

Port of Port Hedland Zone 5 Bypass Channel Project



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Acronyms and Abbreviations

Abbreviation	Definition
AMSA	Australian Maritime Safety Authority
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
BC Act	<i>Biodiversity Conservation Act 2016</i>
BCH	Benthic Communities and Habitats
BIA	Biologically Important Area
BHP	BHP Group Ltd
BOM	Bureau of Meteorology
BPPH	Benthic Primary Producer Habitats
CCC	(Port Hedland) Community Consultive Committee
CD	Chart Datum
CHMP	Pilbara Ports Cultural Heritage Management Plan
CO ₂	Carbon Dioxide
COPC	Contaminants of Potential Concern
CROP	Channel Risk and Optimisation Project
CSD	Cutter Suction Dredge
DAFF	Commonwealth Department of Agriculture, Fisheries and Forestry
Db	Decibel
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEMMP	Dredging Environmental Monitoring and Management Plan
DITRDCA	Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts
DWER	Department of Water and Environmental Regulation
DMA	Decision-making Authorities
DoF	Department of Fisheries
DPIRD	Department of Primary Industries and Regional Development
DTMI	Department of Transport and Major Infrastructure
DWER	Department of Water and Environmental Regulation
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
EPBC Act	Environmental Protection, Biodiversity and Conservations Act
EPO	Environmental Protection Outcomes
EQO	Environmental Quality Outcomes
ERD	Environmental Referral Document
EV	Environmental Values
FMG	Fortescue Ltd
GHG	Greenhouse Gas
ha	Hectare
HF	High Frequency
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMO	International Maritime Organization
IMS	Invasive Marine Species
IUCN	International Union Conservation of Nature
KAC	Kariyarra Aboriginal Corporation

Abbreviation	Definition
LAT	Lowest Astronomical Tide
LAU	Local Area Unit
LEP	Levels of Ecological Protection
LF	Low Frequency
LiDAR	Light Detection and Ranging
MARPOL	International Convention for the Prevention of Pollution from Ships
MFO	Marine Fauna Observer
MNES	Matters of National Environmental Significance
MT	Management Target
μPa	Micropascal
MS	Ministerial Statement
NAGD	National Assessment Guidelines for Dredging
NTU	Nephelometric Turbidity Units
PCB	Polychlorinated Biphenyl
PFAS	Per- and poly-fluoroalkyl substances
Pilbara Ports	Previously Pilbara Ports Authority
PMST	Protected Matters Search Tool
PPA	Pilbara Ports Authority (now Pilbara Ports)
PTS	Permanent Threshold Shift
re	Reference
RFI	Request for Further Information
SAP	Sampling and Analysis Plan
SDP	Sea Dumping Permit
SEL	Sound exposure Level
SG	Spoil Ground
SI	Sirenian
SOPEP	Ship Oil Pollution Emergency Plan
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentration in the water column
SST	Sea Surface Temperature
TACC	Technical Advisory and Consultative Committee
TOPH	Town of Port Hedland
TSHD	Trailing Suction Hopper Dredge
TSS	Total Suspended Sediments in a sample
TTS	Temporary Threshold Shift
UCL	Upper Confidence Limit
VBRAMP	Vessel Biofouling Risk Assessment and Management Procedure
WA	Western Australia
ZOHI	Zone of High Impact
ZOI	Zone of Influence
ZOMI	Zone of Moderate Impact

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SUMMARY

The Port of Port Hedland (Port) is a single-channel port that underpins a significant proportion of Western Australia's export economy. The channel can be broken down into six distinct zones based on location, bathymetry, channel slopes and sea conditions. As vessel sizes have increased and traffic volumes grown, the consequences of any disruption to this route have become more pronounced. Although vessel control failures remain relatively infrequent, incidents in recent years have demonstrated that even brief mechanical or navigational issues can escalate quickly within the confined geometry of the channel. In certain sections, such as Zone 5, the physical characteristics of the channel provide limited opportunity for recovery once control is lost.

Pilbara Ports is proposing to conduct capital dredging to create a bypass channel to the east of Zone 5 of the existing channel (the Proposal). Once the capital works are completed, this area will become part of the annual channel maintenance dredging campaign (via amendment to the existing Port of Port Hedland five-year Sea Dumping Permit for maintenance dredging SD2022/4041). The Proposal is a strategic marine risk-mitigation project intended to maintain vessel transit at an acceptable reduced capacity, should a grounding incident occur in Zone 5 of the channel.

Key elements and extents of the Proposal are shown in Figure 1-1 and Figure 1-2, which include:

- A 432-ha navigation channel (incl 50 m buffer) to design depth of – 11.5 m Chart Datum (plus allowance for 1.0 m of over-dredge). Of which 63 ha is within State waters.
- Up to 800,000 m³ (including up to 1.0 m of over-dredge) of capital dredging will be undertaken within a total disturbance footprint of 162 ha (63 ha in State waters and 98 ha in Commonwealth waters) and development envelope of 432 ha (63 ha in State waters and 369 ha in Commonwealth waters). Disposal of dredge material will be to an approved spoil ground located entirely within Commonwealth waters.

It is currently anticipated that the dredging will be undertaken by a trailing suction hopper dredge (TSHD). In the event small areas of consolidated material are identified that cannot be removed by the TSHD, a Cutter Suction Dredge (CSD) with side casting capabilities may be used to break up the consolidated material in place within the channel design footprint for later removal by a TSHD.

This document has been prepared as a supporting document to provide sufficient details on the Proposal to form part of a referral to the Environmental Protection Authority (EPA) under Section 38 of Part IV of the Western Australian *Environmental Protection Act 1986*. The majority of the disturbance footprint (98 of 162 ha) and all of the disposal site (282 ha) are located within Commonwealth waters and will be regulated by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the *Environment Protection (Sea Dumping) Act 1981* (the Sea Dumping Act) by applying the National Assessment Guidelines for Dredging (the NAGD) (Commonwealth of Australia 2009a). An application for a sea dumping permit, supported by a Dredging Environmental Monitoring and Management Plan (DEMMP) has been submitted under the Sea Dumping Act and is under review. Pilbara Ports believes the potential impacts of the Proposal on the environment can be mitigated under the Sea Dumping Act.

A summary of the assessment of key environmental factors considered relevant to the Proposal is provided in Table ES - 1. The assessment concluded that for all relevant environmental factors, the associated EPA objectives can be met, and any residual impacts to the environment resulting from implementation of the Proposal are not significant. On this basis and the requirement for

Commonwealth environmental approvals of the dredging project, the Proponent believes further environmental approvals are not required.

Table ES - 1. Summary of key environmental factors

Benthic Communities and Habitats	
Potential significant environmental impacts	<p><u>Direct</u></p> <ul style="list-style-type: none"> Dredging activities within the proposed dredge and disposal footprint may lead to the direct removal and loss of BCH. <p><u>Indirect</u></p> <ul style="list-style-type: none"> Temporary, localised, elevation of suspended sediment concentrations (SSC) from sediment uplift and disposal may lead to increased light attenuation through the water column, resulting in shading and potential loss of BCH around the dredging and disposal areas. Temporary, localised, elevation of SSC from sediment uplift and disposal may lead to increased sedimentation smothering and potential loss of BCH adjacent to the dredging and disposal footprint.
Mitigation hierarchy	<p>Avoid</p> <ul style="list-style-type: none"> Spoil ground is located in an area devoid of BCH. <p>Minimise</p> <ul style="list-style-type: none"> Channel design selected to minimise direct removal of BCH. Dredging and disposal will only occur in the permitted areas specified on approved plans and with material approved in the Sea Dumping Permit. Accurate positioning systems will be used on the dredge plant to ensure direct impacts are restricted to the approved dredging and disposal areas. The dredge plant will utilise mechanical devices to reduce turbidity generation during dredging and disposal, such as turbidity-reducing ("green") valves in the overflow of the dredge. The dredge hopper doors will be kept in good condition to minimise loss of sediment during transport. Best practice measures will be implemented to minimise the concentration of suspended solids released during the loading and disposal of dredge material, including adaptive management based on monitoring. <p>The potential significant impacts will be controlled by the implementation of both outcome-based and objective-based conditions that have been outlined in the DEMMP developed for the Proposal.</p>
Residual impacts, including significant residual impacts	<p>The proposed capital dredging will result in a potential direct loss within the dredging footprint of 5.1 ha of sparse to low density (2 to <20% cover) invertebrates, and 1.7 ha of medium density mixed community.</p> <p>There is a low risk that indirect effects of turbidity and burial associated with the plume generated during dredging and disposal may cause temporary (matter of weeks) sublethal responses to a relatively small area of mixed community within State waters (6.4 ha) that consist primarily of non-BBP.</p>

	No significant residual impacts to BCH are anticipated as a result of dredging and disposal operations.
Expected environmental outcomes	<p>Pilbara Ports has proposed the following environmental outcomes for BCH:</p> <ul style="list-style-type: none"> • Disturbance of no more than 63 ha of BCH. • No direct loss of BCH outside of the ZoHI. • No sublethal impacts to BCH outside of the 'probable' ZoMI from increased SSC or sedimentation associated with dredging activities. <p>Pilbara Ports considers the proposed environmental outcomes can be assured through the conditions prescribed by a sea dumping permit issued under the Commonwealth <i>Environment Protection (Sea Dumping) Act 1981</i>, including an approved Dredging Environmental Monitoring and Management Plan.</p>
Marine Environmental Quality	
Potential significant environmental impacts	<p><u>Direct and Indirect</u></p> <ul style="list-style-type: none"> • Uplift and disposal of sediments may lead to a temporary, localised, elevation of SSC, resulting in increased light attenuation through the water column and sedimentation on the seabed. • Physical disturbance of the seabed may lead to the release of contaminants bound in sediments, resulting in release of toxicants into the water column. • Operation of the dredge vessel may lead to a hydrocarbon spill /waste discharge, resulting in release of toxicants into the water column
Mitigation hierarchy	<p>Avoid</p> <ul style="list-style-type: none"> • Sampling and analysis of marine sediments has been undertaken to demonstrate that sediments located within and adjacent to the dredging and disposal areas present a low risk of releasing contaminants potentially bound in the sediments. <p>Minimise</p> <ul style="list-style-type: none"> • The dredge plant will utilise mechanical devices to reduce turbidity generation during dredging and disposal, such as turbidity-reducing ("green") valves in the overflow of the dredge. • The dredge hopper doors will be kept in good condition to minimise loss of sediment during transport. • Dredge vessels will be required to adopt standard industry practices to minimise the risk of oil spills and will have an industry standard Ship Oil Pollution Emergency Plan (SOPEP). • The Port's standard operational spill management controls will be implemented in accordance with the DEMMP. <p>The potential significant impacts will be controlled by the implementation of both outcome-based and objective-based conditions that have been outlined in the DEMMP developed for the Proposal.</p>
Residual impacts, including significant residual impacts	During marine dredging and disposal activities, the Proposal is likely to result in temporary disturbances to water quality by elevating suspended sediment concentrations 5 mg/L above background within a total area of 13,899 ha, but no permanent, long-term change is expected.

	<p>No significant residual impacts to marine environmental quality are anticipated as a result of dredging and disposal operations.</p>
<p>Expected environmental outcomes</p>	<p>Pilbara Ports has proposed the following environmental outcomes for marine environmental quality:</p> <ul style="list-style-type: none"> • No indirect impacts to BCH from increased SSC or sedimentation associated with dredging or disposal activities. • No reported hydrocarbon spills or waste discharge into the marine environment from the Proposal. <p>Pilbara Ports considers the proposed environmental outcomes can be assured through the conditions prescribed by a sea dumping permit issued under the Commonwealth <i>Environment Protection (Sea Dumping) Act 1981</i>.</p>
<p>Marine Fauna</p>	
<p>Potential significant environmental impacts</p>	<p><u>Direct and Indirect</u></p> <ul style="list-style-type: none"> • Operation of the dredge vessel may lead to increased underwater noise around the location of the operating vessels, resulting in disruption to marine fauna behaviour, migratory and foraging activities. • Operation of the TSHD drag head may lead to entrainment of marine fauna, resulting in injury/mortality to marine fauna. • Dredging within the proposed dredge footprint may lead to the direct removal of BCH, resulting in direct loss of important habitat for marine fauna. • Transiting of dredge vessel may lead to a marine fauna collision, resulting in injury/mortality to marine fauna. • Artificial lighting on the dredge vessel operating at night may temporarily increase the light spill into the marine environment, resulting in disruption to light sensitive marine fauna. • Uplift and disposal of sediments during dredging activities may lead to a temporary, localised, elevation of SSC resulting in reduced water quality, resulting in a stress effect and disruption to marine fauna foraging activities (including loss of foraging habitat through shading and/or smothering). • Presence of dredge vessel may lead to introduction of introduced marine species (IMS), resulting in a loss of local biodiversity.
<p>Mitigation hierarchy</p>	<p>Avoid</p> <ul style="list-style-type: none"> • Channel design selected to avoid areas of known BCH that may support marine fauna. • Spoil ground is located in an area devoid of BCH that may support marine fauna. • Fauna/vessel interaction distances detailed in the Australian National Guidelines for Whale and Dolphin Watching (Commonwealth of Australia 2017a) will be adhered to throughout dredging. • and planned as far as practicable to be outside of peak turtle nesting and hatchling emergence periods to avoid interactions with marine turtles. • A dredge vessel that is already located within WA State waters will be sourced where practicable to avoid introduction of IMS. In the event a dredge vessel is sourced from interstate or international waters, the vessel would adhere to Australian biofouling and ballast water management requirements.

	<p>Minimise</p> <ul style="list-style-type: none"> • The length of the campaign will be minimised. • The campaign will be planned as far as practicable to minimise overlap with peak turtle nesting and hatchling emergence periods to avoid interactions with marine turtles. • Within port waters, the dredge vessel will be slow moving during transit between dredging and disposal areas. The dredge vessel will control its speed in accordance with the Pilbara Ports Port Hedland Vessel Movement Protocols (Pilbara Ports Website Link), which aligns with the <i>Port Authorities Regulations 2001</i> that states <i>vessel must not move at a speed that exceeds the maximum speed at which the vessel can be safely moved in the port</i>. • A trained MFO will be aboard the dredge when the vessel is in motion and operation to check for marine fauna. • A minimum distance of 300 m will be maintained between the vessel and observed marine fauna. • TSHD fitted with turtle exclusion devices on the drag heads. • Procedural controls whilst dredging to minimise off-bed suction time. • Minimise the duration of run-time for vessel engines, thrusters and dredging plant to reduce underwater noise by avoiding stand-by or running mode to the degree practical and consistent with safe operations. • Dredge vessel will be subjected to a marine pest risk procedure which complies with the relevant Commonwealth and State biosecurity requirements and Pilbara Ports IMP Risk Assessment procedure. • Light levels from the dredging vessel will be minimised to those lights that are necessary for the safe operation of the vessel. • Operational lights will not be directed towards the sea unless required for the safe operation of the vessel. <p>The potential significant impacts will be controlled by the implementation of both outcome-based and objective-based conditions that have been outlined in the DEMMP developed for the Proposal.</p>
<p>Residual impacts, including significant residual impacts</p>	<p>It is considered that impacts to humpback whales from continuous noise generated during dredging activities will be a temporary behavioural response up to ~ 5 km from the dredge vessel, and may cause onset of temporary hearing damage and/or impairment up to 10 m from the operating vessel. There is unlikely to be any impact to marine turtles from continuous noise generated during dredging activities.</p> <p>Noting the limited area of impact to BCH (approximately 1.1 ha), temporary period for dredging (five weeks) and current levels of disturbance in the Port waters, as well as the proposed management measures in the DEMMP, including minimising undertaking dredging activities during key nesting periods and employing marine fauna observers, the potential impacts can be managed to acceptable levels. The Proposal is therefore unlikely to result in permanent or irreversible impacts to conservation significant marine fauna at a species or population level, and is unlikely to cause a population decline, impact critical ecological functions and breeding cycles, or remove habitat critical to the survival of marine fauna.</p> <p>No significant residual impact to marine fauna are anticipated as a result of dredging and disposal operations.</p>

<p>Expected environmental outcomes</p>	<p>Pilbara Ports has proposed the following environmental outcomes for marine fauna:</p> <ul style="list-style-type: none"> • No collision with marine mammals during dredging activities associated with the Proposal. • No entrainment of marine turtles during dredging activities associated with the Proposal. • No introduction of marine pests as a result of the Proposal. • No impact to important habitats (nesting, nursery, foraging or breeding areas) outside of the ZoHI. • No reported hydrocarbon spills or waste discharge into the marine environment from the Proposal. <p>Pilbara Ports considers the proposed environmental outcomes can be assured through the conditions prescribed by a sea dumping permit issued under the Commonwealth <i>Environment Protection (Sea Dumping) Act 1981</i>.</p>
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1 THE PROPOSAL

1.1 Proposal Description

Consistent with the EPA instructions ‘How to prepare an Environmental Review Document’ and ‘How to identify the Content of a Proposal’, a general Proposal content description and summary of the Proposal elements has been provided in Table 1-1 and Table 1-2, respectively.

The Proposal covers only the construction of the bypass navigation channel. As the channel is for emergency use only and may never be used, usage impacts are considered minor and not discussed here.

Table 1-1. General Proposal content description

Proposal title	Port Hedland Zone 5 Bypass Channel Project
Proponent name	Pilbara Ports
Short description	The Proposal is for the capital dredging of a bypass navigation channel to the east of (what is known as) Zone 5 of the existing shipping channel within the Port of Port Hedland. The Proposal is a strategic marine risk-mitigation project intended to maintain vessel transit at an acceptable reduced capacity, should a grounding incident occur in Zone 5 of the channel. Key construction elements of the Proposal include dredging of up to 800,000 m ³ of seabed material within a total disturbance footprint of 162 ha (63 ha in WA State waters) and disposal of dredge material to an approved spoil ground located within Commonwealth (port) waters.

Table 1-2. Proposal content elements

Element	Location/ Description	Maximum extent, capacity or range
Physical Elements		
Navigation channel	Figure 1-1	432 ha navigation channel (incl 50 m buffer) to design depth of – 11.5 m Chart Datum (plus 1.0 m of over-dredge). Of which 63 ha is within State waters.
Spoil Ground	Figure 1-2	282 ha area located in Commonwealth waters within established Spoil Ground 7. Sub area termed SG7C.
Construction elements		
Capital dredging	Figure 1-1	Up to 800,000 m ³ (including up to 1.0 m of over-dredge) of capital dredging will be undertaken using a trailing suction hopper dredge ¹ within a total disturbance footprint of 162 ha (63 ha in State waters and 98 ha in Commonwealth waters)

¹ Where spots of harder material are encountered, it is possible that Pilbara Ports will remove the material using alternative dredging methods (e.g. cutter suction dredge)

Element	Location/ Description	Maximum extent, capacity or range
		inside a development envelope of 432 ha (63 ha in State waters and 369 ha in Commonwealth waters).
Disposal of dredged material	Figure 1-2	Dredge spoil to be placed within Spoil Ground 7, 282 ha sub area C (SG7C) located within Commonwealth (Port) waters.
Operational elements		
Ongoing maintenance dredging	Figure 1-1	On an 'as required' basis, with the activity covered within Pilbara Ports 5-year SDP for maintenance dredging (SD2022/4041)
Elements with greenhouse gas emissions		
Construction elements		
Scope 1	Total GHG emissions from dredging plant associated with the Project is estimated to be less than 100,000 t CO2-e over the capital dredging program.	
Scope 2	Nil	
Scope 3	Nil	
Operation elements		
Scope 1	Total GHG emissions from future maintenance dredging of the navigation channel are estimated to be less than 100,000 t CO2-e over each maintenance campaign. Future maintenance dredging requirements for this area will be addressed by Pilbara Ports under a separate application to incorporate this area within Pilbara Ports existing Sea Dumping Permit for maintenance dredging.	
Scope 2	Nil	
Scope 3	Nil	
Rehabilitation		
N/A		
Commissioning		
N/A		
Decommissioning		
N/A		
Other elements which affect extent of effects on the environment		
Proposal time	Maximum project life	50+ years
	Construction phase	5 Weeks
	Operations phase	50 Years
	Decommissioning phase	N/A

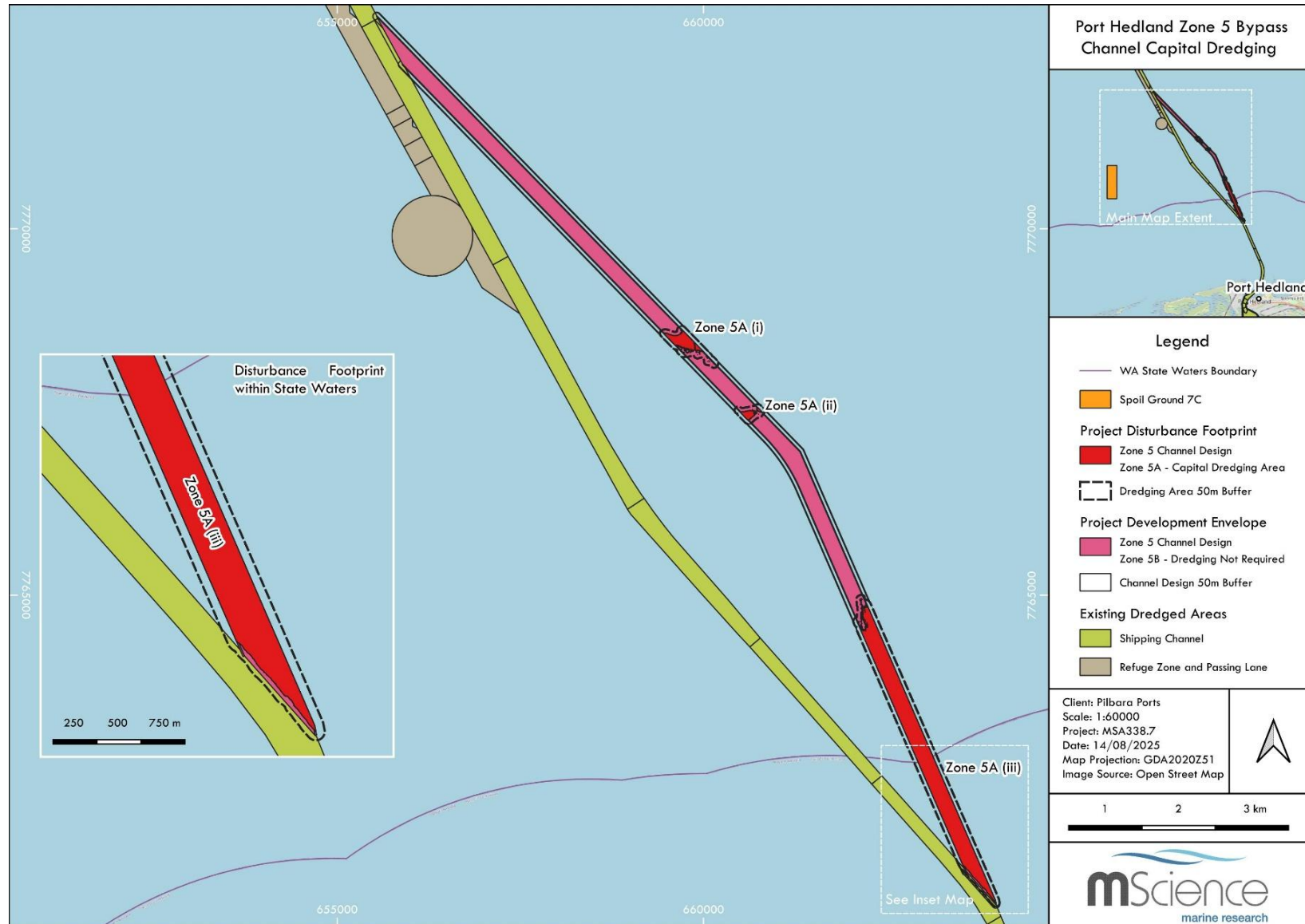


Figure 1-1. Proposed dredge area

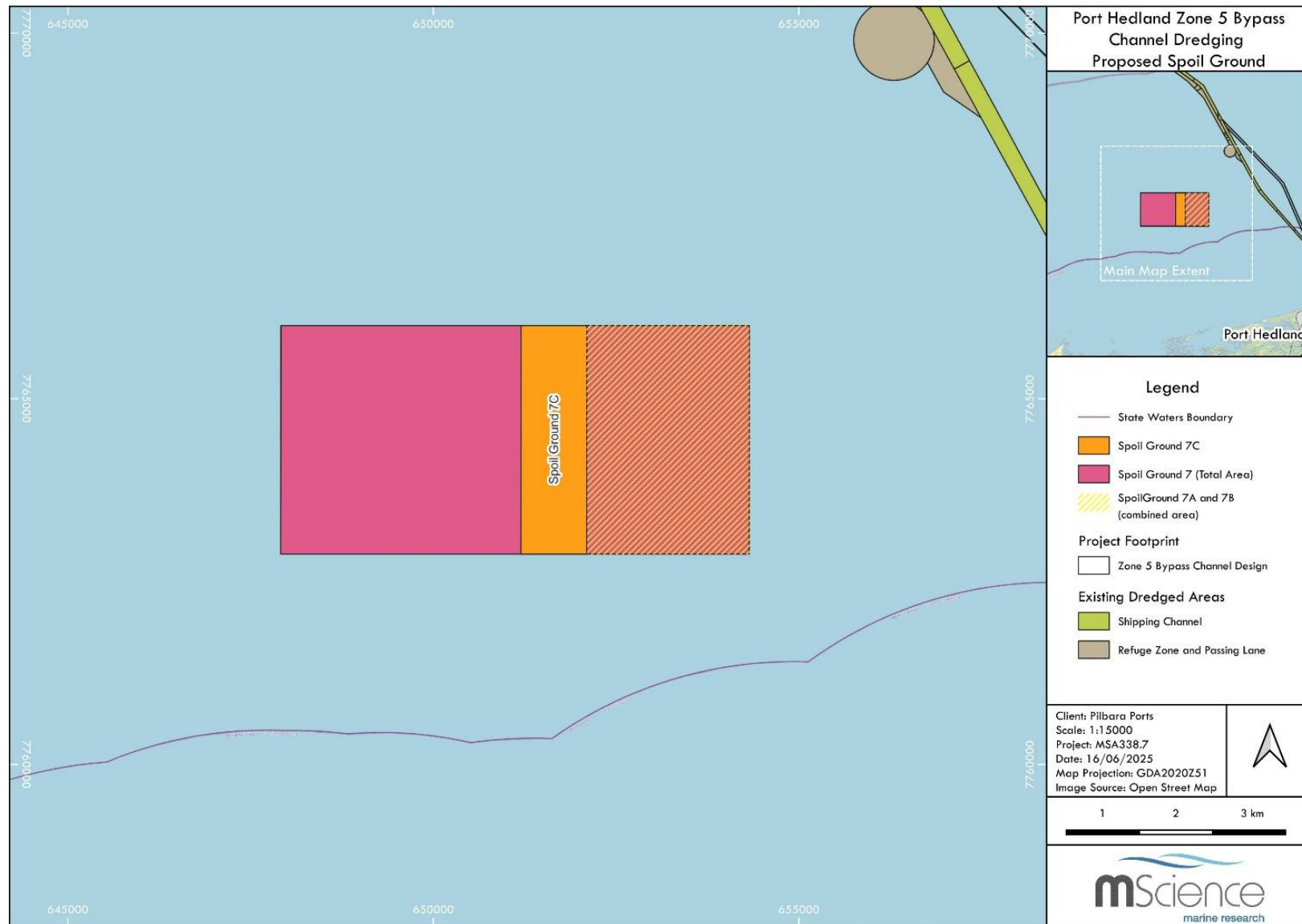


Figure 1-2. Spoil ground location

1.1.1 Proposal Justification

The Port of Port Hedland (Port) is a single-channel port that underpins a significant proportion of Western Australia's export economy. The safe and continuous movement of vessels through the channel is fundamental to maintaining supply chain reliability for the States iron ore industry and the broader national economy. While the channel has been progressively deepened and operational procedures strengthened over time, its underlying configuration remains challenging: all shipping activity depends on a single navigable route.

As vessel sizes have increased and traffic volumes grown, the consequences of any disruption to this route have become more pronounced. Although vessel control failures remain relatively infrequent, incidents in recent years have demonstrated that even brief mechanical or navigational issues can escalate quickly within the confined geometry of the channel. In certain sections, such as Zone 5, the physical characteristics of the channel provide limited opportunity for recovery once control is lost.

The Proposal would address this specific vulnerability. It would establish a secondary navigable path adjacent to the existing alignment allowing vessel movements to continue should the main channel become obstructed. Unlike procedural or operational mitigations, which reduce likelihood, the bypass provides a physical redundancy that ensures continuity of trade during a major incident within this section of the channel. This Proposal is therefore a strategic resilience measure. It strengthens the Port's ability to manage low-probability, high-consequence events and safeguards the economic value generated by uninterrupted export operations.

1.1.2 Dredging Areas

The capital dredging footprint occurs to the east of Zone 5 of the existing Channel (Figure 1-1). The bathymetry of Zone 5 is predominantly greater than 10 metres depth with scattered shoal patches, one of which lies close to the Channel with water depths of 8 meters at lowest astronomical tide (LAT).

The bypass navigation channel design depth is -11.5 m chart datum (CD) and would be 200 m wide between the designed toelines. In order to achieve a design depth of -11.5 mCD, Pilbara Ports have provisioned for an average maximum vertical over-dredge of 1.0 m, bringing the average maximum vertical design depth to -12.5 mCD. The inclusion of the 1 m over-dredge to the overall design will allow for the tooth depth of a cutter suction dredge (CSD), in the event small areas of consolidated material are identified that cannot be removed by the TSHD (refer to section 1.1.3).

The majority of the new channel exists at or below design depth and capital dredging within the channel design profile is only required in two discrete areas (5A(ii) and 5A(iii)) that have been shown via hydrographic survey to be above the channel design depth of -11.5 m (Figure 1-1). The area designated 5A(i) is below the designated channel design depth but above the maximum vertical design depth of -12.5 mCD. As such, dredging in this area is unlikely and its inclusion has been provided for due diligence purposes.

1.1.3 Disposal Areas

An established spoil ground (Spoil Ground 7 [SG7]) previously approved for spoil disposal and used in several recent capital and maintenance dredging campaigns will be used for spoil disposal. Recent campaigns have used sub-areas SG7A and SG7B inside the SG7 boundaries. These areas are too shallow for the expected draft of the TSHD and disposal for the Project will target sub-area SG7C inside the greater SG7.

The spoil ground location is shown in Figure 1-2 and its coordinates are provided in Table 1-3.

Management and allocation of space within existing spoil grounds is the responsibility of Pilbara Ports and is subject to consultation with its Port Hedland TACC.

Table 1-3. Spoil ground coordinates

Spoil Ground	Latitude	Longitude
Spoil Ground 7C	20°11.851'S	118°26.827'E
	20°11.847'S	118°27.344'E
	20°13.544'S	118°26.841'E
	20°13.540'S	118°27.358'E

1.1.4 Dredging Methodology

The dredging program is expected to take up to five (5) weeks and is planned to be conducted once all necessary approvals for the Project have been granted. The exact timing and duration of the works will depend on the availability and size/capacity of the dredge offered by the preferred contractor. The capital dredging program is planned to be conducted in conjunction with the annual maintenance dredging of Pilbara Ports port facilities at the Port of Port Hedland, commencing in August 2026.

Port Hedland is characterised by hard, abrasive and variably cemented calcareous materials. Only two dredging methodologies are considered viable and are being progressed for the Proposal.

- Method 1: Trailing Suction Hopper Dredge (TSHD) only
 - rip and loosen seabed material;
 - Immediately dredge the loosened material by suction; and
 - transport material directly to Spoil Ground 7C for disposal.
- Method 2: Crushing using a Cutter Suction Dredge (CSD) with rehandling by a TSHD
 - Mechanically crush hard material in situ using CSD;
 - Place crushed material back onto the seabed; and
 - Enable a TSHD to subsequently re-handle and dispose of material to Spoil Ground 7C.

A TSHD is a self-propelled vessel equipped with one or two drag arms (each with an attached drag head), powerful pumps and a hopper to store the dredged material. The drag arms are lowered so the drag heads can be trailed across the seabed where material is to be dredged. Suction induced by the dredge pumps generates a strong flow field about the drag head intakes. This flow field entrains particles of bed material. A solids-water mixture is formed, drawn in through the drag heads, up suction pipes in the drag arms and is pumped into the hopper. The coarser-sized solids deposit more rapidly inside the hopper to form a material bed, while some finer-sized particles remain suspended in water overlying the hopper bed. As dredging continues the surface level of the water in the hopper rises till it reaches the (adjustable) level of a weir. Excess water then leaves the hopper by overflowing the weir and is conveyed through an overflow pipe to a discharge point at the base of the vessel. The overflow discharge carries with it suspended solids (predominantly finer, more slowly settling fractions of the dredged material) that have not been retained in the hopper.

A CSD with side casting capabilities is hydraulic vessel that breaks up hard material with a rotating cutter head and immediately discharges the slurry to the side of the cut via a short pipeline. CSD's are anchored in position, and moved forward, by spud poles. Once removed from the seabed, material is uplifted by the TSHD and is pumped into the hopper.

The boundary of the dredging area and spoil grounds will be displayed live on the screen of the dredger, along with the position of the dredger and associated equipment e.g. trailing arms / head. This will ensure dredging activities stay within the boundary of the approved dredging areas.

1.1.5 Disposal Methodology

On completion of loading, the TSHD will sail to the nominated spoil ground where its contents are discharged by opening the doors or valves in the hopper bottom. Release of the dredged material will typically be managed to preferentially fill deeper sections of the disposal site, although vessel safety and navigational constraints will dictate the exact location of any individual dump. Rate and duration of discharge will depend on the dredging plant selected. Vessel speed during release will vary as a function of the water depth at the site and the type (gradation and cohesiveness) of material being released. Release of the dredged material will be managed to ensure that the spoil ground is filled in an organised and consistent manner using a pre-determined grid pattern. Once empty, the dredge/barge returns to the dredge area where the cycle is repeated. The position of the dredge/barge will always be monitored and recorded by a vessel positioning system, which will allow the actual track of the vessel to be plotted and the location of individual dump operations to be recorded.

The duration of each disposal event (including positioning and hopper rinsing) may be up to 30 minutes, however, the active disposal phase (when most of the material is discharged through the bottom doors) is typically less than 10 minutes.

1.2 Proposal Alternatives

Zone 5 has been identified as the section of the channel where a grounding would be most difficult to refloat and most likely to cause long-duration closure. Pilbara Ports has completed comprehensive options assessments for addressing the risk of a prolonged channel blockage in Zone 5. These assessments considered a full range of structural and non-structural alternatives to improve channel resilience, including dredged bypass alignments, operational strategies, environmental considerations and the option of not pursuing capital works (Table 1-4), including:

- Optimise without capital (operational controls only)
- Option A – Eastern Zone 5 Channel Bypass
- Option B - Western Zone 5 Channel Bypass
- Option C - Enhanced Towage and Procedural Controls
- Option D - Channel Widening in Zone 5 (no bypass)

The structural options outlined above were selected based on:

- Alignment and connection to the main navigation channel, including channel modifications that were completed as part of the Channel Risk and Optimisation Project (CROP);

- Examination of bathymetry to both the east and west of the main navigation channel to minimise dredging requirements and impacts to benthic communities and habitats;
- Potential outbound vessel draft requirements, the bypass channel alignment targeted areas within the existing bathymetry that had minimum depths of -11m LAT;
- Avoidance of a significant shoal feature identified in the bathymetry approximately 3.5 km to east of Beacon 16 along the main navigation channel;
- Avoidance of a significant shoal feature approximately 300 m to the west of Beacon 23 along the main navigation channel, that extends for 3 km; and
- Minimising vessel manoeuvres through the bypass channel by including only one major bend, at an angle no greater than the main navigation channel at C6/C7 (≈51 degrees).

The options assessment concluded that Option A – Eastern Zone 5 Channel Bypass offers the most favourable balance of dredge volume, navigational safety, operational performance, and environmental impacts (i.e., dredging volumes and duration, impacts to benthic habitats).

Table 1-4. Channel Resilience Options Assessment (Summary)

Option	Summary of Considerations
Optimise without capital (operational controls only)	A non-capital solution that relies solely on existing and enhanced operational measures, such as additional towage support, updated escort requirements, and emergency response refinements, but does not address the inherent risk of operating a single navigational channel. While these measures reduce the likelihood of a grounding and don't require capital dredging, they cannot provide an alternative transit path if an obstruction occurs. Under this option, the Port remains exposed to the full economic and operational impacts of a prolonged closure in Zone 5. This approach is therefore not considered viable as a long-term resilience strategy. Not preferred.
Option A – Eastern Zone 5 Channel Bypass	This option involves constructing a dedicated bypass channel on the eastern side of Zone 5. It has the lowest required dredge volume and potential environmental impacts of the structural alternatives and provides the most favourable navigational outcome, with minimal interaction between salvage operations and continuing vessel transits. The eastern alignment allows ship movements to be maintained at a significant proportion of normal throughput, thereby materially reducing the consequences of a blockage event. It offers strong operational performance, low ongoing dredging maintenance requirements and has broad support from port users. Importantly, this option utilises existing natural seabed depths to minimise dredging volumes and impacts to benthic habitats, as well as utilising existing navigational routes to the Port. Preferred Option.
Option B Western Zone 5 Channel Bypass	The western alignment was assessed as a feasible alternative but is associated with significantly higher dredging requirements (volume and time) and more complex channel geometry. Pilotage

Option	Summary of Considerations
	assessments identified increased navigational challenges compared to the eastern route, and operational modelling showed lower throughput under bypass conditions. Interaction between a grounded vessel and transiting vessels is also more likely in this corridor. While technically possible, this option also provided reduced operational benefit at a higher cost. Not preferred.
Option C Enhanced Towage and Procedural Controls	Enhancing towage capability and updating procedures can strengthen incident response but cannot prevent a prolonged blockage. This option does not provide physical redundancy and therefore cannot maintain vessel movements during salvage. It may complement, but cannot replace, a structural solution. Not preferred.
Option D Channel Widening in Zone 5 (no bypass)	Widening the existing channel in Zone 5 was examined as a major capital alternative. Although widening may marginally improve manoeuvrability, it does not eliminate the risk of a vessel grounding and obstructing the channel. The required dredge volume is significantly larger than a bypass, and the environmental impact footprint is materially higher. This approach is therefore not considered viable. Not preferred.

A full review of alternatives to the ocean disposal of spoil was undertaken as part of the application for a sea dumping permit. On the basis of economic, environmental and social criteria, that review concluded that ocean disposal was the only viable option for spoil disposal.

1.3 Local and Regional Context

1.3.1 Locality

The Port of Port Hedland is in the Pilbara Region of Western Australia located immediately adjacent to the Port Hedland township, approximately 1,630 kilometres (by road) north of Perth. The Port of Port Hedland is one of Western Australia's most important infrastructure assets and continues to make significant and growing contributions to the Australian economy. The total economic contribution of the Port Hedland Port Supply Chain within Australia was approximately \$103.73 billion in 2022-23.

The proposed Zone 5 Bypass Channel is located between ~8 to 22km north of the Port Hedland township (Figure 1-3), entirely within the Port of Port Hedland boundaries, managed by Pilbara Ports.

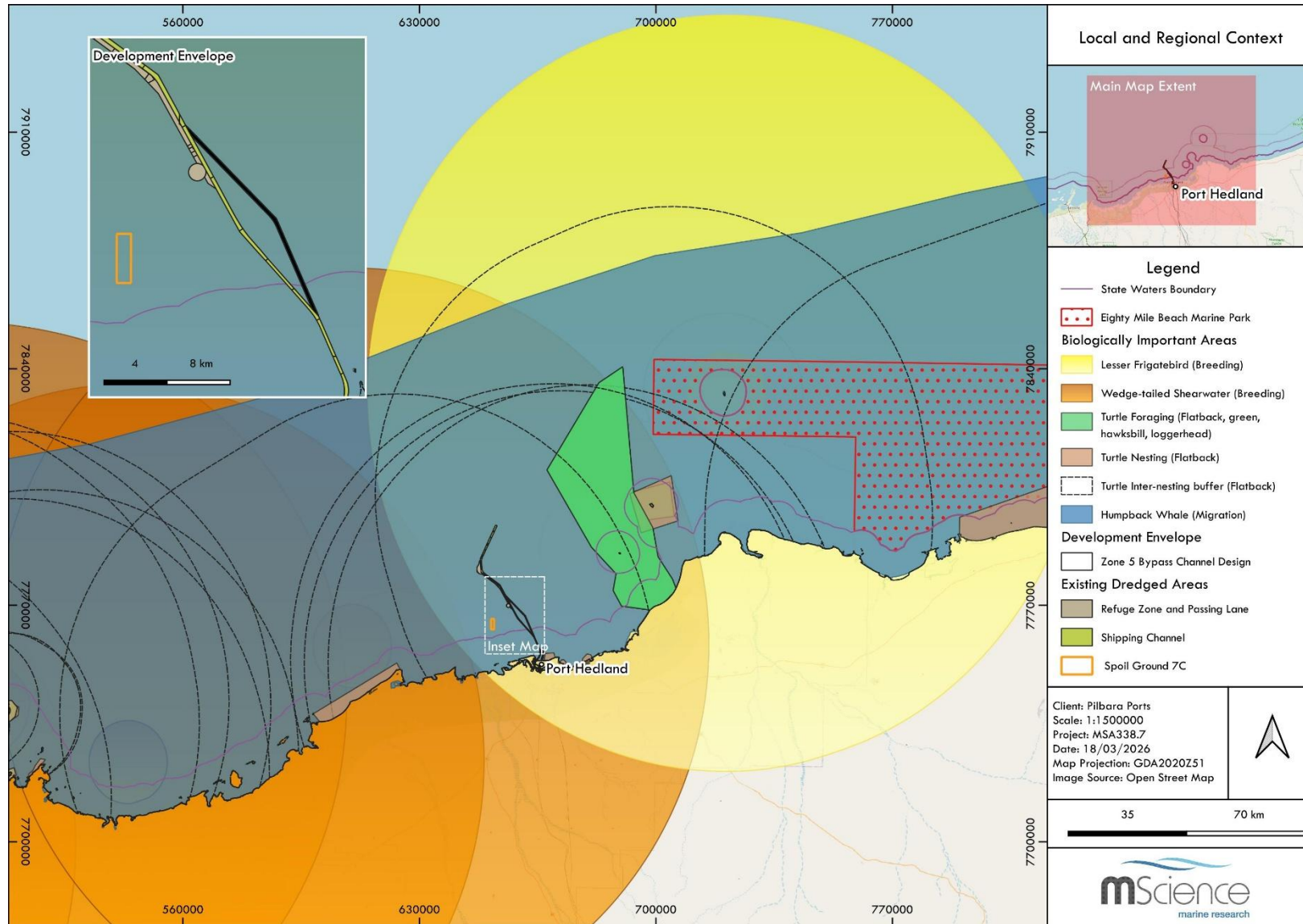


Figure 1-3. Proposal location within local and regional context

Pilbara Ports owns and operates four public berths within the port's inner harbour with two additional berths being constructed as part of the Lumsden Project. There are 15 additional private berths (constructed by other entities under State Agreement Acts or a lease or licence agreement with Pilbara Ports), which facilitate the export of bulk minerals such as iron ore. Pilbara Ports public berths facilitate the trade of bulk minerals (iron ore, manganese, salt, lithium, and copper concentrate), petroleum products, ammonium nitrate, bulk liquids, general cargo, containerised cargo and livestock.

Port Hedland, and the wider region, has historically been the subject of numerous large-scale infrastructure developments, including extensive and periodic capital and maintenance dredging campaigns.

1.3.2 Heritage

The Port Hedland region contains a diverse range of Aboriginal heritage sites and objects, including petroglyph (rock art) sites, ethnographic sites, shell middens, artefact scatters, quarries and grinding patches.

Port Hedland is situated within the traditional Country of the Kariyarra People. The Kariyarra People Native Title claim (National Native Tribunal File No. WCD2018/015) was determined in December 2018, and the Kariyarra Aboriginal Corporation is the Registered Native Title Body Corporate representing the interests of the Kariyarra People. However, the Native Title ruling also determined that Native Title has been extinguished over the majority of Port vested land and waters, including the project area.

Pilbara Ports maintains an active program of Aboriginal heritage consultation and management. Previous consultation with Kariyarra Traditional Owners undertaken during capital dredging and other port developments at Port Hedland has not identified any underwater archaeological heritage sites or ethnographic values within the project area.

Pilbara Ports (2025) completed a desktop assessment of the potential for cultural heritage to be encountered during activities undertaken for the proposed Zone 5 Bypass Channel in accordance with Section 4.2 of Pilbara Ports' Cultural Heritage Management Plan (CHMP). The CHMP is publicly available on Pilbara Ports' website. The assessment considered the results of previous cultural heritage surveys undertaken within the Port Hedland area and subsequent identified heritage sites; the geology and topography of Port Hedland, and the likely impacts sea level rises (post-Last Glacial Maximum) would have on presently submerged coastlines and potential evidence for past human occupation. The assessment concluded the current proposed program has a very low probability of encountering extant cultural heritage and is, therefore, unlikely to result in impacts to heritage sites.

1.3.3 Existing Marine Environment

The marine environment offshore from Port Hedland is connected to the wider Indo-Pacific biogeographic region through the Leeuwin and Holloway Currents (BHP 2009). Prevailing winds are west to north westerly during the warmer months (September to April), and northerly and easterly during the cooler months (May to August). During the warmer months wind strength tends to increase throughout the day and are strongest in the afternoons, whilst the opposite occurs in the cooler months (BOM 2025). The north westerly winds average between 20 and 25 knots and easterly winds typically between 15 and 20 knots.

Tropical cyclones generally occur between November and April in the Pilbara. Winds in excess of 250 km/hr, torrential rain, storm surges, large waves and substantial movement of coastal sediments can be experienced during cyclones.

Typically, swell and waves approach the Pilbara coast from the north and north-west as a result of Southern Ocean swell refracted by the regional bathymetry and islands of the North West Shelf (Semeniuk 1996). The tidal regime of the area is predominantly semi-diurnal and range from 1.5 m during neap tides to 6.0 during springs, with the highest astronomical tide being 7.9 m (BHP 2009).

The natural current direction in the local area is north westerly to south easterly. Influences on the currents and circulation in the North West Shelf include the Indonesian through-flow current, the Western Australian current, the Leeuwin current, cyclones and large tidal ranges. The large tides drive oscillating currents of around 1 m/s (BHP 2009). Under cyclonic conditions, large waves, strong winds and storm surges can be created which can significantly alter current and wave energy patterns, and subsequent background water quality conditions (APASA 2009).

Marine waters within the Port of Port Hedland are typically well mixed and subjected to substantial variation in water quality following rainfall events and inflows from five shallow creek systems that discharge into the harbour. Marine water quality within the Port of Port Hedland is described in detail in Section 4.

Nearshore environments are characterised by extensive sand plains of low relief, medium to coarse-grained sand with shell fragments. Exposed limestone outcrops have resulted in the development of protected embayment's, wide salt flats, offshore ridgelines and several offshore islands with associated reef communities. The distribution and composition of subtidal benthic communities and habitats off the coast of Port Hedland have been described previously for the proposed BHP Outer Harbour Development (SKM 2009a). Areas relevant to the Proposal were verified during a recent benthic habitat assessment (MScience 2025a). These are discussed further in Section 3.

The closest marine conservation areas are the Rowley Shoals Marine Park (approximately 300 km offshore to the north) and Eighty Mile Beach Marine Park (approximately 100 km east) (Figure 1-3).

Biologically Important Areas (BIAs) are spatially defined areas where aggregations of individuals of a regionally significant species are known to display biologically important behaviours such as breeding, foraging, resting or migration (Commonwealth of Australia 2021). The dredging footprint of the Proposal overlaps BIAs (Figure 1-3) for:

- Humpback Whale – Migration
- Flatback Turtle – Inter-nesting Buffer
- Short-tailed Shearwater – Breeding
- Lesser Frigatebird – Breeding

The only other BIA within a 20km buffer of the dredging footprint exists for Flatback Turtle – Nesting.

2 STAKEHOLDER ENGAGEMENT

A detailed record of the stakeholder consultation has been provided in Appendix 3.

2.1 Key Stakeholders

Pilbara Ports hosts a long-standing Technical Advisory and Consultative Committee (TACC) for the Port of Port Hedland. The TACC is representative of industry, community and government at all levels, including the following organisations:

- Pilbara Ports (Environment and Heritage Manager, Harbour Master and Dredging and Survey Manager, or their representatives).
- Government organisations:
 - Commonwealth DCCEEW;
 - Western Australian Department of Primary Industries and Regional Development (DPIRD);
 - Western Australian Department of Biodiversity Conservation and Attractions (DBCA) Parks and Wildlife Service; and
 - Western Australian Department of Transport and Major Infrastructure (DTMI).
- Community Stakeholders:
 - Kariyarra Aboriginal Corporation (KAC)
 - Town of Port Hedland (TOPH); and
 - Care for Hedland Environmental Association.
- Port Industry and Users:
 - BHP Billiton;
 - Roy Hill; and
 - Fortescue Metals Group (FMG).

2.2 Stakeholder Engagement Process

The TACC meets at least twice per annum to discuss all matters relating to dredging in the Port. Stakeholder engagement commenced in June 2025 and has been ongoing throughout the approvals process.

The main objective of the TACC is to ensure a transparent process with respect to dredging and ocean disposal of dredged material. Consultation has been targeted with the key stakeholders through face-to-face presentations and meetings.

The intent and purpose of the TACC is to:

- Provide continuity of direction and effort in protecting the local environment of the Port of Port Hedland in relation to dredging and dredged material disposal;
- Aid communication between stakeholders and provide a forum where points of view can be discussed, and conflicts resolved;
- Assist in the establishment, as appropriate, of longer term permitting arrangements through activities such as the provision of comments, review of plans and integration of activities;
- Review ongoing management of dredging and dumping activities in accordance with the guidelines and permitting arrangements;
- Make recommendations to Pilbara Ports, State agencies and/or relevant Commonwealth agencies as necessary in relation to the above as appropriate.

2.3 Stakeholder Consultation Outcomes

Stakeholder	Date	Issues/Topics Raised	Proponent Response/Outcome
Port Hedland Technical Advisory Consultation Committee (TACC)	6 June 2025	<p>Pilbara Ports provided an overview of the proposed Zone 5 Bypass project including the location of the new channel, environmental investigations to be carried out and indicative timeline to TACC members.</p> <p>Members were encouraged to ask questions regarding this project.</p> <p>No issues raised by the TACC members.</p>	Pilbara Ports will continue to liaise with the TACC members regarding the Proposal. Next scheduled meeting is November 2025. – see item at end of table
Department of Climate Change, Energy, the Environment and Water (DCCEEW) (Sea Dumping Section; Environmental Permitting and Compliance Division)	3 July 2025	<p>Pilbara Ports presented the proposed Sampling and Analysis Plan (SAP) for the Zone 5 Bypass Channel Project to DCCEEW for discussion and comment.</p> <p>DCCEEW provided a request for further information (RFI) on 25 July 2025, including clarification on:</p> <ul style="list-style-type: none"> • Whether further investigations to characterise sediments at the disposal site were required. • Additional information on pesticides, polychlorinated biphenyl (PCBs), phenolic compounds, PFAS and acid generating soils. 	<p>Pilbara Ports issued a response to the RFI on 28 July 2025.</p> <p>The SAP was formally approved by DCCEEW on 14 August 2025.</p>

Stakeholder	Date	Issues/Topics Raised	Proponent Response/Outcome
Kariyarra Aboriginal Corporation (KAC)	26 September 2025	<p>A letter outlining the project was provided to KAC. The letter included:</p> <ul style="list-style-type: none"> • The reasoning behind the Project. • Location of proposed bypass channel (map provided). • Description of dredge design. • Indicative timeline of the Project. <p>No issues raised by KAC (no formal response received).</p>	<p>Pilbara Ports' First Nations Engagement Manager and team maintain regular engagement with KAC. As part of this ongoing engagement, follow-up was undertaken in relation to the letter issued in September (including a meeting in December to seek feedback on the Project). To date, no queries or concerns have been raised by KAC. Pilbara Ports will continue to engage with KAC throughout the Project. Note that KAC is also a standing invitee to the Port Hedland TACC and Community Consultative Committee forums.</p>
Port Hedland TACC	13 November 2025	<p>Following on from the June TACC meeting, Pilbara Ports gave a more in-depth description of the Project and updated timeline. The outcomes of the environmental investigations were also presented.</p> <p>The TACC member Care for Hedland asked for clarity on:</p> <ul style="list-style-type: none"> • when environmental approval documents would be submitted. • what timeframe will the dredge campaign cover (duration and specific months). • Care for Hedland wanted to note the importance of considering whale migration 	<p>Pilbara Ports provided the following response to Care for Hedland during the meeting:</p> <ul style="list-style-type: none"> • Approval submission will be partly dependent on geotechnical results, but Pilbara Ports is aiming to submit in January 2026. • The campaign is expected to take three to four weeks² and will likely occur in August to September and will coincide with the maintenance dredge campaign. • Pilbara Ports acknowledged the need to consider whale and turtle activity in the area, especially during the summer months. The aim is to undertake the dredge campaign in August/September reducing any risks to

² Three-to-four-week timeframe was accurate at the time of the meeting (updated geotechnical data led Pilbara Ports to amend the dredging method, which impacted the proposed dredging timeframe by one to two weeks).

Stakeholder	Date	Issues/Topics Raised	Proponent Response/Outcome
		and turtle breeding activity if the campaign goes into October.	<p>marine fauna and potential operational impacts during cyclone season.</p> <p>Pilbara Ports will continue to liaise with the TACC members regarding the Proposal. Next scheduled meeting is May 2026.</p>
Port Hedland Community Consultive Committee (CCC)	5 December 2025	<p>A targeted Community Communications and Engagement Plan was designed and implemented in December 2025. The Plan included an information leaflet outlining the key elements of the Zone 5 Bypass project. This was disseminated to the CCC members with an invitation for further discussions if members required more details.</p> <p>No issues raised by Port Hedland CCC members</p>	Pilbara Ports will continue to liaise with the CCC members regarding the Proposal, as required.
Department of Water and Environment Regulation (DWER) (Environmental Protection Authority Services)	8 December 2025	<p>Pilbara Ports presented an overview of the dredge project including the need for the project, dredge design, project timeline and results from past and current benthic habitat, sediment and dredge spill modelling assessments.</p> <p>No issues raised by DWER.</p>	Pilbara Ports will continue to update DWER on the Proposal, as required.
DCCEEW (Sea Dumping Section; Environmental Permitting and Compliance Division)	9 December 2025	Pilbara Ports presented an overview of the dredge project including the need for the project, dredge design, project timeline and results from past and current benthic habitat, sediment and dredge spill modelling assessments.	As requested in the meeting, Pilbara Ports will continue to update DCCEEW on the submission timeframe for the sea dumping permit application.

Stakeholder	Date	Issues/Topics Raised	Proponent Response/Outcome
		No issues raised by DCCEEW. Representatives from the sea dumping section appreciated the long lead time between notification of the application and proposed submission timeframe.	
Kariyarra Aboriginal Corporation	25 December 2025	Face-to-Face meeting between KAC and Pilbara Ports First Nations Engagement Manager following the letter sent in September 2025. No issues raised by KAC	Face-to-Face engagement between Pilbara Ports First Nations Engagement team and KAC has been proposed to be frequent and ongoing throughout the approvals process and development of the Proposal.
DCCEEW (Sea Dumping Section; Environmental Permitting and Compliance Division) and, DWER (Environmental Protection Authority Services)	18 Feb 2026	An email was sent to the regulators to update them on Pilbara Ports submission timeframe. Additional plume modelling was commissioned by Pilbara Ports as a result of the geotechnical assessment outcomes and changes to proposed dredging methodology. As such, Pilbara Ports submission deadline was revised for March/early April 2026. Responses were provided by both regulators, confirming no additional pre-lodgement presentations were required.	Pilbara Ports will continue to update to the regulators on the submission timeframe for the Proposal.

3 ENVIRONMENTAL FACTOR ASSESSMENT – BENTHIC COMMUNITIES AND HABITATS

3.1 EPA Objective

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

3.2 Policy and Guidance

Table 3-1 details the EPA, State and/or Commonwealth policies and guidance that have been considered in evaluation of potential impacts on Benthic Communities and Habitats (BCH).

Table 3-1. Policy and guidance – benthic communities and habitats

Policy and Guidance	How the guidance has been considered
Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021a)	The assessment of significance of impacts to BCH has considered the EPA's consideration of 'significance' in this guidance.
Environmental Factor Guideline – Benthic Communities and Habitats (EPA 2016a)	The considerations for EIA stated in this guidance have been addressed in evaluation of potential impacts on BCH as a result of the Proposal. The Proposal design has addressed the guidance in this document and been adjusted to avoid and minimise any impacts.
Technical Guidance – Protection of Benthic Communities and Habitats (EPA 2016b)	Mapping of BCH within and adjacent to the Proposal has been completed in accordance with this guidance. The guidance has been used to establish a local assessment unit for the Proposal and to determine the cumulative impacts and losses.
Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2021b)	This guidance has been considered in evaluation of potential impacts associated with the proposed dredging. Zones of impact relevant to BCH due to dredging activities have been established using this guidance.
WAMSI Dredging Science Node Theme 4 Synthesis Report: Defining Thresholds and Indicators of Coral Response to Dredging-Related Pressures (Jones et al. 2019)	This guidance has been considered in setting the potential zones of impact relevant to BCH associated with the proposed capital dredging.

3.3 Receiving Environment

3.3.1 Surveys and Studies

The impact assessment has been completed with a high degree of confidence based on a combination of comprehensive desktop studies, information from past projects and field surveys. Where existing information was available this was reviewed and considered during the assessment, whilst specific field surveys were conducted to address existing data gaps. Modelling technical studies have been conducted

to provide an understanding of the spatial extent of predicted impacts to BCH associated with the dredging activities.

The studies and surveys completed to inform the impacts to BCH are summarised in Table 3-2. For detailed information on each study, please refer to the complete technical report.

Table 3-2. Surveys and studies specific for BCH

Survey/Study	Findings
<p>Port of Port Hedland Zone 5 Bypass Channel Project Benthic Habitat Assessment (MScience 2025a)</p> <p>Found in Appendix 4 of this ERD.</p>	<p>The objective of the survey was to validate the location and structure of known BCH within and adjacent to the Proposal, utilising existing BCH data and hydrographic data (LiDAR) to optimise the survey design.</p> <p>The study was aligned with state and federal legislation and technical guidance relevant to BCH in the Proposal area, including the EPA Technical Guidance – Protection of Benthic Communities and Habitats.</p> <p>The outcomes of the investigation included:</p> <ul style="list-style-type: none"> • Validation and refinement of the existing map of subtidal BCH offshore of Port Hedland, which may be affected either directly (i.e. within the dredging footprint) or indirectly (i.e. from increased SSC and reduced light availability during dredging) by the Proposal; and • Identification and evaluation of the regional significance and functional ecological value of the BCH in the vicinity of the Proposal to inform the Proposal impact assessment.
<p>Port of Port Hedland Zone 5 Bypass Channel Project Modelling of Hydrodynamics, Waves and Dredging Spill (DHI 2026)</p> <p>Found in Appendix 5 of this ERD.</p>	<p>The study details the numerical modelling assessment of the proposed capital dredge program and associated offshore disposal, including the development of a 2D Regional hydrodynamic model (MIKE 21) and 3D local hydrodynamic model (MIKE3 FM HD) to force the sediment transport model (3D MIKE3 FM Mud Transport). Simulations were run for the two dredging methodologies outlined in Section 1.1.4 (TSHD only and CSD/TSHD) over three metocean scenarios. The study was completed with consideration of EPA Technical Guidance - Environmental Impact Assessment of Marine Dredging Proposals and WAMSI Dredging Node publications.</p> <p>The study outputs were used to define the following predicted zones of impact to inform the impact assessment as well as monitoring and management:</p> <ul style="list-style-type: none"> • Zone of High Impact (ZoHI) (Possible, Probable); • Zone of Moderate Impact (ZoMI) (Possible, Probable); and • Zone of Influence

3.3.2 Existing Environment

The distribution and composition of subtidal BCH off the coast of Port Hedland, including the Project area, have been described previously for the proposed BHP Outer Harbour Development (SKM 2009a) (Figure 3-1). The distribution and extent of BCH within the extensive outer harbour study area (~3,650 km², extending 50 km east and west of Port Hedland Inner Harbour, and 40 km seaward) was modelled and predicted using a combination of Light Detection and Ranging (LiDAR) data and ground truthing

surveys. The outer harbour study area was observed to be dominated by sand plains, devoid of benthic primary producers (BPP), interspersed with a series of hard substrate ridgelines (running parallel to the coastline) capable of supporting BPP.

Prediction of the presence of a biota or substrate class in a given location was reliant on a benthic percentage cover of $\geq 5\%$. Consequently, the presence of one class did not preclude the presence of another; intermingling of classes was common. For biota classes, BPP and non-BPP, this was particularly so across the hard bottom ridgelines. Validation established that there was a high degree of confidence in the model outputs.

Modelling predicted the study area to be comprised of the following substrate classes:

- 88% sediment;
- 7% hard substrate;
- 3% sediment covered hard substrate (when two categories above predicted in same location); and
- 2% not modelled with confidence.

Biota classes, either BPP or non-BPP, were predicted to occur in isolation or mixed communities over 13% of the study area. Presence of biota in the study area was predicted as follows:

BPP:

- hard coral: 5.0% (of which 2.8% was predicted to occur in isolation);
- macroalgae: 4.4% (2.2% in isolation); and
- seagrass: could not be modelled as it was not recorded at enough sites in the study area.

Non-BPP:

- invertebrates including sponges, soft corals, ascidians: 5.6% (2.8% in isolation).

Of areas where biota were predicted, 5.2% occurred in mixed communities (13% - 2.8% (hard coral) – 2.2% (macroalgae) – 2.8% (non-BPP)).

In relation to benthic primary producer habitat (BPPH), habitat modelling of the study area predicted the following percentage covers:

- 86.7% was non BPPH (sand or sediment not capable of supporting BPP);
- 11.5% was BPPH; and
- 1.8% could not be accurately modelled.

Benthic habitat, biota or community structures considered to be endemic, especially unique or of regional significance were not identified within the study area. BPPH was not observed to support dense or complex BPP communities. Likewise, no unique organisms or communities were observed on non BPPH areas.

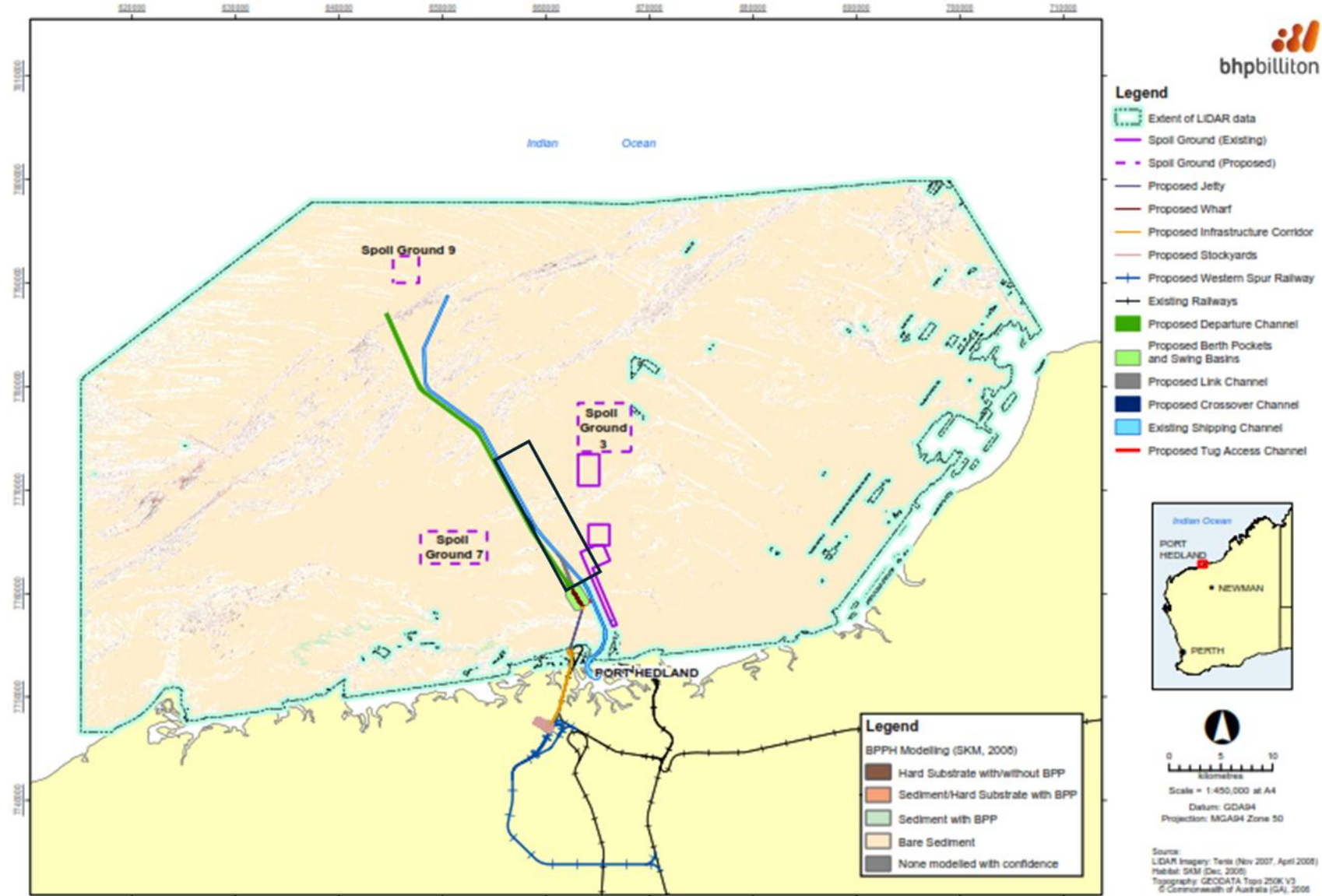


Figure 3-1. Distribution of BCH off the coast of Port Hedland from SKM (2009). Relevant Proposal area marked by the black rectangle

Hard corals identified within Port Hedland are not true coral reefs as they occur on limestone structures rather than on the bases of calcium carbonate accretion (SKM 2009a). Extensive coral surveys undertaken by SKM (2009b) recorded a total of 51 coral species from 19 genera from the offshore environment of Port Hedland, dominated by massive, encrusting and foliose morphologies. The species richness of coral taxa is very low in comparison to other studies carried out in the Pilbara region. The dominant coral taxon is *Turbinaria*, and other subdominant taxa include members of the Faviidae, Poritidae families and branching *Acropora* species.

Fifty-eight macroalgal species have been recorded at Port Hedland (Huisman et al. 2008). SKM (2009a) reported extensive stands of the green algae genera *Caulerpa* and *Halimeda*, with transient stands of the brown alga *Sargassum*. The presence and abundance of macroalgae commonly varies substantially between seasons as they are strongly driven by environmental factors such as water clarity, nutrient availability and sand movement (Huisman et al. 2008). *Sargassum spp*, which was one of the most prolific species recorded during field surveys exhibits strong seasonal growth patterns, indicating the cover of macroalgae in the Port Hedland region is likely to vary greatly dependant on seasonal conditions.

Four species of seagrass have previously been identified offshore of Port Hedland (Walker and Prince 1987); *Thalassia hemprichii*, *Halodule uninervis*, *Halophila ovalis*, and *Halophila decipiens*. However, seagrass is uncommon in Port Hedland and typically form rare patches of low to medium densities of ephemeral species which are spatially and temporally dynamic. SKM (2009a) identified the following rare seagrass patches offshore:

- A low cover patch (approximately 5 m x 5 m) of *H. decipiens* offshore of Weerde Island;
- A low cover patch (approximately 5 m x 5 m) of *H. ovalis* at North Turtle Island; and
- Patches of seagrass intermingled with macroalgae and sponges with low to medium cover (5-50%), predominantly *H.ovalis*, encompassing approximately 5% of the shallow protected embayment between Weerde and Downes Islands to the west of Finucane Island.

3.3.3 Marine Habitats Specific to the Proposal

A ground truthing survey specific to the Proposal was completed to provide a greater certainty and precision in the current location and structure of known BCH within and adjacent to the Zone 5 Bypass Channel dredging design and SG7C disposal footprint (the survey area). The study utilised existing BCH data and hydrographic data to optimise the proposed survey design.

The benthic habitat verification report for the Proposal has been provided as Appendix 4.

Overall, evaluation of transects surveyed in the present assessment recognised two habitat types, with five community types found within one or more of those habitats (Table 3-3 and Figure 3-2).

Close to 94% of the survey area was mapped as bare sand (<2 % cover of biota). Sparse (2 to <10 % cover) to medium density (20 to <40 %) invertebrates (non-coral) growing on unconsolidated and hard consolidated substrate formed 4% of the area. Approximately 85 ha, or 2%, consisted of mixed community (up to 40% cover of sponges, soft corals and mixed filter feeders and up to 20% of hard coral cover) growing on isolated outcrops of hard substrate and the hard substrate ridgeline running parallel to the coastline in the north of the zone which appears to be an extension of Minilya Bank to the east of the Project area.

Within the areas proposed for capital dredging within Commonwealth waters, Zone 5A(i) (18.9 ha) was mapped as bare unconsolidated sand habitat (<2 % biota cover) and Zone 5A(ii) (6.6 ha) was mapped as mixed community (turf algae, sponges, soft corals and other mixed filter feeders and up to 20% cover of hard corals) growing on consolidated hard substrate.

Within the area proposed for capital dredging that is partially located in State waters, Zone 5A(iii) (136.4 ha) was mapped as 99% bare unconsolidated sand habitat (<2 % biota cover) and 1% sparse (2 to <10 % cover) to low density (10 to 20 %) sessile invertebrates (non-coral) growing on either unconsolidated sediment or consolidated hard substrate.

Table 3-3. Zone 5 Bypass Channel Project BCH types

Habitat Type	Community Type	Biota Present
Unconsolidated Sediment Sand (flat or rippled, medium to coarse grained) and gravel	Bare	Occasional macroalgae (including <5 m ² patches of turf algal mats and filamentous algae), filter feeders (<2 % cover) and <2 m ² patches of seagrass (<2 % cover)
	Sparse Invertebrates	2 to <10 % cover of invertebrates (sponges and other mixed filter feeders) growing in sand.
Low Relief (<1 m) Consolidated Hard Substrate Hard limestone pavement or rubble with or without a sand veneer	Sparse Invertebrates	2 to <10 % cover of invertebrates (sponges, soft corals, gorgonians and other mixed filter feeders) and occasional hard corals (<3% cover) growing on hard substrate surrounded by patches of bare sand.
	Low Density Invertebrates	10 to <20 % cover of invertebrates (soft corals, sponges, gorgonians and other mixed filter feeders) and hard corals (<5% cover) growing on hard substrate surrounded by patches of bare sand.
	Medium Density Invertebrates	20 to <40 % cover of invertebrates (sponges, soft corals and other mixed filter feeders) and hard corals (<10% cover) growing on hard substrate surrounded by patches of sand.
	Medium Density Mixed Communities	Mixed benthos up to 40% cover of turf algae, invertebrates (sponges, soft corals and other mixed filter feeders) and hard corals (10 to 20 % cover), growing on hard substrate surrounded by patches of sand.

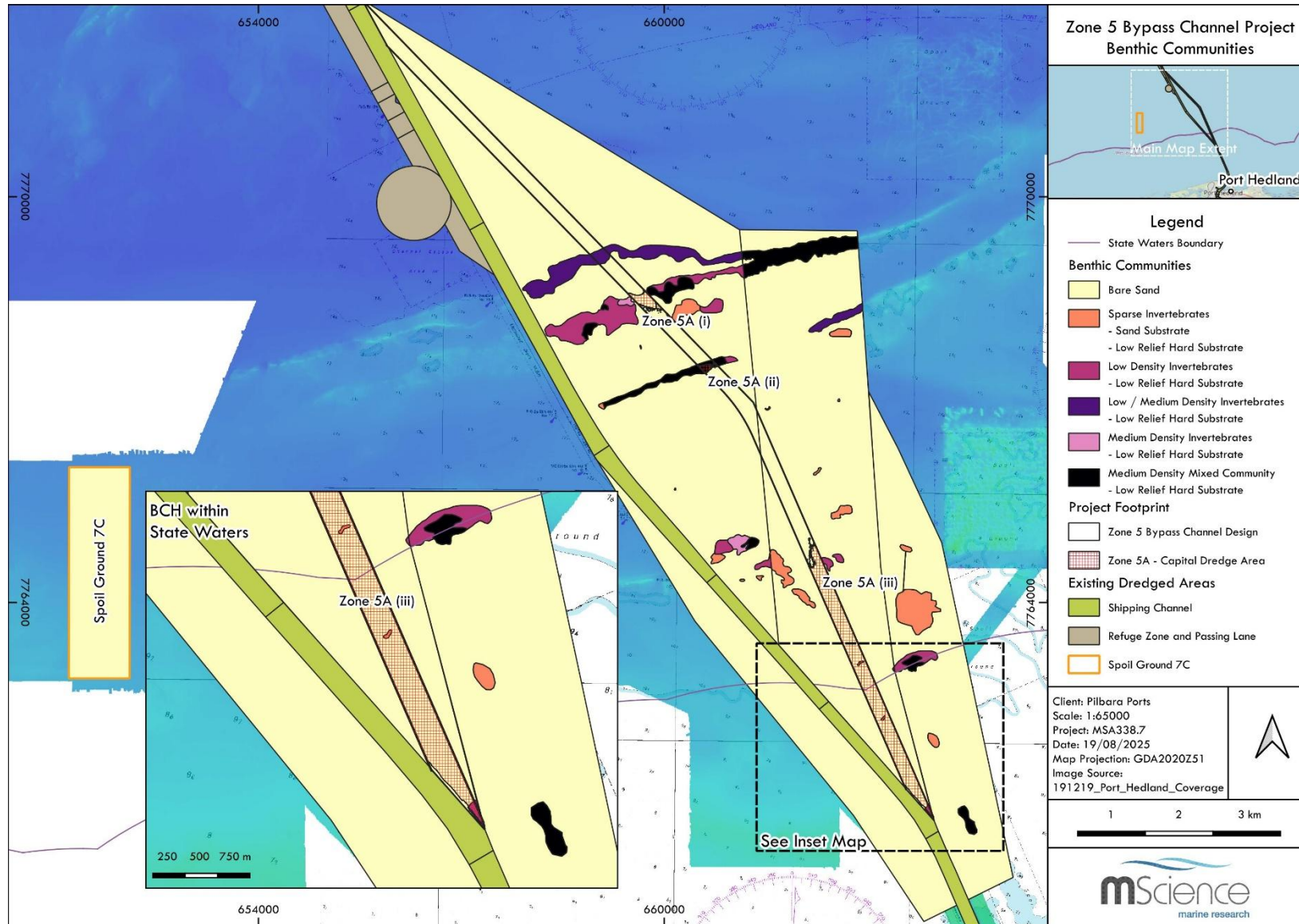


Figure 3-2. Zone 5 Bypass Channel benthic communities

Table 3-4 details the proportion of BCH within State waters covered by the Proposal footprint (63 ha).

Table 3-4. BCH of the Proposal footprint within State waters

BCH Classification	Proportion of Proposal footprint within State Waters	
	Area (ha)	Composition of Total (%)
Bare Sand	61.9	98.3
Sparse Invertebrates, growing on: <ul style="list-style-type: none"> - Unconsolidated Sand; and/or - Low Relief Hard Consolidated Substrate 	0.2	0.3
Low Density Invertebrates, growing on: <ul style="list-style-type: none"> - Low Relief Hard Consolidated Substrate 	0.9	1.4
Medium Density Invertebrates, growing on: <ul style="list-style-type: none"> - Low Relief Hard Consolidated Substrate 	0	0
Medium Density Mixed Community, growing on: <ul style="list-style-type: none"> - Low Relief Hard Consolidated Substrate 	0	0
Total	63	100

The five community types identified are common elsewhere offshore of Port Hedland, as shown by habitat mapping for the BHP Outer Harbour Development (SKM 2009a). The present mapping presents the distribution of benthos at a single time. The habitats identified within this survey are known to change their density and distribution over time in response to natural disturbances and seasonal effects. In particular, seagrasses and macroalgae beds of the nearshore Pilbara are recorded as showing regular large seasonal changes in distribution and density.

There were no benthic habitats, communities or biota of regional significance identified in this survey of the Proposal area. Whilst community distributions may vary over time (Babcock et al. 2021), this survey provides an accurate representation of the distribution of communities and habitats immediately prior to dredging and was used to inform the impact assessment provided in this document.

3.4 Proposed Mitigation

The EPA's mitigation hierarchy to avoid and minimise environmental impacts has been applied to the environmental factor Benthic Communities and Habitats. Rehabilitation options are not available or not relevant, and offsets are not expected to be required for this factor.

Avoid

- Spoil disposal uses existing spoil ground located in an area devoid of BCH.

Minimise

- Channel design selected to minimise proximity to and direct removal of BCH.
- Dredging and disposal will only occur in the permitted areas specified on approved plans and with material approved in the Commonwealth Sea Dumping Permit.
- Accurate positioning systems will be used on the dredge plant to ensure direct impacts to BCH are restricted to the approved dredging and disposal areas.
- The dredge plant will utilise mechanical devices to reduce turbidity generation during dredging and disposal, such as turbidity-reducing ("green") valves in the overflow of the dredge.
- The dredge hopper doors will be kept in good condition to minimise loss of sediment during transport.
- Routes to and from the spoil ground will be selected to consider safety and environmental impacts, and to minimise the risk of spillage outside of defined areas.
- Best practice measures will be implemented to minimise the concentration of suspended solids released during the loading and disposal of dredge material, including adaptive management based on monitoring.

The mitigation measures outlined above are industry standard and best practice, and have been shown during past dredging campaigns implemented by Pilbara Ports to be effective at minimising impacts to BCH.

The potential significant impacts identified in Section 3.5 will be controlled by the implementation of adaptive management of dredging based on both outcome-based and objective-based conditions that have been outlined in the dredging environmental monitoring and management plan (DEMMP) (Appendix 10) developed for the Proposal.

Pilbara Ports considers the potential impacts of the Proposal can be mitigated under the Commonwealth *Environment Protection (Sea Dumping) Act 1981*. As such, the DEMMP has been prepared with consideration of the DCCEE requirements for monitoring and management plans to dredge and dispose material at sea, in the first instance. The EPA 'Instruction and template: How to prepare Part IV Environmental Management Plans', has been considered when setting management targets and environmental protection outcomes in the DEMMP.

Impacts to BCH associated with maintenance dredging during operation of the Zone 5 Bypass Channel will be managed and monitored in accordance with Pilbara Ports Port of Port Hedland long term monitoring and management plan for maintenance dredging. The existing long-term monitoring and management plan for maintenance dredging will be updated to include the Zone 5 Bypass Channel design and be issued to DCCEE for approval prior to any maintenance dredging activities.

3.5 Potential Environmental Impacts

3.5.1 Identified Environmental Impacts

The possible cause-effect pathways leading to potential impacts to BCH values identified in Section 3.3, and justification for their relevance to the Proposal assessment, have been summarised in Table 3-5.

Table 3-5. Identified potential impacts to BCH

Activity	Cause/Effect	Potential Impact	Impact Type	Relevance to Proposal Assessment
Dredging and spoil disposal operations	Dredging within the proposed dredge footprint may lead to the direct removal of BCH	Direct loss of BCH	Direct	Potential significant impact requires further assessment. Assessment of impact provided in Section 3.5.2.2
	Temporary, localised, elevation of suspended sediment concentrations (SSC) from sediment uplift and disposal may lead to increased light attenuation through the water column and increased sedimentation	Shading and smothering, and potential loss, of BCH	Indirect	Potential significant impact requires detailed assessment. Assessment of impact provided in Section 3.5.2.3

3.5.2 Predicted Environmental Impacts

Consistent with the EPA instructions ‘How to prepare an Environmental Review Document’ a table summary of the likely extent of potential significant impacts (direct, indirect, total and cumulative) has been provided in Table 3-6. Detailed assessment information has been provided in the following sections.

Table 3-6. Predicted extent of impacts to BCH

Environmental value	Regional and Local Context	Extent				Cumulative effects of other Proposals	Level of Certainty
		LAU	Direct Impact	Indirect Impact	Total Impact		
Invertebrates (sponges, soft corals, gorgonians and other mixed filter feeders), growing on: <ul style="list-style-type: none"> - Unconsolidated Sand; and/or - Low Relief Hard Consolidated Substrate with or without a sand veneer 	The Proposal is located within the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Pilbara nearshore bioregion which covers an area of 23,875,865 ha. A local assessment unit (LAU) has been defined for the Proposal (refer to Section 3.6.2 for details).	312 ha	1.1 ha - Permanent loss	4.0 ha - Temporary/ Recoverable	1.1 ha – loss 4.0 ha - Recoverable	A cumulative loss assessment is provided in Section 3.6.2. 16.1 ha (5.2 % of original BCH) will be permanently lost from the LAU. This is 0.3% more than the current loss estimate of 15 ha.	High – Direct impacts are known. Indirect impacts have been calculated on the basis of current mapping data and dredge spill modelling.
Mixed Community (algae, invertebrates and some hard corals), growing on: <ul style="list-style-type: none"> - Low Relief Hard Consolidated Substrate with or without a sand veneer 	The LAU covers an area of 5,680 ha	258 ha	0 ha	8.1 ha - Temporary/ Recoverable	8.1 ha - Recoverable		

3.5.2.1 ZONES OF IMPACT

In accordance with EPA’s Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2021b), impact zones have been conservatively established to determine the potential extent and significance of direct and indirect impacts to BCH as a consequence of the Proposal (Table 3-7), based on predictive modelling of the dredge/disposal turbid plume intensity, extent and duration (DHI 2026) (refer to Section 4 and Appendix 5 for details) and the tolerances of benthic primary producers.

Table 3-7. Zones of impact and

Impact Zone	Definition	Boundary Thresholds
Zone of High Impact (ZoHI)	The area where serious damage to benthic communities is predicted or where impacts are considered to be irreversible. The term serious damage means ‘damage to benthic communities and/or their habitats that is effectively irreversible or where any recovery, if possible, would be unlikely to occur for at least 5 years’.	ZoHI Probable – Direct disturbance footprint for dredging and disposal. ZoHI Possible – 50 m buffer around direct disturbance footprint (indirect).
Zone of Moderate Impact (ZoMI)	The area within which predicted impacts on benthic organisms are sub-lethal, and/or the impacts are recoverable within a period of 5 years following completion of the dredging activities.	ZoMI Probable – The area where the 14 day SSC running mean probable effect threshold of Jones et al. (2019) was exceeded (18 mg/L). ZoMI Possible – The area where the 14 day SSC running mean possible effect criteria of Jones et al. (2019) was exceeded (11.7 mg/L).
Zone of Influence (Zol)	The area within which changes in environmental quality associated with dredge plumes are predicted and anticipated during the dredging operations, but where these changes would not result in a detectable impact on benthic biota	The 95% percentile of the area where a SSC of >5 mg/L was exceeded within the sediment transport model.

A ZoHI was defined as the direct disturbance footprint for dredging and disposal (best-case boundary), including a 50 m buffer (worst-case boundary).

The total SSC fields predicted within the plume model were assessed against the WAMSI ‘possible’ and ‘probable’ 1, 3, 7, 14 and 28 day running mean threshold criteria from Jones et al. (2019) so that the maximum envelope of each running mean window could be calculated (Figure 3-3 and Figure 3-4). The largest footprint for both ‘possible’ and ‘probable’ effects occurred for the 14-day running mean during both dredging methodologies. As such, the maximum envelope for the ‘possible’ and ‘probable’ 14-day running mean threshold criteria of both dredging scenarios was combined to define the likely worst-case and best-case Zone of Moderate Impact (ZoMI). The model of plume dispersal for the proposed capital dredging predicted plumes with a SSC \geq 5 mg/L above background may disperse up to 15 km from the site of dredging and disposal. This area has been defined as the Zol.

The established impact zones are shown in Figure 3-5. The zone of influence is shown in Figure 3-6.

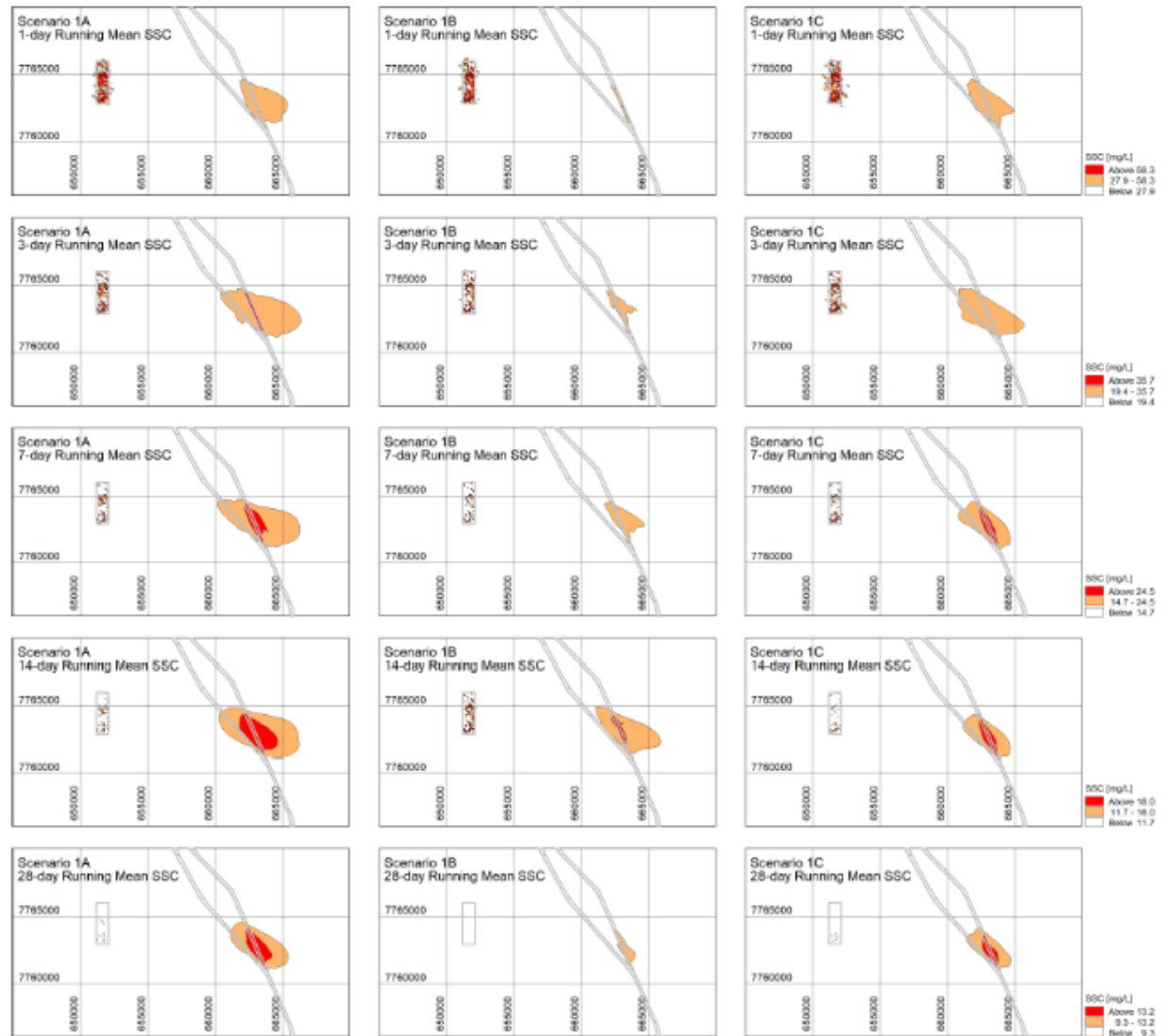


Figure 3-3. Scenario 1 (i.e., TSHD only) impact mapping based upon running mean SSC fields using thresholds of Jones et al (2019). Orange = Possible impact, Red = Probable impact

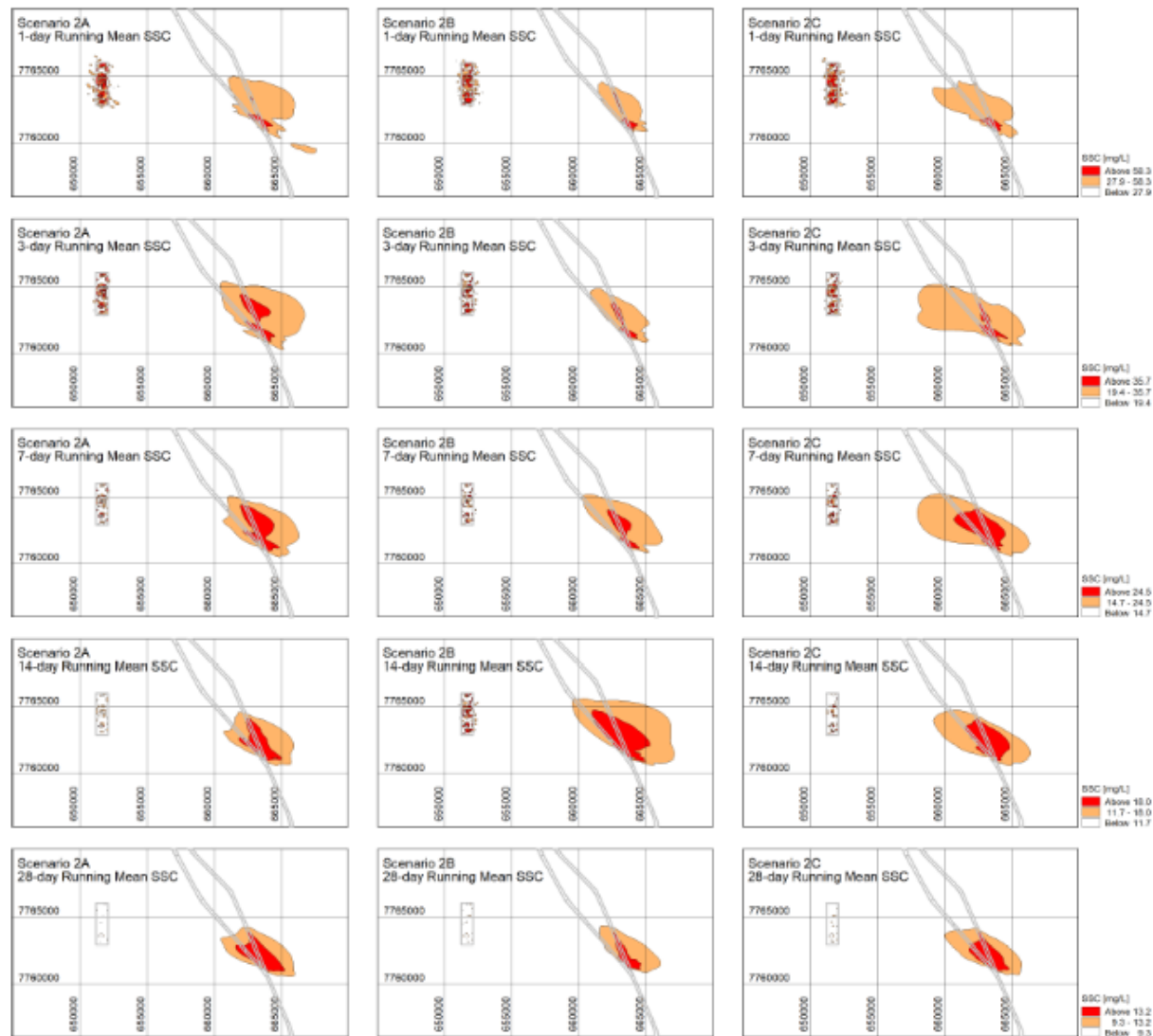


Figure 3-4. Scenario 2 (i.e., CSD and TSHD) impact mapping based upon running mean SSC fields using thresholds of Jones et al (2019). Orange = Possible impact, Red = Probable impact

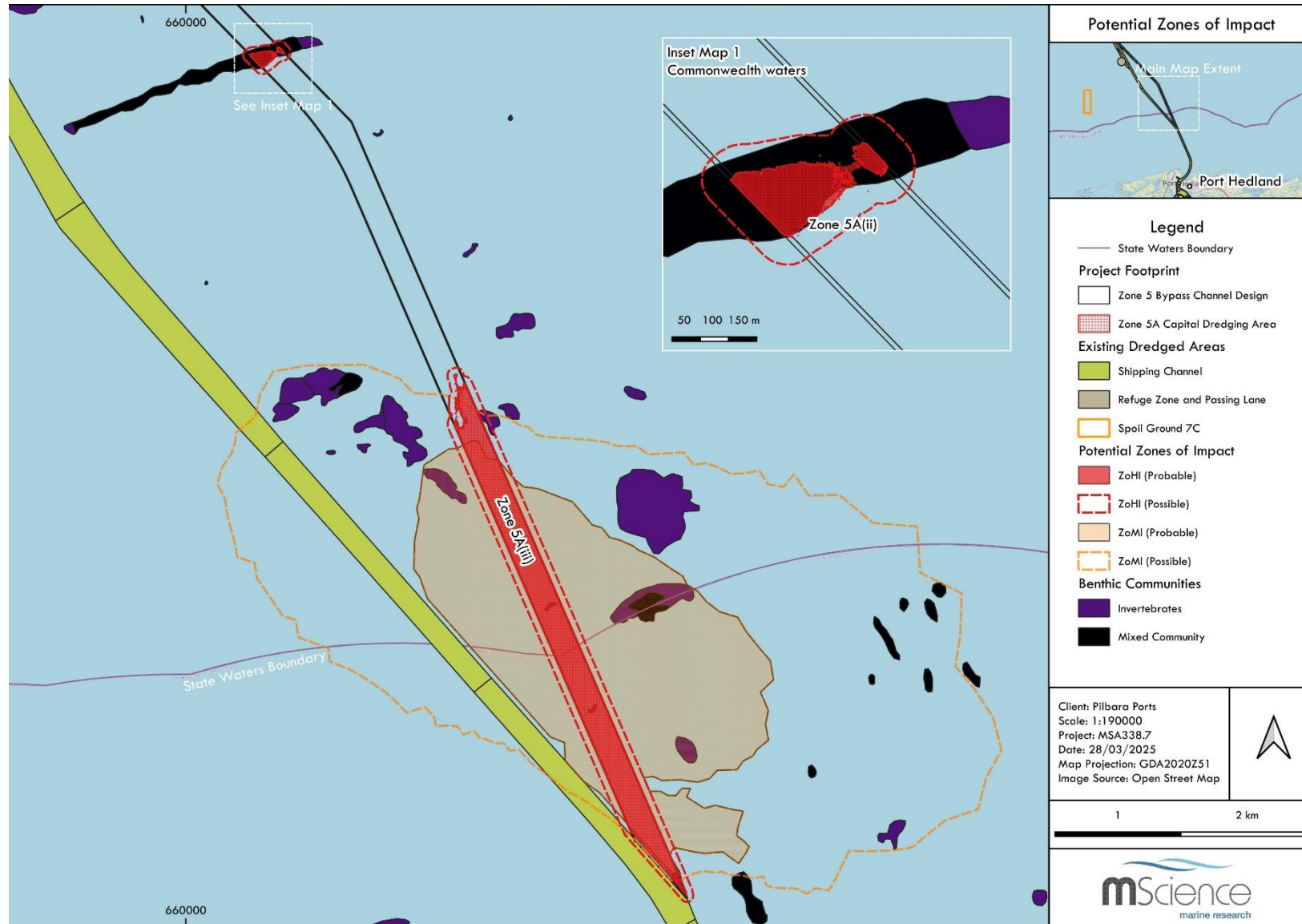


Figure 3-5. Potential zones of impact

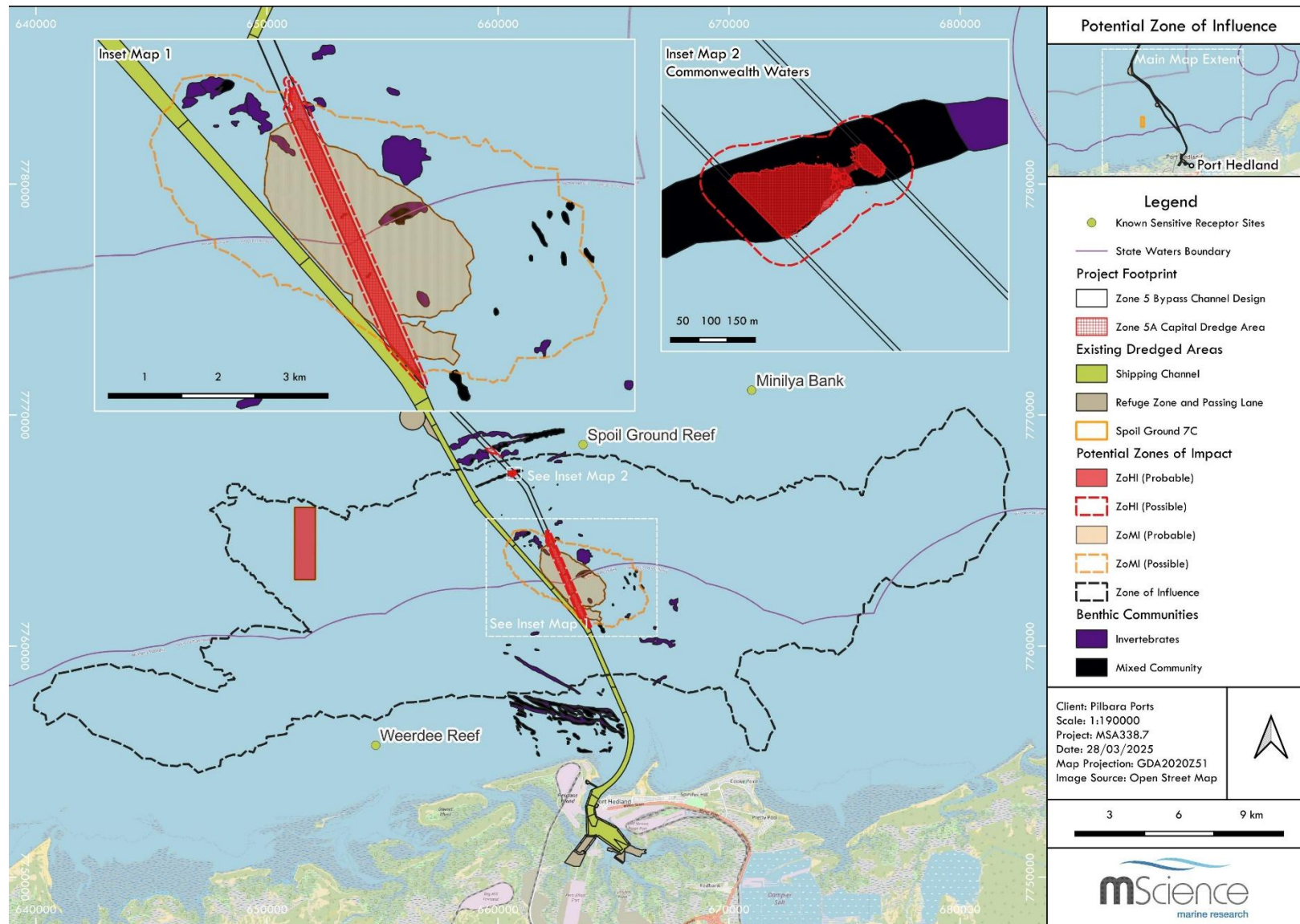


Figure 3-6. Potential zone of influence

3.5.2.2 DIRECT REMOVAL OF BCH

Dredging associated with the Proposal will result in the direct removal of potential BCH occurring in the dredging area and irreversible impact to BCH located within a 50 m buffer i.e. within the ZoHI.

Within the dredging area located within State waters, there is 61.9 ha of bare sand and 1.1 ha of sparse to low density (2 to <20 % cover) of sessile invertebrates.

Within the areas proposed for capital dredging within Commonwealth waters, there is 92.1 ha of bare unconsolidated sand habitat (<2 % biota cover), 0.2 ha of sparse density (2 to <10 % cover) sessile invertebrates and 6.6 ha of mixed community (predominantly turf algae, sponges, soft corals and other mixed filter feeders with up to 20% cover of hard corals). The disposal area (Spoil Ground 7C) within Commonwealth waters is devoid of benthos, as such there will be no direct loss of benthos from smothering during placement of sediments associated with the Proposal.

3.5.2.3 INDIRECT IMPACTS TO BCH

A series of studies undertaken for the Dredging Science Node of the Western Australian Marine Science Institution (WAMSI) have focussed on improving capacity to predict the impacts of dredging within the Pilbara Region (WAMSI 2019). A synthesis of several of those studies has developed guidance as to what frequency-intensity-duration (FID) thresholds might be used to indicate various levels of impact to corals (Jones et al. 2019), which have been adopted by the EPA within its Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2021b). Findings of the WAMSI studies on the indirect impacts of dredging (i.e. those not physically caused by the action of the dredging plant on biota i.e. direct removal) show that the significant impacts of dredging on corals are caused from smothering by sedimentation or loss of light due to increased SSC (Jones et al. 2019).

Applying the 14-day running mean WAMSI thresholds to the validated sediment plume model developed for the Proposal (DHI 2026) was found to produce the largest (worst-case) extent for the ZoMI (probable and possible). Noting that in interrogating the model, the maximum SSC of the depth strata was used and, as such, the predictions are likely to be conservative (overly large). It is likely sedimentation and light loss could occur at FID combinations within the ZoMI (probable) which would cause impacts to BCH, but these impacts would likely be recoverable within five years:

Total (State and Commonwealth waters):

- Invertebrates – 13.3 ha
- Mixed Community – 4.1 ha

State waters only:

- Invertebrates – 4 ha
- Mixed Community – 1.7 ha

It is predicted that 6.4 ha of mixed community located within the ZoMI (possible) will be shaded by a plume that may potentially induce some form of temporary sublethal response.

There is not predicted to be any lethal /permanent impacts to BCH within the ZoMI (probable or possible).

3.6 Assessment of Significance of Residual Impacts

3.6.1 Proposal

The proposed capital dredging will result in a potential loss of 1.1 ha of sparse to low density (2 to <20% cover) invertebrates (non-BBP) within State waters.

There is a low risk that indirect effects of turbidity and burial associated with the plume generated during dredging and disposal may cause temporary (matter of weeks) sublethal responses or impacts (recoverable within five years) to a relatively small area of invertebrates (4 ha) and mixed community (primarily of non-BBP) (8.1 ha) within State waters.

The dominant coral taxa recorded in the areas of mixed community, *Turbinaria spp*, are known to have relatively low susceptibility to increases in sedimentation and light reduction associated with turbidity, as such, the predicted losses are conservatively high.

The BCH occurring within the Proposal dredge footprint is extremely well represented both locally and more broadly across Western Australia and considered to be of low ecological value relative to nearby habitat.

No significant residual impacts to BCH are anticipated as a result of dredging and disposal operations after application of the proposed mitigation measures and monitoring and management described in the DEMMP.

Consequently, it has been determined that there will be no significant residual impact to BCH as a result of the Proposal.

3.6.2 Cumulative Impacts

An assessment of the potential cumulative impacts for BCH within State waters in the vicinity of the Proposal area is presented herein. Cumulative BCH loss has been calculated in-line with the methods for determining cumulative impact on BCH provided in EPA's Technical Guidance – Protection of Benthic Communities and Habitats (EPA 2016b). These methods include eight steps to calculate cumulative BCH loss and assess the significance of potential losses and are described in the context of the Proposal below, noting that the majority of the Proposal is located in Commonwealth waters.

Step 1: What is the 'local assessment unit'?

The EPA's Technical Guidance – Protection of Benthic Communities and Habitats (EPA 2016b) has defined a local assessment unit (LAU) for Port Hedland due to different proponents defining different LAUs for assessing the cumulative losses of BCH associated with their proposals in Port Hedland. The LAU defined by the EPA for Port Hedland is limited to the inner Port Hedland port area, whereas the Proposal area is located seaward of the northern boundary of this LAU. As such, Pilbara Ports propose to use an existing LAU that was defined for the BHP Outer Harbour Development which covers the area of the Proposal within State and port waters. This will maintain consistency with previous studies and improve the clarity and efficiency of the EIA.

LAU 8 (Figure 3-7), defined for the BHP Outer Harbour Development, covers an area of 5,680 ha (SKM 2011). Approximately 837 ha of LAU 8 within and adjacent to the proposed dredging area within State waters was verified during the BCH mapping study completed for the Proposal (Figure 3-2).

Step 2: What is there now? What is the current area of each benthic community type and associated habitat within the LAU?

Table 3-8 summarises the types, areas and proportion of BCH reported within LAU 8 for the BHP Outer Harbour Development (SKM 2011). The distribution of hard corals overlapped with other biota classes (algae and invertebrates) in many areas. As such, for consistency with the BCH mapping implemented for the Proposal, these areas were classified as mixed community. Areas of non- benthic primary producers (BPP) (sponges, soft corals, gorgonians and other mixed filter feeders) mapped in isolation were classified as invertebrates. The types, area and proportion of BCH mapped for the Proposal located within LAU 8 are included in Table 3-8.

Table 3-8. Composition of BCH within LAU 8 and proportion verified for the Proposal

BCH Classification	Total LAU 8		Proportion of LAU 8 verified for the Proposal	
	Area (ha)	Composition of Total (%)	Area (ha)	Composition of Total (%)
Bare Sand	5,110	90	824.8	98.6
Invertebrates (sponges, soft corals, gorgonians and other mixed filter feeders)				
- Unconsolidated Sand; and/or - Low Relief Hard Consolidated Substrate with or without a sand veneer	312	5.5	5.1	0.6
Mixed Community (algae, invertebrates and hard corals)				
- Low Relief Hard Consolidated Substrate with or without a sand veneer	258	4.5	6.7	0.8
Total	5,680	100	836.6	100



Figure 3-7. LAU 8 and associated benthic communities

Step 3: Do any of the benthic communities have any particular tenure or conservation, ecological or social values that should be considered?

The predominant BPP identified in the survey area and LAU were hard corals. These were found to be growing on limestone pavement, rather than on bases of calcium carbonate accretion from coral. LiDAR mapping for the BHP Outer Harbour Development indicated low relief ridgelines extending along the entire extent of the coastline from North Turtle Island in the north-east to beyond Cape Thouin in the south-west, which implies a uniform ecosystem composed of parallel ridge lines extends along this coastline (SKM 2011). Microphytobenthos generally occur in stable unconsolidated substrates and are rarely seen in mobile sands such as those observed in the survey area (MacIntyre et al. 1996). The dominant coral taxa recorded were *Turbinaria spp* which are known to have relatively low susceptibility to increases in sedimentation and light reduction associated with turbidity (Gilmour et al. 2006; Sofonia and Anthony 2008). Quantitative, diver-based, benthic habitat surveys conducted at sites located along the western low relief ridgeline extension of Minilya Bank reported *Turbinaria spp* as the dominant hard coral and at a similar average percent cover to that reported here (~10%) (Advisian 2019; SKM 2009a).

The predominant non-BPP within the survey area were invertebrate filter feeders. This finding is consistent with the benthic habitat surveys completed as part of the Outer Harbour Development (SKM 2009a). That report hypothesized that as the waters in the region are typically turbid, the subtidal marine fauna will have become established under conditions which are more suitable for feeding on particulates than for photosynthesis.

Seagrass (predominantly *Halophila ovalis*) has been observed previously in the Port Hedland area within the embayments between Downes and Weerde Islands (O2 Marine 2019; Walker and Prince 1987) but was not observed within the LAU during ground truthing for the Proposal.

Based on the above, it is considered that the identified BCH within the survey area and LAU are not of conservation or ecological significance.

Step 4. What area of each community and habitat was originally present within the LAU? (i.e. original baseline)

The exact spatial extent of BCH located outside of the inner harbour prior to European settlement is difficult to determine because there is no baseline habitat data, aerial imagery or mapping available prior to the first dredging and spoil disposal activities to establish the approach channel to the harbour. The detailed habitat mapping carried out for the proposed BHP Outer Harbour Development was the first time the subtidal marine habitat offshore from Port Hedland was quantified (SKM 2009a). Mapping identified 293 ha of low relief hard consolidated substrate capable of supporting benthos within LAU 8.

In estimating the area of BCH originally present within the LAU, it has been assumed that permanent loss has only occurred where hard substrate has been physically removed during dredging of the approach channel. By interpreting where the existing channel has cut through hard substrate or ridgelines, approximately 15 ha of hard consolidated substrate capable of supporting benthos has been removed from the LAU. As such a total of 308 ha of benthic primary producer habitat (BPPH) was estimated to originally be present within the LAU.

Step 5: What percentage of the original area of each benthic community and its associated habitat is present now?

The historical loss estimates of BCH within the LAU are based on conservative assumptions of permanent loss most recently carried out by SKM (2011) as part of calculating potential impacts to BCH associated with the BHP Outer Harbour Development.

SKM (2011) based their estimates on existing data and the assumptions outlined in Step 4 above. Given that there have been no disturbances to BCH in the LAU since 2011, it is assumed that the estimates provided in Table 3-9 remain accurate.

Table 3-9. Historical loss of BPPH within LAU

Estimated Original Area (ha)	Historical Loss (ha)	Historical Loss (%)
308	15	4.9

Step 6: How much more will be impacted and lost if this proposal was implemented?

Habitat losses within State Waters due to the direct impacts of the Proposal are shown in Table 3-10.

On the bases microphytobenthos generally occur in stable unconsolidated substrates and are rarely seen in mobile sands such as those observed in the survey area, the area of bare sand habitat within the proposed dredge footprint has not been included in the loss assessment.

The duration and intensity of the sediment plume associated with dredging was predicted to rapidly diminish with distance from the dredge footprint. Predicted impacts as a result of indirect impacts within the ‘probable’ ZoMI are considered to be sub-lethal and/or recoverable and will not result in loss of BCH.

Table 3-10. BCH losses (ha) within State Waters due to the Proposal

BCH Classification	Direct Loss (ha)	Indirect Loss (ha)	Total Loss (ha)
Invertebrates (sponges, soft corals, gorgonians and other mixed filter feeders) - Unconsolidated Sand; and/or - Low Relief Hard Consolidated Substrate with or without a sand veneer	1.1	0	1.1
Mixed Community (algae, invertebrates and hard corals) - Low Relief Hard Consolidated Substrate with or without a sand veneer	0	0	0

Step 7: How much would be lost in total if the proposal proceeds?

If the Proposal were to proceed, in total, 16.1 ha, or 5.2 % of BCH originally within the LAU will be permanently lost from the Proposal area located within State Waters (Table 3-11). This is 0.3% more than current loss estimates (see Step 5 above).

A fully ecological LAU for the Proposal was established (encompassing State and Commonwealth waters), this would encompass a much wider area and thus reduce the percentage loss on an ecological/functional basis.

Table 3-11. Total cumulative losses of BCH due to the Proposal in State waters

Estimated Original Area (ha)	Historical Loss (ha)	Direct Loss (ha)	Indirect Loss (ha)	Total Loss (ha)	Total Loss (%)
308	15	1.1	0	16.1	5.2

Step 8. What will be the consequences for biological diversity and ecological integrity if the proposal proceeds?

The EPA's environmental objective is to ensure no net loss of BCH and, where possible, to generate a net increase. On the basis of the information presented in addressing steps 1–7, it is concluded that the loss of an additional 1.1 ha of non-BBP sessile invertebrates in an area that is already disturbed by propeller wash from frequent shipping movements, presents no ecological consequence for the biological diversity and ecological integrity of the Proposal area.

3.7 Environmental Outcome

Pilbara Ports considers that the EPA objective for BCH will be met based on the assessment of the significance of residual impacts and application of avoidance and minimisation mitigation measures, including the monitoring and management actions described in the DEMMP.

The DEMMP includes project specific management targets (MTs) to mitigate the potential impacts on BCH and subsequently ensure that the EPA's objective for BCH is met, and the predicted environmental protection outcomes (EPOs) are achieved.

In accordance with the EPA document 'Interim Guidance - Environmental outcomes and outcomes-based conditions', Pilbara Ports has proposed the following environmental outcomes for BCH:

- Disturbance of no more than 63 ha of BCH within State waters.
- No direct loss of BCH outside of the ZoHI.
- No sublethal impacts to BCH outside of the ZoMI from increased SSC or sedimentation associated with dredging activities.

Pilbara Ports considers the proposed environmental outcomes can be assured through the conditions prescribed by a sea dumping permit issued under the Commonwealth *Environment Protection (Sea Dumping) Act 1981*.

4 ENVIRONMENTAL FACTOR ASSESSMENT – MARINE ENVIRONMENTAL QUALITY

4.1 EPA Objective

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

4.2 Relevant Policy and Guidance

Table 4-1 details the EPA, State and/or Commonwealth policies and guidance have been considered in evaluation of potential impacts on Marine Environmental Quality.

Table 4-1. Policy and guidance – marine environmental quality

Policy and Guidance	How the guidance has been considered
Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021a)	The assessment of significance of impacts to marine environmental quality has considered the EPA's consideration of 'significance' in this guidance.
Environmental Factor Guideline – Marine Environmental Quality (EPA 2016c)	The considerations for EIA stated in this guidance have been addressed in evaluation of potential impacts on Marine Environmental Quality as a result of the Proposal. The Proposal design has addressed the guidance in this document and been adjusted to minimise any impacts.
Technical Guidance – Protecting the Quality of Western Australia's Marine Environment (EPA 2016d)	Marine Environmental Quality surveys conducted for the Proposal have been completed in accordance with this guidance.
Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2021b)	This guidance has been considered in evaluation of potential impacts associated with the proposed capital dredging and turbidity plume dispersal model developed for the Proposal.
WAMSI Dredging Science Node Theme 4 Synthesis Report: Defining Thresholds and Indicators of Coral Response to Dredging-Related Pressures (Jones et al. 2019)	This guidance has been considered in setting the potential zones of impact associated with the proposed capital dredging and turbidity plume dispersal.
National Assessment Guidelines for Dredging (Commonwealth of Australia 2009a)	The sediment quality assessment of the material to be dredged was implemented in accordance with this guidance.

4.3 Receiving Environment

4.3.1 Surveys and Studies

The impact assessment has been completed with a high degree of confidence based on a combination of comprehensive desktop studies and field surveys. Where existing information was available this was collated into desktop studies, whilst specific field surveys were conducted to address existing data gaps.

Modelling technical studies have been conducted to provide an understanding of the spatial extent of predicted impacts associated with the dredging activities.

The studies and surveys completed to inform the impacts to marine environmental quality are summarised in Table 4-2. Refer to the complete technical report for detailed information on each study.

Table 4-2. Surveys and studies specific for marine environmental quality

Survey/Study	Findings
<p>Port of Port Hedland Zone 5 Bypass Channel Project Modelling of Hydrodynamics, Waves and Dredging Spill (DHI 2026) Found in Appendix 5 of this ERD</p>	<p>The study details the numerical modelling assessment of the proposed capital dredge program and associated offshore disposal, including the development of a 2D Regional hydrodynamic model (MIKE 21) and 3D local hydrodynamic model (MIKE3 FM HD) to force the sediment transport model (3D MIKE3 FM Mud Transport). Simulations were run for the two dredging methodologies outlined in Section 1.1.4 (TSHD only and CSD/TSHD) over three metocean scenarios. The study was completed with consideration of EPA Technical Guidance - Environmental Impact Assessment of Marine Dredging Proposals.</p> <p>Calculation of the 95th percentile and maximum suspended sediment concentration (SSC) fields clearly showed plume excursion from the immediate dredge area to follow the principal axis of tidal motion. The 95th percentile contours of predicted elevations in depth averaged SSC indicated plumes of ≥5 mg/L extended up to 15 km from the site of dredging and disposal.</p>
<p>Port of Port Hedland Zone 5 Bypass Channel Project Sampling and Analysis Plan (MScience 2025b) Found in Appendix 6 of this ERD</p>	<p>The sampling and analysis plan (SAP) included a desktop study evaluation of existing information on sediment characteristics within and adjacent to the dredge area. The document outlined the proposed sediment sampling program to characterise the properties of the sediments to be dredged and disposed for the Project based on guidance provided in the Commonwealth National Assessment Guidelines for Dredging (NAGD).</p>
<p>Port of Port Hedland Zone 5 Bypass Channel Project Sediment Sampling and Analysis Plan Implementation Report (MScience 2025c) Found in Appendix 7 of this ERD</p>	<p>The survey implemented the SAP. Samples were collected from 33 sites via a combination of diver coring and grab sampling techniques in July 2025. Samples were assessed for particle size distribution, total metals, total organic carbon, organotins, total recoverable hydrocarbons and polycyclic aromatic hydrocarbons. Results were assessed against the numerical screening levels for contaminants of potential concern listed in Table 2 of the NAGD. Overall, sediment concentrations of candidate COPCs were shown to be either below the initial screening levels described in the NAGD or having a high naturally occurring background concentration. These findings suggest that sediment from the proposed capital dredging footprint meet NAGD criteria for unconfined ocean disposal at the approved Spoil Ground 7C.</p>

4.3.2 Existing Environment

4.3.2.1 MARINE ENVIRONMENTAL QUALITY MANAGEMENT FRAMEWORK

The Environmental Values (EVs) and associated Environmental Quality Objectives (EQOs) for the local marine environment are already well established in the Pilbara Coastal Waters Consultation Outcomes (Department of Environment 2006). Table 4-3 details the EVs and EQOs that have been considered applicable to the Proposal.

Table 4-3. Environmental values and environmental quality objectives relevant to the Proposal

Environmental Values	Environmental Quality Objectives	Relevance to the Proposal
Ecosystem Health (ecological value)	Maintain ecosystem integrity: 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 to an appropriate level (maximum, high, moderate and low)	Dredging activities have the potential to impact water quality through sediment resuspension.
Recreation and Aesthetics (social use value)	Water quality is safe for recreational activities in the water (e.g. swimming). Water quality is safe for recreational activities on the water (e.g. boating). Aesthetic values of the marine environment are protected.	No significant impacts expected on recreational or aesthetic values within the Port of Port Hedland due to the Proposal.
Culture and Spiritual (social use value)	Cultural and spiritual values of the marine environment are protected.	No registered Aboriginal heritage sites are known to occur within the Proposal area.
Fishing and Aquaculture (social use value)	Seafood (caught or grown) is of a quality safe for eating. Water quality is suitable for aquaculture purposes.	No significant impacts expected on fishing or aquaculture values within the Port of Port Hedland due to the Proposal.
Industrial Water Supply (social use value)	Water quality is suitable for industrial supply purposes.	No significant impacts expected on industrial water supply values within the Port of Port Hedland due to the Proposal.

The Pilbara Coastal Water Consultation Outcomes (Department of Environment 2006) spatially defines the Levels of Ecological Protection (LEP) for 'Ecosystem Health' for Port Hedland (Figure 4-1). The ecological protection areas are set at one of four levels as described in Table 4-4.

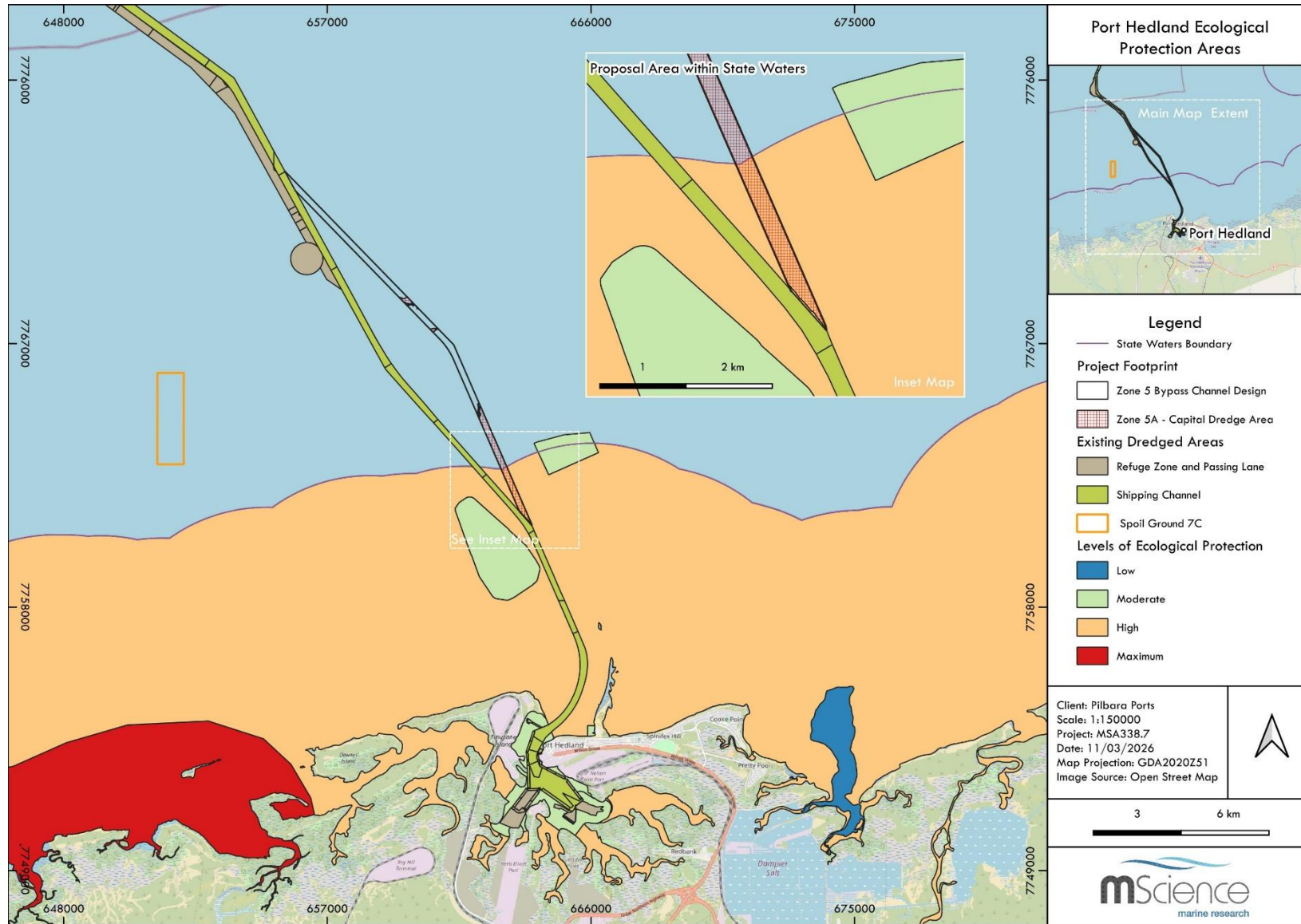


Figure 4-1. Ecological protection areas for Port Hedland

Table 4-4. Levels of ecological protection and corresponding environmental quality conditions

Level of Ecological Protection	Environmental Quality Condition (limit of acceptable change)	
	Contaminant concentration indicators	Biological indicators
Maximum	No contaminants – pristine	No detectable change from natural variation
High	Very low levels of contaminants	No detectable change from natural variation
Moderate	Elevated levels of contaminants	Moderate changes from natural variation
Low	High levels of contaminants	Large changes from natural variation

Areas around port infrastructure and wastewater outfalls are generally assigned a moderate or low level of ecological protection to ensure that ecosystem integrity is maintained whilst still allowing multiple uses. In relation to the Proposal the marine area within State Waters has been designated a High LEP (Figure 4-1).

4.3.2.2 SEDIMENT QUALITY

Sediment quality within and adjacent to the Project development envelope was assessed most recently in July 2025 (MScience 2025c) and in May 2022 as part of the Channel Entry Project (CEP) (MScience 2022).

Investigation showed that the 95% upper confidence limit (UCL) of metal and metalloid concentrations in were below the ANZG (2018) and NAGD (Commonwealth of Australia 2009a) screening guideline levels for all metals. Arsenic concentrations were shown to exceed the listed numerical screening level, however after normalisation for grain size, arsenic concentrations met the screening assessment value derived from comparison with the 80th percentile of the background. High arsenic concentrations in sediments from the Pilbara is a well-documented feature (DEC 2006; Stoddart et al. 2019). Normalisation of arsenic concentrations for grain size in Pilbara sediments has been confirmed to be indicative of reduced bioavailability of these metals – both through dilute acid extraction and elutriation of sediment metals (Stoddart et al. 2019). Assay for a suite of organic compounds (total petroleum hydrocarbons, polycyclic aromatic hydrocarbons and organotins) showed that none of these compounds were detected in any sample.

Sediments within and around the Project development envelope would be classified as uncontaminated under ANZG (2018) and safe for unconfined ocean disposal under the NAGD (Commonwealth of Australia 2009a).

4.3.2.3 WATER QUALITY

Waters of the North West Shelf are usually temperature-stratified, with sea surface temperatures (SST) attaining a mean temperature of 29.3°C in March, dropping to 24°C in August (Pearce et al. 2003).

Marine water quality in the region is heavily influenced by these seasonal patterns and incidences of extreme weather. Typically, nearshore waters are characterised by variable turbidity and high sedimentation rates, with associated highly variable light regimes and seawater temperatures. Offshore waters exhibit fewer extremes in the water quality, but still display occasional high levels of sedimentation and turbidity, low light and variable seawater temperatures (BHP 2009; SKM 2009c). In

general, light, turbidity, seawater temperature and sedimentation rates are weather dependent and show a strong seasonal transition from the dry to the wet seasons. Large daily tidal ranges (>5 m), strong winds (gusts >50 km/h) and increased wave activity (such as associated with cyclonic activity) are known to elevated suspended sediments by driving sediment resuspension in this nearshore region. In summary, waters in the vicinity of the Project are subject to naturally fluctuating levels of turbidity and a reduced light climate heavily influenced by seasonal weather patterns.

Nutrient concentrations from the nearshore waters of the Port of Port Hedland are considered oligotrophic (BHP 2009). During the warmer months, blooms of nitrogen-fixing microbes such as *Trichodesmium* or mangrove mud-flat cyanobacteria are known to occur and may contribute significantly to the nutrient budget, however there have been no known deleterious water quality impacts caused by toxic algal blooms in the region (Heyward et al. 2000).

Coastal waters of the North West Shelf are generally very high quality, the concentration of metals are low by world standards. Localised elevations of some metals have been reported adjacent to the industrial centres and port operations of Port Hedland (O2 Marine 2024; Wenziker et al. 2006).

4.3.2.4 TURBIDITY AND SSC

Water quality investigations have been undertaken throughout the Port of Port Hedland, often as part of compliance monitoring in association with dredging and construction activities. More recently Pilbara Ports has collected water quality data within the inner harbour as part of its marine environmental quality management program. Quarterly monitoring implemented under this plan between 2020 and 2023 showed a mean turbidity value of 4.5 NTU.

Sediment resuspension occurs more readily in nearshore to mid-shore waters (depths between 5 to 10 m CD) during major tidal changes or strong winds, compared to offshore locations or deeper waters (greater than 10 m CD). Nearby estuaries and land-based run-off during the outgoing tide deposit fine material in the inshore areas, further increasing turbidity (BHP 2009). The deeper, offshore, waters of the North West Shelf are characterised by a relatively clear water column.

Past studies of water quality within the Port of Port Hedland have typically addressed turbidity, with suspended sediment concentration measured only occasionally. While there will be a relationship between these parameters, that will vary dependent on the particle size distribution of suspended sediment, the optical properties of sediments, the water depth and spectral properties of light reaching the sediments. Studies have shown that local variation in exposure to wind and wave conditions may cause areas of the Port of Port Hedland to react differently from adjacent areas. Baseline monitoring was implemented over a 12 month period for the Outer Harbour Development (SKM 2009c). That study showed median turbidity recorded at inshore, mid-shore and offshore sites was 6, 4.6 and <2 NTU, respectively.

A long term study of turbidity offshore of Port Hedland established four sites to monitor turbidity over three dredging phases implemented between October 2017 and August 2019 for the Channel Risk and Optimisation Project (CROP) (MScience 2018a; MScience 2018b; MScience 2019). The mean turbidity at all sites ranged from 0.64 to 1.93 (Phase 1, 95%ile turbidity not exceeding 6 NTU), 0.64 to 1.17 (Phase 2-1, 95%ile turbidity not exceeding 3.5 NTU) and 2.8 to 6.9 (Phase 2-2, 95%ile turbidity not exceeding 25 NTU). The measurements recorded during Phase 2-2 of the CROP dredging program were influenced by the passing of Tropical Cyclone Veronica.

4.4 Proposed Mitigation

The EPA's mitigation hierarchy to avoid and minimise environmental impacts has been applied to the environmental factor Marine Environmental Quality. Rehabilitation options are not available, and offsets are not expected to be required for this factor.

Avoid

- Sampling and analysis of marine sediments has been undertaken to demonstrate that sediments located within and adjacent to the dredging and disposal areas present a low risk of releasing chemical contaminants potentially bound in the sediments.

Minimise

- The dredge plant will utilise mechanical devices to reduce turbidity generation during dredging and disposal, such as turbidity-reducing ("green") valves in the overflow of the dredge.
- The dredge hopper doors will be kept in good condition to minimise loss of sediment during transport.
- The dredge vessel shall develop and implement an industry standard Ship Oil Pollution Emergency Plan (SOPEP).
- Industry standard operational spill management controls will be implemented in accordance with the DEMMP.
- Monitoring of water quality will be used to drive adaptive management of dredging to minimise SSC elevation around sensitive receptors.

The mitigation measures outlined above are industry standard and best practice, and have been shown during past dredging campaigns implemented by Pilbara Ports to be effective at minimising impacts to marine environmental quality.

The potential significant impacts identified in Section 4.5 will be controlled by the implementation of both outcome-based and objective-based conditions that have been outlined in the DEMMP developed for the Proposal.

Pilbara Ports considers the potential impacts of the Proposal can be mitigated under the Commonwealth *Environment Protection (Sea Dumping) Act 1981*. As such, the DEMMP has been prepared with consideration of the DCCEEW requirements for monitoring and management plans to dredge and dispose material at sea, in the first instance. The EPA 'Instruction and template: How to prepare Part IV Environmental Management Plans', has been considered when setting management targets and environmental protection outcomes in the DEMMP.

Impacts to marine environmental quality associated with maintenance dredging during operation of the Zone 5 Bypass Channel will be managed and monitored in accordance with Pilbara Ports Port of Port Hedland long term monitoring and management plan for maintenance dredging. The existing long-term monitoring and management plan for maintenance dredging will be updated to include the Zone 5 Bypass Channel design and be issued to DCCEEW for approval prior to any maintenance dredging activities in this area.

4.5 Potential Environmental Impacts

4.5.1 Identified Environmental Impacts

The possible cause-effect pathways leading to potential impacts to the marine environmental quality values identified in Section 4.3, and justification for their relevance to the Proposal assessment, have been summarised in Table 4-5. Consequential secondary impact effects on BCH and Marine Fauna are detailed and assessed in Section 3, and 5, respectively.

Table 4-5. Identified potential impacts to marine environmental quality

Activity	Cause/Effect	Potential Impact	Impact Type	Relevance to Proposal Assessment
Dredging and spoil disposal operations	Uplift and disposal of sediments may lead to a temporary, localised, elevation of suspended sediment concentrations (SSC)	Increased light attenuation through the water column and sedimentation on the seabed.	Direct	<p>Potential significant impact requires further assessment.</p> <p>Assessment of impact provided in Section 4.5.2.1</p> <p>Indirect impacts to BCH have been assessed in Section 3.5.</p>
	Physical disturbance of the seabed may lead to the release of contaminants bound in sediments	Release of toxicants into the water column	Indirect	<p>Sediment samples within the proposed dredge footprint and channel design area were sampled and analysed for contaminants of potential concern (COPC) in accordance with the NAGD (refer to report in Appendix 7 for details). The 95% upper confidence limit (UCL) concentrations of candidate COPCs were shown to be either below the initial screening levels described in the NAGD or having a high naturally occurring background concentration and were considered to meet NAGD criteria for unconfined ocean disposal at the nominated spoil ground (MScience 2025c).</p> <p>Not likely to have a significant impact on marine environmental quality. As such, the potential impact has not been assessed further.</p>

Activity	Cause/Effect	Potential Impact	Impact Type	Relevance to Proposal Assessment
Dredge vessel operations	Operation of the dredge vessel may lead to a hydrocarbon spill /waste discharge	Release of toxicants into the water column	Direct	Impact considered to be appropriately managed through Pilbara Ports existing industry standard and best practice port operating procedures to prevent hydrocarbon and other spills into the marine environment. All vessels within port limits must manage wastes in accordance with the Port of Port Hedland requirements appropriate to the class of vessel (including Australian Marine Safety Authority [AMSA] and International Convention for the Prevention of Pollution from Ships [MARPOL] legislative requirements) Not likely to have a significant impact on marine environmental quality. As such, the potential impact has not been assessed further.

4.5.2 Predicted Environmental Impacts

Consistent with the EPA instructions 'How to prepare an Environmental Review Document' a table summary of the likely extent of potential significant impacts (direct, indirect, total and cumulative) has been provided in Table 4-6.

Table 4-6. Predicted extent of impacts to marine environmental quality

Environmental value	Regional and Local Context	Direct Impact	Indirect Impact	Total Impact	Cumulative effects of other Proposals	Level of Certainty
Marine water quality Physical change – Predicted 95 th ile elevation of TSS ≥5 mg/L above background.	The Proposal is located within the IMCRA Pilbara nearshore bioregion which covers an area of 23,875,865 ha.	Total area 30,885 ha 13,899 ha in State Waters	Not applicable	13,899 ha	While the Proposal will result in temporary disturbances to water quality within State waters (13,899 ha), no cumulative impacts are predicted as there are no past, present or future Proposals contributing to cumulative changes in this value.	High – impacts calculated on the basis of project specific dredge spill modelling. Modelling has been validated against long-term measured water levels and currents within the extensive network of metocean instrumentation maintained by Pilbara Ports.

4.5.2.1 ELEVATED SUSPENDED SEDIMENT CONCENTRATIONS

To better understand the likely intensity, extent and duration of turbid plumes generated from dredging and disposal, a numerical modelling assessment of the proposed capital dredge program and associated offshore disposal was completed for the Proposal (DHI 2026) (Appendix 5). The study included the development of a 2D Regional hydrodynamic model and 3D local hydrodynamic model using industry standard model systems (MIKE 21 and MIKE3 FM HD) to force an industry standard sediment transport model (3D MIKE3 FM Mud Transport). The hydrodynamic modelling identified the prevailing residual current conditions were likely to be a key mechanism which dominate plume character. It was seen that the residual current climate at the project site varies over the year, with a neutral or eastward drift prevailing much of the year but with periods of briefly sustained westward drift frequently occurring during the winter months. As the Proposal dredging campaign is proposed to occur in late winter / spring shoulder season, this implies that a westward residual current is more likely to be experienced early within the construction window and toward the earlier portion of the dredging sequence. As the bulk of production and spillage tends to occur in the first weeks of the programme, this increases the chances of the initial heavy production rates overlapping with a western residual. However, any of neutral, westward or eastward residual character is possible. As such, simulations were run for the two dredging methodologies outlined in Section 6.2 of this application (Scenario 1 - TSHD only and Scenario 2 - CSD/TSHD) over three metocean scenarios (A- neutral, B - eastward and C - westward residual current drift).

The dredge plume modelling results from the ensemble of simulations were processed as spatial plots to illustrate median, 95th percentile and maximum contours of predicted elevations in depth averaged suspended solid concentrations (Figures 4-2 to 4-7).

The 95th percentile and maximum SSC contours highlight the degree to which the plume excursion from the immediate work area follows the principal axis of tidal motion. The max SSC fields also illustrate the degree to which the prevailing residual currents affect the extent of the sediment plumes. The simulations exhibiting neutral residual character (Scenarios 1A, 2A) feature the smallest longshore footprints. In contrast, the simulations with eastward residual character (Scenarios 1B, 2B) lead to 1 mg/L contours extending ~50km NE of the Zone 5 Channel. Simulations with westward residual character (Scenarios 1C, 2C) lead to 1 mg/L contours extending ~30km NE of the Zone 5 Channel. The smaller westward vs. eastward extent is largely a result of the season being simulated, during which the predominant residual direction tends to be transitioning from westward to eastward.

The “speckled” character of the Max SSC fields around SG7C in Figures 4-2 to 4-7 is due to highly mobile, very localised high resolution disposal plumes being resolved at a timestep of 30 minutes (refer to Appendix 5 for details).

Modelling predicted the 95thile contours for SSC \geq 5mg/L would cover a total area of 30,885 ha, of which 13,899 ha was located in State Waters (Figure 4-8).

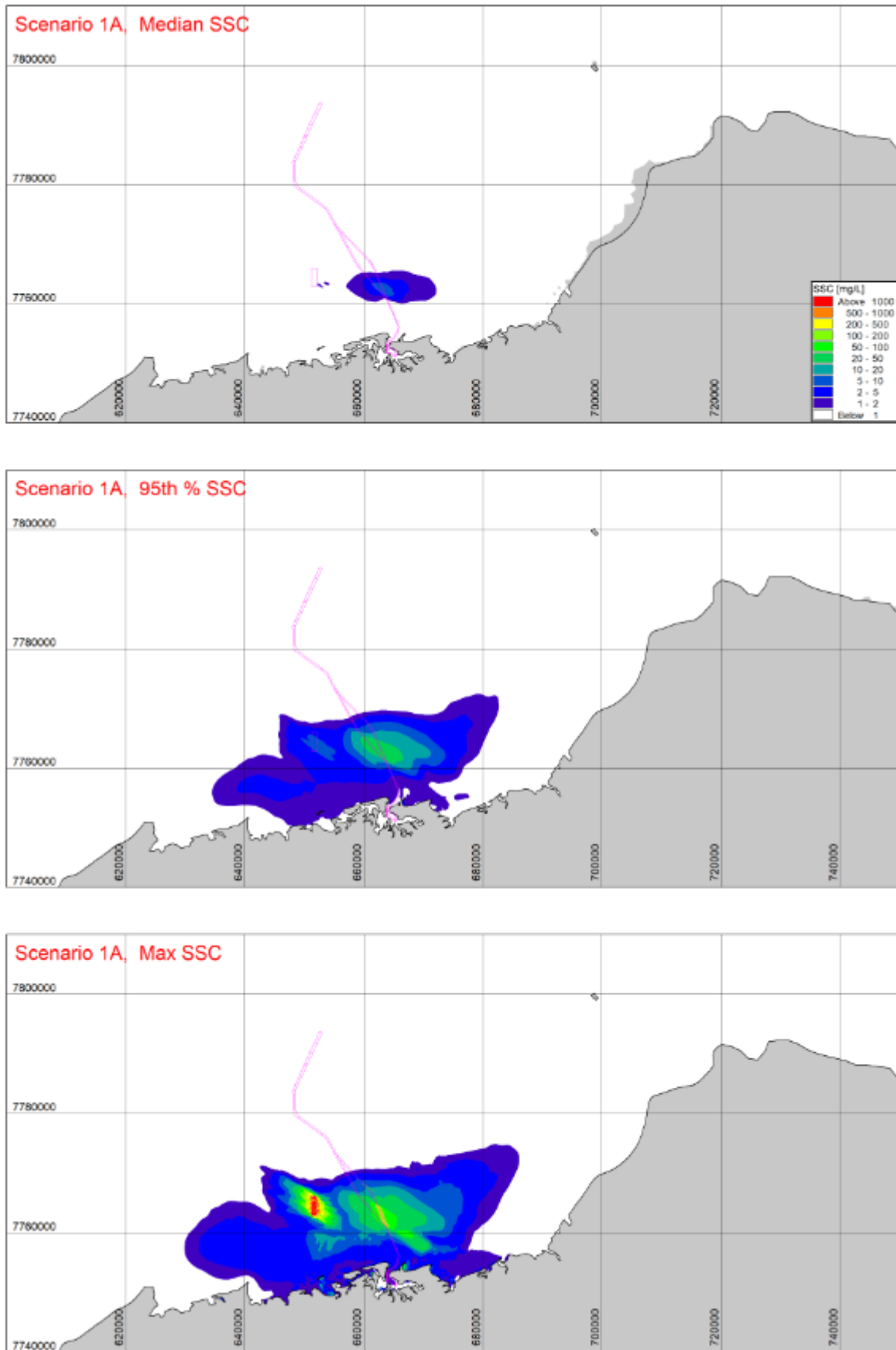


Figure 4-2. Statistical SSC fields of sediment plumes from Scenario 1A (TSHD only, neutral residual character). Derived from the depth-maximum total SSC at each output timestep.

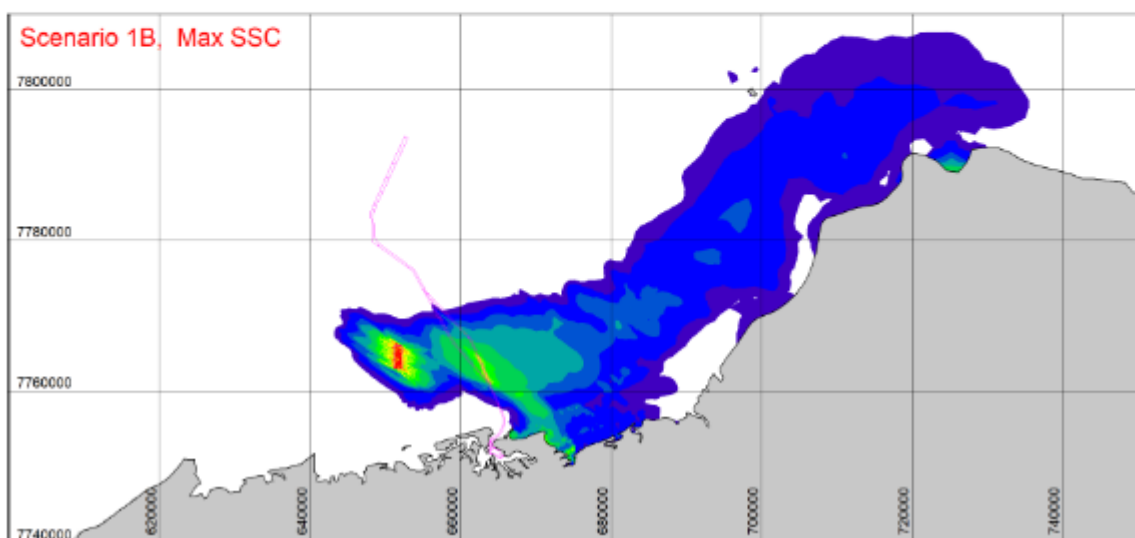
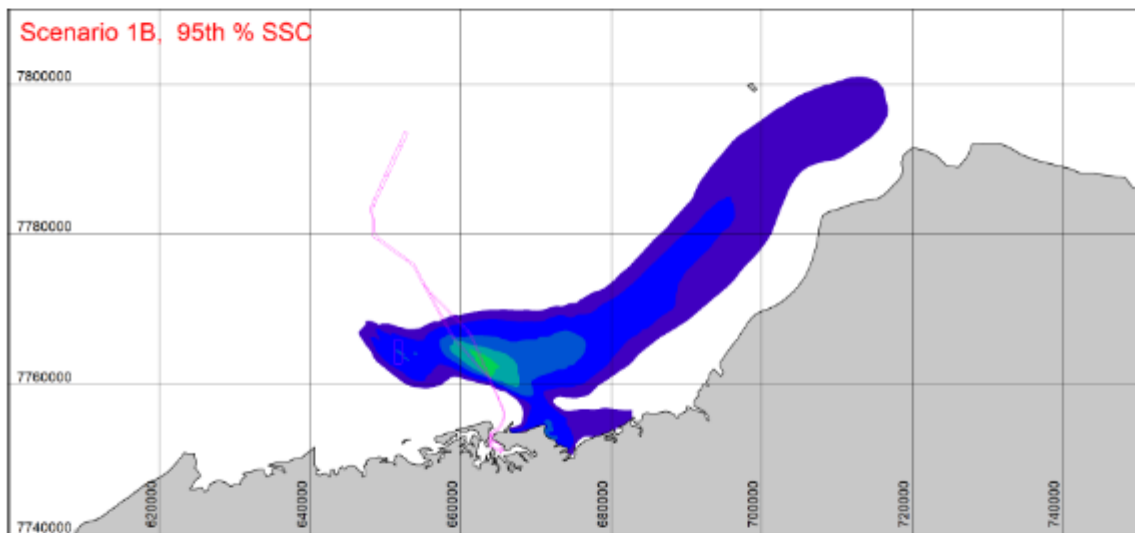
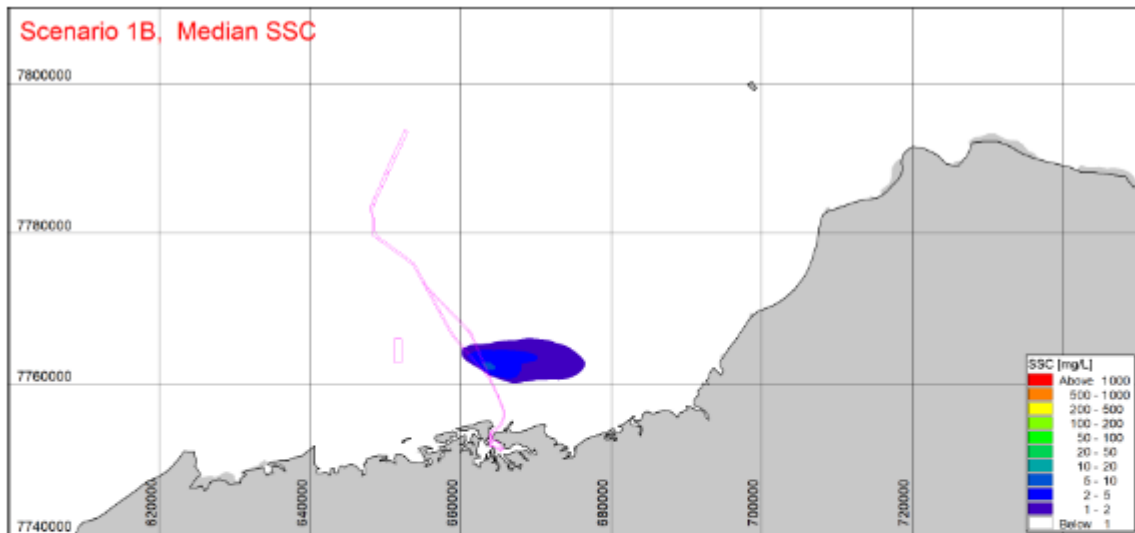


Figure 4-3. Statistical SSC fields of sediment plumes from Scenario 1B (TSHD only, eastward residual character). Derived from the depth-maximum total SSC at each output timestep.

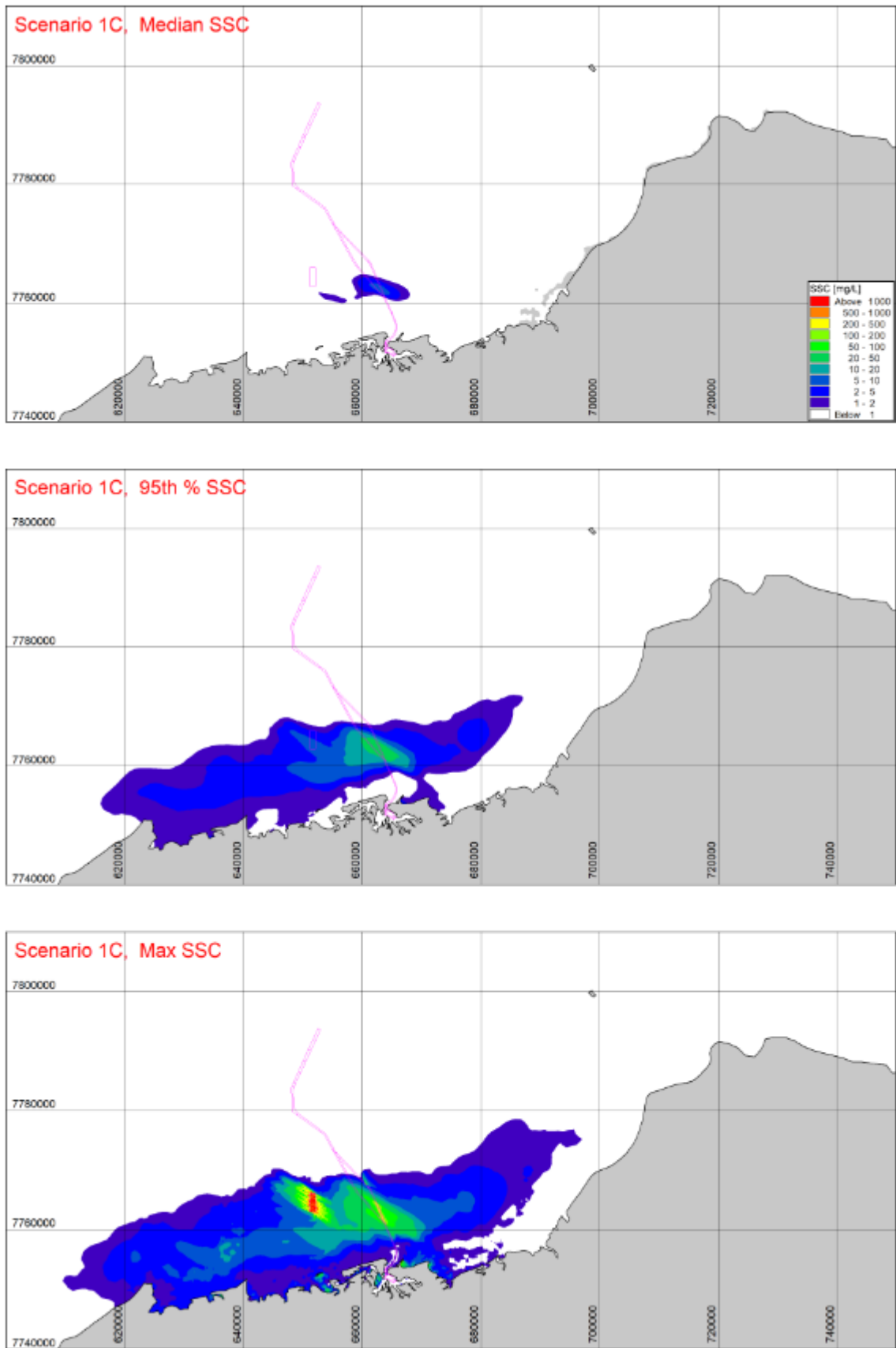


Figure 4-4. Statistical SSC fields of sediment plumes from Scenario 1C (TSHD only, westward residual character). Derived from the depth-maximum total SSC at each output timestep.

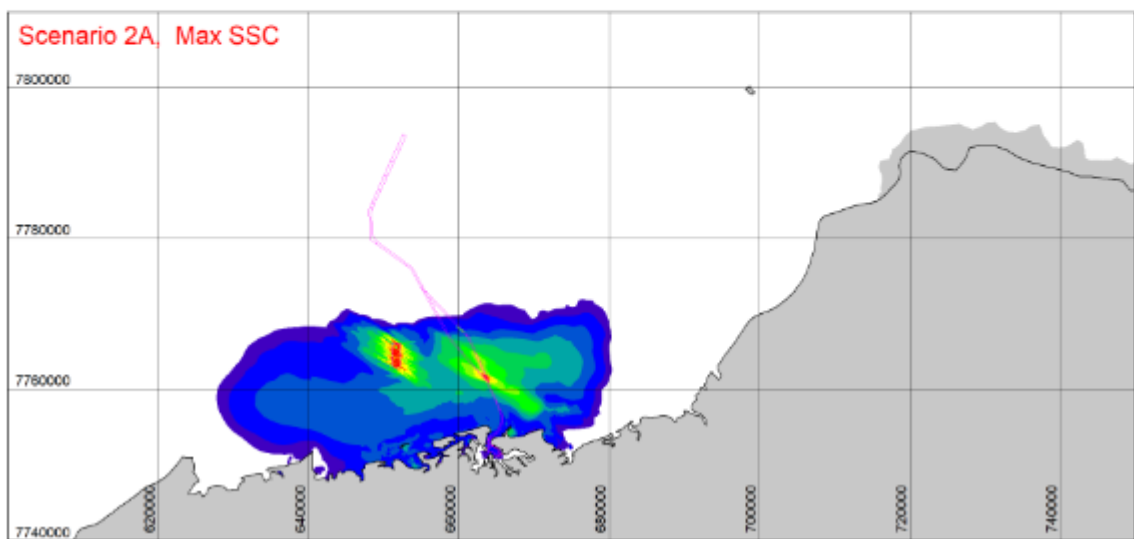
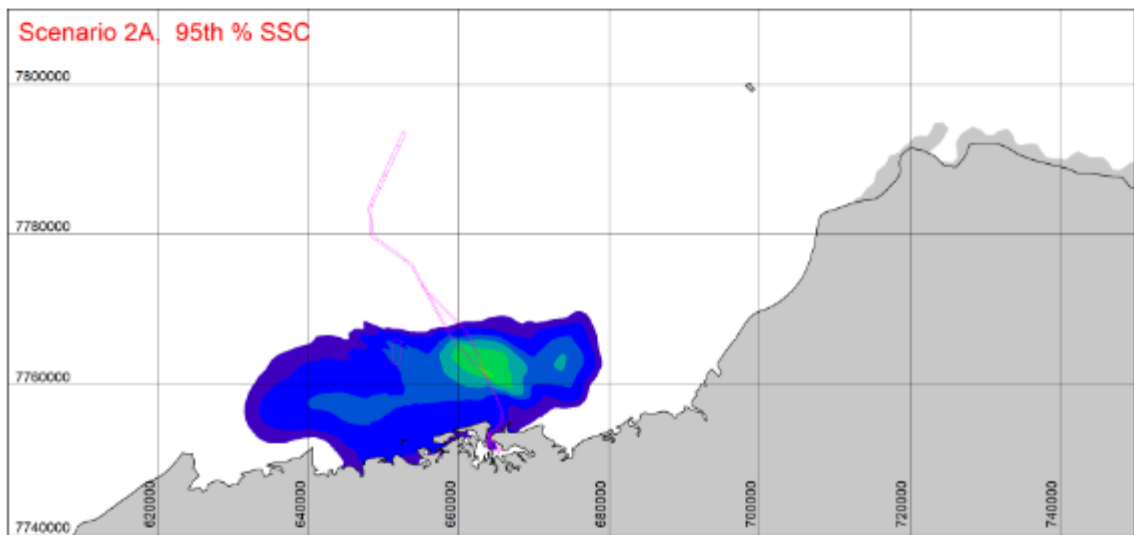
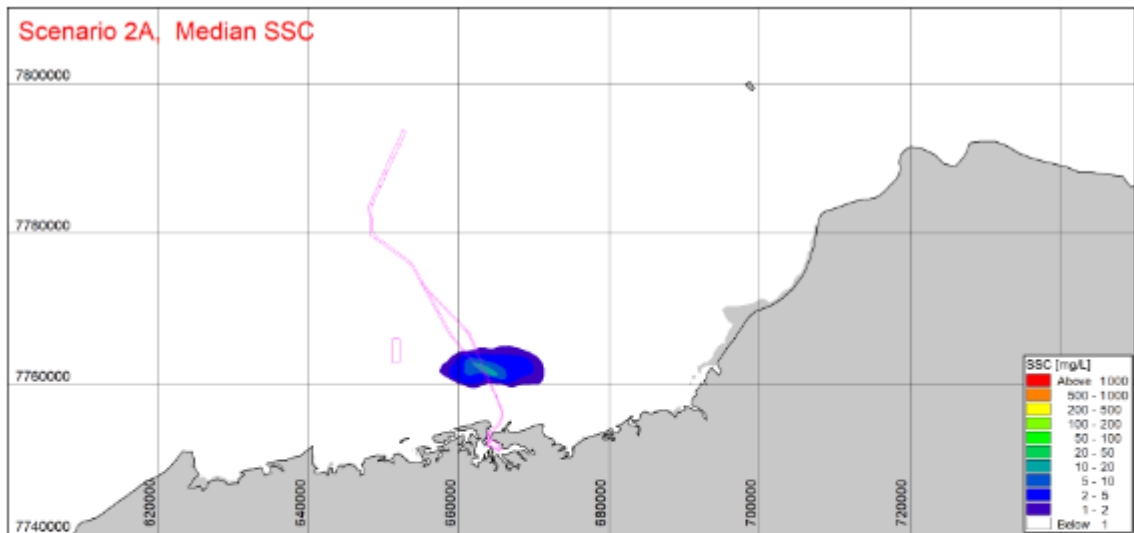


Figure 4-5. Statistical SSC fields of sediment plumes from Scenario 2A (CSD/TSHD, neutral residual character). Derived from the depth-maximum total SSC at each output timestep.

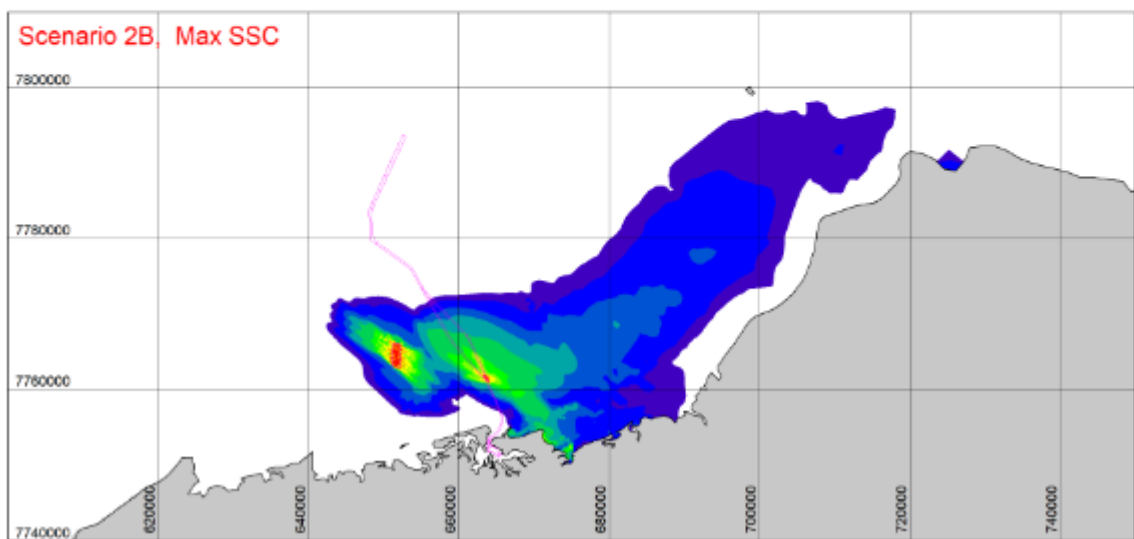
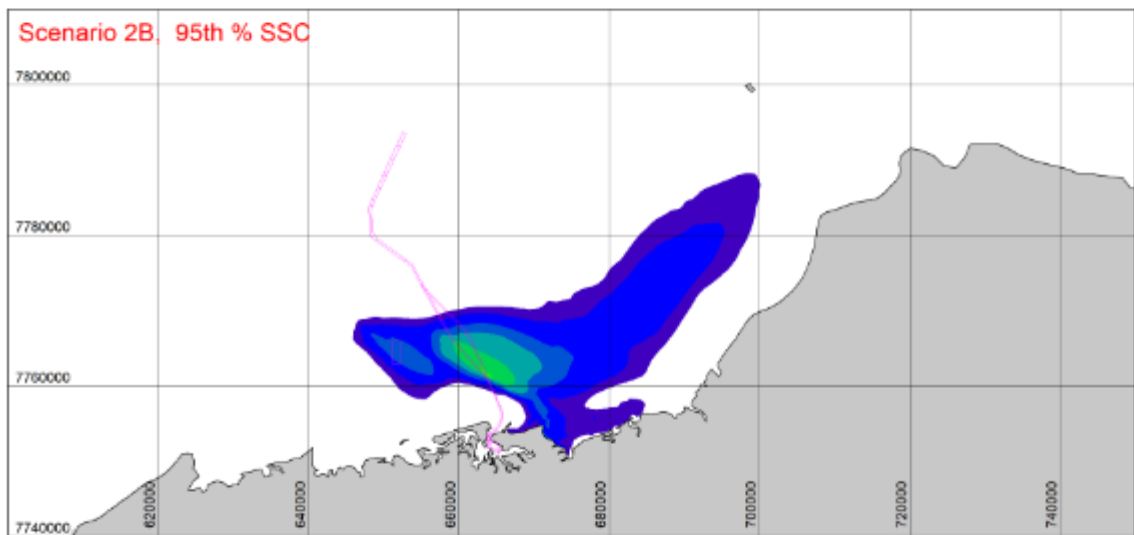
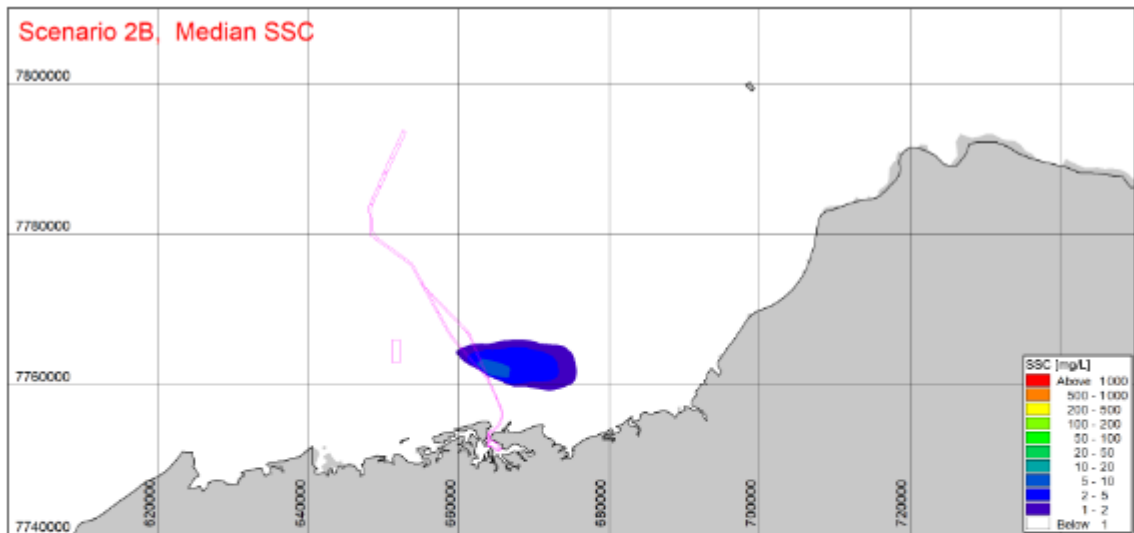


Figure 4-6. Statistical SSC fields of sediment plumes from Scenario 2A (CSD/TSHD, eastward residual character). Derived from the depth-maximum total SSC at each output timestep.

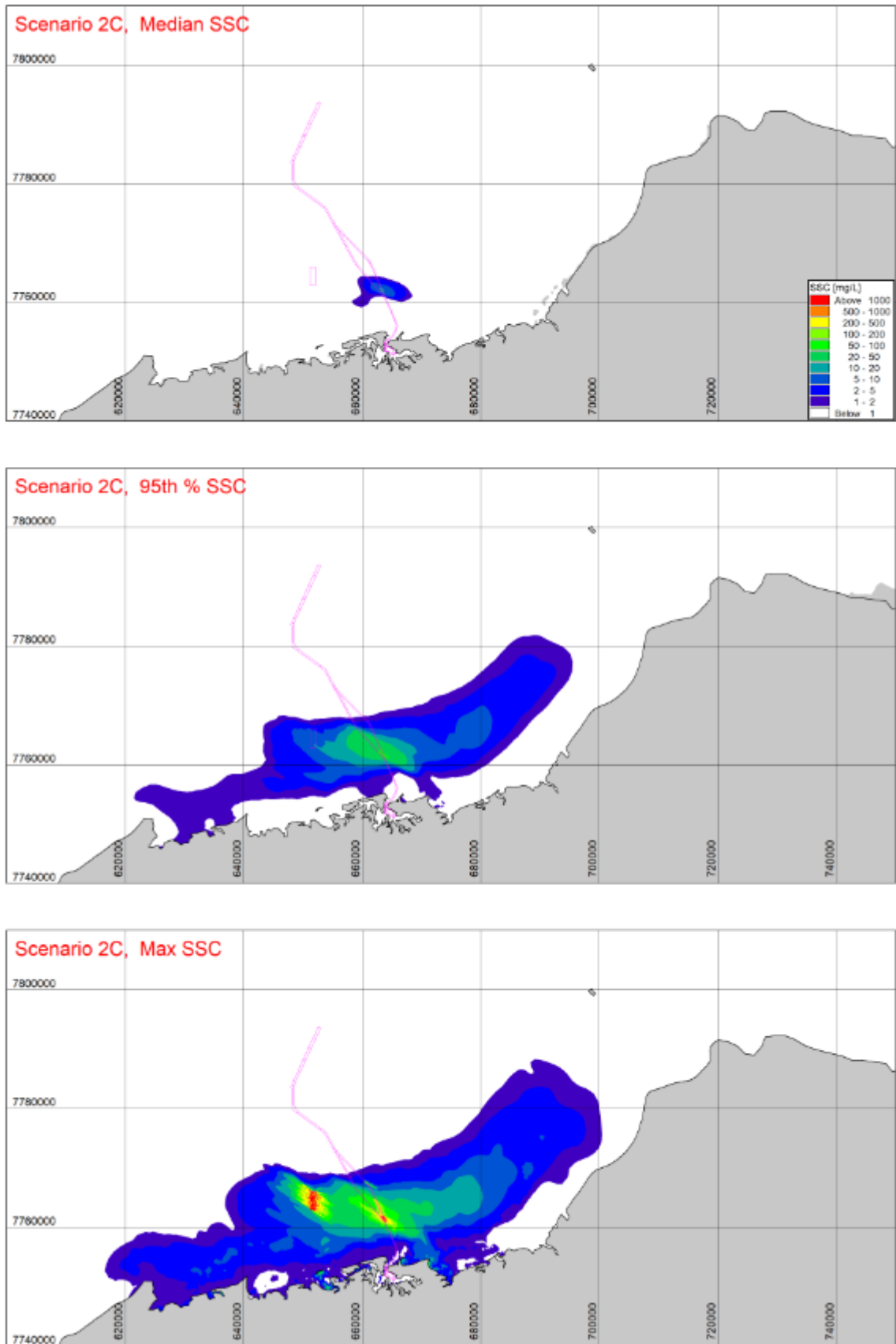


Figure 4-7. Statistical SSC fields of sediment plumes from Scenario 2A (CSD/TSHD, westward residual character). Derived from the depth-maximum total SSC at each output timestep.

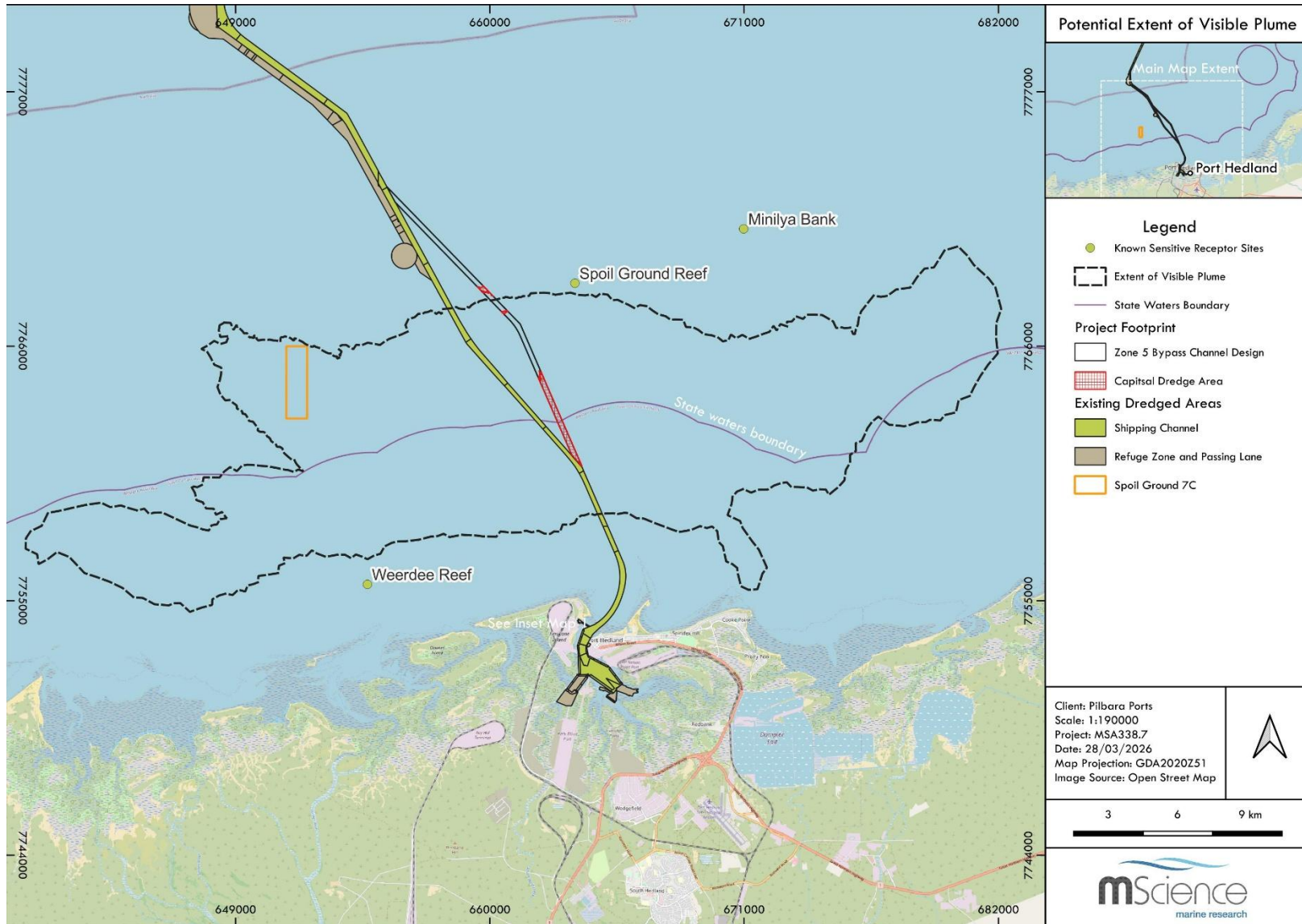


Figure 4-8. The potential extent of the visible plume calculated from 95th percentile contour of SSC ≥ 5 mg/L for all modelled scenarios

4.6 Assessment of Significance of Residual Impacts

4.6.1 Proposal

Sediment analysis has indicated the sediments to be dredged and disposed are suitable for unconfined ocean disposal. Further, management procedures for the handling of hydraulic fluids and fuels will be incorporated into the DEMMP.

During marine dredging and disposal activities, the Proposal is likely to result in temporary disturbances to water quality by elevating SSC ≥ 5 mg/L above background within State waters in a total area of 13,899 ha, but no permanent, long-term change is expected. Management controls incorporated in the DEMMP will be employed to limit sediment plume dispersion during dredging and disposal activities.

The implications and significance of elevated SSC on BCH has been assessed in Section 3.5.

In light of the above, it was predicted that there will be no significant residual impact to marine environmental quality from the Proposal, and so consideration of offsets for this environmental factor is not required.

4.6.2 Cumulative Impacts

Effects of offshore dredging and disposal activities on marine environmental quality were determined to be temporary, within the range of naturally occurring seasonal effects and highly unlikely to induce permanent changes in the marine environment. As such, the Proposal has been considered in combination with other Proposals in the region to determine whether the combined effects could lead to increased deleterious effects on environmental and social values.

Three significant marine Proposals have been referred or are currently operating under Part IV of the EP Act within the Port of Port Hedland that are located outside of the inner harbour area. Each one identified marine environmental quality as a key environmental factor.

The Fibre Optic Submarine Cable between Port Hedland and Darwin Proposal and the Port Hedland Spoilbank Marina Proposal both received a 'not assessed' decision. The EPA noted that the former may have the potential to impact on local marine environmental quality from the release of drilling fluid during construction, and the potential impacts to marine environmental quality from the latter (including increased SSC from dredging activities) would be temporary and localised. Construction of each Proposal was completed in 2023 and 2024, respectively. No known impacts to marine environmental quality have been reported from either Proposal.

The BHP Port Hedland Outer Harbour Development was approved in 2012 under Ministerial Statement (MS) 890. The EPA identified the key marine environmental quality issues associated with the proposal to be:

- potential environmental quality impacts on receiving water quality in Salmon Creek should dewatering during the construction of the car dumpers be required; and
- ongoing contaminant inputs from operational activities at the wharf and unloading area.

The BHP Port Hedland Outer Harbour Development has not substantially commenced since its approval. As such, authorisation to implement the proposal has lapsed due to becoming void five years after the date of approval.

Based on the above, no cumulative impacts to marine environmental quality are predicted as there are no past, present or future Proposals contributing to cumulative changes in this value.

4.7 Environmental Outcome

Pilbara Ports considers that the EPA objective for marine environmental quality will be met based on the assessment of the significance of residual impacts and application of avoidance and minimisation mitigation measures, including the monitoring and management actions described in the DEMMP.

The DEMMP includes project specific management targets (MTs) to mitigate the potential impacts on marine environmental quality and subsequently ensure that the EPA's objective for this environmental value is met, and the predicted environmental protection outcomes (EPOs) are achieved.

In accordance with the EPA document 'Interim Guidance - Environmental outcomes and outcomes-based conditions', Pilbara Ports has proposed the following environmental outcomes for marine environmental quality:

- No indirect impacts to BCH from increased SSC or sedimentation associated with dredging or disposal activities.
- No reported hydrocarbon spills or waste discharge into the marine environment from the Proposal.

Pilbara Ports considers the proposed environmental outcomes can be assured through the conditions prescribed by a sea dumping permit issued under the Commonwealth *Environment Protection (Sea Dumping) Act 1981*.

5 ENVIRONMENTAL FACTOR ASSESSMENT – MARINE FAUNA

5.1 EPA Objective

To protect marine fauna so that biological diversity and ecological integrity are maintained.

5.2 Policy and Guidance

Table 5-1 details the EPA, State and/or Commonwealth policies and guidance have been considered in evaluation of potential impacts on Marine Fauna.

Table 5-1. Policy and guidance – marine fauna

Policy and Guidance	How the guidance has been considered
Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021a)	The assessment of significance of impacts to Marine Fauna has considered the EPA’s consideration of ‘significance’ in this guidance (see Section 5.6)
Environmental Factor Guideline – Marine Fauna (EPA 2016e)	The considerations for EIA stated in this guidance have been addressed in evaluation of potential impacts on Marine Fauna as a result of the Proposal. The Proposal design has addressed the guidance in this document and been adjusted to minimise any impacts.
The Matters of National Environmental Significance (MNES) Significant Impact Guidelines (Commonwealth of Australia 2013)	Criteria to assess potential for significant impacts to marine species listed as matters of national environmental significance and their habitats have been considered.
National Light Pollution Guidelines for Wildlife (including marine turtles, seabirds and migratory shorebirds) (Commonwealth of Australia 2020a)	This guidance has been considered in assessment of the Proposals impact to light sensitive marine fauna and proposed mitigation measures through design of the Proposal to limit impacts to light sensitive marine fauna.
Marine Bioregional Plan for the North-west Marine Region (Commonwealth of Australia 2012)	Advice on the pressures affecting marine fauna of significance provided in this plan has been considered in the assessment of the Proposals impact to marine fauna and proposed mitigation measures to limit its impacts.
Marine Fisheries Service Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS 2024)	This guidance has been considered in assessment of the Proposals underwater noise impacts to marine mammals.
Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III) (Finneran et al. 2017)	This guidance has been considered in assessment of the Proposals underwater noise impacts to marine turtles.

5.3 Receiving Environment

5.3.1 Surveys and Studies

The impact assessment has been completed with a high degree of confidence based on the review of existing information and collation of comprehensive desktop studies. The studies used to inform the impacts to marine fauna are summarised in Table 5-2. Refer to the complete technical report for detailed information on each study.

Table 5-2. Studies specific for marine fauna

Survey/Study	Findings
<p>Marine Fauna Desktop Review (MScience 2026)</p> <p>APPENDIX 8</p>	<p>A desktop review of the marine fauna species likely to occur within and adjacent to the Proposal based on the results of the Commonwealth Protected Matters Search Tool (PMST) report. The review objectives were to:</p> <ul style="list-style-type: none"> Identify the marine fauna of significance that may occur within or adjacent to the Proposal; Assess the likelihood of the identified marine fauna of significance occurring within or adjacent to the Proposal; Summarise the ecological characteristics (i.e., population, distribution, habitat use and life history) for the species with a greater than 'possible' potential to occur within or adjacent to the Proposal (i.e. species of relevance to the Proposal); and Identify and assess the known threats to the relevant listed marine fauna against potential impact pathways from the Proposal to allow identification of the species of key concern. <p>No conservation significant or commercially important marine fauna species populations are restricted to the Proposal.</p> <p>Identified marine fauna of key concern included the humpback whale, flatback turtle, green turtle, hawksbill turtle and loggerhead turtle. This assessment was based on:</p> <ul style="list-style-type: none"> the dredging and disposal areas spatially overlapping, or being in close proximity to, biologically important areas for these species; and the identification of vessel collision (humpback whale) and entrainment (marine turtles) impacts due to dredging activities to be a potential significant impact pathway for the listed species.
<p>Spoilbank Marina Proposal: Review of Potential impacts to flatback turtles.</p> <p>(Pendoley 2019)</p> <p>EPA Website Link to Document</p>	<p>The report provides a desktop review of current literature on the flatback turtle population at Port Hedland and includes expert opinion on potential pathways for significant impact to the species due to offshore dredging activities associated with the Spoilbank Marina proposal. The report outlines monitoring and management actions to mitigate any potential impacts to an acceptable level that meet State and Commonwealth environmental objectives.</p> <p>Offshore dredging at Port Hedland was considered to be a potential pathway for impact to flatback turtles via entrainment within the dredge vessels drag head.</p>

Survey/Study	Findings
Underwater Noise Modelling – Spoilbank Marina Project (Talis 2020) EPA Website Link to Document	<p>The report summarises the method and results of an underwater noise modelling study for construction activities (including dredging) associated with the Spoilbank Marina proposal. The report includes the predicted ranges at which the marine fauna of concern could potentially experience onset of temporary hearing damage/ impairment and/or a behavioural response.</p> <p>A dredging noise source level of 182 dB re 1µPa @ 1m was modelled. Sound exposure levels were predicted to attenuate below the threshold criteria for a behavioural response in humpback whales at 5,300 m from the dredge vessel. Received noise levels only exceeded the threshold criteria for a behavioural response in marine turtles at the dredging location.</p>

5.3.2 Threatened and Migratory Marine Fauna Species Relevant to the Assessment

The marine fauna desktop study completed for the Proposal (Appendix 8) identified the threatened and/or migratory species considered to have a greater than ‘possible’ likelihood of being present within (1km) and/or adjacent (within 20km) to the proposed dredging footprint and spoil ground. Six species of marine mammal, five marine reptiles, seven elasmobranchs and other fish species, three seabirds and 29 migratory shorebirds were identified. Of those marine fauna species identified, the following were considered to be of key concern for the Proposal based on the location of biologically important areas (BIAs) for the species, their known threats (as per advice provided in the North-west marine bioregional plan) and potential impact pathways due to the proposed dredging:

- Humpback whale (*Megaptera novaeangliae*)
- Flatback turtle (*Natator depressus*)
- Green turtle (*Chelonia mydas*)
- Hawksbill turtle (*Eretmochelys imbricata*)
- Loggerhead turtle (*Caretta caretta*)

Humpback whales have been recorded within Port Hedland, and the Proposal footprint overlaps a BIA for migration of the species (Figure 5-1). The flatback turtle is known to commonly nest on beaches in the Port Hedland area and these nesting beaches, and their inter-nesting buffer, are designated BIAs (Figure 5-2) (Commonwealth of Australia 2017b; Pendoley 2009; Pendoley 2019; Pendoley 2005; Prince 1993). A foraging BIA for flatback, green, hawksbill and loggerhead turtles has been defined extending from the De Grey River area out to the North Turtle/Little Turtle islands, approximately 35 km northeast of the Project dredging footprint (Figure 5-2).

5.3.2.1 HUMPBACK WHALE

Humpback whales migrate from feeding grounds in the Antarctic to breeding grounds in Camden Sound in the Kimberley region of Western Australia. A population of 33,000 humpback whales are known to make this migration annually (Salgado Kent et al. 2012). The north bound migration peaks adjacent to the Port Hedland area between approximately late July and early August. The peak of the south bound migration occurs during late August and mid-October (Table 5-3). Jenner et al. (2001) suggested that the majority of migrating whales are found in waters deeper than 50 m; however, some individuals come closer to shore, particularly during the southern migration. This migration route is designated a BIA for the species (Figure 5-1).

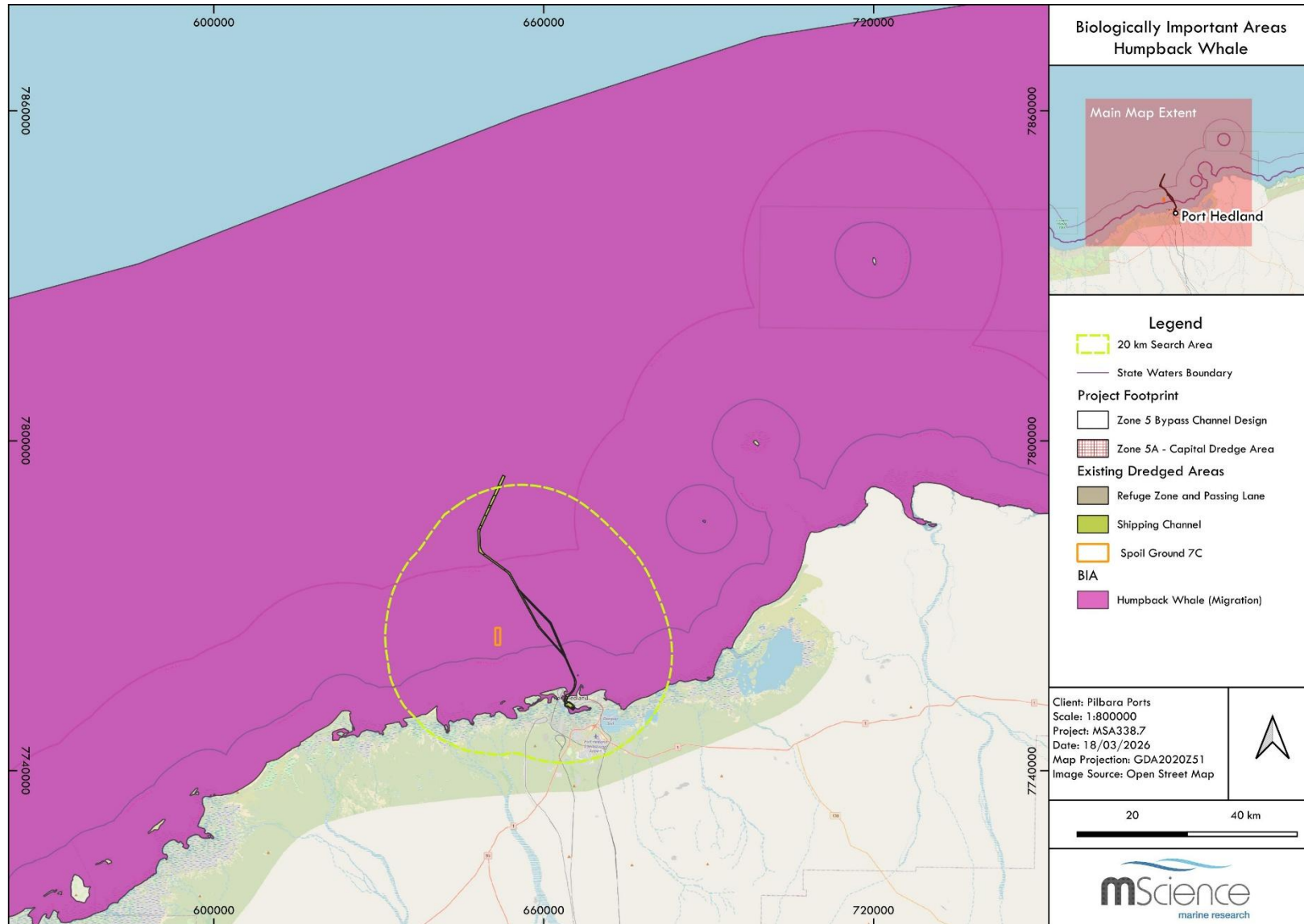


Figure 5-1. Biologically important area for the humpback whale relevant to the Project

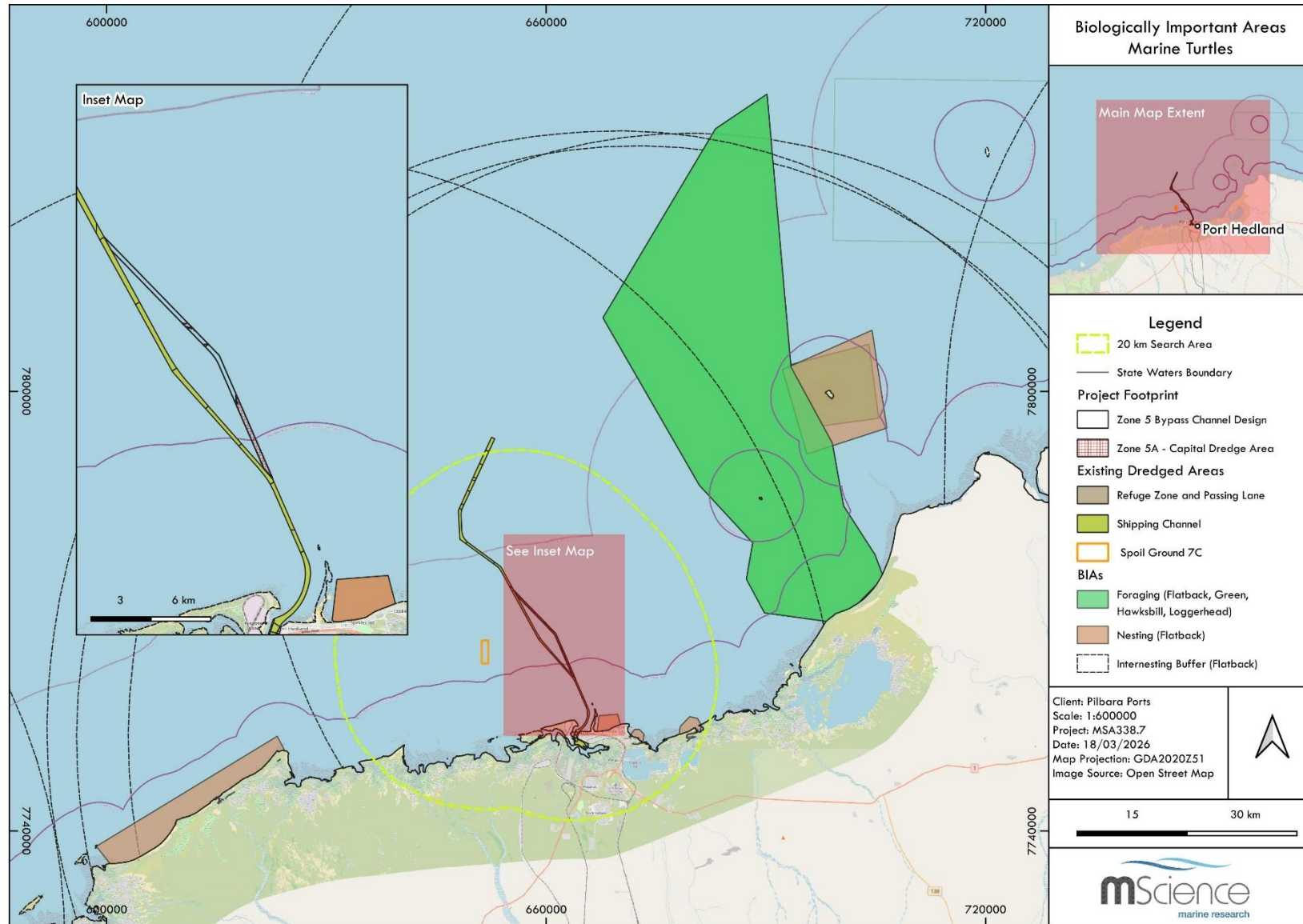


Figure 5-2. Biologically important areas for Project relevant marine turtle species

The Port Hedland region is not a known feeding, aggregation or major calving area for this species (Jenner and Jenner 2009; Jenner and Jenner 2011).

Table 5-3. Peak (dark grey) migration periods for humpback whales in the Port Hedland area

Species	Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Humpback Whale	Northern Migration												
	Southern Migration												

Humpback whales are listed as Migratory under the EPBC Act and as Conservation Dependant fauna under the BC Act. Their global (non-statutory) listing by the IUCN is Least Concern. There is no current Recovery Plan for the species.

Humpback whales have been recorded within Port Hedland, and the area is listed as a BIA for migration of the species. As such, whales may be present in the outer Port Hedland harbour and Spoil Ground 7C during the known migrations.

5.3.2.2 FLATBACK TURTLE

Mundabullangana, located approximately 50 km west of Port Hedland, supports a regionally important flatback turtle rookery. This population is considered one of the largest nesting flatback turtle populations in the world (Pendoley 2009). Eighty Mile Beach, approximately 280 km north-east of Port Hedland Harbour, is thought to support a similar size nesting population to Mundabullangana. Flatback turtle nesting has been recorded across a number of mainland beaches and offshore islands within the Port Hedland area. These nesting beaches, and associated inter-nesting buffer, are designated BIAs (Figure 5-2). A low to moderate density of nesting has been recorded at Cemetery Beach, Paradise Beach, Pretty Pool and Cooke Point, whilst a very low density of nesting has been recorded at Downes Island (Pendoley 2009). None of these rockeries are considered regionally significant when compared with the rookery at Mundabullangana. Nesting at Cemetery Beach typically occurs between October and February, peaking between November and January with hatchling emergence occurring between December and March (Table 5-4) (Pendoley 2019). Inter-nesting activities are likely to occur during the same period of nesting.

Table 5-4. Peak (dark grey) activity of mating, nesting and inter-nesting flatback turtles and emerging hatchlings

Activity	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Mating												
Nesting/Inter-nesting												
Emergence												
Foraging												

Concentrations of resident (all year round) foraging turtles have been found to be generally located around the offshore islands, including North and Little Turtle Islands, in creek mouths, over shallow

intertidal platforms and the De Grey River area. North Turtle Island is considered to be a biologically important foraging habitat for the species (Figure 5-2) (Pendoley 2005).

Knowledge of the inter-nesting movements of flatback turtles within the Port Hedland area is provided by satellite tracking of 16 individuals nesting at Cemetery Beach (Pendoley 2009). During inter-nesting, some individuals remained relatively close (within 10 km) to the nesting beach in shallow coastal waters (<3 m depth), whilst others were observed to travel over 50 km from the nesting beach. The principal inter-nesting habitat utilised by flatback turtles nesting at Cemetery Beach was to the north and northeast of the nesting beach. There is no published data that indicates where hatchling flatback turtles move to offshore once they leave Cemetery Beach. Pendoley (2019) suggested hatchlings are likely to move in the same direction as nearshore tidal driven currents., based on offshore tracking data recorded for flatback hatchlings at other nesting beaches within the same genetic stock (Thevenard Island). At Port Hedland, a very large tidal range of up to 6 m occurs and the maximum flood tide rate is approximately 1.5 knots. On a flood tide (i.e. incoming), the nearshore current flows in an easterly direction and on an ebb tide (i.e. outgoing), the nearshore current flows in a north-westerly direction.

Flatback turtles are listed as Vulnerable and Migratory under the EPBC Act and BC Act. Their conservation is managed under the most recent Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017b).

Inter-nesting and foraging adult flatback turtles, and flatback hatchlings, may occur in the waters within and adjacent to the dredging footprint; however, large numbers are not expected, given the lack of significant foraging habitat and known movements of inter-nesting and hatchling turtles away from the Proposal footprint.

5.3.2.3 GREEN TURTLE

Very little green turtle nesting has been recorded within the Port Hedland area (Pendoley 2009).

The intertidal platform at North Turtle Island is considered to be a significant foraging habitat for green turtles and is a designated BIA for this behaviour (Figure 5-2). Other foraging habitats include Little Turtle Island, Weerde Island, in creek mouths, over shallow intertidal platforms and within the Inner Harbour of the port. Foraging behaviour for this species is likely to occur all year round (Pendoley 2009).

Green turtles are listed as Vulnerable and Migratory under the EPBC Act and BC Act. Their conservation is managed under the most recent Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017b).

Foraging and migrating green turtles may occur in the waters adjacent to the dredging and disposal areas; however, large numbers are not expected given the lack of significant foraging habitat and based on understanding of known migration routes (usually offshore in depth of 12 to 80 m).

5.3.2.4 HAWKSBILL TURTLE

Very little hawksbill turtle nesting has been recorded within the Port Hedland area (Pendoley 2009).

Hawksbill turtles are found within rock and reef habitats, coastal areas and ponds. They are known to forage amongst vertical underwater cliffs, on coral reefs and on gorgonian (soft coral) flats, as well as seagrass or algae meadows (Limpus 2009). The species has been recorded from satellite transmitters as spending time in the vicinity of North Turtle Island and use the area between that island and Little Turtle Island for foraging, given the presence of sponges. As such, this area is a

designated BIA for foraging for the species (Figure 5-2). Foraging behaviour for this species is likely to occur all year round (Pendoley 2009).

Hawksbill turtles are listed as Vulnerable and Migratory under the EPBC Act and BC Act. Their conservation is managed under the most recent Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017b).

Foraging and migrating hawksbill turtles may occur in the waters adjacent to the dredging footprint; however, large numbers are not expected, given the lack of significant foraging habitat and our understanding of known migration routes (usually offshore in depth of 12 to 80 m).

5.3.2.5 LOGGERHEAD TURTLE

Knowledge of loggerhead turtle populations at Port Hedland is sparse, and no loggerhead turtle nesting has been recorded within the Port Hedland area (Pendoley 2009).

The Western Australian loggerhead turtle stock is one of the largest in the world and is distributed from the Gascoyne (Dirk Hartog Island) to Pilbara (Varanus Island) Regions (Commonwealth of Australia 2017b). Loggerhead turtles are a nearshore species which prefer warm, shallow continental shelves and coastal bays and estuaries (Limpus 2008). The species feed in a wide range of tidal and subtidal habitats including coral and rocky reefs, seagrass meadows, and soft-bottomed sand or mud areas. The North Turtle/Little Turtle islands and De Grey River area is a designated BIA for foraging for the species (Figure 5-2). Foraging behaviour for this species is likely to occur all year round (Pendoley 2009).

Loggerhead turtles are listed as Endangered and Migratory under the EPBC Act the BC Act. Their conservation is managed under the most recent Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017b).

Foraging and migrating loggerhead turtles may occur in the waters adjacent to the dredging footprint. However, significant numbers are not expected, given the sparsity of optimal foraging habitat.

5.4 Proposed Mitigation

The EPA's mitigation hierarchy to avoid and minimise environmental impacts has been applied to the environmental factor Marine Fauna. Rehabilitation options are not available, and offsets are not expected to be required for this factor.

Avoid

- Channel design selected to avoid areas of known BCH that may support marine fauna.
- Spoil ground is located in an area devoid of BCH that could support marine fauna.
- Fauna/vessel interaction distances detailed in the Australian National Guidelines for Whale and Dolphin Watching (Commonwealth of Australia 2017a) will be adhered to throughout dredging.
- A dredge vessel that is already located within WA State waters will be sourced where practicable to avoid introduction of IMS. In the event a dredge vessel is sourced from interstate or international waters, the vessel would adhere to Australian biofouling and ballast water management requirements.
- No hydrocarbon or waste spills.

Minimise

- The length of the campaign will be minimised (expected 5 weeks).
- The campaign will be planned as far as practicable to minimise overlap with peak turtle nesting and hatchling emergence periods to avoid interactions with marine turtles.
- Within port waters, the dredge vessel will be slow moving during transit between dredging and disposal areas. The dredge vessel will control its speed in accordance with the Pilbara Ports Port Hedland Vessel Movement Protocols ([Pilbara Ports Website Link](#)), which aligns with the *Port Authorities Regulations 2001* that states *vessel must not move at a speed that exceeds the maximum speed at which the vessel can be safely moved in the port*.
- A trained MFO will be aboard the dredge when the vessel is in motion and operation to check for marine fauna.
- A minimum distance of 300 m will be maintained between the vessel and observed marine fauna.
- TSHD fitted with turtle exclusion devices on the drag heads.
- Procedural controls whilst dredging to minimise off-bed suction time.
- Minimise the duration of run-time for vessel engines, thrusters and dredging plant to reduce underwater noise by avoiding stand-by or running mode to the degree practical and consistent with safe operations.
- Dredge vessel will be subjected to a marine pest risk procedure which complies with the relevant Commonwealth and State biosecurity requirements and Pilbara Ports IMP Risk Assessment procedure.
- Light levels from the dredging vessel will be minimised to those lights that are necessary for the safe operation of the vessel.
- Operational lights will not be directed towards the sea unless required for the safe operation of the vessel.

The mitigation measures outlined above are industry standard and best practice, and have been shown during past dredging campaigns implemented by Pilbara Ports to be effective at minimising impacts to marine fauna.

The potential identified impacts detailed in Section 5.5 will be controlled by the implementation of both outcome-based and objective-based conditions that have been outlined in the DEMMP developed for the Proposal.

Pilbara Ports considers the potential impacts of the Proposal can be mitigated under the Commonwealth *Environment Protection (Sea Dumping) Act 1981*. As such, the DEMMP has been prepared with consideration of the DCCEEW requirements for monitoring and management plans to dredge and dispose material at sea, in the first instance. The EPA 'Instruction and template: How to prepare Part IV Environmental Management Plans', has been considered when setting management targets and environmental protection outcomes in the DEMMP.

Impacts to marine fauna associated with maintenance dredging during operation of the Zone 5 Bypass Channel will be managed and monitored in accordance with Pilbara Ports Port of Port Hedland long term monitoring and management plan for maintenance dredging. The existing long-term monitoring and management plan for maintenance dredging will be updated to include the Zone 5 Bypass Channel design and be issued to DCCEEW for approval prior to any maintenance dredging activities within this area.

5.5 Potential Environmental Impacts

5.5.1 Identified Environmental Impacts

The possible cause-effect pathways leading to potential impacts to the marine fauna identified in Section 5.3, and justification for their relevance to the Proposal assessment, have been summarised in Table 5-5.

Table 5-5. Identified potential impacts to marine fauna

Activity	Cause/Effect	Potential Impact	Impact Type	Relevance to Proposal Assessment
Capital dredging and spoil disposal	Operation of the dredge vessel may lead to increased underwater noise in the location of the operating vessel.	Disruption to marine fauna behaviour, migratory and foraging activities.	Direct	<p>Risk of impact considered low but cannot be appropriately managed using industry-standard controls and requires further assessment.</p> <p>Assessment of impact provided in Section 5.5.2.1</p>
	Operation of the TSHD drag head may lead to entrainment of marine fauna	Injury/mortality to marine fauna	Direct	<p>Impact considered to be appropriately managed using industry-standard controls.</p> <p>The dredgers drag head presents a risk of entrainment for species that forage or shelter on the seabed, such as marine turtles.</p> <p>A review of potential impacts to flatback turtles from dredging activities at Port Hedland associated with the Spoilbank Marina proposal (Pendoley 2019) concluded that the following mitigation measures would likely minimise the risk of dredge entrainment to marine turtles as much as possible to an acceptable level:</p> <ul style="list-style-type: none"> • avoidance of dredging during peak turtle nesting and hatchling emergence periods; • Presence of a MFO on the dredge vessel during transit and operational activities; and • Use of turtle disturbance devices (such as chains) on the dredge vessel.

Activity	Cause/Effect	Potential Impact	Impact Type	Relevance to Proposal Assessment
				<p>The above measures have been proposed for the current Proposal (Section 5.4) and have been included in the DEMMP (Appendix 9)</p> <p>Not likely to have a significant impact on marine fauna using industry-standard controls and proposed mitigation measures to minimise entrainment of marine turtles within the TSHD drag head. As such, the potential impact has not been assessed further.</p>
	Dredging within the proposed dredge footprint may lead to the direct removal of BCH	Direct loss of important habitat for marine fauna.	Direct	<p>Assessment of direct impact to BCH provided in Section 3.5.</p> <p>Dredging activities associated with the Proposal are not considered likely to impact areas of habitat considered critical to the survival of identified marine fauna populations, their occupancy within their habitat, or fragment the population into two or more populations. Furthermore, the proposed dredging would not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the identified species of significance relevant to the Proposal could decline.</p> <p>Not likely to have a significant impact on marine fauna after implementation of proposed mitigation measures within the DEMMP to avoid and minimise direct loss of BCH. As such, the potential impact has not been assessed further.</p>
	Uplift and disposal of sediments during dredging activities may lead to a temporary, localised, elevation of SSC resulting in reduced water quality	Stress effect and disruption to marine fauna foraging activities (including loss of foraging habitat through shading and/or smothering).	Indirect	<p>Assessment of impact to BCH and marine environmental quality provided in Section 3.5 and 4.5, respectively.</p> <p>Elevated SSC concentrations are likely to be localised and short in duration (refer to Section 4.5). The short duration of sediment uplift events in a naturally turbid environment are unlikely to significantly impact marine fauna in the Proposal area, which is an area of high vessel traffic that mobile marine fauna are likely to avoid.</p> <p>Not likely to have a significant impact on marine fauna after implementation of the mitigation measures proposed in the DEMMP to minimise turbidity generation and</p>

Activity	Cause/Effect	Potential Impact	Impact Type	Relevance to Proposal Assessment
				sediment loss from the dredger. As such, the potential impact has not been assessed further.
Dredge vessel operations	Transiting of dredge vessel may lead to a marine fauna collision	Injury/mortality to marine fauna	Direct	<p>Impact considered to be appropriately managed using industry-standard controls.</p> <p>Factors such as vessel speed and approach direction are relevant in considering the risk of vessel impact on marine fauna. Research has shown that the probability for vessels to collide with marine fauna is directly related to the speed at which the vessel travels, and can be limited by reducing operational speeds to <13 knots (Laist et al. 2001; Schoeman et al. 2020; Vanderlaan and Taggart 2007). The dredge vessel will be stationary during most of the works and slow moving over small distances when in transit.</p> <p>Not likely to have a significant impact on marine fauna after implementation of industry-standard controls and the mitigation measured proposed in the DEMMP to manage vessel speeds within port waters and to observe exclusion zones for marine fauna. As such, the potential impact has not been assessed further.</p>
	Artificial lighting on the dredge vessel operating at night may temporarily increase the light spill into the marine environment	Disruption to light sensitive marine fauna	Direct	<p>Impact considered to be appropriately managed using industry-standard controls.</p> <p>Artificial light from shipping is considered a temporary source in nearshore and offshore waters (Davies et al. 2014). The risk of artificial light from the dredge vessel impacting on light sensitive marine fauna relevant to the Proposal (marine turtles) was assessed in accordance with the National Light Pollution Guidelines for Wildlife (2020a). For adult turtles, lighting has to be relatively close to the nesting habitat for an impact to occur, whereas hatchling turtles are considered more sensitive to light, with impacts recorded at nesting habitat situated over 18 km away from a light source. The nearest recorded flatback turtle nesting location to the southernmost section of the proposed bypass channel design dredge area is on Cemetery Beach (Pendoley 2009; Pendoley 2019), ~8 km away.</p>

Activity	Cause/Effect	Potential Impact	Impact Type	Relevance to Proposal Assessment
				<p>Pendoley (2019) suggested inter-nesting flatback turtles are not considered to feed during the breeding season and are unlikely to move to well-lit areas, and their known foraging grounds are situated away from the bypass channel design area. As such, adult marine turtles are unlikely to be significantly impacted by the artificial light from the dredge vessel. Considering the large amount of existing artificial sky glow currently occurring in Port Hedland, and location of the operating dredge vessel relevant to Cemetery Beach, it is unlikely there would be any detectable impact from the dredge vessel on the Cemetery Beach night environment or hatchling turtles.</p> <p>Not likely to have a significant impact on marine fauna after implementation of industry-standard controls and the mitigation measured proposed in the DEMMP to minimise the light levels from the dredge vessel. As such, the potential impact has not been assessed further.</p>
	Presence of dredge vessel may lead to introduction of IMS	Loss of local biodiversity	Indirect	<p>Impact considered to be appropriately managed using industry-standard controls.</p> <p>Vessels must adhere to the Australian Biofouling Management Requirements (Commonwealth of Australia 2009b). Vessels entering Australian Territorial Waters must complete a Pre-Arrival Report (PAR) and Maritime Arrivals Reporting System (MARS) report (for international arrivals). All vessels must provide a Biofouling Management Plan (BMP) or cleaning report or implement a pre-approved alternative biofouling management method.</p> <p>Ballast carrying vessels must adhere to the Australian Ballast Water Management Requirements (Commonwealth of Australia 2020b) which include a Ballast Water Management Plan (BWMP) and a valid Ballast Water Management Certificate (BWMC). Chapter five of the <i>Biosecurity Act 2015</i> specifies the general requirements of compliance with ballast water management plans and certificates.</p>

Activity	Cause/Effect	Potential Impact	Impact Type	Relevance to Proposal Assessment
				Not likely to have a significant impact on marine fauna with implementation of industry-standard controls and mitigation measures proposed in the DEMMP. As such, the potential impact has not been assessed further.
	Operation of the dredge vessel may lead to a hydrocarbon spill /waste discharge resulting in reduced water quality	Stress effect to marine fauna	Indirect	Impact considered to be appropriately managed using industry-standard controls to manage hydrocarbon spills and waste on the dredge vessel (refer to Table 4-5). Not likely to have a significant impact on marine fauna after implementation of industry-standard controls and mitigation measures proposed in the DEMMP. As such, the potential impact has not been assessed further.

5.5.2 Predicted Environmental Impacts

Consistent with the EPA instructions ‘How to prepare an Environmental Review Document’ a table summary of the likely extent of potential significant impacts (direct, indirect, total and cumulative) has been provided in Table 5-6. Detailed assessment information has been provided in the following sections.

Table 5-6. Predicted extent of impacts to marine fauna

Environmental value in Regional and local extent	Extent			Cumulative effects of other Proposals	Level of Certainty
	Direct Impact	Indirect Impact	Total Impact		
Humpback whale	<p>Onset of temporary hearing damage and/or impairment up to 10 m from dredge vessel (worst case 0.31ha radial area).</p> <p>Onset of behavioural response up to 5,300 m from the dredge vessel (worst case 8,825 ha radial area).</p> <p>Figure 5-3</p>	Not applicable	8,825 ha radial area for a behavioural response	<p>While the Proposal will result in temporary disturbance to marine fauna behaviour up to ~5km from the dredge vessel, no cumulative impacts are predicted as there are no past, present or future Proposals contributing to cumulative changes in this value.</p>	<p>Medium – specific underwater noise modelling has not been completed for the Proposal. Recent underwater noise modelling was completed for the Spoilbank Marina proposal (Talis 2020). That study predicted the distances sound levels would attenuate to below threshold criteria for relevant marine fauna within the Port Hedland area. Distance estimates from that study are considered to be suitable for the current Proposal.</p> <p>Note that the Proposal sits in an area with a long history of high traffic of large vessels to which local fauna will have been exposed.</p>
Marine turtles (flatback, green, hawksbill and loggerhead)	<p>Onset of behavioural response up to 10 m from the dredge vessel (worst case 0.31 ha radial area).</p> <p>Figure 5-3</p>	Not applicable	0.31 ha radial area for a behavioural response		

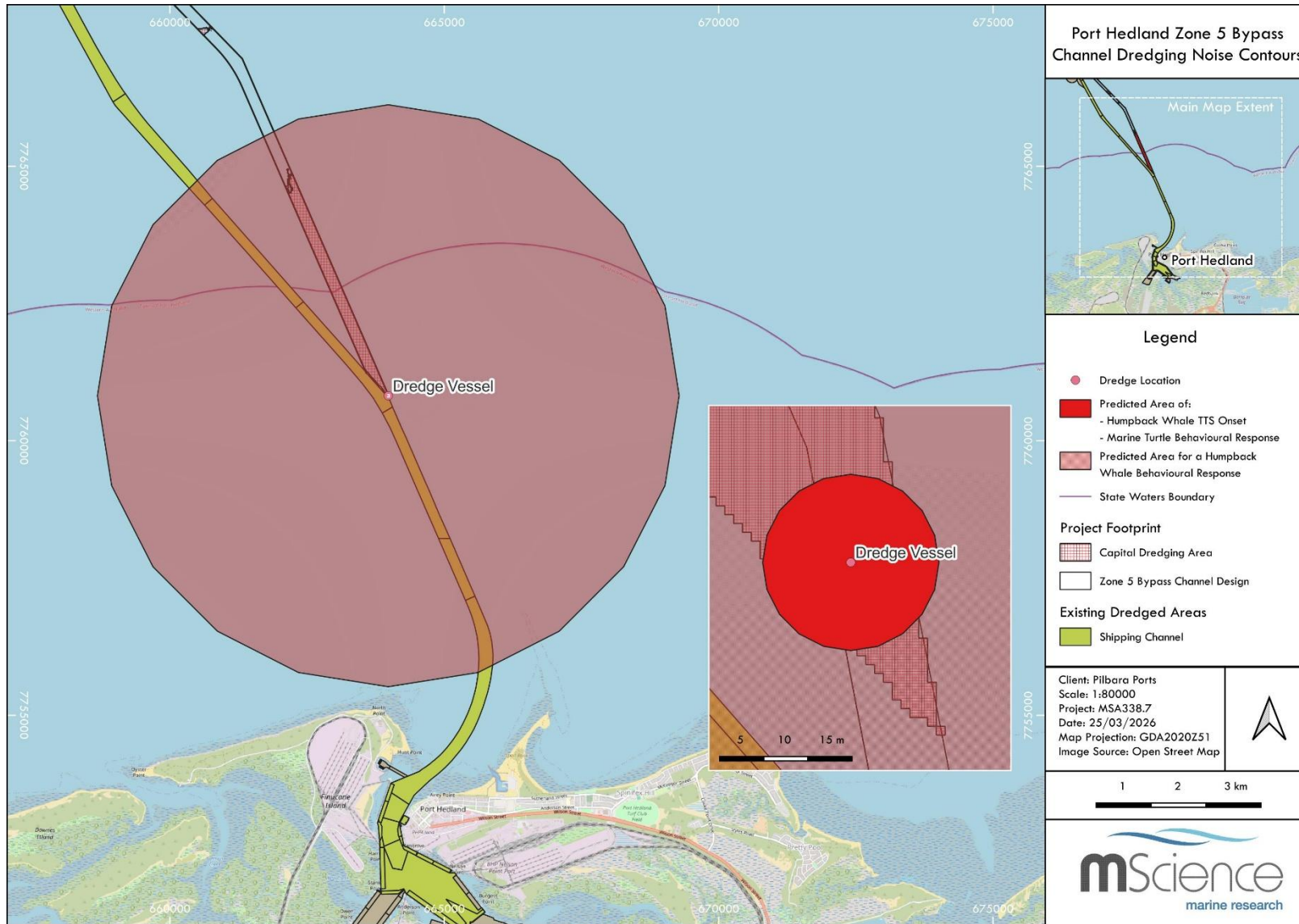


Figure 5-3. Predicted underwater noise contours for TTS and behavioural response in relevant marine fauna

5.5.2.1 UNDERWATER NOISE

Pilbara Ports notes that cetaceans (most likely humpback whales) and marine turtles (flatback, green, hawksbill and loggerhead) may transit the development envelope during dredging activities but are likely to occur in small numbers.

Underwater sound levels from dredging activities (for a TSHD and CSD) are known to be similar to levels reported for underwater sound associated with commercial shipping, being between 160 to 185 dB re 1µPa at 1 m from the dredge vessel (CEDA 2011; McQueen *et al.* 2019; OSPAR 2009; Reine *et al.* 2014). The National Marine Fisheries Service Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS 2024) outlines the criteria for effect of continuous (non-impulsive) noise exposure criteria for marine mammals (Table 5-7). The guidance provides the frequency-weighted accumulated sound exposure levels (SEL_{24h}) for the onset of permanent or temporary hearing damage/and or impairment, termed permanent threshold shift (PTS) and temporary threshold shift (TTS), respectively. The threshold for a marine mammal behaviour response (displacement, avoidance, communication interference) is 120 dB re 1 µPa. Relevant to this assessment, the humpback whale is part of the low frequency (LF) cetacean group. Thresholds for the high frequency (HF) Cetacean group (dolphin species) and Sirenian (SI) group (relevant to dugongs) have been included here for completeness.

Table 5-7. Criteria for effect of non-impulsive noise exposure for marine mammals

Marine Mammal Group	Dredge Vessel Source Level	Behaviour	PTS onset thresholds	TTS onset thresholds
	SPL	SPL	Weighted SEL _{24h}	Weighted SEL _{24h}
Cetacean - Low Frequency (LF)	160 to 185	120	197	177
Cetacean – High Frequency (HF)			201	181
Sirenian (SI)			200	180

Sound Pressure Level (SPL) thresholds are in dB re 1 µPa

Sound Exposure Level (SEL) thresholds are in dB re 1 µPa²s. SEL_{24h} denotes cumulative sound exposure over a 24 h period.

The threshold criteria outlined in Table 5-7 indicate permanent injury from a dredging noise source as being unlikely to any marine mammal group i.e. PTS onset thresholds are not exceeded by dredging sound source level. An underwater noise modelling study was completed for offshore dredging associated with the Spoilbank Marina Proposal in Port Hedland (Talis 2020). The study was based on a dredging sound source of 182 dB re 1µPa and it showed the underwater noise produced by dredging attenuated below the TTS onset thresholds for each marine mammal group within ~10 meters of the sound source. Noting that an animal could only be exposed to the sound level associated with impairment if it remained in that location for 24 hours. The onset of a behavioural response was estimated to occur up to 5,300 m from the dredge vessel for the LF cetacean group (humpback whale) and 800 m for the HF cetacean group (dolphin species). This equates to a worst-case radial area of impact to humpback whales of 8,825 (Figure 5-3).

Popper et al. (2014) suggested thresholds for onset of mortal injury (including PTS), recoverable injury and TTS for marine turtles for non-impulsive noise exposure (Table 5-8). Finneran et al. (2017) in turn presented revised thresholds for marine turtle injury and hearing impairment (TTS and PTS) (Table 5-9). The rationale being that marine turtles have best sensitivity at low frequencies and are known to have poor auditory sensitivity. Accordingly, TTS and PTS thresholds for turtles are likely more similar to those of fishes than to marine mammals (Popper et al. 2014).

McCauley et al. (2000) observed the behavioural response of caged marine turtles—green and loggerhead—to an approaching seismic airgun (impulsive noise source). For received levels above 166 dB re 1 µPa (SPL), the marine turtles increased their swimming activity, and above 175 dB re 1 µPa they began to behave erratically, which was interpreted as an agitated state. The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017b) acknowledges the 166 dB re 1 µPa SPL reported by McCauley et al. (2000) as the level that may result in a behavioural response to marine turtles. The 175 dB re 1 µPa level from McCauley et al. (2000) is recommended as a criterion for behavioural disturbance (Table 5-9).

Table 5-8. Criteria for non-impulsive noise exposure for marine turtles, adapted from Popper et al. (2014)

Marine Fauna Type	Mortality and Potential mortal injury	Impairment			Behaviour
		Recoverable Injury	TTS	Masking	
Sea Turtle	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low

Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N) – tens of metres, intermediate (I) – hundreds of metres, and far (F) – thousands of metres.

Table 5-9. Suggested sound level thresholds related to various acoustic effects of non-impulsive sound on marine turtles, adapted from Finneran et al. (2017)

Effect type	SPL	Weighted SEL _{24h}
Behavioural response	166	n/a
Behavioural disturbance	175	
PTS onset	n/a	220
TTS onset		200

Sound Pressure Level (SPL) thresholds are in dB re 1 µPa

Weighted SEL_{24h} denotes cumulative sound exposure over a 24 h period in dB re 1 µPa²s

Marine turtles have been observed rapidly acclimating to regular, continuous underwater noise sources such as those generated by dredging, with the response dependent on the distance from the sound source (Whitlock et al. 2017). The thresholds for marine turtle injury (TTS – 200 dB re 1 µPa²s) and hearing impairment (PTS – 220 dB re 1 µPa²s) presented by Finneran et al. (2017) are above the maximum sound levels generated by dredge vessels cited in the literature (160 to 185 dB re 1µPa at 1 m

from the dredge vessel) (CEDA 2011; McQueen *et al.* 2019; OSPAR 2009; Reine *et al.* 2014) and are unlikely to be exceeded. The Spoilbank Marina underwater noise modelling study showed that at a hearing bandwidth of 100 to 800 Hz, the received noise levels for marine turtles exceeded the threshold level for onset of a behavioural response only at the location of the dredge vessel. This assessment has assumed a behavioural response may occur up to 10 m from the dredge vessel, or within a radial area of 0.31 ha, as a worst case scenario (Figure 5-3).

5.6 Assessment of Significance of Residual Impacts

5.6.1 Proposal

It is considered that impacts to LF cetaceans (humpback whales) from continuous noise generated during dredging activities will be a temporary behavioural response up to ~ 5 km from the dredge vessel, and may cause onset of temporary hearing damage and/or impairment up to 10 m from the operating vessel. There is unlikely to be any impact to marine turtles from continuous noise generated during dredging activities. As a worst-case scenario, Pilbara Ports has considered a behavioural response may occur up to 10 m from the dredge vessel.

Noting the limited area of impact to BCH (approximately 6.8 ha), temporary period for dredging (five weeks) and current levels of disturbance in the Port waters, as well as the proposed management measures in the DEMMP, including avoiding undertaking dredging activities during key nesting periods and employing marine fauna observers, the potential impacts can be managed to acceptable levels. The Proposal is therefore unlikely to result in permanent or irreversible impacts to conservation significant marine fauna at a species or population level, and is unlikely to cause a population decline, impact critical ecological functions and breeding cycles, or remove habitat critical to the survival of marine fauna. Therefore, there is no pathway for a significant impact from dredging activities to marine fauna populations at Port Hedland.

In light of the above, it was determined that there is no significant residual impact to marine fauna predicted to occur from the Proposal, and so consideration of offsets for this environmental factor is not required.

5.6.2 Cumulative Impacts

The Port of Port Hedland is an active operational port area and, as such, is subject to existing levels of underwater noise from daily shipping activities. A single dredge vessel is proposed to be operating at one time under each of the dredging methodologies being considered for the Proposal. The most likely scenario will utilise only a TSHD, the same TSHD that will already be implementing maintenance dredging in the area under a DCCEEW approved sea dumping permit (SD2022/4041). As such, the proposed dredging activity is not likely to significantly increase underwater noise levels above the existing levels generated by daily shipping activities.

Three significant marine Proposals have been referred or are currently operating under Part IV of the EP Act within the Port of Port Hedland that are located outside of the inner harbour area. Each one identified marine fauna as a key environmental factor.

The Fibre Optic Submarine Cable between Port Hedland and Darwin Proposal received a 'not assessed' decision. The EPA noted that the proposal may impact on marine fauna during horizontal directional

drilling works but considered impacts could be mitigated by only drilling in March. Construction of the proposal was completed in 2023. No known impacts to marine fauna have been reported from the proposal.

The Port Hedland Spoilbank Marina Proposal also received a 'not assessed' decision. The EPA noted that the proposal may impact the flatback turtle population at Cemetery Beach during construction dredging activities and through artificial light spill during operations. The EPA considered the impacts could be mitigated through implementation of appropriated management plans for dredging and light spill. Construction of the proposal was completed in 2024. Operational monitoring is ongoing. No known impacts to marine fauna have been reported from the Proposal.

The BHP Port Hedland Outer Harbour Development was approved in 2012 under MS 890 and has not substantially commenced since its approval. As such, authorisation to implement the proposal has lapsed due to becoming void five years after the date of approval.

Based on the above, no cumulative impacts to marine fauna are predicted as there are no past, present or future Proposals contributing to cumulative changes in this value.

5.7 Environmental Outcome

Pilbara Ports considers that the EPA objective for marine fauna will be met based on the assessment of the significance of residual impacts and application of avoidance and minimisation mitigation measures, including the monitoring and management actions described in the DEMMP.

The DEMMP includes project specific management targets (MTs) to mitigate the potential impacts on marine fauna and subsequently ensure that the EPA's objective for this environmental value is met, and the predicted environmental protection outcomes (EPOs) are achieved.

In accordance with the EPA document 'Interim Guidance - Environmental outcomes and outcomes-based conditions', Pilbara Ports has proposed the following environmental outcomes for marine fauna:

- No collision with marine mammals during dredging activities associated with the Proposal.
- No entrainment of marine turtles during dredging activities associated with the Proposal.
- No introduction of marine pests as a result of the Proposal.
- No impact to important habitats (nesting, nursery, foraging or breeding areas) outside of the ZoHI.
- No reported hydrocarbon spills or waste discharge into the marine environment from the Proposal.

Pilbara Ports considers the proposed environmental outcomes can be assured through the conditions prescribed by a sea dumping permit issued under the Commonwealth *Environment Protection (Sea Dumping) Act 1981*.

6 OFFSETS

Offset is the last of the four steps in the mitigation hierarchy (Avoid, Minimise, Rehabilitate and Offset). Offsets are only applied to counterbalance residual significant impacts when the other steps have already been applied to a Proposal.

6.1 Summary of Significant Residual Impacts

No significant residual impacts were identified during assessment of any the relevant key environmental factors, after implementation of industry standard controls and proposed mitigation measures.

6.2 Proposed Offsets

No offsets are proposed for this Proposal

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8 APPENDIX 1 – LEGISLATIVE CONTEXT

8.1 Environmental Impact Assessment Process

8.1.1 Western Australian Environmental Protection Act 1986

In Western Australian (WA) State waters, marine dredging proposals are regulated by the Environmental Protection Authority (EPA) services branch of the Department of Water and Environmental Regulation (DWER) under the *Environmental Protection Act 1986* (EP Act). Part IV of the EPA Act makes provisions for EPA services to undertake environmental impact assessment (EIA) of significant and strategic proposals. The Proposal has been considered a significant proposal.

The Proposal will be referred to the EPA under Part IV of this Act. As the Proposal has no specific emissions and does not represent a prescribed premise it will not require approval under Part V of this act.

Pilbara Ports notified EPA services of its intention to refer the Proposal during a pre-referral meeting held on 08 December 2025.

8.1.2 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) an action requires approval from the Commonwealth Environment Minister if it will have, or is likely, to have a significant impact on a matter of national environmental significance. With relevance to the Proposal, Matters of National Environment Significance (MNES) include interactions with:

- Listed threatened species and communities; and
- Migratory species protected under international agreements.

Based on a documented process, Pilbara Ports evaluation is that this Proposal is not likely to have a significant impact on a MNES.

8.1.3 Commonwealth Environment Protection (Sea Dumping) Act 1981

In Australian waters, uplift and ocean disposal of dredged material is regulated by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the *Environment Protection (Sea Dumping) Act 1981* (the Sea Dumping Act) by applying the National Assessment Guidelines for Dredging (the NAGD) (Commonwealth of Australia 2009a). The NAGD (2009a) contains provision for the granting of sea dumping permits (SDPs) for dredging on the following basis:

- An assessment of the applicant's capacity to meet their obligations under the Sea Dumping Act and any permit granted;
- Establishment of a Technical Advisory and Consultative Committee (TACC) for long-term management; and
- Development and implementation of a satisfactory dredge environmental management plan (DEMMP) for the loading and disposal activities and provide a sediment sampling and analysis plan (SAP) to support the application.

Pilbara Ports notified DCCEEW of its intention to submit a SDP application during a meeting held on 09 December 2025. A SDP application will be submitted for the Proposal in parallel with this referral.

8.2 Other Approvals and Regulation

The Proposal is located entirely within the Port of Port Hedland boundaries, managed by Pilbara Ports. Implementation of the Proposal is subject to other approvals in addition to Part IV of the EP Act. Table 8-1 identifies the other approvals, legislation and associated decision-making authorities (DMA) that will apply to the Proposal.

Table 8-1. Other decision-making authority approvals

Decision-making authority	Legislation or Agreement regulating the activity	Proposal element	Approval required/amended
DCCEEW	<i>Environment Protection (Sea Dumping) Act 1981</i>	Uplift and disposal of dredge spoil within Australian waters.	Sea Dumping Permit
Department of Agriculture, Fisheries and Forestry (DAFF)	<i>Biosecurity Act 2015</i>	Operation of the dredge vessel within Australian waters	No approval required under the Biosecurity Act for the dredge vessel to operate, but mandatory compliance with biosecurity processes apply to a vessel arriving from overseas. Including pre-arrival reporting, biosecurity clearance and control orders if a risk of introducing invasive marine species is identified.
Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts (DITRDCA)	<i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i>	Operation of the dredge vessel within Australian waters	No approval required under the Protection of the Sea Act for the dredge vessel to operate, but mandatory compliance under the legislation to meet pollution prevention obligations under MARPOL. Including relevant certificates, plans and records.
Minister for Ports	<i>Port Authorities Act 1999</i>	Operation of the dredge vessel within port waters	Approval required from the port Harbour Master to conduct dredging activities within the ports management area.
Department of Transport and Major Infrastructure	<i>Western Australian Marine Act 1982</i>	Operation of the dredge vessel within Western Australian waters	Vessel Certificate of Survey

Table 8-2 outlines how Pilbara Ports considers a SDP issued under the *Environment Protection (Sea Dumping) Act 1981* can mitigate the potential impacts of the Proposal on the marine environment.

Table 8-2. Other statutory decision-making processes which can mitigate potential impacts on the environment

Environmental impact	How is the impact regulated by other decision-making process(es)?	Limit(s) of the decision-making process(es) to regulate the impact e.g. time limits, excluded operations	Likely environmental outcome of decision-making process(es), and consistency with EPA objective	Conditions, enforcement, and review process required by decision-making process(es)	Stakeholder engagement in decision-making process(es)
Marine Environmental Quality					
Increased light attenuation through the water column and sedimentation on the seabed.	<p>Environment Protection (Sea Dumping) Act 1981</p> <p>Application for a Sea Dumping Permit – Section 7.1 of the application requires an assessment of potential water quality issues including:</p> <ul style="list-style-type: none"> turbidity levels and dispersal of disposed material through the water column at the loading and disposal site, and surrounding areas. changes in the concentration of nutrients, oxygen 	No relevant limitations	<p>The sea dumping permit has the ability to apply conditions to avoid and minimise impacts to marine environmental quality, ensuring the quality of water, sediment and biota are maintained so that environmental values are protected.</p> <p>Conditions include implementation of the dredging environmental management plan (DEMMP) developed for the Proposal which includes auditable management targets and environmental</p>	<p>Pilbara Ports will be required to comply with conditions outlined in the sea dumping permit. Conditions will include implementation of an approved DEMMP that outlines the audit and review process for the document.</p>	<p>Proponents are required to consult with stakeholders prior to submission of a sea dumping permit application.</p> <p>Formal, written consultation includes providing stakeholders with all the details of the application such as the alternatives investigated, the proposed location and timing, any contamination issues, predicted impacts, mitigation measures, and proposals for</p>
Release of toxicants into the water column	<p>Environment Protection (Sea Dumping) Act 1981</p> <p>Application for a Sea Dumping Permit – Section 7.1 of the application requires an assessment of potential water quality issues including:</p> <ul style="list-style-type: none"> turbidity levels and dispersal of disposed material through the water column at the loading and disposal site, and surrounding areas. changes in the concentration of nutrients, oxygen 	No relevant limitations	<p>The sea dumping permit has the ability to apply conditions to avoid and minimise impacts to marine environmental quality, ensuring the quality of water, sediment and biota are maintained so that environmental values are protected.</p> <p>Conditions include implementation of the dredging environmental management plan (DEMMP) developed for the Proposal which includes auditable management targets and environmental</p>	<p>Pilbara Ports will be required to comply with conditions outlined in the sea dumping permit. Conditions will include implementation of an approved DEMMP that outlines the audit and review process for the document.</p>	<p>Proponents are required to consult with stakeholders prior to submission of a sea dumping permit application.</p> <p>Formal, written consultation includes providing stakeholders with all the details of the application such as the alternatives investigated, the proposed location and timing, any contamination issues, predicted impacts, mitigation measures, and proposals for</p>

Environmental impact	How is the impact regulated by other decision-making process(es)?	Limit(s) of the decision-making process(es) to regulate the impact e.g. time limits, excluded operations	Likely environmental outcome of decision-making process(es), and consistency with EPA objective	Conditions, enforcement, and review process required by decision-making process(es)	Stakeholder engagement in decision-making process(es)
	<p>depletion, and any increased bioaccumulation of contaminants.</p> <p>Section 7.4 of the application requires a description of the proposed monitoring program for the dredging activities.</p>		<p>protection outcomes for marine environmental quality.</p> <p>Implementation of the DEMMP is considered suitable to mitigate impacts to marine environmental quality.</p>		<p>ongoing management and monitoring.</p> <p>The application documents the consultation undertaken, the stakeholders engaged, any issues raised and how they were addressed.</p> <p>Pilbara Ports undertake consultation for ongoing maintenance dredging and new capital dredging in the Port of Port Hedland, through a Technical Advisory and Consultative Committee that meets a minimum of twice per year.</p>

Environmental impact	How is the impact regulated by other decision-making process(es)?	Limit(s) of the decision-making process(es) to regulate the impact e.g. time limits, excluded operations	Likely environmental outcome of decision-making process(es), and consistency with EPA objective	Conditions, enforcement, and review process required by decision-making process(es)	Stakeholder engagement in decision-making process(es)
Benthic Communities and Habitats					
Direct loss of BCH	<p>Environment Protection (Sea Dumping) Act 1981</p> <p>Application for a Sea Dumping Permit – Section 7.1 of the application requires an assessment of the predicted zone of influence and zones of impact including a discussion on any physical impacts including, but not limited to, the:</p> <ul style="list-style-type: none"> • smothering of biota (using appropriate species thresholds) • direct removal of biota • change in substrate • reduced light attenuation for benthic habitats 	No relevant limitations	<p>The sea dumping permit has the ability to apply conditions to avoid and minimise impacts to benthic communities and habitats, ensuring benthic communities and habitats are protected so that biological diversity and ecological integrity are maintained.</p> <p>Conditions include implementation of the DEMMP developed for the Proposal which includes auditable management targets and environmental protection outcomes for benthic communities and habitats.</p> <p>Implementation of the DEMMP is considered suitable to mitigate</p>	As above – Compliance with SDP conditions including implementation, audit and review of the DEMMP	As above.
Shading and/or smothering, and potential loss, of BCH					

Environmental impact	How is the impact regulated by other decision-making process(es)?	Limit(s) of the decision-making process(es) to regulate the impact e.g. time limits, excluded operations	Likely environmental outcome of decision-making process(es), and consistency with EPA objective	Conditions, enforcement, and review process required by decision-making process(es)	Stakeholder engagement in decision-making process(es)
	<p>present (seagrasses, corals, sponges, etc)</p> <p>Section 7.4 of the application requires a description of the proposed monitoring program for the dredging activities.</p>		<p>impacts to benthic communities and habitats.</p>		
Marine Fauna					
<p>Direct impacts to significant marine fauna (vessel interaction, noise, light etc.).</p>	<p>Environment Protection (Sea Dumping) Act 1981</p> <p>Application for a Sea Dumping Permit –</p> <p>Section 7.1 of the application requires an assessment of potential biological and physical impacts on marine life, including possible translocation of introduced marine species (pest species), increased predation and loss of available habitats</p>	<p>No relevant limitations</p>	<p>The sea dumping permit has the ability to apply conditions to avoid and minimise impacts to marine fauna, ensuring marine fauna are protected so that biological diversity and ecological integrity are maintained.</p> <p>Conditions include implementation of the DEMMP developed for the Proposal which includes auditable management targets and</p>	<p>As above – Compliance with SDP conditions including implementation, audit and review of the DEMMP</p>	<p>As above.</p>
<p>Indirect impacts to significant marine fauna (IMS translocation, reduced water quality etc.)</p>					

Environmental impact	How is the impact regulated by other decision-making process(es)?	Limit(s) of the decision-making process(es) to regulate the impact e.g. time limits, excluded operations	Likely environmental outcome of decision-making process(es), and consistency with EPA objective	Conditions, enforcement, and review process required by decision-making process(es)	Stakeholder engagement in decision-making process(es)
	<p>Section 7.2 of the application requires and assessment of the proposed dredging on any Matter of National Environmental Significance.</p> <p>Section 7.4 of the application requires a description of the proposed monitoring program for the dredging activities.</p>		<p>environmental protection outcomes for marine fauna.</p> <p>Implementation of the DEMMP is considered suitable to mitigate impacts to marine fauna.</p>		

8.3 Object and Principals of the EP Act

Table 8-3 provides a summary of how the EP Act Principles have been considered in relation to the Proposal.

Table 8-3. EP Act Principles

Principle	Consideration
<p>1. The precautionary principle</p> <p>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by:</p> <ul style="list-style-type: none"> a. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and b. an assessment of the risk-weighted consequences of various options. 	<p>Various design options were considered for the Proposal during channel blockage mitigation studies. The final Proposal design has taken into consideration relevant environmental factors, local community and stakeholder consultation to minimise impacts to as low as reasonably practicable.</p> <p>Investigations to determine the baseline state of the environment within the Proposal’s development envelop have been undertaken to assist in the evaluation of potential environmental impacts.</p>
<p>2. The principle of intergenerational equity</p> <p>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</p>	<p>The Port of Port Hedland is one of Western Australia’s most important infrastructure assets and continues to make significant and growing contributions to the Australian economy. The Zone 5 Bypass Channel will enable ongoing shipping operations (at a reduced capacity) in the event of a channel blockage in Zone 5.</p> <p>The Proposal is contemporary best-practice port design that has been developed in consultation with relevant stakeholders.</p> <p>The Proposal meets the principle of intergenerational equity by ensuring the health of the environmental values, maintaining ecological functions for future generations, whilst minimising any impacts on the environment.</p> <p>The Proposal is unlikely to result in any significant environmental impacts that would pose a threat to the health, diversity and productivity of the environment.</p>

Principle	Consideration
<p>3. Principles relating to improved valuation, pricing and incentive mechanisms</p> <p>(1) Environmental factors should be included in the valuation of assets and services.</p> <p>(2) The polluter pays principles –those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</p> <p>(3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.</p> <p>(4) Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.</p>	<p>Pilbara Ports will be responsible for implementing and funding the cost of environmental avoidance, mitigation and management measures. Avoidance and minimising impacts to environmental factors was critical to the proposed design and location as outlined in this referral.</p> <p>The Proposal is not expected to generate any significant pollution or waste.</p> <p>Where possible, the Project will:</p> <ul style="list-style-type: none"> • Employ appropriately trained local personnel and source local goods and services • Ensure leading best practice standards during dredging to minimise emissions and discharges as far as reasonably possible <p>Source goods and services that have the least environmental impact.</p>
<p>4. The principle of the conservation of biological diversity and ecological integrity</p> <p>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</p>	<p>Throughout the design phase of the Proposal, the conservation of biological diversity and ecological integrity has consistently been a fundamental consideration including:</p> <ul style="list-style-type: none"> • Examination of bathymetry to both the east and west of the main navigation channel to minimise dredging requirements. • Avoidance of significant shoal features identified in the bathymetry to conserve benthic communities. • Selection of a dredge methodology to minimise impacts to water quality.
<p>5. The principle of waste minimisation</p>	<p>Waste generated from the Project will be minimised through the implementation of the hierarchy of waste controls: reduce, re-use, recycle, recover and dispose.</p>

Principle	Consideration
All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	A comparative assessment of the risks of various alternate options to sea disposal of dredged material to project cost, human health and the environment has been undertaken.
6. Description of how the Object of the EP Act has been considered	Consideration of the environmental Principals in the manner described above will protect the environment of the State of Western Australia.

9 APPENDIX 2 – OTHER ENVIRONMENTAL FACTORS OR MATTERS

The EPA lists a number of environmental factors that need to be considered in the EIA process (EPA 2021a). Justification for why the remaining environmental factor for Sea and the environmental factors for Land, Water, Air and People were not considered to be ‘key’ or ‘other’ environmental factors has been provided in Table 9-1.

Table 9-1. Other environmental factors or matters

Environmental Factor	Justification
SEA	
Coastal Processes <i>To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.</i>	<p>Capital dredging activities can directly alter the morphology of the coastal zone resulting in changes to sediment sources or sinks. The Proposal development envelope is located offshore and only a small area (63 ha) within State waters will be dredged to the same depth of the surrounding environment. Disposal of dredged material is proposed to occur at an approved spoil ground within Commonwealth waters. As such, interruption of longshore sediment transport and changes in erosion/deposition patterns are unlikely.</p> <p>Similarly, removal of natural communities and habitats may lead to increased erosion. Assessment of the Proposal identified there would be no significant impacts to benthic communities and habitats. Just 1.1 ha of habitat (unconsolidated sand and low relief hard consolidated substrate with or without a sand veneer) supporting invertebrate communities (sponges, soft corals, gorgonians and other mixed filter feeders) will be removed within State waters for the Proposal. As such, an increase in erosion within coastal waters is unlikely.</p> <p>No impacts to coastal processes are anticipated.</p>
LAND	
Flora and Vegetation <i>To protect flora and vegetation so that biological diversity and ecological integrity are maintained.</i>	<p>The Proposal development envelope is located offshore.</p> <p>No impacts to flora and vegetation are anticipated.</p>
Landforms <i>To maintain the variety and integrity of distinctive physical landforms so that environmental values are protected.</i>	<p>The Proposal development envelope is located offshore.</p> <p>No impacts to landforms are anticipated.</p>
Subterranean Fauna <i>To protect subterranean fauna so that biological diversity and ecological integrity are maintained.</i>	<p>The Proposal development envelope is located offshore.</p> <p>No impacts to subterranean fauna are anticipated.</p>
Terrestrial Environmental Quality	The Proposal development envelope is located offshore.

Environmental Factor	Justification
<i>To maintain the quality of land and soils so that environmental values are protected.</i>	No impacts to terrestrial environmental quality are anticipated.
Terrestrial Fauna <i>To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.</i>	The Proposal development envelope is located offshore. No impacts to terrestrial are anticipated.
WATER	
Inland Waters <i>To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.</i>	The Proposal development envelope is located offshore. No impacts to groundwater or surface water are anticipated.
AIR	
Air Quality <i>To maintain air quality and minimise emissions so that environmental values are protected.</i>	No significant impacts to Air Quality are anticipated.
Greenhouse gas emissions <i>To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change</i>	The Port is required to report greenhouse gas (GHG) emissions and energy production and consumption in accordance with the <i>National Greenhouse and Energy Reporting Act 2007</i> . If the Port meets or exceeds the facility threshold it must be reported. The Proposal will contribute to GHG from the use of petrol- and/or diesel-powered dredging plant. However, Scope 1 GHG emissions from the dredge vessel are anticipated to be far less than the EPA threshold of 100,000 tCO ₂ -e. No significant impacts from GHG emissions are anticipated.
PEOPLE	
Social Surroundings <i>To protect social surroundings from significant harm.</i>	Dredging activities will take place entirely within the port boundaries of the Port of Port Hedland approximately 7 to 15 km offshore from the town of Port Hedland. Port Hedland is the traditional grounds of the Kariyarra tribe. The Kariyarra people live around the town of Port Hedland area in the northwest of Western Australia - from Port Hedland west to the Sherlock River and south to the Yule River. The Kariyarra country is bound by Ngarla country to the north, Nyamal to the east and Ngarluma to the southwest. The Proposal is located within the Port of Port Hedland boundaries, managed by Pilbara Ports. The waters of the Port Hedland are used extensively for general boating, fishing, swimming and other recreation pursuits by the people of Port Hedland, and other areas of the Pilbara.

Environmental Factor	Justification
	<p>Recreational fishing is popular in the Port Hedland area; recreational fishers target subtidal reefs and rocky shoals offshore such as Cornelisse and Coxon Shoals and Minilya Bank. There would be minimal effects on recreational fishers as the areas targeted for dredging and spoil disposal are largely within those experiencing heavy vessel traffic, and large vessels have priority and 'right of way' within the proposed dredging area.</p> <p>Pilbara Ports (2025) completed a desktop assessment of the potential for cultural heritage to be encountered during activities undertaken for the proposed Zone 5 Bypass Channel (Appendix 9). The assessment was conducted in accordance with Section 4.2 of Pilbara Ports Cultural Heritage Management Plan (CHMP), which details the management process Pilbara Ports undertake when a proposed activity has been identified as having the potential to impact cultural heritage.</p> <p>An interrogation of the Aboriginal Heritage Inquiry System identified that there are no Registered Aboriginal Sites known to occur within the Proposal development envelope.</p> <p>Interrogation of the Western Australian Museum Shipwreck database, and DCCEEW Australasian Underwater Cultural Heritage database identified that there are no presently known shipwrecks or other underwater cultural heritage within the vicinity of the Proposal. The closest documented and confirmed offshore shipwreck, the <i>Min Pin Liu</i>, is located approximately 16 km north-west of the northern most extent of the Channel design footprint.</p> <p>No impacts to social surroundings are anticipated.</p>
<p>Human Health</p> <p><i>To protect human health from significant harm.</i></p>	<p>Factor is only relevant to impacts associated with radiation.</p>

10 APPENDIX 3 – STAKEHOLDER CONSULTATION RECORD

11 APPENDIX 4- BENTHIC HABITAT ASSESSMENT

12 APPENDIX 5 – MODELLING OF HYDRODYNAMICS, WAVES AND DREDGING SPILL

13 APPENDIX 6 – SAMPLING AND ANALYSIS PLAN

14 APPENDIX 7 – SAMPLING AND ANALYSIS PLAN IMPLEMENTATION REPORT

15 APPENDIX 8 – MARINE FAUNA DESKTOP REVIEW

16 APPENDIX 9 – CULTURAL HERITAGE DESKTOP ASSESSMENT

17 APPEDNDIX 10 – DREDGING ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN