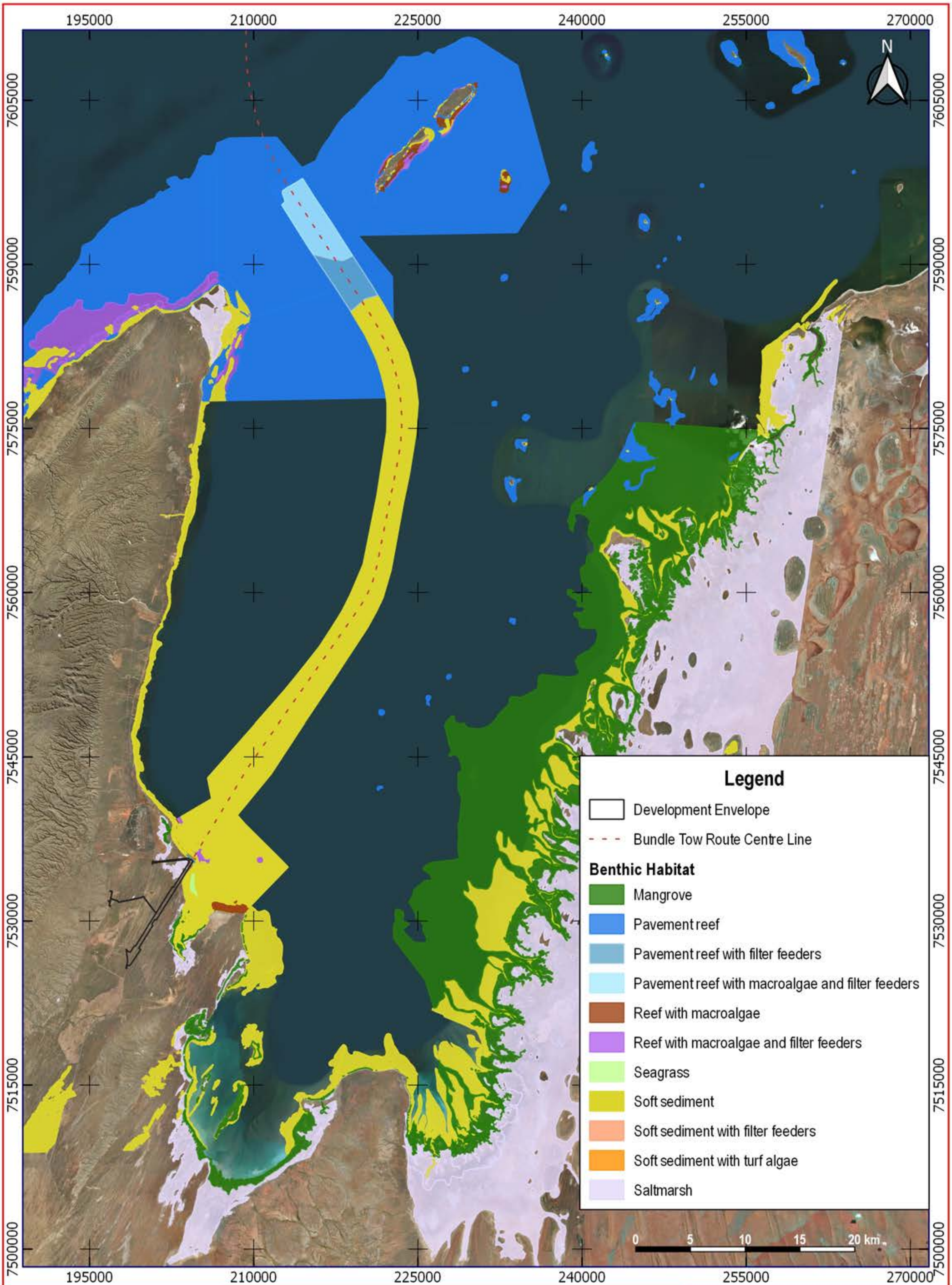
The most abundant infauna species recorded in the soft sediment off Heron Point were *Sipuncula* sp. (unsegmented worm), *Ampleliscidae* sp. (amphidod [shrimp]) and Spionidae (polychaete worm). Sipunculids were recorded at all sites within the Bundle laydown area, Ampleliscidae were recorded in most samples and Spionids were the second most dominant group, by individuals. A principal difference between the communities off Heron Point and within the Bundle laydown area was the higher abundance of Capitellidae and Lumbrineridae (polychaete worms) and lower abundance of Corophiidae (Amphipod shrimp) at the Bundle laydown area.

#### 5.1.3.3 Benthic Communities and Habitats of Importance to Marine Fauna

Australian humpback dolphins have been recorded in various habitat types including dredged channels, reefs, seagrass flats, and mangroves. Foraging behaviour has been observed mainly in nearshore habitats over intertidal rocky reefs and over shallow sub-tidal reef habitats (Parra and Cagnazzi 2016). During aerial surveys undertaken for the Proposal, dolphins were recorded throughout Exmouth Gulf (Figure 5-23) (Attachment 2J).

Dugong activity is thought to be focused on the east coast of the Gulf associated with the shallow seagrass habitat in this area (Figure 5-25). There is a lack of understanding regarding fine-scale movements and the importance of various habitats for resting, breeding or feeding (Oceanwise 2005). During aerial surveys undertaken for the Proposal, Dugong were primarily recorded adjacent to the southern and eastern shores of Exmouth Gulf, with only small numbers (13) recorded adjacent to the western shore to the north of Heron Point and only isolated individuals were recorded over deeper soft sediment habitats in proximity to the tow route (Figure 5-26) (Attachment 2J).

Aerial surveys have shown that turtles occur throughout Exmouth Gulf, with densities greatest in the shallow southern and eastern portions of the Gulf. The majority of animals sighted were identified as Green turtles (Oceanwise 2005, Oceanica 2006). During aerial surveys undertaken for the Proposal, marine turtles were widely recorded. The greatest numbers were recorded adjacent to the southern and eastern shores of Exmouth Gulf, with only isolated individuals recorded over deeper soft sediment habitats in proximity to the tow route (Figure 5-29) (Attachment 2J). Female turtles may use the soft sediment habitat within and adjacent to Exmouth Gulf as internesting habitat (an area to rest on the seabed between nesting attempts).

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Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Bancroft (2003), SeaMap (2017), 360 Environmental (2017), and MBS Environmental (2018).

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Figure 5-2: Combined Local and Regional BCH Mapping in Exmouth Gulf

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#### 5.1.3.4 Benthic Communities and Habitats of Importance to Commercial Fisheries

The Exmouth Gulf prawn fishery utilises a large portion of the soft sediment habitat within the deeper basin of Exmouth Gulf (refer Section Figure 2-14). A designated prawn fishery nursery area has been defined within the eastern and southern portions of Exmouth Gulf (Figure 2-11).

It is difficult to reconcile the habitats of most importance to aquarium specimen collectors and charter fishing operators due to the coarse nature of the information available from DPIRD (Figure 5-31, Figure 5-32). A single aquarium specimen collector has identified the filter feeder habitat off Heron Point as a key fishing area, and potential impacts to this habitat have been discussed with this operator, and are assessed in Section 5.4.6.4.

### 5.1.4 Potential Impacts

Construction and operation of the Proposal has the potential to directly and indirectly impact BCH. Table 5-3 summarises the potential impacts during each project phase.

| Project Phase | Potential Impact |
|---|---|
| Construction | Direct loss of BCH during launchway construction |
| | Indirect loss or degradation of BCH due to turbidity created during launchway construction |
| Operations | Direct loss of BCH during Bundle launch and tow |
| | Indirect loss or degradation of BCH during Bundle launch and tow |
| | Direct loss of BCH during Bundle tow in the event of a loss of control of the Bundle |
| | Indirect loss of BCH during Bundle tow in the event of a loss of control of the Bundle or support vessel (e.g. from physical contact or a chemical spill) |
| | Indirect loss of BCH due to altered water flows and sediment movement as a result of the presence of the launchway |
| Closure | Impacts to BCH as a result of maintenance or removal of the launchway |

Table 5-3: Potential Impacts to BCH

### 5.1.5 Potential Cumulative Impacts

Several third party projects or proposals (refer Section 2.5.8) have resulted in, or have the potential to result in, impacts to BCH within Exmouth Gulf. Given the EPA framework for the assessment of cumulative impacts to BCH, involving the use of Local Assessment Units (refer Section 5.1.6.1), only those projects or proposals impacting BCH within the same Local Assessment Units as potentially impacted by the Proposal need to be considered. Cumulative impacts to BCH within Exmouth Gulf are addressed in Section 5.1.6.11.

### 5.1.6 Assessment of Impacts

#### 5.1.6.1 Local Assessment Units

The EPA uses a spatial assessment framework for evaluating cumulative temporary and irreversible loss of and/or serious damage to BCH. The evaluation scheme is based on cumulative changes within a defined area and includes determining the spatial extent of benthic communities and their habitats:

- Prior to all human-induced disturbance.

- Existing at the time of the proposal.
- Remaining after implementation of the proposal (EPA 2016d).

To apply this assessment approach a number of LAUs have been defined offshore of Heron Point, and along the proposed Bundle launch and tow route, to facilitate the quantitative assessment of potential direct and indirect impacts on BCH.

EPA (2016e) states that '*Local assessment units (LAUs) are location specific and should be configured to take into account aspects of the local marine environment such as bathymetry and position of offshore reefs/islands, substrate type, water circulation patterns, exposure to waves and currents and biological attributes such as habitat types'.* The LAUs were defined taking account of this guidance and in consultation with DWER.

Given the location of the launchway at Heron Point within the area previously nominated for reservation, and within the Bay of Rest mangrove area (EPA 2001) (Figure 2-11), a single LAU (LAU 'Heron Point') was initially developed based on these datasets (Figure 5-3). The LAU was developed to be broadly consistent with the general guidance presented in Section 4.2 of EPA (2016e), and utilises the existing mapped boundaries of the above proposed conservation zones. LAU 'Heron Point' was discussed with the Marine Ecosystems Branch of the EPA, and endorsed, prior to completion of habitat mapping across this area (Attachment 2B).

Subsequently, following definition of the Offshore Operations Area including the Bundle Parking area and tow route, a number of additional LAUs were defined to encompass the areas within which direct or indirect impacts to BCH could occur (Table 5-4).

| LAU No. | LAU Name | Area ($km^2$) | Proposal Risk Aspect |
|---|---|---|---|
| 1 | Heron Point | 83 | Launchway and Bundle chains |
| 2 | Offshore Operations Area (Off bottom tow) | 84 | Bundle chains |
| 3 | Parking area | 32 | Bundle chains |
| 4 | Offshore Operations Area (Surface tow) | 77 | Potential for seabed disturbance in the event of loss of control of Bundle during tow |

Table 5-4: Local Assessment Unit Areas and Short Descriptions

The sub-sections below provide an assessment of potential direct and indirect impacts to BCH resulting from construction and/or operation of the Proposal.

#### 5.1.6.2 Impact Zonation Scheme

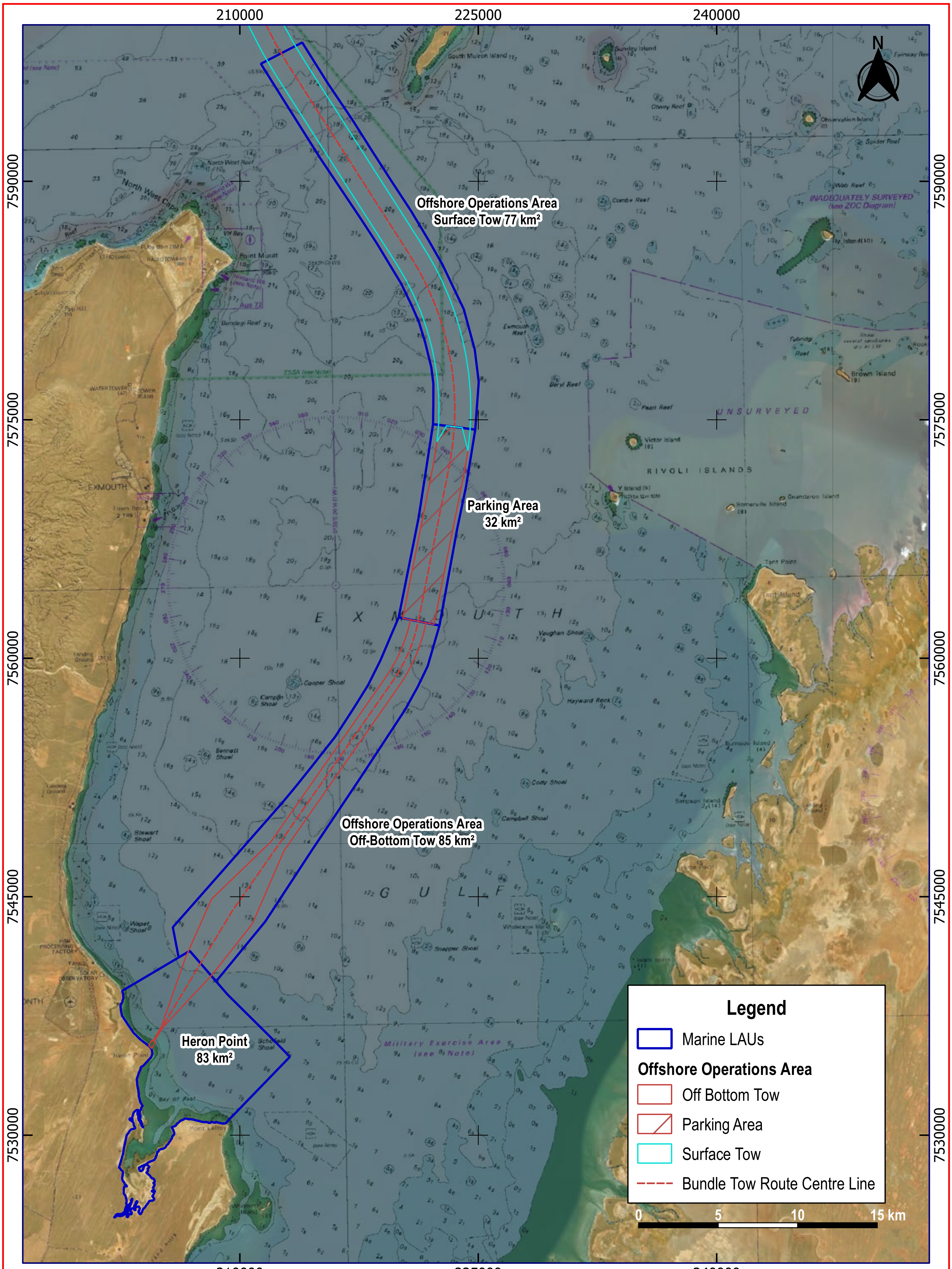
The EPA has developed a spatially-based zonation scheme for proponents to use as a common basis to describe the predicted extent, severity, and duration of impacts associated with dredging proposals (EPA 2016v).

The scheme consists of three zones that represent different levels of impact:

- The Zone of High Impact (ZoHI) is the area where impacts on benthic communities or habitats are predicted to be irreversible. The term irreversible means 'lacking a capacity to return or recover to a state resembling that prior to being impacted within a timeframe of five years or less'.

- The Zone of Moderate Impact (ZoMI) is the area within which predicted impacts on benthic organisms are recoverable within a period of five years.
- The Zone of Influence (ZoI) is the area within which changes in environmental quality are predicted and anticipated at some point, but where these changes would not result in a detectible impact on benthic biota. These areas can be large, but at any point in time impacts to water quality are likely to be restricted to a relatively small portion of the Zone of Influence.

While the Proposal does not involve dredging, it does involve marine construction (launchway), a small amount of seabed excavation (offshore end of launchway) and the generation of turbidity associated with Bundle launch and tow. Thus the approach outlined above has been referenced to assist in the spatial representation of the zones of potential impact to BCH.

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Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Subsea 7 (2018) and Commonwealth of Australia (2018).

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Figure 5-3: Local Assessment Units used for the assessment of the Proposal

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#### 5.1.6.3 Direct Loss of BCH during Launchway Construction

The Bundle launchway will be 380 m long (measured from the dune line) and up to 15 m wide.

The following construction sequence is expected during launchway construction:

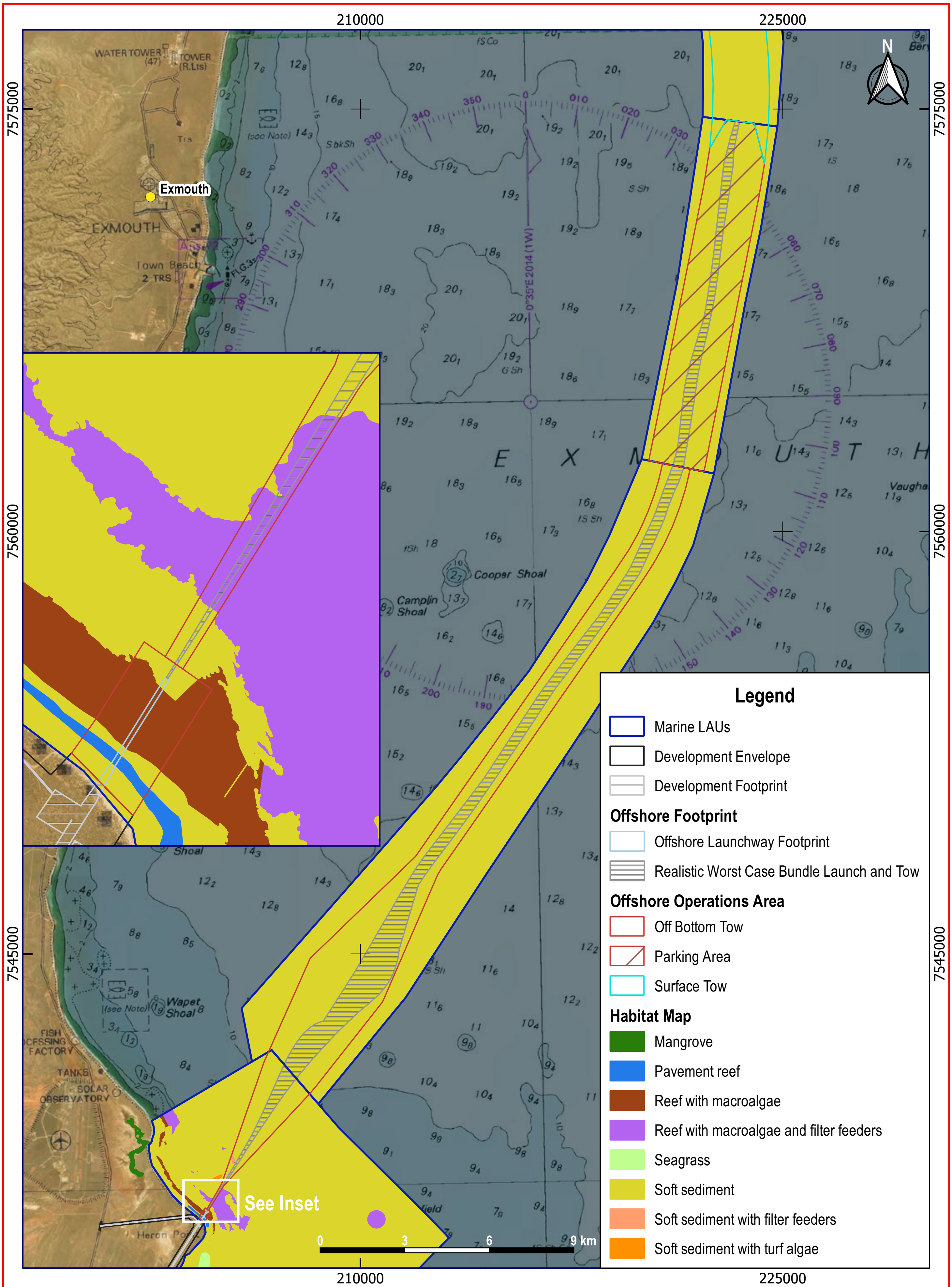
- Shallow excavation of sand on land including the area through the sand dunes.
- Shallow excavation or compaction of sand on the beach.
- Progressively construct the launchway from the landward extent to the seaward extent, by repeating the following steps:
  - Place rock fill.
  - Place concrete panels.
  - Place concrete mattress or rock armour.

Rock fill will be placed from the shoreline, being pushed seaward down the onshore end of the launchway. For the offshore end of the launchway, the rock fill will be placed from a barge.

The launchway footprint has been used to define the ZoHI for BCH in this area, where impacts on benthic communities or habitats are predicted to be irreversible. Predicted BCH losses (permanent) as result of the launchway footprint are as follows:

- Soft sediment (0.2 ha) (< 0.1% of that mapped within the Heron Point LAU).
- Reef with macroalgae (0.3 ha) (0.1% of that mapped within the Heron Point LAU).
- Pavement reef (0.1 ha) (3.2% of that mapped within the Heron Point LAU) (refer Figure 5-4).

Under some circumstances a 'halo' can occur immediately adjacent (usually within 50 m) of coastal infrastructure, such as a groyne, where local changes in hydrodynamic conditions prevent the survival and/or recruitment of BCH, particularly seagrass, within this area. This can, for example, be observed adjacent to the rock walls of the Success Boat Harbour in Fremantle, where seagrass is absent immediately adjacent to the seaward side of the rock walls. No 'halo' effect is expected surrounding the launchway given the BCH in this area is Soft sediment and Reef with macroalgae. Macroalgae is routinely recorded on and immediately adjacent to built structures.

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Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Subsea 7 and Commonwealth of Australia (2018).

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Figure 5-4: Direct losses of BCH

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#### 5.1.6.4 Indirect Loss or Degradation of BCH due to Turbidity Created during Launchway Construction

Launchway construction will occur during daylight hours only, so any sediment resuspended during a shift will be likely to dissipate prior to commencement of the next shift.

Sediment may be resuspended, resulting in elevated turbidity, as a result of:

- Disturbance of the seabed in areas of soft sediment (i.e. when the rock fill material makes contact with the seafloor and displaces superficial material).
- Any rock 'fines'[7] contained within the rock fill, or generated as the fill is placed and rocks come into contact with each other.
- Disturbance of the seabed by construction equipment, including when an approximately 300 mm layer of sediment is removed from the last 24 m length of the launchway footprint.

The inshore BCH at Heron Point are likely to be tolerant to short-term extremes in water column turbidity as such events occur under natural conditions (refer Section 5.3.3). The macroalgae (*Halimeda* sp., *Padina* sp., *Sargassum* sp.) and occasional hard corals (*Turbinaria* spp.) and soft corals (*Lobophytum* spp.) recorded within the lower-littoral pavement reef habitat are known to occur widely across North West Australia (Hanley and Morrison 2012).

Brown algae within the genus *Sargassum* (as recorded as a dominant component of the Reef with macroalgae habitat inshore adjacent to the launchway (Attachment 2B)), are common and important features in benthic ecosystems around the world. It is thought that these species have an advantage in higher sediment environments due to their abundance in turbid, inshore reef habitats (e.g. on the Great Barrier Reef). Schaffelke (1999) observed an increase in rates of *Sargassum* growth of up to 180% when particulate matter (i.e. suspended sediment) was present on the thallus surface, potentially due to the creation of a nutrient-rich boundary layer. It appears that this group is resistant to the negative effects of sedimentation if it is already established in a system (Short *et al*. 2017).

In studies to investigate the tolerance of sponges in the north west of Western Australia, it has been noted that '*most sponges survived under low to moderate turbidity scenarios (suspended sediment concentrations of ≤ 33 mg/L, and a daily light integral of ≥0.5 mol photons/m$^2$/day) for up to 28 days*' and '*all three sponge species exhibited mechanisms to effectively tolerate dredging-related pressures in the short-term (e.g. oscula closure, mucus production and tissue regression)*' (Pineda *et al*. 2017). Coral communities recorded adjacent to the Port of Dampier, at Port Hedland, at Cape Preston and throughout the wider Dampier Archipelago are generally similar, with Faviid, Porites and Turbinaria coral groups making up ~70% of all hard corals (WorleyParsons 2009). *Turbinaria* spp. corals were by far the most dominant of the corals present within the nearshore habitats off Heron Point, though their absolute density was low (Attachment 2B). These coral groups are all relatively resistant to bleaching, are able to withstand strong wave action and can cope with high levels of sedimentation (Ayling and Ayling 2006, Berkelmans and Oliver 1999, GHD 2008). Post-construction monitoring of coral communities adjacent to the Coral Bay Boating Facility, which was constructed over eight months in 2007, and involved significant rock (limestone) dumping, concluded that the construction works had not impacted coral communities noticeably at distances of more than 50 m from the physical structure (MScience 2007). Thus impacts to less sensitive, turbidity tolerant, corals at Learmonth are not expected beyond the immediate vicinity (50 m) of the launchway footprint.

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[7] Particles with a diameter of less than 63 µm

Given the short-term and 'pulse' nature of the expected sediment resuspension, significant losses of BCH are not expected. Local and minor changes to BCH health could occur, dependent upon the effectiveness of the mitigation measures. As such, the area within the immediate vicinity of the launchway footprint (<50 m) has been defined as a ZoMI within which impacts on benthic organisms may occur, but are recoverable within a period of five years following completion of construction. In reality, given the tolerance of such BCH types (refer above), any impacts resulting from the up to six months' construction duration are expected to be more short-term (<1 year).

Predicted indirect BCH impacts (recoverable) as a result of the launchway construction are as follows:

- Reef with macroalgae (2.5 ha) (0.7% of that mapped within the Heron Point LAU).
- Soft sediment (2.0 ha) (< 0.1% of that mapped within the Heron Point LAU).
- Pavement reef (0.4 ha) (12.9% of that mapped within the Heron Point LAU).

Given the absence of significant coral cover in the vicinity of the launchway (the nearest appreciable coral cover was recorded 24 km north of the launchway at Cooper Shoal), the likelihood of impacts to coral spawning, due to locally elevated suspended sediment concentrations, is considered negligible. As such, no suspension of construction activities is proposed during the regional autumn or spring coral spawning periods, though in the event of elevated turbidity beyond the nominated ZoMI additional management measures will be implemented, including potential suspension of the works (refer Table 5-8, MCMMP in Attachment 3).

#### 5.1.6.5 Direct impacts to BCH during Bundle Launch and Tow

During launch the Bundle rolls down the track, which extends across the beach and along the launchway, and into the shallow subtidal area. As the Bundle towheads (both lead and trailing towheads) enter the water and gain depth, they will become buoyant.

Ballast chains are attached at intervals along the length of the Bundle to provide stability control during the launch and lift during the offshore Controlled Depth Tow Method (CDTM) tow out to the production field. Typically the ballast chains that hang beneath the Bundle vary between short and long lengths, typically alternating in a short-long-short-long configuration. The longer Bundle chain lengths will have some contact (4-5 links or approx 1 to 1.5 m) in contact with the seabed along the length of the tow route out to the Bundle Parking area.

To address this seabed disturbance, an Offshore Operations Area (Off bottom tow) has been defined (Figure 2-4). This area, which overlaps the Heron Point and Offshore Operations Area (Off bottom tow) LAUs, represents an envelope within which any and all disturbance associated with Bundle launches, over the life of the facility, will occur. The whole of the Offshore Operations Area (Off bottom tow) lies within the Exmouth Gulf Prawn Fishery area (Figure 2-14). The effect of the chains touching the seabed within this already disturbed, primarily soft sediment habitat, a maximum of three times per year, is not expected to have a significant impact on BCH. However, to define the potential impacts associated with the chain footprint, a number of potential scenarios were assessed (refer Section 5.1.6.11 for details).

A 'realistic best case' (or 'most likely best case') disturbance footprint associated with a Bundle launch is 501.8 ha. This disturbance footprint represents the seabed disturbance that would result from the launch of a 4 km Bundle under mean current velocity (i.e. mid-way between neaps and springs). On this basis, predicted BCH impacts (expected to be recoverable well within one year, but repeat impacts expected) as a result of a Bundle launch are as follows:

- Soft sediment (500.4 ha).
- Reef with macroalgae and filter feeders (0.9 ha).
- Soft sediment with filter feeders (0.4 ha).

A 'realistic worst case' (or 'most likely worst case') disturbance footprint associated with a Bundle launch is 1,817.7 ha (Figure 5-4). This disturbance footprint represents the seabed disturbance that would result from the launch of an 8 km Bundle under mean current velocity (i.e. mid-way between neaps and springs). The launch of an 8 km Bundle, under mean tidal conditions, is considered the realistic worst case as Bundles of this length, or longer, would generally be launched during neap tide conditions, leading to reduced tidal forcing and a reduced footprint. On this basis, predicted BCH impacts (expected to be recoverable well within one year, but repeat impacts expected) as a result of a Bundle launch are :

- Soft sediment (1815.8 ha) (9.6% of that mapped within the Heron Point, Offshore Operations Area (Off bottom tow) and Parking area LAUs).
- Reef with macroalgae and filter feeders (1.5 ha) (0.7% of that mapped within the Heron Point, Offshore Operations Area (Off bottom tow) and Parking area LAUs).
- Soft sediment with filter feeders (0.4 ha) (5.9% of that mapped within the Heron Point, Offshore Operations Area (Off bottom tow) and Parking area LAUs).

No impacts to BCH within the Surface tow portion of the Offshore Operations Area are predicted as the Bundle will be on the sea surface and the chains well clear of the seabed (refer Section 2.3.8). The targets for filter feeders within the Ningaloo Marine Park of '*no loss of filter feeding community diversity*' and '*no loss of living filter feeding community biomass*' (CALM 2005) will not be compromised as a result of the Proposal.

#### 5.1.6.6 Indirect Loss or Degradation of BCH during Bundle Launch and Tow

To predict potential indirect impacts to BCH during Bundle launch and tow operations, a sediment fate model was setup and interrogated to accurately predict the magnitude and duration of water quality impacts associated with suspended sediment (leading to increased turbidity)[8] (Attachment 2H).

Field Data Collection

To assist in defining sediment source terms (such as the sediment flux rate, particle-size distribution (PSD) and vertical distribution of suspended sediments) related to the Bundle launch operations, which are the greatest drivers of changes in plume dispersion patterns, a field experiment was conducted. This involved towing a single chain (76 mm diameter chain with a chain link length of 304 mm, as will be attached to each Bundle) along a 2 km section of soft sediment habitat off Heron Point, in proximity of the path to be followed during proposed future Bundle launches. It was determined that 4-5 links (or approximately 1.5 m) of chain had been in contact with the seabed at the offshore end of the transect. Concurrent measurements of water quality were taken to determine the

[8] Total suspended sediment (TSS) concentrations are measured in mg/L while the resulting reduction in water clarity is measured as turbidity in 'Nephelometric Turbidity Units (NTU)'. Site-specific relationships between TSS and turbidity can be determined through concurrent measurements. In the sections below the terms are used interchangeably depending upon the units referred to in the relevant papers and reports.

sediment flux rate, PSD and vertical distribution of sediments resuspended by the chain as it was towed along the seabed at a speed of 3 knots (MBS Environmental 2018c). The data obtained from the single chain tow trial were used to inform assumptions with regard to the sediment flux rate and behaviour (for example settling velocity) associated with many chains in sequence (Attachment 2H).

Sediment Fate Modelling

The Delft3D suite was used to complete the modelling of turbidity associated with a Bundle launch and tow. Delft3D is a fully integrated computer software package composed of several modules (e.g. flow, waves, sediment, water quality, and ecology) grouped around a common interface. This software suite has been developed to carry out studies with a multi-disciplinary approach and multi-dimensional calculations (e.g. 2D and 3D) for a range of systems, such as oceanic, coastal, estuarine and river environments. It can simulate the interaction of flows, waves, sediment transport, morphological developments, water quality and aquatic ecology. The Delft3D suite of models adheres to the International Association for Hydro-Environment Engineering and Research guidelines for documenting the validity of computational modelling software, closely replicating an array of analytical, laboratory, schematic, and real-world data. The D-FLOW model, which is the hydrodynamic component of the Delft3D suite, has been used for a vast array of applications all over the world and is considered to be a reliable and robust model for oceanic, coastal, estuarine, riverine, and flooding applications (Attachment 2H).

A hydrodynamic model framework for the Exmouth Gulf area was constructed and validated. A three-dimensional hydrodynamic model was established over a domain covering the Exmouth Gulf and surrounding areas. A number of sub-domains, with horizontal resolutions becoming finer towards the Bundle tow route, were developed to allow increased resolution around the Bundle tow route while optimising model run times by having coarser resolution further from the site (Attachment 2H). The hydrodynamic model predictions of water level and current were validated against site-specific ADCP data collected near the proposed launchway site and further offshore near the Bundle Parking area (GHD 2018a).

To model the potential field of effect of sediments suspended by Bundle launch and tow operations, the specialised sediment fates model, DREDGEMAP, was used. This model is designed to calculate suspended sediment loads and sedimentation (above background levels) resulting from more than one concurrent source of input. The model is suited to long-run simulations using parallel inputs of wave and current data to calculate for transport, dispersion, settlement and resuspension of sediments. Both settlement and resuspension take account of local wave and current forces. This model has previously been applied to dredging investigations at Port Hedland, Mermaid Sound, Cockburn Sound, Ocean Reef, Alkimos, Darwin Harbour, Gladstone Port, Keppel Bay, and other locations (Attachment 2H).

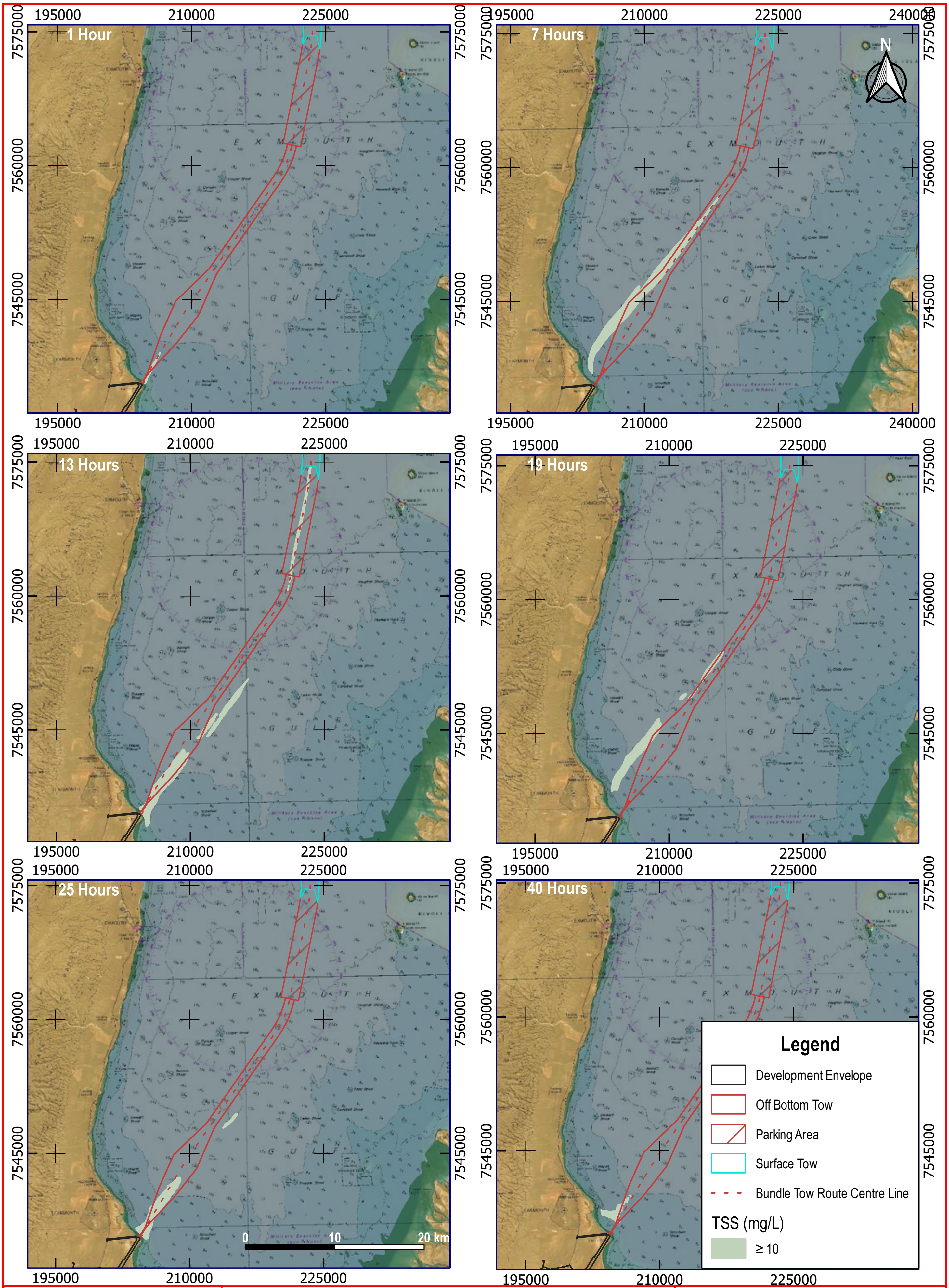
The sediment fate modelling was based on the worst-case potential seabed disturbance associated with a 10 km Bundle with long chains spaced at 20 m intervals (noting that to date Subsea 7 has not designed or built such a long Bundle).

To model the sediment suspended as a result of the Bundle chains, during a Bundle launch, the tow route was split into seven sections based on bathymetry, and the number of chain links assumed to be in contact with the seabed was varied depending on the average depth within each section of the route. In the innermost section (nearshore), it was assumed that six chain links would usually be in contact; in the outermost section (including the laydown area), it was assumed that two chain links would be in contact. The sediment flux rate for one chain was calculated as the volume of material on the seabed likely to be disturbed by the dragging chain, multiplied by a rate of suspension of this material into the water column. The volume of material disturbed by each chain link was calculated as the cross-sectional area of contact, multiplied by the length of the route section under consideration, multiplied further by the number of chain links in contact with the seabed within the route section (Attachment 2H).

The period simulated in the model commenced on 3 January 2017, during spring tides. The sediment fate model produced contours representing the median (or 'middle value'), 80$^{th}$ percentile (the value below which 80% of records occur), and 95$^{th}$ percentile (the value below which 95% of records occur) maximum water column turbidity[9], and depth-averaged water column turbidity[10], during a Bundle launch and the period immediately following when resuspended sediments are transported within the water column prior to settlement (Attachment 2H).

The general pattern of suspended sediment movement predicted by the modelling was that the sediment suspended in the lower layers of the water column will drift to one side of the tow route (north during an ebb tide or south during a flood tide), before a proportion is deposited on the seabed during the next slack tide period. The remaining suspended sediments will then be transported by subsequent tidal currents back and forth (north-south) across the tow route, with deposition occurring steadily. Figure 5-5 presents the modelled suspended sediment plume at intervals following the commencement of a Bundle launch, during an ebb tide. The suspended sediment 'plume' generated during the launch and tow (only concentrations ≥ 10 mg/L displayed) drifts to the north during ebb tide conditions for the initial seven hours before drifting south under flood tide conditions for the next six hours, before changing direction and returning northwards. As the suspended sediments drift back and forth they gradually resettle onto the seabed, leading to a decrease in the spatial extent of the plume, until only a small area immediately offshore of Heron Point exhibits concentrations > 10 mg/L) after 40 hours (Figure 5-5, Attachment 2H).

[9] Maximum value recorded anywhere in the water column (in the majority of instances this will be immediately adjacent to the seabed)
[10] Average value through the water column between the seabed and sea surface

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Notes: Data sourced from RPS (2019).

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Figure 5-5: Snap Shots of Predicted Depth Averaged TSS Following a Bundle Launch

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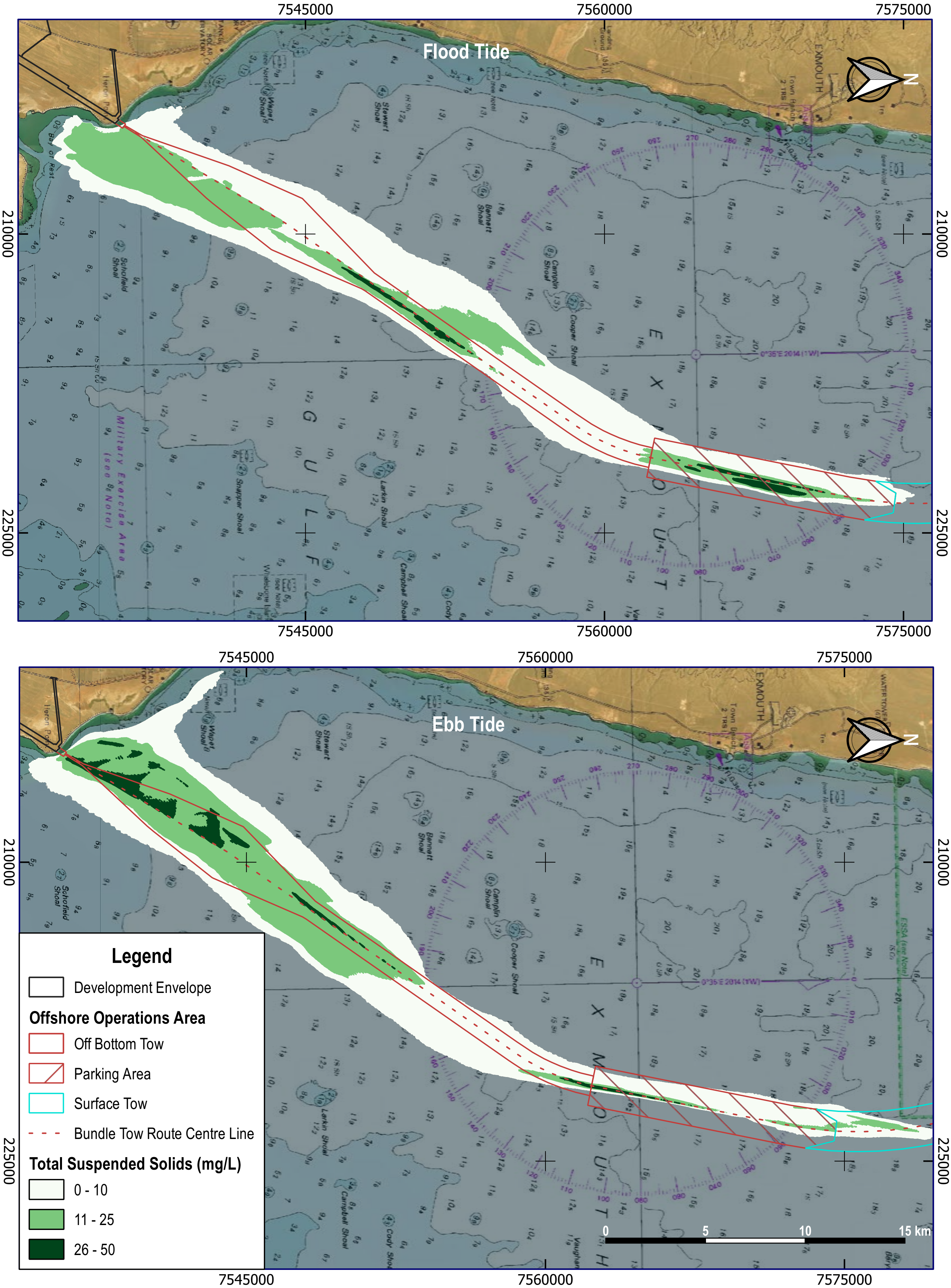
The 95th percentile values, representing the near worst-case turbidity occurring during a Bundle launch (values above these 95th percentile values will only occur for 5% of the time) are presented for the maximum water column turbidity (Figure 5-6), and depth-averaged water column turbidity (Figure 5-7). The difference between the modelled maximum water column turbidity and depth-averaged water column turbidity demonstrates that the high turbidity values are primarily limited to waters adjacent to the seabed, resulting in reduced depth-averaged values compared to the maximum values.

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Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Commonwealth of Australia (2018) and RPS (2019).

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Figure 5-6: Predicted Maximum Water Column Turbidity During a Bundle Launch and Tow (95th Percentile Values)

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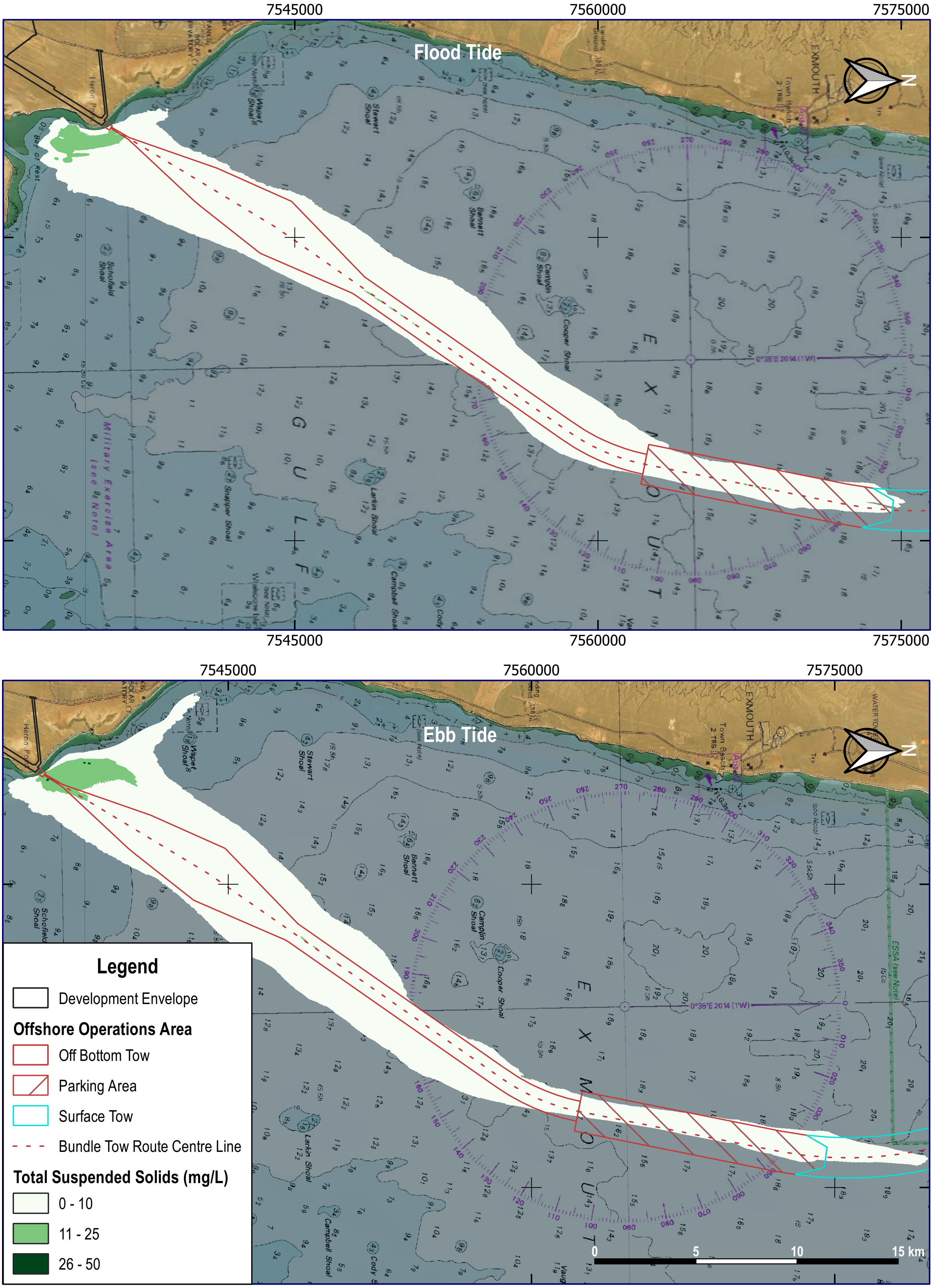


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Notes: Data sourced from Commonwealth of Australia (2018) and RPS (2019).

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Figure 5-7: Predicted Depth Averaged Water Column Turbidity During a Bundle Launch and Tow (95th Percentile Values)

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Impact Thresholds

Brown algae within the genus Sargassum (as recorded as a dominant component of the Reef with macroalgae habitat inshore (Attachment 2B)) is resistant to the negative effects of sedimentation if it is already established in a system (Short *et al*. 2017).

An area of sparse seagrass (*H. uninervis* and *H. ovalis*) was recorded approximately 1 km south of Heron Point (Figure 5-2), in water depths of 2.5 m to 4 m (at the time of survey, being immediately before a high tide of 2.46 m) (Attachment 2B). A key driver of seagrass distribution is the amount of sunlight reaching the seabed, which is affected by seabed depth and water clarity. It is expected that the seagrass in this area is depth limited, meaning that there is insufficient light at greater depths to support growth. This would be broadly consistent with the findings of other studies (Section 5.1.3).

Given the short-term, and intermittent, nature of potential shading of the mapped sparse seagrass habitat during and immediately following a Bundle launch, and the reported recovery of seagrass biomass over weeks following light reduction treatments (Lavery *et al*. 2017), no impact is expected.

In studies to investigate the tolerance of sponges in the north west of Western Australia, it has been noted that '*most sponges survived under low to moderate turbidity scenarios (suspended sediment concentrations of ≤ 33 mg/L) for up to 28 days*' and '*all three sponge species exhibited mechanisms to effectively tolerate dredging-related pressures in the short-term (e.g. oscula closure, mucus production and tissue regression)*' (Pineda *et al*. 2017).

A generally accepted model for how corals tolerate turbidity is that they survive short-term periods of high suspended sediment concentrations by shifting between phototrophic and heterotrophic dependence, by relying on energy reserves, and by rapidly replenishing reserves in periods between turbidity events (Jones *et al*. 2017). The ephemeral nature of plumes and the potential for corals to recover from individual turbidity events, means dredging programs can be managed by considering cumulative pressure. Implicit in this concept is that natural turbidity events (or periods of low light), are an integral component of the total pressure (Jones *et al*. 2017). It is noted that experience from large scale dredging programmes in the Pilbara has shown that impacts have generally been limited to areas close to the dredging activity (<500 m), and that impacts have been consistently over-estimated (MScience 2009, Hanley 2011). The recently published WAMSI Science Dredging Node Theme 4 Synthesis report (Jones *et al*. 2019) proposes, based on observations and laboratory experiments on a clear water and high diversity shallow water coral reef ecosystem, a threshold for possible coral mortality of 'mean total suspended sediment (TSS) concentration > 27.9 mg/L over 24 hours'.

Given the above information regarding the tolerance of sponges and filter feeders to shorter 'bursts' of turbidity and the lack of coral or seagrass habitats in proximity to the Bundle tow route (the nearest coral habitat is located at Cooper Shoal, over 2 km from the tow route, the nearest sparse seagrass is located 3 km south of the launchway), no specific impact thresholds have been developed for these BCH types. Instead, a threshold for the ZoI was developed based on the modelled change to baseline turbidity, to identify areas likely to experience short-term changes in environmental quality, but where these changes would not result in a detectible impact on benthic biota. The threshold developed was 'the median depth-averaged turbidity over 24 hours exceeds the $80^{th}$ percentile of baseline data'. This approach is similar to that recommended for the seagrass *H. ovalis* which is to compare the median value at an 'impact' site to the $20^{th}$ percentile at a 'non-impact' site (Lavery *et al*. 2017). The baseline monitoring period used in the assessment of this threshold extended from 22 May – 21 June 2018 and included two full tidal cycles (refer Section 5.3.3). The average turbidity recorded at the launchway location was 4.3 NTU (equivalent to a TSS of approximately 7.5 mg/L).

Impact Calculation

Areas of BCH within the area predicted to experience short-term elevated turbidity, beyond the threshold nominated above (refer Figure 5-8), are as follows[11]:

- Soft sediment with turf algae (6.2 ha).
- Soft sediment with filter feeders (6.7 ha).
- Reef with macroalgae (0.4 ha).
- Reef with macroalgae and filter feeders (112.1 ha).
- Seagrass (7.2 ha).

The time-series data presented in Figure 5-9 shows the modelled duration of elevated TSS, associated with a Bundle launch at two points adjacent to the tow route, under a flood tide launch scenario (top panel) and an ebb tide launch scenario (bottom panel). As can be seen from the graphs, elevated TSS concentrations of up to 72 mg/L during a flood tide launch and 382 mg/L during an ebb site launch were predicted. The forecast duration of these elevated concentrations is limited, with the cumulative (modelled plus background) TSS predicted to be greater than 4.10 mg/L (the value representing the 80$^{th}$ percentile of baseline data (Attachment 2H)) for a period of six hours (flood tide) and two hours (ebb tide) (Figure 5-9). The second and third peaks in TSS represent the 'return' of the suspended sediment plume over the sites following a change in tidal direction (refer Figure 5-5). The magnitude of TSS concentrations is reduced due to the ongoing settlement of the suspended sediment particles following their initial disturbance. The predicted 24 hour average TSS concentrations during a Bundle launch were 9.2 mg/L (16.7 mg/L including background) over seagrass habitat to the south of the launchway during a flood tide (Figure 5-9) and 21.8 mg/L (29.3 mg/L including background) over the filter feeder habitat immediately adjacent to the tow route during an ebb tide (Figure 5-9).

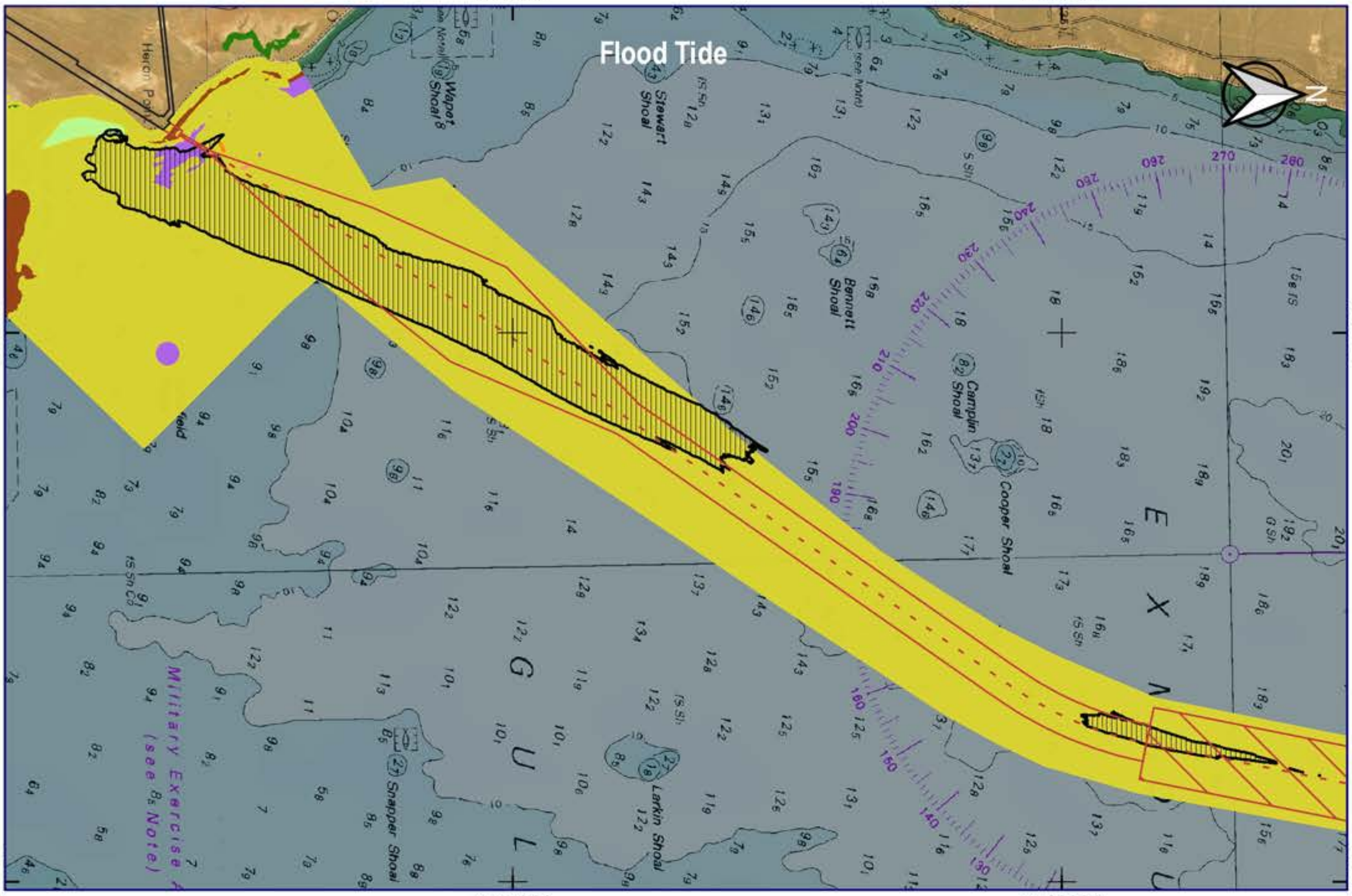
Based on the expected tolerance of the local BCH to short-term increases in turbidity (as occur naturally), the area of exceedance of the threshold (under both flood and ebb tide) has been classified as a ZoI, within which temporary minor changes in environmental quality are predicted and anticipated, but where these changes would not result in a detectible impact on benthic biota.

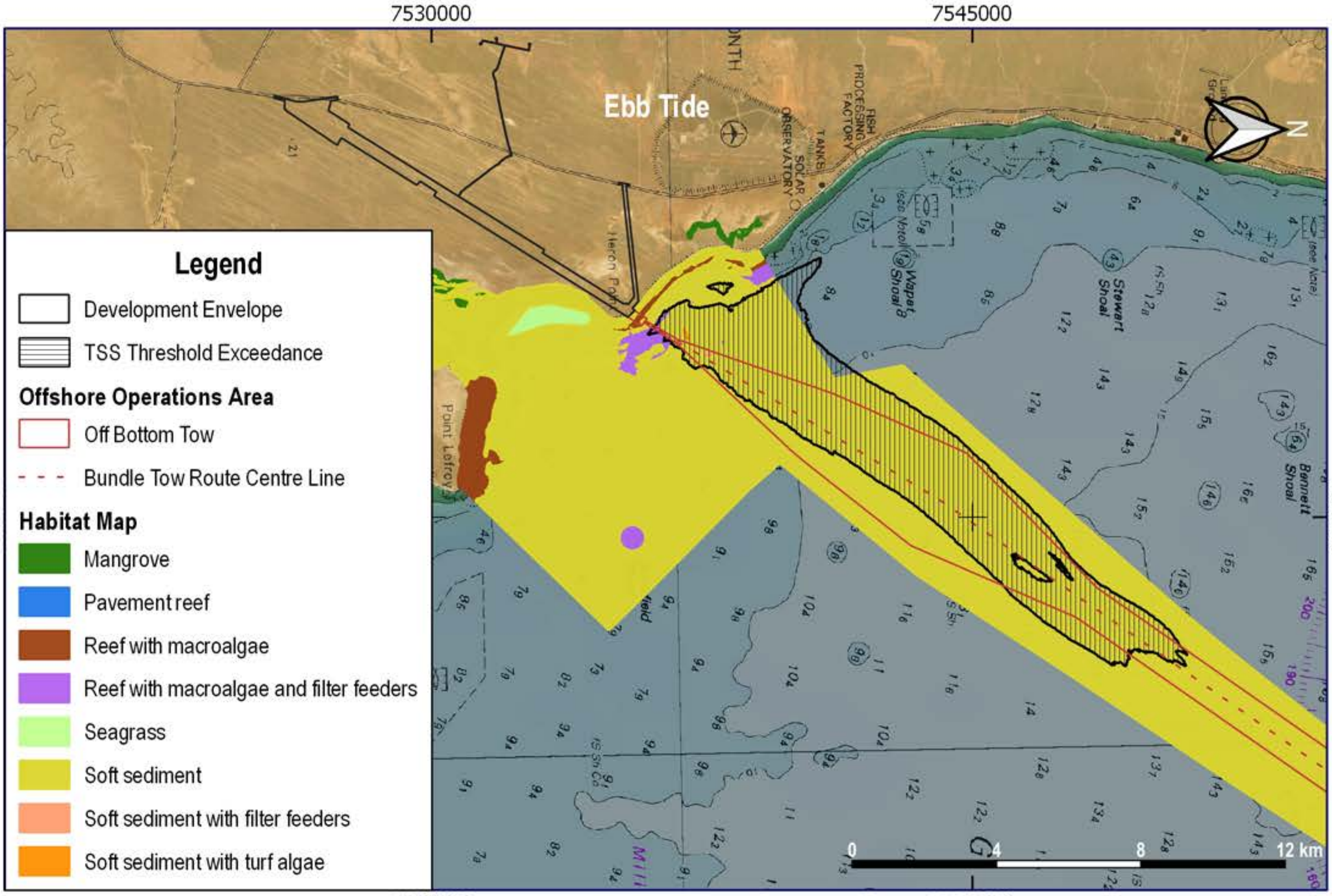
Studies recently completed under the Western Australian Marine Science Institution (WAMSI) Dredging Science Node have revealed a threat to coral reproductive success, whereby suspended sediments adhered to the mucous membrane of the egg-sperm bundles, reducing their ascent or preventing them from reaching the water surface. Further studies investigated how elevated suspended sediments may directly impact the fertilisation of coral eggs at the water's surface (Negri *et al*. 2019). Some early life stages were sensitive (i.e. fertilization), very sensitive (i.e. settlement) and others were quite insensitive (embryogenesis and larval development) to suspended sediments. Activities that generate suspended sediment concentrations of tens of mg/L could affect the egg–sperm bundles and cause sperm limitation effects. Under some circumstances the use of the coral spawning 'critical windows of environmental sensitivity' could be adopted to protect spawning and fertilisation under the precautionary principle. However, where coral spawning occurs at a distance from activities and developing embryos and larvae drift into a turbid plume, there

[11] Unvegetated 'soft sediment' has been excluded given no impact is considered plausible.

is comparatively little risk of negative effects on embryo and larval survivorship (Negri *et al*. 2019).

Given the absence of significant coral cover in the vicinity of the Off bottom tow area (the nearest appreciable coral cover was recorded at Cooper Shoal, located 4.5 km to the west, where minimal changes to water column suspended sediment concentrations were predicted (Figure 5-5, Figure 5-6)), the likelihood of impacts to coral spawning, due to locally elevated suspended sediment concentrations, is considered negligible. Bundle launches during the secondary regional coral spawning period in spring will be avoided due to the proposed no launch period associated with the Humpback whale southern migration (refer Section 5.4.7).

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Notes: Data sourced from Commonwealth of Australia (2018) and RPS (2019).

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Figure 5-8: Area of Exceedance of the 80th Percentile of Baseline Depth Averaged Turbidity (over 24 hours)

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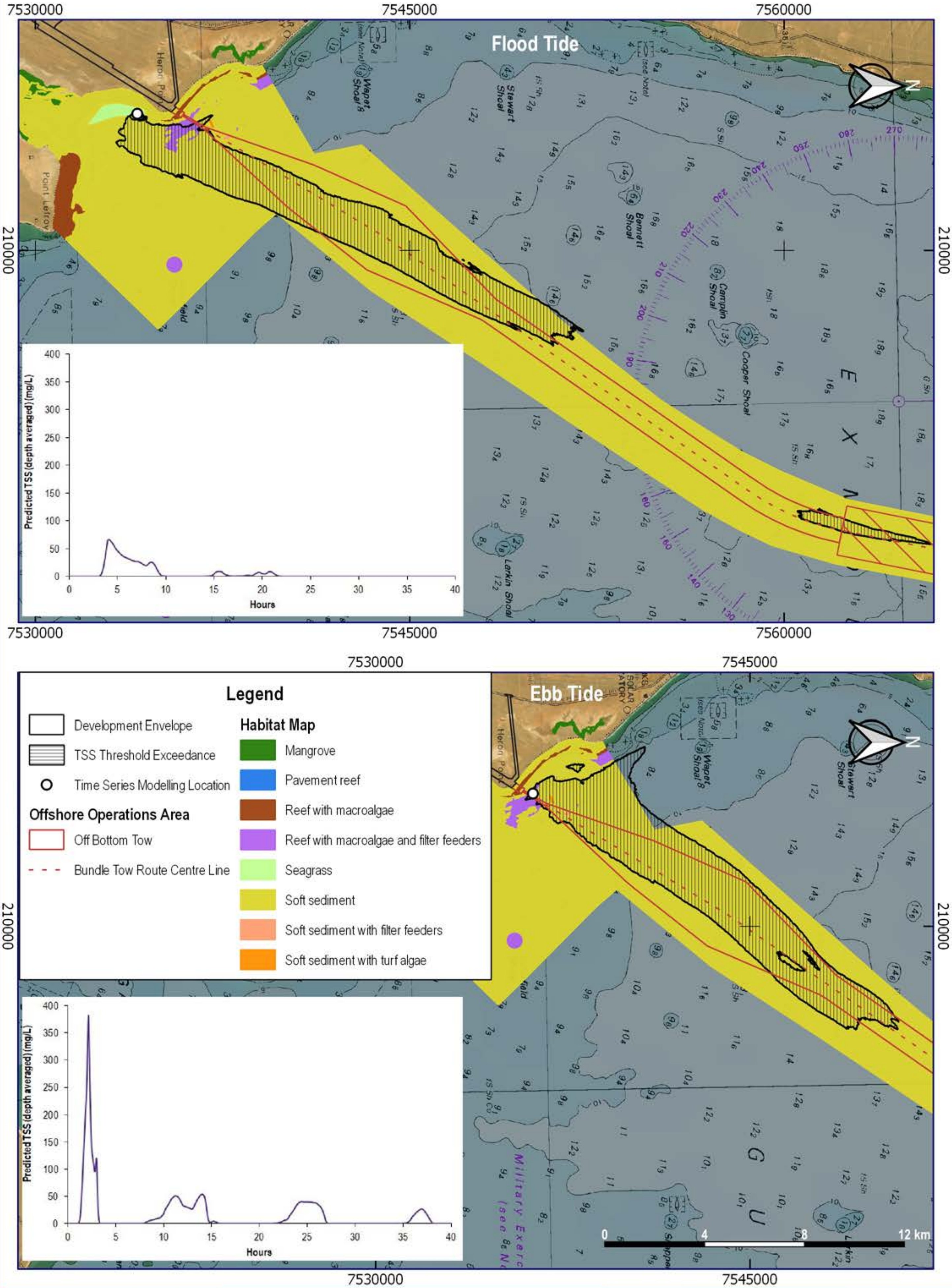


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| Scale: 200000<br>Original Size: A4<br>Aerial Photo: ESRI Satellite<br>Grid: GDA 94 / MGA Zone 50 | Notes: Data sourced from Commonwealth of Australia (2018) and RPS (2019).<br><br>Subsea 7 Pipeline Fabrication Facility | subsea 7<br><br>Figure 5-9: Time-Series of Predicted Depth Averaged TSS Following Bundle Launch |

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#### 5.1.6.7 Direct Loss of BCH during Bundle Tow in the Event of a Loss of Control of the Bundle

A number of measures are proposed to minimise the likelihood of the loss of control of a Bundle during launch and tow (Table 5-8). With these measures in place, the likelihood of such an event is considered negligible (in over 80 Bundle launches at Wick no such event has occurred).

The Marine Emergency Response Plan (Attachment 3) includes a risk assessment and provides details on the management actions and control measures in place to minimise the likelihood of a loss of control of the Bundle or support vessel (under various scenarios) leading to an indirect loss of BCH during Bundle tow.

#### 5.1.6.8 Indirect Loss of BCH during Bundle Tow in the Event of a Loss of Control of the Bundle or Support Vessel (from Physical Contact or a Chemical Spill)

A number of measures are proposed to minimise the likelihood of the loss of control of a Bundle during launch and tow (Table 5-8). With these measures in place, the likelihood of such an event is considered negligible (in over 80 Bundle launches at Wick no such event has occurred).

The Bundle pipelines can be split in two categories, the internal pipelines, and the outside carrier pipe that sleeves the internal pipelines. The internal Bundle pipelines are designed for high-pressure, high-temperature environments, and therefore have a pipe wall thickness and design strength much higher than what is required for the Bundle launch and tow. The carrier pipe is designed to physically protect these internal pipelines, provide an environmental barrier, and transfer the loads from the launch and tow from the towheads, dissipating these forces along the length of the Bundle.

All fabrication processes of the internal pipelines and the carrier pipe sections are subject to extensive material selection, production and testing criteria, in accordance to a number of Subsea 7 and industry standards, such as:

- DNV-OS-F101 (Submarine Pipeline Systems, DNV).
- ASME IX (Welding and Brazing Operations, American Society of Mechanical Engineers).
- AS 1554 (Structural steel welding Set, Standards Australia).

Subsea 7 conducts many preliminary tests on materials before each batch is used in production to ensure that no material defects exist prior to fabrication. Any material that has failed testing will be immediately quarantined and replaced. All welders will be individually qualified to a specific Weld Procedure Specification (WPS) to confirm welder competency and the repeatability of the WPS. Each completed weld is subject to non-destructive testing (NDT), with specific weld repair procedures in place should a weld be found to be defective. Finally, a full system hydrostatic pressure test is completed, to verify that the line volumes can contain pressure as per the pipeline design.

The likelihood of material damage or loss of containment of the internal pipelines is considered to be low, due to the high-pressure design and the regulated control of the fabrication process. The risk of material damage or failure of the carrier pipe, that has a lower strength capacity than the internal pipelines, is also considered low.

The Bundle pipeline will contain no hydrocarbons during fabrication, launch and tow activities. The carrier pipe will be charged with nitrogen gas, and this allows the Bundle to be positively buoyant during the tow. The carrier pipe will contain solid chemical packs, designed to dissolve in the seawater that floods the carrier pipe once the Bundle is in the final position offshore. These chemical packs create a non-corrosive environment for the internal pipelines.

It is difficult to envisage a circumstance where sufficient force is imparted to the carrier pipe to cause a leak or rupture. This notwithstanding, material damage to the carrier pipe, leading to a leak would result in a release of nitrogen gas. The carrier pipe internal pressure is monitored during the launch and tow, and any change in pressure will be immediately reported. Such a leak would result in the Bundle becoming positively buoyant (as the weight of nitrogen is reduced) and it would rise to the water surface. If left untreated, the carrier pipe could eventually take on enough seawater to cause the Bundle to become negatively buoyant and sink (depending on the extent of the damage). The seawater within the carrier pipe would mix with the solid chemical packs, but any discharge would be limited and localised. Significant impacts to water or sediment quality, leading to an impact to BCH, are considered extremely unlikely.

Tow vessels will be high specification tow vessels equipped with 'Dynamic Positioning' (DP) systems, with a suitable level of system redundancy. In addition, vessel assurance suitability surveys will be conducted prior to the commencement of tow operations. In the event of a vessel breakdown the Tow Master will communicate a controlled 'All-Stop' of the Bundle Tow. The Bundle would be put into Off bottom tow configuration and the support vessels would provide assistance to the compromised vessel. The breakdown would then be fully assessed by the vessel's Chief Engineer and repairs completed. Therefore the likelihood of significant impacts to BCH as a result of the loss of control of a support vessel is considered negligible.

The Marine Emergency Response Plan (Attachment 3) includes a risk assessment and provides details on the management actions and control measures in place to minimise the likelihood of a loss of control of the Bundle or support vessel leading to an indirect loss of BCH during Bundle tow.

#### 5.1.6.9 Indirect loss of BCH due to altered water flows and sediment movement as a result of the presence of the launchway

Due to the relatively small size and low elevation of the launchway relative to the seabed, the launchway is not expected to have any significant impact on the local wave or current conditions at or adjacent to the site (Attachment 2E).

There is a net longitudinal migration of sediment from north to south along the beach at Heron Point (Attachment 2E). It is anticipated that sediment transport over the launchway would be limited until the beach has accreted to the point that the beach berm roughly aligns with the top of the launchway rail. Once this occurs sediment would begin to be transported over the structure during high water level and wave energy conditions. Once sediment begins to be transported past the structure, the rate of beach accretion on the northern side would slow. It would be expected that the beach would continue to accrete until such time as the shoreline on the northern side is sufficiently advanced that the sediment will transport past the launchway at the same rate as it is transported into the area (Attachment 2E). The area of potential sediment accretion, in relation to mapped BCH, is shown in Figure 5-10. In the absence of any mitigation measures, sediment accretion is predicted to occur across existing beach sands and across intertidal, unvegetated, pavement reef habitat.

Sediment deposition on the northern side of the launchway would temporarily impact the quantity of sediment available to the south. Temporary impacts to the south of the launchway are likely to be limited to a narrowing or possible loss of the small perched beach formations that exist seaward of the onshore rock platforms and bluffs (Attachment 2E), which occur above sea level and do not support BCH (Figure 5-10).

#### 5.1.6.10 Impacts to BCH as a Result of Maintenance or Removal of the Launchway

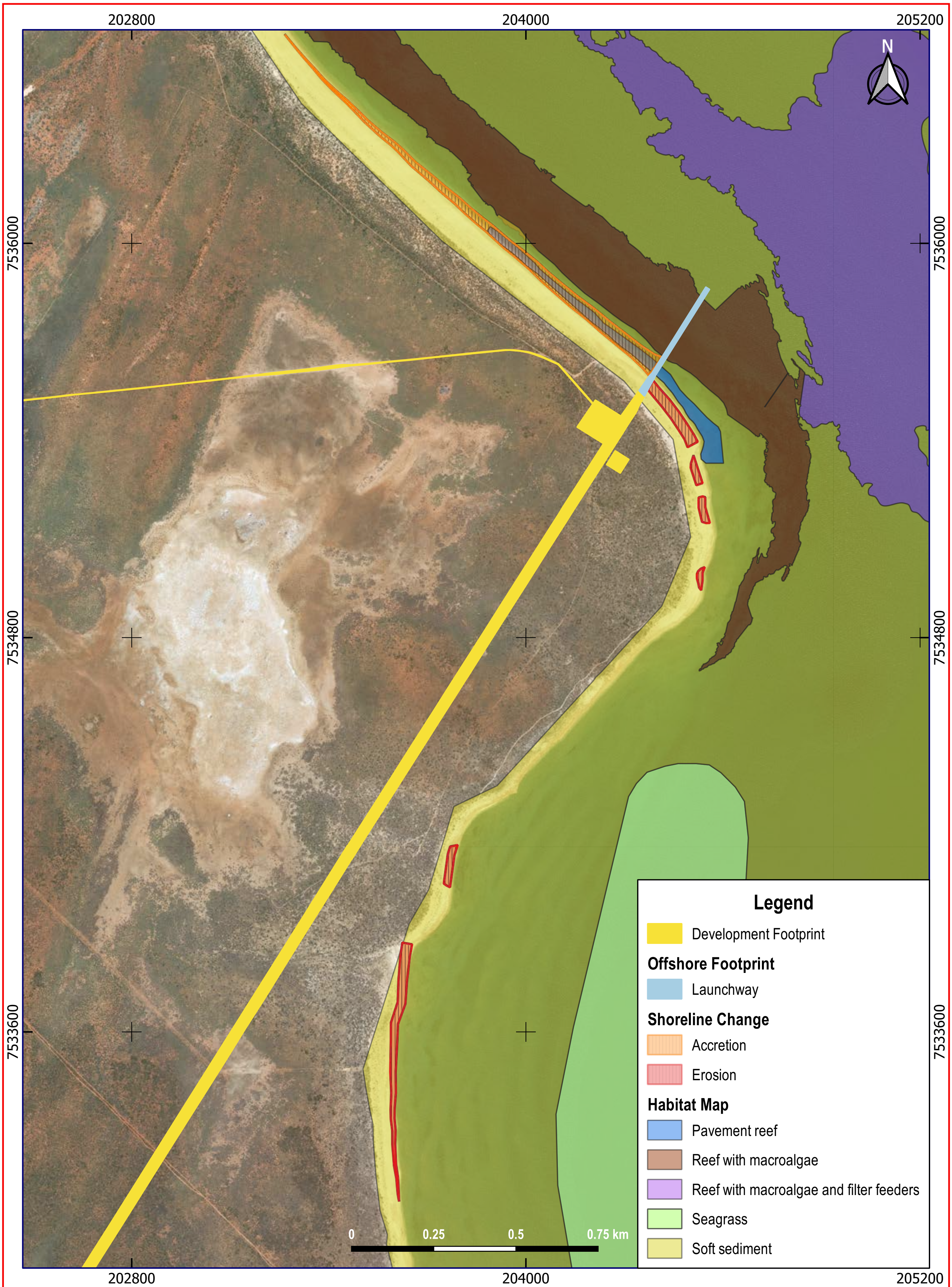
The works associated with the removal of the launchway are likely to generate localised turbidity associated with disturbance of surface sediments. However, the turbidity levels and spatial extent are unlikely to exceed those expected during launchway construction and the duration of works will be significantly shorter than the launchway construction program.

Given the short-term and 'pulse' nature of the expected sediment resuspension, losses of BCH are not expected. Local and minor changes to BCH health could occur, dependent upon the effectiveness of the mitigation measures. As for the construction phase, the area within the immediate vicinity of the launchway footprint (<50 m) has been defined as the ZoMI within which impacts on benthic organisms may occur, but are recoverable within five years. In reality, given the tolerance of such BCH types (refer Section 5.1.6.4), any impacts are expected to be more short-term (<1 year).

Potential indirect BCH impacts (recoverable) as result of the launchway removal are as follows:

- Reef with macroalgae (2.5 ha) (0.7% of that mapped within the Heron Point LAU).
- Soft sediment (2.0 ha) (< 0.1% of that mapped within the Heron Point LAU).
- Pavement reef (0.4 ha) (12.9% of that mapped within the Heron Point LAU).

Prior to a Bundle launch, any sand that has accreted between the two launchway rails will be removed. The portion of the launchway above sea level, where the majority of sand is expected to accrete (Attachment 2E), will be excavated using an excavator, with sand placed immediately south of the launchway to promote the natural southwards migration of beach sands. The small volumes of displaced sediment are expected to be rapidly redistributed and no impacts to BCH are expected.

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Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from MP Rogers (2019).

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Figure 5-10: Predicted Indirect Impacts to BCH Adjacent to Launchway

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#### 5.1.6.11 Potential Cumulative Impacts

Historic Impacts

EPA 2016e advises that the approach to determine cumulative losses within a defined LAU includes determining the spatial extent of BCH:

- Prior to all human-induced disturbance.
- Existing at the time of the proposal.
- Remaining after implementation of the proposal.

Given the lack of information regarding the habitats within deeper waters prior to European habitation, it has been assumed, given that the key driver of habitat types are the substrate type and depth, that the general habitat types have remained the same.

It is likely that some areas of filter feeder habitat within the deeper parts of Exmouth Gulf were lost during development of the prawn fishery. The Exmouth Gulf Prawn Managed Fishery has impacted on some shallow water areas (less than 12 m in depth) containing sponge habitats, but the trawling has focused in the deeper central and north western sectors of Exmouth Gulf since the 1980's (Kangas *et al*. 2015).

The quantification of these historic losses is only required, under the EPA framework, when additional losses of the same habitats are predicted to occur, as a result of the Proposal, within the same LAUs.

Impacts from Third Party Projects or Proposals

The risk of environmental impacts due to turbidity generated by prawn trawling activities was considered 'negligible' (Kangas *et al*. 2006b). This conclusion was made on the basis that the trawl gear design is such that it is not in direct and consistent contact with the substrate and therefore does not disturb the substrate to any significant degree, and that the ground trawled in Exmouth Gulf is typically comprised of coarse sediments that do not readily 'silt'.

The quantification of these third party impacts is only required, under the EPA framework, when additional losses of the same habitats are predicted to occur, as a result of the Proposal, within the same LAUs.

Potential cumulative impacts following multiple Bundle launches

To take account of the impact from multiple Bundle launches, Figure 5-11 presents the cumulative footprint following a number of Bundle launches. The modelled scenarios were as presented in Table 5-5.

The lateral movement of a Bundle during a launch was modelled using the information from the current measurements obtained in May/June 2018 (Attachment 2G) and Subsea 7's extensive experience of Bundle behaviour during launch and tow. The tidal speed and direction changes through the flood-ebb cycle, and the resulting effects on the movement of a Bundle, can be seen by the modelled footprints swinging from one side of the tow centreline to the other during the duration of the inshore part of a tow (when the tidal currents are more perpendicular to the direction of the tow route). As the tow route turns to the north, tidal currents run more parallel to the Bundle and the lateral deflection is significantly reduced.

| Scenario No. | Bundle Length (km) | Tidal Condition |
|---|---|---|
| 1 | 6 | Mean |
| 2 | 6 | Mean |
| 3 | 6 | Neap |
| 4 | 4 | Mean |
| 5 | 4 | Spring |
| 6 (Realistic Worst Case) | 8 | Mean |

Table 5-5: Bundle Chain Footprint Modelling Scenarios

As stated in Section 5.1.6.2, while the Proposal does not involve dredging, the approach outlined within the EPA's '*Technical Guidance - Environmental Impact Assessment of Marine Dredging Proposals*' (EPA 2016v) has been referenced to assist in the spatial representation of the zones of potential impact to BCH.

In relation to the prediction of impacts associated with suspended sediments, the EPA (2016v) states '*Uncertainty is a factor inherent in all predictions and there is an array of sources of uncertainty associated with dredging impact predictions. In order to take account of this uncertainty in the EIA process, the final set of predictions may describe the lower and upper ends of the likely range of impacts associated with the proposal (i.e. the likely best case and the likely worst case). This range should be realistic and based on understanding of probable scenarios and their associated environmental outcomes. For the majority of proposals, the range of predictions to be considered should be conservative but not include unrealistic best or worst case (or other improbable) predictions'*. It is further stated that '*the upper end of the range should reflect a likely worst case outcome that the proponent is both confident of achieving and prepared to be conditioned to'*.

To assess the potential impacts associated with multiple Bundle launches a 'realistic best case' (or 'most likely best case') and a 'realistic worst case' (or 'worst case') were defined and assessed.

A 'realistic best case' disturbance footprint associated with a Bundle launch is 501.8 ha. This disturbance footprint represents the seabed disturbance that would result from the launch of a 4 km Bundle under mean current velocity (i.e. mid-way between neaps and springs) (Scenario 4 within Table 5-5 and Figure 5-11). On this basis, predicted BCH impacts (recoverable) as a result of a Bundle launch are as follows:

- Soft sediment (500.4 ha).
- Reef with macroalgae and filter feeders (0.9 ha).
- Soft sediment with filter feeders (0.4 ha).

Scenario 6 (Table 5-5, Figure 5-11) was assessed as the 'realistic worst case' given that this Bundle length (8 km) is approaching the maximum Bundle length (refer Section 5.1.6.5), and a Bundle of this length would generally be launched under neap tide conditions (so the modelling of a launch under mean tidal conditions is an over-estimate of impacts). On this basis, predicted BCH impacts as a result of a Bundle launch are as follows:

- Soft sediment (1815.8 ha) (9.6% of that mapped within the Heron Point, Offshore Operations Area (Off bottom tow) and Parking area LAUs).
- Reef with macroalgae and filter feeders (1.5 ha) (0.7% of that mapped within the Heron Point, Offshore Operations Area (Off bottom tow) and Parking area LAUs).

- Soft sediment with filter feeders (0.4 ha) (5.9% of that mapped within the Heron Point, Offshore Operations Area (Off bottom tow) and Parking area LAUs).

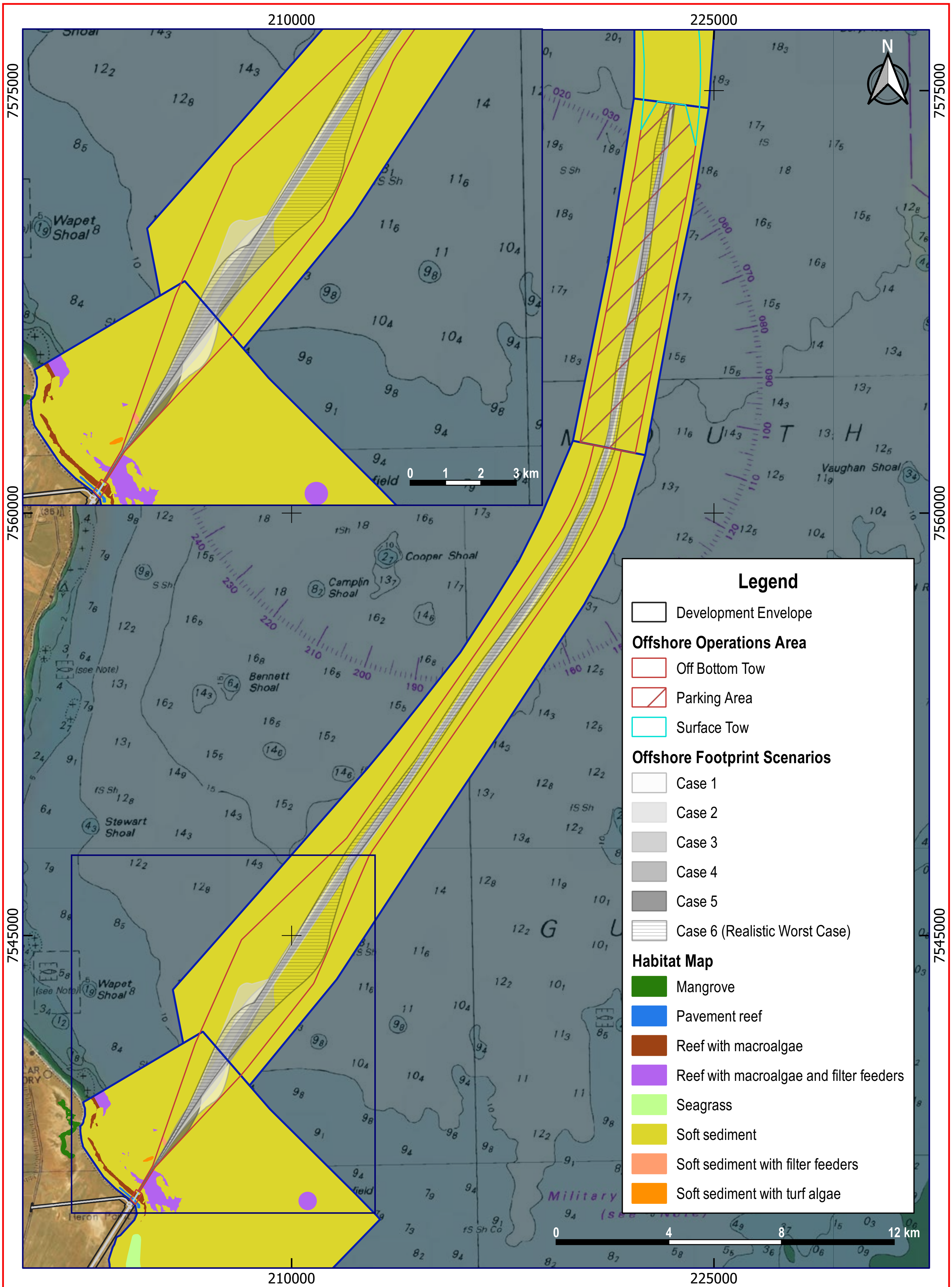
In the event that six different Bundles (ranging from 4 km to 8 km in length) are launched under differing tidal conditions (neap, mean and spring), over a period of several years, a total of 2,120 ha of soft sediment habitat could be disturbed. Disturbance would occur intermittently (nominally once every four to six months, for up to one day per launch) and restoration of the natural seabed topography would be expected to occur between events, with little to no trace of physical disturbance expected within four weeks of a Bundle launch. Based on the expected minimal impact to Soft sediment habitat from a Bundle launch, and anticipated rapid recovery, Scenario 6 was used to define a 'realistic worst case' for potential cumulative impacts following multiple Bundle launches (refer Table 5-6). The premise behind the use of this scenario is that it describes the maximum area of BCH likely to exhibit impacts from Bundle launch activities at any time during the life of the Proposal.

Impacts across the whole of the cumulative impact footprint (6 launches) are unlikely to ever occur, as the modelled scenarios include a launch under spring tides (unlikely), and no recovery of BCH between launches, over multiple (minimum three) years. As stated in Section 5.1.6.5 and above, the effect of the chains touching the seabed within this already disturbed, primarily soft sediment habitat is not expected to have a significant impact. However, to quantify the potential (but highly unlikely) 'absolute worst case' outcome following multiple Bundle launches, and assuming no recovery of BCH between Bundle launches, calculations have been completed based on the total area potentially impacted by all six scenarios as outlined in Table 5-5 and Figure 5-11. This area has been designated a potential ZoHI. On this basis, potential cumulative impacts as a result of the Proposal are as follows (refer also to Table 5-7):

- Soft sediment (2213.6 ha) (9.9% of that mapped within the Heron Point, Offshore Operations Area (Off bottom tow) and Parking area LAUs).
- Reef with macroalgae (0.1 ha) (< 0.1% of that mapped within the Heron Point, Offshore Operations Area (Off bottom tow) and Parking area LAUs).
- Reef with macroalgae and filter feeders (3.6 ha) (1.8% of that mapped within the Heron Point, Offshore Operations Area (Off bottom tow) and Parking area LAUs).
- Soft sediment with filter feeders (0.7 ha) (10.3% of that mapped within the Heron Point, Offshore Operations Area (Off bottom tow) and Parking area LAUs).

Table 5-7 presents the predicted cumulative losses of BCH as a result of the Proposal, and presents the 'absolute worst case' cumulative loss total for each BCH type within each of the LAUs (as requested by the EPA).

The ZoHI associated with multiple Bundle launches, as presented in Figure 5-12, was derived from the 'absolute worst case' scenario described above. Figure 5-12 also presents the ZoHI associated with the launchway footprint, the ZoMI associated with launchway construction and potential altered sediment transport adjacent to the launchway, and the ZoI associated with Bundle launch.




Scale: 1:175000
Original Size: A4
Aerial Photo: ESRI Satellie
Grid: GDA 94 / MGA Zone 50

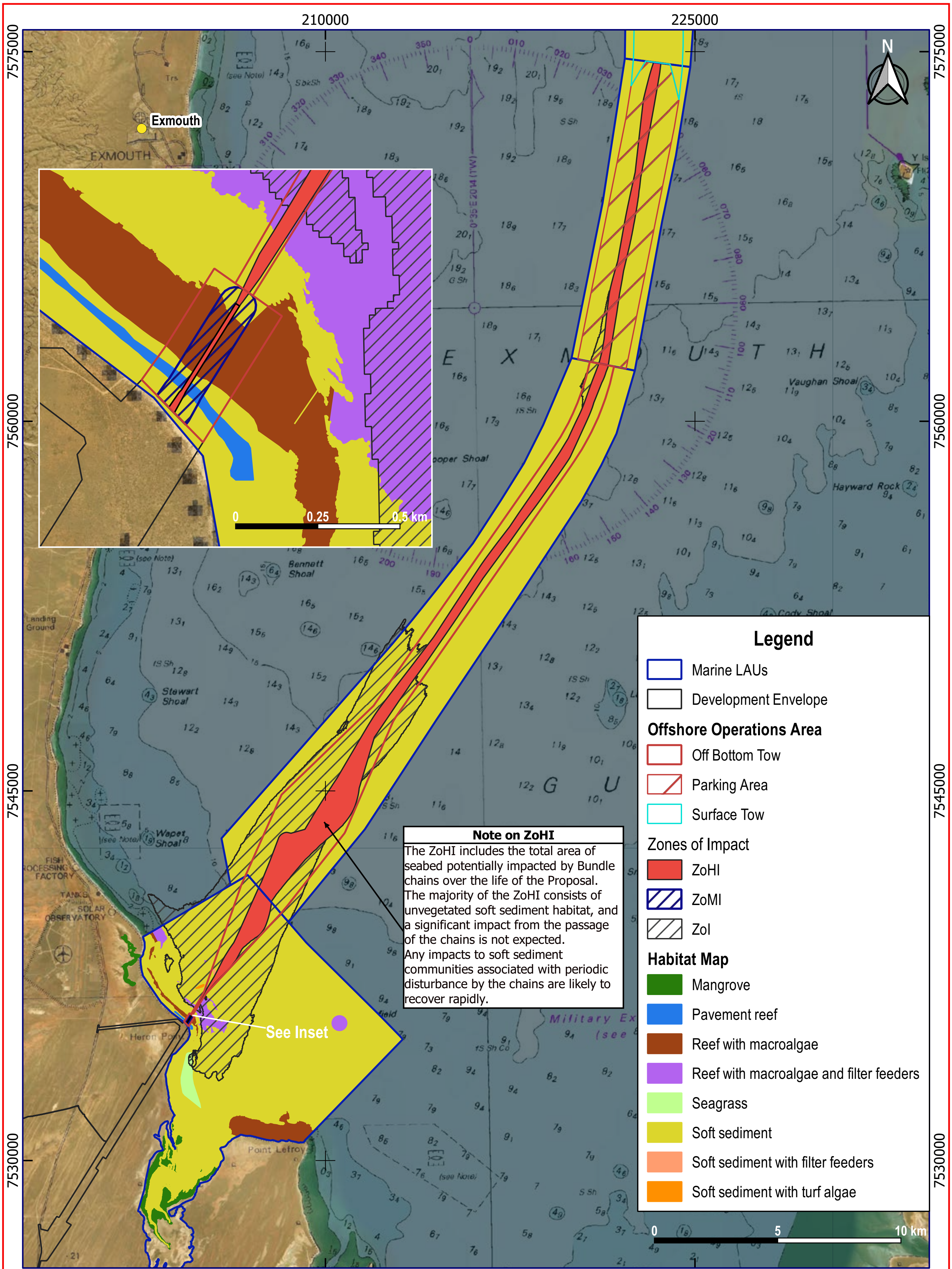
Notes: Data sourced from Subsea 7 and Commonwealth of Australia (2018).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-11: Potential Direct Impact to BCH Following Multiple Bundle Launches

W:\Subsea 7\Data References\Spatial data\Project Area\Marine\Chain Disturbance Envelope 20180918\Chain Disturbance Envelope 20180918.qgz 29/08/2019




Scale: 1:200000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Commonwealth of Australia (2018) and RPS (2019).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-12: Zones of High and Moderate Impact and Zone of Influence (Worst Case)

W:\Subsea 7\Data References\Spatial data\Project Area\Marine\Chain Disturbance Envelope 20180918\Chain Disturbance Envelope 20180918.qgz 09/09/2019

## Calculations

Table 5-6 presents the estimated pre-European habitation coverage of BCH within Exmouth Gulf, the historic loss of BCH, the predicted direct and indirect loss of BCH as a result of the Proposal (realistic worst case), and the cumulative loss total for each BCH type within each of the LAUs.

| BCH Type | Pre-European Habitation Coverage (ha) | Historic Losses (ha) | Direct Proposal Impacts (ZoHI) (ha)[12] | Direct Proposal Impacts (ZoHI) (%) | Cumulative Impacts (%) |
|---|---|---|---|---|---|
| Heron Point LAU | | | | | |
| Soft sediment | 6,930.7 | 0.0 | 110.3 | 1.6 | 1.6 |
| Reef with macroalgae | 347.8 | 0.0 | 0.3 | 0.1 | 0.1 |
| Pavement reef | 3.1 | 0.0 | 0.1 | 3.2 | 3.2 |
| Reef with macroalgae & filter feeders | 203.4 | 0.0 | 1.5 | 0.7 | 0.7 |
| Soft sediment with filter feeders | 6.8 | 0.0 | 0.4 | 5.9 | 5.9 |
| Soft Sediment with turf algae | 6.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| Seagrass | 109.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mangrove | 261.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| Offshore Operations Area (Off bottom tow) LAU | | | | | |
| Soft sediment | 8,553.1 | 0.0 | 1,338.5 | 15.6 | 15.6 |
| Parking area LAU | | | | | |
| Soft sediment | 3,259.0 | 0.0 | 367.2 | 11.3 | 11.3 |
| Offshore Operations Area (Surface tow) LAU | | | | | |
| Soft sediment | 3,676.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pavement reef | 389.9 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pavement reef with | 1,414.1 | 0.0 | 0.0 | 0.0 | 0.0 |

[12] Launchway footprint and Bundle chain footprint (realistic worst case)

| BCH Type | Pre-European Habitation Coverage (ha) | Historic Losses (ha) | Direct Proposal Impacts (ZoHI) (ha)[12] | Direct Proposal Impacts (ZoHI) (%) | Cumulative Impacts (%) |
|---|---|---|---|---|---|
| filter feeders | | | | | |
| Pavement reef with macroalgae & filter feeders | 2,239.8 | 0.0 | 0.0 | 0.0 | 0.0 |

Table 5-6: Cumulative Impacts to BCH ('Realistic Worst Case')

Table 5-7 presents the estimated pre-European habitation coverage of BCH within Exmouth Gulf, the historic loss of BCH, the predicted direct and indirect loss of BCH as a result of the Proposal (absolute worst case), and the cumulative loss total for each BCH type within each of the LAUs.

| BCH Type | Pre-European Habitation Coverage (ha) | Historic Losses (ha) | Direct Proposal Impacts (ZoHI) (ha)[13] | Direct Proposal Impacts (ZoHI) (%) | Cumulative Impacts (%) |
|---|---|---|---|---|---|
| Heron Point LAU | | | | | |
| Soft sediment | 6,930.7 | 0.0 | 707.5 | 10.2 | 10.2 |
| Reef with macroalgae | 347.8 | 0.0 | 0.4 | 0.1 | 0.1 |
| Pavement reef | 3.1 | 0.0 | 0.1 | 3.2 | 3.2 |
| Reef with macroalgae & filter feeders | 203.4 | 0.0 | 3.6 | 1.8 | 1.8 |
| Soft sediment with filter feeders | 6.8 | 0.0 | 0.7 | 10.3 | 10.3 |
| Soft Sediment with turf algae | 6.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| Seagrass | 109.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mangrove | 261.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| Offshore Operations Area (Off bottom tow) LAU | | | | | |
| Soft sediment | 8,553.1 | 0.0 | 1,506.30 | 17.6 | 17.6 |
| Parking area LAU | | | | | |
| Soft sediment | 3,259.0 | 0.0 | 458.8 | 14.1 | 14.1 |
| Offshore Operations Area (Surface tow) LAU | | | | | |
| Soft sediment | 3,676.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pavement reef | 389.9 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pavement reef with filter feeders | 1,414.1 | 0.0 | 0.0 | 0.0 | 0.0 |

[13] Launchway footprint and Bundle chain footprint (absolute worst case)

| BCH Type | Pre-European Habitation Coverage (ha) | Historic Losses (ha) | Direct Proposal Impacts (ZoHI) (ha)[13] | Direct Proposal Impacts (ZoHI) (%) | Cumulative Impacts (%) |
|---|---|---|---|---|---|
| Pavement reef with macroalgae & filter feeders | 2,239.8 | 0.0 | 0.0 | 0.0 | 0.0 |

Table 5-7: Cumulative Impacts to BCH ('Absolute Worst Case')

Overall the potential cumulative impacts to BCH are minor and the EPA Objective will be met.

### 5.1.7 Mitigation, Monitoring, and Predicted Outcome

The proposed mitigation measures to address potential impacts to BCH as a result of the Proposal, the predicted outcome, and monitoring (where proposed to verify the outcome), are provided in Table 5-8.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Direct loss of BCH during launchway construction | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill).<br>• Use of pre-cast concrete panels will reduce seabed disturbance.<br>Measures to rehabilitate:<br>• Removal of launchway at the end of the project life. | Habitats within the launchway footprint are well represented elsewhere and the predicted losses represent a small proportion of the habitat present within the Heron Point LAU, as follows:<br>• Soft sediment – 0.2 ha (< 0.1%) of mapped habitat.<br>• Reef with macroalgae – 0.3 ha (0.1%) of mapped habitat.<br>The biological diversity and ecological integrity of BCH will be maintained.<br><br>Monitoring<br>Habitat mapping of BCH adjacent to launchway within one year of construction being completed (refer to the Marine Construction Monitoring and Management Plan (MCMMP) in Attachment 3). |
| Indirect loss or degradation of BCH due to turbidity created during launchway construction | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill) thus reducing seabed disturbance and duration of construction.<br>• Use of pre-cast concrete panels will reduce seabed disturbance and duration of construction. | Construction of the Bundle launchway is estimated to take up to six months. Elevated turbidity is expected to be limited to the immediate surrounds (<50 m) of the work site. The adjacent habitats are expected to be tolerant of short-term pulses in turbidity and suspended sediment.<br>Potential reversible impacts could |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | • Construction material to be screened and washed to remove 'fines' (particles <63 µm in diameter).<br>• Silt curtains deployed during turbidity-generating construction activities (refer MCMMP)..<br>• Suspension of turbidity-generating construction activity in the event elevated turbidity is recorded beyond the ZoMI (refer MCMMP).<br>Measures to rehabilitate:<br>• NA | occur as follows:<br>• Soft sediment 2.0 ha (< 0.1%) of mapped habitat.<br>• Reef with macroalgae 2.5 ha (0.7%) of mapped habitat.<br>The biological diversity and ecological integrity of BCH will be maintained.<br><br><u>Monitoring</u><br>Monitoring of water quality adjacent to launchway (refer to the MCMMP in Attachment 3).<br><br>Quantitative survey of BCH adjacent to launchway before construction, and within one year of construction being completed (refer to the Marine Construction Monitoring and Management Plan (MCMMP) in Attachment 3). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Direct loss of BCH during Bundle launch and tow | Measures to avoid:<br>• Surface tow operations within Ningaloo Marine Park to avoid impacts to BCH.<br>Measures to minimise:<br>• All launch and tow operations will occur within the nominated Offshore Operations Area to minimise cumulative impacts to BCH.<br>• Bundle tethered to 'Leading Tug' and 'Trailing Tug' at all times, including within Parking area, to ensure minimal lateral movement of Bundle.<br>• Chains arranged and connected to the Bundle provide lateral stability during the initial launch and off-bottom tow to ensure operations remain within the Offshore Operations Area.<br>Measures to rehabilitate:<br>• NA | An average of two Bundle launches will occur per year with a maximum of three. Soft sediment communities are expected to rapidly recover from what will be a short-term, periodic, superficial physical disturbance of the top sediment layer.<br><br>Direct impacts to Reef with microalgae and Reef with macroalgae and filter feeder habitats will be limited to a narrow corridor adjacent to the end of the launchway. These habitats are well represented to the north and south of the launchway alignment.<br><br>On the basis of the 'realistic worst case' scenario, predicted BCH impacts as a result of a Bundle launch are as follows:<br>• Soft sediment (1815.8 ha).<br>• Reef with macroalgae and filter feeders (1.5 ha).<br>• Soft sediment with filter feeders (0.4 ha).<br>Localised loss will not result in significant impacts on biological diversity or ecological integrity of the local or regional ecosystem. |
| Indirect loss or degradation of BCH | | An average of two Bundle launches will occur per year with a maximum |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| during Bundle launch and tow | Measures to avoid:<br>• A maximum of three launches per year, for a nominal duration of two days per launch, is unlikely to lead to indirect impacts to BCH.<br>Measures to minimise:<br>• NA<br>Measures to rehabilitate:<br>• NA | of three.<br><br>It is expected that the macroalgae and filter feeders on reefs adjacent to the inshore section of tow route will be tolerant of isolated, short-term, 'pulses' of elevated turbidity (as occur naturally) and as such will not be significantly impacted. Thus the area of potential elevated turbidity has been deemed a ZoI, where no impacts to BCH are expected.<br><br>Biological diversity and ecological integrity of BCH will be maintained.<br><br><u>Monitoring</u><br>Water quality monitoring adjacent to sensitive BCH outside of the Offshore Operation Area during initial Bundle launch to validate sediment fate modelling predictions (refer Marine Operational Environmental Monitoring Plan (MOEMP) in Attachment 3).<br><br>Quantitative survey of BCH within and outside of the Offshore Operation Area before and following initial Bundle launch to validate impact predictions (refer Marine Operational Environmental Monitoring Plan (MOEMP) in Attachment 3). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Direct loss of BCH during Bundle tow in the event of a loss of control of the Bundle | Measures to avoid:<br>• Weather forecast/seasonal data reviewed to inform launch schedule to avoid tow in adverse conditions.<br>• Weather forecast monitored ahead of launch operations and launch window defined to avoid tow in adverse conditions.<br>• Defined limiting weather criteria.<br>• Bundle tethered to 'Leading Tug' and 'Trailing Tug' at all times, including within Parking area.<br>• High specification tow vessels used for launch operations.<br>• Secondary system/redundancy design in Bundle monitoring system.<br>• Tow vessels to be equipped with 'Dynamic Positioning' (DP) systems, with a suitable level of system redundancy.<br>• Full tow vessel position monitoring system verification prior to leaving Bundle Parking area.<br>• Secondary tow vessel position keeping system in place for passage through Ningaloo Marine Park.<br>• Vessel Assurance Suitability Surveys conducted prior to commencement of operations.<br>• Notice to mariners supporting information issued prior to tow to inform local vessels of operations.<br>• Guard vessel to monitor/enforce exclusion zones.<br>• Each vessel operating in adherence to International Regulations for Preventing Collisions at Sea (COLREGs).<br>• Vessel intervention if required (as described in guard vessel procedure for engaging 3rd party vessels).<br>• Visual monitoring of Bundle on surface (surface buoys and | Given the controls in place during each Bundle launch, the likelihood of a loss of control of a Bundle, leading to an impact to BCH beyond the defined Offshore Operations Area (Off bottom tow) is considered negligible (refer Marine Emergency Response Plan (Attachment 3)).<br><br>Biological diversity and ecological integrity of BCH will be maintained.<br><br><u>Monitoring</u><br>In the event of a loss of control of the Bundle leading to seabed contact outside the Offshore Operation Area (Off bottom tow) or Offshore Operation Area (Parking area), habitat mapping of BCH adjacent to site(s) of contact within one month. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | lights).<br>• Timing of Surface tow through Ningaloo Marine Park chosen to coincide with benign sea, tidal and weather conditions.<br>Measures to minimise:<br>• Community engagement and announcements locally.<br>• Broadcasting on VHF as required.<br>Measures to rehabilitate:<br>• NA. | |
| Indirect loss of BCH during Bundle tow in the event of a loss of control of the Bundle or support vessel (e.g. from physical contact or a chemical spill) | Measures to avoid:<br>• Bundle fully pressure tested and leak tested prior to launch.<br>• Ongoing monitoring of Bundle pressures prior to and during launch.<br>• Weather forecast/seasonal data reviewed to inform launch schedule.<br>• Weather forecast monitored ahead of launch operations and launch window defined.<br>• Weather conditions monitored during launch operations.<br>• Defined limiting weather criteria.<br>• High specification tow vessels used for launch operations.<br>• System confirmation check completed prior to departing Parking area.<br>• Secondary system/redundancy design in bundle monitoring system.<br>• Tow vessels to be equipped with 'Dynamic Positioning' (DP) systems, with a suitable level of system redundancy.<br>• Full tow vessel position monitoring system verification prior to | Given the controls in place during each Bundle launch, the likelihood of a loss of control of a Bundle, and of a resulting chemical leak or spill and an impact to BCH, is considered negligible (refer Marine Emergency Response Plan (Attachment 3)).<br><br>Biological diversity and ecological integrity of BCH will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | leaving Bundle Parking area.<br>• Secondary tow vessel position keeping system in place for passage through Ningaloo Marine Park.<br>• Vessel Assurance Suitability Surveys conducted prior to commencement of operations.<br>• Notice to mariners supporting information issued prior to tow to inform local vessels of operations.<br>• Guard vessel to monitor/enforce exclusion zones.<br>• Each vessel operating in adherence to International Regulations for Preventing Collisions at Sea (COLREGs)<br>• Vessel intervention if required (as described in guard vessel procedure for engaging 3rd party vessels).<br>• Community engagement and announcements locally.<br>• Broadcasting on VHF as required.<br>• Visual monitoring of Bundle on surface (surface buoys and lights).<br>• Timing of Surface tow through Ningaloo Marine Park chosen to coincide with benign sea, tidal and weather conditions.<br>Measures to minimise:<br>• Bundle carrier pipe does not contain any hydrocarbons (filled with inert nitrogen gas plus solid corrosion inhibitors).<br>• Any chemical to be used within flow lines must have:<br>o An OCNS Hazard Quotient rating of Gold, Silver, E or D and have no substitution or product warning; or<br>o Further assessment is to be undertaken to ensure the environmental risk is ALARP. | |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• Each vessel equipped with a vessel specific Shipboard Oil Pollution Emergency Plan (SOPEP) or equivalent, and will follow response actions to incidental pollution in accordance with the vessel's emergency plan.<br>• Emergency Response Plan (Attachment 3). | |
| Indirect loss of BCH due to altered water flows and sediment movement as a result of the presence of the launchway | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>• Periodic bypassing of sand during launchway maintenance to limit sand accumulation to the north of the launchway and associated sand depletion to the south of the launchway.<br>Measures to rehabilitate:<br>• Management of onshore sediment accretion via monitoring and, when management triggers are exceeded, sand bypassing. | Due to its relatively small size and low elevation of the launchway relative to the seabed, the launchway is not expected to have any significant impact on the local wave or current conditions at or adjacent to the site.<br><br>Sediment accretion is predicted to occur adjacent to the north side of the launchway, across existing beach sands and across intertidal pavement reef habitat. This pavement reef habitat does not support any macroalgae or fauna, and the biological diversity and ecological integrity of BCH will not be affected.<br><br>Biological diversity and ecological integrity of BCH will be maintained.<br><br><u>Monitoring</u><br>The following monitoring is proposed:<br>• Survey of beach profiles adjacent to launchway |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | (annual).<br>• Inspections, including photographic monitoring of shoreline adjacent to launchway (annual).<br>• Shoreline mapping (every 3-6 years). |
| Impacts to BCH as a result of removal of the launchway | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Silt curtains deployed during turbidity generating construction activities (refer MCMMP).<br>• Suspension of turbidity-generating construction activity in the event elevated turbidity is recorded beyond the ZoMI (refer MCMMP).<br>Measures to rehabilitate:<br>• NA | No permanent impacts to BCH expected.<br>Elevated turbidity is expected to be limited to the immediate surrounds (<50 m) of the work site. Potential reversible impacts could occur as follows:<br>• Soft sediment 2.0 ha (< 0.1%) of mapped habitat.<br>Reef with macroalgae 2.5 ha (0.7%) of mapped habitat.Biological diversity and ecological integrity of BCH will be maintained. |

Table 5-8: Proposed Mitigation Measures and Predicted Outcome for BCH

### 5.1.8 Assessment of Residual Impacts to Biological Diversity and Ecological Integrity

In the context of this objective 'Ecological integrity' is the composition, structure, function, and processes of ecosystems, and the natural variation of these elements. The objective for this factor recognises that marine benthic communities are important components of almost all marine ecosystems, and are fundamental to the maintenance of ecological integrity and biological diversity of the marine environment as a whole.

As defined by the EPA, '*Ecosystem integrity is considered in terms of structure (e.g. the biodiversity, biomass and abundance of biota) and function (e.g. food chains and nutrient cycles)*' (EPA 2000). Habitat structure varies from the two-dimensional habitats of unvegetated soft sediment areas to the complex three-dimensional habitat available on reefs, with the latter offering more ecological 'niches' for colonisation by macroalgae and fauna. Habitat function includes the following:

- Primary production: a measure of the growth rates and therefore potential contribution to food webs of the main groups of aquatic plants on the seabed (benthic primary production).
- Secondary production: a measure of the growth rates of invertebrates.
- Water filtering capacity: a measure of the rate at which particulate organic matter (phytoplankton, zooplankton, detritus) in the water column is removed by filter-feeding organisms (e.g. bivalves, sponges, soft corals).
- Biogeochemical cycling: an estimate of the rate at which biologically significant materials (in this case nitrogen) are converted from inorganic forms into organic forms (nitrogen cycling by plants), or cycled within the sediments (e.g. as represented by the degree of sediment bioturbation by invertebrates, as this affects sediment oxygen levels that in turn affect nitrogen cycling within sediments).

For the assessment of the potential impacts to biological diversity and ecological integrity, the maximum cumulative impact to each habitat type under the 'realistic worst case' scenario has been considered. Where an impact to less than 1% of a particular BCH type is predicted within an LAU, it is considered that the risk of a significant impact to the biological diversity or ecological integrity within the LAU is unlikely. This is based on the previous guidance from the EPA that, for areas defined as 'High Protection Areas', which included areas recommended for inclusion in WA's marine reserve system (i.e. 'Wilson Report areas, CALM 1994), a cumulative loss threshold of 1% be applied. This guidance suggests that losses of less than 1% are considered unlikely to significantly affect the ecological integrity of the wider ecosystem.

Where a loss of more than 1% of a particular BCH type is predicted, further analysis of the potential impacts to biological diversity and ecological integrity has been undertaken. The following impacts to > 1% of a BCH type for each LAU are predicted, in order of impact:

- Heron Point LAU: Pavement reef (3.2%), Soft sediment with filter feeders (5.9%) and Soft sediment (1.6%).
- Offshore Operations Area (bottom tow) LAU: Soft sediment (15.6%).
- Parking area LAU: Soft sediment (11.3%).

The Pavement reef habitat was described as '*Unvegetated pavement reef within the upper littoral zone*' (Attachment 2B). Given the lack of macroalgae or fauna, likely due to the position of this habitat in the upper littoral zone and periodic smothering by beach sediment, the loss of this habitat will not result in an impact to biological diversity and ecological integrity.

The Soft sediment with filter feeders habitat was described as '*Soft sediment veneer overlying low relief reef. Sparse cover of filter feeders (sponges and soft corals)*' (Attachment 2B). Given the sparse nature of the fauna within this habitat, the habitat is not considered a key contributor to biological diversity or ecological integrity.

Within the Heron Point LAU, impacts to Soft sediment habitat occur as a result of the launchway footprint (0.2 ha) and due to periodic disturbance associated with the Bundle chain footprint (110.1 ha). The periodic (on average two, maximum of three per year) Bundle launches will result in physical disturbance of the top sediment layers. This may result in a minor, short-term displacement of infauna, although as no material is being removed, it is expected that the infauna community will remain relatively stable.

Within the Offshore Operations Area (bottom tow) LAU and the Parking area LAU, impacts to 1,338.5 ha and 367.2 ha, respectively, of Soft sediment habitat are predicted as a result of the Bundle chains. The periodic (on average two, maximum of three per year) Bundle launches will result in physical disturbance of the top sediment layers. This may result in a minor, short-term displacement of infauna, although as no material is being removed it is expected that the infauna community will remain relatively stable.

Infauna communities living in fine mobile deposits are characterised by large populations of a restricted variety of species that are well adapted to rapid recolonisation of deposits that are subject to frequent disturbance. Recolonisation of disturbed sediment is initially by 'opportunistic' species and the community is subsequently supplemented by an increased species variety of long-lived and slow-growing 'equilibrium' species that characterise stable undisturbed deposits. Recovery times following disturbance have been reported as shorter in warmer waters, but may be extended in colder waters at high latitudes where communities typically comprise large slow-growing species (Newell *et al*. 1998). It is generally understood that muddy or sandy sediment communities recover more quickly than coarser sediment communities (Ferns *et al*. 2000), which may take 2-3 years to recover from full removal, although this is not always the case (Dernie *et al*. 2003). Given the lack of physical removal of sediment, the muddy nature of the sediments and the tropical location of the site, the infauna communities are expected to recover rapidly, if indeed there is any impact. No impact to biological diversity and ecological integrity is expected as a result of the predicted impacts to soft sediment.

Overall the potential cumulative impacts to BCH are low and no impact to biological diversity and ecological integrity is predicted. The EPA objective '*to protect benthic communities and habitats so that biological diversity and ecological integrity are maintained*' will be met.

## 5.2 KEY ENVIRONMENTAL FACTOR 2 – COASTAL PROCESSES

### 5.2.1 EPA Objective

To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.

### 5.2.2 Policy and Guidance

Subsea 7 has taken into consideration relevant policy and guidance in the design of the Proposal, completion of the environmental impact assessment and through the development of this ERD.

A summary of the policy and guidance relevant to Coastal Processes, and how Subsea 7 has considered these, is presented in Table 5-9.

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Statement of Environmental Principles, Factors and Objectives (EPA 2016c, 2018c) | Referred to in the identification and assessment of Preliminary Key Environmental Factors. |
| Environmental Factor Guideline – Coastal Processes (EPA 2016f) | This guidance was consulted in the consideration of potential impacts to geophysical processes and how these may impact natural coastal dynamics causing an impact to coastal ecosystems and associated values such as landforms, recreation and tourism. Consideration of this factor in the context of climate change was also completed. |
| State Planning Policy No. 2.6 – State Coastal Planning Policy (WA Planning Commission 2006) | This policy was consulted in the assessment of potential impacts to coastal processes. |
| Sea Level Change in Western Australia – Application of Coastal Planning (Department of Transport 2010) | This document was consulted in the assessment of potential impacts to coastal processes under future sea level scenarios. |
| WA Environmental Offsets Policy (Government of Western Australia 2011) | These policies were considered as part of the determination of the need for offsets. |
| WA Environmental Offsets Guidelines (Government of Western Australia 2014) | |
| Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPAC 2012a) | |

Table 5-9: Policy and Guidance Relevant to Coastal Processes

### 5.2.3 Receiving Environment

A number of marine studies have been undertaken within the region, as outlined in Table 5-10. Subsea 7 has augmented the information from previous studies by commissioning additional, Proposal-specific studies, to ensure an appropriate level of information is available to support completion of the environmental impact assessment and development of environmental management plans.

The Proposal-specific studies, as listed in Table 5-10, were undertaken by various technical specialists, and are included in full within Attachment 2. They are also referred to, as appropriate, in the assessment of potential impacts and proposed management measures.

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| Regional Studies | | |
| 2012 | Eliot *et al*. (Damara WA Pty Ltd) and Geological Survey of Western Australia | The Coast of the Shires of Shark Bay to Exmouth, Gascoyne, Western Australia: Geology, Geomorphology & Vulnerability |
| Project-specific Studies | | |
| 2017 | MP Rogers | Subsea 7 Bundle Facility Shoreline Movement Assessment |
| 2017 | 360 Environmental | Learmonth Habitat Surveys |
| 2017 | GHD | WA Bundle Fabrication Facility – Site Designs. Design Report (Drainage & Coastal Engineering) |
| 2018 | MP Rogers | Subsea 7 Bundle Facility Coastal Processes Assessment |

Table 5-10: Overview of Local and Regional Coastal Processes Studies

Limited regional studies have been conducted within Exmouth Gulf. Eliot *et al*. (2012) described the Exmouth Gulf region's susceptibility to change and landform instability as low. This was concluded from the following regional attributes including:

- Partial sheltering from swell.
- Presence of subtidal terraces and rocky features.
- Sheltered beach faces.
- Perching of beaches on inshore rock and moderately stable foredunes.

Several project-specific studies, conducted by MP Rogers, 360 Environmental, and GHD, have been carried out to provide further information for the Development Envelope.

A shoreline movement assessment was undertaken by MP Rogers (2017) (Attachment 2D) evaluating the sediment transport regimes and erosion patterns adjacent to the Learmonth Jetty over the past 60-70 years. This jetty provides a useful case study for what could be expected adjacent to the proposed Bundle launchway, given the similarities in exposure, aspect, and nearshore bathymetry.

The shoreline movement assessment for the Learmonth Jetty site shows a degree of change in the adjacent shoreline between 1949 and 2013. The shoreline adjacent to the northern side of the jetty abutment has averaged 70-100 m of accretion, measured as a seaward movement in shoreline position, of over a 800 m length of shoreline, while the average accretion on the southern side was in the order of 20 m over 700 m. The assessment concluded that although some impediment to longshore sediment transport does occur, there has been no net erosion over the long-term (Attachment 2D). However, short-term erosion of the southern shoreline occurred for a period of years after construction of the jetty with erosion peaking in 1968. The erosion extent during this time may have peaked at 40 m in certain areas.

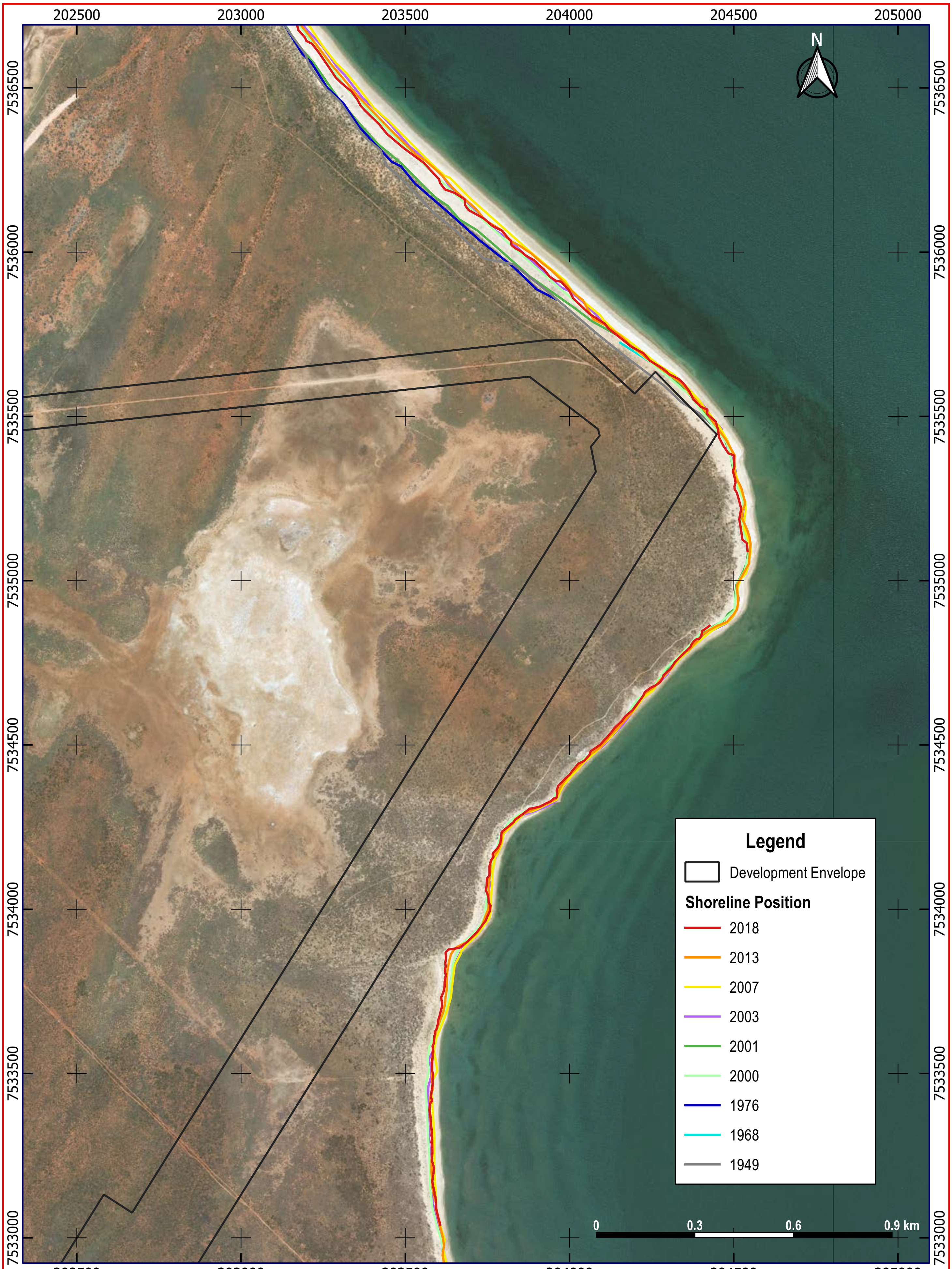
The main findings from the shoreline movement assessment were:

- A varying degree of fluctuation in the shoreline position, with an overall net accretion trend.
- A long-term accretion trend between 1949 – 2001, with an average net accretion of 30 m.
- A predominately medium grain sand shoreline, with median grain sizes ranging from 0.15 to 0.5 mm (diameter). Due to the sandy nature of these materials, longshore transport processes would be expected along these shorelines, however small sediment transport quantities are predicted as a result of the calm nature of the site.

Of note, the total net accretion average of 30 m may be influenced by the ephemeral vegetation during a calm period when the 2013 aerial imagery was taken. Discounting the 2013 shoreline position, the average net accretion from 1949-2001 was approximately 20 m (Attachment 2D).

A subsequent study was completed to improve the understanding of existing coastal dynamics so that potential impacts of the Proposal could be assessed with greater certainty, and to inform the development of appropriate monitoring and management measures (M P Rogers 2019; Attachment 2E). Shoreline movement plans show that the shoreline north of the launchway site has experienced accretion over the period between 1949 and 2018, although this overall trend has been interspersed with periods of apparent erosion (Figure 5-13). The most significant accretion appears to have occurred between 1976 and the early 2000s. Thereafter the shoreline has appeared to erode slightly. South of the launchway site the shoreline has experienced far less movement, although available aerial imagery in these areas generally only extends back to 2000. The limited movement of the shoreline south of the launchway site may be attributable to the extent of visible rock in this area (Attachment 2E). For the shoreline at the launchway site there is potential for both northerly and southerly sediment transport to occur due to the difference in wave exposure angle that is possible. For the shoreline south of Heron Point it is expected that sediment could only be transported in a southerly direction, since there is insufficient fetch length from the south west to generate any significant transport of sediment in a northerly direction.

Seasonal, inter-annual and episodic changes in the shoreline position have not been specifically studied. While such shorter-term variations may occur, particularly following the passage of a cyclone, the longer-term record demonstrates that any such changes are relatively short lived, with the shoreline position returning to its ambient state (Attachment 2E).

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Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from MP Rogers (2017).

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Figure 5-13: Longterm Changes in Shoreline Position Adjacent to Heron Point (1949-2018)

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#### 5.2.4 Potential Impacts

Development of the proposed Bundle site launchway has potential to directly and indirectly impact coastal processes within the immediate and surrounding areas at Heron Point during operations and closure. Table 5-11 summarises the potential impacts during each project phase.

| Project Phase | Potential Impact |
|---|---|
| Operations | Direct impact to sediment transport leading to seabed, beach or dune erosion on downdrift side of launchway |
| | Indirect impacts to coastal morphology by altered wave climate, water flows and sediment movement as a result of the presence of the launchway |
| | Altered wave overwash and drainage due to launchway leads to dune instability during extreme flooding events |
| Closure | Permanent change altering water flows and sediment movement as a result of the presence of the launchway |

Table 5-11: Potential impacts to Coastal Processes

#### 5.2.5 Potential Cumulative Impacts

Several third party projects or proposals (refer Section 2.5.8) have resulted in, or have the potential to result in, impacts to coastal processes within Exmouth Gulf. However, such impacts would be restricted to the immediate vicinity of the coastal infrastructure, and no third party project or proposal is situated in proximity to the Development Envelope (Figure 2-15). Cumulative impacts to coastal processes as a result of the Proposal, and a third party project or proposal, are considered unlikely.

#### 5.2.6 Assessment of Impacts

##### 5.2.6.1 Direct Impact to Sediment Transport Leading to Seabed, Beach or Dune Erosion on Downdrift Side of Launchway

Previous investigations have determined that the sediment transport along this section of the coastline is predominately from north to south. There will be periods where this trend may reverse, most likely associated with the passage of tropical cyclones; however, over the longer-term an accretion on the northern side of the launchway would be expected (Attachment 2E). It is anticipated that sediment transport over the launchway would be limited until such time as the beach has accreted to the point that the beach berm roughly aligns with the top of the rail. Once this occurs sediment would begin to be transported over the structure during high water level and wave conditions. Once sediment begins to be transported past the structure, the rate of beach accretion on the northern side would slow. It would be expected that the beach would continue to accrete until such time as the shoreline on the northern side is sufficiently advanced that the sediment will transport past the launchway at the same rate as it is transported into the area (Attachment 2E). The area of potential 'worst case' sediment accretion is shown in Figure 5-14.

Sediment deposition on the northern side of the launchway would temporarily impact the quantity of sediment available to the south. However, the response of the southern shoreline will be limited by the presence of rock on Heron Point and along the shoreline further south. Due to the presence of this rock, limited changes to the shoreline are expected to the south of the launchway (Attachment 2E). Any changes that do occur are likely to be limited to a narrowing or possible loss of the small perched beach formations that exist seaward of the onshore rock platforms and bluffs (Attachment 2E). The area of potential 'worst case' sediment erosion is shown in Figure 5-14.

The assessment of alternative 'best' and 'most likely' cases is presented in Table 6.1 of Attachment 2E.

It is anticipated that average sand bypassing rates of 2,500 to 5,000 $m^3$/year could be required, though this could vary depending on prevailing weather conditions. In the event that any erosion, attributable to the construction of the launchway, causes recession of the vegetation line by > 5 m then sand bypassing will be initiated.

#### 5.2.6.2 Indirect Impacts to Coastal Morphology by Altered Wave Climate, Water Flows, and Sediment Movement as a Result of the Presence of the Launchway

Due to the relatively small size and low elevation of the launchway, it is not expected to have any significant impact on the local wave or current conditions at or adjacent to the site (Attachment 2E). Thus no significant indirect impacts to coastal morphology as a result of altered wave climate, water flows and sediment movement, following launchway construction, are expected.

#### 5.2.6.3 Altered Wave Overwash and Drainage due to Launchway leads to Dune Instability during Extreme Flooding Events

The construction of the launchway will necessitate a cut through the dune system. The construction of the launchway will reduce the elevation of the coastal dune in this area from approximately 5 mAHD down to an elevation of around 2.5 mAHD at the foundation level. Such a reduction in the elevation could result in a localised increase in erosion risk and inundation vulnerability to the land side of the dune.

Wapet Creek and the connection of this system to the salt flats inland from the site already provide an avenue for ingress of seawater during extreme events. It is expected that this area would be at least partially inundated prior to any breach of the launchway cut. Nevertheless, for more severe events, or those that cause more rapid fluctuations in sea level, the ingress of seawater through the launchway cut could occur, potentially resulting in scour of the adjoining area (Attachment 2E). Such an event might be associated with the nearby passage of a cyclone.

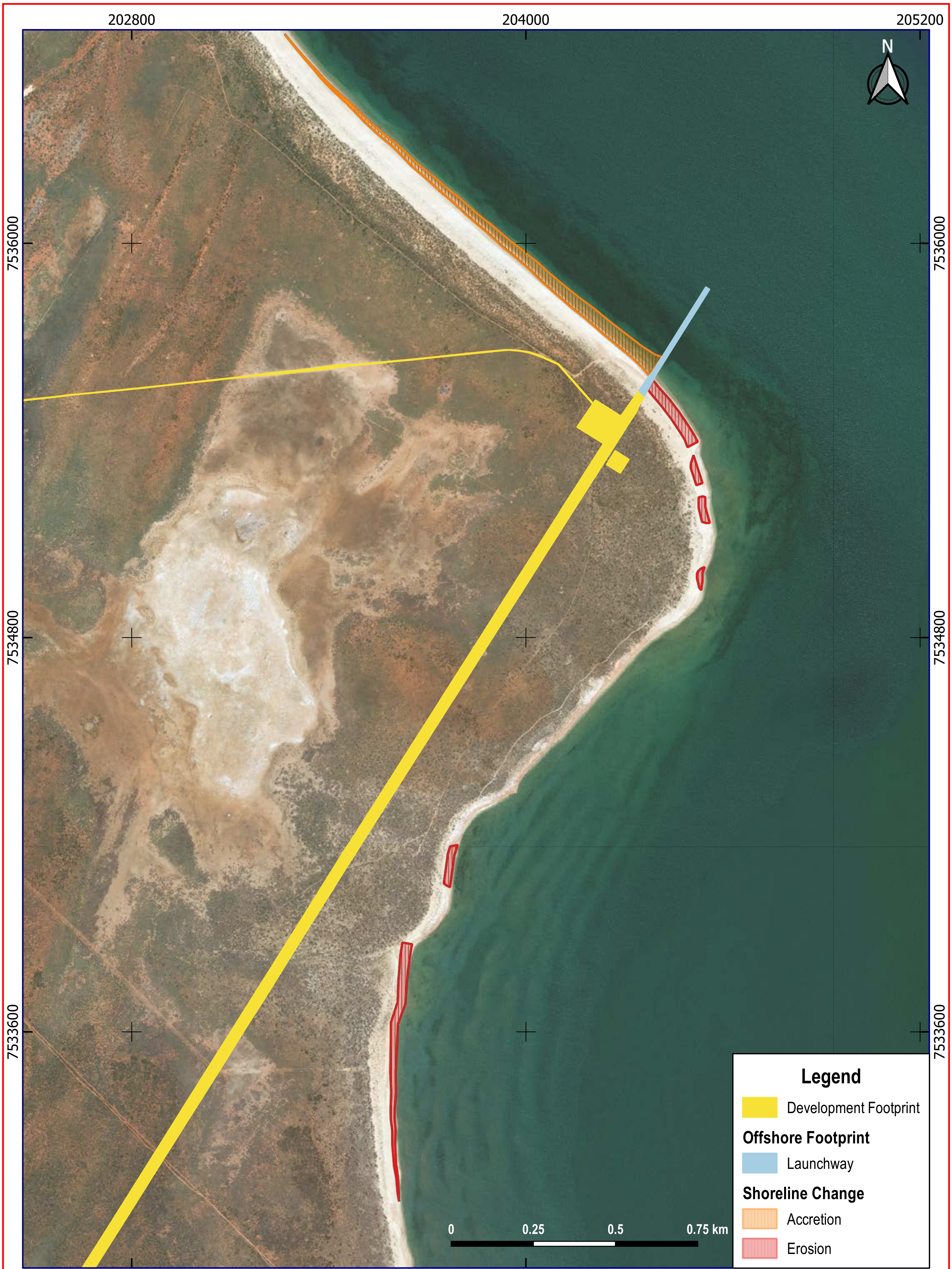
Following any event that causes significant re-profiling of the dune system, the dune structure would be reinstated and the cut embankments stabilised. This reinstatement will be stabilised to an appropriate standard to prevent wind generated sediment transport and would match the shape and structure of the adjacent, non-impacted, dunes.

#### 5.2.6.4 Permanent Change to Water Flows and Sediment Movement as a Result of the Presence of the Launchway

At the end of the service life of the facility, decommissioning will be completed including full removal of the launchway. The dune system will also be reinstated to match the shape and structure of the adjacent dunes. Thus a permanent change to water flows and sediment movement will not occur.

Upon decommissioning of the facility it is anticipated that the shoreline would realign (revert to pre-construction state) following removal of the launchway. This realignment would likely result in some erosion of accumulated sediment to the north of the launchway location, where accretion has occurred in response to the presence of the structure.

Concurrent sediment accretion along the southern shoreline would occur as the sediment is transported southwards (Attachment 2E). It is anticipated that such changes would occur over a relatively short duration (months).




Scale: 1:15000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from MP Rogers (2019)

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Figure 5-14: Potential Changes in Sediment Transport Adjacent to the Bundle Launchway

### 5.2.7 Mitigation, Management, and Predicted Outcome

The proposed mitigation measures to address potential impacts to coastal processes as a result of the Proposal, the predicted outcome, and monitoring (where proposed to verify the outcome) are provided in Table 5-12.

Overall the changes to coastal processes will be localised and minimal and the EPA objective '*to maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected*' will be met.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Direct impact to sediment transport leading to seabed, beach or dune erosion on downdrift side of launchway | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>• Periodic bypassing of sand during launchway maintenance to limit sand accumulation to the north of the launchway and associated sand depletion to the south of the launchway.<br>Measures to rehabilitate:<br>• Management of onshore sediment accretion (north of launchway) and depletion (south of launchway) via monitoring and sand bypassing.<br>Note: Governance Arrangements<br>During construction and operations, Subsea 7 will be responsible for the implementation of the nominated monitoring and mitigation measures.<br><br>For three years post closure Subsea 7 will be responsible for the implementation of the nominated monitoring and mitigation measures. After this time, if the monitoring of shoreline position demonstrates a stable shoreline (in comparison to adjacent unimpacted sections of shoreline), Subsea 7's monitoring and mitigation commitments will cease. | It is predicted that sand would accumulate along the northern side of the launchway, above the low tide mark, until sediment on the beach berm starts to move across the structure. Due to the temporary reduction in sand migrating to the shoreline to the south, some narrowing or possible loss of the small perched beach formations to the south of the launchway could occur.<br><br>Given the relatively slow rates of sediment transport, the proposed monitoring program, and the implementation of sand bypassing in the event that trigger values are exceeded, the geophysical processes that shape coastal morphology will be maintained so that the environmental values of the coast are protected.<br><br>Monitoring<br>The following monitoring is proposed:<br>• Survey of beach profiles adjacent to launchway (annual).<br>• Inspections, including photographic monitoring of shoreline adjacent to |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | launchway (annual).<br>• Shoreline mapping (every 3-6 years). |
| Indirect impacts to coastal morphology by altered wave climate, water flows and sediment movement as a result of the presence of the launchway | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>• Periodic bypassing of sand during launchway maintenance to limit sand accumulation to the north of the launchway and associated sand depletion to the south of the launchway.<br>Measures to rehabilitate:<br>• Management of onshore sediment accretion (north of launchway) and depletion (south of launchway) via monitoring and sand bypassing.<br>• Removal of the launchway at the end of the project life. | Due to its relatively small size and low elevation of the launchway relative to the seabed, the launchway is not expected to have any significant impact on the local wave or current conditions. Thus no significant indirect impacts to coastal morphology as a result of altered wave climate, water flows and sediment movement following launchway construction are expected.<br><br>The geophysical processes that shape coastal morphology will be maintained so that the environmental values of the coast are protected.<br><br><u>Monitoring</u><br>The following monitoring is proposed:<br>• Survey of beach profiles adjacent to launchway (annual).<br>• Inspections, including photographic monitoring of shoreline adjacent to launchway (annual). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | • Shoreline mapping (every 3-6 years). |
| Altered wave overwash and drainage due to launchway leads to dune instability during extreme flooding events | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>• Stabilisation of cut embankments.<br>Measures to rehabilitate:<br>• Management of onshore sediment accretion via monitoring and sand bypassing.<br>• Reinstatement of the dune following any significant re-profiling following an extreme weather event. | The construction of the launchway will necessitate a cut through the dune system. The construction of the launchway will reduce the elevation of the coastal dune in this area from approximately 5 mAHD down to an elevation of around 2.5 mAHD at the foundation level. Such a reduction in the elevation could result in a localised increase in erosion risk and inundation vulnerability. For more severe events, or those that cause more rapid fluctuations in sea level, the ingress of seawater through the launchway cut could occur, potentially resulting in scour of the adjoining area.<br><br>With the commitment to reinstate the dune structure following any significant re-profiling of the dune system, it is considered that the environmental values of the coast will be protected.<br><br><u>Monitoring</u><br>Inspections, including photographic monitoring, of the shoreline and dunes adjacent to the launchway will be undertaken annually. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Permanent change to water flows and sediment movement as a result of the presence of the launchway post closure | Measures to avoid:<br>• Full removal of the launchway will occur. | At the end of the service life of the facility, decommissioning will be completed including full removal of the launchway and reinstatement of the dune system will occur.<br><br>The geophysical processes that shape coastal morphology will be maintained so that the environmental values of the coast are protected.<br><br>Monitoring<br>Annual monitoring of the shoreline position for a period of three years to monitor recovery of pre-development beach alignment. |

Table 5-12: Proposed Mitigation Measures and Predicted Outcome for Coastal Processes

## 5.3 KEY ENVIRONMENTAL FACTOR 3 – MARINE ENVIRONMENTAL QUALITY

### 5.3.1 EPA Objective

To maintain the quality of water, sediment and biota so that environmental values are protected.

### 5.3.2 Policy and Guidance

Subsea 7 has taken into consideration relevant policy and guidance in the design of the Proposal, completion of the environmental impact assessment and through the development of this ERD.

A summary of the policy and guidance relevant to marine environmental quality, and how Subsea 7 has considered these, is presented in Table 5-13.

| Policy / Guidance | Consideration for Proposal |
|---|---|
| Statement of Environmental Principles, Factors and Objectives (EPA 2016c, 2018c, 2019) | Referred to in the identification and assessment of Preliminary Key Environmental Factors |
| Environmental Factor Guideline – Marine Environmental Quality (EPA 2016g) | Referred to in the assessment of potential impacts to marine water quality as a result of the Proposal |
| Technical Guidance – Protecting the quality of Western Australia's marine environment (EPA 2016h) | Referred to in the identification of the relevant environmental values and environmental quality objectives for the waters of Exmouth Gulf and in the assessment of potential impacts to marine environmental quality |
| Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives (DoE 2006) | Referred to in the identification of the relevant environmental values and environmental quality objectives for the waters of Exmouth Gulf |
| Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005 – 2015 (MPRA and CALM 2005) | This management plan was reviewed during assessment of potential impacts on marine environmental quality within the Ningaloo Marine Park and Muiron Islands Marine Management Area, and in the development of management measures |

Table 5-13: Policy and Guidance Relevant to Marine Environmental Quality

The 'Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives' (DoE 2006) recommends the Levels of Ecological Protection (LEPs), Environmental Values (EVs) and Environmental Quality Objectives (EQOs) for Pilbara waters, including Exmouth Gulf (Table 5-14).

| Environmental Values | Environmental Quality Objectives (EQOs) |
|---|---|
| Ecosystem Health (ecological value) | EQO1:<br>Maintain ecosystem integrity at a:<br>• Maximum level of ecological protection.<br>• High level of ecological protection.<br>• Moderate level of ecological protection.<br>• Low level of ecological protection.<br>This means maintaining the structure (e.g. the variety and quantity of life forms) and functions (e.g. the food chains and nutrient cycles) of marine ecosystems. |
| Fishing and Aquaculture (social use value) | EQO2: Seafood (caught or grown) is of a quality safe for eating<br><br>EQO3: Water quality is suitable for aquaculture purposes. |
| Recreation and Aesthetics (social use value) | EQO4: Water quality is safe for primary contact recreation (e.g. swimming and diving)<br><br>EQO5: Water quality is safe for secondary contact recreation (e.g. fishing and boating)<br><br>EQO6: Aesthetic values of the marine environment are maintained |
| Cultural and Spiritual (social use value) | EQO7: Cultural and spiritual values of the marine environment are protected. |

Table 5-14: Environmental Values and Environmental Quality Objectives for the Marine Waters of Exmouth Gulf

### 5.3.3 Receiving Environment

A number of marine studies have previously been undertaken within the region, as outlined in Table 5-15. Subsea 7 has augmented the information from these previous studies by commissioning additional, Proposal-specific studies, to ensure an appropriate level of information is available to support completion of the environmental impact assessment and development of environmental management plans.

The Proposal-specific studies, as listed in Table 5-15, were undertaken by various technical specialists, and are included in full within Attachment 2. They are also referred to, as appropriate, in the assessment of potential impacts and proposed management measures.

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| Regional Studies | | |
| 2000 | Department of Fisheries (Pearce *et al.*) | Review of productivity levels of Western Australian coastal and estuarine waters for mariculture planning purposes. |
| 2001 | Brunskill *et al.* | Geochemistry and particle size of surface sediments of Exmouth Gulf, North West Shelf, Australia. |
| 2006 | Department of Environment | Background water quality of the marine |

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| | and Conservation | sediments of the Pilbara coast. |
| 2006 | Oceanica | Yannarie Salt Project: Marine and coastal environment of the eastern Exmouth Gulf. |
| 2006 | Wenziker *et al*. | Background quality for coastal marine waters of the North West Shelf, Western Australia. |
| 2014 | IMOS | West Australian Integrated Marine Observing System (WAIMOS) Node Science and Implementation Plan 2015-25. |
| 2016 | Vanderklift *et al*. | Western Australian Marine Science Institution (WAMSI) Dredging Science Node Project 5.3. |
| Project-specific Studies | | |
| 2017 | 360 Environmental | Baseline Water and Sediment Quality Assessment. |
| 2018 | GHD | Exmouth Gulf Current Monitoring Field Report. |

Table 5-15: Overview of Local and Regional Marine Environmental Quality Studies

The Exmouth Gulf region has a limited number of studies carried out characterising the water and sediment quality. Therefore, along with the limited assessments undertaken within the region, general water and sediment quality documents have been reviewed and applied to the context of the Exmouth Gulf region.

Previous regional studies have characterised Exmouth Gulf as having a naturally turbid state due to wind, waves and tidal currents causing resuspension of the fine sediments found throughout the gulf. Primary productivity within the region from phytoplankton biomass is relatively low and is limited by the availability of nitrogen within the system. Water temperatures range from 18° to 30°C (tropical) depending on season, with salinity ranges similar to oceanic measurements (34 to 36 PSU).

A sediment quality survey to determine background concentrations of a range of selected heavy metals and organic chemicals in the Pilbara marine waters from Exmouth Gulf to Port Hedland found the sediments from five sites within Exmouth Gulf to exhibit relatively low levels of contaminants (DEC 2006), as follows:

- Arsenic (7-19 mg/kg).
- Cobalt (0.5-27 mg/kg).
- Copper (0.5-2.1 mg/kg).
- Nickel (1.0-4.8 mg/kg).
- Lead (<1-3 mg/kg).
- Zinc (1.2-9.8 mg/kg).

The differences between sites were predominantly driven by the sediment particle size, with contaminants known to bind to fine (<63 µm) particles. The percentage of fines recorded within the samples varied from 0.5 to 11.3% (DEC 2006).

360 Environmental (2017b) conducted a water and sediment quality assessment for the Proposal. The main findings of the assessment were:

- The physical parameters (temperature, salinity, and dissolved oxygen) were typical of the north western Australian coastline. No significant variation was observed vertically throughout the water column, except for measurements of higher turbidity nearer to the seabed.

- Turbidity was recorded to increase with distance from the shoreline (ranging from 1.1 to 2.4 NTU). This was attributed to the change in sediment composition with offshore locations characterised by a greater proportion of fine sediments (mud and sand). Even with this increased turbidity offshore, the levels of light attenuation fell well within regional measurements for the Exmouth Gulf.
- Consistent with results of previous regional studies, the total and dissolved nutrients within the gulf are limited and not readily available for benthic primary producers (BPP), but this may be due to them being utilised prior to measurements being taken. The chlorophyll and overall nutrient content measured was consistent within the regional and local context of the gulf area.
- Sediment within Exmouth Gulf was found to increase in fine sand proportion with increasing distance offshore.
- There was no indication of contamination within the study area, and therefore it was concluded that the likelihood of contaminant release from sediment disturbance was low.
- Short-term disturbances were concluded likely to have minimal impact on the local and regional environmental values (ecological and social).

A recent ocean current monitoring programme was completed by GHD (2018a) within Exmouth Gulf for the Proposal. The monitoring period included two full tidal cycles (22 May to 21 June 2018) and comprised two deployment locations. Additional instrumentation was deployed with the current monitoring equipment to record turbidity and photosynthetic available radiation (PAR) data. The average turbidity recorded at the launchway location was 4.3 NTU (or 3.6 if the storm of 5 June 2018 was excluded from the dataset) (Figure 5-15). The average turbidity recorded in the vicinity of the Bundle Parking area was 3.6 NTU (Figure 5-15). Generally there was a slight trend of increasing turbidity through the spring tidal cycle, although numerous short-term variations in turbidity were superimposed over this trend. There was no clear trend between wave height measured at the launchway location and turbidity.

Additional turbidity measurements were made in November/December 2018, at a site 2 km offshore along the tow route (site KP2) and at a site 4.5 km offshore along the tow route (site KP4.5). Numerous short-term turbidity peaks were recorded at up to approximately 30 NTU (Figure 5-16). Turbidities of above 10 NTU were recorded for longer durations (Figure 5-16).

A comprehensive analysis of the water quality data was completed, with observed turbidity peaks compared to available wave, wind and tidal data. No clear trend against any of these datasets was found. It is likely that the occurrences of elevated turbidity are related to a number of factors, including wind speed and direction, tidal state (both range and state during periods of strong wind) and potentially adjacent prawn trawling activity. It has been suggested, anecdotally, that elevated turbidity can occur a few days following the peak of a spring tide cycle, though such a trend was not clearly apparent from the available data.

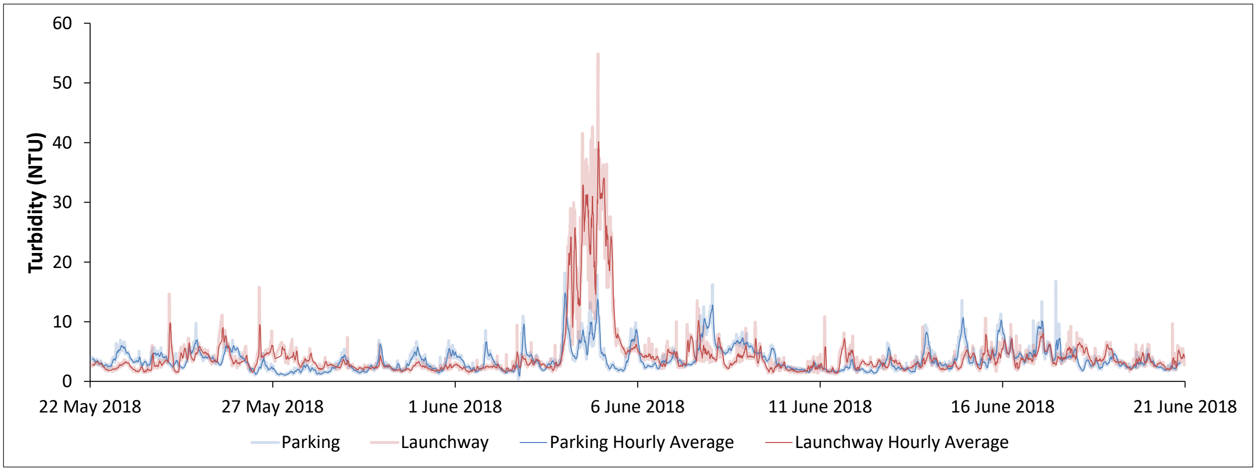



Figure 5-15: Background Turbidity within Exmouth Gulf (May/June 2018)

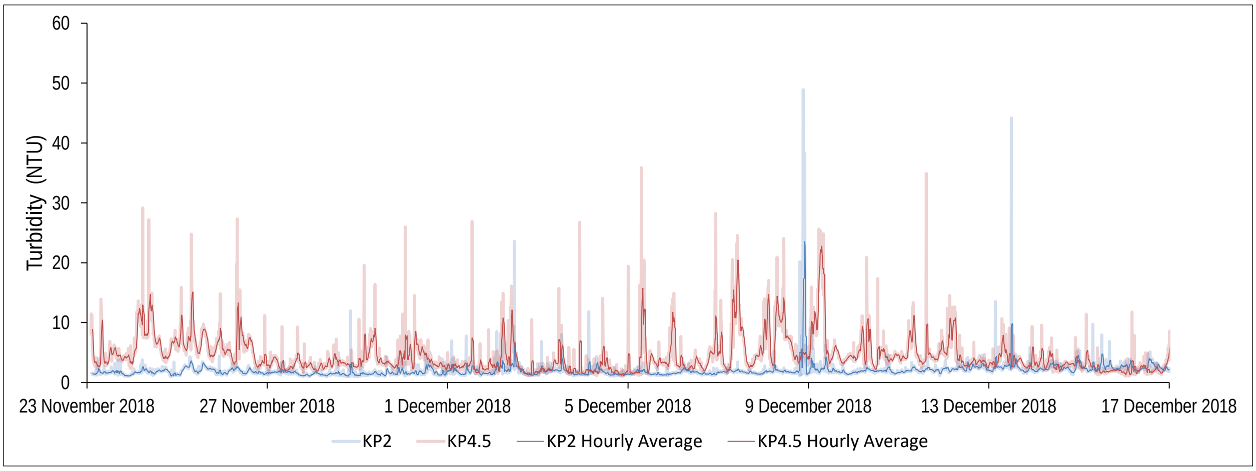



Figure 5-16: Background Turbidity within Exmouth Gulf (November/December 2018)

### 5.3.4 Potential Impacts

The construction and operation of the Proposal has the potential to directly and indirectly impact the marine environmental quality within the immediate and surrounding areas. Table 5-16 summarises the potential impacts during each project phase.

| Project Phase | Potential Impact |
|---|---|
| Construction | Temporary impacts to water quality through release of fines, nutrients or contaminants from sediments during launchway construction |
| | Temporary impacts to water quality (turbidity) due to release of fines from launchway construction materials (quarry rock) |
| Operations | Temporary impacts to water quality during Bundle launch and tow due to chains on the seabed |
| | Impacts to water and/or sediment quality in the event of a loss of control of the Bundle or support vessel (e.g. from a chemical spill) |

Table 5-16: Potential Impacts to Marine Environmental Quality

### 5.3.5 Potential Cumulative Impacts

Several third party projects or proposals (refer Section 2.5.8) have resulted in, or have the potential to result in, impacts to marine environmental quality within Exmouth Gulf. To date the Exmouth Marina and several mariculture operations have resulted in a reduced level of ecological protection being applied in the immediate vicinity of these projects (Figure 2-11). Cumulative impacts to marine environmental quality are addressed in Section 5.3.6.5.

### 5.3.6 Assessment of Impacts

#### 5.3.6.1 Temporary Impacts to Water Quality through the Release of Fines, Nutrients or Contaminants from Sediments during Launchway Construction

During construction the following sequence of activities is expected:

- Excavate sand on land including the area through the sand dunes.
- Excavate or compact sand on the beach.
- Progressively construct the launchway from the landward extent to the seaward extent, by repeating the following steps:
    - Place rock fill.
    - Place concrete panels.
    - Place concrete mattress or rock armour.

Rock fill will be placed from the shoreline, being pushed seaward down the onshore end of the launchway. For the offshore end of the launchway, the rock fill will be placed from a barge. Sediment may be resuspended as a result of:

- Disturbance of the seabed in areas of soft sediment (i.e. when the rock fill material makes contact with the seafloor and displaces superficial material).
- Disturbance of the seabed by construction equipment, including when an approximately 300 mm layer of sediment is removed from the last 24 m length of the launchway footprint.

The Bundle launchway construction will take up to six months, during which periodic, local, impacts to water quality will occur. A single daylight shift is proposed during launchway construction, so any sediment resuspended during a shift will be likely to dissipate prior to the commencement of the next shift.

The naturally low nutrient and contaminant status of sediments within the launchway and adjacent areas means that release of nutrients or contaminants from sediments during launchway construction, in concentrations above naturally occurring levels, is unlikely. Elevated TSS concentrations are expected in the immediate vicinity of the launchway during the construction period, with the area within 50 m of the launchway footprint nominated as a ZoMI (refer Section 5.1.6.4), due to potential impacts on benthic organisms (recoverable within a period of five years following completion of construction).

EPA guidance (EPA 2016h) states that '*in cases where 'short-term' non-compliance with an EQO or level of ecological protection over a 'small' area is predicted and appears to be unavoidable, proponents could consider proposing temporary exclusion of an EQO or lower level of ecological protection for the small area…….'* and '*When determining the acceptability of such a proposal the EPA would consider the nature and reversibility of the effects, the spatial extent of the impact, timeframes for recovery and any other relevant matters.*'

Based on the approach adopted for other capital works programmes, it is proposed that the ZoMI remain as a maximum ecological protection area. As such, no ongoing impacts to ecosystem processes, biodiversity, abundance, and biomass of marine life, water or sediment quality are acceptable. Given the period of construction is short (six months) and the low concentrations of naturally occurring nutrients and other contaminants in sediments, it is considered unlikely there would be any significant adverse impact to marine environmental quality over the longer-term. Based on the predicted severity and duration of the elevated TSS concentrations, no persistent impacts to ecosystem processes, biodiversity, abundance and biomass of marine life are expected. The environmental quality objective, to maintain ecosystem integrity, will be met.

Refer to the Marine Construction Monitoring and Management Plan (MCMMP) and Environmental Quality Plan (EQP) in Attachment 3.

#### 5.3.6.2 Temporary Impacts to Water Quality (Turbidity) due to Release of Fines from Construction Materials (Quarry Rock)

Rock fill will be placed from the shoreline, being pushed seaward down the onshore end of the launchway. For the offshore end of the launchway, rock fill will be placed from a barge.

Any rock 'fines' contained within the rock fill, or generated as the fill is placed and rocks come into contact with each other, could mix with the surrounding seawater and create localised turbidity. Such turbidity is likely to be minimal given that screened hard rock will be used as the rock fill material. Hard rock or concrete mattress will be used for the armour and pre-cast concrete panels will be used for the main structure of the launchway.

The likelihood of increased turbidity during construction resulting from construction materials is considered insignificant relative to turbidity generated by re-suspension of *in situ* sediments during launchway construction. Refer to the Marine Construction Monitoring and Management Plan (MCMMP) and Environmental Quality Plan (EQP) in Attachment 3.

#### 5.3.6.3 Temporary Impacts to Water Quality during Bundle Launch and Tow due to Chains on Seabed

It is expected that chains, suspended at regular intervals along the Bundle to assist in stability and towing, will contact the seabed along the tow route out to the Bundle Parking area. Thus a degree of seabed (soft sediment) disturbance is expected along the length of the tow route from the launchway up to the northern extent of the Bundle Parking area.

Subsea 7 undertook a field study to quantify site-specific sediment characteristics and behaviour to define sediment source terms for utilisation in sediment fate modelling. These terms include the sediment flux rate, particle-size distribution (PSD) and vertical distribution of suspended sediments that are likely to be generated by the chains disturbing the local seabed environment. The accurate definition of these source terms is critical to production of an accurate sediment dispersion model. The field experiment was undertaken involving towing of a single chain (76 mm diameter with a chain link length of 304 mm as will be attached to each Bundle) along the seabed off Heron Point, in proximity of the path to be followed during proposed future Bundle launches. A range of environmental data were collected through the deployment of turbidity loggers, capture of multiple vertical turbidity profiles (sea surface to seabed), collection of multiple near-seabed water samples and collection of benthic grab samples of sediment within the vicinity of the trial. No elevated turbidity was visible at the sea surface during the trial. Turbidity levels of up to 10 NTU were recorded at 1 m off the seabed. TSS loads of 2 mg/L to 30 mg/L were recorded, with the resuspended sediments dominated by silts (2-63 µm diameter).

Sediment fate modelling was completed to predict the magnitude and extent of turbidity generated during a Bundle launch and tow (refer Section 5.1.6.6).

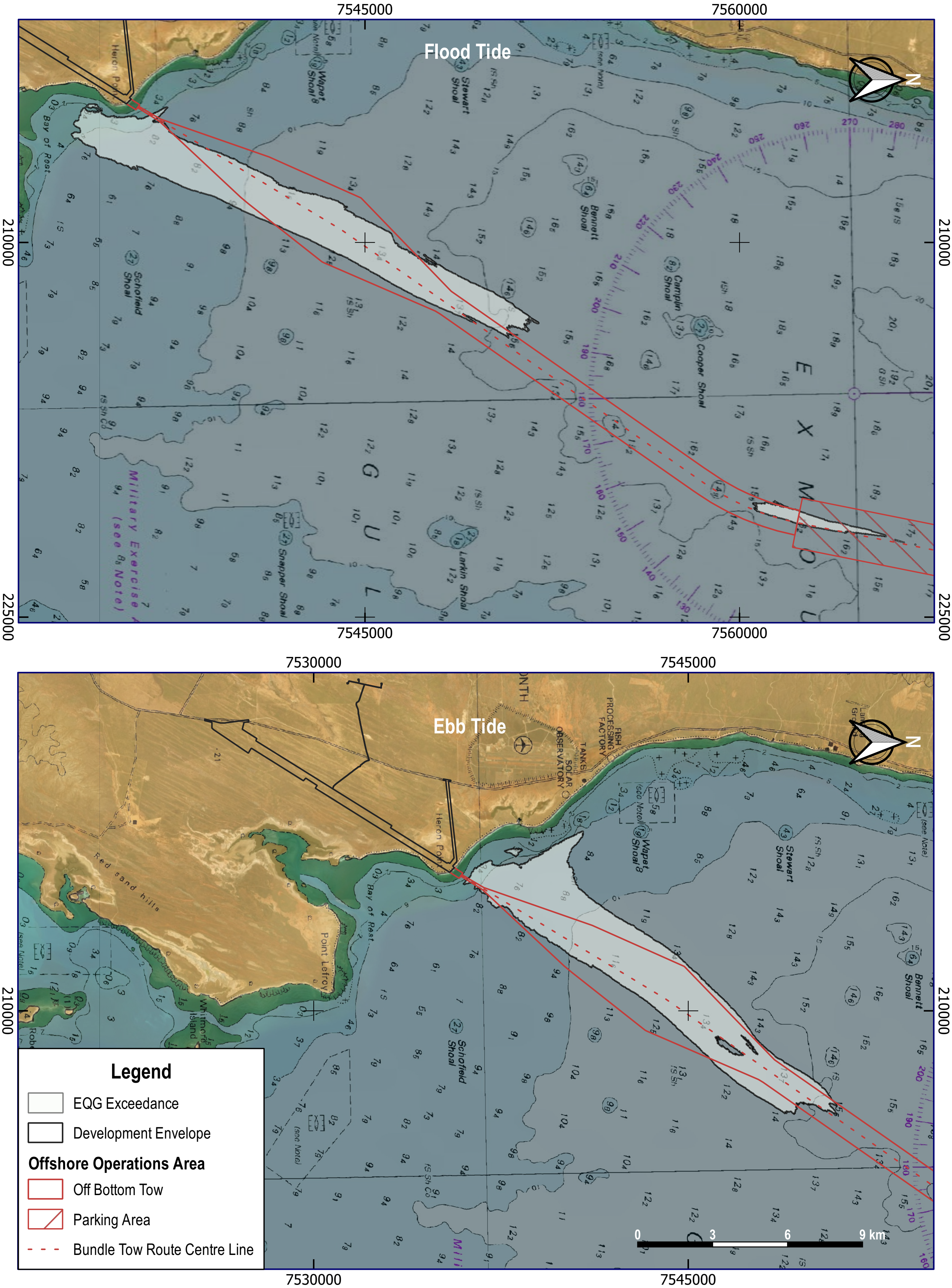
For most environmental quality indicators, the approach adopted for comparing monitoring data with the Environmental Quality Guidelines (EQG) and determining when a significant and unacceptable change has occurred, is consistent with ANZECC & ARMCANZ (2018). For physical stressors, such as turbidity or TSS, the approach for high ecological protection areas (the majority of Exmouth Gulf as shown in Figure 2-11) is to compare the median of the test site data (or modelled impact data) with the 80$^{th}$ percentile of the unimpacted reference distribution (EPA 2017). Thus the threshold, or EQG, relevant to the maintenance of ecosystem health within the high ecological protection area was defined as the 'median depth-averaged turbidity over 24 hours exceeds the 80$^{th}$ percentile of baseline data'.

For maximum ecological protection areas (nearshore areas around the south and east coasts of Exmouth Gulf) no changes beyond natural variation in ecosystem processes, biodiversity, abundance and biomass of marine life or in the quality of water sediment or biota are permitted.

In both the flood-tide and ebb-tide launch cases, the threshold (or EQG) was forecast to be exceeded in a zone mainly confined to the shallowest half of the Bundle tow route and its surroundings (Figure 5-17). The forecast duration of these elevated concentrations is limited, with the cumulative (modelled plus background) TSS greater than 4.10 mg/L (the value representing the 80$^{th}$ percentile of baseline data (Attachment 2H)) only predicted during the launch for a period of six hours (flood tide) and two hours (ebb tide) (Figure 5-9). The second and third peaks in TSS represent the 'return' of the suspended sediment plume over the sites following a change in tidal direction. Areas of BCH within this zone are presented in Section 5.1.6.6.

The inshore section of the Bundle tow route traverses a maximum ecological protection area, within which no changes beyond natural variation in ecosystem processes, biodiversity, abundance and biomass of marine life or in the quality of water, sediment or biota are permitted. Based on the expected tolerance of the local BCH to short-term increases in turbidity (as occur naturally as shown in Figure 5-15 and Figure 5-16), temporary minor changes in environmental quality are predicted and anticipated (Figure 5-17), but these changes are considered unlikely to result in impacts to ecosystem processes, biodiversity, abundance and biomass of marine life. As stated in Section 5.3.6.1, EPA (2016h) states that '*in cases where 'short-term' non-compliance with an EQO or level of ecological protection over a 'small' area is predicted and appears to be unavoidable, proponents could consider proposing temporary exclusion of an EQO or lower level of ecological protection for the small area……*' and '*When determining the acceptability of such a proposal the EPA would consider the nature and reversibility of the effects, the spatial extent of the impact, timeframes for recovery and any other relevant matters*.'

The environmental quality objective, to maintain ecosystem integrity, will be met for the area of maximum ecological protection and the area of high ecological protection.
Refer to the Marine Construction Monitoring and Management Plan (MCMMP) and Environmental Quality Plan (EQP) in Attachment 3.




Scale: 200000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Commonwealth of Australia (2018) and RPS (2019).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-17: Modelled Exceedance of EQG for the Maintenance of Ecosystem Health During Bundle Launch and Tow

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#### 5.3.6.4 Impacts to Water and/or Sediment Quality in the Event of a Loss of Control of the Bundle or Support Vessel (e.g. from a Chemical Spill)

A number of measures are proposed to minimise the likelihood of the loss of control of a Bundle during launch and tow (Table 5-8). With these measures in place, the likelihood of such an event is considered negligible (in over 80 Bundle launches at Wick no such event has occurred).

The Bundle pipelines can be split in two categories, the internal pipelines, and the outside carrier pipe that sleeves the internal pipelines. The internal Bundle pipelines are designed for high-pressure, high-temperature environments, and therefore have a pipe wall thickness and design strength much higher than what is required for the Bundle launch and tow. The carrier pipe is designed to physically protect these internal pipelines, provide an environmental barrier, and transfer the loads from the launch and tow from the towheads, dissipating these forces along the length of the Bundle.

All fabrication processes of the internal pipelines and the carrier pipe sections are subject to extensive material selection, production and testing criteria, in accordance with a number of Subsea 7 and industry standards (Section 5.1.6.8).

Subsea 7 conducts many preliminary tests on materials before each batch is used in production to ensure that no material defects exist prior to fabrication. Any material that has failed testing will be immediately quarantined and replaced. All welders will be individually qualified to a specific Weld Procedure Specification (WPS) to confirm welder competency and the repeatability of the WPS. Each completed weld is subject to non-destructive testing (NDT), with specific weld repair procedures in place should a weld be found to be defective. Finally, a full system hydrostatic pressure test is completed, to verify that the line volumes can contain pressure as per the pipeline design.

The likelihood of material damage or loss of containment of the internal pipelines is considered to be low, due to the high-pressure design and the regulated control of the fabrication process. The likelihood of material damage or failure of the carrier pipe, that has a lower strength capacity than the internal pipelines, is also considered as low.

The Bundle pipeline will contain no hydrocarbons during fabrication, launch and tow activities. The carrier pipe will be charged with nitrogen gas, and this allows the Bundle to be positively buoyant during the tow. The carrier pipe will contain solid chemical packs, designed to dissolve in the seawater that floods the carrier pipe once the Bundle is in the final position offshore. These chemical packs create a non-corrosive environment for the internal pipelines.

Material damage to the carrier pipe, leading to a leak would result in a release of nitrogen gas. The carrier pipe internal pressure is monitored during the launch and tow, and any change in pressure will be immediately reported. Such a leak would result in the Bundle becoming positively buoyant (as the weight of nitrogen is reduced) and it would rise to the water surface. If left untreated, the carrier pipe could eventually take on enough seawater to cause the Bundle to become negatively buoyant and sink (depending on the extent of the damage). The seawater within the carrier pipe would mix with the solid chemical packs, but any discharge would be limited and localised. Significant impacts to water or sediment quality are considered extremely unlikely.

The Marine Emergency Response Plan (Attachment 3) provides details on the management actions and control measures in place to minimise the likelihood of a loss of control of the Bundle or support vessel leading to an impact to marine environmental quality.

Several emergency scenarios were assessed, during a Preliminary Hazard Analysis (PHA) (refer to the Marine Emergency Response Plan in Attachment 3), to determine the risk of impact to marine environmental quality, including with Ningaloo Marine Park or the World Heritage Area.

A leak of Bundle corrosion inhibitor could occur following a loss of integrity of a Bundle. It was noted that the Bundle carrier pipe is completely filled with nitrogen, with solid corrosion inhibitors installed at intervals inside the pipe. If a leak occurs during a tow, the nitrogen would be displaced by seawater, which would cause the solid inhibitor packages to dissolve, creating a chemical concentration within the carrier pipe of up to 500 ppm. With no positive pressure in the carrier pipe at this stage, there will be no active transmission to the marine environment. A localised discharge ('weep') may occur in the immediate area surrounding the Bundle, with this discharge deemed to be low risk to marine environment quality. A number of control measures were identified and the residual risk (after the adoption of control measures) was assessed as a 'D' during Bundle launch, and a 'B' during Surface tow (Attachment 3). A 'D' risk is defined as '*Negligible: Low Technical Risk (slight or negligible consequences), Work can proceed with HSE Risk Assessment L1 (HIRA)*'. A 'B' risk is defined as '*Special Focus Required: Medium Technical Risk (serious consequences), Required mitigation actions including specific risk assessments/studies*'.

A vessel collision could potentially result in impacts to marine environment quality due to a spill of ship oil. It was noted that a major spill (e.g. due to the rupture of a fuel tank) is very unlikely to occur during a Bundle tow operation, and is no more likely to occur than in other normal tug marine operations due to the nature of the Bundle operations. A number of control measures were identified and the residual risk (after the adoption of control measures) was assessed as a 'C' during Bundle launch preparations and Off bottom tow mode, and a 'B' during Surface tow (Attachment 3). A 'C' risk is defined as '*Acceptable: Medium Technical Risk (moderate consequences), Work can proceed with HSE Risk Assessment L1 (HIRA)*'.

Given the outcomes of the PHA it is considered that the risk of a significant impact to marine environmental quality is very low. Additional, specific, risk assessments would be completed prior to each Bundle tow to address those risks assessed as a 'B' or 'C'.

#### 5.3.6.5 Cumulative Impacts

To date the Exmouth Marina and several mariculture operations have resulted in a reduced level of ecological protection being defined in the immediate vicinity of these projects (Figure 2-11). However, the vast majority of Exmouth Gulf retains a maximum or high level of protection. The Exmouth Gulf Prawn Fishery is likely to cause local, short-term (hours), impacts to water quality (elevated turbidity) associated with the trawling operations but no impacts to environmental values have been identified as a consequence. The Proposal is not expected to cause any long-term impacts to marine environmental quality and, as stated in the Environmental Quality Plan (Attachment 3), no changes to the current levels of ecological protection are proposed. Given the very low frequency of marine operations associated with Bundle launching and the lack of cumulative turbidity impacts, cumulative impacts to marine environmental quality resulting in impacts to environmental values, as a result of the Proposal and third party projects or proposals, are considered unlikely.

### 5.3.7 Mitigation, Monitoring and Predicted Outcome

The proposed mitigation measures to address potential impacts to marine environmental quality as a result of the Proposal, the predicted outcome, and monitoring (where proposed to verify the outcome) are provided in Table 5-17. Refer also to the Marine Construction Monitoring and Management Plan (MCMMP) and Environmental Quality Plan (EQP) in Attachment 3.

The EPA objective '*to maintain the quality of water, sediment and biota so that environmental values are protected*' will be met.

| Potential Impact | Mitigation Measures | Predicted Outcome |
| --- | --- | --- |
| Temporary impacts to water quality through the release of fines, nutrients or contaminants from sediments during launchway construction | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill) thus reducing seabed disturbance and duration of construction.<br>• Use of pre-cast concrete panels will reduce seabed disturbance and duration of construction.<br>• Construction methods to minimise the disturbance of sediments.<br>• Silt curtains deployed to ensure environmental objectives are achieved.<br>• Construction occurs during single shift allowing time for settling and/or dissipation of fines.<br>Measures to rehabilitate:<br>• Suspension of turbidity-generating construction activity in the event a persistent turbidity plume is observed beyond the silt curtain(s). | Construction of the Bundle launchway is estimated to take up to six months. Elevated turbidity is expected to be limited to the immediate surrounds (<50 m) of the work site. Sediments do not contain elevated concentrations of nutrients or contaminants. Any changes in marine water quality as a result of the project are likely to affect an extremely small area. The magnitude of such changes is considered likely to be consistent with short-term increases in suspended solids associated with natural processes such as large storms.<br><br>Implementation of management measures during construction will ensure that the quality of marine water, sediment and biota will be maintained and the EQOs will be met.<br><br><u>Monitoring</u><br>Twice daily (during works: approximately 10am and 2pm) visual monitoring during construction.<br>In the event of persistent turbidity, assessment of water quality at the 50 m boundary (refer to Attachment 3). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Temporary impacts to water quality (turbidity) due to release of fines from construction materials (quarry rock) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Construction material to be screened and washed to remove 'fines' (particles <63 µm in diameter).<br>• Silt curtains deployed as required to ensure environmental objectives are achieved.<br>Measures to rehabilitate:<br>• Suspension of turbidity-generating construction activity in the event a persistent turbidity plume is observed beyond the silt curtain(s). | Rock fill (expected to be hard rock) will be screened and washed prior to use, resulting in minimal turbidity release. Any changes in turbidity as a result of the project will be short-term and are likely to affect an extremely small area. The magnitude of such changes are considered likely to be consistent with short-term increases in turbidity associated with natural processes such as large storms or the regular strong wind events experienced in the area.<br><br>Implementation of management measures during construction will ensure that the quality of water, sediment and biota will be maintained and the EQOs will be met. |
| Temporary impacts to water quality during Bundle launch and tow due to chains on the seabed | Measures to avoid:<br>• No more than three launches per year will occur.<br>Measures to minimise:<br>• NA<br>Measures to rehabilitate:<br>• NA | An average of two Bundle launches may occur per year with a maximum of three. Water quality impacts will be minor, local, and of short duration.<br><br>The quality of water, sediment and biota will not be significantly impacted and the EQOs will be met.<br><br><u>Monitoring</u><br>Given the short-term nature of |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | the predicted turbidity, no formal monitoring is proposed, although a visual assessment (likely aerial) will be undertaken during the first Bundle launch). |
| Impacts to water and/or sediment quality in the event of a loss of control of the Bundle or support vessel (e.g. from a chemical spill) | Measures to avoid:<br>• Bundle fully pressure tested and leak tested prior to launch.<br>• Ongoing monitoring of Bundle pressures prior to and during launch.<br>• Weather forecast/seasonal data reviewed to inform launch schedule.<br>• Weather forecast monitored ahead of launch operations and launch window defined.<br>• Weather conditions monitored during launch operations.<br>• Defined limiting weather criteria.<br>• High specification tow vessels for launch operations.<br>• System confirmation check completed prior to departing Parking area.<br>• Secondary system/redundancy design in bundle monitoring system.<br>• Lead tow vessels to be equipped with 'Dynamic Positioning' (DP) systems, with a suitable level of system redundancy.<br>• Full tow vessel position monitoring system verification prior to leaving Bundle Parking area.<br>• Secondary tow vessel position keeping system in place for passage through Ningaloo Marine Park.<br>• Vessel Assurance Suitability Surveys conducted prior to commencement of operations. | Given the control measures to be implemented to prevent a loss of control of the Bundle or support vessel, any such incident is extremely unlikely.<br><br>Further, given the inherent strength of the carrier pipe (the outside casing of the Bundle), the lack of liquid chemicals within the carrier pipe, the release of a chemical, leading to an impact to marine environmental quality, is extremely unlikely.<br><br>The quality of water, sediment and biota will not be significantly impacted and the EQOs will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | • Notice to mariners supporting information issued prior to tow to inform local vessels of operations.<br>• Guard vessel to monitor/enforce exclusion zones.<br>• Each vessel operating in adherence to International Regulations for Preventing Collisions at Sea (COLREGs)<br>• Vessel intervention if required (as described in guard vessel procedure for engaging 3rd party vessels).<br>• Community engagement and announcements locally.<br>• Broadcasting on VHF as required.<br>• Visual monitoring of bundle on surface (surface buoys and lights).<br>• Timing of Surface tow through Ningaloo Marine Park chosen to coincide with benign sea, tidal and weather conditions.<br>Measures to minimise:<br>• Bundle carrier pipe does not contain any hydrocarbons (filled with inert nitrogen gas plus solid corrosion inhibitors).<br>• Any chemical to be used within flow lines must have:<br>o An OCNS Hazard Quotient rating of Gold, Silver, E or D have no substitution or product warning; or<br>o Further assessment to ensure the environmental risk is ALARP.<br>Measures to rehabilitate:<br>• Each vessel equipped with a vessel specific Shipboard Oil Pollution Emergency Plan (SOPEP) or equivalent, and will follow response actions to incidental pollution in accordance with the vessel's emergency plan. | |

Table 5-17: Proposed Mitigation Measures and Predicted Outcome for Marine Environmental Quality

## 5.4 KEY ENVIRONMENTAL FACTOR 4 – MARINE FAUNA

### 5.4.1 EPA Objective

To protect marine fauna so that biological diversity and ecological integrity are maintained.

### 5.4.2 Policy and Guidance

Subsea 7 has taken into consideration relevant policy and guidance in the design of the Proposal, the completion of the environmental impact assessment and through the development of this ERD.

A summary of the policy and guidance relevant to Marine Fauna, and how Subsea 7 has considered these, is presented in Table 5-18.

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Statement of Environmental Principles, Factors and Objectives (EPA 2016c, 2018c) | Referred to in the identification and assessment of Preliminary Key Environmental Factors. |
| Environmental Factor Guideline – Marine Fauna (EPA 2016i) | This guidance was consulted in the consideration of potential direct and indirect impacts on marine fauna as a result of the Proposal, and in the consideration of critical habitats and ecological windows. |
| Environmental Assessment Guideline (No. 5) for Protecting Marine Turtles from Light Impacts (EPA 2010) | General guidance on light design (wavelength, height, direction, shielding) referred to in the lighting design for the Proposal to minimise impacts to marine fauna (noting that turtle nesting does not occur within Exmouth Gulf). |
| WA Environmental Offsets Policy (Government of Western Australia 2011) | These policies were considered as part of the determination of the need for offsets. |
| WA Environmental Offsets Guidelines (Government of Western Australia 2014) | |
| Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPAC 2012a) | |
| Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005 – 2015 (MPRA and CALM 2005) | This management plan was reviewed during the assessment of potential impacts on marine fauna within the Ningaloo Marine Park and Muiron Islands Marine Management Area, and in the development of management measures. |
| Marine bioregional plan for the North-west Marine Region (DSEWPAC 2012b) | This management plan was reviewed during the assessment of existing values (receiving environment) and potential impacts on marine fauna, and in the development of management measures. |

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Wildlife Conservation Plan for Migratory Shorebirds (DoE 2015a) | Referred to in the assessment of potential impacts to migratory birds, including any 'important habitat'. |
| EPBC Act Policy Statement 3.21 – Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE 2017a) | Referred to in the design of the migratory shorebird surveys and the assessment of the significance of potential impacts to migratory birds, including any 'important habitat'. |
| Recovery Plan for Marine Turtles in Australia (DoEE 2017b) | This plan was reviewed during the assessment of existing values (receiving environment) and potential impacts on marine turtles, and in the development of management measures. |
| Additional relevant International Treaties, recovery plans, conservation advices and/or threat abatement plans for conservation significant species that are known to occur, or are likely to occur in the vicinity of the proposal area and tow route through Ningaloo Marine Park/Ningaloo Coast World Heritage Area and the Ningaloo Coast World Heritage Place | Reviewed during the assessment of the status of listed species, identification of the existing pressures on these species and in the identification of biologically important areas. |

Table 5-18: Policy and Guidance Relevant to Marine Fauna

### 5.4.3 Receiving Environment

A number of marine studies have been undertaken within the region, as outlined in Table 5-19. Subsea 7 has augmented the information from these previous studies by commissioning additional, Proposal-specific studies, to ensure an appropriate level of information is available to support completion of the environmental impact assessment and development of environmental management plans.

The Proposal-specific studies, as listed in Table 5-19, were undertaken by various technical specialists, and are included in full within Attachment 2. They are also referred to, as appropriate, in the assessment of potential impacts and proposed management measures.

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| Regional Studies | | |
| 1998-1999 | Department of Conservation and Land Management (now DBCA) | North West Cape and Muiron Islands Marine Turtle Nesting Population Study |
| 2001 | Centre for Whale Research | Geographical and temporal movements of Humpback Whales in Western Australian waters |
| 1994 | James Cook University | Aerial Survey (cetacean, dugong, turtle) of Exmouth and Ningaloo Reef |
| 1995-2004 | Centre for Whale Research | Humpback Whale survey report for Exmouth Gulf (1995-2004) |
| 2004-2005 | Centre for Whale Research | Distribution and abundance of Humpback Whales and other mega-fauna in Exmouth Gulf during 2004/2005 |

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| 2005 | Oceanwise | Review of the Dugong in Exmouth Gulf |
| 2004-2005 | Biota | Survey of migratory birds along eastern and southern shores of Exmouth Gulf |
| 2010 | Murdoch University | Vessel—based survey of inshore dolphins off the North West Cape |
| 2016 | University of Tasmania, Institute for Marine & Antarctic Studies, Curtin University | Aerial survey program to describe the distribution and abundance of Humpback Whale calves within Ningaloo Marine Park |
| 1981-2018 | Bird Life Australia | Exmouth Gulf Shorebird 2020 surveys |
| 2018 | Oceanwise | Exmouth Gulf, north western Australia: A review of environmental and economic values and baseline scientific survey of the south western region |
| Proposal-specific Studies | | |
| 2016 | 360 Environmental | Survey of benthic habitats off Heron Point |
| 2017 | 360 Environmental | Survey of benthic habitats within Local Assessment Unit (LAU) |
| 2017 | 360 Environmental | Opportunistic observations of marine fauna within and adjacent to the LAU |
| 2017 | 360 Environmental | Survey of benthic habitats within the 'Bundle Laydown Area' |
| 2017 | 360 Environmental | Learmonth Level 1 Fauna Survey |
| 2018 | MBS Environmental | Exmouth Gulf Benthic Communities and Habitat survey report |
| 2018 | Western Wildlife | Learmonth Migratory Bird Survey |
| 2018 | Lyn Irvine | Exmouth Gulf aerial humpback whale survey (southern migration) |

Table 5-19: Overview of Local and Regional Marine Fauna Studies

Based on a review of the guidance documents referred to in Table 5-18, the outcomes of the studies referred to in Table 5-19, reports produced by the EPBC Act Protected Matters Search Tool for the Proposal area (DoEE 2017m, 2017n), and other resources including species profiles and recovery plans, the Conservation Values Atlas, the Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012b), a number of marine fauna occur or are likely to occur within Exmouth Gulf and/or adjacent waters. These species are discussed below. Additional information regarding the EPBC listed species is provided in Section 7.

#### 5.4.3.1 Cetaceans

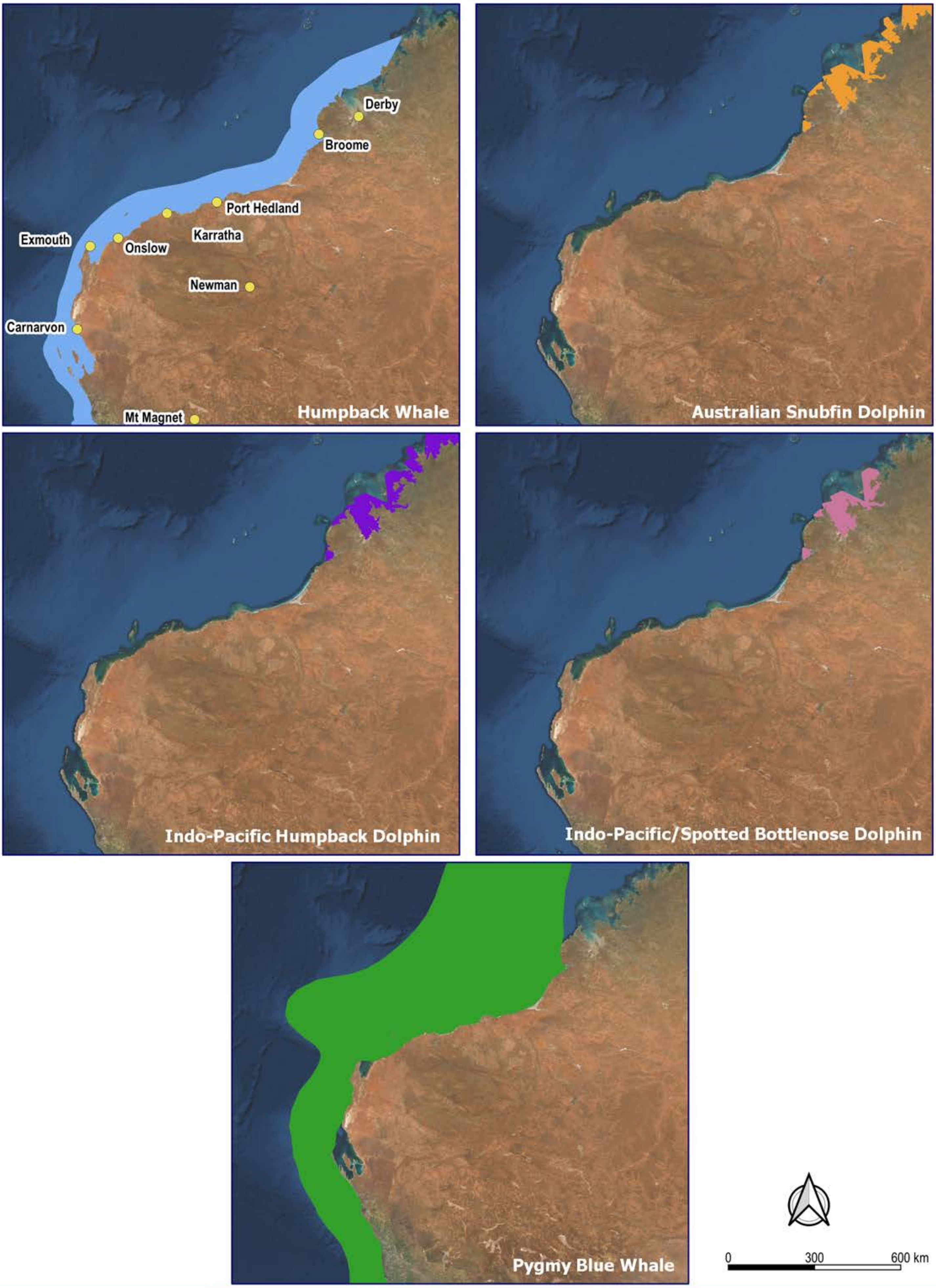
Based on the mapping of biologically important areas of Regionally Significant Marine Species (DoEE 2015), also available through the Conservation Values Atlas, biologically important areas for cetaceans within the wider region include (Figure 5-18):

- A migration route for the Humpback whale, which extends the length of the WA coastline.
- Breeding habitat for the Australian Snubfin dolphin (in the Kimberley region).
- Breeding and calving habitat for the Indo-Pacific / Spotted bottlenose dolphin (in the Kimberley region).
- Pygmy blue whale migration and foraging (to the west of the North West Cape).

A total of 13 species of toothed whale and dolphin and seven species of baleen whale have been recorded from Ningaloo Marine Park (CALM 2005), as follows:

- Sperm whale (*Physeter macrocephalus*).
- Pygmy sperm whale (*Kogia breviceps*).
- Killer whale (*Orcinus orca*).
- Pygmy killer whale (*Feresa attenuatta*).
- False killer whale (*Pseudorca crassidens*).
- Short-finned pilot whale (*Globicephala macrorhychus*).
- Melon-headed whale (*Peponocephala electra*).
- Bottlenose dolphin (*Tursiops truncatus*).
- Australian Humpback Dolphin (*Sousa sahulensis*).
- Common dolphin (*Delphinus delphis*).
- Risso's dolphin (*Grampus griseus*).
- Striped dolphin (*Stenella coeruleoalba*).
- Spinner dolphin (*Stenella longirostris*).
- Blue whale (*Balaenoptera musculus*).
- Humpback whale (*Megaptera novaeangliae*).
- Minke whale (*Balaenoptera acutorostrata*).
- Bryde's whale (*Balaenoptera edeni*).
- Sei whale (*Balaenoptera borealis*).
- Fin whale (*Balaenoptera physalus*).
- Southern right whale (*Eubalaena australis*).

An overview of the use of Exmouth Gulf, and adjacent waters, by marine fauna is provided below, by species. Refer also to Section 7.5.3 for further information on species listed under the EPBC Act.




Scale: 1:15000000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94

Notes: Data sourced from DoEE (2015).

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Figure 5-18: Biologically Important Areas for Cetaceans Within the Region

Humpback Whale

Since the cessation of whaling, the Group IV population (also referred to as the WA population) of Humpback whales is thought to have been recovering at an annual rate of between 7 and 12% from the lowest population size (of approximately 800 individuals), such that numbers were thought to be approaching 12,000 to 15,000 by 2000 (Bannister and Hedley 2001). By extrapolating this recovery rate forward to 2010, it was estimated that the population could reach 20,000 to 30,000 individuals (CWR 2005). More recently the rate of population increase has been estimated at a rate of between 9.7% and 13% (Salgago Kent *et al*. 2012). A further extrapolation of the same population growth rate to 2018 would result in a population estimate in the range of 35,000 to 60,000.

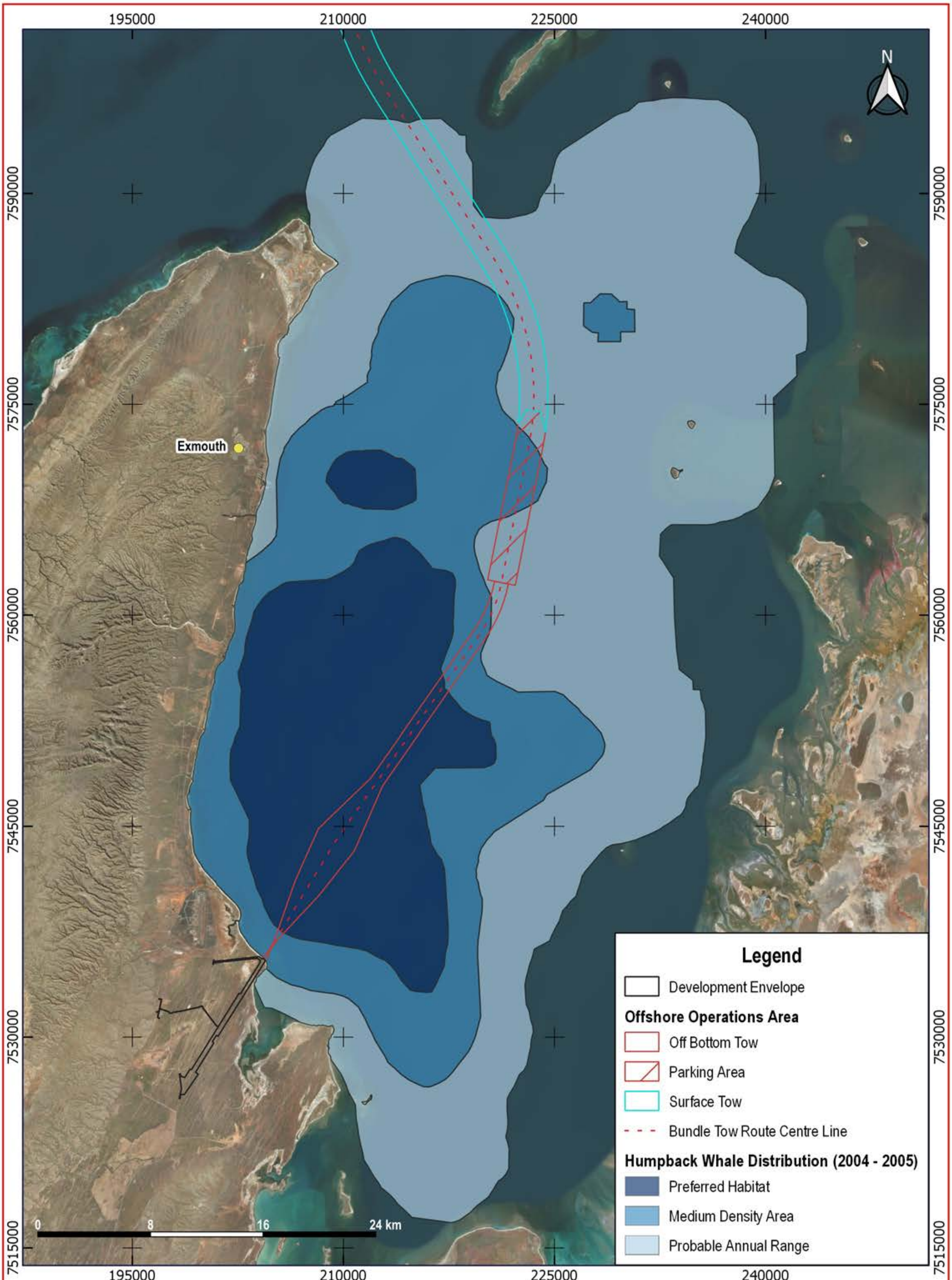
At the estimated average annual rate of increase, the number of cow/calf pairs potentially using Exmouth Gulf (1,000 to 1,500 cow/calf pairs in 2005) may have almost doubled by 2010 to nearly 3,000 cow/calf pairs (CWR 2005), with the number of cow/calf pairs in 2018 potentially exceeding 6,000.

Exmouth Gulf has been identified as a biologically important area in recognition of its value as a resting area for migrating Humpback whales, with very high densities of nursing cows with calves during the southern migration (DSEWPAC 2012b).

The migration of Humpback whales both north and south past Exmouth Gulf follows predictable, but complicated patterns each season. Humpback whales are found in Exmouth Gulf from early August until late November each year (CWR 2004 & 2005). Whale numbers have historically peaked inside the Gulf during the first two weeks of October, coinciding with the arrival of southbound cow/calf pods from the Kimberley. Cow/calf pods and males can rest and nurse inside the Gulf for up to two weeks and three weeks respectively before continuing their southern migration. This makes the Gulf a critical resting area for this portion of the population (CWR 2004 & 2005).

Whales are predominantly found in water depths greater than 7 m with the greatest number of whales being sighted in the deepest (~20 m) portions of the Gulf (CWR 2004 & 2005) (Figure 5-19).

Humpback whales were first observed within Exmouth Gulf and to the north in late July 2018 (Lyn Irvine pers comm. 2018a). Aerial surveys undertaken in 2018, between early August and early November (Irvine 2019, Attachment 2J) recorded 1,661 pods, consisting of 2,772 whales at locations shown in Figure 5-20. Of the whales recorded, a total of 688 were calves (Attachment 2J). Humpback whale numbers were relatively low (approximately 100) during the first half of August, before increasing to a maximum of approximately 750 by mid-September (Figure 5-21, Figure 5-22). From this peak, numbers rapidly declined to approximately 50 by early November (Figure 5-21, Figure 5-22). Linear regression of the decline in abundance from the peak in September through to the final survey in early November 2018 (R Square value=0.995) indicated that by 5 November 2018 all Humpback whales were likely to have left Exmouth Gulf. A total occupancy period of 10 weeks, or 3 months, was recorded during the 2018 southern migration.




Scale: 1:350000
Original Size: A4
Aerial Image: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from CWR (2005).

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Figure 5-19: Distribution of Humpback Whales in Exmouth Gulf in 2004/2005

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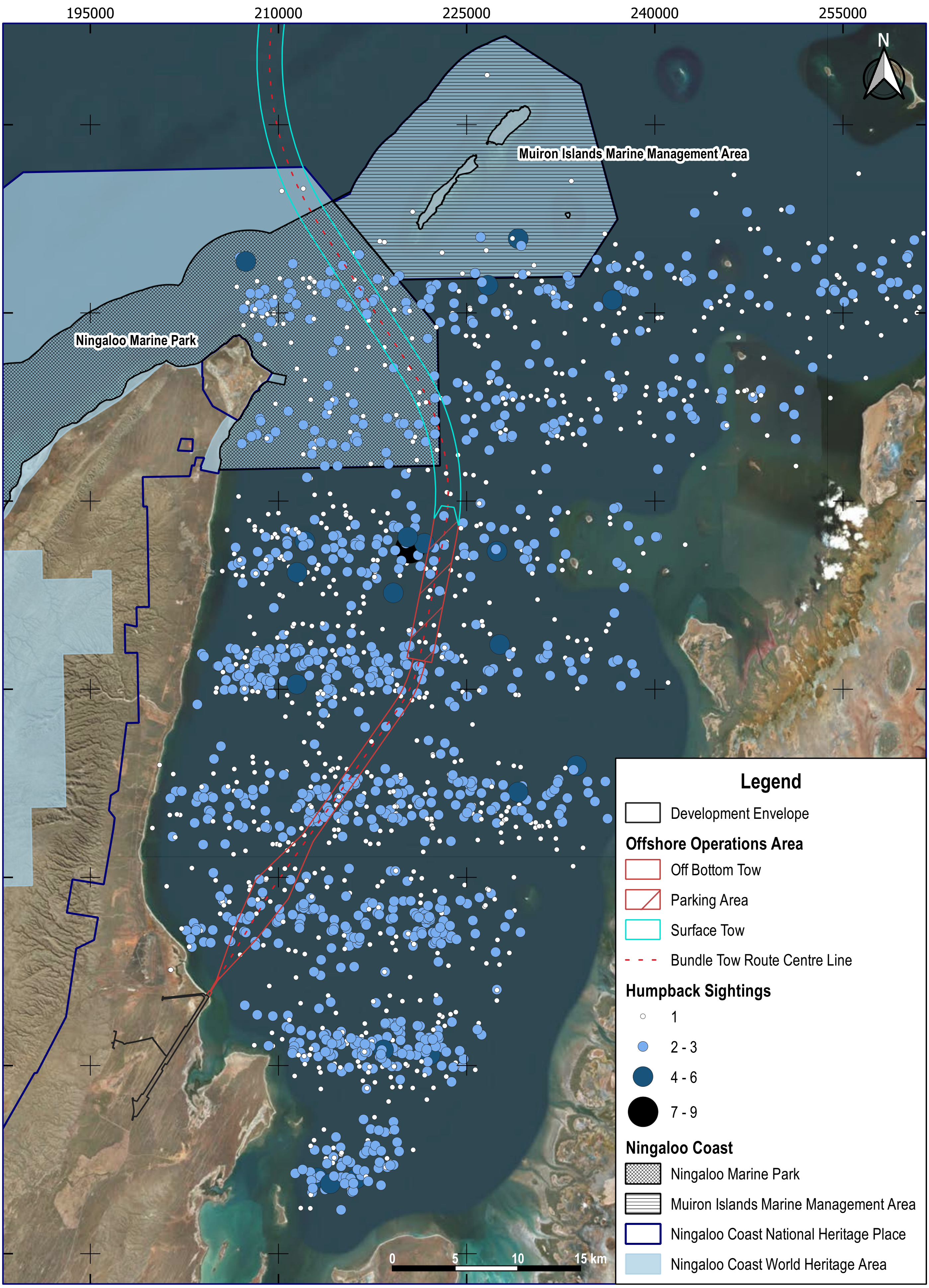


Scale: 1:400000
Original Size: A4
Aerial Image: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Irvine 2019.

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Figure 5-20: Distribution of Humpback Whales in Exmouth Gulf in 2018

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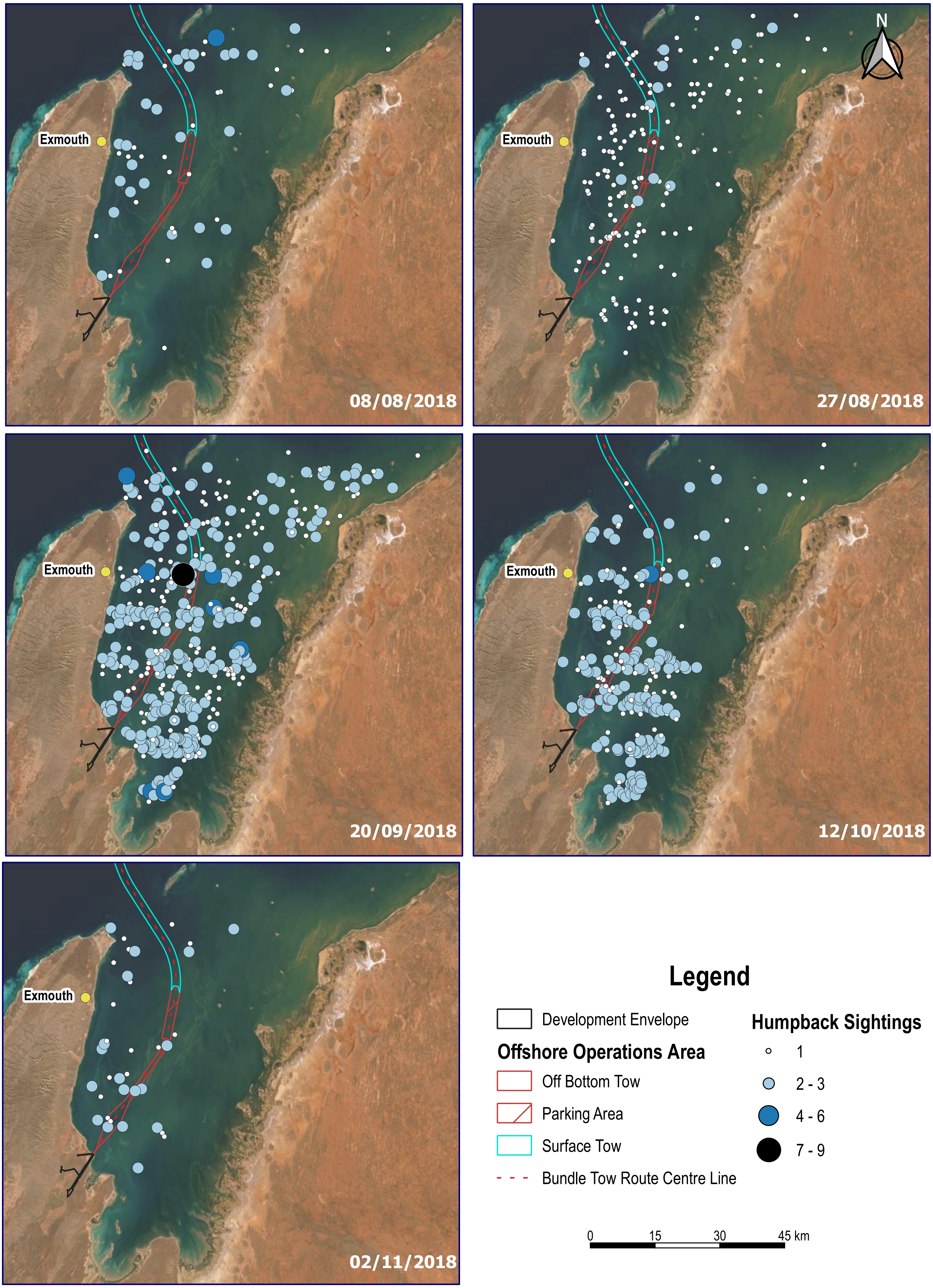


Scale: 1:1150000
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Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Irvine (2019).

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Figure 5-21: Temporal Variation in Abundance of Humpback Whales in Exmouth Gulf in 2018

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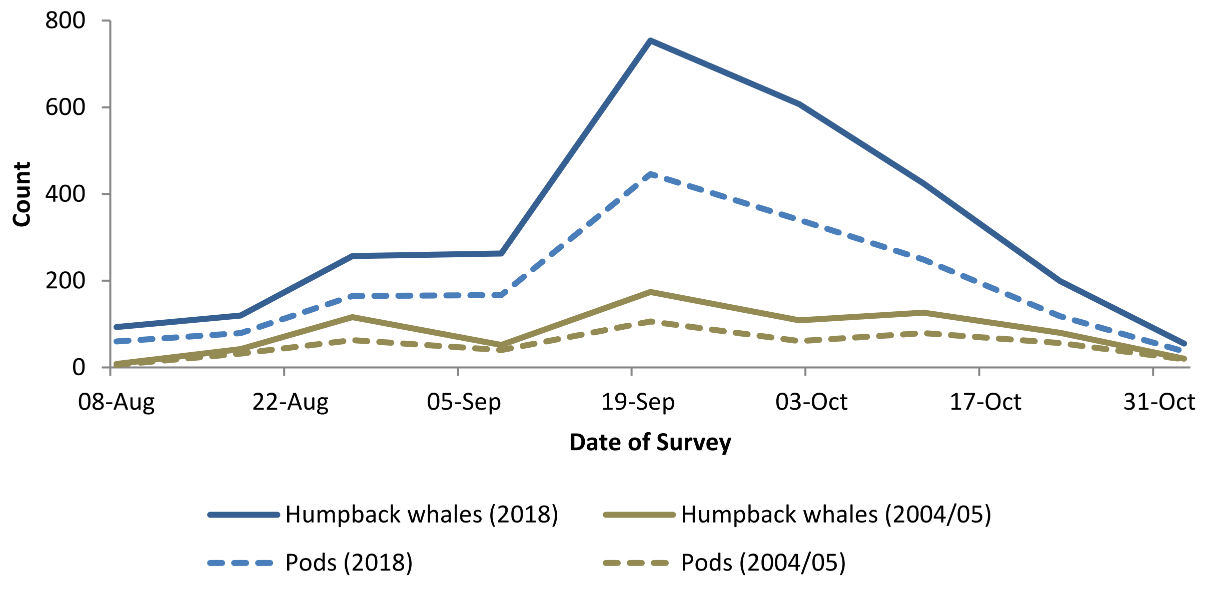



Figure 5-22: Seasonal Variation of Humpback Whale Numbers in Exmouth Gulf During the Southern Migration (2018 and 2004/2005) (from Irvine 2019 and CWR 2005)

Snub-fin Dolphin (*Orcaella heinsohni*)

The Snub-fin dolphin (*Orcaella heinsohni*) is not expected to be present in or adjacent to the Proposal area, although it has previously been reported from the region (Attachment 2A), and is included within this section for that reason. The distribution of Australian Snubfin dolphins covers the coastal waters of Queensland, Northern Territory and north western Australia, from approximately Broome (17° 57´ S) on the west coast to the Brisbane River (27° 32´ S) on the east coast.

In WA the species is found predominantly in nearshore State waters along the coast from Cape Londonderry south to Roebuck Bay, with records of vagrants as far south as Exmouth Gulf. Boat-based surveys along the east coast of Queensland indicate that Australian snubfin dolphins are primarily found in shallow waters less than 20 m deep, close to the coast, close to river and creek mouths and in the proximity of seagrass beds (DSEWPaC 2012b).

Australian Humpback Dolphin (*Sousa sahulensis*) (previously named the Indo-Pacific humpback dolphin (*Sousa chinensis*)

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 & Cagnazzi 2016). In Western Australia, the majority of sightings have been obtained within 5 km of the coast (Parra and Cagnazzi 2016). Around the North West Cape, dolphins have been sighted in clear waters over Ningaloo Reef, and in turbid waters in Exmouth Gulf and in depths ranging from 1 to 40 m (Parra & Cagnazzi 2016).

Across Australia, humpback dolphins have been observed feeding in a wide range of inshore-estuarine coastal habitats including rivers and creeks, exposed banks, shallow flats, rock and coral reefs as well as over submerged reefs in waters at least up to 40 m deep (Allen *et al*., 2012; Cagnazzi, 2011; Parra, 2006). In Western Australia, foraging behaviour has been observed mainly in nearshore habitats over intertidal rocky reefs and over shallow sub-tidal reef habitats (Parra and Cagnazzi 2016). The analysis of stomach contents of six Australian humpback dolphins stranded in Queensland suggested they are opportunistic-generalist feeders, preying on a wide variety of fishes including both bottom-dwelling species as well as pelagic species (Parra and Cagnazzi 2016).

Humpback dolphins are considered to be migratory, with evidence of migration across international boundaries leading to listing of the species under Appendix II of Convention of Migratory Species (CMS) (Culik 2003). Home ranges for this species appear to be relatively large (Jefferson and Karczmarski 2001). In most studies home ranges have not been calculated due to their extension beyond the boundaries of the study area, but in Hong Kong and the Pearl River Estuary home ranges extend from about 29 to 395 km$^2$ (Hung 2000). Throughout their distribution range, only some animals show 'resident' tendencies.

Adult humpback dolphins may be found singly or in pairs, while immature individuals tend to associate with groups containing more than one adult. This species is notorious for poor detectability. Group size is generally four to seven, but may be as large as 25 (Ross 2002). Additionally, its regular occurrence in turbid waters near river mouths makes detection difficult. Determination of the level of philopatry (fidelity to area of birth) in this species is important, as the impact of the loss of reproductive females from such groups is potentially greater than that for species forming large schools (Ross 2006).

Habitat destruction and degradation, including noise pollution and harassment, are threatening humpback dolphin populations, particularly those close to major cities (DSEWPaC 2012c).

Hunt *et al*. (2017), in a study of Australian humpback dolphins around the North West Cape, estimated a super-population size (the total number of animals that theoretically used the study area during the course of the study) of 129 humpback dolphins.

<u>Indo-pacific Bottlenose Dolphin (*Tursiops aduncus*)</u>

In Australia, the Indo-Pacific bottlenose dolphin (or Spotted bottlenose dolphin) is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands. Spotted bottlenose dolphins are also known to associate with whales, such as Humpback whales. Movement patterns in Australia are variable, and include year-round residency in small areas, long-range movements and migration. The Spotted bottlenose dolphin has a low reproductive rate, with an inter-birth interval of three to six years, and high calf mortality, making population recovery a slow process (DSEWPaC 2012d).

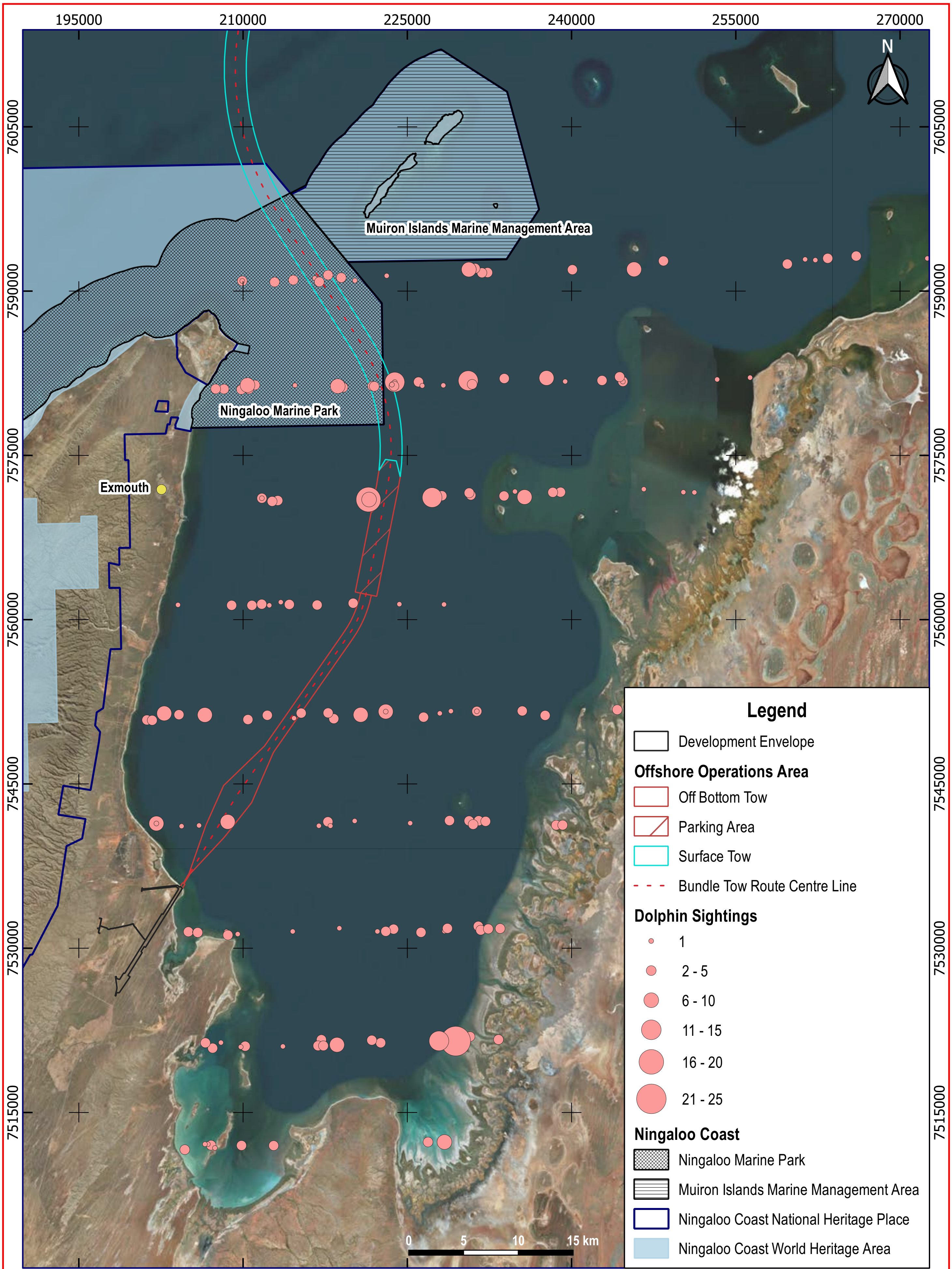
Threats to the global population include direct and indirect catches by fisheries, intentional killing, live capture, pollution, competition with fisheries and tourism. Incidental catches, especially in gillnet and purse seine fisheries, are a problem in many countries, including Australia, but the level of mortality from this threat is unknown. Bottlenose dolphins are also caught in shark nets in South Africa and Australia (Wells and Scott 2002).

As part of broader studies estimating genetic connectivity for three coastal delphinids (Indo-Pacific bottlenose dolphins, Australian snubfin dolphins, and Australian humpback dolphins) across north-western Australia, photo-identification images of Indo-Pacific humpback dolphin groups were obtained off the North West Cape from Ningaloo Reef to Exmouth. Preliminary results identified fifty-three adults and juveniles and six calves over approximately 80 km of coastline around the Cape. The North West Cape, Exmouth, represents the south western limit of the species' Australian distribution (Bejder *et al*. 2011).

All Dolphins

During aerial surveys undertaken in 2004/2005, dolphins (likely Indo-pacific bottlenose dolphins or Indo-pacific humpback dolphins as identified from boat observations) were sighted on all but three of the flights. A total of 359 dolphins in 109 pods were sighted. Dolphin pods were widely distributed in the Gulf and were found in average depths of approximately 10 m (Centre for Whale Research 2005).

Aerial surveys undertaken in 2018, between early August and early November (Irvine 2019, Attachment 2J) recorded a total of 556 dolphins within Exmouth Gulf, widely distributed across the whole survey area (Figure 5-23).




Scale: 1:450000
Original Size: A4
Aerial Image: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Irvine 2019.

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Figure 5-23: Distribution of dolphins in Exmouth Gulf in 2018

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#### 5.4.3.2 Dugong

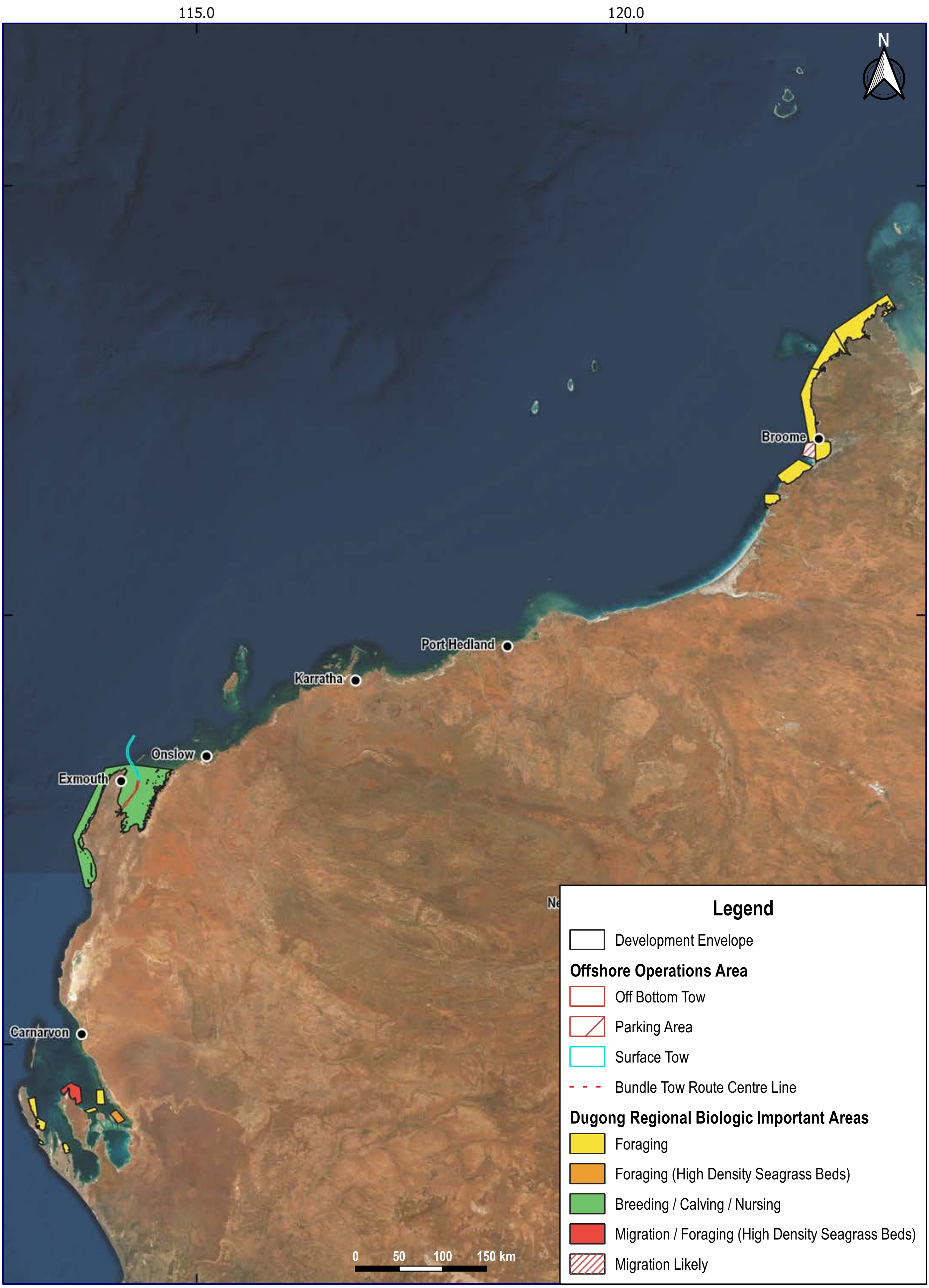
Exmouth Gulf and Ningaloo Reef have been identified as biologically important areas, year round, for Dugong breeding, calving and nursing (Figure 5-24, DSEWPAC 2012b).

Quantitative surveys of Exmouth Gulf resulted in population estimates of 1,062 in 1989 (Grech and Marsh 1994), 1,006 in 1994 (Preen *et al*. 1997) and 174 in 1999 (Gales *et al*. 2004). Quantitative aerial surveys in 2004 indicated a minimum Dugong population estimate of approximately 1,000 individuals in Exmouth Gulf during winter (Oceanwise 2005). An additional survey in 2007 estimated numbers in excess of the 1989 and 1994 estimates (Hodgson *et al*. 2007).

Dugong activity is thought to be focused on the east coast of the Gulf associated with the shallow seagrass habitat in this area (Figure 5-25), but there is a lack of understanding regarding fine-scale movements and the importance of various habitats for resting, breeding or feeding (Oceanwise 2005).

A single aerial survey undertaken for the Wheatstone Project in August 2010 recorded of 85 animals within Exmouth Gulf (compared to 14 animals off the Wheatstone Project area). Of these animals, 94% were located in water depths of less than 10 m, with many in the south east of the Gulf. In the northern Gulf, observations were concentrated in an area approximately 7 km from Tubridgi Point, in the area between Brown Island, Fly Island and Rocky Island. The Exmouth Gulf population estimate was found to be between 1,369 and 2,088 individuals (RPS 2010a).

Aerial surveys undertaken in 2018, between early August and early November (Irvine 2019, Attachment 2J) recorded 605 Dugong within Exmouth Gulf, predominantly adjacent to the eastern and southern shorelines (Figure 5-26).




Scale: 1:5000000
Original Size: A4
Aerial Image: ESRI Satellite
Projection: GDA 94 Lat/Long

Notes: Data sourced from DoEE 2015.

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Figure 5-24: Biologically Important Areas for Dugong within the Region

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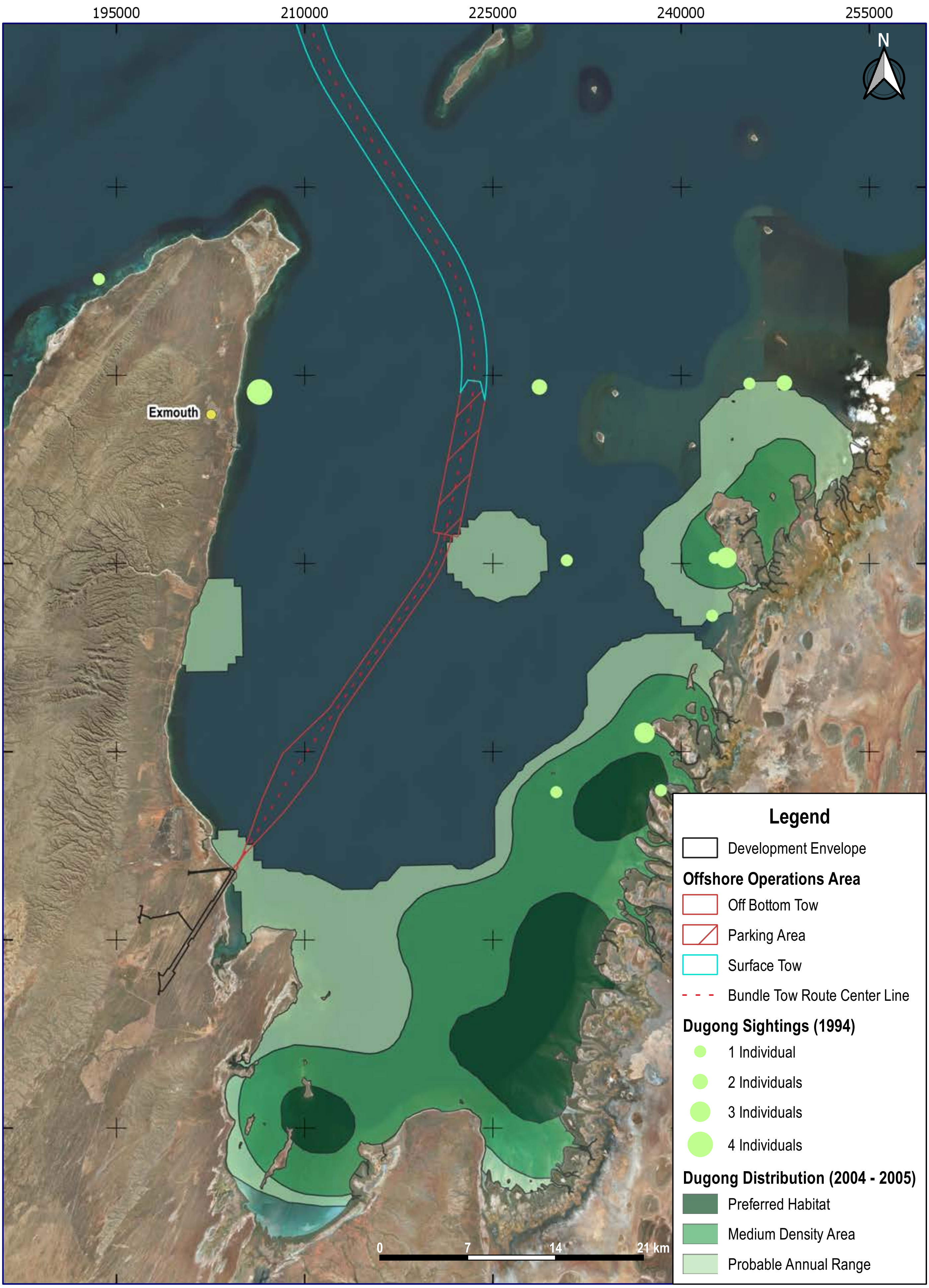


Scale: 1:400000
Original Size: A4
Aerial Image: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from CWR (2005) and Dugong sightings from survey carried out by James Cook University in 1994.

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Figure 5-25: Distribution of Dugong in Exmouth Gulf

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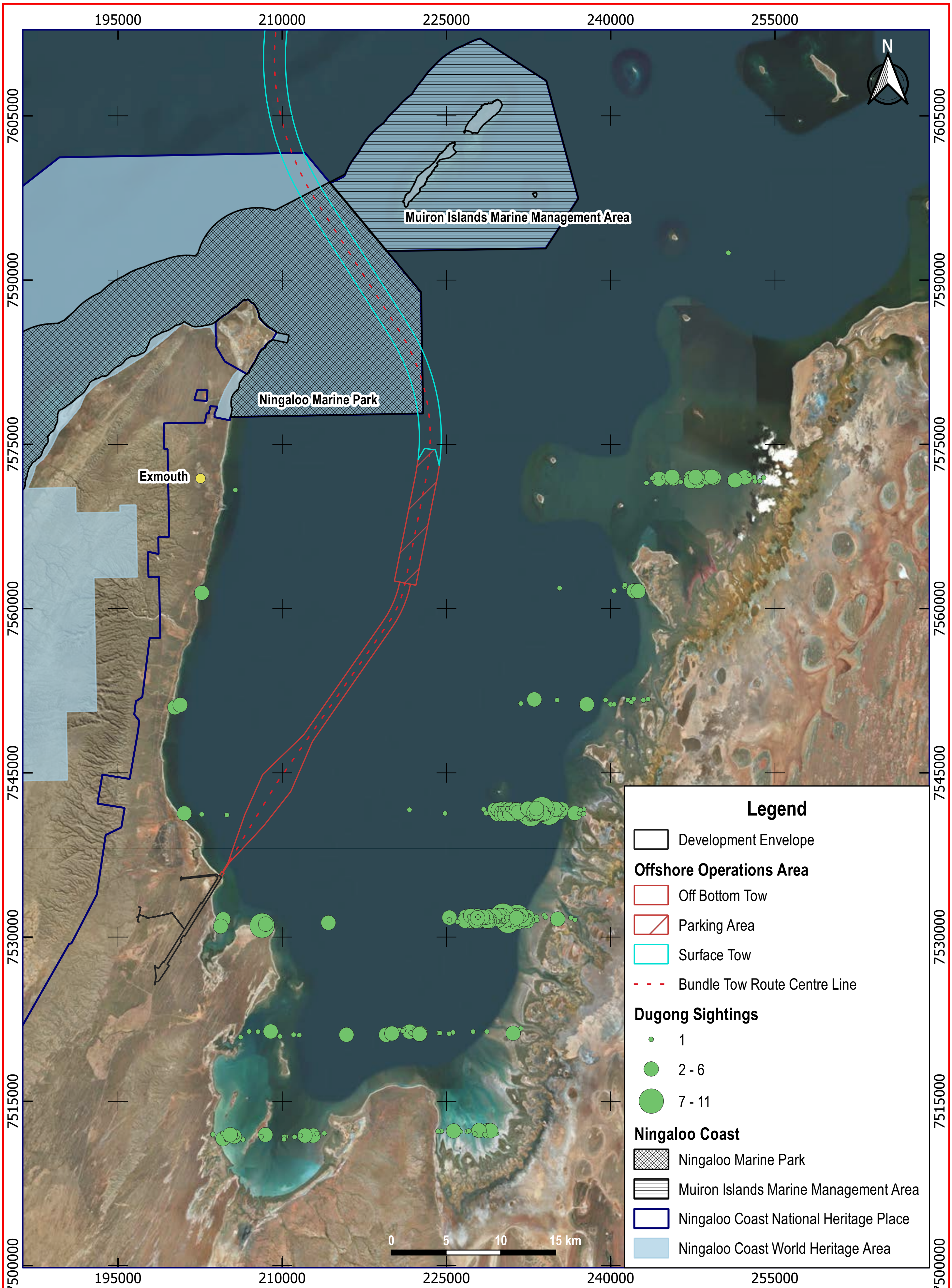


Scale: 1:450000
Original Size: A4
Aerial Image: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Irvine 2019.

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Figure 5-26: Distribution of Dugong in Exmouth Gulf in 2018

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#### 5.4.3.3 Marine Turtles

Based on the mapping of biologically important areas of Regionally Significant Marine Species (DoEE 2015), also available through the Conservation Values Atlas, extensive areas within the region are important for marine turtle migration, foraging, mating, nesting and internesting (Figure 5-27). The shoreline around the North West Cape, and the Muiron Islands, are areas of importance for Flatback, Green, Hawksbill and Loggerhead turtle nesting, while the surrounding areas (within an approximate radius of 20 km) are important internesting (the period between a successful clutch and the next nesting attempt) habitat (Figure 5-28).

Four species of marine turtle have been recorded from Ningaloo Marine Park and the Muiron Islands Marine Management Area, these being the Loggerhead (*Caretta caretta*), Green (*Chelonia mydas*), Flatback (*Natator depressus*) and Hawksbill (*Eretmochelys imbricata*) turtles. There are also records of occasional foraging by Leatherback turtles and Olive ridley turtles along the Ningaloo Coast (CALM 2005). The majority of nesting turtles in the reserves are Green or Loggerhead turtles, with Hawksbills also nesting to a lesser extent. Green and loggerhead turtles regularly use the sandy beaches in the reserves for nesting in December to March each year. Green turtles tend to nest in higher proportions in the northern areas of the reserves while Loggerheads tend to favour the sandy beaches of the southern areas of the reserves. The Hawksbill turtle population is significant as the populations in Western Australia represent the largest remaining population in the Indian Ocean. There have been occasional records of nesting by Flatback turtles on the Jurabi Coast and Muiron Islands. Seasonal aggregations of turtles occur in the protected lagoon environments of the reserves and specific locations, such as Graveyards in the northern section of Ningaloo Reef, have been identified as important sites for mating aggregations (CALM 2005).

Aerial surveys undertaken in 2018, between early August and early November (Irvine 2019, Attachment 2J) recorded 1,472 marine turtles within Exmouth Gulf, predominantly adjacent to the eastern and southern shorelines (Figure 5-29).

Despite the high intensity of prawn trawling within Exmouth Gulf, and the significant overlap between the areas fished (refer Figure 2-14) and the mapped marine turtle habitat and recorded distribution (Figure 5-28, Figure 5-29), bycatch levels for Exmouth Gulf are relatively low by tropical trawl fisheries standards (Gaughan and Santoro 2018). Grids and other secondary bycatch reduction devices (square mesh panels) were implemented in all nets in 2005. While protected species including Dugongs, turtles and sea snakes occur in the general area, only sea snakes, sawfish and occasionally turtles (16 caught in 2016) are encountered in the trawl catches (Gaughan and Santoro 2018). This suggests that internesting turtles do not extensively use the deeper waters within Exmouth Gulf.

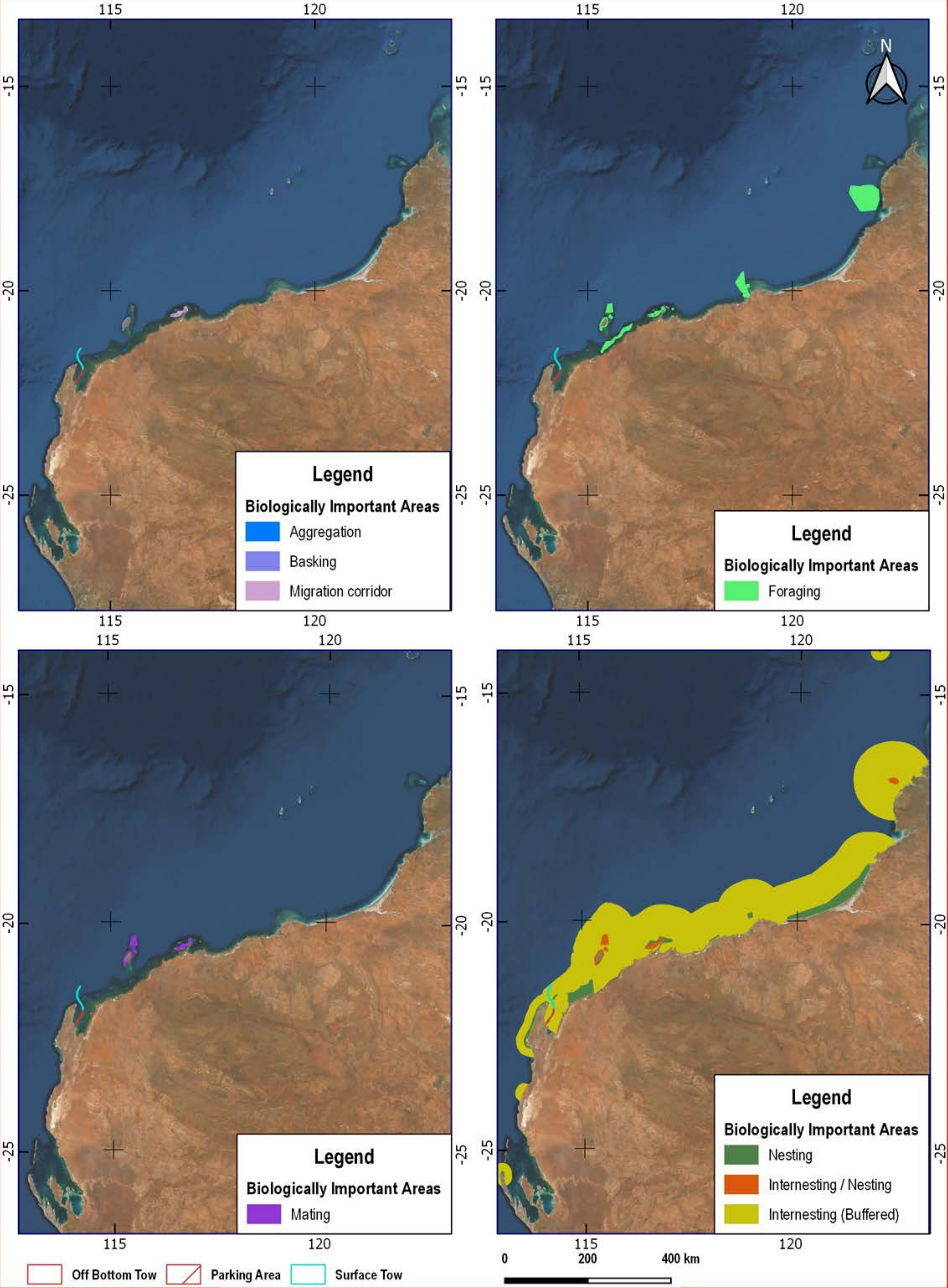
The breeding cycles of the marine turtles likely to be present within Exmouth Gulf and adjacent waters are summarised in Table 5-20. The critical windows of sensitivity, related to breeding activity, for marine turtles, occur between October and April.

| Species | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Green turtle mating aggregations | | | | | | | | | | | | |
| Green turtle nesting, internesting females present offshore | | | | | | | | | | | | |
| Green turtle hatching | | | | | | | | | | | | |
| Flatback turtle mating aggregations | | | | | | | | | | | | |
| Flatback turtle nesting, internesting females present offshore | | | | | | | | | | | | |
| Flatback turtle hatching | | | | | | | | | | | | |
| Hawksbill turtle mating aggregations | | | | | | | | | | | | |
| Hawksbill turtle nesting, internesting females present offshore | | | | | | | | | | | | |
| Hawksbill turtle hatching | | | | | | | | | | | | |
| Loggerhead turtle nesting | | | | | | | | | | | | |
| Loggerhead turtle hatching | | | | | | | | | | | | |

Legend:

| | |
|---|---|
| | Peak activity, presence reliable and predictable each year. |
| | Low level of abundance. Activity or presence. Note: this may vary from year to year but not with a variation of more than one to two months. |
| | Activity typically not occurring in measurable quantities in the area. |

Table 5-20: Turtle Breeding Cycles




Original Size: A4
Aerial Image: ESRI Satellite
Grid: GDA 94

Notes: Data sourced from DoEE (2015). Species include Flatback Turtle, Green Turtle, Hawksbill Turtle and Loggerhead Turtle.

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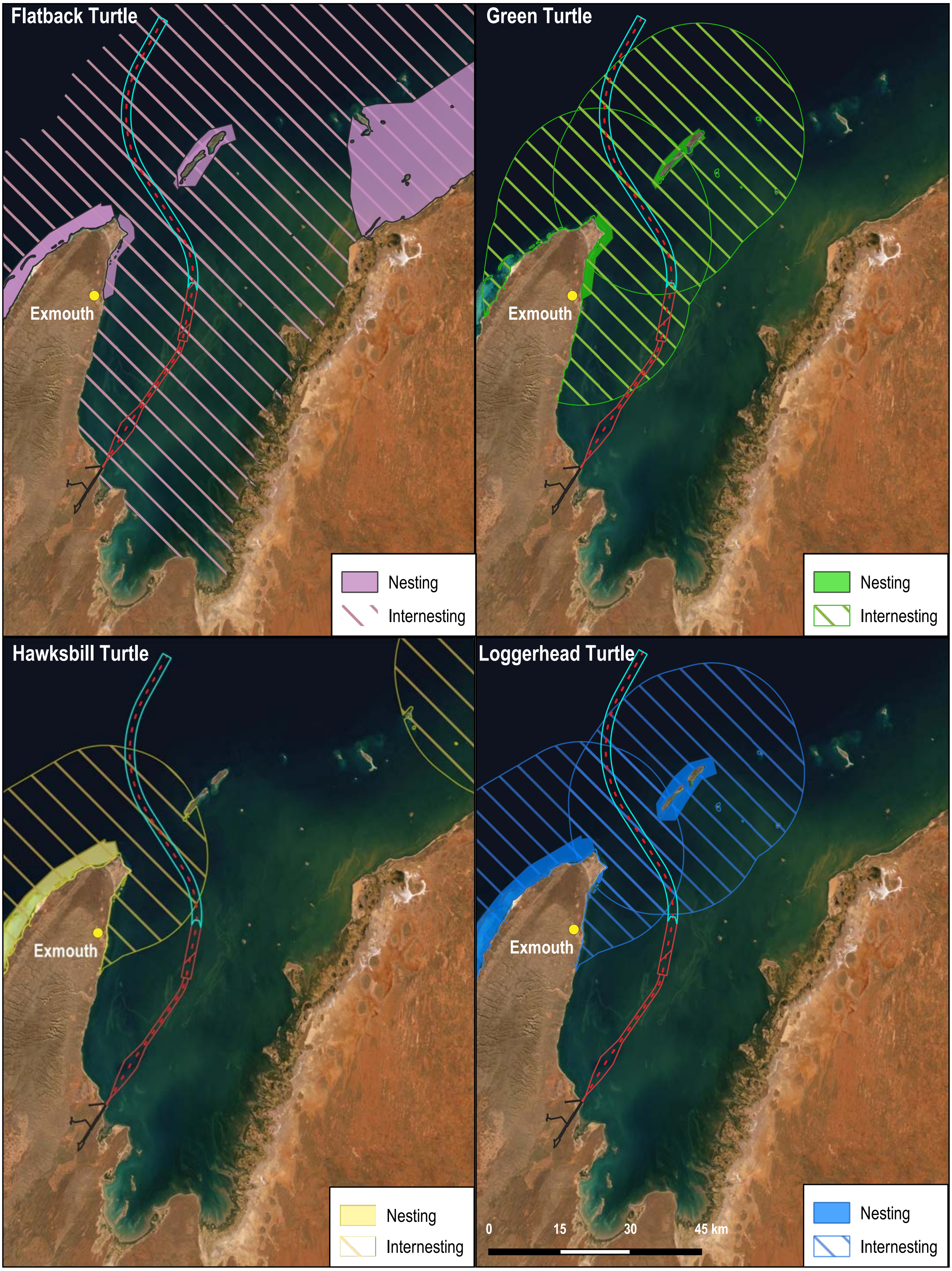
Figure 5-27: Biologically Important Areas for Marine Turtles within the Region




Development Envelope | Off Bottom Tow | Parking Area | Surface Tow | Bundle Tow Route Centre Line

Scale:1,100,000
Original Size: A4
Aerial Image: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from DoEE (2015).

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Figure 5-28: Marine Turtle Habitat in and Surrounding Exmouth Gulf

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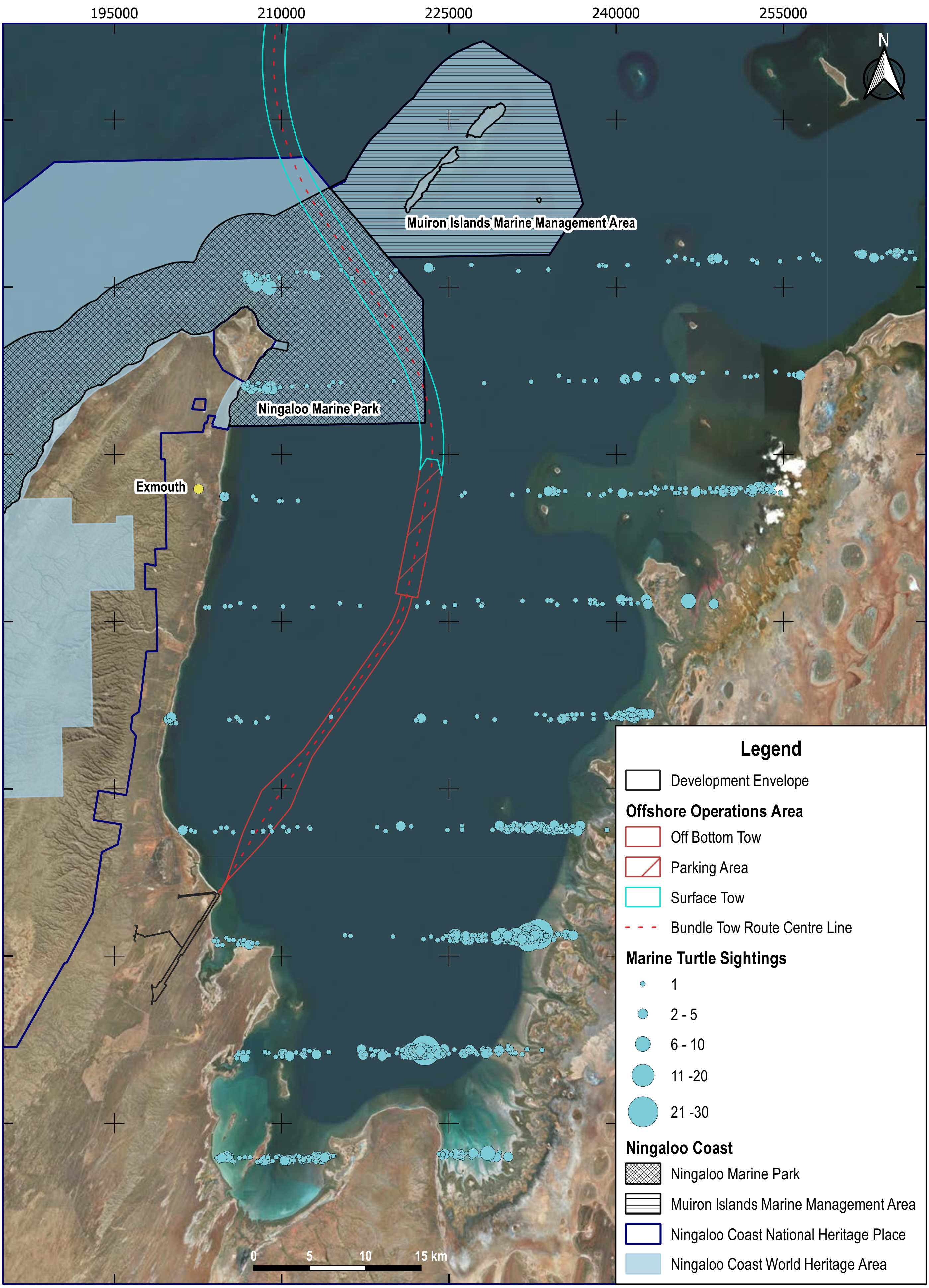


Scale: 1:450000
Original Size: A4
Aerial Image: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Irvine 2019.

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Figure 5-29: Distribution of Marine Turtles in Exmouth Gulf in 2018

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## Flatback Turtles

The Flatback turtle is a locally abundant breeding species, frequently nesting on beaches on the mainland and offshore islands, ranging from the east coast of Barrow Island to Torres Strait and the Great Barrier Reef (Prince 1993, DEWHA 2008). Approximately a third of the Pilbara population (approximately 700 individuals) nests on Barrow Island (EPA 2006).

Flatback turtles are primarily carnivorous, feeding on soft-bodied invertebrates. Juveniles eat gastropod molluscs, squid, and siphonophores. Limited data indicate that cuttlefish, hydroids, soft corals, crinoids, molluscs, and jellyfish are also eaten (DoEE 2017c).

Based on satellite telemetry studies and habitat mapping, the area between Barrow Island and the Muiron Islands appears to be an important Flatback turtle foraging area, with turtles from several nesting locations in the Pilbara migrating to this area (RPS 2010b). Flatback turtles are known to favour soft sediment habitats that support benthic invertebrates. Post-nesting satellite tracking indicates that high use areas include water around Thevenard Island, adjacent to Eighty Mile Beach and Quondong Point, Lynher Banks, and the Holothuria Banks (DoEE 2017c). Characteristics of their foraging behaviour are considered to reduce their susceptibility to potential anthropogenic and natural threats within the region i.e. they forage in areas that are broadly dispersed across the entire region, utilising inter-connecting pathways between several foraging areas and the same foraging areas are used by multiple turtles (Whittock *et al*. 2016).

Surveys undertaken for the Wheatstone Project, to determine the presence of nesting along the beaches north of Locker Point, recorded no evidence of current or prior nesting between Locker Point and Urala. Similarly no evidence of current or prior nesting was recorded along Onslow Back Beach (Pendoley Environmental 2009). No evidence of Flatback turtle nesting on the Muiron Islands was recorded in 1998/1999, and only two nesting female Flatback turtles had previously been recorded at South Muiron Island (Prince 1999).

Studies of Flatback turtles nesting at Mundabullangana and Cemetery Beach, Port Hedland indicate that they inter-nest within 20 km of their mainland nesting rookery (Pendoley Environmental 2010). Flatback turtles nesting at Barrow Island have been recorded travelling up to 60 km to the nearshore mainland during their internesting period (seaturtle.org 2018). Flatback turtles have been noted as resting within soft sediment habitats (K. Pendoley, pers. comm).

## Green Turtles

The Western Australian population of Green turtles numbers in the tens of thousands, with the principal rookeries being the Lacepede Islands, some islands in the Dampier Archipelago, Barrow Island, Montebello Islands, and at North West Cape (DEC 2009). It was estimated that approximately 7,000 to 9,000 live around the North West Cape (Preen *et al*. 1997).

At South Muiron Island, over the period 1991 to 1998, 961 Green turtles were tagged while visiting the island to nest (Prince 1999). It was reported that a number of the Green turtles recorded nesting at the Muiron Islands were known to feed within Shark Bay and the Kimberley (Prince 1999).

Green turtles are primarily herbivorous, foraging on algae, seagrass and mangroves. In their pelagic juvenile stage, they feed on algae, pelagic crustaceans, and molluscs (DoEE 2017d). Foraging habitat across the North West Shelf includes tidal/sub-tidal habitats with coral reef, mangrove, sand, rocky reefs, and mudflats where there are algal turfs or seagrass meadows present (DoEE 2017d).

Aerial surveys have shown that turtles occur throughout Exmouth Gulf, with densities greatest in the shallow southern and eastern portions of the Gulf (Oceanwise 2005, Oceanica 2006, Figure 5-29). The majority of animals sighted were identified as Green turtles (Oceanwise 2005, Oceanica 2006). This is consistent with the general understanding that it is Green turtles that predominantly utilise Exmouth Gulf, with smaller individuals being more abundant than larger animals. Nesting by Green turtles within Exmouth Gulf is very rare (Lyn Irvine, pers comm. 2018b). Green turtles are thought to remain in the vicinity of their nesting beaches between nesting events (Pendoley Environmental 2010).

Hawksbill Turtles

Hawksbill turtles occur in Australia in coral and rocky reef habitats, extending into warm temperate areas (DEWHA 2008), feeding on sponges, algae, seagrasses, soft corals and shellfish (Paladino and Morreale 2001, DoEE 2017e) and breeding in spring or summer. On the North West Shelf, key rookeries include Rosemary Island and Varanus Island.

At South Muiron Island, over the period 1991 to 1998, 10 Hawksbill turtles were tagged while visiting the island to nest (Prince 1999). Hawksbill turtles also nest around the western side of the North West Cape (Prince 1999). Hawksbill turtles are thought to remain in the vicinity of their nesting beaches between nesting events (Pendoley Environmental 2010).

Loggerhead Turtles

Loggerhead turtles are found throughout the world in temperate and tropical waters. They typically inhabit shelf and coastal waters to breed and feed (DEWHA 2008). Loggerheads are primarily carnivorous feeding on crustaceans, molluscs, tube worms, sea pens, soft corals, and small crustaceans (Paladino and Morreale 2001). Loggerhead turtles in Australia breed from November to March with a peak in late December/early January (Limpus 1985). Foraging habitat includes tidal/sub-tidal habitats with hard and soft substrates including rocky and coral reefs, muddy bays, sand flats, estuaries, and seagrass meadows (DoEE 2017f).

In Western Australia, nesting occurs from Shark Bay (including on the mainland near Steep Point) to the North West Cape with major nesting at Dirk Hartog Island (800-1,500 females breeding per year); Gnaraloo Bay (estimated 61-84 (range 38-211) females breeding per year); Muiron Islands (150 to 350 females breeding per year); and the beaches of the North West Cape (50 to 150 females breeding per year) (Baldwin *et al*. 2003; Prince 1994).

South Muiron Island is known as a significant Loggerhead turtle rookery with an annual nesting population of 150-350 females (Baldwin *et al*. 2003). Over the period 1991 to 1998, 772 Loggerhead turtles were tagged while visiting the island to nest (Prince 1999). It was reported that a number of the Loggerhead turtles were known to feed within Shark Bay, but also in Indonesia and the Northern Territory (Prince 1999).

#### 5.4.3.4 Whale Shark

The Whale shark (*Rhincodon typus*) population in the Indo-Pacific has been estimated, based on individual counts, modelled population estimates and habitat availability, at 75% of the global population with the remaining 25% in the Atlantic (Pierce and Norman 2016). Wildbook for Whale Sharks has an online database that comprises photographs of global Whale shark sightings from both researchers and the public (www.Whale shark.org) (Wild Me 2016, Norman *et al*. 2017). There are currently 9,739 individual Whale sharks that have been identified through the database from images submitted between 1964 and 2018, with the majority being males with most of these likely to be immature due to the estimated lengths (Norman and Stevens 2007). It is assumed that the current dataset does not fully represent the global whale shark population (Norman *et al*. 2017).

Whale sharks have been recorded along the continental shelf of the central west coast of Australia, with the aggregations within Ningaloo Marine Park, corresponding to a key foraging area (Figure 5-30), being one of the largest seasonal aggregations in the world. Whale sharks travel to Ningaloo Marine Park between March and July every year, with individuals sometimes remaining until early August (DPaW 2013, DoF 2011). Whale sharks exhibit high individual fidelity to the Ningaloo Reef area during the autumn/winter, with individuals often re-sighted in the area over consecutive years (Reynolds *et al*. 2017).

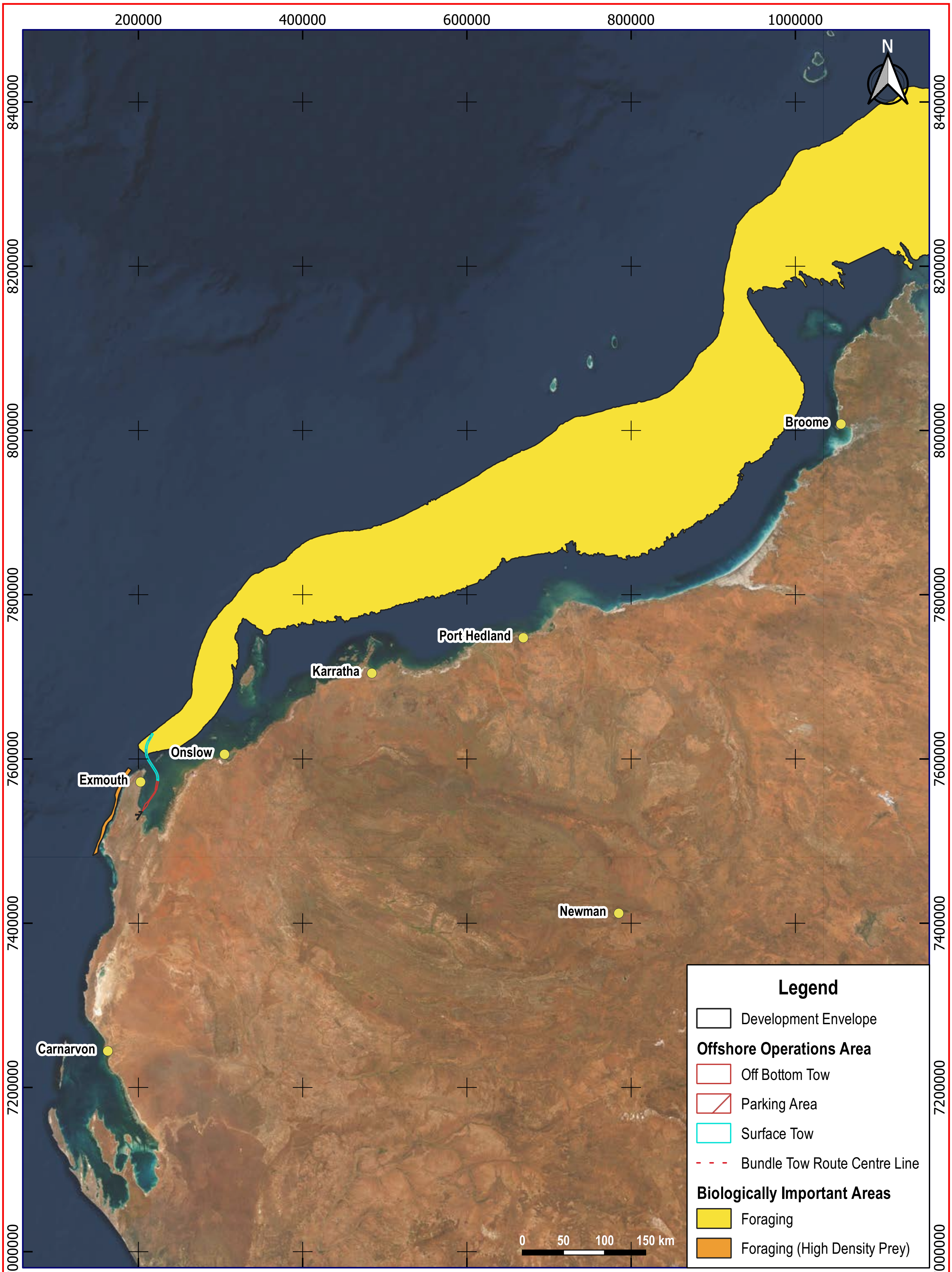
Whale shark abundance at Ningaloo Reef has been modelled by two studies. Meekan *et al*. (2006) estimated the total population size to be 319 to 436 (between the years 1992 and 2004), and Holmberg *et al*. (2009) estimated the annual abundance to vary between 86 and 143 sharks (between the years 2004 and 2007). Whale shark abundance at Ningaloo has been shown to correlate with the Southern Oscillation Index and several other oceanographic variables, which potentially relate to the strength of ocean currents and local productivity (Sleeman *et al*. 2010).

Reynold *et al*. (2017) recorded movements of Whale sharks migrating to and from Ningaloo Marine Park and observed that some sharks migrate long distances before returning intra-annually. Tracking data suggests that Ningaloo Marine Park is of importance year round for Whale sharks. Whale sharks have been observed to utilise the north western portion of Ningaloo Marine Park during the peak season, moving southwards towards Coral Bay outside of season (Reynolds *et al*. 2017, Norman *et al*. 2017). Whale sharks displayed habitat preference for warmer, shallower waters and have been shown to move into international waters, Indonesian waters, and down the West Australian Coastline. Waters to the south of Ningaloo Reef, between Shark Bay and Geraldton, were found to be an area with the highest Whale shark sightings outside of Ningaloo Marine Park, predominantly between October and March (Norman *et al*. 2016).

Several individuals have been tagged between 2004 and 2017 under several research programmes. Much of this data has yet to be formally published and, although requested, was not available for reproduction within this document. A number of Whale shark tracks are available for public review at: http://www.seaturtle.org/tracking/?project_id=1112. Data presented in 2017 showed that in July and August 2016 two tagged Whale sharks (Tag IDs 143669 and 161736) were recorded to the north east of the North West Cape, in the vicinity of the proposed Bundle tow route (Vanderclift *et al*. 2017).

The majority of foraging (on plankton) conducted by Whale sharks occurs close to the surface, with approximately 25% of the time spent at depths of 2 m or less and 40% of their time within the upper water column (15 m or less) (DoEE 2016). During migration, Whale sharks spend most of their time within the upper 15 m of the water column (DoEE 2016).

There is evidence for Whale shark presence around offshore oil and gas facilities, with subsea remote-operated vehicle footage showing two Whale sharks, around oil and gas facilities at depths exceeding 100 m, feeding on small fish aggregating around these structures. A further four tagged sharks were recorded surfacing near oil and gas facilities close to the Goodwyn and Rankin fields (140 km north west of Karratha), supporting the possibility that these facilities provide a type of fish aggregation device which Whale sharks utilise (Norman *et al*. 2016).

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Aerial Image: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from DoEE 2015.

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Figure 5-30: Biologically Important Areas for the Whale Shark within the Region

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#### 5.4.3.5 Grey Nurse Shark

The Grey nurse shark (*Carcharias taurus*) (west coast population) is predominantly found in the south west coastal waters of Western Australia but has been recorded as far north as the North West Shelf (DoEE 2017h). There have been occasional sightings of this species near Exmouth and the Muiron Islands (DoEE 2017h). A study of footage from a camera deployed at the Point Murat Navy Pier in Exmouth, 8 km west of the Bundle tow route, recorded the occurrence of a total of 16 individuals. Individuals displayed strong philopatry, with ten individuals returning to the site over multiple years (Hoschke and Whisson 2016).

Mature females from populations in other parts of the world undertake a biennial or triennial migration along the coast to mate and breed. Tagging studies in New South Wales indicated a northerly migration in autumn and winter, and a southerly migration over spring/summer (Hoschke and Whisson 2016). Otway *et al*. (2003) defined 'aggregation sites' for *C. taurus* as 'locations where five or more grey nurse sharks were consistently found throughout the year' (Hoschke and Whisson 2016).

The diet of the adult Grey Nurse Shark consists of a wide range of fish, other sharks and rays, squids, crabs and lobsters. In Australia it is likely that the Grey Nurse Shark diet consists of species such as pilchards, jewfish, tailor, bonito, moray eels, wrasses, sea mullet, flatheads, yellowtail kingfish, small sharks, squid, and crustaceans (Commonwealth of Australia 2002).

#### 5.4.3.6 Marine Species Important to Commercial and Recreational Fishing

A total of 500 finfish species from 234 genera and 86 families have been recorded within the Ningaloo Marine Park, while 393 species have been recorded at study sites at the Muiron Islands (CALM 2005). A large number of the fish species found in the area have reproductive modes that rely on dispersal of eggs and larvae in the water column and it is likely that recruitment for these species is supplemented from elsewhere, such as from the northwest (ie. the Dampier Archipelago and Montebello Islands) via the Leeuwin Current and from the south (ie. Shark Bay and Abrolhos Islands) via the Ningaloo Current (CALM 2005).

A small percentage of the fish species found within the reserves are important to commercial and recreational fishers, including the emperors (Lethrinidae), Spanish mackerel (*Scoberomorus commerson*), red emperor (*Lutjanus sebae*), coral trout (*Plectropomus* spp.), snappers (*Lutjanus* spp.), and golden trevally (*Gnathanodon speciocus*) (CALM 2005).

Fishing within the Exmouth Gulf can be broken down into three main sectors:

- Collector.
- Charter.
- Commercial.
- Recreational.

Catch and effort data for 2014 to 2017 was obtained from DPIRD. The data provided catch and effort for the fisheries blocks within and surrounding Exmouth Gulf.

<u>Collectors</u>

Collectors target aquarium species, which were grouped into the following categories:

- Fish species (which include, but are not limited to, wrasse, butterfly fish, coralfish, blenny, toadfish, triggerfish, snapper, and bream).

- Hard coral.
- Soft coral.
- Sponges.
- Specimen shells.
- Seahorses and puffer fish.

Figure 5-31 illustrates the key fishing areas (10x10 nautical mile fisheries blocks) within Exmouth Gulf for each of these key species categories. Fish, hard coral, and soft coral are fished in the largest number of fisheries blocks (10 to 13 blocks). The fishery areas are found throughout inshore and offshore waters within the gulf and do not appear to be limited by depth.

Charter

Four key charter (tour operator) target fish species were highlighted during Subsea 7's consultation with the local community. The four key target species were:

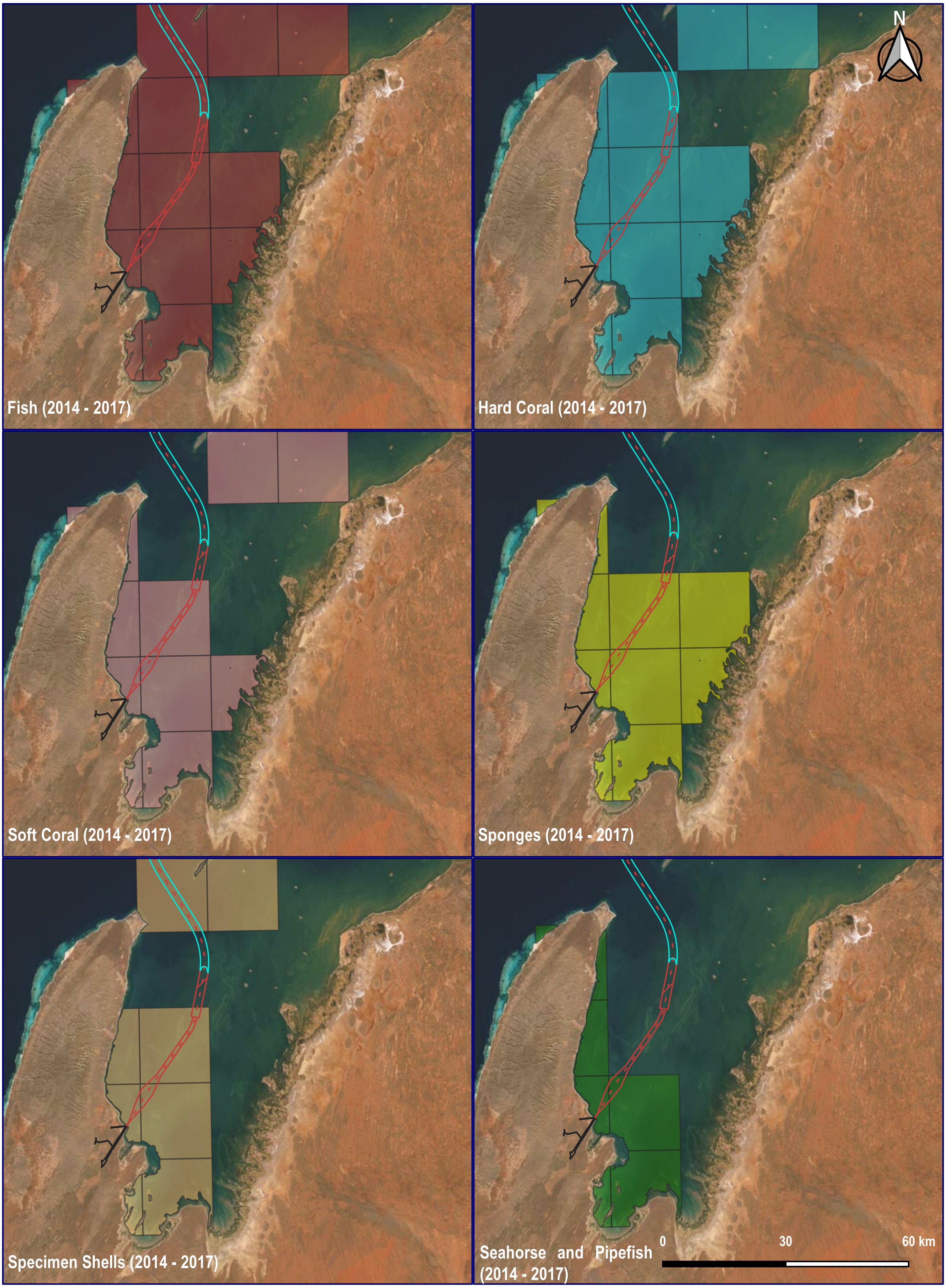
- Permit (or Snubnose dart) (*Trachinotus blochii*).
- Bonefish (*Albula vulpes*).
- Barramundi (*Lates calcarifer*).
- Giant trevally (*Caranx ignobilis*).

Data obtained from DPIRD (2018) identifies the key areas where these species are targeted. Snubnose dart (also called Permit) and Bonefish were predominately fished within shallow inshore waters. Snubnose dart were reported as caught in seven fisheries' blocks, with four of these blocks lying inside Exmouth Gulf (Figure 5-32). The only records of Snubnose dart catches from the inshore waters off Heron Point occurred in October 2017, though catches of Dart (*Trachinotus botla*) were reported during January and November 2017 (DPIRD 2018). Bonefish were only fished outside Exmouth Gulf (Figure 5-32). Barramundi were fished within three shallow inshore fishery blocks in the southern and eastern parts of Exmouth Gulf (Figure 5-32). Giant trevally were fished within 11 fishery blocks in Exmouth Gulf and another 12 fishery blocks outside Exmouth Gulf (Figure 5-32).

Commercial

The Exmouth Gulf Prawn Fishery targets Banana, Tiger, King, and Endeavour prawns with a focus of Tiger, King, and Endeavour prawns (DPIRD 2018). Juvenile brown tiger prawns occupy shallow waters with seagrass and algal communities, which form the main juvenile habitat for this species. A main migration of juvenile prawns into deeper waters occurs during late summer and autumn, after the juveniles have spent approximately six months in the nursery areas. Adult brown tiger prawns are generally found over mud or sandy mud substrates in coastal waters less than 30 m depth (Kangas 2015). King prawns undertake a migration from nursery areas to deeper waters to spawn. Post-larval and juvenile King prawns can be found inshore on shallow tidal flats with sand or mud sediments. Because there is very little freshwater input to Exmouth Gulf, such inshore areas can have salinities higher than seawater (i.e. hypersaline waters). The juveniles of King prawns prefer this habitat, unlike most other prawn species, which prefer estuarine conditions where seawater is diluted by freshwater. Juvenile King prawns spend about three to six months in the nursery grounds before they reach maturity and migrate offshore, entering the trawl fishing grounds. A smaller group of slow-growing juveniles that have spent the winter in nursery areas move offshore in early spring, appearing on the offshore trawl grounds in Exmouth Gulf in September/October. In contrast, the spring-spawned recruits grow faster over summer and arrive on the trawl grounds in February, March and April of each year. This cycle has been observed annually in Exmouth Gulf, where specific closures are used to protect the autumn spawned recruits later in the fishing season. More information on the Exmouth Gulf Prawn Fishery is provided in Section 2.5.8.1.

The region also includes some other small commercial fishing activities including a small beach-seining fishery within Exmouth Gulf (Gaughan *et al*. 2018).




Development Envelope | Off Bottom Tow | Parking Area | Surface Tow | Bundle Tow Route Centre Line

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Aerial Image: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from DPIRD (2018).

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Figure 5-31: Key Specimen Collector Fishing Areas Within Exmouth Gulf for 2014 to 2017

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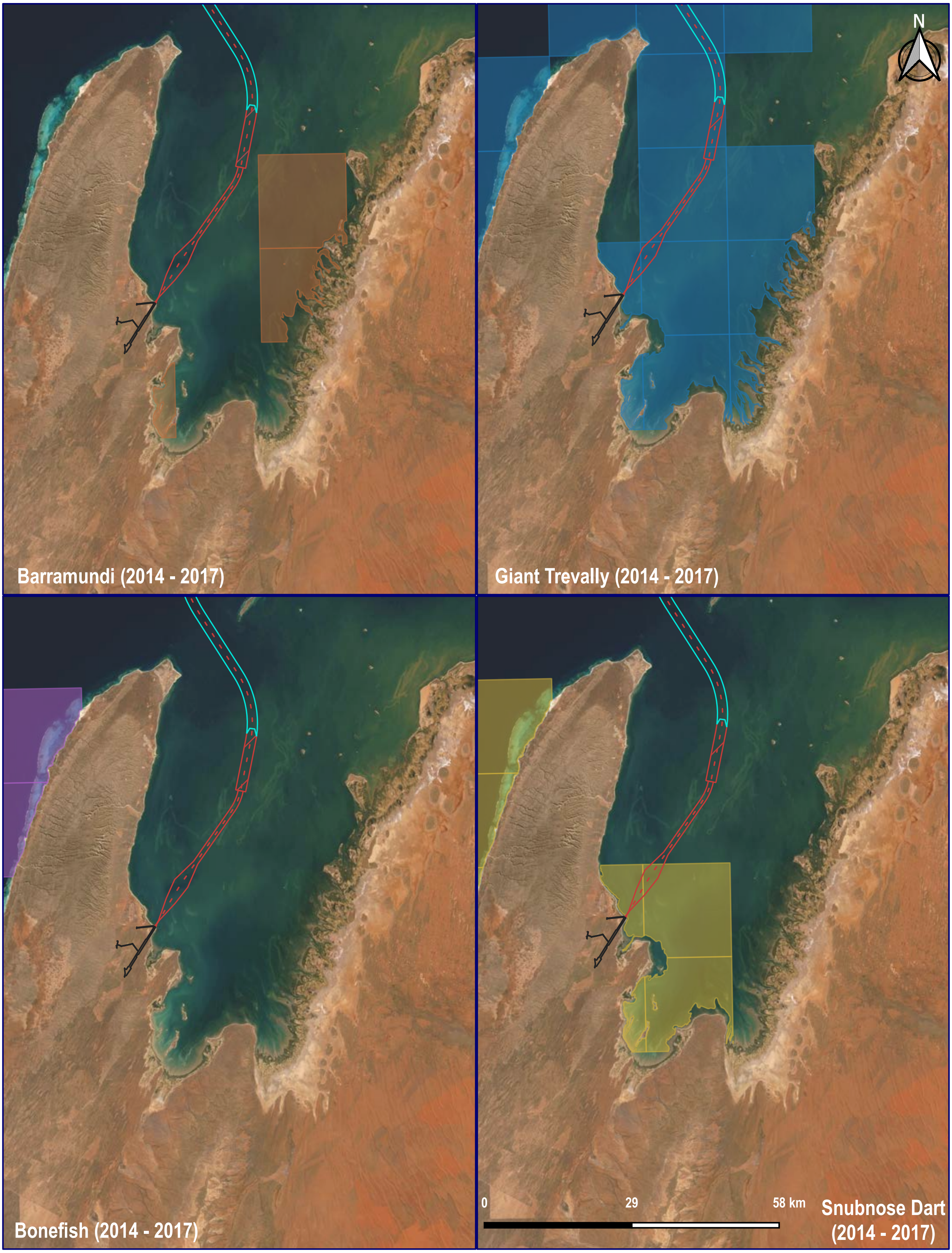


Development Envelope | Off Bottom Tow | Parking Area | Surface Tow | Bundle Tow Route Centre Line

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Aerial Imagery: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from DPIRD (2018).

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Figure 5-32: Key Charter Fishing Areas Within Exmouth Gulf for 2014 to 2017

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Recreational

Recreational fishing effort in the Gascoyne region was monitored during a 12-month creel survey between April 1998 and March 1999. The estimated total annual recreational boat-based angling effort for the region was 53,336 fisher days, with approximately half of this fishing effort occurring within Ningaloo Marine Park. The estimated total annual recreational shore-based angling effort for the region was 77,196 fisher days, with the greatest effort in Exmouth Gulf. The area between Exmouth and Wapet Creek was particularly popular (Figure 5-33), with retirees targeting whiting and western yellowfin bream. The shore-based fishing effort in Ningaloo Marine Park was also high (Sumner *et al*. 2002) (Figure 5-33).

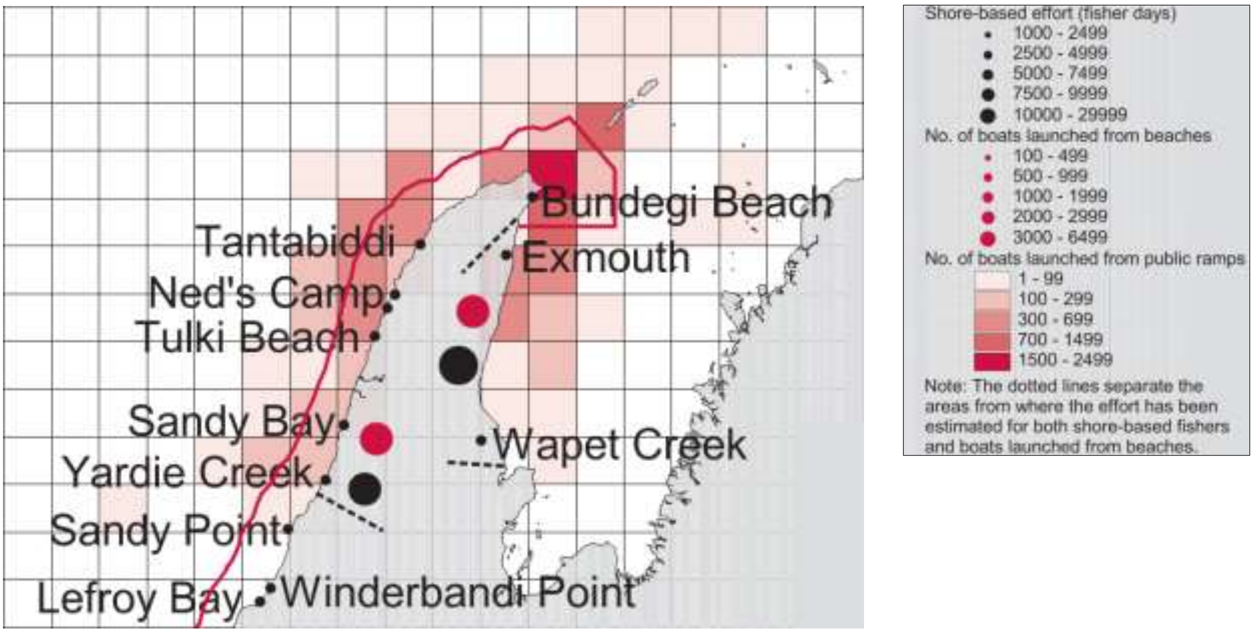



Figure 5-33: Recreational Fishing Effort Within Exmouth Gulf and Along the North West Cape (from Sumner *et al*. 2002)

### 5.4.3.7 Migratory Birds

Migratory shorebirds (included under marine fauna due to their use of and reliance on intertidal and supratidal habitats) are the 37 species listed in EPBC Act policy statement 3.21 (DoEE 2017a). These species are listed under the EPBC Act and regularly visit Australia on their migration. The migratory shorebirds that visit Australia are from the East Asian–Australasian (EAA) flyway. The EEA Flyway, which stretches from Siberia and Alaska to Australia and New Zealand, is a geographic region supporting populations of migratory waders during annual migrations (Bamford *et al*. 2008, DEWHA 2008). It is one of eight major flyways recognised around the world and is used by about 8 million waders of 54 different species (Bamford *et al*. 2008). Sites considered internationally important to migratory waders are those that regularly support 1% or more of the flyway population of a species or that are known to regularly support more than 20,000 waders in total (Ramsar Convention 2000).

Migratory birds, including waders, undertake annual migrations of thousands of kilometres between their breeding areas in the Arctic and their non-breeding areas in Australasia, Africa and South America (Bamford *et al*. 2008). Southward migration to non-breeding grounds in the southern hemisphere typically occurs from September to November. Waders spend summer in the non-breeding habitats (December to February), feeding intensively on invertebrates to build up stores of fat and protein in preparation for migration back to the Arctic (Bamford *et al*. 2008, Priest *et al*. 2002). Northward migration to the Arctic breeding grounds takes place between March and April, and waders capitalise on the abundant food supply during the Arctic summer (Bamford *et al*. 2008).

Roebuck Bay and Eighty Mile Beach are two of the most important sites for migratory waders in Australia, supporting greater than 1% of the EAA Flyway populations for 18 and 16 species respectively (Bamford *et al*. 2008). Annually, the areas have supported over 850,000 waders. The Saltworks at Port Hedland support > 1% of the population for five species (DEWHA 2008). Dampier Saltworks supports internationally important habitat for the Curlew Sandpiper (1.67%) and Oriental Plover (2.6%). Migratory bird surveys completed in Exmouth Gulf for the Yannarie Solar project ranked the Exmouth Gulf survey area as internationally important for five migratory species (Grey-tailed Tattler, Bar-tailed Godwit, Ruddy Turnstone, Sanderling, Greater Sand Plover) (Biota 2005).

Exmouth Gulf is known as an area of international conservation significance for a number of migratory bird species, which are present in numbers greater than 1% of the flyway population, including (Dan Weller pers comm. 2018):

- Eastern curlew.
- Bar-tailed godwit.
- Grey-tailed tattler.
- Ruddy turnstone.
- Sanderling.

A 'staging criterion' of 0.25% of the EAA Flyway population, which takes account of the expected turnover of migratory birds at a site during migratory periods, is also relevant.

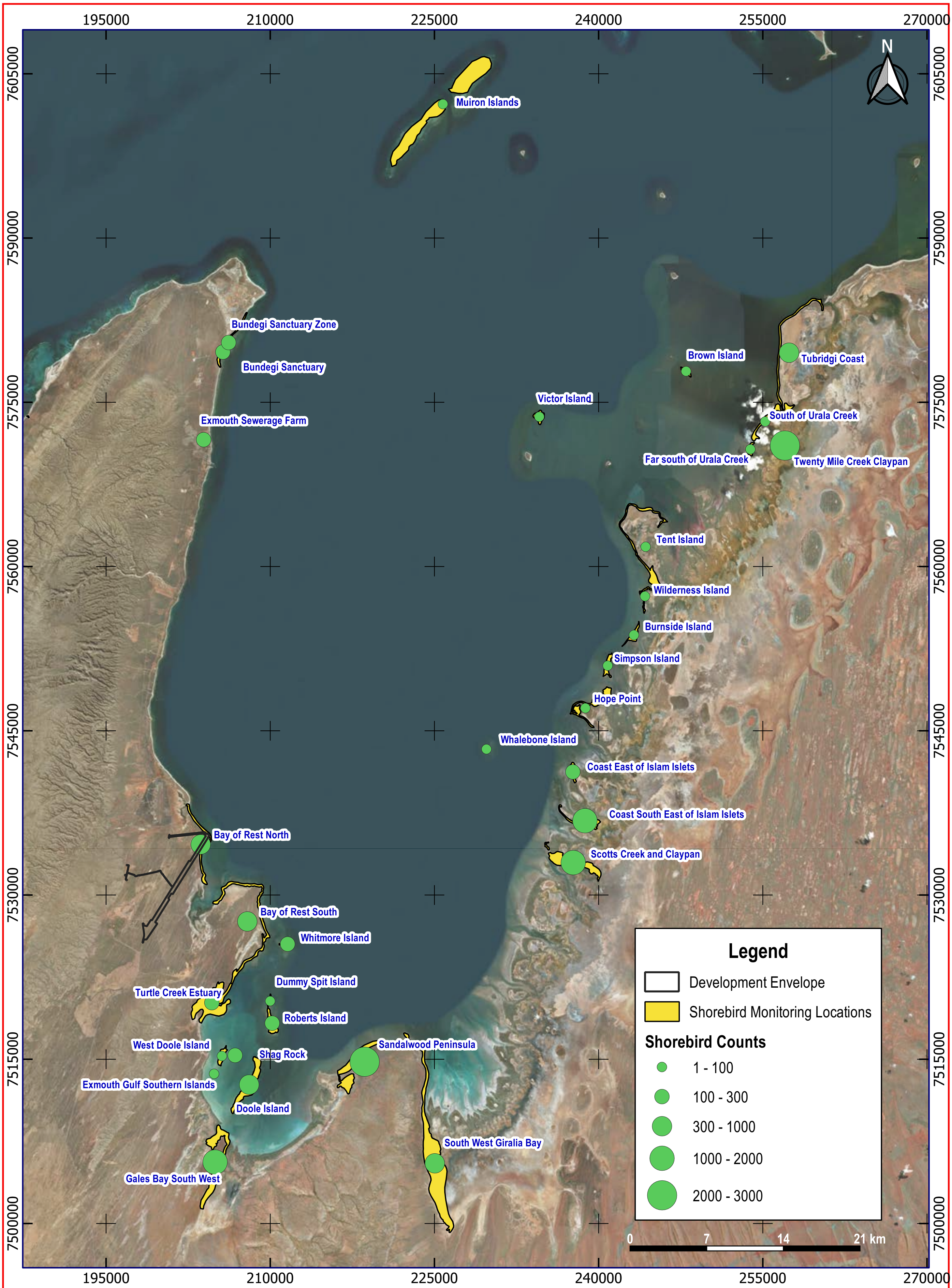
Nationally significant sites are considered to be those that support at least:

- 0.1% of the flyway population of a migratory shorebird species.
- 2,000 migratory shorebirds.
- 15 migratory shorebird species.

Exmouth Gulf is known as an area of national conservation significance for a number of migratory bird species, which are present in numbers greater than 0.1% of the EAA Flyway population, including (Dan Weller pers comm. 2018):

- Red-necked stint.
- Great knot.
- Greater sand plover.
- Whimbrel.
- Lesser sand plover.
- Common greenshank.
- Terek sandpiper.
- Grey plover.

Under the Shorebird 2020 Program, annual counts are completed at over 150 key shorebird areas around Australia, including Exmouth Gulf. Survey areas within Exmouth Gulf, and total (all species) migratory bird counts from January 2018, are shown in Figure 5-34.

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Notes: Data sourced from BirdLife (2018).

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Figure 5-34: Total shorebird Counts in Exmouth Gulf January 2018

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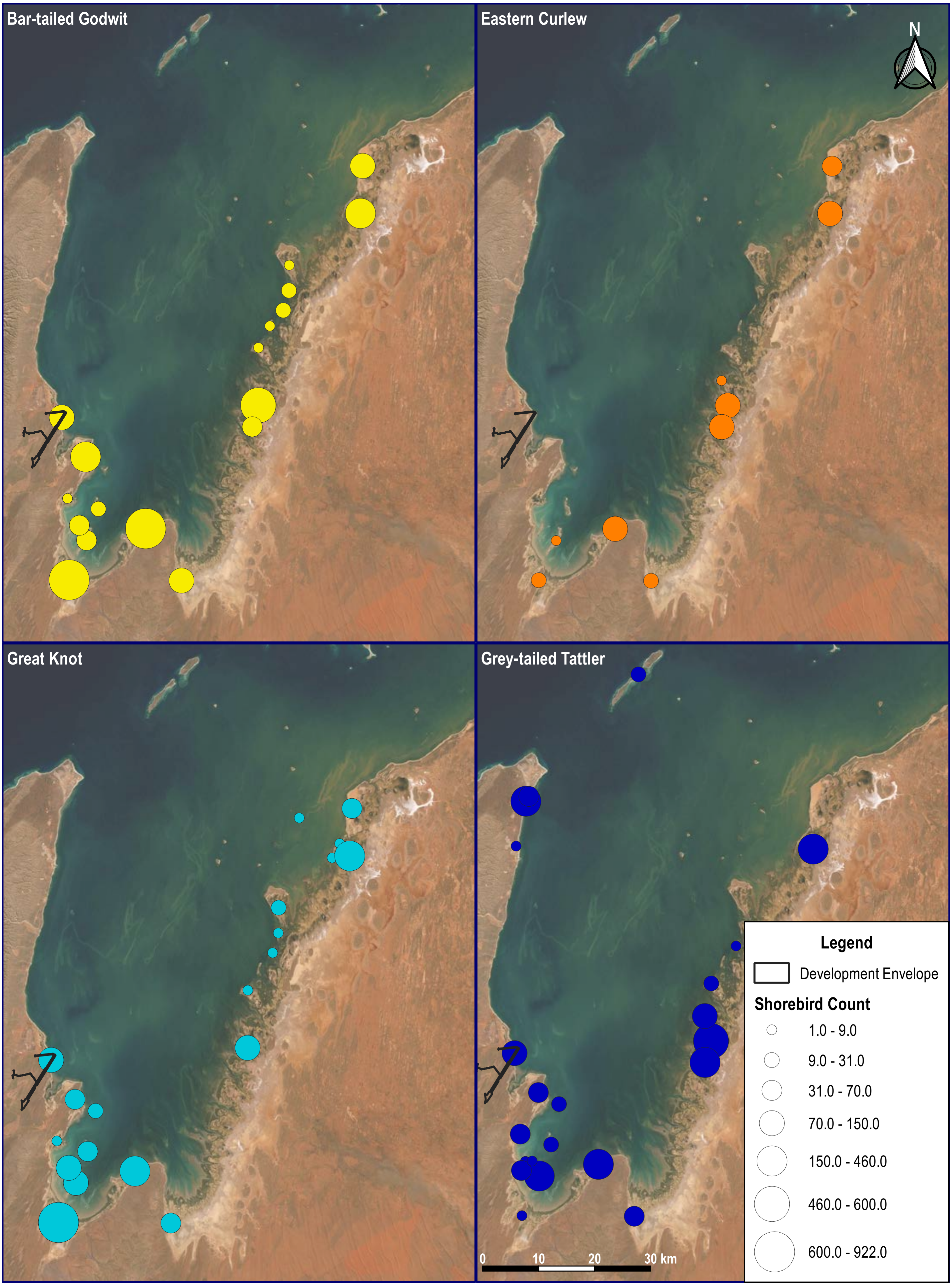
The Shorebird 2020 survey area known as 'Bay of Rest North' includes Heron Point and the Development Envelope. In January 2018 the most abundant species utilising the 'Bay of Rest North' were the Bar-tailed godwit, Eastern curlew, Great knot and Grey-tailed tattler, with numbers of the latter exceeding 0.1% of the EAA Flyway population. All these species were widely recorded elsewhere around the shores of Exmouth Gulf (Figure 5-35).

Shorebird 2020 data from the period February 2008 to February 2018 indicate that during the non-breeding season, numbers of Bar-tailed godwit, Grey-tailed tattler and Sanderling within the Bay of Rest North survey area have exceeded 0.1% of the EAA Flyway population (Attachment 2K). All major roosts were located well to the south of the proposed launchway location (Figure 5-36).

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Aerial Image: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Birdlife (2018).

Subsea 7 Pipeline Fabrication Facility

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Figure 5-35: Key shorebird species counts within Exmouth Gulf (January 2018)

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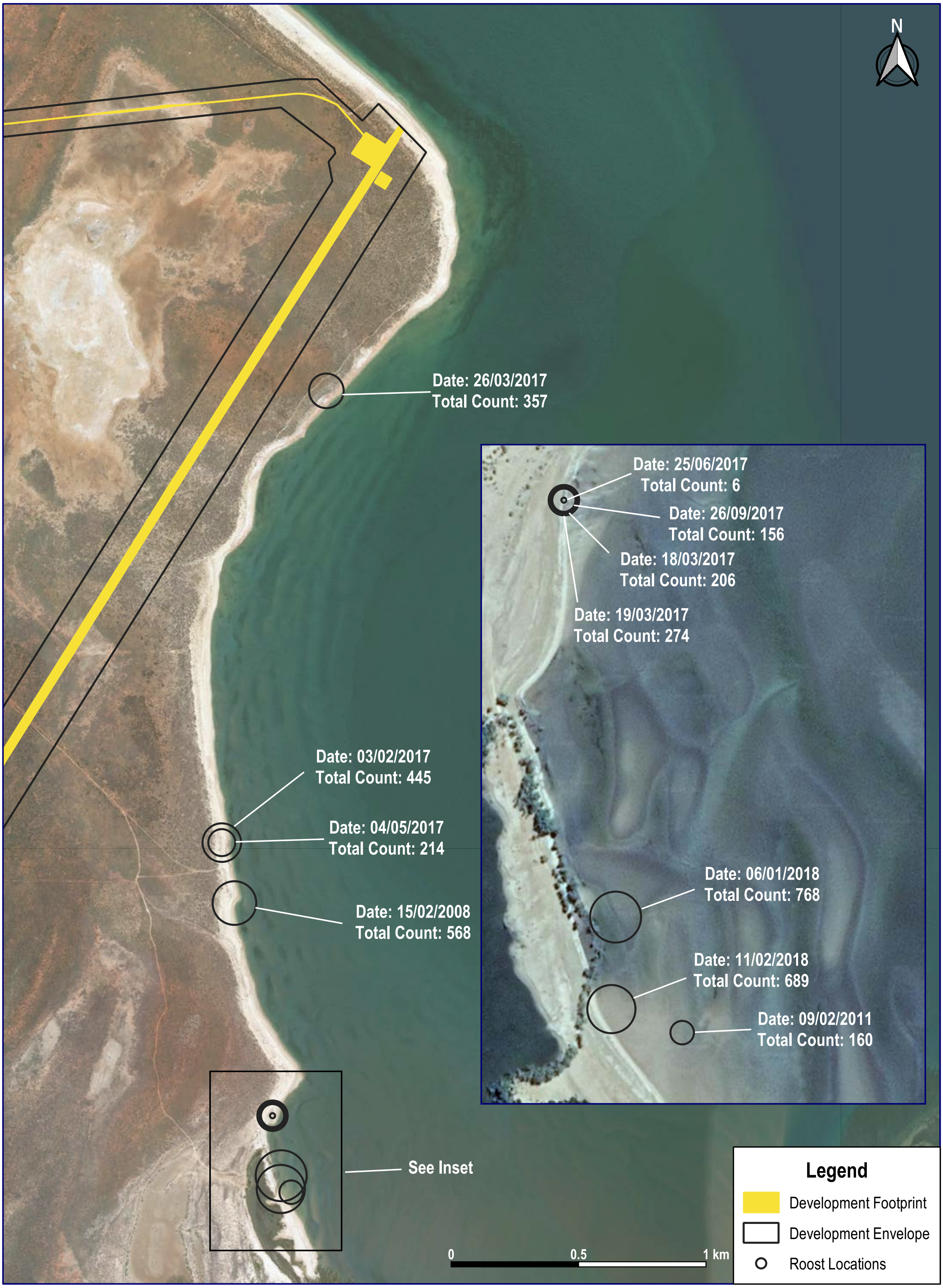


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Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Birdlife (2018).

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Figure 5-36: Nationally Significant Shorebird Counts Within the Bay of Rest North Shorebird2020 Survey Area

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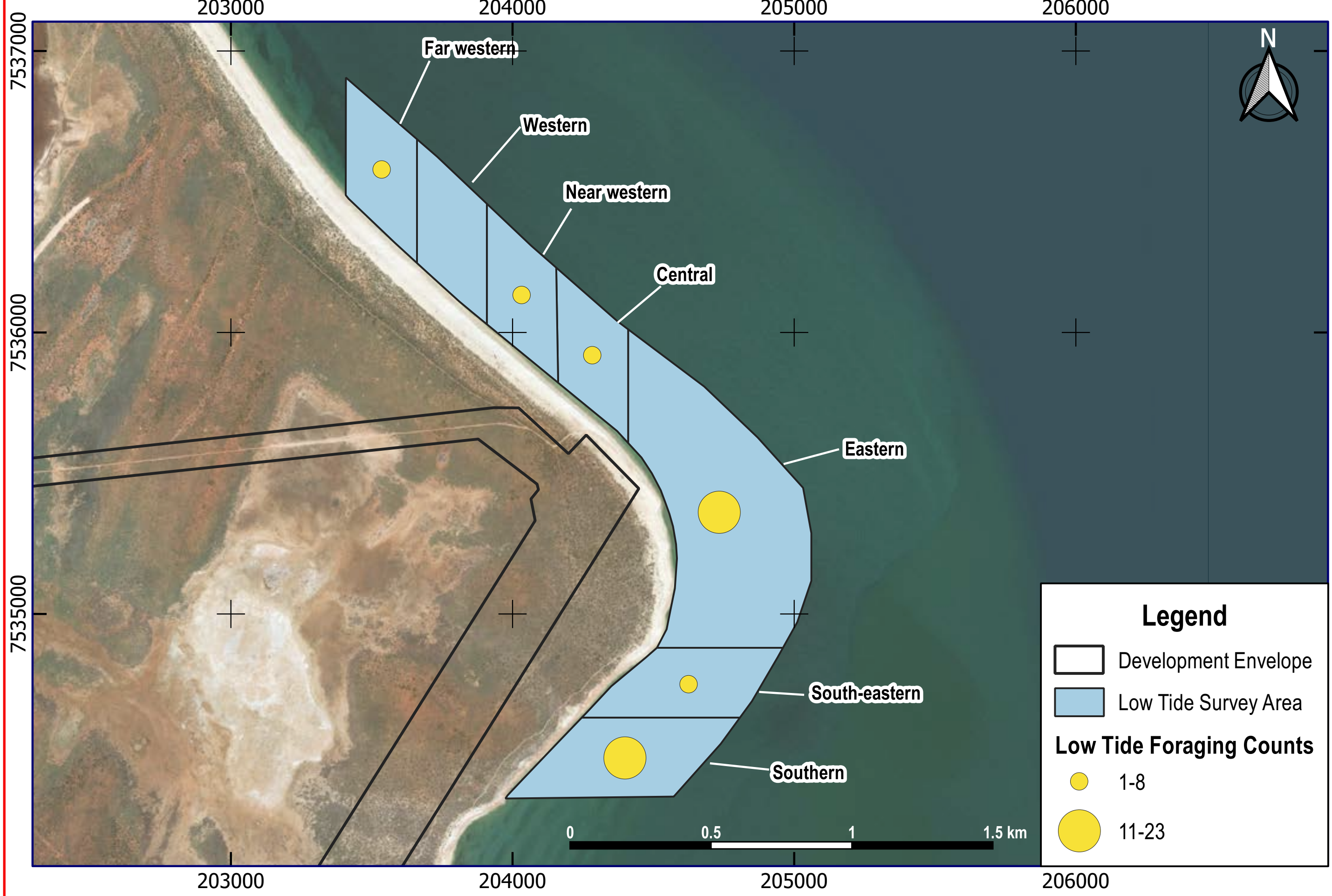
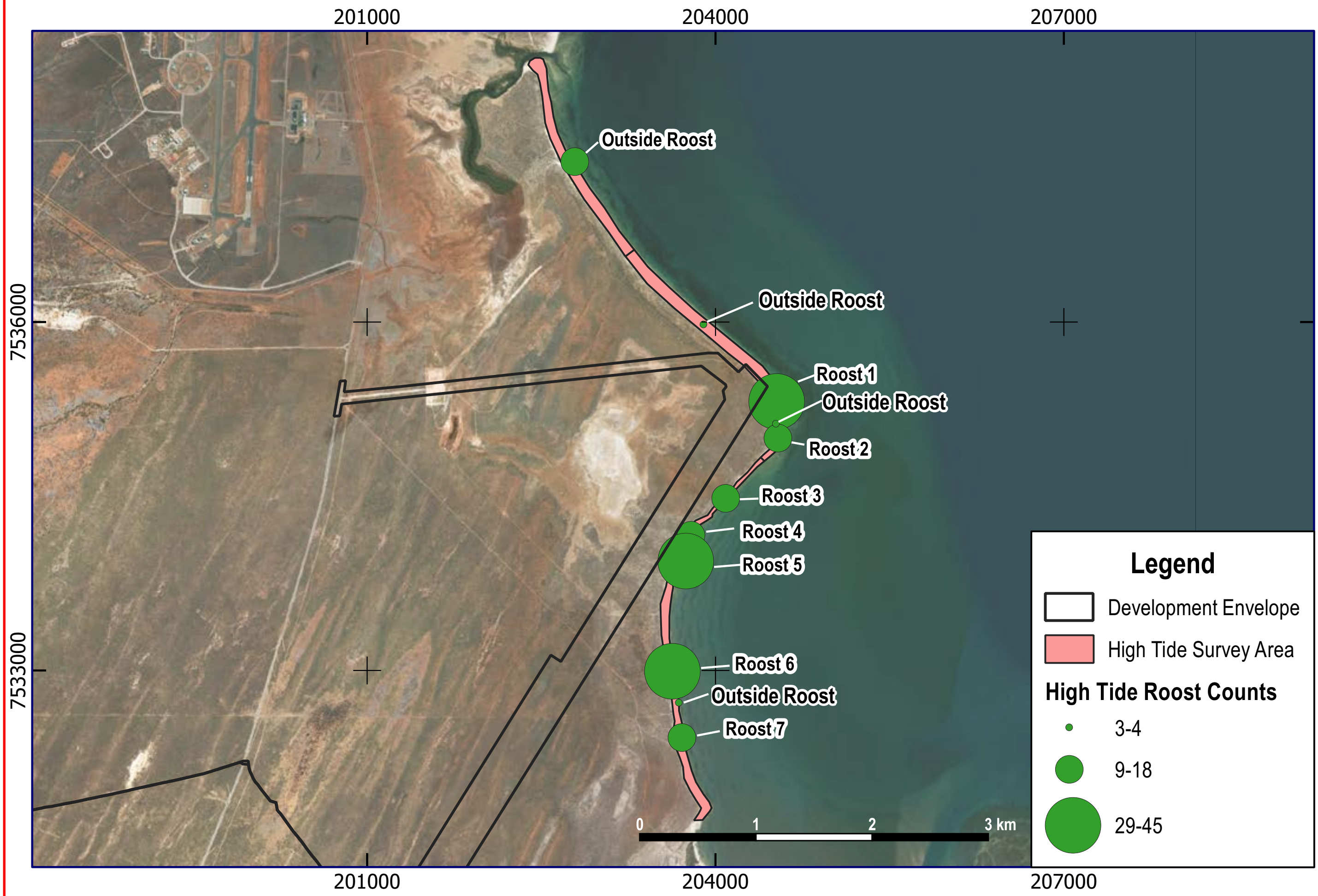
During a survey of migratory shorebirds within the Shorebird 2020 'Bay of Rest North' survey area in October 2018, during the southward migration, 345 birds were recorded roosting at high tide, with 179 being migratory shorebirds, the most common being Red-capped plover (105), Greater sand plover (75) and Grey-tailed tattler (31) (Western Wildlife 2019, Attachment 2K). No migratory shorebird recorded approached the 1% population criterion, 0.25% staging criterion or 0.1% national significance criterion for their species. A total of 76 birds were recorded at low tide of which 47 were migratory species (Attachment 2K). No migratory birds were recorded roosting or foraging within the Development Envelope (Figure 5-37). A high tide roost of 29 migratory shorebirds, including Greater sand plover (12) and Grey-tailed tattler (6), was recorded approximately 150 m to the south east of the Development Envelope. A total of 23 migratory shorebirds, including Grey-tailed tattler (11) and Greater sand plover (8), were recorded foraging at low tide approximately 300 m to the south east of the Development Envelope.

During a repeat survey in January 2019, during the non-breeding season, 439 birds were recorded roosting at high tide, with 155 being migratory shorebirds, the most common being Red-capped plover (121), Greater sand plover (67) and Grey-tailed tattler (27) (Western Wildlife 2019, Attachment 2K). No migratory shorebird recorded approached the 1% population criterion, 0.25% staging criterion or 0.1% national significance criterion for their species. A total of 153 birds were recorded at low tide of which 78 were migratory species (Attachment 2K). No migratory birds were recorded foraging within the Development Envelope (Figure 5-38). Five migratory shorebirds, consisting of Bar-tailed godwit (4) and Oriental plover (1), were recorded roosting at high tide within the Development Envelope. A high tide roost of 31 migratory shorebirds, including Bar-tailed godwit (11), Greater sand plover (6) and Red-necked stint (6), was recorded approximately 150 m to the south east of the Development Envelope. A total of 52 migratory shorebirds, including Ruddy turnstone (16), Greater sand plover (8), Grey-tailed tattler (8) and Sanderling (8), were recorded foraging at low tide approximately 250 m to the south east of the Development Envelope.

In these surveys, no counts of any migratory species exceeded the internationally or nationally significant criteria of 1% or 0.1% of the flyway population, respectively. Total counts of migratory shorebirds were well below the internationally significant threshold of 20,000 birds and the nationally significant threshold of 2,000 birds. No more than 13 migratory shorebird species were recorded, less than the > 15 species that indicates a nationally important site. The habitats of the survey area clearly support small numbers of shorebirds. However, the habitats may be less suitable for shorebirds compared with other parts of the Exmouth Gulf, that have wider and/or more sheltered beaches with islets or sandbars for roosting and muddier substrates for foraging birds at low tide (Attachment 2K).

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| Scale: 1:30000 / 1:60000<br>Original Size: A4<br>Aerial Photo: ESRI Satellite<br>Grid: GDA 94 / MGA Zone 50 | Notes: Data sourced from Western Wildlife (2019).<br><br>Subsea 7 Pipeline Fabrication Facility | subsea 7<br><br>Figure 5-37: Shorebird species counts within the 'Bay of Rest North' survey area (October 2018) |

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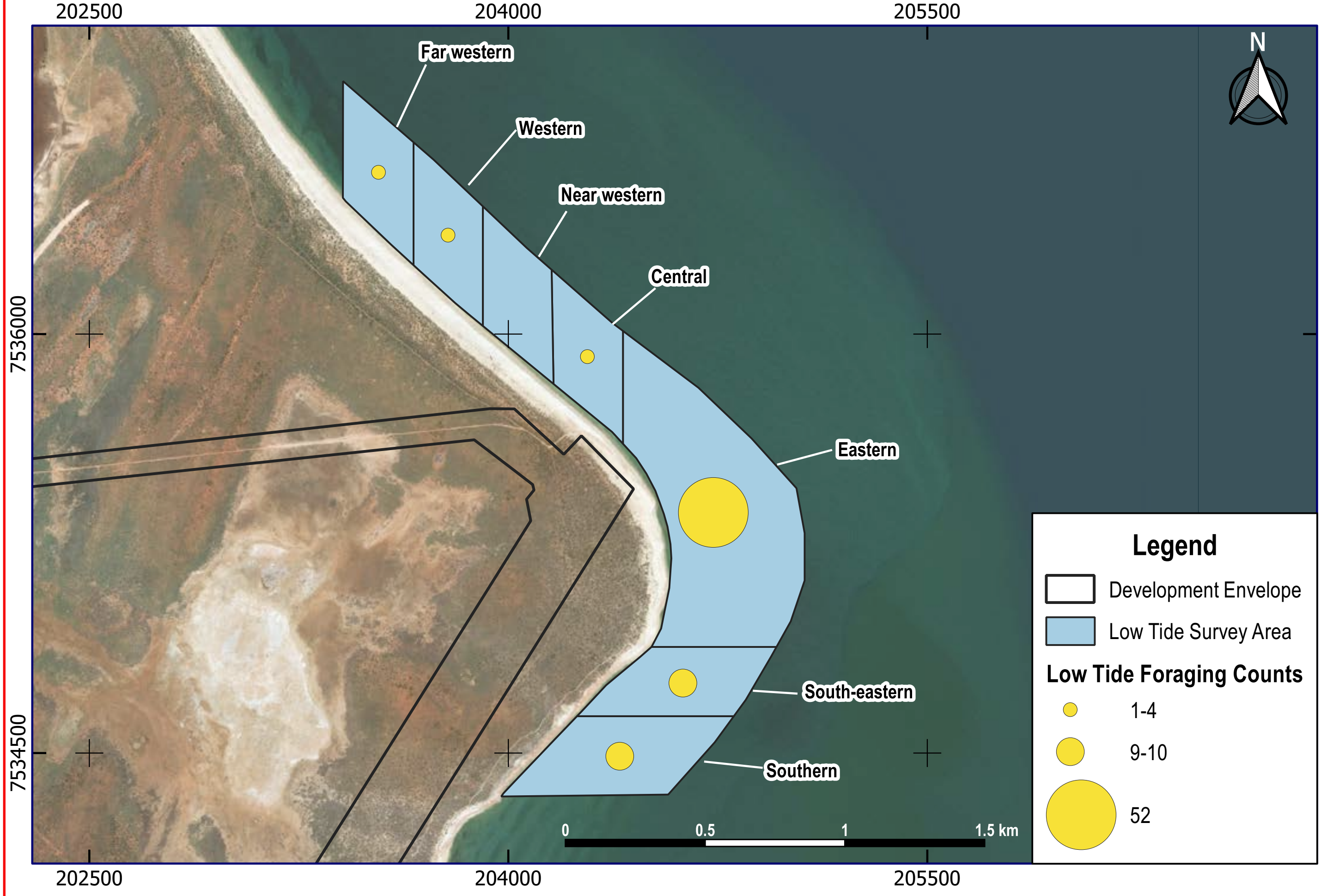


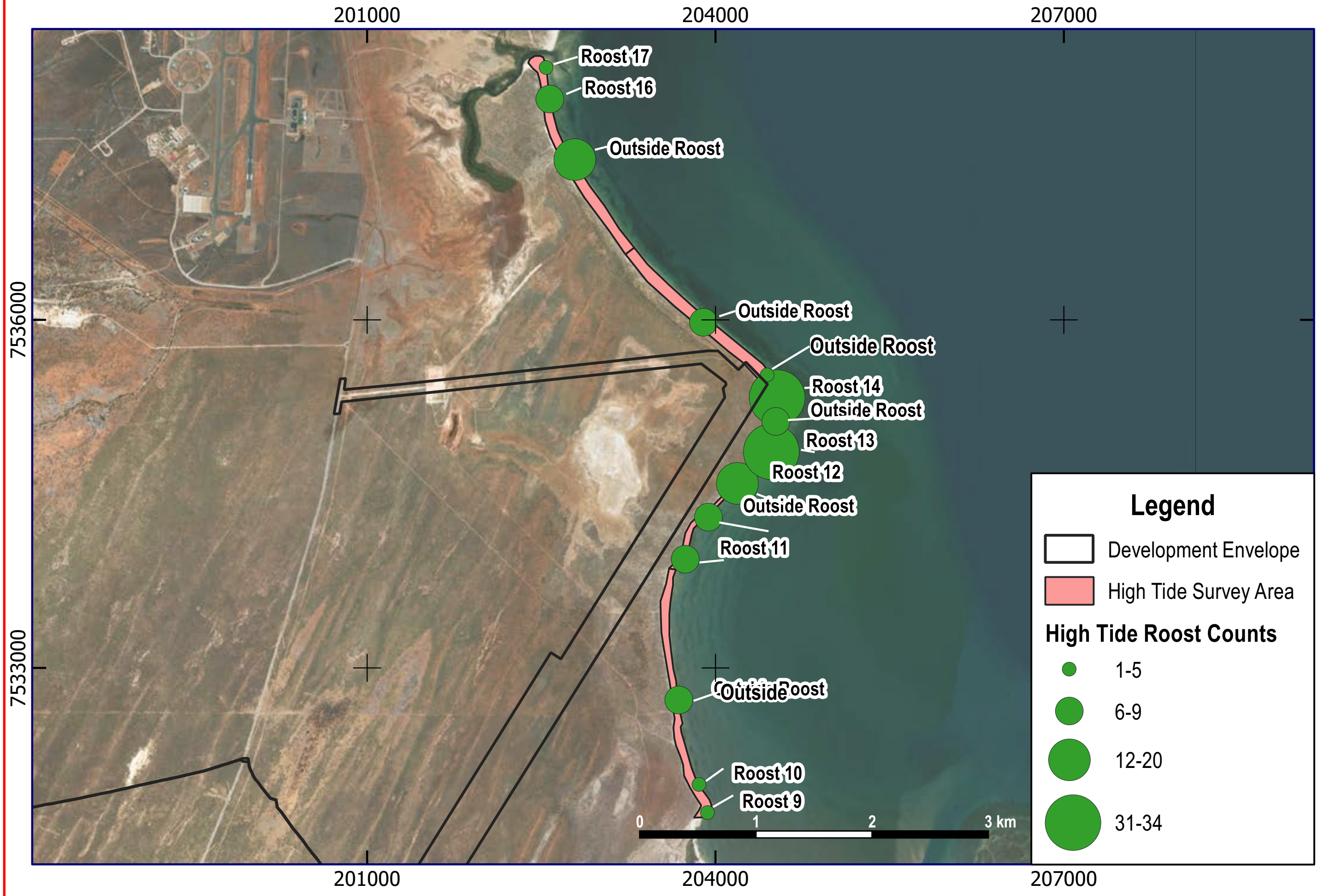


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Aerial Photo: ESRI Satellite
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Notes: Data sourced from Western Wildlife (2019).

Subsea 7 Pipeline Fabrication Facility

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Figure 5-38: Shorebird species counts within the 'Bay of Rest North' survey area (January 2019)

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#### 5.4.3.8 Introduced Marine Pests

Introduced marine species (IMS) are animals and algae that are not indigenous to Australia (or particular habitats within Australia), but have been transferred to local waters and have either established or have the potential to establish within the marine environment (DAFF 2009). Most introduced marine species are innocuous, causing no apparent harm to the local marine environment or marine ecological communities.

Introduced marine species typically include marine gastropods (e.g. sea snails), bivalves (e.g. mussels), polychaetes (e.g. encrusting worms), crustaceans (e.g. barnacles and crabs), echinoderms (e.g. sea stars), some fish species, zooplankton (e.g. copepods), phytoplankton (toxic or bloom-forming microalgae) and macroalgae (seaweed). Over 250 species have been recorded as introduced into Australian waters, 60 of which are in Western Australia (Huisman 2000). The primary mechanisms by which these species can be introduced are through ballast water and biofouling (on vessel hulls).

In contrast, introduced marine pests are introduced marine species that pose a significant risk to environmental values, biodiversity, ecosystem health, human health, fisheries, aquaculture, shipping, ports or tourism (DAFF 2009). Introduced marine pests can cause a variety of adverse effects, which include (Wells *et al*. 2009):

- Damaging the health of local species or eliminating them.
- Fundamentally changing ecosystems.
- Interrupting industrial operations by clogging piping, fouling structures etc.

McDonald (2008) conducted a likelihood analysis of non-indigenous marine species being introduced into fifteen ports in Western Australia through ballast water and biofouling. The analysis used vessel visits data collated for each of the 15 ports during 2006 and compared the relative number of vessel visits, their ports of origin, volumes and locations of ballast water uptake/discharges, size of vessels and vessel types. This report concluded that the Port of Exmouth was the least likely of the 15 Western Australian ports examined for the introduction of non-indigenous marine species.

At the time of writing, DPIRD has yet to conduct a port survey targeting IMS in the Port of Exmouth due to the relative lack of international vessel visits or regular trade. The only IMS recorded from this region is the invasive colonial ascidian, *Didemnum perlucidum,* which appears to be confined to vessels within the Exmouth Marina (DPIRD 2015, Wells 2018). It has been confirmed on artificial structures in Esperance, Albany, Perth, Geraldton, Onslow, Dampier, and Broome (DPIRD 2015).

#### 5.4.3.9 Other Marine Fauna

Two species of hammerhead sharks occur in the Exmouth Gulf; the Great hammerhead shark (*Sphyrna mokarran*) and the Scalloped hammerhead (*Sphryna lewini*). Both species are widely distributed throughout tropical waters and are highly migratory. Seven species of shark that occur in the Exmouth Gulf are listed as Vulnerable on the IUCN Red List (IUCN 2018); the Great white shark (*Carcharodon carcharias*), Oceanic white tip (*Carcharhinus longimanus*), Grey nurse shark (*Carcharias taurus*), Sandbar shark (*Carcharinus plumbeus*), Sicklefin weasel shark (*Hemigaleus microstoma*), Snaggletooth shark (*Hemipristis elongata*), and Sicklefin lemon shark (*Negaprion acutidens*). Other species identified as inhabiting Exmouth Gulf include the Tiger shark (*Galeocerdo cuvier*), Spinner shark (*Carcharhinus brevipinna*), Bull shark (*Carcharhinus leucas*), Black tip reef shark (*Carcharhinus melopterus*), Grey reef shark (*Carcharinus amblyrhynchos*), Black tip (*Carcharinus limbatus*), Brown banded bamboo shark (*Chiloscyllium punctatum*), Blue shark

(*Prionace glauca*), White tip reef shark (*Triaenodon obesus*) and Nervous shark (*Carcharhinus cautus*) (Fitzpatrick *et al*. 2019).

The Green sawfish (*Pristis zijsron*) occurs in inshore coastal environments including estuaries, river mouths, embayments and along sandy and muddy beaches, as well as offshore marine habitat (DoE 2015b). The Ashburton River estuary, north of Locher Point and outside of Exmouth Gulf, is currently the only identified pupping site and nursery for Green sawfish (Morgan *et al*. 2016).

The Reef manta ray (*Manta alfredi*) and Giant manta ray (*Manta birostris*) are known to occur within or adjacent to Exmouth Gulf (refer Section 7.5.3).

Fifteen of Australia's 35 species of sea snake have been recorded in Exmouth Gulf. These include the Short-nosed seasnake (*Aipysurus apraefrontalis*), the Leaf-scaled seasnake (*Aipysurus foliosquama*), (*Emydocephalus* sp. indet) and the North-western mangrove seasnake (*Ephalophis greyi*) (Fitzpatrick *et al*. 2019). Recently, populations of *A. foliosquama* and *A. apraefrontalis* were identified in coastal Western Australia, in the Exmouth Gulf and Shark Bay, resulting in substantial range expansions (Fitzpatrick *et al*. 2019). Numerous seasnakes were recorded within Exmouth Gulf during the aerial surveys (Attachment 2J) though the species and types of activity could not be determined.

### 5.4.4 Potential Impacts

Construction and operation of the Proposal has the potential to directly and indirectly impact marine fauna. Table 5-21 summarises the potential impacts during each project phase.

| Project Phase | Potential Impact |
|---|---|
| Construction | Loss or degradation of BCH representing marine fauna habitat (e.g. breeding and or foraging habitat) due to launchway construction |
| | Temporary behavioural responses of marine fauna due to noise or light spill during construction |
| | Introduction of non-indigenous marine pests via construction vessels |
| Construction and Operations | Temporary behavioural response of marine fauna due to changes in marine water quality |
| | Reduction in abundance of commercial and recreational fishing species due to loss of habitat and/or changes in marine water quality |
| Operations | Loss or degradation of BCH representing marine fauna habitat (e.g. breeding and/or foraging habitat) during Bundle launch and tow |
| | Temporary behavioural response of marine fauna due to noise or light spill during Bundle launch and tow |
| | Direct impact (strike or entanglement) during Bundle launch and tow |
| | Introduction of non-indigenous marine pests via operational vessels |
| | Loss or alteration of coastal habitat as a result of changes to coastal processes or hydrodynamic/hydrological regimes |
| | Leak or spill of chemicals (including hydrocarbons) associated with launch and tow activities, accidental collisions and loss of control of pipeline Bundle during launch, laydown, towing, or ship groundings, impacting marine fauna health |

Table 5-21: Potential Impacts to Marine Fauna

### 5.4.5 Potential Cumulative Impacts

Several third party projects or proposals (refer Section 2.5.8) have, or have had, potential to result in impacts to marine fauna within Exmouth Gulf. Past direct impacts to marine fauna are most likely to have occurred as a result of the Exmouth Gulf Prawn Fishery. Low-level (behavioural) impacts could be occurring as a result of recreational and commercial vessel operations within Exmouth Gulf (refer Section 2.5.8.7). Cumulative impacts to marine fauna are addressed in Section 5.4.6.11.

### 5.4.6 Assessment of Impacts

#### 5.4.6.1 Loss or Degradation of BCH Representing Marine Fauna Habitat (e.g. Foraging Habitat) due to Launchway Construction

Some benthic communities are critical to the long-term viability of marine fauna species protected under State or Commonwealth legislation or of particular iconic status or commercial importance. They may either function as recruitment sites, nursery areas, or as important feeding areas.

The EPA expects proponents to identify any critical associations between important marine fauna and key BCH that are likely to be impacted (EPA 2016d).

Marine turtles are known to occur within Exmouth Gulf, and nest on the beaches of the North West Cape and Muiron Islands, with internesting likely to occur adjacent to these nesting sites (Section 5.4.3.3). The BCH within or adjacent to the launchway footprint is not considered to represent important foraging habitat to any marine turtle species.

The Department for Sustainability, Environment, Water, Population and Communities (DSEWPaC), during development of the draft Marine Bioregional Plan for the North-west Marine Region (DSEWPaC 2011c), identified biologically important areas for four species of cetacean in the North-west Marine Region: the Humpback whale, Australian snubfin dolphin, Indo-Pacific humpback dolphin and Indo-Pacific bottlenose dolphin. Such areas are those where aggregations of individuals of a species display biologically important behaviours. Behaviours that have been used to define biologically important areas are breeding, calving, and foraging for each of the three dolphin species. The areas identified are all well north of the Proposal area, ranging from Broome in the south to just short of the Northern Territory border in the north (DSEWPaC 2011c).

Exmouth Gulf has been identified as a biologically important area in recognition of its value as a resting area for migrating Humpback whales, with very high densities of nursing cows with calves during the southern migration (DSEWPAC 2012b). However, Humpback whales do not forage during their southern migration (Lyn Irvine, pers. Comm 2018b) and are not dependent upon any BCH.

The Australian humpback dolphin (*Sousa sahulensis*) (previously named the Indo-Pacific humpback dolphin (*Sousa chinensis*)) shows selection for various types of habitats including dredged channels, reefs, seagrass flats, and mangroves (Parra and Cagnazzi 2016). Around the North West Cape, dolphins have been sighted in clear waters over Ningaloo Reef, and in turbid waters in Exmouth Gulf and in depths ranging from 1 to 40 m deep (Parra & Cagnazzi 2016). It is not expected that the BCH within or adjacent to the launchway footprint represents critical habitat to any dolphin species. Whilst dolphins may feed in the launchway area, as described in Section 5.1.3.2, this habitat (and the associated prey items) is widely distributed both locally and regionally and loss of the small area of potential foraging habitat (Soft sediment (0.2 ha) and Reef with macroalgae (0.3 ha) is considered unlikely to adversely impact dolphins.

While Exmouth Gulf has been identified as a biologically important area for foraging and nursing by Dugong (DSEWPAC 2012b), Dugong activity is thought to be focused on the east coast of the Gulf associated with the shallow seagrass habitat (Oceanwise 2005). This was supported by data collected for the Proposal during aerial surveys between August and November 2018 (Attachment 2J). It is not expected that the BCH within or adjacent to the launchway footprint represents critical habitat to Dugong. Thus no impact to Dugong is expected as a result of the potential local impacts to BCH during construction of the launchway off Heron Point.

#### 5.4.6.2 Temporary Behavioural Responses of Marine Fauna due to Noise or Light Spill during Construction

<u>Light</u>

Construction activities will typically occur during daylight hours (12-hour shifts) limiting the likelihood of exposure of marine fauna to artificial light disturbance. A small number of artificial light sources, appropriate to the task and compliant with occupational health and safety requirements, may be required (for example navigational lighting on a construction barge if moored off Heron Point overnight or security lighting at an active construction site).

Construction phase lighting at the launchway has the potential to cause minor behavioural impacts to marine fauna. It is noted that turtle nesting does not occur within Exmouth Gulf, so turtle hatchlings, known to be highly sensitive to artificial light during emergence, will not be affected.

Migratory birds are adapted to natural changes associated with the day and night cycle, as well as the night-time phase of the moon, to guide feeding patterns and orient flight during migration. The introduction of artificial lighting during nocturnal periods has potential to create a constant level of light that can reverse these natural levels and cycles, potentially impacting on behaviour. Additionally, lighting may also increase detection of birds by predators (Rogers *et al*. 2006). During migratory shorebird surveys in October 2018 and January 2019 only five migratory shorebirds, consisting of Bar-tailed Godwit (4) and Oriental Plover (1), were recorded roosting at high tide within the Development Envelope. High tide roosts of 29 migratory shorebirds (October 2018) and 31 migratory shorebirds (January 2019) were recorded approximately 150 m to the south east of the Development Envelope and a total of 23 migratory shorebirds (October 2018) and 52 migratory shorebirds (January 2019) were recorded foraging at low tide to the south east of the Development Envelope (Attachment 2K). Given the relatively low numbers of migratory birds roosting within and adjacent to the Development Envelope, and the presence of numerous alternative roosts nearby, a significant impact to migratory birds as a result of any temporary construction phase lighting is not expected.

Given construction of the launchway will primarily occur during daylight hours, the amount of lighting required will be limited (e.g. for safety or security purposes only). The short-term nature of launchway construction means the need for marine vessels for construction will be low, with vessels present for only short durations. As such, adverse impacts on marine fauna from lighting are considered to be insignificant.

Management measures will be put in place to avoid or minimise impacts to marine fauna from light during construction (refer Section 5.4.7). Lighting will take account of measures proven to reduce the risk of impact on marine fauna including the use of shrouded or directional lighting, motion-sensor or timed lighting and placement of lights to minimise offshore light spill. Construction vessels moored offshore will display the minimum light necessary for maritime safety.

<u>Noise</u>

Potential impacts to marine mammals and reptiles from underwater noise include physical injury, a temporary or permanent threshold shift (TTS/PTS), a behavioural response and masking and interference. Behavioural impacts resulting from marine noise may include interference in communication, localised deviations in migratory patterns and displacement from foraging or resting areas (McCauley et. al. 2000, Weilgart 2007, Tyack 2008).

Noise from vessels and construction equipment during construction of the launchway is likely to fall within the sensory bandwidth of marine mammals. For the majority of low frequency cetaceans, such as Humpback whales, behavioural disturbance due to non-pulsed noise sources (such as vessel noise) has been found to occur at a received sound pressure level (SPL) of 120-160 dB re 1 µPa, with little if any response to levels <120 dB re 1 µPa (SPL) (Southall *et al*. 2007). Mid-frequency cetaceans, such as dolphins, exhibit varied sensitivity to non-pulsed noise, but have been reported to exhibit a response following exposure to 90-120 dB re 1 µPa (SPL) (Southall *et al*. 2007). The sirenian group, including Manatees and Dugong, have been found to exhibit lower sensitivities compared to the mid-frequency cetaceans (NOAA 2016). Little is known about the source levels and associated frequencies that cause physical injury to turtles. Testing has shown change in swimming behaviour in Green and Loggerhead turtles at noise levels of 166 to 175 dB re 1 µPa (SPL), which is understood to be an avoidance response (SVT 2010).

Construction activities with potential underwater noise impacts on marine fauna will be limited to those associated with launchway construction. Launchway construction will involve minor sediment excavation work, rock armour dumping and the placement of pre-cast concrete panels. The barge-based rock armour dumping operation is expected to generate the greatest underwater noise due to the vessel operational noise (propellers inducing cavitation noise) and the noise from the splash, tumble and grinding of rocks during the placement process.

A screening-level assessment of potential underwater noise impacts associated with the proposed launchway construction works has been completed to determine the level of risk of impacts to marine fauna (SLR 2019). A conservative (worst case) assumption has been made that the barge noise levels could be similar to those of a trailing suction hopper dredge (TSHD) with a typical source level (RMS) of 182 dB re 1µPa @ 1m (SLR 2019). With distance from a noise source, sound energy decreases as a result of spreading effects and bottom interaction effects (absorption) at lower frequencies or scattering losses at high frequencies. Given the shallow water depths within Exmouth Gulf, strong interaction between the sound field and the seabed is expected (SLR 2019). Thresholds for the onset of TTS and PTS, as presented by Southall *et al*. (2019), were applied to the predicted maximum noise levels during launchway construction. For low frequency cetaceans, such as Humpback whales, exposure to barge and rock dumping noise could lead to the onset of TTS for individuals remaining within 20 m of construction activities for half an hour (SLR 2019). Other hearing groups (high-frequency cetaceans, very high-frequency cetaceans, sirenians and marine turtles) are less sensitive and are considered unlikely to experience PTS or TTS impacts (SLR 2019). Behavioural responses in Humpback whales (and other marine mammals) could occur within 2.2 km of construction activities, while the risk of behavioural impacts in turtles was considered low (SLR 2019).

Given the low sound levels at the source, the rapid attenuation of sound energy in water with distance from the source, and the adoption of an exclusion zone around marine construction works (refer Table 5-22), no PTS or TTS impacts to marine fauna from underwater noise are expected. A behavioural response (for example temporary movement away from the launchway area) may occur during excavation or rock dumping operations. No key foraging habitat is located within 2.2 km of the launchway footprint.

Coastal construction activities have the potential to displace migratory birds using the adjacent areas for roosting or foraging. During migratory shorebird surveys in October 2018 and January 2019 limited numbers of shorebirds were recorded roosting or foraging within, or adjacent to, the Development Envelope (Attachment 2K). Given the relatively low numbers of migratory birds roosting within and adjacent to the Development Envelope, and the presence of numerous alternative roosts nearby, a significant impact to migratory birds as a result of any construction phase airborne noise is not expected.

Management measures will be put in place to avoid or minimise impacts to marine fauna from noise (refer Section 5.4.6.11).

#### 5.4.6.3 Temporary Behavioural Response of Marine Fauna due to Changes in Marine Water Quality

Elevated suspended sediment concentrations vary spatially, temporally and vertically in the water column (Section 5.3.3).

During launchway construction, elevated suspended sediment concentrations will be limited to the immediate vicinity of the launchway footprint. Surveys have recorded relatively low numbers of Humpback whales, dolphins, Dugong, and marine turtles in the vicinity of the launchway (Figure 5-21, Figure 5-23, Figure 5-26, and Figure 5-29). Controls will predominantly be focussed on the prevention of broad scale and persistent turbidity plumes that could potentially cause impacts to surrounding BCH (refer Section 5.1.6.4). However, these controls will also minimise the likelihood of impact on marine fauna within the local area.

Elevated suspended sediment concentrations during Bundle launch and tow will vary, but will be transient (short-term) and local (Figure 5-8). Humpback whales communicate predominantly using sound (C. Jenner, pers. comm. 2010, Lyn Irvine pers. comm. 2018b), and do not feed during the southern migration, so are not expected to be significantly impacted by elevated turbidity. It is noted that no Bundle launches will occur during the peak of the Humpback whale southern migration so minimal numbers would be exposed to elevated turbidity associated with a Bundle launch.

Other marine fauna, such as dolphins and marine turtles that occur widely across Exmouth Gulf, and Dugong that generally inhabit the margins of Exmouth Gulf, commonly forage in turbid inshore areas such as tidal creeks (Section 5.4.3).

Internesting marine turtles are understood to show inactive behaviour (Hays *et al*. 1999), and it has been demonstrated that one behavioural strategy employed by internesting marine turtles to optimise energy reserves, is to rest and remain inactive on the seabed (Hays *et al*. 2000, Fossette *et al*. 2012). In particular it is suggested that, when resting, turtles:

- Use deeper and slower moving water in order to remain on the seabed for longer periods, thus minimising the energy cost of commuting to the surface.
- Alter their dive behaviour to utilise a specific bathymetric depth that maximises the oxygen store, while still attaining near-neutral buoyancy on the seabed (Hays *et al*. 2000, Whittock *et al*. 2014).

Thus they are unlikely to be affected by short-term elevated turbidity during this phase.

Dolphins primarily feed using echo location so would be relatively unaffected by reduced underwater visibility, Dugong feed on shallow seagrass which is not present in the vicinity of the tow route and marine turtles feed on a range of plant and animal food sources, none of which are present in high abundance within the disturbed soft sediment habitat of the central Exmouth Gulf (Figure 5-2). Marine fauna are not expected to be significantly impacted.

#### 5.4.6.4 Reduction in Commercial and Recreational Fishing Species due to Loss of Habitat and/or Changes in Marine Water Quality

Fish

A recent study (Wenger *et al*. 2018) was undertaken to assess the potential vulnerability of coastal fish and fisheries to dredging activities on a global scale. The study included the development of threshold reference values for suspended sediment.

Threshold reference values required to protect 99% of species from either physical damage or lethal impacts from suspended sediment were relatively similar, ranging from 4 to 9 mg/L, respectively. The threshold value necessary to protect 90% of species from minor physical damage or moderate behavioural impacts was 26 mg/L, while a threshold value of 102 mg/L would protect 90% of species from lethal impacts (Wenger *et al*. 2018). This indicates that a small minority of species included within the study were highly sensitive to suspended sediment concentrations below 26 mg/L, compared to the majority that were not. Larvae and juveniles are more vulnerable than adults and will experience lethal impacts at lower concentrations and exposure durations. Exposure of larvae to concentrations up to 60 mg/L did not have a lethal impact until after 24 hours (Wenger *et al*. 2018).

Within an environment that regularly experiences elevated suspended sediment concentrations, such as Exmouth Gulf, it can be assumed that the majority of species would have a degree of tolerance to suspended sediment. The threshold values determined by Wenger *et al*. (2018) to protect 80% of species from physical damage or lethal impacts were 58 mg/L and 274 mg/L respectively. The area within which potential impacts to fish could occur during Bundle launch and tow was modelled against a potential impact threshold of 'average TSS concentration over 24 hours exceeds 60 mg/L', which is considered conservative (worst case) given the resident fish species are exposed to naturally elevated TSS concentrations known to regularly occur within Exmouth Gulf (refer Section 5.3.3). Under both flood-tide and ebb-tide launch scenarios; the threshold was not exceeded at any time (Attachment 2H).

Given the minor, local, extent of elevated suspended sediment concentrations associated with launchway construction (Section 5.1.6.4) and the localised and transient increases in suspended sediment concentrations during a Bundle launch and tow, no significant impacts on commercial or recreational fish species are expected. The subtidal launchway structure is likely to represent habitat that provides food (once colonised by macroalgae and invertebrates) and shelter to fish species, potentially resulting in a local benefit to some fish species.

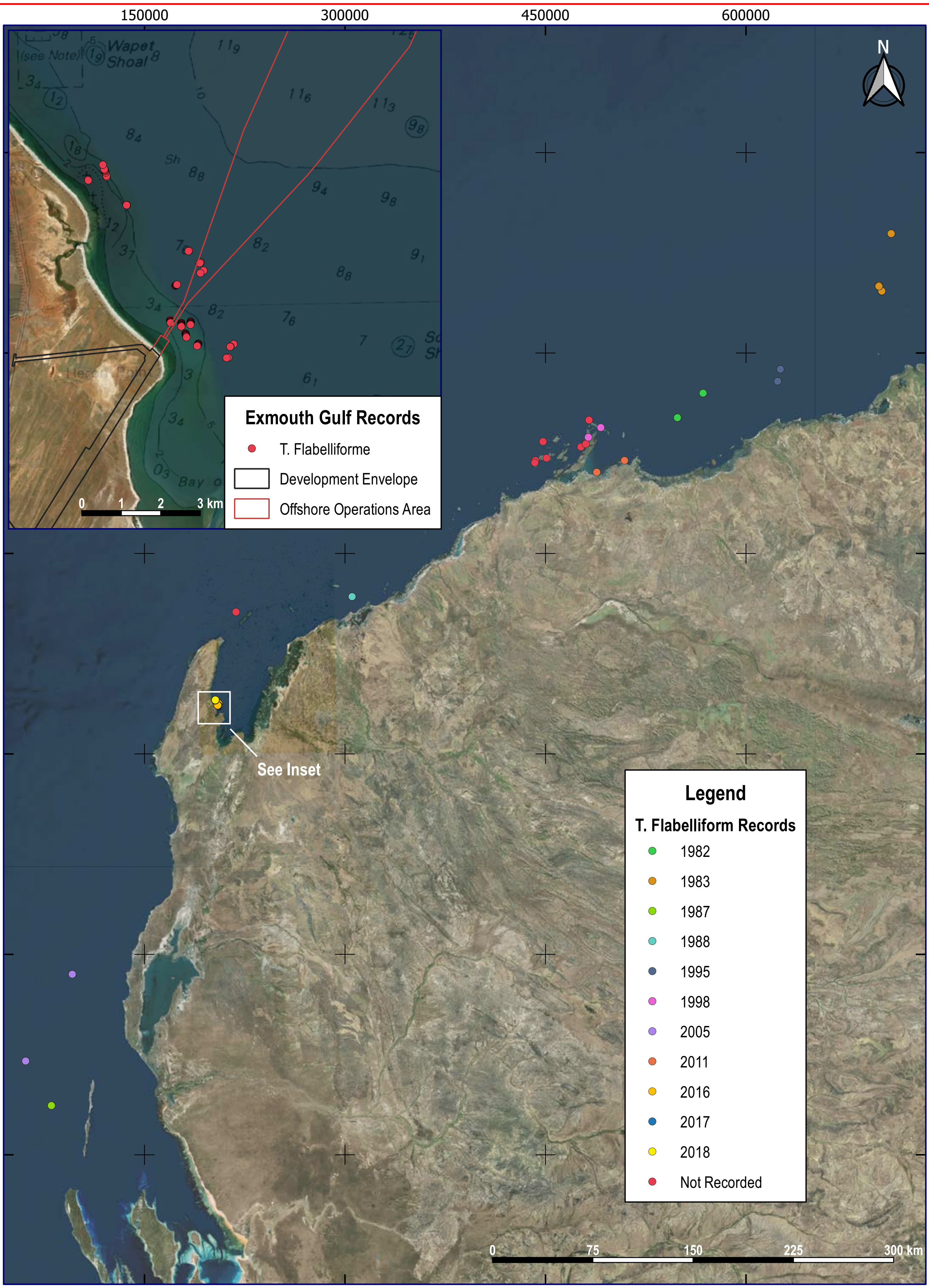
Invertebrates

The Exmouth Gulf Prawn Fishery targets Banana, Tiger, King, and Endeavour prawns with a focus of Tiger, King, and Endeavour prawns (DPIRD 2018). Information on the life cycles and habitat use of Tiger and King prawns is presented in Section 5.4.3.6. Suspended sediment tolerances of cultured prawn species, noted as similar to Banana and Brown tiger prawns, were recorded to be in excess of 130 mg/L (Preston *et al*. 2001). The Catch and Effort Statistics System (CAESS) records from the Exmouth Gulf prawn fishery from 1980 to 2000 showed that the dominant by-products, in terms of weight and value, were Coral prawns, squid and Blue swimmer crabs (Kangas *et al*. 2006b). Blue swimmer crabs (*Portunus armatus*) are also targeted within Exmouth Gulf by recreational fishers.

Due to similar life cycles the Dungeness crab, a commercially important species to fisheries in North America, has been used as a proxy to Blue swimmer crabs. For this species exposure of adults to a suspended sediment concentration of 3,500 mg/L for 28 days resulted in a 10% mortality, and exposure of juveniles to a concentration of 1,800 mg/L for 28 days resulted in 5% mortality (Peddicord and McFarland 1976). There was little variation of mortality with increasing suspended sediment concentrations (up to 18,900 mg/L) over a short duration (eight days) (Peddicord and McFarland 1976). Given the lack of exceedance of the potential impact threshold for fish (60 mg/L, 24 hr average) during Bundle launch and tow, no impact to invertebrates is expected.

It is understood that at least one licenced fisher collects specimens of the sponge *Trikentrion flabelliforme*, more commonly referred to as the 'Spider Sponge', from the Heron Point area (Darren Gebbetis pers comm. 2018). *T. flabelliforme* has a recorded depth range of 3 m at shallow offshore rock and coral rubble reefs to depths of greater than 80 m in offshore waters (Hooper 1991, Fromont 2004, Fromont *et al*. 2016). The most noticeable characteristic of *T. flabelliforme* is the infestations of white zoanthids that commonly heavily infest these sponges. This characteristic makes this species particularly popular as an aquarium specimen (Darren Gebbetis pers comm. 2018). *T. flabelliforme* has been recorded in varying abundance along the north west coast of Australia from Shark Bay to Darwin. The most dense recordings have been off the coast of Darwin with > 100 individuals recorded (Atlas of Living Australia 2018). *T. Flabelliforme* has also been recorded off the coast of Karratha and near Anketell Point (Fromont 2004; Wilson and Fromont 2011, Fromont *et al*. 2016) (Figure 5-39). Off Heron Point, *T. flabelliforme* was observed, during towed video surveys undertaken for the Proposal (Attachment 2B, Attachment 2C), in inshore areas of low relief reef dominated by macroalgae, in areas of moderate turbidity. All individuals were observed with infestations of white zoanthids. Based on the historical records and Learmonth towed video recordings and observations, *T. flabelliforme* appears to be commonly found within shallow soft sediment/low relief reef habitat in waters less than 10 m with elevated turbidity. Based on the current literature and towed video data, *T. flabelliforme* is likely to be present throughout the inner waters of Exmouth Gulf where low relief reef with macroalgae is present, however the species may also occur in deeper waters (e.g. Ningaloo Marine Park). While a small proportion of the current *T. flabelliforme* population off Heron Point will be directly impacted by the proposed Bundle launch operations, habitat and species records exist in adjacent, non-impact areas, and regionally. The licenced fisher noted that his operations could viably continue if only a small proportion of the population was affected (Darren Gebbetis pers comm. 2018).

Given the predicted magnitude and duration of elevated suspended sediment concentrations associated with launchway construction (Section 5.1.6.4) and Bundle launch and tow (Figure 5-17), no significant adverse impacts on commercial or recreational invertebrate species are expected.




Scale: 1:3750000
Original Size: A4
Aerial Photo Date: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from MBS Environmental (2018) and Atlas of Living Australia (2018) with submissions of records from the Western Australian Museum, CSIRO Oceans & Atmosphere, Queensland Museum, and Northern Territory Museum and Art Gallery, Wilson and Fromont (2011).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-39: Local and Regional Trikentrion Flabelliforme Records

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#### 5.4.6.5 Loss or Degradation of BCH representing Marine Fauna Habitat (e.g. Foraging Habitat) during Bundle Launch and Tow

Some benthic communities are critical to the long-term viability of marine fauna species protected under State or Commonwealth legislation or of particular iconic status or commercial importance. They may either function as recruitment sites, nursery areas, or as important feeding areas. The EPA expects proponents to identify any critical associations between important marine fauna and key benthic communities and habitats that are likely to be impacted (EPA 2016d).

Exmouth Gulf has been identified as a biologically important area in recognition of its value as a resting area for migrating Humpback whales, with very high densities of nursing cows with calves during the southern migration (DSEWPAC 2012b). However, Humpback whales do not forage during their southern migration (Lyn Irvine, pers. comm. 2018b) and are not dependent upon any BCH.

Dolphins show selection for various types of habitats including dredged channels, reefs, seagrass flats and mangroves (Parra and Cagnazzi 2016) and were recorded as widespread across Exmouth Gulf (Figure 5-23). It is not expected that the soft sediment habitat within and adjacent to the Bundle tow route (Figure 5-2) represents critical habitat to any dolphin species.

Dugong generally inhabit the margins of Exmouth Gulf (Figure 5-26) and primarily feed on shallow seagrass, which is not present in the vicinity of the tow route (Figure 5-2). Thus impacts to BCH representing important Dugong habitat is not expected.

Marine turtles feed on a range of plant and animal food sources (Section 5.4.3.3), none of which are present in high abundance within the disturbed soft sediment habitat of the central Exmouth Gulf (Figure 5-2).

Thus no impact to marine fauna is expected as a result of potential local impacts to BCH within the Offshore Operations Area.

#### 5.4.6.6 Temporary Behavioural Response of Marine Fauna due to Noise or Light Spill during Bundle Launch and Tow

Light

Bundle launch activities will occur infrequently (up to three times a year) and will continue through day and night shifts. Artificial light sources appropriate to the task and compliant with occupational health and safety requirements will be required during Bundle launch, including lighting at the launchway and onboard the tugs and launch support vessels.

Temporary mobile lighting units (directional flood lights) will be used during a Bundle launch and will include lighting at the Bundle launchway and along the Bundle track. Lighting at the launchway has the potential to cause minor behavioural impacts to marine fauna. It is noted that turtle nesting does not occur within Exmouth Gulf, so turtle hatchlings, known to be highly sensitive to artificial light during emergence, will not be affected. Migratory birds are adapted to natural changes associated with the day and night cycle, as well as the night-time phase of the moon, to guide feeding patterns and orient flight during migration. Introduction of artificial lighting during nocturnal periods has potential to create a constant level of light that can reverse these natural levels and cycles, potentially impacting on behaviour. Additionally, lighting may also increase detection of birds by predators (Rogers *et al*. 2006).

During migratory shorebird surveys in October 2018 and January 2019 limited numbers of shorebirds were recorded roosting or foraging within, or adjacent to, the Development Envelope (Attachment 2K). Given the relatively low numbers of migratory birds roosting within and adjacent to the Development Envelope, and the presence of numerous alternative roosts nearby, light spill during Bundle launch and tow is unlikely to affect the behaviour of large numbers of migratory birds, as such a significant impact is not expected.

Lighting at the launchway will take account of measures proven to reduce the likelihood of impact on marine fauna including the use of shrouded or directional lighting and the placement of lights to minimise offshore light spill. Vessels involved in Bundle tow operations will be required, for safety reasons, to have a level of permanent lighting. This will be minimised as much as possible. Given the short duration and infrequent nature of Bundle launch operations, significant impacts to marine fauna are not anticipated.

Noise

Potential impacts to marine mammals and reptiles from underwater noise include physical injury, a temporary or permanent threshold shift (TTS/PTS), a behavioural response and masking and interference. Behavioural impacts resulting from marine noise may include interference in communication, localised deviations in migratory patterns and displacement from foraging or resting areas (McCauley *et al*. 2000, Weilgart 2007, Tyack 2008).

For the majority of low frequency cetaceans, such as Humpback whales, behavioural disturbance due to non-pulsed noise sources (such as vessel noise) has been found to occur at a received level of 120-160 dB re 1 µPa (SPL), with little if any response to levels <120dB re 1 µPa (SPL) (Southall *et al*. 2007). In Exmouth Gulf, acoustic masking could affect mating behaviour or calf fitness (Bejder *et al*. 2019). Groups with calves are generally more sensitive to vessel traffic than those without calves (Bauer 1993) with mother-calf pairs being the most sensitive cohort in the population (Nowacek *et al*. 2007). Humpback whales rely on finite energy reserves whilst in the breeding grounds and mothers must maximise energy transfer to their calves, in the form of fat-rich milk, in order to support the rapid calf growth required for the long migration down to the Antarctic feeding grounds. Any energy that is allocated to cow activity other than lactation could reduce calf fitness or growth rates and thus affect their ability to migrate successfully to the feeding grounds (Bejder *et al*. 2019). Additional energy use could also potentially compromise the cow's ability to complete the migration as they cannot replenish their own energy reserves until they reach the Antarctic feeding grounds (Attachment 2J).

Mid-frequency cetaceans, such as dolphins, exhibit varied sensitivity to non-pulsed noise, but have been reported to exhibit a response following exposure to 90-120 dB re 1 µPa (SPL) (Southall *et al*. 2007). Dolphins are commonly observed within busy port areas and are often observed riding the bow waves of large vessels (C. Jenner, pers. comm. 2010), indicating that they are unlikely to be harmed or displaced by the noise levels produced. The sirenian group, including Manatees and Dugong, have been found to exhibit lower sensitivities compared to the mid-frequency cetaceans (NOAA 2016). Little is known about the source levels and associated frequencies that cause physical injury to turtles. Testing has shown change in swimming behaviour in Green and Loggerhead turtles at noise levels of 166 to 175 dB re 1 µPa (SPL), which is understood to be an avoidance response (SVT 2010).

The operational phase of the Proposal involves the launch and tow of the pipeline Bundle using two leading tugs (e.g. anchor handling tugs (AHTs)), a trailing tug and one ROV command vessel. The major noise emissions are expected to be from the cavitation noise generated by propellers and thrusters.

A screening-level assessment of potential underwater noise impacts associated with a Bundle launch has been completed to determine the level of risk of impacts to marine fauna (SLR 2019). The AHTs and command vessel have typical noise source levels (RMS) of 184 dB re 1µPa @ 1m, with an overall combined source level of 190 dB re 1µPa @ 1m. The assumed overall noise level represents worst case noise emissions, considering only the two leading tugs to be undertaking high power operations (the trailing tug and Command vessel will be on low power) (SLR 2019). With distance from a noise source, sound energy decreases as a result of spreading effects and bottom interaction effects (absorption) at lower frequencies or scattering losses at high frequencies. Given the shallow water depths within Exmouth Gulf strong interaction between the sound field and the seabed is expected. Thresholds for the onset of TTS and PTS as presented by Southall *et al*. (2019) were applied to the predicted noise levels. For a 'worst case' scenario which assumes continuous operation of the vessels over 24 hours and that the affected marine fauna stay at a fixed distance from the source over the entire 24 hour period (i.e. they follow the tow fleet northwards during a tow), low frequency cetaceans could experience the onset of PTS within 70 m of the lead tugs and the onset of TTS within 900 m of the lead tugs (SLR 2019).

A more realistic scenario would be that there is a short period of time when the tow fleet passes marine fauna individuals, or faster moving marine fauna individuals pass the tow fleet. Under a scenario when marine fauna are in proximity to the tow fleet for half an hour, low frequency cetaceans could experience the onset of PTS within 10 m of the lead tugs and the onset of TTS within 70 m of the lead tugs (SLR 2019). It is unlikely that marine fauna individuals would remain within 70 m of the lead tugs for half an hour (or over a distance of 2 km that would be travelled in that time). Potential behavioural disturbance to all marine mammals groups (including Humpback whales, dolphins and Dugong) could occur at up to 8 km from the lead tugs (SLR 2019). The risk of behavioural impacts in turtles was considered low (SLR 2019).

The use of Bundle technology is predicted to result in a net reduction in marine traffic in Exmouth Gulf (Section 2.4.8.1), and will effectively reduce the volume of commercial vessel operations during the southern migration period. Thus the implementation of the Proposal will reduce the frequency of impact to Humpback whales resting or nursing in Exmouth Gulf, and help to maintain Exmouth Gulf as suitable resting and nursing habitat.

Resting or milling whales, in particular calving females and calves, are likely to be most at risk of vessel noise effects, and may exhibit a behavioural response up to approximately 8 km from tug operations. Calving females and calves can also demonstrate a lack of adequate avoidance behaviour to approaching vessels (Nowaeck et. al 2004). For these reasons Subsea 7 has committed to not undertaking Bundle launches during the period of peak usage of Exmouth Gulf by Humpback whales (refer Section 5.4.7 and the Marine Fauna Management Plan in Attachment 3).

During migratory shorebird surveys in October 2018 and January 2019 limited numbers of shorebirds were recorded roosting or foraging within, or adjacent to, the Development Envelope (Attachment 2K). Given the relatively low numbers of migratory birds roosting within and adjacent to the Development Envelope, and the presence of numerous alternative roosts nearby, noise emissions during Bundle launch and tow are unlikely to affect the behaviour of large numbers of migratory birds, as such a significant impact is not expected.

Given the relatively low sound levels and the short-term nature of Bundle launch activities, significant impacts to marine fauna are not expected.

#### 5.4.6.7 Direct Impact (Strike or Entanglement) during Bundle Launch and Tow

The activities of vessels during a Bundle launch present a risk of collision with marine mammals, marine reptiles and Whale sharks. The number of vessels, the abundance of fauna moving within or through the area and the timing of launch activities in relation to marine fauna, particularly whale migrations will influence the potential frequency of strikes.

Whales

Whales may be more at risk of vessel strike than dolphins because they are larger, slower swimming and typically less agile, with Humpback whales the most frequently impacted species. Several vessel collisions have occurred in the Exmouth area resulting in the death of a cetacean (DoEE 2016, 2017o).

Interactions between vessels and whales are most likely to occur during the southern migration, as migrating whales enter and rest in Exmouth Gulf. Resting or milling whales are likely most at risk of adverse vessel interaction due to their inability to rapidly alter course (Vanderlaan and Taggart 2007) and demonstration of a lack of adequate avoidance behaviour to approach vessels (Nowaech *et al* 2004). In general, cetacean calves and juveniles are reported to have a higher risk of impact possibly due to less frequent and shorter dives (Stevick 1999, Szabo and Duffus, 2008). Laist *et al*. (2001) has indicated that all sizes and types of vessels can hit whales. The most lethal and severe injuries are caused by vessels greater than 80 m in length travelling at speeds of 14 knots or faster (Laist *et al*. 2001).

The likelihood of collisions between Humpback whales and vessels associated with Bundle launch, outside of the period when whales are milling and resting within Exmouth Gulf, is considered very low. Whales have wide estimated bandwidths (20 Hz to 24 kHz), which would allow them to hear approaching vessels, and they are likely to exhibit avoidance behaviour. Elsewhere the risk of impact through vessel collision is mitigated by mandatory speed limits (e.g. 10 knot seasonal speed limit off sections of the east coast of N. America to protect the North Atlantic Right Whale) (DoEE 2016). Tugs are less frequently involved in collisions with cetaceans than many other types of vessel (DoEE 2016).

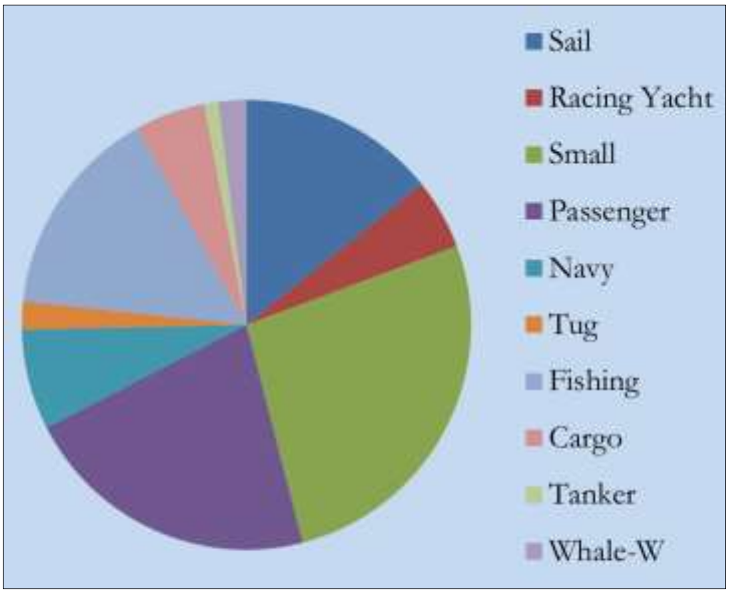



Figure 5-40: Proportion of Vessel Type Involved in Collisions with Cetaceans in Australian Waters (from DoEE 2016)

The likelihood of collisions between whales and vessels associated with a Bundle launch and tow is further reduced, given the low proposed tow speed (≤ 8 knots), low number of launches per year (maximum three) and commitment to no Bundle launches during the peak period of usage of Exmouth Gulf by Humpback whales.

Dolphins

Dolphins are commonly observed within busy port areas, and often ride the bow waves of large vessels (C. Jenner, pers. comm. 2010), indicating that they are able to detect and avoid (or seek out) such vessels. Impacts are more likely to occur as a result of fast moving small recreational vessels and discarded recreational or commercial fishing gear (C. Jenner, pers. comm. 2010). The International Whaling Commission database has limited records of vessel strike with dolphins in Australian waters; between 1988 and 2000 there were three documented incidents involving an Indo-Pacific humpback dolphin, a Common bottlenose dolphin and an unidentified dolphin (DoEE 2016).

The likelihood of collisions between dolphins and vessels associated with a Bundle launch is considered low, given the low proposed tow speed (≤8 knots), low number of launches per year (maximum three) and evidence these species can exhibit avoidance behaviour.

Turtles

The broad frequency spectrum of vessel noise (Richardson *et al*. 1995) overlaps the relatively low auditory range of turtles (Ketten and Bartol 2006). The range is 100-500 Hz for adult turtles and 100-800 Hz for juveniles (Ridgeway et. al. 1969, Bartol 2007) with sensitivity decreasing with age. Turtles are expected based on previous knowledge to hear and avoid vessels. A study by Hazel *et al*. (2007) recorded 60% of Green turtles (benthic and non-benthic) fleeing from vessels travelling at 2 knots, while only 4% fled from vessels travelling at 10 knots, suggesting that vessel speed is a key factor. Elsewhere the risk of impact through vessel collision is mitigated by mandatory speed limits (e.g. 'go slow' areas in Moreton Bay to protect turtles and Dugong (10 knots)) (DoEE 2016).

The likelihood of collisions between marine turtles and vessels associated with a Bundle launch is considered low, given the low tow speed (≤8 knots), low number of launches per year (maximum three), and evidence that these species are likely to exhibit avoidance behaviour.

The use of noise or vibration to 'startle' and disperse marine turtles away from the path of a dredge draghead has been tested. Controls have included sonic pingers, air cannons, draghead chains, bubblers, and electricity (USAE WES 1997). Chevron Australia's Gorgon Gas Development Jansz Feed Dredging and Spoil Disposal Management and Monitoring Plan (DSDMMP) considered the noise generated from the vessels themselves, as well as from the draghead chains, to be suitable in disturbing or deterring turtles from the area and reducing the likelihood of entrainment (Chevron Australia 2011). The absence of any marine turtle injury or mortality records at Barrow Island indicates that these measures were effective in preventing entrainment, particularly when considered alongside the large amount of time tracked turtles spent within the active dredge areas (39.5% of overall internesting time) and their close proximity to the seabed (and operating TSHD drag head) when diving (Whittock *et al*. 2017). Thus it is expected that any turtles present in the path of the Bundle chains, whether foraging or internesting, would be likely to move away prior to a collision.

Dugong

Dugong are killed when struck by boats and propellers while feeding in shallow inshore waters, particularly in areas where fast boats are used (Marsh *et al*. 2002). The relative contribution of vessels of different types to Dugong mortality is not known and is likely to be area specific. The greatest danger of a collision appears to be in narrow channels used by boats and Dugongs at low tide (Groom *et al*. 2004). Dugongs can become habituated to boat traffic, especially traffic concentrated around large seagrass meadows on which they feed. There are anecdotal reports of Dugongs being killed by vessel strike in and adjacent to the North-west Marine Region, even though there is little evidence of a substantial impact within the region to date (DSEWPAC 2012b).

For Dugong, Hodgson (2004) believes that vessel speed is the primary factor affecting collision risk due to 'the time available to flee being equal to the time the boat takes to travel the distance from the flee threshold to the dugong'. Elsewhere the risk of impact through vessel collision is mitigated by mandatory speed limits (e.g. 'go slow' areas in Moreton Bay to protect turtles and Dugong (10 knots)) (DoEE 2016).

The likelihood of collisions between Dugong and vessels associated with a Bundle launch is considered low, given this species is not expected to commonly occur within the Offshore Operations Area, and, if present during a Bundle launch, individuals are likely to exhibit effective avoidance behaviour given the low proposed tow speed (≤ 8 knots).

Whale Shark

Whale sharks travel to Ningaloo Marine Park between March and July every year, with individuals sometimes remaining until early August (DPaW 2013, DoF 2011). Whale sharks have been observed to utilise the north western portion of Ningaloo Marine Park during the peak season, moving southwards towards Coral Bay outside of season (Reynolds *et al*. 2017, Norman *et al*. 2017). Whale sharks have not been recorded in the literature as being frequently sighted within Exmouth Gulf. Whale sharks are likely to occur within the Ningaloo Marine Park and in the vicinity of the Surface tow route between March and July.

During migration Whale sharks spend most of their time within the first 15 m of the water column. During foraging activity, Whale sharks spend approximately 25% of the time spent at depths of 2 m or less and 40% of their time within the upper water column (15 m or less) (DoEE 2016). This behaviour means that there is potential risk of collision with Bundle tow vessels and chains. Boat strike is recognised by the Approved Conservation Advice for the Whale shark as one of the key threats to their recovery (TSSC 2015a), though the risk is not well understood and a research priority is to '*conduct further research into the impacts of boat strike on whale sharks to determine the significance of the threat*' (TSSC 2015a).

Responses such as rolling, banking, and diving in response to approaches by divers and boats have been recorded. At Ningaloo Whale sharks may have become wary of ecotourism vessels and concerns have been raised about the potential for injury to the sharks from boat strikes (Sanzogni *et al*. 2015). Whale sharks have been observed to make significantly more (approximately double) directional changes when ecotourism vessels were present (Raudino *et al*. 2016).

Research into the movement and habitat use of Whale sharks within and adjacent to Ningaloo Marine Park, as a part of the Ningaloo Outlook programme, determined that, based on a number of tagged sharks:

- Whale sharks are predominantly present near the sea surface (top 3 m) during daylight hours but dive to greater depths (frequently 20 m to 100m, or deeper) during the night.
- Whale sharks can dive at speeds exceeding 0.4 m/s (or 24 m in one minute), though the most common dive speeds are between 0.16 m/s and 0.4 m/s during the day and between 0.05 m/s and 0.25 m/s during the night.

The likelihood of collision between a Bundle or tow vessel and a Whale shark is considered low, given:

- Whale sharks predominantly aggregate to the west of North West Cape (Pillans *et al*. 2018), though they are also thought to aggregate northeast of the Murion Islands (DoEE 2018a) in the vicinity of the tow route (Figure 5-30) and do travel between the North West Cape and waters to the north east.
- Whale sharks are able to swim at relatively high speed and dive rapidly, thus allowing them to avoid an approaching vessel or Bundle.
- Bundle tow speeds will be below 8 knots.
- An average of two, up to a maximum of three, Bundle launches will occur each year, so the likelihood of a Whale shark being present within the Offshore Operation Area during a tow is low.

The risk will be further mitigated by use of a 'spotter plane' during Bundle launches undertaken between March and July (inclusive) (refer note beneath Table 5-22).

<u>Grey Nurse Shark</u>

A total of 16 individuals were recorded at the Navy Piers between 2007 and 2012, with ten returning over multiple years. While individual sharks may forage over a wide area, including within the Ningaloo Marine Park and the Muiron Islands Marine Management Area (Figure 2-11), given the low relief of the BCH recorded within and adjacent to the Bundle tow route, they would not be expected to spend significant portions of time within this area.

The likelihood of collisions between Grey nurse shark and vessels associated with a Bundle launch is considered low, given that this species is not expected to commonly occur within the Offshore Operations Area, and given the low proposed tow speed (≤ 8 knots) and low number of launches per year (maximum three).

#### 5.4.6.8 Introduction of Non-indigenous Marine Pests via Construction or Operational Vessels

Most introduced marine species are innocuous, causing no apparent harm to the local marine environment or marine ecological communities. Over 250 species have been recorded as introduced into Australian waters, 60 of which are in Western Australia (Huisman 2000). In contrast, introduced marine pests (IMP) are introduced marine species that pose a significant risk to environmental values, biodiversity, ecosystem health, human health, fisheries, aquaculture, shipping, ports or tourism (DAFF 2009).

Introduced marine pests can cause a variety of adverse effects, which include damaging the health of local species or eliminating them; fundamentally changing ecosystems; and interrupting industrial operations by clogging piping, fouling structures etc. (Wells *et al*. 2009).

A variety of vectors are responsible for translocating marine species around the world and along coastlines domestically, including shipping, fisheries, mariculture and the aquarium trade. International shipping is generally considered to be responsible for the majority of inadvertent IMP introductions. A variety of shipping-related mechanisms are recognised in the potential translocation of IMP including ballast and bilge water discharges, hull fouling (also referred to as biofouling), internal seawater systems, and even via immersible equipment such as anchors. Ballast water discharge is considered the greatest contributor to the unwanted dispersal of IMP, hence the adoption of Australia's Mandatory Ballast Water Management Requirements (Version 7). The Australian Ballast Water Management Requirements provide guidance on how vessel operators should manage ballast water when operating within Australian seas in order to comply with the *Biosecurity Act 2015*.

In addition, the Commonwealth Government has also recently introduced the 'Quick Domestic Ballast Water (DBW) Risk Assessment Tool' (DAWR 2018) to assist with managing the unwanted spread of introduced IMS around Australia. This tool provides an indication of whether ballast water taken up at a particular Australian port, on a certain date, and discharged at a particular Australian port, will be considered Low or High Risk. Any High Risk ballast water must be managed prior to discharge at the intended port. For Low Risk ballast water, an application must be made in the Maritime Arrivals Reporting System (MARS) for a risk-based exemption from management.

More recent research has found that more IMP have been introduced to Australia historically via vessel biofouling than ballast water, but the Commonwealth Government has yet to introduce any mandatory biofouling management requirements. In lieu of this, DPIRD has introduced mandatory management requirements under their *Fish Resources Management Act 1994*, and Fish Resources Management Regulations 1995, in an attempt to protect Western Australian waters from the introduction of IMP. To assist industry manage potential risks, DPIRD has developed an on-line decision-support tool called 'Vessel Check'. Vessel Check is an online vessel risk assessment tool designed to help vessel operators manage a vessel's biofouling risk. Completing a Vessel Check risk assessment helps to clarify a vessel's current risk status and provide possible actions to reduce the risk, if necessary.

All these measures have contributed greatly towards reducing the likelihood of unwanted IMP being introduced and spread around Australia's coastline.

Subsea 7 engaged the services of Biofouling Solutions Pty Ltd to conduct a desktop risk assessment to assess the probability and consequences of marine pests being introduced to Exmouth Gulf as a result of the Proposal (Biofouling Solutions 2018, Attachment 2I). Several potential scenarios were investigated.

<u>Construction Phase</u>

The scenario of a construction barge sourced from WA coastal waters entering Exmouth Gulf for the purpose of construction of the launchway was assessed as posing a low risk of impact from IMP, but a high risk of impact from pathogens, in the absence of management (Attachment 2I). A nominated management measure, to reduce the risk to low, was the adoption of the DAWR 'Quick Domestic Ballast Water (DBW) Risk Assessment Tool' (DAWR 2018).

The risk of a construction barge or launch/tow vessel, sourced from Australian coastal waters outside of WA, introducing an IMP via biofouling or ballast water was assessed as posing a low risk (Attachment 2I).

Operations Phase

The following scenarios relating to the operational phase of the Proposal were assessed (Attachment 2I):

- One or more Bundle launch and tow vessels are sourced from shallow coastal waters within WA.
- One or more Bundle launch and tow vessels are sourced from shallow coastal waters within Australia, but outside WA.
- One or more Bundle launch and tow vessels are sourced from shallow coastal waters outside Australia.

The risk of a launch/tow vessel, sourced from WA coastal waters, introducing a pathogen via ballast water was assessed as posing a high risk in the absence of management. A nominated management measure, to reduce the risk to low, was the adoption of the DAWR 'Quick Domestic Ballast Water (DBW) Risk Assessment Tool' (DAWR 2018). The risk of a launch/tow vessel, sourced from WA coastal waters, introducing an IMP via biofouling was assessed as posing a low risk (Attachment 2I).

The risk of a launch/tow vessel, sourced from Australian coastal waters outside of WA, introducing a pathogen via ballast water was assessed as posing a high risk in the absence of management (Attachment 2I). A nominated management measure, to reduce the risk to low, was the adoption of the DAWR 'Quick Domestic Ballast Water (DBW) Risk Assessment Tool' (DAWR 2018).

The risk of a launch/tow vessel, sourced from international waters, introducing a pathogen via ballast water, or an IMP via ballast water or biofouling, was assessed as posing a high risk in the absence of management (Attachment 2I). Nominated management measures, to reduce the risks to low, were the adoption of the DAWR 'Mandatory Ballast Water Management Requirements (Version 7)' and the DPIRD on-line 'Vessel Check' decision support tool and the adoption of appropriate biofouling management requirements.

Level of Risk

It is widely practiced within the oil and gas industry to develop and utilise Biofouling Management Plans, to ensure that all vessels utilised on a project meet the requirements for operating in Australian waters. Typically, these plans have a focus on vessels entering Australia from international waters, and typically consider the previous voyage history, status of anti-fouling application, and the location and extent of operations being performed in Australia. Where necessary, it is common practice for vessel operators to perform hull cleaning operations prior to entering Australia to ensure the risk of introducing marine pests is minimised and mitigated appropriately. This general industry practice exceeds what is typically performed in other marine industries (such as general shipping and vessel tourism), and this contributes to the assessed low risk of introduction of an IMP due to the Proposal.

A review of the desktop risk assessment by DPIRD confirmed that the assessment was considered satisfactory, and the identified biosecurity measures sufficient, to reduce any likelihood of introduction or spread of an IMP to as low as reasonably practicable (Attachment 2I). Further, it was determined, in consultation with DPIRD and the EPA, that there was no need for any large-scale baseline survey of the Gulf (Attachment 2I). The risk of the introduction of an IMP due to the Proposal, and a subsequent impact on marine fauna, is considered low.

#### 5.4.6.9 Loss or Alteration of Coastal Habitat as a Result of Changes to Coastal Processes or Hydrodynamic/Hydrological Regimes

Loss of coastal habitat, such as roosting or foraging habitat for migratory birds, could potentially occur as a result of changes to coastal processes leading to altered erosion or accretion patterns.

The shoreline at Heron Point adjacent to the launchway was not found to represent key foraging or roosting habitat for migratory birds (Figure 5-37, Figure 5-38, and Attachment 2K). Significant changes to the beach profile adjacent to the launchway are not expected, with potential changes limited to potential sand accretion to the north of the launchway and erosion of small perched beaches to the south (Figure 5-14, Attachment 2E). None of the areas potentially affected by sand accretion or erosion overlap with areas recorded as migratory bird foraging or roosting habitat (Attachment 2E, Attachment 2K).

Monitoring and mitigation will ensure no significant changes to coastal habitat (Table 5-12), and as such no significant impacts to marine fauna are expected. Biological diversity and ecological integrity of marine fauna will be maintained.

#### 5.4.6.10 Leak or Spill of Chemicals (including hydrocarbons) associated with Launch and Tow Activities, Accidental Collisions, and Loss of Control of Pipeline Bundle during Launch, Laydown, Towing, or Ship Groundings, impacting Marine Fauna Health

A number of measures are proposed to minimise the risk of the loss of control of a Bundle during launch and tow (Table 5-8). With these measures in place, the likelihoodk of such an event is considered negligible (in over 80 Bundle launches at Wick no such event has occurred).

As described in Section 5.3.6.4, the internal Bundle pipelines are designed for high-pressure, high-temperature environments, and therefore have a pipe wall thickness and design strength much higher than what is required for the Bundle launch and tow. The carrier pipe is designed to physically protect these internal pipelines, provide an environmental barrier, and transfer the loads from the launch and tow from the towheads, dissipating these forces along the length of the Bundle.

The likelihood of material damage or loss of containment of the internal pipelines is considered to be low, due to the high-pressure design and the regulated control of the fabrication process. The likelihood of material damage or failure of the carrier pipe is also considered low. The Bundle pipeline will contain no hydrocarbons during fabrication, launch and tow activities. The carrier pipe will be charged with nitrogen gas, and this allows the Bundle, not including the Bundle chains, to be positively buoyant during the tow. The carrier pipe will contain solid chemical packs, designed to dissolve in the seawater that floods the carrier pipe once the Bundle is in the final position offshore. These chemical packs create a non-corrosive environment for the internal pipelines.

As described in Section 2.3.6.2, selection of Bundle transport and installation contents is performed in consultation with the field operator and NOPSEMA to confirm compatibility with existing infrastructure, and ensure environmental impacts and risks associated with any chemicals are managed to a level that is acceptable and ALARP.

To control chemicals selected for use within the Bundle during tow and installation operations, Subsea 7 has deemed that chemicals which have an OCNS Hazard Quotient corresponding to ratings of Gold, Silver, E or D on the OCNS Ranked List of Notified Chemicals, and have no substitution or product warning, do not require further assessment, as they do not represent a significant risk to the environment. This is in line with the chemical selection standards of most offshore field operators. Should a field operator have a more stringent chemical selection process, this will take precedence.

Chemicals not meeting the criteria above (i.e. OCNS Hazard Quotient white, blue, orange, purple, A, B, C or have product/substitution warning), or those that are not on the OCNS Ranked List of Notified Chemicals, will require further assessment to understand the potential environmental impacts of a leak or spill into the marine environment. This assessment will be documented and will include:

- Assessment of the toxicity and biodegradation of the chemical in the marine environment and any other environmental issues or potential risks.
- Investigation of potential alternatives for the chemical, with preference for options that are on the OCNS Ranked List of Notified Chemicals with OCNS Hazard Quotient of Gold, Silver, or are Group E or D with no substitution or product warning.
- Justification of the selected chemical.
- Further risk reduction measures (i.e. specific controls on the use of the chemical).
- Determination of whether the environmental risk is ALARP.

The risk of impact to marine fauna following the exposure to the chemicals present within a Bundle is therefore considered to be low.

Diesel will be carried onboard all the vessels associated with a Bundle launch. Each vessel will have a specific response plan to be followed in the event of a leak or spill to minimise the potential for an environmental impact. It is recognised that Exmouth Gulf is widely utilised by many vessels of varying types and sizes, as part of oil and gas, shipping, tourism, fishing and defence industries, among others. These vessels are often similar (if not the same) in specification to those proposed for Bundle launch operations, and have operated largely without causing diesel spills in the area to date. Due to the limited fuel volumes, standard management protocols and response plans, the risk of impact to marine fauna following a leak or spill of diesel from a launch vessel is considered to be low.

The Marine Emergency Response Plan (Attachment 3) provides details on the management actions and control measures in place to minimise the likelihood of a loss of control of the Bundle or support vessel leading to an impact on marine fauna.

#### 5.4.6.11 Potential Cumulative Impacts

The Exmouth Gulf Prawn Fishery historically resulted in mortality of marine fauna, particularly marine turtles, through bycatch. Current practices in the Exmouth Gulf Prawn Fishery have reduced the incidence of marine turtle capture, though injury or behavioural responses to a number of marine fauna species may still occur. Current recreational and commercial vessel traffic in Exmouth Gulf poses a risk of direct (e.g. vessel collision) and indirect (e.g. underwater noise) impacts to marine fauna. Currently the soundscape in Exmouth Gulf is mainly dominated by biological sounds from wave action, Humpback whales and snapping shrimp, with low noise contribution from shipping, boating and other anthropogenic activities (Bejder *et al*. 2019). Increased development within or adjacent to Exmouth Gulf could result in an increase in marine traffic and an increase in anthropogenic noise, including within Humpback whale breeding/resting habitat, with the potential for increased likelihood of ship strikes and acoustic disturbance (Bejder *et al*. 2019). It is noted that the use of Bundle technology is predicted to result in a net reduction in marine traffic in Exmouth Gulf (Section 2.4.8.1).

Any direct or indirect impacts to marine fauna from the Proposal will be limited given the lack of impact to important foraging habitat, the low risk of vessel strike due the nominated Bundle tow speeds and infrequent nature of tow operations, and the short-term nature and local scale of any turbidity effects associated with launchway construction or Bundle launch and tow. Impacts to Humpback whales will be virtually avoided with the adoption of the 'no launch period' (refer to note below Table 5-22). The Proposal is therefore not expected to cause any significant impacts to marine fauna or marine fauna habitat. Further, given that the use of Bundle technology reduces the extent of marine operations (both in Exmouth Gulf and offshore) associated with the development of an offshore gas field (Table 2-5), the Proposal is likely to lead to a reduction in indirect impacts to marine fauna associated with vessel traffic and associated underwater noise.

Key pressures of potential concern to migratory birds include physical habitat modification, light pollution and human presence at sensitive sites (DSEWPaC 2012b). The greatest current threat to migratory birds utilising the western shore of Exmouth Gulf, including the Bay of Rest North area (Figure 5-34), is likely to be the uncontrolled usage of the area for camping, fishing and touring (recreational vehicles) (Attachment 2E, Attachment 2K). Activities associated with the Proposal (launchway construction and Bundle launch) with the potential to cause disturbance to migratory birds are short-term, and will occur within an area already subject to significant human presence. Significant additional impacts to migratory birds, and significant cumulative impacts, are not expected.

### 5.4.7 Mitigation, Monitoring, and Predicted Outcome

The proposed mitigation measures to address potential impacts to marine fauna as a result of the Proposal, the predicted outcome, and monitoring (where proposed to verify the outcome) are provided in Table 5-22.

The EPA objective '*to protect marine fauna so that biological diversity and ecological integrity are maintained*' will be met.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Loss or degradation of BCH representing marine fauna habitat (e.g. foraging habitat) due to launchway construction | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill) thus reducing seabed disturbance and duration of construction.<br>• Use of pre-cast concrete panels will reduce seabed disturbance and duration of construction.<br>• Construction material to be screened and washed to remove 'fines' (particles <63 µm in diameter).<br>• Silt curtains will be deployed during construction to minimise impacts to water quality beyond 50 m from the construction area.<br>• Suspension of turbidity-generating construction activity (refer MCMMP in Attachment 3).<br>Measures to rehabilitate:<br>• NA | Habitats within the launchway footprint are well represented elsewhere and the predicted losses represent a small proportion of the habitat present within the Heron Point LAU, as follows:<br>• Soft sediment – direct loss of 0.2 ha (< 0.1%) of mapped habitat, indirect impact to 2.0 ha (< 0.1%) of mapped habitat.<br>• Reef with macroalgae – direct loss of 0.3 ha (0.1%) of mapped habitat, indirect impact to 2.5 ha (0.7%) of mapped habitat.<br>Construction of the Bundle launchway is estimated to take up to six months. Elevated turbidity is expected to be limited to the immediate surrounds (<50 m) of the work site. The adjacent habitats are expected to be tolerant of short-term pulses in turbidity and suspended sediment.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained.<br><br>Monitoring<br>Habitat mapping of BCH adjacent to launchway within one year of construction being completed. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Temporary behavioural responses of marine fauna due to noise or light spill during construction phase | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Shrouded or directional lighting as well as motion-sensor or timed lighting will be used and placed such that the majority of light is focused on the working areas and not out to sea.<br>• Deployment of silt curtains around active construction areas to assist in preventing marine fauna from entering these areas.<br>• Use of a Marine Fauna Observer (MFO) during marine construction activities to ensure no listed marine fauna enter within a 'marine fauna exclusion zone' of 50 m surrounding active construction (e.g. placement of rock fill, placement of pre-cast slabs). Works will be suspended in the event an animal enters this zone during active construction.<br>Measures to rehabilitate:<br>• NA | Given the management measures, no significant impacts to marine fauna are expected.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |
| Introduction of introduced marine pests (IMP) via construction vessels | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Adoption of the Department of Agriculture and Water Resources (DAWR) 'Quick Domestic Ballast Water (DBW) Risk Assessment Tool (DAWR 2018).<br>• Adoption of the DPIRD on-line 'Vessel Check' decision support tool and the adoption of appropriate | Given the management measures no significant impacts to marine fauna are expected.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | biofouling management requirements.<br>Measures to rehabilitate:<br>• NA | |
| Temporary behavioural response of marine fauna due to changes in marine water quality | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill) thus reducing seabed disturbance and duration of construction.<br>• Use of pre-cast concrete panels will reduce seabed disturbance and duration of construction.<br>• Construction methods selected to minimise disturbance of sediments.<br>• Silt curtains will be deployed during construction to minimise impacts to water quality beyond 50 m from the construction area.<br>• A maximum of three launches per year, for a duration of nominally two days per launch.<br>• No launches during period of peak usage of Exmouth Gulf by Humpback whales (see note following this table).<br>Measures to rehabilitate:<br>• Suspension of turbidity-generating construction activity in the event a persistent turbidity plume is observed beyond the silt curtain(s). | Construction of the Bundle launchway is estimated to take up to 6 months. Elevated turbidity is expected to be limited to the immediate surrounds (<50 m) of the work site.<br><br>Water quality impacts during a Bundle launch will be minor, local, and of short duration.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Reduction in abundance of commercial and recreational fishing species due to loss of habitat and/or changes in marine water quality (construction and operations) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Launchway designed to minimise footprint (including extent of rock fill) thus reducing seabed disturbance and duration of construction.<br>• Use of pre-cast concrete panels will reduce seabed disturbance and duration of construction.<br>• Construction material to be screened and washed to remove 'fines' (particles <63 µm in diameter).<br>• Silt curtains will be deployed as required to minimise impacts to water quality beyond 50 m from the construction area.<br>• Suspension of turbidity-generating construction activity (refer MCMMP in Attachment 3).<br>• Launch and tow operations will only occur within the nominated Offshore Operation Area to minimise impacts to nearshore BCH.<br>• Bundle remains tethered to 'Leading Tug' and 'Trailing Tug' at all times, including within Parking area, to ensure minimal lateral movement of Bundle.<br>Measures to rehabilitate:<br>• Maximum of three launches per year to allow soft sediment habitats to recover from any superficial physical disturbance between launches. | The local fish and invertebrate species, and the habitats they rely on, are expected to be tolerant of occasional short-term pulses in turbidity and suspended sediment during a Bundle launch.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Loss or degradation of BCH representing marine fauna habitat (e.g. foraging habitat) during Bundle launch and tow | Measures to avoid:<br>• Bundle engineering completed to increase buoyancy of towheads.<br>• A maximum of three launches per year, for a duration of up to two days per launch, is unlikely to lead to indirect impacts to BCH.<br>Measures to minimise:<br>• NA<br>Measures to rehabilitate:<br>• NA | During Bundle launch impacts to water quality will be short-term and local.<br><br>The adjacent habitats are expected to be tolerant of occasional short-term pulses in turbidity and suspended sediment during a Bundle launch, such that no measurable impacts will occur.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |
| Temporary behavioural response of marine fauna due to noise or light spill during Bundle launch and tow | Measures to avoid:<br>• No launches during period of peak usage of Exmouth Gulf by Humpback whales (see note following this table).<br>Measures to minimise:<br>• Lighting design during Bundle launches will be a continuation of lighting management measures implemented during fabrication operations and will take account of measures proven to reduce the risk of impact on marine fauna such as shrouded or directional lighting.<br>Measures to rehabilitate:<br>• NA | Negligible risk of a significant impact from underwater noise given the short-term and low level nature of underwater noise associated with a Bundle launch, and the low frequency of launches.<br><br>A significant impact from light spill is unlikely given the absence of turtle nesting within Exmouth Gulf, the short duration and low frequency of launches and the measures to minimise light spill. |
| Direct impact (strike or entanglement) during Bundle launch | Measures to avoid:<br>• No Bundle launches during period of main Humpback whale usage of Exmouth Gulf (see note under this | Low risk of a significant impact (i.e. direct physical interaction) with marine fauna. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| and tow | table).<br>• Adherence to the *Environment Protection and Biodiversity Amendment Regulations 2000*, which make provision for regulation of the interaction of persons with cetaceans within the Australian Whale Sanctuary[14].<br>• Specific training on marine fauna observation and avoidance provided to vessel crews.<br>• MFO on board lead support vessel and key support vessels, to identify marine fauna within 500 m ahead of tow, to allow avoidance measures to be implemented. Avoidance measures may include a change to the Off bottom tow speed, delay to the start of the Surface tow component of a tow or a slight change to the tow route (within the 2 km wide Surface tow envelope). Adherence to Marine Fauna Management Plan (MFMP).<br>• Ability to suspend transit if required to avoid collision.<br>• Tow vessels and Bundle launch speeds low during launch (≤ 2 knots) and tow (≤ 8 knots).<br>• Use of a 'spotter plane' during any Bundle launches undertaken between March and July to identify location of any Whale sharks within Ningaloo Marine Park and allow avoidance (see note under this table).<br>Measures to minimise:<br>• NA | Biological diversity and ecological integrity of marine fauna will be maintained.<br><br>Monitoring<br>Visual monitoring by MFOs during Bundle launch and tow. Recording of any strikes or entanglement. Any vessel strikes with cetaceans will be reported in the National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike). |

[14] The Australian Whale Sanctuary covers Australian waters within 200 nautical miles of the coast of Australia.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• Any fauna injuries and/or deaths will be reported and a register maintained.<br>• Injured fauna will be taken to the Exmouth office of DBCA, or to Exmouth Wildlife Care Group, for assessment/rehabilitation. | |
| Introduction of introduced marine pests (IMP) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Adoption of the Department of Agriculture and Water Resources (DAWR) 'Quick Domestic Ballast Water (DBW) Risk Assessment Tool (DAWR 2018).<br>• Adoption of the DPIRD on-line 'Vessel Check' decision support tool and the adoption of appropriate biofouling management requirements.<br>Measures to rehabilitate:<br>• NA | Given the management measures no significant impacts to marine fauna are expected.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |
| Loss or alteration of coastal habitat as a result of changes to coastal processes or hydrodynamic/ hydrological regimes | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>Measures to rehabilitate:<br>• Management of onshore sediment accretion via monitoring and sand bypassing. | The shoreline at Heron Point adjacent to the launchway was not found to represent key foraging or roosting habitat. Significant changes to the beach profile adjacent to the launchway, leading to a loss of marine fauna habitat, are not expected. Monitoring and mitigation will ensure no significant changes to coastal habitat.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | Monitoring<br>The following monitoring is proposed:<br>• Survey of beach profiles adjacent to launchway (annual).<br>• Inspections, including photographic monitoring of shoreline adjacent to launchway (annual).<br>• Shoreline mapping (every 3-6 years). |
| Leak or spill of chemicals (including hydrocarbons) associated with launch and tow activities, accidental collisions and loss of control of pipeline Bundle during launch, laydown, towing, or ship groundings.<br>Impacting marine fauna health | Measures to avoid:<br>• Bundle fully pressure tested and leak tested prior to launch.<br>• Ongoing monitoring of Bundle pressures prior to and during launch.<br>• Weather forecast/seasonal data reviewed to inform launch schedule.<br>• Weather forecast monitored ahead of launch operations and launch window defined.<br>• Defined limiting weather criteria.<br>• High specification tow vessels used for launch operations.<br>• System confirmation check completed prior to departing Parking area.<br>• Secondary system/redundancy design in Bundle monitoring system.<br>• Tow vessels to be equipped with 'Dynamic Positioning' (DP) systems, with a suitable level of | Given the inherent strength of the carrier pipe (the outside casing of the Bundle), the lack of liquid chemicals within the annulus and the control measures to be implemented to prevent a loss of control of the Bundle or support vessel (refer Marine Emergency Response Plan (Attachment 3)), the likelihood of a chemical leak or spill leading to an impact on marine fauna health is considered negligible.<br><br>Standard 'operating over water' management measures will be employed during the construction of the launchway to prevent spills of chemicals into the marine environment.<br><br>Biological diversity and ecological integrity of marine fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | system redundancy.<br>• Full tow vessel position monitoring system verification prior to leaving Bundle Parking area.<br>• Secondary tow vessel position keeping system in place for passage through Ningaloo Marine Park.<br>• Vessel Assurance Suitability Surveys conducted prior to commencement of operations.<br>• Notice to mariners supporting information issued prior to tow to inform local vessels of operations.<br>• Guard vessel to monitor/enforce exclusion zones.<br>• Each vessel operating in adherence to International Regulations for Preventing Collisions at Sea (COLREGs).<br>• Vessel intervention if required (as described in guard vessel procedure for engaging 3rd party vessels).<br>• Community engagement and announcements locally.<br>• Broadcasting on VHF as required.<br>• Visual monitoring of bundle on surface (surface buoys and lights).<br>• Timing of Surface tow through Ningaloo Marine Park chosen to coincide with benign sea, tidal and weather conditions.<br>• Standard 'operating over water' management measures will be employed during the construction of the launchway.<br>Measures to minimise:<br>• Bundle carrier pipe does not contain any | |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | hydrocarbons.<br>• Any chemical to be used within flow lines must have:<br>  o An OCNS Hazard Quotient rating of Gold, Silver, E or D have no substitution or product warning; or<br>  o Further assessment to ensure the environmental risk is ALARP.<br>Measures to rehabilitate:<br>• Each vessel equipped with a vessel specific Shipboard Oil Pollution Emergency Plan (SOPEP) or equivalent, and will follow response actions to incidental pollution in accordance with the vessel's emergency plan.<br>• Thorough clean-up of environment in the event of a leak or spill. | |

Table 5-22: Proposed Mitigation Measures and Predicted Outcome for Marine Fauna

**NOTE ON 'NO LAUNCH' PERIOD TO MITIGATE RISK TO HUMPBACK WHALES**

Within the original referral supporting document Subsea 7 noted that, to minimise the risk of direct interaction between marine fauna and a tow vessel or Bundle during Bundle launch/tow, the following mitigation measure would be implemented:

> *No bundle launches during period of main Humpback whale usage of Exmouth Gulf (nominally mid-September to mid-November).*

It was noted that the timing of this 'no launch' period would be accurately determined through survey prior to the initial Bundle launch. Since submission of the original referral, aerial surveys have been completed to characterise the current Humpback whale usage patterns and period within Exmouth Gulf. Prior to these surveys the most recent data was collected by Curt Jenner in 2004/05.

During the 2018 surveys (Irvine 2019, Attachment 2K) 1,661 pods, consisting of 2,772 whales, were recorded. Humpback whales were first observed within Exmouth Gulf and to the north in late July 2019, just prior to the first formal survey (Lyn Irvine pers comm. 2018a). Humpback whale numbers were relatively low (approximately 100) during the first half of August before increasing to a maximum of approximately 750 by mid-September. From this peak, numbers rapidly declined to approximately 50 by early November. Based on the rapid decline in numbers through October and into early November, all Humpback whales were considered likely to have left Exmouth Gulf by 5 November 2018. Thus a total occupancy period of three months was recorded during the 2018 southern migration.

To avoid impacts to Humpback whales during their southern migration, Subsea 7 commits to a 12 week 'no launch' period, which will be in force for the months of August, September and October each year. This period was defined with reference to:

- The occurrence of young calves, the most sensitive life stage (likely born off the North West Cape), within Exmouth Gulf during the initial survey on 8 August 2018.
- The high abundance of Humpback whales between late August and mid-October 2018.
- The rapid decline in Humpback whales numbers, including calf numbers, through October.
- The lack of young calves during the last survey on 2 November 2018.

NOTE **ON 'SPOTTER PLANE' TO MITIGATE RISK TO WHALE SHARKS**

Research into the movement and habitat use of Whale sharks within and adjacent to Ningaloo Marine Park, as a part of the Ningaloo Outlook programme, determined that, based on a number of tagged sharks:

- Whale sharks are predominantly present near the sea surface (top 3 m) during daylight hours but dive to greater depths (frequently 20 m to 100m, or deeper) during the night.
- Whale sharks can dive at speeds exceeding 0.4 m/s (or 24 m in one minute), though the most common dive speeds are between 0.16 m/s and 0.4 m/s during the day and between 0.05 m/s and 0.25 m/s during the night.

The risk of collision between a Bundle or tow vessel and a Whale shark is considered low, given:

- Whale sharks predominantly aggregate to the west of North West Cape (Pillans *et al*. 2018) but do travel between the North West Cape and waters to the north east.
- Whale sharks are able to swim at relatively high speed and dive rapidly, thus allowing them to avoid an approaching vessel or Bundle.
- Bundle tow speeds will fall below 8 knots.
- An average of two, up to a maximum of three, Bundle launches will occur each year, so the likelihood of a Whale shark being present within the Offshore Operation Area during a tow is low.

Notwithstanding the above, Subsea 7 understands the local social significance of the Whale shark, and proposes to further reduce the risk of a collision through the use a 'Spotter Plane' during Bundle launches between the beginning of March and the end of July each year. The objectives of the 'Spotter Plane' are to:

- Survey the tow route (between the southern boundary of Ningaloo Marine Park out to a distance of approximately 20 km off the North West Cape) prior to the Surface tow component of the tow.
- Record and report to the command vessel any Whale sharks (or other marine megafauna) present in the vicinity of the tow route and report their position and heading.
- In the event of one of more Whale sharks being present within or adjacent to the tow route, maintain a visual as the tow proceeds and provide advice to the command vessel to allow avoidance measures to be implemented. Such measures may include a delay to the start of the Surface tow component of a tow or a slight change to the tow route, within the 2 km wide Offshore Operations Area (Surface tow), to maximise the temporal and/or spatial separation between Bundle tow vessels and Whale shark(s).

## 5.5 KEY ENVIRONMENTAL FACTOR 5 – FLORA AND VEGETATION

### 5.5.1 EPA Objective

To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

### 5.5.2 Policy and Guidance

Subsea 7 has taken into consideration relevant policy and guidance in the design of the Proposal, the completion of the environmental impact assessment and through the development of this ERD.

A summary of the policy and guidance relevant to Flora and Vegetation, and how Subsea 7 has considered these, is presented in Table 5-23.

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Statement of Environmental Principles, Factors and Objectives (EPA 2016c, 2018c) | Referred to in the identification and assessment of Preliminary Key Environmental Factors. |
| Environmental Factor Guideline – Flora and Vegetation (EPA 2016j) | Referred to in the assessment of potential impacts as a result of the Proposal |
| Technical Guidance – Flora and vegetation surveys for environmental impact assessment (EPA 2016k) | Referred to in the survey design |
| WA Environmental Offsets Policy (Government of Western Australia 2011) | These policies were considered as part of the determination of the need for offsets. |
| WA Environmental Offsets Guidelines (Government of Western Australia 2014) | |
| Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPAC 2012a) | |

Table 5-23: Policy and Guidance Relevant to Flora and Vegetation

### 5.5.3 Receiving Environment

The Interim Biogeographic Regionalisation of Australia (IBRA7) divides Australia into 89 bioregions based on major biological and geographical/geological attributes. These bioregions are subdivided into 419 subregions, as part of a refinement of the IBRA framework (DoEE 2016). The Development Envelope is located in the Cape Range subregion of the Carnarvon Bioregion. The Carnarvon bioregion is composed of quaternary alluvial, aeolian, and marine sediments overlying Cretaceous strata. It is characterised by a mosaic of saline alluvial plains with samphire and saltbush low shrublands, Bowgada low woodland on sandy ridges and plains, Snakewood scrub on clay flats, and tree to shrub steppe over hummock grasslands on and between red sand dune fields. Limestone strata with *Acacia stuartii* or *A. bivenosa* shrubland outcrop in the north, where extensive tidal flats in sheltered embayment support Mangal (Kendrick and Mau 2002).

Land systems of the Western Australian rangelands have been mapped and described by the Department of Agriculture and Food WA (DAFWA), providing comprehensive descriptions and maps of the biophysical resources of the region, together with an evaluation of the condition of the soils and vegetation throughout. Two land systems occur within the Proposal area, the Cardabia and Littoral systems (Attachment 2L):

- Cardabia System: Undulating sandy plains with linear dunes, minor limestone plains and low rises, supporting mainly soft spinifex hummock grasslands with scattered acacias and other shrubs.
- Littoral System: Bare coastal mudflats (unvegetated), samphire flats, sand islands, coastal dunes and beaches, supporting samphire low shrublands, sparse Acacia shrublands, and mangrove forests.

Mapping of Pre-European vegetation within Western Australia was completed on a broad scale (1:1,000,000) by Beard (1975) and later re-assessed by Shepherd *et al*. (2001) with some larger vegetation units divided into smaller units. Two broad vegetation types were identified and mapped over the Proposal area:

- Cape Range 117: Grass-steppe – Hummock grassland *Triodia* spp. (87.8% of Pre-European extent in Cape Range subregion remaining).
- Coastal Dunes 662 – Hummock grassland; shrub steppe; mixed Acacia scrub and dwarf scrub with soft spinifex and *Triodia basedowii* (99.6% of Pre-European extent in Cape Range subregion remaining) (Attachment 2L).

A limited number of terrestrial flora and vegetation studies have previously been undertaken within the region, as outlined in Table 5-24. Subsea 7 has augmented the existing information by commissioning additional, Proposal-specific studies, to ensure an appropriate level of information is available to support completion of the environmental impact assessment and development of environmental management plans.

The Proposal-specific studies, as listed in Table 5-24, were undertaken by various technical specialists, and are included in full within Attachment 2. They are also referred to, as appropriate, in the discussion on the assessment of potential impacts and proposed management measures.

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| Regional Studies | | |
| 1993 | Keighery and Gibson | Survey of the limestone hills, ranges and calcarenite outcrops extending north from Lake MacLeod to Vlaming Head |
| 2010 | Department of Environment and Conservation (DEC) | Priority flora survey in the Cape Range National Park |
| 2015 | 360 Environmental | Level 1 Flora and Vegetation Assessment on Truscott Crescent, Exmouth. |
| 2018 | 360 Environmental | Level 2 Flora and Vegetation Assessment within Shark Bay and the Exmouth- Minilya Road area |
| Proposal-specific Studies | | |
| 2017 | 360 Environmental | Detailed flora and vegetation field surveys (May and September) of the entire Development Envelope and vegetation habitat and condition mapping |
| 2017 | 360 Environmental | Detailed Flora and Vegetation Survey for additional quadrat surveys, within and adjacent to the Development Envelope |

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| 2018 | 360 Environmental | Targeted Flora survey for priority flora within and adjacent to the Development Envelope |

Table 5-24: Overview of Local and Regional Flora and Vegetation Studies

The flora of the Cape Range peninsula has not been extensively surveyed, with limited regional surveys undertaken, particularly within the Learmonth area. Surveys conducted by Keighery and Gibson (1993), DEC (2009) and 360 Environmental (2015, 2018b) have provided a regional context of the flora and vegetation in the Cape Range peninsula.

The Keighery and Gibson 1993 regional survey identified five distinctive community types throughout the Cape Range peninsula region, extending north from Lake MacLeod to Vlamingh Head, as follows:

- Low heaths dominated by *Grevillea variifolia*, *Melaleuca cardiophylla* or *Acacia tetragonophylla* over *Triodia* sp.
- Red Quaternary sands over limestone, with shrubland dominated by *Banksia ashbyii*, *Hibbertia spicata* and *Hakea stenophylla*.
- Tertiary limestones of the Gnargoo and Giralia Ranges, dominated by *Acacia startii*, *A. victoriae* or *A. tetragonophylla*.
- Tertiary limestones of the Cape Range consisting of shrublands dominated by *Acacia tetragonophylla*, *A. bivenosa*, *Grevillea variifolia* subsp. *variijolia*, *G. calcicola*, and *Melaleuca cardiophylla*. The terraces north of Yardie Creek were dominated by *Ipomoea yardiensis, Triodia wiseana* or *T. pungens* hummock grasses.
- Younger limestones of the western coastal plain and the Rough Range, which is generally dominated by *Melaleuca cardiophylla* and/or *Hibbertia spicata* low heaths over *Triodia* spp. Occasionally they are dominated by Acacia low heaths.

Three flora and vegetation surveys (two detailed and one targeted) have been undertaken for the Proposal between 2017 and 2018 (Table 5-24). Follow-up surveys were completed in September 2017 and August 2018 for the revised Development Envelope and for targeted conservation significant flora species surveys. The flora and vegetation surveys were undertaken with reference to *Technical Guidance – Flora and Vegetation surveys for environmental impact assessment* (EPA 2016k). The Detailed flora and vegetation survey area was approximately 540 ha and the Targeted Flora survey area was approximately 793 ha. Inside the two survey areas is the Development Envelope (470 ha).

Project specific surveys identified 126 flora species, representative of 87 genera and 32 families within the survey area. The taxa recorded within the survey area included:

- Fabaceae (24 taxa).
- Chenopodiaceae (10 taxa).
- Poaceae (10 taxa).

Surveys identified *Acacia spp.* as the most frequently occurring genus.

#### 5.5.3.1 Vegetation Communities

Ten vegetation communities were defined and mapped within the Development Envelope (360 Environmental 2018a) as shown in Table 5-25 and Figure 5-41. In addition to the 10 vegetation communities, 7.8 ha of disturbed area/existing tracks were mapped. Three

*Acacia* shrubland vegetation communities (AbTe, AgTe, and AsSs) accounted for approximately 77% of the survey area and 75% of the Development Envelope.

| Vegetation Code | Description | Total Mapped (ha) | Development Envelope (ha) |
|---|---|---|---|
| AgTe | *Acacia gregorii* low open shrubland over *Triodia epactia* closed grassland | 209.8 | 180.2 |
| AsTe | *Acacia sclerosperma* subsp. *sclerosperma* shrubland over *Triodia epactia* hummock grassland | 43.3 | 30.7 |
| McTe | *Melaleuca cardiophylla* low shrubland over *Triodia epactia* hummock grassland | 18.7 | 18.4 |
| AbTe | *Acacia bivenosa* open shrubland over *Triodia epactia* hummock grassland | 84.9 | 81.1 |
| SoTe | *Stemodia sp. Onslow* low open shrubland over *Triodia epactia* hummock grassland | 5.8 | 5.0 |
| AbAc | *Acacia bivenosa* and *Acacia coriacea* open shrubland over *Spinifex longifolius* and *Triodia epactia* open grasssland | 4.4 | 1.6 |
| AcAt | *Acacia coriacea* and *Acacia tetragonophylla* open shrubland over *Triodia epactia* hummock grassland | 21.1 | 13.9 |
| AsSs | *Acacia stellaticeps* and *Scaevola sericophylla* open shrubland over *Triodia epactia* hummock grassland | 122.4 | 90.1 |
| AcCl | *Acacia coriaecea* and *Cullen* sp. shrubland over *Sida rohlenae* subsp. *rohlenae* low shrubland over *Triodia epactia* | 7.3 | 7.3 |
| TiFp | *Tecticornia* spp. and *Frankenia pauciflora* low shrubland on saline flat | 13.8 | 13.5 |
| CD | Completely Degraded/Track | 7.8 | 7.7 |
| Other | Beach (unvegetated, considered under fauna habitat), access tracks and borefield (cleared), offshore area within launchway envelope (considered under BCH) | 0 | 20.5 |
| Total Area | | 539.2 | 470 |

Table 5-25: Proposal Area Vegetation Communities

Statistical analysis of the 10 identified vegetation communities indicated that there was up to 90% similarity of flora species identified between all surveyed quadrats due to the mosaic nature of the landscape (360 Environmental 2018a). These groupings helped confirm field identification of vegetation types, and the similarity between quadrats within, and outside of, the Development Envelope.

The majority of vegetation within the Development Envelope comprises of *Acacia* shrubland vegetation communities AgTe (38%), AsSs (19%), and AbTe (17%). These vegetation communities are characterised by *Acacia gregorii*, *Acacia stellaticeps, Acacia bivenosa*, and *Scaevola sericophylla* low open shrubland over *Triodia epactia* open/closed grassland, and are considered typical in the Carnarvon bioregion (Keighery and Gibson 1993).

All vegetation types mapped during the surveys for the Proposal are considered typical in the Carnarvon bioregion (Keighery and Gibson 1993). No vegetation associated with groundwater dependent ecosystems (GDEs) was recorded within the survey area (360 Environmental 2018a). There are no Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) within 10 km of the Development Envelope.

#### 5.5.3.2 Conservation Significant Flora

No flora designated as Critically Endangered (CR) under the *Biodiversity and Conservation Act 2016* (BC Act) or EPBC Act were recorded within the survey area (360 Environmental 2018a, Attachment 2L).

A targeted survey for Priority species undertaken by the Department of Environment and Conservation (DEC 2010a) identified five Priority listed species in the Cape Range National Park; *Brachychiton obtusilobus* (Priority 4), *Grevillea calcicola* (Priority 3), *Eremophila forrestii* subsp. *capensis* (Priority 3), *Corchorus congener* (Priority 3), and *Tinospora esiangkara* (Priority 2). The majority of the Priority listed taxa identified are associated with limestone, red sands or rocky soils that are present on the west side of the Cape or on the Cape Range. As none of these specific habitats occur in the Development Envelope, the majority of the Priority taxa were considered unlikely to occur (360 Environmental 2018a).

One Priority species was recorded in the survey area, *Corchorus congener* (P3). *Corchorus congener* is a spreading shrub endemic to the Cape Range peninsula, with a preferred habitat of red sand or sandy loam with limestone on sand dunes and plains (WAH 2018). *C. congener* was found to be locally common both within and outside the survey area, occurring readily along tracks and road sides. Regional locations were also surveyed outside of the Development Envelope during the targeted survey to gather population details in a regional context (360 Environmental 2018a).

#### 5.5.3.3 Flora of Interest

*Calytrix* sp. was recorded on a rocky hilltop near the northern end of the survey area (outside of the Development Envelope). Additional targeted searches for the species were undertaken, however none were found. It is considered unlikely that *Calytrix* sp. occurs within the Development Envelope (360 Environmental 2018a).

A total of 13 species records were considered to be an extension of their known range as follows:

- *Calandrinia ? polyandra.*
- *Chenopodium murale.*
- *Clerodendrum tomentosum* var. *lanceolatum.*
- *Corynotheca micrantha.*
- *Cucumis variabilis.*
- *Cyperus bulbosus.*
- *Hibiscus sturtii* var. *platychlamys.*
- *Indigofera chamaeclada* subsp. *pubens.*
- *Indigofera trita.*
- *Lotus australis.*
- *Maireana lanosa.*

- *Pimelea ammocharis.*
- *Tephrosia uniovulata.*

All are likely to be common throughout the region and not of conservation significance (Attachment 2L). The range extensions are considered likely to be associated with the low level of survey in the Exmouth area. Specimens recorded and collected within the survey area have been vouchered at the WA Herbarium.

#### 5.5.3.4 Vegetation condition

The vegetation condition of the survey area ranged from Very Good to Completely Degraded, with the majority (83%) of the area considered Very Good (360 Environmental 2018a).

#### 5.5.3.5 Environmentally Sensitive Areas (ESAs)

The Cape Range National Park occurs approximately 4 km to the west of the Development Envelope. The Development Envelope intersects the Cape Range Subterranean Waterways which is designated as an ESA (Figure 2-12). This ESA is related to the underground aquifer system that has been identified in the Directory of Important Wetlands in Australia and is not related to flora and vegetation values.

#### 5.5.3.6 Introduced Flora

Eight introduced species were recorded within the survey area, representing approximately 6% of the total taxa, and included:

- *Aeva javanica.*
- *Bidens subalternans* var. *simulans.*
- *Cenchrus ciliaris.*
- *Chenopodium murale.*
- *Solanum nigrum.*
- *Sonchus oleraceus.*
- *Sisymbrium orientale.*
- *Vachellia farnesiana.*

*Cenchrus ciliaris* (Buffel Grass) is a widespread weed, widely planted in pastoral regions as a pasture grass. It has become common along roadsides, creeklines, river edges and most vegetation types from Shark Bay to the Pilbara and adjacent desert.

No listed Declared Pests or Weeds of National Significance (WoNS) under the *Biodiversity and Agriculture Management Act 2007* (BAM Act) were recorded during the surveys undertaken for the Proposal.

### 5.5.4 Potential Impacts

Construction and operation of the Proposal has potential to directly and indirectly impact flora and vegetation. Table 5-26 summarises the potential impacts during each project phase.

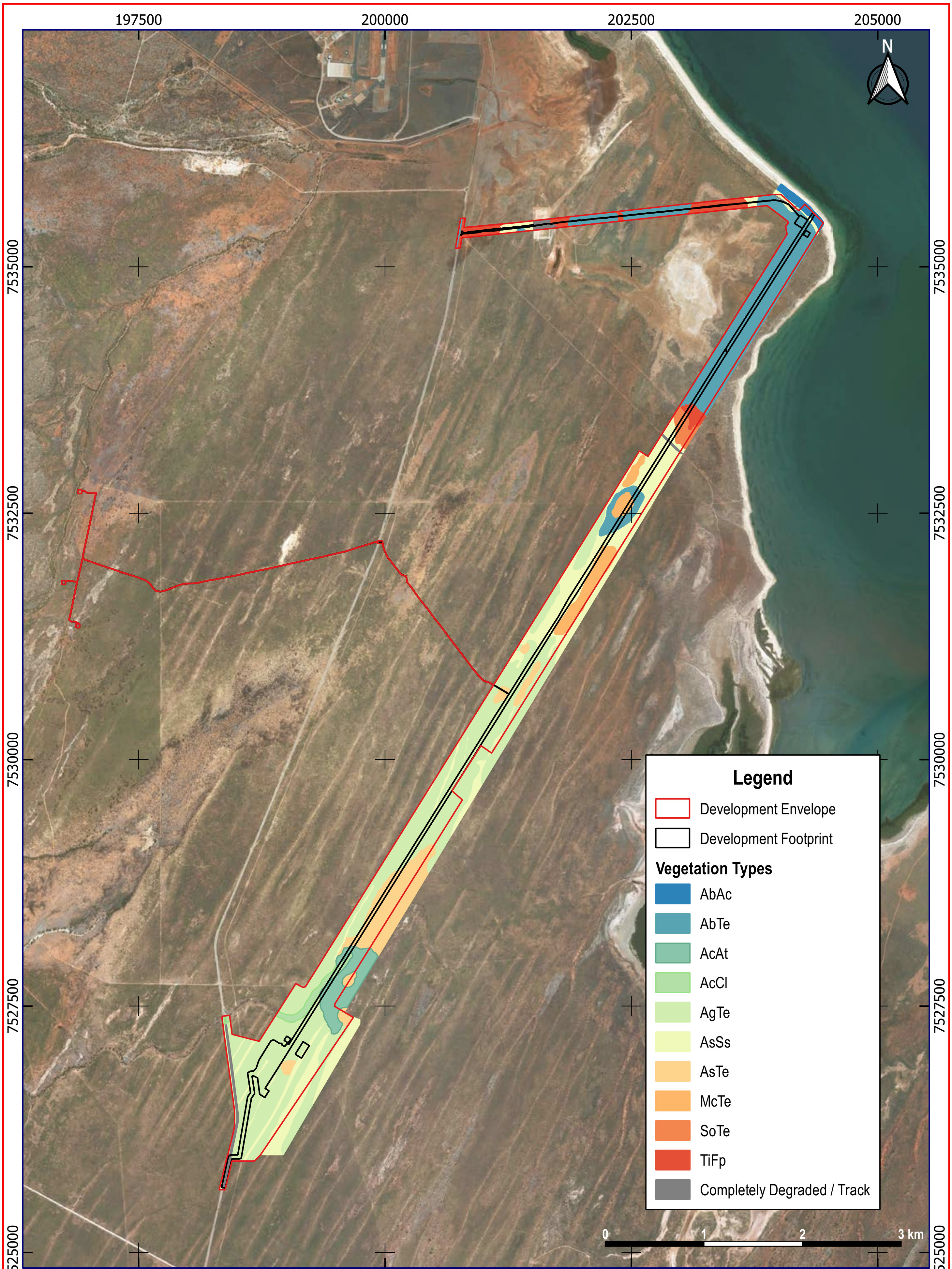
| Project Phase | Potential Impact |
|---|---|
| Construction | Direct loss of native vegetation and significant flora species during clearing for onshore infrastructure |
| | Indirect loss or degradation of native vegetation and significant flora species due to dust emissions |
| | Indirect loss or degradation of native vegetation and significant flora due to introduction or spread of weeds |
| | Fragmentation of native vegetation and significant flora species during clearing for onshore infrastructure |
| Operations | Indirect loss or degradation of native vegetation and significant flora due to changes in surface water flows or quality |
| | Indirect loss or degradation of native vegetation and significant flora due to changes in groundwater flows or quality |
| | Loss or degradation of native vegetation and significant flora due to leak or spill of chemicals (including hydrocarbons) |

Table 5-26: Potential Impacts to Flora and Vegetation

### 5.5.5 Potential Cumulative Impacts

Several third party projects (refer Section 2.5.8) have resulted in impacts to flora and vegetation adjacent to Exmouth Gulf. Only the Cape Seafarms project, now abandoned, has resulted in impacts to flora and vegetation at Heron Point.

Other future projects with potential to impact flora and vegetation include the proposed clearing of up to 499 ha for gravel extraction (clearing permit CPS 7532/1 granted to Main Roads Western Australia) and an application by Horizon Power to clear up to 42 ha of native vegetation for a rebuild of a high voltage power line (clearing permit CPS 8067/1 currently under assessment). No impacts at Heron Point are likely. Potential cumulative impacts are discussed in Section 5.5.6.8.




Scale: 1:50000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from 360 Environmental (2018).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-41: Vegetation Communities Mapped Within the Survey Area

W:\Subsea 7\GIS\Infrastructure Map.qgs 29/08/2019

### 5.5.6 Assessment of Impacts

#### 5.5.6.1 Direct Loss of Native Vegetation during Clearing for Onshore Infrastructure

Up to 176 ha of native vegetation will be cleared for the Proposal. A total of 56 ha are required for infrastructure (site offices, staff facilities, messing facilities, storage area and car park, Bundle tracks (2), launchway facilities area, access roads, spray field, drainage sumps, hydro testing water pond, and groundwater production bores and supply pipeline) (Figure 5-42).

Up to an additional 120 ha of clearing relates to clearing required for drains, internal tracks, fences, firebreaks and construction areas. To allow for the comprehensive assessment of impacts associated with the clearing of native vegetation, indicative areas of potential disturbance for these purposes have been mapped as 'Miscellaneous disturbance' (Figure 5-42) and included in the impact calculations (Table 5-27).

| Vegetation Code | Description | Total Mapped (ha) | Clearing Area (ha) | Impact (%) |
|---|---|---|---|---|
| AgTe | *Acacia gregorii* low open shrubland over *Trioida epactia* closed grassland | 209.8 | 64.9 | 31 |
| AsTe | *Acacia sclerosperma* subsp. *sclerosperma* shrubland over *Triodia epactia* hummock grassland | 43.3 | 10.8 | 25 |
| McTe | *Melaleuca cardiophylla* low shrubland over *Triodia epactia* hummock grassland | 18.7 | 4.9 | 26 |
| AbTe | *Acacia bivenosa* open shrubland over *Triodia epactia* hummock grassland | 84.9 | 38.2 | 45 |
| SoTe | *Stemodia sp. Onslow* low open shrubland over *Triodia epactia* hummock grassland | 5.8 | 2.5 | 42 |
| AbAc | *Acacia bivenosa* and *Acacia coriacea* open shrubland over *Spinifex longifolius* and *Triodia epactia* open grasssland | 4.4 | 0.3 | 8 |
| AcAt | *Acacia coriacea* and *Acacia tetragonophylla* open shrubland over *Triodia epactia* hummock grassland | 21.1 | 3.9 | 18 |
| AsSs | *Acacia stellaticeps* and *Scaevola sericophylla* open shrubland over *Triodia epactia* hummock grassland | 122.4 | 33.7 | 27 |
| AcCl | *Acacia coriaecea* and *Cullen* sp. shrubland over *Sida rohlenae* subsp. *rohlenae* low shrubland over *Triodia epactia* | 7.3 | 1.9 | 26 |

| Vegetation Code | Description | Total Mapped (ha) | Clearing Area (ha) | Impact (%) |
|---|---|---|---|---|
| TiFp | *Tecticornia* spp. and *Frankenia pauciflora* low shrubland on saline flat | 13.8 | 7.6 | 55 |
| CD | Completely Degraded/Track | 7.8 | 5.0 | 63 |
| Other | Beach (unvegetated, considered under fauna habitat), access tracks and borefield (cleared), offshore area within launchway envelope (considered under BCH) | 0 | 2.3 | 0 |
| Total | | 539.3 | 176 | - |

Table 5-27: Proposed Vegetation Community Disturbance Within the Development Footprint

The majority of clearing will occur in vegetation communities AbTe (loss of 38.2 ha or 45% of the total mapped area), AgTe (loss of 64.9 ha or 31% of the total mapped area), AsSs (loss of 33.7 ha or 27% of the total mapped area), and AsTe (loss of 10.8 ha or 25% of the total mapped area) (Table 5-27).

It is noted that the survey area was only marginally larger than the Development Envelope. A large proportion of the pre-European extents of the broad vegetation types within the region (Shepherd *et al*. 2001) remain:

- Cape Range 117 (Grass steppe – Hummock grassland *Triodia* spp.) remains at 87.8%.
- Coastal Dunes 662 (Hummock grassland; shrub steppe; mixed *Acacia* scrub and dwarf scrub with soft spinifex and *Triodia basedowii)* remains at 99.6%.

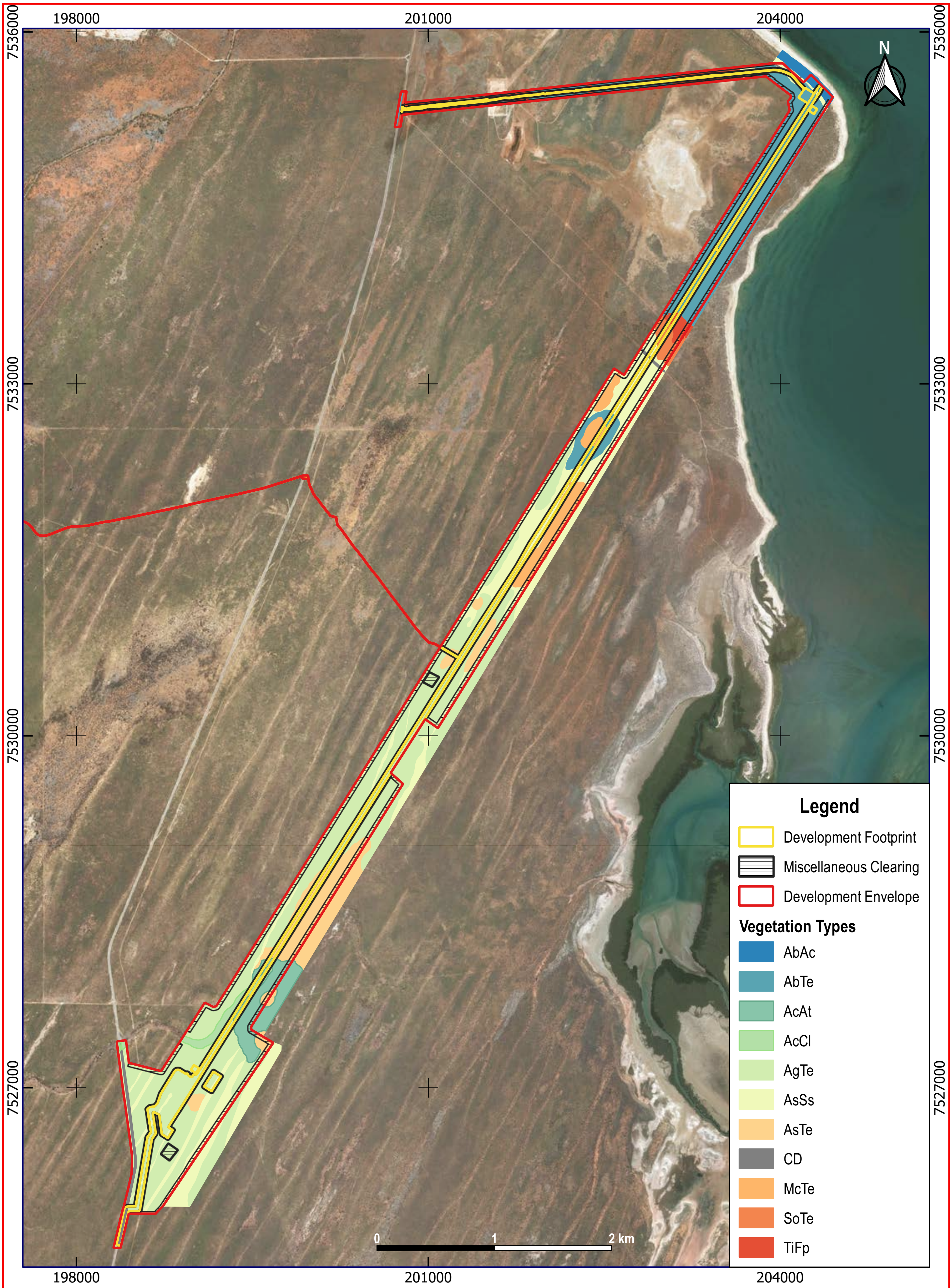
The Development footprint will utilise cleared and degraded areas where possible.

One Priority flora species, *Corchorus congener*, (Priority 3) has been recorded as abundant within the Development Envelope and across the wider regional area (Figure 5-43). During the targeted flora surveys, 1,200 locations of *C. congener* and approximately 2,400 individual plants were recorded (Figure 5-43). It is estimated that out of 2,400 plants approximately 400 (16.6%) will be removed.

A total of 793 ha of *C. congener* habitat was recorded during the targeted flora survey, of which 470 ha (59% of total targeted mapped area) are within the Development Envelope and 176 ha (22%) are proposed to be cleared.

It is noted that 1,200 specimens of *C. congener* were recorded (i.e. georeferenced using a handheld GPS), however the species was observed extensively outside of the Development Envelope and it was not feasible to record each individual at a a regional scale due to the vast numbers present. The potential impact numbers (16.6% and 22%) are highly conservative (worst case) and expected to be far less due to the abundance of the species across the region. It was also noted during the surveys that *C. congener* appeared to be a disturbance species, occurring readily along tracks and roadsides.

Additionally, DBCA database search results identified an additional nine confirmed records of the species within a 50 km radius of the Development Envelope. The majority of these locations are in the DBCA protected nature reserve of Cape Range National Park.




Scale: 1:42000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from 360 Environmental (2018a).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-42: Potential Loss of Vegetation Communities During Clearing for Onshore Infrastructure

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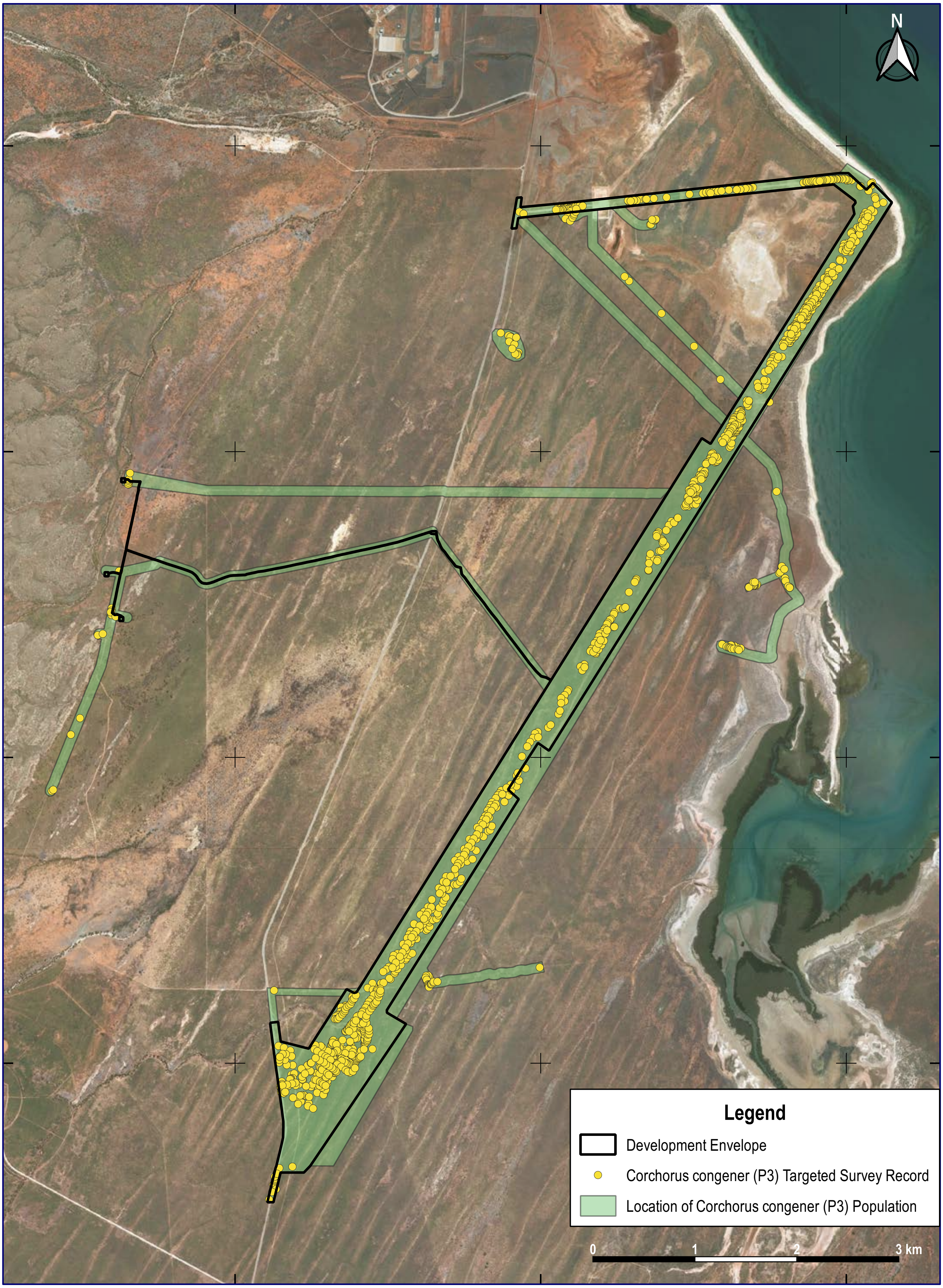


Scale: 1:50000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from 360 Environmental (2018a).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-43: Priority Flora Records

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#### 5.5.6.2 Indirect Loss or Degradation of Native Vegetation due to dust emissions

Accumulation of dust particulates on leaf surfaces can potentially occur as a result of exposure to dust, resulting in a reduced ability for plants to photosynthesise and transpire, potentially causing a decline in health and eventual plant death. Dust is likely to be generated during construction as a result of clearing. To limit the generation of dust, water carts will be used during construction.

Impacts from dust generation are likely to be limited to within 50 m of the generation point and are likely to be short-term during the land clearing process. Potential short-term impacts during construction are considered unlikely to significantly affect vegetation condition or result in loss of vegetation. If loss of vegetation was to occur, given the vegetation communities are well represented locally and regionally, this is unlikely to result in an adverse impact on the biological diversity and ecological integrity of these communities.

There are no listed Threatened species or communities located within the Development Envelope or immediate surrounding area. The Priority species *C. congener* (Priority 3) is located throughout the Development Envelope (Attachment 2L), and is widespread throughout the Learmonth area. Short-term dust deposition on individual plants is considered unlikely to result in degradation of plant community health or result in loss of the species on a local or regional basis. It is noted that this species was frequently recorded adjacent to existing tracks and is therefore expected to be tolerant of dust associated with vehicle traffic (Attachment 2L).

Appropriate mitigation measures to address potential impacts are presented in Table 5-29.

#### 5.5.6.3 Indirect Loss or Degradation of Native Vegetation due to Introduction or Spread of Weeds

Of the eight weed species identified within the Development Envelope, Kapok bush (*Aerva javanica*), Buffel grass (*Cenchrus ciliaris*), and Mimosa bush (*Vachellia farnesiana*) are widespread through the region. Kapok bush and Buffel grass have been introduced widely within pastoral regions as a pasture grass from Shark Bay to the Kimberley.

Weeds have the potential to outcompete and displace native vegetation if introduced or conditions are altered to favour their growth. Additionally, weeds can displace palatable feed for stock, reducing carrying capacity of pastoral areas (DoEE 2018b).

Weeds may be spread and/or introduced by poor hygiene practices on vehicles and equipment, resulting in soil and weed vegetative material or seeds being transported around site, or into or offsite (Section 2.3.3).

Given the existing presence of weeds across the area, and the plans to use locally-sourced construction equipment, it is unlikely that project activities will result in an introduction of new weed species. The spread or proliferation of weeds during construction will be managed through the management measures nominated in Table 5-29.

#### 5.5.6.4 Fragmentation of Native Vegetation during Clearing for Onshore infrastructure

Implementation of the Proposal will result in disturbance to 22.3% of the total mapped habitat of *C. congener* (Attachment 2L). Fragmentation from clearing is not expected to impact the overall health and viability of the population within the area, as the species was recorded within all vegetation communities, except one (TiFp), and was also found to be well represented across a broad area to the north and south of the Development Envelope including within areas of disturbance (for example road and track margins and pipeline easements).

The infrastructure footprint will disturb up to 176 ha, or 33%, of the total mapped native vegetation. No TECs or PECs were recorded within the Development Envelope or adjacent area.

The potential for habitat fragmentation is most likely to occur where flora taxa or vegetation communities with limited populations or extents exist immediately adjacent to areas of disturbance. Due to the lack of TECs and PECs within the area, the widespread nature of *C. congener* and the vegetation communities mapped and the generally linear, narrow footprint (which does not constitute an impediment to pollinators or gene flow), the potential for changes to genetic diversity, colonisation, or recruitment within or adjacent to the Development Envelope is considered low.

The infrastructure footprint is narrow (ranging in width from approximately 3 m to 200 m), and the adjacent vegetation communities well represented regionally. The proposed clearing will not isolate any spatially restricted vegetation communities. It is considered unlikely that the proposed clearing will result in fragmentation of flora and vegetation communities.

#### 5.5.6.5 Indirect Loss or Degradation of Native Vegetation due to Changes in Surface Water Flows or Quality

Depending on the local topography, vegetation communities have adapted to site conditions that will allow for survival in intermittent flooding. Periods of sustained flooding will generally result in soil conditions becoming anaerobic, reducing the ability of vegetation to survive. The lack of soil oxygen will place vegetation under stress and a number of physiological and morphological responses will begin such as stomata closure, leaf curling, leaf dieback and crown loss. These survival mechanisms are critical to allow the plant to become tolerant to flood events.

Plant tolerance or adaptation to waterlogging generally correlates well with the degree of flooding in the natural habitat of any given species (Visser et al. 2000). Flood events in dryland systems are often unpredictable, infrequent and short lived (Ruprecht and Ivanescu 2000). Therefore dryland plant species typically exhibit moderate flooding tolerance with capacity to recover quickly once flooding has subsided (Argus *et al*. 2014). This capacity to adapt quickly to the post-flooding environment, for example through the re-establishment of an extensive root system, would be equally important in seedlings and saplings as surface substrates rapidly dry.

Given the high evapotranspiration rates characteristic of the region, it is not expected that flood inundation would remain over a long duration. The vegetation communities recorded within the survey area (Section 5.5.3.1) are typical coastal communities and are likely to have adapted over time to seasonal flood events.

Flood modelling (Attachment 2R) assessed the flood extent for a:

- 10-year average recurrence interval (ARI) event.
- 50-year ARI event.
- 100-year ARI event.
- Probable Maximum Precipitation (PMP) event.

The results for a 100-year ARI event are shown in Figure 5-50. It is expected that vegetation within the Development Envelope could be impacted to some degree following a change to surface water flow patterns associated with development of the proposed Bundle track infrastructure. It is predicted that a general increase in flood levels and velocities will occur on the western side of the Bundle track, and a general decrease in flood levels on the eastern side of the Bundle track that will be due to a proposed open drain to divert water (refer Section 5.8.6.1).

The potential impacts to each vegetation type were assessed based on the modelled changes to surface water flow patterns and depths (Attachment 2R, Figure 5-50). The risk of impact to each vegetation type, based on both the likelihood of each flood event and the consequence of the event, were the same for each flood event (Table 5-28).

| Vegetation Community | Vegetation Characteristics | Risk of Impact | Estimated Recovery Period (years) |
|---|---|---|---|
| Acacia Shrubland | Predominantly mesophytic, or xerophytic meaning that they prefer moderate to dry conditions. *Acacias* located in the Pilbara are often located in extreme drying environments and are often short-lived perennials. Species like Mulga (*Acacia aneura*) have adapted to survive with minimal water over extended periods, but rely on flood events or surface sheet flow. | Moderate based on alteration or disturbance to 5-30% of a habitat, species or ecosystem | 1-2 |
| Melaleuca Shrubland | Predominantly helophytic to xerophytic species meaning that they can survive in both high and low water available environments. Drake *et al*. (2013) found that some Melaleuca species (*M. strobophylla*) can capitalise on inundation events suggesting a preference to excess water. | Moderate based on alteration or disturbance to 5-30% of a habitat, species or ecosystem | 1-2 |
| Stemodia Shrubland | Predominantly helophytic, or mesophytic, or xerophytic species meaning that they can adapt to survive to varying environments from high, medium, to low water availability respectively. | Moderate based on alteration or disturbance to 5-30% of a habitat, species or ecosystem | 1-2 |
| Tecticornia Shrubland | These species are often located near tidal landforms frequent to regular tidal/flooding event and survive in highly saline and waterlogged soil conditions | Minor based on alteration or disturbance to less than 5% of a habitat, species or ecosystem | <1 |

| | | | |
|---|---|---|---|
| Cullen and Acacia Shrubland | Similar to Acacia shrubland as these species are also mesophytic or xerophytic. | Moderate based on alteration or disturbance to 5-30% of a habitat, species or ecosystem | 1-2 |

Table 5-28: Potential Impacts to Vegetation Communities from Changes in Surface Water Flows

The potential indirect impacts to vegetation adjacent to the Development Envelope, within areas potentially impacted by changes in surface water flows, are expected to be minor (less than 5% of habitat impacted) to moderate (5-30% of habitat impacted) and recoverable in the short to medium-term (1-2 years) even following a PMP event. A surface water diversion (open drain) and a culvert will be installed to manage surface water flows adjacent to the Bundle track (refer Section 5.8.6.1).

Given the vegetation within and adjacent to the Development Envelope is well represented locally and regionally, no significant impact on the diversity or ecological integrity of vegetation communities is expected at a local or regional scale as a result of minor changes to surface water flows as a result of implementation of the Proposal.

#### 5.5.6.6 Indirect Loss or Degradation of Native Vegetation due to Changes in Groundwater Flows or Quality

Depth to groundwater was greatest in bores situated in the western part of the Development Envelope, to the west of the Minilya-Exmouth Road, at between 22 and 32 m below ground level (mbgl). Water quality in these bores is fresh to slightly brackish with Total Dissolved Solids (TDS) concentrations of <1,700 mg/L. These bores will be used as the water supply for the Proposal. Within the central part of the Development Envelope, groundwater levels were shallower at 12-17 mbgl and groundwater is hypersaline (TDS > 46,000 mg/L).

Proposal-specific flora and vegetation studies did not identify groundwater dependent ecosystems (GDEs) within the Development Envelope. Vegetation communities in which the abstraction bores are located are not dependent on groundwater.

The proposed groundwater abstraction is not considered likely to impact native vegetation in either the short or long-term due to the low abstraction rates (0.3 L/s) and associated small extent of drawdown (refer Section 5.8.6.4).

Discharge of treated wastewater has potential to alter groundwater quality within the immediate vicinity of the spray field. Groundwater within the sprayfield is currently at approximately 15 mbgl, beyond the shallow root systems of the coastal vegetation, and is saline. Thus the discharge of treated wastewater is unlikely to adversely impact groundwater quality or native vegetation.

#### 5.5.6.7 Loss or Degradation of Native Vegetation due to Leak or Spill of Chemicals (including Hydrocarbons)

The likelihoodk of the loss or degradation of native vegetation due to leak or spill of hazardous materials is considered low given the relatively small volumes of hazardous materials proposed to be stored and used, and adoption of robust hazardous materials storage and handling procedures.

Appropriate mitigation measures to address potential impacts are presented in Table 5-29.

#### 5.5.6.8 Cumulative Impacts

Proposals within the area that also have a terrestrial footprint, and therefore impact on native vegetation, include the Exmouth Marina, Cape Seafarms Projects, and WA Limestone's Barge Loading Facility. Native vegetation within the onshore footprint of the Exmouth Marina is likely to have been consistent with the vegetation types found broadly across the region. The EPA (1997c) noted that a '*number of pioneer species as Spinifex longifolius, Salsola kali, Cakile maritima, Ipomea brasiliensis, and Tetragonia decumbens occur in the foredune/primary dune with Ptilotus spp., Atriplex isatidea, Olearia axillaris, Scaevola crassifolia and Euphorbia sp. in the swales*'. It was further noted that '*existing foredunes are badly degraded in places due to uncontrolled access. Weed invasion has also occurred in a number of areas*' (EPA 1997c).

For the Cape Seafarms Project, no Declared Rare or Priority listed flora were found in the project area and all species are described as common in the Exmouth area and in most coastal regions of the north west of Western Australia (EPA 1997a).

For the Exmouth Limestone Project Barge Loading Facility proposal, an onshore footprint of 20.6 ha was expected as a result of the project. To date the project has not been implemented.

Other future projects with potential to impact flora and vegetation include the proposed clearing of up to 499 ha for gravel extraction (clearing permit CPS 7532/1 granted to Main Roads Western Australia) and an application by Horizon Power to clear up to 42 ha of native vegetation for a rebuild of a high voltage power line (clearing permit CPS 8067/1 currently under assessment).

CPS 7532/1 approved clearing across seven separate sites, with one site (Site 7, 86 ha) being within the vicinity of the Development Envelope. The following vegetation associations were recorded within the clearing area:

- Coastal Dunes 662 – 'Hummock grassland; shrub steppe; mixed acacia scrub & dwarf scrub with soft spinifex & *Triodia basedowii*'.
- Mosaic Plain – Mixed High to Low Open Shrubland of Acacia bivenosa, *A. synchronicia*, *Eremophila longifolia*, *Scaevola acacioides*, *S. tomentosa* sometimes over Closed Hummock Grassland of *Triodia basedowii* with Scattered Bunch Grass/ Closed Bunch Grass of **Cenchrus ciliaris*, *Iseilema membranaceum* with Very Open Herbs of *Goodenia forrestii*, *Lobelia heterophylla*.
- Triodia Hummock Grassland – Triodia Hummock Grassland of Triodia basedowii, *T. angusta* with Scattered Shrubs of *Solanum asiophyllum*, *Pimelea ammocharis*, *Stylobasium spathulatum* over Scattered herbs of *Goodenia cusackiana*.
- Open Low Mixed Shrubland on Sand dune – Open Mixed Shrubland of *Crotalaria cunninghammii*, Pileanthus septentrionalis, Stylobasium spathulatum, *Dampiera*

*incana*, Corchorus crozophoriforius over Tussock Grass of *Cenchrus ciliaris, *Eriachne obtusa* and *Triodia* steppe of *T. angusta*, *T. basedowii* on Sand dune.

- Low Scattered Shrubland and Herbs on Outcrop – Low Scattered Shrubland of *Calytrix truncatifolia* over Herbs of *Dysphania kapari*, *Ipomoea yardiensis* on calcareous outcrops.
- Learmonth Land System 'Sandy outwash plains marginal to the Cape Range, supporting mainly soft spinifex hummock grasslands with scattered acacia shrubs'.

The Coastal Dunes 662 vegetation type was also recorded within the Development Envelope, but cumulative impacts are not considered likely to be significant as this vegetation type remains at 99.6% of the pre-European extent. The other vegetation types recorded within Site 7 are less similar to those recorded within the Development Envelope.

Under CPS 8067/1 clearing of a total of 42 ha is proposed, within Lots running from the bottom of Exmouth Gulf up the North West Cape to Exmouth town. No information on the vegetation types to be cleared is currently available.

Given the above, and the findings of the flora and vegetation surveys undertaken for the Proposal, it is considered likely that native vegetation cleared, or to be cleared, as a result of the Proposal and third party projects is relatively common within the region and remains well represented. Cumulative impacts from clearing of native vegetation are not expected to threaten the biological diversity and ecological integrity of the regional flora and vegetation.

### 5.5.7 Mitigation and Predicted Outcome

The proposed mitigation measures to address potential impacts to flora and vegetation as a result of the Proposal and the predicted outcome are provided in Table 5-29.

The EPA objective '*to protect flora and vegetation so that biological diversity and ecological integrity are maintained*' will be met.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Direct loss of native vegetation and significant flora species during clearing for onshore infrastructure | Measures to avoid:<br>• Proposal design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>• Where practicable, land clearing will be undertaken progressively with the amount of active disturbance minimised.<br>• The site induction program will provide written and verbal information on protection of vegetation, conservation significant flora and ground disturbance authorisation procedures.<br>Measures to rehabilitate:<br>• Compacted areas will be ripped on the contour to remove soil compaction.<br>• Cleared vegetation and topsoil material will be retained for use in rehabilitation.<br>• Rehabilitation will be undertaken on disturbed construction areas (e.g. directional drilling sites, adjacent to access road) as they become available. | The proposed clearing is of communities that are common and widespread with all 10 vegetation communities directly impacted by the Proposal being well represented outside of the Development Envelope.<br><br>Limited removal of individuals of Priority species *Corchorus congener* (P3) will occur as a result of implementation of the Proposal. *Corchorus congener* is known to occur widely in the Development Envelope and more broadly across the Learmonth area.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained.<br><br><u>Monitoring</u><br>Inspections/survey to confirm no clearing beyond Development Envelope. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Indirect loss or degradation of native vegetation due to dust emissions | Measures to avoid:<br>• Proposal design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>• Vehicles and equipment will keep to designated roads and tracks.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Water cart used during clearing to prevent significant dust emissions.<br>• Topsoil will be stored in designated locations and respread over rehabilitated areas to act as a seed source.<br>• Cleared vegetation will be stored for subsequent respread over rehabilitation areas to protect the soil from erosion.<br>Measures to rehabilitate:<br>• Progressive rehabilitation will be undertaken on impacted areas (as required). | Dust emissions during construction will be short-term in nature and the potential impact area will be localised (<50 m from source). Flora and vegetation in areas adjacent to land clearing activities is locally and regionally common.<br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Indirect loss or degradation of native vegetation due to the introduction or spread of weeds | Measures to avoid:<br>• Earth moving machinery will be cleaned of soil and vegetation prior to entering or leaving the Development Envelope.<br>• No weed affected soil, mulch or fill will be brought into the Development Envelope.<br>• During operations, vehicles and equipment will keep to designated roads and tracks.<br>Measures to minimise:<br>• A weed hygiene system will be developed and implemented during the construction phase to avoid the establishment of new populations within the Development Envelope.<br>Measures to rehabilitate:<br>• Weed control to be implemented within rehabilitation areas as required. | Increased presence of weeds, (species and abundance) may affect flora and vegetation. However these impacts would, at worst, result in localised and incidental effects on the health, abundance and structure of vegetation communities, all of which are well represented locally and in the region.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Fragmentation of native vegetation during clearing for onshore infrastructure | Measures to avoid:<br>• Proposal design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>Measures to minimise:<br>• Clearing activities will be managed to ensure clearing is strictly limited to that necessary for construction.<br>Measures to rehabilitate:<br>• Rehabilitation will be undertaken on disturbed construction areas (e.g. directional drilling sites, adjacent to access road) as | Fragmentation may affect flora and vegetation. However these impacts would, at worst, result in localised and incidental effects on the health, abundance and structure of vegetation communities, all of which are well represented in the region.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | they become available. | residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Indirect loss or degradation of native vegetation due to changes in surface water flows or quality | Measures to avoid:<br>• Where necessary, suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns.<br>Measures to minimise:<br>• Proposal design has considered the local surface water flow paths and location of drainage lines with the aim of minimising changes to natural flows.<br>• Hazardous materials will be stored in accordance with relevant Australian Standards.<br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas.<br>• Upon closure reinstatement of the natural flow paths will occur after removal of the project infrastructure. | Modification to surface water flows are considered to be minor at a local scale and as such are unlikely to affect the survival of, or reduce the condition of, vegetation within or adjacent to the Development Envelope. Vegetation communities within the Development Envelope are locally and regionally widespread and are resilient to both drought and short-term inundation associated with seasonal rainfall events.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation, and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Indirect loss or degradation of native vegetation due to changes in groundwater flows | Measures to avoid:<br>• NA<br>Measures to minimise: | It is not expected that changes in groundwater levels that may result from abstraction of groundwater will impact flora and vegetation. No GDE communities have been |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| or quality | • Groundwater abstraction will be no more than 12 ML/annum at abstraction rates of 0.3 L/s in individual bores.<br>• Hazardous materials will be stored in accordance with relevant Australian Standards.<br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas. | identified in the Development Envelope.<br><br>No changes in groundwater quality are anticipated to result from development and implementation of the Proposal.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation, and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Loss or degradation of native vegetation due to leak or spill of chemicals (including hydrocarbons) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Hazardous materials will be stored in accordance with relevant Australian Standards.<br>• Refuelling will occur on concrete or HDPE-lined pads to contain any drips and spills. The pads will drain to a sump to allow removal of collected material.<br>• Spill kits will be located at strategic locations throughout the project area and employees trained in their use.<br>• Spills will be cleaned up and contaminated soils will either be treated in situ or removed from site by a licensed third party. | Leaks or spills have potential to cause adverse impacts to flora and vegetation, however these impacts will result in localised and incidental effects on the health, abundance and structure of vegetation communities, all of which are well represented in the region.<br><br>Subsea 7 considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | • <br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas. | diversity and ecological integrity of the present flora and vegetation will be maintained. |

Table 5-29: Proposed Mitigation Measures and Predicted Outcome for Flora and Vegetation

## 5.6 KEY ENVIRONMENTAL FACTOR 6 – SUBTERRANEAN FAUNA

### 5.6.1 EPA Objective

To protect subterranean fauna so that biological diversity and ecological integrity are maintained.

### 5.6.2 Policy and Guidance

Subsea 7 has taken into consideration relevant policy and guidance in the design of the Proposal, the completion of the environmental impact assessment and through the development of this ERD.

A summary of the policy and guidance relevant to Subterranean Fauna, and how Subsea 7 has considered these, is presented in Table 5-30.

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Statement of Environmental Principles, Factors and Objectives (EPA 2016c, 2018c) | Referred to in the identification and assessment of Preliminary Key Environmental Factors. |
| Environmental Factor Guideline – Subterranean Fauna (EPA 2016l) | This guidance was consulted in the consideration of potential impacts on subterranean fauna and the assessment of the significance of the subterranean fauna values within and adjacent to the Development Envelope. |
| Technical Guidance – Subterranean fauna survey (EPA 2016m) | This guidance was consulted to determine the level of survey likely to be required. |
| Technical Guidance – Sampling methods for subterranean fauna (EPA 2016n) | This guidance was consulted to determine the level of survey likely to be required and the survey design. |
| A review of subterranean fauna assessment in Western Australia – Discussion paper (EPA 2012) | Referred to in the review of subterranean fauna values within and adjacent to the Proposal area and in the assessment of potential impacts. |
| WA Environmental Offsets Policy (Government of Western Australia 2011) | These policies were considered as part of the determination of the need for offsets. |
| WA Environmental Offsets Guidelines (Government of Western Australia 2014) | |
| Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPAC 2012a) | |

Table 5-30: Policy and Guidance Relevant to Subterranean Fauna

### 5.6.3 Receiving Environment

A number of subterranean fauna studies have previously been undertaken within the region, as outlined in Table 5-31. Subsea 7 has augmented the information from previous studies by commissioning additional, Proposal-specific studies, to ensure an appropriate level of information is available to support completion of environmental impact assessment and development of environmental management plans.

The Proposal-specific studies, as listed in Table 5-31, were undertaken by various technical specialists, and are included in full within Attachment 2. They are also referred to, as appropriate, in the discussion on the assessment of potential impacts and proposed management measures.

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| Regional Studies | | |
| 1988 | Harvey, M.S. | A new troglobitic schizomid from Cape Range, Western Australia (Chelicerata: schizomida). |
| 1993 | Deeleman-Reinhold C.J. | *Trichocyclus septentrionalis* a new species of cave dwelling pholcid spider from north-western Australia (Araneae: Pholcidae). |
| 1993 | Humphreys and Shear | Troglobitic millipedes (Diplopoda: Paradoxosomatidae) from semi-arid Cape Range, Western Australia: systematics and biology. |
| 1994 | Humphreys | The subterranean fauna of the Cape Range coastal plain, north-western Australia. |
| 1995 | Humphreys and Feinberg | Food of the blind cave fishes of north-western Australia. |
| 1996 | Shear and Humphreys | A new Stygiochiropus from a North West Cape (Western Australia) coastal plain cave (Diplopoda: Polydesmida: Paradoxosomatidae). |
| 1999 | Humphreys | Relict stygofaunas living in sea salt, karst and calcrete habitats in arid north-western Australia contain many ancient lineages. In: The other 99%. The conservation and biodiversity of invertebrates. |
| 2000 | Humphreys | Chapter 30. The hypogean fauna of the Cape Range peninsula and Barrow Island, North-western Australia. In Ecosystems of the world. Subterranean ecosystems. |
| 2001 | Gray and Thompson | New lycosoid spiders from cave and surface habitats in southern Australia and Cape Range peninsula (Araneae: Lycosoidea). |
| 2004 | Humphreys | Cape Range, Australia: Biospeleology. |
| 2008 | Page *et al*. | Shrimps down under: Evolutionary relationships of subterranean crustaceans from Western Australia (Decapoda: Atyidae: Stygiocaris). |
| 2018 | Moore *et al*. | New populations of the rare subterranean blind cave eel *Ophisternon candidum* (Synbranchidae) reveal recent historical connections throughout north-western Australia |
| Proposal-specific Studies | | |
| 2017 | Invertebrate Solutions | Desktop assessment of subterranean fauna for the Learmonth Bundle Project, Cape Range, Western Australia. |
| 2017 | Bennelongia | Review of subterranean fauna at Learmonth Bundle Project. |
| 2019 | Bennelongia | Subsea 7 Pipeline Fabrication Facility Stygofauna Survey |

Table 5-31: Overview of Local and Regional Subterranean Fauna Studies

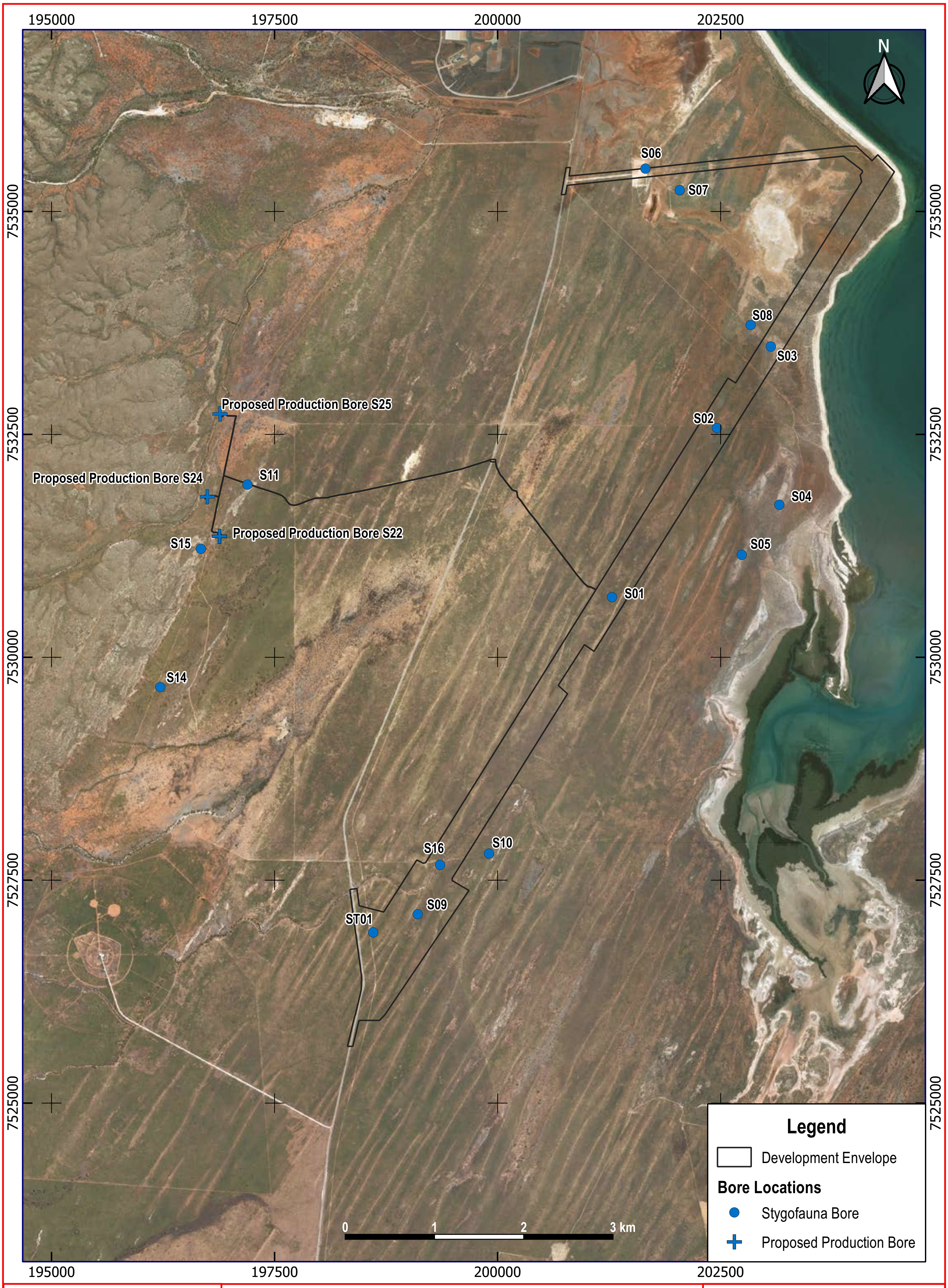
The Cape Range coastline, specifically the Western Cape, is a hotspot and key habitat for subterranean fauna due to the extensive limestone caves and karstic geologies found. A diverse relictual rainforest fauna of over 55 species of subterranean fauna have been documented and recorded (Humphreys 2000, 2004, 2008).

Many of the subterranean species associated with Cape Range karstic habitat (aquatic, troglobitic) are protected under legislation. Two of Australia's four stygobitic vertebrate species, the stygofaunal fish blind gudgeon *Milyeringa veritas* and the blind cave eel *Ophisternon candidum*), are listed as vulnerable under the EPBC Act, and the blind shrimp (*Stygiocaris stylifera*) is listed as a Priority 4 species by the DBCA (Bennelongia 2017).

Two desktop reviews were completed to assess the likelihood of subterranean fauna within the Development Envelope, prior to the inclusion of the borefield within the Development Envelope (Invertebrate Solutions 2017, Bennelongia 2017). The reviews identified that the presence of troglofauna was unlikely (Attachment 2M, Attachment 2N) and it was determined unlikely that the subterranean fauna ecological communities recognised as TECs, such as the Bundera Cenote Anchialine community on Cape Range or Cameron's Cave near the townsite of Exmouth, occur in proximity to the Proposal area (Attachment 2N). In general, troglofauna are considered to be most abundant in karstic and fractured rock habitats. Some potential troglofauna habitat, in the form of small patches of nodular calcrete, has more recently been observed adjacent to the site of the proposed fabrication facility at the western end of the main portion of the Development Envelope, but the presence of troglofauna is unlikely (Attachment 2O). More favourable habitat occurs in the borefield, where the depth to groundwater is 20 to 30 m and there is some karstic habitat present (Attachment 2O). Sandplain is considered to have low prospectivity for troglofauna due to the small pore spaces, though troglofaunal could occur in the deeper substrates of Exmouth sandstone and Bundera calcarenite, if suitable (Attachment 2O). The occurrence of troglofauna is highly unlikely in the supratidal flats near the coast because the silt/clay substrate does not have large enough pore spaces and the depth to groundwater is only a few metres (Attachment 2O). On the basis of the information above, it was considered unlikely that a significant troglofauna community occurs within the main Development Envelope but could occur at the borefield (Attachment 2O).

Due to the presence of the Cape Range Subterranean Waterways (WA006), listed in the Directory of Important Wetlands in Australia', within and adjacent to the Development Envelope, surveys to target stygofauna were undertaken to determine the presence of stygofauna habitat and species, including these listed species (Attachment 2O).

A three phase stygofauna survey was conducted to document the stygofauna species present in, and adjacent to, the Development Envelope and to determine whether stygofauna may be impacted by the Proposal. Twenty bores were sampled (Figure 5-44), with each bore sampled three times (in October 2018, January 2019 and April 2019) (Attachment 2O).

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Notes: Locations of proposed production bores and stygofauna sampling bores.

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Figure 5-44: Location of Stygofauna Sampling Bores

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A total of 180 specimens belonging to 11 species were collected during the three phases of the survey. All species collected were crustaceans and comprised two amphipods and nine copepods (Attachment 2O).

Eight species were collected from the main part of the Development Envelope and surrounds east of the Minilya-Exmouth Road. Six of these species are known only from the Development Envelope and surrounds. The remaining two species were the copepod *Stygoridgwayia trispinosa*, which is found widely in the Pilbara (Tang *et al*. 2008), and the copepod *Phyllopodopsyllus wellsi*, which occurs elsewhere on the Cape Range Peninsula and on Barrow Island. Three species were collected from the proposed borefield. All species are known to occur in other parts of the Cape Range Peninsula or further afield.

The Blind shrimp (*Stygiocaris stylifera*), listed as a Priority 4 species, was recorded from bores S24 and S25, within the proposed borefield (Attachment 2N). This species is also known from the northern and eastern sides of the North West Cape and Barrow Island (Page *et al*. 2008, Attachment 2N).

It was estimated that approximately 70% of stygofauna species likely to be present within or adjacent to the Development Envelope were collected during the surveys (Attachment 2O). Stygofauna were collected from the proposed borefield area and the coastal bores but not from any of the bores in the sand plain adjacent to the proposed fabrication shed and sprayfield locations (Attachment 2O).

### 5.6.4 Potential Impacts

Construction and operation of the Proposal has the potential to directly and indirectly impact subterranean fauna. Table 5-32 summarises the potential impacts during each project phase.

| Project Phase | Potential Impact |
|---|---|
| Construction | Direct loss of individuals or habitat during construction of onshore infrastructure |
| Construction | Loss of individuals or habitat due to leak or spill of chemicals (including hydrocarbons), which results in groundwater contamination |
| Operations | Indirect loss of individuals or habitat due to presence of onshore infrastructure impacting surface water infiltration |
| Operations | Indirect loss of individuals or habitat due to changes to groundwater flows or quality (including from groundwater abstraction, or discharge of treated wastewater) |
| Operations | Indirect loss of individuals or habitat due to leak or spill of chemicals (including hydrocarbons), which results in groundwater contamination |

Table 5-32: Potential Impacts to Subterranean Fauna

### 5.6.5 Potential Cumulative Impacts

Cumulative impacts to subterranean fauna could occur as a result of the proposed groundwater abstraction associated with the Proposal and third party users of the regional groundwater resource, or from impacts to regional groundwater quality as a result of the Proposal and third party activities. Potential cumulative impacts are considered in Section 5.6.6.5.

### 5.6.6 Assessment of Impacts

#### 5.6.6.1 Direct Loss of Individuals or Habitat during Construction of Onshore Infrastructure

No direct loss of individuals or habitat will occur as a result of the construction of onshore infrastructure as the proposed excavations are shallow (up to 1 m), so will not impact stygofauna habitat, and will mainly occur in areas unlikely to support stygofauna. No troglofauna habitat was recorded within the Development Envelope (Attachment 2O).

#### 5.6.6.2 Loss of Individuals or Habitat due to Leak or Spill of Chemicals (including Hydrocarbons) that result in Groundwater Contamination

An impact to individuals or habitat could potentially occur as a result of a leak or spill of a chemical. The likelihood of groundwater contamination due to leak or spill of chemicals is considered low given the depth to groundwater and the adoption of robust chemical storage and handling procedures.

Given the above, the lack of stygofauna habitat in the vicinity of the fabrication shed (where the vast majority of chemical storage and handling will occur) and the large distance between the fabrication shed and habitats found to support stygofauna (6-7 km), the likelihood of an impact to stygofauna in the event of a chemical leak or spill is considered negligible.

#### 5.6.6.3 Indirect Loss of Individuals or Habitat due to Presence of Onshore Infrastructure Impacting Surface Water Infiltration

Given the lack of stygofauna habitat in the vicinity of a large proportion of the proposed infrastructure (including the fabrication shed, the majority of the Bundle tracks and the access roads) (Figure 5-45), and the proposed measures to maintain pre-development surface water flows as much as possible, the risk of impact to stygofauna from altered surface water infiltration is considered negligible.

#### 5.6.6.4 Indirect Loss of Individuals or Habitat due to Changes to Groundwater Flows or Quality (including from Groundwater Abstraction or Discharge of Treated Wastewater)

Stygofauna were collected from the proposed borefield area and the coastal bores but not from any of the bores in the sand plain (Dunes/Residual Sand Plains) adjacent to the proposed fabrication shed and sprayfield locations (Figure 5-45) (Attachment 2O).

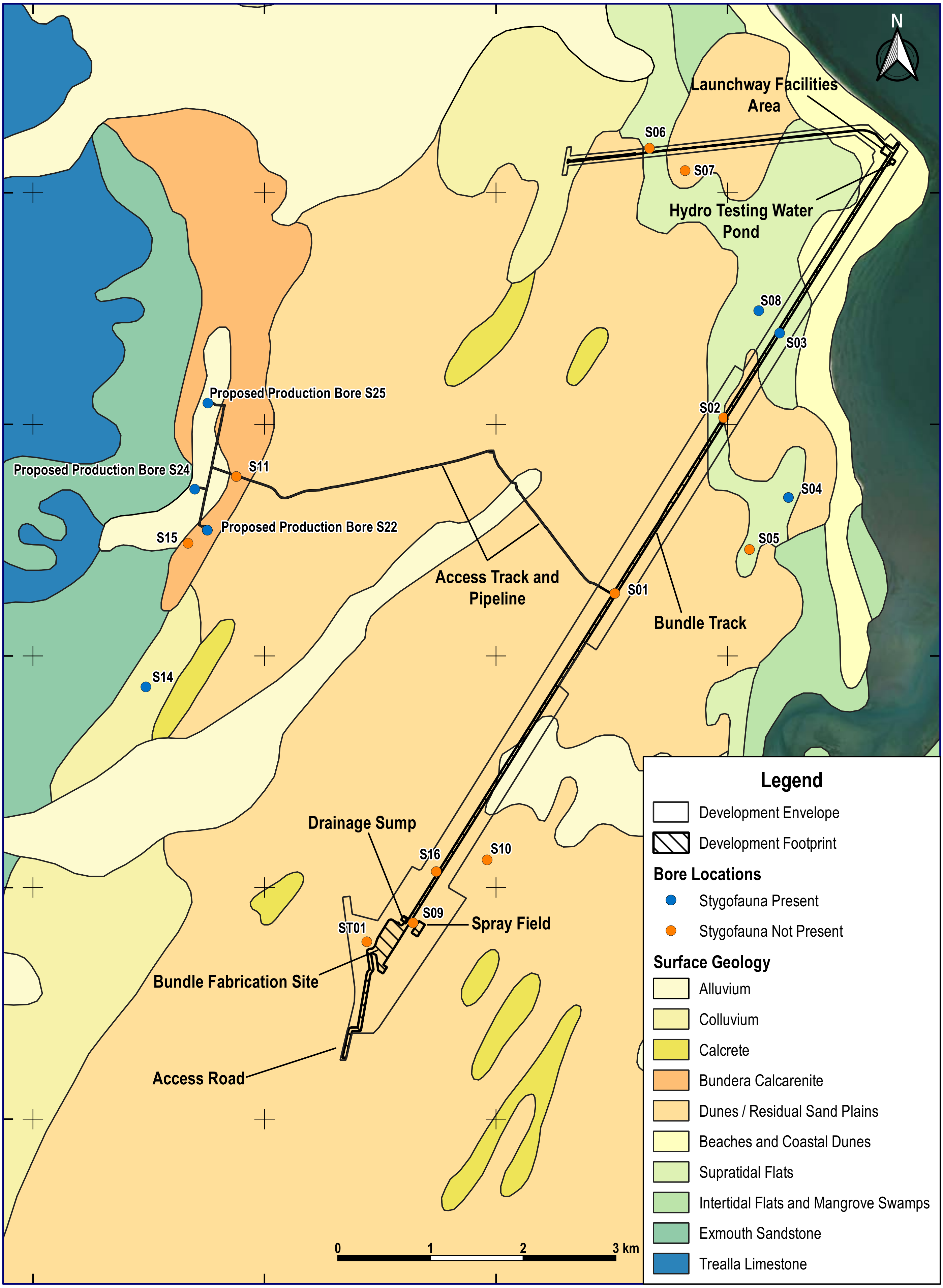
The stygofaunal fish the Blind gudgeon (*Milyeringa veritas)* and the Blind cave eel (*Ophisternon candidum*), listed under the EPBC Act, were not recorded, though suitable habitat may be present in the borefield area (bores S22, S24 and S25)(Figure 5-45), based on the presence of *Stygiocaris* spp.

The Blind shrimp (*Stygiocaris stylifera*), listed as a Priority 4, was recorded from two bores within the proposed borefield area, but is also known from habitat on the northern and eastern sides of the North West Cape and Barrow Island (Page *et al*. 2008). While collections of *Stygiocaris stylifera* demonstrate that suitable habitat for this species occurs, the wider range of the species means the Proposal will not have significant impact on the species, irrespective of any groundwater changes that could occur (Attachment 2O).

Discharge of treated wastewater has the potential to raise the water table and alter groundwater quality within the immediate vicinity of the spray field. Groundwater within the sprayfield is currently at 15 mbgl, and is saline. No stygofauna species were recorded in the vicinity of the sprayfield (Figure 5-45). Given the minor volumes of treated wastewater to be discharged, the low nutrient concentrations, and the large distance between the sprayfield and habitats found to support stygofauna (6-7 km), an impact to stygofauna from altered groundwater flows or quality is considered unlikely, even in the event of a significant wastewater plume (which is not expected given the very low volumes of wastewater).

Modelling of the potential groundwater drawdown associated with the abstraction of groundwater for the life of the Proposal has been completed, based on a total period of 10,000 days (~27 years) (Attachment 2R). Two scenarios were modelled to reflect drawdown effects under two plausible transmissivity values of 10 $m^2$/day and 100 $m^2$/day. Under the most conservative scenario (worst case), modelled with a transmissivity value of 10 $m^2$/day, maximum drawdown in the immediate location of the bores is up to 2.5 m after 10 years of continuous abstraction (refer Figure 5-46 and Figure 19 in Attachment 2R[15]). Drawdown at a range of 3 km from the bores is predicted to not exceed 5 cm (Figure 5-46). It is noted that the model does not include any recharge to the aquifer over this period and that continuous abstraction is assumed (whereas in reality bores are likely operate on average for around 50% of the time at maximum abstraction limits (0.3 L/s) to meet the Proposal water demand), meaning that an impact of this magnitude would be unlikely. The small reduction in stygofauna habitat as a result of the borefield drawdown is considered highly unlikely to be biologically meaningful (Attachment 2O).

[15] Note that due to scale the 2.5 m drawdown contour, immediately adjacent to the bores, is not visible in the figures.

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Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from DMIRS (2017) .

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Figure 5-45: Location of Proposal Infrastructure in Relation to Surface Geology and Stygofauna Records

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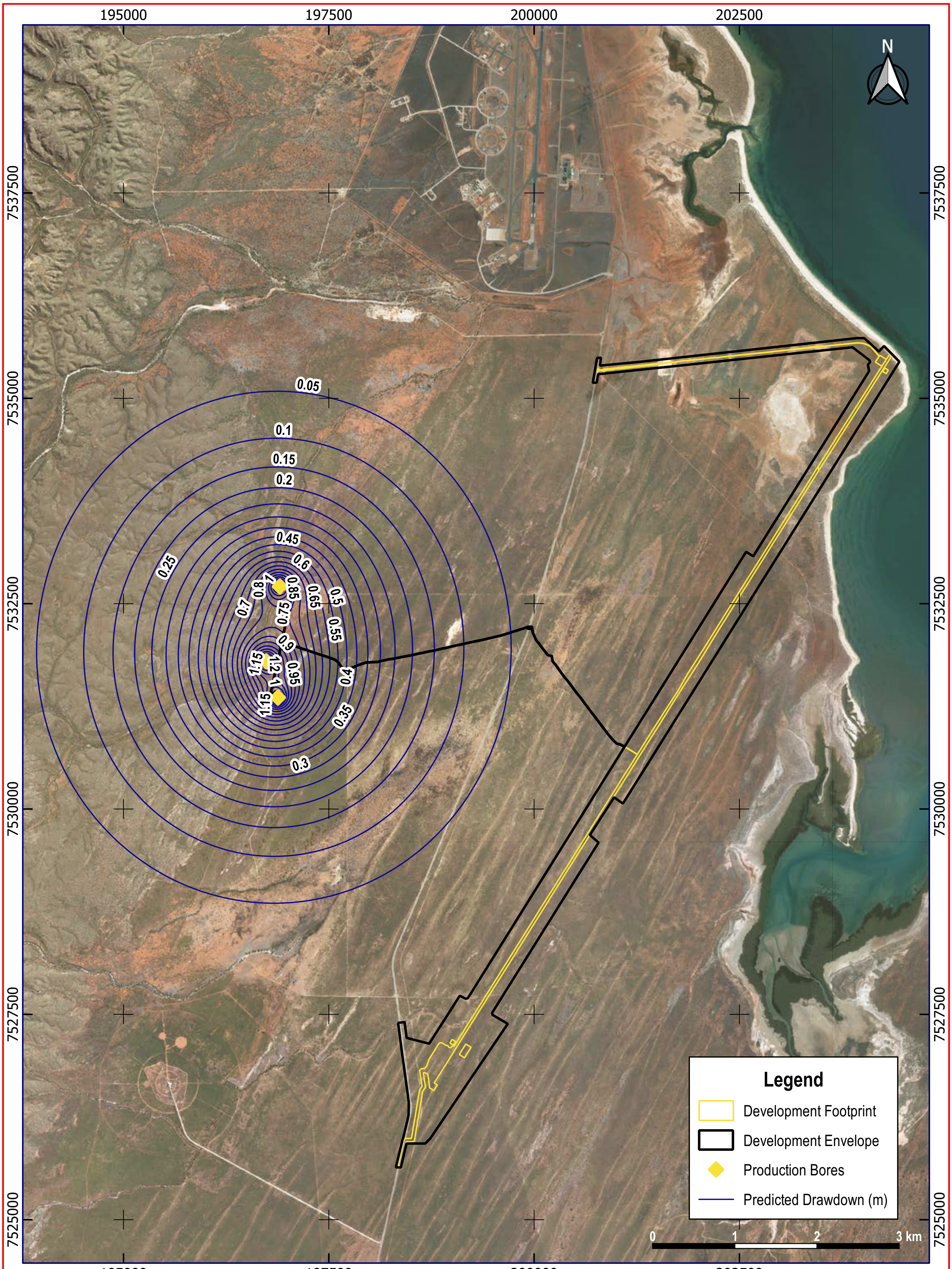


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Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from GHD (2018).

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Figure 5-46: Modelled Groundwater Drawdown at the Production Bores

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##### 5.6.6.5 Cumulative Impacts

Cumulative impacts to subterranean fauna from groundwater abstraction associated with the Proposal and third party users of the regional groundwater resource could occur, but are considered unlikely given:

- DWER's licencing of groundwater abstraction on a sub-area basis, with the Exmouth South groundwater sub-area currently only 2% allocated.
- The lack of any other substantial groundwater abstraction in proximity to the proposed bores.
- The low abstraction rate and the minimal drawdown predicted from the Proposal (Figure 5-46).

Cumulative impacts to groundwater quality as a result of leaks or spills associated with existing infrastructure (for example the Minilya-Exmouth Road or RAAF Learmonth) and the Proposal are unlikely given the lack of impacts expected from the Proposal and the geographical separation of the Development Envelope from other potential sources of contamination. Groundwater plumes containing elevated concentrations of PFAS in the groundwater adjacent to RAAF Learmonth are localised and are predicted to be limited to the north of the Development Envelope, flowing east from RAAF Learmonth to the Wapet Creek area (Department of Defence 2019). Thus no cumulative impacts from the RAAF Learmonth and the Proposal are expected.

#### 5.6.7 Mitigation and Predicted Outcome

The proposed mitigation measures to address potential impacts to subterranean fauna as a result of the Proposal and the predicted outcome are provided in Table 5-33.

The EPA objective '*to protect subterranean fauna so that biological diversity and ecological integrity are maintained*' will be met.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Direct loss of individuals or habitat (including Directory of Important Wetlands in Australia Cape Range Subterranean Waterways – WA006) during construction of onshore infrastructure | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Ground excavation will be kept to a minimum (expected to be limited to cuts through the tops of dunes and minor excavations during the construction of surface water drainage infrastructure).<br>Measures to rehabilitate:<br>• Rehabilitation will be undertaken on disturbed construction areas (e.g. directional drilling sites, adjacent to access road) as they become available. | Subterranean fauna habitat was not recorded in proximity to the fabrication shed, sprayfield or the majority of the Bundle tracks. Excavations associated with the construction of the Proposal will be shallow (up to 1 m) and are predominantly within areas not supporting stygofauna. No troglofauna habitat was recorded within the main Development Envelope but may be present at the borefield.<br><br>The EPA objective for Subterranean Fauna will be met. |
| Loss of individuals or habitat due to leak or spill of chemicals (including hydrocarbons) which result in groundwater contamination | Measures to avoid:<br>• Hazardous materials will be stored, in or adjacent to the fabrication shed, in accordance with relevant Australian Standards and Dangerous Goods Storage regulations.<br>• Chemical storage and handling procedures to prevent leaks or spills.<br>Measures to minimise:<br>• Refuelling to occur on concrete or HDPE-lined pads to contain any drips and spills. The pads will drain to a sump to | Considering the application of standard industry practices for chemical storage and handling, and the absence of stygofauna or troglofauna habitat in proximity to the fabrication shed, the risk of impacts to subterranean fauna is considered low.<br><br>The quality of groundwater will be maintained and the EPA objective for Subterranean Fauna will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | allow removal of collected material.<br>• Spill kits will be located at strategic locations throughout the project area and employees trained in their use.<br>• Employees and contractors will be trained in use of spill kits.<br>• Spills will be cleaned up and contaminated soils will be removed from site by a licensed third party.<br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas. | |
| Indirect loss of individuals or habitat due to presence of onshore infrastructure impacting surface water infiltration | Measures to avoid:<br>• Where necessary, suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns.<br>Measures to minimise:<br>• Project design has considered the location of drainage lines with the aim of minimising changes to natural flows.<br>Measures to rehabilitate:<br>• Upon closure the reinstatement of the natural flow paths after removal of project infrastructure. | After installation of surface water drainage measures, surface water flow patterns are expected to remain similar to baseline flow patterns. Therefore significant impacts to surface water infiltration patterns are not expected. Subterranean fauna habitat was not recorded in proximity to the fabrication shed, sprayfield or the majority of the Bundle tracks.<br><br>The EPA objective for Subterranean Fauna will be met. |
| Indirect loss of individuals or habitat due to changes to groundwater flows or quality | Measures to avoid:<br>• NA | Under the most conservative (worst-case) scenario, modelling predicts a maximum drawdown in the immediate location of the |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| (including from groundwater abstraction, or discharges of treated wastewater) | Measures to minimise:<br>• Minimise water abstraction through the storage and re-use of hydrotest water.<br>• Water storages will be lined to minimise seepage.<br>• Low abstraction rates to reduce the likelihood of groundwater drawdown.<br>Measures to rehabilitate:<br>• NA. | production bores of 1.15 m after 10 years of continuous abstraction, assuming no recharge occurs. Changes to localised groundwater levels are not predicted to significantly impact stygofauna habitat. The EPA objective for Subterranean Fauna will be met.<br><br><u>Monitoring</u><br>Regular (quarterly) monitoring of groundwater quality (including salinity) and levels, in accordance with abstraction licence conditions. |

Table 5-33: Proposed Mitigation Measures and Predicted Outcome for Subterranean Fauna

## 5.7 KEY ENVIRONMENTAL FACTOR 7 – TERRESTRIAL FAUNA

### 5.7.1 EPA Objective

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

### 5.7.2 Policy and Guidance

Subsea 7 has taken into consideration relevant policy and guidance in design of the Proposal, the completion of the environmental impact assessment and throughout the development of this ERD.

A summary of the policy and guidance relevant to Terrestrial Fauna, and how Subsea 7 has considered these, is presented in Table 5-34.

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Statement of Environmental Principles, Factors and Objectives (EPA 2016c, 2018c) | Referred to in the identification and assessment of Preliminary Key Environmental Factors |
| Environmental Factor Guideline – Terrestrial Fauna (EPA 2016o) | Referred to in the assessment of potential impacts as a result of the Proposal |
| Technical Guidance – Sampling methods for terrestrial vertebrate fauna (EPA 2016p) | Referred to in the survey design which included a desktop study and reconnaissance survey<br>Based on the habitat identified and likelihood of occurrence for conservation significant species, it was determined that a targeted or Level 2 survey was not required. |
| Technical Guidance – Terrestrial fauna surveys (EPA 2016q) | Referred to in the survey design |
| Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016r) | Referred to in the assessment of potential impacts as a result of the Proposal |
| EPA Position Statement No. 3, Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) | Referred to in the survey design |
| EPA Guidance Statement No. 20, Short Range Endemic Invertebrate Fauna (EPA 2009b) | |
| EPA Guidance Statement No. 56, Terrestrial Fauna Surveys for Environmental Impact Assessment (EPA 2004a; revised 2016) | |
| EPA and DEC Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA and DEC 2010; revised 2016) | |
| Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011a) | |
| Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011b) | |
| WA Environmental Offsets Policy (Government of Western Australia 2011) | These policies were considered as part of the determination of the need for offsets. |

| Policy/Guidance | Consideration for Proposal |
|---|---|
| WA Environmental Offsets Guidelines (Government of Western Australia 2014) | |
| Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPAC 2012a) | |

Table 5-34: Policy and Guidance Relevant to Terrestrial Fauna

### 5.7.3 Receiving Environment

A limited number of terrestrial fauna studies have previously been undertaken within the region. Subsea 7 has augmented previous studies by commissioning additional, Proposal-specific studies, to ensure an appropriate level of information is available to support environmental impact assessment and development of environmental management plans.

Two Proposal-specific field studies, and one desktop assessment, have been undertaken (Table 5-35), with the reports included in Attachment 2. The 360 Environmental Level 1 fauna surveys (2017 and 2018) covered an area of approximately 547 ha. Each survey was undertaken in accordance with the relevant policy and guidance (Table 5-34).

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| Regional Studies | | |
| 2015 | 360 Environmental | Level 1 Fauna Assessment on Truscott Crescent, Exmouth. |
| Proposal-specific Studies | | |
| 2017 | 360 Environmental | Learmonth Level 1 Fauna Survey |
| 2017 | Invertebrate Solutions | Desktop Assessment of Short Range Endemic Invertebrates |
| 2018 | 360 Environmental | Learmonth Level 1 Fauna Survey – Amended Development Envelope |

Table 5-35: Overview of Local and Regional Terrestrial Fauna Studies

#### 5.7.3.1 Fauna Habitats

Four broad fauna habitats (including 'Beach' habitat) were identified within the Development Envelope (360 Environmental 2018b, Attachment 2P) with all considered widespread and common in the Exmouth region (Table 5-36).

| Fauna Habitat | Description | Survey Area (ha) | Area Within Development Envelope (ha) |
|---|---|---|---|
| HG | *Triodia* hummocks made up the majority of the habitat with patches of scattered *Acacia* species (*A. gregorii*, *A.bivenosa*, *A. coriacea* and *A. tetragonophylla*) characterised by areas of dense lower strata and grasses provide habitat and cover for small reptile, bird and mammal species. Some woody debris and leaf litter is present providing microhabitat for some common reptile | 512.8 | 423.6 |

| Fauna Habitat | Description | Survey Area (ha) | Area Within Development Envelope (ha) |
|---|---|---|---|
| | bird and mammal species. | | |
| DL | Minor Drainage Line characterised by rocky outcrops, woody debris and leaf litter within this habitat provide important features of microhabitats for reptile, bird, and mammal species. Birds may also roost or nest in scattered trees. | 4.4 | 4.4 |
| TiFp | Tecticornia low shrubland (*Tecticornia* and *Frankenia*). Characterised by low shrubland (*Tecticornia* and *Frankenia*) on saline flats and lacks an overstorey and midstorey. This habitat provides limited foraging opportunities for small bird species. | 13.6 | 13.3 |
| Beach | Beach characterised by a sandy/shelly shoreline. Shorebirds (i.e. waders) utilise this habitat for roosting and/or foraging | 7.1 | 0.0 |
| CD | Cleared/Track | 8.5 | 8.4 |
| | Total Area | 546.4 | 449.7 |

Table 5-36: Extent of Fauna Habitats within the Development Envelope

#### 5.7.3.2 Fauna Species

Project specific fauna studies identified 40 species from 29 families, comprising five reptile species, 29 bird species and six mammal species including the European rabbit (Attachment 2P). Out of the 40 species of fauna recorded, six significant species were recorded in the survey area:

- Osprey (*Pandion cristatus*)
- Lesser sand plover (*Charadrius mongolus*).
- Caspian tern (*Hydroprogne caspia*).
- Lesser crested tern (*Thalasseus bengalensis*).
- Crested tern (*Thalasseus bergii*).
- Rainbow bee-eater (*Merops ornatus*).

The migratory shorebirds recorded within the survey area (including the Lesser sand plover) are discussed in Section 5.4.3.7.

#### 5.7.3.3 Short Range Endemics

A desktop assessment of Short Range Endemic (SRE) species was undertaken by Invertebrate Solutions (2017) and is provided as Attachment 2Q. The assessment identified that nine confirmed SRE species of land snails occur within the region. The majority of the species are restricted to the central Cape Range Peninsula and are not likely to occur within the Development Envelope (Invertebrate Solutions 2017).

Based on habitat preferences, there is potential for two species of land snail, *Plectorhagaha* sp. 1 and *Quistrachia* sp. 1 to occur within the coastal plain area of the Development Envelope. However, given the absence of limestone outcropping within the Development Envelope, the likelihood of these species being present was considered low (Attachment 2Q).

### 5.7.4 Potential Impacts

Construction and operation of the Proposal has the potential to directly and indirectly impact terrestrial fauna. Table 5-37 summarises the potential impacts during each project phase.

| Project Phase | Potential Impact |
|---|---|
| Construction | Direct loss of native fauna due to vehicle strike |
| | Direct loss of native fauna due to entrapment within water pipeline trench |
| | Direct loss of fauna habitat during clearing for onshore infrastructure |
| | Indirect loss or degradation of fauna habitat due to dust emissions |
| | Indirect loss or degradation of fauna habitat due to introduction or spread of weeds |
| Operations | Direct loss of native fauna due to vehicle strike |
| | Fragmentation of fauna habitat due to presence of onshore infrastructure |
| | Indirect loss or degradation of fauna habitat due to changes in surface water or groundwater levels or quality |
| | Indirect loss or degradation of fauna habitat due to changes in fire regimes |
| | Indirect impacts to native fauna as a result of introduction or increase of feral animals |
| | Loss or alteration of coastal habitat as a result of changes to coastal processes or hydrodynamic/hydrological regimes |

Table 5-37: Potential Impacts to Terrestrial Fauna

### 5.7.5 Potential Cumulative Impacts

Several third party projects or proposals (refer Section 2.5.8) have resulted in impacts to terrestrial fauna in the wider region. Only the Cape Seafarms project has resulted in an impact to terrestrial fauna habitat at Heron Point. Potential cumulative impacts are discussed in Section 5.7.6.11.

#### 5.7.6 Assessment of Impacts

##### 5.7.6.1 Direct Loss of Native Fauna due to Vehicle Strike during Construction and Operations

Injury or death of fauna from vehicle strike during construction is most likely to occur from heavy vehicle usage within the infrastructure footprint during the construction phase.

Vehicles undertaking land clearing will be slow moving and operating only during daylight hours to reduce the likelihood of fauna strike.

Due to the relatively short duration of the clearing phase (2 months) and the proposed management measures (Table 5-38), a significant impact on the biological diversity and ecological integrity of terrestrial fauna due to land clearing during construction of infrastructure is not expected.

Injury or death of fauna from vehicle strike during operations is most likely to occur during transport of materials to the Bundle fabrication facility by way of double road trains and extendable trailers on North West Coastal Highway, Minilya-Exmouth Road and Burkett Road. Transport of materials for the Proposal will result in additional heavy vehicle traffic associated with construction of a Bundle. This constitutes an increase of:

- 1% vehicles per day on North West Coastal Highway.
- 5% vehicles per day on Minilya Exmouth Road.
- 1% vehicles per day on Burkett Road.

Double road trains will be required for 28 days and extendable trailers will be required for 32 days, per Bundle project. Heavy vehicle movements for delivery to the site are focused at the landward end of the Development Envelope. Specific transit routes over the site will be developed to ensure that all movements are appropriately managed and controlled, inclusive of suitable measures to control and limit the interface between fauna and the operations area. Outside of the primary fabrication area of the site, heavy vehicle movements will be rare.

A small number of additional small vehicle movements will be generated by employees going to and from the Project on a daily basis, though it is expected that mini-buses will be used to transport the majority of the workforce to/from Exmouth and Learmonth.

The site is proposed to be fenced to provide appropriate separation between adjacent pastoral operations and the proposed Bundle site operations. The fence will also act to deter fauna from entering the site, and create segregation between vehicles and fauna during operations.

Due to the relatively short duration of the increased traffic and the relatively small proportional increase in vehicle movements, a significant impact on the biological diversity and ecological integrity of terrestrial fauna is not expected.

##### 5.7.6.2 Direct Loss of Native Fauna due to Entrapment Within Water Pipeline Trench

In the event that the production water pipeline is installed within a shallow trench, rather than on the surface, there is potential for smaller fauna to become trapped within the open trench during the construction phase. The construction period will be relatively short (approximately six weeks) and the trench required for the burial of the pipe (≤ 150 mm) will be relatively small. In addition, the trench will be running alongside existing tracks, so along the margin and not through existing fauna habitat. Given the above, fauna entrapment is not expected to be a significant risk to local fauna populations.

Industry standard trench management measures will be implemented and a significant impact on the biological diversity and ecological integrity of terrestrial fauna is not expected.

#### 5.7.6.3 Direct Loss of Fauna Habitat during Clearing for Onshore Infrastructure

The clearing of the Development Footprint will result in loss of fauna habitat, which may cause increased competition with individuals already using adjacent uncleared habitat. Clearing for the Proposal is expected to lead to a loss of 176 ha or 33% of the total mapped area. Figure 5-47 presents the proposed onshore Development Footprint.

Triodia Hummock Grassland (HG) is the most widespread fauna habitat with 160.1 ha (31%) of the mapped habitat to be impacted. The highest percentage impacts are to CD (Cleared/Track) (58%) and TiFp (Tecticornia low shrubland) (56%). The vegetation associated with the HG and TiFp habitats is considered to be widespread and representative of the Learmonth area (Attachment 2M and Attachment 2Q).

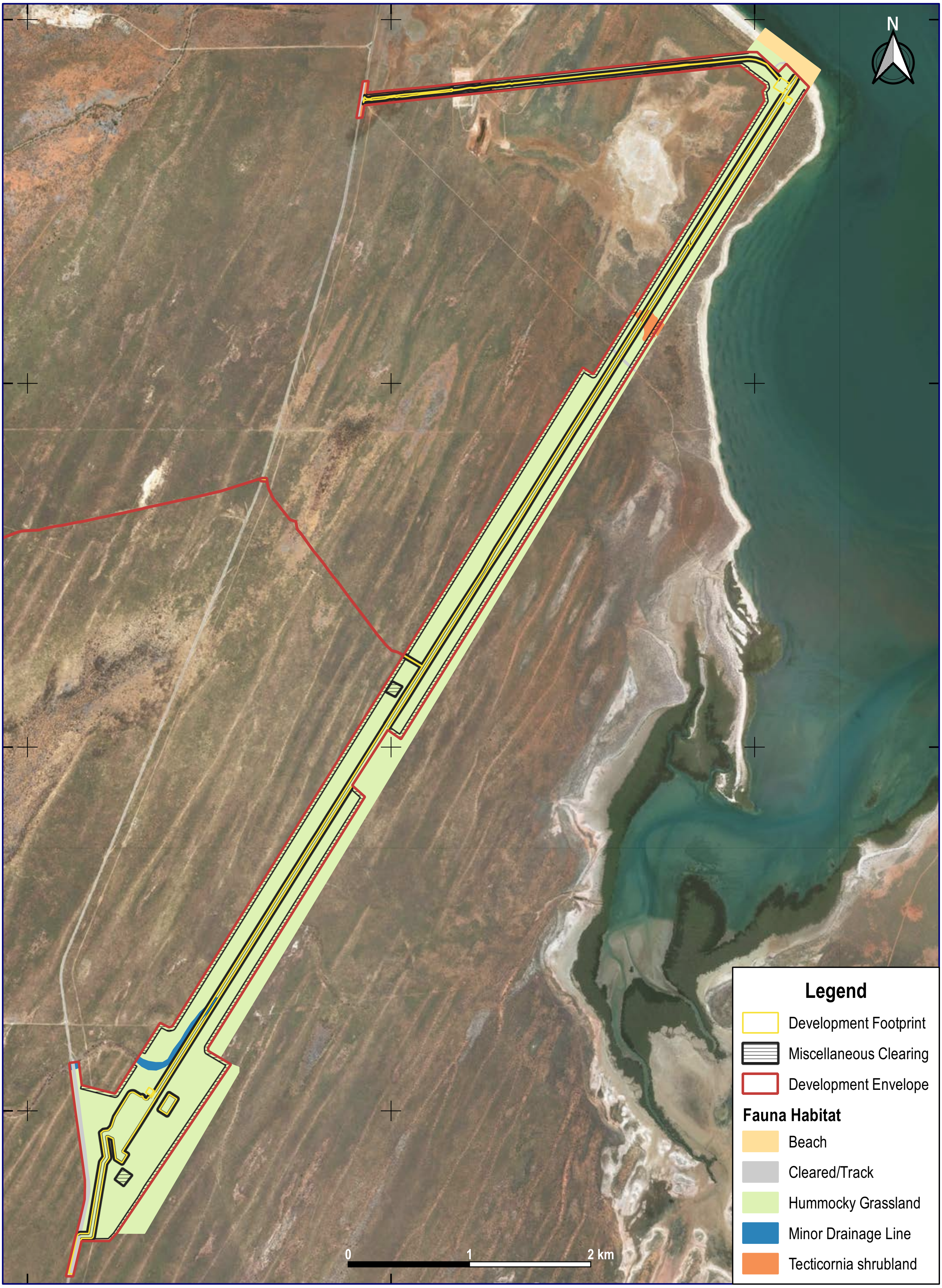
All significant fauna identified were migratory/marine birds including the Lesser sand plover, Caspian tern, Lesser crested tern and Crested tern. Potential impacts to coastal wader habitat (Fauna Habitat – Beach) are considered very limited, particularly at a regional scale (Section 5.4.5). Rainbow bee-eaters were also recorded and are a highly common and widespread species in Australia, with a distribution that covers the majority of Australia (Barrett *et al*. 2003 in 360 Environmental 2018b).

#### 5.7.6.4 Indirect Loss or Degradation of Fauna Habitat due to Dust Emissions

As outlined in Section 5.5.6.2 the potential accumulation of dust particulates on vegetation can potentially occur as a result of exposure to dust, resulting in a reduced ability for plants to photosynthesise and transpire, potentially causing a decline in health and eventual plant death which may negatively impact availability of fauna habitat. Dust is likely to be generated during construction as a result of clearing for the Bundle fabrication facility infrastructure such as the access road, Bundle fabrication site and Bundle tracks. To limit the generation of dust, water carts will be used during construction.

Impacts from dust generation are likely to be limited to within 50 m of the generation point and are likely to be short-term during the land clearing process. Potential short-term impacts during construction are considered unlikely to significantly affect surrounding fauna habitat and result in loss of habitat. The mapped fauna habitats are well represented by local and regional vegetation communities and any potential impact is not likely to have an adverse impact on the biological diversity or ecological integrity of faunal assemblages.

Dust suppression procedures will apply (mitigation measures are outlined in Table 5-38).




Scale: 1:42000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from 360 Environmental (2018b).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-47: Potential Loss of Fauna Habitat During Clearing for Onshore Infrastructure

W:\Subsea 7\GIS\Infrastructure Map.qgs 29/08/2019

#### 5.7.6.5 Indirect Loss or Degradation of Fauna Habitat due to Introduction or Spread of Weeds

Of the eight weed species identified within the Development Envelope, Kapok bush (*Aerva javanica*), Buffel grass (*Cenchrus ciliaris*), and Mimosa bush (*Vachellia farnesiana*) are widespread through the region. Kapok bush and Buffel grass have been introduced widely within pastoral regions as a pasture grass from Shark Bay to the Kimberley.

Weeds may be spread and/or introduced by poor hygiene practices on vehicles and equipment, resulting in soil and weed vegetative material or seeds being transported around site, or into or offsite. Additionally, weed growth may be encouraged by watering and nutrient loading from the irrigation of treated wastewater.

Given the existing presence of weeds across the area, and the plans to use locally-sourced construction equipment, it is unlikely that Proposal activities will result in an introduction of new weed species. The spread or proliferation of existing weeds will be managed through the management measures nominated in Table 5-38.

The introduction or spread of weeds as a result of the Proposal is unlikely and an impact biological diversity and ecological integrity is not expected.

Appropriate weed control procedures will be implemented to control the introduction and spread of weeds (refer Table 5-38 and Section 5.5.6.3).

#### 5.7.6.6 Fragmentation of Fauna Habitat due to Presence of Onshore Infrastructure

Fragmentation of fauna habitat due to loss of vegetation reduces the ability of fauna to move freely to access dispersed or temporary resources and potentially reduces gene flow. Habitat fragmentation potentially exacerbates other threats, like predation by feral species, by providing access into habitats that were previously dense and difficult to traverse. The potential for habitat fragmentation is most likely to occur where there is limited extent of a fauna habitat supporting a population of breeding fauna species, or where a particular species is limited to that specific habitat. SREs, particularly vulnerable to habitat loss and fragmentation, were considered unlikely to occur in the Development Envelope (Section 5.7.3.3).

Implementation of the Proposal will result in disturbance to 176 ha (33%) of the total mapped fauna habitat (Attachment 2P). Current land use (grazing) may have resulted in a low level of habitat fragmentation in the region.

Of the 40 species of fauna recorded within the Development Envelope, six species are of significance. All were migratory/marine birds including the Lesser sand plover, Caspian tern, Lesser crested tern and Crested tern. Potential losses of coastal habitat are very limited (0.2 ha or 2.8% of total mapped area) (see Section 5.4.6).

The site will be surrounded by stock fencing (minimum requirement as advised by the Department of Planning, Lands and Heritage). The boundary fencing will extend from the fabrication shed seaward to the top of the beach. The fence will inhibit the movement of stock between the areas to the north and south of the site, but is not expected to significantly impede the movement of native fauna across the Development Envelope. Larger fauna such as the Western grey kangaroo or Black-footed rock-wallaby, which occur across the wider region, are likely to be able to jump a stock fence, or could pass the site along the beach or adjacent to the Minilya-Exmouth Road, while smaller fauna will be able to pass through or under the fencing.

Fragmentation is not expected to impact the overall health and viability of fauna populations within the area.

#### 5.7.6.7 Indirect Loss or Degradation of Fauna Habitat due to Changes in Surface Water or Groundwater Levels or Quality

Proposal infrastructure, associated surface water drainage features, onsite water storage (hydrotest pond), treated wastewater discharge and groundwater abstraction have the potential to result in localised changes surface water flows, groundwater levels and groundwater quality within and adjacent to the Development Envelope.

The region is often subjected to seasonal flooding from cyclones or heavy rainfall events between January and March. Depending on the local topography, vegetation communities have adapted to site conditions that will allow for survival through intermittent flooding. Based on modelling (Attachment 2R), it is likely that some areas would be susceptible to flooding impacts as a result of changes to surface water flows associated with development of the Proposal, but the associated vegetation would be expected to recover, if an impact does occur, within 1 -2 years (refer Section 5.5.6.5). Thus a long-term loss of fauna habitat, or change in the biological diversity and ecological integrity of fauna habitat, is not expected to result from localised changes in surface water flows.

Depth to groundwater throughout the Development Envelope ranged from 12 mbgl near the fabrication shed to 32 mbgl at the proposed groundwater bores to the west. Groundwater in the area of the bores is fresh to slightly brackish with TDS measurements of <1,700 mg/L. Groundwater near the fabrication shed is shallower, and of higher TDS (> 46,000 mg/L) and will not be abstracted for use.

Modelling of the potential groundwater drawdown associated with the abstraction of groundwater for the life of the Proposal has been completed, based on a total period of 10,000 days (~27 years) (Attachment 2R). Two scenarios were modelled to reflect drawdown effects under two plausible transmissivity values of 10 $m^2$/day and 100 $m^2$/day. Under the most conservative scenario (worst case), modelled with a transmissivity value of 10 $m^2$/day, maximum drawdown in the immediate location of the bores is up to 2.5 m after 10 years of continuous abstraction (Figure 5-46). Drawdown at a range of 3 km from the bores is predicted to not exceed 5 cm (Figure 5-46). The maximum predicted drawdown after 10 years of continuous abstraction, at a distance of 1 km, is 0.2 m. It is noted that the model does not include any recharge to the aquifer over this period and that continuous abstraction is assumed (whereas in reality bores are likely to operate on average for around 50% of the time at maximum abstraction limits (0.3 L/s) to meet the Proposal water demand), meaning that an impact of this magnitude would be unlikely.

Given the absence of GDE within the Development Envelope, the locally and regionally widespread nature of the fauna habitats recorded within the Development Envelope, the significant depth to groundwater and the localised and minor changes to groundwater levels following groundwater abstraction, significant changes on the biological diversity and ecological integrity of fauna habitats are not expected.

No changes to groundwater quality are expected. The low groundwater abstraction rates will prevent significant elevation of saline groundwater underlying the freshwater aquifer. The low treated wastewater discharge volumes and nutrient concentrations will prevent an impact to fauna habitat adjacent to the sprayfield (refer Section 5.8.6.3).

Proposed management measures applicable to protection of fauna habitat and species are provided in Table 5-38.

#### 5.7.6.8 Indirect Loss or Degradation of Fauna Habitat due to Changes in Fire Regimes

The region has a hot semi-arid climate with hot summers and mild winters (Section 2.5.1) and is subject to frequent natural fires, often preceded by several seasons of above average rainfall (DEC 2010b). Controlled burning is conducted as part of pastoral activities as part of regional fire management programs.

Due to the increased presence of people and machinery in the area, there is an increased risk of accidental fires, which could affect fauna habitat on a local and regional scale. Uncontrolled or unintentional fires may result from such activities as welding or natural causes such as lightning strike.

Vehicles associated with the Proposal, other than those involved in vegetation clearing, will not be permitted to enter vegetated areas. Firefighting equipment will be maintained within light vehicles, earth moving equipment and buildings. Fire breaks will be installed, as required, to manage the risk to people and infrastructure. Management procedures including hot work permits will be applied to minimise the risk of accidental fire.

It is considered unlikely that an accidental fire will be generated by Proposal activities.

Subsea 7 will perform a Bushfire Attack Level (BAL) assessment as part of the development application and approval process. This assessment will identify the appropriate BAL rating to be applied to the development to ensure that the risks associated with fire are appropriately managed.

In the event of fire, the loss or degradation of fauna habitat from fire is likely to be localised and short-term in nature and would not be anticipated to adversely impact the environment given the open structure of the vegetation and locally and regionally common nature of the fauna habitats within the Development Envelope (Section 5.6.3).

#### 5.7.6.9 Indirect Impacts to Native Fauna as a Result of Introduction or Increase of Feral Animals

Establishment of infrastructure, such as the spray field, hydro testing pond, production bores or temporary waste storage areas may result in an increase in abundance of feral animals within or adjacent to the Development Envelope. This can result not only in an increase in predation of native fauna, but also result in an increase in competition for food resources.

Containment or fencing of freshwater storages will limit potential for an increase in feral animals within the area, and aligns with the threat abatement plan for predation by feral cats (DoE 2015c). The hydrotest water pond will be covered to prevent contamination, or industrial water bladders will be used, reducing the likelihood of access by feral animals.

Temporary waste storages will use lidded bins, with all waste regularly removed offsite for disposal by a licenced third party contractor.

It is not considered likely that development and operation of the Proposal will result in introduction of new feral animal species to the area or an increase in abundance of feral animals. It is anticipated that the proposed controls will be effective and will prevent an increase in the abundance of feral animals within the Development Envelope (Table 5-38).

#### 5.7.6.10 Loss or Alteration of Coastal Habitat as a Result of Changes to Coastal Processes or Hydrodynamic/Hydrological Regimes

Potential impacts to migratory birds and their habitat from the loss or alteration of coastal habitat are discussed in Sections 5.4.6.1 and 5.4.6.9. No impacts to other fauna species are anticipated due to loss or alteration of coastal habitat.

#### 5.7.6.11 Cumulative Impacts

Survey of the Development Envelope identified four broad fauna habitats that are considered widespread and common in the Exmouth region (Section 5.7.3.1). Additional impacts to coastal vegetation representing potential fauna habitat include the loss of generally degraded native vegetation within the onshore footprint of the Exmouth Marina and small-scale residential and light industrial developments between Exmouth Marina and Heron Point. The habitats impacted are widespread and do not represent key fauna habitat.

Losses of terrestrial fauna are likely to occur primarily due to vehicle strike. Due to the relatively short duration of the increased traffic associated with the operation of the Proposal, and the relatively small proportional increase in vehicle movements (1% on North West Coastal Highway, 5% on Minilya-Exmouth Road, and 1% on Burkett Road), a significant cumulative impact on terrestrial fauna is not expected.

Given the common and widespread nature of the fauna habitats likely to be impacted by the Proposal, and the regional distribution of similar, and higher value, fauna habitats, cumulative impacts associated with the loss of fauna habitat are not expected to threaten the biological diversity and ecological integrity of terrestrial fauna.

### 5.7.7 Mitigation, Monitoring, and Predicted Outcome

Proposed mitigation measures to address potential impacts on terrestrial fauna, the predicted outcomes and monitoring (where proposed to verify the outcome) are outlined in Table 5-38.

The EPA objective '*to protect terrestrial fauna so that biological diversity and ecological integrity are maintained*' will be met.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Direct loss of native fauna due to vehicle strike during construction and operations | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the Proposal.<br>• Where practicable, land clearing will be undertaken progressively with the amount of active disturbance minimised.<br>• A fauna relocation team will be present to assist in recovery and relocation of any native fauna displaced during land clearing.<br>• Vehicle traffic will be confined to defined roads and tracks (except during active clearing).<br>• Speed limits will be implemented and enforced to minimise fauna mortality due to vehicle strike.<br>• The site induction program will provide information on fauna of conservation significance, including their appearance and habitats.<br>Measures to rehabilitate:<br>• Vertebrate fauna injuries and/or deaths will be reported and a register maintained.<br>• Injured vertebrate fauna will be taken to the Exmouth office of DBCA, or to Exmouth Wildlife Care Group, for assessment/ rehabilitation. | Fauna injury or mortality due to vehicle strikes may occur during construction and operations. Implementation of management measures will reduce the likelihood of vehicle strike. Given fauna species of conservation significance are all migratory or marine bird species, the likelihood of interaction with vehicles is considered low.<br><br>Given the proposed management measures, a significant impact on the biological diversity and ecological integrity of terrestrial fauna is not predicted. |
| Direct loss of native fauna due to entrapment within water pipeline trench | Measures to avoid:<br>• NA<br>Measures to minimise: | Given the short construction period (approximately six weeks), the small diameter of the pipe (≤ 150 mm) and resultant small size of the trench required, and the use of existing |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | • Fauna shelters (e.g. hessian bags) placed every 50 m or less in open trench.<br>• Open sections of trench inspected in the morning, within three hours of sunrise, and immediately before pipe laying and backfilling. Any entrapped fauna retrieved and released.<br>• Trench inspections, and fauna retrieval and release, by a suitably trained fauna handler.<br>• Trench backfilled (to at least cover pipe) as soon as practicable after pipe laying.<br>• Retrieved fauna released into suitable habitat near point of rescue, at appropriate distance from trench, as soon as practicable, except where they need to be held for treatment (dehydration, hypothermia, etc.), or are a nocturnal species best released in the evening.<br>Measures to rehabilitate:<br>• Fauna unfit for release referred to the Exmouth office of DBCA, or to Exmouth Wildlife Care Group, for assessment/ rehabilitation. | tracks, fauna entrapment is not expected to be a significant risk to local fauna populations.<br><br>Following the implementation of the proposed management measures, a significant impact on the biological diversity and ecological integrity of terrestrial fauna is not expected. |
| Direct loss of fauna habitat during clearing for onshore infrastructure | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>• Where practicable, land clearing will be undertaken | The fauna habitats identified within the Development Envelope are associated with vegetation communities that are well represented locally and regionally.<br><br>The six conservation significant fauna identified in the Development Envelope are marine and migratory bird species that use coastal habitat. Impacts on this habitat are low at a local and regional scale. This is discussed further in Section 5.4.5. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | progressively with the amount of active disturbance minimised.<br>• The site induction program will provide information on fauna of conservation significance, their appearance and habitats.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available.<br>• Topsoil will be appropriately stored and respread over rehabilitated areas to act as a seed source.<br>• Cleared vegetation will be appropriately stored and respread over rehabilitated areas to protect the soil from erosion and provide habitat for fauna. | Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained.<br><br><u>Monitoring</u><br>Inspections/survey to confirm no clearing beyond Development Envelope. |
| Indirect loss or degradation of fauna habitat due to dust emissions | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>Measures to minimise:<br>• Water carts will be utilised for dust suppression during construction.<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>Measures to rehabilitate:<br>• NA | Potential short-term and local impacts may occur during construction but are considered unlikely to significantly affect fauna habitat condition or result in loss of habitat.<br><br>The biological diversity and ecological integrity of terrestrial fauna will be maintained. |
| Indirect loss or degradation of fauna habitat due to introduction or spread of weeds | Measures to avoid:<br>• Earth moving machinery will be cleaned of soil and vegetation prior to entering or leaving the Development Envelope.<br>• No weed affected soil, mulch or fill will be brought into the | Increased presence of weeds (species and abundance) may affect fauna habitat. Given the proposed management measures these impacts will not result in significant impacts on |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Development Envelope.<br>• During operations, vehicles and equipment will keep to designated roads and tracks.<br>Measures to minimise:<br>• A weed hygiene system will be developed and implemented during the construction phase to avoid the establishment of new populations within the Development Envelope.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available.<br>• Conduct ongoing weed control in rehabilitation areas. | the health, abundance and structure of fauna habitat.<br><br>Subsea 7 considers that the potential impacts to fauna habitat can be managed such that there are no significant residual impacts to terrestrial fauna habitat and the biological diversity and ecological integrity of fauna will be maintained. |
| Fragmentation of fauna habitat due to presence of onshore infrastructure | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>Measures to minimise:<br>• Clearing activities will be managed to ensure clearing is strictly limited to that necessary for operations.<br>• Stock fencing to be installed around site boundary that will allow native fauna to cross site.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available. | The potential for habitat fragmentation is most likely to occur where there is limited extent of a fauna habitat supporting a population of breeding fauna species or where a particular species is limited to that specific habitat. Fauna habitats in the Development Envelope are well represented locally and regionally and do not support species of conservation significance that are restricted.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained. |
| Indirect loss or degradation of fauna habitat due to changes in surface water flows or changes in groundwater levels or | Measures to avoid:<br>• Project infrastructure and associated surface water management infrastructure has considered existing conditions and has been designed to minimise impacts to surface drainage patterns. | Long-term losses of fauna habitat or changes in the biological diversity and ecological integrity of fauna habitat are not expected to result from localised changes in surface water flows. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| quality | Measures to minimise:<br>• Monitoring of groundwater levels and quality as required under the licence to abstract groundwater (under 5C of the *Rights in Water and Irrigation Act 1914*).<br>Measures to rehabilitate:<br>• Rehabilitation of areas impacted by changes to surface water flows or quality. | Given the absence of GDE within the Development Envelope and locally and regionally widespread nature of fauna habitats within the Development Envelope, localised changes to groundwater levels and or quality are not considered likely to have significant changes on the biological diversity and ecological integrity of fauna habitats.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained. |
| Indirect loss or degradation of fauna habitat due to changes in fire regimes | Measures to avoid:<br>• NA.<br>Measures to minimise:<br>• Development to be conducted in accordance with appropriate BAL specifications/conditions.<br>• Vehicle traffic will be confined to defined roads and tracks (except during active clearing).<br>• Firefighting equipment will be located on site and in project vehicles.<br>• Project personnel will be trained in fire response.<br>• A Hot Work Permit system will be developed and implemented.<br>• The project site induction will include information on the prevention and management of fires.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available. | Mitigation measures will minimise the risk of Proposal-related fires. The Proposal-specific impacts on local fire regimes are not anticipated to adversely impact the environment given the open structure of the vegetation and locally and regionally common nature of fauna habitats within the Development Envelope.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Indirect impacts to native fauna as a result of introduction or increase of feral animals | Measures to avoid:<br>• Lidded bins.<br>• Regular removal of waste by a licenced contractor.<br>Measures to minimise:<br>• Access control measures implemented to sources of water (e.g. fencing, or the use of sealed bladders, covers, etc.).<br>Measures to rehabilitate:<br>• A feral animal control program will be implemented if populations of feral animals noticeably increase. | It is not considered likely that development and operation of the Proposal will result in introduction of new feral animal species to the area or an increase in abundance of feral animals. It is anticipated that the proposed controls will be effective and will prevent an increase in diversity and abundance of feral animals.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained. |
| Loss or alteration of coastal habitat as a result of changes to coastal processes or hydrodynamic/ hydrological regimes | Addressed within Section 5.4.6.11 as related to migratory bird habitat. | |

Table 5-38: Proposed Mitigation Measures and Predicted Outcome for Terrestrial Fauna

## 5.8 KEY ENVIRONMENTAL FACTOR 8 – INLAND WATERS

### 5.8.1 EPA Objective

To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

### 5.8.2 Policy and Guidance

Subsea 7 has taken into consideration relevant policy and guidance in design of the Proposal, the completion of the environmental impact assessment and through the development of this ERD.

A summary of the policy and guidance relevant to Inland Waters, and how Subsea 7 has considered these, is presented in Table 5-39.

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Statement of Environmental Principles, Factors and Objectives (EPA 2016c, 2018c) | Referred to in the identification and assessment of Preliminary Key Environmental Factors. |
| Environmental Factor Guideline – Hydrological Processes (EPA 2016s) | This guidance was consulted in the consideration of the environmental values dependent upon the current surface water and groundwater regimes and the potential impacts on hydrological processes. |
| Environmental Factor Guideline – Inland Waters (EPA 2018d) | Referred to in the determination of data requirements to support the development of the PER |
| Identification and investigation of acid sulphate soils and acidic landscapes (DER 2015a) | Referred to in the assessment and identification of acid sulfate soils |
| Treatment and management of soil and water in acid sulphate soil landscapes (DER 2015b) | Referred to in the treatment and management of identified acid sulfate soils as well as groundwater |
| National Water Quality Management Strategy, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ 2000) | Referred to in the assessment of potential impacts to surface and groundwater quality |
| Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian State and Territory Governments (ANZECC & ARMANZ 2018) | |
| WA Environmental Offsets Policy (Government of Western Australia 2011) | These policies were considered as part of the determination of the need for offsets. |
| WA Environmental Offsets Guidelines (Government of Western Australia 2014) | |
| Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets | |

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Policy (DSEWPAC 2012a) | |

Table 5-39: Policy and Guidance Relevant to Inland Waters

### 5.8.3 Receiving Environment

A limited number of studies relating to Inland Waters have previously been undertaken within the region, as outlined in Table 5-40. Subsea 7 has augmented these previous studies by commissioning additional, Proposal-specific studies, to ensure an appropriate level of information is available to support completion of environmental impact assessment and development of environmental management plans.

The Proposal-specific studies, as listed in Table 5-40, were undertaken by various technical specialists, and are included in full within Attachment 2. They are also referred to, as appropriate, in the discussion on the assessment of potential impacts and proposed management measures.

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| Regional Studies | | |
| 2007 | SKM | Exmouth Floodplain Management Study |
| 2014 | hyd$_2$0 | Exmouth Hydrological Study |
| Proposal-specific Studies | | |
| 2018 | GHD | Bundle Fabrication Facility Surface and Groundwater Investigation |

Table 5-40: Overview of Local and Regional Studies Relating to Inland Waters

#### 5.8.3.1 Topography and Soils

The elevation of the Proposal area ranges from about 25 m Australian Height Datum (AHD) at the inland end to 0 m AHD at the coast and generally slopes from the south west end to the north east. Topographical data indicates the site drains internally, with a coastal dune preventing discharge to the ocean (GHD 2018b, Attachment 2R).

The majority of the area is characterised by a series of parallel network dunes and residual sand plains made up of red brown to yellow quartz sand. The dunes are approximately 5 m in height and are stabilised by light vegetation comprising grasses and small shrubs. The dunes generally trend north north east to south south west (Attachment 2R).

#### 5.8.3.2 Geology

The Development Envelope is located on the coastal plains within a minor syncline between Cape Range in the west and Rough Range in the south east. Within the Development Envelope east of the Minilya-Exmouth Road, the site surface geology is typically residual sand plains forming longitudinal dunes, with intertidal flats (calcareous clay, silt and sand) and supratidal flats (calcareous clay, silt and sand with authigenic gypsum and salt) identified in the far north east of the Development Envelope along the coastal fringes (GSWA 1980).

The Cape Range foothills are located approximately 4 km west of the site and coincide with the proposed groundwater supply bores. Within this area, the surface geology is typically Exmouth Sandstone, and Bundera Calcarenite. Higher in the range, Trealla Limestone and Tulki Limestone are exposed (GSWA 1980).

#### 5.8.3.3 Hydrogeology

Groundwater drilling has been completed at 20 locations to confirm a suitable groundwater supply for the Proposal (Attachment 2R), and to support stygofauna investigations (Attachment 2O). A summary of the site geology and hydrogeological units is presented in Table 5-41.

| Unit | Thickness (m) | Comment |
|---|---|---|
| Sand | 0-3 | Coastal dune sand. Present across the main Development Envelope at surface, thickest in the west, absent in the water supply area, and thin or absent in coastal flats. Generally not saturated. |
| Sandstone (Exmouth Sandstone) | 5-20 | An interbedded sequence of pale red to yellow sandstone, varying from well cemented to poorly cemented. Was found throughout the Development Envelope. In some areas, the sandstone was interbedded with more calcareous sediments. Some minor clay bands were also noted. The sandstone, where found in lower elevation areas, was found to be saturated and offered reasonable groundwater flow. |
| Calcarenite/ limestone (Bundera Calcarenite, and possibly Trealla Limestone in the west at depth). | > 40 | An interbedded sequence of white to brown, well to poorly cemented calcarenite/limestone was found throughout the Development Envelope where drilling continued deep enough. Shell fragments and minor clays were noted, particularly in the western areas at depth. The calcarenite/limestone was found to be saturated and offered reasonable to good groundwater flow.<br><br>*Note: The sandstone and calcarenite/limestone units are considered to represent a single connected aquifer, with no discernible separation between the two.* |

Table 5-41: Summary of Lithologies Recorded during the Drilling Program (from GHD 2018b)

Based on an interpretation of the surface geology, it is inferred that minor sandstone and calcarenite underlie the surface sands, with a succession of limestone beneath. Where saturated, the sandstone and limestone units are considered a regionally important aquifer and are currently utilised for Exmouth Town water supply, Learmonth RAAF base water supply, together with various stock and domestic supply bores (Attachment 2R).

#### 5.8.3.4 Groundwater

The Public Drinking Water Source Area (PDWA) for Exmouth is located approximately 20 km from the Development Envelope. No bores within the Development Envelope or surrounding area intersect with the PDWA.

Groundwater within the limestone aquifer generally flows eastwards, from Cape Range (source of groundwater recharge) towards Exmouth Gulf where it discharges (DoW 2011). Local groundwater flow patterns are likely to be significantly affected by karstic features. Within the proposed fabrication shed area, groundwater appears to be flowing in an east southeasterly direction, whereas in the area closer to the proposed Bundle launchway, groundwater was flowing in a more easterly direction (Attachment 2R).

Due to the highly permeable nature of the limestone aquifer, the saline interface is known to extend up to 5 km inland. The freshwater aquifer thickens to the west, with distance from the coast, and is known to be up to 150 m in depth, but the aquifer permeability may also decrease with aquifer thickness (Attachment 2R).

The greatest depth to groundwater is found in the western bores where groundwater occurs at an approximate elevation of around 1.6 mAHD, equivalent to a depth to groundwater from ground level of 22-32 m depending on location. The shallowest depth to groundwater is found in the low lying bores located closest to the coast (e.g. S04, S05, and S06) where groundwater occurs at a depth of less than 1.5 m bgl, equivalent to less than 0.5 mAHD. In the main fabrication area, groundwater is found to occur at a depth of between 12 and 17 mbgl depending on location.

Groundwater quality at the site is typified by two distinct groundwater signatures:

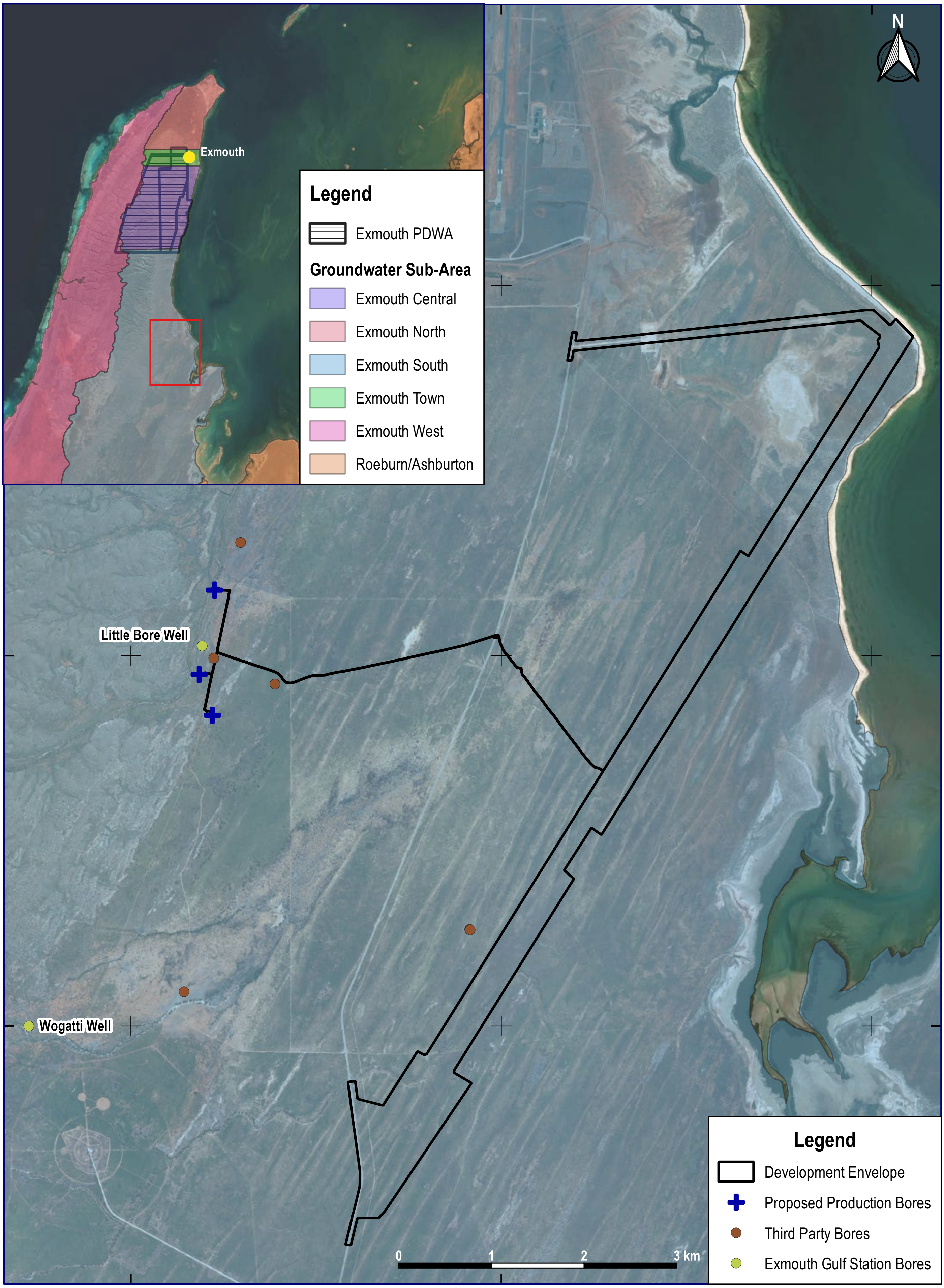
- Salt dominant groundwater (hypersaline i.e. higher salinity than seawater) in bores located in the main project footprint.
- Fresh to slightly brackish groundwater for those bores sampled in the western area (S24 and S25) representing the proposed groundwater supply area (Figure 5-46).

All four bores sampled in the main part of the Development Envelope recorded salinities (as Total Dissolved Solids (TDS)) of between 46,900 mg/L (S09) and 73,700 mg/L (S06) (Figure 5-44). The most saline groundwater was sampled at S06 in an area identified as tidal flats/salt plain. The high salinity of the groundwater as this location is likely caused by the concentration of salts in areas of tidal flats.

Two bores, Wogatti Well and Little Bore (Figure 5-48), were initially investigated as potential water sources for the Proposal. Little Bore is located on Exmouth Gulf Station while Wogatti Well is located on Crown land. Groundwater is currently abstracted from both for pastoral purposes. A number of additional bores were developed in September 2018 to support the stygofauna sampling programme (Figure 5-44) and to further investigate the quality and availability of groundwater within the area. The Development Envelope is located within the Exmouth South groundwater sub-area (Figure 5-48), with the relevant aquifer being the Cape Range Limestone aquifer. The Exmouth South groundwater sub-area is currently only 2% allocated (Attachment 2R).

The relatively fresh groundwater found in the western area (S24 and S25) has a very similar signature to the Exmouth Town Water Supply water (DoW 2011). The low concentration of nutrients and biological components indicate that regional groundwater is un-impacted by its current use for sheep grazing (Attachment 2R).

The location of the expected saline wedge and interface between fresh groundwater in the west and saline groundwater in the east is not accurately known, due to an absence of bores between the water supply area (where underlying saline groundwater was not intercepted) and the main portion of the Development Envelope (where overlying fresh groundwater was absent) (Attachment 2R). It is noted that the bores in the water supply area were drilled and installed through at least 12 m of saturated aquifer, and no change in salinity was noted with depth at these locations, implying that the interface is some distance east of these bores (Attachment 2R).




| | | |
|---|---|---|
| Scale: 1:55000<br>Original Size: A4<br>Aerial Photo: ESRI Satellite<br>Grid: GDA 94 / MGA Zone 50 | Notes: Data sourced from BoM (2016). Project located within the Exmouth South Groundwater Sub-Area.<br><br>Subsea 7 Pipeline Fabrication Facility | subsea 7<br><br>Figure 5-48: Groundwater Sub-Areas |

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#### 5.8.3.5 Surface Water

The floodplain has very few defined flow paths based on aerial imagery and topographical data, making it difficult to determine exact catchment boundaries. These ephemeral watercourses are expected to flow only during, and for short period following, significant rainfall events. Catchment areas draining to the proposed infrastructure areas were delineated using CatchmentSim v3.5 software and are shown in Figure 5-49. Three catchments with associated areas were delineated as follows:

- Catchment A – 108.3 km$^2$.
- Catchment B – 36.9 km$^2$.
- Catchment C – 59.8 km$^2$.

### 5.8.4 Potential Impacts

Construction and operation of the Proposal has potential to directly and indirectly impact Inland Waters including both surface and groundwater. Table 5-42 summarises the potential impacts during each project phase.

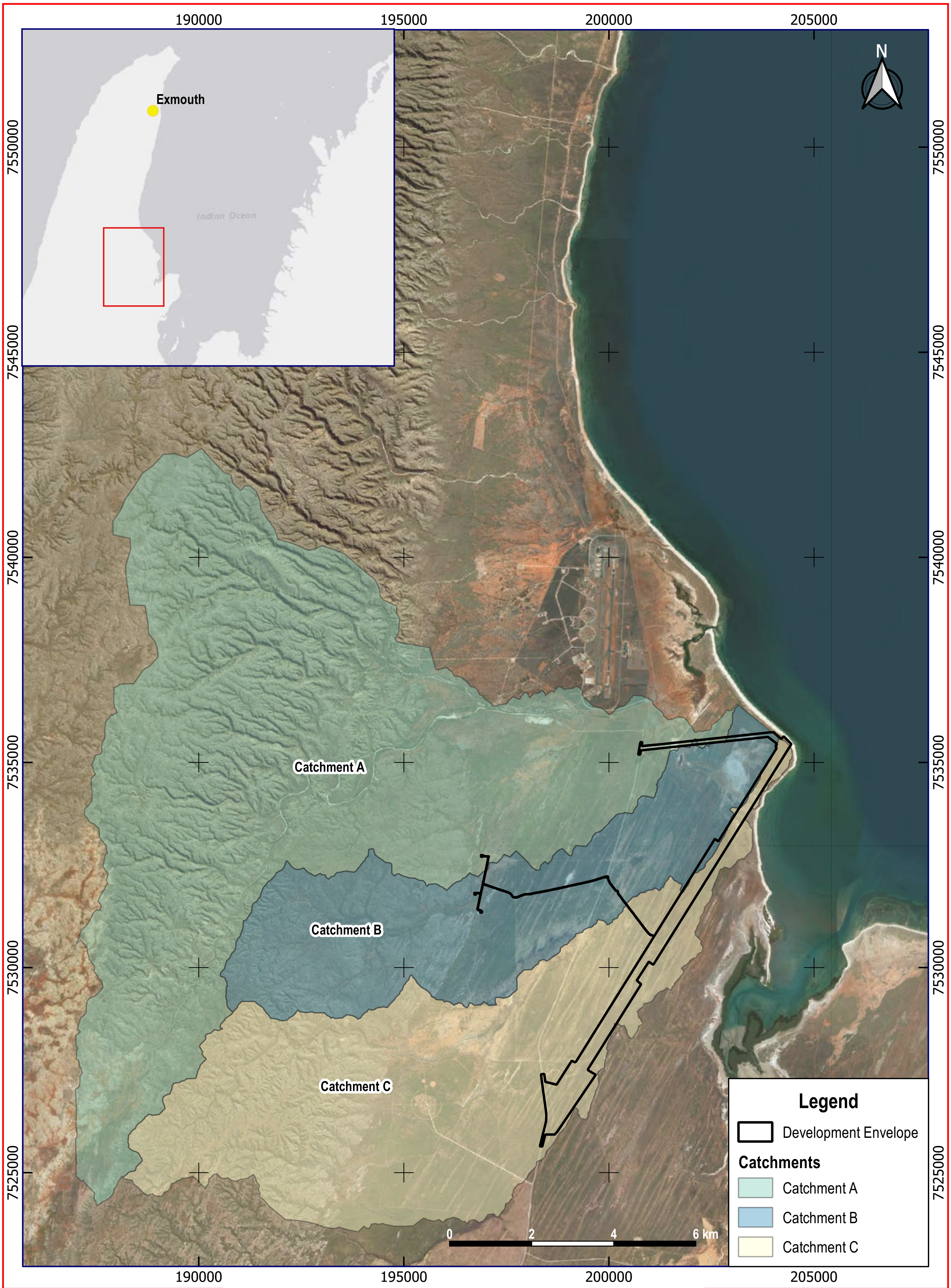
| Project Phase | Potential Impact |
|---|---|
| Construction | Impact to surface water quality due to exposure of soils (risk of erosion and elevated suspended solids) |
| Operations | Changes to surface water flow patterns and flood levels due to the presence of infrastructure |
| | Impact to surface water quality due to exposure of soils (risk of erosion and elevated suspended solids) |
| | Impact to surface or groundwater quality due to treated wastewater discharge |
| | Impact to groundwater levels due to groundwater abstraction |
| | Impact to surface or groundwater quality due to leak or spill of chemicals (including hydrocarbons) |

Table 5-42: Potential Impacts to Inland Waters

### 5.8.5 Potential Cumulative Impacts

Cumulative impacts to groundwater quality or quantity could occur as a result of the proposed groundwater abstraction associated with the Proposal and third party users of the regional groundwater resource. Potential cumulative impacts are considered in Section 5.8.6.6.

Cumulative impacts to surface water flows or quality could occur as a result of existing infrastructure (for example the Minilya-Exmouth Rd) and the Proposal, and are discussed in Section 5.8.6.6.

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Notes: Data sourced from GHD (2018b).

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Figure 5-49: Catchment Areas

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#### 5.8.6 Assessment of Impacts

##### 5.8.6.1 Changes to Surface Water Flow Patterns due to the Presence of Infrastructure

The Proposal consists of a Bundle fabrication shed located on a pad, Bundle tracks to provide transport to the launch site and an access road from the Minilya-Exmouth Road to the launch site. The Bundle track will follow the contours of the land wherever possible to minimise earthworks, though due to the presence of dune formations, there are locations where this is not possible and existing features will be disturbed.

Current (baseline) and post-development surface water flow patterns were modelled using a rain-on-grid 2D approach (Attachment 2R). Modelling scenarios included:

- 10-year average recurrence interval (ARI) event, which was used to design the surface water infrastructure such as culverts, channels and floodways.
- 50-year ARI event to determine the potential risks of climate change and associated impacts to infrastructure.
- 100-year ARI event, which was used to design flood damage protection measures, to ensure damage to infrastructure and discharge of chemicals does not occur.
- Probable Maximum Precipitation (PMP) Design Flood, which was used to demonstrate how the Proposal could modify flood behaviour following a worst-case flood event.

The following surface water drainage management measures were included within the post-development modelling scenarios:

- A culvert beneath the Bundle track (Figure 5-50) to allow surface water to flow north east to south west beneath the track, along the existing flow path.
- An open drain running to the north east, and adjacent to, the Bundle track (Figure 5-50), to convey surface flows to a natural depression where ponding is expected to occur under baseline conditions (Attachment 2R).

A comparison of the 10 and 50-year ARI events showed that the expected flows for the 50-year ARI range from two to six times greater than the 10-year ARI. Although the drainage design event is the 10-year ARI, the Bundle track drainage and elevations will be designed such that floods up to the 100-year ARI event will not inundate the track alignment or Bundle facility.

A comparison of the existing and future case modelling for a 100-year ARI event is presented in Figure 5-50. Note that within Figure 5-50 the change in water levels was determined using existing case and subtracting the future case, so areas of increased flood levels are represented by negative values while areas experiencing reduced flood levels are represented by positive values. Modelling showed that there is very little change to maximum water levels as:

- Water is allowed to pass under the Bundle track through the culvert.
- The open drain conveys flows along the Bundle track alignment, ending up in the same end location as current flows.

The following residual impacts were noted:

- A general decrease in peak flood levels on the eastern side of the Bundle track.
- An expected marginal increase in flooding in the natural depression caused by additional inflow from the open drain.

Other than these points, surface water flow patterns are expected to remain similar to baseline flow patterns, and changes to flow velocities are not expected to alter any natural scour or sediment deposition characteristics of the area (Attachment 2R).

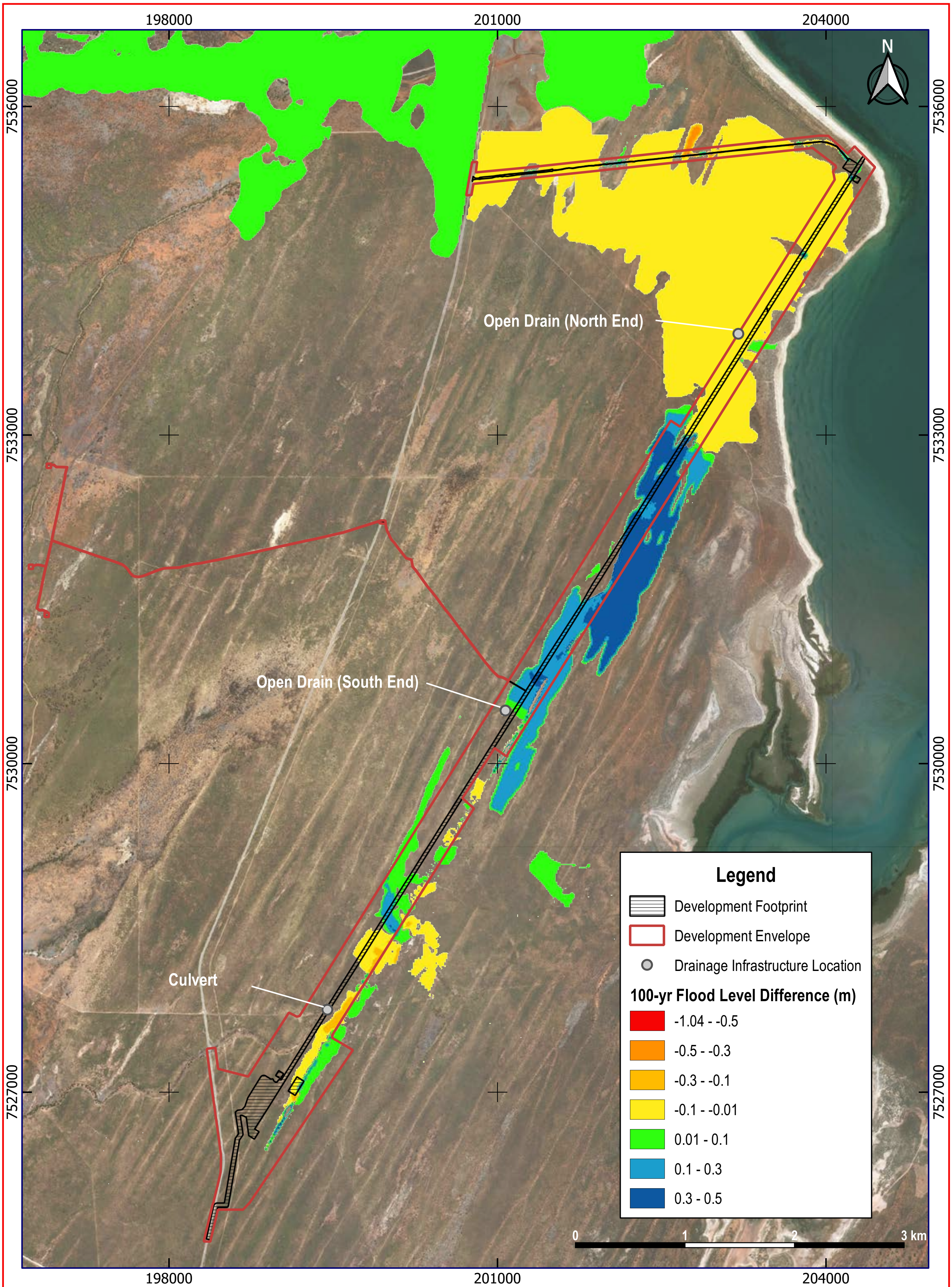
#### 5.8.6.2 Impact to Surface Water Quality due to Exposure of Soils (Risk of Erosion and Elevated Suspended Solids) during Construction and Operations

During construction, stormwater runoff from construction areas has potential to contain elevated concentrations of suspended solids. This will be controlled through use of temporary cut-off drains leading to sediment basins that will settle out fines before discharge.

During operations, exposed soil areas will be minimised. As noted above, changes to flow velocities are not expected to alter any natural scour or sediment deposition characteristics of the area (Attachment 2R). Some sediment may be mobilised from disturbed or cleared surfaces, but it is noted that the Bundle track will have sediment basins placed along the alignment to control suspended sediment loads.

Ongoing monitoring of the proposed drainage infrastructure will involve regular inspection and maintenance of the culvert and open channel to ensure they remain sediment and debris free. In the event that significant erosion of disturbed or cleared surfaces is experienced, management measures will be initiated to stabilise erosion and minimise on-going erosion.

Significant impacts to surface water quality from erosion during construction and operations are not expected.

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Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from GHD (2018b)

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Figure 5-50: Modelled Changes to Surface Water Flood Levels(100-Year ARI Event)

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#### 5.8.6.3 Impact to Surface and Groundwater Quality due to Treated Wastewater Discharge

All blackwater will be tankered to the Water Corporation's Exmouth Wastewater Treatment Plant (WWTP) for treatment. An estimated maximum greywater (wastewater from showers plus wash basins in ablution/shower block areas) volume of 6,560 L/day (or 2,394 kL/year based on the site operating year-round) will require treatment prior to disposal via surface irrigation within the nominated sprayfield (Figure 2-3). The estimated treated greywater total nitrogen (TN) and total phosphorus (TP) concentrations are 4 mg/L and 2 mg/L (GHD 2018b). These nutrient concentrations are relatively low, being comparable with those in recycled water produced by a WWTP designed to achieve a high level of nutrient reduction.

Nutrients (nitrogen and phosphorus) in treated greywater will be managed by following guidelines provided by Department of Water (DoW) Water Quality Protection Note 22 (WQPN 22) 'Irrigation with nutrient-rich wastewater' (DoW 2008). The proposed land disposal area consists of a deep profile of calcareous soil, sediments and weathered limestone (typically 15 m to groundwater) with a very high phosphorus buffering capacity, as confirmed by a measured value of 100 units for the Phosphorus Buffering Index (PBI). These conditions indicate a nutrient risk rating of Category D (low) according to criteria presented in the WQPN 22.

Table 5-43 compares the estimated nitrogen and phosphorus loadings to the guidelines for Category D (from Table 2 of WQPN 22). The calculated loading were based on discharge of 6,560 L/day of treated greywater containing 4 mg/L and 2 mg/L of total nitrogen and phosphorus, respectively, to 1.5 ha of land (vegetated by native *Spinifex* and *Acacia* shrubs). Risks of nutrient enrichment of groundwater by leaching from the spray field are considered extremely low. Most of the applied wastewater (average application rate 0.44 mm/day) will be lost by evaporation and uptake by plants. The average annual nitrogen load (6.4 kg/ha/yr) is similar to plant uptake calculated for growth of 1,000 kg/ha of *Spinifex* (Grigg *et al*. 2008) or 2,000 kg/ha of *Acacia* (He 2012). The proposed phosphorus load (3.2 kg/ha/yr) is substantially less than plant uptake calculated for growth of 1,000 kg/ha of *Spinifex* (Grigg *et al*. 2008) or 2,000 kg/ha of *Acacia* (He 2012).

| Parameter | Proposed Land Discharge | WQPN 22 Guideline (Category D) | Comments |
|---|---|---|---|
| Treated Water Application Rate | 0.44 mm/day<br>160 mm/yr | 50 mm/week (32 weeks/yr)<br>1,600 mm/yr | 10% of maximum discharge rate |
| Inorganic N (maximum load) | 6.4 kg/ha/yr (as total N) | 480 kg/ha/yr | 1.3% of maximum load |
| Inorganic N (maximum concentration) | 4 kg/L (as total N) | 30 mg/L | 13% of maximum concentration |
| Reactive P (maximum load) | 3.2 kg/ha/yr | 120 mg/kg/yr | 2.7% of maximum load |
| Reactive P (maximum concentration) | 2 mg/L (as total P) | 7.5 mg/L | 27% of maximum concentration |

Table 5-43: Comparison of Proposed Nutrient Loads and Concentrations to Guideline Values

There is a buffer area allotted in the proposed spray area to prevent humans or livestock from being exposed to the treated wastewater, as well as fencing around the field. There are no defined drainage channels within the vicinity of the proposed sprayfield, mitigating the risk of any impacts to surface waters.

The WWTP will be constructed, operated and maintained in accordance with Shire of Exmouth permitting requirements.

It is considered unlikely that discharge of treated effluent from the WWTP would result in changes to surface or groundwater quality in the Development Envelope or adjacent areas. Any changes that may occur on a localised level are considered unlikely to adversely impact beneficial uses of surface or groundwater or impact environmental values.

##### 5.8.6.4 Impact to Groundwater Levels due to Groundwater Abstraction

The proposed borefield is located within the Exmouth South groundwater sub-area, with the relevant aquifer being the Cape Range Limestone. DWER has noted that due to the sensitivity of the Cape Range Limestone to saline intrusion, any groundwater abstraction licence is likely to be issued with the following conditions:

- Abstraction rates for each bore are not to exceed 0.3 L/s.
- Salinity should not be greater than 467 milli-siemens per metre measured at 25°C (equivalent to a total dissolved solids (TDS) load of 2,500 mg/L).

Based on the expected total water demand for the project (12.0 ML/annum) and the likely pumping rate restriction condition, three production bores would be required. The proposed locations for these three bores are shown in Figure 2-3.

Modelling of the potential groundwater drawdown associated with the abstraction of groundwater for the life of the Proposal has been completed, based on a total period of 10,000 days (~27 years) (Attachment 2R). Two scenarios were modelled to reflect drawdown effects under two plausible transmissivity values of 10 $m^2$/day and 100 $m^2$/day. Under the most conservative scenario (worst case), modelled with a transmissivity value of 10 $m^2$/day, maximum drawdown in the immediate location of the bores is up to 2.5 m after 10 years of continuous abstraction (Figure 5-46). Drawdown at a range of 3 km from the bores is predicted to not exceed 5 cm (Figure 5-46). It is noted that the model does not include any recharge to the aquifer over this period and that continuous abstraction is assumed (whereas in reality bores are likely to operate on average for around 50% of the time at maximum abstraction limits (0.3 L/s) to meet the Proposal water demand), meaning that an impact of this magnitude would be unlikely. Monitoring of groundwater levels during the project life will enable validation of modelling predictions (Table 5-45).

##### 5.8.6.5 Impact to Surface Water and Groundwater Quality due to Leak or Spill of Chemicals (including Hydrocarbons)

During operations, a number of different fuels and chemicals are likely to be stored within the Proposal area, as outlined in Table 5-44.

| Chemical | Typical Volume | Use onsite |
|---|---|---|
| Diesel | 110 kL | Fuel for generators and vehicles |
| Petrol | 40 L | Fuel for generators and vehicles |
| Monoethylene Glycol (MEG) | 300 $m^3$ | Pumped into small flowlines within the Bundle during construction to protect from corrosion and improve start-up conditions |
| RX-5720 | 3000 kg | Inserted into the Bundle during construction |
| Acothene | 320 L | 2 part epoxy used for the coating on the Bundle |

| Chemical | Typical Volume | Use onsite |
|---|---|---|
| International 410 | 20 L | Painting identification numbers onto Bundles |

Table 5-44: Typical Chemicals Likely to be Stored Within the Development Envelope

Chemical and hydrocarbons will be stored in facilities designed and constructed in accordance with relevant Australian Standards. Failure of chemical and hydrocarbon containment or equipment malfunction may result in spillages to the environment. Spill kits and equipment will be maintained on site. Staff will be trained in refuelling procedures, handling and management of chemicals and spill response. Spills will be cleaned up and contaminated soil will either be remediated in situ or removed from site by a licensed third party. Incident investigation will be undertaken to determine the cause of spills/leaks and control measures identified to prevent similar future incidents.

The risk of a discharge from the hydrotest water pond into the marine environment is considered unlikely given the distance of the pond from the coast (> 100 m), the presence of large dunes (5 m in height [GHD 2017]) between the pond and the shoreline (M P Rogers 2017). Further, the pond will be lined and covered to prevent contamination of the hydrotest water and reduce evaporation. An alternative to a flexible cover would be the use of industrial water bladders as an alternative to a pond, which would further reduce the risk of discharge of hydrotest water.

Under cyclonic conditions the pond (if industrial water bladders are not used) could potentially overflow following heavy rain. However, it is noted that the hydrotest water is fresh, would infiltrate into the ground on the inland (west) side of the dunes, and that substantial volumes of rainwater would be flowing across the wider landscape. The hydrotest water will be treated with either Hydrosure O-3670R or Roemex RX-5254, dissolved at a concentration of 500 ppm. These are the same chemicals that will be present in the carrier pipe for the Bundle tow and final installation and pose a low risk to the environment (refer Section 2.3.6.2).

Considering the small number and volume of chemicals and hydrocarbons planned to be stored and used, and application of standard industry practices for storage and handling, the risk of contamination of surface and groundwaters on a local and regional scale is considered low.

#### 5.8.6.6 Cumulative Impacts

Cumulative impacts from groundwater abstraction associated with the Proposal and third party users of the regional groundwater resource are considered unlikely given:

- DWER's licencing of groundwater abstraction on a sub-area basis, with the Exmouth South groundwater sub-area currently only 2% allocated.
- The lack of any other substantial groundwater abstraction in proximity to the proposed bores.
- The low abstraction rate and the minimal drawdown predicted from the Proposal (Figure 5-46).

It is considered unlikely that discharge of treated effluent from the WWTP would result in changes to surface or groundwater quality in the Development Envelope. Any changes that may occur on a localised level are considered unlikely to adversely impact beneficial uses of surface or groundwater or impact environmental values.

Cumulative impacts to water quality could occur as a result of leaks or spills associated with existing infrastructure (for example the Minilya-Exmouth Road or the RAAF base at Learmonth) and the Proposal. Groundwater sampling from the stygofauna monitoring bores (Figure 5-44) recorded no contamination within the regional groundwater. Leaks or spills associated with a vehicle collision on the Minilya-Exmouth Road could occur, but are unlikely to result in a large-scale contamination of surface or groundwater within the region.

The Department of Defence recently completed a preliminary ecological risk assessment (ERA) (GHD 2019) following completion of a detailed site investigation (DSI) at RAAF Learmonth characterising the nature and extent of the contamination associated with the historical use of aqueous film forming foam (AFFF) containing perfluoroalkyl and polyfluoroalkyl substances (PFAS) at the facility (GHD 2018c). There are two main source areas with the highest PFAS concentrations in soil and groundwater: the Fuel Farm, and the Maintenance Area. Although there are elevated concentrations of PFAS in the groundwater in these two source areas, the findings of the DSI and subsequent Preliminary ERA indicated that the plumes of contamination are localised and pose a low risk to human health and ecological systems. The plumes are predicted to be located to the north of the Development Envelope, flowing east from the facility to the Wapet Creek area (Department of Defence 2019). Thus no cumulative impacts from the RAAF Learmonth and the Proposal are expected.

No significant impacts to water quality are likely to occur as a result of the Proposal. The risk of cumulative impacts on surface or groundwater quality is considered low.

The Minilya-Exmouth Road intersects a surface water flow path immediately south of RAAF Learmonth (Attachment 2R), with flows expected to remain within the floodway, which directs runoff across the road to the north east. Further south another flow path crosses the Minilya-Exmouth Road. Only minor local changes to the natural flowpaths occur as a result of the Minilya-Exmouth Road, which do not lead to changes in the surface water flows entering the Development Envelope. The risk of cumulative impacts on surface water flows is considered low.

### 5.8.7 Mitigation and Predicted Outcome

Proposed mitigation measures to address potential impacts on Inland Waters and the predicted outcomes are outlined in Table 5-45.

The EPA objective '*to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected*' will be met.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Changes to surface water flow patterns due to the presence of infrastructure | Measures to avoid:<br>• Where necessary, suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns.<br>Measures to minimise:<br>• Project design has considered the location of drainage lines with the aim of minimising changes to natural flows.<br>Measures to rehabilitate:<br>• Upon closure the reinstatement of the natural flow paths after removal of the project infrastructure. | After installation of surface water drainage measures, surface water flow patterns are expected to remain similar to baseline flow patterns, and changes to flow velocities are not expected to alter the natural scour or sedimentation characteristics of the catchment.<br><br>The hydrological regimes will be maintained after implementation of the Proposal so that environmental values are protected consistent with the EPA objective for Inland Waters. |
| Impact to surface water quality due to exposure of soils (risk of erosion and elevated suspended solids) | Measures to avoid:<br>• Where necessary, suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns.<br>• Project design has considered the location of drainage lines with the aim of minimising changes to natural flows.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the project.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>• Where practicable, land clearing will be undertaken progressively with the amount of active disturbance minimised.<br>• Use of erosion control measures, such as surface treatments (compaction, hydromulch) of disturbed areas, as required, to minimise soil erosion. | Significant impacts to surface water quality from erosion during construction and operations are not expected as no significant changes to surface water flow velocities have been predicted.<br><br>The quality of surface water will be maintained so that environmental values are protected and the EPA objective for Inland Waters will be achieved. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• Rehabilitation will be undertaken on disturbed construction areas (e.g. directional drilling sites, adjacent to access road) as they become available.<br>• Upon closure the reinstatement of the natural flow paths after removal of the project infrastructure. | |
| Impact to surface water and groundwater quality due to treated wastewater discharge | Measures to avoid:<br>• WWTP designed and located consistent with regulatory requirements relevant to the protection of water quality.<br>• Treatment of greywater will be provided by an advanced system (such as a Wise Water system) to ensure a high recovery of nutrients.<br>• Location of sprayfield chosen to avoid defined drainage channels.<br>Measures to minimise:<br>• All blackwater will be tankered offsite.<br>• Spray field appropriately sized to promote nutrient update by vegetation and soil.<br>Measures to rehabilitate:<br>• NA. | No significant impact to surface or groundwater quality is expected as a result of the discharge of treated wastewater.<br><br>The quality of surface and groundwater will be maintained so that environmental values are protected and the EPA objective for Inland Waters will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
| --- | --- | --- |
| Impact to groundwater levels due to groundwater abstraction | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Minimise water abstraction through the storage and re-use of hydrotest water.<br>• Water storages will be lined to minimise seepage and covered to minimise evaporative loss.<br>• Low abstraction rates to reduce the likelihood of groundwater drawdown.<br>Measures to rehabilitate:<br>• NA. | Under the most conservative (worst-case) scenario, modelling predicts a maximum drawdown in the immediate location of the production bores of 1.15 m after 10 years of continuous abstraction, assuming no recharge occurs. Changes to localised groundwater levels are not predicted to adversely impact on beneficial uses. Local hydrological regimes will be maintained and the EPA objective for Inland Waters will be met.<br><br>Monitoring<br>Regular (quarterly) monitoring of groundwater quality (including salinity) and levels, in accordance with abstraction licence conditions. |
| Impact to surface water and groundwater quality due to leak or spill of chemicals (including hydrocarbons) | Measures to avoid:<br>• Hazardous materials will be stored in accordance with relevant Australian Standards and Dangerous Goods Storage regulations.<br>• Chemical storage and handling procedures to prevent leaks or spills.<br>Measures to minimise:<br>• Refuelling to occur on concrete or HDPE-lined pads to contain any drips and spills. The pads will drain to a sump to allow removal of collected material.<br>• Spill kits will be located at strategic locations throughout the project area and employees trained in their use.<br>• Employees and contractors will be trained in use of spill kits. | Considering the application of standard industry practices for chemical storage and handling, the risk of contamination of surface and groundwaters is considered low.<br><br>The quality of surface and groundwater will be maintained so that environmental values are protected and the EPA objective for Inland Waters will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | • Spills will be cleaned up and contaminated soils will be removed from site by a licensed third party.<br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas. | |

Table 5-45: Proposed Mitigation Measures and Predicted Outcome for Inland Waters

## 5.9 KEY ENVIRONMENTAL FACTOR 9 – SOCIAL SURROUNDINGS

### 5.9.1 EPA Objective

To protect social surroundings from significant harm.

### 5.9.2 Policy and Guidance

Subsea 7 has taken into consideration relevant policy and guidance in design of the Proposal, completion of the environmental impact assessment and through the development of this ERD.

A summary of the policy and guidance relevant to Social Surroundings, and how Subsea 7 has considered these, is presented in Table 5-46.

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Statement of Environmental Principles, Factors and Objectives (EPA 2016c, 2018c) | Referred to in the identification and assessment of Preliminary Key Environmental Factors. |
| Environmental Factor Guideline – Social Surroundings (EPA 2016t) | This guidance was consulted in the consideration of potential impacts from the Proposal to the social surroundings, as a result the mitigation hierarchy has been applied.<br><br>The guidance states that '*for social surroundings to be considered in EIA, there must be a clear link between a Proposal or scheme's impact on the physical or biological surroundings and the subsequent impact on a person's aesthetic, cultural, economic or social surroundings'*.<br><br>This chapter of the PER and the relevant supporting studies (Visual Impact Assessment and Social Impact Assessment) show the link between the Proposal and associated impacts. |
| Guidance for the Assessment of Environmental Factors – Assessment of Aboriginal Heritage (EPA 2004b) | Provides guidance on the process of Environmental impact assessment of Aboriginal Heritage. Referred to in the development of Aboriginal Heritage surveys and approvals. Section 5.9.3.3 provides a summary of the Heritage survey. |
| WA Aboriginal Heritage Act 1972 (AHA) | An act to make provision for the preservation on behalf of the community of places and objects customarily used by or traditional to the original inhabitants of Australia or their descendants. |
| Aboriginal Heritage Due Diligence Guidelines (DAA & DPC 2013) | All Aboriginal sites are protected by the AHA, the due diligence guidelines assist land users to be more aware of how their activities could impact Aboriginal sites. These guidelines were referred to in the |

| Policy/Guidance | Consideration for Proposal |
|---|---|
| | determination of the work required to understand the potential impacts to Aboriginal heritage. |
| Visual Landscape Planning in Western Australia: a manual for evaluation, assessment, siting and design (Western Australian Planning Commission 2007) | Used in the development of the Landscape Visual Impact Assessment (LVIA) for the Proposal. |
| Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005 – 2015 (MPRA and CALM 2005) | Objectives for social values were considered when assessing planned activities within the Ningaloo Marine Park. |
| International Principles for Social Impact Assessment 2003 (Vanclay 2003) and Social Impact Assessment: Guidance for Assessing and Managing the Social Impacts of Projects (Vanclay *et al.* 2015) | Used in the development of the Social Impact Assessment study to understand the social setting, potential impacts of the Proposal on the community and to describe potential mitigation measures. |
| WA Environmental Offsets Policy (Government of Western Australia 2011) | These policies were considered as part of the determination of the need for offsets. |
| WA Environmental Offsets Guidelines (Government of Western Australia 2014) | |
| Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPAC 2012a) | |

Table 5-46: Policy and Guidance Relevant to Social Surroundings

### 5.9.3 Receiving Environment

A Social Impact Assessment (SIA) was undertaken to identify the key social risks, opportunities, and impacts that may occur as a result of the Proposal (Attachment 2T). The SIA process involved three main steps:

- Social Scan – a high level review of the social characteristics, trends, and emerging issues within the potentially affected communities.
- Social Risk Rating– identification and ranking of the potential social risks and impacts on communities and the development of mitigation measures for each identified significant social risk or impact as well as opportunity realisation.
- Social Impact Assessment – assessment and discussion of the significance of potential social impacts (positive or negative) and recommended management measures.

The following sections describe the outcomes of the SIA.

#### 5.9.3.1 Regional Surroundings

A limited number of publicly available social surroundings studies have been undertaken within the region, as outlined in Table 5-47. Subsea 7 has augmented the information available by commissioning additional, Proposal-specific studies – to ensure an appropriate level of information is available to support the completion of the environmental impact assessment and mitigation measures. The Proposal-specific studies, as listed in Table 5-47, were undertaken by various technical specialists, and are included in full within Attachment 2.

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| Regional Studies | | |
| 1993 | Martinick and Associates | Aboriginal site survey Learmonth area |
| 2000 | Morse, K. & Jackson, G. | An aboriginal archaeological assessment of Cape Seafarms' proposed prawn farm development, Heron Point, Cape Range Peninsula. |
| 2008 | Cooperative Research Centre for Sustainable Tourism. | Socio-economic impacts of sanctuary zone changes in Ningaloo Marine Park. |
| Proposal-specific Studies | | |
| 2018 | SJC Heritage Consultant | Aboriginal Heritage Survey – Proposed Monitoring Bores |
| 2019 | 360 Environmental | Landscape Visual Impact Assessment |
| 2019 | 360 Environmental | Social Impact Assessment |
| 2019 | ACIL Allen Consulting | Economic Impact of Learmonth Fabrication Facility |
| 2019 | SJC Heritage Consultants Pty Ltd | Aboriginal Heritage Survey – Project Envelope |

Table 5-47: Overview of Local and Regional Studies relating to Social Surroundings

The Learmonth Fabrication Facility is located 35 km south of Exmouth, in the Shire of Exmouth local government area within the Gascoyne region of WA (Figure 5-51). The Gascoyne region covers an area of approximately 138,000 $km^2$ representing about 5.5% of the state of WA (DPIRD 2019). The Gascoyne is made up of four local government areas – Carnarvon, Exmouth, Shark Bay, and Upper Gascoyne. The Gascoyne is known as WA's food bowl with 84% of the land covered by Pastoral Leases and home to WA's biggest prawn fishery in Shark Bay (DPIRD & Gascoyne Development Commission [GDC] 2018).

In 2016, the Gascoyne population was 9,485; the lowest estimated resident population of all the regions in WA (ABS 2016b, GDC 2017). Of the population, 52.7% were male and 47.3% were female. Aboriginal and/or Torres Strait Islander people made up 13.4% of the population, which is significantly higher than the indigenous representation on a statewide basis (3.1%).

Most of the Gascoyne working population is employed in accommodation (primarily tourism-related), followed by supermarket and grocery stores, local government and hospitals (ABS 2016b). Other employing industries include tourism, fishing, mining, horticulture and pastoralism. Opportunities are being created for fly-in fly-out mining jobs from Carnarvon to the West Pilbara as well as indigenous and eco-tourism in inland and coastal areas of the Gascoyne (GDC 2019b). There is a labour shortage in the majority of the industries in the Gascoyne including seasonal workers for the horticultural, fishing and tourism industries and qualified tradespersons for small businesses (GDC 2019b).

The Gascoyne economy is supported by the tourism, mining, agriculture and construction industries; with tourism contributing the largest to the region's economy (DPIRD & GDC 2018). The Gascoyne Development Commission (GDC) aims to expand the tourism industry through investment in eco-tourism (flora and fauna, geology, fossils, artesian hot springs, bird watching), adventure tourism (scuba diving, surfing, hiking, four-wheel driving), cruise shipping, fishing and station stays.

Pastoralism is the predominant land use in the Gascoyne region, contributing to 2% of the State's gross total domestic product and 27% of the region's income (GDC 2019b). The Gascoyne's physical location gives it a comparative advantage – being adjacent to major mineral and energy regions, offshore oil and gas fields and associated investment pipelines as well as proximal to Asia. According to the GDC (2018), Exmouth has been an important hub for oil and gas production in the Carnarvon Basin, leading to migration-based population growth and rising incomes at a faster rate than the rest of the region. This has been realised as an investment opportunity for long-term development of mineral and energy resources in the Gascoyne. Key outcomes and priorities for the region identified by the GDC's *Gascoyne Regional Development Plan 20120-2020* include establishment of new industries and services, continued expansion of the tourism industry, a skilled Gascoyne community and a diversified and expanded mining industry (GDC 2010).

The large Gascoyne coastline attracts about 11% of the State's recreational fishers and supports three major fishing competitions including Gamex in Exmouth, Shark Bay Fishing Fiesta and Carnar-fin in Carnavon (GDC 2019b). Sport plays a significant part of the Gascoyne community with over 140 sporting clubs and recreational facilities in the region. Motorsports such as the Gascoyne Dash desert enduro race and the Carnarvon Speedway Club attract many locals and visitors to racing events.

The Shire of Exmouth covers an area of 650,300 ha. Over the past decade the population within the Shire of Exmouth has increased by approximately 32% (2,063 persons in 2006 to 2,728 in 2016) (ABS 2006; 2016a). Every year, during the cooler winter months (May – August), the population in Exmouth triples due to short-term or seasonal visitors (Shire of Exmouth 2018).

The highest employing industries in Exmouth are accommodation, light engineering and construction. Tourism has now become the largest industry and major economic contributor in the Shire with hospitality, accommodation and retail also accounting for a large proportion of Exmouth's economy and job market (SGS Economics & Planning [SGS] 2012, ABS 2016a). Other key industries include fishing, aquaculture, pastoralism and mining. A key finding from the public consultation process in the Shire of Exmouth's Strategic Community Plan 2030 was the need for greater full-time employment opportunities. Additionally, the community would like to see in the next ten years a stronger and more diverse local economy enabling year-long employment opportunities (Shire of Exmouth 2018). The Social Impact Assessment undertaken for the Proposal provides a more detailed social setting (Attachment 2T).


Scale:1:3,600,000
Original Size: A4
Aerial Photo: ESRI
Grid: GDA 94/ MGA Zone 50

Notes: Data sourced from Subsea 7 (2018)

Subsea 7 Pipeline Fabrication Facility

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Figure 5-51
Gascoyne Regional Area

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#### 5.9.3.2 Natural and Historical Heritage

The Exmouth region's history is embedded in defence and pastoralism. Dutch sailors made the first recorded landing on the Ningaloo Coast in 1618 near the tip of the North West Cape. Since then, pearl farmers visited the region from Broome and a number of pastoralists operated sheep stations along the coastline.

In the early 1940s the United States (US) Navy established a submarine base under the code name Operation Potshot which soon became a refuelling facility for submarines. Operation Potshot included the establishment of a landing field on the western shore of Exmouth Gulf. In the 1950s, this became the RAAF Learmonth. The Potshot Monument has now been established as a historical attraction (Ningaloo Visitors Centre 2018a). In 1963, an agreement between the United States (US) and Australian government lead to the establishment of the Harold E. Holt Very Low Frequency (VLF) communication station at the tip of the North West Cape. As a result, the town of Exmouth was established to support the operations of the facility. In 1992 the US and Australian defence force military presence was withdrawn. This triggered the development of Exmouth and Ningaloo Coast as an eco-tourism destination, with tourism still being the largest driver of the Shire's economy (Ningaloo Visitor Centre 2018a).

Other historical attractions within the Shire include the Solar Observatory, the Navy Pier, the Wreck of SS Mildura (a cattle ship from the Kimberley region wrecked during a cyclone in 1907), and the Vlamingh Head Lighthouse.

<u>World Heritage – Ningaloo Coast World Heritage Area</u>

The Ningaloo Coast World Heritage Area (WHA) (Reference 1369) was inscribed on the World Heritage List on 1 November 2011 under criteria (vii) and (x), as follows:

- Criterion (vii): contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
- Criterion (x): contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation (DEWHA 2010).

The adopted boundary of the World Heritage Property (or World Heritage Area (WHA)) (604,500 ha) excludes all areas under Pastoral Lease but includes the Ningaloo Marine Park (Commonwealth Waters), Ningaloo Marine Park (State Waters) and Muiron Islands Marine Management Area (including the Muiron Islands), Jurabi Coastal Park, Bundegi Coastal Park, Cape Range National Park and Learmonth Air Weapons Range (Figure 2-11, Figure 2-12). Ningaloo is recognised for the outstanding value of the area's diverse and abundant marine life, unique cave fauna and the contrast between the rugged landscapes of the Cape Range and the serene seascapes (United Nations Educational, Scientific and Cultural Organisation [UNESCO] 2019). The Learmonth Pipeline Fabrication Facility is located outside the WHA. The proposed tow route intersects the WHA near the North West Cape and the fabrication facility and Bundle tow route would be visible from some locations in the WHA.

Together the landscape and seascape of the WHA include mostly intact and large-scale marine, coastal and terrestrial environments. The site supports rare and large collections of Whale sharks (*Rhincodon typus*) along with important aggregations of other fish species and marine mega fauna, including turtles (UNESCO 2019). The marine environment of the WHA supports a diversity of habitats including lagoons, mangroves, reef, ocean and continental shelf. Additionally, Ningaloo reef boasts more than 300 documented coral species; over 700 reef fish species; roughly 650 mollusc species; around 600 crustacean species; more than

1,000 species of marine algae; 155 sponge species; and 25 new species of echinoderms (UNESCO 2019).

The terrestrial environment of Ningaloo supports rare cave systems providing habitat for a diversity of subterranean fauna, which is noteworthy on a global scale. The vegetation complexes in the region provides habitat for a range of flora and fauna with notable reptiles and vascular plants in the drylands (UNESCO 2019).

National Heritage – The Ningaloo Coast National Heritage Place

Ningaloo was listed on the Australian National Heritage List due to its extraordinary natural qualities and Indigenous significance. Listed heritage places are protected under the EPBC Act.

The Ningaloo Coast National Heritage Place covers approximately 710,000 ha, comprising Ningaloo Marine Park, Muiron Islands Marine Management Area (including the Muiron Islands), Jurabi Coastal Park, Bundegi Coastal Park, Cape Range National Park, Learmonth Air Weapons Range and portions of Exmouth, Ningaloo, Cardabia, Warroora, Gnaraloo and Quobba Pastoral Leases (Figure 2-11, Figure 2-12) (DoEE 2019a). Tenure includes government-owned land and conservation reserves (including Department of Defence land and Commonwealth and state marine and terrestrial protected areas), Commonwealth Heritage listed places, areas subject to Native Title claims, exploration and Pastoral Leases, and freehold land.

The official values of the Ningaloo Coast National Heritage Place are listed in Table 5-48 below.

| Natural Values | Indigenous Values |
|---|---|
| Criterion A: Events, Processes | |
| Demonstrating late Quaternary deformation at a passive continental margin, the uplifted Neogene wave-cut terraces and fossil reefs which fringe Exmouth Peninsula and the submerged fossil reef terraces which form the substrate of the modern reef, in immediate juxtaposition with the undeformed modern Ningaloo Reef, and late Pleistocene Tantabiddi terrace, have outstanding heritage value to the nation under criterion (a) for their contribution to understanding mechanisms which led to the modern character of the west coast of Australia (van de Graaff *et al*. 1976, Veeh *et al*. 1979, Stirling *et al*. 1998).<br><br>The story of Australia during the Neogene period (beginning about 25 million years ago) is a story of increasing post-Gondwanan isolation and the expansion of aridity. The subterranean faunas and rangeland communities of Exmouth Peninsula exemplify both these evolutionary drivers and accentuate the intimate ties between ecology and geological history more vividly than any | Elsewhere in Australia records of early human occupation have been drowned with the post-glacial return of the sea over the broad coastal areas exposed during the last glacial maximum. Exmouth Peninsula's proximity to the continental shelf during the harsh climatic conditions of the last ice age, when sea levels were lower, means that Cape Range was never far from marine resources (Morse 1993c).<br><br>Archaeological deposits in the rock shelters on Cape Range show Aboriginal people had a comprehensive and sophisticated knowledge of edible and non-edible marine resources between 35,000 and 17,000 years BP (Morse 1993a, Przywolnik, 2005). The rock shelters of Exmouth peninsula have outstanding heritage value to the nation under criterion (a) because they provide the best evidence in Australia for the use of marine resources during the Pleistocene including their uses as food and for |

| Natural Values | Indigenous Values |
|---|---|
| other place in Australia. Demonstrating speciation and adaptation since the break up of the supercontinent Gondwana and the opening of the ancient Tethys sea more than 250 million years ago, the expansion of aridity in Australia and continued biogeographic isolation during the Quaternary (the last 2.6 million years), the subterranean and terrestrial ecosystems of Exmouth Peninsula help translate a complicated biogeographical story. These communities have outstanding heritage value to the nation under criterion (a) for their importance in demonstrating the pattern of Australia's natural history (Humphreys and Collis 1990, Kendrick 1993, Jaume *et al*. 2001, Russell 2004, Humphreys 2006, Spate 2006). | personal adornment. |
| Criterion B: Rarity | |
| The taxonomic composition of the anchialine community of Bundera Sinkhole, while characteristic of remipede communities, is unique in the southern hemisphere and Indo-West Pacific. Bundera Sinkhole is outstanding for its unique anchialine community, reflecting its unusual hydrology, geological history, and stable environment over thousands of millennia.<br><br>The presence of active karst solution as a result of seawater incursion is rare in Australia. The Ningaloo Coast is one of the best examples in Australia of this globally significant process (Gillieson *et al*. 2006). As the only example in Australia of a Tertiary orogenic karst and a rare example of active marine karst solution, the Ningaloo Coast contains rare aspects of Australia's natural history. | None |
| Criterion C: Research | |
| Anchialine and groundwater ecosystems are of considerable scientific interest globally, yielding important information about the evolution of life on earth. The Exmouth Peninsula subterranean estuary has outstanding heritage value to the nation for supporting the most diverse and the richest anchialine and groundwater fauna in Australia, among the richest in the world. These ecosystems and the troglobites and stygofauna they support have the potential to yield information about biogeography, evolution and changing climates in Australia | Research on the freshwater subterranean fauna of the Ningaloo Coast (Humphreys and Adams 1991, Poore and Humphreys 1992) suggests that even in times of greater aridity than the present day semi-desert terrestrial environment, freshwater may have been widely available across the emergent coastal plain bordering Cape Range. The steep topography of Cape Range has protected Pleistocene occupation sites from the destructive effects of rising sea levels; while the alkaline environment of the |

| Natural Values | Indigenous Values |
|---|---|
| over hundreds of millions of years, from the late Palaeozoic to the present (AHDB 2002, Humphreys and Danielopol 2005, Humphreys 2006, Spate 2006). | limestone geology has acted to preserve archaeological evidence of human occupation.<br><br>Given that only a handful of the caves and rock shelters of the Exmouth Peninsula region has been investigated (O'Connor 2007) the place has outstanding heritage value to the nation under criterion (c) because of its potential to provide further insights into marine resource use by Aboriginal people in the Pleistocene and the less well understood last glacial maximum. |
| Criterion D: Principal characteristics of a class of places | |
| Biologically unique in the southern hemisphere and the Indo-Pacific region, characteristic of the remipede crustacean-type of anchialine community, the Ningaloo Coast has outstanding heritage value to the nation under criterion (d) for demonstrating the principal characteristics of a Tertiary karst environment in Australia, including a high concentration of karst features and subterranean ecosystems of global importance, unparalleled in Australia (Humphreys 2006, Spate 2006).<br><br>The integration of the Ningaloo Reef and Exmouth Peninsula karst system as a cohesive limestone structure is at the heart of the natural heritage significance of the Ningaloo Coast. The modern Ningaloo Reef, Exmouth Peninsula karst, and the wave-cut terraces, limestone plains, Pleistocene reef sediments of Exmouth Peninsula and associated marine, terrestrial and subterranean ecosystems, including the Muiron Islands, have outstanding heritage value to the nation under criterion (d) for demonstrating a geological, hydrological and ecological unity which harmonises the region's present ecosystem functions with its evolutionary history as a time-series of coral reefs and an evolving karst system (Carter 1987, Allen 1993, Wyrwoll *et al*. 1993, Hamilton-Smith *et al*. 1998, EPA 1999, Humphreys 2006, Spate 2006). | None |

| Natural Values | Indigenous Values |
|---|---|
| Criterion F: Creative or technical achievement | |
| None | The evidence for standardisation in size and manufacture of the shell beads found at Mandu Mandu Creek rock shelter, coupled with the fact they provide the earliest unequivocal evidence for the creation of personal ornaments in Australia, demonstrates a high degree of creative and technical achievement. On this basis, Exmouth Peninsula and the shell beads that were found in association with the place have outstanding heritage value to the nation under criterion (f). |

Table 5-48: Official Values of the Ningaloo Coast (Commonwealth of Australia 2010)

#### 5.9.3.3 Aboriginal Heritage and Culture

In Australia the *Native Title Act 1993* and Aboriginal and Torres Strait Islander Heritage Protection Act 1984 provide for the recognition and protection of native title rights of Aboriginal people who have maintained a traditional connection to their land and waterways since sovereignty. One registered Native Title claim exists across the Site: Gnulli WC1997/028 (DAA 2019). This Native Title claim covers approximately 82,708 km$^2$ of land and sea in the Yamatji Region.

In Western Australia, *the Aboriginal Heritage Act 1972 (*AH Act 1972*)* protects places and objects customarily used by, or traditional to, the original habitants of Australia. A register of such places and objects is maintained under the Act however all sites are protected under the Act whether they are registered or not.

The Exmouth Peninsula provides important insight into the early indigenous inhabitants of the region. Many records of early human inhabitants in parts of Australia have been drowned due to the post-glacial return of the sea over the broad coastal areas that were once exposed during the last glacial maximum around 25,000 years ago (DoEE 2019a). However, Exmouth's close proximity to the continental shelf during the harsh conditions of the last ice age meant that it was always near to marine resources. Additionally, the steep landscape of the Cape Range protected ancient sites from rising sea levels and the limestone geology has preserved historical evidence from otherwise acidic environments (DoEE 2019a). Archaeological deposits in the rock shelters of the Cape Range demonstrate Aboriginal people had a comprehensive understanding and knowledge of edible and non-edible marine resources between 35,000 and 17,000 years ago (DoEE 2019a). The rock shelters of Exmouth peninsula also provide the best evidence in Australia for the use of marine resources during the Pleistocene, including their uses as food and for personal adornment (DoEE 2019a). Shell beads found at Mandu Mandu Gorge provide the earliest evidence of creation and personal ornaments in Australia, and shows significant creative and technical achievement (DoEE 2019a).

The Gnulli Native Title Claim stretches from Wooramel River to North West Cape and Exmouth Gulf, and is comprised of three groups – the Ingaarda-Teddei, the Baiyungu and the Thalanyji peoples (SJC Consultants 2019). Anthropologists place the Ingaarda-Teddei, as occupying land south of the Gascoyne River and the Baiyungu and Thalanyji peoples living north of the Gascoyne. Several historical accounts (e.g. Steffano Manuscript) of the region provide an indication of the ways of life for the three indigenous inhabitant groups of the North West Cape (SJC Consultant 2019). Their staple diet being fish caught by the men, using nets (made from grass trees) or spears and sometimes using stone-walled tidal traps. Women foraged for various plant foods and seeds and were responsible for collecting water (carried in wooden bowls and large sea shells) and firewood. Their diets were supplemented by turtles (mainly eggs) and shellfish, and very occasionally dugong (SJC Consultant 2019). Anthropological accounts of the North West Cape peninsula told of 'coast-frequenting people', venturing out to sea on rafts of mangrove sticks and living amongst mangroves on the eastern shore of the Gulf (SJC Consultant 2019).

Department of Planning, Lands and Heritage (DPLH) records show two previous heritage surveys have been carried out in the vicinity of Heron Point; Martinick (1993) and Morse and Jackson (2001). The Martinick (1993) survey covered the proposed footprint for a similar pipeline fabrication project, located to the north and east of the Development Envelope. The Morse and Jackson (2001) survey examined the site of the Cape Seafarms Project between Wapet Creek and Point Heron.

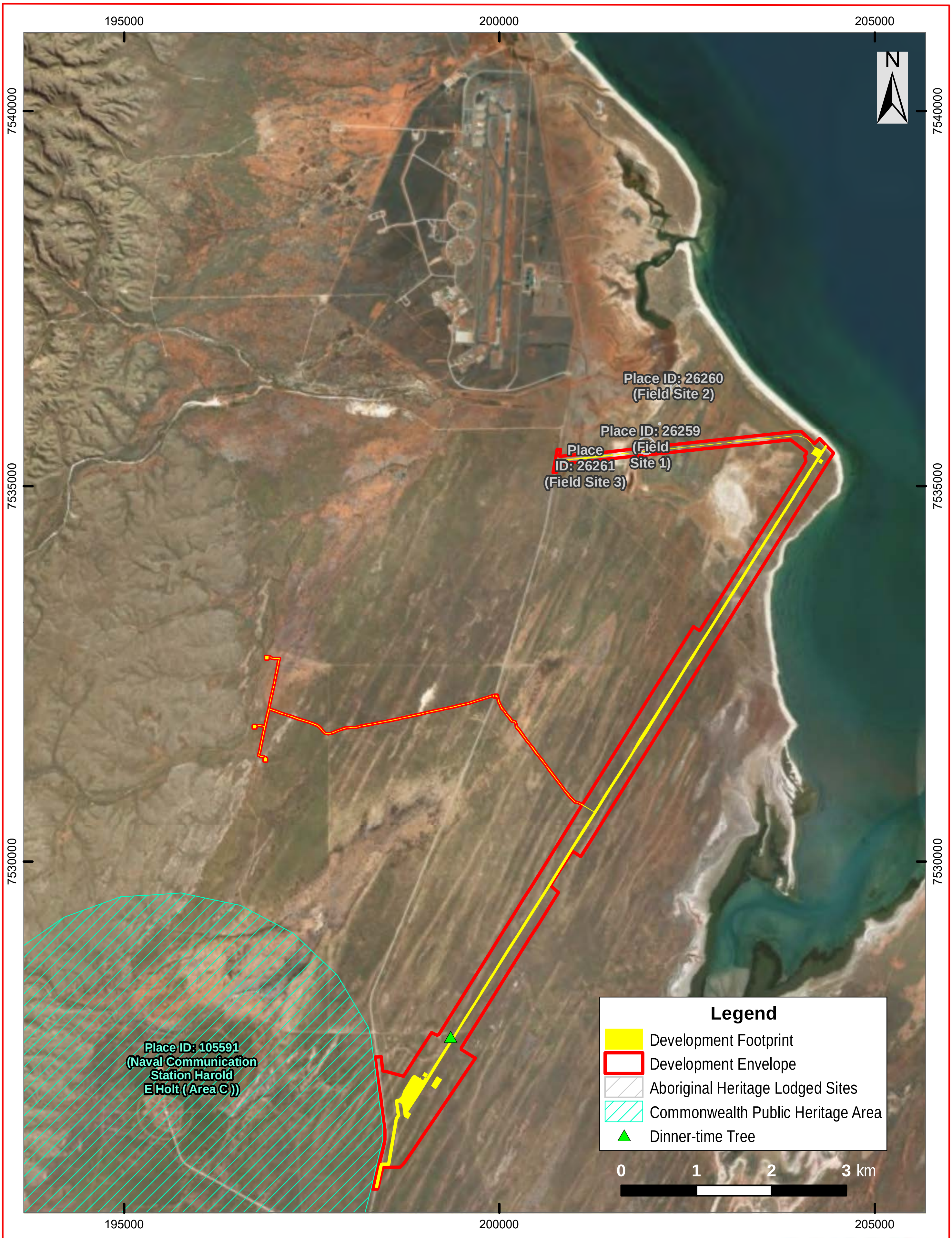
A desktop review of the DPLH Aboriginal Heritage Inquiry System (AHIS) identified no Registered Aboriginal sites and 4 lodged Aboriginal Sites partially within or adjacent to the Development Envelope (Table 5-52) (Figure 5-52) (DAA 2019).

| Site ID | Name | Status | Type | Distance from Site |
|---|---|---|---|---|
| 26259 | Field Site 1 | Lodged | Artefacts/Scatter, Shell | Partially within extent of the Site |
| 26260 | Field Site 2 | Lodged | Artefacts/Scatter, Shell | 687m |
| 26268 | CSF Isolated Find | Lodged | Other: 3 Isolated artefacts | 280m |
| 26261 | Field Site 3 | Lodged | Artefacts/Scatter, Shell | 20m |

Table 5-49: Registered Aboriginal Heritage Sites

Subsea 7 has had ongoing engagement with the Yamatji Marlpa Aboriginal Corporation (YMAC), acting for the Gnulli Native Title Claim Group (Gnulli NTCG) throughout the development of the Proposal. On 12 December 2017 Subsea 7 obtained an Infrastructure Heritage Agreement with YMAC, acting for the Gnulli NTCG. The agreement sets out the process for managing potential impacts on heritage as a result of the implementation of the Proposal (SJC Consultants 2019). In accordance with the agreement, two Aboriginal heritage surveys were undertaken for sites of archaeological and ethnographic significance, with representatives of the Gnulli NTCG. The first survey was undertaken in March 2018 for the purposes of the groundwater and stygofauna monitoring bore network. No sites of archaeological significance were recorded by the heritage survey team (SJC Consultants 2019). The heritage survey team also identified concerns regarding dust management and reiterated the importance of staged and minimal clearing (Steve Corsini pers comm. 2019).

The second Aboriginal heritage survey took place in early February 2019, surveying the Development Envelope and including a discussion of associated Proposal activities. No archaeological or ethnographical sites, as defined under Section 5(a), (b) or (c) of the AH Act 1972, were recorded within the Development Envelope (SJC Consultants 2019).

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Aerial Photo: ESRI
Grid: GDA 94/ MGA Zone 50

Notes: Data sourced from Subsea 7 (2019), DPLH (2019)

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Figure 5-52:Heritage

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The area is said to be important as a breeding and nesting area for Emus, and several varieties of edible plant foods occur in the region, though none were recorded during the heritage surveys (Steve Corsini pers comm. 2019).

The Heritage Survey team identified several matters for consideration during operations (Steve Corsini pers comm. 2019):

- The possibility of artefacts to emerge in the more mobile soils once clearing works commence allowing wind to blow sand away.
- Maintaining public access to Heron Point.
- Maintaining public access to the Bay of Rest lagoon.
- Impacts to terrestrial wildlife, particularly Emus, due to habitat loss or restriction of movement due to fences.
- Potential impacts on marine life.

Additionally, a tree, identified as the 'Dinner Time Tree' within the Development Envelope, was noted as having cultural importance for the group and requested that it not be disturbed (Figure 5-52). Subsea 7 has marked the location of the tree and will ensure it is not disturbed.

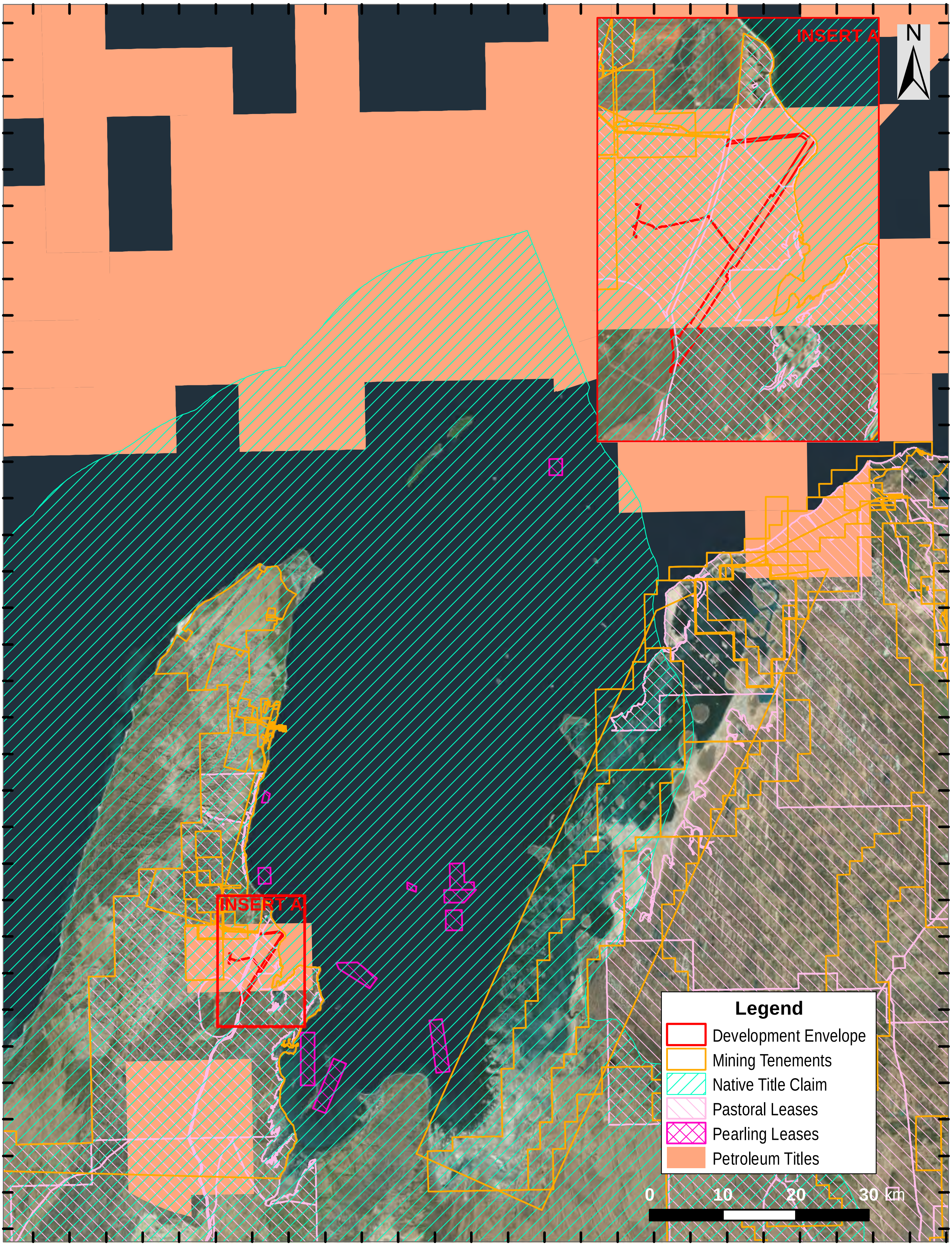
#### 5.9.3.4 Local Surroundings

The Development Envelope is located within Lots 233 and 1586 within the Shire of Exmouth Local Government Area and is approximately 35 km south of the Exmouth Townsite. The Site is positioned on the eastern side of the Minilya-Exmouth Road, with direct access to the Exmouth Gulf and in proximity to the Bay of Rest.

The Development Envelope is located on Crown Land and is subject to the 'Exmouth Gulf' Pastoral Lease, which has a term of 39 years, 3 months, 1 day that commenced on 1 July 2015. The Exmouth Gulf Pastoral Lease underlies Lots 233 and 1586. Subsea 7 has engaged with the Pastoral Lease holder of the Exmouth Gulf Station and a Land Use Agreement has been signed and is valid for the term of the Pastoral Lease.

There are no sensitive receptors in proximity to the Development Envelope. The Exmouth Gulf Station homestead is 5 km south east of the fabrication shed and the Minilya-Exmouth Road is approximately 500 m to the west.

The Proposal will include the construction of a Bundle launchway (380 m long x 15 m wide), crossing the beach and extending into the shallow subtidal zone at Heron Point. The community has reported that this general area is used for recreational four-wheel driving, camping and fishing via various access tracks across the Exmouth Gulf Station. Heron Point and its immediate surrounds is not a gazetted or a Shire approved camping site.

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Aerial Photo: ESRI
Grid: GDA 94/ MGA Zone 50

Notes: Data sourced from Subsea 7 (2019), DPIRD (2018), Commonwealth of Australia (2018), DMIRS (2018)

Subsea 7 Pipeline Fabrication Facility

Figure 5-53: Land Tenure

A number of marine activities are currently undertaken in Exmouth Gulf including commercial fishing, Humpback whale and Whale shark based tourism, recreational boating and fishing, aquaculture and diving. Since the Ningaloo Coast was inscribed into the World Heritage listings and access to the region improved, tourism has become the largest industry in the Shire. Eco-tourism is expected to experience significant growth (Shire of Exmouth 2018).

#### 5.9.3.5 Land and Recreation Uses and Amenity Values

The Exmouth region is located within the Western Australian Planning Commission's (WAPC) Gascoyne Planning Region (Figure 5-51) and is subject to the strategic regional land-use plan – *The Ningaloo Coast Regional Strategy Carnarvon to Exmouth* (WAPC 2004) (Ningaloo Coast Regional Strategy).

Exmouth is the gateway to the Ningaloo World Heritage Area, including the Ningaloo Marine Park and Cape Range National Park. The town is situated in the disparity between the flat, low lying Exmouth Gulf coast and the steep topography of the Cape Range. The landscape provides quality scenic values and an array of outdoor activities including fishing, boating, scuba-diving, swimming, whale-watching, camping, hiking, and four-wheel driving.

The LVIA characterises the landscape, recreational and amenity values of the area (Attachment 2S). The SIA describes the social environment (Attachment 2T).

<u>Topography, Soil, and Vegetation</u>

The Proposal is located in the Cape Range subregion of the Carnarvon Bioregion. The Cape Range forms part of the Exmouth peninsula with a rugged topography. The Range is bordered on the west site by the Indian Ocean and a narrow continental shelf that developed the Ningaloo fringing reef; the eastern side is the shallow Exmouth Gulf. The Proposal site itself is relatively flat to gently sloping with the elevation ranging from approximately 25 m Australian Height Datum (AHD) inland to 0 m AHD to the coast, sloping from the south west to the north east (GHD 2017a). A drainage line runs through the south west of the Development Envelope near the proposed fabrication shed.

The Carnarvon bioregion is composed of quaternary alluvial, aeolian, and marine sediments overlying Cretaceous strata. Cape Range forms the northern part of the Carnarvon Basin with rugged tertiary limestone ranges and extensive areas of red aeolian dunefield (CALM 2002). Vegetation comprises *Triodia* (spinifex) hummock grasslands with sparse Eucalyptus trees and shrubs; tidal mudflats in sheltered bays of Exmouth Gulf support extensive mangroves; beach dunes with Spinifex communities and an extensive mosaic of saline alluvial plains with samphire and saltbush low shrublands along the eastern side of the Gulf (DPaW 2002). The vegetation surveyed across the Proposal's development envelope is typical of the Carnarvon bioregion and consists mostly *Acacia gregorii* low open shrubland over *Triodia epactia* closed grassland (Attachment 2L).

The site comprises various pastoral access tracks and previously cleared areas in the northern sections as a result of the Cape Seafarms Project (refer Section 2.5.8.4). The launchway component of the Proposal crosses the beach interface at Heron Point and operations will extend into the Exmouth Gulf.

Landforms

Landforms and landscape character units across the region were characterised and assessed (Attachment 2S). Unlike a Landscape Character Unit (LCU), a Land System is a classification system that excludes land uses and other human activities. The Land Systems that make up the majority of the region are the Range and Cardabia systems (DAFWA 2012), consisting of Hills/Ranges and Plains. Landforms in the region can be grouped by the following dominant landform types:

- Hills and Ranges (45.78%).
- Dunes (23.81%).
- Flats (13.62%).
- Plains (16.19%).
- Slopes and Plains (0.6%).

The Development Envelope is located in the Dune landform (Cardabia System) (Attachment 2L).

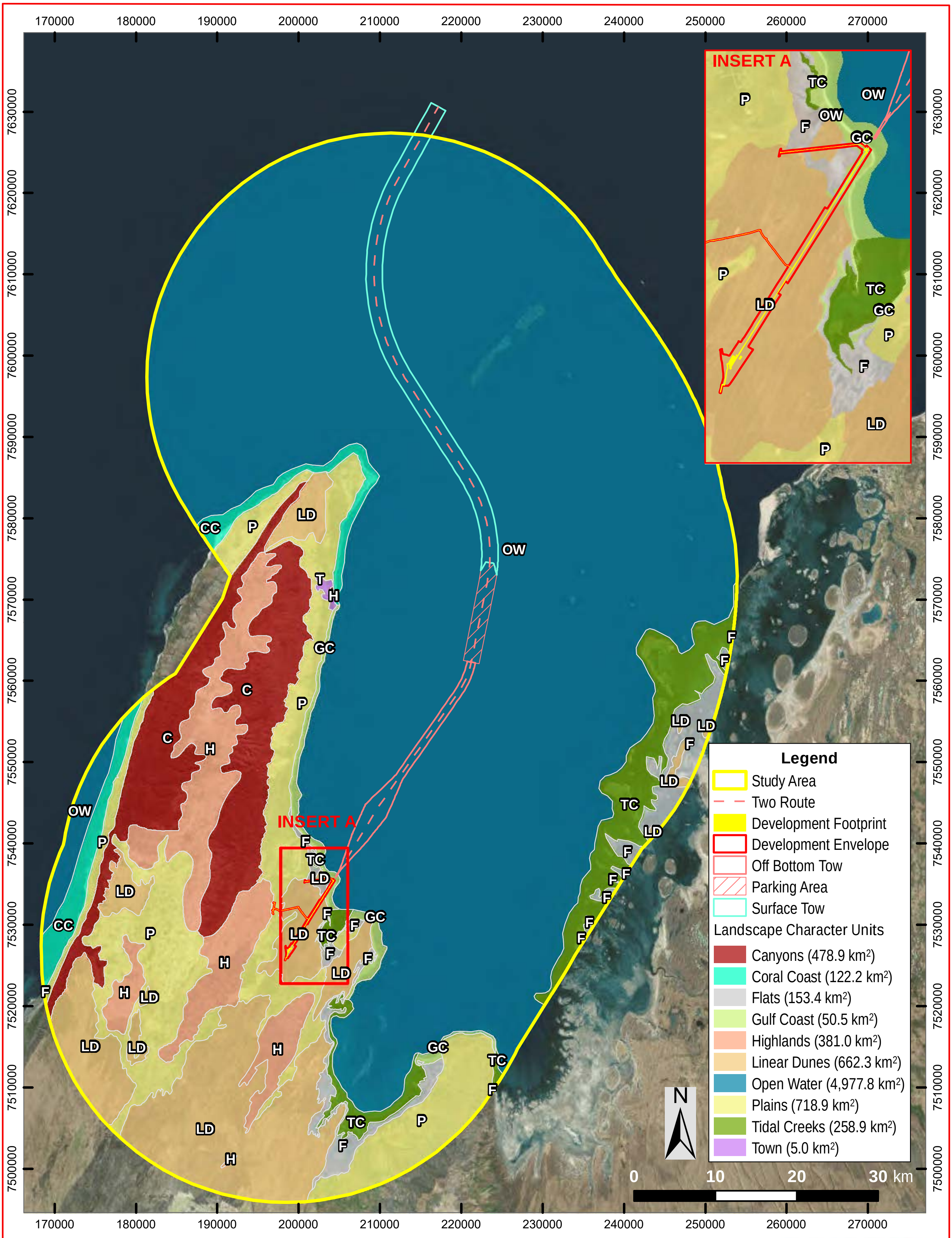
Landscape Character Units

Landscape Character is typically defined by the combination of physical/environmental elements and aesthetic elements and socio-cultural elements. While it is possible to define the former using data available on soil, geology, vegetation etc., the latter can only be defined through consultation and first-hand experience. Previous landscape and seascape assessments carried out in the area were also used to help define landscape character of coastal and marine areas (Heap *et al.* 2011).

The assessment of landscape character included visiting sites of valued places and sensitive receptors (identified using stakeholder engagement, guidance from the EPA, and Exmouth tourist information). A total of 10 Landscape Character Units (LCU) were identified:

- Canyon (16.9%).
- Coral Coast (4.3%).
- Flats (5.4%).
- Gulf Coast (1.8%).
- Highlands (13.5%).
- Linear Dune (23.4%).
- Plains (25.4%).
- Tidal Creek (9.1%).
- Town (0.2%).
- Open Water (beyond nearshore zone).

The distribution of these LCUs is illustrated in Figure 5-54. Detailed descriptions of each LCU can be found in the LVIA study report (Attachment 2S).

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Original Size: A4
Aerial Photo: ESRI
Grid: GDA 94/ MGA Zone 50

Notes: Data sourced from Subsea 7 (2018)

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-54
Landscape Character Units

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Scenic Quality Values

During the LCU assessment, a value of each landscape unit was allocated based on the rarity of the landscape and the combined environmental, social and cultural usage. The onshore Proposal area intersects four LCUs – Plains (low value), Linear Dunes (low value), Flats (moderate value) and Gulf Coast (high value). The offshore Proposal area intersects one LCU – Open Water (low value). The majority of the onshore Proposal Envelope is comprised of Linear Dunes, which is generally a low valued landscape and is not unique to the region (Attachment 2S).

The assessment of the visual impact of the Proposal from surrounding vantage points was also undertaken. Charles Knife Canyon lookout provides a viewing point for visitors and tourists to experience landscape views of the Canyon LCU (high value). The assessment showed that the Proposal Envelope was not visible from this location.

The Canyon LCU is in stark contrast to the Gulf Coast LCU which is described as low-lying, flat coastal scrubland, with soft dunes and clayey sandy beaches with muddy and or rocky reef and open water and cool colour palette (Attachment 2S). The Gulf Coast LCU has cultural values as a locally popular fishing and camping location and has a recreational land use. The Gulf Coast LCU is considered a high value landscape.

Amenity

No permanent sensitive receptors are located within 5 km of the onshore Development Envelope. The Exmouth Gulf Station Homestead is approximately 5 km to the south east. Whilst community engagement has indicated that Heron Point is used for recreational camping, four-wheel driving and fishing, it is not a gazetted camping area. Visitation to Heron Point is *ad hoc* and likely to be short-term. Activities of relevance to the Offshore Operations Area include recreational boating and fishing and charters (including fishing).

Current Land Uses and Tenure

The LVIA study area represents a combination of various land tenures. Most of the tenure is overlapping and is predominantly:

- Pastoral Lease (11.77%).
- Mining Tenements (16.65%).
- Petroleum Titles (31.68%).
- Conservation Estate – DBCA (14.64%).
- Conservation Estate – Commonwealth Marine Reserve (3.2%).
- Ningaloo Coast World Heritage Area (16.99%).
- Native Title Claim Area (76.87%).
- Offshore – Pearling Leases (0.79%).
- Offshore – Exmouth Gulf Prawn Fishery (23.9%).

The current land use of the Development Envelope is pastoralism. Surrounding land uses other than pastoralism include:

- Airfields/Defence (0.034%).
- Built Areas (Exmouth Town) (0.05%).
- Communications (0.017%).
- Conservation (17.9%).

- Extractive Industries (0.004%).
- Industrial (0.006%).
- Other (large private complexes) (0.002%).
- Main Roads (0.030%).
- Petroleum (363 wells).
- Commercial Prawn Trawling (15%).

Pastoralism

The primary land use within and surrounding the Development Envelope is currently pastoral. Pastoralism is the primary land use in the Gascoyne region with the industry being founded on wool, but pastoralists diversified their incomes through tourism, cattle, sheep, goats and horticulture (GDC 2010). The pastoral industry's production value in the Gascoyne was valued at $30 million in 2015 (GDC 2018).

Tourism

The Gascoyne region receives many visitors and tourism is the largest component of the industry. Tourism is Exmouth's major economic contributor with eco-tourism experiencing significant growth. Hospitality, accommodation and retail activity associated with tourism contribute significantly to the Shire's economy and job market. The seasonal nature of Exmouth's population fluctuates with the peak tourist seasons (peaking at 6000 people), with the town attracting a mix of intrastate, interstate and international visitors for holidays and recreational purposes (Shire of Exmouth 2016). The peak tourism season is March – October. Table 5-50 provides an estimate of the number of overnight visitors to the region (ABS 2016a).

| Overnight Visitor Origins for the North West Region | Average Annual Visitors (2015/16/17) | Percentage of Total |
|---|---|---|
| Estimated Visitors | | |
| Domestic Total | 110,800 | 79 |
| International Total | 28,900 | 21 |
| Total | 139,700 | 100 |
| Average Length of Stay (Estimated Nights) | | |
| Domestic | 7.9 | - |
| International | 5.0 | - |
| Total | 7.3 | - |

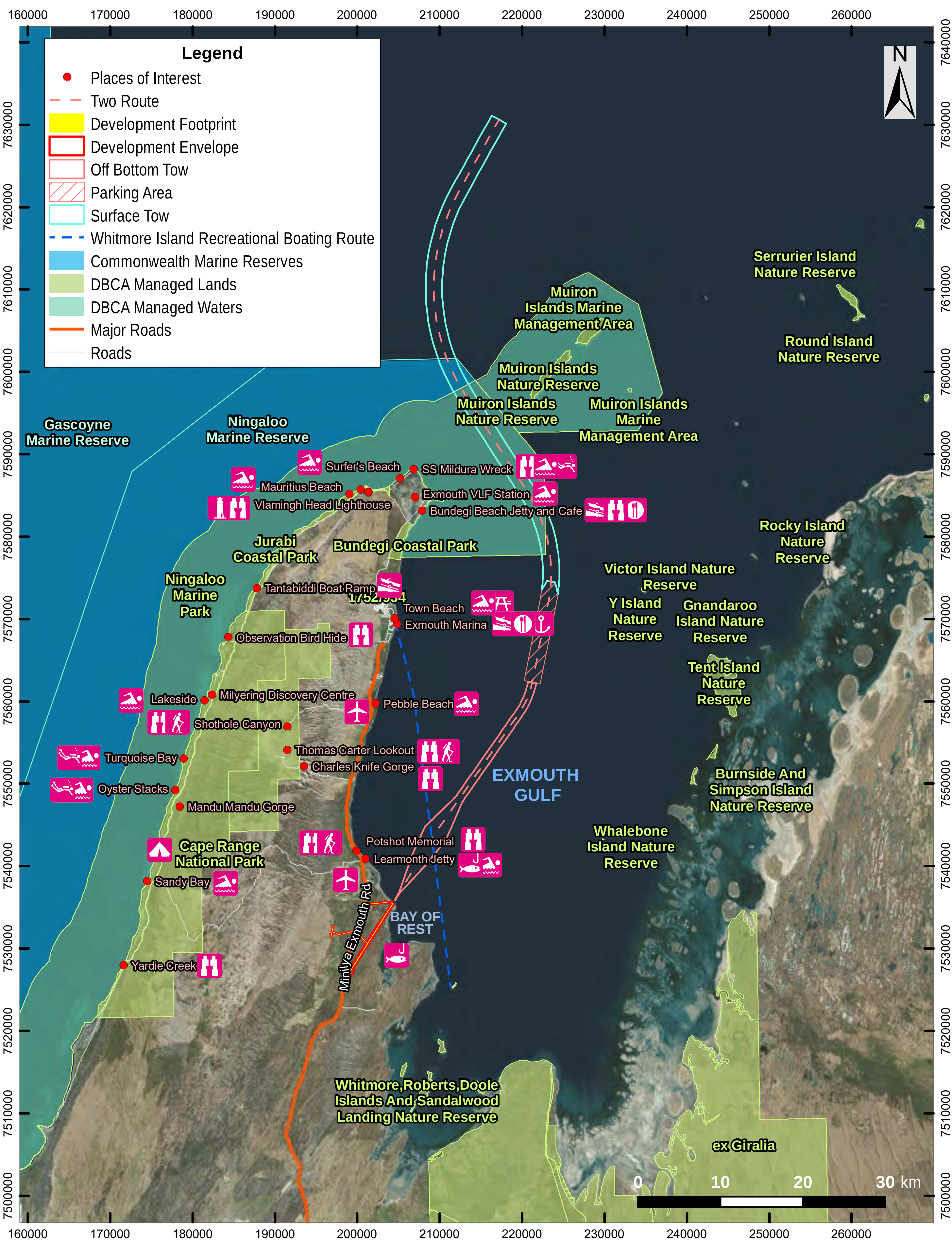
Table 5-50: Visitor Summary in the Shire of Exmouth (ABS 2016a)

Tourists and visitors are attracted to Exmouth region for the 'Ningaloo Experience', which is valued for its remote and self-sufficient recreational opportunities in undeveloped natural areas along the Ningaloo Coast and includes camping with minimal facilities (DBCA 2019). Other tourist attractions include swimming with Whale sharks and Humpback whales, scuba-diving, wildlife watching, boating, fishing, hiking, snorkelling, beach leisure, four-wheel driving, surfing, kayaking and sightseeing (Figure 5-55).

Whale sharks are one of the major attractions to Exmouth and the season runs from March to July each year. More recently, swimming with Humpback whales is an approved tourist attraction and has contributed to the extension of the tourist season and improved the viability of tour operator businesses (Tourism WA 2016). Some of the key diving locations within the Ningaloo Coast include the Exmouth Navy Pier, Muiron Islands, Lighthouse Bay sanctuary area, Bundegi Reef and locations along the Ningaloo Reef (Ningaloo Visitor Centre 2018b).

Recreational Use of Proposal Area

The Development Envelope overlies Exmouth Gulf Station. Stakeholder engagement sessions revealed that coastline of Heron Point is used for recreational camping and fishing. Though not a gazetted campsite, locals have been using this area for recreational purposes. The Offshore Operations Area traverses the Gulf and a small portion of the Ningaloo Marine Park and World Heritage Area. Boating, fishing, diving, whale-watching and snorkelling are popular recreational activities in Exmouth Gulf but are not understood to be focussed on areas within or adjacent to the Offshore Operations Area.

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Original Size: A4
Aerial Photo: ESRI
Grid: GDA 94/ MGA Zone 50

Notes: Data sourced from Subsea 7 (2018)

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-55
Recreational Values

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Defence

The defence industry plays an important role in Exmouth's economy with current facilities including the Learmonth Royal Australian Airforce (RAAF) Base, the Learmonth Solar Observatory, the Air Weapons Range, and the deep-water Navy fuel wharf/pier. The Shire has lease arrangements with the Commonwealth through to 2033 for the civilian terminal at the Learmonth RAAF Base Airport and the airport continues to be a significant economic driver for the tourism and business sectors, in addition to servicing the local community (Shire of Exmouth 2016).

The Shire has indicated its interest in the expansion of Defence operations in Exmouth as it would provide a critical mass of employment, population, and expenditure activity (Shire of Exmouth 2018).

Petroleum

Oil and gas production in the Shire is the largest mining activity in the region with the majority of oil production carried out on FPSO facilities (Gascoyne Development Commission [GDC] 2010). Full-scale oil and gas production in Exmouth began in 2006 with Woodside's Enfield FPSO project. The majority of these activities are carried out in Commonwealth waters and therefore the share of economic benefits is not captured in the Gascoyne's economy (GDC 2018a, ACIL Allen 2019).

Exmouth plays an important 'supporting services' role for the oil and gas sector though current supply chain inputs to major projects is limited. An expansion of supply chain opportunities and capture of a greater share of expenditure in the local economy would drive economic growth in the region (GDC 2018a).

Fishing and Aquaculture

Commercial fishing is regulated by the Department of Primary Industries and Regional Development (DPIRD), which maintain a district office in Exmouth to ensure sustainable stock and spawning levels. Commercial fishing within the Exmouth Gulf can be broken down into three main sectors; collector, charter, and commercial (refer Section 5.4.3.6).

Conservation

Conservation is the largest land use in the Exmouth region and conservation estate includes the Cape Range National Park (CRNP), Ningaloo Marine Park, Jurabi Coastal Park, Bundegi Coastal Park, Muiron Islands Management Area/Nature Reserve and other DBCA managed areas, including the previous Giralia pastoral area (Figure 2-11).

The Proposal area does not intersect any of the conservation areas other than the Ningaloo Marine Park. This area is also listed as the Ningaloo Coast on the National Heritage List. The Ningaloo Marine Park covers 263,343 ha and the Murion Islands Management Area covers 28,616 ha. The Management Plan (2005-2015) for this area was produced on behalf of the Marine Parks and Reserves Authority (MPRA), by the Department of Conservation and Land Management (CALM). The Management Plan outlines a set of management strategies to protect the marine plants and animals found in the region, as well as to ensure there is opportunity for sustainable recreational and commercial uses (CALM 2005). One of the key management strategies outlined is the protection of Social Values since the Ningaloo region has a rich cultural heritage including Indigenous heritage associated with Aboriginal occupation and maritime heritage associated with early European explorers. In this context, Social Values are defined as the major cultural, aesthetic, recreational and economic attributes of the area (CALM 2005).

The draft Nyinggulu (Ningaloo) coastal reserves joint management plan has been recently released which defines the planning and management of land that is considered the terrestrial portion of the Ningaloo Marine Park (a reserve 40 m landward of the high-water mark) and other lands. This plan outlines the current status and proposed management actions for a number of social values that were described in the Ningaloo Marine Park and Muiron Islands Marine Management Plan (CALM 2005).

A description of the Social Values described by the Ningaloo Marine Park and Muiron islands Management Plan and the overlap with the draft Nyingulu plan is provided in Table 5-51.

Future Land Uses of the Proposal Area

According to the Shire of Exmouth's *Local Planning Strategy 2012-2025* (LPS) a number of future land uses and zonings are being considered in the Exmouth area including residential, rural residential, industrial, tourism and restricted rural. Some of the future tourism zonings include short-stay tourism, tourism/residential, caravan and camping and wilderness camping investigation areas.

The Development Envelope is currently zoned as 'Rural' under the Shire of Exmouth Local Planning Scheme No. 4. Subsea 7 has submitted a scheme amendment application to the Shire of Exmouth, proposing to change the zoning to a Special Use Zone, to reflect the unique and very particular nature of the proposed pipeline fabrication facility. The application was accepted by the Shire on the 28 March 2019, and is proceeding through the planning process for assessment. The Site is located on Crown Land and is subject to the 'Exmouth Gulf' Pastoral Lease, which has a term of 39 years, 3 months, 1 day and commenced on 1 July 2015.

| Social Values | Management Measures Identified in the Ningaloo Marine Park and Muiron Islands Management Plan | Status of Implementation of Management Measures |
|---|---|---|
| **Indigenous heritage** | | |
| The area has significant Indigenous heritage value associated with historical and current use by indigenous people. | • To involve local Aboriginal community in the management of reserves.<br>• To protect Indigenous heritage sites in the reserves. | The Nyinggulu (Ningaloo) coast reserves draft joint management plan (2019) has been developed in consultation with the local Aboriginal community and outlines the role in the management of coastal reserves in the Ningaloo area. |
| **Maritime heritage** | | |
| Significant maritime heritage sites including numerous historic shipwrecks, the Vlamingh Head lighthouse and the whaling station in Norwegian Bay. | Human activities do not significantly impact historic sites in the reserves. | Human activities are not to impact maritime heritage in the reserves. The management of maritime heritage is managed by the Western Australian maritime museum. |
| **Seascapes** | | |
| Panoramic vistas of turquoise lagoon waters, reefs, beaches, breaking surf and the blue open ocean beyond the reef line are major attractions of the reserves. | To identify designated seascapes of the reserves and seek to minimise degradation of seascapes by coastal developments, island structures or marine infrastructure within the reserves. | The Nyinggulu (Ningaloo) coast reserves draft joint management plan (2019) outlines the management and proposed works for the Nyinggulu (Ningaloo) planning area. The criteria for the prioritisation of the site works include the protection of cultural values, management of risks to users, protection of natural values, level of visitor use of site and improvement of the visitor experience. Seascapes are yet to be designated. |

| Social Values | Management Measures Identified in the Ningaloo Marine Park and Muiron Islands Management Plan | Status of Implementation of Management Measures |
|---|---|---|
| **Wilderness** | | |
| Areas of secluded coastline and remote coastal waters offer opportunities for remote experiences that are integral to the Ningaloo experience. | To identify designated 'wilderness' areas of the reserves and manage the waters and adjacent coast so that these values are maintained. | The Nyinggulu (Ningaloo) coast reserves draft joint management plan (2019) outlines the management of the coastal and recreation reserves along the Nyinggulu (Ningaloo) planning area which covers the terrestrial portion of the Ningaloo Marine park, crown land and previous Pastoral Lease areas. It is proposed that the planning area will be managed in accordance with a visitors management setting criteria that includes Wilderness as a class. Wilderness areas are yet to be designated. |
| **Water Sports** | | |
| The pristine nature and diversity of the natural environment of the Ningaloo Reef and the Muiron and Sunday islands provide recreational opportunities for swimming, boating, snorkelling, scuba diving, free-diving, surfing, and other water sports. | • To ensure water sports are managed in a manner that is consistent with maintaining the ecological and social values of the reserves.<br>• To maintain the ecological and passive social values of the reserves that are important to recreational water sports.<br>• To manage recreational activities in a manner that minimises conflict between reserve users. | The Nyinggulu (Ningaloo) coast reserves draft joint management plan (2019) defines a number of strategies around visitor experience to appreciate and understand the cultural and natural values of the area. The plan recommends recreational planning is undertaken to address existing conflicts with the use of sites for water sports. Mooring plans and recreational master plans are in development. |
| **Marine nature-based tourism** | | |
| An unspoilt natural environment and easy access ensure significant opportunity for a variety of marine nature-based tourism activities. | • To ensure that marine nature-based tourism activities are managed in a manner that is consistent with maintaining the ecological and social | The Nyinggulu (Ningaloo) coast reserves draft joint management plan (2019) outlines the management of the coastal and recreation reserves along the Nyinggulu (Ningaloo) planning area. Tourism is managed through DBCA's commercial tour operation licensing system; all |

| Social Values | Management Measures Identified in the Ningaloo Marine Park and Muiron Islands Management Plan | Status of Implementation of Management Measures |
|---|---|---|
| | values of the reserves.<br>• To maintain the ecological and passive social values of the reserves that are important to the tourism industry.<br>• Cooperate with the industry to maintain a viable tourism industry in the reserves. | operators are licensed and depending on operations some are restricted in number, type and area of operation. |
| Coastal Use | | |
| Recreational use of headlands, dunes and long white beaches for walking, swimming, surfing and fishing is a major value of the reserves. | • To ensure that coastal uses are managed in a manner that is consistent with maintenance of the reserves' values.<br>• To maintain the ecological values of the reserves that are important for coastal use.<br>• To ensure management of the coastal portion of the Park is integrated with the management of adjacent coastal lands. | Ongoing |
| Recreational fishing | | |
| A diverse range of quality recreational fishing opportunities for local and visiting fishers targeting a variety of marine finfish and invertebrates. | • To ensure that, in collaboration with the DoF, recreational fishing in the reserves is managed in a manner that is consistent with maintaining the reserves' values.<br>• To maintain the ecological values of | Recreational fishing is managed through the designation of Sanctuary zones and fisheries legislation such as catch limits and minimum sizes. |

| Social Values | Management Measures Identified in the Ningaloo Marine Park and Muiron Islands Management Plan | Status of Implementation of Management Measures |
|---|---|---|
| | the reserves that are important to recreational fishing.<br>• Cooperate with the Department of Fisheries (now DPIRD) in maintaining quality recreational fishing opportunities in the reserves. | |
| Scientific research | | |
| A largely undisturbed coral reef environment together with shallow clear and protected waters provide unique opportunities for scientific studies. | • To promote the use of the reserves for social and ecological research.<br>• To ensure ecological and social research is ethical and ecologically sustainable.<br>• To maintain the ecological values of the reserves that are important for scientific research. | The Nyinggulu (Ningaloo) coast reserves draft joint management plan (2019) outlines a number of strategies for research and monitoring in the planning area. |
| Education | | |
| Easy access and the close proximity of the reef to Ningaloo shoreline provide unique opportunities for education about the marine environment. | To promote the use of the reserves for marine education opportunities. | The Nyinggulu (Ningaloo) coast reserves draft joint management plan (2019) outlines a number of management strategies with the objective of providing educational and interpretative information on the area. |
| Commercial fishing | | |
| A number of commercial fisheries operate in the reserves. | • To ensure that, in collaboration with the industry and DoF, commercial fishing activities in the reserves are managed in a manner consistent with maintaining the values of the | Ongoing |

| Social Values | Management Measures Identified in the Ningaloo Marine Park and Muiron Islands Management Plan | Status of Implementation of Management Measures |
|---|---|---|
| | reserves.<br>• To maintain the ecological values of the reserves that are important to commercial fisheries.<br>• Cooperate with the industry and DoF in facilitating a viable commercial fishing industry in the reserves. | |
| Petroleum development | | |
| The area around the Muiron and Sunday islands is highly prospective for hydrocarbons. | To ensure that, in collaboration with the petroleum industry, DoIR, and the EPA, petroleum industry activities in the reserves are managed in a manner that is consistent with maintaining the values of the reserves. | Ongoing |

Table 5-51: Social Values of the Ningaloo Marine Park and Muiron Islands Marine Management Area (CALM 2005) and Nyinggulu Coastal Reserves Plan (DBCA 2019)

#### 5.9.3.6 Economic Surroundings

The Gascoyne region is located between two resource regions; the Pilbara and the Mid-West, and lies in close proximity to significant oil and gas exploration and extraction basins (SGS 2012). SGS (on behalf of the GDC) identified a number of opportunities for the Gascoyne to capitalise on, including both current and future developments (SGS 2012). Exmouth is the major settlement and the largest service centre between Carnarvon and Karratha. It is also the tourist gateway to the Ningaloo Marine Park, Ningaloo World Heritage and a number of national parks. Tourism has now become the largest industry and major economic contributor in the Shire, with eco-tourism expected to experience significant growth (Shire of Exmouth 2018). Hospitality, accommodation and retail also represent a considerable proportion of the Shire's economy and job market. Other key industries include fishing, pastoral activities, aquaculture, oil and gas, limestone mining, industrial activities, light engineering and government agency business.

The overall economic objective for the Shire of Exmouth is to '*diversify and grow our economy in manner that provides year-round employment opportunities*' (Shire of Exmouth 2018). Community priorities and outcomes were identified to achieve this objective during stakeholder engagement sessions. Some of these included:

- Develop and encourage opportunities for business investment to develop a diverse economy.
- Create a strategic approach to economic development to attract investment and jobs in new and existing industries.
- Engage with local, state, national, and international stakeholders to build a stronger and sustainable tourism industry.
- Advocate and lobby for the provision of infrastructure that supports the local economy.

The GDC commissioned a report to identify economic development opportunities for the Gascoyne Region (SGS 2012). As a result, opportunities and priority projects were recommended in order to maximise economic and social benefits for Exmouth. These included the Exmouth Marina Expansion, marketing and promoting Exmouth as a logistics hub, development of the Exmouth Marine Supply Base, Fly In-Fly Out (FIFO) and Drive In–Drive Out (DIDO) initiatives (i.e. promoting Exmouth as a permanent residential base) and a number of Exmouth tourism initiatives (SGS 2012). Core values and considerations were also identified to guide future decision-making. Stakeholder engagement revealed that environmental protection and social advancement are equally as important as economic development and economic prosperity (SGS 2012). The Shire's Strategic Community Plan 2030 shows similar sentiments with the community wishing to build and diversify local businesses whilst ensuring the protection of the natural environment.

An Economic Impact Assessment was undertaken to model the economic contribution likely to be made by the Proposal to the Gascoyne Region and to Western Australia (ACIL Allen 2019). The results of the assessment are discussed further in Section 9.3. Stakeholder engagement undertaken by Subsea 7 suggested that the onshore development is unlikely to significantly interfere with local businesses or operators (a land use agreement has been signed with the Pastoral Lease holder).

### 5.9.4 Potential Impacts

Impacts to social surroundings could occur as a result of the disturbance to Aboriginal heritage places and/or cultural associations within the Development Envelope or impacts to the social values (e.g. aesthetics or active use) of the surrounding area (Table 5-52).

| Project Phase | Potential Impact |
|---|---|
| Construction | Disturbance to Aboriginal heritage places and/or cultural associations within the area |
| | Impacts to the social values (e.g. aesthetics or active use) of the proposal area during construction |
| | Temporary constraint on access and traditional cultural activities |
| | Changes to surface water flow patterns and/or coastal processes which may impact on Aboriginal heritage places |
| Operations | Permanent constraint on access and traditional cultural activities |
| | Impacts to the heritage values of the Ningaloo Coast World Heritage Area and the Ningaloo Coast National Heritage Place |
| | Impacts to amenity values (including visual landscape, scenic and visual aesthetic values and recreational tourism) in a marine park |
| | Impacts to the social values (e.g. aesthetics or active use) during operations |
| | Impacts to commercial fishing and recreational fishing operations/businesses and tourism activities in the proposal area |

Table 5-52: Potential Impacts to Social Surroundings

### 5.9.5 Potential Cumulative Impacts

Several third party projects or proposals (refer Section 2.5.8) have resulted in, or have the potential to result in, impacts to the social surroundings of Learmonth and Exmouth Gulf. Third party projects with existing social impacts include:

- RAAF Learmonth.
- Various Radio Communications facilities.
- Solar Observation Station near Heron Point.
- Large vessels operating in the Exmouth Gulf.
- Offshore oil and gas platforms visible from some areas.
- Exmouth Gulf Prawn Fishery.

Cumulative impacts as a result of existing projects and the Proposal, and are discussed in Section 5.9.6.9.

#### 5.9.6 Assessment of Impacts

##### 5.9.6.1 Disturbance to Aboriginal Heritage Places and/or Cultural Associations during Construction

Construction is expected to take approximately 9-12 months. Desktop assessments did not identify any recorded registered Aboriginal Heritage sites within the Development Envelope. Heritage surveys across the Development Envelope, incorporating the advice and guidance of the Gnulli people, did not record any archaeological or ethnographic places. Therefore impacts to Aboriginal Heritage places or cultural associations are not expected.

The heritage survey team identified the potential for artefacts to be present sub-surface, or to emerge in the more mobile soils following wind erosion of cleared or disturbed areas. Subsea 7 will engage heritage monitors during ground disturbing works to identify and retain any heritage significant material exposed during the construction phase. The Gnulli considered this an acceptable mitigation measure (Steve Corsini pers comm. 2019). Maintaining public access to Heron Point and Bay of Rest was considered important to the Gnulli. As discussed in the Social Impact Assessment (Attachment 2T), access to both areas will be maintained during construction. A tree, identified as the Dinner Time Tree, was noted as having cultural value to the Gnulli and it was requested that it not be disturbed (Figure 5-52). Subsea 7 has marked the location of the tree and will ensure it is not disturbed during construction or operations.

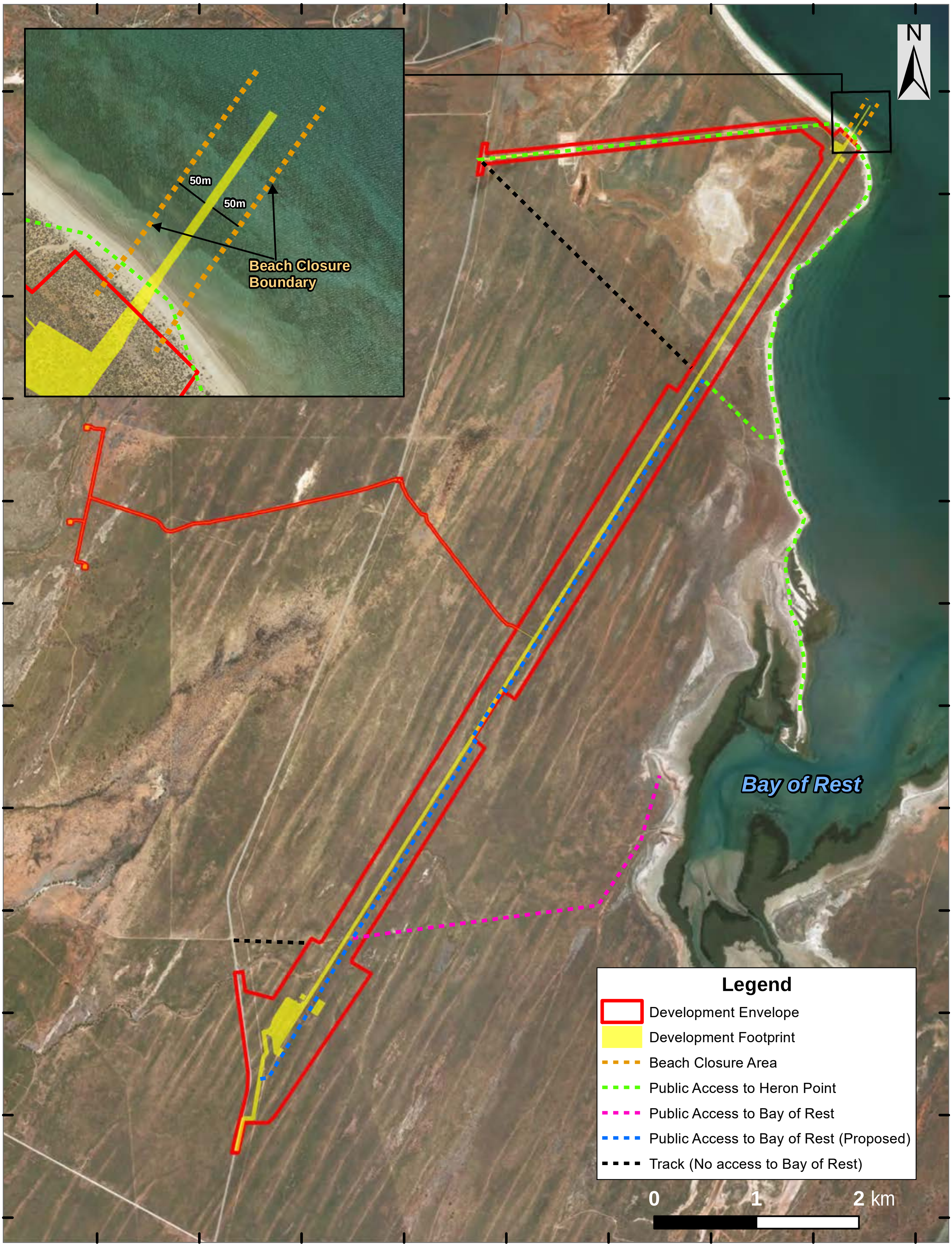
##### 5.9.6.2 Impacts to the Social Values (e.g. Aesthetics or Active Use) of the Proposal Area during Construction

Construction activities have the potential to impact social values as follows:

- Restricted access to parts of the beach and areas adjacent to the Development Envelope.
- Short-term and temporary noise, dust and light impacts.
- Minor visual impacts from sections of the Minilya-Exmouth road and surrounding vantage points.

<u>Access to Area</u>

Access to the Development Envelope will be restricted once construction has commenced to comply with safety obligations. This is a standard safety practice that is implemented on all sites of this nature both in Australia and generally in industry around the world. From the early stages of stakeholder engagement regarding this Proposal, the public's interest in ensuring that access to Heron Point and the Bay of Rest is maintained has been well communicated and understood. To provide certainty of this, Subsea 7 has proposed that a launchway crossing will be incorporated into the launchway design that allows off-road vehicles to continue along the beach to Heron Point and the Bay of Rest. Access along the beach will be temporarily (<3 months) impacted during launchway construction. To ensure that access to Heron Point and the Bay of Rest is maintained, a new access track will be created that runs from Minilya-Exmouth Road, to the intersection of the existing track and the Bundle track, running parallel to the Bundle tracks (refer Figure 5-56). Consequently, significant impacts to the active use of the area are not expected.




Scale:1:50,000
Original Size: A4
Aerial Photo: ESRI
Grid: GDA 94/ MGA Zone 50

Notes: Data sourced from Subsea 7 (2019), 360 Environmental (2019)

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-56: Access to Heron Point (Post development)

K:\Projects\9.0 APP\2061 Subsea 7 - Environmental Approvals\Figures\Social Surrounds Chapter\2061 F5-26 Access to Heron Point.mxd

Noise and Dust Impacts

Noise will be generated during the construction phase by the various plant and vehicles operating. No loud noise sources, such as piling or blasting, are proposed. Further, construction activities will occur during daylight hours (12 hour shifts), limiting the risk of impacts to social values.

Dust is likely to be generated during construction as a result of clearing for the Bundle fabrication facility infrastructure such as the access road, Bundle fabrication site and Bundle tracks. To limit the generation of dust, water carts will be used during construction.

Heron Point is not a gazetted camping site and there are no permanent sensitive receptors in close proximity to the Development Envelope. Recreational users of the area immediately adjacent to the Development Envelope may experience short-term (9-12 months) impacts to amenity due to intermittent noise and dust emissions during daylight hours during the construction phase.

Construction activities will comply with Australian Standard *2436-2010 'Guide to noise and vibration control on construction, demolition and maintenance sites'* and Noise Regulations. Activities that may create dust include the clearing of vegetation and vehicle movements on unsealed roads. Given the temporary and intermittent nature of potential dust and noise emissions, and the absence of nearby sensitive receptors, the potential impacts are not considered significant.

Lighting Impacts

The construction phase of the Proposal will require some artificial light sources appropriate to the task and compliant with occupational health and safety requirements. Construction activities will occur during daylight hours (12 hour shifts) limiting the risk of impacts to social values. Given the temporary and local nature of construction phase lighting, and the absence of nearby sensitive receptors, the potential impacts are not considered significant.

#### 5.9.6.3 Changes to Surface Water Flow Patterns and/or Coastal Processes that may Impact on Aboriginal Heritage Places

No sites of archaeological or cultural significant places were identified during the heritage survey (Attachment 2U). Surface water flow patterns are expected to remain similar to baseline flow patterns, and changes to flow velocities as a result of the Proposal are not expected to alter any natural scour or sediment deposition characteristics of the area (Section 5.8.6.1). No significant indirect impacts to coastal morphology as a result of altered wave climate, water flows and sediment movement following launchway construction are expected (Section 5.2.6). Given all of the above, impacts to Aboriginal places are considered unlikely.

#### 5.9.6.4 Permanent Constraint on Access and Traditional Cultural Activities

Access to the site will remain restricted due to safety reasons, to ensure there is no unplanned interaction between the onsite operation and members of the public or other groups that are not appropriately inducted, escorted, or trained to be onsite. This is a standard safety practice that is implemented on all sites of this nature both in Australia and generally in industry around the world.

Given that the site does not contain any culturally significant areas used for customary practices (Attachment 2U), impacts are considered unlikely. Members of the Gnulli will be able to enter the site upon request to do so for a specified purpose. An Indigenous Land Use Agreement (ILUA) is currently under negotiation between the Gnulli Claimant Group and Subsea 7 and will be approved prior to the construction of the Proposal.

The only area of the site where access will generally not be restricted is the launchway area to the east (seaward) of the dune line. During Subsea 7's extensive stakeholder engagement process, access restrictions to this area were discussed in depth, with the following considerations:

- The beach in this area is often used by members of the public to drive to/from the Bay of Rest, or just generally to drive along this stretch of beach.
- Efforts to control access, such as fences, would impose a visual impact to the area that is not preferred by the public.

To maintain the current accessibility to this area of Heron Point, no access restrictions to the launchway area will be in force for the large majority of the site operation. To provide for ongoing access to Heron Point and the Bay of Rest a launchway crossing has been incorporated into the launchway design that allows off-road vehicles to safely drive over the launchway. The crossing will be of a low profile design that is not prohibitive for any 4WD vehicle that is able to drive on the beach.

The launchway area will have an access restriction imposed during Bundle launch activities. This is expected to be for 1-2 days per launch, for an average of two launches per year (and not more than three) (i.e. up to 72 hours in a year, or 0.8% of the time). Notices regarding any upcoming launches will be well publicised and communicated to ensure that this closure is well understood. As Bundle launch operations are planned well in advance, sufficient notice will be provided. As a last measure, signage will also be erected in the approaches to the beach crossing to ensure that the temporary closure is known.

During launch operations, access to the Bay of Rest will be maintained via an alternative access route. At present, there is direct access to the Bay of Rest from Minilya-Exmouth Road via an access track that extends across the proposed Bundle track. This track would be cut off by the construction and then operation of the site. Subsea 7 have engaged with available stakeholders and recognises that this track is utilised by both members of the public and small businesses that wish to access the Bay of Rest directly, without driving along the beach. This appears to be the most direct route for those wishing to launch a boat into the Bay of Rest. To ensure continued access, a new access track will be created that runs from Minilya-Exmouth Road, to the intersection of the existing track and the Bundle tracks, running parallel to the Bundle site (refer Figure 5-56). This will ensure that access to the Bay of Rest is maintained at all times, irrespective of the status of the Bundle site operation, for those wishing to reach the Bay of Rest. It is recognised that the entry to this track from Minilya Road is an additional 1.7 km from the current turn off. At an average speed of 90 km/hr (speed limit in this area is 110 km/hr), this represents a very small increase in driving duration, particularly considering that the large majority of those accessing this track will have departed from Exmouth. A significant impact to long-term access to the area is not expected.

#### 5.9.6.5 Impacts to the Heritage Values of the Ningaloo Coast World Heritage Area and the Ningaloo Coast National Heritage Place

Visual Landscape, Scenic, and Visual Aesthetic Values

When assessing the significance of impacts of the Proposal on the WHA, the criterion '*superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance*', the visual impact of the Bundle tow was considered.

The only interaction between the Proposal and the WHA occurs when the Bundle is towed through the WHA (Figure 2-12). The proposed Surface tow of the Bundle occurs at approximately 5-6 knots (up to a maximum of 8 knots). The tow length within the WHA is 25.4 km long and this portion of the tow will take approximately 3 hours, 48 mins to traverse. An exclusion zone will be in place for 6 hours for safety purposes. Of the 604,000 ha, access to a maximum of 2,540 ha of the WHA will be temporarily constrained (by a safety zone that moves relative to the Bundle tow)) during a Bundle tow. Assuming the maximum of up to three Bundle tows per year; this equates to 10.44 hours per year (0.24% temporal impact per year).

A viewshed analysis from the Vlamingh Head Lighthouse was undertaken (this vantage point has uninterrupted views of the sea across the WHA and is a popular tourist destination) (Attachment 2S). The assessment found that from this vantage point, the proposed Bundle tow impacts are consistent with existing impacts evident from this location, such as other vessels operating in the area, the Harold E. Holt Naval Communication Station (significantly more visually impacting) and offshore oil platforms visible from this location. Given the temporary, short-term nature of a Bundle tow, with up to three Bundle tows a year and a 0.24% temporal impact, the Proposal is not likely to impact the natural beauty or aesthetic importance of the WHA.

None of the listing criteria for the Ningaloo Coast National Heritage Place relate to social values, so the visual impact of the Bundle tow are not considered relevant.

Social Values

Many tourists are attracted to the Exmouth region for the experience of whale watching; the southern migration period for Humpback whales past the North West Cape occurs from early August until late October each year. Subsea 7 has committed to no Bundle launch and tow activities between August and October (inclusive). Therefore whale-watching activities within the WHA will not be significantly impeded by the Proposal.

The Ningaloo Coast WHA is used for recreational fishing, boating, kayaking and scuba diving. Out of the 604,500 ha, a maximum of 2,540 ha of the WHA would potentially be subject to an exclusion zone during a Bundle tow. The towpath length within the WHA is 25.4 km long and will take approximately 3 hours, 48 mins to traverse. A six-hour exclusion zone would be in place while the Bundle traverses the WHA; this equates to 18 hours per year that a Bundle tow will potentially occupy/affect this small area of the WHA.

Recreational users will not be significantly inhibited whilst traveling through the Gulf or though the WHA. None of the key diving locations within the Ningaloo WHA (Exmouth Navy Pier, Muiron Islands, Lighthouse Bay sanctuary area, Bundegi Reef, and locations along the Ningaloo Reef) (Ningaloo Visitor Centre 2018b) intersect the path of the Bundle tow route or associated exclusion zone and therefore will not be significantly impacted.

Bundle tow operations are not exclusive and existing vessels will be able to continue to operate in this area, including recreational vessels, charter vessels, commercial fishing vessels and other commercial vessels (e.g. heavy lift crane vessels and FPSO vessels).

Further assessment of potential impacts to the Ningaloo Coast World Heritage Area and the Ningaloo Coast National Heritage Place is presented in Section 7.6.1. Section 7.6.2 provides a detailed assessment of potential impacts to MNES, including those contributing to the values of the WHA and National Heritage Place.

#### 5.9.6.6 Impacts to Amenity Values (including Visual Landscape, Scenic, and Visual Aesthetic Values, and Recreational Tourism) in a Marine Park

Visual Landscape, Scenic and Visual Aesthetic Values

The estimated time the Bundle and associated vessels will take to travel through the Ningaloo Marine Park is 3 hrs 48 mins. This equates to 10.44 hours per year (0.24% visual impact per year).

The Bundle tow operations are not exclusive and existing vessels will be able to continue to operate in this area. A viewshed analysis from the Vlamingh Head Lighthouse was undertaken (Attachment 2S). During the assessment from this vantage point, the proposed Bundle tow impacts are consistent with existing impacts evident from this location such as other vessels operating in the vicinity, the Harold E. Holt Naval Communication Station (significantly more visually impacting) and offshore oil platforms visible from this location towards the north west of the peninsula. Given the temporary, short-term nature of the Bundle tow, with up to three Bundle tows a year and a 0.24% visual amenity impact, the Proposal is not likely to impact the aesthetic values of the Ningaloo Marine Park.

Impacts to Ningaloo Marine Park in the context of the Management Plan for Ningaloo Marine Park and Muiron Islands Marine Management Area

*Water Sports:* No seabed disturbance will occur within the Ningaloo Marine Park and Muiron Islands Marine Management Area. The minimal disturbance to water users during a Bundle Surface tow is not considered likely to result in a significant impact to water sports.

*Nature-based Tourism:* Operations of the Proposal will not significantly interrupt marine nature-based tourism activities within the Ningaloo Marine Park and Muiron Islands Marine Management Area. No launch activities will occur during the main Humpback whale migration period (August to October). The majority of Whale shark tours occur on the western side of the North West Cape and will not be impacted by Bundle tow operations. Therefore there will be minimal disruptions to marine tourism in the area.

*Coastal Use:* Management objectives have been developed within the Management Plan for Ningaloo Marine Park and Muiron Islands Marine Management Area to ensure that high use areas are managed to limit any degradation of the ecological value and prevent conflict between coastal users. The Proposal does not interact with the coastal area within the Ningaloo Marine Park and Muiron Islands Marine Management Area and the Proposal is considered unlikely to result in a significant impact to the coastal use of the Ningaloo Marine Park and Muiron Islands Marine Management Area.

*Recreational Fishing:* Although the Bundle tow route intercepts areas potentially used for recreational fishing it will not significantly interrupt recreational fishing across the Ningaloo Marine Park and Muiron Islands Marine Management Area. Minimal disruption to recreational fishing will occur due to the rare and short-term passage of a Bundle tow through the Ningaloo Marine Park and adjacent to the Muiron Islands Marine Management Area. This is not considered to be a significant impact to the social value.

*Scientific Research:* The Proposal has resulted in the completion of numerous scientific studies within and adjacent to the Ningaloo Marine Park and Muiron Islands Marine Management Area. There will be a positive outcome in relation to the knowledge gained in relation to the BCH and marine fauna values of the Ningaloo Marine Park and Muiron Islands Marine Management Area.

*Education:* The Proposal has resulted in the collection of data on the use of the Ningaloo Marine Park and Muiron Islands Marine Management Area by marine fauna and on the BCH within the Ningaloo Marine Park. Further data will be collected and made publically available during the operation of the Proposal.

*Commercial Fishing:* Commercial fishing occurs within the reserves (for example the Exmouth Gulf Prawn Fishery (Figure 2-14)). The primary management objective across the Ningaloo Marine Park and Muiron Islands Marine Management Area in relation to commercial fishing is, in liaison with DPIRD, to ensure that commercial fishing activities are ecologically sustainable and help maintain the natural values (e.g. high water and sediment quality) of the reserves on which the industry depends. The Proposal will not influence the sustainability of commercial fishing operations or impact marine environmental quality within the Ningaloo Marine Park and Muiron Islands Marine Management Area.

*Petroleum Development:* Subsea 7 will engage with the operators of petroleum related operations in the Ningaloo Marine Park and Muiron Islands Marine Management Area (for example vessel anchoring and transit) to ensure that the tow operations will have no impact on these operations.

#### 5.9.6.7 Impacts to the Social Values (e.g. Aesthetics or Active Use) of the Proposal Area during Operations

Recreational and Active Use

Activities undertaken in proximity to the Development Envelope include recreational camping, fishing and four-wheel driving, primarily at the coast. Impacts to access to Heron Point and the Bay of Rest are discussed in Section 5.9.6.4.

Noise and Dust Impacts

Limited noise and dust emissions are expected during the operations phase of the Proposal. Noise will be generated by vehicles, including those delivering Bundle materials, visiting the site and low levels of noise may be generated during Bundle fabrication and launch. Minor dust emissions may occur associated with vehicles travelling along unsealed roads around the site.

Heron Point is not a gazetted camping site and there are no permanent sensitive receptors in close proximity to the Development Envelope. Recreational users of the area immediately adjacent to the Development Envelope may experience minor impacts to amenity due to intermittent noise and dust emissions during the operations phase although, given the distances between the fabrication shed and the coast, and the lack of loud activities during operations, significant impacts to activities at the coast are unlikely.

Lighting Impacts

The operations phase of the Proposal will require some artificial light sources appropriate to the task and compliant with occupational health and safety requirements. Operational activities will occur during daylight hours (12 hour shifts), except in the days leading up to a Bundle launch when extended hours may be worked.

Temporary mobile lighting units (directional flood lights) will be used during a Bundle launch and will include lighting at the Bundle launchway and along the Bundle track. Bundle launch activities will occur infrequently (up to three times a year) and will continue through day and night shifts. These operational phases of the Proposal require artificial light sources to enable tasks to be completed safely and efficiently during dark hours in accordance with occupational health and safety requirements. Vessels involved in Bundle tow operations will be required, for safety reasons, to have a level of permanent lighting. Light spill will be minimised as much as possible.

Given the short duration and infrequent nature of Bundle launch operations, as well as existing activities in the Gulf, significant impacts to onshore and offshore social values are not anticipated.

Aesthetic Impacts (Onshore)

The results of the LVIA (photomontages and viewshed analysis) suggest that the fabrication facility will be visible from several locations along the Minilya-Exmouth Road (Figure 5-57) (Attachment 2S). The field assessment found that based on typical observer speeds, the facilities will likely be visible mostly off axis to the direction of travel. The zone of theoretical visibility (ZTV) for onshore components suggests that the facility could be visible from several other areas in the surrounding landscape. The field assessment did not find any high value receptor sites within these areas (Attachment 2S).

The Bundle tracks are unlikely to be visible from much of the surrounding area due to the surrounding dunes and the limited alteration of the surrounding landforms (Figure 5-57) (Attachment 2S).

The launchway will be visible from adjacent beach areas, but is expected to blend in with the regional landscape in the same way as the current Learmonth Jetty which is a significantly higher structure (Attachment 2S).

Aesthetic Impacts (Offshore)

Charles Knife Canyon, Bundegi Beach, Mildura Wreck, and Vlamingh Head Lighthouse all showed very low levels of visual impact from offshore operations (Attachment 2S). The level of impact is expected to be minimal due to:

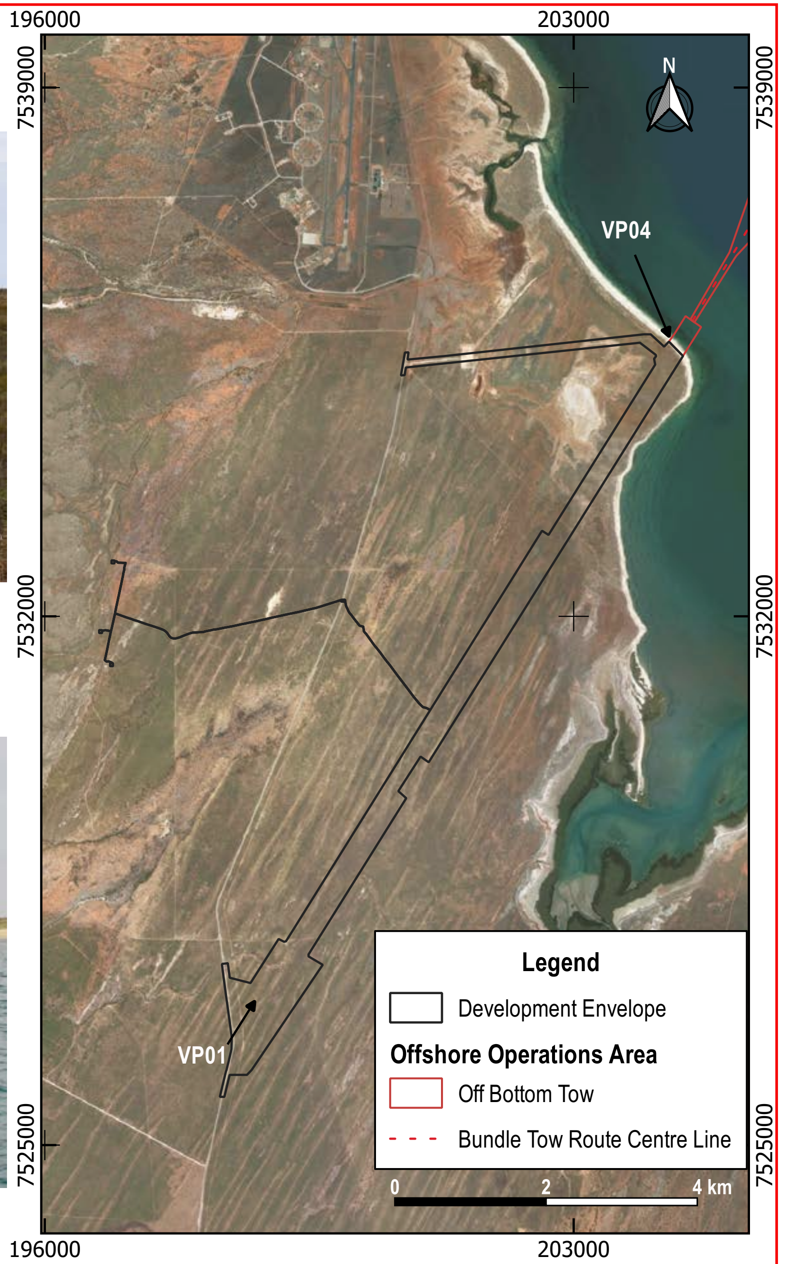
- The large distance (over 8km) of the tow route from the shore causing the activities to blend into the ocean due to atmospheric distortions.
- The nature of impact caused by the Bundle tow activities being equal to or less than existing impacts such as vessels already operating in Exmouth Gulf and the permanent offshore oil platforms.
- The large distance and the relative opaqueness of the sea surface due to the low angle of viewing (close to parallel to the surface), reflectance and surface waves making it very unlikely that a mostly submerged Bundle (during Surface tow) would be visible from land-based viewpoints.
- The Bundle and tow vessels were not practically visible at these sites. Although support vessels are likely to be visible to the keen eye, the expected impact duration for these sites were estimated as being a maximum of 18 hours per launch as seen from Vlamingh Head Lighthouse, which had the largest viewshed.

The Proposal may have some short-term, significant visual impacts to users of Heron Point and Schofield Shoal during Bundle launches (Figure 5-57). These impacts will be rare (three times per year) and short-term (expected to last no longer than 43 hours per launch) equating to an impact for a total of up to 129 hours per year (or approximately 3% of daylight hours per year).

Sediment fate modelling was completed to predict the magnitude and extent of visible turbidity (i.e. the extent of a visual impact) generated during a Bundle launch and tow. The threshold used to assess potential impacts to the environmental value of 'Recreation and Aesthetics (social use value)' was '20% (or greater) increase in turbidity in the top 6 m of the water column'. In both the flood-tide and ebb-tide launch cases, the threshold (or EQG) for aesthetic quality was forecast to be exceeded only in isolated patches near the launch site, with the location of the exceedances dependent on the tidal state at the time of launch (Figure 5-58). Thus a significant impact to recreational users of Exmouth Gulf, from an aesthetic point of view, is not expected.

## VP01

## VP04




Scale: 1:100000
Original Size: A4
Aerial Photo Date: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Viewshed Locations VP01 and VP04.

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-57: Operations Phase Photomontages

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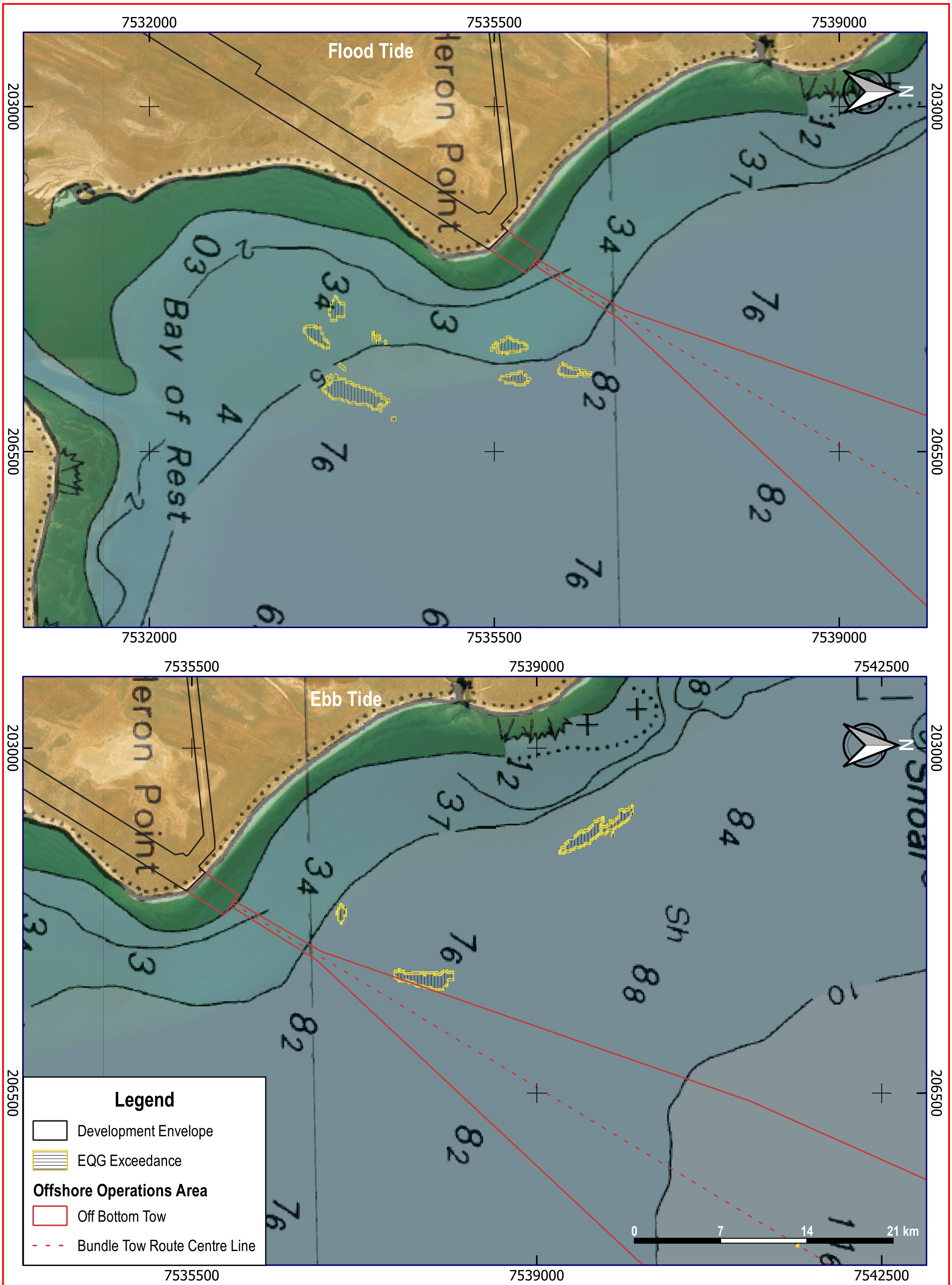


Scale: 50000
Original Size: A4
Aerial Photo: ESRI Satellite
Grid: GDA 94 / MGA Zone 50

Notes: Data sourced from Commonwealth of Australia (2018) and RPS (2019).

Subsea 7 Pipeline Fabrication Facility

subsea 7

Figure 5-58: Modelled Exceedance of EQG for Maintenance of Recreation and Aesthetics During Bundle Launch and Tow

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##### 5.9.6.8 Impacts to Commercial Fishing and Recreational Fishing Operations/Businesses and Tourism Activities in the Proposal Area

To understand the wider operations in the Exmouth region and in Exmouth Gulf, Subsea 7 arranged three community engagement sessions in 2017. The intent of these engagements was to introduce the Proposal to the local community, establish a better understanding of local community priorities, seek feedback on any concerns relating to potential environmental or social impacts and develop a distribution list for future Proposal updates (currently with 76 members).

The Shire of Exmouth provided a list of local business operators (registered 2018-2019 members of the Ningaloo Visitors Centre). Of the listed 165 businesses, 38 were categorised as tour operators. Subsea 7 identified 18 businesses as locally-based and likely to periodically operate within Exmouth Gulf and the Offshore Operations Area. The identified tour operations included:

- Humpback whale watching tours.
- Whale shark or Humpback whale snorkelling tours.
- Fishing charters.
- SCUBA and snorkelling tours.
- Light aircraft tours.

An assessment of the potential impacts to these operations associated with the Proposal is presented in the sections below.

<u>General Impacts to Marine Operations in Exmouth Gulf</u>

Tour operations within Exmouth Gulf will be able to operate during a Bundle tow. During a Bundle launch an exclusion zone will be setup to ensure safety of marine operations. This will be a 500 m buffer extending in front, behind, and either side of the Bundle. The location of the exclusion zone will progress as the Bundle is launched and then towed offshore. The location, and associated durations, of the exclusion zone will be as follows:

- The launch area adjacent to Heron Pt will have the exclusion zone in place for ~36 hours per launch.
- The Off bottom tow to the Parking area will have the exclusion zone in place for ~6 hours per launch.
- The Parking area will have the exclusion zone in place for ~12 hours per launch.
- The Surface tow area (through the WHA) will have an exclusion zone in place for ~6 hours per launch.

Tour operators will be able to depart from Exmouth Marina and travel to Ningaloo Reef unhindered at all times. Direct travel to or from the Muiron Islands from Exmouth Marina will also be possible, except during the Surface tow window (~6 hours) when a detour up to approximately 10 km would be required. Such a detour may be required up to three times per year (up to 0.42% of daylight hours per year).

Commercial operators, recreational vessels and the local community will have advanced notice of a Bundle launch and will be able to schedule activities to avoid the Bundle tow route (if required).

To minimise impacts to Humpback whales during the southern migration period, Subsea 7 has committed to a 'no launch' period, which will be in force for the months of August, September and October each year. The majority of Humpback whale watching tours operate during these months only (Hogstrom, A. pers comm. 2019). No impacts to whale watching tour operators are expected.

The most prominent SCUBA location within Exmouth Gulf is the Exmouth Navy Pier, with the Muiron Islands another popular diving, and snorkelling, location. The Bundle tow route is (at its closest) > 8 km from the Exmouth Navy Pier and > 5.5 km from the most south-west point of the Muiron Islands, and therefore the Bundle will not visible underwater or from the surface from these locations.

The Whale shark tour season runs from March to August, with most tours operating on the western side of the North West Cape (away from the Bundle tow operations) (Hogstrom, A. pers comm. 2019).

Given the low number of Bundle launches, the relatively short duration of Bundle launch activities, notification of the public prior to a Bundle launch and the commitment of no Bundle launches between August and October (inclusive), significant impacts to tour operators and tourism activities are not expected.

Improved economic and employment opportunities predicted as a result of the Proposal are in line with the Shire of Exmouth's objectives to '*Diversify and grow our economy in a manner that provides year round employment opportunities*' and '*To protect and value our unique natural and built environment as we grow our economy*'. Subsea 7 has engaged extensively with the Exmouth business community, including the Shire of Exmouth, the Exmouth Chamber of Commerce and Industry, and the Gascoyne Development Commission. The feedback has been overwhelmingly positive, with the Proposal seen as offering a tangible opportunity to diversify the local economy that is currently heavily reliant on seasonal tourism.

<u>Impacts to Commercial Fishing Operations</u>

Operating areas and schedules have been discussed with the Exmouth Gulf Prawn Fishery operators (June 2018). The prawn fishing operations occur across approximately 300 square nautical miles (in 2016 for example, a total of 325 square nautical miles (28.5%) of the trawlable grounds were fished). The proposed area of Bundle operations overlaps with only a very small component (~6%) of this area. Impacts to the soft sediment habitat within the Offshore Operations Area (Off bottom tow) will be minor, short-term and infrequent, given an average of two (maximum of three) Bundle launches per year. The Exmouth Gulf Prawn Fishery operators identified that the key area of concern is the prawn nursery area in the eastern part of Exmouth Gulf. Given the small area of seabed disturbance during a Bundle launch (comparative to the fished area), the absence of impacts to the prawn nursery habitat, and the low frequency of offshore operations, the Proposal was considered to represent a low risk to the prawn fishery (Alex Kailis pers comm. 2018).

During stakeholder consultation, it was identified that one licenced fisher collects specimens of the sponge *Trikentrion flabelliforme*, more commonly referred to as the 'Spider Sponge', from the Heron Point area (Darren Gebbetis pers comm. 2018). While a small proportion of the current *T. flabelliforme* population off Heron Point will be directly impacted by the Proposal, habitat and species records exist in adjacent, non-impact areas, and regionally. The licenced fisher noted that his operations could viably continue if only a small proportion of the population was affected (Darren Gebbetis pers comm. 2018), refer Section 5.4.6.4 for more details. During engagement with the licenced fisher, access to the Bay of Rest was also discussed, noting that this operation relies on the ability to launch a vessel from the beach in this area. In response it was noted that access would be maintained at all times.

Engagement with the Western Australian Fishing Industry Council (WAFIC) (November 2018) identified another commercial operation, the Exmouth Beach Seine Fishery. Information on the Proposal was provided to the lisencee, via WAFIC, and no additional queries were raised. Subsea 7 concluded that the Proposal will not significantly impact this fishery.

Impacts to Charter Fishing Operations

It is understood that charter fishing operations occur extensively on both the western and eastern sides of the North West Cape. Activities are understood to occur throughout a large area, including the Muiron Islands, Thevenard Island, many of the islands and shoals in Exmouth Gulf and further north east off the coast of Onslow, and north to the Montebello Islands.

During stakeholder engagement, a local recreational fly fishing operator, Ningaloo Fly Fishing, has raised specific concerns regarding the Proposal. Subsea 7 has been unable to meet the operator directly. It is understood that primarily concerns relate to reduced access to the Bay of Rest and impacts to visual amenity due to the presence of the launchway across the beach. Access to the Bay of Rest will be maintained (refer Sections 5.9.6.2 and 5.9.6.4) and the impacts to visual amenity are expected to be negligible (refer in Section 5.9.6.6).

The number of Bundle launches will be set at a maximum of three per year, access to the the southern and eastern parts of Exmouth Gulf will be maintained and a Notice to Mariners will be issued well in advance of a Bundle launch. Charter operators could readily plan activities to avoid Bundle launch and tow operations.

Significant impacts to recreational fishing within the Exmouth Gulf are not expected. Understanding the significance of the recreational fishing competition 'Gamex' hosted by the Exmouth Game Fishing Club, Subsea 7 commits to no Bundle launch and tow operations during the six day fishing period associated with this competition, to ensure no impact to this longstanding competition.

#### 5.9.6.9 Cumulative Impacts

Cumulative impacts from offshore activities are also considered to be minor, primarily from the low frequency of offshore operations (three Bundle launches per year, with an estimated total time of 48 hours per launch, and up to nominally 24 hours of Bundle tow reconfiguration). Existing activities in Exmouth Gulf, such as commercial prawn trawling, pearl shell harvesting and freight are likely to continue. The Project represents a relatively low impact Proposal that would not affect the recreational or commercial use of the area or the visual amenity of the region.

The impact assessment presented above conservatively (worst case) assumes that there is no associated decrease in vessel activity in Exmouth Gulf resulting from the introduction of Bundle technology to the Australian oil and gas industry. It is considered likely that the use of Bundle technology would result in a reduction in large pipelay vessel activity (including associated support pipe transport vessels) in both the local region (Exmouth Gulf), and the broader area of the North West Shelf. In this case, the introduction of Bundle technology may result in a net positive impact to the visual landscape of the Ningaloo Marine Park and Muiron Islands Marine Management Area.

Cumulative impacts to social surroundings as a result of this Proposal, and third party projects or proposals, are considered unlikely.

### 5.9.7 Mitigation and Predicted Outcome

Proposed mitigation measures and predicted outcomes for potential impacts on social surroundings are outlined in Table 5-53.

The EPA objective '*to protect social surroundings from significant harm*' will be met.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Disturbance to Aboriginal heritage places and/or cultural associations during construction | Measures to avoid:<br>• Heritage surveys completed to allow any significant heritage sites to be mapped and avoided.<br>Measures to minimise:<br>• Cultural awareness training for the workforce.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>• The site induction program will provide written and verbal information on cultural and heritage awareness.<br>• Heritage monitors during clearing and construction activities. The quantity and extent of monitoring activities will be agreed on a case by case basis for each clearing or excavation operation.<br>• If artefacts are located, all work will be stopped until appropriate assessment has been completed and approval to remove/disturb is obtained.<br>• Approved Indigenous Land Use Agreement (ILUA) to be obtained and adhered to.<br>• Cultural Heritage Management Plan to be developed and implemented.<br>• Providing Culture Awareness training to workforce.<br>Measures to rehabilitate:<br>• NA | Given that no sites or cultural places of significance were identified during the heritage surveys, significant impacts to Aboriginal Heritage are not expected.<br><br>The proposed management measures will ensure the EPA Objective for Social Surroundings will be met. |
| Impacts to the social values (e.g. aesthetics and active use) of the Proposal area | Measures to avoid:<br>• Access to Heron Point and the Bay of Rest will be maintained. | Given the maintenance of access to Heron Point and the Bay of Rest, and the management of potential aesthetic and amenity impacts associated with noise, dust |

| Potential Impact | Mitigation Measures | Predicted Outcome |
| --- | --- | --- |
| during construction | Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the Proposal.<br>• Minimisation of disturbance to dunes and other elevated vantage points within the Development Envelope.<br>• Appropriate management of noise, dust and light emissions.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available. | and light, it is considered that the EPA objective for Social Surroundings will be met. |
| Changes to surface water flow patterns and/or coastal processes which may impact on Aboriginal heritage places | Measures to avoid:<br>• Heritage survey completed to allow any significant heritage sites to be mapped and impacts avoided.<br>• Where necessary, suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns.<br>Measures to minimise:<br>• Design of launchway to minimise height of structure above surrounding beach or seabed.<br>• Project design has considered the location of drainage lines with the aim of minimising changes to natural flows.<br>• Management of onshore sediment accretion via monitoring and sand bypassing.<br>• Cultural Heritage Management Plan to be developed and implemented. | Given that no Aboriginal sites or places of significance were identified, and taking into account the proposed management of surface water flows and coastal processes, it is considered that the EPA objective for Social Surroundings will be met. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | Measures to rehabilitate:<br>• Upon closure the reinstatement of the natural flow paths after removal of the project infrastructure. | |
| Permanent constraint on access and traditional cultural activities | Measures to avoid:<br>• Access to Heron Point and the Bay of Rest will be maintained.<br>• Subsea 7 commits to ensuring that the Gnulli will be welcome visitors into the Development Envelope and that access will not be unreasonably refused.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the Proposal.<br>• Cultural Heritage Management Plan to be developed and implemented.<br>• Approved Indigenous Land Use Agreement (ILUA) to be obtained and adhered to.<br>Measures to rehabilitate:<br>• Disturbed areas will be rehabilitated as they become available. | Given that the Development Envelope does not contain any culturally significant areas used for customary practices, and that access to Heron Point and the Bay of Rest will be maintained, impacts will be minimal. The EPA objective for Social Surroundings will be met. |
| Impacts to the heritage values of the Ningaloo Coast World Heritage Area and the Ningaloo Coast World Heritage Place | Measures to avoid:<br>• Surface tow to avoid interaction with the seabed within the Ningaloo Coast WHA.<br>Measures to minimise:<br>• Limit on the number of Bundle launches (average of two, up to a maximum of three, per year).<br>• No launches during period of peak usage of Exmouth Gulf by Humpback whales (August to October). | Given the short-term nature of the tow operations through the Ningaloo Coast WHA, the Bundle tow operation is not likely to have any significant impacts on the natural beauty and aesthetic importance of the area, or on the important and significant natural habitats. There will be no contact with the seabed in this area and therefore no impacts to BCH. The likelihood of a marine fauna strike is low due to the numerous control measures that will be |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | • Local stakeholder engagement team in place to receive continuous feedback from local community groups.<br>Measures to rehabilitate:<br>• NA | implemented (refer Section 5.4.7).<br><br>The heritage values of the Ningaloo Coast WHA are unlikely to be impacted as a result of the Proposal. |
| Impacts to amenity values (including visual landscape, scenic and visual aesthetic values and recreational tourism) in a marine park | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Limit on the number of Bundle launches (average of two, up to a maximum of three, per year).<br>• Public notification prior to Bundle tow operations.<br>• No launches during period of peak usage of Exmouth Gulf by Humpback whales (August to October).<br>• Local stakeholder engagement team in place to receive continuous feedback from local community groups.<br>Measures to rehabilitate:<br>• NA | A Bundle tow will traverse Ningaloo Marine Park for a duration of approximately four hours per launch, with no residual effect following this period. A maximum of three Bundles will be launched per year.<br><br>Impacts to amenity values will not be significant and the EPA objective for Social Surroundings will be met. |
| Impacts to the social values (e.g. aesthetics or active use) of the Proposal area during operations | Measures to avoid:<br>• Access to Heron Point and the Bay of Rest will be maintained.<br>Measures to minimise:<br>• Limit on the number of Bundle launches (average of two, up to a maximum of three, per year).<br>• Public notifications prior to and during a Bundle launch.<br>• Local stakeholder engagement team in place to | The Bundle and tow/support vessels will only be visible from Vlamingh Head Lighthouse for approximately 18 hours 21 minutes per tow. The Bundle tow will only occur within the WHA for a total of 3 hours 48 mins.<br><br>Third party vessels will be able to navigate, and utilise, the area outside of the exclusion zone, during a Bundle launch and tow. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | receive continuous feedback from local community groups.<br>Measures to rehabilitate:<br>• NA | Impacts to social values will not be significant and the EPA objective for Social Surroundings will be met. |
| Impacts to commercial fishing and recreational fishing operations/businesses and tourism activities in the Proposal area | Measures to avoid:<br>• Public notifications prior to and during a Bundle launch.<br>• Local stakeholder engagement team in place to receive continuous feedback from local operators.<br>Measures to minimise:<br>• Limit on the number of Bundle launches (average of two, up to a maximum of three, per year).<br>• Preferential use of local vessels to support Bundle launches.<br>Measures to rehabilitate:<br>• NA | Commercial fishing operators will have advanced notice of a Bundle launch and will be able to schedule activities to avoid the Bundle tow route (as required). The Exmouth Gulf prawn fishery occurs across approximately 300 square nautical miles, so the area affected during a Bundle launch is negligible.<br><br>Recreational tour operators will be able to navigate, and utilise, the area outside of the exclusion zone during a Bundle launch and tow.<br><br>Impacts to commercial fishing and recreational fishing operations/businesses and tourism activities will not be significant. Therefore the EPA objective for Social Surroundings will be met. |

Table 5-53: Proposed Mitigation Measures and Predicted Outcome for Social Surroundings

# 6. OTHER ENVIRONMENTAL FACTORS OR MATTERS

## 6.1 TERRESTRIAL ENVIRONMENTAL QUALITY

### 6.1.1 EPA Objective

To maintain the quality of land and soils so that environmental values are protected.

### 6.1.2 Policy and Guidance

Subsea 7 has taken into consideration relevant policy and guidance in design of the Proposal, completion of the environmental impact assessment and through the development of this ERD.

A summary of the policy and guidance relevant to Terrestrial Environmental Quality, and how Subsea 7 has considered these, is presented in Table 6-1.

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Statement of Environmental Principles, Factors and Objectives (EPA 2016c, 2018c) | Referred to in the identification and assessment of Preliminary Key Environmental Factors. |
| Environmental Factor Guideline – Terrestrial Environmental Quality (EPA 2016u) | Referred to in the determination of data requirements to support the development of the PER |
| Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DER 2015a) | Referred to in the assessment and identification of acid sulphate soils |
| Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes (DER 2015b) | Referred to in the assessment and identification of acid sulphate soils |
| Acid sulfate soil risk maps (DWER 2016) | Referred to in the selection of sampling locations |

Table 6-1: Policy and Guidance Relevant to Terrestrial Environmental Quality

### 6.1.3 Receiving Environment

The Proposal is located on coastal plains within a minor syncline between Cape Range in the west and Rough Range in the south east. Within the main Proposal footprint, east of the Minilya-Exmouth Road, the surface geology is typically residual sand plains forming longitudinal dunes, with intertidal flats (calcareous clay, silt and sand) and supratidal flats (calcareous clay, silt and sand with authigenic gypsum and salt) identified in the far north east of the Proposal area along the coastal fringes (GSWA 1980).

The elevation of the Development Envelope ranges from about 25 m Australian Height Datum (AHD) at the inland (southern) end to 0 m AHD at the coast and it generally slopes from the south west to the north east (Attachment 2R). The majority of the Development Envelope is characterised by a series of parallel network dunes and residual sand plains made up of red brown to yellow quartz sand. The dunes are approximately 5 m in height and are stabilised by light vegetation comprising grasses and small shrubs.

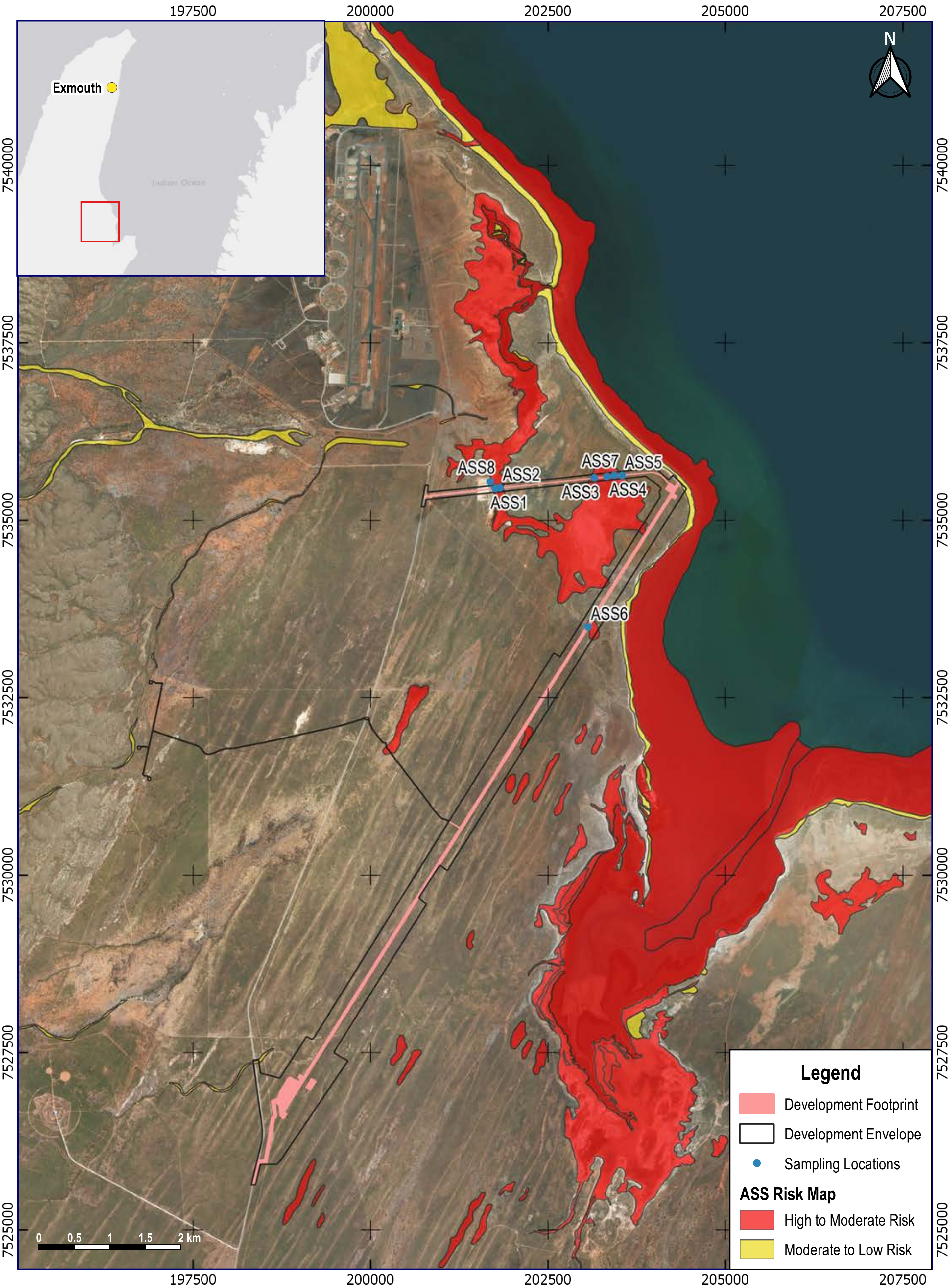
Acid Sulphate Soils (ASS) are naturally occurring soils, sediments and peats that contain iron sulphides that are generally found in a layer of waterlogged soil or sediment in low-lying land bordering the coast, or estuarine, saline or freshwater wetlands throughout Western Australia (DER 2015a).

ASS are benign in an anoxic state and do not pose a significant risk to human or environmental health. However, when these soils are disturbed or exposed to air, they can oxidise and produce sulfuric acid, iron precipitates and concentrations of heavy metals. Disturbing ASS has the potential to cause significant environmental and economic impacts (DER 2015a).

DWER maintain ASS risk maps (DWER 2016) for the State that show potential areas of ASS risk. Results of the ASS risk map in relation to the Development Envelope and site layout are shown on (Figure 6-1).

Review of the risk maps in relation to the Development Envelope identified:

- Minor portions of the Development Envelope are mapped as Class 1 'High to Moderate' risk of ASS within 3 m of the natural soil surface.
- A minor portion of the Development Envelope along the coast is mapped as Class 2: 'Moderate to Low' risk of ASS within 3 m of natural soil surface with 'High to Moderate' risk of ASS beyond 3 m (DWER 2016). These areas correspond generally with supratidal mud flats.
- The surrounding landscape is mostly mapped as having no risk of ASS.




| | | |
|---|---|---|
| Scale: 1:70000<br>Original Size: A4<br>Aerial Photo: ESRI Satellite<br>Grid: GDA 94 / MGA Zone 50 | Notes: Data sourced from Department of Water and Environmental Regulation (DWER) 2016, MBS Environmental 2018.<br><br>Subsea 7 Pipeline Fabrication Facility | subsea 7<br><br>Figure 6-1: Desktop ASS risk mapping and ASS investigation sampling locations |

W:\Subsea 7\Studies\Terrestrial Environmental Quality\Drawing and spatial data\ASS QGIS MAP.qgs 17/06/2019

Dewatering and/or excavation within a Class 1 'High to Moderate' risk area has the potential to disturb ASS. DER's guideline 'Identification and Investigation of Acid Sulphate Soils and Acidic Landscapes' (2015) outlines the nature of disturbance that triggers an ASS investigation (refer Table 6-2).

| Class of Land | Nature of Disturbance |
|---|---|
| Class 1 – 'High to Moderate' risk of ASS occurring within 3 m of natural soil surface | • Earthworks that will disturb more than 1,000 $m^3$ of soil.<br>• Dewatering or soil draining activity. |
| Class 2 – 'Moderate to Low' risk of ASS occurring within 3 m of natural soils surface but 'High to Moderate' risk of ASS beyond 3 m of natural soil surface | • Works involving lowering of water table (temporary or permanent).<br>• Earthworks extending to beyond 3 m below natural ground surface.<br>• Works within 500 m of a wetland. |

Table 6-2: Types of Disturbance Triggering an ASS Investigation

The risk of disturbing ASS within the Proposal area was considered low given that:

- Excavations will be shallow (<1 m) and the majority of the Proposal footprint falls outside high-risk ASS zones.
- Dewatering is not expected to occur during any stage of construction as excavations will be limited to a maximum depth of 1 m, which is above regional groundwater levels (GHD 2018).

Notwithstanding, Subsea 7 commissioned a targeted ASS investigation to confirm the presence, or absence, of ASS within the Proposal footprint. ASS risk mapping (DER 2014), and the proposed layout of infrastructure, was used as a guide to determine the ASS investigation sites. The data obtained from the construction of the stygofauna monitoring bores (refer Section 1.1) also informed the location of the ASS investigation sites. Results from field tests ($pH_F$ and $pH_{FOX}$) performed on all the soil samples obtained during the ASS investigation indicated that no samples were actual or potential ASS (MBS Environmental 2018b, Attachment 2U).

Results from laboratory analysis of selected soil samples indicated that net acidity was less than 0.005% (wet weight) and well below DER (2015a) criteria for ASS. In addition, the measured acid neutralising capacity (ANC) was found to be high and variable, ranging from 0.67 to 11% (wet weight), indicating capacity to neutralise any acidity.

### 6.1.4 Potential Impacts

Impacts to terrestrial environmental quality could occur as a result of the exposure or disturbance of acid sulphate soils or from chemical leaks or spills (Table 6-3).

| Project Phase | Potential Impact |
|---|---|
| Construction | Impact to soil quality following the exposure or disturbance of acid sulphate soils |
| Construction and Operations | Impacts to soil quality due to leaks or spills |

Table 6-3: Potential Impacts to Terrestrial Environmental Quality

#### 6.1.5 Cumulative Impacts

Given the absence of acid sulphate soils within the Development Envelope, no cumulative impacts to terrestrial environmental quality are likely to occur.

#### 6.1.6 Assessment of Impacts

##### 6.1.6.1 Impact to Soil, Surface Water or Groundwater Quality following the Exposure or Disturbance of Acid Sulphate Soils

Based on the findings of the project-specific ASS investigation (Attachment 2U) there is no identified risk of disturbing ASS during construction of the Proposal, and therefore negligible risk of impact to soil quality due to exposure or disturbance of ASS.

##### 6.1.6.2 Impacts to Soil, Surface Water or Groundwater Quality due to Leaks or Spills

There will be no significant volumes of toxicants/chemicals or hazardous goods, other than hydrocarbons, on site during the construction/operation of the Proposal. All chemical storage, with the exception of smaller volumes of diesel for mobile plant, will be located adjacent to the fabrication shed at the western (inland) end of the Development Envelope.

There is potential for diesel, hydraulic fluid and lubricant spills during construction and operations phases from the storage of diesel, refuelling, and operation of land-based machinery.

Hazardous materials will be stored in facilities designed and constructed in accordance with relevant Australian Standards. Chemical and hydrocarbon storage vessels will be bunded appropriately to minimise the risk of leaks and spills. Failure of hazardous materials containment or equipment malfunction could result in spillages to the environment. As activities such as refuelling and minor vehicle servicing (major servicing to be undertaken offsite) will be undertaken in purpose-built containment areas and will be controlled via instrumentation and manual intervention, the likelihood of spills directly to the terrestrial environmental quality is considered low. Spill kits and equipment will be maintained on site. Employees and contractors will be trained in refuelling procedures, handling and management of chemicals and spill response. Spills will be cleaned up and contaminated soil will either be remediated *in situ* or removed from site by a licensed third party. Incident investigation will be undertaken to determine the cause of spills/leaks and control measures identified to prevent similar future incidents.

Considering the small number and volume of hazardous materials planned to be stored and used and application of standard industry practices for storage and handling, the risks arising from contamination of soil on a local and regional scale are considered low.

#### 6.1.7 Mitigation and Predicted Outcome

The proposed mitigation measures to avoid, minimise and rehabilitate potential impacts to terrestrial environmental quality as a result of the Proposal, and the predicted outcome, are provided in Table 6-4. The EPA objective '*to maintain the quality of land and soils so that environmental values are protected*' will be met.

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Impact to soil, surface water or groundwater quality following the exposure or disturbance of acid sulphate soils | Measures to avoid:<br>• None (no ASS recorded).<br>Measures to minimise:<br>• Minimise the extent and depth of excavations.<br>Measures to rehabilitate:<br>• In the event of any ASS disturbance undertake treatment (e.g. lime dosing) and post-treatment testing. | Given no ASS were identified within the Development Envelope, the Proposal will not cause impacts associated with their disturbance.<br><br>The EPA objective for terrestrial environmental quality will be met. |
| Impacts to soil, surface water or groundwater quality due to leaks or spills | Measures to avoid:<br>• None (no ASS recorded)<br>Measures to minimise:<br>• Implement appropriate chemical transport, storage and handling procedures.<br>• Chemical and hydrocarbon storage vessels will be bunded.<br>• Staff will be trained in refuelling procedures and the handling and management of chemicals.<br>• Oil spill kits and equipment will be available on site.<br>Measures to rehabilitate:<br>• In the event of a leak or spill the contamination will be contained and contaminated material remediated or removed for offsite disposal at a licenced facility. | No significant impact to terrestrial environmental quality is expected.<br><br>The EPA objective for terrestrial environmental quality will be met. |

Table 6-4: Proposed Mitigation Measures and Predicted Outcome for Terrestrial Environmental Quality

# 7. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

## 7.1 OBJECTIVE

The objective of the EPBC Act is to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance (MNES).

## 7.2 CONTROLLING PROVISIONS UNDER THE EPBC ACT

The EPBC Act establishes a process for assessment and approval of proposed actions that have potential to significantly impact MNES or Commonwealth land.

As discussed in Section 1.3.1, the controlling provisions relevant to this proposal are:

- World Heritage Properties (Sections 12 & 15A).
- National Heritage Places (Sections 15B & 15C).
- Listed Threatened species and communities (Sections 18 & 18A).
- Listed Migratory Species (Sections 20 & 20A).
- Commonwealth Marine Areas (Sections 23 & 24A).

## 7.3 OTHER AGREEMENTS AND LEGISLATION

The *Environment Protection and Biodiversity Amendment Regulations 2000* make provision for regulation of the interaction of persons with cetaceans within the Australian Whale Sanctuary[16].

The Listed Migratory Species protected under the EPBC Act includes those listed under the following international conventions:

- Japan-Australia Migratory Bird Agreement (JAMBA).
- China-Australia Migratory Bird Agreement (CAMBA).
- Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA).
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

## 7.4 POLICY AND GUIDANCE

Subsea 7 has taken into consideration relevant policy and guidance, including management plans, recovery plans, conservation advice and threat abatement plans in the design of the Proposal, completion of environmental impact assessment and throughout the development of this ERD. The Proposal is not inconsistent with the guidance presented in the relevant policy and guidance.

A summary of the policy and guidance pertinent to the relevant MNES, and how Subsea 7 has considered these, is presented in Table 7-1. Specific references to the species-specific plans and advice are included, where relevant, within Section 7.6.

[16] The Australian Whale Sanctuary covers Australian waters within 200 nautical miles of the coast of Australia.

| Policy/Guidance | Consideration for Proposal |
|---|---|
| Environmental Assessment Guideline (No. 5) for Protecting Marine Turtles from Light Impacts (EPA 2010) | General guidance on light design (wavelength, height, direction, shielding) referred to in the nomination of measures to minimise impacts to marine fauna (noting that turtle nesting does not occur within Exmouth Gulf). |
| Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005 – 2015 (MPRA and CALM 2005) | This management plan was reviewed during the assessment of potential impacts on marine fauna within the Commonwealth Ningaloo Marine Park and Muiron Islands Marine Management Area, and in the development of management measures. |
| North-west Marine Parks Network Management Plan 2018 (Director of National Parks 2018) | This management plan was reviewed during the assessment of potential impacts on marine fauna within the Ningaloo Marine Park, and in the development of management measures. |
| Matters of National Environmental Significance: Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (DoE 2013) | Although the key purpose of these guidelines is to assist a proponent in deciding whether or not they should submit a referral under the EPBC Act, the guidelines provide guidance on what constitutes a 'significant impact'. |
| Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPAC 2012a) | This policy was considered as part of the determination of the need for offsets. |
| Marine bioregional plan for the North-west Marine Region (DSEWPAC 2012b) | This management plan was reviewed during the assessment of existing values (receiving environment) and potential impacts on marine fauna, and in the development of management measures. |
| Wildlife Conservation Plan for Migratory Shorebirds (DoE 2015a) | Considered in the assessment of potential impacts to shorebirds. |
| Significant impact guidelines for 36 migratory shorebird species' (DEWHA 2009) | Considered in the assessment of potential impacts to shorebirds. |
| EPBC Act Policy Statement 3.21 – Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE 2017a) | |
| Recovery Plan for Marine Turtles in Australia (DoEE 2017b) | This plan was reviewed during the assessment of potential impacts on marine turtles, and in the development of management measures. |
| Recovery Plan for the Grey Nurse Shark (west coast population) (DoEE 2014) | This plan was reviewed during the assessment of existing values (receiving environment) and potential impacts on the species. |
| Conservation Advice – Whale shark (TSSC 2015a). | This advice was reviewed during the assessment of potential impacts on the species. |
| Conservation Advice – Eastern curlew (TSSC 2015b). | This advice was reviewed during the assessment of potential impacts on the species. |
| Conservation Advice - Great knot (TSSC 2016). | This advice was reviewed during the assessment of potential impacts on the species. |
| Conservation Advice – Blind Gudgeon (TSSC 2008a). | This advice was reviewed during the assessment of potential impacts on the species. |

| | |
|---|---|
| Conservation Advice – Blind Cave Eel (TSSC 2008b). | This advice was reviewed during the assessment of potential impacts on the species. |

Table 7-1: Policy and Guidance Relevant to MNES

## 7.5 SUMMARY OF EXISTING ENVIRONMENTAL VALUES THAT RELATE TO MNES

This section provides a summary of the information relevant to MNES contained within various sections of this ERD including:

- Section 5.4 (Marine Fauna, including migratory birds).
- Section 5.6 (Subterranean Fauna).
- Section 5.7 (Terrestrial Fauna).
- Section 5.9 (Social Surroundings).

### 7.5.1 World Heritage Properties

The Ningaloo Coast World Heritage Area (Reference 1369) was inscribed on the World Heritage List on 1 November 2011. The adopted boundary includes the Ningaloo Marine Park (Commonwealth Waters), Ningaloo Marine Park (State Waters), Muiron Islands Marine Management Area (including the Muiron Islands), Jurabi Coastal Park, Bundegi Coastal Park, Cape Range National Park and Learmonth Air Weapons Range (Figure 2-12).

Ningaloo is recognised for its diverse and abundant marine life, its unique cave fauna and the contrast between the rugged landscapes of the Cape Range and the serene seascapes of the Ningaloo Coast (UNESCO 2019). The World Heritage values of the Ningaloo Coast are described in detail in Section 5.9.3.2.

The Proposal's onshore Development Envelope does not intersect any part of the Ningaloo Coast World Heritage Area. The Offshore Operations Area (Surface tow) intersects a portion of the marine component of the Ningaloo Coast World Heritage Area (Figure 2-12).

### 7.5.2 National Heritage Places

The Ningaloo Coast National Heritage Place covers approximately 710,000 ha, comprising Ningaloo Marine Park, Muiron Islands Marine Management Area (including the Muiron Islands), Jurabi Coastal Park, Bundegi Coastal Park, Cape Range National Park, Learmonth Air Weapons Range and portions of Exmouth, Ningaloo, Cardabia, Warroora, Gnaraloo, and Quobba Pastoral Leases (Figure 2-12).

The Development Envelope does not intersect any part of the Ningaloo Coast National Heritage Place. The Offshore Operations Area (Surface tow) intersects the marine component of the Ningaloo Coast National Heritage Place. The official values of the Ningaloo Coast are described in Section 5.9.3.2.

### 7.5.3 Listed Threatened Species, Communities, and Migratory Species

A number of marine studies have been undertaken within the region, as outlined in Table 7-2. Subsea 7 has augmented the information available as a result of these previous studies by commissioning additional, Proposal-specific studies, to ensure an appropriate level of information is available to support the completion of the environmental impact assessment and environmental management plans.

The Proposal-specific studies, as listed in Table 7-2, were undertaken by various technical specialists, and are included in full within Attachment 2. They are also referred to, as appropriate, in the assessment of potential impacts and proposed management measures.

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| Regional Surveys | | |
| 1998-1999 | Department of Conservation and Land Management (now DBCA) | North West Cape and Muiron Islands Marine Turtle Nesting Population Study |
| 2001 | Centre for Whale Research | Geographical and temporal movements of Humpback whales in Western Australian waters |
| 1994 | James Cook University | Aerial Survey (cetacean, dugong, turtle) of Exmouth Gulf and Ningaloo Reef |
| 1995-2004 | Centre for Whale Research | Humpback whale survey report for Exmouth Gulf (1995-2004) |
| 2004-2005 | Centre for Whale Research | Distribution and abundance of Humpback Whales and other mega-fauna in Exmouth Gulf during 2004/2005 |
| 2005 | Oceanwise | Review of the Dugong in Exmouth Gulf |
| 2004-2005 | Biota | Survey of migratory birds along eastern and southern shores of Exmouth Gulf |
| 2010 | Murdoch University | Vessel—based survey of inshore dolphins off the North West Cape |
| 2016 | University of Tasmania, Institute for Marine & Antarctic Studies, Curtin University | Aerial survey program to describe the distribution and abundance of Humpback whale calves within Ningaloo Marine Park |
| Annually | Birdlife Australia | Surveys of Exmouth Gulf shoreline |
| Site-specific Surveys | | |
| Marine Fauna | | |
| 2016 | 360 Environmental | Survey of benthic habitats off Heron Point |
| 2017 | 360 Environmental | Survey of benthic habitats within the Heron Point Local Assessment Unit (LAU) |
| 2017 | 360 Environmental | Opportunistic observations of marine fauna within and adjacent to the Heron Point LAU |
| 2017 | 360 Environmental | Survey of benthic habitats within the 'Bundle Laydown Area' |
| 2018 | MBS Environmental | Exmouth Gulf Benthic Communities and Habitat survey report |
| 2018 | Lyn Irvine | Aerial Humpback whale surveys (southern migration) |
| Migratory Birds | | |
| 2018-19 | Western Wildlife | Survey of the Bay or Rest North during southern migration and non-breeding seasons |
| Terrestrial Fauna | | |
| 2017 | 360 Environmental | Learmonth Level 1 Fauna Survey |
| Subterranean Fauna | | |
| 2017 | Bennelongia | Desctop review of subterranean fauna. |

| Survey Date | Researcher/Consultant | Study Description/Title |
|---|---|---|
| 2017 | Invertebrate Solutions | Desktop Assessment of subterranean fauna for the Learmonth Bundle Project |
| 2018-19 | Bennelongia | Subterranean fauna surveys |

Table 7-2: Overview of Studies Relevant to MNES

Based on reports produced by the EPBC Act Protected Matters Search Tool for the Proposal area (DoEE 2017a, 2017b), species profiles and recovery plans, the Conservation Values Atlas, the marine bioregional plan for the north west marine region (DSEWPaC 2012b) and regional and site-specific surveys, a number of listed threatened and migratory species, and 'other matters', may occur (Table 7-3).

For species likely to occur at Learmonth, within Exmouth Gulf or adjacent to the proposed Bundle tow route through Ningaloo Marine Park and into Commonwealth waters, a more detailed summary of the type of presence is provided in Sections 7.5.3.1 to 7.5.3.7 (see also Section 5.4.3). A more detailed summary of the potential impacts as a result of the Proposal is provided in Section 7.6.2.

| Scientific Name | Common Name | EPBC Listing | Comments | Type of Presence |
|---|---|---|---|---|
| Whales | | | | |
| *Megaptera novaeangliae* | Humpback whale | Vulnerable Migratory | Species known to pass Exmouth during the northern and southern migrations, mother and calf pairs known to rest in Exmouth Gulf during southern migration (CWR 2005, Jenner *et al.* 2001). Contemporary aerial survey programme completed for Proposal (Irvine 2019) | Known to Occur |
| *Balaenoptera borealis* | Sei whale | Vulnerable Migratory | Individuals may occur in the region on rare occasions. | Unlikely to Occur |
| *Eubalaena australis* | Southern right whale | Endangered Migratory | Sightings in more northern waters are relatively rare, but there have been records from Exmouth on the west coast (DoEE 2017g). Not recorded during surveys for the Proposal (Irvine 2019). | Unlikely to Occur |
| *Balaenoptera edeni* | Bryde's whale | Migratory | Species may occur in area. Small numbers recorded offshore of Proposal area during historic surveys. | Unlikely to Occur |
| *Balaenoptera musculus* | Blue whale | Endangered Migratory | On their northern migration pygmy blue whales come into the Perth Canyon in the period January to May, and then move up the coast passing Exmouth in the period April through to August before continuing north, with animals known to frequent Indonesian waters.<br>They tend to pass along the shelf edge at depths of 500 m out to 1000 m, moving faster on the southern migration and coming in close to the coast in the Exmouth – Montebello Islands area (McCauley and Jenner 2010). | Unlikely to Occur |
| *Balaenoptera physalus* | Fin whale | Vulnerable Migratory | Individuals may occur in the region on rare occasions but there have been no published reports of this species off Exmouth. | Unlikely to Occur |
| *Physeter macrocephalus* | Sperm whale | Migratory | Individuals may occur in the region on rare occasions but there have been no published reports of this species off Exmouth. | Unlikely to Occur |

| Scientific Name | Common Name | EPBC Listing | Comments | Type of Presence |
|---|---|---|---|---|
| *Orcinua orca* | Killer whale | Migratory | In Western Australia, Orcas are known to frequent the colder, southern waters near Albany. In 2014 a group of up to 27 killer whales were reported to be resident in the Exmouth Gulf for up to two months each year (ABC 2014). Species not recorded during surveys for the Proposal. | May Occur |
| Dolphins | | | | |
| *Sousa sahulensis* *(previously named Sousa chinensis)* | Australian humpback dolphin | Migratory | Species or species habitat likely to occur in area. Dolphins were observed during surveys (but species not identified). | Likely to Occur |
| *Tursiops aduncus* | Indo-pacific bottlenose dolphin | Migratory | Species or species habitat likely to occur in area. Dolphins were observed during surveys (but species not identified). | Likely to Occur |
| Marine Turtles | | | | |
| *Carretta caretta* | Loggerhead turtle | Endangered Migratory | Major nesting at Muiron Islands (150 to 350 females breeding per year) and the beaches of the North West Cape (50 to 150 females breeding per year) (DoEE 2017f) | Known to Occur |
| *Chelonia mydas* | Green turtle | Vulnerable Migratory | The Green turtle is the most common to the Ningaloo region (Preen *et al*. 1997). No nesting activity has been recorded on beaches of the Exmouth Gulf, however the mangrove creeks and vegetated shallows of the east coast of the Exmouth Gulf are an important nursery for this species (Oceanica 2006). | Known to Occur |
| *Eretmochelys imbricata* | Hawksbill turtle | Vulnerable Migratory | Hawksbill turtles nest on the Muiron Islands, located approximately 30 km off the coast of Exmouth. Feeding areas for this species potentially occur as far south as Shark Bay (DoEE 2017e). The species was recorded from Sandalwood Peninsula (located at the bottom of Exmouth Gulf) between 1990-1998 (Oceanica 2006). | Known to Occur |
| *Dermochelys coriacea* | Leatherback turtle | Endangered Migratory | There are no records of Leatherback turtles nesting in Western Australia. Furthermore the area is not known as a foraging ground or a nursery. It is unlikely that this species occurs in the Exmouth Gulf (Oceanica 2006). | Unlikely to Occur |

| Scientific Name | Common Name | EPBC Listing | Comments | Type of Presence |
|---|---|---|---|---|
| *Natator depressus* | Flatback turtle | Vulnerable Migratory | No nesting sites or rookeries have been recorded in the Exmouth Gulf (DoEE 2017c). Some data on foraging distribution comes from bycatch, with three adult turtles having been caught in trawler nets from the top half of the Exmouth Gulf (Oceanica 2006). An internesting habitat buffer is mapped across the northern end of Exmouth Gulf and to the west (DoEE 2018a). | May Occur |
| Other Marine Fauna | | | | |
| *Dugong dugon* | Dugong | Migratory | Species or species habitat known to occur in Exmouth Gulf. Species was recorded during surveys. Foraging habitat not present in proximity to Bundle tow route. | Known to Occur |
| *Rhincodon typus* | Whale shark | Vulnerable Migratory | Whale sharks aggregate close to the Ningaloo Reef from late March to early May following the mass spawning of coral when there is an abundance of food in the form of planktonic larvae and schools of small fish in the waters adjacent to the reefs. Whale Sharks have been sighted within the northern end of Exmouth Gulf (Oceanica 2006). Not recorded within Exmouth Gulf during surveys undertaken for the proposal (Irvine 2019). | Known to Occur |
| *Carcharias taurus* | Grey nurse shark (west coast population) | Vulnerable | The Grey nurse shark (west coast population) is predominantly found in the south west coastal waters of Western Australia but has been recorded as far north as the North West Shelf (DoEE 2017h). There have been occasional sightings of this species near Exmouth and the Muiron Islands (DoEE 2017h). A study of footage from a camera deployed at the Point Murat Navy Pier in Exmouth, 8 km west of the Bundle tow route, recorded 16 *C. taurus* individuals and suggested that the systematic nature of visitations by individual sharks, over a number of years, qualifies the location as a noteworthy aggregation site (Hoschke and Whisson 2016). | Known to Occur |

| Scientific Name | Common Name | EPBC Listing | Comments | Type of Presence |
|---|---|---|---|---|
| *Carcharodon carcharias* | Great white shark | Vulnerable Migratory | Great white sharks are widely, but not evenly, distributed in Australian waters. Tagging of sharks suggests that the species is highly mobile and movement is often seasonal. In Western Australia tagging has shown the species to move north during spring and return south during summer (DoEE 2017i). The aggregation of calving Humpback whales may attract Great white sharks to the Exmouth Gulf (Oceanica 2006). For this reason, it is possible that the Great white shark may occasionally forage within the Exmouth Gulf and to the north and west. | Unlikely to Occur |
| *Pristis clavata* | Dwarf sawfish, Queensland sawfish | Vulnerable, migratory | There are no known records of the Dwarf sawfish occurring within the Exmouth Gulf (DoEE 2017j). Surveys of Dwarf sawfish have previously encountered individuals over fine substrates (mainly silt) in river channels. There is a low likelihood of this species occurring in Exmouth Gulf. | Unlikely to Occur |
| *Pristis zijsron* | Green sawfish, Dindagubba, Narrowsnout sawfish | Vulnerable Migratory | Green sawfish occur in inshore coastal environments including estuaries, river mouths, embayments and along sandy and muddy beaches, as well as offshore marine habitat (DoE 2015b). They have been recorded in very shallow water (< 1 m) to offshore trawl grounds in over 70 m of water (DoEE 2017k). The Ashburton River estuary is currently the only identified pupping site and nursery for Green Sawfish (Morgan *et al*. 2016). While individuals may occur in Exmouth Gulf, they are considered unlikely to occur in proximity to Heron Point or the proposed tow route. | Unlikely to Occur |
| *Anoxypristis cuspidata* | Narrow sawfish | Migratory | It is possible that the species may occasionally utilise shallow waters within Exmouth Gulf. | Unlikely to Occur |
| *Aipysurus apraefrontalis* | Short-nosed seasnake | Critically Endangered | The Short-nosed seasnake is endemic to Western Australia, and has been recorded in Exmouth Gulf, Western Australia (DoEE 2017l) | May Occur |
| Marine fish | | | | |
| *Manta alfredi* | Reef manta ray, Coastal manta ray, | Migratory | Single individuals have been recorded in Exmouth Gulf during studies undertaken for the Proposal (Attachment 2J). | Known to Occur |

| Scientific Name | Common Name | EPBC Listing | Comments | Type of Presence |
|---|---|---|---|---|
| | Inshore manta ray | | | |
| *Manta birostris* | Giant manta ray, Chevron manta ray | Migratory | Recorded off the North West Cape, likely to occasionally enter the northern portion of the Gulf.<br><br>Single individuals have been recorded in Exmouth Gulf during studies undertaken for the Proposal (Attachment 2J). | Known to Occur |
| *Halicampus grayi* | Mud pipefish | Marine | Recorded in Exmouth Gulf (Kangas *et al.* 2006a) | Known to Occur |
| *Hippocampus zebra* | Zebra seahorse | Marine | Recorded in Exmouth Gulf (Kangas *et al.* 2006a) | Known to Occur |
| *Hippocampus angustus* | Narrow-bellied seahorse | Marine | Recorded in Exmouth Gulf (Kangas *et al.* 2006a) | Known to Occur |
| Migratory birds | | | | |
| *Calidris canutus* | Red Knot, Knot | Endangered Migratory | Not recorded within the 'Bay of Rest North' survey area (including Heron Point) during southern migration survey or non-breeding season survey (Attachment 2K) | May Occur |
| *Calidris tenuirostris* | Great knot | Critically Endangered Migratory | Two individuals recorded within the 'Bay of Rest North' survey area (including Heron Point) during surveys (Attachment 2K) | Known to Occur |
| *Calidris ferruginea* | Curlew sandpiper | Critically Endangered Migratory | Not recorded within the 'Bay of Rest North' survey area (including Heron Point) during southern migration survey or non-breeding season survey (Attachment 2K) | May Occur |
| *Limosa lapponica baueri* | Bar-tailed godwit (baueri) | Vulnerable Migratory | Exmouth Gulf is known as an area of international conservation significance (numbers greater than 1% of the flyway population) for this species. | Known to Occur |
| *Limosa lapponica menzbieri* | Northern Siberian bar-tailed godwit | Critically Endangered Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (Attachment 2K) | Known to Occur |
| *Numenius Madagascar-iensis* | Eastern curlew | Critically Endangered Migratory | Exmouth Gulf is known as an area of international conservation significance (numbers greater than 1% of the flyway population) for this species. | Known to Occur |

| Scientific Name | Common Name | EPBC Listing | Comments | Type of Presence |
|---|---|---|---|---|
| *Sternula nereis nereis* | Australian fairy tern | Vulnerable | Not recorded within the 'Bay of Rest North' survey area (including Heron Point) during southern migration survey or non-breeding season survey (Attachment 2K). | May Occur |
| *Pandion haliaetus* | Eastern osprey | Migratory | Single individual recorded within the 'Bay of Rest North' survey area (including Heron Point) during southern migration survey (Attachment 2K) | Known to Occur |
| *Tringa brevipes* | Grey-tailed tattler | Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (Attachment 2K) | Known to Occur |
| *Tringa nebularia* | Common greenshank | Migratory | It occurs around most of the coast from Cape Arid in the south to Carnarvon in the north west. Sites of international importance in Australia include Eighty Mile Beach and Roebuck Bay in WA (DoEE 2018c). Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (Attachment 2K) | Known to Occur |
| *Actitis hypoleucos* | Common sandpiper | Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (Attachment 2K) | Known to Occur |
| *Charadrius leschenaultii* | Greater sand plover | Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (K) | Known to Occur |
| *Pluvialis squatarola* | Grey plover | Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (Attachment 2K) | Known to Occur |
| *Charadrius veredus* | Oriental plover | Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (Attachment 2K) | Known to Occur |
| *Pluvialis fulva* | Pacific golden plover | Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (Attachment 2K) | Known to Occur |
| *Calidris ruficollis* | Red-necked stint | Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (Attachment 2K) | Known to Occur |
| *Arenaria interpres* | Ruddy turnstone | Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (Attachment 2K) | Known to Occur |
| *Calidris alba* | Sanderling | Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (Attachment 2K) | Known to Occur |
| Numenius phaeopus | Whimbrel | Migratory | Small numbers recorded within the 'Bay of Rest North' survey area (including Heron Point) (Attachment 2K) | Known to Occur |

| Scientific Name | Common Name | EPBC Listing | Comments | Type of Presence |
|---|---|---|---|---|
| Terrestrial Fauna | | | | |
| *Dasyurus hallucatus* | Northern quoll, Digul | Endangered | Not known to occur within region. | Unlikely to Occur |
| *Petrogale lateralis lateralis* | Black-flanked rock-wallaby, Moororong, black-footed | Endangered | Known to occur across the North West Cape, unlikely to occur within the Development Envelope. | Unlikely to Occur |
| *Rhinonicteris aurantia* (Pilbara form) | Pilbara leaf-nosed bat | Vulnerable | Given the lack of records for this species in the area (and region) and the lack of suitable habitat, the Pilbara leaf-nosed bat is considered unlikely to occur. | Unlikely to Occur |
| *Pezoporus occidentalis* | Night parrot | Endangered | There is an absence of nearby records and a very limited number of records in WA. The key habitats for the Night Parrot are thought to be chenopod shrublands and spinifex grasslands, with the chenopod shrublands a refuge during dry conditions (Garnett *et al*. 2011). Nesting sites are in mature spinifex, often large ring-forming clumps (DPAW 2017). Foraging habitats are likely to vary across Australia, but include herbs, grasses, grass-like plants, *Sclerolaena* spp. and other chenopods (DPAW 2017). Given the absence of regional records and of key habitat, the Night parrot is considered unlikely to occur. | Unlikely to Occur |
| Subterranean Fauna[17] | | | | |
| *Milyeringa veritas* | Blind gudgeon | Vulnerable | The nearest species records are from habitat is 8.5 km west of the Development Envelope (DoEE 2017m). The stygofauna surveys undertaken for the Proposal did not collect the Blind gudgeon (*Milyeringa veritas*). Based on known geology and salinity levels, it is not expected that the Blind gudgeon will be present in the main Development Envelope, but could be present within the proposed borefield area (Attachment 2O). | Possible |

[17] The initial PMST search did not return any subterranean fauna species as possibly occurring within the Proposal area (using a 1 km buffer on the Development Envelope) (DoEE 2017m). A second PMST search, using a 40 km buffer, returned two subterranean fish species as possibly occurring; the Blind cave eel (*Ophisternon candidum*) and the Blind gudgeon (*Milyeringa veritas*).

| Scientific Name | Common Name | EPBC Listing | Comments | Type of Presence |
|---|---|---|---|---|
| *Ophisternon candidum* | Blind cave eel | Endangered | The nearest species records are from 23 km north of the Development Envelope (DoEE 2017n). The species has been recorded from a total of 18 locations across the North West Cape, on Barrow Island and Bungaroo Creek in the Pilbara (Moore *et al*. 2018). The stygofauna surveys undertaken for the Proposal did not collect the Blind cave eel (*Ophisternon candidum*). Based on known geology and salinity levels, it is not expected that the Blind gudgeon will be present in the Development Envelope, but could be present within the proposed borefield area (Attachment 2O). | Possible |

Table 7-3: Listed Threatened, Migratory and Marine Species Present or Likely to be Present Within Exmouth Gulf

#### 7.5.3.1 Cetaceans

Humpback Whale

The migration of Humpback whales (*Megaptera novaeangliae*) both north and south past Exmouth Gulf follows predictable but complicated patterns each season.

Aerial surveys were completed in 2018, between early August and early November (Irvine 2019, Attachment 2J). A total of 1,661 pods, consisting of 2,772 whales, were recorded (Figure 5-21). Of the whales recorded, a total of 688 were calves (Attachment 2J). Humpback whale numbers were relatively low (approximately 100) during the first half of August before increasing to a maximum of approximately 750 by mid-September (Figure 5-22). From this peak, numbers rapidly declined to approximately 50 by early November (Figure 5-22). Humpback whales were first observed within Exmouth Gulf and to the north in late July 2019 (Lyn Irvine pers comm. 2018a).

Australian Humpback Dolphin

Australian humpback dolphins (*Sousa sahulensis*) (previously named the Indo-Pacific humpback dolphin (*Sousa chinensis*)) have been sighted in clear waters over Ningaloo Reef, and in turbid waters in Exmouth Gulf and in depths ranging from 1 to 40 m deep (Parra & Cagnazzi 2016). Hunt *et al*. (2017), in a study of Australian humpback dolphins around the North West Cape, recorded a total of 145 humpback dolphin schools (sizes 1 to 19 individuals) and estimated a super-population size (the total number of animals that theoretically used the study area during the course of the study) of 129 humpback dolphins.

Indo-pacific Bottlenose Dolphin

In Australia, the Indo-Pacific bottlenose dolphin (or Spotted bottlenose dolphin) (*Tursiops aduncus*) is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands.

As part of broader studies estimating genetic connectivity for three coastal delphinids (Indo-Pacific bottlenose dolphins, Australian snubfin dolphins, and Australian humpback dolphins) across north-western Australia, photo-identification images of Indo-pacific humpback dolphin groups were obtained off the North West Cape from Ningaloo Reef to Exmouth. Preliminary results identified 53 adult and juveniles and six calves over approximately 80 km of coastline around the Cape. The North West Cape, Exmouth, represents the south western limit of the species' Australian distribution (Bejder *et al*. 2011).

All Dolphins

During aerial surveys undertaken in 2004/2005 dolphins (likely Indo-pacific bottlenose dolphins or Indo-pacific humpback dolphins as identified from boat observations) were sighted on all but three of the flights. A total of 359 dolphins in 109 pods were sighted. Dolphin pods were widely distributed in the Gulf and were found in average depths of approximately 10 m (Centre for Whale Research 2005).

Aerial surveys undertaken in 2018, between early August and early November (Irvine 2019, Attachment 2J) recorded a total of 556 dolphins within Exmouth Gulf, widely distributed across the whole survey area (Figure 5-23).

#### 7.5.3.2 Dugong

Exmouth Gulf and Ningaloo Reef have been identified as biologically important areas, year round, for Dugong foraging and nursing (DSEWPAC 2012b).

Quantitative surveys of Exmouth Gulf resulted in population estimates of 1,062 in 1989 (Grech and Marsh 1994), 1,006 in 1994 (Preen *et al*. 1997) and 174 in 1999 (Gales *et al*. 2004). Quantitative aerial surveys in 2004 indicated a minimum Dugong population estimate of approximately 1,000 individuals in Exmouth Gulf during winter (Oceanwise 2005). An additional survey in 2007 estimated numbers in excess of the 1989 and 1994 estimates (Hodgson *et al*. 2007).

Dugong activity is thought to be focused on the east coast of the Gulf associated with the shallow seagrass habitat in this area (Figure 5-25), but there is a lack of understanding regarding fine-scale movements and the importance of various habitats for resting, breeding or feeding (Oceanwise 2005).

Aerial surveys undertaken in 2018, between early August and early November (Irvine 2019, Attachment 2J) recorded a total of 605 Dugong within Exmouth Gulf, predominantly adjacent to the eastern and southern shorelines (Figure 5-26).

#### 7.5.3.3 Marine Turtles

<u>Flatback Turtles</u>

The Flatback turtle (*Natator depressus*) is a locally abundant breeding species, frequently nesting on beaches on the mainland and offshore islands, ranging from the east coast of Barrow Island to Torres Strait and the Great Barrier Reef (Prince 1993, DEWHA 2008). Approximately a third of the Pilbara population (approximately 700 individuals) nests on Barrow Island (EPA 2006).

Surveys undertaken for the Wheatstone Project, to determine the presence of nesting along the beaches north of Locker Point, recorded no evidence of current or prior nesting between Locker Point and Urala. Similarly no evidence of current or prior nesting was recorded along Onslow Back Beach (Pendoley Environmental 2009). No evidence of Flatback turtle nesting on the Muiron Islands was recorded in 1998/1999, and only two nesting female Flatback turtles had previously been recorded at South Muiron Island (Prince 1999).

<u>Green Turtles</u>

The Western Australian population of Green turtles (*Chelonia mydas*) numbers in the tens of thousands, with the principal rookeries in the Lacepede Islands, some islands in the Dampier Archipelago, Barrow Island, Montebello Islands, and at North West Cape (DEC 2009). It was estimated that approximately 7,000 to 9,000 live around the North West Cape (Preen *et al*. 1997).

At South Muiron Island, over the period 1998 to 1991, a total of 961 Green turtles were tagged while visiting the island to nest (Prince 1999). Aerial surveys have shown that turtles occur throughout Exmouth Gulf, with densities greatest in the shallow southern and eastern portions of the Gulf. The majority of animals sighted were identified as Green turtles (Oceanwise 2005, Oceanica 2006). This is consistent with the general understanding that it is Green turtles that predominantly utilise Exmouth Gulf, with smaller individuals being more abundant than larger animals. Nesting by Green turtles within Exmouth Gulf is very rare (Lyn Irvine, pers comm. 2018b).

Hawksbill Turtles

On the North West Shelf key rookeries of Hawksbill turtles (*Eretmochelys imbricata*) include Rosemary Island and Varanus Island. At South Muiron Island, over the period 1998 to 1991, a total of 10 Hawksbill turtles have been tagged while visiting the island to nest (Prince 1999). Hawksbill turtles also nest around the western side of the North West Cape (Prince 1999).

Loggerhead Turtles

In Western Australia nesting by Loggerhead turtles (*Caretta caretta*) occurs from Shark Bay (including on the mainland near Steep Point) to the North West Cape with major nesting at Dirk Hartog Island (800 to 1500 females breeding per year); Gnaraloo Bay (estimated 61-84 (range 38-211) females breeding per year); Muiron Islands (150 to 350 females breeding per year); and the beaches of the North West Cape (50 to 150 females breeding per year) (Baldwin *et al*. 2003, Prince 1994).

South Muiron Island is known as a significant Loggerhead turtle rookery with an annual nesting population of 150-350 females (Baldwin *et al*. 2003). Over the period 1998 to 1991, a total of 772 Loggerhead turtles were tagged while visiting the island to nest (Prince 1999). It was reported that a number of the Loggerhead turtles were known to feed within Shark Bay but also in Indonesia and the Northern Territory (Prince 1999).

All Turtle Species

Aerial surveys undertaken in 2018, between early August and early November (Irvine 2019, Attachment 2J) recorded a total of 1472 marine turtles within Exmouth Gulf, predominantly adjacent to the eastern and southern shorelines (Figure 5-29).

#### 7.5.3.4 Whale Shark

Whale sharks (*Rhincodon typus*) travel to Ningaloo Marine Park between March and July every year, with individuals sometimes remaining until early August (DPaW 2013, DoF 2011).

The Whale shark abundance at Ningaloo Reef has been modelled by two studies. Meekan *et al*. (2006) estimated the total population size to be 319 to 436 sharks (between the years 1992 and 2004), and Holmberg *et al*. (2009) estimated the annual abundance to vary between 86 and 143 sharks (between the years 2004 to 2007). Whale shark abundance at Ningaloo has been shown to correlate with the Southern Oscillation Index and several other oceanographic variables, which potentially relate to the strength of ocean currents and local productivity (Sleeman *et al*. 2010). Whale sharks exhibit high individual fidelity to the Ningaloo Reef area during the autumn/winter, with individuals often re-sighted in the area over consecutive years (Reynolds *et al*. 2017).

#### 7.5.3.5 Migratory Birds

Migratory shorebirds are the 37 species listed in EPBC Act Policy Statement 3.21 (DoEE 2017a). These species are listed under the EPBC Act and regularly visit Australia on their migration. The migratory shorebirds that visit Australia are from the East Asian–Australasian (EAA) flyway. The EEA Flyway, stretching from Siberia and Alaska to Australia and New Zealand, is a geographic region supporting populations of migratory waders during annual migrations (Bamford *et al*. 2008, DEWHA 2008). It is one of eight major flyways recognised around the world and is used by about 8 million waders of 54 different species (Bamford *et al*. 2008). Sites considered internationally important to migratory waders are those that regularly support 1% or more of the flyway population of a species or that are known to regularly support more than 20,000 waders in total (Ramsar Convention 2000). A 'staging criterion' of 0.25% of the EAA Flyway population, which takes account of the expected turnover of migratory birds at a site during migratory periods, is also relevant.

Exmouth Gulf and the broader region are likely to be used by a range of migratory bird species that travel seasonally between Australia and northern Asia. Migratory birds, including waders, undertake annual migrations of thousands of kilometres between their breeding areas in the Arctic and their non-breeding areas in Australasia, Africa and South America (Bamford *et al*. 2008). Southward migration to non-breeding grounds in the southern hemisphere typically occurs from September to November. Waders spend summer in the non-breeding habitats (December to February), feeding intensively on invertebrates to build up stores of fat and protein in preparation for migration back to the Arctic (Bamford *et al*. 2008, Priest *et al*. 2002). Northward migration to the Arctic breeding grounds takes place between March and April, and waders capitalise on the abundant food supply during the Arctic summer (Bamford *et al*. 2008).

Under the Shorebird 2020 Program annual counts are completed at over 150 key shorebird areas around Australia, including Exmouth Gulf. Along the eastern shore of Exmouth Gulf the 'Exmouth Gulf Mangroves' Important Bird Area (IBA) has been defined. This area, covering 42,000 ha, has been nominated as an IBA primarily due to the seasonal abundance of the Pied Oystercatcher, Grey-tailed Tattler and Dusky Gerygone (Birdlife Australia 2018).

During three surveys of the eastern and southern shores of Exmouth Gulf a total of over 200,000 coastal birds were recorded with the following species present in numbers greater than 1% of the flyway population (Biota 2005):

- Grey-tailed tattler.
- Bar-tailed godwit.
- Ruddy turnstone.
- Sanderling.
- Greater sand plover.

During a survey of migratory shorebirds within the Shorebird2020 'Bay of Rest North' survey area, which includes Heron Point and the coastal section of the Development Envelope, in October 2018, during the southward migration, 345 birds were recorded roosting at high tide. A total of 179 were migratory shorebirds, the most common being Red-capped plover (105), Greater sand plover (75) and Grey-tailed tattler (31) (Western Wildlife 2019, Attachment 2K). No migratory shorebird recorded approached the 0.25% staging criterion or 1% population criterion for their species. A total of 76 birds were recorded at low tide of which 47 were migratory species (Attachment 2K). During a repeat survey in January 2019, during the non-breeding season, 439 birds were recorded roosting at high tide. A total of 155 were migratory shorebirds, the most common being Red-capped plover (121), Greater sand plover (67) and Grey-tailed tattler (27) (Western Wildlife 2019, Attachment 2K). No migratory shorebird recorded approached the 0.25% staging criterion or 1% population criterion for their species. A total of 153 birds were recorded at low tide of which 78 were migratory species (Attachment 2K).

During these surveys, no counts of any migratory species exceeded the internationally or nationally significant criteria of 1% or 0.1% of the flyway population. Total counts of migratory shorebirds were well below the internationally significant threshold of 20,000 birds and the nationally significant threshold of 2,000 birds. No more than 13 migratory shorebird species were recorded in each survey, less than the > 15 species that indicates a nationally important site (Attachment 2K). Two threatened species were noted as occurring, or likely to occur, within the Bay of Rest North (Attachment 2K):

- The Great knot (listed as Critically Endangered) – single birds roosting during each survey and two birds recorded foraging in October 2018.
- The Eastern curlew (listed as Critically Endangered) – not recorded during surveys but small numbers (2 to 20 birds) have previously been recorded in the Bay of Rest. This species favours sheltered coasts with large intertidal mudflats or sandflats for foraging. The low nearby counts and generally exposed habitat suggest that Heron Point is unlikely to be favoured by the Eastern curlew (Attachment 2K).

#### 7.5.3.6 Terrestrial Fauna

No EPBC Act listed fauna are expected to occur within or adjacent to the Development Envelope.

#### 7.5.3.7 Subterranean Fauna

The three stygofauna sampling bores in or adjacent to the mapped Directory of Important Wetlands 'Cape Range Subterranean Waterways – WA006' did not yield any stygofauna (Attachment 2O).

The surveys did not collect either the Blind cave eel (*Ophisternon candidum*) or the Blind gudgeon (*Milyeringa veritas*). Both species are listed as Vulnerable under the EPBC Act and occur on the western and eastern sides of the North West Cape. The current most southerly known records on the eastern side of the Cape Range Peninsula are from Mowbowra Well, approximately 10 km south of Exmouth (Humphreys and Adams 1991). Based on known geology and salinity levels, it is not expected that the Blind cave eel and Blind gudgeon will be present in the Development Envelope. The fresher goundwater, observed presence of karst on the surface and collection of *Stygiocaris stylifera* are indications that habitat in the proposed borefield is similar to that from which the Blind cave eel and Blind gudgeon are known to occur. Thus, it remains possible that the Blind cave eel and Blind gudgeon eel and gudgeon occur in the borefield or its vicinity (Attachment 2O).

### 7.5.4 Commonwealth Marine Areas

The Commonwealth Marine Area is defined in the EPBC Act as any part of the sea, including the waters, seabed, and airspace, within Australia's Exclusive Economic Zone and/or over the continental shelf of Australia. Generally, the Commonwealth Marine Area stretches from the territorial sea baseline to the outer limit of the Exclusive Economic Zone, 200 nautical miles from the baseline.

Key environmental impacts required to be assessed for Commonwealth Marine Areas are:

- Establishment of pest species.
- Impact on marine ecosystem functioning or integrity.
- Effect on a population of a marine species.
- Substantial change in water quality.
- Accumulation of potentially harmful chemicals in the marine environment; and
- Impact on heritage values.

These are assessed in Section 7.6.3.

## 7.6 ASSESSMENT OF POTENTIAL IMPACTS ON MNES

### 7.6.1 World Heritage Area and National Heritage Place

World and Nationally listed heritage places are protected under the EPBC Act and therefore considered MNES. Impacts to the World and National Heritage Places are discussed in Table 7-4 below. Impacts are assessed against each of the heritage-listing criteria. The Ningaloo Coast WHA is listed under criteria (vii) and (x). The Ningaloo Coast National Heritage Place is listed on the Australian National Heritage List under criteria A, B, C, D, F for significant natural and indigenous values.

It is noted that the WHA and Ningaloo Coast National Heritage Place cover the same geographical area, and only the offshore component of the Proposal will intersect the area between the northern-most tip of the peninsula and the Murion Islands (Figure 2-12). Therefore, no impacts to onshore geological formations, subterranean ecosystems terrestrial elements, or archaeological artefacts will occur.

The Proposal will intersect the WHA and Ningaloo Coast National Heritage Place only during Bundle tow operations, which will occur a maximum of three times a year. It is expected that the flotilla of tugs, support vessels and the Bundle itself will enter and exit the WHA and Ningaloo Coast National Heritage Place within 3 hours 48 mins per launch. There will however be a 500 m exclusion zone surrounding the defined Bundle tow route in place for six hours in the WHA and Ningaloo Coast National Heritage Place. The Bundle will be towed at the surface through the WHA and Ningaloo Coast National Heritage Place.

| Criterion | Potential Impacts to Natural & Indigenous Values | Assessment of Impacts |
|---|---|---|
| Ningaloo Coast World Heritage Area | | |
| vii) Contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance. | Impacts to amenity values (including visual landscape, scenic and visual aesthetic values and recreational tourism) in a marine park. | The estimated time the Bundle and associated vessels will take to travel through the Ningaloo WHA is 3 hours 48 mins per launch. This equates to a 0.27% impact per year (based on 12 hours of daylight and three Bundle launches a year). It is noted that other vessels are currently present within the WHA, including prawn trawlers, heavy lift crane vessels and FPSO vessels, so the Proposal represents an incremental increase (or even a decrease) to vessel activity in the area.<br><br>In further assessing potential impacts to the visual landscape, scenic and visual aesthetic values of the WHA, a viewshed analysis from the Vlamingh Head Lighthouse was undertaken (Attachment 2S). This vantage point has uninterrupted views of the sea across the WHA, is a popular tourist destination and is the highest point on the northern end of the peninsula (and therefore has the largest zone of theoretical visibility (ZTV)). The viewshed analysis suggests that the following components of the project will be visible:<br>• A 55.7 km section of the proposed tow route (of which 25.4 km is within the World Heritage Area).<br>• A section of the Bundle Parking area.<br><br>The proposed Surface tow of the Bundle occurs at approximately 5-6 knots (up to a maximum of 8 knots). The Bundle and tow/ support vessels should only be visible from Vlamingh Head Lighthouse for approximately 18 hours 21 minutes per tow (including time taken for submerged weight checks within the Bundle Parking area). The total visible time of 18 hours 21 mins is considered insignificant when considering the total daylight hours per year (approximately 0.42% impact per launch).<br><br>From this location towards the north west end of the peninsula the |

| Criterion | Potential Impacts to Natural & Indigenous Values | Assessment of Impacts |
|---|---|---|
| | | proposed Bundle tow visual presence is similar in character to existing vessel activity (though less frequent) and offshore oil platforms. It is significantly less visually intrusive than the Harold E. Holt Naval Communications Station. Photomontages of the visual impact from Vlamingh Head can be seen in Attachment 2S.<br><br>Tourism activities in the WHA are not expected to be significantly impacted by the Proposal. There will be a 6 hour (500 m) exclusion zone in place during a Bundle tow in the WHA, which equates to up to 18 hours per year. Travel to or from the Muiron Islands will be unaffected, except during the short 6 hour period, during which vessels will need to detour up to 10 km for access between the North West Cape and the Muiron Islands. Bundle tows and necessary exclusion zones will be broadly communicated well in advance to avoid any inconvenience.<br><br>The Humpback whale tour season runs from early August to late October. Bundle launches will not occur during the peak humpback whale migration period as a 'no launch' period will be enforced during August to October. Therefore whale-watching tourism in the WHA will not be significantly impeded. The Whale shark tour season runs from March to August, with most (if not all) tours operating on the western side of the North West Cape (away from the Bundle tow operations). Some of the key diving locations within the Ningaloo WHA are Exmouth Navy Pier, Murion Islands, Lighthouse Bay sanctuary area, Bundegi Reef and locations along the Ningaloo Reef (Ningaloo Visitor Centre 2018b). These locations are not likely to be inhibited by the Bundle tow operations as they do not intersect, or lie close to, the Bundle tow route or associated exclusion zone.<br><br>Notification of a proposed launch will be announced via a Temporary Notice to Mariners and supplementary notifications with the support of AMSA (Australian Maritime Safety Authority). Notification will also be |

| Criterion | Potential Impacts to Natural & Indigenous Values | Assessment of Impacts |
|---|---|---|
| | | directly sent to all commercial and recreation operators via a mailing list, to which any stakeholder may register. Details of the launch and exclusion zones will be advertised in local media and on public noticeboards.<br><br>Given the infrequent and temporary, short-term nature of the Bundle tow, with up to three Bundle tows a year, the minor visual amenity impact, and the ability for tourism operators to continue the businesses virtually unimpeded, the Proposal is not likely to impact the natural beauty or aesthetic importance of the WHA. |
| x) Contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation. | Loss or degradation of BCH representing marine fauna habitat (e.g. breeding and or foraging habitat) during Bundle tow. | During the tow route through the Ningaloo WHA the chains hanging beneath the Bundle will not contact the seabed and therefore no impacts will occur to BCH.<br><br>Given the short-term nature of the tow operations and the lack of contact with the seabed through the Ningaloo Coast WHA, the Bundle tow operation is not impact natural habitats.<br><br>The risk of impact to Whale sharks and their contribution to the Ningaloo WHA (both for biodiversity and aesthetic values) are considered to be low since:<br>• The Whale shark tour season runs from March to August, with most (if not all) tours operating on the western side of the North West Cape (away from the Bundle tow operations).<br>• The tow length within the WHA is 25.4 km long and this portion of the tow will take approximately 3 hours, 48 mins to traverse. This equates to a potential impact for 0.27% of a year (based on 12 hours of daylight and three Bundle launches a year).<br>• Whale sharks are able to swim at relatively high speed and dive rapidly, thus allowing them to avoid an approaching vessel or Bundle. The Bundle tow speeds will be on average 5-6 knots (a |

| Criterion | Potential Impacts to Natural & Indigenous Values | Assessment of Impacts |
|---|---|---|
| | | maximum of up to 8 knots) thus minimising potential collisions.<br>• Risk of collision will be further mitigated by the use of a 'spotter plane' during bundle launches from March to July (inclusive). This will give the Bundle tow an early opportunity to adjust its route slightly in an attempt to avoid any sighted whale sharks.<br>• Tourism activities in the WHA are not expected to be significantly impacted by the Proposal. There will be a six hour (500 m) exclusion zone in place during a Bundle tow in the WHA, which equates to up to 18 hours per year. Travel to or from the Muiron Islands will be unaffected, except within the short six hour period, during which vessels will need to detour up to 10 km for access between the North West Cape and Muiron Islands.<br>Given the infrequent and temporary, short-term nature of the Bundle tow, with up to three Bundle tows a year and the ability for tourism operators to continue their businesses virtually unimpeded, the Proposal is not likely to impact on Whale Shark habitat or the tourism they generate.<br><br>The Proposal will not intersect the onshore boundaries of the Ningaloo WHA or the Ningaloo Coast National Heritage Place. Therefore, there will be no impacts to the subterranean ecosystems inscribed in the WHA as they occur on the western side of the peninsula. |
| Ningaloo Coast National Heritage Place | | |
| a) The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history. | Impacts to the heritage values of the Ningaloo Coast National Heritage Place.<br><br>Disturbance to Aboriginal heritage places and/or cultural associations within the area. | This criterion relates to wave cut terraces, fossil reefs and geological formations of the Exmouth Peninsula and subterranean and terrestrial ecosystems.<br><br>Since the Proposal will only intersect the offshore waters of the Ningaloo Coast National Heritage Place and will not contact the seabed, no impacts are expected. |

| Criterion | Potential Impacts to Natural & Indigenous Values | Assessment of Impacts |
|---|---|---|
| b) The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history. | Impacts to the heritage values of the Ningaloo Coast National Heritage Place. | This criterion specifically relates to the Bundera Sinkhole and the associated karst system that contributes to the understanding of Australia's natural history. These areas of the Ningaloo Coast National Heritage Place occur on the western side of the peninsula and will not be impacted by the Proposal. |
| c) The place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history. | Impacts to the heritage values of the Ningaloo Coast National Heritage Place.<br><br>Disturbance to Aboriginal heritage places and/or cultural associations within the area. | This criterion specifically relates to the groundwater and subterranean ecosystems of the Exmouth peninsula that contribute to the understanding of evolution and climate changes in Australia. It also relates to the historical indigenous values of the caves and rock shelters in the Cape Range.<br><br>The Development Envelope does not intersect the Cape Range or onshore areas of the Ningaloo Coast National Heritage Place and therefore no impacts are expected. |
| d) The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of:<br>(i) a class of Australia's natural or cultural places; or<br>(ii) a class of Australia's natural or cultural | Impacts to the heritage values of the Ningaloo Coast National Heritage Place. | This criterion relates specifically to the modern Ningaloo Reef, Exmouth peninsula karst, wave-cut terraces, limestone plains, reef sediments of the peninsula and associated marine, terrestrial and subterranean ecosystems (including the Muiron Islands) and their importance in contributing to the understanding of the evolutionary history of Australia.<br><br>The Proposal will not impact the onshore components of the WHA. The Bundle tow operations will intersect the waters of a portion of the marine/offshore Ningaloo Coast National Heritage Place, but the Bundle will not contact the seabed and therefore not impact any reef formations. |

| Criterion | Potential Impacts to Natural & Indigenous Values | Assessment of Impacts |
|---|---|---|
| environments. | | |
| f) The place has outstanding heritage value to the nation because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period. | Disturbance to Aboriginal heritage places and/or cultural associations within the area. | This criterion specifically relates to the indigenous values of the shell beads found at Mandu Mandu Creek rock shelter which provide evidence of the creative and technical achievement of indigenous people and therefore the Exmouth Peninsula is valued as having outstanding heritage value to Australia.<br><br>Mandu Mandu Creek and Gorge area is on the western side of the peninsula and therefore will not be impacted by the Proposal. The Proposal Development Envelope does not intersect any portions of the onshore components of the Ningaloo Coast National Heritage Place and therefore impacts are not expected for this criterion. |

Table 7-4: Assessment of Potential Impacts on World and National Heritage

### 7.6.2 Listed Threatened Species, Communities and Migratory Species

Numerous resources including the Conservation Values Atlas, the marine bioregional plan for the north west marine region (DSEWPaC 2012b), species profiles and statutory documents including recovery plans, threat abatement plans and approved conservation advice have been referred to in the assessment of potential impacts to listed species.

The '*Matters of National Environmental Significance Significant impact guidelines 1.2 Environment Protection and Biodiversity Conservation Act 1999*' (DoE 2013) list criteria that need to be addressed to determine whether a proposal has the potential to have a significant impact on MNES. The criteria for each listing are summarised in Table 7-5.

| EPBC Status | Criteria |
|---|---|
| *Critically Endangered and Endangered species* | An action is likely to significantly impact a critically endangered or endangered species if there is a real chance or possibility that it will:<br>• Lead to a long-term decrease in the size of a population.<br>• Reduce the area of occupancy of the species.<br>• Fragment an existing population into two or more populations.<br>• Adversely affect habitat critical to the survival of a species.<br>• Disrupt the breeding cycle of a population.<br>• Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.<br>• Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.<br>• Introduce disease that may cause the species to decline.<br>• Interfere with the recovery of the species. |
| *Vulnerable species* | An action is likely to significantly impact a vulnerable species if there is a real chance or possibility that it will:<br>• Lead to a long-term decrease in the size of an important population of a species.<br>• Reduce the area of occupancy of an important population.<br>• Fragment an existing important population into two or more populations.<br>• Adversely affect habitat critical to the survival of a species.<br>• Disrupt the breeding cycle of an important population.<br>• Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.<br>• Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.<br>• Introduce disease that may cause the species to decline.<br>• Interfere substantially with the recovery of the species. |

| EPBC Status | Criteria |
|---|---|
| *Migratory species* | An action is likely to significantly impact a migratory species if there is a real chance or possibility that it will:<br>• 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.<br>• Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.<br>• Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species. |

Table 7-5: Listed Threatened Species and Listed Migratory Species Significant Impact Criteria (DoE 2013)

The 'Significant impact guidelines for 36 migratory shorebird species' (DEWHA 2009) and 'EPBC Act Policy Statement 3.21 – Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species' (DoEE 2017a) provide significant impact thresholds for migratory shorebird species (Table 7-6). The thresholds are not designed to be prescriptive, but rather to clarify the level and type of impacts that may be significant at a national level, having regard for the biology, ecology and status of the species.

| Ecological Element Affected | Significant Impact Assessment | Comment |
|---|---|---|
| *Important habitat*<br><br>*(a site is defined as important habitat if it is internationally important or supports at least 0.1% of the EAA Flyway population of a species, at least 2,000 migratory shorebirds or at least 15 shorebird species)* | Loss of important habitat | The loss (for example, clearing, infilling or draining) of important habitat areas is likely to have a significant impact on migratory shorebirds when it results in a reduction in the capacity of the habitat to support migratory shorebirds. The magnitude of the impact may increase with the number of shorebirds using the area, the regional significance of the site and/or the extent to which the loss reduces carrying capacity. |
| | Degradation of important habitat leading to a substantial reduction in migratory shorebirds using the site | Defining substantial reduction will need to be made on a case-by-case basis. Factors to consider will include:<br>• The number of migratory shorebirds historically using a site (based on surveys and historical data). |
| | Increased disturbance leading to a substantial reduction in migratory shorebirds using important habitat | |
| | Direct mortality of birds leading to a substantial reduction in migratory | |

| Ecological Element Affected | Significant Impact Assessment | Comment |
|---|---|---|
| | shorebirds using important habitat | • Likely resultant changes in bird numbers and species diversity.<br>• Alterations to the value, quality, geographic extent of the site (for example, will the site still be classed as important habitat).<br>• The function and role of the site (roosting, foraging) and likely changes in ecology and hydrology.<br>• The regional and local context of the site.<br>• The nature, extent, duration of impacts, their likelihood and consequence. |

Table 7-6: Significant Impact Assessment for Migratory Shorebirds (DEWHA 2009, DoEE 2017a)

For listed Threatened or Migratory species likely or known to occur at Learmonth, or within Exmouth Gulf adjacent to the proposed Bundle tow route (refer Table 7-3), a summary of the potential impacts as a result of the Proposal is provided in the following sections.

#### 7.6.2.1 Assessment of Impacts to Vulnerable Species

An assessment of potential impacts to species listed as Vulnerable under the EPBC Act, against the significant impact criteria (DoE 2013), is provided in Table 7-7.

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| Lead to a long-term decrease in the size of an important population of a species | | | | | |
| Baseline and regional studies have identified Exmouth Gulf as a biologically important area for resting and nursery habitat from August to November for migrating Humpback whales and calves (DSEWPAC 2012b, Attachment 2J, Section 5.4.3.1).<br><br>The proposed Bundle tow route intersects the biologically important area, so there is potential for impact to mothers and calves during the southern migration.<br><br>The risk of impact is considered to be effectively mitigated through the proposed 'no launch period' (refer note beneath Table 5-22). The risk | Regional studies have identified that Whale sharks travel to Ningaloo Marine Park between March to July every year, with individuals sometimes remaining until early August (DPaW 2013, DoF 2011, Section 5.4.3.4). Whale sharks have been observed to utilise the north western portion of Ningaloo Marine Park during the peak season, moving southwards towards Coral Bay outside of season (Reynolds *et al*. 2017, Norman *et al*. 2017, Section 5.4.3.4).<br><br>In Australian waters, threats to the recovery of the species include boat strike from large vessels and habitat disruption from mineral | The Western Australian population of Green turtles numbers in the tens of thousands, with the principal rookeries being the Lacepede Islands, some islands in the Dampier Archipelago, Barrow Island, Montebello Islands, and at North West Cape (DEC 2009). It was estimated that approximately 7,000 to 9,000 live around the North West Cape (Preen *et al*. 1997).<br><br>Aerial surveys have shown that turtles occur throughout Exmouth Gulf, with densities greatest in the shallow southern and eastern portions of the Gulf (Figure 5-29). Green turtles are primarily herbivorous, | An important population does not occur within Exmouth Gulf.<br><br>At South Muiron Island, over the period 1991 to 1998, 10 Hawksbill turtles were tagged while visiting the island to nest (Prince 1999). Hawksbill turtles also nest around the western side of the North West Cape (Prince 1999, Section 5.4.3.3). Hawksbill turtles are thought to remain in the vicinity of their nesting beaches between nesting events (Pendoley Environmental 2010). They feed on sponges, algae, seagrasses, soft corals and shellfish | An important population does not occur within Exmouth Gulf.<br><br>A total of 16 individuals were recorded at the Navy Pier between 2007 and 2012, with ten individuals returning to the site over multiple years (Hoschke and Whisson 2016).<br><br>The Navy Pier population does not meet the 'aggregation site' criteria derived by Otway *et al*. (2003) and is unlikely to represent an important population.<br><br>The risk of impact is considered low | The main identified threats include sedimentation from mining and construction, canal development, water abstraction and point source pollution from sewage (TSSC 2008a).<br><br>The surveys did not collect the Blind gudgeon (*Milyeringa veritas*). Based on known geology and salinity levels, it is not expected that the Blind gudgeon will be present in the main Development |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| of impact to individual animals outside of the 'no launch period' is considered low given the:<br>• Small Bundle tow route disturbance footprint in relation to the available habitat.<br>• The low Bundle tow speeds during launch (≤ 2 knots) and tow (≤ 8 knots).<br>• Limited duration of Bundle launch and tow operations (<2 days).<br>• The limited frequency of Bundle launches (on average two, up to three, per annum).<br>• Low sound exposure level expected adjacent to Bundle tow vessels.<br><br>It is considered unlikely that any harm | exploration, production and transportation (TSSC 2015a). Key recommended conservation and management actions include:<br>• Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with Whale shark aggregations (including Ningaloo Reef.<br>Management of all domestic tourism industry interactions with Whale sharks in accordance with the Western Australian 'Whale Shark Management with particular reference to Ningaloo Reef' Wildlife Management Program No. 57 (TSSC 2015a).During migration Whale sharks spend most of their time within the first 15 m of the water column, so there | foraging on algae, seagrass and mangroves. Foraging habitat across the North West Shelf includes tidal/sub-tidal habitats with coral reef, mangrove, sand, rocky reefs and mudflats where there are algal turfs or seagrass meadows present (DoEE 2017d). It is generally understood that it is Green turtles that predominantly utilise Exmouth Gulf (Section 5.4.3.3).<br><br>The proposed Bundle tow route intersects an identified internesting area (DoEE 2015, Figure 5-28), so individuals may occur in the area. The BCH types present within and adjacent to the Offshore Operations Area (Figure 5-2) are not considered key foraging habitat. The risk of impact is considered low given | (Paladino and Morreale 2001, DoEE 2017e)<br><br>The proposed Bundle tow route intersects an identified internesting area (DoEE 2015, Figure 5-28), so low numbers of individuals may occur in the area. The BCH types present within and adjacent to the Offshore Operations Area (Figure 5-2) are not considered key foraging habitat. The risk of impact is considered low given the:<br>• Small Bundle tow route disturbance footprint.<br>• Lack of impacts to BCH representing key foraging habitat.<br>• The low Bundle tow speeds during launch (≤ 2 knots) and | given the:<br>• Lack of impacts to BCH representing key foraging habitat.<br>• The low Bundle tow speeds during launch (≤ 2 knots) and tow (≤ 8 knots).<br>• Limited duration of Bundle launch and tow operations (<2 days).<br>• The limited frequency of Bundle launches (on average two, up to three, per annum).<br>• The separation between the population and the Offshore Operations Area (8 km).<br>It is considered unlikely that any harm to individuals, leading to a decrease in the | Envelope, but it may be present in the proposed borefield area. The risk of a long—term decrease in the abundance of the population across the North West Cape is considered low given the minimal groundwater drawdown within the proposed borefield (modelling predicts a maximum drawdown in the immediate location of the production bores of 1.15 m after 10 years of continuous abstraction) and lack of other impacts. |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| to individuals, leading to a decrease in the population, will occur as a result of the implementation of the Proposal. | is a risk of collision from Bundle tow vessels and the Bundle chains. During foraging activity, Whale sharks spend approximately 25% of the time at depths of 2 metres or less and 40% of their time within the upper water column (15 metres or less) (DoEE 2016) so again there is a risk of collision from Bundle tow vessels and the Bundle chains.<br><br>The proposed Bundle tow route overlaps a congregation area identified for Whale sharks (Figure 5-30).<br><br>The risk of impact is considered low given the:<br>• Small Bundle tow route disturbance footprint in relation to the area of occurrence.<br>• The low Bundle tow speeds during launch (≤ 2 knots) and tow | the:<br>• Small Bundle tow route disturbance footprint.<br>• Lack of impacts to BCH representing key foraging habitat.<br>• The low Bundle tow speeds during launch (≤ 2 knots) and tow (≤ 8 knots).<br>• Limited duration of Bundle launch and tow operations (<2 days).<br>• The limited frequency of Bundle launches (on average two, up to three, per annum).<br><br>It is considered unlikely that any harm to individuals, leading to a decrease in the population, will occur as a result of the implementation of the Proposal. | tow (≤ 8 knots).<br>• Limited duration of Bundle launch and tow operations (<2 days).<br>• The limited frequency of Bundle launches (on average two, up to three, per annum).<br><br>It is considered unlikely that any harm to individuals, leading to a decrease in the population, will occur as a result of the implementation of the Proposal. | population, will occur as a result of the implementation of the Proposal. | |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| | (≤ 8 knots).<br>• Limited duration of Bundle launch and tow operations (<2 days).<br>• The limited frequency of Bundle launches (on average two, up to three, per annum).<br>The risk of impact is further mitigated by the proposed use of a 'spotter plane' (refer note beneath Table 5-22).<br><br>It is considered unlikely that any harm to individuals, leading to a decrease in the population, will occur as a result of the implementation of the Proposal. | | | | |
| Reduce the area of occupancy of an important population | | | | | |
| The Offshore Operations Area intersects a biologically important area for Humpback whale resting and nursing from August to November | Whale sharks have been observed to utilise the north western portion of Ningaloo Marine Park during the peak season (March to July), moving southwards towards Coral Bay outside of | The Western Australian population of Green turtles numbers in the tens of thousands, with the principal rookeries being the Lacepede Islands, some islands in the Dampier | An important population does not occur within Exmouth Gulf.<br><br>On the North West Shelf, key rookeries include Rosemary | An important population does not occur within Exmouth Gulf.<br><br>The Proposal will not impact the Navy Pier or potential | The Blind gudgeon (*Milyeringa veritas*) may be present in the proposed borefield area. The risk of a |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| (DSEWPAC 2012b, Attachment 2J, Section 5.4.3.1).<br><br>The Offshore Operations Area intersects with approximately 19,000 ha of the 292,000 ha within which individuals were recorded in 2018 (or 6.5%).<br><br>Given the proposed mitigation measures, including the 'no launch period', no reduction of the area of occupancy of the population using Exmouth Gulf will occur. | season (Reynolds *et al*. 2017, Norman *et al*. 2017). Whale sharks have not been reported within the literature as being frequently sighted within Exmouth Gulf (Section 5.4.3.4).<br><br>The proposed Bundle tow route is outside the main congregation areas identified for Whale sharks though individuals are known to travel north east past the North West Cape and would cross the Bundle tow route (Section 5.4.3.4).<br><br>No reduction of the area of occupancy of the population using Ningaloo Marine Park, or transiting through the area, will occur. | Archipelago, Barrow Island, Montebello Islands and at North West Cape (DEC 2009). It was estimated that approximately 7,000 to 9,000 live around the North West Cape (Preen *et al*. 1997).<br><br>No impact to nesting will occur. The predicted impacts to potential foraging habitat (Seagrass, Mangroves, and Reef with macroalgae) are low.<br><br>The Proposal is unlikely to reduce the area of occupancy of the population using Exmouth Gulf. | Island and Varanus Island. Smaller numbers of Hawksbill turtles nest on South Muiron Island and around the western side of the North West Cape (Prince 1999).<br><br>No impact to nesting will occur. The predicted impacts to potential foraging habitat (Seagrass, Mangroves, and Reef with macroalgae) are low.<br><br>The Proposal is unlikely to reduce the area of occupancy of the population using Exmouth Gulf. | foraging areas around the North West Cape or Muiron Islands. The Proposal is unlikely to reduce the area of occupancy of the population using Exmouth Gulf. | long—term reduction in the area of occupancy, if the species is present, is considered low given the minimal groundwater drawdown within the proposed borefield and lack of other impacts. |
| Fragment an existing important population into two or more populations | | | | | |
| Given the mobility of the population, minimal nature of marine infrastructure (launchway only) and short and infrequent nature of Bundle | The proposed Bundle tow route is outside the main congregation areas identified for Whale sharks.<br><br>Given the mobility of | An important population does not occur within Exmouth Gulf.<br><br>No fragmentation of an existing important population into two or more populations will occur. | | An important population does not occur within Exmouth Gulf.<br><br>The Proposal will not impact the Navy | Given the minimal groundwater drawdown within the proposed borefield and lack of other |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| launches, no fragmentation of an existing important population into two or more populations will occur. | the population, minimal nature of marine infrastructure (launchway only) and short-term nature of Bundle launches, no fragmentation of an existing population into two or more populations will occur. | | | Pier and no fragmentation of an existing population into two or more populations will occur. | impacts, fragmentation of an existing population, if present, will not occur. |
| **Adversely affect habitat critical to the survival of a species** | | | | | |
| The largest Humpback whale population on the globe, the Breeding Stock D (BSD) population, breeds along the coast of Western Australia. Along this coast, there are a number of locations that have been identified as critical habitat, essential for the survival of Humpback whales. These habitats are areas known to seasonally support significant aggregations of Humpback whales undertaking vital life-processes such as migrating, calving, and resting. Exmouth | Habitat critical to the survival of the species occurs off Christmas Island (TSSC 2015a).<br><br>Implementation of the Proposal does not have the potential to impact habitat of importance to Whale sharks. | The Western Australian population of Green turtles numbers in the tens of thousands, with the principal rookeries being the Lacepede Islands, some islands in the Dampier Archipelago, Barrow Island, Montebello Island, Montebello Islands and at North West Cape (DEC 2009). No impact to nesting will occur. No impact to BCH within the shallower southern and eastern margins of Exmouth Gulf, representing key foraging habitat, will occur.<br><br>No impacts to habitat critical to the survival | On the North West Shelf, key rookeries include Rosemary Island and Varanus Island. Smaller numbers of Hawksbill turtles nest on South Muiron Island and around the western side of the North West Cape (Prince 1999).<br><br>No impact to nesting will occur. No significant impact to BCH, representing key foraging habitat, will occur.<br><br>No impacts to habitat critical to the survival of the | No sites in Western Australia are listed as critical habitat (Commonwealth of Australia 2002).<br><br>The Proposal will not impact the Navy Pier or potential foraging areas around the North West Cape of Muiron Islands.<br><br>No impacts to habitat critical to the survival of the species will occur. | Although not collected during the field surveys, it remains possible the species may occur in the borefield or surrounding area.<br><br>If present, the area is unlikely to represent habitat critical to the survival of the species given the known occurrence of the species more widely across the North West Cape and elsewhere. Habitat critical to |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| Gulf has been identified as one of three important resting areas along the Western Australian coast, as it provides a sheltered environment for cow-calf pairs and mature males to rest and mate during their southern migration (Attachment 2J).<br><br>The Offshore Operations Area intersects a biologically important area for Humpback whale resting and nursing from August to November (DSEWPAC 2012b, Attachment 2J, Section 5.4.3.1).<br><br>Given the proposed mitigation measures, including the 'no launch period' during August, September and October, no impact to habitat critical to the survival of the species, when | | of the species will occur. | species will occur. | | the species will not be impacted. |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| that habitat is in use, will occur.<br><br>Given that the use of Bundle technology is predicted to result in a net reduction in marine traffic in Exmouth Gulf (Section 2.4.8.1), the implementation of the Proposal will reduce the volume of commercial shipping movements, particularly during the peak of the southern migration, and help to maintain Exmouth Gulf as suitable resting and nursing habitat. | | | | | |
| Disrupt the breeding cycle of an important population | | | | | |
| The largest Humpback whale population on the globe, the Breeding Stock D (BSD) population, breeds along the coast of Western Australia. Exmouth Gulf has been identified as one of three important resting areas along the Western | Implementation of the Proposal does not have the potential to impact the breeding cycle of the Whale sharks, which are not known to breed in coastal waters. | The Western Australian population of Green turtles numbers in the tens of thousands, with the principal rookeries being the Lacepede Islands, some islands in the Dampier Archipelago, Barrow Island, Montebello Islands and at North West Cape (DEC | An important population does not occur within Exmouth Gulf.<br><br>On the North West Shelf, key rookeries include Rosemary Island and Varanus Island. Smaller numbers of Hawksbill turtles | An important population does not occur within Exmouth Gulf.<br><br>It is not known whether the Navy Pier is used for reproduction-related purposes, though some scarring, potential related to | Although not collected during the field surveys, it remains possible the species may occur in the borefield or surrounding area.<br><br>If present, given |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| Australian coast, as it provides a sheltered environment for cow-calf pairs and mature males to rest and mate during their southern migration (Attachment 2J).<br><br>Given the proposed mitigation measures, including the 'no launch period' during August, September and October, no impact to the breeding cycle of the BSD population will occur. | | 2009). No nesting occurs within Exmouth Gulf (Section 5.4.3.3).<br><br>No impacts to the breeding cycle of the Green turtle will occur. | nest on South Muiron Island and around the western side of the North West Cape (Prince 1999). No nesting occurs within Exmouth Gulf (Section 5.4.3.3).<br><br>No impacts to the breeding cycle of the Green turtle will occur. | mating or pre-mating behaviour has been recorded.<br><br>No impacts to the Navy Pier or potential foraging habitat within Ningaloo Marine Park and Muiron Islands Marine Management Area will occur and no impact to the breeding cycle of the Grey nurse shark is expected. | the minimal groundwater drawdown within the proposed borefield and lack of other impacts, an impact on the breeding cycle of the species is not expected. |
| **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline** | | | | | |
| The Offshore Operations Area intersects a biologically important area for Humpback whale resting and nursing from August to November (DSEWPAC 2012b, Attachment 2J, Section 5.4.3.1).<br><br>Given the proposed mitigation measures, including the 'no | Implementation of the Proposal does not have the potential to impact habitat of importance to Whale sharks. | No impact to nesting will occur. No impact to BCH within the shallower southern and eastern margins of Exmouth Gulf, representing key foraging habitat, will occur.<br><br>No modification, destruction, removal, isolation or decrease in the availability or quality of habitat will | On the North West Shelf, key rookeries include Rosemary Island and Varanus Island. Smaller numbers of Hawksbill turtles nest on South Muiron Island and around the western side of the North West Cape (Prince 1999).<br><br>No impact to nesting | Due to the lack of impact within the Ningaloo Marine Park (including the Navy Pier, and the Muiron Islands Marine Management Area, no modification, destruction, removal, isolation or decrease in the availability or quality of habitat will occur. | Given the minimal groundwater drawdown within the proposed borefield and lack of other impacts, a significant impact to the species' potential habitat in the local area is not expected. Therefore the |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| launch period' during August, September and October, no modification, destruction, removal, isolation or decrease in the availability or quality of habitat will occur.<br><br>Given that the use of Bundle technology is predicted to result in a net reduction in marine traffic in Exmouth Gulf (Section 2.4.8.1), the implementation of the Proposal will reduce the volume of commercial shipping movements, particularly during the peak of the southern migration, and help to maintain Exmouth Gulf as suitable resting and nursing habitat. | | occur. | will occur. No significant impact to BCH representing key foraging habitat ('Seagrass', 'Mangroves', 'Reef with macroalgae'), will occur.<br><br>No modification, destruction, removal, isolation or decrease in the availability or quality of habitat will occur. | | likelihood of a decline in the species as a result of the Proposal is negligible. |
| Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat | | | | | |
| A desktop risk assessment (Attachment 2I) demonstrated that, following the implementation of the identified biosecurity measures, the likelihood of the introduction or spread of an IMP was as low as reasonably practicable. This assessment was endorsed by DPIRD (Attachment 2I). The risk of invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat is considered low. | | | | | It is highly unlikely that the proposed activities at the borefield (e.g. |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| | | | | | development and operation of the production bores), where the species may be present, would have the potential to result in the introduction of an invasive stygofauna species. |
| Introduce disease that may cause the species to decline | | | | | |
| A desktop risk assessment (Attachment 2I) demonstrated that, following the implementation of the identified biosecurity measures, the likelihood of the introduction or spread of a pathogen was as low as reasonably practicable. This assessment was endorsed by DPIRD (Attachment 2I). The risk of the introduction of disease that may cause the species to decline is considered low. | | | | | It is highly unlikely that the proposed activities at the borefield (e.g. development and operation of the production bores), where the species may be present, would have the potential to result in the introduction of a disease that may cause the species to decline. |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| Interfere substantially with the recovery of the species | | | | | |
| The largest Humpback whale population on the globe, the Breeding Stock D (BSD) population, breeds along the coast of Western Australia. Exmouth Gulf has been identified as one of three important resting areas along the Western Australian coast, as it provides a sheltered environment for cow-calf pairs and mature males to rest and mate during their southern migration (Attachment 2J).<br><br>Since the cessation of whaling, the Group IV population is thought to have been recovering at an annual rate of between 9.7% and 13% (Salgago Kent *et al*. 2012).<br><br>Given the proposed mitigation measures, including the 'no | Implementation of the Proposal does not have the potential to impact the recovery of the species. | The Recovery Plan for Marine Turtles in Australia (DoEE 2017) identified that the majority of the Green turtle North West Shelf population is considered stable with two key threats identified to the recovery of the species:<br>• Chemical discharge.<br>• Light pollution.<br>The Proposal will not lead to chemical discharges that will impact marine water quality.<br><br>Minor coastal lighting is proposed during launchway construction (for a period of up to six months) and for one to two days during a Bundle launch (Section 5.4.6), but no impacts to Green turtle nesting, which does not occur within 30 km of Heron Point, will | The Recovery Plan for Marine Turtles in Australia (2017) identified that the majority of the Hawksbill turtle population of Western Australian population has an unknown status with three key threats identified to the recovery of the species:<br>• International take.<br>• Climate change.<br>• Light pollution.<br>The Proposal will not influence the International take of individuals, or the effects of climate change.<br><br>Minor coastal lighting is proposed during launchway construction (for a period of up to six months) and for one to two days during a | The recovery plan (Commonwealth of Australia 2002) identifies commercial and recreational fishing as two of the key threats to the species.<br><br>The Proposal will not influence the site of known occurrence of the species (Navy Pier) and no impact on the recovery of the species will occur. | No recovery plan for the species currenly exists. The Cape Range Remipede Community, known from the Bundera Sinkhole on the western side of the North West Cape, includes the Blind gudgeon. Recovery actions implemented or planned for this community include controls on access to the sinkhole and monitoring of groundwater quality and levels.<br>The Proposal will not significantly influence groundwater quality or levels in proximity to potential habitat of the species, and the recovery |

| Humpback Whale | Whale Shark | Green Turtle | Hawksbill Turtle | Grey Nurse Shark | Blind Gudgeon |
|---|---|---|---|---|---|
| launch period' during August, September and October, no impact to the recovery of the species will occur. | | occur.<br><br>The recovery of the species will not be affected. | Bundle launch (Section 5.4.6), but no impacts to Hawksbill turtle nesting, which does not occur within 50 km of Heron Point, will occur. The recovery of the species will not be affected. | | of the species will not be impacted. |

Table 7-7: Assessment of Impacts to Listed Vulnerable Species against the Significant Impact Criteria

#### 7.6.2.2 Assessment of Impacts to Critically Endangered or Endangered Species

An assessment of potential impacts to species listed as Critically Endangered or Endangered under the EPBC Act, against the significant impact criteria (DoE 2013) is provided in Table 7-8. The Great knot (*Calidris tenuirostris*) and Eastern curlew (*Numenius madagascariensis*) are also considered separately, against the 'Significant impact guidelines for 36 migratory shorebird species' (DEWHA 2009) in Section 7.6.2.4.

| Loggerhead Turtle | Blind Cave Eel | Great Knot | Eastern Curlew |
|---|---|---|---|
| Lead to a long-term decrease in the size of a population | | | |
| The Western Australian loggerhead turtle stock is one of the largest in the world with major nesting sites identified as being Dirk Hartog Island, South Muiron Island, North West Cape, Gnaraloo Bay (DoEE 2017). Surveys have shown that South Murion Island is a significant Loggerhead turtle rookery with an annual nesting population of 150-350 females (Baldwin *et al*. 2003). Over the period 1991 to 1998, 772 Loggerhead turtles were tagged while visiting the island to nest (Prince 1999).<br><br>The Proposal will not influence nesting at any of these sites.<br><br>The proposed Bundle tow route intersects an identified internesting area (DoEE 2015, Figure 5-28), so low numbers of individuals may occur in the area. However the likelihood of impact is low considering no contact to seabed (in Surface tow area), a negligible increase in benthic disturbance relative to historical and existing disturbance through commercial fishing, the low | The main identified threats include sedimentation from mining and construction, canal development, water abstraction and point source pollution from sewage (TSSC 2008b).<br><br>The surveys did not collect the Blind cave eel (*Ophisternon candidum*). Based on known geology and salinity levels, it is not expected that the Blind cave eel will be present in the Development Envelope, but it may be present in the proposed borefield area.<br>The likelihood of a long—term decrease in the abundance of the population across the North West Cape is considered low given the minimal groundwater drawdown within the proposed borefield (modelling predicts a maximum drawdown in the immediate location of the production bores of 1.15 m | Single birds were recorded roosting within the Bay of Rest North survey area during each survey, and two birds were recorded foraging in October 2018 (Attachment 2K).<br><br>The key threats for this species are the loss of mudflats, particularly in the Yellow Sea, resulting from coastal developments and habitat degradation and human disturbance (TSSC 2016).<br><br>The counts within the Bay of Rest North survey area were very low. The rock platforms within the intertidal area within and adjacent to the launchway footprint are not considered key foraging habitat. The likelihood of a long-term decrease in the | This species was not recorded during surveys but small numbers (two to 20 birds) have previously been recorded in the area (Attachment 2K). This species favours sheltered coasts with large intertidal mudflats or sandflats for foraging. The low nearby counts and generally exposed nature of the habitat suggest that Heron Point is unlikely to be favoured by the Eastern curlew (Attachment 2K).<br><br>The likelihood of a long-term decrease in the size of a population is considered negligible. |

| Loggerhead Turtle | Blind Cave Eel | Great Knot | Eastern Curlew |
|---|---|---|---|
| Bundle tow speeds during launch (≤ 2 knots) and tow (≤ 8 knots), the limited duration of Bundle launch and tow operations (<2 days) and the limited frequency of Bundle launches (on average two, up to three, per annum).<br><br>The BCH types 'Pavement reef with filter feeders' and 'Pavement reef with macroalgae and filter feeders' mapped within Ningaloo Marine Park (Figure 5-2) may represent foraging habitat. The risk of impact is considered low given the lack of impacts to BCH within Ningaloo Marine Park (due to the proposed Surface tow).<br><br>The Proposal will not lead to a long-term decrease in the size of a population. | after 10 years of continuous abstraction) and lack of other impacts. | size of a population is considered negligible. | |
| Reduce the area of occupancy of the species | | | |
| Given the minor disturbance of potential internesting habitat mapped across the region (Figure 5-28), and the lack of impact to potential foraging habitat (due to the Surface tow through Ningaloo Marine Park), the Proposal is unlikely to reduce the area of occupancy of the population using Exmouth Gulf. | The Blind cave eel may be present in the proposed borefiled area. The likelihood of a long—term reduction in the area of occupancy, if the species is present, is considered low given the minimal groundwater drawdown within the proposed borefield and lack of other impacts. | Given the low counts within the Bay of Rest North survey area and lack of key foraging habitat, the likelihood of a reduction in the occupancy of the species is considered negligible. | Given the lack of records during the 2018/2019 surveys, the previous low counts and lack of key habitat, the likelihood of a reduction in the occupancy of the species is considered negligible. |
| Fragment an existing population into two or more populations | | | |
| Given the minimal nature of marine infrastructure (launchway only), the short-term nature of Bundle launches | Given the minimal groundwater drawdown within the proposed borefield and lack | Given the low counts within the Bay of Rest North survey area and lack | Given the lack of records during the 2018/2019 surveys and the previous |

| Loggerhead Turtle | Blind Cave Eel | Great Knot | Eastern Curlew |
|---|---|---|---|
| and the absence of impact to nesting sites, fragmentation of an existing population into two or more populations will not occur. | of other impacts, fragmentation of an existing population, if present, will not occur. | of key foraging habitat, a 'population' is not considered to occur. | low counts and lack of key habitat, a 'population' is not considered to occur. |
| Adversely affect habitat critical to the survival of a species | | | |
| Key rookeries include Dirk Hartog Island, South Muiron Island, North West Cape and Gnaraloo Bay (DoEE 2017). These sites could potentially be considered critical habitat. No direct or indirect impact to these sites will occur and therefore no impacts to habitat critical to the survival of the species will occur. | The Blind cave eel may be present in the proposed borefiled area. If present, the area is unlikely to represent habitat critical to the survival of the species given the known occurrence of the species more widely across the North West Cape. | Given the low counts within the Bay of Rest North survey area and lack of key foraging habitat, habitat critical to the survival of the species will not be affected. | Given the lack of records during the 2018/2019 surveys, the previous low counts and lack of key habitat, habitat critical to the survival of the species will not be affected. |
| Disrupt the breeding cycle of a population | | | |
| Key rookeries include Dirk Hartog Island, South Muiron Island, North West Cape and Gnaraloo Bay (DoEE 2017). No nesting occurs within Exmouth Gulf (Section 5.4.3.3). No impacts to the breeding cycle of the Loggerhead turtle will occur. | The Blind cave eel may be present in the proposed borefiled area. If present, given the minimal groundwater drawdown within the proposed borefield and lack of other impacts, an impact on the breeding cycle of the species is not expected. | The Great knot breeds in the northern hemisphere and undertakes biannual migrations along the EAA flyway (TSSC 2016).<br><br>Given the low usage of the Bay of Rest North survey area and lack of key foraging habitat, no disruption of the breeding cycle is expected. | The Eastern curlew takes an annual migratory flight to Russia and north-eastern China to breed, arriving back home to Australia in August to feed on crabs and molluscs in intertidal mudflats (DoEE 2019b).<br><br>Given the low usage of the Bay of Rest North survey area and lack of key foraging habitat, no disruption of the breeding cycle is expected. |

| Loggerhead Turtle | Blind Cave Eel | Great Knot | Eastern Curlew |
|---|---|---|---|
| Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | | | |
| The Proposal will not influence nesting at any sites (refer above).<br><br>The BCH types 'Pavement reef with filter feeders' and 'Pavement reef with macroalgae and filter feeders' mapped within Ningaloo Marine Park (Figure 5-2) may represent foraging habitat. The risk of impact is considered low given the lack of impacts to BCH within Ningaloo Marine Park (due to the proposed Surface tow). The Proposal will not lead to a long-term decrease in the size of a population. | Given the minimal groundwater drawdown within the proposed borefield and lack of other impacts, a significant impact to the species' potential habitat in the local area is not expected. Therefore the likelihood of a decline in the species as a result of the Proposal is negligible. | Given the low counts within the Bay of Rest North survey area and lack of key foraging habitat, habitat critical to the survival of the species will not be affected. | Given the lack of records during the 2018/2019 surveys, the previous low counts and lack of key habitat, habitat critical to the survival of the species will not be affected. |
| Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered **species' habitat** | | | |
| A desktop risk assessment (Attachment 2I) demonstrated that, following the implementation of the identified biosecurity measures, the likelihood of the introduction or spread of an IMP was as low as reasonably practicable. This assessment was endorsed by DPIRD (Attachment 2I). The risk of invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat is considered low. | It is highly unlikely that the proposed activities at the borefield (e.g. development and operation of the production bores), where the species may be present, would have the potential to result in the introduction of an invasive stygofauna species. | It is highly unlikely that the Proposal would result in the establishment of an invasive species leading to impacts to the coastal habitat of value to the species.<br><br>Management measures to address the potential introduction and/or spread of marine pests and weeds are outlined in Table 5-22 and Table 5-29 respectively. | Threats in Australia, especially eastern and southern Australia, include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants (TSSC 2015b).<br><br>It is highly unlikely that the Proposal would result in the establishment of an invasive plant (refer Section 5.5.6.3) leading to impacts to the coastal |

| Loggerhead Turtle | Blind Cave Eel | Great Knot | Eastern Curlew |
|---|---|---|---|
| | | | habitat of value to the species.<br><br>Management measures to address the potential introduction and/or spread of marine pests and weeds are outlined in Table 5-22 and Table 5-29 respectively. |
| **Introduce disease that may cause the species to decline** | | | |
| A desktop risk assessment (Attachment 2I) demonstrated that, following the implementation of the identified biosecurity measures, the likelihood of the introduction or spread of a pathogen was as low as reasonably practicable. This assessment was endorsed by DPIRD (Attachment 2I). The risk of the introduction of disease that may cause the species to decline is considered low. | It is highly unlikely that the proposed activities at the borefield (e.g. development and operation of the production bores), where the species may be present, would have the potential to result in the introduction of a disease that may cause the species to decline. | It is highly unlikely that the proposed activities within the onshore Development Envelope would have the potential to result in the introduction of a disease within an avifauna population that may cause the species to decline.<br><br>A desktop risk assessment (Attachment 2I) demonstrated that, following the implementation of the identified biosecurity measures, the likelihood of the introduction or spread of a pathogen was as low as reasonably practicable.<br><br>The risk of the introduction of disease that may cause | It is highly unlikely that the proposed activities within the onshore Development Envelope would have the potential to result in the introduction of a disease within an avifauna population that may cause the species to decline.<br><br>A desktop risk assessment (Attachment 2I) demonstrated that, following the implementation of the identified biosecurity measures, the likelihood of the introduction or spread of a pathogen was as low as reasonably practicable. |

| Loggerhead Turtle | Blind Cave Eel | Great Knot | Eastern Curlew |
|---|---|---|---|
| | | the species to decline is considered low. | The risk of the introduction of disease that may cause the species to decline is considered low. |
| **Interfere with the recovery of the species** | | | |
| The Recovery Plan for Marine Turtles in Australia (DoEE 2017) identified the following as high risk threats to the recovery of the species in WA waters:<br>• Climate change and variability.<br>• Chemical and terrestrial discharge.<br>• Fisheries bycatch.<br>The Proposal will not lead to climate change, chemical discharges or increased fisheries bycatch. The recovery of the species will not be affected. | No recovery plan for the species currenly exists. The Proposal will not significantly influence groundwater quality or levels in proximity to potential habitat of the species (the proposed borefield area), and the recovery of the species will not be impacted. | There is no recovery plan for the species.<br><br>The key threats for this species are the loss of mudflats, particularly in the Yellow Sea, resulting from coastal developments and habitat degradation and human disturbance (TSSC 2016).<br><br>Given the low counts within the Bay of Rest North survey area and lack of key foraging habitat, the likelihood of an impact to the recovery of the species is considered negligible. | There is no recovery plan for the species.<br><br>Threats in Australia, especially eastern and southern Australia, include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants (TSSC 2015b). As discussed above, the likelihood of a significant impact to the species as a result of habitat loss or an invasive species is considered negligible.<br><br>No interference to the recovery of the species is expected. |

Table 7-8: Assessment of Impacts to Listed Critically Endangered or Endangered Species against the Significant Impact Criteria

#### 7.6.2.3 Assessment of Impacts to Migratory Species (excluding Migratory Birds)

An assessment of potential impacts to species listed as Migratory under the EPBC Act, against the significant impact criteria (DoE 2013), is provided in Table 7-9.

| Australian Humpback Dolphin | Indo-Pacific Bottlenose Dolphin | Dugong | Giant Manta Ray and Reef Manta Ray |
|---|---|---|---|
| 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 | | | |
| No important habitat has been identified for this species in Exmouth Gulf.<br><br>Foraging has been observed to occur mainly in nearshore intertidal rock and shallow sub-tidal reef habitats and studies have suggested the species is an opportunistic generalist feeder, preying on a wide variety of fishes including both bottom-dwelling species as well as pelagic species (Parra and Cagnazzi 2016).<br><br>No significant impact to BCH potentially representing key foraging habitat will occur (Section 5.1.6).<br><br>No substantial modification, destruction, removal, isolation or decrease in the availability of important habitat will occur. | No important habitat has been identified for this species in Exmouth Gulf.<br><br>Indo-pacific bottlenose dolphins have been observed in inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands.<br><br>No significant impact to BCH potentially representing key foraging habitat will occur (Section 5.1.6).<br><br>No substantial modification, destruction, removal, isolation or decrease in the availability of important habitat will occur. | Exmouth Gulf and Ningaloo Reef have been identified as biologically important areas, year round, for Dugong foraging and nursing (DSEWPAC 2012b).<br><br>Dugong activity is focused on the east coast of the Gulf associated with the shallow seagrass habitat in this area (Figure 5-25, Figure 5-26).<br><br>No significant impact to BCH representing key foraging habitat (Seagrass) will occur (Section 5.1.6).<br><br>No modification, destruction, removal, isolation or decrease in the availability or quality of habitat will occur. | Manta rays are a pelagic species, inhabiting marine environments all around the globe, although they are most commonly found in the tropics or along productive coastlines in temperate areas.<br><br>Individuals have been recorded within Exmouth Gulf and larger numbers are known to utilise waters to the west of North West Cape where they are a target of ecotours.<br><br>No impact to an area of important habitat will occur as a result of the Proposal. |

<table>
<tr><th>Australian Humpback Dolphin</th><th>Indo-Pacific Bottlenose Dolphin</th><th>Dugong</th><th>Giant Manta Ray and Reef Manta Ray</th></tr>
<tr><td colspan="4">Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species</td></tr>
<tr><td colspan="4">A desktop risk assessment (Attachment 2I) demonstrated that, following the implementation of the identified biosecurity measures, the likelihood of the introduction or spread of an IMP was as low as reasonably practicable. This assessment was endorsed by DPIRD (Attachment 2I). The risk of invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat is considered low.</td></tr>
<tr><td colspan="4">Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species</td></tr>
<tr><td>An ecologically significant proportion of the population is not known to occur within Exmouth Gulf.<br><br>Impacts to feeding will be limited given the negligible impacts to BCH.<br><br>No breeding, migration or resting behaviour is known to occur in Exmouth Gulf.</td><td>An ecologically significant proportion of the population is not known to occur within Exmouth Gulf.<br><br>Impacts to feeding will be limited given the negligible impacts to BCH.<br><br>No breeding, migration or resting behaviour is known to occur in Exmouth Gulf.</td><td>Exmouth Gulf and Ningaloo Reef have been identified as biologically important areas, year round, for Dugong foraging and nursing (DSEWPAC 2012b).<br><br>Dugong activity is focused on the east coast of the Gulf associated with the shallow seagrass habitat in this area (Figure 5-25, Figure 5-26).<br><br>No impacts to breeding, feeding or resting (and nursing) behaviour will occur given the separation distance of over 15 km between the Offshore Operations Area and the key habitat adjacent to the south and east coasts of Exmouth Gulf (Figure 5-25, Figure 5-26).</td><td>Individuals have been recorded within Exmouth Gulf and larger numbers are known to utilise waters to the west of North West Cape where they are a target of ecotours.<br><br>No impact to the lifecycle of an ecologically significant proportion of the population will occur as a result of the Proposal.</td></tr>
</table>

Table 7-9: Assessment of Impacts to Listed Migratory Species against the Significant Impact Criteria

#### 7.6.2.4 Assessment of Impacts to Migratory Birds

The assessment of impacts to migratory birds requires the following issues to be considered (DEWHA 2009):

- Loss of important habitat.
- Degradation of important habitat leading to a substantial reduction in migratory shorebirds using the site.
- Increased disturbance leading to a substantial reduction in migratory shorebirds using important habitat.
- Direct mortality of birds leading to a substantial reduction in migratory shorebirds using important habitat.

A number of migratory shorebirds, including the Great knot, Eastern curlew, Bar-tailed godwit, Grey-tailed tattler, Red-necked stint, Greater sand plover, Whimbrel, Lesser sand plover, Common greenshank, Terek sandpiper and Grey plover were recorded during surveys of Heron Point and the surrounding Bay of Rest North survey area (Section 7.5.3.4).

During surveys of migratory shorebirds within the Shorebird2020 'Bay of Rest North' survey area in October 2018 and January 2019, no counts of any migratory species exceeded the internationally or nationally significant criteria of 1% or 0.1% of the flyway population. Total counts of migratory shorebirds were well below the internationally significant threshold of 20,000 birds and the nationally significant threshold of 2,000 birds. No more than 13 migratory shorebird species were recorded in this survey, less than the > 15 species that indicates a nationally important site (Attachment 2K).

Therefore the Proposal will not lead to the loss or degradation of important habitat (as the Bay of Rest North does not qualify as important habitat). Given the minor footprint of the launchway and absence of important habitat, significant impacts to listed migratory birds are not expected (Table 7-6).

### 7.6.3 Commonwealth Marine Area

Potential impacts to the Commonwealth Marine Area are assessed in Table 7-10.

| Potential Impact | Assessment |
|---|---|
| Establishment of pest species | Through the risk identification and assessment process (Attachment 2I), a number of scenarios relating to the construction and operational phase of the Proposal were assessed.<br><br>The risk of a construction barge or launch/tow vessel, sourced from WA coastal waters, introducing a pathogen via ballast water was assessed as posing a high risk in the absence of management. A nominated management measure, to reduce the risk to low, was the adoption of the DAWR 'Quick Domestic Ballast Water (DBW) Risk Assessment Tool' (DAWR 2018). The risk of a construction barge or launch/tow vessel, sourced from WA coastal waters, introducing an IMP via biofouling was assessed as posing a low risk.<br><br>The risk of a construction barge or launch/tow vessel, sourced from Australian coastal waters outside of WA, introducing an IMP via biofouling or ballast water was assessed as posing a low risk. The risk of a |

| Potential Impact | Assessment |
|---|---|
| | launch/tow vessel, sourced from Australian coastal waters outside of WA, introducing a pathogen via ballast water was assessed as posing a high risk in the absence of management. A nominated management measure, to reduce the risk to low, was the adoption of the DAWR 'Quick Domestic Ballast Water (DBW) Risk Assessment Tool' (DAWR 2018).<br><br>The risk of a launch/tow vessel, sourced from international waters, introducing a pathogen via ballast water, or an IMP via ballast water or biofouling, was assessed as posing a high risk in the absence of management. Nominated management measures, to reduce the risks to low, were:<br>• The adoption of the DAWR 'Mandatory Ballast Water Management Requirements (Version 7)'.<br>• The adoption of the DPIRD on-line 'Vessel Check' decision support tool and the adoption of appropriate biofouling management requirements.<br><br>Biofouling Management Plans are widely used within the oil and gas industry to ensure that all vessels utilised on a project meet the requirements for operating in Australian waters. Typically, these plans have a focus on vessels entering Australia from international waters, and typically consider the previous voyage history, status of anti-fouling application, and the location and extent of operations being performed in Australia. Where necessary, it is common practice for vessel operators to perform hull cleaning operations prior to the vessel entering Australia to ensure the risk of introducing marine pests is minimised and mitigated appropriately. This general industry practice exceeds what is typically performed in other marine industries (such as general shipping and internal vessel tourism), and this contributes to the assessed low risk of introduction of an IMP due to the Proposal. |
| Impact on marine ecosystem functioning or integrity | Ecological integrity is the composition, structure, function and processes of ecosystems, and the natural variation of these elements, and is defined by the EPA as '*Ecosystem integrity is considered in terms of structure (e.g. the biodiversity, biomass and abundance of biota) and function (e.g. food chains and nutrient cycles)*' (EPA 2000).<br><br>The loss or degradation of BCH, or impacts to environmental quality or fauna populations, could result in an impact to ecosystem integrity. Given no impacts to BCH, water quality or marine fauna are predicted within Commonwealth waters, no impact on ecosystem integrity is predicted. The integrity and ecological function of the marine ecosystem in the Commonwealth Marine Area will be maintained. |
| Effect on a population of a marine species | Marine species within Commonwealth Waters could potentially be impacted through vessel strike. With the proposed CTDM tow speed of 5-to 6 knots, it is considered unlikely that significant impacts to any species of marine fauna will occur (refer 5.4.6.7). |
| Substantial change in water quality | No changes to water quality within the Commonwealth Marine Area are expected. |
| Accumulation of potentially harmful chemicals in the | The storage and handling of hazardous materials at sea will be strictly controlled to minimise the risk of leaks or spills into the marine environment, and emergency response procedures will be in place in the |

| Potential Impact | Assessment |
|---|---|
| marine environment | event of an incident involving the leak or spill of such materials. Bundle chemicals will be selected based on their environmental risk profile (Section 5.3.6.4). No accumulation of potentially harmful chemicals in the marine environment is predicted. |
| Impact on heritage values | Refer Section 7.6.1. No significant impacts expected. |

Table 7-10: Assessment of Potential Impacts to Commonwealth Marine Areas

# 8. OFFSETS

Environmental offsets are '*actions that provide environmental benefits which counterbalance the significant residual environmental impacts or risks of a proposal*' (EPA 2008).

The assessment and potential application of offsets for the Proposal has been undertaken with consideration of the following:

- EPA Environmental Protection Bulletin No.1: Environmental Offsets (EPA 2014).
- WA Environmental Offsets Policy (Government of WA 2011).
- WA Environmental Offsets Guidelines (Government of WA 2014).
- *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy (DSEWPAC 2012a).

To determine whether offsets were required, the potential environmental impacts, following the application of the nominated mitigation measures, were reviewed. The mitigation measures described in this document were developed and applied based on the mitigation hierarchy, which involves:

- Avoidance.
- Minimisation.
- Rehabilitation.
- Offsets.

Offsets are applied for significant residual environment impacts remaining after mitigation measures have been implemented.

After applying the proposed mitigation measures, it is believed that there will be no significant residual environmental impacts from the Proposal, and that the EPA objective for each of the preliminary key factors and other environmental factors or matters can be met. Thus no offsets are proposed.

# 9. HOLISTIC IMPACT ASSESSMENT

EPA (2018b) guidance suggests that the holistic impact assessment should provide a holistic assessment of the impacts of the proposal on the whole environment. The connections and interactions between the parts of the environment (environmental factors) and the predicted outcomes in relation to the environmental principles and the EPA's environmental objectives should be discussed.

A holistic impact assessment of the Proposal, focussing on the potential additive impacts on regional biodiversity, ecosystem integrity, and the social environment, is presented in the following sub sections.

## 9.1 BIODIVERSITY

### 9.1.1 Terrestrial

The proposed onshore clearing will result in a negligible reduction (on a spatial basis) of native vegetation that is common and widespread outside of the Development Envelope. The removal of individuals of the priority species *Corchorus congenor* (P3), which occurs widely across the Learmonth area, will not materially impact on the overall distribution or abundance of the species. No significant impacts to flora and vegetation are expected as a result of indirect impacts from the Proposal.

The vegetation within the Development Envelope is not considered high value fauna habitat. Indirect impacts to terrestrial fauna habitat associated with altered surface water flows or fire regimes are unlikely to result in a significant impact on terrestrial fauna. The increase in risk of vehicle strikes on terrestrial fauna represents an incremental increase to current risks. Discrete and cumulative impacts to terrestrial fauna associated with dust, weeds, or feral animals are not likely to be significant.

Stygofauna were collected from the proposed borefield area and the coastal bores but not from any of the bores in the sand plain adjacent to the proposed fabrication shed and sprayfield locations (Attachment 2O). The Blind shrimp (*Stygiocaris stylifera*), listed as a Priority 4, was recorded from two bores within the proposed borefield area. While collections of *Stygiocaris stylifera* demonstrate that suitable habitat for this species, and other stygofauna, occurs in proximity to the borefield, the minimal groundwater drawdown predicted to occur as a result of the Proposal means a significant impact on subterranean fauna is not expected.

Overall, a significant impact to the biodiversity of the region is not expected.

### 9.1.2 Marine

Direct impacts to BCH are minor relative to the mapped extent of each BCH within the LAUs. Potential cumulative impacts above 1% (within the relevant LAUs) are predicted to BCH types 'Soft sediment', 'Pavement reef' (64.6%), and 'Soft sediment with filter feeders' (5.9%). Additional, temporary, indirect impacts are predicted adjacent to the launchway during launchway construction. None of the BCH types likely to be impacted exhibit a limited distribution or unique community. The cumulative impacts are considered unlikely to compromise the biodiversity of Exmouth Gulf given the limited spatial extend of impacts in the context of the widespread regional distributions.

Impacts to marine fauna will be limited to potential behavioural responses during launchway construction and Bundle launch. It is noted that the use of Bundle technology is predicted to result in a net reduction in marine traffic (Section 2.4.8.1).

No injury or mortality of marine fauna is expected. Further, no impact to critical habitat of a species of marine fauna, or to the viability of a population of marine fauna, will occur. The construction and operation of the Proposal has the potential to temporarily and locally displace migratory birds utilising the shoreline at Heron Point for foraging or roosting. No significant impact to migratory bird species is expected.

Overall, a significant impact to the marine biodiversity of Exmouth Gulf is not expected.

## 9.2 ECOLOGICAL INTEGRITY (HEALTH AND PRODUCTIVITY)

### 9.2.1 Terrestrial

Direct impacts to native vegetation will be at a local scale and will not impact the ecological integrity of the Heron Point area or wider region. No significant impacts to flora and vegetation are expected as a result of indirect impacts from the Proposal.

Impacts to terrestrial fauna will be managed through the implementation of the nominated mitigation measures to maintain the abundance, health and productivity of terrestrial fauna in the Exmouth region.

No subterranean fauna were recorded adjacent to the proposed fabrication shed and sprayfield locations (Attachment 2O). Potential impacts due to loss of habitat at the proposed borefield, from groundwater drawdown, will be minimal and is not expected to be biologically meaningful (Attachment 2O). A significant impact to the health or productivity of subterranean fauna is not expcted.

Overall, a significant impact to the ecological integrity of the region is not expected.

### 9.2.2 Marine

Impacts to BCH will be at a local scale and will not impact the ecological integrity of Exmouth Gulf.

It is noted that the use of Bundle technology is predicted to result in a net reduction in marine traffic (Section 2.4.8.1) in Exmouth Gulf which would result in a reduction in associated underwater noise and the risk of impacts to marine fauna. As noted in Attachment 2J, Humpback whales rely on finite energy reserves whilst in the breeding grounds and mothers must maximise energy transfer to their calves to support the rapid calf growth required for the long migration down to the Antarctic feeding grounds. Thus the implementation of the Proposal, which will reduce the volume of commercial shipping movements during the peak of the southern migration, will help to maintain Exmouth Gulf as suitable resting and nursing habitat, and result in a net benefit to Humpback whales.

Impacts to marine fauna will be managed through the implementation of the nominated mitigation measures to maintain the abundance, health and productivity of marine fauna in Exmouth Gulf.

Overall, a significant impact to the ecological integrity of the region is not expected.

## 9.3 SOCIAL ENVIRONMENT

The EP Act defines social surroundings of people as their aesthetic, cultural, economic and social surroundings to the extent that those surroundings directly affect, or are affected by, their physical or biological surroundings.

### 9.3.1 Aesthetics

The natural beauty of the Exmouth region, including the Learmonth area is not expected to be significantly impacted. The visual impact assessment predicted minor visual impacts from a comprehensive selection of vantage points around the Exmouth region. Against the backdrop of current activities in Exmouth Gulf (for example prawn trawling and commercial shipping) and terrestrial infrastructure (for example the Learmonth RAF base and airport) the Proposal will not markedly change the aesthetic values of the region. Long-term or significant impacts to the 'wilderness' values of the Exmouth region are very unlikely.

At a local scale the Proposal may have significant short-term impacts in the immediate vicinity of Heron Point during a Bundle launch. Given the short duration of these visible impacts (1.47% of the year), this is not expected to detract significantly from the overall aesthetic values of the area.

### 9.3.2 Culture

No significant sites of Aboriginal Heritage (archaeological or ethnographical) were recorded in the Development Envelope, which is not used for cultural or customary activities. Aboriginal Heritage values will not be significantly impacted or inhibited.

Existing recreational and cultural activities associated with the Development Envelope and Offshore Operations Area will maintained. Given that a maximum of three Bundle launches will occur in a year, with beach closure lasting less than two days per launch, access to Heron Point will be impacted 1.2% of the year. Subsea 7 will ensure that access to Heron Point and Bay of Rest will be maintained and will create additional tracks for ease of public access. The public and tour operators will continue to be able to navigate Exmouth Gulf, with a slight detour potentially required if wishing to cross the Bundle tow route during specific time windows (measured in hours) that coincide with Bundle launches (that will occur on up to six days per annum).

Overall, customs and social behaviour are not expected to be significantly impacted.

### 9.3.3 Economics

An Economic Impact Assessment was undertaken to model the economic contribution to the Proposal on the Gascoyne Region and to Western Australia (ACIL Allen 2019). To determine the economic contribution of the Proposal, the Proposal's economics (revenue, expenditure, employment, wages and taxation payments) were modelled in relation to the State and regional (Gascoyne) economy. This was used to predict the economic contribution of the Proposal over the study period from 2017-18 to 2052-53.

The study concluded that the Proposal would make an important economic contribution to Western Australia and the Gascoyne Region. ACIL Allen estimated that the Proposal will directly contribute $742.2 million to the State's economy (in Gross Value Added terms) over the study period, averaging $20.6 million per annum. The level of activity is in turn expected to generate a further $880.7 million indirectly to the WA economy (an average of $24.5 million per annum), resulting in a total contribution of $1.62 billion over the study period at an average of $45.1 million per annum. When these values are compared to the

Shires annual revenue for the 2017/2018 period (approximately $13 million) it is 60% higher and indicates a significant contribution to the regional economy.

Approximately 70% of the Proposal's economic contribution will be to the Gascoyne region, with the Proposal expected to contribute $1.14 billion to the Gascoyne economy over the study period at an average of $31.7 million per annum.

It was estimated that the Proposal would directly support an average of 40 full time eequivalent (FTE) jobs per year over the study period, while a further 149 FTE positions per year on average would be indirectly created as a consequence of the Proposal. Overall, it was estimated that an average of 189 FTE employees would be supported by the Proposal each year over the study period.

Other economic impacts (contributions) as a result of the Proposal would include:

- Capitalising on an untapped natural advantage – the Proposal presents an opportunity for the Gascoyne region to take advantage of its location (i.e. proximity to oil and gas fields, suitable geography and topography).
- Capturing oil and gas sector activity – the Proposal presents an important opportunity to capture a share of the State's energy market that has previously eluded the Gascoyne region.
- Upskilling of workforce – Subsea 7 intends to establish a local workforce with no accommodation facilities on site, with workers accommodated in and sourced from Exmouth. An apprenticeship program is proposed in collaboration with the Central Regional TAFE in Exmouth. Recognised industry training opportunities will be offered to increase workforce capabilities and career progression.
- Employment – The Proposal also provides an opportunity to provide long-term, stable employment that usually fluctuates with high and low seasons of the tourism industry.

A significant impact to the social environment is not expected and any impacts will be managed through the implementation of a stakeholder engagement strategy. Overall a significant positive contribution to economic surroundings is expected due to the Proposal's estimated economic contributions and employment and industry opportunities.

As discussed in Sections 5 and 6, significant impacts on physical and biological factors (BCH, Coastal Processes, Marine Environmental Quality, Flora and Vegetation, Marine/Subterranean/Terrestrial fauna, Inland Waters, and Terrestrial Environmental Quality) are not expected.

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## Personal Communication

Alex Kailis, Director Operations, MG Kailis Group. 2018. Meeting, June 2018

Arvid Hogstrom, District Manager, Exmouth District, Parks and Wildlife Service, Department of Biodiversity, Conservation and Attractions. 2019. Email correspondence, March 2019.

Curt Jenner, Whale biologist, Centre for Whale Research. 2010. Meeting, October 2010.

Dan Weller, Migratory Shorebird Program Manager, BirdLife Australia. 2018. Email correspondence, March 2018.

Darren Gebbetis, Owner, Ningaloo Aquaria. 2018. Meeting, August 2018.

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Lyn Irvine, PhD Candidate, Institute of Marine and Antarctic Studies (IMAS). 2018a. Telephone conversation with Subsea 7 prior to the commencement of the aerial surveys. August 2018.

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Steve Corsini, Archaeologist and Ethnographer, SJC Heritage Consultants. 2019. Email correspondence, April 2019.

# 11. GLOSSARY OF TERMS

| Term | Description |
|---|---|
| ALARP | As Low As Reasonably Practicable |
| Ballast Chain | Large diameter chain that is installed at fixed intervals along the cross section to provide Bundle weight control |
| Bogie Pit | Break in track and launchway that allows Bundle bogies to be recovered during launch |
| Bundle | Pipeline product that incorporates all structures, valve work, pipelines and control systems necessary to operate subsea field development |
| Bundle Bogie | A pipe support mounted on the rail track that supports the Bundle cross section |
| Bundle Service Lines | Pipeline or control line situated within the Bundle carrier pipe, suitably rated for the field operating service (i.e. hydrocarbon transfer, well/ reservoir control, valve control, heat transfer) |
| Bundle Track | Standard rail track that allows the Bundle to move along the site, supported by Bundle Bogies, during fabrication activities and launch |
| Carrier Pipe | Structural steel outer pipe that houses the production and utility lines, providing protection and on-bottom stability |
| Controlled Depth Tow Method | Bundle tow configuration at medium speeds (typically 3-4 knots) that allows for all components of the Bundle to lift-off the seabed (including ballast chains). Small adjustments in tow forces can be used to achieve a desired bundle profile between surface and seabed along the total length of a Bundle |
| Fabrication Workshop | 350 m long fabrication workshop situated at the landward end of the Bundle Track. Consists of four firing lines where pipe preparation, welding, non-destructive testing and coating activities take place. |
| Guard Vessel | The vessel that will provide navigational warnings and perform guard duties during the bundle tow |
| Holdback Winch | Winch situated onshore, which is connected to the Trailing Towhead to provide back tension during launch. |
| Launch | Operation when the Bundle is towed off the Bundle track, across the launchway, and enters the water |
| Launchway | Rail structure with rock ballast, that provides the beach crossing for the Bundle. The launchway follows the beach/ seabed profile and extends approximately 300 m from high water mark. |
| Leading Towhead | The termination assembly located at the seaward end of the Bundle and is connected to the lead tug vessel |
| Leading Tug | The vessel(s) that will provide the required pull force to launch the bundle into the water and tow the bundle to the field development |
| Off bottom tow | Bundle tow configuration at slow speeds (typically 2-3 knots). Ballast chains will maintain contact with seabed for Bundle stability |
| Parking area | Designated area where the tow speed is zero, the chains touch down on seabed, and a full inspection of the Bundle after the launch takes place, including the Submerged Weight Check |

| Term | Description |
|---|---|
| Pipeline Storage | Pipe delivery and offloading facility, adjacent to facilities at the landward end of the Bundle Track. |
| ROV Support Vessel | The vessel that provides the ROV and survey support during launch, tow and installation of the bundle. This vessel may perform Bundle intervention works such as trimming and flooding |
| Submerged Weight Check | Visual and telemetric survey of the Bundle once fully submerged, to confirm final weight and trim. Ballast can be added or removed if required. |
| Surface tow | Bundle tow configuration at medium speeds (typically 5-6 knots), with additional back-tension that allows for all components of the Bundle to lift-off towards the water surface, providing the greatest clearance between Bundle and seabed |
| Tow | Operation where the Bundle is towed to subsea field development |
| Towhead Bogie | Large towhead skid frame that supports towhead on the Bundle track |
| Towline | Suitably rated rigging, primarily comprising of a high-modulus polyethylene synthetic rope sling |
| Trailing Towhead | The termination assembly located at the landward end of the Bundle and is connected to the trailing tug vessel |
| Trailing Tug | The vessel that will connect to the trailing towhead and provide the required back-tension during tow |
| Zone of High Impact | Zone of High Impact area where impacts on benthic communities or habitats are predicted to be irreversible (lacking a capacity to return or recover to a state resembling that prior to being impacted within a timeframe of five years or less). |
| Zone of Moderate Impact | Zone of Moderate Impact is the area within which predicted impacts on benthic organisms are recoverable within a period of five years following completion of the dredging activities. |
| Zone of Influence | Zone of Influence is the area within which changes in environmental quality are predicted and anticipated, but where these changes would not result in a detectible impact on benthic biota. |

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