Chevron

Volume 4

Technical Appendices O6, QFA, S1 and S2

Final Environmental Impact Statement/Response to Submissions on the Environmental Review and Management Programme for the Proposed Wheatstone Project

February 2011

Wheatstone Project

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Volume 4: Technical Appendices O6, QFA, S1 and S2

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Draft Marine Fauna Management Plan

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Acronyms and Abbreviations

ABU	Australasia Business Unit
BEMP	Blasting Environment Management Plan
BPPH	Benthic Primary Producer Habitat
CEMP	Coastal Environmental Management Plan
Chevron	Chevron Australia Pty Ltd
CPMP	Coastal Process Management Plan
Cth	Commonwealth
DEC	Department of Environment and Conservation (State)
DEMP	Decommissioning Environmental Management Plan
DEWHA	Department for the Environment, Water, Heritage and the Arts (Cth)
DMP	Department of Mines and Petroleum (WA)
DSDMP	Dredge and Spoil Disposal Management Plan
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (Cth) - formerly DEWHA
EIS/ERMP	Environmental Impact Statement/Environmental Review and Management Programme
EMP	Environment Management Plan
EPA	Environmental Protection Authority (state)
EP Act (WA)	Environmental Protection Act 1986
EPBC Act (Cth)	Environmental Protection and Biodiversity Conservation Act 1999
HES	Health, Environment and Safety
Km	kilometer
LNG	Liquefied Natural Gas
M	meter
MFMP	Marine Fauna Management Plan
NES	National Environmental Significance
OBC	Outcome Based Condition
OE	Operational Excellence
OEMP	Operations Environmental Management Plan
OEMS	Operational Excellence Management System
OPGGSA	Offshore Petroleum and Greenhouse Gas Storage Act 2006
PIO	Pilbara Offshore bioregion
PIN	Pilbara Inshore bioregion
PLF	Product Loading Facility
SIA	Strategic Industrial Area
SME	Subject Matter Experts
WA	Western Australia

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NOTE:
This section summarises the commitments made within this plan in relation to the marine fauna species identified as key receptors in the Wheatstone Project EIS / ERMP. It will be completed on finalisation of Ministerial Conditions, objectives and management measures.

Amendments to Marine Fauna Management Plan

Section	Change
Commitment Register	**Text added:** Updated to show all commitments
Section 1.0	**Text added:** Refer to Section 8.4.5.8 of the Wheatstone Draft EIS/ERMP for a preliminary literature review regarding potential impact zones to marine fauna and the previous approaches that have been applied.
Section 2.0	**Text added:** Further to the management strategies, a set of Draft Environmental Awareness Guidelines for Boaters and Fishers are provided in Appendix B and issued to every person employed directly or indirectly on the Wheatstone Project and who visits or is resident in Onslow. They will be used to guide the workforce regarding responsible environmental conduct during marine-based recreational activities. The guidelines will not be enforced, but the workforce will receive relevant educational training and be encouraged to comply. The guidelines may be presented separately to, or as part of, the Recreational Code of Conduct. The Recreational Code of Conduct, with specific training and inductions, will also be developed and implemented with components to manage impacts relating to recreational fishing, boating and island access. Signing this Code of Conduct is a condition of employment on the Project for workers employed directly or indirectly on the Wheatstone Project and who visits or is resident in Onslow. Failure to adhere to the Workforce Code of Conduct may result in disciplinary action including withdrawal of allocated accommodation at the workforce accommodation village, disciplinary action, and/or termination of employment.
Table 3.1	**Text added:** NB. It is possible that Whale Sharks may be present in the Project Area in very low densities. There are no aggregation sites. The risk to this species is therefore low and they have not been included in this MFMP. Should a Whale Shark be sighted then management procedures as for Dugong in this plan will be invoked.
Table 3.1	**Text replaced:** *From:* (Humpback Whale) Cow/calf pairs susceptible to acoustic impacts from piling activities *To:* (Humpback Whales) susceptible to acoustic impacts from piling activities.
Table 3.1	**Text replaced:** *From:* All whales susceptible to vessel strike when vessels are present in large numbers. *To:* (Humpback Whales) Susceptible to vessel strike.
Table 3.1	**Text added:** (Dugongs are) susceptible to displacement from feeding areas
Table 3.1	**Text added:** Although humpback whales occur in offshore waters in greater densities relative to shallow nearshore waters, there is

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	potential for humpback whales to occur in shallow nearshore waters i.e. in depths less than 10m.
Table 3.1	**Text added:** Juvenile marine turtles are likely to be found in large numbers in nearshore waters including tidal creeks, nearshore coastal waters and inlets.
Section 4.1.1	**Text added:** Further collection of baseline light and hatchling orientation data prior to commencement of construction will be collected.
Section 4.1.1	**Text replaced:** *From:* The floatel will be located away from turtle nesting beaches so that marine turtles are not significantly impacted from floatel light emissions. *To:* The floatel will be located at least 1.5 km away from turtle nesting beaches and situated where the seafloor is characterised by bare sand without seagrass or microalgae.
Section 4.1.1	**Text replaced:** *From:* (Operating procedures) to manage potential impacts to marine turtles from artificial lighting emissions from vessels when operating 1 km from turtle nesting beaches. *To:* to manage potential impacts to marine turtles from artificial lighting emissions from vessels when operating 1.5 km from turtle nesting beaches.
Section 4.2	**Text added:** NB. It is possible that Whale Sharks may be present in the Project Area in very low densities. There are no aggregation sites. The risk to this species is therefore low and they have not been included in this MFMP. Should a Whale Shark be sighted then management procedures as for Dugong in this plan will be invoked.
Section 4.2.1.1	**Text replaced:** *From:* Implementation of designated vessel corridors that avoid highest densities of known turtle and Dugong use. *To:* Implementation of designated vessel corridors that avoid highest densities of known turtle and dugong use (seagrass beds) particularly in the zone of “highest level of construction vessel activity” depicted in Figure 8.62 of the draft EIS/ERMP will be included;
Section 4.2.1.1	**Text added:** Mapping of designated navigation areas and coordinates of marine fauna habitats will be made available to vessel masters.
Section 4.2.1.2	**Text added:** Vessel logs be maintained to record marine fauna sightings. These logs, wherever possible, to include the following information: ♦ Time and date of sighting(s); ♦ Location of sighting; ♦ Number of fauna sighted; ♦ Type of fauna (whale, dugong, turtle); ♦ Vessel type turtle sighted from; ♦ Vessel speed at time of sighting; ♦ Behaviour of fauna; ♦ Changes to behaviour due to vessel proximity;

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	♦ Vessel contact/strike; ♦ Species (where possible to obtain a positive confirmation of species).
Section 4.2.1.2	**Text added:** Should marine megafauna (marine fauna of conservation significance) be sighted within close proximity of the vessel / navigational path of a vessel then the observing person will report the sighting to the vessel master immediately, or as soon as it is safe to do so, and a reasonable effort made to avoid collision.
Section 4.2.1.2	**Text added:** Standardised immediate informing of the vessel master should marine fauna of conservation significance be sighted within close proximity to or within the navigational path of an approaching vessel, with reasonable efforts made to avoid collision.
Section 4.2.1.2	**Text replaced:** *From:* Table 4.3 documents procedures to be followed if the vessel is approaching cetaceans or if cetaceans are approaching the vessel. Procedures relating to vessel manoeuvrers are to be followed only if within the capabilities of the vessel and safety and environmental aspects are not compromised. *To:* Table 4.3 documents procedures to be followed if the vessel is approaching marine mega-fauna (turtles, Dugongs or cetaceans) or if marine megafauna are approaching the vessel. Procedures relating to vessel manoeuvrers are to be followed only if within the capabilities of the vessel and safety and environmental aspects are not compromised.
Section 4.2.1.2	**Text replaced:** *From:* Figure 4.1: Marine Megafauna Approach Zones *To:* Figure 4.2: Marine Megafauna Approach Zones (Whales and Dugongs)
Section 4.2.2	**Text added:** On a regular basis, vessel logs should be entered into the DEC Threatened Fauna Report form and submitted to DEC. Report forms can be downloaded from http://www.dec.wa.gov.au/content/view/5388/2237/
Section 4.3.1	**Text replaced:** The Piling Observation and Suspension zones have Marine Fauna Observation Zone: The Piling Supervisor will monitor for marine mammals or turtles within the 1500 m – *formerly 500 m* – around the pile hammer during daylight hour operations, starting observation 30 minutes prior to start-up.
Section 4.3.1.1	**Text added:** In the case of concurrent pile driving activities, the observation and suspension zones will be applied to each active pile driving operation.
Section 4.3.1.2	**Text replaced:** *To:* Marine Fauna Observation Zone: The movement of marine megafauna sighted within 1500 m – *formerly 500 m* – of the pile-hammer during or immediately prior to commencement of piling operations will be monitored If a whale is present within the Marine Fauna Observation Zone for 30 minutes then pile driving activities will cease Marine Mammal Suspension Zone: Pile driving activities will cease if marine mammals are observed within 500 m – *formerly 100 m* – of the pile hammer

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Section 4.4	**Text added:** It is improbable that blasting will occur. Should blasting take place then a Blasting Management Plan will be developed with Cetaceans, including Humpback Whale mother/calf pairs, Turtles, and Dugongs included as a management focus. Refer to Section 8.4.5.8 of the Wheatstone Draft EIS/ERMP for a preliminary literature review undertaken in the draft EIS regarding potential impacts to marine fauna associated with blasting activities and potential impact zones that have been applied.
Section 4.4.1.1	**Text added:** Refer to Section 8.4.5.8 of the Wheatstone Draft EIS/ERMP for a preliminary literature review regarding potential impact zones to marine fauna and the previous approaches that have been applied.
Section 4.5	**Section added:** Vertical Seismic Profiling Management
Figure 4.3	**Text replaced:** *From:* Figure 4.3: Marine Megafauna Approach Zones *To:* Figure 4.3: Marine Megafauna Approach Zones (Dolphins and Turtles)
Figure 4.1	**Figure added:** Turtle Nesting Beaches and Buffer Zones
Figure 4.5	**Figure replaced:** Piling Operations Zoning
Figure 4.6	**Figure replaced:** Piling Activities Procedures
Appendix B	**Text added:** Images within this marine megafauna species identification guide will be updated prior to the commencement of construction to show species from a similar viewpoint to that from a vessel in order to maximise the potential for correct identification. Additional images will also be included that show unique or characteristic features of marine species to further assist identification.
Appendix B	**Table added:** Whale Shark Identification Guide
Appendix B	**Text added:** Images within this marine megafauna species identification guide will be updated prior to the commencement of construction to show species from a similar viewpoint to that from a vessel in order to maximise the potential for correct identification. Additional images will also be included that show unique or characteristic features of marine species to further assist identification.
Appendix C	**Appendix added:** Recreation Code of Conduct overview
Appendix D	**Appendix added:** Sawfish Management Summary Report
Appendix F	**Appendix added:** Injured and Deceased Marine Fauna Investigation Procedures

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Commitment Register

Reference	Commitment	Timing
2.0	A set of Draft Environmental Awareness Guidelines for Boaters and Fishers will be issued to every person employed directly or indirectly on the Wheatstone Project and who visits or is resident in Onslow.	Prior to commencement of work
2.0	The Recreational Code of Conduct, with specific training and inductions, will be developed and implemented with components to manage impacts relating to recreational fishing, boating and island access.	Prior to commencement of activities
2.0	Key personnel are required to attend environmental inductions and training relevant to their role on the Wheatstone Project.	Prior to commencement of work
2.0	Chevron will prepare internal documents related to training and inductions for the identification and assessment of required competencies for environmental roles that it requires its employees, contractors, etc. to comply with. Training and inductions will be facilitated by Chevron or suitably qualified contractors.	Prior to commencement of activities
2.0	The Wheatstone Project will use a number of routine internal reporting formats to effectively implement the requirements of this MFMP. Routine reporting includes daily, weekly and/or monthly Health, Environment and Safety (HES) reports for specific scopes of work on the Project	Continuously implemented throughout the duration of the activity.
2.0	Chevron has prepared the ABU Emergency Management Process (Chevron 2007) and Incident Investigation and Reporting Process (Chevron 2008a), which it internally requires its employees, contractors, etc. to follow in the event of environmental incidents. These processes will also be applied to environmental incidents identified in this plan where this is appropriate and reasonably practicable.	Continuously implemented throughout the duration of the activity.
2.0	An adaptive management approach will be applied to all Project activities. The adaptive approach enables management strategies to be implemented in a way that allows for adjustments to changing events, decisions, and circumstances, and that can modify implementation and mitigation strategies as new knowledge is gained.	Continuously implemented throughout the duration of the activity.

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2.0	Chevron has prepared the internal Compliance Assurance ABU – Standardised Operational Excellence (OE) Process (Chevron 2008b) to manage compliance, and which it internally requires its employees, contractors, etc. to comply with. This Process will also be applied to assess compliance of the Wheatstone Project.	Continuously implemented throughout the duration of the activity.
2.0	If changes occur to the design or operation of the Project after completion of the MFMP the document will be reviewed and revised as appropriate. The review will include a reassessment of the environmental risks presented by the works and the corresponding management strategies being implemented. Any such changes will be communicated to the Department of Environment and Conservation (DEC) and the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) as required.	Continuously implemented throughout the duration of the activity.
2.0	Chevron will review the Marine Fauna Management Plan every five years or more often as required.	Continuously implemented throughout the duration of Project activities.
4.1	Further collection of baseline light and hatchling orientation data prior to commencement of construction will be collected.	Prior to commencement of activities
4.1	Visiting LNG and condensate vessels are intended to comply with international lighting standards.	Continuously implemented throughout the duration of the activity.
4.1	Mooring at night will not take place at night during Nov-April, the turtle nesting season, within 1.5 km of turtle nesting beaches.	Continuously implemented throughout the duration of the activity.
4.1	Vessel lighting is not to be continuously ‘on’; lighting should be ‘off’ when not required, within 1.5 km of turtle nesting beaches	Continuously implemented throughout the duration of the activity.
4.1	Vessels must make best endeavours to reduce light spill and direct overboard lighting to the safe minimum level at all times within 1.5 km of turtle nesting beaches.	Continuously implemented throughout the duration of the activity.
4.1	The floatel will be located at least 1.5 km away from turtle nesting beaches and situated where the seafloor is characterised by bare sand without seagrass or microalgae.	The floatel’s location will be designated prior to commencement of the activity.
4.2	Operators of specified vessels will have on duty selected, trained crew members to undertake observations for marine fauna.	Selection and training of staff to occur prior to mobilisation.

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4.2	Implementation of designated vessel corridors that avoid highest densities of known turtle and Dugong use	Vessel corridors will be designated prior to commencement of the activity
4.2	Mapping of designated navigation areas and coordinates of marine fauna habitats will be made available to vessel masters.	Prior to commencement of activities
4.2	Vessels will be maintained in good condition to minimise the transfer of noise into the water (DEH 2005).	Continuously implemented throughout the duration of the activity.
4.2	Operators of specified vessels will have on duty crew members that have undertaken the Marine Megafauna Training and Induction during daytime marine operations and vessel movements.	Selection and training of staff to occur prior to mobilisation.
4.2	Management of cetacean interactions will be in accordance with the requirements for cetacean interactions specified under Part 8 of the EPBC Regulations 2000 (Cth), the Australian National Guidelines for Whale and Dolphin Watching.	Continuously implemented throughout the duration of the activity.
4.2	Should marine megafauna (marine fauna of conservation significance) be sighted within close proximity of the vessel / navigational path of a vessel then the observing person will report the sighting to the vessel master immediately, or as soon as it is safe to do so, and a reasonable effort made to avoid collision.	Continuously implemented throughout the duration of the activity.
4.2	Standardised immediate informing of the vessel master should marine fauna of conservation significance be sighted within close proximity to or within the navigational path of an approaching vessel, with reasonable efforts made to avoid collision.	Continuously implemented throughout the duration of the activity.
4.2	Vessel logs will be maintained to record marine fauna sightings.	Continuously implemented throughout the duration of the activity.
4.2	Should a vessel strike any individual of marine megafauna, or should a vessel crew member sight injured or deceased any individual of marine megafauna, the observing person will report the sighting to the vessel master immediately, or as soon as it is safe to do so.	Continuously implemented throughout the duration of the activity.
4.2	The vessel master will maintain a log documenting incidents of management procedures invoked, in-water incidents and observed injured/dead turtles and marine mammals.	Continuously implemented throughout the duration of the activity.

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4.2	On a regular basis, vessel logs should be entered into the DEC Threatened Fauna Report form and submitted to DEC. Report forms can be downloaded from http://www.dec.wa.gov.au/content/view/5388/2237/	Continuously implemented throughout the duration of the activity.
4.1 4.2 4.3 4.4 4.5	Any detected injury or mortality attributed to the Wheatstone Project of any marine species listed as specially protected under the provisions of Section 14 (2)(ba) of the *Wildlife Conservation Act 1950* (WA) or the *EPBC Act* (Cth) shall be reported by Chevron to the DEC, and to also DSEWPC if the marine species is a turtle, within 48 hours of observation.	Continuously implemented throughout the duration of the activity.
4.1 4.2 4.3 4.4 4.5	Details of any incident – including time and date of incident, cause of injury/mortality (if known), location, and the species (if known) – will be documented in a Chevron Database and reported to the DEC.	Continuously implemented throughout the duration of the activity.
4.2	A vessel log will be maintained to record marine fauna sightings, management measures invoked and vessel strikes	Continuously implemented throughout the duration of the activity.
4.3 4.4	Use of selected, trained, crew members to undertake marine fauna observations to confirm that no protected marine fauna are within the vicinity of designated suspension zones for blasting and piling operations.	Training of staff to occur prior to mobilisation.
4.3	Piling operations will commence with a slow start/partial strike to encourage marine fauna to leave the area	A ‘soft start’ is to occur at the commencement of each individual piling activity.
4.3	Marine Fauna Observation Zone: The Piling Supervisor will monitor for marine mammals or turtles within the 1500 m around the pile hammer during daylight hour operations, starting observation 30 minutes prior to start-up.	Continuously implemented throughout the duration of the activity.
4.3	In the case of concurrent pile driving activities, the observation and suspension zones will be applied to each active pile driving operation.	Continuously implemented throughout the duration of the activity.
4.3	Marine Fauna Observation Zone: The movement of marine megafauna	Continuously implemented throughout the

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	sighted within 1500 m of the pile-hammer during or immediately prior to commencement of piling operations will be monitored	duration of the activity.
4.3	If a whale is present within the Marine Fauna Observation Zone for 30 minutes then pile driving activities will cease.	Continuously implemented throughout the duration of the activity.
4.3	Marine Mammal Suspension Zone: Pile driving activities will cease if marine mammals are observed within 500 m of the pile hammer.	Continuously implemented throughout the duration of the activity.
4.3	Turtle Suspension Zone: Pile driving activities will cease if turtles are observed within 100 m of the pile hammer.	Continuously implemented throughout the duration of the activity.
1.1 4.4	Should blasting take place then a Blasting Management Plan will be developed with Cetaceans, including Humpback Whale mother/calf pairs, Turtles, and Dugongs included as a management focus.	Prior to blasting activities
4.4	Blasting operations will commence with a succession of small charges to encourage marine fauna to leave the area.	A ‘soft start’ is to occur at the commencement of each individual piling activity.
4.4	Marine Fauna Observation Zone: The blasting supervisor will be on duty to monitor for marine mammals or turtles within an appropriate zone* around the charge locations during and immediately prior to commencement of blasting operations, starting observations 30 minutes prior to starting blast.	Zones to be defined prior to mobilisation of blasting equipment. Zones to be continuously implemented throughout the duration of the activity.
4.4	Humpback whales, including mother/calf pairs, dolphins, Dugongs and turtles will be a management focus for blasting activities.	Continuously implemented throughout the duration of the activity.
4.4	Site specific impact zones for blasting will be developed, should blasting become part of the Wheatstone Project.	Prior to blasting activities
4.5	Visual observations would be undertaken within the observation zone by a suitably trained crew member for at least 30 minutes before the commencement of the soft start procedure. Observation zone to include a 3km horizontal radius from the VSP acoustic source.	Continuously implemented throughout the duration of the activity.
4.5	The VSP acoustic source would be initiated at the lowest setting, with a gradual ramp-up of the acoustic source over a 20 minute period until the full operating power level is reached	Continuously implemented throughout the duration of the activity.

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4.5	Visual observations of the observation zone will be maintained continuously to identify if any whales are present.	Continuously implemented throughout the duration of the activity.
4.5	At the event of sighting a whale within the observation zone the operator of the acoustic source will be placed on stand-by to power down the acoustic source.	Continuously implemented throughout the duration of the activity.
4.5	At the event of sighting a whale entering the shut-down zone (a 500m horizontal radius from the VSP acoustic source) the acoustic source will be shut down completely.	Continuously implemented throughout the duration of the activity.
4.5	Low Visibility Operating Procedures: During periods of low visibility, where the observation zone cannot be clearly viewed out to 3 km (including night time), the VSP source will be utilised as described above, provided that during the preceding 24 hour period: ♦ There have not been 3 or more whale instigated shut down situations; and ♦ A two-hour period of continual observations was undertaken in good visibility (to the extent of the observation zone) and no whales were sighted. If these conditions are not satisfied then the VSP will not be utilised.	Continuously implemented throughout the duration of the activity.
Design	The design of the open sea intake currently includes a vertical caisson (pipe) located on the Product Loading Facility. Multiple screens will be attached to the caisson and will act as a filtration device. The screens are likely to have openings ranging from 0.5 mm to 10 mm and are usually oriented on a horizontal axis. The velocity of water at the face of the intake structure is not anticipated to exceed 0.15 m/sec, in order to minimise entrainment of marine fauna and debris on the intake screen structure.	Prior to start-up of the desalination plant during the operations phase.
Recreational Code of Conduct	A recreational code of conduct, supported with specific training and inductions, will be implemented to manage impacts from recreational boating, fishing and island access. This will entail: ♦ Inform Project staff/contractors of DEC rules relating to offshore nature reserves e.g. domesticated animals (such as dogs and cats)	Initial inductions will occur as part of the 'onboarding' employment phase. Training and inductions of staff to occur prior to mobilisation.

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	will be prohibited on offshore islands/reserves ♦ Chevron will work with the DEC to reduce potential risks from excessive recreational use of the islands within a 25km radius of Onslow ♦ Recreational boats and recreational vehicles will not be permitted within the workforce accommodation village or to travel on the access road from Onslow Road. ♦ Behaviour standards to be expected from all construction workers will be clearly articulated in a Recreation Code of Conduct. Construction workers will be asked to sign the Code of Conduct ♦ Inform Project staff/contractors of recreational fishing Regulations. ♦ Chevron will work with the DoF to reduce potential risks to the existing recreational fishery. ♦ Conservation induction programs will be run for employees and contractors (e.g. to include education of better disposal of fishing line and use of biodegradable fishing line). ♦ A community feedback procedure will be established whereby any complaints from the community about unacceptable behaviour from construction workers will be investigated and, where necessary, action taken.	Management messages to be continuously reiterated throughout duration of the Project's life. Management measures to be continuously implemented throughout the duration of the Project's life.

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PREFACE

This Marine Fauna Management Plan (MFMP) is based on the Proposed Outcome Based Conditions (OBCs) presented in Chevron Australia's (Chevron) Wheatstone Draft EIS/ERMP (Chevron 2010). It aims to provide a performance-based approach for the environmental management of activities not governed by their own dedicated management plan that have the potential to affect protected marine fauna. It focuses on managing residual risks presented in the Wheatstone EIS/ERMP as well as some 'perceived risks' to marine megafauna of the Project Area (Chevron 2010). It is inclusive of both construction phase and operational phase activities, associated with both downstream and upstream Project components.

This plan has been guided by the *Environmental Protection Act* 1986 (WA) (EP Act), the *Wildlife Conservation Act* 1950 (WA) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Specifically, the following environmental principals, factors and management objectives will be aspired to:

- To maintain the abundance, diversity, geographic distribution and productivity of marine fauna in the region through the avoidance, or mitigation, of adverse impacts that could arise from construction and operational activities
- To provide for the protection of the environment, especially matters of National Environmental Significance (NES) and to conserve Australian biodiversity
- To be consistent with all relevant legislation and guidance.

This document is in the form of a WORKING DRAFT; its purpose to inform interested parties of proposed management procedures in relation to marine fauna. The components will be further developed to ensure specific, measurable, achievable, realistic and timely management results. Adaptive management will be an important feature of marine fauna management, with the assessment of management effectiveness being a key component. Input from the relevant regulatory authorities will be a key step in finalising this management plan.

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1.0 INTRODUCTION

1.1 Purpose of this Plan

The purpose of this MFMP is to convey the marine fauna management procedures that are to be implemented in Project activities that do not have their own specific management plan, e.g. the Dredge and Spoil Disposal Management Plan (DSDMP). Activities governed by their own dedicated management plan are not included here, refer to Appendix A for list of those management plans. Project activities that are addressed in this plan are presented in Table 1.1.

This MFMP aims to demonstrate the methods and approaches to achieve the Outcome-based conditions (OBCs) relating to marine fauna in both construction and operational phases. Refer to the DMDMP for dredging operations. OBCs are still being finalised and this plan will be updated accordingly.

Table 1.1: Project Activities Addressed in this MFMP

Project Phase	Project Activity	Residual Risk
Construction and Operation	Light emissions from coastal facilities, vessels, floatel and flaring events	**Low**
Construction and Operation	Vessel movements	**Low**
Construction	Underwater noise emissions from pile driving	**Low**
Construction	Underwater noise emissions from blasting*	**Very Low**

*It is improbable that blasting will occur. Should blasting take place then a Blasting Management Plan will be developed with Cetaceans, including Humpback Whale mother/calf pairs, Turtles, and Dugongs included as a management focus. Refer to Section 8.4.5.8 of the Wheatstone Draft EIS/ERMP for a preliminary literature review regarding potential impact zones to marine fauna and the previous approaches that have been applied.

The management strategies contained within this plan are to be used by contractors in the development of their subsidiary management plans for specific activities (Figure 1.1).

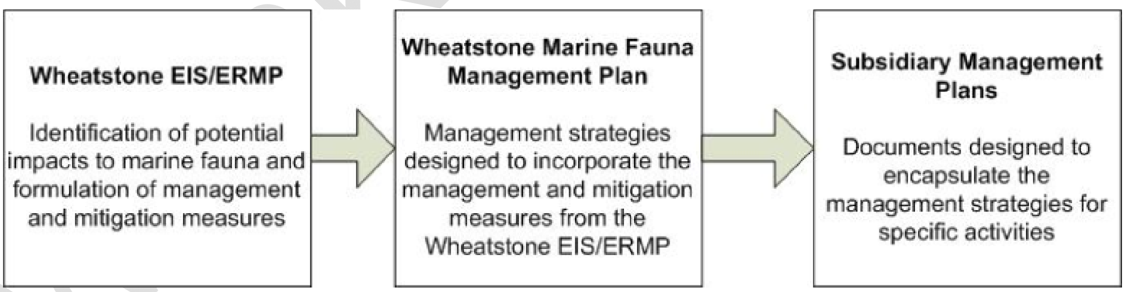

Figure 1.1: Implementation of Management Procedures

1.2 Objectives of this Plan

The key objectives of the MFMP are to provide a management framework to:

- reduce the likelihood of injury/mortality to marine fauna from vessel strike
- reduce the potential Project-attributable impacts to marine fauna resulting from noise emissions
- reduce the potential Project-attributable impacts to marine fauna resulting from light emissions

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1.3 Structure of this Plan

This plan outlines the Project's environmental objectives in relation to marine fauna and describes the responsibilities, training, timing, auditing and adaptive management procedures that will be implemented in order to achieve these objectives.

This plan is structured as follows:

- Section 1 introduces the plan.
- Section 2 provides an overview of the management strategies to be implemented.
- Section 3 outlines habitats surrounding the Project Area and summarises the potential marine fauna sensitivities to Project activities.
- Section 4 presents the management strategies relevant to specific Project activities:
  - Project Vessels: Artificial Light Spill.
  - Project Vessels: Vessel Movements.
  - Piling Operations.
  - Blasting Operations.
  -

▪ In keeping in line with the risk based approach, marine fauna management measures focus on species or fauna groups with highest sensitivity to particular activity components. These are highlighted in each

▪

▪ Refer to the EIS/ERMP for detailed descriptions of the Project, Existing Environment and Risk Assessments (Chevron 2010).

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2.0 MANAGEMENT STRATEGIES

This MFMP contains various components, each related to separate Project activities. Each component identifies the relevant potential impacts to marine fauna and the proposed management strategies and their implementation, including training and inductions, environmental management procedures, and reporting requirements. These management strategies are further described below.

Further to the management strategies, a set of Draft Environmental Awareness Guidelines for Boaters and Fishers are provided in Appendix B and issued to every person employed directly or indirectly on the Wheatstone Project and who visits or is resident in Onslow. They will be used to guide the workforce regarding responsible environmental conduct during marine-based recreational activities. The guidelines will not be enforced, but the workforce will receive relevant educational training and be encouraged to comply. The guidelines may be presented separately to, or as part of, the Recreational Code of Conduct.

The Recreational Code of Conduct, with specific training and inductions, will also be developed and implemented with components to manage impacts relating to recreational fishing, boating and island access. Signing this Code of Conduct is a condition of employment on the Project for workers employed directly or indirectly on the Wheatstone Project and who visits or is resident in Onslow. Failure to adhere to the Workforce Code of Conduct may result in disciplinary action including withdrawal of allocated accommodation at the workforce accommodation village, disciplinary action, and/or termination of employment.

2.1 Training and Induction

Key personnel are required to attend environmental inductions and training relevant to their role on the Wheatstone Project. Training and induction programs facilitate the understanding personnel have of their environmental responsibilities, and increase their awareness of the management and protection measures required to reduce potential impacts on the environment. The outline of the environmental inductions and training session specific to each component of this plan are detailed in each component of this MFMP, below.

Chevron will prepare internal documents related to training and inductions for the identification and assessment of required competencies for environmental roles that it requires its employees, contractors, etc. to comply with. Training and inductions will be facilitated by Chevron or suitably qualified contractors. Refer to Appendix C for a draft Wheatstone Project Marine Megafauna Species Identification Guide, to be developed to assist Project personnel to recognise marine megafauna through physical and behavioural characteristic observations.

Environmental training and competency requirements for personnel, including contractors and subcontractors, will be maintained in a Wheatstone Project training matrix. This matrix will be reviewed and updated on an ongoing basis to ensure that the required competencies are met and the required training has been completed.

2.2 Environmental Management Procedures

To operate in an environmentally responsible manner, the Project has committed to a number of mitigation and management measures. These are documented in the Wheatstone EIS/ERMP (Chevron 2010). This MFMP presents environmental management procedures to be followed during various construction and operational phase activities that have been developed to fulfil the environmental commitments relevant to the activities.

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2.3 Reporting

The Wheatstone Project will use a number of routine internal reporting formats to effectively implement the requirements of this MFMP. Routine reporting includes daily, weekly and/or monthly Health, Environment and Safety (HES) reports for specific scopes of work on the Project, as detailed below. These reports include information on a number of relevant environmental aspects, such as details of environmental incidents (if any), environmental statistics and records, records of environmental audits and inspections undertaken, status of environmental monitoring programs, tracking of environmental performance against performance indicators, targets and criteria, etc.

Chevron has prepared the ABU Emergency Management Process (Chevron 2007) and Incident Investigation and Reporting Process (Chevron 2008a), which it internally requires its employees, contractors, etc. to follow in the event of environmental incidents. These processes will also be applied to environmental incidents identified in this plan where this is appropriate and reasonably practicable.

2.4 Adaptive Management

An adaptive management approach will be applied to all Project activities. The adaptive approach enables management strategies to be implemented in a way that allows for adjustments to changing events, decisions, and circumstances, and that can modify implementation and mitigation strategies as new knowledge is gained. The process model is depicted in Figure 3.1 below. The ongoing assessment of management effectiveness is a key part of the adaptive management process that will be developed further, in consultation with relevant regulatory authorities.

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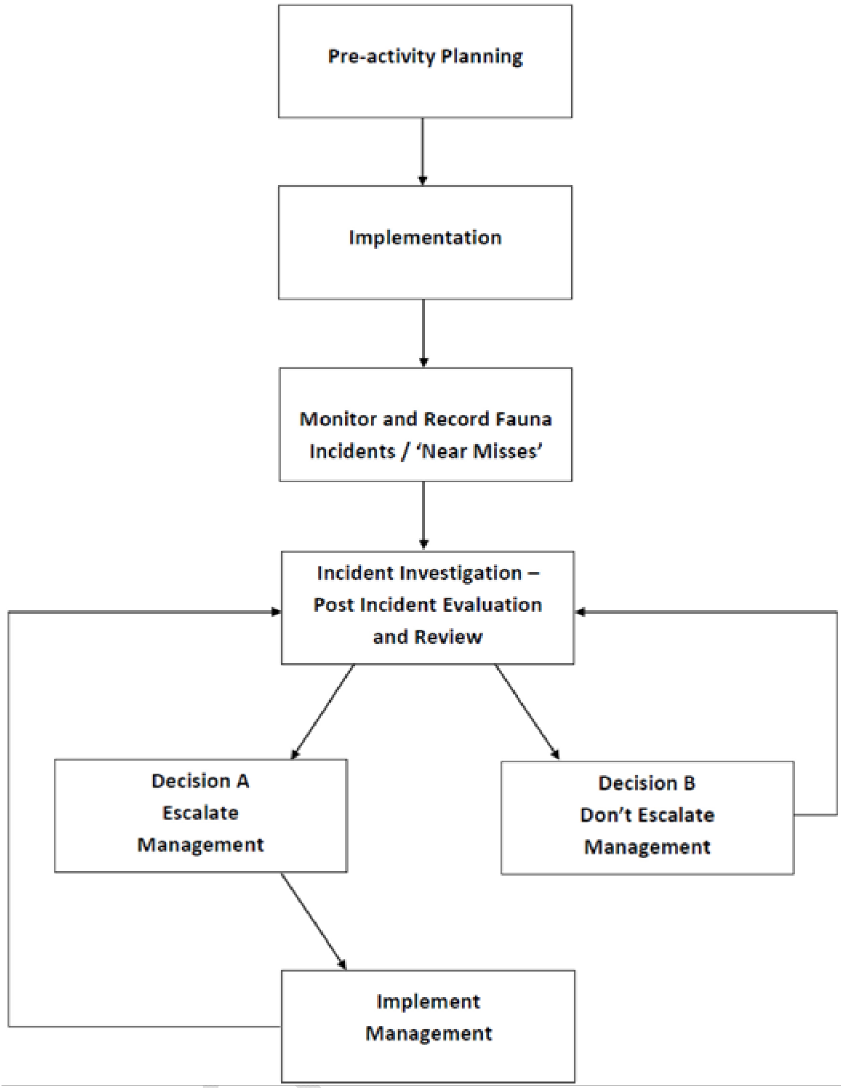

Figure 2.1: Wheatstone Project Adaptive Management Process

Chevron recognises the need for adaptive management in the form of contingency measures and adjustments to the management strategies in the event that an unacceptable event occurs. Possible contingency measures have been included within each component of this plan.

2.5 Audit

Chevron has prepared the internal Compliance Assurance ABU – Standardised Operational Excellence (OE) Process (Chevron 2008b) to manage compliance, and which it internally requires its employees, contractors, etc. to comply with. This Process will also be applied to assess compliance of the Wheatstone Project.

2.6 Stakeholder Engagement

If changes occur to the design or operation of the Project after completion of the MFMP the document will be reviewed and revised as appropriate. The review will include a reassessment of the environmental risks presented by the works and the corresponding management strategies being implemented. Any such changes will be communicated to the Department of Environment and Conservation (DEC) and the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) as required.

2.7 Review and Revision of this Plan

Chevron is committed to conducting activities in an environmentally responsible manner and aims to implement review of its environmental management procedures as part of a programme of continuous improvement. This commitment to continuous improvement means Chevron will review this Plan every five years or more often as required (e.g. in response to new information).

Reviews will address matters such as the overall design and effectiveness of the Plan, progress in environmental performance, changes in environmental risks, changes in business conditions, and any relevant emerging environmental issues.

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3.0 POTENTIAL MARINE FAUNA SENSITIVITIES TO PROJECT ACTIVITIES

3.1 Project Area and Surrounding Habitats

The Project will require the installation of gas gathering, processing and export facilities in Commonwealth and State waters (Figure 3.1) and onshore (Figure 3.2). An offshore platform will provide initial treatment of the gas and natural gas condensate (condensate), which will then be transported via a subsea pipeline to the onshore Liquefied Natural Gas (LNG) processing facility. Export product will be loaded onto medium to large capacity vessels docking regularly at a Product Loading Facility (PLF) adjacent to the processing facility. The resultant LNG and condensate will be exported to worldwide markets via both dedicated and spot-cargo vessels.

The Project's upstream components are primarily situated in deep open ocean on the steep outer edge of the continental slope in water depths of approximately 70 to 300 m. The undulating terrain of the area contributes to upwelling or more nutrient rich waters from greater depths (DEWHA 2008). Such areas support zooplankton and demersal fish and squid communities which in turn attract predatory cetaceans including baleen whales, oceanic dolphins and sperm whales (DEWHA 2008).

The subsea pipeline route and LNG carriers will traverse the continental shelf, in the Pilbara Offshore (PIO) bioregion. This area is characterised by clear oceanic waters and contains many nearshore islands. Wide intertidal sand flats occur on the leeward sides of most of the islands, often over rock pavements, and mangal communites are not well developed. Key species of the Indo–West Pacific oceanic coral reef invertebrate assemblages occur here, and the burrowing invertebrate fauna of the island sand flat habitats are also diverse and abundant. Many of the Pilbara islands are important nesting sites for turtles and seabirds (IMCRA 2006).

The bulk of the marine infrastructure will be situated within 10 km of the coast, in the Pilbara Inshore (PIN) bioregion. A range of costal habitats are supported here: sandy substrate, rocky coastline, mangroves and seagrasses and algal mats. The nearshore Project area is broadly characterised by silt and sand sheets overlying limestone. The onshore Project area is located in the Ashburton River Catchment where the surface water environment is characterised by local rainfall, runoff from upstream catchments and tidal variation. The Ashburton River, which has a shifting nature, makes a significant contribution to sediment deposition along the coast, particularly when it is in flood. Net alongshore sediment transport is generally considered to be from west to east and the entrance bar at Hooley Creek is dynamic.

All benthic habitats in the Project area are widespread, and found throughout the nearshore and offshore Pilbara marine environment. Benthic Primary Producer Habitat (BPPH) include: reefs and shoals supporting hard corals and macroalgae; patchy and low cover seagrass beds; and mangrove stands fringing creeks and lagoons. However, the dominant habitat, in terms of spatial extent, is unconsolidated sediment without vegetation cover.

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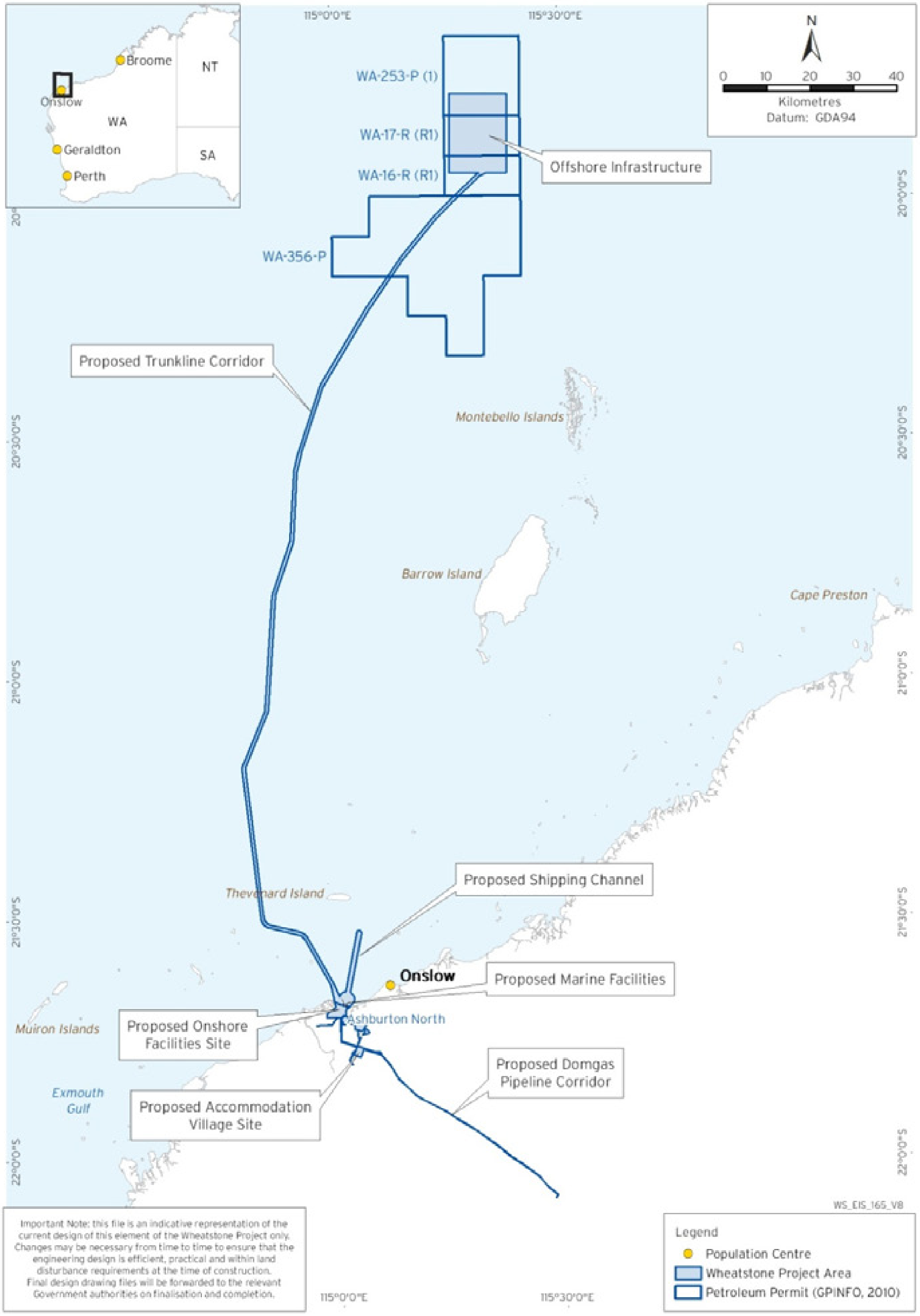

Figure 3.1: Location of the Project Area

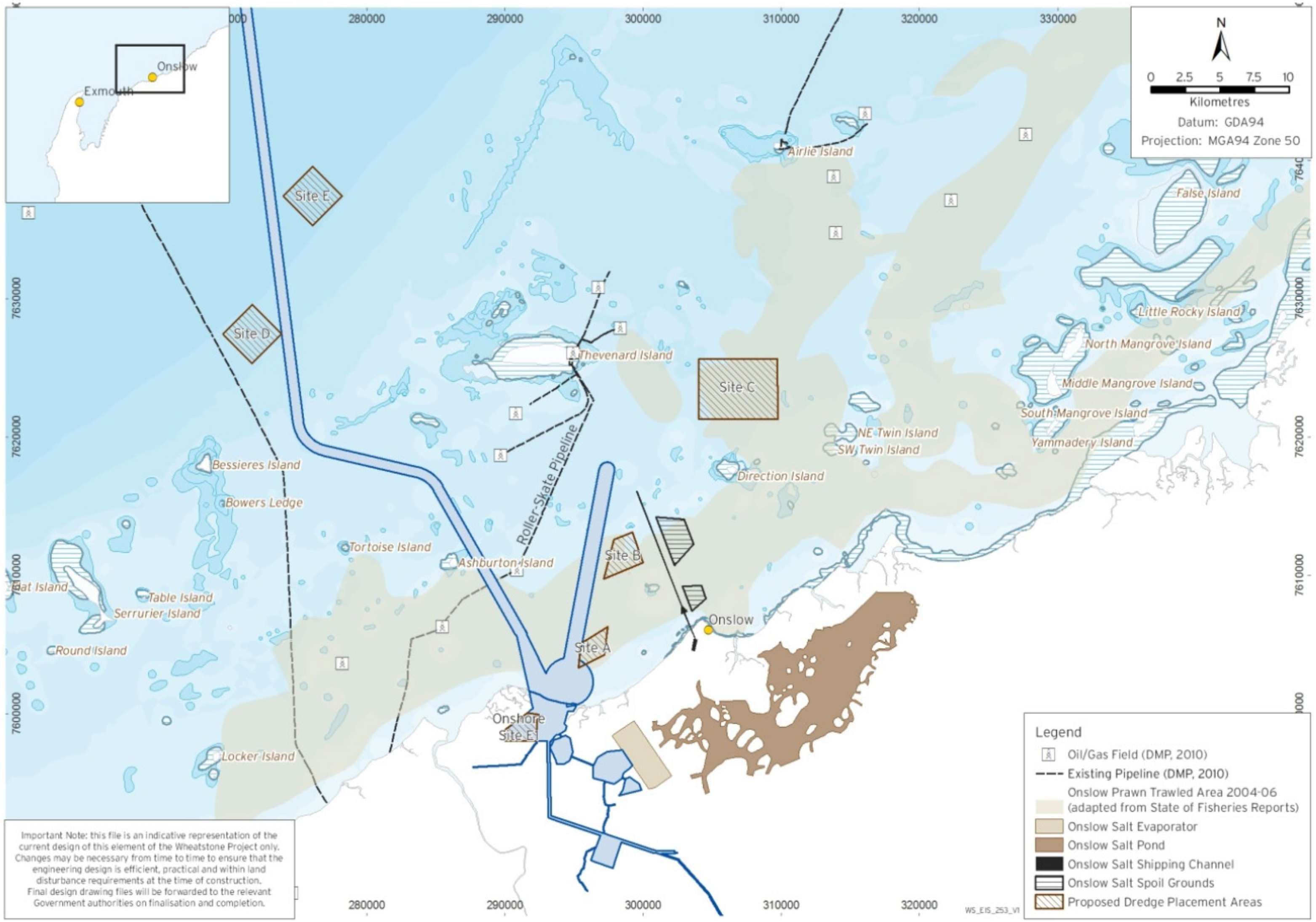

Figure 3.2: Project Precinct and Nearshore Project Area

3.2 Marine Fauna

EPBC Act (Cth) and *Wildlife Conservation Act 1950* (WA) listed, threatened and migratory species of birds, marine mammals, reptiles and sharks/rays are known to be present in the nearshore and offshore Project area. These include Humpback Whales, Dugongs, marine turtles and sawfish. Humpback Whales are known to utilise the waters of the region between May and November (RPS 2010a). Dugongs are present in low densities throughout the year, with varying distribution but often close to the coast or in the lee of reef-fringed islands and sometimes near areas where seagrass has previously been recorded (RPS 2010b). Marine turtles are present in the Project area and nest on offshore islands including Serrurier, Thevenard, Bessieres, Locker and Ashburton during the summer (RPS 2010c). Low density nesting has been observed on the beach 4 km west of the onshore Project area but not in front of onshore infrastructure; beaches at the Ashburton North Strategic Industrial Area (SIA) are unsuitable for nesting as they are inundated by spring tides.

3.2.1 Marine Fauna Sensitivities to Project Activities

This plan focuses on those marine fauna species identified as ‘key receptors’ in the Wheatstone EIS/ERMP (Table 3.1) (Chevron 2010). The key receptors were selected from the inventory of marine fauna whose distributions overlap the Project area and have been assessed by their:

- Spatial distribution within the Project footprint
- Spatial distribution within the regional context
- Temporal distribution within the Project footprint
- Dependence on critical habitats or foraging areas within the Project footprint
- Presence within the Project footprint during sensitive life history stages
- Interaction with aspects of the Project.

The sensitivities of the marine fauna groups identified as key receptors are summarised in Table 3.1 below. Also identified are their likely exposure to impacts from the Project and the potential for Project activities to adversely affect them. These are the main data used in the assessment of the consequences of impacts associated with the Project.

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Table 3.1: Potential Marine Fauna Sensitivities to Project Activities

Key Receptor	Potential Exposure	Potential Impact
Humpback Whale	♦ Migrate through the offshore waters of the Project area annually between June and November. ♦ Exmouth Gulf is a recognised resting area for cow/calf pairs. However, the southward migration pathway through the Project area is not well known. Cow/calf pairs expected to be present from late September to early November. ♦ Known to be present, although very rarely, inshore of the 50 m isobath during southward migration, with fewer than five per cent of whales surveyed between May and December 2009 recorded within 10 km of the shore. ♦ Although humpback whales occur in offshore waters in greater densities relative to shallow nearshore waters, there is potential for humpback whales to occur in shallow nearshore waters i.e. in depths less than 10 m.	♦ Susceptible to acoustic impacts from piling activities. ♦ Susceptible to vessel strike.
Coastal Dolphins	♦ Dolphins present throughout the Project area. ♦ Indo-Pacific Humpback and Bottlenose dolphins are the most common species in the Project area. ♦ The Indo-Pacific Humpback Dolphin generally inhabits shallow coastal waters, embayments and estuaries (< 20 m)	♦ Sensitive to habitat degradation and possible population fragmentation due to coastal developments. ♦ Susceptible to acoustic impacts from piling activities in nearshore areas during the construction phase. ♦ Susceptible to vessel strike when fast-moving vessels are present in coastal areas.
Dugong	♦ Present throughout the year in coastal waters throughout the Project area. ♦ Cow/calf pairs have been recorded within herds during aerial surveys in the vicinity of the Project area.	♦ Susceptible to acoustic impacts from piling activities in nearshore areas during the construction phase. ♦ Susceptible to vessel strike when fast-moving vessels are present in coastal areas. ♦ Susceptible to displacement from feeding areas

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Key Receptor	Potential Exposure	Potential Impact
Marine turtles (Green, Flatback, Hawksbill, Loggerhead)	♦ Marine turtles likely to be resident and foraging in coastal waters of the Project area throughout the year. ♦ Predominantly Flatback nesting on islands near the Project area. Medium density nesting on Ashburton River Delta and Ashburton Island (approximately 4 km and 12 km from the Project area, respectively). ♦ Very low density nesting of Flatback Turtles on the mainland beaches and nest success expected to be low due to tidal inundation of nest sites. ♦ Peak periods of mating (October to December), nesting (October to February) and hatching (December to April). ♦ Reef habitats surrounding the islands offshore from the Ashburton North SIA appear to be important foraging habitat for juvenile and adult Green Turtles. ♦ Juvenile marine turtles are likely to be found in large numbers in nearshore waters including tidal creeks, nearshore coastal waters and inlets.	♦ Susceptible to acoustic impacts from piling activities in nearshore areas during the construction phase. ♦ Susceptible to vessel strike when fast-moving vessels are present in coastal areas. ♦ Hatchlings susceptible to misorientation from artificial lighting.
Sawfish (potentially various species) *Refer to Appendix D for further information	♦ Present in coastal waters, including Hooley Creek and the north eastern parts of the Ashburton Lagoon areas.	♦ Susceptible to changes to hydrodynamics of lagoons and tidal creek systems.

NB. It is possible that Whale Sharks may be present in the Project Area in very low densities. There are no aggregation sites. The risk to this species is therefore low and they have not been included in this MFMP. Should a Whale Shark be sighted then management procedures as for Dugong in this plan will be invoked.

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4.0 ENVIRONMENTAL MANAGEMENT OF PROJECT ACTIVITIES

This section provides the environmental objectives, management focus and management procedures for each project activity that has the potential to impact upon marine fauna, as described in Section 3.0.

4.1 Artificial Light Spill Management

Environmental Objective:	Artificial light spill will be managed so that potential impacts on marine turtles are reduced, as far as reasonably practicable.
Management Focus:	Flatback Turtle hatchlings emerging from nests on the Ashburton Delta beach and Ashburton Island are deemed to be at highest risk from Project light emissions.
Relevant Aspects / Activities:	LNG and condensate vessels; floatel* *It is uncertain, but probable, that a floatel will form part of the Wheatstone Project.

4.1.1 Environmental Management Procedures

- Further collection of baseline light and hatchling orientation data prior to commencement of construction will be collected.
- Visiting LNG and condensate vessels are intended to comply with international lighting standards.

The following operating procedures will be put in place to manage potential impacts to marine turtles from artificial lighting emissions from vessels when operating 1.5 km from turtle nesting beaches (Figure 4.1):

- Mooring at night will not take place at night during Nov-April, the turtle nesting season, within the 1.5 km area
- Vessel lighting is not to be continuously ‘on’; lighting should be ‘off’ when not required.
- Vessels must make best endeavours to reduce light spill and direct overboard lighting to the safe minimum level at all times.
- The floatel will be located at least 1.5 km away from turtle nesting beaches and situated where the seafloor is characterised by bare sand without seagrass or microalgae.

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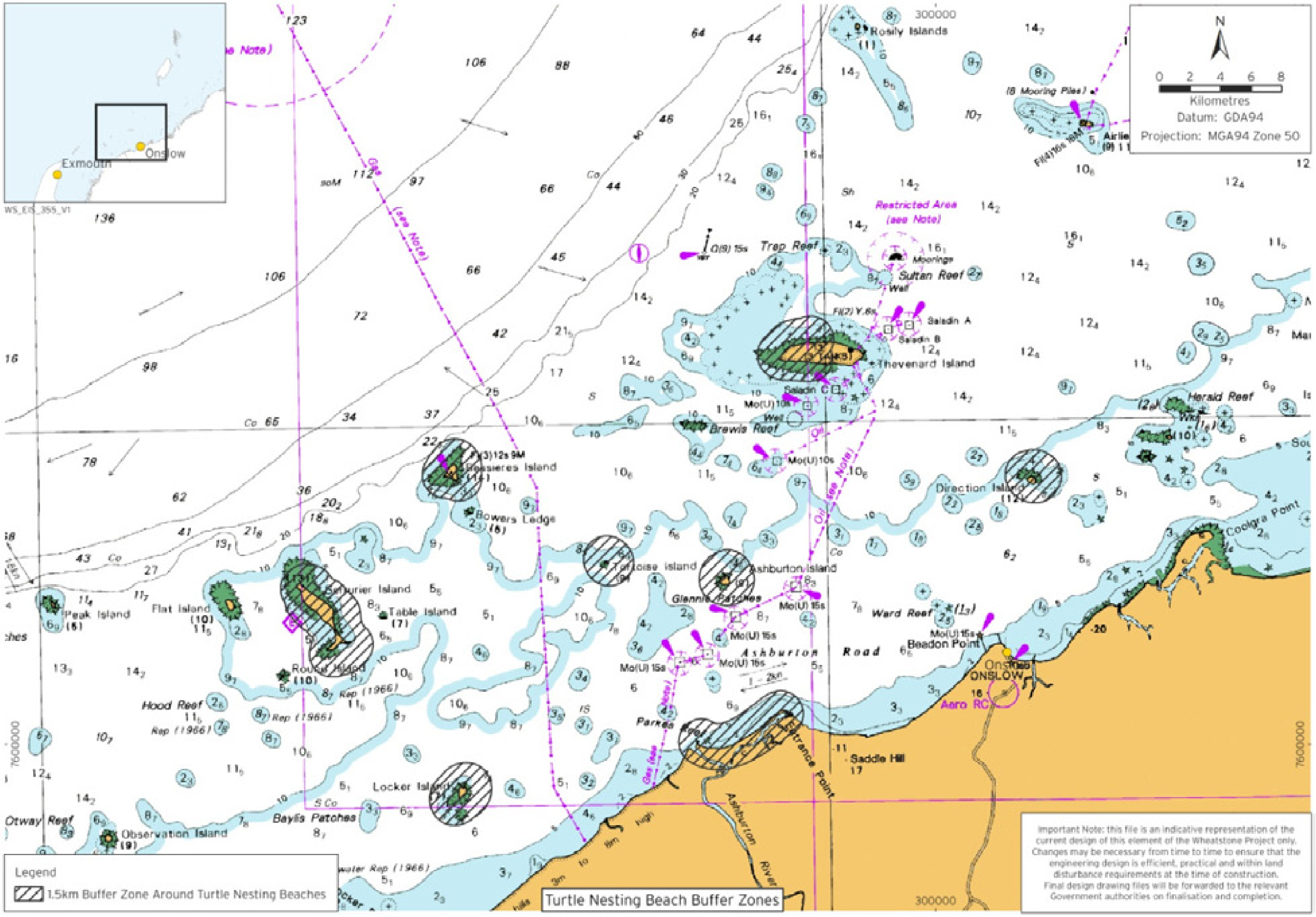

Figure 4.1: Turtle Nesting Beaches and Buffer Zones

4.1.2 Reporting

4.1.2.1 Routine Reporting

The Wheatstone Project will use a number of routine internal reporting formats to effectively implement the requirements of this MFMP.

4.1.3 Roles and Responsibilities

Table 4.1 defines the key roles and responsibility of Project personnel, both Chevron-employed and contractor companies.

Table 4.1: Project Personnel and Responsibility

Personnel	Responsibility
Training Leaders	Facilitating training and induction sessions
Vessel Operators	Adherence to Vessel lighting standards
Vessel Master	Adherence to vessel management procedures

4.1.4 Training and Inductions

Key personnel are required to attend environmental inductions and training relevant to their role on the Wheatstone Project. Table 4.2 presents the specific training and induction requirements of Project personnel.

Table 4.2: Specific Training and Induction Requirements

Personnel	Content	Timing
Vessel skippers Select vessel crew	Basic biology of marine turtles, ecologically important habitat areas and nesting locations in the Project area Marine Turtle identification and behaviour Potential impacts to marine turtles, relating to artificial light emissions, on navigation, hatchling orientation and sea-finding ability Overview of relevant legislation Introduction to environmental management and reporting procedures	Prior to commencing activities in the Wheatstone Project area

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4.2 Vessel Movements

Environmental Objective:	Vessel movements* are to be managed so that risk to marine megafauna is reduced, as far as reasonably practicable.
Management Focus:	Dugongs**, turtles and coastal dolphins are deemed to be at highest risk from Project vessels in nearshore waters. Migrating Humpback Whales are deemed to be at highest risk from Project vessels in offshore waters.
Relevant Aspects:	Vessels and the activities they will undertake include: ♦ Construction phase – support, refuelling/bunkering, towing platform, crew transfers, drilling rigs ♦ Operation phase – supply, standby tugs, crew transfers, LNG and condensate vessels ♦ Decommissioning phase – removal of offshore platform removal of offshore platform (including legs/moorings), subsea wells, manifolds and flowlines, support.

* Management of dredgers and support vessels is not covered here. Refer to the Dredging and Spoil Disposal Management Plan.

** It is possible that Whale Sharks may be present in the Project Area in very low densities. There are no aggregation sites. The risk to this species is therefore low and they have not been included in this MFMP. Should a Whale Shark be sighted then management procedures as for Dugong in this plan will be invoked.

4.2.1 Environmental Management Procedures

The following procedures have been put in place to manage potential impacts to marine megafauna resulting from Project-related vessel movements within the Project area.

- Section 4.2.1.1 details standard vessel operating procedures
- Section 4.2.1.2 details the procedures to be followed in case of a marine megafauna sighting
- Section 4.2.1.3 details the procedures to be followed in case of an injured or deceased marine megafauna sighting and/or vessel strike.

4.2.1.1 Standard Vessel Operating Procedures

- Implementation of designated vessel corridors that avoid highest densities of known turtle and Dugong use, particularly in the zone of “highest level of construction vessel activity” depicted in Figure 8.62 of the draft EIS/ERMP.
- Mapping of designated navigation areas and coordinates of marine fauna habitats will be made available to vessel masters.
- Vessels will be maintained in good condition to minimise the transfer of noise into the water (DEH 2005).

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- Operators of specified vessels will have on duty crew members that have undertaken the Marine Megafauna Training and Induction (Table 4.7: Specific Training and Induction Requirements) during daytime marine operations and vessel movements.

- Avoid making loud or sudden noises near marine mammals (DEH 2005).

- Do not intentionally make any noise to attract marine mammals (DEH 2005).

- A person should not deliberately feed or attempt to feed a wild whale or dolphin (DEH 2005).

4.2.1.2 Marine Megafauna Sighting Procedures

- Should marine megafauna (marine fauna of conservation significance) be sighted within close proximity of the vessel / navigational path of a vessel then the observing person will report the sighting to the vessel master immediately, or as soon as it is safe to do so, and a reasonable effort made to avoid collision.
- Standardised immediate informing of the vessel master should marine fauna of conservation significance be sighted within close proximity to or within the navigational path of an approaching vessel, with reasonable efforts made to avoid collision.

- Vessel logs be maintained to record marine fauna sightings. These logs, wherever possible, to include the following information:
  - Time and date of sighting(s);
  - Location of sighting;
  - Number of fauna sighted;
  - Type of fauna (whale, dugong, turtle);
  - Vessel type turtle sighted from;
  - Vessel speed at time of sighting;
  - Behaviour of fauna;
  - Changes to behaviour due to vessel proximity;
  - Vessel contact/strike;
  - Species (where possible to obtain a positive confirmation of species).

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Table 4.3 documents procedures to be followed if the vessel is approaching marine mega-fauna (turtles, Dugongs or cetaceans) or if marine megafauna are approaching the vessel. Procedures relating to vessel manoeuvrers are to be followed only if within the capabilities of the vessel and safety and environmental aspects are not compromised.

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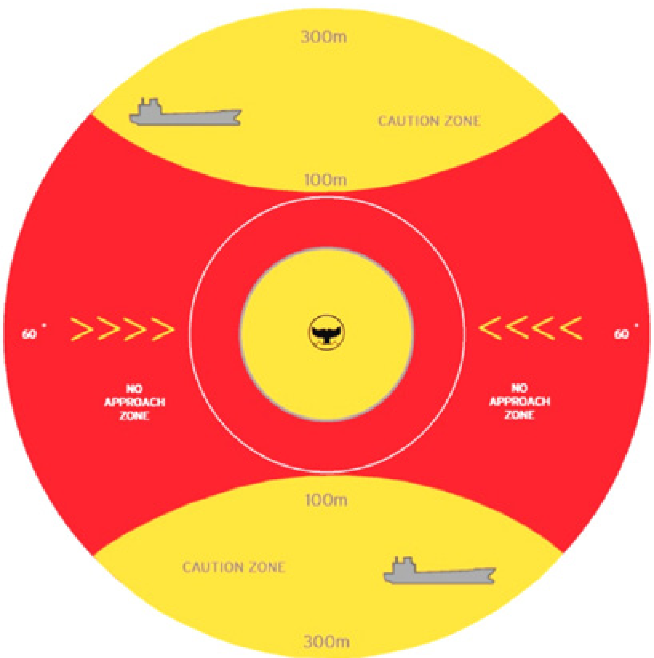
Table 4.3: Megafauna Sighting Procedures

Vessel is Approaching Marine Megafauna	Vessel is Approached by Marine Megafauna
Do not intercept the path of travel or approach head-on, and do not pursue marine mammals or turtles	Take all care necessary to avoid collisions when safe to do so. This may include stopping, slowing down and/or steering away from the animal
Do not enter caution zone[1] if animals are stranded, entangled or distressed	Do not encourage bow riding
Operate at a no-wake speed if within the caution zone[1]	When animals are bow riding : ♦ Do not change course or speed suddenly. ♦ If there is a need to stop, reduce speed gradually
Do not enter the no-approach zone[2]	
When leaving the caution zone[1], vessels should move off at a slow no wake speed gradually increasing speed when reaching the limit of the caution zone from the closest animal	

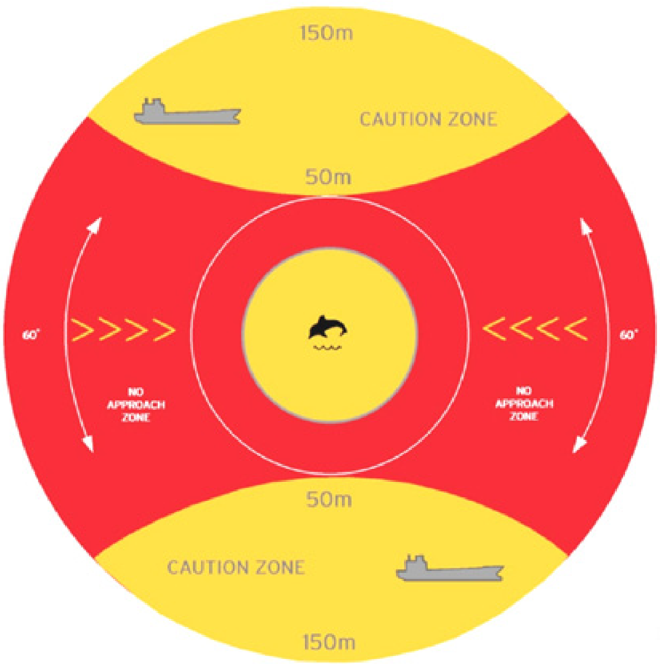
Source: DEH (2005)

1. The caution and no-approach zones relevant for whales and Dugongs are shown in Figure 4.2
2. The caution and no-approach zones for dolphins and turtles are shown in Figure 4.3.



Source: DEH (2005)

Figure 4.2: Marine Megafauna Approach Zones (Whales and Dugongs)



Source: DEH (2005)

Figure 4.3: Marine Megafauna Approach Zones (Dolphins and Turtles)

4.2.1.3 Injured or Deceased Marine Megafauna Procedures

Should a vessel strike any individual of marine megafauna, or should a vessel crew member sight injured or deceased any individual of marine megafauna, the following procedures will be followed:

- The observing person will report the sighting to the vessel master immediately, or as soon as it is safe to do so

- The vessel master will maintain a log documenting incidents of management procedures invoked, in-water incidents and observed injured/dead turtles and marine mammals. Reporting requirements are detailed in Section 4.2.2.

4.2.2 Reporting

The Wheatstone Project will use a number of routine internal reporting formats to effectively implement the requirements of this MFMP. Figure 4.4 depicts the reporting decision-making process for Project vessels operating within the Project area. The reporting requirements are detailed in Table 4.4.

- On a regular basis, vessel logs should be entered into the DEC Threatened Fauna Report form and submitted to DEC. Report forms can be downloaded from http://www.dec.wa.gov.au/content/view/5388/2237/

- Any detected injury or mortality attributed to the Wheatstone Project of any marine species listed as specially protected under the provisions of Section 14 (2)(ba) of the *Wildlife Conservation Act 1950* (WA) or the *EPBC Act* (Cth) shall be reported by Chevron

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to the DEC, and to also DSEWPC if the marine species is a turtle, within 48 hours of observation.

- Details of the incident – including time and date of incident, cause of injury/mortality (if known), location, and the species (if known) – will be documented in a Chevron Database and reported to the DEC (Appendix F).

- To facilitate reporting requirements, a vessel log will be maintained to record marine fauna sightings, management measures invoked and vessel strikes.

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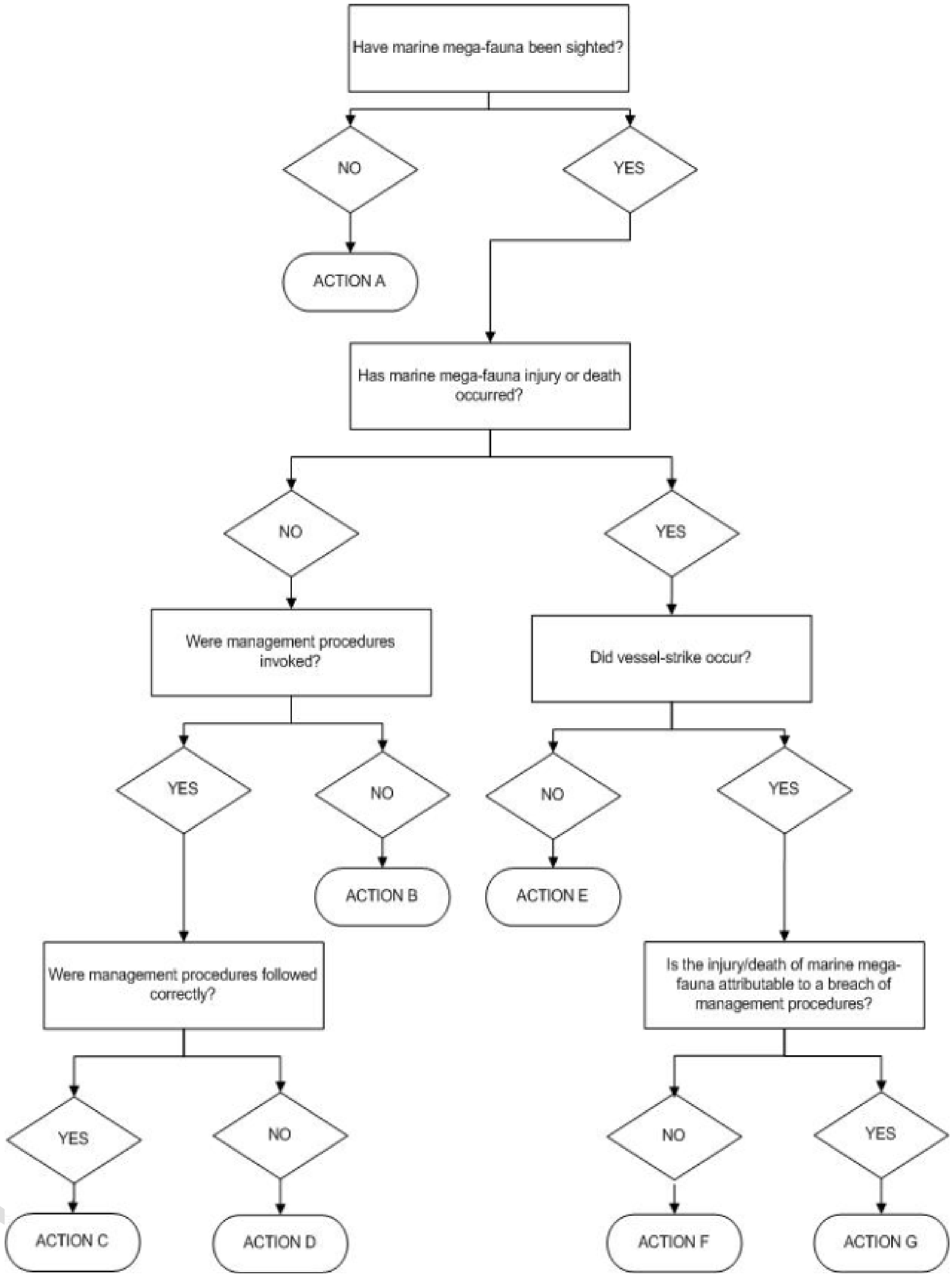

Figure 4.4: Vessel Reporting Procedures

Table 4.4: Incident, Non-Conformance and Corrective Action Reporting

Reporting	Reporting Content	Responsible for Reporting	Reporting To	Timing
Vessel Reporting Action A	No marine megafauna observations	Vessel Master	Chevron	*To be determined. Example:* Weekly to address previous 7-day period
Vessel Reporting Action B	Megafauna observations	Vessel Master	Chevron	*To be determined. Example*: Weekly to address previous 7-day period
Vessel Reporting Action C	Megafauna observations and management procedures invoked	Vessel Master	Chevron	*To be determined. Example:* Weekly to address previous 7-day period
Vessel Reporting Action D	Megafauna observations and management procedures invoked and management procedure non-compliance details	Vessel Master	Chevron	*To be determined. Example:* Within 24 hours of management procedure breach
Vessel Reporting Action E	Megafauna and injury observations (no vessel interaction)	Vessel Master	Chevron	*To be determined. Example:* Within 24 hours of observation
		Chevron	DEC / DSEWPC	Within 48 hours of observation
Vessel Reporting Action F	Vessel strike. Megafauna and injury observations, management procedures invoked	Vessel Master	Chevron	*To be determined. Example:* Within 24 hours of observation
		Chevron	DEC / DSEWPC	Within 48 hours of incident
Vessel Reporting Action G	Vessel strike. Megafauna and injury observations, management procedures invoked and management procedure non-compliance details	Vessel Master	Chevron	*To be determined. Example:* Within 24 hours of observation
		Chevron	DEC / DSEWPC	Within 48 hours of incident
DEC Reporting	Vessel logs to be entered into the DEC Threatened Fauna Report form	Chevron	DEC	*To be determined. Example:* Monthly
Compliance Assessment Report	Addresses the previous 12-month period.	Chevron	DEC	Annually to reflect the previous 12 month period

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4.2.3 Contingency Measures

Chevron recognises the need for adaptive management in the form of contingency measures and adjustments to the management strategies in the event of non-compliance with management procedures or if an unacceptable impact occurs. The reporting requirements will inform the decision-making process, which is detailed in Table 4.5.

The following are examples of management procedures that may be considered in the event that an injury or death of marine megafauna occurs attributable to Project-related vessel movements:

- If marine megafauna are sighted, relevant vessels operating in the area may be notified and the behaviour and direction of animal(s) may be monitored and recorded.
- Caution and No-approach zoning may be reviewed and distances increased.

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Table 4.5: Adaptive Management

Reporting	Reporting Content	Adaptive Management Strategy
Vessel Reporting Action D	Megafauna observations Management procedures invoked Management procedure non-compliance details	♦ Appropriate measures to correct non-compliance with environmental management procedures
Vessel Reporting Action E	Megafauna and injury observations (no vessel interaction)	♦ Investigation to determine if megafauna injury/death may be attributable to Project activities. If not attributable then no further action
Vessel Reporting Action F	Vessel strike. Megafauna and injury observations, management procedures invoked	♦ Current management strategies review ♦ Identification and implementation of potential interim management strategies that may be appropriate ♦ Identification and implementation of potential longer-term additional or alternative management strategies that may be appropriate ♦ Periodic review of effectiveness of management strategies
Vessel Reporting Action G	Vessel strike. Megafauna and injury observations, management procedures invoked and management procedure non-compliance details	♦ Appropriate measures to correct non-compliance with environmental management procedures ♦ Current management strategies review ♦ Identification and implementation of potential interim management strategies that may be appropriate ♦ Identification and implementation of potential longer-term additional or alternative management strategies that may be appropriate ♦ Periodic review of effectiveness of management strategies

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4.2.4 Roles and Responsibilities

Table 4.6 defines the key roles and responsibility of Project personnel, both Chevron-employed and contractor companies.

Table 4.6: Project Personnel and Key Responsibility

Role	Responsibility
Training Leaders	Facilitating training and induction sessions
Vessel Operators	Vessel condition
Vessel Master	Adherence to vessel management procedures, marine megafauna reporting
Vessel Crew	Adherence to vessel management procedures

4.2.5 Inductions and Training

Key personnel are required to attend environmental inductions and training relevant to their role on the Wheatstone Project. Table 4.7 presents the specific training and induction requirements of Project personnel, both Chevron-employed and contractor companies, involved in management of vessel strike on marine megafauna.

Table 4.7: Specific Training and Induction Requirements

<table>
<tr><th>Personnel</th><th>Details</th><th>Timing</th></tr>
<tr><td>Vessel skippers</td><td rowspan="2">Basic marine megafauna biology, ecologically important habitat areas and turtle nesting locations
Marine megafauna identification and behaviour
Potential impacts to marine megafauna relating to vessel movements
Overview of relevant legislation
Introduction to environmental management and reporting procedures</td><td rowspan="2">Prior to commencing activities in the Wheatstone Project area</td></tr>
<tr><td>Select Vessel crew</td></tr>
</table>

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4.3 Pile Driving Management

Environmental Objective:	Pile driving will be managed so that impacts from noise on marine megafauna species are reduced, as far as reasonably practicable.
Management Focus:	Turtles are deemed to be at highest risk from pile driving noise as they are most likely to occur in nearshore waters. Dugongs, coastal dolphins and Humpback Whales are deemed to be at some risk from pile driving noise as they are could occur in nearshore waters at some time.
Relevant Aspects:	Pile driving activities

4.3.1 Environmental Management Procedures

The following procedures have been put in place to manage adverse impacts to marine megafauna resulting from Project-related piling activities within the Project area.

- Section 4.3.1.1 details standard pile driving operating procedures.
- Section 4.3.1.2 details the procedures to be followed in case of a marine megafauna sighting.

4.3.1.1 Standard Environmental Pile Driving Procedures

- Piling operations will commence with a slow start/partial strike to encourage marine fauna to leave the area.
- Marine Fauna Observation Zone: The Piling Supervisor will monitor for marine mammals or turtles within the 1500 m around the pile hammer (Figure 4.5) during daylight hour operations, starting observation 30 minutes prior to start-up.
- In the case of concurrent pile driving activities, the observation and suspension zones will be applied to each active pile driving operation.

4.3.1.2 Marine Fauna Sighting Procedures

This section presents the management procedures to be followed if marine megafauna are sighted in the vicinity of the piling works. Site specific zones for piling works have been defined for the project as follows (Figure 4.5):

- Marine Fauna Observation Zone: The movement of marine megafauna sighted within 1500 m of the pile-hammer during or immediately prior to commencement of piling operations will be monitored.
- If a whale is present within the Marine Fauna Observation Zone for 30 minutes then pile driving activities will cease.
- Marine Mammal Suspension Zone: Pile driving activities will cease if marine mammals are observed within 500 m of the pile hammer.
- Turtle Suspension Zone: Pile driving activities will cease if turtles are observed within 100 m of the pile hammer.

Figure 4.6 further details the procedures to be followed in the event of marine megafauna observation. Reporting procedures, including those in the event of a sighting of injured or deceased marine megafauna, are detailed in Section 4.3.2.

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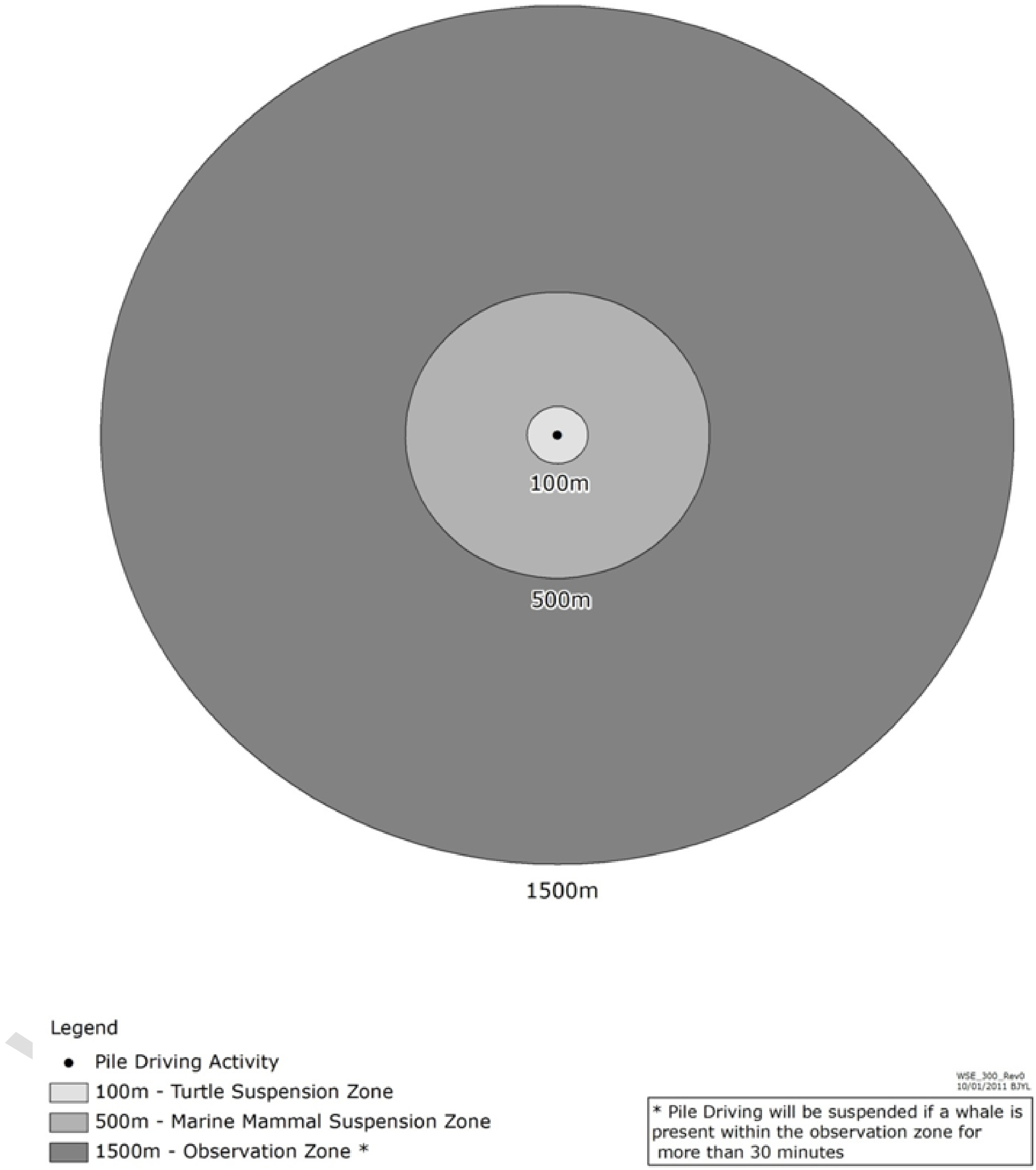
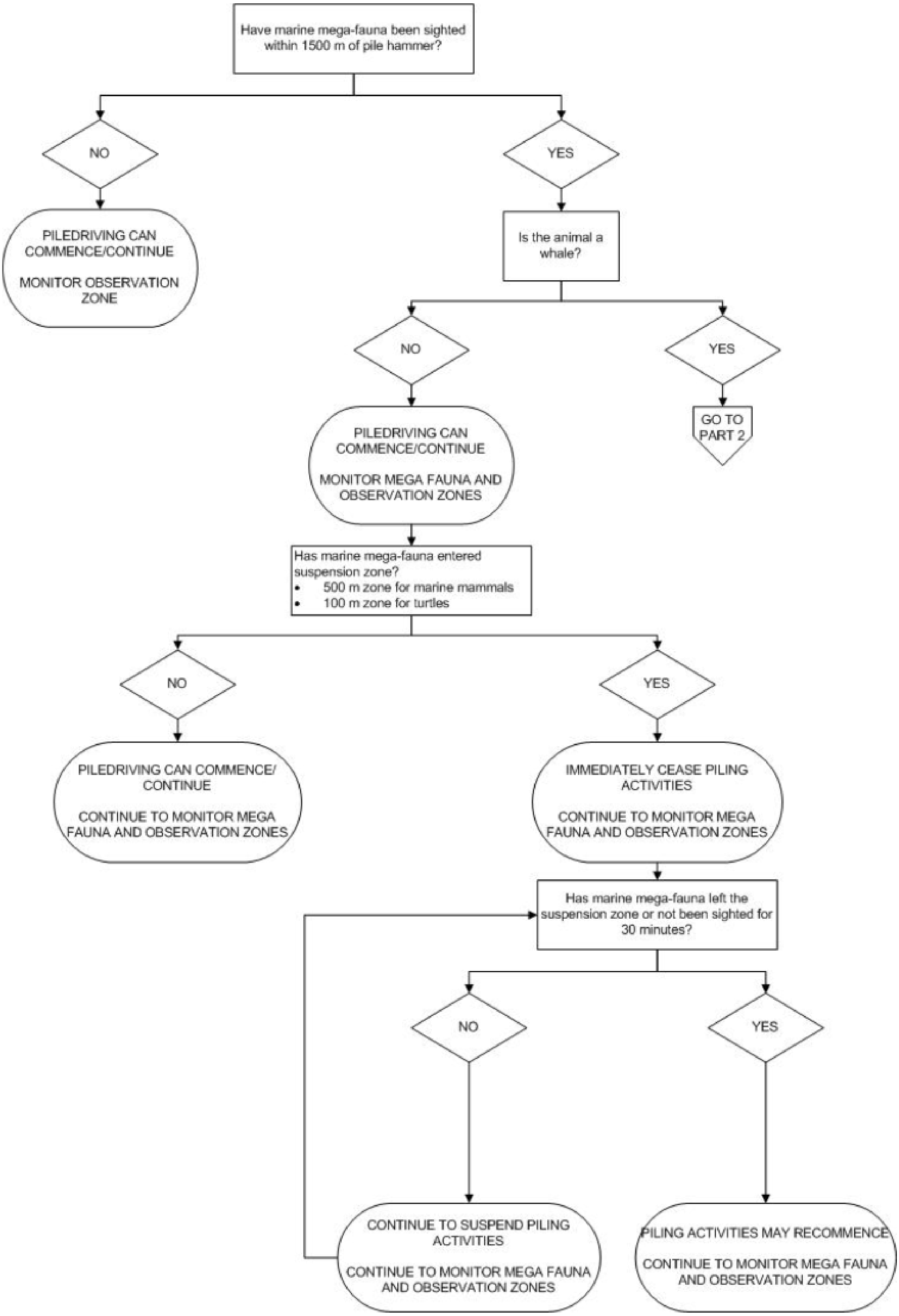


Figure 4.5: Piling Operations Zoning


Have marine mega-fauna been sighted within 1500 m of pile hammer?
NO
YES
PILEDRIVING CAN COMMENCE/CONTINUE
MONITOR OBSERVATION ZONE
Is the animal a whale?
NO
YES
GO TO PART 2
PILEDRIVING CAN COMMENCE/CONTINUE
MONITOR MEGA FAUNA AND OBSERVATION ZONES
Has marine mega-fauna entered suspension zone?
• 500 m zone for marine mammals
• 100 m zone for turtles
NO
YES
PILEDRIVING CAN COMMENCE/ CONTINUE
CONTINUE TO MONITOR MEGA FAUNA AND OBSERVATION ZONES
IMMEDIATELY CEASE PILING ACTIVITIES
CONTINUE TO MONITOR MEGA FAUNA AND OBSERVATION ZONES
Has marine mega-fauna left the suspension zone or not been sighted for 30 minutes?
NO
YES
CONTINUE TO SUSPEND PILING ACTIVITIES
CONTINUE TO MONITOR MEGA FAUNA AND OBSERVATION ZONES
PILING ACTIVITIES MAY RECOMMENCE
CONTINUE TO MONITOR MEGA FAUNA AND OBSERVATION ZONES

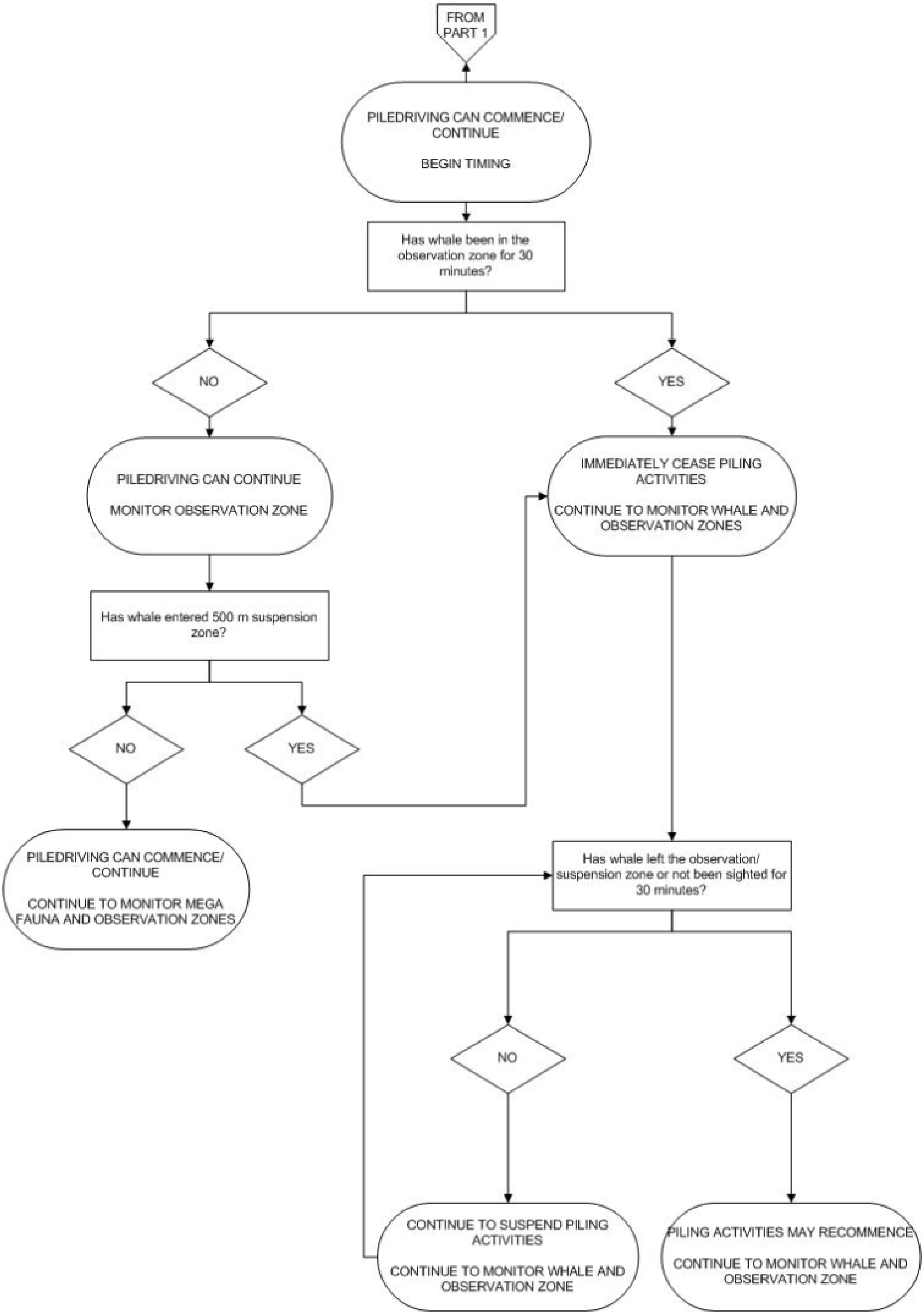


Figure 4.6 Piling Activities Procedures

4.3.2 Reporting

The Wheatstone Project will use a number of routine internal reporting formats to effectively implement the requirements of this MFMP.

Figure 4.7 depicts the reporting decision-making process for piling activities conducted within the Project area. The reporting requirements are detailed in Table 4.8.

- Any detected injury or mortality attributed to the Wheatstone Project of any marine species listed as specially protected under the provisions of Section 14 (2)(ba) of the *Wildlife Conservation Act 1950* (WA) or EPBC Act (Cth) shall be reported by Chevron to the DEC, and to also DSEWPC if the marine species is a turtle, within 48 hours of observation.

- Details of the incident – including time and date of incident, cause of injury/mortality (if known), location, and the species (if known) – will be documented in a Chevron Database and reported to DEC (Appendix F).

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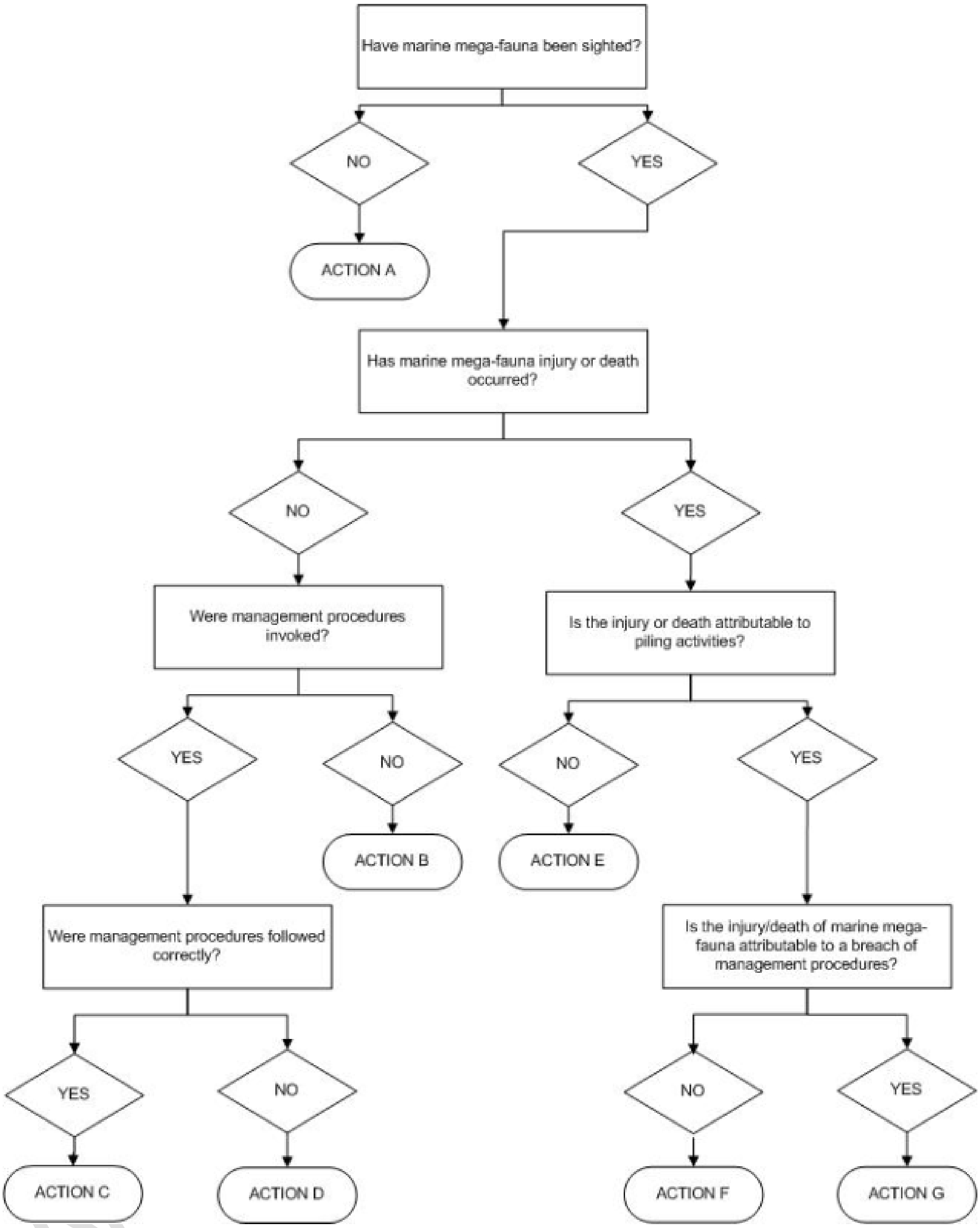

Figure 4.7 Piling Reporting Procedures

Table 4.8: Reporting Responsibilities

Reporting	Reporting Content	Responsible for Reporting	Reporting To	Timing
Action A Piling Reporting	No marine megafauna observations	Piling Supervisor	Chevron	*To be determined. Example:* Weekly to address previous 7-day period
Action B Piling Reporting	Megafauna observations (Humpback whale and turtle reporting only)	Piling Supervisor	Chevron	*To be determined. Example:* Weekly to address previous 7-day period
Action C Piling Reporting	Megafauna observations and management procedures invoked (Humpback whale and turtle reporting only)	Piling Supervisor	Chevron	*To be determined. Example:* Weekly to address previous 7-day period
Action D Piling Reporting	Megafauna observations, management procedures invoked and management procedure non-compliance details	Piling Supervisor	Chevron	*To be determined. Example:* Within 24 hours of management procedure breach
Action E Piling Reporting	Megafauna and injury observations (not attributable to piling activity)	Piling Supervisor	Chevron	*To be determined. Example:* Within 24 hours of observation
		Chevron	DEC / DSEWPC	Within 48 hours of observation
Action F Piling Reporting	Megafauna and injury observations	Piling Supervisor	Chevron	*To be determined. Example:* Within 24 hours of observation
		Chevron	DEC / DSEWPC	Within 48 hours of observation
Action G Piling Reporting	Megafauna and injury observations, management procedures invoked	Piling Supervisor	Chevron	*To be determined. Example:* Within 24 hours of observation
		Chevron	DEC / DSEWPC	Within 48 hours of incident
Compliance Assessment Report	Addresses the previous 12-month period.	Chevron	DEC	Annually to reflect the previous 12 month period

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4.3.3 Contingency Measures

Chevron recognises the need for adaptive management in the form of contingency measures and adjustments to the management strategies in the event of non-compliance with management procedures or if an unacceptable impact occurs. The reporting requirements will inform the decision-making process, which is detailed in Table 4.5.

The following are examples of management procedures that may be considered in the event that an injury or death of marine megafauna occurs attributable to Project-related piling activities:

- Suspension zones may be increased
- Turtles may be physically removed from the suspension zone and placed at a safe distance from activities, subject to approval from DSEWPC and assessment of potential health and safety implications.

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Table 4.9: Adaptive Management

Reporting	Reporting Content	Adaptive Management Strategy
Action D	Megafauna observations, management procedures invoked management procedure non-compliance details	♦ Appropriate measures to correct non-compliance with environmental management procedures
Action E	Megafauna and injury observations (deemed not related to piling activity, e.g. physical injury from other marine fauna)	♦ Investigation to determine if Megafauna injury/death may be attributable to Project activities. If not attributable then no further action.
Action F	Piling activity related Megafauna and injury observations (all megafauna), management procedures invoked (marine mammals and turtles)	♦ Current management strategies review ♦ Identification and implementation of potential interim management strategies that may be appropriate ♦ Identification and implementation of potential longer-term additional or alternative management strategies that may be appropriate ♦ Periodic review of effectiveness of management strategies
Action G	Piling activity related Megafauna and injury observations (all megafauna), management procedures invoked (marine mammals and turtles) and management procedure non-compliance details	♦ Appropriate measures to correct non-compliance with environmental management procedures ♦ Current management strategies review ♦ Identification and implementation of potential interim management strategies that may be appropriate ♦ Identification and implementation of potential longer-term additional or alternative management strategies that may be appropriate ♦ Periodic review of effectiveness of management strategies

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4.3.4 Roles and Responsibilities

Table 4.10 defines the key roles and responsibility of Project personnel, both Chevron-employed and contractor companies.

Table 4.10: Project Personnel and Key Responsibility

Role	Responsibility
Training Leaders	Facilitating training and induction sessions
Piling Operators	Adherence to piling operations management procedures
Piling Supervisor	Monitoring for marine megafauna Marine megafauna reporting

4.3.5 Inductions and Training

Key personnel are required to attend environmental inductions and training relevant to their role on the Wheatstone Project. Table 4.11 presents the specific training and induction requirements of Project personnel.

Table 4.11: Specific Training and Induction Requirements under this Plan.

Personnel	Details	Timing
Piling supervisor	Basic marine megafauna biology, ecologically important habitat areas and turtle nesting locations. Marine megafauna identification and behaviour. Potential impacts to marine megafauna relating to noise and vibration from piling activities. Overview of relevant legislation. Introduction to environmental management and reporting procedures.	Prior to commencing activities in the Wheatstone Project area
Select piling operations personnel		

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4.4 Blasting Activity Management

Environmental Objective:	Any blasting* will be managed so that any impacts on marine megafauna species are reduced, as far as reasonably practicable.
Management Focus:	Dugongs, turtles, coastal dolphins and Humpback Whales are deemed to be at highest risk from blasting in nearshore waters.
Relevant Aspects:	Blasting* *It is unlikely that blasting will be required during the Wheatstone Project. If blasting is confirmed as a part of the construction activities a separate Blasting Environment Management Plan (BEMP) will be developed.

It is improbable that blasting will occur. Should blasting take place then a Blasting Management Plan will be developed with Cetaceans, including Humpback Whale mother/calf pairs, Turtles, and Dugongs included as a management focus. Refer to Section 8.4.5.8 of the Wheatstone Draft EIS/ERMP for a preliminary literature review undertaken in the draft EIS regarding potential impacts to marine fauna associated with blasting activities and potential impact zones that have been applied.

4.4.1 Environmental Management Procedures

The following procedures have been put in place to manage adverse impacts to marine megafauna resulting from Project-related blasting activities within the Project area.

- Section 4.4.1.1 details standard blasting operating procedures
- Section 4.4.1.2 details the procedures to be followed in case of a marine megafauna sighting.

4.4.1.1 Standard Environmental Blasting Procedures

- Blasting operations will commence with a succession of small charges to encourage marine fauna to leave the area
- Marine Fauna Observation Zone: The blasting supervisor will be on duty to monitor for marine mammals or turtles within an appropriate zone* around the charge locations during and immediately prior to commencement of blasting operations, starting observations 30 minutes prior to starting blast.

  **Should blasting become part of the Wheatstone Project, appropriate observation and suspension zones will be developed.*

Humpback whales, including mother/calf pairs, dolphins, Dugongs and turtles will be a management focus for blasting activities.

Refer to Section 8.4.5.8 of the Wheatstone Draft EIS/ERMP for a preliminary literature review regarding potential impact zones to marine fauna and the previous approaches that have been applied.

4.4.1.2 Marine Fauna Sighting Procedures

This section presents the management procedures to be followed if marine megafauna are sighted in the vicinity of blasting operations. Site specific impact zones for blasting will be developed, should blasting become part of the Wheatstone Project. These will be:

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- Marine Fauna Observation Zone: The movements of marine megafauna sighted within an appropriate zone of the charge site during or immediately prior to commencement of blasting operations will be monitored
- Marine Fauna Suspension Zone: Charges will not be detonated if marine megafauna are observed within an appropriate zone of the charge site.

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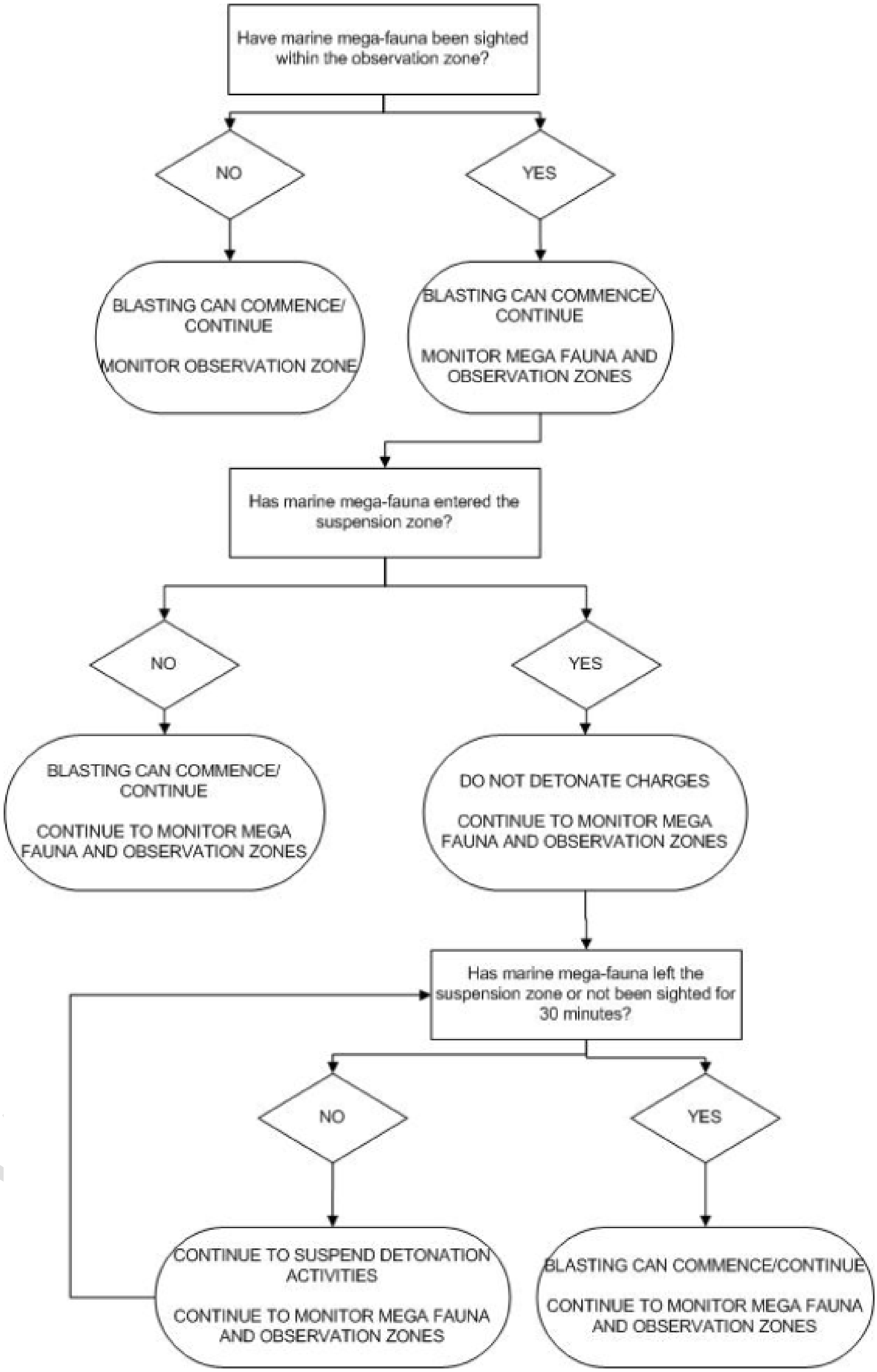

Figure 4.8: Marine Fauna Sighting Procedures

4.4.2 Reporting

The Wheatstone Project will use a number of routine internal reporting formats to effectively implement the requirements of this MFMP.

Figure 4.9 depicts the reporting decision-making process for piling activities conducted within the Project area. The reporting requirements are detailed in Table 4.12.

- Any detected injury or mortality attributed to the Wheatstone Project of any marine species listed as specially protected under the provisions of Section 14 (2)(ba) of the *Wildlife Conservation Act 1950* (WA) or the *EPBC Act* (Cth) shall be reported by Chevron to the DEC, and to also DSEWPC if the marine species is a turtle, within 48 hours of observation.

- Details of the incident – including time and date of incident, cause of injury/mortality (if known), location, and the species (if known) – will be documented in a Chevron Database and reported to DEC and DSEWPC (Appendix F).

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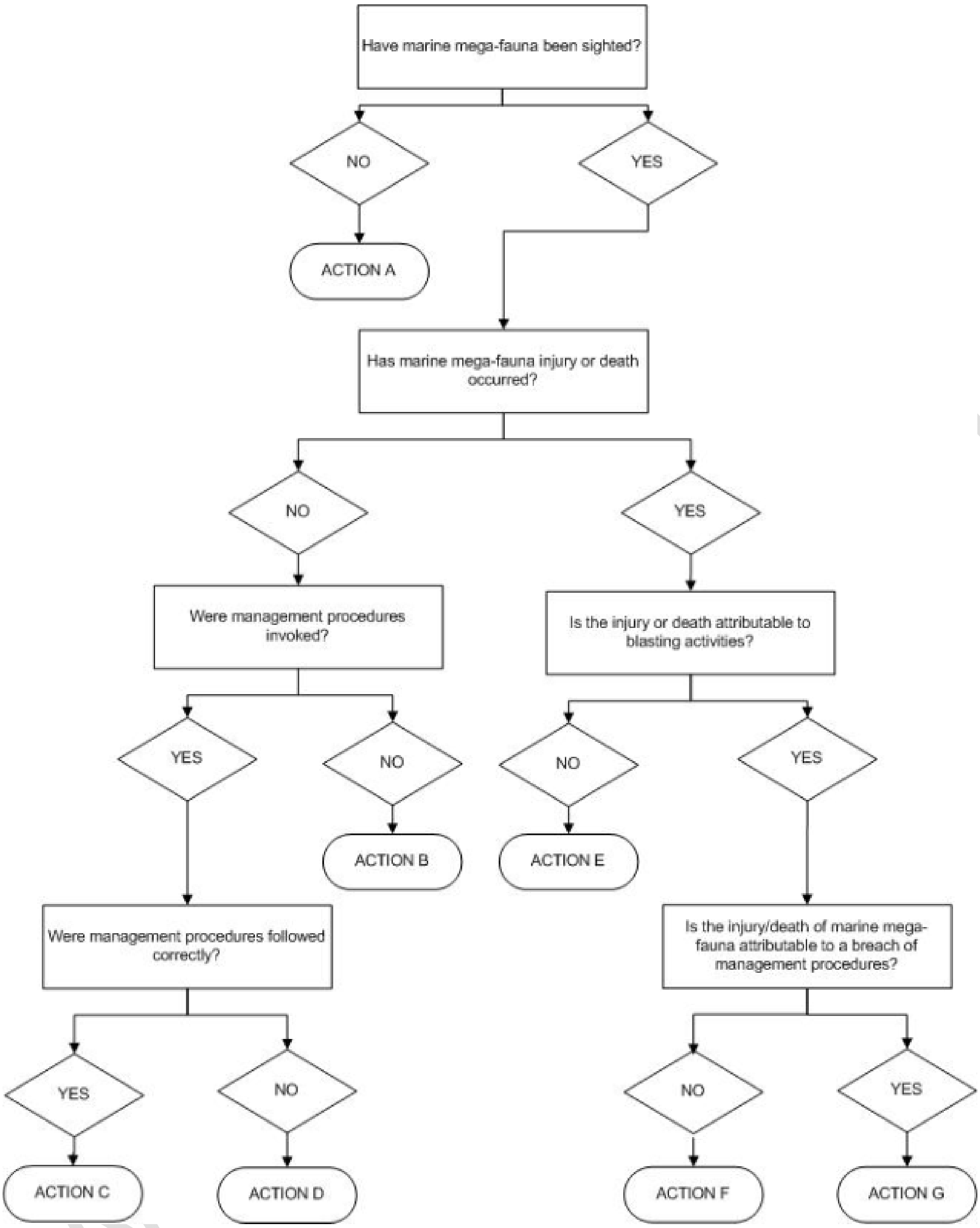

Figure 4.9: Reporting Procedures

Table 4.12: Reporting Responsibilities

Action	Reporting Content	Responsible for Reporting	Reporting To	Timing
A	No marine megafauna observations	Blasting Supervisor	Chevron	*To be determined. Example:* Weekly to address previous 7-day period
B	Megafauna observations (Humpback whale and turtle reporting only)	Blasting Supervisor	Chevron	*To be determined. Example:* Weekly to address previous 7-day period
C	Megafauna observations and management procedures invoked (Humpback whale and turtle reporting only)	Blasting Supervisor	Chevron	*To be determined. Example:* Weekly to address previous 7-day period
D	Megafauna observations, management procedures invoked and management procedure non-compliance details	Blasting Supervisor	Chevron	*To be determined. Example:* Within 24 hours of management procedure breach
E	Megafauna and injury observations (no blasting activity interaction)	Blasting Supervisor	Chevron	*To be determined. Example:* Within 24 hours of observation
		Chevron	DEC / DSEWPC	Within 48 hours of observation
F	Megafauna and injury observations	Blasting Supervisor	Chevron	*To be determined. Example:* Within 24 hours of observation
		Chevron	DEC / DSEWPC	Within 48 hours of observation
G	Megafauna and injury observations, management procedures invoked	Blasting Supervisor	Chevron	*To be determined. Example:* Within 24 hours of observation
		Chevron	DEC / DSEWPC	Within 48 hours of incident
Compliance Assessment Report	Addresses the previous 12-month period.	Chevron	DEC	Annually to reflect the previous 12 month period

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4.4.3 Contingency Measures

Chevron recognises the need for adaptive management in the form of contingency measures and adjustments to the management strategies in the event of non-compliance with management procedures or if an unacceptable impact occurs. The reporting requirements will inform the decision-making process, which is detailed in Table 4.5.

The following are examples of management procedures that may be considered in the event that an injury or death of marine megafauna occurs attributable to Project-related blasting activities:

- Suspension zones may be increased
- Turtles may be physically removed from the suspension zone and placed at a safe distance from activities, subject to approval from DSEWPC and assessment of potential health and safety implications.

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Table 4.13: Adaptive Management

Reporting	Reporting Content	Adaptive Management Strategy
Action D	Megafauna observations management procedures invoked management procedure non-compliance details	♦ Appropriate measures to correct non-compliance with environmental management procedures
Action E	Megafauna and injury observations (deemed not related to blasting activity, e.g. physical injury from other marine fauna)	♦ Investigation to determine if Megafauna injury/death may be attributable to Project activities. If not attributable then no further action.
Action F	Blasting activity related Megafauna and injury observations (all megafauna), management procedures invoked (marine mammals and turtles)	♦ Current management strategies review ♦ Identification and implementation of potential interim management strategies that may be appropriate ♦ Identification and implementation of potential longer-term additional or alternative management strategies that may be appropriate ♦ Periodic review of effectiveness of management strategies
Action G	Blasting activity related Megafauna and injury observations (all megafauna), management procedures invoked (marine mammals and turtles) and management procedure non-compliance details	♦ Appropriate measures to correct non-compliance with environmental management procedures ♦ Current management strategies review ♦ Identification and implementation of potential interim management strategies that may be appropriate ♦ Identification and implementation of potential longer-term additional or alternative management strategies that may be appropriate ♦ Periodic review of effectiveness of management strategies

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4.4.4 Roles and Responsibilities

Table 4.14 defines the key roles and responsibility of Project personnel, both Chevron-employed and contractor companies.

Table 4.14: Project Personnel and Key Responsibility

Role	Responsibility
Training Leaders	Facilitating training and induction sessions
Blasting Operators	Adherence to blasting operations management procedures
Blasting supervisor	Monitoring for marine megafauna Marine megafauna reporting

4.4.5 Inductions and Training

Key personnel are required to attend environmental inductions and training relevant to their role on the Wheatstone Project. Table 4.15 presents the specific training and induction requirements of Project personnel.

Table 4.15: Specific Training and Induction Requirements under this Plan

Personnel	Details	Timing
Blasting Operators key personnel	Basic marine megafauna biology and ecologically important habitat areas. Marine megafauna identification and behaviour. Potential impacts to marine megafauna relating to blasting activities. Overview of relevant legislation Introduction to environmental management and reporting procedures.	Prior to commencing activities in the Wheatstone Project area.
Blasting supervisor		

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4.5 Vertical Seismic Profiling Management

The following management measures will be followed for VSP activities associated with the Project:

- Pre-start-up Visual Observations: Visual observations would be undertaken within the observation zone by a suitably trained crew member for at least 30 minutes before the commencement of the soft start procedure. Observation zone to include a 3km horizontal radius from the VSP acoustic source.
- Soft Start-Up Procedures: The VSP acoustic source would be initiated at the lowest setting, with a gradual ramp-up of the acoustic source over a 20 minute period until the full operating power level is reached.
- Operating Procedures: While the VSP acoustic source is operating the following procedures would be implemented:
  - Visual observations of the observation zone will be maintained continuously to identify if any whales are present
  - At the event of sighting a whale within the observation zone the operator of the acoustic source will be placed on stand-by to power down the acoustic source
  - At the event of sighting a whale entering the shut-down zone (a 500m horizontal radius from the VSP acoustic source) the acoustic source will be shut down completely.
- Low Visibility Operating Procedures: During periods of low visibility, where the observation zone cannot be clearly viewed out to 3 km (including night time), the VSP source will be utilised as described above, provided that during the preceding 24 hour period:
  - There have not been 3 or more whale instigated shut down situations
  - A two-hour period of continual observations was undertaken in good visibility (to the extent of the observation zone) and no whales were sighted.

  If these conditions are not satisfied then the VSP will not be utilised.
- Any detected injury or mortality attributed to the Wheatstone Project of any marine species listed as specially protected under the provisions of Section 14 (2)(ba) of the *Wildlife Conservation Act 1950* (WA) or the *EPBC Act* (Cth) shall be reported by Chevron to the DEC, and to also DSEWPC if the marine species is a turtle, within 48 hours of observation.
- Details of any incident – including time and date of incident, cause of injury/mortality (if known), location, and the species (if known) – will be documented in a Chevron Database and reported to the DEC.

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5.0 REFERENCES

Chevron Australia. 2008a. *Incident Investigation and Reporting.* Chevron Australia, Perth, Western Australia.

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Department of Environment and Heritage (DEH), 2005. *Australian National Guidelines for Whale and Dolphin Watching 2005*. Department of Environment and Heritage.

Department of Environment, Water, Heritage and the Arts (DEWHA), 2008. *The north-west marine bioregional plan: Bioregional profile: a description of the ecosystems, conservation values and uses of the north-west marine region*. Australian Government Department of the Environment, Water, Heritage and the Arts.

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APPENDIX A: WHEATSTONE ENVIRONMENTAL MANAGEMENT PROGRAM (HIERARCHY OF DOCUMENTATION)

This MFMP will be implemented for the Wheatstone Project via the Wheatstone Environmental Management Program. The Wheatstone Environmental Management Program is structured into three tiers of management which reflects the cascading but interconnected nature of documentation required for Chevron to meet its environmental obligations.

Tier 1 of the program comprises Chevron Corporation's Operational Excellence Management System (OEMS) as well as Chevron's Australasia Business Unit (ABU) Policy 530 which is central to the implementation of the OEMS in Australia.

Tier 2 of the Environmental Management Program comprises a set of OBCs and associated Statutory Environmental Management Plans (EMPs) (Table 6.1). The list of proposed Statutory EMPs is based on regulatory triggers from the EP Act (WA), EPBC Act (Cth), or the specific project guidelines that have been approved by the EPA and DSEWPC for this Project.

Tier 3 comprises a set of Subsidiary Plans which are defined as those environmental plans which are required by and/or impose relevant legal obligations on Chevron under legislation, but are not legally binding under the Ministerial Approvals of the EIS/ERMP. Management plans which are required for Chevron internal purposes but which are not legally binding in their own right are also included in the list of Subsidiary Plans. Subsidiary Plans will not be submitted for Ministerial Approval with the EIS/ERMP (Table 6.2).

Key Western Australian and Commonwealth legislation relating to onshore, nearshore (State waters) and offshore (Commonwealth waters) components of the Project have been considered in developing Tier 3 of the Environmental Management Program.

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Table A1.1: Statutory Environmental Management Plans

Plan	Purpose
Dredging and Spoil Disposal Management Plan (DSDMP)	The purpose of the DSDMP is to reduce additional loss of benthic primary producer habitat (BPPH) to that specified in the EIS/ERMP for the nearshore coastal waters as a result of Chevron's dredging and spoil disposal operations.
Coastal Processes Management Plan (CPMP)	The purpose of the finalised CPMP is to reduce potential Project-attributable impacts to coastal processes associated with the placement of project marine infrastructure of the Wheatstone Project.
Construction Environmental Management Plan (CEMP)	The purpose of the CEMP is to reduce the Project-attributable impacts of onshore construction (vegetation clearing, earthworks, vehicle access) and nearshore installation (rock placement, piling, and shipping) associated with the Wheatstone Project.
Operations Environmental Management Plan (OEMP)	The purpose of the OEMP is to reduce the Project-attributable impacts of onshore operations and associated activities including, LNG and Domgas production, FIFO operations, vehicle access and product shipping associated with the Wheatstone Project.
Decommissioning Environmental Management Plan (DEMP)	The purpose of the DEMP is to reduce Project-attributable impacts of all activities associated with the shutdown and decommissioning of the Wheatstone Project at the end of the project lifespan.

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Table A1.2: Subsidiary Plans and Secondary Permit Requirements

Plan / Permit	Legislation	Regulator
Shipping & Navigation Plan	Navigable Waters Regulations 1958 - (WA)	WA Department of Infrastructure and Planning
SAP Report and Sea Dumping Permits	Environmental Protection (Sea Dumping) Act 1981 - (Cth)	WA Department of Mines & Petroleum (DMP)
Offshore Drilling Environment Plans (for each campaign)	Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGSA) - (Cth)	DMP
Offshore Installation and Commissioning EP	OPGGSA	DMP
Offshore Operations EP	OPGGSA	DMP
Offshore Decommissioning EP	OPGGSA	DMP
Marine Pipeline Installation EMP (WA) and EP (Cth)	Petroleum (Submerged Lands) Act 1982 (PSLA) - (WA) OPGGSA	DMP
Offshore Oil Spill Contingency Plans	PSLA OPGGSA	DMP
Onshore Pipeline Installation EMP	*Petroleum Pipelines Act 1969 - (WA)*	DMP
Onshore Oil Spill Contingency Plan	*Petroleum and Geothermal Energy Resources Act 1967 - (WA)*	DMP
Mosquito Management Plan	*Environment Protection Act 1986 (WA)*	WA Department of Health
Aboriginal Cultural Heritage Plan	*Aboriginal Heritage Act 1972 - (WA)*	WA Department of Indigenous Affairs
Old Onslow Townsite Development and Impact Mitigation Plan	*Heritage of WA Act 1990 - (WA)*	Heritage Council of WA

N.B. This list may change dependent on changes to project design and subsequent consultation with relevant agencies

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APPENDIX B: DRAFT ENVIRONMENTAL AWARENESS GUIDELINE SHEET FOR BOATERS AND FISHERS

Introduction

Potential impacts to marine fauna associated with recreational activities and use of the island Nature Reserves from workforce include:

- Change to fish abundance and population size structure
- Boat strikes to Cetaceans, Dugongs and turtles
- Disturbance to nesting birds and turtles on islands
- Entanglement or ingestion of debris (e.g. fishing lines) by marine fauna.

These guidelines have been developed to educate the workforce and reduce the risk posed to marine fauna from recreational activities.

Compliance with the guidelines is encouraged by Chevron.

Marine-Based Recreational Activities Guidelines

The guidelines will include, but not be limited to, the following:

Fishing

- Ensure that you are aware of, and adhere to, the fishing regulations.
- Ensure you are in possession of the correct fishing licence during your fishing activities.
- Some species, such as sawfish, are protected by law. You must not deliberately target these animals when fishing and must return them back alive to the water if accidentally caught.
- Take care to dispose of unwanted fishing line responsibly.
- The use of biodegradable fishing line is encouraged.

Boating

- Recreational vessels should be launched at recognised boat ramps or launching areas.
- Keep engines in good condition to reduce the likelihood of leaks and spills of fuel, oil or pollutants.
- Keep equipment and supplies for cleaning up in the case of spilt fuel oil, and dispose of in an appropriate facility.
- Avoid refuelling at sea. Refuelling should take place on-shore or at a marina if possible.
- Conduct boat repairs on-shore if possible to reduce the chance of leaks and spills entering the marine environment.
- Don’t use chemical cleaning products when the vessel is in the water.
- Limit vessel speed limits to 10 knots in water depths of 10 m or less and when operating within 1 km of islands to reduce the risk of accidentally striking turtles or Dugongs.
- Wear polarised sunglasses and always look in the direction of travel to make it easier to spot and avoid turtles, Dugongs, whales and dolphins.
- Use anchors over sand and not on corals, which are easily damaged.

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Islands

- Care should be taken that no feral animals are introduced to the islands.
- Walking on exposed/shallow coral reefs should not take place.
- Nesting turtles or hatchlings should not be approached.
- Lights should not be directed on nesting turtles or hatchlings.
- Marine-derived souvenirs should not be collected.
- Take all your litter back with your and dispose of responsibly.
- Contact DEC before undertaking island visits to ensure that access is permitted (permits may be required for some islands).

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APPENDIX C: WHEATSTONE PROJECT MARINE MEGAFAUNA SPECIES IDENTIFICATION GUIDE

Images within this marine megafauna species identification guide will be updated prior to the commencement of construction to show species from a similar viewpoint to that from a vessel in order to maximise the potential for correct identification. Additional images will also be included that show unique or characteristic features of marine species to further assist identification.

Table C1.1: Humpback Whale Identification Guide

Humpback whale (*Megaptera novaeangilae*)			
Length	**Notable Behaviour**	**Habitat**	**Seasonality**
♦ Calves: 4 - 4.6 m. ♦ Adults: 16 – 17 m (males slightly smaller).	♦ Typically alone or in small groups (i.e. cow-calf or female-male escort pairs). ♦ Variety of surface activity/behaviours (breaching, male competition, flipper slapping, etc.). ♦ During southern migration, whales resting and milling close to shore.	♦ Long migrations through deep waters. ♦ Travel close to shore (<20 km from coast) in shallow water close to 50 m isobath. ♦ Possibly seen between coast and Thevenard Island.	♦ Migration through the Project area between June – November.

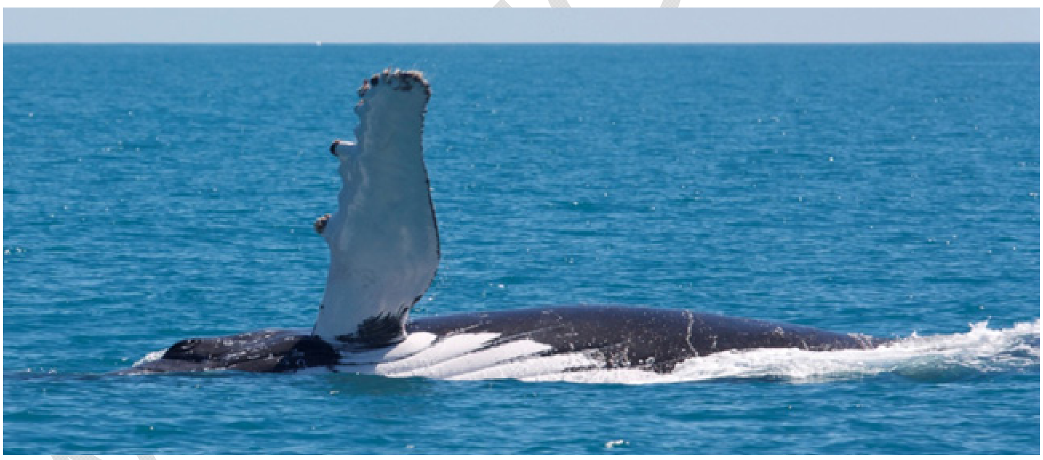

Image donated by Simon Allen, Murdoch University WA

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Table C1.2: Coastal Dolphin Identification Guide

Bottlenose dolphins (Tursiops sp.)

Indo-Pacific bottlenose dolphin (*Tursiops aduncus*)

Common bottlenose dolphin (*Tursiops truncatus*)

Indo-Pacific humpback dolphin *(Sousa chinensis)*

Species	Length	Notable Behaviour	Habitat	Seasonality
Common bottlenose dolphin (*T truncatus)*	♦ Calves: 0.84–1.4 m ♦ Adults: approx. 2.5 – 4 m	♦ Often observed bow-riding and approaching vessels. ♦ Small groups (2 – 15 individuals) in bays. ♦ Large groups (tens or hundreds) offshore.	♦ Coastal habitats: bays, estuaries, and rivers mouths. ♦ Offshore habitats: pelagic deep water.	♦ Commonly occurring within the Project area throughout the year.
Indo-Pacific bottlenose dolphin (*T. aduncus*)	♦ Calves: 0.84 – 1.12 m ♦ Adults: 2.6 m	♦ Often observed bow-riding and approaching vessels. ♦ Groups vary from small (5 – 15 individuals) to large (tens to hundreds). ♦ Mix with groups of other dolphin species. ♦ Often groups of 2-3 swim in sync; females present in family groups of different-sized animals, including juveniles and calves.	♦ Shallow waters (< 30 m deep), often close to the shore.	♦ Commonly occurring within the Project area throughout the year.
Indo-Pacific humpback dolphin (*Sousa chinensis*)	♦ Calves: 1 m ♦ Adults: approx. 2.5 – 2.8 m	♦ Usually swimming slowly (approx. 5 km/h). ♦ Little and brief surface activity. ♦ Do not approach boats or bow-ride.	♦ Coastal, turbid habitats: bays, estuaries, mangrove forests, sandbanks. ♦ Shallow areas (< 20 m deep). ♦ Close to freshwater inputs.	♦ Commonly occurring within the Project area throughout the year.

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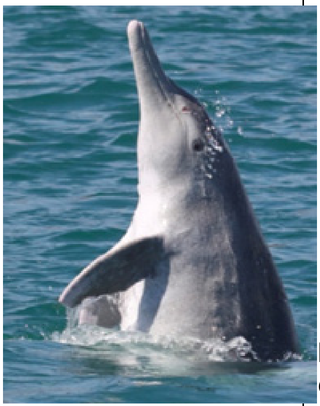
	 **Indo-Pacific bottlenose dolphin (*Tursiops aduncus*)**	 **Indo-Pacific humpback dolphin *(Sousa chinensis)***	 **Indo-Pacific humpback dolphin *(Sousa chinensis)***
	Images donated by Simon Allen, Murdoch University WA		

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Table C1.3: Dugong Identification Guide

Length	Notable Behaviour	Habitat	Seasonality
♦ Calves: 1.15 m ♦ Adults: 3.3 - 4.1 m ♦	♦ Usually swimming at slow speeds (<10 km/h). ♦ Feeds on bottom vegetation leaving trails of cropped plants. ♦ Spends most time on seafloor (< 10 m deep) and surfaces only to breathe. ♦ Dugong calves often stay over their mothers' backs (rendering them susceptible to boat strikes). ♦ Usually seen as single individuals or as cow-calf pairs.	♦ Primary habitats are close to the coast or in the lee of reef-fringed islands. ♦ Seagrass meadows or sandy areas where seagrass may be present in patches.	♦ Present throughout the year in nearshore waters throughout the Project area, particularly in close proximity to seagrass beds. ♦
HOLD: Image to be confirmed and supplied			

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Table C1.4: Turtle Identification Guide

Marine Turtles				
Species	**Length**	**Notable Behaviour**	**Habitat**	**Seasonality**
Green turtle (*Chelonia mydas*)	♦ Hatchlings: 0.05 m ♦ Adults: 0.91 m ♦ circular or heart shaped carapace/shell	♦ Adults seen feeding on seagrass and algae, and in mangrove areas. ♦ Generally solitary individuals, swimming on surface or within water column. ♦ Nesting on beaches. ♦ Resting on seafloor. ♦ Surface to breathe.	♦ Typical foraging habitat of shallow seagrass or algae beds. ♦ Juveniles and adults foraging habitat in reefs surrounding islands offshore from Ashburton North. ♦ Nesting habitats on steeply-sloped beaches on islands near the Project area. ♦ Internest areas in shallow, inshore waters (<20 m deep).	♦ Likely resident in nearshore waters of Project area throughout the year. ♦ Peak mating periods: October – December. ♦ Peak nesting period: December – February. ♦ Peak period when hatchlings emerge from nests: February – April.

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Marine Turtles				
Species	**Length**	**Notable Behaviour**	**Habitat**	**Seasonality**
Flatback turtle (*Natator depressus*)	♦ Hatchlings: 61 mm ♦ Adults: 0.92 m ♦ dome shaped carapace/shell	♦ Adults seen feeding mainly in shallow, soft-bottom habitats. ♦ Generally solitary individuals, swimming on surface or within water column. ♦ Hatchlings swim near shore and foraging habitats ♦ Nesting on beaches. ♦ Resting on seafloor. ♦ Surface to breathe.	♦ Foraging habitats include soft-bottom areas, such as the area between Barrow Island and Muiron Islands (20–100 m). ♦ Nesting areas include beaches with narrow slope, predominantly on islands near Project area (Ashburton River Delta and Ashburton Island). ♦ Internesting habitats in shallow, inshore areas within 5-10 km of nesting beach.	♦ Likely resident in nearshore waters of the Project Area throughout the year. ♦ Peak mating periods: November – December. ♦ Peak nesting period: December – January. ♦ Peak period when hatchlings emerge from nests: January – March.

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Marine Turtles				
Species	**Length**	**Notable Behaviour**	**Habitat**	**Seasonality**
Hawksbill turtles (*Eretmochelys imbricata*)	♦ Hatchlings: 0.042 m ♦ Adults: 0.63-0.9 m ♦ (highly domed and heart shaped shell, with parrot like beak)	♦ Generally solitary individuals, swimming on surface or within water column. ♦ Nesting on beaches. ♦ Resting on seafloor. ♦ Surface to breathe.	♦ Mating habitats include shallow waters close to nesting beaches. ♦ Foraging habitats are on or near coral reefs. ♦ Nesting habitats on island beaches near the Project area. ♦ Internesting habitats in shallow, inshore waters within several kilometres of nesting beach.	♦ Likely to be resident in nearshore waters of the Project area throughout the year. ♦ Peak mating periods: September – October. ♦ Peak nesting period: October – December. ♦ Peak period when hatchlings emerge from nests: November – February.
	HOLD: Images to be confirmed and supplied			

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Table C1.5: Sawfish Identification Guide

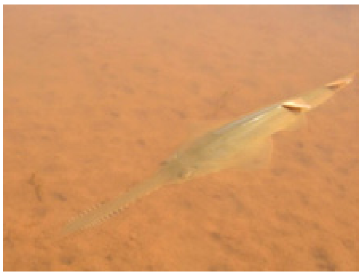
Green Sawfish			
Length	**Notable Behaviour**	**Habitat**	**Seasonality**
♦ Adults: 5 m	♦ May be seen feeding on shoaling fish (such as mullet) by stunning prey with sideswipes of the snout.	♦ Marine waters, estuaries, river mouths, embankments and waters along sandy and muddy beaches. ♦ Very shallow water (<1 m) to water depths of over 70 m.	♦ Pup during the wet season (January).
			

Table C1.6: Whale Shark Identification Guide

Whale Shark			
Length	**Notable Behaviour**	**Habitat**	**Seasonality**
♦ Adults: up to 12 m	♦ Largely solitary ♦ Slow swimmer ♦ Non-aggressive ♦ Can be observed swimming close to the surface as well as diving deeply ♦ ♦	♦ Offshore waters. ♦	♦ Mid-March to mid-May, but potentially in other months ♦
HOLD: Images to be confirmed and supplied			

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APPENDIX D: SAWFISH MANGEMENT SUMMARY REPORT

Introduction

Chevron Australia Pty Ltd (Chevron) proposes to construct and operate a multi-train Liquefied Natural Gas (LNG) plant and a domestic gas (Domgas) plant at Ashburton North, 12 km south-west of Onslow on the Pilbara coast of Western Australia (WA). The plant will initially process gas from the Wheatstone natural gas fields, approximately 200 km offshore from Onslow in the West Carnarvon Basin. The Wheatstone Project will require the installation of gas gathering, exporting and processing facilities in Commonwealth and state waters and in the Shire of Ashburton. The LNG plant will be located in the Ashburton North Strategic Industrial Area and have a combined maximum capacity of 25 million tonnes per annum (MTPA) of LNG.

The Wheatstone Project is currently subject to an environmental approvals process, and is being assessed by the WA Environmental Protection Authority (EPA) and the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC, formerly DEWHA) via a joint Environmental Impact Statement/Environmental Review and Management Program (EIS/ERMP) document (Chevron 2010). Chevron submitted the draft EIS/ERMP to the EPA and DEWHA in June 2010 and it was released for public comment in July 2010.
Green sawfish (*Pristis zijsron*) have been recorded near the Project Area within the north-eastern lagoon of the Ashburton Delta and in Hooley Creek (URS 2010a). More recently, juveniles were caught and released within the north-eastern lagoon of the Delta and Hooley Creek as part of ongoing biodiversity surveys in the Project Area. Risk to sawfish populations and their habitat was raised as a concern during the EIS assessment and review phase.

The purpose of this report is to summarise the suite of environmental risk management strategies that will be employed by the Wheatstone Project so that potential impacts to sawfish populations and habitat are reduced, as far as reasonably practicable. A key commitment by Chevron is to limit disturbance to sawfish habitat in the Project Area. Thus, Hooley Creek and Ashburton Delta, two know habitats for juveniles, will remain unaltered as a result of Project activities. This report focuses on the green sawfish because it has been confirmed within the Project Area, however management is likely to be applicable to all species. A survey will be undertaken in summer 2011 to describe sawfish population demographics, movement patterns and site fidelity.

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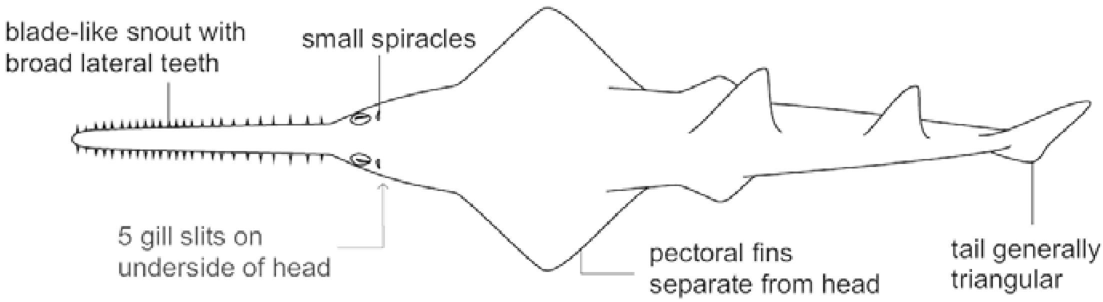
Biological Overview

Description

Sawfishes are large and highly mobile modified rays that possess a long rostrum with lateral teeth, resembling a saw (Pogonoski et al. 2002) (Figure 5.1).



Source: McAuley et al 2002

Figure 5.1: Generalised Sawfish Anatomy

Four sawfish species occur in Australia, all with high conservation status (Table E1.1, Appendix E). These are:

- Green Sawfish (*Pristis zijsron)*
- Freshwater Sawfish *(Pristis microdon)*
- Dwarf Sawfish *(Pristis clavata)*
- Narrow Sawfish *(Anoxypristis cuspidata)*

Of these species, the first three have been reported in the southern Pilbara (Morgan, 2010). The green sawfish has been observed near the Project Area within the north-eastern lagoon of the Ashburton Delta and in Hooley Creek in late 2009 (URS 2010a). In November 2010, six to eight sawfish of varying sizes were observed. During a netting survey to assess biodiversity in these two areas, three green sawfish, ranging from 1.2 m to 2 m in length, were caught and released (F Well [URS] 2010, pers comm).

Habitat and Behaviour

Potential sawfish habitat in the Project Area is presented in
Figure 5.2. Known habitat for juveniles is the Ashburton Delta and Hooley Creek. Similar habitat, in the form of lagoons and creeks, is found east and west of the Project Area (Figure 5.2). The distribution of sawfish in these creeks is predicted to vary spatially and seasonally due to tidal movement and other environmental conditions. Adults are known to frequent coastal waters in the Pilbara (Newman et al. 2003).

Sawfish are bottom dwellers inhabiting coastal, estuarine and/or freshwater habitats in warm-temperate to tropical regions (Pogonoski et al. 2002; McAuley 2002; Last and Stevens 2008; Morgan 2010). Sawfish predate upon slow-moving shoaling fish such as mullet, which they stun using their rostrum but also molluscs and crustaceans which are collected through sweeping their rostrum through mud or sand bottoms (Pogonoski et al. 2002).

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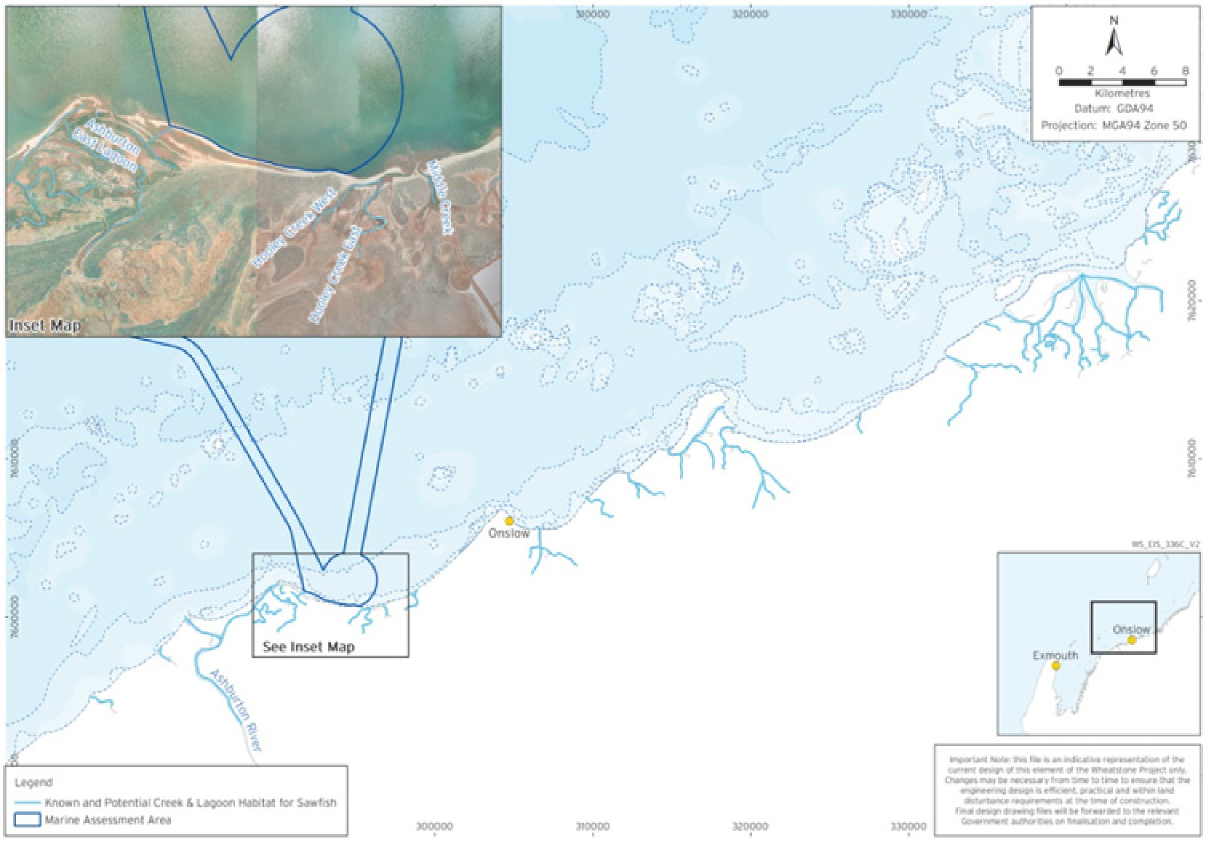

Figure 5.2: Known and Potential Sawfish Creek and Lagoon Habitat in the Project Area and Adjacent Areas

Juveniles and sub-adult green sawfish prefer inshore marine coastal areas, as well as estuaries, river mouths, creeks and bays at slightly reduced salinities, but do not venture into freshwater (DSEWPaC 2010a). Adults will utilise coastal waters and offshore waters in water depths of 70 m or more (Department of Fisheries 2010).

Sawfish typically return to inshore coastal waters to breed and pup (give birth) on a seasonal basis. Green sawfish are reported to breed and pup in January, during the wet season (DSEWPC 2010a and Department of Fisheries 2010). Sawfish daily movements are poorly understood. Stevens et al. (2008) reported that sawfish appear to occupy restricted areas, moving only small distances. Acoustic tracking data of an adult green sawfish indicates continuous movement with no rest periods (Stevens et al. 2005).

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Potential Impacts

Key Potential Impacts

Key potential impacts are habitat loss or alteration through:

- Habitat infilling (e.g. rock breakwaters)
- Habitat removal (e.g. dredging)
- Unplanned leaks or spills
- Changes in coastal processes, as a secondary Project impact resulting in habitat modification.

Table presents the potential for direct infilling or removal to occur in each of the sawfish habitats in the vicinity of the Wheatstone Project area.

Table D1.1: Potential for Infilling or Removal of Sawfish Habitat in the Vicinity of the Wheatstone Project Area

Type of Habitat Impact and Where Described	Hooley Creek	Ashburton Delta East Lagoon	Nearshore Waters Opposite Proposed Plant Site
Infilling of habitat (Ch 2 EIS/ERMP)	No	Yes – small section of potential habitat at the most extreme eastern end of the lagoon (Figures 3.1 and 3.2)	Yes – small area of potential habitat where the MOF will be situated
Removal of habitat (Ch 8.3 EIS/ERMP)	No	No	Yes – small area of potential habitat where the turning basin and channel will be situated
Unplanned leaks and spills (Ch 8.3 and 8.4 EIS/ERMP)	Unplanned	Unplanned	Unplanned
Physical presence of marine infrastructure leading to changes in coastal processes	♦ Potential for erosion of the Hooley Creek entrance bar.	♦ Potential for erosion of the east Ashburton River Delta chenier spit.	No

Direct infilling or removal of habitat will not occur at Hooley Creek.

It is unlikely that the proposed direct infilling or removal of a small area of potential habitat at Ashburton Delta East Lagoon will result in a long-term decrease in the local sawfish population because:

- only a very small proportion of the overall lagoon will be affected (Figure 5.3)
- this most eastern portion of the lagoon is not deemed to be critical habitat because at low tide it is a series of shallow, segregated pools (Figure 5.4) (URS 2010c), and
- the eastern portion of this lagoon is unlikely to support a significant proportion of the sawfish population in this region.

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Figure 5.3: Location of Infilling and Dredging to Occur at Ashburton Delta East Lagoon

Figure 5.4: Ashburton Delta East Lagoon at Low Tide

It is unlikely that the proposed infilling or removal of potential sawfish habitat in nearshore waters due to the proposed MOF and turning basin will result in a long-term decrease in the local sawfish population because this habitat is not considered critical and is widespread throughout coastal areas of this region.

It is unlikely that the unplanned leaks or spills would result in a long-term decrease in the local sawfish population because:

- The risk of unplanned leaks and spills is low, appropriate management and contingency plans will be in place to reduce likelihood of spills reaching Hooley Creek or Ashburton Delta.
- Highest concentrations of oil will remain near the water surface minimising risk of exposure to sawfish which are largely restricted to the lower proportion of the water column
- The minimum arrival time of low concentrations of oil to the creek is 6 hours and it is likely that the sawfish would swim away from the affected area: oil spill contingency measures would be employed within that time to reduce the likelihood of reaching the creek (Chevron 2010).

There is some uncertainty surrounding the potential for altered coastal processes to affect potential sawfish habitat. Onshore infrastructure will be located adjacent to the Ashburton River Delta and Hooley Creek and could potential result in changes to coastal processes. The effect of wave sheltering adjacent to the Hooley Creek tidal spit will produce a local imbalance in sediment transport and is likely to cause erosion of the spit (Chevron EIS/ERMP 2010). Marginal increase in the water level exchange through to Hooley Creek West is anticipated due to the more open entrance, including exposure to greater wave action.

Other Potential Impacts

A number of ‘other’ potential Project attributable impacts to sawfish populations have been identified. Table3.4 presents a description of the ‘other’ potential impacts to sawfish populations, and why they are not considered to be ‘key’ potential impacts.

Of these ‘other’ potential impacts, recreational fishing is considered to be of high concern although it is illegal to target and land sawfish (Morgan 2010). Uncertainty surrounds the predicted increase in recreational fishing effort that will occur in the area due to the Wheatstone Project. However, because sawfish are not targeted by recreational fishers and it is illegal to land them, it is expected that fishers will release accidentally caught sawfish.

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Table D1.2: Other Potential Impacts

Aspect	Description	Why 'Other'	Risk Ranking
Recreational Fishing	♦ Increase in population during construction and operation may lead to increased recreational fishing in the area.	♦ Sawfish are not targeted by recreational fishers but could be accidentally caught.	Low
Reverse Osmosis Plant	♦ Sawfish may be incidentally 'entrained' as part of the intake of water from Hooley Creek.	♦ Multiple screen intake pipes to prevent entrainment of marine fauna.	Low
Leaks and Spills	♦ Toxic effects from leaks and spills. ♦ Potential smothering and/or oiling of fauna leading to injury or mortality.	♦ Risks of unplanned leaks and spills are low. ♦ Appropriate management and contingency plans in place to reduce likelihood of spills reaching Hooley Creek or Ashburton Delta.	Low
Vessel Movements	♦ Injury or mortality due to vessel collision. ♦ Disturbance to sawfish behaviour or migratory patterns due to vessel movements.	♦ Sawfish are highly mobile, it is anticipated that vessel movements may induce avoidance behaviour only.	Low
Construction Noise and Vibration (pile driving)	♦ Behavioural changes, injury or mortality during construction. ♦ Behavioural changes during operations. ♦ Temporary displacement through avoidance of the area.	♦ Sawfish are not restricted to the nearshore waters of the Project Area as they are highly mobile, so it is expected that they would leave the area for the duration of the short-term piling activity.	Low
Operational Noise and Vibration (physical presence)	♦ Temporary displacement through avoidance of the area.	♦ Operational noise will be restricted to vessel movement and maintenance dredging, noise levels associated with these activities are expected to be low. ♦ Sawfish are highly mobile, therefore only temporary displacement is anticipated.	Very Low
Discharges	♦ Toxic effects from discharges into Hooley Creek and at 6 m off the coast into nearshore waters, near the PLF. ♦ Increased nutrients in water leading to eutrophication.	♦ Discharges will be treated according to government regulations. ♦ Only uncontaminated stormwater and hydrotest water will be discharged to Hooley Creek.	Very Low
Light	♦ Behavioural changes, injury or mortality during construction. ♦ Behavioural changes during operations. ♦ Temporary displacement through avoidance of the area.	♦ Light spill will occur in the nearshore waters opposite the plant site; sawfish are highly mobile, therefore only temporary displacement is anticipated.	Very Low

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Environmental Risk Management

The implementation of sawfish management will align with the following management plans that aim to address potential Project-attributable impacts relevant to the protection of the sawfish:

- Marine Fauna Management Plan
- Dredging and Spoil Disposal Management Plan
- Coastal Process Management Plan

In line with this, an adaptive management approach will be applied to all Project activities to allow for adjustments to changing events, decisions, and circumstances. As such, sand bypassing will be implemented as a contingency management measures should it be deemed that elevated erosion and accretion due to physical presence of infrastructure which will result in minimal effects to the local sawfish population.

Environmental Management Procedures

Environmental Objective:	All Project activities will be managed so that potential impacts on sawfish are reduced, as far as reasonably practicable.

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Table D1.3: Sawfish Management Program

Aspect	Management	Timing	Reference[1]	Residual Risk Ranking
Physical presence of marine infrastructure	♦ Define sawfish use of the Project Area through target surveys. ♦ Selection of navigation channel, MOF and placement sites to reduce risks to habitat critical for Protected Marine Fauna.	♦ Design phase.	Critical habitat mapping	Low
	♦ Appropriate construction management	♦ During construction.	CEMP	
	♦ Coastal processes management	♦ Management measures to be continuously implemented throughout the duration of the Project's life.	CPMP	
	♦ Monitoring of coastal processes and mangal areas (including creek systems)	♦ Monitoring to be continuously implemented throughout the duration of the Project's life.	CPMP	
	♦ Implementation of a sand bypassing strategy if accretion has been found to be impacting local habitats	♦ When/if required – <u>contingency measure.</u>	NA	
Dredging	♦ Dredging and material placement will be conducted during favourable weather, tide and current conditions, as far as reasonably practicable, to reduce the risk of impact to marine fauna while in close proximity to sensitive areas.	♦ Throughout dredging operations	DSDMP Dredge operation procedures Crew training Training material	Low
	♦ Dredge and Spoil Management, including the use of tickler chain to reduce risk of fauna entrainment.	♦ Throughout dredging operations.	DSDMP	
	♦ In event of mortality, revision of existing management controls will be undertaken to	♦ <u>Consideration of contingency measures.</u>	EIS/ERMP	

Aspect	Management	Timing	Reference[1]	Residual Risk Ranking
	investigate additional procedures.			
	♦ Water Quality monitoring	♦ Throughout dredging operations.	DSDMP	
	♦ Crew will receive training, which will include details on procedures in the event of sighting, injury and/or death of protected marine fauna	♦ Prior to commencement of dredging.	Training Procedure	
Recreational Fishing	♦ Specific training and inductions in relation to recreational fishing and boating.	♦ Initial inductions will occur as part of the 'onboarding' employment phase. ♦ Training and inductions of staff to occur prior to mobilisation. ♦ Management measures to be continuously implemented throughout the duration of the Project's life.	RCC	Low
	♦ Recreational boats and recreational vehicles will not be permitted within the boundaries of the Project Area or to travel on the access road from Onslow Road.	♦ Management measures to be continuously implemented throughout the duration of the Project's life.		
	♦ Behaviour standards to be expected from all construction workers will be clearly articulated in a Recreation Code of Conduct. Construction workers will be asked to sign the Code of Conduct.	♦ Management messages to be continuously reiterated throughout duration of the Project's life.		
	♦ A community feedback procedure will be established whereby any complaints from the community about unacceptable behaviour from construction workers will be investigated and, where necessary, action taken.	♦ Management measures to be continuously implemented throughout the duration of the Project's life.		
Reverse Osmosis Plant	♦ Multiple screen intake pipes to prevent entrapment of marine fauna.	♦ Management measures to be continuously implemented throughout the duration of the	N/A	Low

Aspect	Management	Timing	Reference[1]	Residual Risk Ranking
		Project's life.		
Leaks and Spills	♦ DMP approved MOPP will be implemented and relevant personnel will be trained in accordance with the MOPP. ♦ An Oil Spill Contingency Plan (OSCP) will be developed and implemented for the Project to manage and mitigate potential impacts from leaks and spills. Management strategies that will be applied will include: ▪ All vessels operating on the Project will be required to have up to date Shipboard Oil Pollution Emergency Programs (SOPEPs) in place. ▪ Refuelling in shallow waters between bunker vessels and dredges will be carried out in accordance with the requirements of the OSCP. ▪ Compliance with legislative requirements and MARPOL and AMSA regulations. ▪ Blowout prevention measures in place.	♦ Management measures to be continuously implemented throughout the duration of the Project's life.	OSCP, MOPP, DSDMP and MFMP	**Low**
Vessel Movements	♦ Use of marine fauna observers to confirm that no marine fauna are within the vicinity of designated fauna exclusion zones. ♦ Recreational boats and recreational vehicles will not be permitted within the boundaries of the Project area or to travel on the access road from Onslow Road.	Management measures to be continuously implemented throughout the duration of the Project's life.	DSDMP and MFMP Training procedure	**Low**
Construction Noise and Vibration	♦ Implement soft start-up procedures for pile driving activities.	During construction.	MFMP	**Low**

Aspect	Management	Timing	Reference[1]	Residual Risk Ranking
(pile driving)	♦ Marine fauna observation procedures to be developed and implemented for pile driving. ♦ Pile driving shall not commence if marine megafauna species are present within the suspension zones ♦ Pile driving activities shall cease if marine fauna are observed within the suspension zone ♦			
Discharges	♦ Implementation of waste management.	Management measures to be continuously implemented throughout the duration of the Project's life.	WMP	
	♦ A framework CEMP will be produced prior to the commencement of construction activities. Specific management measures will include: ♦ Wastewater streams that will be discharged via piped ocean outfall and treated according to government requirements. ♦ Produced water for trains 3, 4 and 5 will be treated in accordance to government requirements and discharged via outfall into deeper water (20 m) to increase mixing. ♦ Diffusers will be provided at piped ocean outfalls to increase mixing. ♦ Drilling fluids will be approved by the DMP through the drilling EP. After use, SBMs will be contained and forwarded for onshore treatment, recycling or disposal. ♦ MEG will be recovered from feed gas wastewater and either reused or disposed of at an appropriate onshore facility. ♦ Spill clean-up procedures will be developed and	Prior to and during construction.	CEMP	**Very Low**

Aspect	Management	Timing	Reference[1]	Residual Risk Ranking
	implemented for the duration of the Project to reduce the level of contaminants present in storm water drainage. ♦ Hydrotest water will be discharged with uncontaminated stormwater into Hooley Creek. Prior to discharge the water will be tested and treated if required to comply with government requirements. ♦ Sewage and grey water will be treated in accordance to government requirements and discharged via ocean outfall. ♦ Sludges produced from the recovery of nutrients from sewage and grey water will be collected and disposed of in accordance with government requirements.			

Acronyms1
RCC Recreational Code of Conduct
MFMP Marine Fauna Management Plan
DSDMP Dredge and Spoil Disposal Management Plan
CPMP Coastal Processes Management Plan
CEMP Construction Environmental Management Plan

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Potential Project Benefits

The presence of the Project may contribute positive outcomes for sawfish conservation in the Project Area. The presence of Project staff and restrictive or security zones around the Plant could potentially discourage illegal net fishing or other activities that could potentially pose a risk to sawfishes and their habitat. Chevron is also committed to fund a study to understand the site fidelity and habitat utilisation of sawfish in a range of habitat within and outside the Project Area. Information gained from this study will help protect and manage sawfish from a range of Project and non-Project related activities.

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Conclusion

Green sawfish have been recorded within the north-eastern lagoon of the Ashburton Delta and in Hooley Creek. A proposed sawfish study planned for 2011 will be undertaken to describe site fidelity and habitat utilisation of this taxa in the Project Area. This will increase our understanding of the ecology of sawfish in this region and lead to better management outcomes.

Minimising loss or alteration of sawfish habitat is the focus of management and mitigation measures during the Wheatstone project. The Wheatstone project and or related activities will not impact habitat critical to sawfish. Hooley Creek and the Ashburton Delta, two areas where juvenile sawfish have been observed, will not be modified. In addition to preventing habitat disturbance, the management measures listed in table 4.1 will be implemented to ensure that impacts to sawfish individuals and populations are minimised. By ensuring these management measures are in place, it is expected that populations of green sawfish and other species will not be affected by the Wheatstone Project.

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APPENDIX E: COMPARISON OF AUSTRALIAN SAWFISH SPECIES

Conservation Status of Australian Sawfish

Five species of sawfish occur in Australian waters, four of which are known to occur in Western Australian waters. Three of the species predicted to occur in Western Australia are currently listed as threatened species under the *Environment Protection and Biodiversity Conservation Act 19*99 (the EPBC Act) (Table 1). All threatened species listed under the EPBC Act are considered Matters of National Environmental Significance and are afforded protection under the Act.

All native fauna are protected under the *Wildlife Conservation Act 1950* (WC Act), meaning that the 'disturbance of' or 'taking' of fauna must be minimised or avoided wherever possible, unless licences are held permitting otherwise. In addition to this general level of care and protection, native fauna may be listed as 'Specially protected' under the WC Act.

Under state legislation:

- The green sawfish is listed as Schedule 1 (Fauna that is rare or is likely to become extinct) under the WC Act.
- The dwarf sawfish is listed on the Department of Environment and Conservation (DEC) Priority Fauna List as Priority 1 (Taxa with few, poorly known populations on threatened lands)
- The freshwater sawfish is listed on the DEC Priority Fauna List as Priority 3 (Taxa with several, poorly known populations, some on conservation lands)
- All sawfish species are protected under the WA *Fish Resources Management Act 1994.*

All four sawfish species are listed as Critically Endangered (considered to be facing an extremely high risk of extinction) under the IUCN red list, the criteria of which are designed for global taxon assessments.

Table E1.1: Conservation Status of Sawfish Species in Australia

Species Name	EPBC Act	*Wildlife Conservation Act 1950*	DEC Priority List	*WA Fish Resources Management Act 1994*	IUCN
Green Sawfish (*Pristis zijsron)*	Vulnerable	Schedule 1	-	Totally Protected	Critically Endangered
Freshwater Sawfish (*Pristis microdon)*	Vulnerable	NA	P3	Totally Protected	Critically Endangered
Narrow Sawfish *(Anoxypristis cuspidate)*	-	NA	-	Totally Protected	Critically Endangered
Dwarf Sawfish *(Pristis clavata)*	Vulnerable	NA	P1	Totally Protected	Critically Endangered

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A1.2 Biological Overview of 'Southern Pilbara' Sawfish

Of the four sawfish species that occur in Australian waters, three species have been recorded in the southern Pilbara; the Green Sawfish (*Pristis zijsron*), Freshwater Sawfish (*Pristis microdon*) and the Narrow Sawfish (*Anoxypristis cuspidata*). An overview of their biological features, for species comparison, is presented in Table A1.2.

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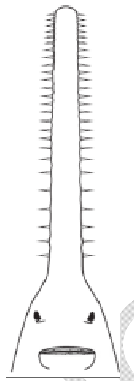
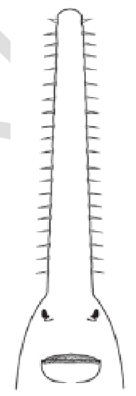
Table E1.2: Biological Overview of 'Southern Pilbara' Sawfish

Species name	Physical Characteristics	Habitat	Distribution
Green Sawfish (*Pristis zijsron)*	A large species of ray with a shark-like body and a flattened, elongate head with an elongated rostrum bearing 24-28 pairs of unevenly spaced rostral teeth (DSEWPaC 2010a) (McAuley et al 2002, image right). Approximately 80 cm in length when born, reach maturity when 3 m and attain a full length of 7.3 m in Australian waters (Last and Stevens 1994). 	Green sawfish inhabit marine waters, estuaries, river mouths, embankments and waters along sandy and muddy beaches (Peverell et al. 2004; Stevens et al. 2005; Thorburn et al. 2004), and have been recorded in very shallow water (<1 m) to water depths of over 70 m (Stevens et al. 2005). Smaller individuals (<2.5 m in length) are more common in foreshore and offshore waters, the larger individuals (>2.5 m) are found in inshore and offshore waters (DSEWPC 2010a).	Green sawfish have been recorded in coastal waters off Broome in WA, around northern Australia and down the east coast as far as Jervis Bay, in New South Wales (Stevens et al. 2005). While Last and Stevens (2009) note that the southward range of the green sawfish has been restricted due to population effects from fishing, the species is found south to Coral Bay and could occur as far south as Perth.
Freshwater Sawfish (*Pristis microdon)*	Differs from other sawfish with the following features: the first dorsal fin anterior to the pelvic fins; caudal fin bearing a conspicuous ventral lobe; 18-23 teeth on the rostrum (McAuley et al 2002, image right). It is believed to reach seven metres in length (Thorburn et al. 2004). Yellowish in colour (McAuley et al 2002). 	The freshwater sawfish extends past estuaries into freshwater habitats, mainly in the juvenile stage (URS 2010a). The species prefers sandy or muddy bottoms of shallow coastal waters, estuaries, river mouths and freshwater rivers and lakes and has most commonly been encountered over fine substrates such as sand and silt, usually caught in a deeper section of a river adjacent to sand or silt shallow, such as a sandbar or shallow backwater (Thorburn et al. 2004). It is believed that the species may utilise rivers, while larger mature animals (up to 7 m) generally remain offshore (Thorburn et al. 2004).	Freshwater sawfish have been found in inland river systems up to 400 km inland (Morgan et al. 2002). It is unsure how far offshore their distribution extends (Stevens et al. 2005). This species extends past the estuaries into freshwater habitats, but it is not known to occur in the Pilbara (URS 2010b).

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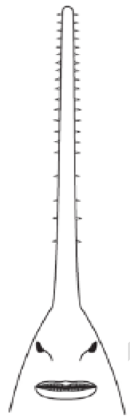
Species name	Physical Characteristics	Habitat	Distribution
Narrow Sawfish *(Anoxypristis cuspidate)*	The species has a slender rostrum with18-22 pairs of teeth beginning some distance from head (McAuley et al 2002, image right). Greyish in colour (McAuley et al 2002). A moderately large, slender sawfish that grows to a length of approximately 350 cm (Pogonoski et al. 2002). 	Occurs inshore and offshore to at least 100 metres.	Queensland, the Northern Territory and WA, such as off Eighty Mile Beach.

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APPENDIX F: INJURED AND DECEASED MARINE FAUNA INVESTIGATION PROCEDURES

In the case of a sighting of an injured or deceased animal of a species detailed in this plan, an investigation will take place to attempt to determine the cause of the injury/death. The investigation process consists of two parts:

Part 1: Marine Fauna Injury/Death Reporting

A report will be completed by the person(s) sighting the injured/deceased marine fauna consisting of a description of:

- The location
- If the animal is injured or deceased
- Any visible injuries or conditions
- Any abnormal conditions or potential causes of injury/death will be noted, including signs of pollution or fishing equipment in the water.
- Photographs will also be obtained, if possible and safe to do so, showing the animal including any injuries and anything that may have contributed towards the injury/death.

Part 2: Investigation

An investigation will take place taking into account the Marine Fauna Injury/Death reporting. A marine fauna expert may be employed to review the reporting if it is deemed expert advice could assist in determining the cause of injury/death. Investigation will include analysis of:

- Marine Fauna Injury/Death Reporting
- Records of recent pollution incidents in the vicinity (if applicable)
- Records of recent vessel interactions in the vicinity (if applicable).

Investigative reporting will be completed within 1 month of the marine fauna observation.

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Appendix QFA

Sediment Quality Assessment Wheatstone Dredging Program Addendum

Report

Sediment Quality Assessment

Wheatstone Dredging Program

Addendum

15 FEBRUARY 2011

Prepared for

Chevron Australia Pty Ltd

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Response to DSEWPC Submissions

1.1 Background

URS Australia Pty Ltd (URS) was contracted by Chevron Australia Pty Ltd (Chevron) in September 2010 to provide the technical address of Public Review submissions and technical information for the Wheatstone Project (Project) updates. This information was to be included in the Project's Final Environmental Impact Statement for the Environmental Review and Management Programme & Response to Submissions. As part of this address process, several Project updates and addendum documents were required to be produced to provide additional information as required. This addendum provides additional information on issues highlighted in the Sediment Quality Assessment: Wheatstone Dredging Program (Appendix Q5, Chevron, 2010).

1.2 DSEWPC Review Submissions & URS' Responses

1.2.1 Submission # 349 (Original RTS # 29.79)

"With regard to 29.79, in the Sampling and Analysis Plan (SAP, Appendix A of Q5),Chevron indicated that field QA/QC would include analysis of 10% of samples as field triplicates and analysis of 5% of samples as split triplicates with the third triplicate sent to a secondary laboratory. These methods are in accordance with the NAGD."

URS Response

Agreed.

1.2.2 Submission # 350

"Section 2.5.1 of Q5 - Chevron indicated that nine duplicate samples were collected, assumed to be split duplicates to assess laboratory variation as per Section 2.5.1 of Q5. Note that it should be clarified that these samples were split duplicates, rather than field duplicates to assess sediment variation."

URS Response

Duplicate and triplicate samples refer to sediment mixed and sub-sampled into different jars in the field. Small-scale spatial variability of contaminant concentrations in sediment (e.g. by collection of multiple cores at each location) was not assessed.

1.2.3 Submission # 351

"It is considered that sufficient duplicate samples were analysed. However, insufficient information has been provided to assess laboratory variation. No data has been provided and no mention of sending a triplicate sample to a reference laboratory has been made. This should be provided."

URS Response

Five interlaboratory quality control (QC) split triplicate samples were collected by URS and analysed by Labmark, a National Association of Testing Authorities (NATA)-accredited laboratory, with the corresponding primary and second split triplicate samples analysed by ALS Environmental (Table 1-1). Data for the five primary samples (G17, G13, SC13, SC16, SC17_0.0-0.35), five duplicate

1 Response to DSEWPC Submissions

samples (QC101, QC102, QC105, QC107, QC109) and the five interlaboratory triplicate samples (QC200-QC204) are shown in Table 1-1.

The assessment of interlaboratory variability of the concentrations of contaminants of potential concern (COPC) in the primary samples, second split triplicate samples and the interlaboratory triplicate samples analysed by Labmark is presented in Table 1-2 and Table 1-3. For COPC which were present above the analytical limit of reporting (LoR) in all three samples the relative standard deviations (RSDs) were calculated. The RSDs of triplicates exceeded 20% RSD for arsenic (one triplicate group), barium (one triplicate group) and nickel (five triplicate groups). The concentrations of COPC in interlaboratory split triplicate samples analysed by Labmark are therefore generally similar to the concentrations of COPC in split triplicate samples analysed by ALS Environmental, although the concentrations of nickel appear to be more variable, in particular at low concentrations (<10 mg/kg) nearer the analytical LoR, when analytical variance may be greater relative to analytical variance at higher concentrations in the samples.

In addition, the variability of analyses of primary, duplicate and triplicate samples expressed as relative standard deviation (RSD, %) are presented in Table 1-4. The RSD values are less than 20% for all split triplicate sample analyses, except for barium in one triplicate group (37.3% RSD in samples SC56_0.0-0.31, QC123, QC205). However, the overall low variability of concentrations of COPC in split triplicate samples indicates that the analytical data are accurate and generally reproducible.

1 Response to DSEWPC Submissions

Table 1-1 Primary sample, duplicate and interlaboratory QC sample analytical data.

QC Sample Type	QC Sample ID	Primary Sample	Al	As	Ba	Cd	Cr	Cu	Hg	Ni	Sb	Pb	Zn
Interlaboratory	QC200	G17	5000	21	10	<2	24	4.6	<0.01	15	3.9	<2	10
Interlaboratory	QC201	G13	5200	20	11	<2	23	5.1	<0.01	15	3.9	<2	11
Interlaboratory	QC202	SC13	7800	26	16	<2	33	11	<0.01	21	6.8	<2	22
Interlaboratory	QC203	SC16	5800	19	12	<2	32	8.2	<0.01	16	5.1	<2	19
Interlaboratory	QC204	SC17-0.0-0.35	6600	22	11	<2	36	9.4	<0.01	16	5.5	<2	21
Duplicate	QC101	G17	4070	28.8	12.7	<0.1	28.6	4.4	<0.01	4.5	4.9	<0.5	14.4
Duplicate	QC102	G13	4760	23.8	13.2	<0.1	29.4	5.3	<0.01	5.4	4.8	<0.5	13.5
Duplicate	QC105	SC13	6640	21.1	14.3	<0.1	33.7	10.8	<0.01	10.8	6.4	<0.5	23.4
Duplicate	QC107	SC16	5970	32.4	12	<0.1	40.1	9.6	<0.01	12.4	6.5	<0.5	22.9
Duplicate	QC109	SC17-0.0-0.35	5310	21.5	7.2	<0.1	40.1	8.7	0.01	9.8	5.7	<0.5	21.4
Primary Sample		G17	4200	25	12.1	0.05	30	5.2	<0.01	5.2	<0.5	4.9	12.7
Primary Sample		G13	4060	19.8	12.3	0.05	25.1	4.7	<0.01	4.7	<0.5	4.4	11.9
Primary Sample		SC13	6820	20.9	17.5	0.05	35	11.1	<0.01	11.4	<0.5	6.2	24
Primary Sample		SC16	5680	20.5	12.9	0.05	34.1	8.2	<0.01	9.4	<0.5	5.6	21.3
Primary Sample		SC17-0.0-0.35	5560	22.6	5.4	0.05	40.4	9.3	0.01	10.9	<0.5	6.1	23

1 Response to DSEWPC Submissions

Table 1-2 Primary sample, duplicate and interlaboratory QC sample analytical data (cont'd).

QC Sample Type	QC Sample ID	Primary sample	Al	As	Ba	Cd	Cr	Cu	Hg	Ni	Sb	Pb	Zn
Interlaboratory	QC200	G17	5000	21	10	<2	24	4.6	<0.01	15	3.9	<2	10
Duplicate	QC101	G17	4070	28.8	12.7	<0.1	28.6	4.4	<0.01	4.5	4.9	<0.5	14.4
Primary Sample	G17		4200	25	12.1	0.05	30	5.2	<0.01	5.2	<0.5	4.9	12.7
		Mean	4423	24.9	11.6	na	27.5	4.7	na	8.2	4.4	na	12.4
		SD	504	3.9	1.42	na	3.14	0.4	na	5.9	0.7	na	2.2
		RSD (%)	11.4	15.6	12.2	na	11.4	8.8	na	**71.3**	16.1	na	17.9
Interlaboratory	QC201	G13	5200	20	11	<2	23	5.1	<0.01	15	3.9	<2	11
Duplicate	QC102	G13	4760	23.8	13.2	<0.1	29.4	5.3	<0.01	5.4	4.8	<0.5	13.5
Primary Sample	G13		4060	19.8	12.3	0.05	25.1	4.7	<0.01	4.7	<0.5	4.4	11.9
		Mean	4673	21.2	12.2	na	25.8	5.0	na	8.4	4.4	na	12.1
		SD	575	2.3	1.1	na	3.3	0.3	na	5.8	0.6	na	1.3
		RSD (%)	12.3	10.6	9.1	na	12.6	6.1	na	**68.8**	14.6	na	10.4
Interlaboratory	QC202	SC13	7800	26	16	<2	33	11	<0.01	21	6.8	<2	22
Duplicate	QC105	SC13	6640	21.1	14.3	<0.1	33.7	10.8	<0.01	10.8	6.4	<0.5	23.4
Primary Sample	SC13		6820	20.9	17.5	0.05	35	11.1	<0.01	11.4	<0.5	6.2	24
		Mean	7087	22.7	15.9	na	33.9	11.0	na	14.4	6.6	na	23.1
		SD	624	2.9	1.6	na	1.0	0.2	na	5.7	0.3	na	1.0
		RSD (%)	8.81	12.7	10.0	na	3.0	1.4	na	**39.7**	4.3	na	4.4
Interlaboratory	QC203	SC16	5800	19	12	<2	32	8.2	<0.01	16	5.1	<2	19
Duplicate	QC107	SC16	5970	32.4	12	<0.1	40.1	9.6	<0.01	12.4	6.5	<0.5	22.9
Primary Sample	SC16		5680	20.5	12.9	0.05	34.1	8.2	<0.01	9.4	<0.5	5.6	21.3
		Mean	5817	24.0	12.3	na	35.4	8.7	na	12.6	na	na	21.1
		SD	146	7.3	0.5	na	4.2	0.8	na	3.3	na	na	2.0
		RSD (%)	2.51	**30.6**	4.2	na	11.9	9.3	na	**26.2**	na	na	9.3
Interlaboratory	QC204	SC17_0.0-0	6600	22	11	<2	36	9.4	<0.01	16	5.5	<2	21
Duplicate	QC109	SC17_0.0-0	5310	21.5	7.2	<0.1	40.1	8.7	0.01	9.8	5.7	<0.5	21.4
Primary Sample	SC17_0.0-0.35		5560	22.6	5.4	0.05	40.4	9.3	0.01	10.9	<0.5	6.1	23
		Mean	5823	22.0	7.9	na	38.8	9.1	na	12.2	na	na	21.8
		SD	684	0.6	2.9	na	2.5	0.4	na	3.3	na	na	1.1
		RSD (%)	11.7	2.5	**36.3**	na	6.3	4.1	na	**27.0**	na	na	4.9

RSD >20% highlighted in bold

1 Response to DSEWPC Submissions

Table 1-3 Primary sample, duplicate and triplicate analytical data (cont'd).

QC ID	Primary Sample ID	Al (mg/kg)	As (mg/kg)	Ba (mg/kg)	Cd (mg/kg)	Cr (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Ni (mg/kg)	Sb (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	TBT (mgSn/kg)	TOC (%)	MC (%)
QC126	SC3	3850	16.2	8.4	<0.1	29.5	11.2	<0.01	8.8	<0.5	5.2	18.9	na	na	28.4
QC208	SC3	3940	19.8	9.6	<0.1	32.4	10.5	<0.01	11.1	<0.5	5.6	22.4	na	na	29.2
	SC3_0.0-0.22	4050	18.3	10.2	<0.1	35.3	10.7	<0.01	10.4	<0.5	6	21.8	<0.5	0.34	27.4
	Mean	3947	18.1	9.4	na	32.4	10.8	na	10.1	na	5.6	21.0	na	na	28.3
	SD	100	1.8	0.9	na	2.9	0.4	na	1.2	na	0.4	1.9	na	na	0.9
	RSD (%)	2.5	10.0	9.8	na	9.0	3.3	na	11.7	na	7.1	8.9	na	na	3.2
QC124	SC6	4460	7.98	14.9	<0.1	41.3	12.9	<0.01	12.9	<0.5	6.8	19.5	<0.5	0.05	21.2
QC206	SC6	3920	8.38	16.1	<0.1	37	12	<0.01	11.4	<0.5	6	17.9	na	na	21.8
	SC6_0.0-0.2	4310	8.65	20.7	<0.1	41	12.5	<0.01	12.7	<0.5	6.6	19.4	<0.5	0.04	22.4
	Mean	4230	8.3	17.2	na	39.8	12.5	na	12.3	na	6.5	18.9	na	na	21.8
	SD	279	0.3	3.1	na	2.4	0.5	na	0.8	na	0.4	0.9	na	na	0.6
	RSD (%)	6.6	4.0	17.8	na	6.0	3.6	na	6.6	na	6.4	4.7	na	na	2.8
QC127	SC38	4040	19	8.6	<0.1	31	10.7	<0.01	10.1	<0.5	5.6	20.2	na	na	26.4
QC209	SC38	4170	11.9	9.6	<0.1	31.9	9	<0.01	9.8	<0.5	5.5	18.4	na	na	25.2
	SC38_0.0-0.40	3920	11.7	8.6	<0.1	31.7	9.4	<0.01	9.6	<0.5	5.5	19.4	<0.5	0.11	23.8
	Mean	4043	14.2	8.9	na	31.5	9.7	na	9.8	na	5.5	19.3	na	na	25.1
	SD	125	4.2	0.6	na	0.5	0.9	na	0.3	na	0.1	0.9	na	na	1.3
	RSD (%)	3.1	**29.3**	6.5	na	1.5	9.2	na	2.6	na	1.0	4.7	na	na	5.2
QC125	SC43	5310	9.31	23.6	<0.1	38.8	13.3	<0.01	13.3	<0.5	7	24.2	<0.5	0.11	22.6
QC207	SC43	5590	9.36	24.8	<0.1	43	15.5	<0.01	15.5	<0.5	7.6	24.8	na	na	25.1
	SC43_0.0-0.23	5300	10.2	21.8	<0.1	39.2	13.2	<0.01	13.6	<0.5	6.8	24	<0.5	0.09	22.5
	Mean	5400	9.6	23.4	na	40.3	14.0	na	14.1	na	7.1	24.3	na	na	23.4
	SD	165	0.5	1.5	na	2.3	1.3	na	1.2	na	0.4	0.4	na	na	1.5
	RSD (%)	3.0	5.2	6.5	na	5.7	9.3	na	8.4	na	5.8	1.7	na	na	6.3
QC128	SC53	4310	12.8	9.1	<0.1	33.6	9.6	<0.01	10.4	<0.5	5.7	18.8	na	na	27.2
QC210	SC53	3930	10.9	8.8	<0.1	30.5	9	<0.01	8.7	<0.5	5.3	19	na	na	24.2
	SC53_0.00.055	4180	12.8	9.8	<0.1	33.5	9.8	<0.01	10.4	<0.5	6	19.7	<0.5	0.1	27.9
	Mean	4140	12.2	9.2	na	32.5	9.5	na	9.8	na	5.7	19.2	na	na	26.4
	SD	193	1.1	0.5	na	1.8	0.4	na	1.0	na	0.4	0.5	na	na	2.0
	RSD (%)	4.7	9.0	5.6	na	5.4	4.4	na	10.0	na	6.2	2.5	na	na	7.4
QC123	SC56	3780	9	8.3	<0.1	36.5	10.8	<0.01	11.2	<0.5	6	18.8	<0.5	0.09	18.9
QC205	SC56	4060	9.73	9.2	<0.1	37.8	10.7	<0.01	11.7	<0.5	6.2	19.8	na	na	24.1
	SC56_0.0-0.31	3670	12	15.9	<0.1	39.4	10.3	<0.01	11.5	<0.5	6.8	20.4	<0.5	0.06	24.1
	Mean	3837	10.2	11.1	na	37.9	10.6	na	11.5	na	6.3	19.7	na	na	22.4
	SD	201	1.6	4.2	na	1.5	0.3	na	0.3	na	0.4	0.8	na	na	3.0
	RSD (%)	5.2	15.3	**37.3**	na	3.8	2.5	na	2.2	na	6.6	4.1	na	na	13.4

RSDs >20% highlighted in bold; na: not analysed

1.2.4 Submission # 352

"It is agreed that the primary samples data provided in Table 3-4 of the SQA Report in Appendix Q5 of the EIS indicates that the concentrations of COPC in each placement area were very similar (i.e. relatively homogenous). The results of the relevant duplicate or triplicate samples should be provided to support this statement."

URS Response

Response as for Submission # 351. For clarity, the assessment of laboratory precision, based on duplicate and triplicate samples is expanded here in addition to the information contained in the Geochemical Data Validation Summary (Appendix Q5, Section 3.4).

Variability of contaminant concentrations over many kilometres was low (in sediment of similar texture). Contaminant variability in the dredge material placement sites would be represented by variability of all samples in each area (less laboratory variability). Contaminant variability in the dredge material placement sites would be represented by variability of all samples in each area (less laboratory variability).

The homogeneity of the concentrations of COPC in sediments in the dredge material placement sites is also demonstrated by the generally low RPDs between primary samples and duplicate samples

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(Table 1-4). The RPDs are less than 20% for all COPC in the four sample pairs (primary sample and duplicate sample) obtained in dredge material placement site C.

Similarly, the RPD in the sample pair from dredge material placement site B is less than 25% for all COPC.

The RPD of COPC in the sample pair from dredge material placement site E is less than 20% for all COPC, except for mercury (66.7%), which is due to the low concentrations of mercury near the analytical LoR (i.e. 0.01-0.02 mg/kg).

The sample pair obtained in dredge material placement site D contained concentrations of COPC with a RPD of less than 20%, except for aluminium (36.6%) and nickel (100%). However, the low concentration of nickel in this sample pair (2.2 mg/kg in sample QC122, 6.6 mg/kg in sample G63) is likely to have increased the analytical variability, resulting in a higher RPD at these low concentrations.

The two sample pairs obtained in dredge material placement site A show the largest variability, with RPDs exceeding 25% for barium (both sample pairs), while concentrations of aluminium, antimony and lead exceeded 25% RPD in on of the two sample pairs. This increased variability is likely due to the very low concentrations of these COPC in the surficial sediments at this dredge material placement site.

In summary, the homogeneity of sediments in the dredge material placement sites is demonstrated through generally low RPD values of concentrations of COPC in duplicate samples as well as through the regional similarity in the concentrations of COPC in sediments.

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Table 1-4 Primary and duplicate samples in dredge material placement sites and relative percent differences (%).

Area	QC Sample Type	Sample ID	QC Sample	Al	As	Ba	Cd	Cr	Cu	Hg	Ni	Sb	Pb	Zn
Dredge Material Placement Site C		G12		3950	28.0	11.6	<0.1	30.4	4.0	<0.01	4.0	<0.5	4.7	11.5
		G12	QC100	3870	24.4	11.1	<0.1	26.6	4	<0.01	4.1	4.5	<1	11.4
	RPD (Sample Pair G12/QC100) (%)			2.0	13.7	4.4	nd	13.3	0.0	nd	2.5	nd	nd	0.9
		G13		4060	19.8	12.3	<0.1	25.1	4.7	<0.01	4.7	<0.5	4.4	11.9
		G13	QC102	4760	23.8	13.2	<0.1	29.4	5.3	<0.01	5.4	4.8	<1	13.5
	RPD (Sample Pair G13/QC102) (%)			15.9	18.3	7.1	nd	15.8	12.0	nd	13.9	nd	nd	12.6
	Triplicate Interlaboratory Sample	G13	QC201	5200	20	11	<2	23	5.1	<0.01	15	3.9	<2	11
		G17		4200	25.0	12.1	<0.1	30.0	5.2	<0.01	5.2	<0.5	4.9	12.7
		G17	QC101	4070	28.8	12.7	<0.1	28.6	4.4	<0.01	4.5	4.9	<1	14.4
	RPD (Sample Pair G17/QC101) (%)			3.1	14.1	4.8	nd	4.8	16.7	nd	14.4	nd	nd	12.5
	Triplicate Interlaboratory Sample	G17	QC200	5000	21	10	<2	24	4.6	<0.01	15	3.9	<2	10
		G69		2790	19.2	10.2	<0.1	22.4	3.7	<0.01	5.1	<0.5	4.3	10.6
		G69	QC116	2990	19.4	10.4	<0.1	22.8	3.7	<0.01	5.4	4.4	<1	10.7
	RPD (Sample Pair G69/QC116) (%)			6.9	1.0	1.9	nd	1.8	0.0	nd	5.7	nd	nd	0.9
Dredge Material Placement Site B		G36		4420	19.4	12	<0.1	40.3	7.1	<0.01	8	<0.5	5.8	17.8
		G36	QC108	5570	17.5	11.3	<0.1	35.2	8.4	<0.01	9.8	5.6	<1	20
	RPD (Sample Pair G36/QC108) (%)			23.0	10.3	6.0	nd	13.5	16.8	nd	20.2	nd	nd	11.6
Dredge Material Placement Site A		G20		1970	58.5	27.4	0.1	19.7	1.3	0.01	2.6	0.62	3.8	3.9
		QC113	G20	1370	49.4	16.9	<0.1	15.8	1.1	<0.01	<1	3.4	0.54	4.4
	RPD (Sample Pair G20/QC113) (%)			35.9	16.9	47.4	nd	22.0	16.7	nd	nd	138.0	150.2	12.0
		G68		2440	22.5	17.3	0.05	22.1	2.7	0.01	3.6	<0.5	4	8.5
		QC115	G68	2320	20	13.1	<0.1	17.6	2.8	<0.01	2.5	3.4	<0.5	7.4
	RPD (Sample Pair G68/QC115) (%)			5.0	11.8	27.6	nd	22.7	3.6	nd	36.1	nd	nd	13.8
Dredge Material Placement Site E		G56		3840	5.03	14.9	0.1	25.7	3.9	0.01	8.8	<0.5	3.5	9.2
		G56	QC120	4090	5.35	15.6	0.1	27.2	4.2	0.02	10.3	3.6	<1	9.5
	RPD (Sample Pair G56/QC120) (%)			6.3	6.2	4.6	0.0	5.7	7.4	66.7	15.7	nd	nd	3.2
Dredge Material Placement Site D		G63		2940	6.68	12.9	0.1	20.9	3	<0.01	6.6	<0.5	3.1	7.8
		G63	QC122	2030	6.26	11.7	0.1	18.9	2.5	<0.01	2.2	2.8	<1	6.6
	RPD (Sample Pair G63/QC122) (%)			36.6	6.5	9.8	0.0	10.1	18.2	nd	100.0	nd	nd	16.7

All values in mg/kg, except RPD values (in %). nd - not determined

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1.2.5 Submission # 354 (Original RTS # 29.80)

"With regard to 29.80, it is acknowledged that Chevron used a recommended method listed in the NAGD (i.e. USEPA ProUCL Program) to calculate the 95% UCL concentrations. However, there are some inconsistencies in Appendix Q5 of the EIS with regard to how this has been reported. In Section 2.7 of Q5, it is stated that a method was used (no longer recommended) different to that specified would be used in Section 4.10 of the SAP. This should be corrected."

URS Response

Agreed. The methodologies should consistently state use of the USEPA ProUCL Program to calculate the 95% upper confidence limit (UCL) of mean concentrations. This addendum confirms the use of the recommended method listed in the National Assessment Guidelines for Dredging (Commonwealth of Australia, 2009) (i.e. USEPA ProUCL Program).

1.2.6 Submission # 355

"With regard to 29.82, the Proponent has not provided a 95% UCL for TBT or Sb as no results were reported above limits of reporting (LOR). It is likely that insufficient results above LOR are available to calculate the 95%UCL for Cd.

While no NAGD Screening Level was provided for Al, the 95%UCL should be calculated and compared to "regional ambient baseline levels in sediments of comparable grainsize" as per p36 of the NAGD. The Proponent has satisfactorily reported the 95%UCL of all remaining COPC in Table 4-2."

URS Response

It can be confirmed that a 95% UCLs for tributilyn (TBT) and antimony was not calculated, as no results were reported above LoR.

The reported results for cadmium in only four samples were greater than LoR. This is less than the USEPA (recently increased) minimum number of samples required to calculate 95% UCL concentrations (10 samples) (Table 1-5).

The table below indicates that out of 73 short core sediment samples, 69 samples contain <0.1 mg/kg cadmium, three samples contain 0.1 mg/kg cadmium and one sample contains 0.4 mg/kg cadmium. While the 95% UCL of the mean concentration of cadmium was not calculated, it is likely that it is below the NAGD Screening Level for cadmium (1.5 mg/kg).

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Table 1-5 Concentrations of Cd in sediment samples in the proposed dredge area.

Sample ID	Cd (mg/kg)	Sample ID	Cd (mg/kg)
SC1_0.0-0.27	<0.1	SC38_0.0-0.4	<0.1
SC2_0.0-0.22	<0.1	SC39_0.00.05	<0.1
SC3_0.0-0.22	<0.1	SC40_0.0-0.3	<0.1
SC4_0.0-0.25	<0.1	SC41_0.0-0.3	<0.1
SC5	<0.1	SC42_0.0-0.2	<0.1
SC6_0.0-0.2	<0.1	SC43_0.0-0.2	<0.1
SC7_0.0-0.10	<0.1	SC44_0.00.05	<0.1
SC8_0.0-0.30	<0.1	SC45_0.0-0.2	<0.1
SC9_0.0-0.20	<0.1	SC46_0.0-0.2	<0.1
SC10_0.0-0.10	<0.1	SC47_0.0-0.2	<0.1
SC11_0.00.055	<0.1	SC48_0.00.05	<0.1
SC12_0.0-0.15	<0.1	SC49_0.00.05	<0.1
SC13	<0.1	SC50_0.0-0.2	<0.1
SC14_0.00.051	<0.1	SC51	0.1
SC15_0.0-0.18	<0.1	SC52_0.00.05	<0.1
SC16	<0.1	SC53_0.00.05	<0.1
SC17_0.0-0.35	<0.1	SC54_0.0-0.2	<0.1
SC18_0.0-0.30	<0.1	SC55_0.0-0.2	<0.1
SC19_0.00.052	<0.1	SC55_0.0-0.3	0.4
SC20_0.0-0.20	<0.1	SC56_0.0-0.3	0.1
SC21_0.0-0.15	<0.1	SC57_0.00.05	<0.1
SC22_0.00.053	<0.1	SC58_0.0-0.1	<0.1
SC23_0.0-0.25	<0.1	SC59_0.0-0.2	<0.1
SC24	<0.1	SC60_0.0-0.2	<0.1
SC25	<0.1	SC61_0.0-0.1	<0.1
SC26_0.00.051	<0.1	SC62_0.0-0.1	<0.1
SC27_0.0-0.32	<0.1	SC63	<0.1
SC28_0.0-0.25	<0.1	SC64_0.0-0.1	<0.1
SC29_0.0-0.20	<0.1	SC65	<0.1
SC30_0.0-0.20	<0.1	SC66	<0.1
SC31_0.0-0.20	<0.1	SC67_0.0-0.1	<0.1
SC32_0.00.05	<0.1	SC68_0.0-0.2	<0.1
SC33_0.0-0.33	<0.1	SC69_0.0-0.1	0.1
SC34_0.0-0.25	<0.1	SC70_0.0-0.1	<0.1
SC35_0.00.055	<0.1	SC71	<0.1
SC36_0.00.050	<0.1	SC72	<0.1
SC37_0.00.051	<0.1		

Mean concentrations of contaminants in dredge area sediments should be compared to regional ambient baseline levels (for sediments of comparable grainsize) for contaminants in which 95% UCL of mean concentrations exceed NAGD Screening Levels. NAGD Screening Levels are not available for aluminium and assessment of this element against baseline values was not triggered.

1.2.7 Submission # 356

“Relevant other sections of Q5 which refer to an exceedance of the NAGD Screening Levels should specify whether the exceedance is by an individual sample or the 95% UCL of the mean concentration.”

URS Response

It is agreed that whether individual or mean concentrations are compared to NAGD Screening Levels should be explicitly stated. It should be clarified that the only mean 95% UCL concentration that exceeds the NAGD Screening Level is for nickel in deep core samples, as per information included in Appendix Q5 (Table 4-2, Chevron, 2010). Exceedances of NAGD Screening levels in individual samples are present only for arsenic, nickel and chromium (82.1 mg/kg chromium in sample SC11_0.00-0.15), and this information was presented in Table 3-3 and Table 3-4 of Appendix Q5 (Chevron, 2010).

1.2.8 Submission # 357 (Original RTS # 29.83)

"With regard to 29.83, it can be noted that in Section 4.2.2 of the NAGD it is stated that "Phase II assessment procedures include comparison to the Screening Levels... and to ambient baseline levels for sediments of comparable grainsize in the vicinity of the disposal site. Where these levels are exceeded, elutriate and bioavailability testing under Phase III is required." The Proponent has indicated that the sediments at the potential disposal sites (muddy sands) are not of comparable grainsize to the clays in the deep cores in the dredge area in which the 95%UCL of the mean exceeds NAGD Screening Levels. The Proponent has undertaken bioavailability testing (weak acid-extractable metals) on short cores (note the 95%UCL of Ni in the short cores were below NAGD Screening Levels) with results well below Screening Levels."

URS Response

No response required.

1.2.9 Submission # 358

"It is agreed that the grainsize of material at the disposal site is not comparable to that of the dredge material with an elevated 95%UCL for Ni. The Proponent provides assumptions that the 95%UCL of Ni in surface sediments is below Screening Levels, and that Ni is probably of natural origin. The Proponent also indicates that Ni in dredge areas would probably not exceed background levels in deeper sediments at the disposal site. The Proponent states that elutriate testing was not undertaken as no allowance was made for the sampling, storing and testing in the sampling program."

URS Response

The 95% UCL of nickel concentrations in surface sediments is below the relevant NAGD Screening Level and therefore this is not an assumption.

Weak acid extracted an average of 1.2 mg/kg nickel (mean 4.8% of total nickel concentrations) in seven individual samples of surface sediments for which total nickel results exceeded NAGD Screening Levels. All weak acid extraction results were below the NAGD Screening Level. If the same extraction efficiency were applied to deep core sediments, it is assumed that concentrations of nickel in those samples would not have exceeded NAGD Screening Levels.

1.2.10 Submission # 359

"While the Proponent's assumptions may be feasible, there is insufficient data to support these assumptions, which should be provided in one or more of the following forms:

- comparison of the 80th percentile of the dredge sediments to the 80th percentile of ambient baseline levels for sediments of comparable grainsize in the vicinity of the dredge material placement sites;

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- comparison of the 80th percentile of the dredge sediments to the 80th percentile of ambient baseline levels for sediments in the vicinity of the dredge material placement site, normalised to a reference element (refer NAGD for references); and/or
- elutriate results for Ni in deep cores as provided for in the Proponent's Sampling and Analysis Plan."

URS Response

In order to adequately address the query, analytical results for shallow and deep sediments are normalised to aluminium and iron, respectively.

The 80th percentile of nickel concentrations (normalised to reference element aluminium) in near surface sediments within the proposed dredge area were compared to the 80th percentile of nickel concentrations (normalised to reference element aluminium) in near surface sediments near the dredge material placement sites, and regionally (URS, 2009).

The raw and normalised analytical data for aluminium and nickel concentrations are shown below (Table 1-6; Table 1-7; Table 1-8).

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Table 1-6 Concentrations of aluminium, nickel and Ni/Al ratios (x10,000) in near surface sediments in dredge material placement sites A, B, C, D and E, the proposed dredge area, and from regional samples (URS, 2009).

Area	Sample ID	Al (mg/kg)	Ni (mg/kg)	Ni/Al (x10000)n	Ni/Al (x1C	SD	RSD (%)
	G1	4130	4.5	10.9	12.2	3.3	27.0
	G2	4650	3.9	8.4			
	G3	4920	5	10.2			
	G4	4240	3	7.1			
	G5	4620	3.6	7.8			
	G6	4280	4.4	10.3			
	G7	4660	5.8	12.4			
	G8	4900	5.9	12.0			
	G9	4110	4.7	11.4			
	G10	4360	4.9	11.2			
Dredge	G11	4400	5.3	12.0			
Material	G12	3950	4	10.1			
Placement	G13	4060	4.7	11.6			
Site C	G14	3690	3.4	9.2			
	G15	4450	6	13.5			
	G16	4090	4.8	11.7			
	G17	4200	5.2	12.4			
	G18	4210	3.8	9.0			
	G19	5590	9.1	16.3			
	G69	2790	5.1	18.3			
	G70	2430	3.5	14.4			
	G71	3600	7.2	20.0			
	G72	3350	5.4	16.1			
	G73	3440	5.7	16.6			
	G30	4860	5	10.3	14.7	5.3	36.3
	G31	6110	8.2	13.4			
	G32	6530	11.2	17.2			
Dredge	G33	7180	13.8	19.2			
Material	G34	6270	11.9	19.0			
Placement	G35	5630	8.6	15.3			
Site B	G36	4420	8	18.1			
	G37	6120	10	16.3			
	G38	7130	11.5	16.1			
	G39	3120	0.5	1.6			
	G40	5440	10.9	20.0	18.7	1.5	8.1
	G41	6040	11.8	19.5			
	G42	5200	10	19.2			
Dredge	G43	6510	12.6	19.4			
Material	G44	5300	9.7	18.3			
Placement	G45	8210	16.5	20.1			
Site A	G46	6670	12.6	18.9			
	G47	7110	14.1	19.8			
	G48	5790	9	15.5			
	G49	5120	8.5	16.6			
	G50	3870	9.1	23.5	22.9	0.5	2.3
	G51	3990	9.1	22.8			
	G52	3640	8.5	23.4			
Dredge	G53	3500	8.1	23.1			
Material	G54	3960	8.6	21.7			
Placement	G55	3120	7.2	23.1			
Site E	G56	3840	8.8	22.9			
	G57	4270	10	23.4			
	G58	4700	10.6	22.6			
	G74	3590	8.2	22.8			
	G59	2890	7.5	26.0	22.9	1.2	5.4
	G60	3230	7.2	22.3			
	G61	2700	6.5	24.1			
Dredge	G62	2640	5.9	22.3			
Material	G63	2940	6.6	22.4			
Placement	G64	3040	6.9	22.7			
Site D	G65	3300	7.4	22.4			
	G66	2950	6.6	22.4			
	G75	2570	5.6	21.8			
	G76	3350	7.5	22.4			

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Table 1-7 Concentrations of aluminium, nickel and Ni/Al ratios (x10,000) in near surface sediments in dredge material placement sites A, B, C, D and E, the proposed dredge area, and from regional samples (URS, 2009) (cont'd).

Area	Sample ID	Al (mg/kg)	Ni (mg/kg)	Ni/Al (x10000)	Mean Ni/Al (x10000)	SD	RSD (%)
	SC1_0.0-0.27	8490	21.1	24.9	19.8	6.0	30.3
	SC2_0.0-0.22	4070	6.1	15.0			
	SC3_0.0-0.22	4050	10.4	25.7			
	SC4_0.0-0.25	4270	4.5	10.5			
	SC5	11000	20.3	18.5			
	SC6_0.0-0.2	4310	12.7	29.5			
	SC7_0.0-0.10	5270	10.2	19.4			
	SC8_0.0-0.30	5730	11.2	19.5			
	SC9_0.0-0.20	7780	16.3	21.0			
	SC10_0.0-0.10	6040	9.6	15.9			
	SC11_0.00.055	13400	37	27.6			
	SC12_0.0-0.15	6080	9.8	16.1			
	SC13	6820	11.4	16.7			
	SC14_0.00.051	5990	18.1	30.2			
	SC15_0.0-0.18	6960	15	21.6			
	SC16	5680	9.4	16.5			
	SC17_0.0-0.35	5560	10.9	19.6			
	SC18_0.0-0.30	6060	11.2	18.5			
	SC19_0.00.052	4660	6.2	13.3			
	SC20_0.0-0.20	10600	24.4	23.0			
	SC21_0.0-0.15	8820	18.1	20.5			
	SC22_0.00.053	4540	13.9	30.6			
	SC23_0.0-0.25	5950	11.8	19.8			
	SC24	4210	3	7.1			
	SC25	3970	5.8	14.6			
	SC26_0.00.051	6100	18.5	30.3			
	SC27_0.0-0.32	5570	12.2	21.9			
	SC28_0.0-0.25	8110	18.1	22.3			
	SC29_0.0-0.20	8900	22.3	25.1			
	SC30_0.0-0.20	6850	9.7	14.2			
Proposed Dredge Area	SC31_0.0-0.20	3860	3.6	9.3			
	SC32_0.00.05	4040	9.4	23.3			
	SC33_0.0-0.33	6850	11.2	16.4			
	SC34_0.0-0.25	8140	16	19.7			
	SC35_0.00.055	4710	8.7	18.5			
	SC36_0.00.050	5660	8.1	14.3			
	SC37_0.00.051	13800	35.4	25.7			
	SC38_0.0-0.40	3920	9.6	24.5			
	SC39_0.00.050	4910	6.9	14.1			
	SC40_0.0-0.31	7890	15.9	20.2			
	SC41_0.0-0.30	7250	17.8	24.6			
	SC42_0.0-0.25	5020	7.8	15.5			
	SC43_0.0-0.23	5300	13.6	25.7			
	SC44_0.00.052	5860	19	32.4			
	SC45_0.0-0.20	4540	5.7	12.6			
	SC46_0.0-0.25	6640	12.6	19.0			
	SC47_0.0-0.25	4770	8.8	18.4			
	SC48_0.00.050	4360	5.7	13.1			
	SC49_0.00.050	4610	5	10.8			
	SC50_0.0-0.23	7350	15.5	21.1			
	SC51	4270	2.2	5.2			
	SC52_0.00.050	4920	7.1	14.4			
	SC53_0.00.055	4180	10.4	24.9			
	SC54_0.0-0.20	8880	17.8	20.0			
	SC55_0.0-0.25	5620	11	19.6			
	SC55_0.0-0.30	8400	14.1	16.8			
	SC56_0.0-0.31	3670	11.5	31.3			
	SC57_0.00.055	10100	26.7	26.4			
	SC58_0.0-0.15	5820	10.6	18.2			
	SC59_0.0-0.23	5760	11.7	20.3			
	SC60_0.0-0.20	6460	13.2	20.4			

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Table 1-8 Concentrations of aluminium, nickel and Ni/Al ratios (x10,000) in near surface sediments in dredge material placement sites A, B, C, D and E, the proposed dredge area, and from regional samples (URS, 2009) (cont'd).

Area	Sample ID	Al (mg/kg)	Ni (mg/kg)	Ni/Al (x10000)	Mean Ni/Al (x10000)	SD	RSD (%)
Additional Samples Collected Near Proposed Dredge Area	SC61_0.0-0.18	10200	23.4	22.9	16.9	6.9	40.5
	SC62_0.0-0.1	9600	23.9	24.9			
	SC63	6820	14.9	21.8			
	SC64_0.0-0.15	7680	18.5	24.1			
	SC65	3470	1.5	4.3			
	SC66	4360	4	9.2			
	SC67_0.0-0.15	3430	3.7	10.8			
	SC68_0.0-0.20	3590	3.5	9.7			
	SC69_0.0-0.16	8020	17.8	22.2			
	SC70_0.0-0.10	6510	10.8	16.6			
	SC71	7020	13.4	19.1			
	SC72	6020	10.5	17.4			
Pilot Study Regional Area (URS, 2009)	W1	2270	3.6	15.9	18.6	2.0	10.9
	W2	3120	5.5	17.6			
	W3	3590	6.6	18.4			
	W4	3760	8.2	21.8			
	W5	3840	7.9	20.6			
	W6	2860	5.2	18.2			
	W7	3020	5.4	17.9			
	W8	5540	10.2	18.4			
	W9	18200	42.2	23.2			
	W10	10800	21.9	20.3			
	W11	10200	19.5	19.1			
	W12	2820	4.4	15.6			
	W13	730	1.1	15.1			
	W14	1100	1.7	15.5			
	W15	2010	3.8	18.9			
	W16	4213	7.1	16.9			
	W17	4410	8.8	20.0			
	W18	5397	11.3	20.9			
	W19	11400	20.1	17.6			
	W20	7285	14.7	20.2			
	W21	4400	8.4	19.1			
	W22	6747	13.5	20.0			
	W23	7580	13.8	18.1			
	W24	5130	9.5	18.5			
	W25	4700	7.9	16.8			

The aluminium-normalized concentration data for nickel reduce variability in the concentrations of nickel due to variations in sediment grainsize. While the mean nickel/aluminium (Ni/Al) concentration ratio (x10,000) in near surface sediments in the proposed dredge area is 19.8 (standard deviation (SD): 6.0) the mean Ni/Al ratios (x 10,000) in the dredge material placement sites vary between 12.2 and 22.9 (Table 1-6; Table 1-7; Table 1-8). However, the Ni/Al concentration ratio (x10,000) in near surface sediments sampled regionally (URS, 2009) is 18.6 (SD: 2.0), which is similar to the Ni/Al concentration ratio in near surface sediments in the proposed dredge area.

A ranking of the Ni/Al ratio data (x10,000) and a determination of the 80th percentile value of the ranked data for the proposed dredge area and the dredge material placement sites resulted in the following (Table 1-9):

- dredge material placement site C – 80th percentile Ni/Al (x10,000) ratio: 16.1;
- dredge material placement site B – 80th percentile Ni/Al (x10,000) ratio: 18.1;

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- dredge material placement site A – 80th percentile Ni/Al (x10,000) ratio: 19.8;
- dredge material placement site E – 80th percentile Ni/Al (x10,000) ratio: 23.4;
- dredge material placement site D – 80th percentile Ni/Al (x10,000) ratio: 22.7;
- proposed dredge area – 80th percentile Ni/Al ratio: 25.1; and
- regional samples (URS, 2009) – 80th percentile Ni/Al ratio: 20.3

The 80th percentile values of the Ni/Al concentration ratios in near surface sediments vary from 16.1 to 25.1, which exemplifies the regional geochemical similarity of the sediments with respect to nickel.

A comparison of the concentrations of nickel in deep core sediments to ambient baseline levels for sediments in the vicinity of the dredge material placement site was performed using iron as a reference element, which was analysed in deep cores and also in near surface sediment samples obtained regionally (URS, 2009).

The nickel/iron (Ni/Fe) concentration ratios in deep core sediments are shown in Table 1-10 and the Ni/Fe concentration ratios in near surface sediments regionally (URS, 2009) are shown in Table 1-11.

Deep core sediment have a mean Ni/Fe (x10,000) concentration ratio of 5.6 (SD: 1.1) (Table 1-10) compared to a Ni/Fe (x10,000) concentration ratio of 5.0 (SD: 1.3) in near surface sediments regionally (Table 1-11). This similarity suggests that the concentrations of nickel in deep core sediments in the proposed dredge area are similar to regional baseline concentrations on an elemental normalized basis (i.e. Fe-normalised) and supports the hypothesis of a regional geochemical homogeneity and a natural origin of nickel.

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Table 1-9 Ranked Ni/Al concentration ratios (x10,000) in near surface sediments in dredge material placement sites, proposed dredge area and regionally (URS, 2009).

Dredge Material Placement Site C	Dredge Material Placement Site B	Dredge Material Placement Site A	Dredge Material Placement Site E	Dredge Material Placement Site D	Proposed Dredge Area	Pilot Study Regional Area
7.1	1.6	15.5	21.7	21.8	5.2	15.1
7.8	10.3	16.6	22.6	22.3	7.1	15.5
8.4	13.4	18.3	22.8	22.3	9.3	15.6
9.0	15.3	18.9	22.8	22.4	10.5	15.9
9.2	16.1	19.2	22.9	22.4	10.8	16.8
10.1	16.3	19.4	23.1	22.4	12.6	16.9
10.2	17.2	19.5	23.1	22.4	13.1	17.6
10.3	**18.1**	**19.8**	**23.4**	**22.7**	13.3	17.6
10.9	19.0	20.0	23.4	24.1	14.1	17.9
11.2	19.2	20.1	23.5	26.0	14.2	18.1
11.4					14.3	18.2
11.6					14.4	18.4
11.7					14.6	18.4
12.0					15.0	18.5
12.0					15.5	18.9
12.4					15.9	19.1
12.4					16.1	19.1
13.5					16.4	20.0
14.4					16.5	20.0
16.1					16.7	20.2
16.3					16.8	**20.3**
16.6					18.2	20.6
18.3					18.4	20.9
20.0					18.5	21.8
					18.5	23.2
					18.5	
					19.0	
					19.4	
					19.5	
					19.6	
					19.6	
					19.7	
					19.8	
					20.0	
					20.2	
					20.3	
					20.4	
					20.5	
					21.0	
					21.1	
					21.6	
					21.9	
					22.3	
					23.0	
					23.3	
					24.5	
					24.6	
					24.9	
					24.9	
					25.1	
					25.7	
					25.7	
					25.7	
					26.4	
					27.6	
					29.5	
					30.2	
					30.3	
					30.6	
					31.3	
					32.4	

NB: 80th percentile Ni/Al concentration ratio is bold.

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Table 1-10 Ranked Ni/Fe concentration ratios (x10,000) in deep core sediments in proposed dredge area.

Sample ID	Ni (mg/kg)	Fe (mg/kg)	Ni/Fe (x10000)	Sample ID	Ranked Ni/Fe (x10000)
MC001 (comp)_1.0-2.0m	30	46200	6.5	MC005_0.45-0.55m	3.2
MC001_0.45-0.55m	20	39100	5.1	MC015_0.45-0.55m	3.3
MC001_0.9-1.0m	38	52000	7.3	MC004_3.9-4.0m	3.5
MC001_3.4-3.5m	13	24200	5.4	MC012_0.45-0.55m	3.8
MC001_6.4-6.5m	12	27500	4.4	MC015_0.9-1.0m	3.9
MC002_1.0-1.1m	15	33300	4.5	MC015_6.4-6.5m	3.9
MC002_1.9-2.0m	17	36100	4.7	MC011_0.0-0.4	4.0
MC002_2.9-3.0m	29	46200	6.3	MC002_6.4-6.5m	4.1
MC002_6.4-6.5m	10	24100	4.1	MC009_1.0-1.1	4.2
MC003_(comp) 1-2m	29	45600	6.4	MC013_6.9-7.0	4.3
MC003_0.45-0.55m	21	39000	5.4	MC001_6.4-6.5m	4.4
MC003_0.9-1.0m	25	40800	6.1	MC013_0.45-0.55	4.4
MC003_3.4-3.5m	35	54500	6.4	MC004_0.9-1.0m	4.4
MC003_6.9-7.0m	19	37100	5.1	MC002_1.0-1.1m	4.5
MC004 (comp)_1-2m	12	24500	4.9	MC008_7.0-7.1	4.5
MC004_0.9-1.0m	12	27100	4.4	MC008_2.0-3.0	4.6
MC004_3.9-4.0m	6	17300	3.5	MC009_13.4-13.5	4.6
MC004_8.0-8.1	15	27100	5.5	MC002_1.9-2.0m	4.7
MC005 (comp)_1-2m	19	34400	5.5	MC014_6.9-7.0	4.7
MC005_0.45-0.55m	9	28100	3.2	MC013_0.8-0.9	4.8
MC005_0.9-1.0m	23	37600	6.1	MC004 (comp)_1-2m	4.9
MC005_3.0-3.1m	29	42200	6.9	MC008_3.8-3.9	5.0
MC005_6.9-7.0m	28	41100	6.8	MC001_0.45-0.55m	5.1
MC006 (comp)_1-2m	22	35300	6.2	MC003_6.9-7.0m	5.1
MC006_0.45-0.55	30	43300	6.9	MC012_0.9-1.0m	5.2
MC006_0.9-1.0	28	40900	6.8	MC001_3.4-3.5m	5.4
MC006_3.26-3.36	20	33000	6.1	MC003_0.45-0.55m	5.4
MC006_9.9-10.0	24	41800	5.7	MC011_1.0-1.1	5.4
MC007_0.45-0.55	21	38700	5.4	MC015 (comp)_1.0-2.0m	5.4
MC007_0.8-0.9	24	44000	5.5	MC007_0.45-0.55	5.4
MC007_1.0-2.0	23	39100	5.9	MC007_0.8-0.9	5.5
MC008_0.45-0.55	32	49600	6.5	MC005 (comp)_1-2m	5.5
MC008_0.8-0.9	32	51700	6.2	MC004_8.0-8.1	5.5
MC008_2.0-3.0	16	35000	4.6	MC014_0.45-0.55	5.7
MC008_3.8-3.9	17	34000	5.0	MC006_9.9-10.0	5.7
MC008_7.0-7.1	9	19800	4.5	MC014_0.8-0.9	5.8
MC009 (comp)_2.0-3.0	29	42100	6.9	MC012 (comp)_1.0-2.0m	5.8
MC009_1.0-1.1	15	35900	4.2	MC007_1.0-2.0	5.9
MC009_13.4-13.5	6	13100	4.6	MC009_8.9-9.0	5.9
MC009_3.9-4.0	38	53000	7.2	MC010_0.45-0.55	5.9
MC009_8.9-9.0	23	39000	5.9	MC010_0.9-1.0	6.0
MC010 (comp)_1.0-2.0	20	32800	6.1	MC011_2.0-3.0	6.0
MC010_0.45-0.55	23	38800	5.9	MC006_3.26-3.36	6.1
MC010_0.9-1.0	22	36800	6.0	MC011_7.5-7.55	6.1
MC010_10.9-11.0	15	24400	6.1	MC010 (comp)_1.0-2.0	6.1
MC010_3.45-3.55	30	42600	7.0	MC014_1.0-2.0	6.1
MC010_7.9-8.0	14	22000	6.4	MC005_0.9-1.0m	6.1
MC011_0.0-0.4	12	29700	4.0	MC003_0.9-1.0m	6.1
MC011_1.0-1.1	26	48100	5.4	MC010_10.9-11.0	6.1
MC011_2.0-3.0	24	40000	6.0	MC008_0.8-0.9	6.2
MC011_3.5-3.6	27	41700	6.5	MC013_1.0-2.0	6.2
MC011_7.5-7.55	23	37800	6.1	MC006 (comp)_1-2m	6.2
MC012 (comp)_1.0-2.0m	26	44600	5.8	MC002_2.9-3.0m	6.3
MC012_0.45-0.55m	10	26500	3.8	MC003_(comp) 1-2m	6.4
MC012_0.9-1.0m	18	34600	5.2	MC010_7.9-8.0	6.4
MC012_4.0-4.1m	36	51600	7.0	MC003_3.4-3.5m	6.4
MC012_9.4-9.5	34	40800	8.3	MC008_0.45-0.55	6.5
MC013_0.45-0.55	22	49800	4.4	MC011_3.5-3.6	**6.5**
MC013_0.8-0.9	16	33200	4.8	MC001 (comp)_1.0-2.0m	6.5
MC013_1.0-2.0	30	48200	6.2	MC014_3.4-3.5	6.5
MC013_3.4-3.5	38	47900	7.9	MC005_6.9-7.0m	6.8
MC013_6.9-7.0	14	32800	4.3	MC006_0.9-1.0	6.8
MC014_0.45-0.55	22	38400	5.7	MC005_3.0-3.1m	6.9
MC014_0.8-0.9	30	51600	5.8	MC009 (comp)_2.0-3.0	6.9
MC014_1.0-2.0	26	42600	6.1	MC006_0.45-0.55	6.9
MC014_3.4-3.5	30	46100	6.5	MC012_4.0-4.1m	7.0
MC014_6.9-7.0	20	42400	4.7	MC010_3.45-3.55	7.0
MC015 (comp)_1.0-2.0m	23	42400	5.4	MC009_3.9-4.0	7.2
MC015_0.45-0.55m	6	18200	3.3	MC001_0.9-1.0m	7.3
MC015_0.9-1.0m	8	20600	3.9	MC013_3.4-3.5	7.9
MC015_3.4-3.5m	34	42700	8.0	MC015_3.4-3.5m	8.0
MC015_6.4-6.5m	8	20300	3.9	MC012_9.4-9.5	8.3

NB: 80th percentile Ni/Al concentration ratio is bold.

Table 1-11 Ranked Ni/Fe concentration ratios (x10,000) in near surface sediments regionally (URS, 2009).

Sample ID	Ni (mg/kg)	Fe (mg/kg)	Ni/Fe (x10000)	Sample ID	Ni/Fe (x10000)
W1	3.6	11900	3.0	W1	3.0
W2	5.5	8130	6.8	W15	3.0
W3	6.6	9420	7.0	W21	3.5
W4	8.2	11600	7.1	W12	3.6
W5	7.9	14500	5.4	W14	3.6
W6	5.2	7500	6.9	W22	3.9
W7	5.4	11300	4.8	W17	4.0
W8	10.2	19300	5.3	W18	4.3
W9	42.2	61900	6.8	W13	4.3
W10	21.9	39800	5.5	W20	4.3
W11	19.5	33100	5.9	W25	4.4
W12	4.4	12300	3.6	W16	4.6
W13	1.1	2580	4.3	W7	4.8
W14	1.7	4660	3.6	W23	5.0
W15	3.8	12500	3.0	W24	5.0
W16	7.1	15300	4.6	W8	5.3
W17	8.8	22000	4.0	W5	5.4
W18	11.3	26500	4.3	W10	5.5
W19	20.1	31400	6.4	W11	5.9
W20	14.7	34100	4.3	W19	6.4
W21	8.4	24300	3.5	W2	**6.8**
W22	13.5	34300	3.9	W9	6.8
W23	13.8	27600	5.0	W6	6.9
W24	9.5	19000	5.0	W3	7.0
W25	7.9	17800	4.4	W4	7.1

NB: 80th percentile Ni/Al concentration ratio is bold.

1.3 Summary

The information above provides an addendum to Appendix Q5 (Chevron, 2010) and responds to additional submissions received by the DSEWPC. The information should be considered in combination with the information contained in, and referred to in, the Appendix Q5 (Chevron Q5).

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References

Commonwealth of Australia (2009). National Assessment Guidelines for Dredging, Commonwealth of Australia, Canberra, 2009.

Chevron Australia Pty Ltd (2010). Draft Environmental Impact Statement/Environmental Review and Management Programme for the Proposed Wheatstone Project: Volume II (Chapters 7 to 12).

URS Australia Pty Ltd (2009). Pilot Marine Sediment Quality Report for the Wheatstone Project, Onslow WA, Report to Chevron Australia Pty Ltd, 27 March 2009.

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Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Chevron Australia Pty Ltd (Chevron) and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated the 7th of September 2010.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between the 10th of January and the 21st of January 2011 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

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Appendix S1

Draft Dredging and Spoil Disposal Management Plan: Capital Dredge and Disposal Program

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DRAFT

TABLES

FIGURES

DRAFT DSDMP COMMITMENTS REGISTER

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
Water Quality and Benthic Primary Producer Habitat Management				
1	**Section 8.1.2**	Trailing Suction Hopper Dredges (TSHD) will be fitted with a turbidity-reducing valve within the overflow pipe.	Evidence of compliance provided by dredge contractor	Prior to commencement of TSHD operations
2	**Section 8.1.2**	Diffusers will be utilised during offshore dredge material placement via the Cutter Suction Dredge (CSD) at placement sites A.	Dredge vessel records	During offshore placement with CSD activities
3	**Section 8.1.2**	Where reasonably practicable the works will be managed to reduce sediment re-suspension via propeller wash by controlling the under-keel clearance of the TSHD.	Dredge vessel records	When practicable
4	**Section8.1.2**	During sediment transport by the TSHD and barges, the level of the overflow pipe will be raised to its highest point to reduce the potential for spillage.	Visual inspection	During all sediment transport by TSHD
5	**Section 8.1.2**	Hopper doors on the TSHD and barges will be maintained to reduce the potential for sediment loss during transport.	Evidence of compliance by dredge contractor	Prior to commencement of TSHD operations
6	**Section8.1.2**	Well-maintained and properly calibrated dredging equipment will be utilised.	Dredge calibration records	Prior to commencement of dredge
7	**Section 8.1.2**	Hopper dewatering will be confined to areas away from sensitive receptors where reasonably practicable.	Dredge vessel records	Throughout TSHD operations
8	**Section 8.1.2**	Overflow will be restricted in designated Restricted Overflow Areas whenever sensitive receptors are considered to be at risk. An example is illustrated in Figure 8-3 however the areas will vary depending on conditions and dredging operations.	Throughout TSHD works	Throughout TSHD operations, dependent on weather conditions
9	**Section 8.1.2**	Impacts to BPPH will be minimised by limiting anchor and anchor chain interference by construction vessels to established 'no anchor areas'.	Evidence of establishment of no anchor zones	Prior to vessel arrival on site
10	**Section 8.1.2**	The TSHD overflow will be calibrated to the green valve.	Dredge vessel records	Throughout TSHD operations
11	**Section**	A buffer of 0.5nm will be maintained around coral reefs to the east of the approach	Dredge vessel records	Throughout construction

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
	8.1.2	channel to limit stress associated with resuspension of sediment from propeller wash **Figure 8-5.**		
12		The floatel will be moored in areas where the seafloor is characterised by bare sand (Figure 4-5) without coral, seagrass or macroalage.	Vessel records	Throughout works
Water Quality and Benthic Primary Producer Habitat (Hard Coral) Management				
13	**Section 8.1.2**	Responsive monitoring and associated tiered responsive management will be implemented to manage any potential impacts that increased turbidity may have on sensitive BPPH. ♦ Water quality, sedimentation and coral health monitoring to be carried out throughout the dredging program and following completion of dredging. ♦ Implementation of a tiered management response program associated with water quality and coral health monitoring. ♦	Water Quality and Coral Health Monitoring Reports	Throughout works
Benthic Primary Producer Habitat Management (Seagrass and filter communities)				
14		Seagrass and filter feeder communities will not be included as a key sensitive receptors in the dredge monitoring program. However, Impact Monitoring will be carried out (refer to Section 9.4) to quantify any potential losses resulting from dredging and dredge material placement activities. Monitoring of seagrass and filter feeder communities will be carried out pre and post-dredging and dredge material placement activities.	Impact monitoring reports	Pre and post dredging
Marine Fauna Management				
15	**Section 8.2**	Personnel trained in marine fauna observations will be present on dredge vessels, during daylight hours.	Record of training courses	Throughout works
16	**Section 8.2**	Whale and dugong observations and response procedures, including not commencing dredging or dredge material placement if whales or dugongs are sighted within a 300 m observation zone and ceasing dredging activities if whales or dugongs enter a 100 m exclusion zone, further details are outlined in **Figure 8-4** of the DSDMP**.** If calves are present the exclusion zone will be extended to 300m.	Mammal sighting reports	Throughout works

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
17		Dolphin observations and response procedures including application of 100 m observation zone will be implemented during dredging and dredge material placement works as outlined in **Figure 8 4**.	Mammal sighting reports	Throughout works
18	**Section 8.2**	A trained crew member will maintain a watch, during daylight hours, for whales and dugongs while any dredge is en route to and from the dredge area to dredge material placement sites. If sighted, direction/speed will be adjusted to avoid potential impact (within the safety constraints of the vessel) to marine mammals.	Mammal sighting reports	Throughout works
19	**Section 8.2**	Designated transit corridors (Corridors A, B and C) have been established for dredge vessels transiting to Placement Site C during the Capital Dredging Program to minimise the disturbance to marine fauna (**Figure 8 5**)	Dredge vessel reports	Throughout works
20	**Section 8.2**	Management of cetacean interactions will be in accordance with the requirements for cetacean interactions specified under Part 8 of the EPBC Regulations 2000 (Cth), the Australian National Guidelines for Whale and Dolphin Watching.	Mammal sighting reports	Throughout works
21	**Section 8.2**	The presence of cetaceans/dugongs in or near exclusion zones established for key dredging and construction activities will be recorded.	Record of mammal sightings	Throughout works
22	**Section 8.3**	Dredge pumps will be stopped as soon as reasonably practicable after completion of dredging and where reasonably practicable the drag head will remain within0.5 m of the seabed until the dredge pump is stopped.	Dredge vessel reports	Throughout works
23	**Section 8.2**	When operating with less than 5 m under-keel clearance, the TSHD will initially move slowly through the area before commencing dredging so that associated noise and vibration will alert marine turtles in close proximity and encourage them to leave. This will only be applied to dredging in new areas and not once the work area has been established.	Dredge vessel reports	Throughout works
24	**Section 8.2**	When initiating dredging, suction through dragheads will be initiated just long enough to prime the pumps, prior to drag heads engaging the seabed	TBC	Throughout works
25	**Section 8.2**	Tickler chains on the drag head of the TSHD will be used as a management mitigation approach to reduce turtle entrainment.	TBC	Throughout works
26	**Section 8.2**	Overflow screens will be used on TSHD to visually assess for turtles and turtle remains associated with entrainment during dredging.	TBC	Throughout works

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
27	**Section 8.2**	Mooring at night will not take place at night during Nov-April, the turtle nesting season, within 1.5 km of nesting beaches.	Vessel reports	Throughout dredging works from Nov-April
28	**Section 8.2**	The Proponent will provide marine fauna aerial sighting data (as presented in the EIS/ERMP) for Department of Environment and Conservation (DEC) planning purposes in the Onslow region.	TBC	
29	**Section 8.2**	Boats and recreational vehicles will not be permitted within the workforce accommodation village or the access road from the Onslow Road.	TBC	Throughout works
30	**Section 8.2**	Conservation and induction programs will be established to ensure staff/contractors are informed of DEC rules relating to offshore nature reserves.	Record of inductions	Prior to staff/contractors mobilisation
Introduced Marine Pests (IMP) Management				
31	**Section 8.3.2**	All dredging and support vessels will be subjected to a risk assessment to assess whether the vessel presents a low, high or uncertain risk of acting as a vector for IMP. The risk assessment will be based on the vessel's recent history and origin, recent inspections, anti-fouling coating status and whether it will be undertaking a direct sail from its point of origin.	Vessel Risk Assessment Pre-mobilisation "Assessment Report"	Throughout works
32	**Section 8.3.2**	All dredging and support vessels determined to be of uncertain or high risk will be subjected to a pre-mobilisation inspection and will not be mobilised until determined to be a low IMP risk.	Vessel Inspection Checklist Pre-mobilisation "Assessment Report"	Throughout works
33	**Section 8.3.2**	All dredges will comply with the Australian Quarantine Regulations 2000 and with the AQIS mandatory ballast water requirements.	Dredge Vessel Ballast Water Logbook	Throughout works
34	**Section 8.3.2**	In the event that IMP are identified on the dredging or support vessels during the arrival inspection or at any time while the construction vessel is on site: ♦ The Department of Fisheries (DoF) and DEC will be notified. ♦ The dredging or support vessel will be moved offshore as soon as practicably possible. Within vessel operating constraints, the construction vessel should be	IMP incident report. Detailed response plan developed	In the event of identification of invasive marine pests on construction vessels

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
		moved to offshore waters, greater than 12 nm from shore or to a water depth greater than 50 m. ♦ The dredging or support vessel will not be permitted to return to site until it has undergone treatment and re-inspection to confirm that the vessel is a low risk. The mobilisation procedure described above will be required to be followed including the mandatory arrival inspection with 48 hours of arrival on site. ♦ A detailed response plan including monitoring and control measures will be developed and implemented. This plan will aim to determine if the identified species has become established and if measures to control the species are required.		
Dredge Material Placement Area Management				
35	**Section 8.5.2**	At the offshore sites the placement of dredge material will comply with the requirements of the Sea Dumping Permit (SDP), including: ♦ Establish by Differential Global Positioning System (DGPS) that, immediately prior to dredge material placement, the vessel is within the approved dredge material placement area. ♦ Any dredge used in connection with the dredge material placement activities and any associated towing vessels must comply with the relevant state, national or international standards with respect to seaworthiness, safety and environmental requirements, or any rules or conditions laid down by the certifying classification society, and be capable of disposing dredged material at the dredge material placement sites in accordance with the SDP. ♦ Marine mammal management procedures as detailed in **Section 8.2** will be followed during dredge material placement activities. ♦ Records comprising either weekly plotting sheets or a certified extract of the ship's log will be retained (for verification and auditing purpose), which detail: ○ the times and dates of when each dredge material placement run is commenced and finished ○ the position (as determined by DGPS) of the vessel at the beginning and end of each dredge material placement run, with the inclusion of the path of each dredge material placement run; and ○ the volume of dredge material (in cubic metres) dumped and quantity (in dry tonnes) for the specified operational period and compare these quantities with	Dredge Logs, dredge vessel reports	Throughout works

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
		the total amount permitted under the SDP.		
36	**Section 8.5.2**	A bathymetric survey of the dredge material placement areas will be undertaken: ♦ Prior to the commencement of dredging. ♦ Within two months of the completion of all dredge material placement activities authorised under the SDP.	Sea dumping compliance reports	Pre-dredging and two months post-dredging
Waste Management				
37	**Section 8.6.2**	Adherence to the requirements of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and MARPOL 73/78 Convention Annex IV (Sewage) and Annex V (Garbage).	Regular audits	Throughout works
Hazardous Waste and Oil Management				
38	**Section 8.7.2**	Hazardous material storage areas will be designed to handle the volumes and operating conditions specifically required for each substance, including product identification, transportation, storage, control and loss prevention (e.g. bunding and drainage).	Regular audits	Throughout works
39	**Section 8.7.2**	Industry standards, port authority and pollution prevention regulations will be adhered to during refuelling, transfer, storage and handling of hazardous materials (e.g. bunding, level gauges, overflow protection, drainage systems and hardstands).	Regular audits	Throughout works
40	**Section 8.7.2**	Hazardous materials (including hazardous waste) will be stored in appropriately labelled drums or tanks. Complete up to date list of material safety data sheets (MSDS) will be available and stored with relevant products.	Regular audits	Throughout works
41	**Section 8.7.2**	The hydraulic oil system will be high quality, well-maintained and regularly inspected.	Regular audits	Throughout works
42	**Section 8.7.2**	The main hydraulic system on each dredging vessel will be equipped with standard low	Regular audits	Throughout works

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
		pressure alarms and shut down systems to limit hydrocarbon loss in the event of a burst hydraulic hose.		
43	**Section 8.7.2**	Detailed refuelling procedures will be developed by the dredge contractor prior to commencement of work on site and will include the following requirements: ♦ Fuel transfer to occur in accordance with port authority and pollution regulations. ♦ Specific safety boundaries used when refuelling. ♦ Requirement of refuelling to be undertaken in fair weather conditions to reduce risk of spills. ♦ Requirement for open communication channels to be maintained during refuelling. ♦ Instructions for visual monitoring. ♦ Emergency response procedures.	Refuelling procedures developed by contractor	Prior to commencement of works
44	**Section 8.7.2**	Personnel involved with refuelling or fuel transfer will be trained in their roles, functions and responsibility, including emergency response, prior to engaging in refuelling or fuel transfer.	Induction records	Prior to commencement of works
45	**Section 8.7.2**	All vessels greater than 400 gross tonnage will have bilge oil/water separators that comply with the requirements of Annex I of MARPOL 73/78 and Part II of the Protection of the Sea (Prevention of Pollution from Ships) Act 1993 (Cth) so that that oil concentrations in discharges are less than 15 ppm.	Regular audits	Throughout works
46	**Section 8.7.2**	Drainage from decks and work areas with potential for oil, grease or hydrocarbon contamination will be collected and processed through an oil/water separator and managed according to International Oil Pollution Prevention (IOPP) procedures prior to discharge or stored for onshore placement.	Regular audits	Throughout works
47	**Section 8.7.2**	Sufficient and appropriate equipment, materials and resources will be available to: ♦ Prevent spills to marine environment from working machinery (e.g. spill trays, one-way valves or other spill prevention features).	Regular audits	Throughout works

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No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
		♦ Respond to spills to the marine environment. Respond to spills to ground (on board vessels).		
48	**Section 8.7.2**	The dredge contractor will comply with and align spill response preparedness with the Oil Spill Contingency Plan (OSCP).	Regular audits	Throughout works
49	**Section 8.7.2**	All relevant personnel will be trained in spill response and reporting.	Induction records	Prior to commencement of works
50	**Section 8.7.2**	All vessels will have a current IOPP Certificate issued by the state in which the vessel is registered and an approved Shipboard Oil Pollution Emergency Plan (SOPEP).	Regular audits	Throughout works
51	**Section 8.7.2**	If vessel does not have an existing approved SOPEP, the vessel will prepare a vessel specific Spill Contingency Plan (SCP) that bridges to the Chevron OSCP to enable an effective, integrated response to any spill.	Spill contingency plan developed	Prior to commencement of works
52	**Section 8.7.2**	Onboard spills will be contained and cleaned up immediately and will not be washed overboard. Product MSDSs will be adhered to during clean-up.	Regular audits	Throughout works

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ACRONYMS AND ABBREVIATIONS

ABU	Australasian Business Unit
ADCP	Acoustic Doppler Current Profiler
ALARP	As Low as Reasonably Practicable
ANZECC	Australian and New Zealand Environment Conservation Council
APPEA	Australian Petroleum Production and Exploration Association
AQIS	Australian Quarantine and Inspection Service
BPP	Benthic Primary Producers
BPPH	Benthic Primary Producer Habitat
CAMBA	China-Australia Migratory Bird Agreement
CCIMPE	Coordinating Committee for Introduced Marine Pest Emergencies
CSD	Cutter Suction Dredge
Chevron ABU	Chevron Australasia Business Unit
Cth	Commonwealth
DBNGP	Dampier Bunbury Natural Gas Pipeline
DEC	Department of Environment and Conservation (state)
DSEWPaC	Department for Sustainability, Environment, Water, Population and Communities
DoE	Department of Environment (state), now the DEC
DoF	Department of Fisheries (state)
Domgas	Domestic Gas
DPI	Department for Planning and Infrastructure (State)
DSDMP	Dredging and Spoil Disposal Management Plan
EA	Environment Australia (now DSEWPaC)
ECU	Ecosystem Unit
EIS/ERMP	Environmental Impact Statement/Environmental Review and Management Programme
EMP	Environmental Management Plan
OEPA	Office of the Environmental Protection Authority (state)
EPBC Act (Cth)	*Environmental Protection and Biodiversity Conservation Act 1999*
EQO	Environmental Quality Objective
EQC	Environmental Quality Criteria
FCC	Fouling Control Coat
IMO	International Maritime Organisation
IMP	Introduced Marine Pests
IOPP	International Oil Pollution Prevention
JAMBA	Japanese-Australia Migratory Bird Agreement
KPI	Key Performance Indicators
LAT	Lowest Astronomical Tide
LEP	Level of Environmental Protection
LNG	Liquefied Natural Gas
MCMP	Marine and Coastal Management Plan
MEB	Marine Ecosystem Branch
Mm^3	Million cubic metres
MODIS	Moderate Resolution Imaging Spectroradiometer

MOF	Materials Offloading Facility
Mtpa	Million tonnes per annum
NADG	National Assessment Guidelines for Dredging
NIMPCG	National Introduced Marine Pests Coordination Group
NTU	Nephelometric Turbidity Units
OBC	Outcome Based Conditions
OE	Operational Excellence
OEMS	Operational Excellence Management System
OSCP	Oil Spill Contingency Plan
PLF	Product Loading Facility
PWQMG	Pilbara Water Quality Management Guidelines
SDP	Sea Dumping Permit
SMFG	Size Management Fish Grounds
SSC	Suspended Sediment Concentration
SWQMG	State Water Quality Management Guidelines
TSHD	Trailing Suction Hopper Dredge
WA	Western Australia

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1.0 INTRODUCTION

1.1 Wheatstone LNG Project

Chevron Australia Pty Limited (Chevron Australia) proposes to construct and operate a multi-train Liquefied Natural Gas (LNG) and domestic gas (Domgas) plant near Onslow on the Pilbara Coast, Western Australia. The Wheatstone Project (the Project) will process gas from various fields located offshore in the West Carnarvon Basin. Ashburton North is the proposed site for the LNG and Domgas plants. The Project will require the installation of gas gathering, export and processing facilities in Commonwealth and State waters and on land. The Project will produce gas from petroleum titles WA-253-P, WA-17-R, WA-356-P and WA-16-R, located 145 km offshore from the mainland, approximately 100 km north of Barrow Island and 225 km north of Onslow. **Figure 1-1** shows the location of the Project.

The Ashburton North site is located approximately 12 km south-west of Onslow along the Pilbara coast within the Shire of Ashburton. The initial Project is expected to consist of two LNG processing trains, each with a capacity of between 4 and 7 million tonnes per annum (Mtpa). Environmental approval is being sought for a 25 Mtpa plant to allow for the expected further expansions. The Domgas plant will be a separate but co-located facility and will form part of the Project. The development of the Domgas plant also includes onshore pipeline installation to tie-in to the existing Dampier-to-Bunbury Natural Gas Pipeline (DBNGP) infrastructure. **Figure 1-2** shows a conceptual design of the downstream infrastructure associated with the Project at Ashburton North.

1.2 Proponent

Chevron Australia is the sole operator and proponent of the Wheatstone Project.

1.3 Aim of Plan

The aim of this Draft Dredging and Spoil Disposal Management Plan (DSDMP) is to manage potential environmental impacts associated with the capital dredging and dredge material placement management activities in a manner that achieves the environmental objectives as detailed within the Environmental Impact Statement/Environmental Review and Management Programme (EIS/ERMP). Outcomes based environmental conditions developed for the project will be included within the Draft DSDMP following review of the EIS/ERMP by the Office of the Environmental Protection Authority (OEPA) and the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC).

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As required by Condition XX <Hold> of the proposed environmental conditions, the finalised DSDMP will:

1) provide a management structure to achieve the environmental objectives outlined within the Outcome Based Conditions (OBC) relating to dredging and dredge material management, in particular the OBCs relating to management of marine benthic communities (including hard coral, seagrass and filter feeder communities) and marine fauna.
2) provide monitoring programs suitable to show compliance with the OBCs relating to dredging and dredge material management

HOLD – the Outcome Based Conditions are still under development and once finalised this Draft DSDMP will updated accordingly to ensure that the methods/approaches used achieve the relevant OBC

This Draft DSDMP has been prepared for inclusion into the Environmental Impact Statement/Environmental Review and Management Programme (EIS/ERMP) for the Project.

The finalised DSDMP will address the requirements of applicable State Ministerial Conditions, Commonwealth Approvals Decision and the Commonwealth Sea Dumping Permit (SDP).

NOTE: This draft document is considered incomplete, pending input from various parties. Various “Hold” points are identified throughout the document where data gaps or other inputs are required.

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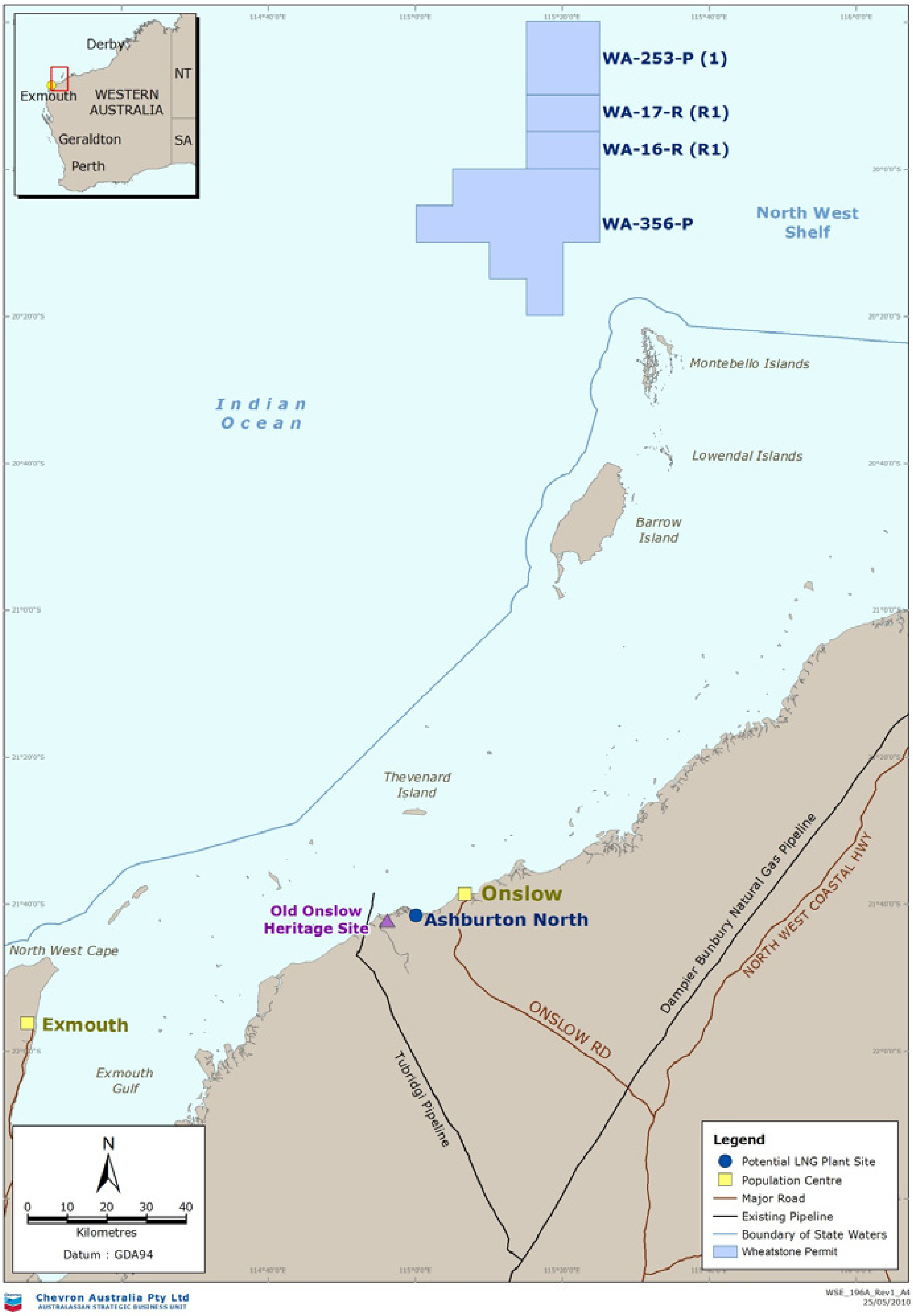

Figure 1-1: Location of Wheatstone Project

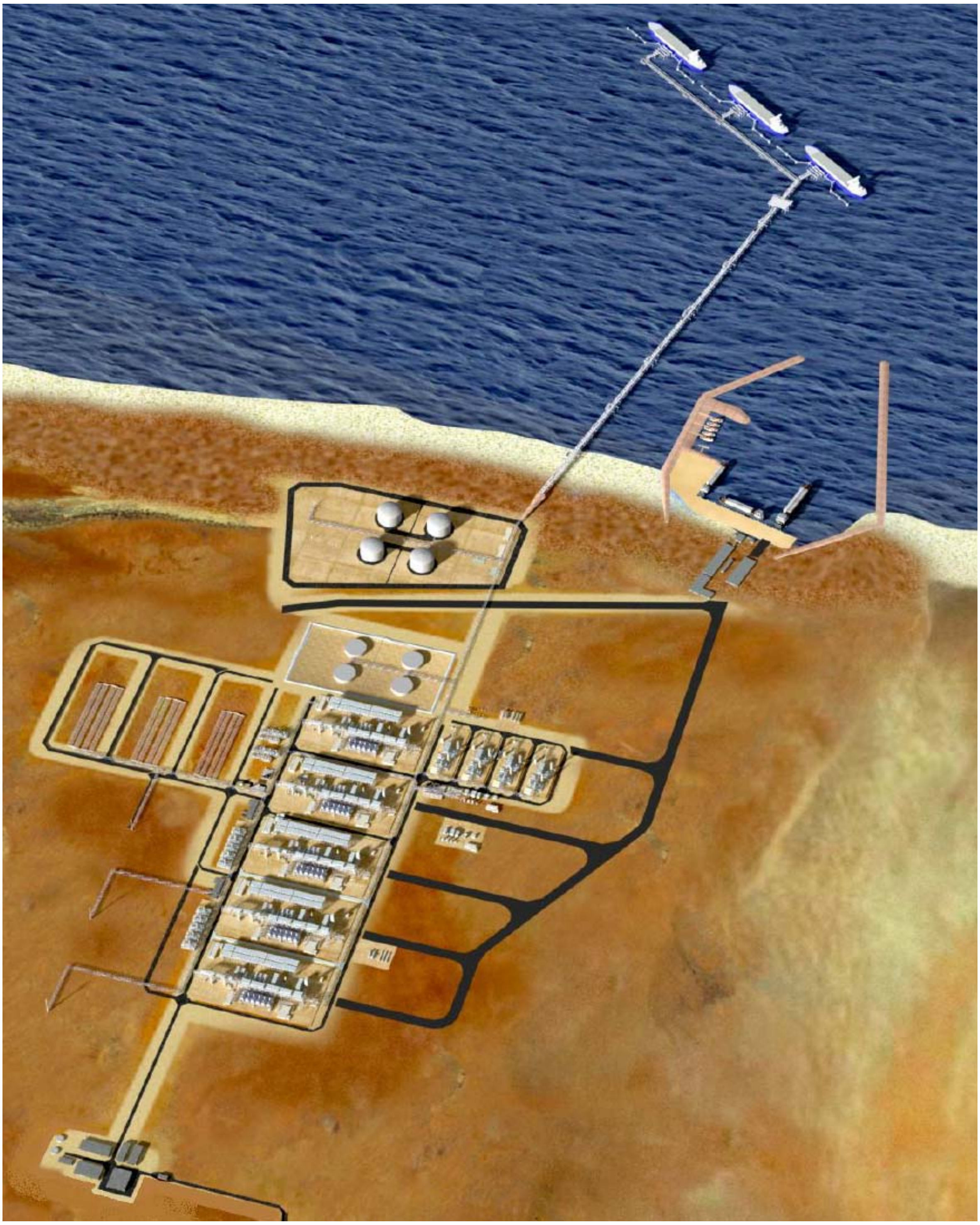

Figure 1-2: Illustrative Representation of Downstream Infrastructure

1.4 Scope

This Draft DSDMP covers the proposed environmental management and monitoring of the capital dredging and dredge material management activities associated with the Project which include:

- Dredging of the access channel to the Materials Offloading Facility (MOF).
- Dredging associated with the construction of the export facilities including the access channel and Product Loading Facility (PLF) incorporating the turning basin and berth pockets.
- Placement of dredge material at the nearshore and offshore dredge material placement sites.

Potential environmental impacts, management and monitoring associated with the nearshore trunkline installation and pipeline dredging are not addressed within this Draft DSDMP.

1.5 Legislative Requirements

The applicable Commonwealth and State legislation pertinent to the activities described with this plan includes, but is not limited to, the following Acts and Regulations (and relevant amendments):

State

- *Wildlife Conservation Act 1950 (WA);*
- *Environmental Protection Act 1986 (WA);*
- Environmental Protection Regulations 1987;
- *Pollution of Waters by Oil and Noxious Substances Act 1987 (WA);*
- Pollution of Waters by Oil and Noxious Substances Regulations 1993 (WA);
- *Conservation and Land Management Act 1994 (WA);*
- *Fish Resources Management Act 1994;*
- *Marine and Harbours Act 1981;*
- *Petroleum (Submerged Lands) Act 1982;*
- Wildlife Conservation Regulations 1970; and
- *Shipping and Pilotage Act 1967.*

Commonwealth

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Environment Protection (Sea Dumping) Act 1981;*
- Environment Protection (Sea Dumping) Regulations 1983;
- Australian Ballast Water Management Requirements 2001;
- Australian Quarantine Regulations 2000;
- *Protection of the Sea (Prevention of Pollution from Ships) Act 1983;*
- *Marine Act 1982;*

- Navigable Waters Regulations 1958; and
- Port and Harbour Regulations 1966.

1.6 Chevron ABU Policy 530

The Chevron Australasia Business Unit (ABU) has stated its commitment to achieving operational excellence in ABU Policy 530 (**Figure 1-3**). The Chevron ABU strives to achieve Operational Excellence (OE) through the implementation of the ABU Operational Excellence Management System (OEMS).

Chevron Australia is committed to implementing the Project in accordance with ABU Policy 530.

1.7 APPEA Code of Environmental Practice

The Australian Petroleum Production and Exploration Association (APPEA) Code of Environmental Practice (Australian Petroleum Production and Exploration Association 2008) is the most relevant Code of Practice for production operations in Australia. Specific requirements of the APPEA Code of Environmental Practice that are relevant to dredging and dredge material placement include:

- Compliance with applicable laws, regulations, standards and guidelines and, in their absence, adopting the best practicable means to prevent or minimise adverse environmental impacts.
- Providing adequate training to enable employees and contractors to adopt environmentally responsible work practices.
- Developing emergency plans and procedures so that incidents can be responded to in a timely and effective manner.
- Developing and maintaining management systems to identify, control and monitor risks.
- Identifying elements of the environment with natural, cultural, scientific or other significance which require avoidance (e.g. shipwrecks, reefs) or special protection procedures.
- Identifying and addressing special impacts from construction and installation techniques.
- Minimising air emissions and water discharges.
- Managing all waste materials generated and chemicals utilised in the construction and commissioning phase in accordance with site waste and chemical management plans and relevant regulations.

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ABU

Policy 530 - Operational Excellence
Achieving World-Class Performance

Chevron
Human Energy™

It is the policy of Chevron Corporation to protect the safety and health of people and the environment and to conduct our operations reliably and efficiently. The systematic management of safety, health, environment, reliability and efficiency to achieve world-class performance is defined as Operational Excellence (OE). Our commitment to OE is embodied in The Chevron Way value of protecting people and the environment, which places the highest priority on the health and safety of our workforce and protection of our assets and the environment.

We will accomplish this through disciplined application of our Operational Excellence Management System (OEMS). Our OEMS consists of three parts: Leadership Accountability, Management System Process and OE Expectations.

Leadership is the largest single factor for success in OE. Leaders are accountable not only for achieving results, but achieving them in the right way by behaving in accordance with our values. Leaders direct the Management System Process to drive improvement in OE results. The Management System Process consists of five steps:

Vision and Objectives	Developing an OE vision, world-class objectives, metrics and targets based on corporate objectives, benchmarking data and other applicable critical business drivers.
Assessment	Completing a comprehensive evaluation to identify priority areas in OE processes and performance against established objectives.
Planning	Developing three-year plans to manage priorities and incorporating those plans into business plans and assigning accountabilities.
Implementation	Implementing planned actions and monitoring plan progress and OE performance.
Review	Annually evaluating progress on performance and identifying necessary adjustments to plans that result in the goal of achieving world-class results.

We will assess and take steps to manage potential risks to our employees, contractors, the public and the environment within the following framework of OE Expectations:

1. **Security of Personnel and Assets** Providing a secure environment in which business operations may be conducted successfully.
2. **Facilities Design and Construction** Designing and constructing facilities to prevent injury, illness and incidents and to operate reliably, efficiently and in an environmentally sound manner.
3. **Safe Operations** Operating and maintaining facilities in a manner that does not cause injuries, illnesses or incidents.
4. **Management of Change** Managing both permanent and temporary changes to prevent incidents.
5. **Reliability and Efficiency:**
   - Reliability - Operating and maintaining facilities to sustain mechanical integrity and prevent incidents.
   - Efficiency - Maximizing efficiency of operations and conserving natural resources.
6. **Third-Party Services** Systematically addressing and managing contractor conformance to OE through contractual agreements.
7. **Environmental Stewardship** Working to prevent pollution and waste; striving to continually improve environmental performance and limiting impacts from our operations.
8. **Product Stewardship** Managing potential risks of our products throughout the products' life-cycles.
9. **Incident Investigation** Investigating incidents to identify, broadly communicate and correct root causes of incidents to reduce the likelihood of recurrence.
10. **Community Awareness and Outreach** Reaching out to the community and engaging in open dialogue to build trust.
11. **Emergency Management** Having preparedness plans in place to quickly and effectively respond to and recover from any emergency.
12. **Compliance Assurance** Complying and verifying conformance with company policy and all applicable laws and regulations; applying responsible standards where laws and regulations do not exist; enabling employees and contractors to understand their safety, health and environmental responsibilities.
13. **Legislative and Regulatory Advocacy** Working ethically and constructively to influence proposed laws and regulations, and debate on emerging issues.

Roy Krzywosinski, Managing Director
25/02/2008

Figure 1-3: Chevron ABU Policy 530

1.8 International Conventions

International agreements applicable to this Draft DSDMP include, but are not limited to:

- The 1996 London Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (ratified by Australia in 2000);
- The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the protocol of 1978 (MARPOL 73/78) (International Maritime Organization 1973);
- The Convention on the Conservation of Migratory Species of Wild Animals (Secretariat of the Convention for the Conservation of Migratory Species of Wild Animals 1979);
- Japan-Australia Migratory Bird Agreement (JAMBA);
- China-Australia Migratory Bird Agreement (CAMBA); and
- The International Convention for the Control and Management of Ship's Ballast Water and Sediments (note: subject to ratification by the International Maritime Organisation - IMO).

1.9 Relevant Standards

A number of Australian Standards are relevant to various aspects of this Draft DSDMP. These include, but are not limited to:

- Australian Standard/New Zealand Standard (AS/NZS) ISO 14001:2004 Environmental Management Systems – Requirements with Guidance for Use (Standards Australia/Standards New Zealand 2004): specifies the requirements for an environmental management system to enable the development and implementation of a policy and objectives which takes into account legal requirements and includes information about significant environmental aspects.
- AS/NZS 4360:2004 Risk Management (Standards Australia/Standards New Zealand 2004a): provides a generic guide for managing risk and specifies the elements of risk management systems
- HB 203:2006 Environmental Risk Management – Principles and Process (Standards Australia/Standards New Zealand 2006): is based on the generic risk management process developed in AS/NZS 4360:2004, but explains the principles and process of environmental risk management, and provides guidance on implementation.
- AS 1940:2004 The Storage and Handling of Flammable and Combustible Liquids (Standards Australia 2004).

1.10 Regulatory Guidance

A number of government strategy and guideline documents have been developed to provide advice to proponents in the development of environmental management and monitoring programs. In the development of the Draft DSDMP the following documents, both Commonwealth and State, have been considered:

Commonwealth

- National Assessment Guidelines for Dredging (Commonwealth Government of Australia 2009).

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- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000).
- National Strategy for Ecologically Sustainable Development (Commonwealth Government of Australia 1992).
- National Water Quality Management Strategy (Commonwealth Government of Australia 1992a).
- Intergovernmental Agreement on the Environment (Commonwealth Government of Australia 1992b).
- National Strategy for Conservation of Australia's Biological Diversity (Commonwealth Government of Australia 1996).
- Intergovernmental Agreement on a National System for the Prevention and Management of Marine Pest Incursions, April 2005.

Western Australia

- The Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives (DoE 2006).
- State Water Quality Management Strategy (Document No. 6) (Government of Western Australia 2004).
- WA EPA Environmental Assessment Guidelines No. 3 – Protection of Benthic Primary Producer Habitats in Western Australia's Marine Environment (Environmental Protection Authority 2009).
- WA EPA Guidance Statement No. 1 – Protection of Tropical Arid Zone Mangroves Along the Pilbara Coastline (Environmental Protection Authority 2001).
- WA EPA Environmental Assessment Guidelines No. 4 – Towards Outcome-based Conditions, Draft, December 2009 (Environmental Protection Authority 2009a).
- WA EPA Environmental Assessment Guidelines No. 7 – Marine Dredging Proposals, Draft, October 2010 (Environmental Protection Authority 2010).

1.11 Existing Management Frameworks

The Pilbara Coastal Water Quality Consultation Outcomes – Environmental Values and Environmental Quality Objectives (DoE 2006) provides various environmental values and Environmental Quality Objectives (EQOs) as a guideline for management of water quality in the Pilbara.

The guidelines recommend a set of environmental values and spatially-allocated EQOs and Levels of Ecological Protection (LEP) for the Pilbara coastal waters (DoE 2006). The LEPs are defined from low to maximum, where areas defined as 'low' have high levels of contaminants and are largely changed from natural variation, while areas defined as 'maximum' are pristine with no contaminants above background levels.

The Wheatstone Project EIS/ERMP details the key water quality values and sensitivities in the Ashburton North area. These environmental values include ecosystem health, recreational and aesthetic values, commercial and recreational fishing and aquaculture activities, cultural and spiritual values and industrial water supply.

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Table 1-1 outlines the environmental values, the EQOs and the Environmental Quality Criteria (EQC) for the Ashburton North areas and the management strategies and performance monitoring that will be applied to meet these objectives.

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Table 1-1: Pilbara Water Quality Objectives and Management Response

Environmental Values	Context	Environmental Quality Objectives	Environmental Criteria	Management Strategies
Ecosystem Health (ecological value)	Majority of the marine area adjacent to Onslow has a high LEP. Potential dredge material placement areas, the saltworks jetty and berths, and saltworks discharge have a moderate LEP. Small areas of significant arid zone mangroves adjacent to the mouth of the Ashburton River have a maximum LEP. No existing or proposed marine conservation reserves nearby. Areas south of the Ashburton river mouth and around Serrurier Island are currently classified as study areas (Department of Environment and Conservation 2008).	Maintain Ecosystem Integrity.	Limit impacts to biological receptors to within predicted and approved limits	♦ **Section 8.1.2**– Benthic Primary Producer Habitat (Hard Coral) Management ♦ **Section 8.1.4** – Benthic Primary Producer Habitat (Mangroves) Management ♦ **Section 8.2** – Marine Fauna Management ♦ **Section 8.3**– Introduced Marine Pests Management ♦ **Section 8.4** – Management of Potential Acid Sulphate Soils (PASS) ♦ **Section 8.5** – Dredge Material Placement Area Management ♦ **Section 8.6** – Waste Management ♦ **Section 8.7** – Hydrocarbon Management
Recreation and Aesthetics (social value)	Recreational boating occurs from the Onslow Maritime Facility in Beadon Creek. Onshore and offshore fishing including residential facilities on the Mackerel Islands. Diving and snorkelling around reefs and islands.	Water quality is safe for activities on and in the water (e.g. swimming and boating). Aesthetic values of the marine environment are protected.	<Hold> to be included in future revision	♦ **Section 8.1.2** – Benthic Primary Producer Habitat (Hard Coral) Management ♦ **Section 8.6** – Waste Management ♦ **Section 8.7** – Hydrocarbon Management
Cultural and Spiritual	<Hold> to be included in future revision	Cultural and spiritual values of the marine environment are protected.	<Hold> to be included in future revision	<Hold> to be included in future revision

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Fishing and Aquaculture (social value)	Onslow Prawn Managed Fishery. Pilbara Fish Trawl (Interim) Managed Fishery.	Fish and seafood (caught or grown) is of a quality safe for eating. Water quality is suitable for aquaculture purposes.	Relevant criteria from Food Standards Australian New Zealand code. Relevant ANZECC guidelines for LEP.	♦ **Section 8.3** – Invasive Marine Species Management ♦ **Section 8.6** – Waste Management ♦ **Section 8.7** – Hydrocarbon Management
Industrial Water Supply	<Hold> to be included in future revision	Water quality is suitable for industrial supply purposes.	<Hold> to be included in future revision	♦

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1.12 Wheatstone Project Approvals

The Project was referred to the Western Australian Environmental Protection Authority (EPA) under the *Environmental Protection Act 1986* (EP Act) in October 2008. The EPA set the level of assessment as an ERMP. The proposal was also referred to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) under the Commonwealth *Environment Protection Biodiversity and Conservation Act 1999* (EPBC Act). It was determined by the DSEWPaC that the proposal is a controlled action and the level of assessment was set as an EIS.

The Wheatstone Project EIS/ERMP will be assessed through a parallel process and will be prepared to meet both the WA EPA Guidelines for Preparing a Public Environmental Review/Environmental Review and Management Programme (2009) and the DSEWPaC Guidelines for the content of a Draft Environmental Impact Statement.

The Project also involves sea placement of dredge material within Commonwealth and State waters and will consequently require a Sea Dumping Permit (SDP) under the *Environmental Protection (Sea Dumping) Act 1981.* The aspects related to the SDP for dredge material management will be assessed as part of the EIS/ERMP under the *EPBC Act (*Cth*)*, as agreed with DSEWPaC.

1.13 Requirements

This Draft DSDMP has been developed to meet the anticipated State and Commonwealth Ministerial Conditions and to be in accordance with Chevron Australia environmental procedures. The Draft DSDMP details the procedures for dredging and dredge material management in order to minimise the environmental risks associated with the project to ‘as low as reasonably practicable’ (ALARP).

The finalised DSDMP will include the ministerial conditions that pertain to the dredging operations and a cross reference to the section of the DSDMP where the requirement is addressed.

1.14 Stakeholder Consultation

The Project stakeholder consultation strategy has been developed in alignment with the Interim Industry Guidelines to Community Involvement (Department of Environment 2003), the International Association for Public Participation Guidelines for best practice in Social Impact Assessment (International Association for Public Participation Australasia 2004) and Chevron’s corporate values (Chevron Australia 2009a).

Consultation was undertaken with government, non-government organisations, indigenous organisations, Onslow residents, tourists and the private sector as part of the development of the EIS/ERMP. The aims, methods and outcomes of stakeholder consultation are presented in **Section 5** of the EIS/ERMP.

The main objectives of the consultation process were to:

- Identify regulatory stakeholder and community stakeholder issues, concerns and potential impacts in relation to the Project.
- Validate community issues and provide further information on the Project through the preparation of appropriate communication materials and engagement forums.

- Identify appropriate strategies to address potential adverse impacts and enhance positive impacts associated with the Project.
- Incorporate social, economic, health and environmental issues raised by stakeholders in Project design, planning and management commitments.

A number of environmental issues were raised by regulatory and community stakeholders and these issues are summarised in **Section 5.6** of the EIS/ERMP. The potential impacts from large-scale dredging on Benthic Primary Producer Habitat (BPPH) and marine fauna was the most commonly raised concern by the regulatory stakeholders. The impacts and management of the potential influx of Project construction and operational workforces was one of the major concerns raised by community stakeholders.

Key potential impacts of concern were addressed in the risk assessments presented in **Section 8 to 10** of the EIS/ERMP and consultation is still ongoing for some potential impacts that were raised. Further regular consultation is also proposed to identify monitor and manage key issues and relevant impacts throughout each phase of the Project.

1.15 DSDMP Approval, Review and Distribution

This Draft DSDMP has been prepared as an appendix to the Wheatstone Project EIS/ERMP (**Figure 1-4**) in order to outline the management and mitigation measures proposed for management of the environmental risks associated with the dredging and dredge material management activities. The management measures to be implemented for some elements of risk (such as accidental spills of hazardous chemicals or hydrocarbons) are presented in detail as standard approaches that will be followed in accordance with the regulatory framework. However, management measures for other components of environmental risk (e.g. the risk of mortality to corals from elevation in suspended sediment in the water column) are conceptual with more detail required once State and Commonwealth Ministerial Conditions have been set.

On completion of the environmental approvals process, this Draft DSDMP will be finalised. The final DSDMP will address the requirements of the State Ministerial Conditions, Commonwealth approvals decisions and the SDP. The final plan will be made publicly available in an approved manner.

In the event there is a significant change in the methods of the dredging works after this plan has been finalised, the plan will be reviewed. The review will include a reassessment of the environmental risks presented by the works and the corresponding management strategies being implemented. Where considered necessary, this plan will be updated to reflect the re-assessment.

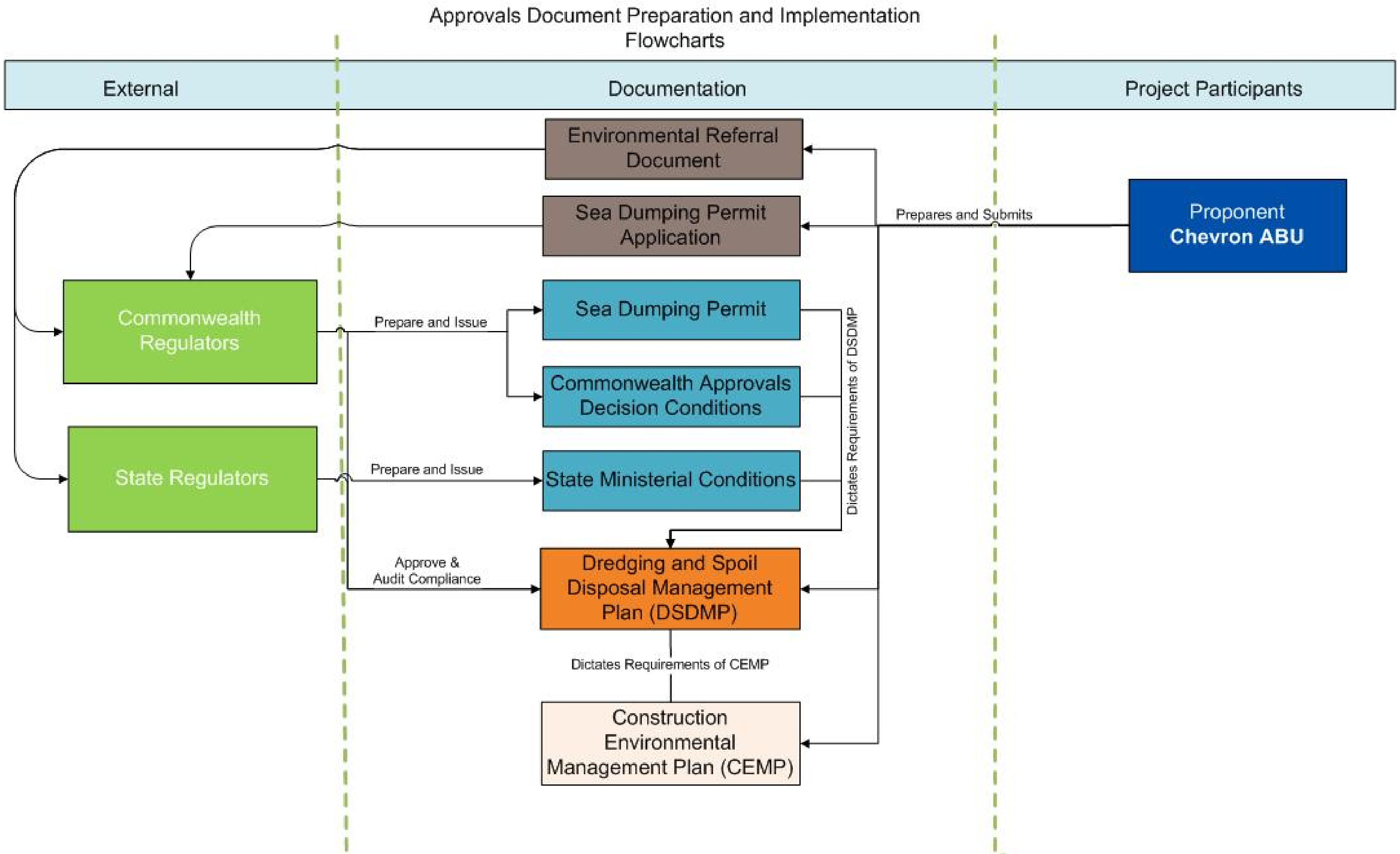

Figure 1-4: Approvals Document Preparation and Implementation Flowchart

2.0 PLAN STRUCTURE

This Draft DSDMP adopts an outcomes based management approach for the environmental management of the dredging and dredge material management.

The Plan is structured as follows:

- **Section 3.0** of this plan details the methods and results of the Environmental Risk Assessment (ERA) that has been undertaken.
- **Section 4.0** of this plan provides an overview of the works that this plan is applicable to.
- **Section 5.0** details the environmental management structure that will be implemented.
- **Section 6.0** provides a high-level overview of the existing environment and the key studies that have been completed.
- **Section 7.0** details the results of the sediment plume modelling and the development of the relevant impact zones that will be applied.
- **Section 8.0** details the management strategies that will form the monitoring program. The management strategies provide the outcomes and performance objectives/indicators against which environmental performance will be measured. The structure of each individual management strategy is shown in **Table 2-1.**
- **Section 9.0** presents the options for monitoring and inspection under consideration.
- **Section 9.0** details the reporting requirements for the project under consideration.

Table 2-1: Structure of Management Strategies

Management Area:	**Specific area to be managed (e.g. BPPH)**
Performance Objective:	The applicable performance objectives against which environmental performance will be measured.
Management:	The proposed management strategies including trigger levels and responses and contingency measures.
Monitoring:	The applicable proposed monitoring programs.
Reporting:	The required reporting including frequency and recipient.
Risk Assessment:	The residual risk ranking (i.e. end risk, taking into consideration management and monitoring measures).

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3.0 ENVIRONMENTAL RISK ASSESSMENT AND PERFORMANCE MEASUREMENTS

3.1 Overview

A series of environmental risk assessments have been completed to identify the most significant risks, these risks will be the focus of environmental management and monitoring. The risk assessments have addressed each aspect of the Project including the dredging and dredge material management activities. The risk assessments have been undertaken in two phases:

- Phase 1 – An environmental risk assessment was conducted during the scoping phase of the Project to identify key areas of environmental risk requiring detailed assessment.
- Phase 2 – A detailed environmental risk assessment was conducted during the preparation of the EIS/ERMP and this Draft DSDMP. This assessment reviewed the environmental acceptability of the Project, identifying key areas of risk and developing potential monitoring and management strategies.

3.2 Risk Assessment Method

The risk assessment completed for the EIS/ERMP was undertaken in accordance with the principles and guidelines contained in the AS/NZ 4360:2004 – Risk Management and the EPA draft guidelines ‘Application of risk-based assessment in EIA’ (EPA 2008). The process evaluates the likelihood and consequence of environmental impacts occurring as a result of a factor’s (receptor) exposure to one or more aspects (project activities) to assess the environmental risk levels.

‘Consequence’ has been defined by the EPA as an indication of the magnitude of an environmental impact resulting from an environmental aspect. The ’likelihood’ is defined as the probability or frequency of the defined consequence occurring and takes into consideration the probability and frequency of the following:

- the environmental aspect occurring;
- the environmental factor being exposed to the environmental impact; and
- the environmental factor being affected.

Subsequent investigations and sediment plume modelling provided additional data upon which the previous risk assessments conducted in the scoping phase (phase 1) could be refined. The risks have been assessed assuming the application of mitigation and management measures and therefore indicate the residual risk levels posed to each key environmental factor.

3.3 Risk Assessment Outcomes

Note that the information presented below does not reflect the consolidated risk tables presented in Chapter 8 of the Draft EIS/ERMP. Reviewer is referred to Chapter 8 of Draft EIS/ERMP. The final risk tables presented in Chapter 8 (EIS/ERMP) will be incorporated into the Draft DSDMP

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The results of the environmental risk assessment of the dredging and dredge material placement management activities are provided in **Chapter 8** of the EIS/ERMP. Environmental risks that have been assessed as posing either a medium or high residual risk include:

Benthic Primary Producer Habitat

- Direct loss of subtidal benthic primary producer habitat (BPPH) through removal within footprint and loss of structural function of BPPH at the dredge material placement sites.
- Indirect impact on benthic primary producers (BPP) and habitats due to increased turbidity, sedimentation and light attenuation leading to temporary loss of habitat in excess of acceptable levels as defined in EPA Guidelines associated with construction (capital) dredging channel and berthing area.

Marine Water Quality and Sediments

- Increased turbidity and light attenuation exceeds agreed water quality targets associated with construction (capital) dredging of the channel, pipeline and berthing area.

3.4 Performance Measurements

The environmental risk assessment detailed in Chapter 8 of the EIS/ERMP has been used to develop a series of environmental objectives and associated performance criteria for the dredging and dredge material placement works. These environmental objectives, performance criteria, management commitments, evidence of compliance measures and timing requirements are provided within **Section 8.0**.

3.4.1 Outcome Based Conditions

The EPA's support for the use of Outcome Based Conditions (OBCs), rather than prescriptive conditions, is constrained to circumstances where the intended outcome can be clearly defined and measured. Prescriptive conditions are still recommended under circumstances where there is uncertainty or where it is difficult to predict the environmental outcome.

OBCs are defined in the WA EPA Environmental Assessment Guidelines No. 4 – Towards Outcome-based Conditions (EPA 2009c) as those conditions that are recommended in an EPA Report or set in a Ministerial Statement that may impose:

- a specific environmental outcome to be achieved (explicit condition) – for example, the avoidance of particularly significant vegetation or habitat, or the progressive rehabilitation of an area; or
- an environmental performance standard that is to be met (performance-based condition) – such as standards that set out the limits or criteria (such as an emission limit) but do not describe how such limits or standards will be met.

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4.0 WORKS OVERVIEW

4.1 Introduction

Dredging and dredge material management will be required for the construction of the:

- temporary access channel to support construction activities;
- Material Offloading Facility (MOF) and MOF approach channel;
- product loading facility (PLF) including turning basins and berth pockets; and
- approach channel.

Clean-up dredging of fine material that settles in the dredging area during the dredging program will also be required. Up to 45 Mm^3 of dredge material may be generated during the dredge works for the key marine infrastructure. This volume does not include dredging volumes that may be generated from the installation of the trunkline.

Dredge material will be disposed of at the proposed nearshore and offshore dredge material placement sites.

Figure 4-1 and **Figure 4-2** show the proposed dredging area, dredge material placement sites and MOF. The dredging and dredge material management works are expected to be undertaken over a four-year period commencing mid 2011.

Accommodation for dredging personnel will be in a floatel, which is expected to accommodate up to 200 to 400 dredge crew. The dimensions of the floatel could be 100m long and 10,000 DWT in weight. The proposed mooring areas for the floatel are illustrated in **Figure 4-4**.

4.2 Dredged Material Management

4.2.1 Nearshore Dredge Material Placement Sites

Three nearshore dredge material placement sites have been identified for the placement of dredged material and are shown in **Figure 4-3**. Within each of these sites, the target placement areas will be the naturally deeper waters within each site.

Proposed Dredge Material Placement Site A has a capacity of approximately 1.5 Mm^3 and will be used early in the works program. Material will be placed here using CSD and a near bed diffuser **[HOLD Details on diffuser required]. [HOLD material type to be disposed at Site A]**

Dredge Material Placement Site B has a capacity of approximately 2–3 Mm^3. Site B may be used as an alternate site to Site C for rock dumping that is removed from the channel by a backhoe excavator.

Placement Site C is the primary placement site for coarse material and has a capacity of up to 40 Mm^3. Material will be placed at the site by the TSHDs via bottom opening doors. If necessary, bed levelling (e.g. via the use of an underwater plough) may be undertaken to minimise the localised raising of sea bed levels.

A summary of the characteristics of nearshore dredge material placement sites is provided in **Table 4-1**.

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4.2.2 Offshore Dredge Material Placement Sites

In addition to the three identified inshore material placement sites, two offshore Placement sites (Site D and E), located in approximately 40 m water depth to the west of Thevenard Island, will be used for placing the finer muddy material from clean-up operations (**Figure 4-3**). Each of these offshore sites is anticipated to have a capacity of up to 40 Mm^3.

A summary of the characteristics of offshore dredge material placement sites is provided in **Table 4-1**.

Table 4-1:
Summary Characteristics of Dredge Material Placement Site

Placement	Assumptions	Water Depth	Mean bed level change (m)	Capacity (Mm^3)
Site A	For use to establish access channel	<7	0.375	1.5
Site B	Site B may be used as an alternative to Site C as a closer alternative for placing weak rock removed by BHP in the PLF Basin and channel	10-12	0.6	3
Site C	The primary placement site	12-15	1.7	40
Site D	Primary placement site for fine material from cleanup operations	38-48	4.45	40
Site E	Alternate site for dredging of the access channel	63-71	4.45	40

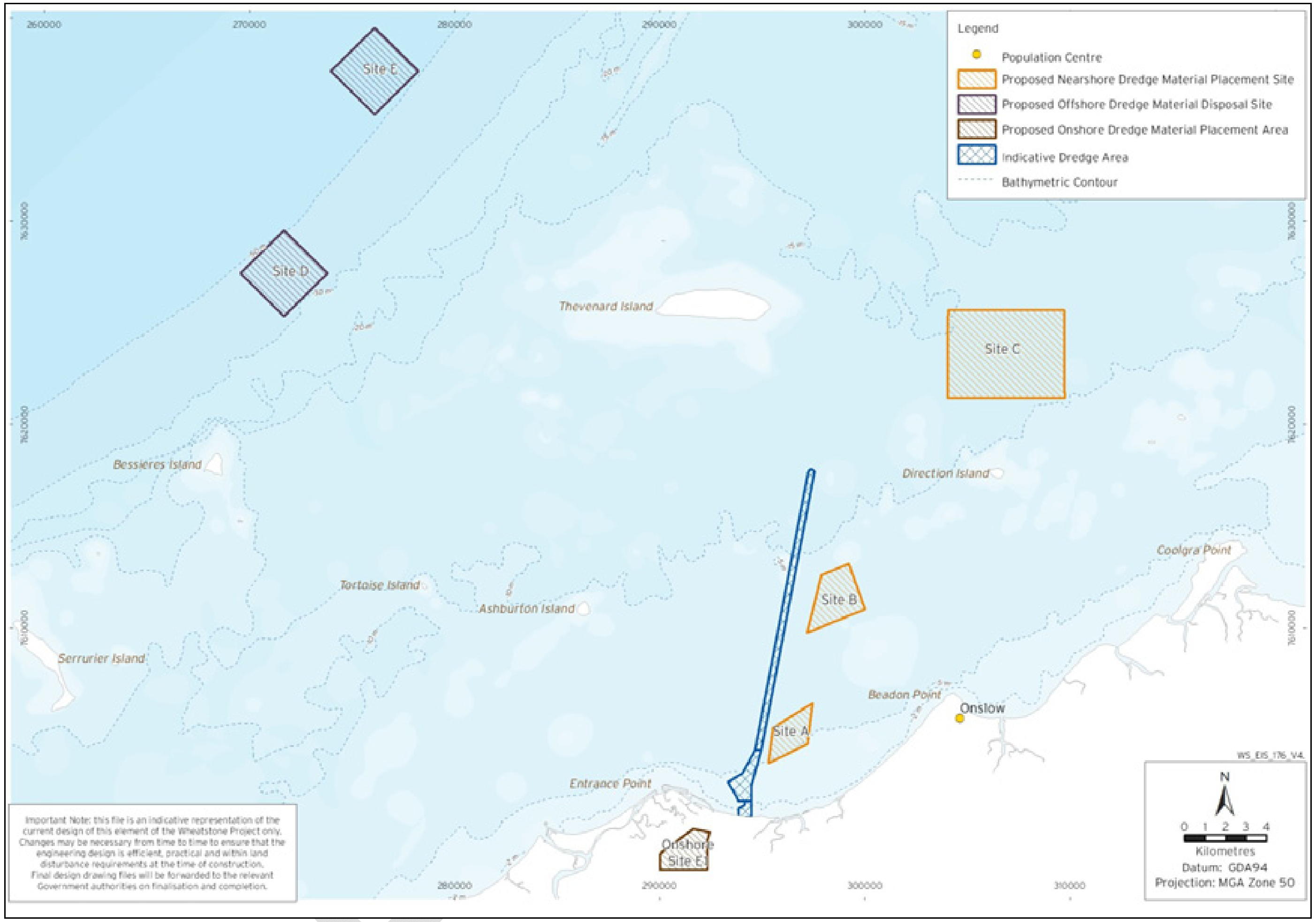

Figure 4-1: Wheatstone Project Dredging and Dredge Material Placement Areas

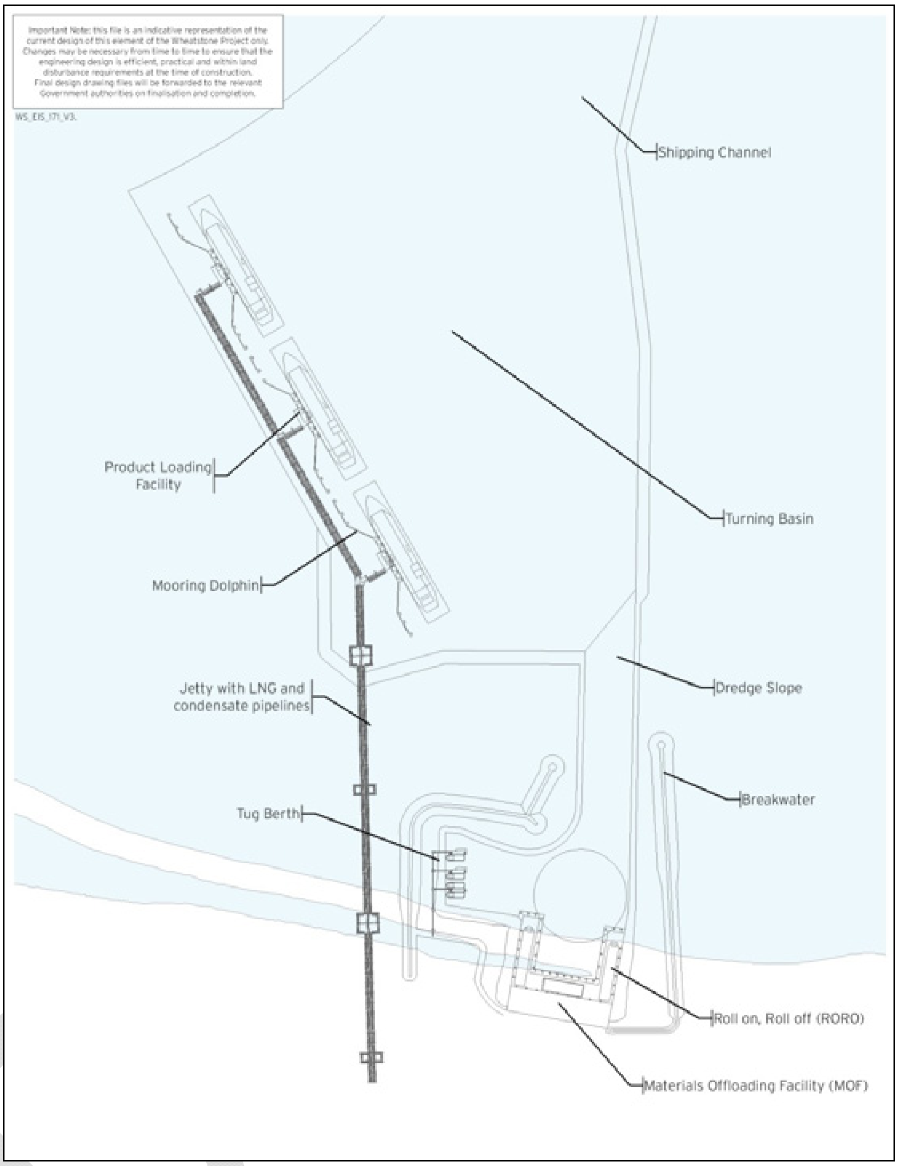

Figure 4-2: Entrance Channel, Turning Basin and Berth Alignment

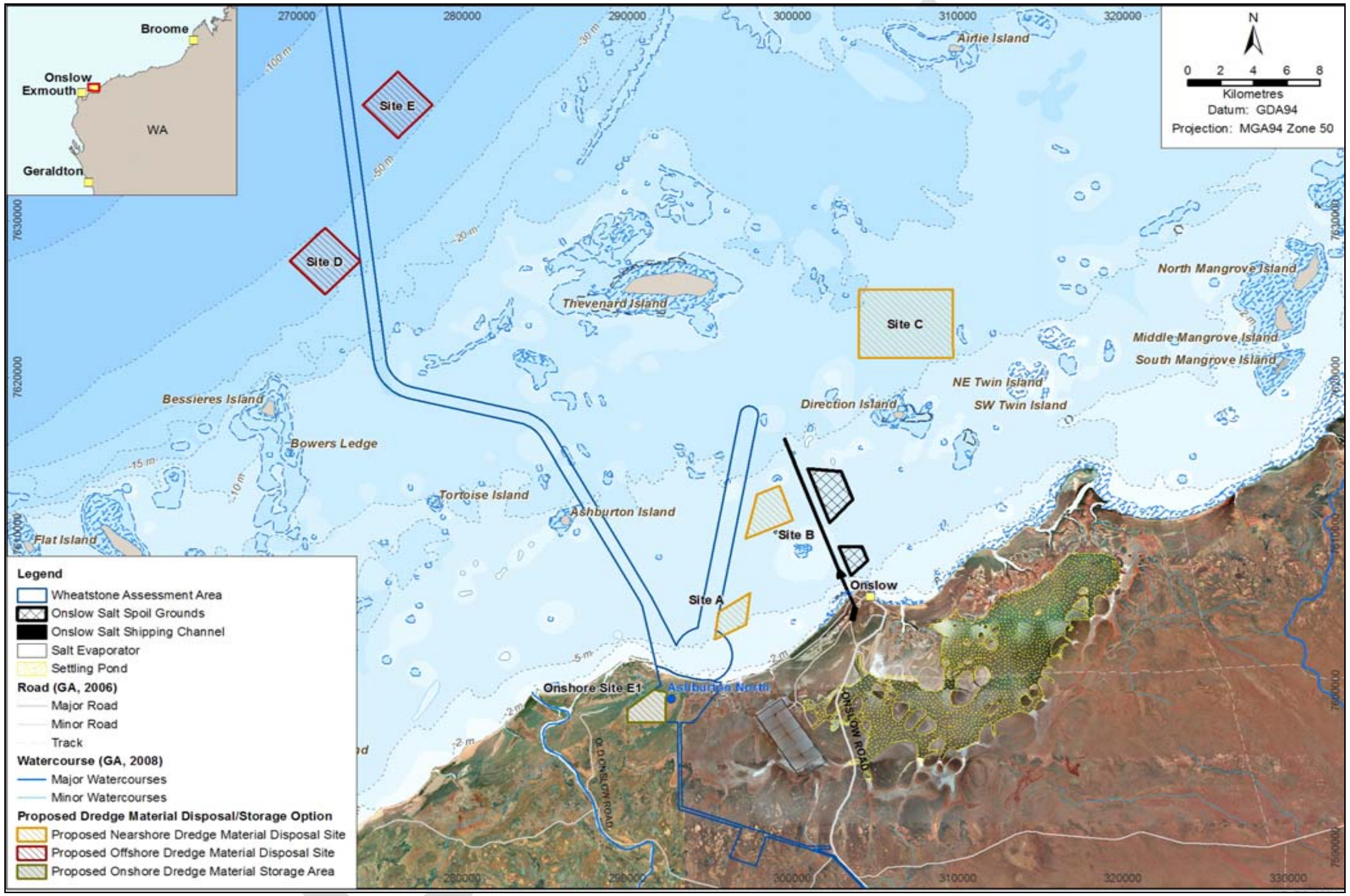

Figure 4-3: Location of Nearshore and Offshore Placement Sites

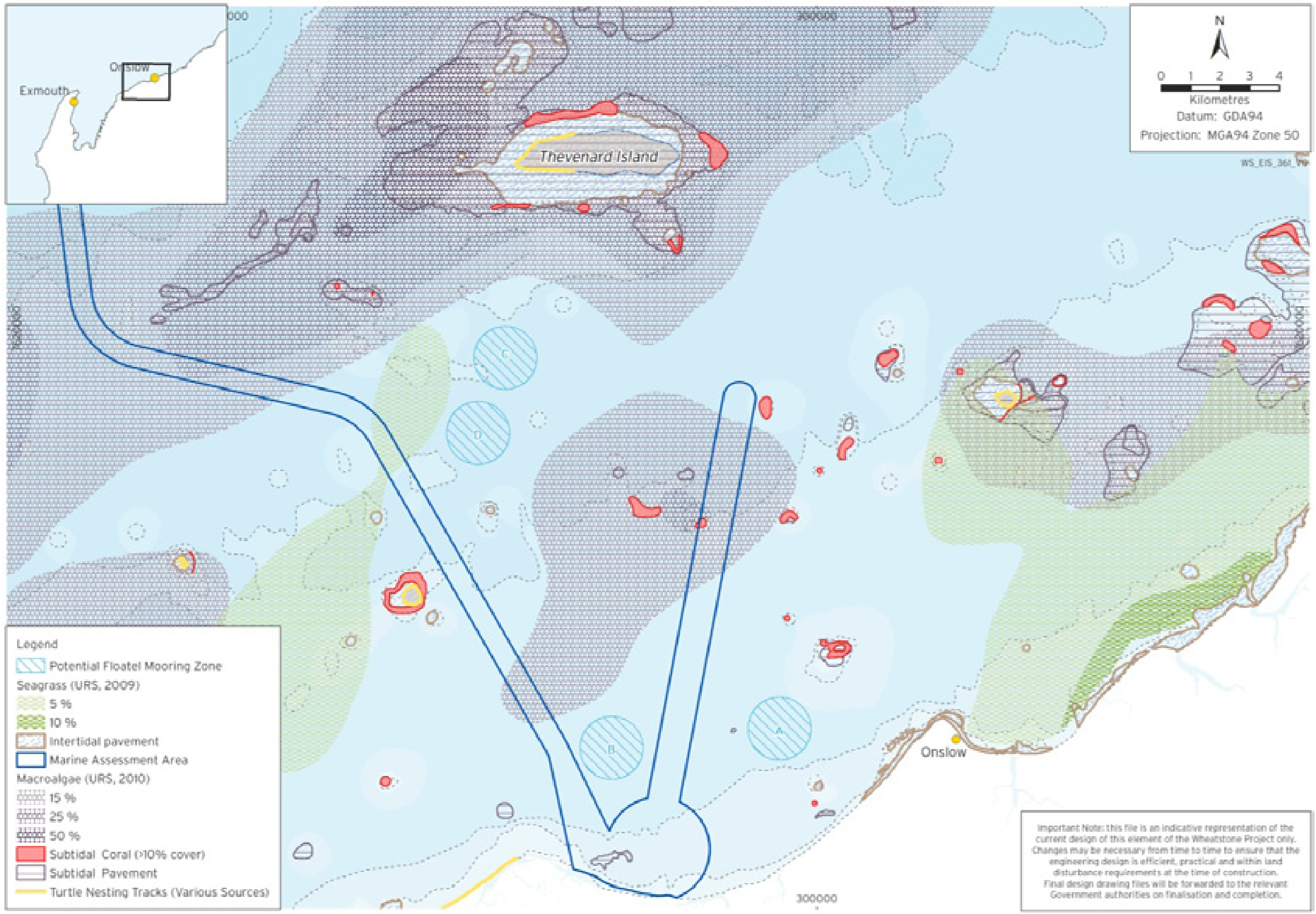

Figure 4-4: Proposed mooring areas for the floatel.

4.3 Dredging Equipment

The dredging and dredge material placement management works will be undertaken by a combination of dredges, support vessels and land based equipment. It is envisaged that the following dredging equipment will be utilised:

- two large-sized (~10,000 m^3) Trailing Suction Hopper Dredges (TSHD);
- one small (~5,000 m^3) TSHD;
- one large (4,000 KW) Cutter Suction Dredge (CSD);
- one large backhoe excavator;
- self-propelled barges; and
- a range of ancillary small craft to service the dredges, transport crew and survey the channels.

The final vessel selection will be made upon awarding of the dredging contract. **Figure 4-5** and **Figure 4-6** provide typical examples of the envisaged dredge vessels. The decision on the selection of the dredging equipment type will be made based on a number of factors including:

- anticipated vessel availability;
- vessel operability (including vessel draft, cutting strength, pumping distance capability);
- soil strength;
- transport distances;
- required dredging accuracy; and
- required environmental performance.

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Figure 4-5: Example of Trailing Suction Hopper Dredge (TSHD)

Figure 4-6: Example of Cutter Suction Dredge (CSD)

4.4 Methods

4.4.1 Temporary Access Channel

A temporary access channel will be constructed during the initial phase of the works to enable the delivery of equipment and supplies to the site. The temporary channel will be 75 m wide and will extend to the -6 m Lowest Astronomical Tide (LAT) contour to accommodate barges and small vessels. Dredging of the temporary channel will involve the dredging of approximately 650,000 m³ of material by a CSD.

Dredging of the temporary access channel will be undertaken in two phases. During the first phase material will be dredged directly with the CSD and pumped via a pipeline to proposed Nearshore Dredge Material Placement Site A. This material will be deposited at the placement site via the use of a diffuser **[HOLD details on diffuser required]**.

During the second phase, dredged material may may be pumped to proposed nearshore dredge material placement Site A.

This temporary access channel will then become part of the MOF and approach channel.

4.4.2 MOF and MOF Approach Channel

The MOF and MOF approach channel require dredging to a depth of -8.3 m LAT. The MOF approach channel is estimated at approximately 1 km long and 120 m wide.

Dredging of the MOF and MOF approach channel will be undertaken using a CSD and will involve the dredging of approximately 1.4 Mm³This activity will follow in a sequence from the temporary access channel dredging. The CSD will commence operations in the nearshore area initially by dredging the MOF and progressively working offshore to dredge the MOF approach channel.

4.4.3 Product Loading Facility

The Product Loading Facility (PLF) area, including the turning basin and berth pocket, will be dredged to a final dredge depth of -14.1 m LAT and will require the dredging of

7.2 Mm³ of material. The PLF approach channel will be approximately 16 km long and 260 m wide.

Dredging of the PLF will be completed in two or three stages. Initially, the CSD used to dredge the MOF and MOF approach channel will dredge to -8 m LAT (2.7Mm^3). From -8 m LAT to the final dredge depth of -14.1 m LAT, a TSHD will be used to remove up to 4.5 Mm^3 of material for placement at Site C. If rock patches are encountered, a backhoe excavator may be required to remove the rock and load onto a self-propelled hopper barge for placement at Site C.

4.4.4 PLF Approach Channel

The approach channel will be extended approximately 15 km from the edge of the PLF and will be dredged to a final dredge depth of -14.1 m LAT. This will involve dredging of approximately 20.7 Mm³ of material.

Initial dredging will be undertaken using a CSD to dredge all high spots above the -6 m LAT level within 1–2 km of the PLF **[HOLD type of material required]**. This is required to allow access for the TSHD. Removal of these high spots will include dredging of ~125,000 m³ of material which will be pumped to nearshore placement Site A via a pipeline and diffuser.

The dredging from -8 m LAT to -14.1 m LAT within the channel will be undertaken by a small TSHD which will dredge approximately 1.5 Mm^3 of mostly sandy material. The TSHD will transport and dispose of this material at offshore placement Site C via direct bottom opening doors. This dredging will involve the use of hopper overflow except when dredging in sensitive areas with restricted overflow (see **Section 8.0**).

Dredging from -10 m LAT to -14.3 m LAT will involve the dredging of approximately 19.1 Mm³ of material. The unconsolidated sands will be dredged using the small TSHD and disposed of at placement Site C. The weak rock material that cannot be directly dredged using the TSHD will instead be dredged by the backhoe excavator and loaded onto barges and transported to Site C.

4.4.5 Clean-up Dredging

Throughout the dredging works fine material is likely to accumulate within the dredge footprint, some of which will be removed by the main capital dredge activities. An allowance has been made for approximately 0.3 Mm^3 of clean-up operations. This material will be dredged during a clean-up phase using a small- and medium-sized TSHD and disposed of at the offshore material placement Site D via bottom opening doors.

4.5 Methods Justification

The dredge methods and equipment listed above are the most suitable in terms of the technical and economic feasibility of the project as well as in terms of environmental performance. In terms of environmental suitability, the methods present a number of environmental benefits including:

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- Where operational restrictions allow, medium to large sized TSHDs and CSDs will be used as opposed to smaller vessels, to minimise the duration of the works and thus reduce the temporal extent of any environmental impacts.
- The use of large CSDs will reduce the risk that the pre-treatment of material via drilling and blasting is required.
- The methods will minimise the double-handling (side casting and re-dredging) of material via direct placement to dredge material placement sites via a diffuser.
- The dredging and dredge material placement accuracy of modern TSHDs and CSDs is of a high standard and will be operated by leading dredge contractors that are experienced in the environmental management of dredging operations, thus providing confidence in environmental performance.
- The floatel is expected to have minimal impacts as proposed mooring locations are characterised by bare sand, without seagrass, macroaglae or coral and are located >1.5 km from turtle nesting beaches.

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5.0 ENVIRONMENTAL PROJECT MANAGEMENT

5.1 Key Roles and Responsibilities

HOLD Key roles and responsibilities for Project personnel, both Chevron-employed and contractor companies, will be defined in subsequent versions of this document.

5.2 Inductions and Training

All personnel (including contractors and subcontractors) are required to attend environmental inductions and training that are relevant to their roles on the Project. Relevant personnel will receive training on the requirements of the finalised DSDMP. Training and induction programs will facilitate the understanding that personnel have of their environmental responsibilities, and ensure awareness of the management and protection measures required to reduce potential impacts on the environment.

Environmental training and competency requirements for personnel, including contractors and subcontractors, will be maintained in Health, Environment and Safety (HES) training matrices. These matrices will be reviewed and updated on an ongoing basis to ensure that the required competencies are met and the required training has been completed.

5.3 Environmental Documentation Management

5.3.1 Chevron ABU OE Documentation

As part of the Chevron ABU, the Project is governed by the requirements of the ABU OEMS, within which a number of OE Processes exist. The Project will implement internal OE Processes (and supporting OE Procedures) that apply to the Project's activities. The OE Processes have been prepared by Chevron Australia to address various issues that Chevron Australia internally requires its employees, contractors, etc to comply with (or equivalent contractor process). These Processes will also be applied to the requirements of this Draft DSDMP where this is appropriate and reasonably practicable.

5.4 Performance Reporting

<Hold pending State and Commonwealth approvals> requires that Chevron Australia submits an Annual Environmental Performance Report to the Minister for the Environment and to the Commonwealth DSEWPaC respectively, on an annual basis, for the previous 12-month period.

5.5 Auditing

A compliance audit schedule will be developed based on the conditions contained within the various environmental approval documents and will include both internal and external audits.

5.5.1 Internal Auditing

Chevron Australia has an internal Compliance Assurance ASBU – Standardized OE Process (Chevron Australia 2006b) to manage compliance. Internally Chevron Australia requires its employees and contractors, etc. to comply with the Process. The Compliance Assurance ASBU will also be applied to assess compliance of the Wheatstone Project against the requirements **<hold pending State and Commonwealth approvals>** where this is appropriate and reasonably practicable.

5.5.2 External Auditing

An independent audit of compliance of the implementation of finalised DSDMP will be conducted by an approved auditor on behalf of DSEWPaC.

5.6 Management Review

Chevron Australia is committed to conducting activities in an environmentally responsible manner and aims to implement best practice environmental management as part of a program of continuous improvement. This commitment to continuous improvement means Chevron Australia will review the finalised DSDMP annually.

Reviews will address matters such as the overall design and effectiveness of the finalised DSDMP, progress in environmental performance, changes in environmental risks, changes in business conditions, and any relevant emerging environmental issues.

If the finalised DSDMP no longer meets the aims, objectives or requirements of the finalised DSDMP, if works are not appropriately covered by the finalised DSDMP, or measures are identified to improve the finalised DSDMP, Chevron Australia may submit an amendment or addendum to the finalised DSDMP for approval.

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6.0 EXISTING ENVIRONMENT AND RELEVANT STUDIES

6.1 Overview

The characterisation of the marine environment within the Project Area has been undertaken as part of the environmental impact assessment which underpins the environmental approvals process. A brief overview of the existing environment, the studies associated with the impact assessment and the development of impact zones and management trigger levels is provided here. This information provides context for determining the management strategies detailed in **Section 8.0** and the monitoring programs detailed in **Section 9.0**. Full details of the existing marine environment and the environmental impact assessment undertaken for the project can be found in **Section 6** and **Section 8, respectively,** of the EIS/ERMP.

6.2 Key Environmental Receptors

The key environmental receptors that could potentially be impacted upon by the proposed dredging and dredge material placement management activities include:

- hard corals;
- seagrasses;
- mangroves;
- marine turtles;
- humpback whales;
- dugongs.

6.3 Marine Reserves and Conservation Areas

There are no protected areas in the immediate vicinity of the Project Area, although a number of marine parks and reserves occur within the Pilbara Nearshore and Pilbara Offshore bioregions. There is no evidence that the dredging and dredge material placement management activities are likely to impact on any of these marine parks and reserves.

The Project Area does not contain any World Heritage Properties, National Heritage Properties or Ramsar Wetlands of International Significance.

6.4 Existing Physical Environment

6.4.1 Water Quality

A review of studies in the Onslow region (MScience 2009) indicate that the regional median turbidity was usually <1 Nephelometric Turbidity Units (NTU) and the 80th percentile was <3 NTU during non-cyclonic periods. Corresponding suspended sediment concentrations (SSC) values ranged from 3–5 mg/l. Across 30 sites median turbidity ranged from <1 NTU during winter up to 6 NTU during non-cyclonic periods in summer. Discharge from the Ashburton River during inland rainfall is the primary source for input of terrestrial sediments to the near shore waters of the Project Area. These events can cause large-scale turbidity elevations in nearshore waters over a period of months.

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Spring and summer are times of the year when there are persistent westerly winds and increased runoff from rainfall as well as periodic cyclones. Turbidity approached or exceeded 12 NTU at 20 % of the sites assessed during some weeks of summer. Turbidity and SSC are significantly elevated by cyclonic activity. During the passage of Tropical Cyclone Dominic in January 2009, daily median turbidity increased to approximately 80 NTU and remained above 20 NTU for at least ten days. Offshore waters in general tend to have lower turbidity levels.

Contaminant levels within the water column are expected to be near background and representative of uncontaminated coastal and marine areas along the Pilbara coast.

Sediment re-suspension is frequent immediately seaward of the intertidal zone, is mainly due to wind-driven waves, and leads to considerable turbidity (Forde 1985). Re-suspension further offshore the sediment movement is a result of internal or subsurface waves (Heywood et al. 2006).

6.4.2 Marine Sediments

The marine sediments in the Project Area mainly consist of silt and sand sheets of varying thickness overlying Pleistocene limestone. Near the Ashburton Delta, sediments are generally fine silts and clays with high silica content.

Broadly, two types of soils are to be dredged: sands intermixed with variable fractions of clays, silts and or gravels, and; rock (siltstone, claystone and sandstone) that is generally weathered and weak. The proportion of the two soil types changes with increasing distance from the shore. In the MOF and PLF basin the material to be dredged consists of 75% sand and 25% weak rock. In the PLF approach channel the material will be 60% sand and 40% weak rock. In both cases, sand is assumed to overly the rock. Sediments become increasingly coarse and increase in calcium carbonate content with distance offshore, due to decreasing input of terrigenous silts and clays from river runoff and coastal erosion (Coffey 2009).

The chemical characteristics of marine sediments in the vicinity of the Project Area has been assessed on two previous occasions; once in 2005 by the DEC (2006) and more recently by URS in the Wheatstone dredging area (URS 2009).

The DEC (2006) study recorded no discernible anthropogenic enrichment of contaminants (e.g. organotins, hydrocarbons, organochlorine pesticides and polychlorinated biphenyls) in sediments offshore of the Ashburton River mouth. The study also measured natural background concentrations of trace metals in the marine sediments, noting that, with the exception of arsenic, natural background concentrations of all metals were below the relevant Australia and New Zealand Environment and Conservation Council/Agricultural and Resource Council of Australia and New Zealand (ANZECC/ARMCANZ) (2000) screening levels (DEC 2006).

During the URS (2009) survey, marine surface sediments and deep cores in the Project Area were sampled within and near the proposed dredging area and grab samples from the proposed nearshore dredge material placement sites. Detailed results of this study are provided within the EIS/ERMP. The study recorded concentrations of all contaminants and trace metals as being below the laboratory limit-of-recording (LOR) or below the relevant National Assessment Guidelines for Dredging (NAGD)

(Commonwealth of Australia 2009d) screening levels, with the exception of arsenic and nickel (URS 2009).

The results of the sampling and analysis program determined that the sediments to be dredged are suitable for unconfined ocean placement in accordance with the NAGD.

6.4.3 Metocean Conditions

6.4.3.1 Waves

The coast around Onslow is sheltered from prevailing south-west swells (i.e. from the Indian Ocean) by the continental landmass of the North West Cape. Similarly, Barrow Island and the shoals of the Lowendal and Montebello Islands provide shelter from Timor Sea swells. Consequently, the nearshore wave climate is mainly influenced by locally-generated wind waves and occasional tropical cyclones (Damara 2009).

These effects were evident in wave conditions recorded via acoustic Doppler current profilers (ADCPs) and a directional wave rider in the nearshore Project Area, by RPS Metocean (RPS Metocean Engineers 2009). Wave conditions from January to April 2009 were generally mild, with a median wave height of 0.2 m and wave period of 4 seconds. However, tropical cyclones and other low pressure systems generated elevated wave conditions. Other energetic conditions similarly occurred due to low pressure systems located to the west of Onslow, producing onshore winds.

6.4.3.2 Winds

The Project Area experiences dominant summer and winter conditions. The climatic conditions are governed by interaction between the south-east trade winds and monsoonal flows. Tropical cyclones affect the area, particularly during the summer and autumn months (November through April). During the summer months from October to March, interaction between a low pressure system induced by heating of the continental land mass and the Asian monsoon tends to draw air toward the Australian continent. This leads to predominantly westerly and south-westerly winds at the site. During the winter months (June to August), the south-east trade winds bring cool dry air from over the Australian continent, leading to easterly to south-easterly winds at the study area.

6.4.3.3 Currents

In the nearshore Project Area, the local topography directs the tidal currents along the coastline with easterly flow on flood tide and westerly flow on ebb tide. This pattern can be interrupted by wind-driven currents during neap tides when tidal currents are weakest. West of the Ashburton Delta, the tidal current directions are controlled by the flow in and out of Exmouth Gulf with southerly flow into the gulf on flood tide and northerly flow out of the gulf on ebb tide.

Induced by wind stress and, to a lesser extent, gradients in pressure, net currents generally propagate along the coastline and can generate significant alongshore flow, particularly in shallower water. The net currents in shallower water are primarily driven by local winds. Magnitudes of simulated net currents are in the order of half the spring tidal current speeds in many areas, including the Project Area. Field measurements (RPS Metocean Engineers 2009) confirm the simulations, including the wind-driven net currents dominating over tidal currents during both neap and spring tidal conditions.

6.4.3.4 Tides

Tides in the nearshore Project Area are semi-diurnal with a spring tidal range of 1.9 m (mean high and low water spring tides of 2.5 m and 0.6 m, respectively). Tidal peaks occur near the equinoxes in March and September. The highest astronomical tide is 2.9 m. The tidal signal changes progressively along the North West Shelf (NWS) coastline with increasing tidal ranges from Exmouth to Broome.

Modelling of extreme cyclonic water levels for the Onslow town site and Onslow Salt (GEMS 2000, Nott & Hubbert 2005) has estimated the 100-year Average Recurrence Intervals (ARI) water level as 4.7 m Australian Height Datum (AHD) (6.2 m Chart Datum - CD), including allowance for wave setup.

6.5 Existing Biological Environment

6.5.1 Marine Habitats

A marine habitat map has been developed for the Project Area and is shown in **Figure 6-1.** The majority of the seafloor **Figure 6-1**, in the vicinity of the Project Area (between the mainland shore and Thevenard Island) is comprised of unvegetated sand and silts.

The BPPH types within the Project Area are sparsely distributed and each type is present at discrete locations reflecting the interaction between geology, geomorphology, and depth. The BPP present include sparse macroalgae, hard coral, seagrasses and mangroves.

On the basis of field surveys, URS (2009a) concluded that the most significant locations with respect to nature conservation value are the shallow fringing coral reefs and macroalgal platforms surrounding Serrurier, Ashburton, Thevenard, Direction, Mangrove, and the Mary Anne Group of Islands (**Figure 6-1**). The Mangrove and Mary Anne Group of Islands are considered the largest and most important nature conservation resource in the vicinity of the project and are important foraging areas for marine turtles and dugongs. Ward Reef is an unusual patch of reef located 4.5 km from the proposed PLF approach channel. The reef is almost completely composed of the genus *Montipora* and characterised by high coral cover Ward Reef is a locally important recreational fishing and due to its uniqueness may have some conservation value.

In addition, there are a number of shallow shoals containing coral communities in close vicinity to the dredging area.

Four major ecosystem units (ECU) were derived from the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) hierarchical ecosystem classification framework and further development by Lyne et al. (2006) for the North West Shelf and these units are detailed within the EIS/ERMP:

- ECU0 – Onslow Onshore encompassing intertidal habitats.
- ECU1 – Onslow Nearshore encompassing waters between LAT and up to 10 m depth in relatively complex bathymetry, covering mainly soft substrates but including a ridge of scattered patch shoals which support corals and sponges.
- ECU2 – Onslow Offshore encompassing waters between 10–20 m depth and including most offshore islands and coral reefs and algal-dominated shoals.

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- ECU3 – Onslow Inner Shelf incorporating the relatively steep gradient shelf break from 20–70 m depth.

These ECUs are shown in **(Figure 6-2**). Subsequently, Local Assessment Units (LAU) were identified within the ECUs based on bio-geomorphic attributes and the distribution of various types of BPPH. These LAUs were the basis of the BPPH loss assessment described in **Section 7.0**. **HOLD LAU being redefined**

Within the defined ECUs there are a number of key sensitive receptors, details of which are provided in **Table 6-1**.

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Table 6-1: Sensitive Receptors in the Project Area

[HOLD table to be updated, pending finalisation of OBC and zones of impact, with associated zones and management for each sensitive receptor]

Habitat Biotype*	Geographic Name	Easting	Northing	Depth (m)	Site/species Descriptor
CR & MA	Tortoise Island	278710	7612383	3.5	Tortoise Island, east side. Reef with 25-50% live hard coral cover close to shore. *Lobophyllia*, *Turbinaria*, *Porites* and faviids present, dominated by *Montipora* with occasional large *Acropora* plates. Patches of coarse sand and shell fragments. Macroalgae on bare rocks.
CR & MA	Roller Shoal	285367	7604532	5.8	Roller Shoal. Reef of up to 50% cover in places of hard live coral with surrounding sand patches. Dominant coral was *Montipora* spp., with *Goniopora*, *Platygyra*, *Porites*, and *Acropora* plates and faviids present. Hydroids, large barrel sponges and algal patches were also present.
CR & SG	Ashburton Island	286705	7611075	4.1	East side of Ashburton Island. Large bommies with up to 75% live hard coral cover. *Acropora*, *Porites*, faviids. Coarse sand and silt areas with moderately dense beds of seagrass. Low diversity of coral.
FF	Brewis Reef East	286437	7621988	12.3	East of Brewis Reef, South west of Thevenard Island. Sponge and fan garden. Gorgonian fans, sea whips, barrel, vase, encrusting and digitated sponges, hydroids and bryozoans. Red coralline algal tufts with coarse sand and shell fragment patches.
MA & CR	Thevenard Island West	288492	7624016	5.7	Flat pavement algae dominated. Occasional outcrop with 2–10% coral cover. Small individual corals including *Pocillopora* and *Turbinaria* spp. Occasional digitated and laminar sponges with solitary ascidians.
CR	Paroo Shoals	293805	7614023	4.5	Patches of high coral cover (up to 50–75%) and a diverse community were found on the ridge on the western edge of the shoal, dominated by either corymbose and tabulate *Acropora* spp. or by *Montipora* spp.
CR, MA & FF	Saladin Shoal	295913	7613337	6.3	Moderate to high live hard coral cover (up to 50% in places), with patches of sand and silt with coarse shell fragments. One large >2 m *Porites* bommie. Plateau of algal-dominated sand. Abundance of filter feeders (ascidians/sponges).

CR	End of Wheatstone Shipping Channel	298328	7617464	6.4	Outcrop at end of shipping channel. Two distinct steep-faced outcrops with 50–75% hard coral cover on top (~5 m). Feature is ~20 m in length. Dominant coral cover encrusting *Montipora* spp. with faviids, *Mycedium* sp. and juvenile *Turbinaria*. Numerous *Nephthea* spp. with occasional digitated sponges.
CR	Hastings Shoal	298803	7613488	7.6	Areas of 50–75% hard coral cover on western side of the shoal at depth of 3 m LAT. The coral community was dominated by *Montipora*, with many *Acropora* spp. and faviids also present. The remainder of the shoal was comprised of coral rubble (mainly branching *Acropora* spp.).
CR	North West Ward Reef	299018	7610106	3.9	Reef. Large outcrop with east-west orientation on sand and silt pavement. Outcrop had 50–75% healthy hard coral cover, dominated by encrusting *Montipora*, with tabular and digitated *Acropora* spp. sub-dominant. *Platygyra* spp. and faviids also present.
CR	Ward Reef	300410	7608868	3.9	Reef. Outcrops dominated by *Acropora* plates, with sub-dominant encrusting *Montipora* spp. Occasional large *Porites* bommies, *Platygyra*, faviids, and *Lobophyllia*. Coral cover 50–75% in places.
CR	Ward Reef	301120	7609196	6.4	Ward Reef, east side. Diverse and abundant live hard coral cover reef (~90% cover) with very little damage and dead coral present from storm damage (typically *Acropora* spp.) with patches of silt. *Montipora*, *Lobophyllia*, *Platygyra*, *Turbinaria*, and *Porites* spp.
CR	Gorgon Patch	300859	7615993	7.1	Gorgon Patch. Steep-walled reef with up to 80% hard live coral cover in middle of shoal. Corals include *Montipora*, *Acropora*, *Platygyra*, *Turbinaria*, *Porites* and *Nephthea* spp. Patches of algae, gorgonians and also barrel and digitate sponges.
CR, MA & FF	Weeks Shoal	302245	7618926	4.6	Flat-topped reef with steep walls, with >75% live hard coral cover in patches including *Montipora*, *Turbinaria*, *Acropora* and faviids. Colonial ascidians, algal patches and gorgonians also present.
CR	Unnamed shoal to NE of Koolinda Patch	304144	7615544	3.2	Shoal east northeast of Koolinda Patch, southwest of Direction Island. Large reef with 50–75% live hard coral cover patches on the top. Dominant coral was tabular *Acropora* with *Lobophyllia*, faviids and *Turbinaria* present.

CR	Direction Island	307430	7617732	5.6	Direction Island, east northeast edge. Up to 100% hard live coral cover in very healthy condition, with occasional small patch of algae. *Montipora*, *Acropora*, *Pocillopora*, *Turbinaria*, faviids, *Lobophyllia*, *Goniopora* and *Porites* spp. all present.
CR & MA	NE Twin Island	314029	7620738	3	Reef with occasional large *Porites* bommies (2–4m). Patches of 25-50% healthy hard coral cover, with overall 10–25%. Hard substrate predominantly covered with fine foliose algae. *Porites* spp. were dominant coral. Edge of hard substrate supports greatest coverage of coral.
FF & CR	West middle Mangrove Is	326341	7624763	7.5	Dominated by sponges and ascidians. Hard, raised pavement with sand silt veneer. Sparse corals (2–10%) on hard substrate including young *Turbinaria*, tabular *Acropora*, occasional *Goniopora*, *Platygyra*, *Favia* and faviids. Very sparse algae present. Digitate, laminar and vase sponges.
SG	East Glennie Patches	283533	7608755	5.5	Rippled coarse sand. Very large and dense meadow of *Halophila spinulosa* and possible *H. ovalis* of 25–50%. Transect graded into bare substrate before returning to dense patches. Possible dugong grazing paths in substrate.
MA	Thevenard Island South	294521	7622970	1.9	Southeast Thevenard Island. Algal-dominated rock platform (*Sargassum* and *Halimeda* spp. dominant).
SG	Nearshore NE of Onslow	310515	7609475		Dense seagrass nearshore between Onslow and Coolgra Point
SG	SW of Coolgra Point	314624	7612352	5.3	Undulating substrate with fine sand and silt and fine shell fragments. Sparse bioturbation with occasional larger hole. Short tufting algae. Seagrass cover 10–25% (with patches of 25–50%) of *Halophila spinulosa*, *H. decipiens* and unidentified thin-bladed seagrass.
SG	Coolgra Point	317246	7614478	3	Sand rippled with patches of dense seagrass (*Halophila* spp 40–60% in places with occasional *H. spinulosa*).
SG & MA	SW Twin Island	313878	7618776	4.3	SW Twin Island – south side. Dense seagrass beds (up to 75% cover in places) of *H. decipiens*. Algal-dominated sand veneer patches on presumed rock platform with <5% live hard coral cover. One large *Porites* bommie (~3 m) with *Montipora* spp.

SG	SE of Direction Island	307170	7613858	8.5	South of Direction Island. Sand with fine shell fragments. Moderate patches of seagrass of up to 25%, including *H. spinulosa* and *H. decipiens* and also the green alga *Caulerpa* sp. Digitate and laminar sponges and solitary ascidians.
SG	West Glennie Patches	282228	7607307	5.5	Rippled coarse sand. Dense patch (~25 m in diameter) of *H. spinulosa* and *H. decipiens* of 25–50%. Transect graded into bare substrate before returning to dense patches. Possible dugong grazing paths in substrate. One sea pen. No observable bioturbation.
CR	SW of Gorgon Patch	300094	7615177	5	Outcrop next to shipping channel. Two distinct steep-faced outcrops, with 25–50% hard coral cover on top (~5 m). Feature is ~20 m in length. Dominant coral cover encrusting *Montipora*, with *Pocillopora*, tabular *Acropora*, faviids, juvenile *Turbinaria*, and *Tubastrea* spp. Numerous *Nephthea* sp.
CR & MA	NW of Direction Island	304867	7618549	11.5	Northwest of Direction Island, very steep-walled reef from 13–4 m depth. Reef with up to 50% live coral cover and algae-dominated in areas. *Montipora*, *Lobophyllia*, *Acropora* and occasional *Porites* bommies (~2 m).
CR	North Herald Reef	315773	7623395	4	Herald Reef – north side in northerly direction. Rock outcrops covered with macroalgae, <10% coral coverage - juvenile *Turbinaria*, tabulate *Acropora*, *Lobophyllia* , and encrusting *Porites* spp.
CR	Nares Rock	323379	7629437	5	Nares Rock, northwest of Twin Islands. Steep-walled reef dominated by encrusting *Montipora*. *Porites*, tabulate *Acropora* and *Lobophyllia* spp. 25% coverage. Coral density increases on southern edge of reef. Dense coral cover on top of reef (25–50% cover). Large rock outcrops on edge of reef with 25–50% cover. Encrusting *Montipora* dominated, also *Lobophyllia* spp.
CR & MA	Airlie Island	307006	7640697	5.7	Algal-dominated on outcrops on presumed hard platform with patches of fine sand.
CR & MA	Taunton Reef	315570	7642531	4.6	Sand and fine shell fragments and coral rubble substrate over presumed reef outcrop. Occasional pavement outcrops supporting macroalgae (*Asparagopsis* sp.) (2–10%) and sparse corals including *Porites*, faviids, tabular *Acropora*, *Lobophyllia* and *Turbinaria* spp. (2–10% in patches) with occasional *Porites* bommies.

*CR = Subtidal coral communities on biogenic reefs. SG = Subtidal seagrass communities, MA = Subtidal macro algal communities, FF = Sessile benthic filter feeder communities, REC = recreational/aesthetic

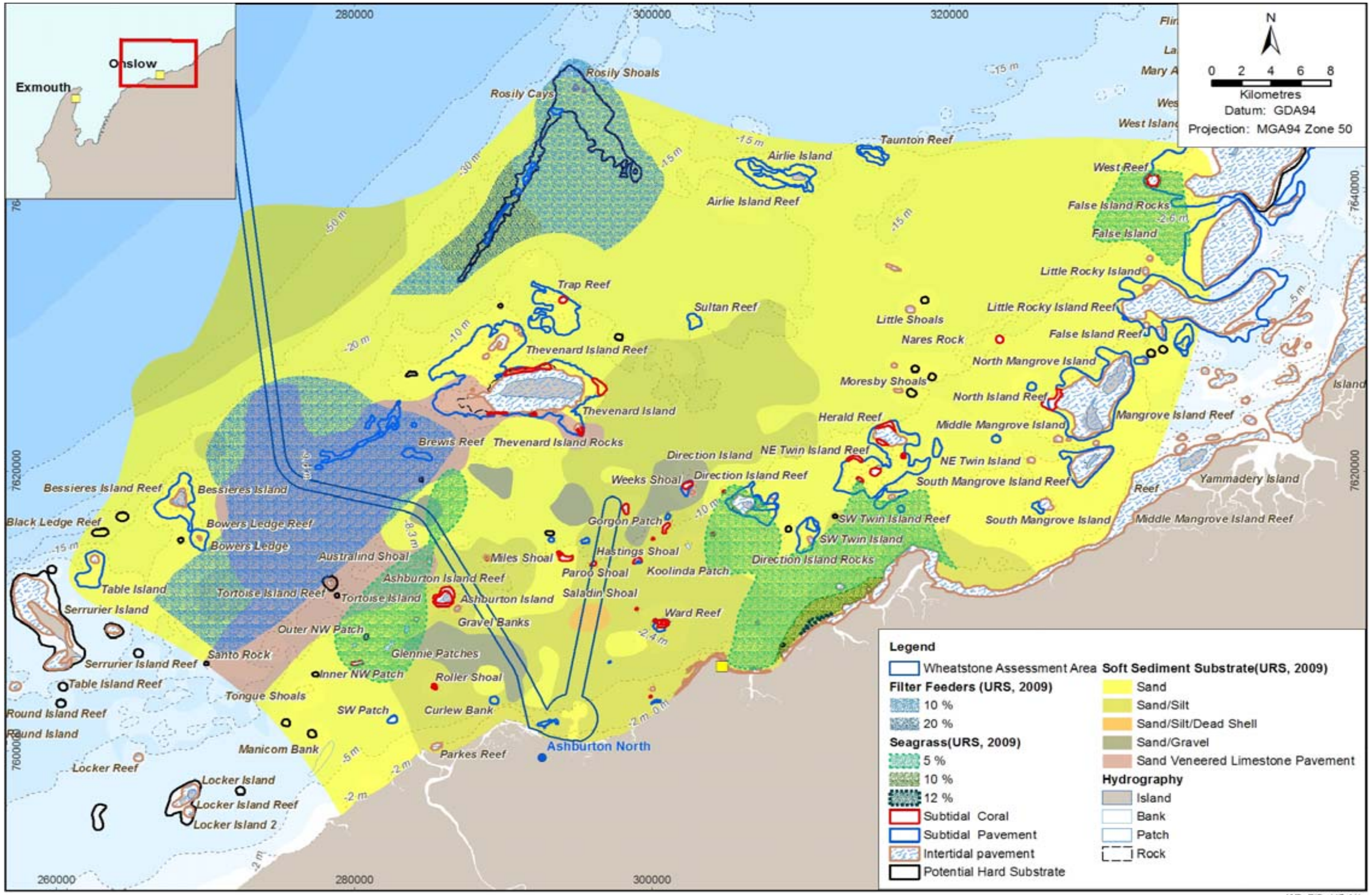

Figure 6-1: Marine Habitat Map

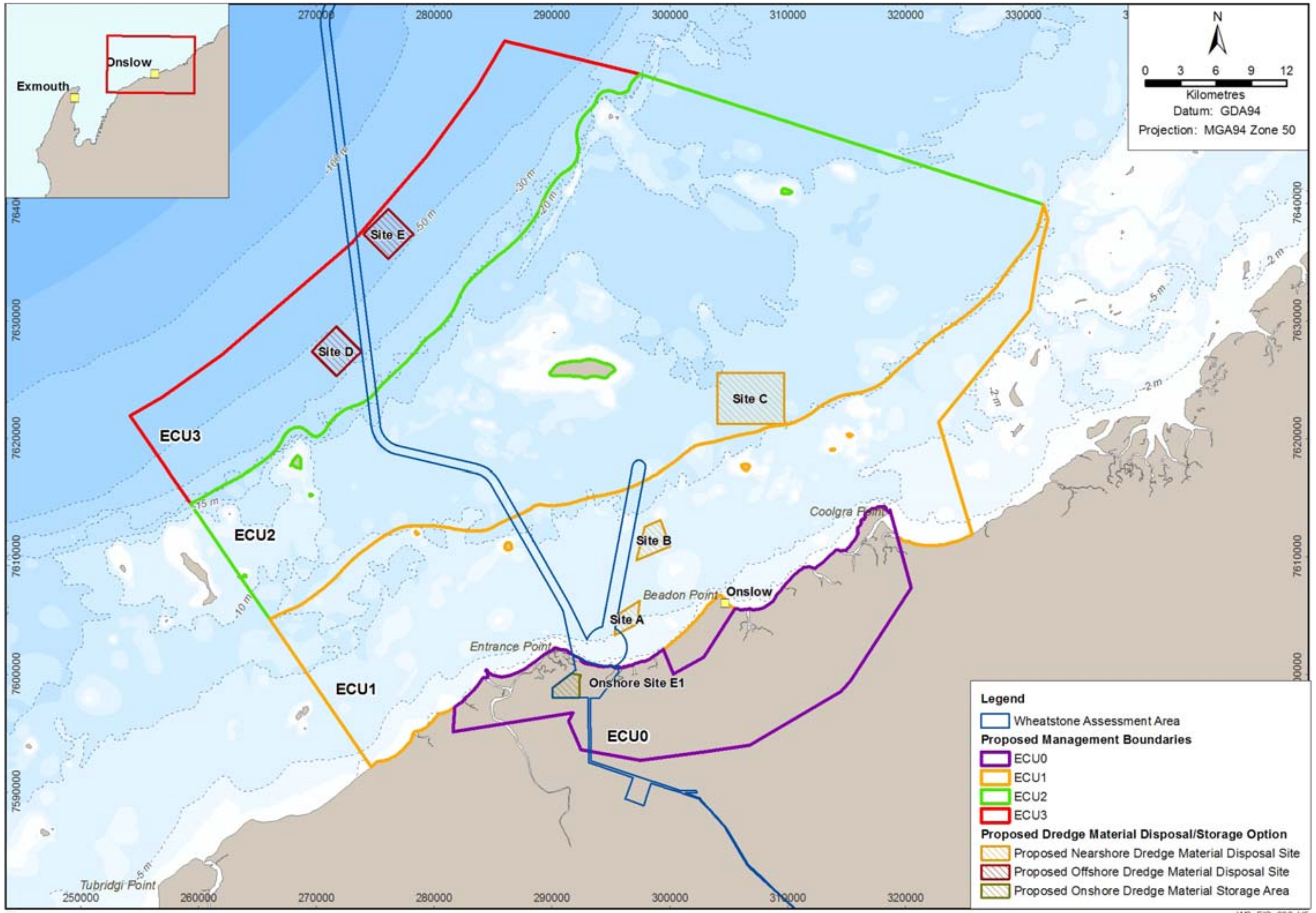

Figure 6-2: Ecosystem Units Defined for the Wheatstone Project

6.5.1.1 Hard Coral

In the immediate vicinity of the Project Area, coral communities are sparsely distributed, restricted to a small number areas located on the fringes of the platforms that surround the offshore islands.

Field survey results within the vicinity of the proposed Project Area indicate that hard coral density varied between 30 and 70% live coral cover (MScience 2009a). However, sites surveyed were biased to areas of highest coral cover and therefore these survey results are not representative of the entire Project Area. The highest cover areas were dominated by spreading corals such as plate *Montipora* and tabulate *Acropora*. A gradient in composition of coral communities was evident from inshore to offshore reefs, with the inshore zone dominated by *Montipora* spp. and the offshore zone dominated by *Acropora*. A transition zone between the inshore and offshore zones was evident and consisted of mixed community types with abundant *Montipora* corals but other corals (including *Acropora)* were also found to be dominant. Coral cover and diversity were correlated with diversity decreasing as coral cover increased, as many sites were dominated by a cover of plate *Montipora* corals.

6.5.1.2 Seagrass

Temporal variability in distribution, density and biomass can occur as a result of seasonal cycles and inter-annual change due to sporadic environmental events and natural variation. The abundance and distribution of tropical seagrass species can vary greatly in response to seasonal changes in water quality (turbidity, light penetration) and conditions (wave action, temperature) (Lanyon and Marsh 1995; Short et al. 2001; Loneragan et al. 2003; Duarte et al. 2006). Inter-annual differences in seagrass biomass, distribution and abundance can be attributed to regional-scale changes in climate (Collier and Waycott 2009). Seagrasses are often important primary producers but their sparse distribution in the Pilbara Nearshore bioregion means that they make only a small contribution to local benthic primary production when compared to mangroves, macroalgae and corals (URS 2009a).

No known meadows of perennial seagrass genera, such as *Thalassodendron* or *Enhalus* spp., occur in the nearshore Project Area. The area is characterised by ephemeral species such as *Halophila* spp. Paling (1990) surveyed subtidal areas off Onslow and found seagrass was absent from most sites. He noted only ‘rare’ patches of *Halophila decipiens*. Around the islands offshore from Onslow, species of a number of genera (e.g. *Halophila*, *Halodule* and *Syringodium*) are known to occur on the shallow intertidal platforms and in the lee of small reefs, while *Thalassodendron* is sparsely distributed in the shallow macroalgal meadows that occur to the west of Thevenard Island (URS 2009a). Seagrasses recorded in surveys of the Project Area were sparsely distributed (when encountered), occurring in small patches.

6.5.1.3 Macroalgae

For the most part, macroalgae in Western Australia do not exhibit a pronounced seasonality. However the brown algal genus, *Sargassum,* is reported to undergo annual growth and reproductive cycles and based on observations in nearby Pilbara locations is likely that intertidal and shallow subtidal *Sargassum* species undergo a seasonal succession with peak growth and reproduction over summer (URS 2009)

Macroalgae are present on many shallow shoals and platforms that surround the offshore islands (e.g. Thevenard, Twin Islands). Macroalgae in the Project Area include large brown algae of the genera *Sargassum*, *Padina* and *Dictyopteris*, and red algae of the genera *Gracilaria* and *Laurencia*. Less common are green algae of the genera *Halimeda* and *Caulerpa* (URS 2009a).

6.5.1.4 Sponge and Whip Gardens

Sessile filter feeders (including soft corals, sponges and ascidians) are common on the sand veneered pavement that dominates the inner shelf and consequently are one of the most common and widespread of the BPPHs present.

6.5.1.5 Intertidal Habitats

Two major types of marine habitats are recognised in the intertidal marine areas, namely mangroves (and associated high tidal mudflats) and algal mats.

Within the nearshore Project Area, mangroves occupy the mainland intertidal zone between mean sea level (MSL) and an elevation of 2.2 m CD, which is between high neap- and spring-tide levels. Mangroves in the area occur mostly within river mouth and tidal creek systems, where they form nearly continuous ribbons of vegetation, fringing the channels. These mangroves are protected and partially isolated from the sea by barrier dune systems. Areas of mangroves also occur along the outer, coastal shoreline on the western and northern sides of Coolgra Point (URS 2009b).

Landward of the mangroves, large areas of high tidal mudflats commonly extend to the hinterland margin or merge with supra-tidal salt flats. These mudflat areas are not inundated by daily tides. Two habitat types were recorded on the high tidal mudflats:

- bioturbated mudflats, devoid of macro-vegetation
- samphire flats, dominated by halophytic shrubs but with some crab burrows.

6.5.2 Marine Fauna

6.5.2.1 Overview

Fourteen threatened marine fauna species occur, or could occur, in the nearshore or offshore Project Areas. These include one bird, four marine mammals, six reptiles and three sharks/rays as shown in **Table 6-2**.

In addition to these species, a number of migratory marine mammals and birds that are also protected under the *EPBC Act (*Cth*)* may occur in the Project Area including cetacean species (whales and dolphins), the dugong, migratory seabirds and wetland birds.

Table 6-2: Threatened Marine Fauna Potentially Inhabiting the Project Area

Scientific Name	Common Name	*EPBC Act* (Cth) Conservation Status	*Wildlife Conservation Act* Status
Birds			
Macronectes giganteus	Southern giant petrel	Endangered	Rare
Mammals			
Balaenoptera musculus	Blue whale	Endangered	Rare
Balaenoptera musculus brevicauda	Pygmy blue whale	Endangered	
Eubalaena australis	Southern right whale	Endangered	Rare
Megaptera novaeangliae	Humpback whale	Vulnerable	Rare
Reptiles			
Caretta caretta	Loggerhead turtle	Endangered	
Chelonia mydas	Green turtle	Vulnerable	Rare
Dermochelys coriacea	Leatherback turtle	Vulnerable	Rare
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Rare
Natator depressus	Flatback turtle	Vulnerable	Rare
Crocodylus porosus	Saltwater crocodile	Protected	
Sharks			
Rhincodon typus	Whale shark	Vulnerable	
Pristis zijsron	Green sawfish	Vulnerable	Rare
Pristis clavata	Dwarf sawfish	Vulnerable	Rare

6.5.2.2 Marine Turtles

Green (*Chelonia mydas*) and flatback turtles (*Natator depressus*) are known to occur in the Project Area during sensitive life-history phases (e.g. mating, nesting and inter-nesting) and may be present in the area year-round (RPS 2010). Loggerhead (*Caretta caretta*) and hawksbill turtles (*Eretmochelys imbricata*) are less abundant and their distribution in the area is not well known. Leatherback turtles (*Dermochelys coriacea*) have not been recorded in the Project Area, nor are they known to nest in the general area.

Surveys have recorded nesting activity by a combination of flatback and green turtles on the large (Serrurier and Thevenard) and moderate sized (Bessieres, Locker and Ashburton) islands. Smaller islands such as Tortoise Island have very small areas of suitable nesting habitat, and very low density nesting activity. Other smaller islands such as Flat, Table, Direction and the Twin Islands have small areas of suitable habitat, with moderate levels of nesting activity (Pendoley Environmental 2009). There was low density of nesting activity observed on the mainland beaches, with large sections of

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beach presenting no evidence of nesting activity at all (Pendoley Environmental 2009; RPS 2010).

Juvenile green turtles were observed around the islands. These animals are likely to be residents at their foraging grounds. Foraging green turtles are likely to be found in seagrass and algal habitats near the Project Area and may also utilise coastal mangrove habitats (Pendoley Environmental 2009). A total of 1,091 turtles were sighted during the aerial surveys from mid-May to late December, off the west Pilbara conducted by CWR (2009).

6.5.2.3 Marine Mammals

The Pilbara region supports migratory, transient and resident marine mammals such as whales, dolphins and dugongs, all of which are EPBC listed. Many of these are protected under Commonwealth law because they are listed on international treaties to which Australia is a signatory.

Baleen Whales
Four species cetaceans, including humpback whales (*Megaptera novaeangliae*), pygmy blue whales (*Balaenoptera musculus brevicauda*), Bryde's whales (*Balaenoptera edeni*) and minke whales (*Balaenoptera acutorostrata*) are known to occur in the Project Area.

Humpback whales are known to move through the region on their northern and southern migrations to and from the Kimberley between June and October. Aerial surveys beginning in May 2009 found northbound humpback whales were concentrated seaward of Thevenard Island and over the continental slope, on average 49 km offshore (CWR 2009). The southbound migration found whales on average 36 km offshore with cows and calves predominantly resting inshore of the 50 m isobath. The data indicate that the area does not have the same importance for resting as Exmouth Gulf or for calving as Camden Sound.

Noise loggers identified pygmy blue whales, dwarf minke whales and Bryde's whales in the offshore waters although none of the species were recorded in the shallow waters near the Project Area. Antarctic minke whales, blue whales and southern right whales were not recorded during the field surveys and are unlikely to be present within the Project Area due to their preference for colder waters.

Dolphins and Toothed Whales
Coastal dolphin species that could occur in the Project Area include the Indo-Pacific humpback dolphin (*Sousa chinensis*) and bottlenose dolphins (*Tursiops* sp.). Little is known of the population structure, movement patterns or ecology of these species within the Project Area. Recent aerial surveys recorded dolphin species within the Project Area although positive identification of dolphins to species level was not possible. However, it is inferred that the Indo-Pacific humpback dolphin and bottlenose dolphins were present (CWR 2009). It can be expected that these coastal dolphin species may be present in shallow and nearshore waters of the Project Area at any time. All coastal species typically occur in low numbers and are widely dispersed, which is in accordance with previous documentation of these species in the Pilbara region (Prince 2001). It is likely that the Indo-Pacific humpback dolphin will move between different shallow water estuaries and inlets along the coast.

Dugongs

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Dugongs (*Dugong dugon*) are found within the region and within the Project Area. Dugongs tend to occur in wide shallow bays, mangrove channels and in the lee of large inshore islands. Shallow waters such as tidal banks and estuaries have also been reported as sites for calving (Oceanwise 2005). While dugongs are found in the Project Area, it is not considered to be a favoured habitat due to the lack of extensive seagrass habitats and limited open water. From the available aerial survey data, it is expected that at least some dugongs are resident in the area year-round but with seasonal variation in densities (CWR 2010). Dugongs were predominantly sighted in the south-western portion of the study area (i.e. towards Exmouth Gulf) and in water depths less than 10 m. This is suggestive of a link to the known populations and possibly to food sources in that area (CWR 2009). Dugongs were often sighted over or near to known areas of seagrass and macroalgae, as identified during benthic surveys of the area (URS 2009a).

6.5.2.4 Migratory Waterbirds

Review of Faunabase (now Fauna Map [WA Museum]), the Birds Australia Atlas Database, the DEC Threatened and Priority Fauna Database, and the EPBC Protected Matters Search Tool indicate that up to 38 migratory waterbird species may be found within the Onslow locality. Bamford (2009) has recorded 26 of these species in the Onslow locality, and those not observed are likely to only occur as infrequent visitors to the area. Of these 26 species, the counts for numbers of waterbird species are all well below any criterion of international significance[1], except for the common tern (*Sterna hirundo*). The subspecies *Sterna hirundo* ssp. *longipennis* breeds in northern Asia and spends the non-breeding period in south-eastern Asia and northern Australia, and has a minimum population estimate of 25,000 (Scott and Delaney 2002). Three migratory species, the whimbrel (*Numenius phaeopus*), eastern curlew (*Numenius madagascariensis*) and sanderling (*Calidris alba*), may be present in regionally important numbers[1] at the Ashburton River delta, Beadon Creek and Town Beach. However, these are again based on uncertain and conservative estimates of regional populations (Bamford et al. 2008) and these areas are outside of the Project Area. Bamford (2009) concluded that the Project Area and surrounds does not support important numbers of migratory waterbirds.

6.5.2.5 Introduced Marine Pests

The National Introduced Marine Pests Coordination Group (NIMPCG 2006) has developed a target list of 55 pest species of concern to Australia. None of these species have been recorded in the Project Area, or elsewhere in the Pilbara Nearshore or Pilbara Offshore bioregions (Huisman et al. 2008).

One introduced marine species, the barnacle *Megabalanus tintinnabulum*, has been recorded in Onslow (Huisman et al. 2008). This species is not considered a “pest” and has been recorded at several other WA ports.

6.6 Social and Economic Environment

The land and sea area surrounding the proposed Project Area has a number of uses and values, including commercial, heritage, environmental conservation, and recreational.

[1] Sites recognized as having international significance are often based on on the Ramsar Convention (Ramsar Convention Bureau 2000) which recognises sites as important if thye support in excess of 20,000 waterbirds, 1 per cent of a species’ population or a 0.25 per cent of a migratory species’ population during migratory passage.

The following section provides a brief overview of the sea use and recreational values of the proposed project area.

6.6.1 Sea Use Values

6.6.1.1 Commercial Fisheries

The waters off the Pilbara coast are home to many managed commercial fisheries including prawn, demersal scalefish, demersal finfish, mackerel, oyster and several types of tuna. The fisheries in closest proximity to Onslow are managed by the Department of Fisheries (DoF), and include:

- Onslow and Nickel Bay Prawn Managed Fisheries (ONPMF);
- Pilbara Managed Trap Fishery;
- North Coast Blue Swimmer Fishery;
- Pearl Oyster Managed Fishery;
- Pilbara Line Fishery;
- Mackerel Managed Fishery;
- Specimen Shell Managed Fishery; and
- Marine Aquarium Fish Managed Fishery.

The ONPMF is a combination of three areas and four associated Size Management Fish Grounds (SMFG) totalling 39 748 km^2. Construction of the proposed Project, including dredging a material offloading facility and construction of an LNG and condensate jetty, would most directly affect Area 1, which also includes the Ashburton SMFG.

6.6.1.2 Pearling

Onslow was one of the earliest commercial pearling centres in WA since the commencement of the State's commercial pearling industry during the nineteenth century. Since 1992, the health of wild oyster stock (the basis for pearl farm production) and the market price of WA pearls have been controlled by a production (output) quota. Quota units are allocated to licence holders (572 units existed in 2006) with one quota unit normally allowing 1000 shells (though there may be annual variations).

6.6.1.3 Oil and Gas Production Facilities

Oil is produced from a number of small fields located in shallow waters offshore from Onslow. These include the Saladin, Coaster, Roller and Skate fields. Further offshore, are the BHP Billiton operated Griffin oilfield, the Chevron operated Barrow Island facility and the Gorgon gas field development, as well as Apache's Varanus Island operations.

Key island facilities for oil and gas processing, storage and shipping facilities are located on Barrow, Thevenard, Airlie and Varanus Islands. Gas gathering pipelines from the Griffin and Roller fields come ashore west of Onslow, near Urala Station. A new structure plan is being developed for Onslow to complement the proposed Ashburton North Hydrocarbon Precinct, which was endorsed in December 2008 to support further opportunities for gas processing plants development in the area. The Ashburton North Hydrocarbon Precinct would cover approximately 8000 ha and include the proposed Project, the BHP Billiton/Apache Macedon Domgas plant, and the ExxonMobil/BHP Billiton Scarborough LNG plant. The Ashburton North Hydrocarbon Precinct would have

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optimal access to the coast, a buffer of about 12 km from the Onslow town site and would accommodate various gas-related industrial land uses.

6.6.1.4 Shipping

Onslow and the surrounding area is currently not a high density shipping channel. Greater shipping activities occur in neighbouring locations including Exmouth, Dampier and Port Hedland (Australian Maritime Safety Authority 2008).

6.6.2 Recreational Values

Coastal recreational value, within and adjacent to the Project area, has been determined by a values and land use assessment study (URS 2009c). The areas of highest value and/or use identified in this study included the Ashburton River, Four Mile Creek, Hooley Creek, Sunset Beach, Sunrise Beach, Onslow Town Beach and Beadon Creek. The high value areas that may be affected by changed coastal processes include the Hooley to Four Mile Creek complex (fishing, boating and crabbing); Sunset Beach (four-wheel driving); and Onslow Town Beach (walking). It is important to note that not all of the values identified in the high value areas by the values and land use study (URS 2009c) would be adversely affected by changed coastal processes.

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7.0 SEDIMENT PLUME MODELLING AND DEVELOPMENT OF IMPACT ZONES

This section to be updated when revised trunkline modelling results are received

7.1 Tolerance Limits

Tolerance limits for both turbidity and sedimentation rates have been established for various receptors including hard coral, seagrass and recreational values. Tolerance limits have been established for both the nearshore (ECU1) and offshore waters (ECU2) to reflect the different natural turbidity climate of these areas (refer to **Section 6.5.1** for description of the four major Ecosystem Units ECUs) (DHI, 2010).

The tolerance limits and the process followed to establish these limits are detailed in the EIS/ERMP document and its technical appendices.
The tolerance limits for turbidity and sedimentation rates established for hard coral are detailed in **Table 7-2**, **Table 7-3**, **Table 7-4** and **Table 7-5**.

Table 7-1: Definition of Impact Zones for Suspended Sediment Impacts on Corals Applicable for Nearshore Waters within 5 m isobath in ECU1 during Summer and Winter Only.

Zone	Definitions
Total Mortality	Excess SSC >25 mg/l for more than 20% of the time
Partial Mortality	Excess SSC >25 mg/l for 5–20% of the time; OR Excess SSC >10 mg/l for more than 20% of the time; OR Excess SSC >5 mg/l for more than 50% of the time.
Influence	Excess SSC >25 mg/l for 1–5% of the time; OR Excess SSC >10 mg/l for 1–20% of the time; OR Excess SSC >5 mg/l for 5–50% of the time.
No Impact	Excess SSC >25 mg/l for less than 1% of the time; OR Excess SSC >10 mg/l for less than 1% of the time; OR Excess SSC >5 mg/l for less than 5% of the time.

Table 7-2: Definition of Impact Zones for Suspended Sediment Impacts on Corals Applicable for Offshore Waters (beyond 5 m isobath) for All seasons and for Nearshore Waters (within 5 m isobath) during Transitional Periods Only.

Zone	Definitions
Total Mortality	Excess SSC >25 mg/l for more than 10% of the time; OR Excess SSC >10 mg/l for more than 25% of the time.
Partial Mortality	Excess SSC >25 mg/l for 2.5–10% of the time; OR Excess SSC >10 mg/l for more than 10–25% of the time; OR Excess SSC >5 mg/l for more than 25% of the time.
Influence	Excess SSC >25 mg/l for 0.5–2.5% of the time; OR Excess SSC >10 mg/l for .05–10% of the time; OR Excess SSC >5 mg/l for 2.5–25% of the time.
No Impact	Excess SSC >25 mg/l for less than 0.5% of the time; OR Excess SSC >10 mg/l for less than 0.5% of the time; OR Excess SSC >5 mg/l for less than 2.5% of the time.

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Table 7-3: Definition of Impact Zones for Sedimentation Impact on Corals Applicable for Nearshore Waters within 5 m isobath in ECU1 during Summer and Winter Only.

Zone	Definitions
Total Mortality	Sedimentation >0.5 kg/m^2/day (> 17.5 mm/14 day*)
Partial Mortality	Sedimentation 0.1–0.5 kg/m^2/day (3.5 – 17.5mm/14 day*)
Influence	Sedimentation 0.025–0.1 kg/m^2/day (0.9 – 3.5mm/14 day*)
No Impact	Sedimentation <0.025 kg/m^2/day (<0.9mm/14 day*)

*conversion from kg/m^2/day to mm/14 days assumes an initial deposition dry density of 400kg/m^3

Table 7-4: Definition of Impact Zones for Sedimentation Impact on Corals Applicable for Offshore Waters (beyond 5 m isobath) for All Seasons and for Nearshore Waters (within 5 m isobath) during Transitional Periods Only.

Zone	Definitions
Total Mortality	Sedimentation >kg/m^2/day (> 7.0mm/14 day*)
Partial Mortality	Sedimentation 0.05–0.2 kg/m^2/day (1.7 – 7.0mm/14 day*)
Influence	Sedimentation 0.01–0.05 kg/m^2/day (0.3 – 1.7mm/14 day*)
No Impact	Sedimentation <0.01 kg/m^2/day (<0.3mm/14 day*)

*conversion from kg/m^2/day to mm/14 days assumes an initial deposition dry density of 400kg/m^3

7.2 Sediment Plume Modelling

7.2.1 Modelled Scenarios

7.2.1.1 Overview

The modelling provides predictions of turbidity and sedimentation patterns associated with the proposed dredging and dredge material placement. Sediment plume modelling has considered two climatic conditions (strong and representative drift), three seasons (summer, winter and transitional periods) and two spill estimates (realistic and worst case) for each of seven combined dredge scenarios, covering the full range of dredging equipment and dredged material placement sites. This gives a total of 84 different scenarios (i.e., 2 release rates x 6 climate scenarios x 7 dredging scenarios) that have been modelled, which are expected to cover the full spectrum of variability in terms of potential sediment plume impacts on sensitive receptors.

7.2.1.2 Dredging Scenarios

The dredging scenarios that have been modelled are (DHI 2010):

Dredging Scenario 1

- Nearshore dredging in the temporary access channel by CSD pumping to placement Site A.

Dredging Scenario 2

- Nearshore dredging in the PLF basin by CSD and pumping dredged material to hopper barges located at the -3 m LAT contour for placement at Site C.

Dredging Scenario 3

- Nearshore dredging in the MOF basin by CSD and pumping dredged material to hopper barges located at the -3 m LAT contour for placement at Site C.
- Offshore dredging by the 5,000 m^3 capacity TSHD in section 4 of the PLF approach channel and placement of dredge material at site C.

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Dredging Scenario 4

- Nearshore dredging in the PLF basin, of weak rock, by 10,000 m^3 capacity TSHD, with placement to Site C.
- Offshore dredging in the PLF approach channel, of sand, by 10,000 m^3 capacity TSHD with placement at Site C.

Dredging Scenario 5

- Nearshore dredging of sand in the PLF basin by 10,000 m^3 capacity TSHD with placement at Site C.
- Offshore dredging in the PLF approach channel in weak rock by 10,000 m^3 capacity TSHD with placement at Site C.
-

Dredging Scenario 6

- Offshore dredging of sand and weak rock in the PLF approach channel by 10,000 m^3 capacity TSHD with placement of dredged material at Site C.

Dredge Scenario 7

- Offshore dredging of sand in the PLF approach channel by 10,000 m^3 capacity TSHD with placement of dredged material at Site C.

Dredge Scenario 7A
An additional dredge scenario was investigated which incorporated dredge spill (i.e. overflow) restrictions along parts of the channel (**Figure 7-1**) in order to reduce potential impacts at nearby sensitive receptor locations such as Paroo Shoal and Hastings Shoal.

- 10,000 m^3 capacity TSHD dredging sand with placement of dredged material at Site C.
- Dredging along Section 2 and parts of Sections 1 and 3 with operational mitigation to avoid overflow in “no overflow” zone.

The modelling for scenario 7A, assumes that for each dredge cycle, the TSHD starts dredging at the centre of the “restricted overflow” zone within Section 2. It takes 25 minutes, corresponding to a sailing distance of 1.5 km for a speed of 1 m/s (app. 2 knots) before overflow starts. The dredge continues dredging for another 3 km with overflow. The dredge travels towards south and north, respectively, on alternate trips. This leads to a 3 km section with no overflow along with 3 km with overflow on each side, i.e. the total channel section being dredged is 9 km.

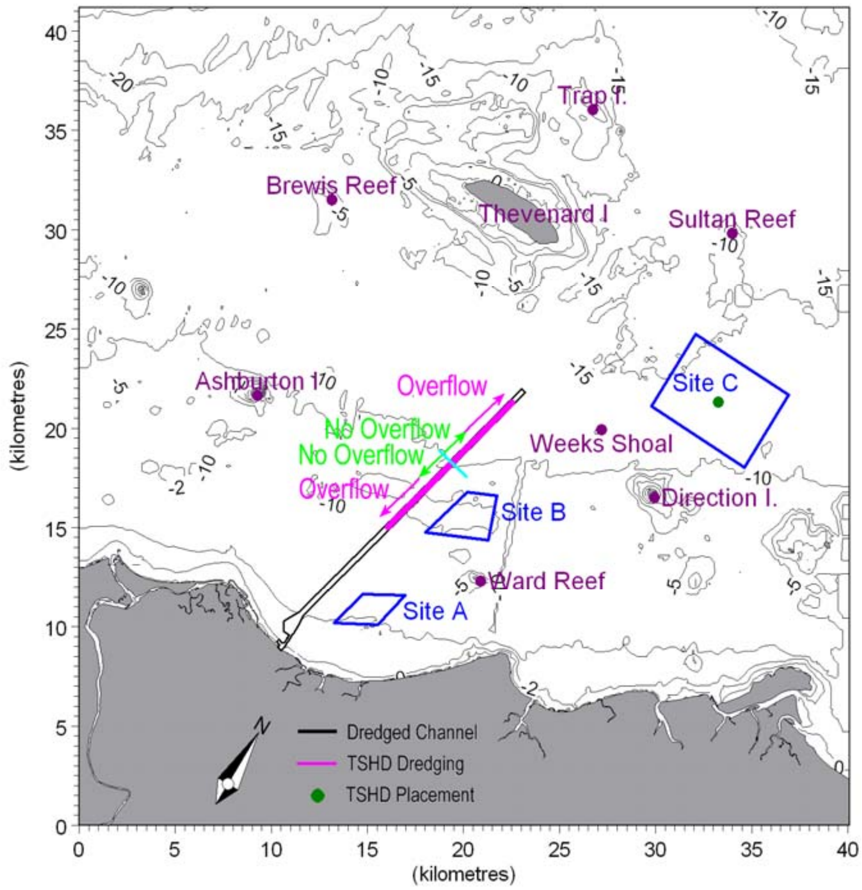

Figure 7-1: Dredging Scenario 7A Incorporating restricted overflow Zone (green) Along the Channel

7.2.1.3 Climatic Scenarios

The Wheatstone area has dominant summer and winter conditions with wind-driven net currents that cause the sediment plumes to travel in a predominant direction. Due to the variable climatic component, a number of scenarios with best estimates of “representative” and “strong” conditions are required to develop an estimate of possible impacts. There is also significant variability throughout the “calm” seasonal period occurring in April and May, therefore there are two representative calm periods to capture this variability. The six climatic scenarios, based on real wind data, are presented in **Table 7-6.** The most complete wind records available for the Project Area are from 2006 and 2007 and comparison to previous years indicate that these two years followed fairly typical patterns, although 2006 encompassed cyclonic events and 2007 had higher than average winds in January. The wind records from 2007 were selected for modelling purposes.

Table 7-5: Climatic Scenarios

Condition Period	Period
Summer A	January 2007
Summer B	February 2007
Winter A	June 2007
Winter B	July 2007
Transition A	April 2007

Condition Period	Period
Transition B	May 2007

7.2.1.4 Sediment Spill

In order to capture the uncertainty during the impact assessment stage of the Project regarding the rate of sediment spill from the various dredging, onshore and offshore material placement activities, upper and lower bound estimates have been developed for each spill source simulated in the model. These are referred to as 'High Spill' and 'Low Spill' scenarios in this report, with the High Spill scenarios considered to be a conservative "worst case" over-estimate of likely sediment release rates, and the Low Spill scenarios considered to be realistic estimate of "most probable" sediment release from the proposed program.

The difference between the high and low spill rates for each scenario is documented in DHI (2010a).

7.2.2 Modelling Results

The detailed modelling results for each scenario are presented in DHI (2010) and discussed in EIS/ERMP documentation. The results are presented within this plan to provide context for the management strategies presented in **Section 8.0** and the monitoring program presented in **Section 9.0**.

Combining the realistic scenarios (low spill rates) discussed above, 42 scenarios in total, illustrates the highest level of impact across the scenarios for each given location in the Project Area. These combined plots are presented in **Figure 7-2**. Note that these represent the maximum areas of impact arising for each zones during all seasons for modelled short-term scenarios. While the scenarios do not provide continuous coverage along the entire extent of the dredging area, it is possible to manually interpolate across the small gaps between scenarios in order to determine indicative impact zones for the full dredging period.

The results of the modelling interrogations (**Figure 7-2** and **Figure 7-3**) show most of the sensitive coral receptors are not located in the near vicinity of the dredging area, and generally lie outside of the Zone of Partial or Total Mortality. Only Saladin Shoal falls within the Zone of Total Mortality, and Paroo Shoal, Hastings Shoal, Gorgon Patch, Ward Reef and the End-of-Channel Shoal fall within the Zone of Partial Mortality.

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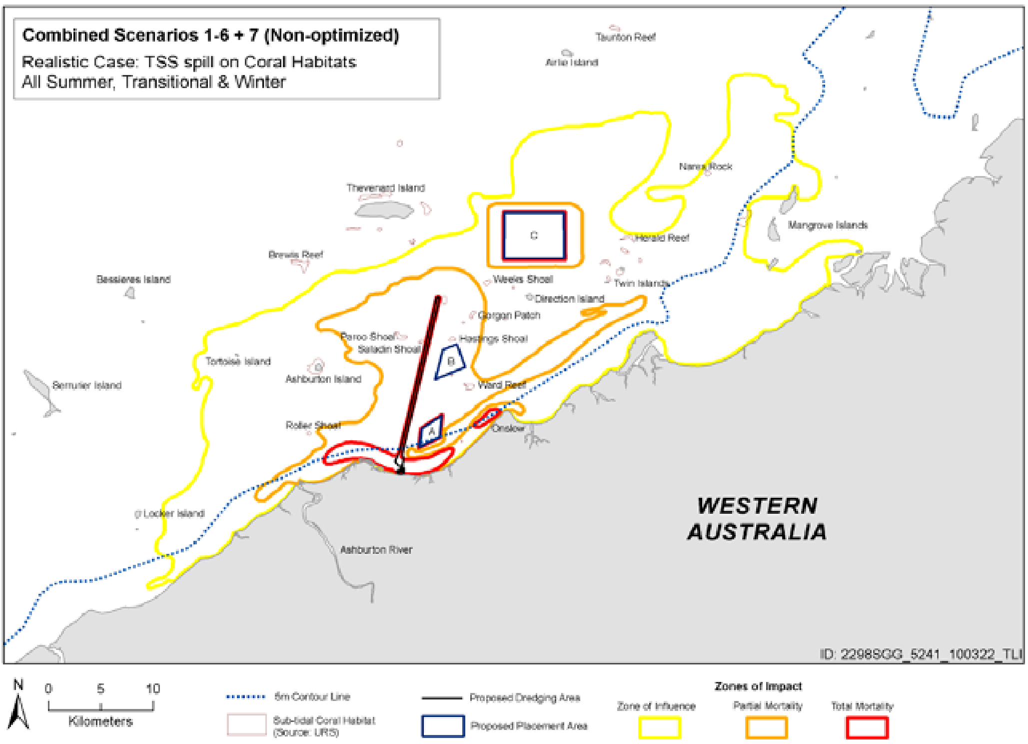

Figure 7-2: All Seasons Indicative Zones of Impact on Coral Habitats from Increased Turbidity (SSC)

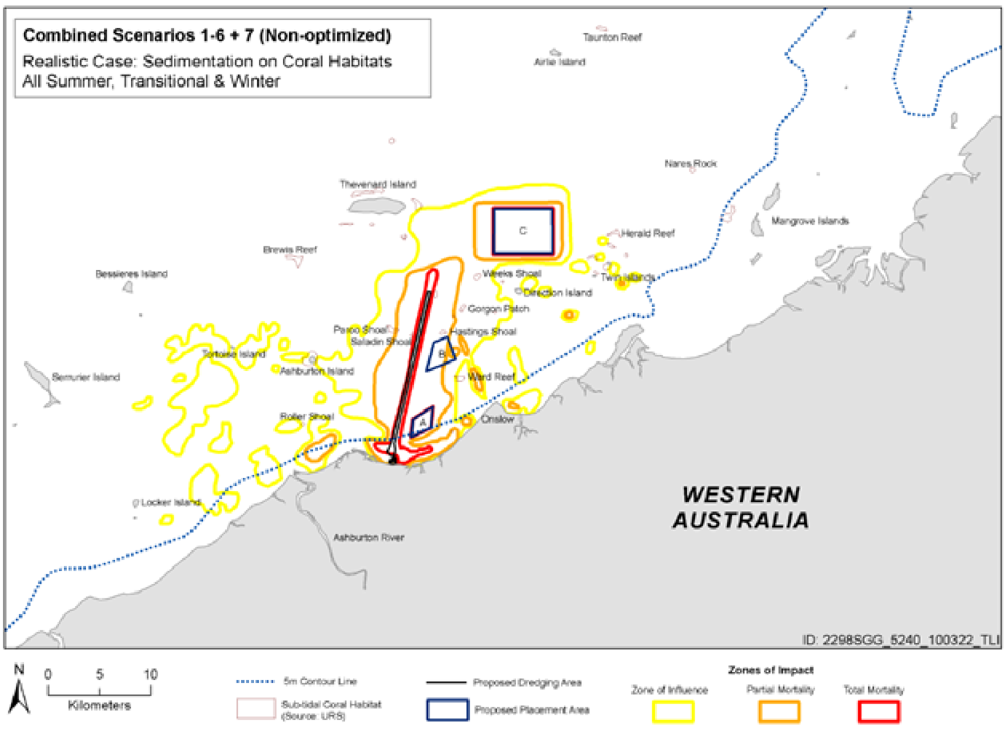

Figure 7-3: All Season Indicative Zones of Impact on Coral Habitats from Increased Sedimentation

7.3 Definition of Impact Zones used within DSDMP

Impact zones were initially developed based on the recommended approach of the OEPA Marine Ecosystem Branch (MEB), which uses four categories of classification. A description of the impact zones initially developed is provided in **Table 7-1** (columns 1 and 2). Refer to the EIS/ERMP document prepared for the Project for further details on the establishment of these zones.

The initial modelling and BPPH loss assessment calculations undertaken and presented in the EIS/ERMP were based on EPA Guidance Statement No 29: Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment (EPA 2004). However, this has now been superseded by Environmental Assessment Guideline #3: Protection of Benthic Primary Producer Habitats In Western Australia's Marine Environment (EPA 2009). The monitoring and management programs described within this DSDMP have been based on both EAG #3 (EPA 2009) and Draft Environmental Assessment Guideline #7: Marine Dredging Proposals (EPA 2010).

There are slight differences between the zones presented in the EIS/ERMP (colums 1 and 2 of **Table 7-1**) and the definitions used for monitoring and management within the DSDMP (columns 3 and 4 of **Table 7-1**) due to differences in definitions contained within new versus superseded Guidance Statement, however, generally the Zone of Total Mortality and Partial Mortality correspond to the Zone of High Impact and Moderate Impact and the Zone of Influence and Zone of No Impact correspond exactly between definitions used in the EIS/ERMP and those used the DSDMP.

Table 7-6: Definition of Impact Zones

HOLD zones being redefined will include in subsequent revision

EIS/ERMP Definitions (as per GS29)		DSDMP Definitions (as per EAG3 and Draft EAG7)	
Zone	**Definition**	**Zone**	**Definition**
Zone of Total Mortality	An area within which key receptors are predicted to suffer total or substantial mortality (>50%), and where loss of structural function is predicted to occur.	**Zone of High Impact**	An area within which BPPH or the BPP communities that they support are predicted to suffer permanent impacts (not recoverable within 5yrs) as a result of direct or indirect impacts attributable to dredging or placement activities.
Zone of Partial Mortality	An area within which key receptors are predicted to suffer partial mortality (up to 50% loss close to the channel and <1% loss at the extremes). Mortality will occur within the area, but will not include all individuals. The outer border will be drawn so that no mortality will be predicted to occur immediately outside of this zone.	**Zone of Moderate Impact**	An area within which non-permanent impacts (recoverable within 5 yrs) are predicted to occur as a result of dredging or placement activities. In order to provide a quantifiable level of impact, this zone has been defined within the DSDMP as an area within which 70% of hard corals will remain unimpacted (up to 30% mortality of corals may occur). See Section 8.1.3 for supporting arguments.
Zone of	Outside the outer boundary of the Zone of Partial Mortality there may	**Zone of Influence**	Outside the outer boundary of the Zone of Partial

EIS/ERMP Definitions (as per GS29)		DSDMP Definitions (as per EAG3 and Draft EAG7)	
Zone	**Definition**	**Zone**	**Definition**
Influence	be influence from the dredge plume at low levels (for example sub-lethal impacts on key receptors, turbidity may be visible or very light sedimentation may occur) but this is predicted to be unlikely to have any material and/or measurable impact on the key receptors.		Mortality there may be influence from the dredge plume at low levels (for example sub-lethal impacts on key receptors, turbidity may be visible or very light sedimentation may occur) but this is predicted to be unlikely to have any material and/or measurable impact on the key receptors.
No Impact	Beyond the outer boundary of the Zone of Influence, there will be an unbounded area where there is no detectable influence on turbidity and sedimentation rates from the dredging. This area would be suitable for locating reference sites.	**No Impact**	Beyond the outer boundary of the Zone of Influence, there will be an unbounded area where there is no detectable influence on turbidity and sedimentation rates from the dredging. This area would be suitable for locating reference sites.

Differences between the definitions used within the EIS/ERMP and those adopted for the DSDMP include:
The Zone of Total Mortality included areas where 50% to 100% of hard corals were predicted to suffer mortality, whereas the corresponding Zone of High Impact includes areas where permanent (not recoverable within 5yrs) impacts are predicted to occur. For the purposes of this DSDMP, this definition includes areas where from 30% to 100% mortality of hard corals is predicted, or where permanent changes to the underlying habitat may occur. Taking this into consideration, Saladdin Shoal and End of Channel Shoal have now been included within this zone since there is a possibility that >30% mortality of corals will occur at these reefs.

The Zone of Partial Mortality included areas where <1% up to 50% of corals were predicted to suffer mortality, whereas the Zone of Moderate Impact includes an area where non-permanent impacts are predicted to occur (defined within the DSDMP as 70% of corals unimpacted, or conversely, up to 30% mortality of hard corals may occur). Based on a range of evidence from modelling predictions and outcomes from recent dredging projects, three reefs (Gorgon Patch, Hastings Reef and Paroo Shoal) have the potential to suffer some mortality that may be considered non-permanent. Therefore, these three reef areas have been included within the Zone of Moderate Impact.

7.4 Predicted Impacts from Dredging

HOLD BPPH Loss being recalculated

8.0 ENVIRONMENTAL MANAGEMENT

THE MANAGEMENT AND MITIGATION MEASURES PRESENTED WITHIN THIS SECTION ARE CONCEPTUAL AND ARE TO BE CONFIRMED BY THE PROJECT STAKEHOLDERS PRIOR TO THE DOCUMENT FINALISATION

8.1 Water Quality and Benthic Primary Producer Habitat Management

8.1.1 Background

8.1.1.1 Overview

Dredging and dredge material placement activities have the potential to affect water quality through the suspension of sediments which may increase turbidity, with the potential for subsequent impacts to receptors. Of particular concern is the potential impacts to Benthic Primary Producers (BPP) as a result of a reduction in light availability caused by elevated turbidity. Dredging and dredge material placement activities also have the potential to affect Benthic Primary Producer Habitat (BPPH) and BPP through the direct removal of habitat (such as the clearing of mangroves or removal of coral habitat) as well as the potential smothering of habitat by sediments suspended during dredging and dredge material placement activities.

Due to the links between monitoring and management of water quality BPPH, these elements are addressed together in this section.

Water quality will be monitored to assist with inferring the cause of any changes observed in coral health. Water quality may also provide an early warning of potential impacts to BPPH.

Key BPPH described within this section to be monitored and managed includes mangroves as well as subtidal BPPH and associated communities (using hard corals as a representative indicator of potential impacts to all subtidal BPPH).

8.1.2 Management of Subtidal BPPH

As described in **Section 6.5**, subtidal BPPH that may potentially be affected by the dredging and dredge material management activities includes habitat supporting hard corals, seagrass and macroalgae. Hard corals are considered to be the most sensitive to the impacts of excessive turbidity caused by the dredging and placement activities. Subsequently, hard corals will be monitored and managed as conservative indicators of any potential impacts to subtidal BPPH.

Potential impacts to seagrasses and macroalgae are considered temporary (EAG#3 definition: recoverable within 5 years; EPA 2009) since the dominant seagrasses and macroalgae within the proposed project area (e.g. *Halophila* spp. seagrasses and *Sargassum* spp. macroalgae) are species that have been reported to be highly variable in space and time. These characteristics do not lend these species to responsive monitoring and management, which calls for precision and confidence in the detection of change and the ability to infer the cause of that change. Instead, hard corals have been chosen as representative indicators of potential impacts to seagrasses and macroalgae since hard corals are believed to be generally more sensitive to impacts of elevated sedimentation and turbidity. In addition, hard coral communities are considered likely to be more through time in the Pilbara than macroalgae and seagrasses, which suggests these organisms can be monitored more easily for a responsive monitoring and management program.

While seagrasses and macroalgae will not be monitored directly for the purposes of responsive management, the potential for detection of permanent loss of these BPP that might be attributed to the effects of dredging or material placement will be assessed through an Impact Monitoring Program (described in **Section 9.6**) that will examine the areal extent of potential impacts using a before versus after, control versus impact design.

8.1.2.1 Outcome-Based Approach for Management of BPPH

Outcome-Based Conditions have been developed for BPPH, following the guidance of Environmental Assessment Guidelines #4 (EPA 2009a), to minimise impacts to BPPH during the proposed Wheatstone dredging and spoil disposal program. A summary of the four Outcome-Based Conditions relating to the management of BPPH are listed in **Section 8.1.3** and the full set of Outcome-Based Conditions are provided in **Appendix XX.**

<Hold – will be included when Conditions agreed and finalised.

Outcome–Based Conditions have been developed that are aimed at protecting the majority of BPPH within the proposed project area, recognising that some unavoidable impacts to BPPH are likely to occur within, and in close proximity to, the proposed dredging and material placement footprints (within the Zones of High Impact and Moderate Impact).

Outcome-Based Conditions have been developed to protect BPPH from dredging and dredge material placement impacts at all recognised ‘Important Reef Areas’ that are within or in close proximity to the influence of dredging or dredge material placement activities, including at Serrurier, Bessieres, Thevanard and Airlie Islands.

Outcome-Based Conditions have also been developed to protect all BPPH from dredging and disposal impacts within the Zone of Influence.

While, it is predicted by the modelling interrogations that some BPP within the Zone of Moderate Impact may suffer partial mortality, Conditions require that no permanent losses of BPPH occur within this Zone as per EAG#7 (EPA 2010).

8.1.2.2 Responsive Monitoring and Management Approach

A tiered, responsive monitoring and management approach will be implemented in order to minimise the likelihood that any potential impacts to BPPH (attributable to dredging and dredge material placement activities) will exceed the allowable limits described in the Outcome-Based Conditions (**Section 8.1.3**). The responsive monitoring and management approach will involve the collection of data on water quality and coral health. These data will be assessed against precautionary water quality early warning criteria and coral health management triggers.

An exceedance of water quality early warning criteria would prompt the prioritisation of coral health monitoring at sites where the exceedance(s) of water quality criteria occurred.

An exceedance of coral health management triggers would prompt the implementation of management measures to minimise the likelihood that impacts to BPPH will exceed the limits of allowable loss stated in the Outcome-Based Conditions.

Gross sedimentation rates will be monitored at all water quality and coral health monitoring sites to assist in the interpretation of potential impacts to BPPH (see **Section 9.3.3**). Gross sedimentation data will not, however, be formally assessed against management triggers for the following reasons:

i) Gross sedimentation data (collected using sediment traps) will only provide a relative, rather than absolute measure of potential impacts to corals. Sediment is likely to be deposited and removed regularly in the existing macro-tidal environment, hence it is net rather than gross sedimentation rates which determine the potential for impacts to occur.
ii) While net sedimentation would provide a better indication of potential impacts to corals, net sedimentation is not able to be measured accurately using existing technology and data could not be compared against management triggers.

Net sedimentation may be monitored adjacent to coral health monitoring sites using a simplified approach such as a graduated marker peg, against which measured changes in levels of sediment accumulation at any given time may be assessed. If this method proves to be reliable, these data may also be used to infer the cause of any changes in coral health that may be observed.

Water quality and coral health monitoring methods are described in **Section 9.3.** It should be noted that the proposed monitoring approach is relevant for the first 12 months of monitoring and management only, and may be refined using an adaptive approach at the end of this period following a review of all available data at that stage (see **Section 9.2**).

The assessment of water quality and coral health data against management trigger criteria differs among management zones and is outlined separately for each zone, below:

<u>Zone of High Impact</u>
It is predicted that hard corals within the Zone of High Impact will suffer up to 100% mortality due to either direct removal of substrate within the dredging or material placement footprints or smothering of BPPH and associated communities within close proximity (hundreds of metres) of these footprints. Therefore, no responsive BPPH management is proposed for the Zone of High Impact. However, following the requirements of Environmental Assessment Guideline No.3 (EPA 2009b) an assessment of BPPH is required prior to and following development activities to provide an estimate of the areal extent of BPPH loss that is attributable to the development.

In addition, water quality and coral health data will be collected from sites located within the Zone of High Impact, when possible, as well as from other zones, in order to develop predictive links between water quality and coral health (described in **Section 9.4**) to provide a better understanding of dredging impacts on BPPH. The relationships between water quality and coral health is poorly understood for this region. As such, water quality early warning criteria used to prompt more intensive monitoring of potential impacts of dredging and dredge material placement activities on coral health are based loosely on a combination of background data and published information. Predictive links monitoring during dredging and material placement serves to explore the relationship between predictable (or detectable) environmental variables and coral health. The relationship between water quality and coral health will be investigated during the dredging program and predictive relationships will be developed, where possible. This will be achieved through an ongoing analysis of water quality and coral health data from all responsive monitoring sites as well as additional sites located in areas where impacts are likely to occur (e.g. within the Zone of High Impact).

Zone of Moderate Impact

EAG 7 (EPA 2010) describes the Zone of Moderate Impact as having 'no permanent loss of BPPH' where a 'permanent' impact or loss is defined in EAG#3 (EPA 2009) as irreversible within a five year period. Following this definition, the Zone of Moderate Impact boundary has been drawn around areas where some impacts to corals are predicted, but no permanent loss of BPPH or associated communities is expected to occur. Subsequently, the Outcome-Based Condition for the Zone of Moderate Impact is 'no permanent impacts to BPPH that are attributable to dredging of the MOF and channel and placement of dredged material' (**Section 8.1.3** and **Appendix XX**). In order to provide a measureable target for the purposes of monitoring and management, this Outcome-Based Condition has been represented as 'no greater than 30% average net mortality of hard corals' within the Zone of Moderate Impact.

Extensive evidence of coral recovery following mass mortality at levels up to and exceeding 50% loss has been documented over a variety of areas (notably in the Persian Gulf: Burt *et al.* 2008 and the Great Barrier Reef: Diaz-Pulido *et al.* 2009). These studies found that the taxa most likely to be affected by bleaching events were also those fastest to recover. For example, recovery in *Acropora* species in the Persian Gulf was relatively rapid following the widespread bleaching events of the late 1990's (Burt *et al.* 2008), despite the fact that *Acropora* cover was virtually eliminated within one 38km^2 study area (Riegl 1999). On the Great Barrier Reef, *Acropora* recovered extremely rapidly following mass mortality, reaching pre-bleaching levels within 12 to 14 months. Within 6 months a 100 to 200% increase in cover of *Acropora* was recorded (Burt et al 2008) at the affected sites. Recovery was not a result of new recruitment, but a rapid regrowth/regeneration of surviving coral tissue.

There is also evidence that massive habitat building coral genera such as *Porites* are capable of rapid recovery following mortality due to sedimentation resulting from dredging operations. Brown et al. (1990) studied an intertidal reef flat in Phuket, Thailand where they reported as much as a 30 per cent reduction in living coral cover one year after the start of dredging. However, after the event the reef had recovered rapidly with coral cover values and diversity indices restored to former levels around 22 months after dredging began. While *Porites* spp. corals are not dominant at all monitoring sites, the example considered above is likely to represent a worst-case of what might happen following impacts to corals within the project area. Further support to this argument is that this area is one of the most cyclone prone regions in Australia (Chevron Australia 2010). Coral communities in the area are likely to experience regular mortality events during cyclones followed by recovery. Therefore, the current community structure is likely to be relatively young, with high natural turnover. A return to this type of community structure following impacts from dredging would be expected to be rapid.

The dominant hard coral genera within the Zone of Moderate Impact include *Acropora* and *Montipora* (MScience 2009a), which are relatively fast growing, highly fecund groups. Given the composition of coral communities present in the Zone of Moderate Impact and the extensive and patchily distributed coral cover in the area (promoting good connectivity and larval supply), it is considered that an Outcome-Based Condition of no impacts to 70% of hard coral communities (no greater than 30% average net partial mortality of hard corals) is representative of no permanent impacts (>5 years; EAG#3) to BPPH within the Zone of Moderate Impact. In addition, three precautionary management triggers (any net detectable hard coral mortality, 10% and 20% average net mortality of hard coral colonies) are proposed for the Zone of Moderate Impact, an exceedance of which would result in the implementation of increasing levels of monitoring and management to minimise the likelihood that the Outcome-Based Condition for the Zone of Moderate Impact of 'no permanent impacts to BPPH' is exceeded.

Monitoring of water quality and coral health will be undertaken on a frequent basis: fortnightly downloading of water quality data (collected at 30 minute intervals) and a fortnightly snapshot of coral health at three sites located within the Zone of Moderate Impact (**Figure 9-2**). Coral health data will be assessed against the management trigger criteria presented in **Table 8-1** following the procedure outlined in **Figure 8-2**. These trigger criteria correspond to precautionary levels of coral mortality that, if exceeded due to dredging or dredge material placement attributable impacts, would result in the implementation of monitoring and/or management measures that would minimise the likelihood that the Outcome-Based Condition for the Zone of Moderate Impact would be exceeded ('No permanent impacts to BPPH, represented by protection of at least 70% of hard corals within this zone).

Since water quality is predicted to decline enough to impact hard corals within this Zone with up to 30% average net mortality of hard corals), there are no useful water quality trigger criteria that could be applied within the Zone of Moderate Impact. Water quality data will be collected to interpret the causes (natural versus dredging-related) of any potential changes in coral health within this zone. The water quality data can also be used to assist with the development of predictive links between water quality and coral health.

Table 8-1: Zone of Moderate Impact Water Quality and Coral Health Trigger Criteria

Level 1	Level 2	Level 3
>Any average[1] net[2] detectable hard coral mortality attributable to dredging or dredge material placement	>10% average[1] net[2] coral mortality attributable to dredging or dredge material placement	>20% average[1] net[2] coral mortality attributable to dredging or dredge material placement

[1]Average refers to the average mortality of corals across all three sites within the Zone of Partial Mortality to avoid pseudo-replication.

[2]Net refers to the difference between levels of mortality recorded at sites within the Zone of Moderate Impact and comparable Reference Sites, to enable the differentiation of potential dredging impacts from natural variation.

Zone of Influence

Monitoring of water quality and coral health will be undertaken on a frequent basis (within the first year, fortnightly downloading of water quality data (collected at 30 minute intervals) and fortnightly collection of coral health data) at representative sites located within the Zone of Influence (**Figure 9-2**). Water quality and coral health data collected from sites within the Zone of Influence will be assessed against trigger criteria described in **Table 8-2** following the procedures outlined in **Figure 8-1** and **Figure 8-2**.

Water quality trigger criteria within the Zone of Influence (Level 1 Trigger) are based on the range of turbidity values (intensity, duration and frequency) experienced by BPP naturally. These will be established using data collected during the baseline period and trigger values will be finalised upon completion of the baseline water quality monitoring program (prior to the commencement of dredging activities). Preliminary water quality trigger criteria will be established prior to the commencement of dredging operations. However, it is likely that these criteria will need to be revised if further water quality and coral health data become available during the dredging program that allow predictive relationships between water quality and coral to be established, or if it is found that the initial criteria do not capture the natural range of baseline turbidity values and hence are being frequently exceeded due to natural turbidity events.

The Level 2 trigger criteria within the Zone of Influence is based on a precautionary level of sub-lethal change in coral health (>20% average net bleaching) prior to mortality being detected. A variety of stressors can result in the phenomenon referred to as 'coral bleaching' or the expulsion of photosynthetic endosymbionts from coral tissue, including thermal stress, deprivation of light and sedimentation (Jones et al 1998; Hoegh-Guldberg 1999, Anthony *et al.* 2007). There is usually a time-lag between bleaching and subsequent coral mortality, the timing of which is influenced by the intensity and duration of the stress (Glynn 1996; Anthony *et al.* 2007). High rates of heterotrophy, high levels of endogenous lipid reserves and rapid recovery of the endosymbiont populations are critical factors in the ongoing survival of the coral post-bleaching (Anthony *et al.* 2009).

Since bleaching is generally a precursor to coral mortality, an exceedance of the Level 2 trigger criteria would lead to the implementation of management measures that would minimise the likelihood of non-compliance with the Outcome-Based Condition of 'no average net detectable coral mortality'.

The Level 3 trigger criteria within the Zone of Influence corresponds to the allowable limits of the Outcome-Based Condition for this zone: 'no average net detectable coral mortality', an exceedance of which would result in a cessation of activities that led to the impact.

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Table 8-2: Zone of Influence Water Quality and Coral Health Trigger Criteria

Level 1	Level 2	Level 3
Exceedance of water quality criteria[1]	>20% average[2] net[3] coral bleaching attributable to dredging or dredge material placement activities	Average[2] net[3] detectable coral mortality attributable to dredging or dredge material placement activities

[1]Water quality criteria (turbidity) will be established prior to dredging using the full baseline water quality data set combined with existing information on coral tolerance thresholds to altered turbidity. Criteria will be established based on the intensity, duration and frequency (i-d-f) of turbidity values experienced during baseline conditions.
[2]Average refers to the average mortality of corals across a number of sites (at least 3) in areas where water quality exceedances have occurred.
[3]Net refers to the difference between levels of mortality recorded at the potential impact and reference sites, to enable differentiation of potential dredging impacts from natural variation.

Important Reef Areas

No impacts to water quality or BPPH are predicted to occur within 'Important Reef Areas' (Serrurier, Thevenard and Airlie Islands). These reef areas have been defined as 'important' due to their ecological, conservation or social value, as described within Section 6.3 of the EIS/ERMP (Chevron 2010).

No impacts to benthic habitats are predicted to occur at these Important Reef Areas as a result of dredging or material placement activities. Serrurier and Airlie Islands lie wholly outside the Zone of Influence, while Thevenard Island lies partly outside and partly within the Zone of Influence.

Monitoring sites will be established at these reefs and used primarily as Reference sites. However, this monitoring will also be used to maintain surveillance on any impacts that may occur as a result of dredging or material placement activities.

Coral health monitoring and downloading of water quality data (collected at 30 minute intervals) will be undertaken at these reefs on an infrequent basis (initially every 3 months) following methods outlined in **Section 9.3**. However, if turbid plumes associated with either dredging or material placement are observed to extend to these 'Important Reef Areas', as detected using daily satellite or aerial imagery or data from *in-situ* water quality loggers, the frequency of coral health monitoring and water quality data downloading will be increased to fortnightly in areas where the plume is observed to occur, in order to closely monitor any potential impacts to coral health, until such time as water quality returns to normal in these areas.

Sites at Thevenard and Serrurier Islands will also be used as Reference Sites in trigger assessments for a subset of potential impact sites within the Zone of Moderate Impact and Zone of Influence.

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8.1.3 BPPH and Water Quality Management Measures

Management Area:	**Management of Subtidal BPPH (Hard Coral)**

Performance Objective:

To comply with the draft Outcome-Based Condition XX as follows:

HOLD – Draft OBC pending finalisation

1. There will be no permanent[1] impacts to Benthic Primary Producer Habitat (BPPH) beyond the predicted boundary of the Zone of High Impact (shown in Figure XX) as a result of dredging of the MOF and channel[4] and placement of dredged material.
2. Within the predicted Zone of Moderate Impact (shown in Figure XX), there will be no permanent[1] impacts to BPPH (represented as no impacts to 70% of hard corals; see **Section 8.1.2.2** of DSDMP for supporting arguments) that are attributable to dredging of the MOF and channel[4] and placement of dredged material.
3. Within the predicted Zone of Influence (shown in **Figure X-X**), there will be no average[2] net[3] detectable[5] impacts to BPPH (represented as no average[2] net[3] detectable[5] mortality of hard corals) as a result of dredging of the MOF and channel[4] and placement of dredged material.

Notes:

1. *''Permanent' impacts to BPPH will be represented as net detectable impacts to hard coral BPP (as an indicator of other BPP types) and their underlying habitat that unlikely to recover within a period of 5 years (EPA 2009). These areas of permanent impact are likely to result from direct physical removal or smothering of habitat or indirect impacts through light reduction that would not allow recovery within a 5 year period from the cessation of marine construction activities. Whilst previous Ministerial Conditions have stipulated the allowable limits of BPPH loss as a hectare value, differences in methods used to map versus monitor changes in BPPH consistently yield different hectare values and each method has an inherent level of sampling error rendering the accurate assessment of compliance with this condition unworkable. To avoid the errors associated with estimating areas of loss, the Outcome-Based approach proposed for the Wheatstone Project stipulates a boundary based on spatial coordinates, beyond which no permanent impacts to BPPH are permitted. This boundary will be delineated on a map and corresponds to the outer limit of the predicted Zone of High Impact.*

2. *<Hold – Draft pending finalisation of OBC> 'Average' refers to the averaging of changes observed across a number of reefs to avoid pseudoreplication. When assessing data against management trigger levels, an estimate of the change in partial mortality of hard corals within the ZoMI will be based on an average recorded across reefs. For the Zone of Influence, levels of partial mortality and bleaching will be averaged across reefs where monitoring sites are established that lie within this zone.*

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3. *'Net' refers to the difference between changes in coral health recorded at impact sites minus the change observed over the same period at associated reference sites.*

4. *'MOF and Channel dredging program' do not include the proposed trunkline dredging program.*

5. *'Detectable' refers to the smallest ecologically significant effect size, based on the proposed monitoring method, level of replication and whether the observed change is greater than natural variation (as recorded during baseline studies and reported in published accounts within the Pilbara Region). An objective framework for determining the smallest ecologically significant effect size is described within Section 9.4.4 of the DSDMP.*

Management:

The water quality and BPPH management framework is described below and illustrated in **Figure 8-1** and **Figure 8-2**.

Overview

The management of water quality and associated potential impacts on sensitive BPPH will be managed via:

- Preventive management including:
  - General preventive management measures to be applied whenever practicable during the dredging and dredge material management activities.
- Responsive monitoring and management, including:
  - Continuous water quality monitoring within representative areas where hard coral communities occur.
  - Coral health monitoring within the Zone of Partial Loss, with an associated tiered management response.

Preventative Monitoring and Management

General Preventive Management

- TSHDs will be fitted with a turbidity reducing valve within the overflow pipe.
- Diffusers will be utilised during dredge material placement via the CSD. **[HOLD type of diffuser required]**
- Where reasonably practicable the works will be managed to optimise the under-keel clearance of the TSHD to reduce sediment re-suspension via propeller wash.
- During sediment transport by the TSHD and barges, the level of the overflow pipe will be raised to its highest point to ensure minimum spillage.
- Hopper doors on the TSHD and barges will be maintained to ensure minimum loss of sediment during transport.
- Well-maintained and properly calibrated dredging equipment will be utilised.
- Hopper dewatering will be confined to areas away from sensitive receptors where reasonably practical.
- A restriction of overflow from the TSHD should occur in the Restricted Overflow Areas (**Figure 8-3**) when sensitive receptors are at risk. The areas will vary depending on conditions and dredging operations.

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- Impacts on BPPH will be limited by limiting anchoring by construction vessels within established ‘no anchoring areas’.

A buffer of 0.5nm will be maintained around coral reefs to the east of the approach channel to limit stress associated with resuspension of sediment from propeller wash **Figure 8-5.**

Responsive Monitoring and Management Procedures

Responsive monitoring and associated tiered responsive management will be implemented to manage any potential impacts that increased turbidity may have on sensitive BPPH. Responsive monitoring will consist of (**Figure 8-1** and **Figure 8-2**):

- Water quality and coral health monitoring to be carried out throughout the dredging program and following completion of dredging.

A tiered management response program associated with water quality and coral health monitoring will include assessment of monitoring data against trigger criteria (as per **Figure 8-1** and **Figure 8-2**), with trigger criteria established to minimise impacts on BPPH (**Section 8.1.2**).

Water Quality Monitoring – Sensitive Receptors

Continuous (30 minute interval data collection) water quality monitoring will be undertaken at all coral health monitoring sites throughout the duration of the dredging and dredge material placement works. Continuous water quality monitoring will be achieved through the use of *in-situ* water quality data logging instruments which will be downloaded on a fortnightly to 3-monthly basis, depending on the location and objective of the monitoring site. Refer to **Section 9.3.2** for further details of the water quality monitoring program. The results of the water quality monitoring will be:

- Used to assist inferring the cause of any observed impacts to coral health..
- Used in the development of predictive relationships between water quality and coral health (**Section 9.4**).

Compared to water quality trigger levels within the Zone of Influence (**Section 9.3.2**), an exceedance of which would trigger a prioritisation of coral health monitoring during the next survey round at sites where water quality exceedance(s) occurred, following the procedure in **Figure 8-1.**

Coral Health Monitoring and Responsive Management

Coral health monitoring during the first year of the program will consist of (to be reviewed at the end of year one following the adaptive management process outlined in **Section 9.2**):

- Monitoring of coral health at 3 sites within the Zone of Moderate Impact on a fortnightly basis.
- Monitoring of coral health at 8 sites within the Zone of Influence, on a fortnightly basis.
- Monitoring of coral health at 3 sites within Important Reef Areas (Serrurier, Thevenard and Airlie Islands) on a less frequent basis (e.g. 3 monthly), increasing to fortnightly monitoring at site(s) where a detectable plume has been observed to extend to these areas.

  Monitoring of 8 reference sites (including the 3 Important Reef Area sites listed above) on an as-needs basis. Monitoring of coral health at reference sites may be required fortnightly in the event that trigger levels are approached or exceeded at potential impact sites, while less frequent monitoring (e.g. 3-monthly) may be sufficient if trigger levels are not being approached or exceeded, in which case data from previous months may be conservatively used in trigger assessments.

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Refer to **Section 9.3.4** for further details of the coral health monitoring program.

The coral health trigger levels that will be applied are provided in **Section 8.1.2.2**.

Potential Responsive Management Measures

The following measures will be considered for implementation in the event that any Level 1, 2 or 3 coral health management trigger is exceeded (as per **Section 8.1.2.2**). It should be noted that the selection of the most appropriate management measure will be made based on the impact observed, including its temporal and spatial scale, metocean conditions, and the planned future dredging operations. Management measures that may be considered include:

- Prioritise coral health monitoring in subsequent rounds at sites where exceedance(s) were detected.
- Increase the frequency of coral health monitoring at sites where exceedance(s) were detected if not already monitored fortnightly.
- Apply tidal or seasonal windows for dredging sections of the dredging area.
- Redefine the zones in the channel where overflow by the TSHD is allowed.
- Move dredging operation to another location or temporarily cease in dredging activities.
- Reduce or stop overflow.
- Reduce or modify the production of the CSD.
- Increase the minimum under keel clearance for the TSHD when dredging in areas where propeller wash is a significant source of turbidity.
- Optimise material placement based on met-ocean conditions and location of affected BPPH.
- Reduce operations.
- Temporarily cease discharge from the reclamation area.

Adaptive Monitoring and Management Approach

The responsive monitoring and management detailed in Sections 8.1 and 8.2 will form the approach taken during the first 12 months of the dredging campaign. However, since the dredge program is expected to occur over a 4-year period and the location of the dredging and material placement plumes are predicted to vary considerably, both seasonally and with changing dredging locations, the optimum approach to monitoring and management of the Wheatstone dredging program would be one that is adaptive, allowing for new evidence to be incorporated into the design of the program as it is gathered.

An adaptive management approach is to be used for the Wheatstone BPPH monitoring and management and is detailed in **Section 9.1**. This approach entails the implementation of a relatively comprehensive monitoring program during the first 12 months of the Wheatstone dredging program, including a wide spatial coverage and high frequency of monitoring, to provide confidence that potential impacts will not go undetected.

During the first 12 months of dredging, data gathered will be reviewed and the responsive monitoring and management program will refined if appropriate, following the procedures outlined in **Section 9.1** and in consultation with regulators. Refinement to the monitoring program will include consideration that chronic impacts may not yet have manifested and that any changes to the program design will need to be able to detect such

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	impacts. Throughout the dredging program, data will be regularly reviewed and further refinements to the responsive monitoring and management program will be made if required in consultation with regulators.
Monitoring:	♦ Responsive Monitoring (**Section 9.3**) ♦ Predictive Links Monitoring (**Section 9.4**) ♦ Impact Monitoring (**Section 9.5**)
Reporting:	♦ Monthly Monitoring Reports to the DEC (**Section 10**)
Risk Assessment	♦ Refer to **Appendix A** for the Risk Assessment Table. The Residual Risk rating for impacts on BPPH from the indirect impacts of the dredging and dredge material management activities is high.

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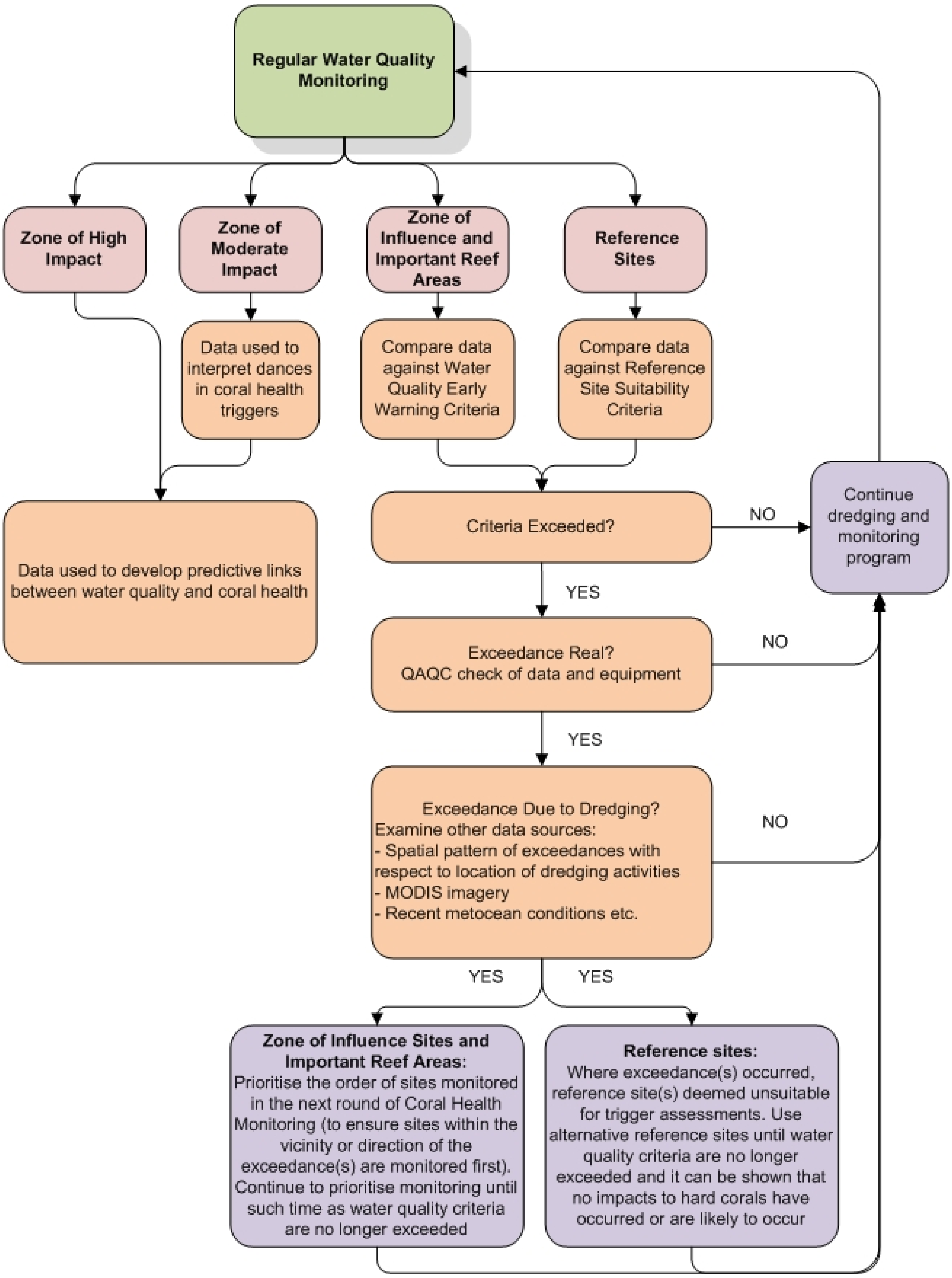

Figure 8-1: Water Quality Monitoring and Management Procedure. Note: Water Quality Early Warning Criteria will be finalised prior to dredging and will be based on the upper percentile of intensity-duration-frequencies of baseline data.

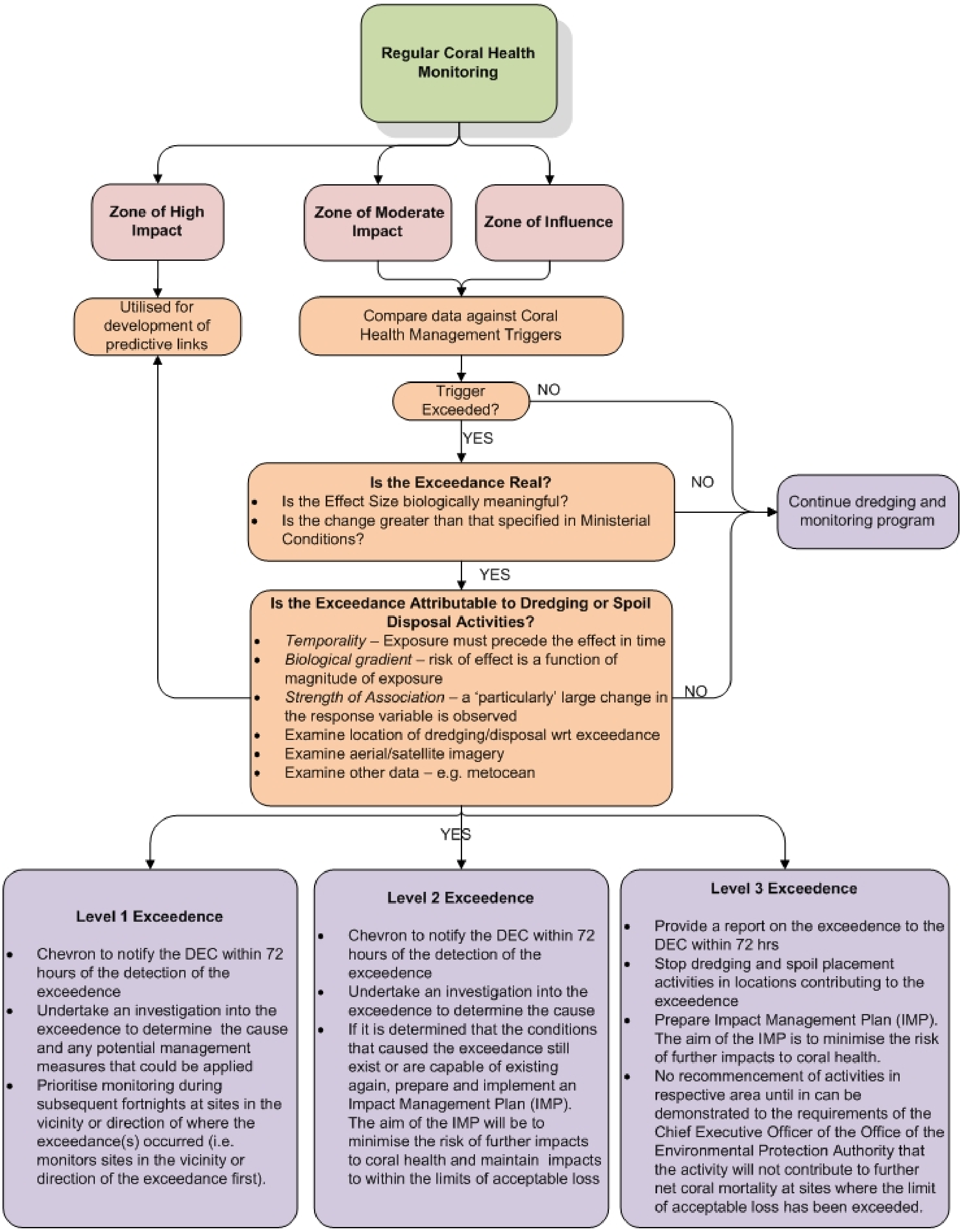

Figure 8-2: Coral Health Monitoring and Management Procedure

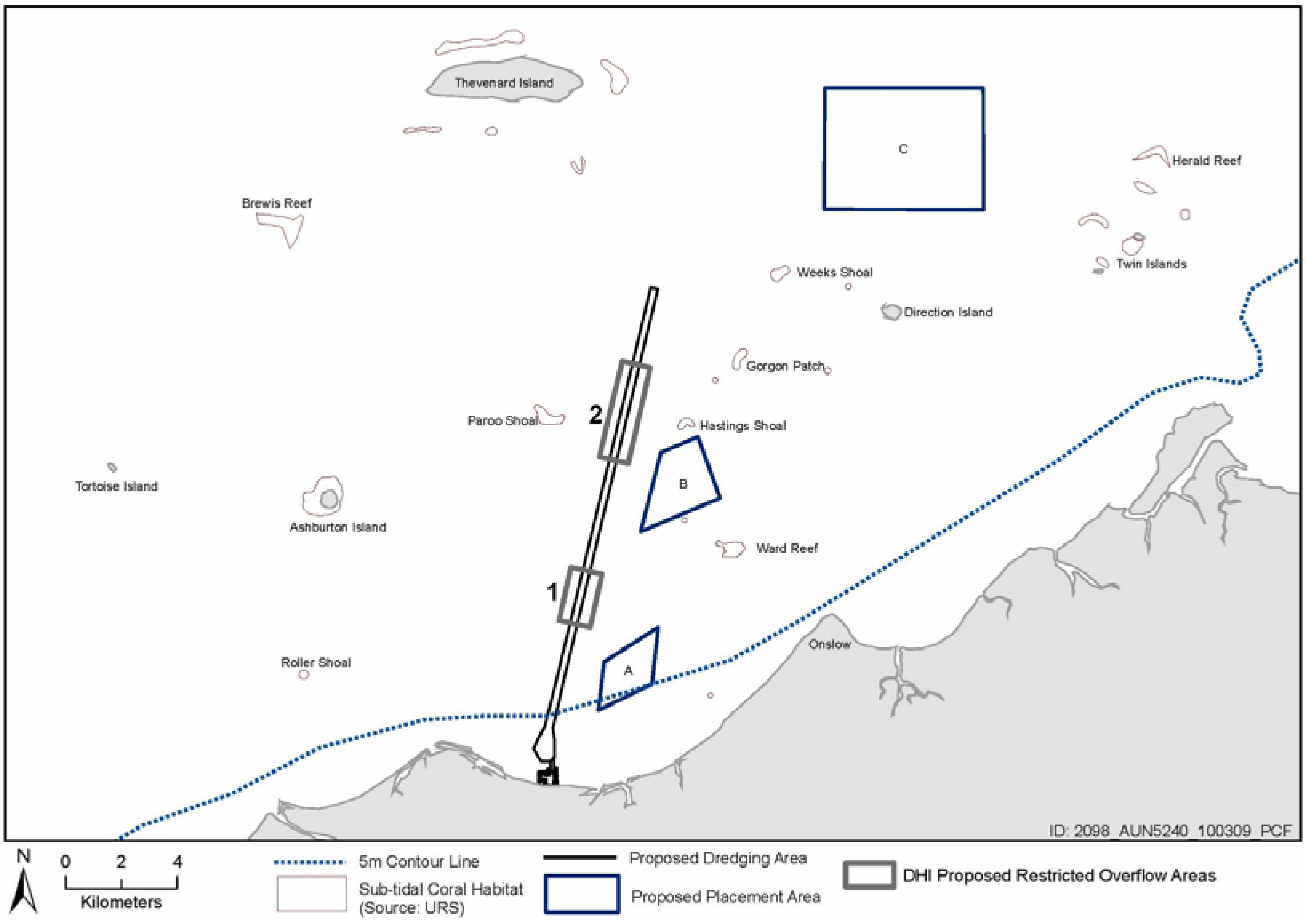

Figure 8-3: Trailing Suction Hopper Dredge (TSHD) Restricted Overflow Areas.

Figure is an example only as the areas will be moveable up and down the channel based on environmental conditions and dredging activities. Area 1: this restricted overflow area is required to protect Ward Reef during summer, and Roller Shoal during winter, though it could possibly be relaxed during the calm transitional periods. Area 2: this restricted overflow area is required to protect Hastings Shoal, Gorgon Patch and Weeks Shoal (and to a lesser extent Direction Island) during summer, and Paroo Shoal during winter and calm transitional periods.

8.2 Marine Fauna Management

8.2.1 Background

8.2.1.1 Marine Mammals

Refer to **Section 6.5.2.3** for details on marine mammals that may be present within the Project Area. The management of marine mammals will focus on the species most likely to be sighted (whales, particularly humpback whales, and dugongs) and will primarily involve observation and avoidance measures to minimise the risk of vessel interaction with both whales and dugongs. Note that with respect to dolphins, while their mobility and intelligence means the risk of impact is negligible interactions will be managed in accordance with the requirements for cetacean interactions specified under Part 8 of the EPBC Regulations 2000 (Cth)

8.2.1.2 Marine Turtles

Refer to **Section 6.5.2.2** for details on turtle species that may be present within the Project Area. The management of marine turtles will primarily involve measures to minimise the risk of entrapment/entrainment of the marine turtles within the dragheads of the TSHD.

8.2.2 Management: Whales, Dolphins, Dugongs and Marine Turtles

Management Area:	Marine Fauna Management (Whales, Dolphins, Dugongs and Marine Turtles)
Performance Objective:	To comply with Outcome based Ministerial Condition XX as follows: *“The Proponent will manage its dredging activities during the construction phase of the Project to reduce, as far as reasonably practicable, Project-attributable impacts on marine fauna.* *The Proponent will manage its construction and operational workforce to reduce, as far as reasonably practicable, potential impacts on marine fauna associated with workforce recreational activities.”*
Management:	Impacts to marine fauna (whales, dolphins dugongs and marine turtles) from increased turbidity and sedimentation (e.g. direct behavioural impacts or indirect impacts through alteration of foraging habitats) are managed via **Section 8.2**. ♦ Prior to commencement of dredging and dredge material placement, selected crew will receive training in marine fauna observations, including procedures in the event of injury or death. ♦ Personnel trained in marine fauna observations will be used to monitor key activities. ♦ All Project vessels will keep a log of observed in-water incidents or reporting’s of injured/dead marine fauna. ♦ Any deaths of marine fauna listed under Section 14(2)(ba) of the *Wildlife Conservation Act (1950)* will be reported to the DEC. <u>Striking impact on Whales, Dolphins and Dugongs</u> ♦ Whale and dugong observations and response procedures including application of 300 m observation zone and 100 m exclusion zone will be implemented during dredging and dredge material placement works as outlined in **Figure 8-4.** If calves are present the exclusion zone will be extended to 300 m. ♦ Dolphin observations and response procedures including application of 100 m observation zone will be implemented during dredging and dredge material placement works as outlined in **Figure 8-4.**

	♦ The presence of cetaceans/dugongs in or near exclusion zones established for key dredging and construction activities will be recorded. ♦ All sightings of whales, dolphins or dugongs that result in management measure being implemented will be recorded. ♦ A trained crew member will maintain a watch, during daylight hours, for whales, dolphins and dugongs while any dredge is on route to and from the dredge area to dredge material placement sites. If sighted, direction/speed will be adjusted to avoid impact (within the safety constraints of the vessel). ♦ A trained crew member will maintain a watch, during daylight hours, for whales, dolphins and dugongs during dredge operations. ♦ Designated transit corridors have been established for dredge vessels transiting to Placement Site C to minimise the disturbance to marine fauna (**Figure 8-5)** ♦ Management of cetacean interactions will be in accordance with the requirements for cetacean interactions specified under Part 8 of the EPBC Regulations 2000 (Cth) and the Australian National Guidelines for Whale and Dolphin Watching. Entrainment impacts on Marine Turtles ♦ When operating with less than 5 m under-keel clearance, the dredge will initially move slowly through the area before commencing dredging so that the noise and vibration alerts marine turtles in the vicinity and encourages them to leave. This will only be applied on dredging in new areas and not once the work area has been established. ♦ Dredge pumps will be stopped as soon as practicably possible after completion of dredging and where practical the draghead will remain within 0.5 m of the seabed until the dredge pump is stopped. ♦ When initiating dredging, suction through dragheads will be initiated just long enough to prime the pumps, prior to drag heads engaging the seabed. ♦ Tickler chains on the draghead of the THSD will be used as a management mitigation approach to reduce turtle entrainment, where safety and logistical constraints permit. ♦ Overflow screens will be used on TSHDs to visually assess for turtles and turtle remains associated with entrainment during dredging. ♦ A framework has been developed to limit the risk of turtle entrainment (**Appendix B**) Lighting impacts on Marine Turtles ♦ Mooring at night will not take place at night during Nov-April, the turtle nesting season, within 1.5 km of nesting beaches (See **Figure 8-6)**. Workforce recreational impacts on Marine Turtles ♦ The Proponent will provide marine fauna aerial sighting data (as presented in the EIS/ERMP) for DEC planning purposes in the Onslow region ♦ Boats and recreational vehicles will not be permitted within the workforce accommodation village or the access road from the Onslow Road ♦ Conservation and induction programs will be established to ensure staff/contractors are informed of DEC rules relating to offshore nature reserves.
Monitoring:	♦ Water quality monitoring (**Section 9.3.2**). ♦ Whale, dolphin, dugong and marine turtle observations throughout the works. ♦ Monitoring of draghead and overflow screens to identify turtle fatalities.

Reporting:	♦ Whale, dolphin, dugong and marine turtle sightings resulting in management measures being implemented will be recorded. ♦ Marine mammal injury or mortality incidents will be reported to the DEC and DSEWPaC.
Risk Assessment :	Refer to **Appendix A**. The Residual Risk rating for impacts on marine fauna is Low.

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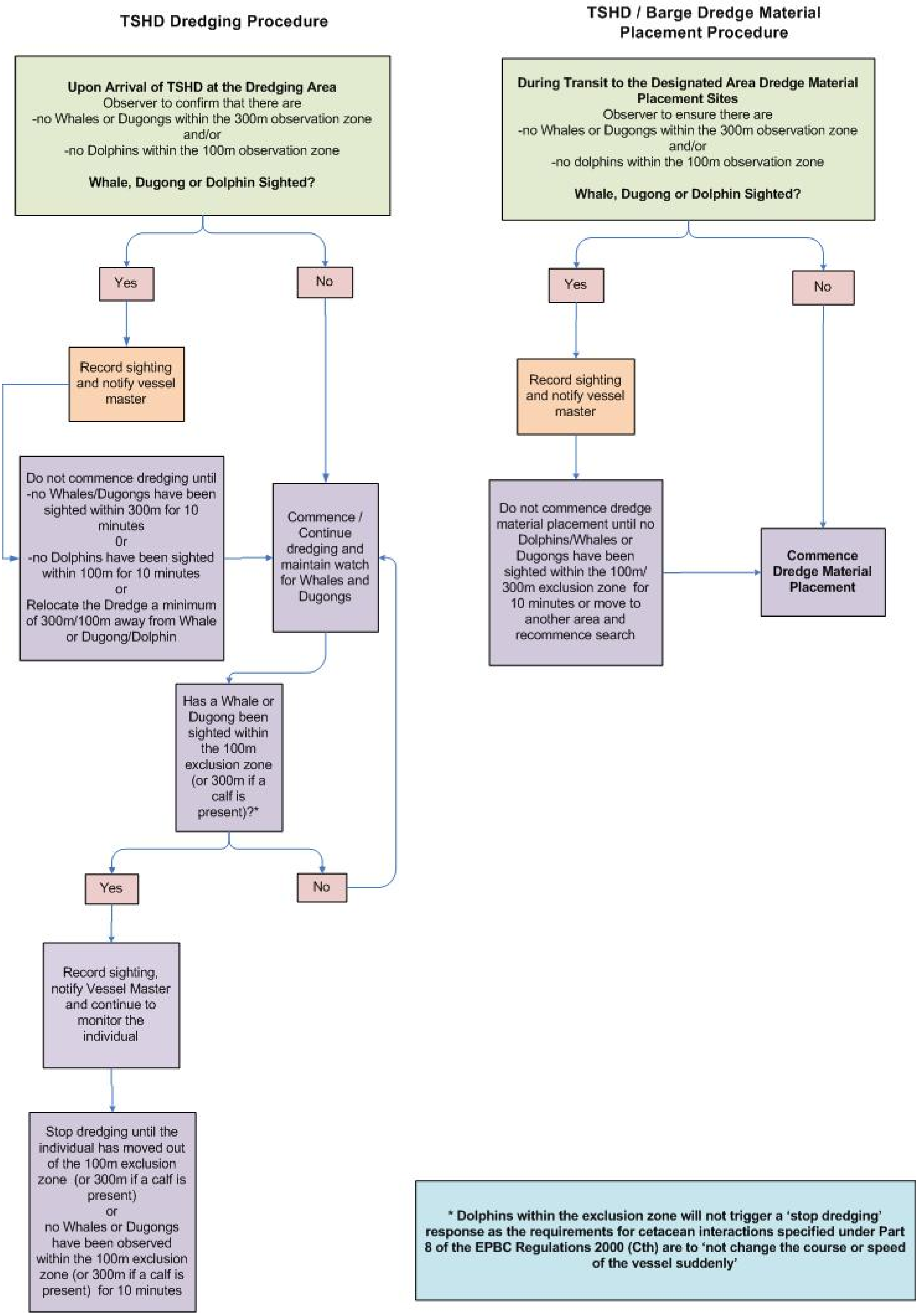

Figure 8-4: Whale, Dolphin and Dugong Interaction Procedures

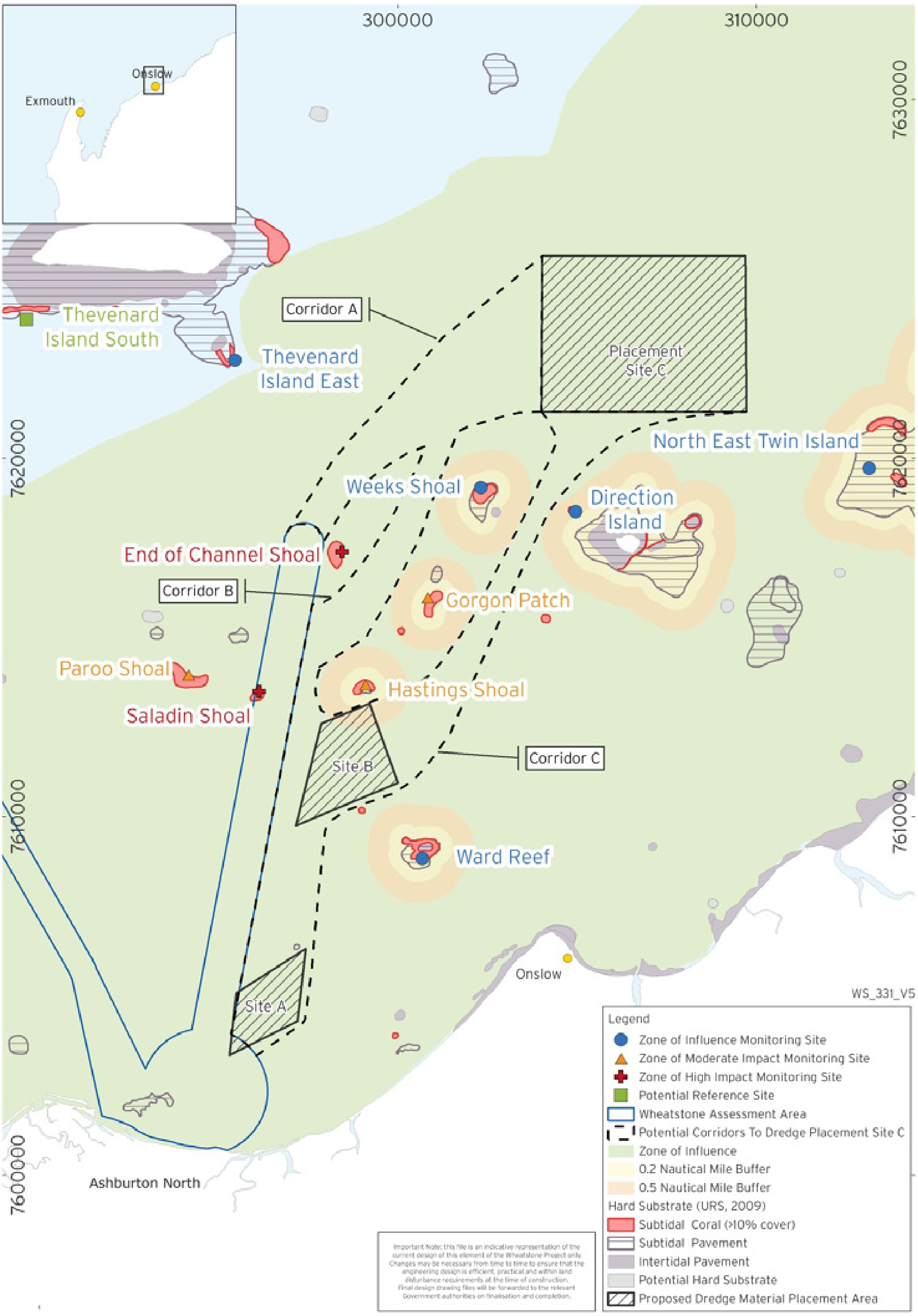

Figure 8-5: Designated transit routes to Placement Site C.

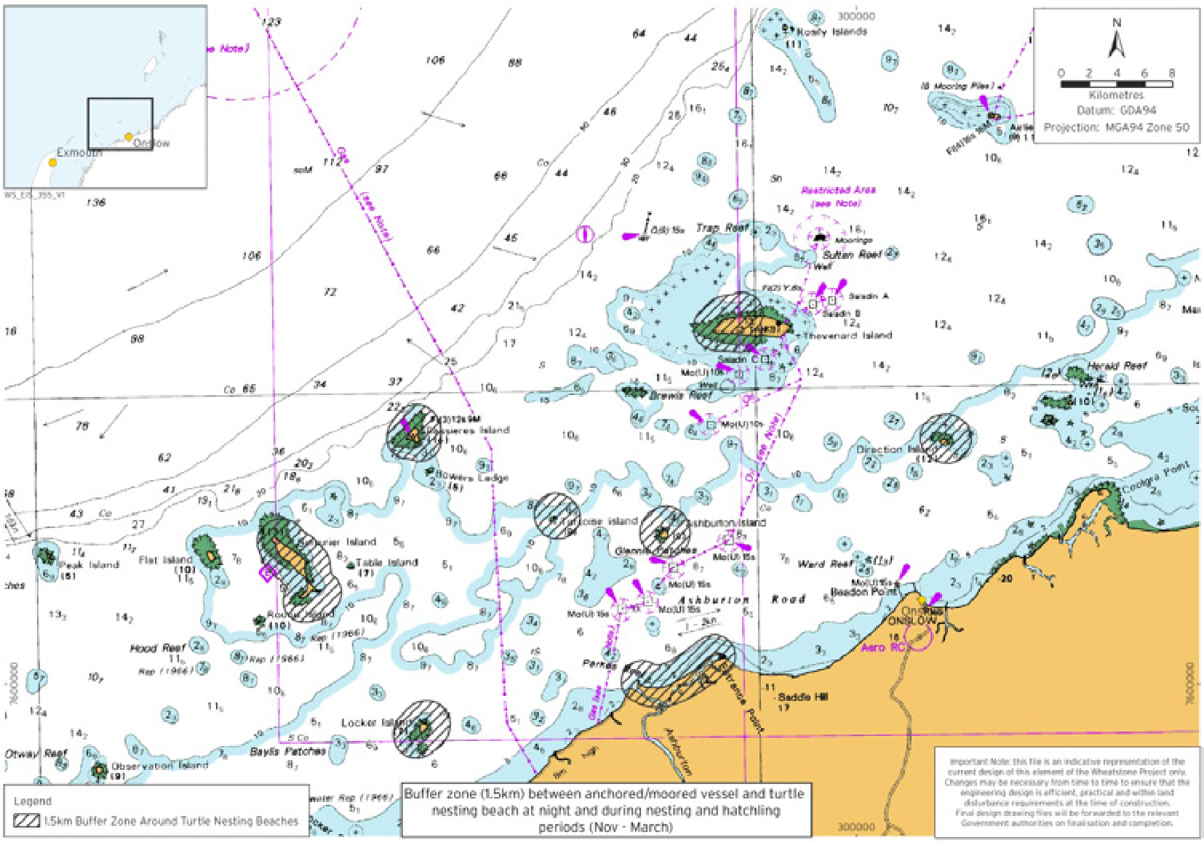

Figure 8-6: Anchoring exclusion zones (lighted vessels) during turtle nesting and hatching season.

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8.3 Introduced Marine Pest Management

8.3.1 Background

Introduced marine pests are biota that are translocated into water outside of their natural distribution ranges, settle and survive in the new area and subsequently form a component of the habitat into which they spread and compete for space and resources with naturally occurring species.

As construction vessels are generally mobilised to Western Australian dredging projects from areas outside of the applicable bioregion, they present a key risk pathway as a vector for the introduction of marine pests. Common high risk niche areas capable of translocating invasive marine species on dredge vessels and dredge associated vessels include:

- ballast tanks
- vessel hull and external niches (e.g. propellers, thrusters)
- internal seawater systems(e.g. seachests and seawater strainers)
- immersible equipment including dredge equipment (trailing pipes, dragheads and anchors) and
- ballast water and sediments.

8.3.2 Management: Introduced Marine Pests

Management Area:	**Introduced Marine Pests (IMP) Management**
Performance	To comply with Outcome Based Ministerial Condition XX as follows:

Objective:	"*The proponent will manage the dredging and dredge material management works so as to prevent the introduction to and establishment of marine pests in the waters adjacent to the proposal'*
Management:	Mobilisation Procedure The primary focus for the management of introduced marine pests (IMP) will be to reduce the risk of IMP introduction by construction vessels prior to their mobilisation to the project. To achieve this, the construction vessel mobilisation procedure, where reasonably practicable, shall be implemented as follows: ♦ All construction vessels will be subjected to a risk assessment to determine if the vessel presents a low, uncertain or high risk vector for IMP. The risk assessment will be based on the vessel's origin, recent history and vessel maintenance since the previous fouling control coating application (FCC) and whether it will be undertaking a direct sail from its point of origin. ♦ All construction vessels determined to be uncertain or high risk will be subjected to a pre-mobilisation inspection and will not be mobilised until the vessel is assessed as being a low risk. In the event that IMP are identified on the vessel during the pre-mobilisation inspection, the vessel will undergo treatment and re-inspection to the satisfaction of the DoF. ♦ Those vessels which do not mobilise immediately and directly to the operational area may be subject to additional risk assessments and management requirements which may include arrival inspection within 48 hours of arrival on site . ♦ Vessel inspections will be undertaken as detailed in **Section 9.8.** ♦ The Revised Coordinating Committee for Introduced Marine Pest Emergencies (CCIMPE) Trigger List (2006) will be used as the basis for the identification of an invasive marine species. However, inspection and management response may be undertaken with respect to unlisted species. ♦ All dredges will comply with the Australian Quarantine regulations 2000 and will comply with the AQIS mandatory ballast water requirements. Contingency Management In the event that IMP are identified on the construction vessel during the arrival inspection or at any time while the construction vessel is on site: ♦ The DoF and DEC will be notified. ♦ The construction vessel will be moved offshore as soon as practicably possible. Within vessel operating constraints, the construction vessel should be moved to offshore waters greater than 12 nm/50 m depth. ♦ The construction vessel will not be permitted to return to site until it has undergone treatment and re-inspection to confirm that the vessel is a low risk. The mobilisation procedure described above will be required to be followed including a mandatory arrival inspection with 48 hours of arrival on site. ♦ A detailed response plan including monitoring and control measures will be developed and implemented. This plan will aim to determine if the identified species has become established and if measures to control the species are required.
Monitoring:	♦ Pre-mobilisation and arrival IMP inspections as required (**Section 9.8**). ♦ Monitoring program to determine establishment of IMP to be developed in the event that invasive marine pests are identified during construction vessel inspections.
Reporting:	Specific details of the requirements of these reports are included in **Section 8.0** of the EIS/ERMP.

	♦ Construction vessel risk assessment provided to DoF/DEC prior to mobilisation of vessel. ♦ Vessel inspection checklist provided to DoF/DEC of any construction vessel inspection. ♦ Pre-mobilisation "Assessment Report" for all construction vessels, including results of risk assessment, vessel history and IMP inspection results to the DoF/DEC. ♦ Incident report to be provided to the DoF/DEC in the event that IMP are identified on a construction vessel within Western Australian State Waters. ♦ Report requirements associated with the IMP response plan will be determined.
Risk Assessment :	*Pending Risk Assessment Finalisation*

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8.4 Dredge Material Placement Area Management

8.4.1 Background

The nearshore and offshore dredge material placement areas that will be utilised are shown in **Figure 4-3**. T

The requirements with respect to the management of the dredge material placement area and offshore dredge material placement activities will be specified in the Sea Dumping Permit (SDP).

8.4.2 Management: Dredge Material Placement Area

Management Area:	**Dredge Material Placement Area Management**
Performance Objective:	To undertake the dredging and dredge material management activities in accordance with the requirements of the SDP.

Management:	Compliance with the requirements of SDP including:
	♦ Establish by Differential Global Positioning System (DGPS) that immediately prior to dredge material placement, the vessel is within the approved dredge material placement area.
	♦ Any dredge used in connection with the dredge material placement activities and any associated towing vessels must comply with the relevant state, national or international standards with respect to seaworthiness, safety and environmental requirements, or any rules or conditions laid down by the certifying classification society, and be capable of disposing dredged material at the dredge material placement locations in accordance with the SDP.
	♦ Marine mammal management procedures as detailed in **Section 8.2** will be followed during dredge material placement activities.
	♦ Records comprising either weekly plotting sheets or a certified extract of the ship's log will be retained (for verification and auditing purpose), which detail:
	  ♦ The times and dates of when each dredge material placement run is commenced and finished.
	  ♦ The position (as determined by DGPS) of the vessel at the beginning and end of each dredge material placement run, with the inclusion of the path of each dredge material placement run.
	  ♦ The volume of dredge material (in cubic metres) moved to the placement area and quantity in dry tonnes for the specified operational period. These quantities will be compared with the total amount permitted under the SDP.

Monitoring:	A bathymetric survey of the dredge material placement areas will be undertaken: ♦ Prior to the commencement of dredging. ♦ Within two months of the completion of all dredge material placement activities authorised under the SDP.
Reporting:	♦ Within two months of the final bathymetric survey a digital copy of each of the bathymetric surveys will be provided to the Royal Australian Navy hydrographer. ♦ To facilitate annual reporting to the International Maritime Organisation (IMO), the proponent will report to the DSEWPaC by 31st January each

	year, including on the day of the expiry of the SDP or completion of all dredging under the SDP, information as specified in Schedule 2 of the SDP.
Risk Assessment:	Not applicable

8.5 Waste Management

8.5.1 Background

The unintentional or uncontrolled release of waste material (solid, liquid, hazardous and sewage wastes) can adversely impact on the marine environment. The discharge of wastes into the marine environment is regulated by the *Protection of the Sea* (*Prevention of Pollution from Ships) Act 1983 (*Cth) which is based on the MARPOL 73/78 Convention Annex IV (sewage) and Annex V (Garbage) to which Australia is a signatory.

The management of wastes will be undertaken in accordance with the Wheatstone Project Waste Management Plan (WMP).

8.5.2 Management: Waste Management

Management Area:	**Waste Management**
Performance Objective:	Minimise the risk of impact on the marine environment as a result of waste materials generated by the dredging and dredge material management activities
Management:	♦ Implementation of Wheatstone Project WMP. ♦ Adherence to the requirements of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (*Cth*)* and MARPOL 73/78 Convention Annex IV (sewage) and Annex V (Garbage).
Monitoring:	Not Applicable.
Reporting:	As per the Wheatstone Project WMP.
Risk Assessment:	Refer to **Appendix A** for the Risk Assessment Table. The Residual Risk rating for impacts of waste from the dredging and dredge material management activities is Low.

8.6 Hydrocarbon Management

8.6.1 Background

The operation of vessels engaged in the dredge program and in support of the program requires adherence to a number of standards in relation to effective minimisation of the risk of hydrocarbon spills and the mitigation of spills into the marine environment.

Hydrocarbons (including diesel fuel, hydraulic oils, engine oils, greases and lubricants) are used and handled everyday during the dredging operations. The accidental release of these substances presents a potential risk to the environment. The main potential sources of release of hydrocarbons into the marine environment are:

- grease
- diesel spills during refuelling (bunkering)
- hydraulic oil spills due to equipment failure (e.g. burst hydraulic hose)
- incorrect storage and handling of hydrocarbons
- release of oily bilge waters
- contaminated deck wash.

8.6.2 Management: Hydrocarbons

Management Area:	**Hydrocarbon Management**
Performance Objective:	Minimise the risk of impacts to the marine environment as a result of accidental spills of hydrocarbons from dredging and support vessels.

Management:	♦ Hazardous material storage areas will be designed to handle the volumes and operating conditions specifically required for each substance, including product identification, transportation, storage, control and loss prevention (e.g. bunding and drainage).
	♦ Industry standards, port authority and pollution prevention regulations will be adhered to during refuelling, transfer, storage and handling of hazardous materials (e.g. bunding, level gauges, overflow protection, drainage systems and hardstands).
	♦ Hazardous materials (including hazardous waste) will be stored in appropriately labelled drums or tanks. Complete up to date list of MSDSs will be available and stored with relevant products.
	♦ The hydraulic oil system will be of a high quality, well maintained and regularly inspected.
	♦ The main hydraulic system on each dredging vessel will be equipped with standard low pressure alarms and shut down systems to minimise hydrocarbon loss in the event of a burst hydraulic hose.
	♦ Detailed refuelling procedures will be developed by the dredge contractor prior to commencement of work on site and will include the following requirements:
	  ♦ Fuel transfer to occur in accordance with port authority and pollution regulations;
	  ♦ Specific safety boundaries used when refuelling;
	  ♦ Requirement of refuelling to be undertaken in fair weather conditions to reduce risk of spills;
	  ♦ Requirement for open communication channels to be maintained during refuelling;
	  ♦ Instructions for visual monitoring; and
	  ♦ Emergency response procedures.
	♦ Personnel involved with refuelling or fuel transfer will be trained in their roles, functions and responsibility, including emergency response prior to

	engaging in refuelling or fuel transfer.
	♦ All vessels greater than 400 gross tonnage will have bilge oil/water separators that comply with the requirements of Annex I of MARPOL 73/78 and Part II of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1993* (Cth) to ensure that oil concentrations in discharges are less than 15 ppm.
	♦ Drainage from decks and work areas with potential for oil, grease or hydrocarbon contamination will be collected and processed through an oil/water separator and managed according to International Oil Pollution Prevention (IOPP) procedures prior to discharge or stored for onshore placement.
	♦ Sufficient and appropriate equipment, materials and resources will be available to:
	  ♦ prevent spills to marine environment from working machinery (e.g. spill trays, one-way valves or other spill prevention features);
	  ♦ respond to spills to the marine environment; and
	  ♦ respond to spills to ground (on board vessels).
	♦ The dredge contractor will comply with and align spill response preparedness with the Chevron Oil Spill Contingency Plan (OSCP).
	♦ All relevant personnel will be trained in spill response and reporting.
	♦ All vessels will have a current International Oil Pollution Prevention Certificate (IOPP) issued by the State in which the vessel is registered and an approved Shipboard Oil Pollution Emergency Plan (SOPEP).
	♦ If vessel does not have an existing approved SOPEP the vessel will prepare a vessel specific Spill Contingency Plan (SCP) that bridges to the Chevron OSCP to ensure an effective, integrated response to any spill.
	♦ Onboard spills will be contained and cleaned up immediately and will not be washed overboard. Product MSDSs will be adhered to during clean-up.

Monitoring:	♦ Audits of each vessel hydrocarbon handling procedures and equipment including spill kits will be undertaken on a regular ongoing basis.
Reporting:	♦ Spills will be documented and reported in accordance with the Chevron Incident Reporting Procedure.
Risk Assessment:	Refer to **Appendix A** for the risk assessment table.

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9.0 MONITORING AND INSPECTION PROGRAMS

9.1 Overview

There are three Monitoring programs and one inspection program comprising:

- Responsive monitoring;
- Predictive links monitoring;
- Impact monitoring; and
- Introduced marine pest inspections.

A responsive monitoring program will be used to monitor and manage potential impacts of dredging and dredge material placement activities on water quality and BPPH health. This program will use the health of corals as an indicator for the health of subtidal BPPH. The program will consist of data collection on water quality (NTU, temperature) and the health of hard corals (percent live tissue, percent bleached) to be assessed against management trigger criteria. Any exceedance of trigger criteria would prompt the implementation of further monitoring and/or management measures to minimise the likelihood of non-compliance with BPPH Outcome-Based Conditions.

Mangrove monitoring will be undertaken to examine potential impacts of construction activities, as per the CEMP.

Predictive links assessments will be undertaken to assist in the development of the relationships between water quality and coral health and to enable, where possible, a refinement of water quality early warning criteria.

BPPH Impact Monitoring will be undertaken to investigate whether permanent losses of BPPH that can be attributed to dredging and dredge material placement activities are within the boundary of the Zone of High Impact (as per Outcome-Based Condition X.X, **Appendix X.X** and shown in **Figure X.X**

<Hold- to be updated pending finalisation of the OBC >

This monitoring will consist of an assessment of subtidal (including hard coral BPPH) and intertidal (including mangroves) BPPH. Subtidal Impact monitoring will also assess the nature of these losses, where possible, in terms of changes to BPP communities and underlying habitat and the potential for recovery of any changes that extend beyond approved boundaries.

9.2 Adaptive Monitoring Approach

The proposed Wheatstone capital dredging and dredge material placement program will continue for up to four years. The proposed program will involve dredging and dredge material placement activities that, at times, will occur within discrete areas of the proposed activity footprints, with associated discrete predicted impacts to water quality and receptors (refer to **Figure 7-1** to **Figure 7-3**). For example, in the first year, dredging will be largely restricted to nearshore waters. Consequently, the plumes generated during the first year are predicted to be limited to a relatively narrow band of shallow water extending only a few kilometres seaward from the coast (**Figure 7-1**). In the second, third and fourth years, dredging activity will move further offshore and the associated plumes are predicted to extend further northeast and southwest from dredging activities, but are not predicted to extend into inshore waters where the plumes during the first year are predicted to be confined.

The Wheatstone monitoring programs are designed to adapt to the changing scope of dredging and dredge material placement activities throughout the four year program. An adaptive framework allows monitoring to be focused at the most relevant locations to enable the detection and minimisation of impacts to receptors that may result from the dredging scope being undertaken at the time.

In any dredging program, to counter the potential for underestimation of impact, the setting of thresholds and the modelling of sediment transport and behaviour tends to be very conservative. While the conservative impact predictions used typically overestimate the losses there still is some potential for underestimation because the information prior to dredging is always imperfect. The time span for completion of dredging is four years, and consequently there is also the likelihood of natural impacts on receptors as a consequence of weather events. There may be changes to the dredging scope and schedule. New techniques for monitoring the health of receptors may appear. The factors which could require an adaptation of one or more of the monitoring programs include:

- Potential inaccuracies in sediment plume modelling inputs and outputs.
- Incomplete understanding of the response of receptors to elevated sedimentation and turbidity loads.
- Potential for over-prediction of impacts resulting from overly conservative modelling and thresholds.
- Potential requirement for flexibility in the dredging program due to the long duration.
- High potential for extreme weather events (e.g. cyclones) during a four year program which may alter the dredging program schedules, receptor health and their response to dredging impacts.
- Development or refinement of monitoring techniques throughout the 4-year period (e.g. diverless methods, more powerful sampling techniques).

The optimum approach to monitoring and management of the Wheatstone dredging program is therefore an approach that allows for new evidence to be incorporated into the design of the relevant program(s) as it is gathered (**Figure 9-1**).

Any refinement to the design of the monitoring programs will include a consideration that chronic stresses to receptors may not yet have manifested as realised impacts. Data on the chronic nature of impacts (such as prolonged sub-lethal stresses or gradual decline in environmental conditions) will be examined and considered to determine whether all potential chronic impacts will be adequately detected using the revised monitoring programs.

Prior to the commencement of dredging, and during the initial stages, there is insufficient evidence available to allow for a narrow focus in monitoring effort for each of the programs. Therefore, as a precautionary measure, during the initial stages of dredging, each of the monitoring programs is designed to provide a comprehensive coverage of sensitive receptors. This provides confidence that potential impacts will not go undetected and allows for a comprehensive data set to be gathered on a range of environmental and dredging-related parameters in order to inform any future adaptive changes to each of the monitoring programs.

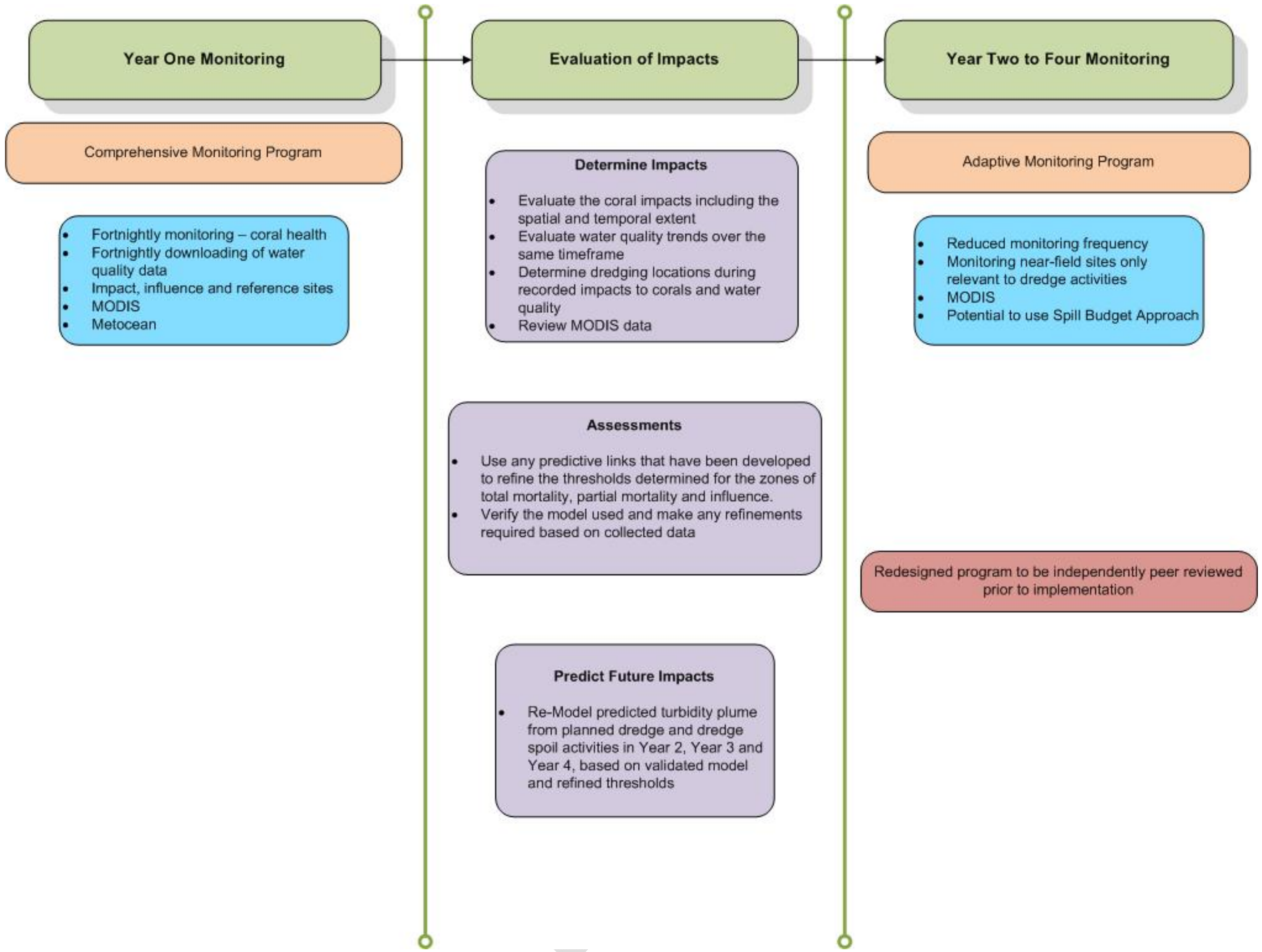

Figure 9-1: Adaptive Approach to Monitoring and Management

9.3 Responsive Monitoring and Management

Throughout the dredging and dredge material placement period, monitoring will be undertaken to assess any potential impacts of the dredging and dredge material placement activities on water quality and coral health. The Responsive Monitoring Program will consist of the collection of data on water quality and coral health to be formally assessed against management triggers as outlined in **Section 8.1.2** and to assist with inferring the cause any changes that may occur. Responsive monitoring will also be reliant upon data collected during the baseline period in order to establish initial trigger values that reflect the level of natural variation in parameters that occur naturally, as observed during baseline conditions, and related to this, an estimate of ecological significance.

The Responsive Monitoring Program will include the following adaptive approach (also refer to **Figure 9-1**):

Year 1: The Responsive Monitoring Program will be comprehensive in the first year as detailed in **Section 8.1.2** and **Section 9.3**. The program will include a wide spatial coverage with frequent (fortnightly) snapshots of coral health and fortnightly downloading of water quality data (collected at 30 minute intervals) at all potential impact sites during the first year. Metocean and satellite data (e.g. MODIS) or aerial imagery will be collected daily in order to assist in the interpretation of water quality and coral health data as described in **Section 9.3.**

End of Year 1: Before the end of the first year of monitoring, a formal review of data will be undertaken, whereby all information collected during the first year of monitoring will be collated and assessed through data analyses and written reviews. These data will include, but are not limited to the following:

- Water quality and coral health data and any predictive relationships that have been developed between these.
- Comparison of scale and location of predicted impacts with actual scale and location of any realised impacts.
- Evidence of decline in coral health due to natural events, including natural rates of mortality with or without catastrophic events such as cyclones or bleaching.
- Location and type of dredging and dredge material placement activities that have occurred.
- Extent of sediment plumes resulting from dredging and material placement activities (e.g. MODIS-derived data).
- Relationships between metocean conditions, dredging activities and impacts to water quality and coral health.
- Verification of sediment plume modelling.

The analysis of data may allow for:

1. An assessment of the threshold levels used in the modelling interrogations including the use of any predictive relationships developed and the data on the spatial extent and nature of any impacts that have occurred. This may allow the refinement of thresholds or the development of site specific thresholds.
2. Validation of sediment plume modelling using MODIS data and *in-situ* sampling, allowing for refinement of the model if required.

3. Use of the site specific coral thresholds (1) and the validated sediment plume model (2) to re-model and predict impacts to water quality and receptors for Year 2, Year 3 and Year 4.
4. Establishing a strong relationship between water quality data obtained using loggers and data satellite imagery, which may allow for greater reliance on satellite imagery for the purposes of management.

Changes in the monitoring program at the end of year 1 may include:

- A change in the spatial focus of monitoring.
- A change in the frequency of monitoring (e.g. more frequent monitoring at sites close to dredging and material placement and less frequent monitoring at sites far-field where impacts have not been observed to date nor are they expected to occur).
- The use of indicator sites close to dredging and dredge material placement if these can be shown to be suitable precautionary indicators of impacts further afield.
- A greater reliance on water quality data if predictive relationships between water quality and coral health can be developed with confidence.
- The use of previous Metocean and MODIS data from Year 1 to determine the relationship between metocean conditions and sediment plumes to allow a changing focus of monitoring based on predicted metocean conditions.

The revised monitoring program will be discussed with the regulators before implementation.

Further Revision and Adaptation: During years 2 – 4 data will be regularly reviewed to determine whether any refinement or modification to the monitoring program could be used to improve management response. Any further refinement to the monitoring and management programs will be discussed with the regulators before implementation.

9.3.1 Responsive Monitoring Site Locations and Frequency of Monitoring

In the first year the monitoring program will provide a wide spatial coverage, as a precautionary approach to managing potential impacts to BPPH, due to the inherent potential for some inaccuracies in the prediction of impacts (discussed in **Section 9.2**).The wide spatial coverage will provide a comprehensive data set which will inform an assessment of the effects of the dredging and dredge material placement activities on water quality, sedimentation regimes and coral health.

Twenty-one sites are proposed to be monitored in the responsive monitoring program during the first 12 months of the Project. Indicative sites are listed in **Table 9-1** and their locations are shown on **Figure 9-2**. The location and number of these sites will be revised prior to finalisation of the DSDMP.

For a full description of BPP communities present at sites that have been surveyed to date, see Appendix N7 of the EIS/ERMP.

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Table 9-1 Responsive Monitoring Program Coral Health and Water Quality Monitoring Sites <Hold – indicative only at this stage>

Zone/Type	Name	Parameters	Monitoring Frequency	Reporting Frequency	Corresponding Reference
High Impact	Saladdin Shoal	Live coral Bleached coral Turbidity (NTU) Gross Sedimentation Temperature	When possible (~6 weekly)	Monthly	West Reef, R1 (West of Locker), R2 (East of Herald)
High Impact	End of Channel Shoal		When possible (~6 weekly)		
Moderate Impact	Paroo Shoal		Fortnightly		
Moderate Impact	Hastings Shoal		Fortnightly		
Moderate Impact	Gorgon Patch		Fortnightly		
Influence	Weeks Shoal		Fortnightly		
Influence	Ward Reef		Fortnightly		
Influence	Roller Shoal		Fortnightly		
Influence	Thevenard Island East	Live coral Bleached coral Turbidity (NTU) Gross Sedimentation Temperature	Fortnightly	Monthly	Thevenard Island South, Serrurier Island, Bessieres Island, Brewis Reef Airlie Reef as a Contingency only.
Influence	Direction Island		Fortnightly		
Influence	North East Twin Island		Fortnightly		
Influence	Herald Reef		Fortnightly		
Influence	Ashburton Island		Fortnightly		
Reference	West Reef	Live coral Bleached coral Turbidity (NTU) Gross Sedimentation Temperature	3 monthly	Monthly	Not applicable
Reference	Thevenard Island South		3 monthly		
Reference	Serrurier Island		3 monthly		
Reference (pseudo)[1]	R1 (West of Locker)		3 monthly		
Reference (pseudo)[1]	R2 (East of Herald)		3 monthly		
Reference (pseudo)[1]	Bessieres Island[2]		3 monthly		
Reference (pseudo)[1]	Brewis Reef[2]		3 monthly		
Reference (Contingency)[3]	Airlie Island		3 monthly		

[1] 'Pseudo' Reference sites are sites located within the Zone of Influence but towards the outer boundary of this Zone. Changes in water quality at these sites are expected to be minimal and impacts to coral health are unlikely. The conditions under which these sites will be considered appropriate reference sites is defined in **Section 9.3.1**.
[2] These sites will become Influence sites if the Wheatstone Trunkline Dredging campaign is undertaken concurrently with the Capital Dredging campaign.
[3] This site is largely incomparable to impact sites and will be used as a reference site in contingency situations only, where other reference sites become unsuitable.

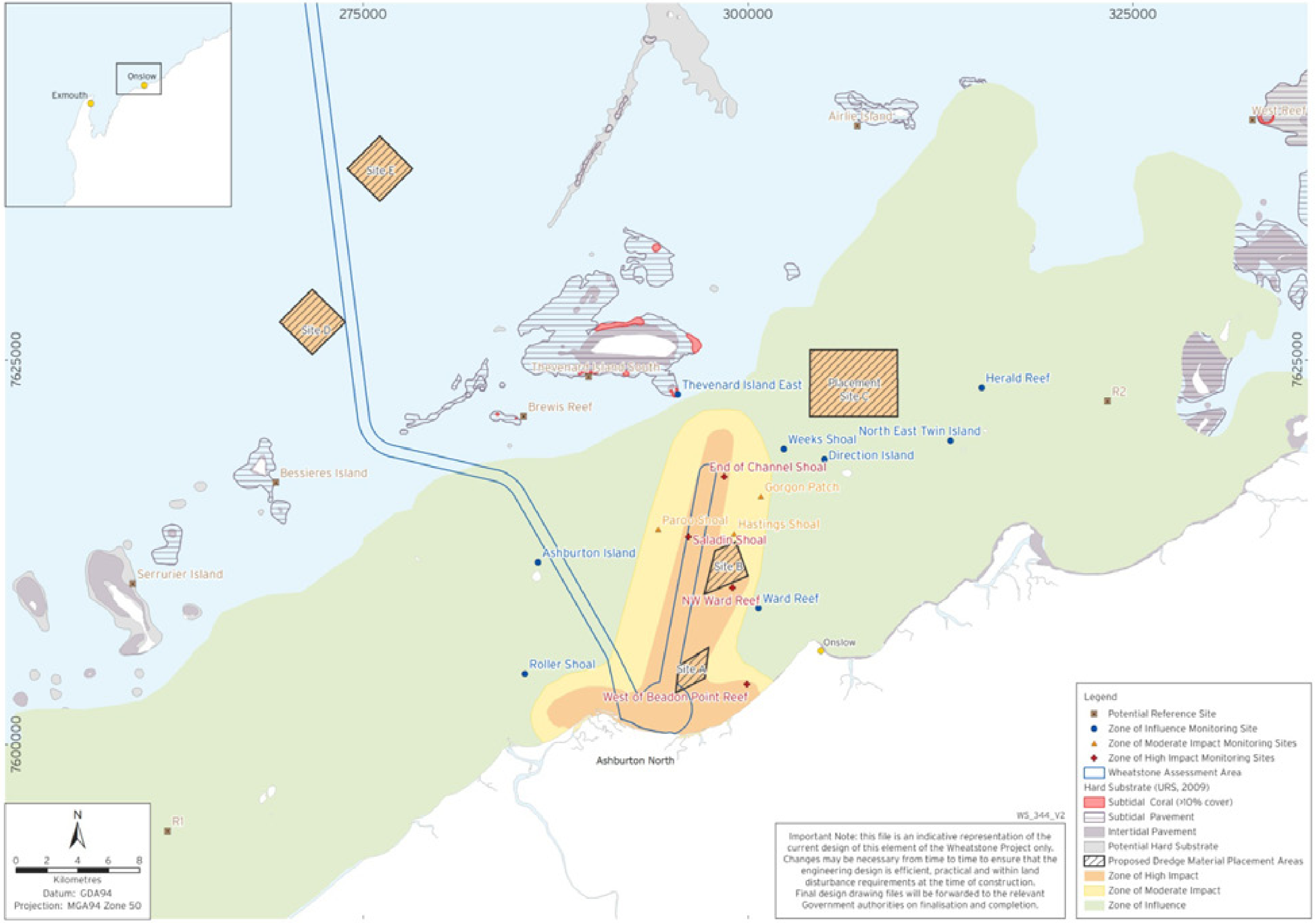

Figure 9-2 Indicative Coral Health and Water Quality Monitoring Sites <Hold – indicative only at this stage>

Zone of High Impact Sites

Two shoals supporting hard corals are located within the predicted Zone of High Impact: Saladdin Shoal and End of Channel Shoal, located within approximately 300m and 900m respectively, of the proposed channel (**Figure 9-3**). These reefs are predicted to suffer up to 100% mortality of hard corals (**Section 7-3**) due to elevated sedimentation or a reduction in benthic light availability caused by the suspension of sediments in the water column as a result of dredging of the channel. Additionally, due to the movement of construction vessels along the proposed channel, propeller wash from these vessels may also result in mortality of corals on these reefs.

Data on coral health will be collected from sites located on each of Saladdin and End of Channel Shoals when possible during the dredging campaign (within safety and logistical constraints). Data on water quality will be collected at 30 minute intervals and downloaded when possible. Likewise, sediment will be collected in traps, which will be emptied when possible. While data collected from these sites will not be assessed against management trigger criteria (since up to 100% mortality of corals is predicted to occur at these sites) monitoring will be undertaken for research purposes to explore relationships between water quality, gross sedimentation and coral health as described in **Section 9-4**.

Zone of Moderate Impact Sites

Three shoals supporting hard corals are present within the predicted Zone of Moderate Impact: Paroo Shoal, Hastings Shoal, and Gorgon Patch. These shoals lie approximately 2km to 3km from the proposed channel. While no permanent impacts to BPPH and BPP communities are predicted to occur on these reefs, some reversible (i.e. recoverable within 5 years as defined by EPA 2009b) impacts to hard corals may occur as a result of elevated sedimentation rates or a reduction in benthic light availability resulting from the dredging of the channel.

Monitoring of coral health will be undertaken on a fortnightly basis at sites located on each of these shoals in order to assess potential changes in coral health that may be attributable the dredging of the channel. Data on coral mortality will be assessed against tiered management triggers, as described in **Section 8.1**.

Water quality and gross sedimentation data will also be collected at these sites to assist in interpretation of the cause/s of any observed changes in coral health. Water quality data (turbidity, benthic light availability and temperature) will be collected at 30 minute intervals using *in-situ* loggers and downloaded on a fortnightly basis. Gross sedimentation data will be collected using sediment traps which will be emptied on a fortnightly basis.

Zone of Influence Sites

Eight sites are located within the Zone of Influence: Weeks Shoal, Ward Reef, Roller Shoal, Thevenard Island East, Direction Island, North East Twin Island, Herald Reef, and Ashburton Island. Within the Zone of Influence, water quality may be altered beyond background levels as a result of dredging and dredge material placement activities, however, no impacts to receptors are predicted to occur (**Section 7-3**). A number of reefs, shoals and islands occur throughout this zone. Representative sites have been chosen at islands, reefs and shoals that lie closest to dredging and dredge material placement activities. These sites will serve as ‘indicators’ of potential impacts of dredging or dredge material placement activities within the entire Zone of Influence since it is anticipated that potential impacts from dredging and dredge material placement would be detected at these sites before they extend further afield.

Monitoring of coral health will be undertaken on a fortnightly basis at all eight sites in order to assess potential changes in coral health that may be attributable to the dredging of the channel. Data on coral bleaching and mortality will be assessed against tiered management triggers, as described in **Section 8.1**.

Water quality data (turbidity) will be collected at all eight sites within the Zone of Influence to be assessed against a Level 1 management trigger for this zone, as described in **Section 8.1**. Additional water quality data (benthic light availability and temperature) as well as gross sedimentation data will be collected at these sites to assist in interpreting the cause(s) of any observed changes in coral health. Water quality data (turbidity, benthic light availability and temperature) will be collected at 30 minute intervals using *in-situ* loggers and data will be downloaded on a fortnightly basis. Gross sedimentation data will be collected using sediment traps which will be emptied on a fortnightly basis.

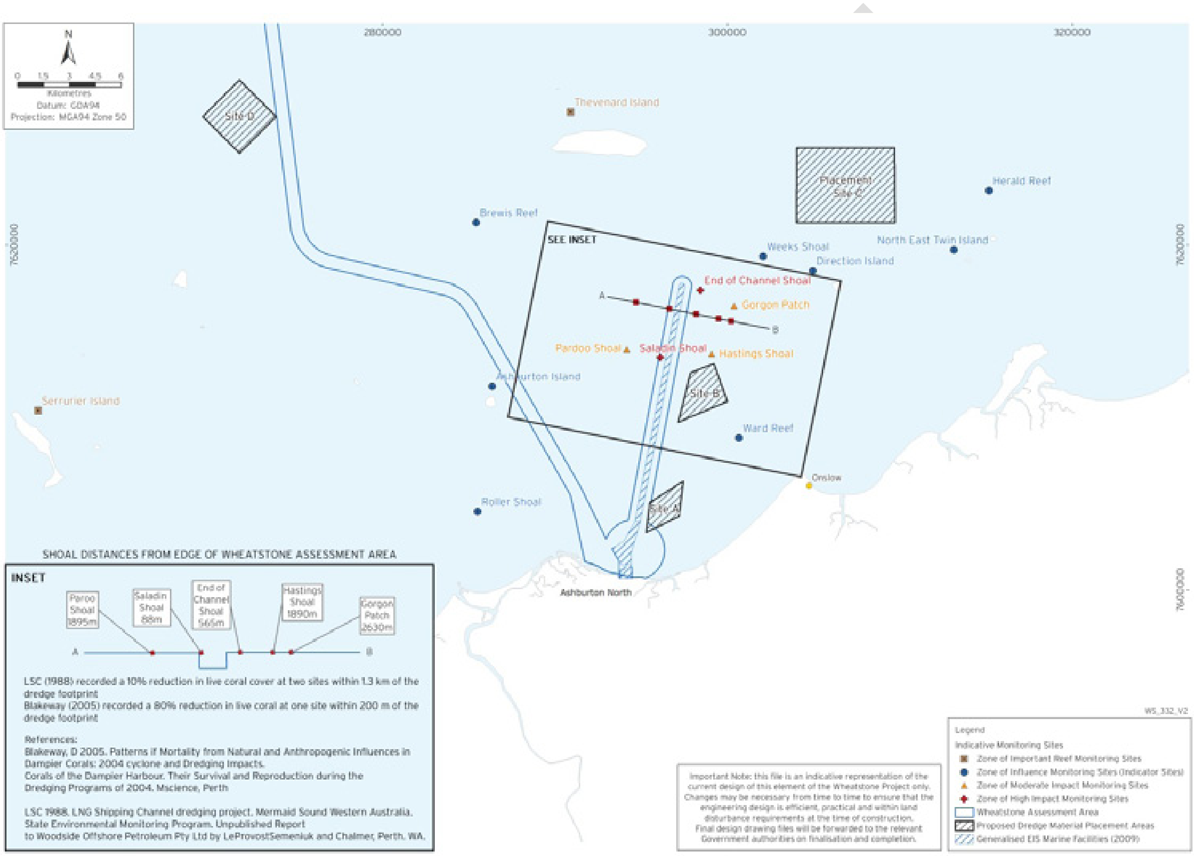

Figure 9-3 Distance of Monitoring Sites within the Zone of High Impact and Zone of Moderate Impact from the proposed channel in relation to the distance of previously observed impacts to corals associated with dredging activities.

Reference Sites and Important Reef Areas

The EPA provides guidance within EAG#3 (EPA 2009b) and Draft EAG#7 (EPA 2010) on the establishment of reference sites for the purpose of monitoring potential impacts to BPPH. This guidance recommends the location of reference sites outside the predicted influence of development activities. In addition to this, reference sites should be as comparable as possible to potential impact sites in order to effectively use data from reference sites to infer whether any 'real' or 'net' change has occurred at impacts sites that may be attributable to development activities as opposed to natural variation.

Four reference sites (including Important Reef Areas) have been identified outside the Zone of Influence (Thevenard Island South, Serrurier Island, Brewis Reef and Bessieres Island) that are comparable to a subset of potential 'impact' sites within the Zones of Influence (Thevenard Island East, Direction Island, North East Twin Island, Herald Reef and

Ashburton Island) (**Table 9-1, Figure 9-2**). However, if Trunkline dredging occurs concurrently with Capital dredging, two of these reference sites (Brewis Reef and Bessieres Island) will be located within the predicted Zone of Influence of Trunkline dredging (see below for discussion on when these sites may be considered appropriate for use as reference sites).

For the proposed Wheatstone project, the predicted Zone of Influence extends a considerable distance west and east of the dredge and dredge material placement locations (see EIS Section 8.3). To the east of the Zone of Influence are the Mangrove Islands. While these areas support coral reefs, environmental conditions are distinctly different to those within the project area, limiting the availability of potential reference sites. To the west of the Zone of Influence is the Exmouth Gulf, where depths and exposure to wind and wave action are distinctly different to those within the project area. As a result, only one potential reference site (West Reef) was identified outside the Zone of Influence that contains coral communities and environmental conditions that are comparable to potential 'impact' sites located at inshore reefs and shoals within the Zone of High Impact, Moderate Impact and Influence (Saladdin Shoal, End of Channel Shoal, Paroo Shoal, Hastings Shoal, Gorgon Patch, Weeks Shoal, Ward Reef and Roller Shoal) (**Table 9-1, Figure 9-2**).

Sites located seaward of the Zone of Influence were not considered appropriate references for inshore potential 'impact' sites for the following reasons:

i. Environmental conditions at offshore reference sites are dissimilar to the majority of inshore impact sites (e.g. offshore areas generally experience lower turbidity and less influence of terrestrial runoff than inshore areas).
ii. Coral communities found in offshore areas are dissimilar to those found at inshore shoals and reefs. Since different species of corals may respond unequally to environmental stresses, corals at offshore sites may display larger or smaller natural changes than corals in inshore areas, which may subsequently affect calculations of 'net' mortality or bleaching at these inshore sites.

The proposed solution to the issue of limited comparable reference sites for inshore 'impact' sites is to establish 'pseudo' reference sites that will be located within the Zone of Influence but towards the outer boundary of this zone. At the outer edge of the Zone of Influence, only minor and occasional elevations in turbidity are predicted to occur and no impacts to corals are expected, rendering these sites suitable as references.

Two 'pseudo' reference sites are proposed that are likely to be comparable to inshore 'impact' sites (**Table 9-1, Figure 9-2**):

R1 – a site yet to be located within an area to the West of Locker Island; and
R2 – a site yet to be located within an area to the East of Herald Island.

These sites are predicted to experience only minor perturbations from background water quality during dredging and material placement, for brief periods during only one out of three seasons (see **Figures 9-4** and **9-5**). These perturbations in water quality are predicted to be insufficient to cause any impacts to coral health that might deem these sites unsuitable as references.

Water quality will be monitored at these sites and conservative turbidity criteria (that are well below the tolerance thresholds of corals) **<Hold – turbidity criteria yet to be established>** will be used to determine whether these sites are likely to continue to remain free from impacts of dredging or dredge material placement. If these criteria are breached, these sites would no longer be considered suitable references and sub-optimal sites further afield (e.g. located seaward of the Zone of Influence) would be used.

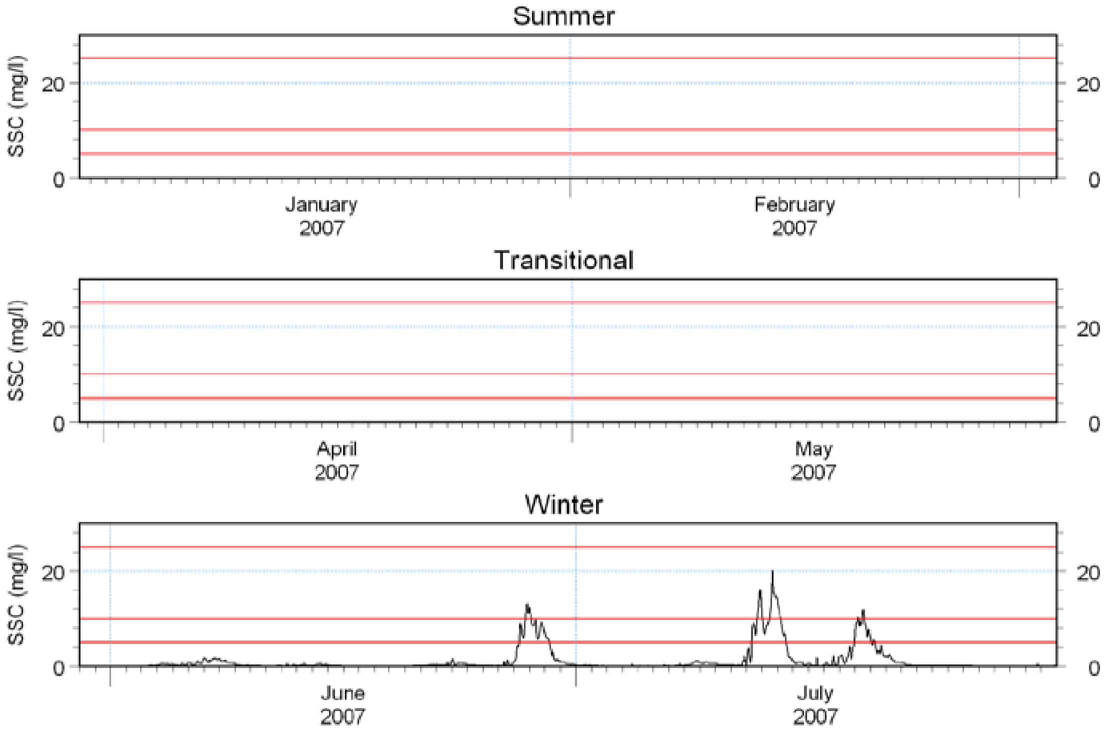

Figure 9-4: Predicted SSC concentrations at pseudo-reference site R1 (for location refer to Figure 9-2) throughout dredging scenario 5. Red lines correspond to SSC levels of 5mg/L, 10mg/L and 25 mg/L above background. X-axis scale in days.

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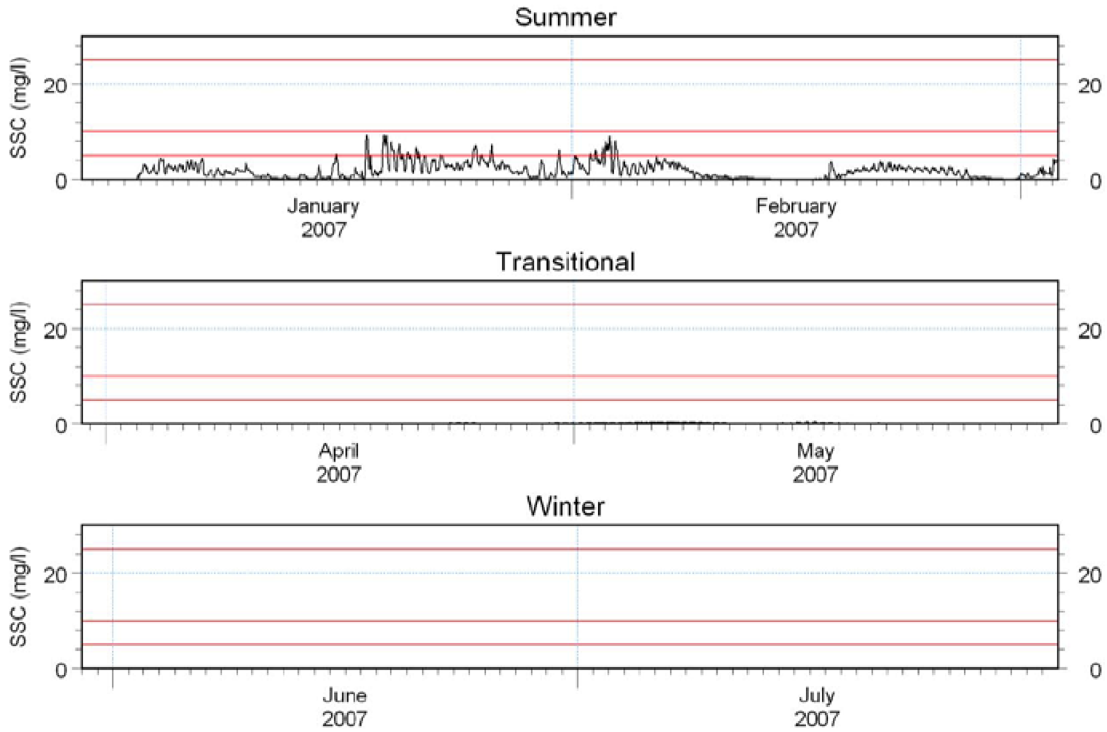

Figure 9-5: Predicted SSC concentrations at 'pseudo' reference site R2 (for location refer to Figure 9-2) throughout dredging scenario 6. Red lines correspond to SSC levels of 5mg/L, 10mg/L and 25 mg/L above background. X-axis scale in days.

Monitoring will also be undertaken at a Contingency Reference Site at Airlie Island. This site does not provide an ideal reference for outer or inner shelf 'impact' sites, since coral communities and environmental conditions at this site are not readily comparable to the majority of 'impact' sites. However, trends in water quality and coral health at this site may still be of use in interpreting changes observed at impact sites. This site may also be used as a contingency in the event that water quality is altered by dredging or dredge material placement activities at any Pseudo-reference sites. Since Airlie Island is considered an Important Reef Area, monitoring at this site will also serve to provide a precautionary approach to minimise the likelihood that impacts due to dredging and dredge material placement activities will occur at this site, undetected.

Monitoring of coral health at reference sites may be required fortnightly in the event that trigger levels are approached or exceeded at potential impact sites, while less frequent monitoring (e.g. 3-monthly) may be sufficient if trigger levels are not being approached or exceeded, in which case data from previous months may be conservatively used in trigger assessments.

Water quality data (turbidity, benthic light availability and temperature) and gross sedimentation data will be collected at reference sites to provide background data that can assist in determining whether changes observed at comparable 'impact' sites are widespread and likely to be natural, or spatially restricted, and potentially due to dredging and dredge material placement activities. Water quality data (turbidity, benthic light availability and temperature) will be collected at 30 minute intervals using *in-situ* loggers and data will be downloaded on an infrequent (e.g. 3-monthly) basis. Gross sedimentation data will be collected using sediment traps which will be emptied on an infrequent (e.g. 3-monthly) basis.

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The frequency of data collection and downloading at some reference sites may be increased as required in the event of an exceedance(s) at comparable 'impact' sites in order to provide recent data to infer the cause of the exceedance(s).

9.3.2 Water Quality Monitoring

9.3.2.1 Objectives and Approach

The key objective of the water quality monitoring component of the responsive monitoring program is to provide data to infer the cause of any observed changes in coral health. Water quality data will also be used within the Zone of Influence as an early warning of potential impacts to hard coral communities due to dredging or dredge material placement activities.

9.3.2.2 Parameters

Water quality parameters that will be measured at monitoring sites during the responsive monitoring program include the following:

Turbidity (measured in nephelometric turbidity units - NTU)
Turbidity provides an indirect measure of the alteration of the light climate received by BPP communities that may be a result of the natural suspension and movement of sediments and/or the suspension and movement of sediments caused by dredging or dredge material placement.

Benthic light climate (photosynthetically active radiation – PAR)
The quanta of light received by BPP, measured in PAR, is a direct measure of potential impacts to BPP as a result of altered water quality. However, this measure must also be combined with turbidity data in order to determine whether changes in light climate are a consequence of the suspension and movement of sediments caused by dredging or material placement activities.

Water Temperature
Water temperature will not be significantly affected by dredging and offshore dredge material placement. However, there have been recorded instances in the Pilbara region of changes in coral health, including bleaching and partial morality, due to natural thermal anomalies (MScience 2008). Therefore, temperature will be recorded at all coral monitoring sites in order to differentiate potential dredging and dredge material placement impacts on coral health from natural thermal anomaly events.

Metocean Conditions
Measurements of metocean conditions (e.g. wave height, current speed, current direction) will be undertaken at a representative range of monitoring sites and used in the interpretation of changes in water quality and coral health. These measurements will be used to identify important relationships between metocean conditions, dredging activity and location, and any subsequent impacts to water quality and coral health.

Satellite Imagery or aerial photography

<Hold – need to confirm type and frequency of data to be collected>

9.3.2.3 Data Analysis

All data will be subjected to rigorous quality assurance and quality control (QA/QC) procedures. Due to issues with bio-fouling of equipment, a regular maintenance schedule is likely to be implemented and all loggers likely to be retrieved, downloaded, cleaned and redeployed or replaced as necessary to maintain the quality of data collected. Prior to the analysis of water quality data to review potential exceedance of trigger levels, a preliminary check of data integrity is likely to be undertaken and anomalous data removed using an objective function, following guidance outlined in ANZECC and ARMCANZ (2000).

Water quality data collected within the Zone of Influence will be assessed against water quality management trigger criteria (as per **Section 8.1**). Data from the Zone of Influence will also be compared against reference site data to assist in inferring whether the exceedance was due to natural variation or potential dredging impacts.

9.3.3 Gross Sedimentation Monitoring

9.3.3.1 Objectives and Approach

The main objective of monitoring gross sedimentation rates is to assist in understanding potential impacts of dredging and dredge material placement activities on sedimentation regimes at monitoring sites, and to infer potential impacts on sensitive BPP receptors. It is likely that permanent sedimentation impacts to BPPH, if any, will occur in areas within close proximity to dredging or dredge material placement activities where there is a fallout of coarse sediments. Therefore, sedimentation monitoring will provide evidence of whether potential impacts within these areas were caused by dredging or other factors.

There are no formal management triggers associated with sedimentation monitoring. Due to the highly dynamic sedimentation regimes that occur in the Pilbara region through the influence of tidal currents and waves, data on gross sedimentation rates collected using sediment traps are likely to only provide broad estimates of sedimentation and may not accurately portray the actual accumulation of sediments and potential impacts on BPP communities. In this regard, data on net sedimentation rates would be more useful for management purposes. However, instruments that measure net sedimentation rates are still in early development and all known systems are unreliable. Therefore, data collected by these instruments would not be suitable for management purposes. Gross sedimentation monitoring will therefore be used only to provide a broad understanding of potential changes in sedimentation regimes caused by dredging and dredge material placement activities and interpretation of potential changes in coral health, along with other types of data.

9.3.3.2 Data Collection

Gross sedimentation rates will be monitored using sediment traps deployed at a selection of monitoring sites where sedimentation impacts are most likely (e.g. within the Zones of Moderate and High Impact) and at sites within the Zone of Influence that are in close proximity to dredge material placement areas). These traps will be retrieved and emptied on a routine basis during the responsive monitoring program. Sediment will be sent to a laboratory for analysis of total sediment weight and occasionally throughout the program (e.g. on a 3-monthly) particle size distribution (PSD) will also be analysed. If instruments become available during the dredging program that accurately measure net sedimentation rates, then it is possible that these instruments may substitute sediment traps or be added to the program.

Net sedimentation may be monitored adjacent to coral health monitoring sites using a simplified approach such as a gradated marker peg, against which measured changes in levels of sediment accumulation at any given time may be assessed. If this method proves to be reliable, these data may also be used to infer the cause of any changes in coral health that may be observed.

9.3.3.3 Reporting and Analysis

Organic and inorganic fractions of the particulate matter in sediment traps can be measured in the laboratory to assess whether the majority of the sediment is organic (not dredge-related) or inorganic (possibly dredge-related). Seasonally or when required, PSD analysis can be undertaken on the material within the sediment traps to relate sediment data to material suspended by dredging and dredge material placement activities. Data will be summarised and reported together with water quality monitoring data at monthly intervals.

9.3.4 Coral Health Monitoring

9.3.4.1 Objectives and Approach

The objectives of coral health monitoring are to detect potential changes in coral health and to infer whether these changes are a result of dredging and placement activities or natural variation. To achieve these objectives, coral health data will be collected on a fortnightly basis at sites located within the Zone of Moderate Impact and Zone of Influence and compared against management trigger criteria, an exceedance of which would prompt the implementation of management measures to limit further impacts. Since it is predicted that up to 100% of hard corals within the Zone of High Impact may be lost, coral health data collected within the zone will not be assessed against management trigger criteria.

It is possible that the frequency of Responsive coral health monitoring may be reduced (in consultation with regulatory authorities) if predictive relationships between water quality and coral health can be developed and water quality criteria can be used reliably and with sufficient precaution to trigger more frequent coral health monitoring if required.

A prioritisation of coral health monitoring will occur in the event of exceedances of any management triggers that are attributable to dredging or placement activities, through the processes detailed in **Section 8.1**. The aim of this prioritisation would be to undertake coral health monitoring firstly at sites in the vicinity or direction of the site (s) of the observed exceedance(s). This would provide a more rapid response to detect and management potential impacts to coral health, or to provide greater power to detect changes through the monitoring of a greater number of sites in the vicinity of the exceedance in the instance that not all sites can be monitored during a survey round (e.g. due to poor weather).

9.3.4.2 Parameters

The key coral health parameters that will be monitored and used in assessment against The key coral health parameters that will be monitored and used in assessment against management triggers are percent cover of living coral tissue and the percent of colonies that are bleached (tissue is white but still intact).

Other qualitative parameters that will be measured to provide diagnostic information to interpret changes in coral communities include:

- mucus production; and
- sediment cover.

However, since the assessment of these parameters can be subjective and there are no clear relationships established in the literature between these parameters and subsequent levels of mortality, data collected on these parameters will not be formally assessed against management trigger criteria.

Data collection

Coral health monitoring is likely to consist of a combination of qualitative and quantitative measures, however, management decisions will be based on quantitative measures only. At each monitoring site, coral colonies and/or coral communities will be inspected and photographed. The number of colonies to be assessed at each monitoring site will be determined through power analyses of baseline data. The species targeted for monitoring at each site may be selected on the basis of their dominance, an initial appraisal of health, and that the size of colonies will be conducive to photography and analysis. A pilot study will be undertaken to determine if it is possible to obtain an appropriate level of power (e.g. power = 0.8) for detecting change in coral health using diver-less monitoring methods, and if so, these methods may be adopted in preference to diver-based methods. In addition, baseline data will be used to determine an appropriate effect size, based on observed rates of natural variability and ecological significance.

Quantitative Indicators – Coral Mortality
Coral mortality will be recorded for all cases where there is no live tissue and/or subsequent algal growth or sediment accumulation has occurred over the surface of the coral. Coral bleaching will be recorded where there is still live tissue present, but that tissue has turned white.

Coral mortality is likely to be assessed by analysing each coral photo with Coral Point Counter with Excel Extensions (CPCe) (Kohler & Gill 2006). This software was developed by NOVA South Eastern University (Boca Raton, Florida) in conjunction with the U.S. National Oceanographic and Atmospheric Administration (NOAA) and has been routinely used to estimate mortality (scored as percentage cover) on recent Pilbara dredging projects. This application is used to estimate the percentage of living coral tissue within each photographed colony. Measures on individual colonies can then be grouped to assess potential changes in coral condition on assemblages and regional scales over time.

Qualitative Measures
A general qualitative visual assessment of coral health will also be undertaken on each coral colony by a trained observer before the colony is photographed to provide contextual information for changes that may be observed in later digital analysis. This may involve the assessment of the production of mucus (presence/absence), sediment presence/absence, evidence of bleaching and any other evidence of sub-lethal stress. Each colony may be compared to a reference photograph taken prior to dredging (baseline), to make a qualitative assessment of an adverse change in coral health.

Data analysis

Hold – to be updated pending finalisation of the OBC

9.4 Predictive Links Monitoring

9.4.1 Objectives and Approach

The key objectives of predictive links monitoring are to:

- Investigate the relationships between water quality and coral health to allow for refinement, where appropriate, of water quality early warning criteria.
- Verify the threshold values used to interrogate the sediment plume model and predict impacts on corals.

The relationships between water quality and coral health are poorly understood for this region. The water quality trigger criteria used to identify and manage potential water quality impacts on coral health, and the coral tolerance thresholds used to interrogate sediment plume modelling and predict the scale of impacts to corals, are based loosely on a combination of background data and published information. In order to refine thresholds and triggers and more accurately manage potential impacts on corals it is useful investigate the relationships between water quality and coral health during the dredging program. Data will be examined throughout the dredging program to develop predictive relationships (where possible) between water quality and impacts on coral health. The development of these predictive relationships can then be used to refine trigger criteria for the responsive monitoring approach.

9.4.2 Parameters

Key parameters likely to be investigated in predictive links monitoring include: turbidity (measured in NTU); temperature, light, gross sedimentation rates, coral mortality (whole colony and partial mortality); and coral sub-lethal health indicators such as colour intensity and mucus production, as described under the responsive monitoring program (**Section 9.3**).

9.4.3 Data collection

The majority of data collection required to meet this objective will be obtained through the responsive monitoring program (**Section 9.3**). All data collected from monitoring sites during the responsive monitoring program in years 1-4 will be examined on a regular basis as collected. In addition, water quality and coral health data will be collected when possible (when logistical and safety constraints permit) from sites located within the Zone of High Impact (Saladdin Shoal and End of Channel Shoal). These sites are likely to provide valuable data on the relationships between water quality and coral health as they are located in areas where coral mortality is currently predicted to occur as a result of dredging activities. Data collection methods for these sites will follow those described under the responsive monitoring programs (**Section 9.3**).

In addition to water quality and coral health data, information on metocean conditions will also be accessed and used in the interpretation of relationships between water quality and coral health.

9.4.4 Analysis and reporting

Hold – To be updated pending finalisation of the OBC

9.5 Impact Monitoring

HOLD – These methods are to be updated pending finalisation of the OBC

9.5.1 Objectives and Approach

The objectives of the Impact Monitoring Program are to:

- ♦ Determine the spatial extent of any permanent losses of key BPP and permanent changes to underlying BPPH that are attributable to both direct and indirect impacts of dredging and dredge material placement activities.
- ♦ Confirm whether the spatial extent of any permanent losses exceeds the boundary of the Zone of High Impact (shown in **Figure X.X**).
- ♦ Where permanent impacts extend beyond the boundary of the predicted Zone of High Impact, provide data on the likelihood of recovery of communities that have been impacted beyond that predicted and approved.

Following the requirements of EAG#3 (EPA 2009b) and Condition X.X <hold>, an assessment of BPPH is required prior to and following development activities to provide an estimate of the areal extent of BPPH loss that is attributable to the development. The Impact Monitoring Program will involve the collection of data on the spatial extent and condition of key subtidal BPPH types and associated BPP communities within the Project Area before and after the completion of dredging and dredge material placement activities. Key BPPH types to be examined include those supporting hard corals and seagrasses. In addition, the non-BPP group, filter feeders, will also be assessed before and after the completion of dredging and dredge material placement activities since they have a wide-ranging distribution within the project area and occur in close proximity to the proposed trunkline dredging activities.

9.5.2 Data collection

9.5.2.1 Hard Coral BPPH

Hard corals are located predominately on the fringes of the platforms that surround offshore islands, as well as on submerged shoals, and percent cover of corals, where they occur, ranges up to 70%. Corals are located elsewhere in the Project Area but distribution is patchy and percent cover is low (range approximately 0 to 10%).

The loss of hard coral will be assessed through the collection of data on hard coral BPPH from all monitoring sites used for the responsive monitoring program. Since sites will be located at the majority of coral reef areas present in the area, data on hard coral BPPH collected from these sites can be extrapolated to reflect losses throughout each zone. This will involve comparing BPPH condition (e.g. level of sedimentation and disturbance) and the level of hard coral mortality prior to and post-dredging activities at monitoring sites within the Zones of High Impact, Moderate Impact and Influence and calibrating these losses against natural changes observed at reference sites.

Sampling at sites will be undertaken using remote (non-diver) methods, such as towed video. Methods will include the collection of data using high resolution video or still photography that can be analysed through digital analysis to quantify coral cover, and levels of mortality. In addition, the spatial extent of permanent impacts to the underlying BPPH will be assessed through the comparison of sedimentation levels and availability of suitable substrate pre- versus post-dredging.

9.5.2.2 Seagrass BPPH

Seagrass communities within the project area are largely sparse in nature and consist mostly of ephemeral species such as *Halophila spinulosa*, *H. decipiens*, and *H. ovalis* (URS 2009e). No known meadows of perennial seagrass genera, such as *Thalassodendron* or *Enhalus* occur in the nearshore project area. Distribution of seagrasses is patchy immediately west of Ashburton Island, north-west of Onslow and at West Reef (**Figure 6-1**). Within these areas, seagrass patches occupy a space of a few square meters to tens of square meters, but the patches are not contiguous. These patches consist predominantly of subtidal *Halophila* spp.

Since seagrass distribution is patchy and communities are temporally dynamic, data will be collected from transects stratified within known patches along a gradient radiating outwards from the dredging footprint within the Zones of High Impact and Moderate Impact as well as from sites where seagrass are known to occur within the Zone of Influence, north-east of Onslow.

Data on the spatial extent of any permanent changes in seagrass associated with dredging will be collected through the use of towed video or other non-diver methods that incorporate a wide spatial coverage in order to account for the patchiness of seagrass distribution. Recorded images will be sampled quantitatively using digital analysis software to provide measures of seagrass cover, such as shoot/leaf counts and percent cover.

To infer whether dredging has been the cause of any changes observed, a before-after/control-impact sampling design will be used that incorporates suitable control and impact sites. As per the Responsive Monitoring Program, some reference sites may need to be placed within the Zone of Influence in order to assess ecologically comparable communities. An examination of water quality data and satellite/aerial imagery collected during the dredging program will be used to infer whether these sites are ‘true’ reference sites or may have been influenced by dredging activities. However, since sites within the Zone of High Impact and Moderate Impact will be established radiating outward from dredging footprints, data can also be examined using a gradient approach, which is not necessarily reliant on reference site data to infer the cause of any observed changes.

Following the guidance of EAG#3 (EPA 2009b), where permanent impacts are found to extend beyond approved limits (beyond the boundary of the Zone of High Impact) the likelihood of recovery of seagrass communities and BPPH will be assessed through the following measures: i) the presence of seagrass seeds will be assessed through grab samples in areas where impacts have occurred to determine the possibility for recovery; and ii) the particle size distribution of sediments will be assessed in areas where seagrass have been impacted to determine whether BPPH has been altered and is likely or unlikely to support recolonisation by seagrasses.

9.5.2.3 Filter feeders

Sessile filter feeders are common on the sand veneered pavement that dominates the inner shelf of the Wheatstone Area. Filter feeders were identified north of Tortoise Island extending from the 10 m contour to the 20 m contour and occur in low to moderate densities (10 to 20% cover of substratum).

Filter feeder cover will be assessed along representative transects radiating outwards from the dredging footprint within the Zone of High Impact and Zone of Moderate Impact. Data collected using this method will be used to infer the spatial extent of permanent impacts to filter feeders and to assess the predicted impacts from the dredge plume. If permanent impacts are detected within the Zone of Moderate Impact, transects will also be assessed within the Zone of Influence to determine whether any impacts to filter feeders have occurred.

Data on the scale and distribution filter feeders will be collected through the use of towed video or other non-diver methods that incorporate a wide spatial coverage. Recorded footage or images will be sampled quantitatively using digital analysis software to provide measures of filter feeder cover and presence/absence of taxonomic groups. Data will also be gathered on changes to underlying habitat through measures such as sediment cover or observed physical disturbance to habitat.

Reference sites and the gradient approach will be used to infer whether any temporal changes are due to dredging and dredge placement activities, as described above in **Section 9.5.2.2**.

9.5.3 Analysis and Reporting

Data on hard coral, seagrass and filter feeder permanent losses will be extracted from video footage frame grabs or digital still photographs using a digital analysis program (e.g. Coral Point Count with Excel extensions: CPCe; Kohler et al. 2006). Since the objective of Impact

Monitoring is to assess permanent loss, images will also be analysed to quantify any damage or change to underlying habitat using measures such as sediment cover or observed physical disturbance.

A report on the baseline condition of subtidal BPPH report will be compiled. A final report will also be produced that details any changes in BPPH pre- versus post-dredging activities.

9.6 Introduced Marine Pests (IMP) – Inspections

9.6.1 Overview

The dredge vessels' mobilisation procedure requires a pre-mobilisation inspection of any vessel considered to be an uncertain or high risk vector for IMP. The risk assessment for vessels will be undertaken as per the form contained in Appendix XXX.

to be developed

9.6.2 Inspection Requirements

IMP inspections will be undertaken by a suitably qualified person with experience in the identification of IMP and in the inspection of construction vessels. All inspections will be undertaken either in 'dry dock' or via 'in water' inspection, with sufficient visibility.

The Revised Coordinating Committee for Introduced Marine Pest Emergencies (CCIMPE) Trigger List (2006) will be used as the basis for the identification of a marine species as an invasive pest, noting the potential presence of other unlisted species, demonstrating invasive characteristics or otherwise of concern. Other species not currently on these lists that are commonly accepted to have the potential to become invasive in some environments will be considered accordingly.

Inspections to examine the occurrence or risk of IMP will involve:

- an inspection of the vessel hull including the external niche areas
- an inspection of the internal niches including accessible ballast tanks, bilge spaces, anchor chain/cables locker, internal seawater systems
- an inspection of the topside wet areas including immersible equipment/dredge equipment (trailing pipes, dragheads and anchors).

Each of these items will be visually inspected and video/photographs will be taken of all niche areas and any species of concern. The ballast water logs will also be inspected to confirm compliance with the AQIS Mandatory Ballast Water Requirements.

In the event that a known or suspected IMP of concern are identified, a photograph or video image showing the species will be taken, including the full extent of the fouling clearly visible and a sample will be taken and sent for expert taxonomic identification. The contingency management measures presented in **Section 8.3** will be implemented when suspected IMP are identified and will not be dependent on the taxonomic identification due to the time required for taxonomic study.

9.6.3 Reporting

An inspection checklist will be completed for each inspection. This checklist, including a statement from the inspector providing an assessment on the status of the vessel in terms of risk, will be forwarded to the DEC and DoF prior to the commencement of the vessel's

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operation. An inspection report detailing the risk assessment, ballast water records and the results of the inspection will be provided to DEC and DoF.

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10.0 REPORTING, REVIEWS AND CORRECTIVE ACTIONS

TO BE POPULATED ONCE ALL MANAGEMENT APPROACHES

10.1 Reporting for the Dredging and Spoil Disposal Management Plan

Table 10-1summarises the regulatory reporting requirements associated with the dredging and dredge material placement activities.

Table 10-1: Reporting requirements for dredging and dredge material placement activities

Report	Contents	Frequency/Timing	Recipient
Monthly Coral Health and Water Quality Reports	Results of the coral health and water quality fortnightly surveys (two surveys included in each report)	10 business days following after the second field trip	EPA/DSEWPaC
Annual Coral Health and Coral Water Quality Report	Annual summary report of the water quality and coral health monitoring data collected during the dredging monitoring period	Annually	EPA/DSEWPaC
Final Water Quality / Coral Health Report	Summary report of the water quality and coral health monitoring data collected during the dredging and post dredging monitoring period	Upon completion of monitoring program	EPA/DSEWPaC
BPPH Monitoring Report	Comparison of pre and post dredging survey results, in relation to Ministerial Conditions	Upon completion of the dredging program	EPA/DSEWPaC
Marine Pest Inspection Checklists	Checklist completed during vessel inspections including assessment of vessel pest status.	48 hours after inspection	DoF
Marine Pest Inspection Report	Report on vessel inspection including vessel history.	10 days after inspection	DoF
Spoil Ground bathymetry	Bathymetry of placement sites after material placement has been completed including written commentary on volume of sediment retained.	As per requirements of SDP	DSEWPaC

IMO Reporting	Permit details. Details on the quantity and type of sediment disposed.	As per requirements of SDP	DSEWPaC

Report	Contents	Frequency/Timing	Recipient
Notification of Coral Health Trigger – Level 1	Details of exceedance and management actions	Within 4 days of exceedance identification	EPA/DSEWPaC
Notification of Coral Health Trigger – Level 2	Details of exceedance and management actions	Within 4 days of exceedance identification	EPA/DSEWPaC
Notification of Coral Health Trigger – Level 3	Details of exceedance and management actions	Within 4 days of exceedance identification	EPA/DSEWPaC
Marine Fauna Incident Report	Details of incident involving injury or mortality to turtle or marine mammals attributable to dredging	Per occasion (within 24 hours of incident)	EPA/DSEWPaC

10.2 Reviews of DSDMP

Hold – to be included in finalised DSDMP

10.3 Corrective Actions

Hold – to be included in finalised DSDMP

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Appendix A Risk Assessment outcomes

<To be included upon finalisation of the DSDMP, refer to the EIS/ERMP for risk assessment outcomes>

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Appendix B Framework to Limit Risk of Entrainment Related Mortality during the Wheatstone Dredging Campaign

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Framework to Limit Risk of Entrainment Related Mortality during the Wheatstone Dredging Campaign

Background

Dredging represents an entrainment risk to marine turtles as they rest and forage on the seabed, particularly juvenile turtles, due to their weaker swimming ability and inability to escape the dredge suction.

Wheatstone proposes to monitor and manage the risk of turtle entrainment during the dredging program using two approaches:

- Incident investigation Reporting
- Adaptive management

Incident investigation reporting is a method Chevron uses to record and assesses the cause of injuries to its workforce. It is also used to identify lessons-learned and forms the basis for recommendations to further limit the risk of injury. Chevron proposes to use the same principles to investigate turtle entrainment events and use the investigation results, along with other criteria, to guide future action, e.g. additional mitigation measures, to minimise the risk of entrainment to turtles.

In addition to incident investigation reporting, an adaptive management framework will be adopted to formalise the assessment of current and future entrainment mitigation measures. The basic tenet of adaptive management is: Plan – Implement – Monitor – Learn. The adaptive management approach will help ensure the assessment of entrainment mitigation measures remains objective and transparent.

Advantages of this framework are:

- It avoids the need to specify an arbitrary rate of entrainment that has no biological justification.
- Each entrainment event is investigated.
- It uses a variety of criteria to decide when to act and what further action is warranted.
- It provides greater certainty for proponents and regulators.

The proposed approach includes six key steps which are described below. Figure 1 conceptualises the process.

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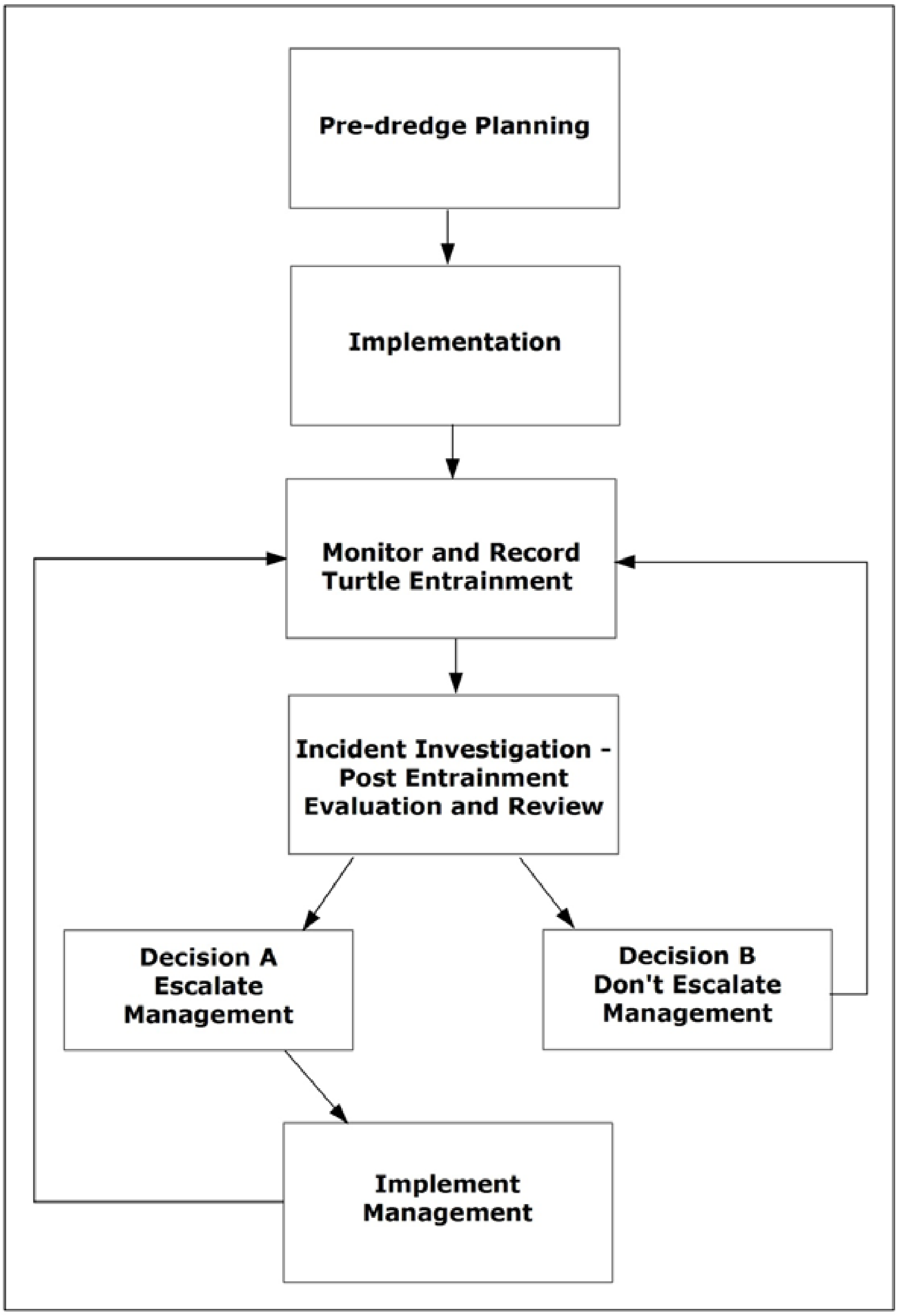

Figure 1: Key Steps in the Proposed Wheatstone Framework to Reduce the Risk and Rate of Turtle Entrainment

Step 1 Pre-dredge Planning

This step is undertaken prior to dredging and includes specifying management objectives, roles and responsibilities, and mitigation actions to reduce risk of entrainment.

Determine specific management objectives:

- Reduce or prevent turtle entrainment.
- Monitor turtle entrainment.
- Assess current mitigation measures to reduce entrainment.
- Adaptively manage to identify and implement further measures to reduce risk of entrainment.

Baseline Information

Little nesting for flatback and green turtles was recorded on the mainland, the closest nesting beach to the Ashburton North Site is approximately 4 km to the west. Surveys did record medium to high nesting activity, by both flatback and green turtles, on the large (Serrurier and Thevanard) and moderate sized (Bessieres, Locker and Ashburton) islands while low levels of nesting activity were recorded on the smaller islands (Flat, Table, Direction and Twin).

Green turtles are not expected to be present in the proposed shipping dredging channel as they generally stay within a few kilometres of their nesting beach during their inter-nesting period, predominantly around offshore reefs and habitats, including reefs around islands. Inter-nesting flatbacks are at risk as flatbacks nesting at Ashburton Island are known to spend at least part of the inter-nesting period in the area of the proposed shipping channel. Foraging surveys undertaken in 2009 indicated no juvenile flatback turtles were recorded during the foraging survey, indicating the project is not a foraging area for these turtles. Aerial surveys confirm that turtles occur only in low densities in the proposed dredge footprint.

The risk of entrainment during the dredging operation is considered low, however Chevron intends on undertaking a conservative approach to ensure risks associated with the dredging operation are minimised.

Roles and Responsibilities

Wheatstone will establish roles, responsibilities and authorities to ensure appropriate people with the correct skills and knowledge are included in decisions making and incident evaluation. The number of people involved in decision making and incident reporting depends on the complexity of the incident and the skills needed to determine cause. Proposed roles and responsibilities for the duration of the dredging operation are provided in Table 1.

In line with the Chevron Incident Investigative Procedure, the following roles are to be considered during incident evaluation:

- A trained facilitator

- The employee(s) or contractor(s) involved in the incident
- The supervisor of the people involved in the incident
- Specialists or subject matter experts, if appropriate. Specialists could include the following people:
  - Company representative
  - Turtle research consultant
  - Equipment inspectors
  - Maintenance mechanics
  - Emergency response specialists

Table 1: Roles and Responsibilities

Role	**Responsibility**
Pre-dredge Planning	
Vessel crew	• Undertake fauna/turtle observation training • Installation of required equipment to reduce turtle entrainment and monitor for incidents
Wheatstone Environmental Advisors	• Development of management/mitigation strategies and objectives • Development of training packages
Trained crew member	• Assist with fauna training and observations • Provides input to inductions on fauna observations
Implementation	
Vessel Captain	• Ensure adequate reporting for marine observations and incidents
Vessel Crew	• Assists observing for turtles as per training
Wheatstone dredging representative	• Ensures implementation of Dredging and Spoil Disposal Management and Monitoring Plan
Trained crew member	• Records all turtle injuries and mortalities • Records all turtle observations
Site Environmental Advisor	• Co-ordinates environmental aspects of dredging and disposal • Assists with fauna training, observations and inductions
Monitor and Record Turtle Entrainment	
Trained crew member	• Record all observations in daily vessel log • Record all injuries or mortalities • Report all incidents
Vessel Captain	• Ensure all incidences are adequately reported
Incident Investigation	
A trained facilitator	• Facilitate incident investigation
The employee(s) or contractor(s) involved in the incident	• Participate in investigation
The supervisor of the people involved in the incident	• Participate in investigation
Specialists or subject matter experts	• Provides advice on alternative mitigation measures

Role	Responsibility
Implement Management	
Vessel Captain	• Ensures that any new recommendations for mitigation or management measures are implemented
Wheatstone dredging representative	• Co-ordinates operational aspects of dredging and disposal
Site Environmental Advisor	• Co-ordinates environmental aspects of dredging and disposal

Chevron has committed to the following management action to reduce risk of turtle entrainment:

1. Prior to the commencement of dredging, selected crew will receive training, which will include details on procedures in the event of turtle sightings, injury or death;
2. When operating with less than 5 m under-keel clearance, the dredge will initially move slowly through the area before commencing dredging so that the noise and vibration alerts marine turtles in the vicinity and encourage them to leave;
3. When initiating dredging, suction through dragheads will be initiated just long enough to prime the pumps, prior to drag heads engaging the seabed;
4. Dredge pumps will be stopped as soon as possible after completion of dredging and, where practical, the draghead remain within 0.5m of the seabed until the dredge pump has stopped;
5. Crew members trained to make observations of marine fauna on dredge vessels;
6. Tickler chains on draghead,
7. Screens on the overflow to allow for visual assessment if turtles have been entrained, and
8. Release of healthy entrained turtles back to the marine environment.

Step 2 Implementation

The following steps will be implemented to achieve the defined objectives:

- Check mitigation actions are in place before dredging.
- Ensure dredge staff are trained (see Action 1 above).

Chevron or their contractors will implement a monitoring program which will include the monitoring of the TSHD overflow screens to ensure in the event of a turtle fatality, the remains are collected and the incident reported and investigated. It is envisioned that identification of a turtle fatality will be by inspection at the conclusion of each dredging cycle by a suitably trained person.

Step 3 Monitor and Record Turtle Entrainment

Monitor and measure against objective.

Table 2: Proposed Monitoring Requirements

Monitoring Requirement	Method	Responsibility	Monitoring Frequency
Turtle Observations/ assessment of sea turtle presence	From-vessel observations	Trained crew member	Daily in vessel log
Turtle injury and mortality	Visual inspections of dredge dragheads	Trained crew member	End of each dredge cycle
	Visual inspections of overflow screens	Trained crew member	End of each dredge cycle
Adaptive Management Framework	Monitor effectiveness	Wheatstone Environmental Advisors	Annually

If turtle is entrained, go to Step 4.

Step 4 Incident Investigation – Post Entrainment Evaluation and Review

Complete *Turtle Entrainment Incident Investigation Report (*See ***Table 3*** *for Table of Content)*

The investigation should include:

- Identifying cause and effect
- Reviewing existing management controls and evaluate management effectiveness
- Documenting lessons learned
- Feeding new information back into the process
- Recommending follow-up action (Step 5)

Forward Incident Investigation Report to DEC for Review within 48 hr.

Step 5 Decide Whether to Escalate Management or Continue to Monitor Only

Deciding whether to escalate management will depend on:

- the effectiveness of current mitigation (has it worked)
- consequence of mortality event on local turtle population
- changes in dredge location and schedule

Further to the above, the following will be considered when reviewing management effectiveness: time since last entrainment (project level rate of entrainment); location in relation to nesting beach or foraging areas (e.g. reef); species and size (adult or juvenile) entrained; number and density of turtles caught; timing (mating, foraging and inter-nesting period); were controls correctly implemented; weather and conditions; and dredge status before the incident occurred (normal operations, startup, shutdown, maintenance).

Evaluate the potential consequence of the mortality event on local population of turtles and whether there is a need to escalate management. If it is deemed that additional mitigation measures are not required, the proponent will demonstrate that the risk of entrainment is as low as reasonably practical.

If escalation is deemed warranted, go to Step 6.

Step 6 Implement Management

Implement new management action.

Continue to monitor entrain after implementation of new mitigation (go back to Step 3).

Table 3: Proposed table of content for *Turtle Entrainment Incident Investigation Report*

Table of Contents	
Executive Summary	
1.0	Background Information
2.0	Timeline
3.0	Findings and Causes
4.0	Lessons Learned
5.0	Action Items
6.0	Attachments including photographs

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Appendix S2

Draft Trunkline Dredging and Spoil Disposal Management Plan

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TABLES

FIGURES

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No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
Water Quality and Benthic Primary Producer (BPP*) Management				
1	**Section 8.1.2**	Trailing Suction Hopper Dredges (TSHD) will be fitted with a turbidity-reducing valve within the overflow pipe.	Evidence of compliance provided by dredge contractor	Prior to commencement of TSHD operations
2	**Section 8.1.2**	Diffusers will be utilised during dredge material placement via the Cutter Suction Dredge (CSD).	Dredge vessel records	During offshore placement with CSD activities
3	**Section 8.1.2**	Where reasonably practicable, the works will be managed to reduce sediment re-suspension via propeller wash by controlling the under-keel clearance of the TSHD.	Dredge vessel records	When practicable
4	**Section 8.1.2**	During sediment transport by the TSHD and barges, the level of the overflow pipe will be raised to its highest point to reduce the potential for spillage.	Visual inspection	During all sediment transport by TSHD
5	**Section 8.1.2**	Hopper doors on the TSHD and barges will be maintained to reduce the potential for sediment loss during transport.	Evidence of compliance by dredge contractor	Prior to commencement of TSHD operations
6	**Section 8.1.2**	Well-maintained and properly calibrated dredging equipment will be utilised.	Dredge calibration records	Prior to commencement of dredge
7	**Section 8.1.2**	Hopper dewatering will be confined to areas away from sensitive receptors where reasonably practicable.	Dredge vessel records	Throughout TSHD operations
8	**Section 8.1.2**	Overflow will be restricted in designated Restricted Overflow Areas whenever sensitive receptors are considered to be at risk. An example is illustrated in Figure 8-3 however the areas will vary depending on conditions and dredging operations.	Throughout TSHD works	Throughout TSHD operations, dependent on weather conditions
9	**Section 8.1.2**	Impacts to BPPH will be minimised by limiting anchor and anchor chain interference by construction vessels to established ‘no anchor areas’.	Evidence of establishment of no anchor zones	Prior to vessel arrival on site
10	**Section 8.1.2**	The TSHD overflow will be calibrated to the green valve.	Dredge vessel records	Throughout TSHD operations
11	**Section 8.1.2**	In the event that dredging occurs concurrently with the Capital Dredging Campaign additional management measures will be implemented, including the following: ♦ Avoiding overlapping plumes from other dredging activities, either by avoiding simultaneous dredging and/or dredging in areas along the same plume extension	Dredge vessel records	Throughout concurrent operations

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
		direction ♦ Targeting seasons with the least risk of impacts, e.g. summer conditions when dredging east of Ashburton Island. ♦ Reducing total sediment release and release rates, e.g. through the choice of methodology or adapting methods of release reduction during the pipe laying.		
12	**Section 8.1.2**	A buffer of 0.5nm will be maintained around coral reefs (as illustrated in **Figure 8-4**) to limit stress associated with resuspension of sedimentation from propeller wash.	Dredge vessel records	Throughout works
13	**Section 8.1.2**	The floatel will be moored in areas where the seafloor is characterised by bare sand (Figure 4-5) without coral, seagrass or macroalage.	Vessel records	Throughout works
Water Quality and Benthic Primary Producer* (Hard Coral) Management				
14	**Section 8.1.2**	Responsive monitoring and associated tiered responsive management will be implemented to manage any potential impacts that increased turbidity may have on sensitive BPP. ♦ Water quality, gross sedimentation and coral health monitoring to be carried out throughout the dredging program and following completion of dredging. ♦ Implementation of a tiered management response program associated with water quality and coral health monitoring.	Water Quality and Coral Health Monitoring Reports	Throughout works
Benthic Primary Producer Habitat Management (Seagrass and filter communities)				
15	**Section 8.1.2**	Seagrass and filter feeder communities will not be included as a key sensitive receptors in the dredge monitoring program. However, Impact Monitoring will be carried out (refer to Section 9.4) to quantify any potential losses resulting from dredging and dredge material placement activities. Monitoring of seagrass and filter feeder communities will be carried out pre and post-dredging and dredge material placement activities.	Impact monitoring reports	Pre and post dredging
Marine Fauna Management				
16	**Section 8.2**	Personnel trained in marine fauna observations will be present on dredge vessels, during daylight hours.	Record of training courses	Throughout works
17	**Section 8.2**	Whales and dugong observations and response procedures, including not commencing dredging or dredge material placement if whales or dugongs are sighted within a 300 m	Mammal sighting reports	Throughout works

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
		observation zone and ceasing dredging activities if whales or dugongs enter a 100 m exclusion zone, further details are outlined in **Figure 8-4** of the DSDMP**.** If calves are present the exclusion zone will be extended to 300m.		
18	**Section 8.2**	Dolphin observations and response procedures including application of 100 m observation zone will be implemented during dredging and dredge material placement works as outlined in **Figure 8 4**.	Mammal sighting reports	Throughout works
19	**Section 8.2**	A trained crew member will maintain a watch, during daylight hours, for whales, dolphins and dugongs while any dredge is en route to and from the dredge area to dredge material placement sites. If sighted, direction/speed will be adjusted to avoid potential impact (within the safety constraints of the vessel) to marine mammals.	Mammal sighting reports	Throughout works
20	**Section 8.2**	Dredge vessels associated with trunkline prelay dredging will transit along the corridors when working at the shorecrossing location out to KP3 and will utilise more direct routes, that avoid sensitive receptors, when working beyond this point.	Dredge logs	Throughout works
21	**Section 8.2**	Management of cetacean interactions will be in accordance with the requirements for cetacean interactions specified under Part 8 of the EPBC Regulations 2000 (Cth), and the Australian National Guidelines for Whale and Dolphin Watching.	Mammal sighting reports	Throughout works
22	**Section 8.2**	The presence of cetaceans/dugongs in or near exclusion zones established for key dredging and construction activities will be recorded.	Record of mammal sightings	Throughout works
23	**Section 8.2**	Dredge pumps will be stopped as soon as practicably possible after completion of dredging and where reasonably practicable the draghead will remain within 0.5 m of the seabed until the dredge pump is stopped.	Dredge vessel reports	Throughout works
24	**Section 8.2**	When operating with less than 5 m under-keel clearance, the TSHD will initially move slowly through the area before commencing dredging so that associated noise and vibration will alert marine turtles in close proximity and encourage them to leave. This will only be applied to dredging in new areas and not once the work area has been established.	Dredge vessel reports	Throughout works
25	**Section 8.2**	When initiating dredging, suction through dragheads will be initiated just long enough to prime the pumps, prior to drag heads engaging the seabed.	Dredge vessel reports	Throughout works
26	**Section 8.2**	Tickler chains on the draghead of the TSHDs will be used as a management mitigation approach to reduce turtle entrainment.	TBC	Throughout works
27	**Section 8.2**	Overflow screens will be used on TSHDs to visually assess for turtles and turtle remains associated with entrainment during dredging.	TBC	Throughout works
28	**Section 8.2**	Mooring at night will not take place at night during Nov-April, the turtle nesting season,	Vessel reports	Throughout dredging

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
		within 1.5 km of nesting beaches.		works from Nov-April
29	**Section 8.2**	The Proponent will provide marine fauna aerial sighting data (as presented in the EIS/ERMP) for Department of Environment and Conservation (DEC) planning purposes in the Onslow region.	TBC	TBC
30	**Section 8.2**	Boats and recreational vehicles will not be permitted within the workforce accommodation village or the access road from the Onslow Road.	TBC	Throughout works
31	**Section 8.2**	Conservation and induction programs will be established to ensure staff/contractors are informed of DEC rules relating to offshore nature reserves.	Record of inductions	Prior to staff/contractors mobilisation
Introduced Marine Pests (IMP) Management				
32	**Section 8.3.2**	All dredging and support vessels will be subjected to a risk assessment to assess whether the vessel presents a low, high or uncertain risk of acting as a vector for IMP. The risk assessment will be based on the vessel's recent history and origin, recent inspections, anti-fouling coating status and whether it will be undertaking a direct sail from its point of origin.	Vessel Risk Assessment Pre-mobilisation "Assessment Report"	Throughout works
33	**Section 8.3.2**	All dredging and support vessels determined to be of uncertain or high risk will be subjected to a pre-mobilisation inspection and will not be mobilised until determined to be a low IMP risk.	Vessel Inspection Checklist Pre-mobilisation "Assessment Report"	Throughout works
34	**Section 8.3.2**	All dredges will comply with the Australian Quarantine Regulations 2000 and with the AQIS mandatory ballast water requirements.	Dredge Vessel Ballast Water Logbook	Throughout works
35	**Section 8.3.2**	In the event that IMP are identified on the dredging or support vessels during the arrival inspection or at any time while the construction vessel is on site: ♦ The Department of Fisheries (DoF) and DEC will be notified. ♦ The dredging or support vessel will be moved offshore as soon as practicably possible. Within vessel operating constraints, the construction vessel should be moved to offshore waters, greater than 12 nm from shore or to a water depth greater than 50 m. ♦ The dredging or support vessel will not be permitted to return to site until it has undergone treatment and re-inspection to confirm that the vessel is a low risk. The mobilisation procedure described above will be required to be followed including the mandatory arrival inspection with 48 hours of arrival on site. ♦ A detailed response plan including monitoring and control measures will be	IMP incident report. Detailed response plan developed	In the event of identification of invasive marine pests on construction vessels

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
		developed and implemented. This plan will aim to determine if the identified species has become established and if measures to control the species are required.		
Dredge Material Placement Area Management				
36	**Section 8.4.2**	The placement of dredge material will comply with the requirements of the Sea Dumping Permit (SDP), including: ♦ Establish by Differential Global Positioning System (DGPS) that, immediately prior to dredge material placement, the vessel is within the approved dredge material placement area. ♦ Any dredge used in connection with the dredge material placement activities and any associated towing vessels must comply with the relevant state, national or international standards with respect to seaworthiness, safety and environmental requirements, or any rules or conditions laid down by the certifying classification society, and be capable of disposing dredged material at the dredge material placement sites in accordance with the SDP. ♦ Marine mammal management procedures as detailed in **Section 8.2** will be followed during dredge material placement activities. ♦ Records comprising either weekly plotting sheets or a certified extract of the ship's log will be retained (for verification and auditing purpose), which detail: ○ the times and dates of when each dredge material placement run is commenced and finished; ○ the position (as determined by DGPS) of the vessel at the beginning and end of each dredge material placement run, with the inclusion of the path of each dredge material placement run; and ○ the volume of dredge material (in cubic metres) dumped and quantity (in dry tonnes) for the specified operational period and compare these quantities with the total amount permitted under the SDP.	Dredge Logs, dredge vessel reports	Throughout works
37	**Section 8.4.2**	A bathymetric survey of the dredge material placement areas will be undertaken: ♦ Prior to the commencement of dredging. ♦ Within two months of the completion of all dredge material placement activities authorised under the SDP.	Sea dumping compliance reports	Pre-dredging and two months post-dredging
Waste Management				

No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
38	**Section 8.5.2**	Adherence to the requirements of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and MARPOL 73/78 Convention Annex IV (Sewage) and Annex V (Garbage).	Regular audits	Throughout works
Hydrocarbon Management				
39	**Section 8.6.2**	Hazardous material storage areas will be designed to handle the volumes and operating conditions specifically required for each substance, including product identification, transportation, storage, control and loss prevention (e.g. bunding and drainage).	Regular audits	Throughout works
40	**Section 8.6.2**	Industry standards, port authority and pollution prevention regulations will be adhered to during refuelling, transfer, storage and handling of hazardous materials (e.g. bunding, level gauges, overflow protection, drainage systems and hardstands).	Regular audits	Throughout works
41	**Section 8.6.2**	Hazardous materials (including hazardous waste) will be stored in appropriately labelled drums or tanks. Complete up to date list of material safety data sheets (MSDS) will be available and stored with relevant products.	Regular audits	Throughout works
42	**Section 8.6.2**	The hydraulic oil system will be high quality, well-maintained and regularly inspected.	Regular audits	Throughout works
43	**Section 8.6.2**	The main hydraulic system on each dredging vessel will be equipped with standard low pressure alarms and shut down systems to limit hydrocarbon loss in the event of a burst hydraulic hose.	Regular audits	Throughout works
44	**Section 8.6.2**	Detailed refuelling procedures will be developed by the dredge contractor prior to commencement of work on site and will include the following requirements: ♦ Fuel transfer to occur in accordance with port authority and pollution regulations. ♦ Specific safety boundaries used when refuelling. ♦ Requirement of refuelling to be undertaken in fair weather conditions to reduce risk of spills. ♦ Requirement for open communication channels to be maintained during refuelling. ♦ Instructions for visual monitoring.	Refuelling procedures developed by contractor	Prior to commencement of works

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No	Reference	Commitment	Criteria (Evidence to Collect)	Timing
		♦ Emergency response procedures.		
45	**Section 8.6.2**	Personnel involved with refuelling or fuel transfer will be trained in their roles, functions and responsibility, including emergency response, prior to engaging in refuelling or fuel transfer.	Induction records	Prior to commencement of works
46	**Section 8.6.2**	All vessels greater than 400 gross tonnage will have bilge oil/water separators that comply with the requirements of Annex I of MARPOL 73/78 and Part II of the Protection of the Sea (Prevention of Pollution from Ships) Act 1993 (Cth) so that that oil concentrations in discharges are less than 15 ppm.	Regular audits	Throughout works
47	**Section 8.6.2**	Drainage from decks and work areas with potential for oil, grease or hydrocarbon contamination will be collected and processed through an oil/water separator and managed according to International Oil Pollution Prevention (IOPP) procedures prior to discharge or stored for onshore placement.	Regular audits	Throughout works
48	**Section 8.6.2**	Sufficient and appropriate equipment, materials and resources will be available to: ♦ Prevent spills to marine environment from working machinery (e.g. spill trays, one-way valves or other spill prevention features); ♦ Respond to spills to the marine environment; and ♦ Respond to spills to ground (on board vessels).	Regular audits	Throughout works
49	**Section 8.6.2**	The dredge contractor will comply with and align spill response preparedness with the Oil Spill Contingency Plan (OSCP).	Regular audits	Throughout works
50	**Section 8.6.2**	All relevant personnel will be trained in spill response and reporting.	Induction records	Prior to commencement of works
51	**Section 8.6.2**	All vessels will have a current IOPP Certificate issued by the state in which the vessel is registered and an approved Shipboard Oil Pollution Emergency Plan (SOPEP).	Regular audits	Throughout works
52	**Section 8.6.2**	If vessel does not have an existing approved SOPEP, the vessel will prepare a vessel specific Spill Contingency Plan (SCP) that bridges to the Chevron OSCP to enable an effective, integrated response to any spill.	Spill contingency plan developed	Prior to commencement of works
53	**Section 8.6.2**	Onboard spills will be contained and cleaned up immediately and will not be washed overboard. Product MSDSs will be adhered to during clean-up.	Regular audits	Throughout works

* Benthic Primary Producer Habitats (BPPH) are defined by the EPA (2009b) as functional ecological communities that inhabit the seabed within which algae (e.g. macroalgae, turf and benthic microalgae), seagrass, mangroves, corals or mixtures of these groups are prominent components. BPPH also indlude areas of seabed that can support these communities.

* Benthic Primary Producers (BPP) are defined in the EIS/ERMP as 'marine plants' such as mangroves, salt marsh, intertidal algal mats, seagrasses and algae- including benthic macroalgae, turf algae and sand algae. BPP also includes some invertebrates such as hard corals and some filterfeeders such as sponges and soft coral which obtain a proportion of their energy requirements from photosynthetic symbiotic macroalgae in their tissues.

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ACRONYMS AND ABBREVIATIONS

ABU	Australasian Business Unit
ADCP	Acoustic Doppler Current Profiler
ALARP	As Low as Reasonably Practicable
ANZECC	Australian and New Zealand Environment Conservation Council
APPEA	Australian Petroleum Production and Exploration Association
AQIS	Australian Quarantine and Inspection Service
BPP	Benthic Primary Producers
BPPH	Benthic Primary Producer Habitat
CAMBA	China-Australia Migratory Bird Agreement
CCIMPE	Coordinating Committee for Introduced Marine Pest Emergencies
CD	Chart Datum
CSD	Cutter Suction Dredge
Chevron ABU	Chevron Australasia Business Unit
Cth	Commonwealth
DBNGP	Dampier Bunbury Natural Gas Pipeline
DEC	Department of Environment and Conservation (state)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth)
DoE	Department of Environment (state), now the DEC
DoF	Department of Fisheries (state)
Domgas	Domestic gas
DPI	Department for Planning and Infrastructure (State)
DSDMP	Dredging and Spoil Disposal Management Plan
EA	Environment Australia (now DSEWPaC)
ECU	Ecosystem Unit
EIS/ERMP	Environmental Impact Statement/Environmental Review and Management Programme
EMP	Environmental Management Plan
OEPA	Office of the Environmental Protection Authority (state)
EPBC Act (Cth)	*Environmental Protection and Biodiversity Conservation Act 1999*
EQO	Environmental Quality Objective
EQC	Environmental Quality Criteria
FCC	Fouling Control Coat
IMO	International Maritime Organisation
IMP	Introduced Marine Pests
IOPP	International Oil Pollution Prevention
JAMBA	Japanese-Australia Migratory Bird Agreement
KPI	Key Performance Indicators
KP	Trunkline Kilometre Point
LAT	Lowest Astronomical Tide
LEP	Level of Environmental Protection
LNG	Liquefied Natural Gas
MCMP	Marine and Coastal Management Plan
MEB	Marine Ecosystem Branch

Mm^3	Million cubic metres
MODIS	Moderate Resolution Imaging Spectroradiometer
MOF	Materials Offloading Facility
MSDS	Material Safety Data Sheet
Mtpa	Million tonnes per annum
NADG	National Assessment Guidelines for Dredging
NIMPCG	National Introduced Marine Pests Coordination Group
NTU	Nephelometric Turbidity Units
OBC	Outcome Based Conditions
OE	Operational Excellence
OEMS	Operational Excellence Management System
OSCP	Oil Spill Contingency Plan
PLF	Product Loading Facility
ppm	Parts per million
PWQMG	Pilbara Water Quality Management Guidelines
SDP	Sea Dumping Permit
SSC	Suspended Sediment Concentration
SWQMG	State Water Quality Management Guidelines
TSHD	Trailing Suction Hopper Dredge
WA	Western Australia

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1.0 INTRODUCTION

1.1 Wheatstone Project

Chevron Australia Pty Limited (Chevron Australia) proposes to construct and operate a multi-train Liquefied Natural Gas (LNG) and domestic gas (Domgas) plant near Onslow on the Pilbara Coast, Western Australia. The Wheatstone Project (the Project) will process gas from various fields located offshore in the West Carnarvon Basin. Ashburton North is the proposed site for the LNG and Domgas plants. The Project will require the installation of gas gathering, export and processing facilities in Commonwealth and State waters and on land. The Project will produce gas from petroleum titles WA-253-P, WA-17-R, WA-356-P and WA-16-R, located 145 km offshore from the mainland, approximately 100 km north of Barrow Island and 225 km north of Onslow. **Figure 1-1** shows the location of the Project.

The Ashburton North site is located approximately 12 km south-west of Onslow along the Pilbara coast within the Shire of Ashburton. The initial Project is expected to consist of two LNG processing trains, each with a capacity of between 4 and 7 million tonnes per annum (Mtpa). Environmental approval is being sought for a 25 Mtpa plant to allow for the expected further expansions. The Domgas plant will be a separate but co-located facility and will form part of the Project. The development of the Domgas plant also includes onshore pipeline installation to tie-in to the existing Dampier-to- Bunbury Natural Gas Pipeline (DBNGP) infrastructure.

One of the major infrastructure components for the Project is the installation of the trunkline. The trunkline will be approximately 225 km long and will operate as an export pipeline, to transfer gas and condensate from the offshore Wheatstone production platform to onshore gas processing facilities.

1.2 Proponent

Chevron Australia is the sole proponent of the Project.

1.3 Aim of Plan

The aim of this Draft Dredging and Spoil Disposal Management Plan (DSDMP) is to manage the potential environmental impacts from the dredging and dredge material placement activities associated with the trunkline installation in a manner that achieves the environmental objectives as detailed within the Environmental Impact Statement/Environmental Review and Management Programme (EIS/ERMP). Outcomes based environmental conditions developed for the Project will be included within the Draft DSDMP following review of the EIS/ERMP by the Office of the Environmental Protection Authority (OEPA) and the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC).

As required by Condition XX of the proposed environmental conditions, the finalised DSDMP will:

1) provide a management structure to achieve the environmental objectives outlined within the Outcome Based Conditions (OBC) relating to dredging and dredge material management, in particular the OBCs relating to management of marine benthic communities (including hard coral, seagrass and filter feeder communities) and marine fauna;

2) provide monitoring programs suitable to show compliance with the OBCs relating to dredging and dredge material management

HOLD – the Outcome Based Conditions are still under development and once finalised this Draft DSDMP will updated accordingly to ensure that the methods/approaches used achieve the relevant OBC

The finalised DSDMP will address the requirements of applicable State Ministerial Conditions, Commonwealth Approvals Decision and the Commonwealth Sea Dumping Permit (SDP).

NOTE: This draft document is considered incomplete, pending input from various parties. Various "Hold" points are identified throughout the document where data gaps or other inputs are required.

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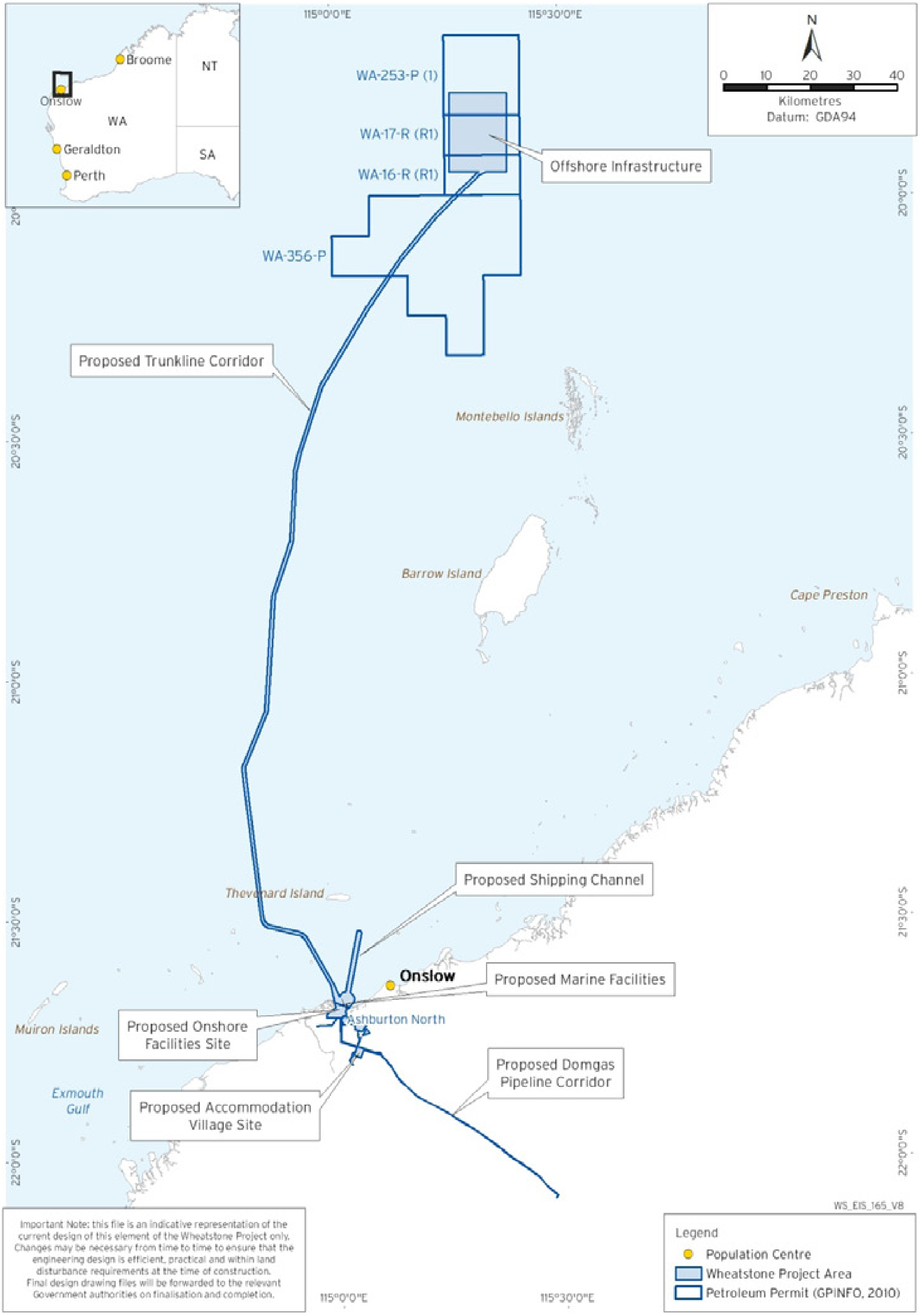

Figure 1-1: Location of Wheatstone Project Area

1.4 Scope

This Draft DSDMP addresses the proposed environmental management and monitoring of dredging and dredge material placement activities associated with the installation of the trunkline component of the Project, which include:

- microtunelling for the shore crossing section;
- trenching (dredging) and stabilisation (backfill) for the nearshore section; and
- placement of dredge material at nearshore and/or offshore dredge material placement sites.

Drilling and blasting activities are not a component of the trunkline installation methods and consequently potential environmental impacts, management and monitoring associated with drilling and blasting activities are not addressed within this Draft DSDMP. In the event that drilling and blasting activities are required for the installation of the trunkline, following further evaluations of the geophysical and geotechnical data, the associated impacts will be managed in a separate management plan.

1.5 Legislative Requirements

The applicable Commonwealth and State legislation pertinent to the activities described with this plan includes, but is not limited to, the following Acts and Regulations (and relevant amendments):

State

- *Wildlife Conservation Act 1950 (WA);*
- *Environmental Protection Act 1986 (WA);*
- *Environmental Protection Regulations 1987;*
- *Pollution of Waters by Oil and Noxious Substances Act 1987 (WA);*
- *Pollution of Waters by Oil and Noxious Substances Regulations 1993 (WA);*
- *Conservation and Land Management Act 1994 (WA);*
- *Fish Resources Management Act 1994;*
- *Marine and Harbours Act 1981;*
- *Petroleum (Submerged Lands) Act 1982;*
- *Wildlife Conservation Regulations 1970; and*
- *Shipping and Pilotage Act 1967.*

Commonwealth

- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act);*
- *Environment Protection (Sea Dumping) Act 1981;*
- *Environment Protection (Sea Dumping) Regulations 1983;*
- *Australian Ballast Water Management Requirements 2001;*
- *Australian Quarantine Regulations 2000;*
- *Protection of the Sea (Prevention of Pollution from Ships) Acts 1983;*
- *Marine Act 1982; and*

- *Navigable Waters Regulations 1958.*

1.6 Chevron Policy 530

The Chevron Australasia Business Unit (ABU) has stated its commitment to achieving operational excellence in ABU Policy 530 (**Figure 1-2**). The Chevron ABU strives to achieve operational excellence (OE) through the implementation of the ABU Operational Excellence Management System (OEMS).

Chevron Australia is committed to implementing the Project in accordance with ABU Policy 530.

1.7 APPEA Code of Environmental Practice

The Australian Petroleum Production and Exploration Association (APPEA) Code of Environmental Practice (Australian Petroleum Production and Exploration Association 2008) is the most relevant Code of Practice for production operations in Australia. Specific requirements of the APPEA Code of Environmental Practice that are relevant to dredging and dredge material placement include:

- Compliance with applicable laws, regulations, standards and guidelines and, in their absence, adopting the best practicable means to prevent or minimise adverse environmental impacts.
- Providing adequate training to enable employees and contractors to adopt environmentally responsible work practices.
- Developing emergency plans and procedures so that incidents can be responded to in a timely and effective manner.
- Developing and maintaining management systems to identify, control and monitor risks.
- Identifying elements of the environment with natural, cultural, scientific or other significance which require avoidance (e.g. shipwrecks, reefs) or special protection procedures.
- Identifying and addressing special impacts from construction and installation techniques.
- Minimising air emissions and water discharges.
- Managing all waste materials generated and chemicals utilised in the construction and commissioning phase in accordance with site waste and chemical management plans and relevant regulations.

ABU

Policy 530 - Operational Excellence
Achieving World-Class Performance

Chevron
Human Energy™

It is the policy of Chevron Corporation to protect the safety and health of people and the environment and to conduct our operations reliably and efficiently. The systematic management of **safety, health, environment, reliability and efficiency** to achieve world-class performance is defined as Operational Excellence (OE). Our commitment to OE is embodied in The Chevron Way value of protecting people and the environment, which places the highest priority on the health and safety of our workforce and protection of our assets and the environment.

We will accomplish this through disciplined application of our Operational Excellence Management System (OEMS). Our OEMS consists of three parts: Leadership Accountability, Management System Process and OE Expectations.

Leadership is the largest single factor for success in OE. Leaders are accountable not only for achieving results, but achieving them in the right way by behaving in accordance with our values. Leaders direct the Management System Process to drive improvement in OE results. The Management System Process consists of five steps:

Vision and Objectives	Developing an OE vision, world-class objectives, metrics and targets based on corporate objectives, benchmarking data and other applicable critical business drivers.
Assessment	Completing a comprehensive evaluation to identify priority areas in OE processes and performance against established objectives.
Planning	Developing three-year plans to manage priorities and incorporating those plans into business plans and assigning accountabilities.
Implementation	Implementing planned actions and monitoring plan progress and OE performance.
Review	Annually evaluating progress on performance and identifying necessary adjustments to plans that result in the goal of achieving world-class results.

We will assess and take steps to manage potential risks to our employees, contractors, the public and the environment within the following framework of OE Expectations:

1. **Security of Personnel and Assets** Providing a secure environment in which business operations may be conducted successfully.
2. **Facilities Design and Construction** Designing and constructing facilities to prevent injury, illness and incidents and to operate reliably, efficiently and in an environmentally sound manner.
3. **Safe Operations** Operating and maintaining facilities in a manner that does not cause injuries, illnesses or incidents.
4. **Management of Change** Managing both permanent and temporary changes to prevent incidents.
5. **Reliability and Efficiency:**
   - Reliability - Operating and maintaining facilities to sustain mechanical integrity and prevent incidents.
   - Efficiency - Maximizing efficiency of operations and conserving natural resources.
6. **Third-Party Services** Systematically addressing and managing contractor conformance to OE through contractual agreements.
7. **Environmental Stewardship** Working to prevent pollution and waste; striving to continually improve environmental performance and limiting impacts from our operations.
8. **Product Stewardship** Managing potential risks of our products throughout the products' life-cycles.
9. **Incident Investigation** Investigating incidents to identify, broadly communicate and correct root causes of incidents to reduce the likelihood of recurrence.
10. **Community Awareness and Outreach** Reaching out to the community and engaging in open dialogue to build trust.
11. **Emergency Management** Having preparedness plans in place to quickly and effectively respond to and recover from any emergency.
12. **Compliance Assurance** Complying and verifying conformance with company policy and all applicable laws and regulations; applying responsible standards where laws and regulations do not exist; enabling employees and contractors to understand their safety, health and environmental responsibilities.
13. **Legislative and Regulatory Advocacy** Working ethically and constructively to influence proposed laws and regulations, and debate on emerging issues.

Roy Krzywosinski, Managing Director
25/02/2008

Figure 1-2: Chevron ABU Policy 530

1.8 International Conventions

International agreements applicable to this Draft DSDMP include, but are not limited to:

- The 1996 London Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (ratified by Australia in 2000);
- The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the protocol of 1978 (MARPOL 73/78) (International Maritime Organization 1973);
- The Convention on the Conservation of Migratory Species of Wild Animals (Secretariat of the Convention for the Conservation of Migratory Species of Wild Animals 1979);
- Japan-Australia Migratory Bird Agreement (JAMBA);
- China-Australia Migratory Bird Agreement (CAMBA); and
- The International Convention for the Control and Management of Ship's Ballast Water and Sediments (note: subject to ratification by the International Maritime Organisation - IMO).

1.9 Relevant Standards

A number of Australian Standards are relevant to various aspects of this Draft DSDMP. These include, but are not limited to:

- Australian Standard/New Zealand Standard (AS/NZS) ISO 14001:2004 Environmental Management Systems – Requirements with Guidance for Use (Standards Australia/Standards New Zealand 2004): specifies the requirements for an environmental management system to enable the development and implementation of a policy and objectives which takes into account legal requirements and includes information about significant environmental aspects.
- AS/NZS 4360:2004 Risk Management (Standards Australia/Standards New Zealand 2004a): provides a generic guide for managing risk and specifies the elements of risk management systems.
- HB 203:2006 Environmental Risk Management – Principles and Process (Standards Australia/Standards New Zealand 2006): is based on the generic risk management process developed in AS/NZS 4360:2004, but explains the principles and process of environmental risk management, and provides guidance on implementation.
- AS 1940:2004 The Storage and Handling of Flammable and Combustible Liquids (Standards Australia 2004).

1.10 Regulatory Guidance

A number of government strategy and guideline documents have been developed to provide advice to proponents in the development of environmental management and monitoring programs. In the development of the Draft DSDMP the following documents, both Commonwealth and State, have been considered:

Commonwealth

- National Assessment Guidelines for Dredging (Commonwealth Government of Australia 2009);

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000);
- National Strategy for Ecologically Sustainable Development (Commonwealth Government of Australia 1992);
- National Water Quality Management Strategy (Commonwealth Government of Australia 1992a);
- Intergovernmental Agreement on the Environment (Commonwealth Government of Australia 1992b);
- National Strategy for Conservation of Australia's Biological Diversity (Commonwealth Government of Australia 1996); and
- Intergovernmental Agreement on a National System for the Prevention and Management of Marine Pest Incursions, April 2005.

Western Australia

- The Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives (DoE 2006);
- State Water Quality Management Strategy (Document No. 6) (Government of Western Australia 2004);
- WA EPA Environmental Assessment Guidelines No. 3 – Protection of Benthic Primary Producer Habitats in Western Australia's Marine Environment (Environmental Protection Authority 2009);
- WA EPA Guidance Statement No. 1 – Protection of Tropical Arid Zone Mangroves Along the Pilbara Coastline (Environmental Protection Authority 2001);
- WA EPA Environmental Assessment Guidelines No. 4 – Towards Outcome-based Conditions, Draft, December 2009 (Environmental Protection Authority 2009c); and
- WA EPA Environmental Assessment Guidelines No. 7 – Marine Dredging Proposals, Draft, October 2010 (Environmental Protection Authority 2010).

1.11 Existing Management Frameworks

The Pilbara Coastal Water Quality Consultation Outcomes – Environmental Values and Environmental Quality Objectives (DoE 2006) provides various environmental values and Environmental Quality Objectives (EQOs) as a guideline for management of water quality in the Pilbara.

The guidelines recommend a set of environmental values and spatially-allocated EQOs and Levels of Ecological Protection (LEP) for the Pilbara coastal waters (DoE 2006). The LEPs are defined from low to maximum: where areas defined as:

- 'low' LEP have high levels of contaminants and are largely changed from natural variation;
- 'moderate' LEP have elevated levels of contaminants with moderate changes from natural variation;
- 'high' LEP have very low levels of contaminants and no detectable changes from natural variation; and
- 'maximum' LEP are considered pristine with no contaminants above background levels.

The Project EIS/ERMP details the key water quality values and sensitivities in the Ashburton North area. These environmental values include ecosystem health, recreational and aesthetic values, commercial and recreational fishing and aquaculture activities, cultural and spiritual values and industrial water supply.

Table 1-1 outlines the environmental values, the EQOs and the Environmental Quality Criteria (EQC) for the Ashburton North areas and the management strategies and performance monitoring that will be applied to meet these objectives.

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Table 1-1: Pilbara Water Quality Objectives and Management Response

Environmental Values	Context	Environmental Quality Objectives	Environmental Criteria	Management Strategies
Ecosystem Health (ecological value)	Majority of the marine area adjacent to Onslow has a high LEP. Potential dredge material placement areas have a moderate LEP. Small areas of significant arid zone mangroves adjacent to the mouth of the Ashburton River have a maximum LEP. No existing or proposed marine conservation reserves nearby. Areas south of the Ashburton River mouth and around Serrurier Island are currently classified as biological study areas (Department of Environment and Conservation 2008).	Maintain Ecosystem Integrity.	Limit impacts to biological receptors to within predicted and approved limits	♦ **Section 8.1.2** – Benthic Primary Producer Habitat (Hard Coral) Management ♦ **Section 1.1.1** – Benthic Primary Producer Habitat (Mangroves) Management ♦ **Section 8.2** – Marine Fauna Management ♦ **Section 8.3** – Invasive Marine Species Management ♦ **Section 8.4** – Dredge Material Placement Area Management ♦ **Section 8.5** – Waste Management ♦ **Section 8.6** – Hydrocarbon Management
Recreation and Aesthetics (social value)	Recreational boating occurs from Onslow Maritime Facility in Beadon Creek. Onshore and offshore fishing including residential facilities on the Mackerel Islands. Diving and snorkelling around the reefs and islands.	Water quality is safe for activities on and in the water (e.g. swimming and boating). Aesthetic values of the marine environment are protected.	<Hold> to be included in future revision	♦ **Section 8.1.2** – Benthic Primary Producer Habitat (Hard Coral) Management ♦ **Section 8.5** – Waste Management ♦ **Section 8.6** – Hydrocarbon Management
Cultural and Spiritual	<Hold> to be included in future revision	Cultural and spiritual values of the marine environment are protected.	<Hold> to be included in future revision	<Hold> to be included in future revision
Fishing and Aquaculture (social	Onslow Prawn Managed	Fish and seafood (caught or	Relevant criteria from Food	♦ **Section 8.3** – Invasive

Environmental Values	Context	Environmental Quality Objectives	Environmental Criteria	Management Strategies
value)	Fishery. Pilbara Fish Trawl (Interim) Managed Fishery.	grown) is of a quality safe for human consumption. Water quality is suitable for aquaculture purposes.	Standards Australian New Zealand code. Relevant ANZECC guidelines for LEP	Marine Species Management ♦ **Section 8.5** – Waste Management ♦ **Section 8.6** – Hydrocarbon Management
Industrial Water Supply	<Hold> to be included in future revision	Water quality is suitable for industrial supply purposes.	<Hold> to be included in future revision	

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1.12 Wheatstone Project Approvals

The Project was referred to the Western Australian Environmental Protection Authority (EPA) under the *Environmental Protection Act 1986* (EP Act) in October 2008. The EPA set the level of assessment as an ERMP. The proposal was also referred to the DSEWPaC under the Commonwealth *Environment Protection Biodiversity and Conservation Act 1999* (EPBC Act). It was determined by the DSEWPAC that the proposal is a controlled action and the level of assessment was set as an EIS. The Wheatstone EIS/ERMP is being assessed through a parallel process.

The Project, including the installation of the trunkline component, also involves the placement of dredge material at sea within both Commonwealth and State waters and therefore requires an SDP under the *Environmental Protection (Sea Dumping) Act 1981.* The identified environmental impacts related to the SDP for the management of dredge material management will be assessed as part of the EIS/ERMP under the *EPBC Act (*Cth*),* as agreed with DSEWPAC.

1.13 Requirements

This Draft DSDMP has been developed to comply with the anticipated State and Commonwealth Ministerial Conditions and to be in accordance with Chevron Australia environmental procedures. This Draft DSDMP details the procedures for the dredging campaign and the management of dredge material transportation and placement in order to minimise the environmental risks associated with the project to ‘as low as reasonably possible’ (ALARP).

The finalised DSDMP will include the approved Ministerial conditions that pertain to the trunkline component of the dredging operations and a cross reference to the section of the DSDMP where the management and/or monitoring requirements are addressed.

1.14 Stakeholder Consultation

The Project stakeholder consultation strategy has been developed in alignment with the Interim Industry Guidelines to Community Involvement (Department of Environment 2003), the International Association for Public Participation Guidelines for best practice in Social Impact Assessment (International Association for Public Participation Australasia 2004) and Chevron’s corporate values (Chevron Australia 2009a).

Consultation was undertaken with government, non-government organisations, indigenous organisations, Onslow residents, tourists and the private sector as part of the development of the EIS/ERMP. The aims, methods and outcomes of stakeholder consultation are presented in **Section 5** of the EIS/ERMP.

The main objectives of the consultation process were to:

- Identify regulatory stakeholder and community stakeholder issues, concerns and potential impacts in relation to the Project.
- Validate community issues and provide further information on the Project through the preparation of appropriate communication materials and engagement forums.
- Identify appropriate strategies to address potential adverse impacts and enhance positive impacts associated with the Project.
- Incorporate social, economic, health and environmental issues raised by stakeholders in Project design, planning and management commitments.

A number of environmental issues were raised by regulatory and community stakeholders and these issues are summarised in **Section 5.6** of the EIS/ERMP. The potential impacts from large-scale dredging on Benthic Primary Producer Habitats (BPPH) and marine fauna was the most commonly raised concern by the regulatory stakeholders. The impacts and management of the potential influx of Project construction and operational workforces was one of the major concerns raised by community stakeholders.

Key potential impacts of concern were addressed in the risk assessments presented in **Section 8 to 10** of the EIS/ERMP and consultation is still ongoing for some potential impacts that were raised. Further regular consultation is also proposed to identify monitor and manage key issues and relevant impacts throughout each phase of the Project.

1.15 DSDMP Approval, Review and Distribution

This Draft DSDMP has been prepared as a supplement to the Wheatstone EIS/ERMP in order to outline the management and mitigation measures proposed for management of the environmental risks associated with the dredging and dredge material management activities (**Figure 1-3**). The management measures to be implemented for some elements of risk (such as accidental spills of hazardous chemicals or hydrocarbons) are presented in detail as standard approaches that will be followed in accordance with the regulatory framework. However, management measures for other components of environmental risk (e.g. the risk of mortality to corals from elevations of suspended sediment in the water column) are conceptual with more detail required once State and Commonwealth Ministerial Conditions have been set.

On completion of the environmental approvals process, this Draft DSDMP will be finalised. The final DSDMP will address the requirements of the State Ministerial Conditions, Commonwealth approvals decisions and the SDP. The final plan will be made publicly available in an approved manner.

In the event there is a significant change in the methods of the dredging works after this plan has been finalised, the plan will be reviewed. The review will include a reassessment of the environmental risks presented by the works and the corresponding management strategies being implemented. Where considered necessary, this plan will be updated to reflect the re-assessment.

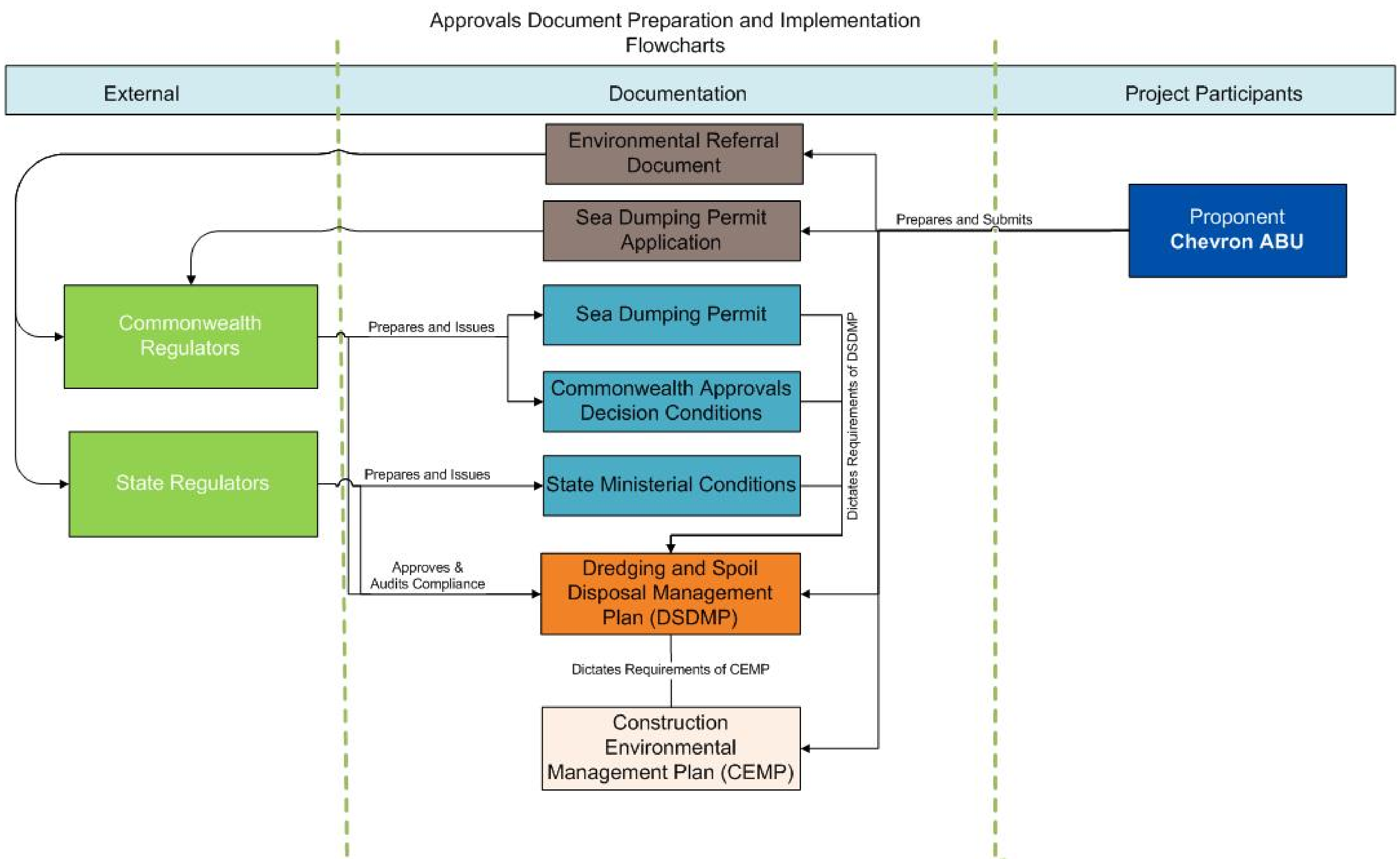

Figure 1-3: Approvals Document Preparation and Implementation Flowchart

2.0 PLAN STRUCTURE

This Draft DSDMP describes an outcomes based management approach for the environmental management of the dredging and dredge material management.
The Plan is structured as follows:

- **Section 3** of this plan details the methods and results of the Environmental Risk Assessment that has been undertaken.
- **Section 4** of this plan provides an overview of the applicable works
- **Section 5** details the environmental management structure that will be implemented.
- **Section 6** provides a high-level overview of the existing environment and the key studies that have been completed.
- **Section 7** details the results of the sediment plume modelling and the development of the relevant impact zones that will be applied.
- **Section 8** details the management strategies that will form the monitoring program. The management strategies provide the outcomes and performance objectives/indicators against which environmental performance will be measured. The structure of each individual management strategy is shown in **Table 2-1.**
- **Section 9** presents the options for monitoring and inspection under consideration.
- **Section 10** details the reporting requirements for the project under consideration.

Table 2-1: Structure of Management Strategies

Management Area:	**Specific factor to be managed**
Performance Objective:	The applicable performance objectives against which environmental performance will be measured.
Management:	The proposed management strategies including trigger levels and responses and contingency measures.
Monitoring:	The applicable proposed monitoring programs.
Reporting:	The required reporting including frequency and recipient.
Risk Assessment:	The residual risk ranking (i.e. end risk, taking into consideration management and monitoring measures).

3.0 ENVIRONMENTAL RISK ASSESSMENT AND PERFORMANCE MEASUREMENTS

3.1 Overview

A series of environmental risk assessments have been completed to identify the most significant risks, these risks will be the focus of environmental management and monitoring. The risk assessments have addressed each aspect of the Project including the dredging and dredge material management activities for the trunkline installation. The risk assessments have been undertaken in two phases:

- Phase 1 – An environmental risk assessment was conducted during the scoping phase of the Project to identify key areas of environmental risk requiring detailed assessment.
- Phase 2 – A detailed environmental risk assessment was conducted during the preparation of the EIS/ERMP and the Draft DSDMP. This assessment reviewed the environmental acceptability of the Project, identifying key areas of risk and developing potential monitoring and management strategies.

3.2 Risk Assessment Method

The risk assessment completed for the EIS/ERMP was undertaken in accordance with the principles and guidelines contained in the AS/NZ 4360:2004 – Risk Management and the EPA draft guidelines 'Application of risk-based assessment in EIA' (EPA 2008). The process evaluates the likelihood and consequence of environmental impacts occurring as a result of a factor's (receptor) exposure to one or more aspects (project activities) to assess the environmental risk levels.

'Consequence' has been defined by the EPA as an indication of the magnitude of an environmental impact resulting from an environmental aspect. The 'likelihood' is defined as the probability or frequency of the defined consequence occurring and takes into consideration the probability and frequency of the following:

- the environmental aspect occurring;
- the environmental factor being exposed to the environmental impact; and
- the environmental factor being affected.

Subsequent investigations and sediment plume modelling provided additional data upon which the previous risk assessments conducted in the scoping phase (Phase 1) could be refined. The risks have been assessed assuming the application of mitigation and management measures and therefore indicate the residual risk levels posed to each key environmental factor.

3.3 Risk Assessment Outcomes

The results of the environmental risk assessment of the dredging and dredge material placement management activities associated with the trunkline installation are provided in section 8 of the EIS/ERMP. The risk assessment presented for the trunkline was based on the case presented in **Section 4**, in the event that the corridor route or installation methods change, further environmental assessment will be undertaken, where necessary.

Environmental risks associated with trunkline trenching and stabilisation, that have been assessed as posing a residual risk include:

Benthic Primary Producer Habitat

- The potential for direct loss of subtidal benthic primary producer habitat (BPPH) through removal and damage of BPPH at the dredge material placement sites and the trunkline route were assessed as low risk.
- The potential for indirect impacts on benthic primary producers (BPP) and habitats due to increased turbidity, sedimentation and light attenuation leading to loss of habitat in excess of acceptable levels as defined in EPA Guidelines (EPA 2009) associated with trunkline trenching and stabilisation was assessed as high risk.

Marine Water Quality and Sediments

- Potential short-term increased turbidity and light attenuation exceeding agreed water quality targets as a result of trunkline trenching operations was assessed as medium risk.

Environmental risks, including direct/indirect impacts to BPPH and changes to water and sediment quality, associated with trunkline shore crossing by microtunnelling (as detailed in **Section 4.1.1**) have been assessed as a low residual risk.

3.4 Performance Measurements

The environmental risk assessment detailed in **Section 8** of the EIS/ERMP has been used to develop a series of environmental objectives and associated performance criteria for the dredging and dredge material placement management works. These environmental objectives, performance criteria, management commitments, evidence of compliance measures and timing requirements are provided within **Section 8.0.**

3.4.1 Outcome Based Conditions

The EPA's support for the use of Outcome Based Conditions (OBCs), rather than prescriptive conditions, is constrained to circumstances where the intended outcome can be clearly defined and measured. Prescriptive conditions are still recommended under circumstances where there is uncertainty or where it is difficult to predict the environmental outcome.

OBCs are defined in the WA EPA Environmental Assessment Guidelines No. 4 – Towards Outcome-based Conditions (EPA 2009c) as those conditions that are recommended in an EPA Report or set in a Ministerial Statement that may impose:

- a specific environmental outcome to be achieved (explicit condition) – for example, the avoidance of particularly significant vegetation or habitat, or the progressive rehabilitation of an area; or
- an environmental performance standard that is to be met (performance-based condition) – such as standards that set out the limits or criteria (such as an emission limit) but do not describe how such limits or standards will be met.

4.0 WORKS OVERVIEW

A single trunkline is proposed to transport the co-mingled dry gas and condensate from the Wheatstone Platform (WP) to the onshore plant. The trunkline route will cross the nearshore shelf between Thevenard and Bessieres Islands and skirts around Ashburton Island before coming ashore at the plant site (**Figure 4-1**). From an initial depth of 70 m at the WP, the trunkline route descends to 120 m and then follows the 110 m water-depth contour for approximately 140 km. The trunkline route begins to gradually slope up the shelf, approximately 60 km from shore, for 30 km to a water depth of 15 m. The last 30 km of the trunkline route remains within 15 – 10 m of water rising to the onshore plant in the last few kilometres. However, during the design development it was identified that rerouting a portion of the nearshore trunkline would allow optimisation of secondary stabilisation requirements, a reduction in the overall trunkline length and a reduction in the portion of the trunkline within proximity to the recommended shipping route. The potential changes to the trunkline route are illustrated in **Figure 4-2**. A final decision on the trunkline route will be dependent on further geophysical and geotechnical data.

The pipeline in the nearshore area, within the 40 m depth contour (~35 km), will require stabilisation to prevent excessive movement. Stabilisation is likely to require dredging and mechanical trenching and the placement of backfill (sand and/or rock) along the pipeline. Therefore, dredging and dredge material management will be required for the construction of the:

- Shore crossing; and
- Trunkline installation.

In addition to dredging, placement of dredge material and backfilling activities, a number of associated works may be undertaken as part of trunkline installation, including;

- Mass flow excavation where the trunkline crosses the existing buried Roller Skate pipelines in order to further lower the Roller Skate pipeline; prior to Trunkline installation;
- Drilling and blasting may be required in areas where the seabed is too hard for dredging and the use of a seabed rock berm design is precluded due to requirements for navigable water depth;
- Spot rock dumping of the Wheatstone trunkline at the Gorgon, Pluto and Jansz pipeline crossings to ensure stability of the trunkline during storm and cyclonic conditions; and
- Rock dumping along the trunkline within 500 m of the Wheatstone Platform and along the flowlines to increase stability and limit movement due to elevated strain levels.
- A floatel will be moored in the nearshore area to accommodate up to 200 to 400 dredge crew. The dimensions of the floatel could be 100m long and 10,000 DWT in weight. The proposed mooring areas for the floatel are illustrated in **Figure 4-3**.

This Draft DSDMP details a conservative assessment case with respect to the proposed installation methods and trunkline route, which were used for the modelling and environmental impact assessment. This assessment case is expected to result in the largest predicted sediment plume and therefore represents the worst case scenario. Alternatives are being investigated and post-lay trenching techniques are being assessed in order to reduce the requirements for pre-trenching (dredging) and sand backfill. Any proposed changes to the installation method and trunkline route outlined for the assessment case are likely to lead to a reduction in the extent of the turbidity plume and therefore in potential environmental impacts; if required, further environmental assessments will be undertaken.

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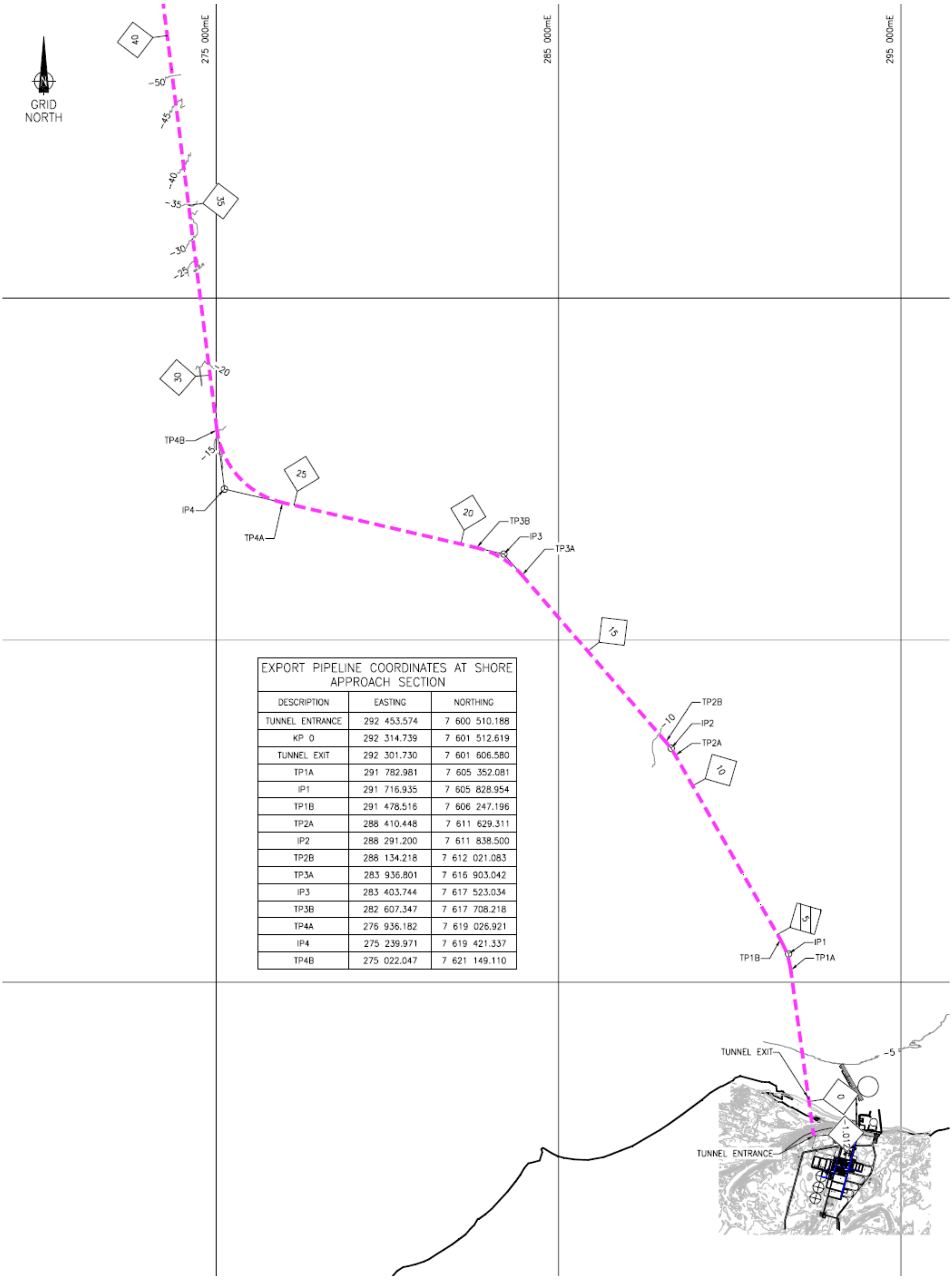

EXPORT PIPELINE COORDINATES AT SHORE APPROACH SECTION		
DESCRIPTION	EASTING	NORTHING
TUNNEL ENTRANCE	292 453.574	7 600 510.188
KP 0	292 314.739	7 601 512.619
TUNNEL EXIT	292 301.730	7 601 606.580
TP1A	291 782.981	7 605 352.081
IP1	291 716.935	7 605 828.954
TP1B	291 478.516	7 606 247.196
TP2A	288 410.448	7 611 629.311
IP2	288 291.200	7 611 838.500
TP2B	288 134.218	7 612 021.083
TP3A	283 936.801	7 616 903.042
IP3	283 403.744	7 617 523.034
TP3B	282 607.347	7 617 708.218
TP4A	276 936.182	7 619 026.921
IP4	275 239.971	7 619 421.337
TP4B	275 022.047	7 621 149.110

Figure 4-1: Trunkline Corridor Requiring Secondary Stabilisation from the Onshore Facility to KP35

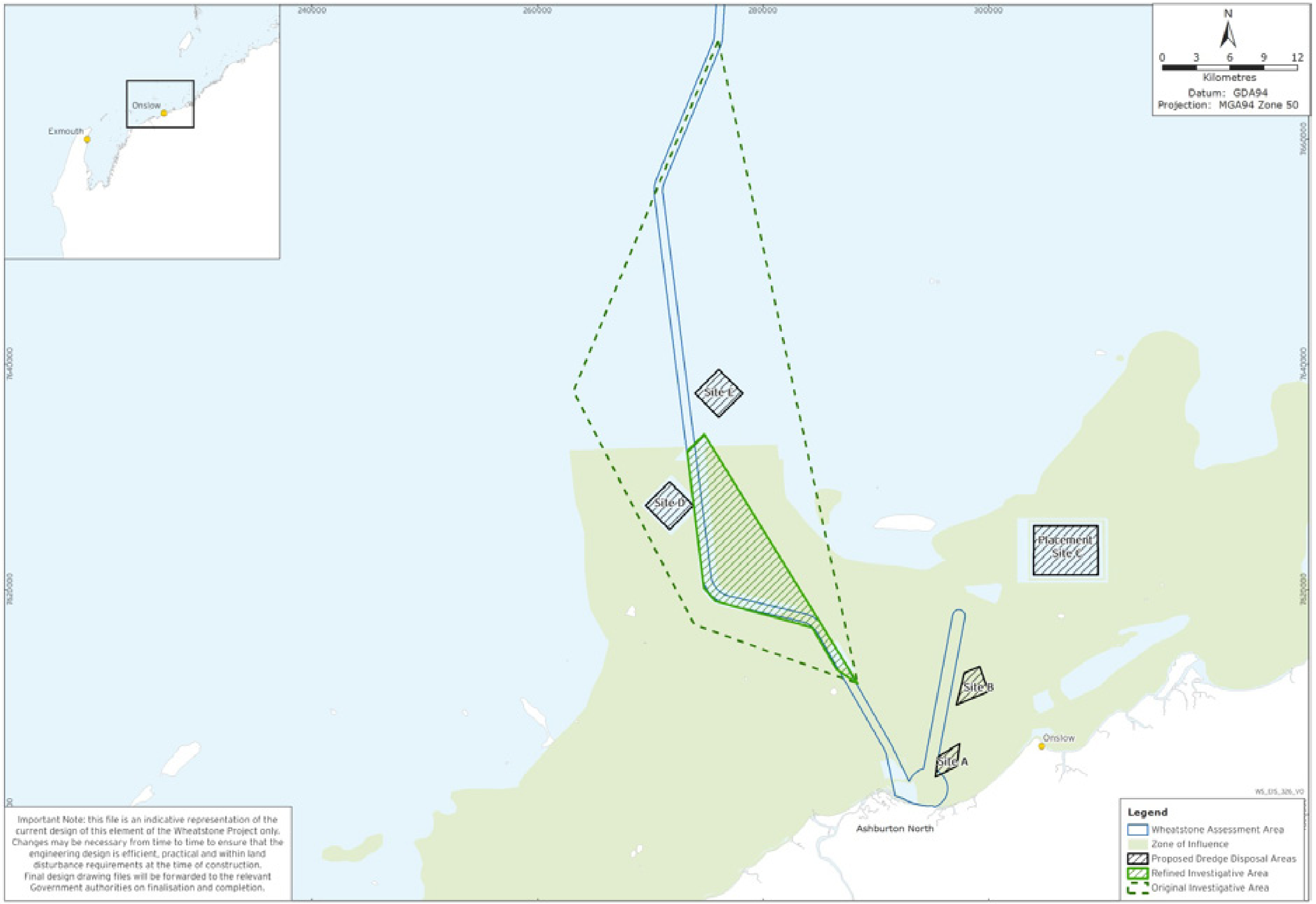

Figure 4-2: Potential Trunkline Corridors

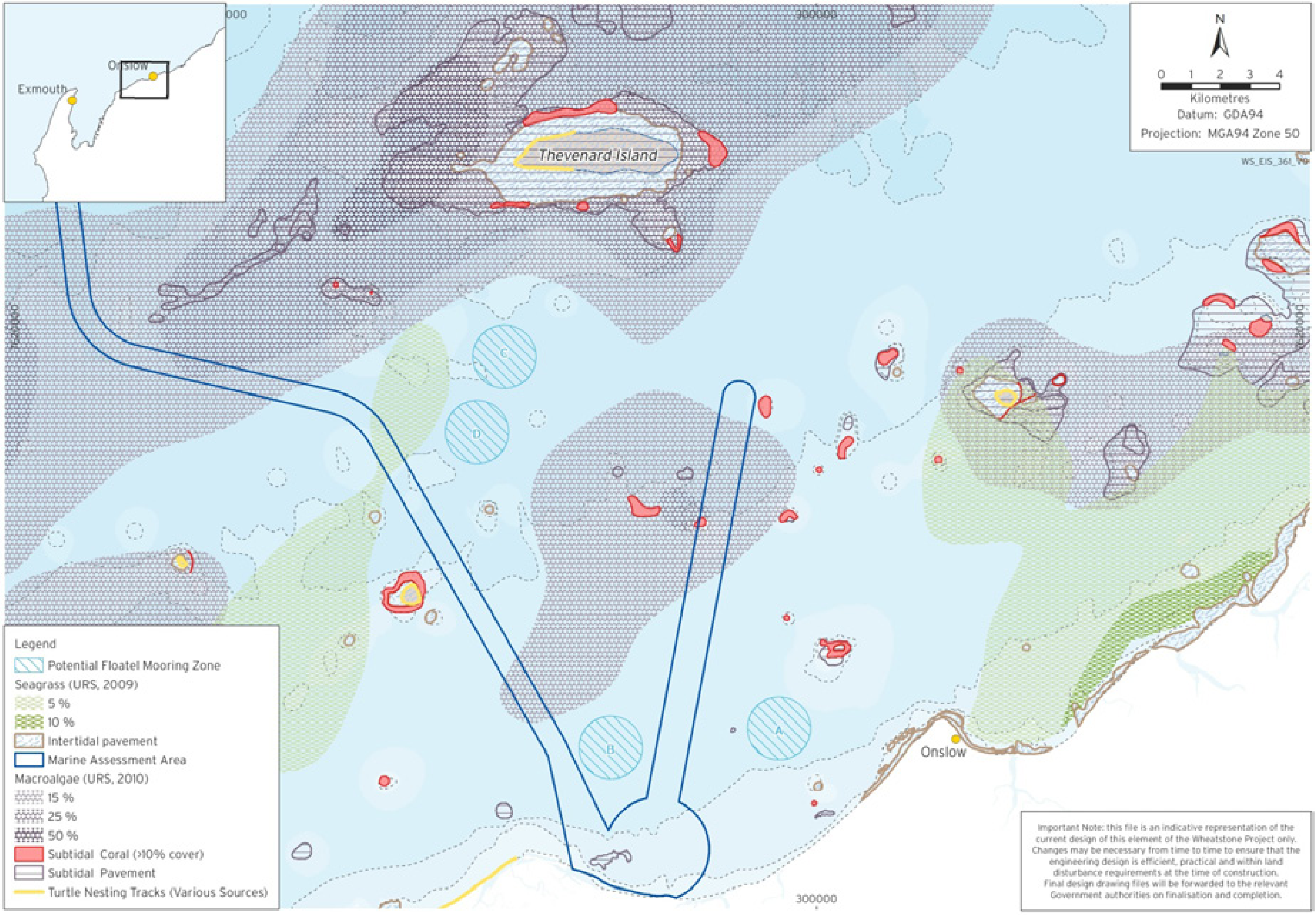

Figure 4-3: Proposed mooring locations for the Floatel to accommodate the dredge crew.

4.1 Trunkline Installation Methods

4.1.1 Shore crossing

The trunkline will approach the site from the north-west and will be routed to avoid nearshore shallow water areas, reefs and other obstructions. The shore crossing section of the pipeline will be installed using microtunnelling, which entails the creation of a tunnel beneath the dunes system exiting in approximately 2 m water depth (**Figure 4-4**). This will be used to pull the pipeline beneath the beach, avoiding any significant environmental impacts.

Microtunnelling will require creation of an entrance shaft up to 10 m diameter and subsequent creation of a tunnel of 2 – 3 m diameter using a combined drill head/thrust system. The exit point, approximately 1200 m from the entrance shaft, will require excavation to create a pit into which the drill head can exit prior to recovery resulting in approximately 19,000 m^3 of dredge material (**Figure 4-5**). The exit pit will then be backfilled with selected sand (7,000 m^3) fill for the arrival of the tunnel boring machine (TBM). There may be a requirement for ground reinforcing which would require grout injection or part of the exit pit to be backfilled with a weak grout (7,000 m^3).

Figure 4-4: Microtunnelling

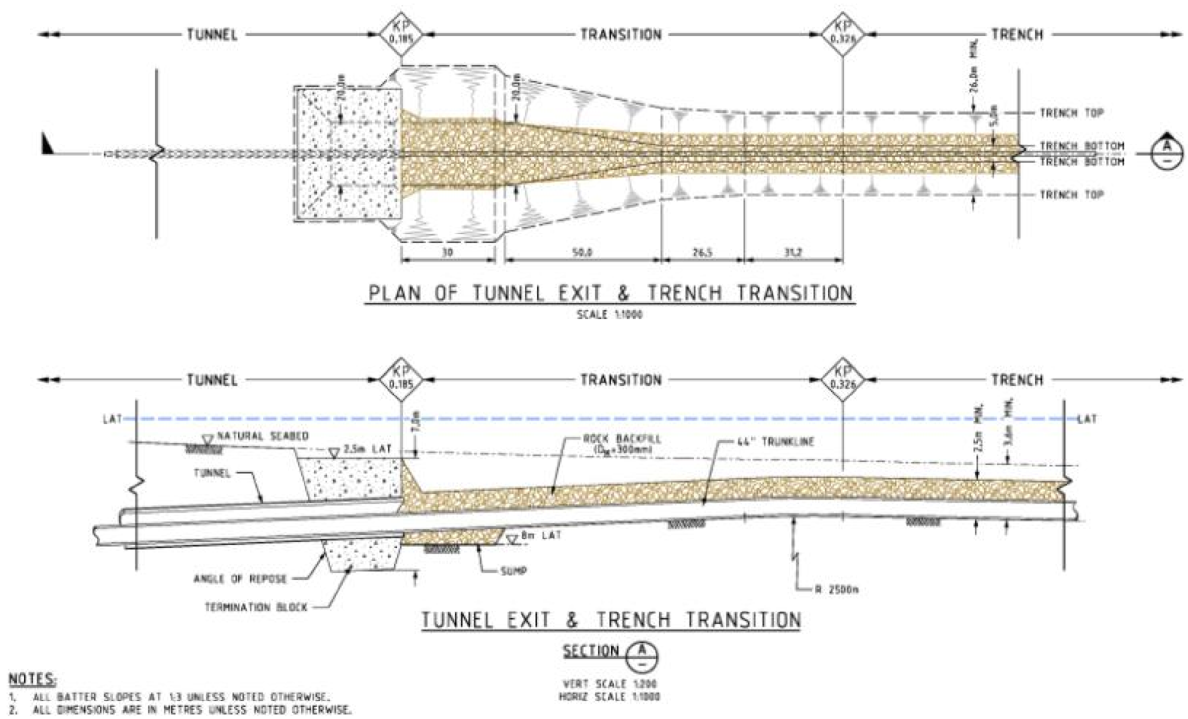

Figure 4-5: Drawings of the Tunnel Exit and Trench Transition

4.1.2 Pre-lay Dredging Works

In the nearshore areas the pipeline will be lowered below nominal seabed for both stability and protection, from approximately the 40 m depth contour to shore (~35 km). The pre-lay works for the pipeline will be undertaken using a Trailing Suction Hopper Dredge (TSHD), Cutter Suction Dredge (CSD) and Backhoe Dredge with associated barges. The pipeline will, where possible, be routed to follow areas of softer sediments that will enable easier lowering of the pipeline below seabed depth. Where seabed conditions are incompatible with lowering, it may be necessary to stabilise the pipeline through the use of rock placement.

Dredging of the trunkline route will initially entail the excavation of a trench from the tunnel exit to the 6 m water depth contour (~1.5 km) using a Backhoe Dredge with the excavated material being loaded onto a barge for placement. This portion of the trench will be approximately 16 m wide and will extend to the -3 m Lowest Astronomical Tide (LAT). Dredging with the backhoe dredge will involve dredging of approximately 73,000 m^3 of material (**Table 4-1**).

Dredging of the remainder of the trench, from the 10 m to the 40 m contour (~33.5 km), will involve a combination of TSHD and CSD. The width of the trench will vary from approximately 16 – 20 m while the depth of the trench will vary from 3 – 4 m. This will result in 2.3 million cubic metres (Mm^3) of dredge material.

Table 4-1: Trunkline Dredge Characteristics

Dredging Area (KP*)	Distance (km)	Seabed Type	Description	Volume (m^3)
KP0.20 to KP0.33	0.13	Uncemented	Pretrench with backhoe	16,000
KP0.33 to KP1.74	1.41	Uncemented	Pretrench with backhoe	57,000
KP1.74 to KP16	14.26	Uncemented	Pretrench with TSHD	537,000
KP16 to KP18.4	2.4	Uncemented	Pretrench with TSHD	138,000
KP18.4 to KP26.6	10.2	Cemented	Pretrench with TSHD/CSD	1,063,000
KP26.6 to KP34	5.4	Cemented	Pretrench with TSHD/CSD	563,000
KP34 to KP35	1.0	Uncemented	Pretrench with TSHD	38,000
TOTAL	**~35**			**~2,400,000**

*Trunkline Kilometre Point

Prior to pipe lay, the trench may need to be cleaned using a mass flow excavator or other suitable equipment to remove sediment from the bottom of the trench. Placement of the removed sediment will be dependent on the equipment and could range from placement at the placement sites or placement on the seabed adjacent to the trench (side casting).

HOLD if side casting details on disturbance footprint required

The excavated width of trench may be up to 20 m, with total removed volumes of ~2.4 Mm^3.

4.1.3 Post-Lay Backfilling

After the pipe is laid it will be necessary to backfill from KP0.20 to KP35 with rock or sand to provide stability. Pipeline stabilisation will involve the laying of the pipeline along the seabed then placement of rock or sand on a continuous profile over the pipeline to prevent movement in storm/cyclonic conditions. The berm will vary in profile according to depth but may have a width of up to 20 m and height of 1 –2 m above the crown of the pipe (2 –3 m above nominal seabed). Approximately 60,000 tonnes of rock and ~1.3 Mm^3 of sand will be required for secondary stabilisation for a continuous full-cover berm over the pipeline.

Sand backfill material will be sourced from the dredge material placement areas or suitable virgin sand borrow areas if sand with the required fines contents can be sourced.

Table 4-2: Trunkline Backfill Volumes

Dredging Area	Backfill Volume	
	Sand (m^3)	Rock (tonnes)
KP0.20 to KP0.33		5,000
KP0.33 to KP1.74		55,000
KP1.74 to KP16	476,000	
KP16 to KP18.4	141,000	
KP18.4 to KP26.6	430,000	
KP26.6 to KP34	228,000	
KP34 to KP35	33,000	
TOTAL	**~1,300,000**	**60,000**

4.2 Dredge Material Management

Placement of the excavated material from the microtunnel will be managed onshore after cleaning of the drill cuttings. The dredged material will be managed in a prescribed manner for waste disposal. The dredge material from the excavated trunkline will be disposed in nearshore and offshore dredge material placement sites. A summary of the dredge placement site characteristics is provided in **Table 4-3**.

HOLD Location of dredge material placement related to KP sections to be included in subsequent revisions

4.2.1 Nearshore Dredge Material Placement Sites

Three nearshore dredge material placement sites have been identified for the placement of dredged material and are shown in **Figure 4-6**. Within each of these sites, the target placement areas will be the naturally deeper waters.

HOLD use of dredge placement sites to be determined and include in subsequent revision

Dredge Material Placement Site A has a capacity of approximately 1.5 Mm^3 and will be used early in the main dredging works program.

Dredge Material Placement Site B has a capacity of approximately 2–3 Mm^3.

Dredge Material Placement Site C is the primary placement site for coarse material and has a capacity of up to 40 Mm^3.

4.2.2 Offshore Dredge Material Placement Sites

In addition to the three identified nearshore dredge material placement sites, two offshore dredge material placement sites (Site D and E), located in approximately 40 m water depth to the west of Thevenard Island (**Figure 4-6**) have been identified. Each of these offshore sites is anticipated to have a capacity of up to 40 Mm^3.

Table 4-3: Summary of Dredge Placement Sites Characteristics

Placement	Water Depth (m)	Mean bed level change (m)*	Capacity (Mm^3)*
Site A	<7	0.375	1.5
Site B	10-12	0.6	3
Site C	12-15	1.7	40
Site D	38-48	4.45	40
Site E	63-71	4.45	40

*Includes dredge material from the capital dredging campaign

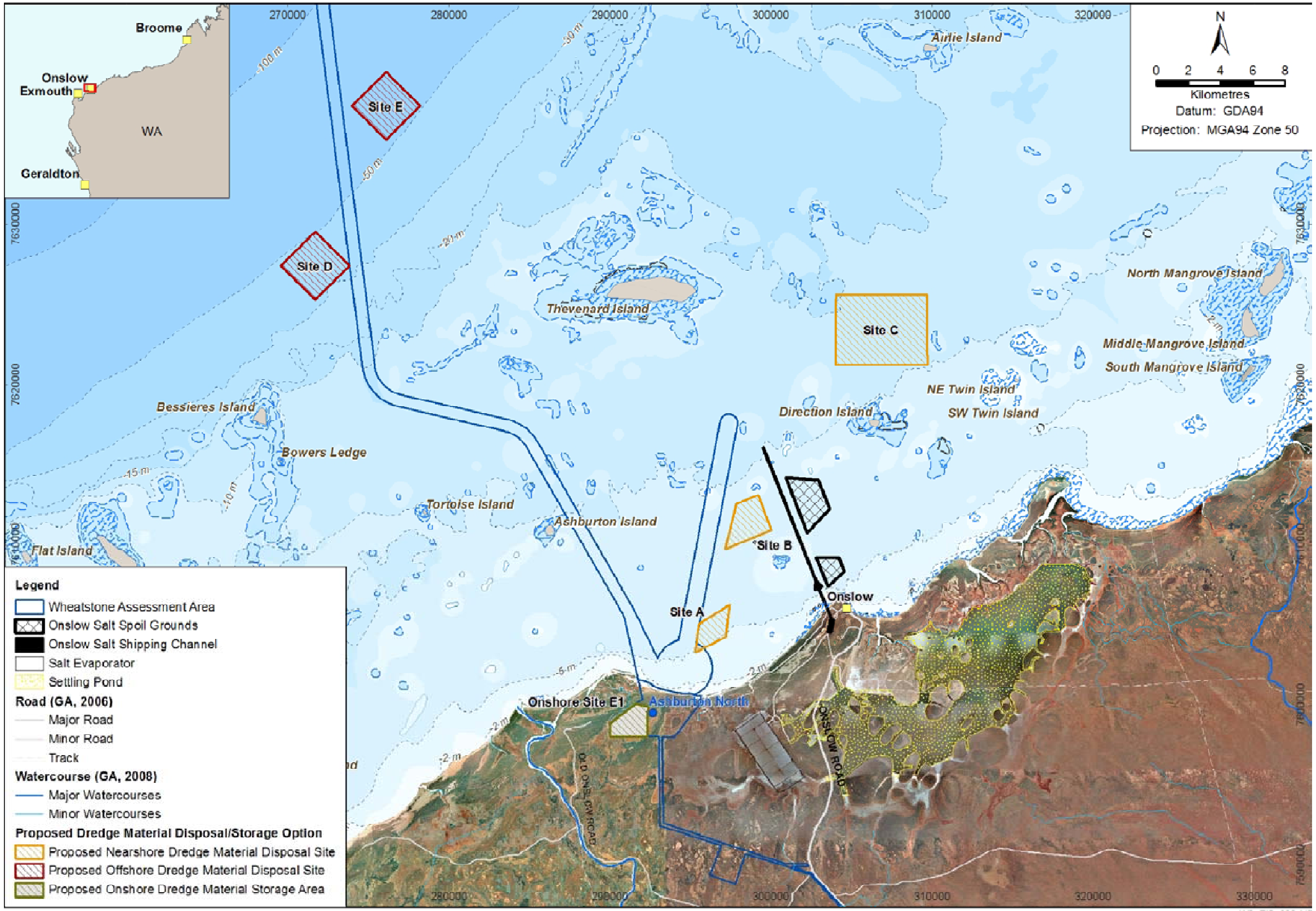

Figure 4-6: Location of Nearshore and Offshore Placement Sites

4.3 Dredging and Tunnelling Equipment

The dredging and dredge material placement works for the trunkline will be undertaken by a combination of dredges, support vessels and land based equipment. It is envisaged that the following dredge equipment will be used:

- Tunnel boring machine;
- Backhoe dredge with dredge material transport spread and anchor handling tug;
- TSHD;
- CSD with dredge material transport spread, self propelled hopper barge and anchor handling tug;
- Mass flow excavator; and
- Post-lay trenching machine[1].

The final vessel selection will be made upon awarding of the dredging and microtunnelling contracts. **Figure 4-7**, **Figure 4-8, Figure 4-9, Figure 4-10** and **Figure 4-11** provide typical examples of the envisaged equipment and dredge vessels.

Figure 4-7: Example of a Tunnel Boring Machine (TBM)

Figure 4-8: Example of Trailing Suction Hopper Dredge (TSHD)

[1] The use of post-lay trenching machine is not included in the 'assessment case' installation methods however its use is being assessed in order to reduce the need for dredging.

Figure 4-9: Example of Cutter Suction Dredge (CSD)

Figure 4-10: Example of Backhoe Dredge

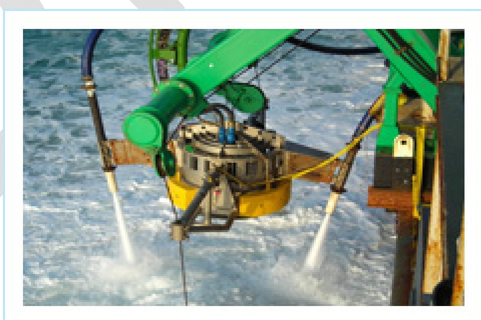

Figure 4-11: Example of a Mass Flow Excavator

4.4 Methods Justification

The decision on the methods to be employed, including the selection of the dredging equipment type, will be based on a number of factors including:

- anticipated vessel availability;

- vessel operability (including vessel draught and cutting strength;
- soil strength;
- transport distances;
- required dredging accuracy; and
- required environmental performance.

The trunkline installation methods selected will be focussed on delivering a number of environmental benefits, including:

- Where operational restrictions allow, medium-sized TSHDs and CSDs will be used as opposed to smaller vessels, to minimise the duration of the works and thus reduce the temporal extent of any environmental impacts.
- The use of large CSDs will reduce the risk that the pre-treatment of material via drilling and blasting is required.
- The dredging and dredge material placement accuracy of modern TSHDs, CSDs, self-propelled and non-propelled hoppers is - high - and will be operated by leading dredge contractors that are experienced in the environmental management of dredging operations, thus providing surety in environmental performance.
- Microtunnelling avoids significant environmental impacts as the tunnel is created underneath the dune system and mangroves within the vicinity of the shore crossing.
- Post-lay trenching is being investigated in order to minimise the volume of material displaced.
- The floatel is expected to have minimal impacts as proposed mooring locations are characterised by bare sand, without seagrass, macroaglae or coral and are located >1.5 km from turtle nesting beaches.

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5.0 ENVIRONMENTAL PROJECT MANAGEMENT

5.1 Key Roles and Responsibilities

HOLD Key roles and responsibilities for Project personnel, both Chevron-employed and contractor companies, will be defined in subsequent versions of this document.

5.2 Inductions and Training

All personnel (including contractors and subcontractors) are required to attend environmental inductions and training that are relevant to their roles on the Project. Relevant personnel will receive training on the requirements of the finalised DSDMP. Training and induction programs will facilitate the understanding that personnel have of their environmental responsibilities, and ensure awareness of the management and protection measures required to reduce potential impacts on the environment.

Environmental training and competency requirements for personnel, including contractors and subcontractors, will be maintained in Health, Environment and Safety (HES) training matrices. These matrices will be reviewed and updated on an ongoing basis to ensure that the required competencies are met and the required training has been completed.

5.3 Environmental Documentation Management

5.3.1 Chevron ABU OE Documentation

As part of the Chevron ABU, the Project is governed by the requirements of the ABU OEMS, within which a number of OE Processes exist. The Project will implement internal OE Processes (and supporting OE Procedures) that apply to the Project's activities. The OE Processes have been prepared by Chevron Australia to address various issues that Chevron Australia internally requires its employees, contractors, etc. to comply with (or equivalent contractor process). These Processes will also be applied to the requirements of this Draft DSDMP where this is appropriate and reasonably practicable.

5.4 Performance Reporting

<Hold pending State and Commonwealth approvals> requires that Chevron Australia submits an Annual Environmental Performance Report to the Minister for the Environment and to the Commonwealth DSEWPaC, respectively, on an annual basis for the previous 12-month period.

5.5 Auditing

A compliance audit schedule will be developed based on the conditions contained within the various environmental approval documents and will include both internal and external audits.

5.5.1 Internal Auditing

Chevron Australia has an internal Compliance Assurance ASBU – Standardized OE Process (Chevron Australia 2006b) to manage compliance. Internally, Chevron Australia requires its employees and contractors, etc. to comply with the Process. The Compliance Assurance ASBU will also be applied to assess compliance of the Wheatstone Project

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against the requirements **<Hold pending State and Commonwealth approvals>** where this is appropriate and reasonably practicable.

5.5.2 External Auditing

An independent audit of compliance of the implementation of the finalised DSDMP will be conducted by an approved auditor on behalf of DSEWPaC.

5.6 Management Review

Chevron Australia is committed to conducting activities in an environmentally responsible manner and aims to implement best practice environmental management as part of a program of continuous improvement. This commitment to continuous improvement means Chevron Australia will review the finalised DSDMP annually.

Reviews will address matters such as the overall design and effectiveness of the finalised DSDMP, progress in environmental performance, changes in environmental risks, changes in business conditions, and any relevant emerging environmental issues.

If the finalised DSDMP no longer meets the aims, objectives or requirements of the finalised DSDMP, if works are not appropriately covered by the finalised DSDMP, or measures are identified to improve the finalised DSDMP, Chevron Australia may submit an amendment or addendum to the finalised DSDMP for approval.

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6.0 EXISTING ENVIRONMENT AND RELEVANT STUDIES

6.1 Overview

The characterisation of the marine environment within the Project Area has been undertaken as part of the environmental impact assessment which underpins the environmental approvals process. A brief overview of the existing environment, the studies associated with the impact assessment and the development of impact zones and management trigger levels is provided here. This information provides context for determining the management strategies detailed in **Section 8.0** and the monitoring programs detailed in **Section 9.0**. Full details of the existing marine environment and the environmental impact assessment undertaken for the Project can be found in Section 6 and Section 8, respectively, of the EIS/ERMP.

6.2 Key Environmental Receptors

The key environmental receptors that could potentially be impacted upon by the proposed dredging and dredge material placement activities include:

- hard corals;
- seagrasses;
- mangroves;
- marine turtles;
- humpback whales; and
- dugongs.

6.3 Marine Reserves and Conservation Areas

There are no protected areas in the immediate vicinity of the Project Area, although a number of marine parks and reserves occur within the Pilbara Nearshore and Pilbara Offshore bioregions. It is not expected that the dredging and dredge material placement management activities will impact on any of these marine parks and reserves.

The Project Area does not contain any World Heritage Properties, National Heritage Properties or Ramsar Wetlands of International Significance.

6.4 Existing Physical Environment

6.4.1 Water Quality

A review of studies in the Onslow region (MScience 2009) indicate that the regional median turbidity was usually <1 Nephelometric Turbidity Units (NTU) and the 80th percentile was <3 NTU during non-cyclonic periods. Corresponding total suspended solids concentration (SSC) values ranged from 3–5 mg/l. Across 30 sites median turbidity ranged from <1 NTU during winter up to 6 NTU during non-cyclonic periods in summer. Discharge from the Ashburton River during inland rainfall is the primary source for input of terrestrial sediments to the near shore waters of the Project Area. These events can cause large-scale turbidity elevations in nearshore waters over a period of months. Spring and summer are times of the year when there are persistent westerly winds and increased runoff from rainfall as well as periodic cyclones. Turbidity approached or exceeded 12 NTU at 20% of the sites assessed during some weeks of summer. Turbidity and SSC are significantly elevated by cyclonic activity. During the passage of Tropical Cyclone Dominic in January 2009, daily median turbidity increased to approximately 80 NTU and remained above 20 NTU for at least ten days. Offshore waters in general tend to have lower turbidity levels.

Contaminant levels within the water column are expected to be near background and representative of that found naturally in coastal and marine areas along the Pilbara coast.

Sediment re-suspension is frequent immediately seaward of the intertidal zone, and leads to considerable turbidity (Forde 1985). Re-suspension is mainly due to wind-driven waves; further offshore the sediment movement is a result of internal or subsurface waves (Heywood et al. 2006).

6.4.2 Marine Sediments

The marine sediments in the Project Area mainly consist of silt and sand sheets of varying thickness overlying Pleistocene limestone. Near the Ashburton Delta, sediments are generally fine silts and clays with high silica content.

HOLD sediment characteristics for trunkline required **Information will be available Q1 2011**

The chemical characteristics of marine sediments in the vicinity of the Trunkline Project Area has been assessed on two previous occasions; once in 2005 by the Department of Environment and Conservation (DEC 2006) and more recently by URS in the Wheatstone dredging area (URS 2009).

The DEC (2006) study recorded no discernible anthropogenic enrichment of contaminants (e.g. organotins, hydrocarbons, organochlorine pesticides and polychlorinated biphenyls) in sediments offshore of the Ashburton River mouth. The study also measured natural background concentrations of trace metals in the marine sediments, noting that, with the exception of arsenic, natural background concentrations of all metals were below the relevant Australia and New Zealand Environment and Conservation Council/Agricultural and Resource Council of Australia and New Zealand (ANZECC/ARMCANZ) (2000) screening levels (DEC 2006).

During the URS (2009) survey, marine surface sediments and deep cores in the Project Area were sampled within and near the proposed dredging area and grab samples from the proposed nearshore dredge material placement sites. Detailed results of this study are provided within the EIS/ERMP. The study recorded concentrations of all contaminants and trace metals as being below the laboratory limit-of-recording (LOR) or below the relevant National Assessment Guidelines for Dredging (NAGD) (Commonwealth of Australia 2009d) screening levels, with the exception of arsenic and nickel (URS 2009).

The results of the sampling and analysis program determined that the sediments to be dredged are suitable for unconfined ocean disposal in accordance with the NAGD.

6.4.3 Metocean Conditions

6.4.3.1 Waves

The coast around Onslow is sheltered from prevailing south-west swells (i.e. from the Indian Ocean) by the continental landmass of the North West Cape. Similarly, Barrow

Island and the shoals of the Lowendal and Montebello Islands provide shelter from Timor Sea swells. Consequently, the nearshore wave climate is mainly influenced by locally-generated wind waves and occasional tropical cyclones (Damara 2009).

These effects were evident in wave conditions recorded via acoustic Doppler current profilers (ADCPs) and a directional wave rider in the nearshore Project Area, by RPS Metocean (RPS Metocean Engineers 2009). Wave conditions from January to April 2009 were generally mild, with a median wave height of 0.2 m and wave period of 4 seconds. However, tropical cyclones and other low pressure systems generated elevated wave conditions. Other energetic conditions similarly occurred due to low pressure systems located to the west of Onslow, producing onshore winds.

6.4.3.2 Winds

The Project Area experiences dominant summer and winter conditions. The climatic conditions are governed by the alternation between the south-east trade winds and monsoonal flows. Tropical cyclones affect the area, particularly during the summer and autumn months (November through April). During the summer months from October to March, interaction between a low pressure system induced by heating of the continental land mass and the Asian monsoon tends to draw air toward the Australian continent. This leads to predominantly westerly and south-westerly winds at the site. During the winter months (June to August), the south-east trade winds bring cool dry air from over the Australian continent, leading to easterly to south-easterly winds at the study area.

6.4.3.3 Currents

In the nearshore Project Area, the local topography directs the coastal tidal currents with easterly flow on flood tide and westerly flow on ebb tide. This pattern can be interrupted by wind-driven currents during neap tides when tidal currents are weakest. West of the Ashburton Delta, the tidal current directions are controlled by the flow in and out of Exmouth Gulf with southerly flow into the gulf on flood tide and northerly flow out of the gulf on ebb tide.

Induced by wind stress and, to a lesser extent, gradients in pressure, net currents generally propagate along the coastline and can generate significant alongshore flow, particularly in shallower water. The net currents in shallower water are primarily driven by local winds. Magnitudes of simulated net currents are in the order of half the spring tidal current speeds in many areas, including the Project Area. Field measurements (RPS Metocean Engineers 2009) confirm the simulations, including the wind-driven net currents dominating over tidal currents during both neap and spring tidal conditions.

6.4.3.4 Tides

Tides in the nearshore Project Area are semi-diurnal with a spring tidal range of 1.9 m (mean high and low water spring tides of 2.5 m and 0.6 m, respectively). Tidal peaks occur near the equinoxes in March and September. The highest astronomical tide is 2.9 m. The tidal signal changes progressively along the North West Shelf (NWS) coastline with increasing tidal ranges from Exmouth to Broome.

Modelling of extreme cyclonic water levels for the Onslow town site and Onslow Salt (GEMS 2000, Nott & Hubbert 2005) has estimated the 100-year Average Recurrence Intervals (ARI) water level as 4.7 m Australian Height Datum (AHD) (6.2 m Chart Datum - CD), including allowance for wave setup.

6.5 Existing Biological Environment

6.5.1 Marine Habitats

A marine habitat map has been developed for the Project Area, including the Trunkline Project Area, and is shown in **Figure 6-1.** The majority of the seafloor in the vicinity of the proposed trunkline route is comprised of sandy sediments and limestone pavement.

BPPH within the Project Area is sparsely distributed and is present at discrete locations. BPP present include sparse macroalgae, hard coral, seagrasses and mangroves (**Figure 6-1**).

On the basis of field surveys, URS (2009a) concluded that the most significant locations with respect to nature conservation value are the shallow fringing coral reefs and macroalgal platforms surrounding Serrurier, Ashburton, Thevenard, Direction, Mangrove, and the Mary Anne Group of Islands (**Figure 6-1**). The Mangrove and Mary Anne Group of Islands are the largest and most important nature conservation resources in the vicinity of the Project Area and are important foraging areas for turtles and dugongs. Ward reef is an unusual inshore reef almost completely composed of the genus *Montipora* and characterised by high coral cover Ward Reef is a locally important recreational fishing and due to its uniqueness may have some conservation value.

Four major ecosystem units (ECU) were derived from the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) hierarchical ecosystem classification framework and further development by Lyne et al. (2006) for the North West Shelf and these units are detailed within the EIS/ERMP:

- ECU0 – Onslow Onshore encompassing intertidal habitats.
- ECU1 – Onslow Nearshore encompassing waters between LAT and up to 10 m depth in relatively complex bathymetry, covering mainly soft substrates but including a ridge of scattered patch shoals which support corals and sponges.
- ECU2 – Onslow Offshore encompassing waters between 10–20 m depth and including most offshore islands and coral reefs and algal-dominated shoals.
- ECU3 – Onslow Inner Shelf incorporating the relatively steep gradient shelf break from 20–70 m depth.

These ECUs are shown in **(Figure 6-2**). Subsequently, Local Assessment Units (LAU) were identified within the ECUs based on bio-geomorphic attributes and the distribution of various types of BPPH. These LAUs were the basis of the BPPH loss assessment described in **Section 7.0**. **HOLD LAU being redefined**

Within the defined ECUs there are a number of key sensitive receptors, details of which are provided in **Table 6-1**.

Table 6-1: Sensitive Receptors in the Project Area

<Hold: table to be updated, pending finalisation of OBC and zones of impact, with associated zones and management for each sensitive receptor >

Sensitive Receptor	Habitat Biotype*	Geographic Name	Easting	Northing	Depth (m)	Site/species Descriptor
1	CR & MA	Tortoise Island	278710	7612383	3.5	Tortoise Island, east side. Reef with 25-50% live hard coral cover close to shore. *Lobophyllia*, *Turbinaria*, *Porites* and faviids present, dominated by *Montipora* with occasional large *Acropora* plates. Patches of coarse sand and shell fragments. Macroalgae on bare rocks.
2	CR & MA	Roller Shoal	285367	7604532	5.8	Roller Shoal. Reef of up to 50% cover in places of hard live coral with surrounding sand patches. Dominant coral was *Montipora* spp., with *Goniopora*, *Platygyra*, *Porites* and *Acropora* plates and faviids present. Hydroids, large barrel sponges and algal patches were also present.
3	CR & SG	Ashburton Island	286705	7611075	4.1	East side of Ashburton Island. Large bommies with up to 75% live hard coral cover. *Acropora*, *Porites*, faviids. Coarse sand and silt areas with moderately dense beds of seagrass. Low diversity of coral.
4	FF	Brewis Reef East	286437	7621988	12.3	East of Brewis Reef, South west of Thevenard Island. Sponge and fan garden. Gorgonian fans, sea whips, barrel, vase, encrusting and digitate sponges, hydroids and bryozoans. Red coralline algal tufts with coarse sand and shell fragment patches.
5	MA & CR	Thevenard Island West	288492	7624016	5.7	Flat pavement algae dominated. Occasional outcrop with 2–10% coral cover. Small individual corals including *Pocillopora* and *Turbinaria* spp. Occasional digitate and laminar sponges with solitary ascidians.
6	CR	Paroo Shoals	293805	7614023	4.5	Patches of high coral cover (up to 50–75%) and a diverse community were found on the ridge on the western edge of the shoal, dominated by either corymbose and tabulate *Acropora* spp. or by *Montipora* spp.
7	CR, MA & FF	Saladin Shoal	295913	7613337	6.3	Moderate to high live hard coral cover (up to 50% in places), with patches of sand and silt with coarse shell fragments. One large >2 m *Porites* bommie. Plateau of algal-dominated sand. Abundance of filter feeders (ascidians/sponges).
8	CR	End of Wheatstone Shipping Channel	298328	7617464	6.4	Outcrop at end of shipping channel. Two distinct steep-faced outcrops with 50–75% hard coral cover on top (~5 m). Feature is ~20 m in length. Dominant coral cover encrusting *Montipora* spp. with faviids, *Mycedium* sp. and juvenile *Turbinaria*. Numerous *Nephthea* spp. with occasional digitate sponges.

9	CR	Hastings Shoal	298803	7613488	7.6	Areas of 50–75% hard coral cover on western side of the shoal at depth of 3 m LAT. The coral community was dominated by *Montipora*, with many *Acropora* spp. and faviids also present. The remainder of the shoal was comprised of coral rubble (mainly branching *Acropora* spp.).
10	CR	North West Ward Reef	299018	7610106	3.9	Reef. Large outcrop with east-west orientation on sand and silt pavement. Outcrop had 50–75% healthy hard coral cover, dominated by encrusting *Montipora*, with tabular and digitate *Acropora* spp. sub-dominant. *Platygyra* spp. and faviids also present.
11	CR	Ward Reef	300410	7608868	3.9	Reef. Outcrops dominated by *Acropora* plates, with sub-dominant encrusting *Montipora* spp. Occasional large *Porites* bommies, *Platygyra*, faviids, and *Lobophyllia*. Coral cover 50–75% in places.
12	CR	Ward Reef	301120	7609196	6.4	Ward Reef, east side. Diverse and abundant live hard coral cover reef (~90% cover) with very little damage and dead coral present from storm damage (typically *Acropora* spp.) with patches of silt. *Montipora*, *Lobophyllia*, *Platygyra*, *Turbinaria*, and *Porites* spp.
13	CR	Gorgon Patch	300859	7615993	7.1	Gorgon Patch. Steep-walled reef with up to 80% hard live coral cover in middle of shoal. Corals include *Montipora*, *Acropora*, *Platygyra*, *Turbinaria*, *Porites* and *Nephthea* spp. Patches of algae, with barrel and digitate sponges and gorgonians.
14	CR, MA & FF	Weeks Shoal	302245	7618926	4.6	Flat-topped reef with steep walls, with >75% live hard coral cover in patches including *Montipora*, *Turbinaria*, *Acropora* and faviids. Colonial ascidians, algal patches and gorgonians also present.
15	CR	Unnamed shoal to NE of Koolinda Patch	304144	7615544	3.2	Shoal east northeast of Koolinda Patch, southwest of Direction Island. Large reef with 50–75% live hard coral cover patches on the top. Dominant coral was tabular *Acropora* with *Lobophyllia*, faviids and *Turbinaria* present.
16	CR	Direction Island	307430	7617732	5.6	Direction Island, east northeast edge. Up to 100% hard live coral cover in very healthy condition, with occasional small patch of algae. *Montipora*, *Acropora*, *Pocillopora*, *Turbinaria*, faviids, *Lobophyllia*, *Goniopora* and *Porites* spp. all present.
17	CR & MA	NE Twin Island	314029	7620738	3	Reef with occasional large *Porites* bommies (2–4m). Patches of 25-50% healthy hard coral cover, with overall 10–25%. Hard substrate predominantly covered with fine foliose algae. *Porites* spp. were dominant coral. Edge of hard substrate supports greatest coverage of coral.
18	FF & CR	West middle Mangrove Is	326341	7624763	7.5	Dominated by sponges and ascidians. Hard, raised pavement with sand silt veneer. Sparse corals (2–10%) on hard substrate including young *Turbinaria*, tabular *Acropora*, occasional *Goniopora*, *Platygyra*, *Favia* and faviids. Very sparse algae present. Digitate, laminar and vase sponges.

19	SG	East Glennie Patches	283533	7608755	5.5	Rippled coarse sand. Very large and dense meadow of *Halophila spinulosa* and possible *H. ovalis* of 25–50%. Transect graded into bare substrate before returning to dense patches. Possible dugong grazing paths in substrate.
20	MA	Thevenard Island South	294521	7622970	1.9	Southeast Thevenard Island. Algal-dominated rock platform (*Sargassum* and *Halimeda* spp. dominant).
21	SG	Nearshore NE of Onslow	310515	7609475		Dense seagrass nearshore between Onslow and Coolgra Point
22	SG	SW of Coolgra Point	314624	7612352	5.3	Undulating substrate with fine sand and silt and fine shell fragments. Sparse bioturbation with occasional larger hole. Short tufting algae. Seagrass cover 10–25% (with patches of 25–50%) of *Halophila spinulosa*, *H. decipiens* and unidentified thin-bladed seagrass.
23	SG	Coolgra Point	317246	7614478	3	Sand rippled with patches of dense seagrass (*Halophila* spp 40–60% in places with occasional *H. spinulosa*).
24	SG & MA	SW Twin Island	313878	7618776	4.3	SW Twin Island – south side. Dense seagrass beds (up to 75% cover in places) of *H. decipiens*. Algal-dominated sand veneer patches on presumed rock platform with <5% live hard coral cover. One large *Porites* bommie (~3 m) with *Montipora* spp.
25	SG	SE of Direction Island	307170	7613858	8.5	South of Direction Island. Sand with fine shell fragments. Moderate patches of seagrass of up to 25%, including *H. spinulosa* and *H. decipiens* and also the green alga *Caulerpa* sp. Digitate and laminar sponges and solitary ascidians.
26	SG	West Glennie Patches	282228	7607307	5.5	Rippled coarse sand. Dense patch (~25 m in diameter) of *H. spinulosa* and *H. decipiens* of 25–50%. Transect graded into bare substrate before returning to dense patches. Possible dugong grazing paths in substrate. One sea pen. No observable bioturbation.
27	CR	SW of Gorgon Patch	300094	7615177	5	Outcrop next to shipping channel. Two distinct steep-faced outcrops, with 25–50% hard coral cover on top (~5 m). Feature is ~20 m in length. Dominant coral cover encrusting *Montipora*, with *Pocillopora*, tabular *Acropora*, faviids, juvenile *Turbinaria*, and *Tubastrea* spp. Numerous *Nephthea* sp.
28	CR & MA	NW of Direction Island	304867	7618549	11.5	Northwest of Direction Island, very steep-walled reef from 13–4 m depth. Reef with up to 50% live coral cover and algae-dominated in areas. *Montipora*, *Lobophyllia*, *Acropora* and occasional *Porites* bommies (~2 m).

29	CR	North Herald Reef	315773	7623395	4	Herald Reef – north side in northerly direction. Rock outcrops covered with macroalgae, <10% coral coverage – juvenile *Turbinaria*, tabulate *Acropora*, *Lobophyllia* , and encrusting *Porites* spp.
30	CR	Nares Rock	323379	7629437	5	Nares Rock, northwest of Twin Islands. Steep-walled reef dominated by encrusting *Montipora*. *Porites*, tabulate *Acropora* and *Lobophyllia* spp. 25% coverage. Coral density increases on southern edge of reef. Dense coral cover on top of reef (25–50% cover). Large rock outcrops on edge of reef with 25–50% cover. Encrusting *Montipora* dominated, also *Lobophyllia* spp.
31	CR & MA	Airlie Island	307006	7640697	5.7	Algal-dominated on outcrops on presumed hard platform with patches of fine sand.
32	CR & MA	Taunton Reef	315570	7642531	4.6	Sand and fine shell fragments and coral rubble substrate over presumed reef outcrop. Occasional pavement outcrops supporting macroalgae (*Asparagopsis* sp.) (2–10%) and sparse corals including *Porites*, faviids, tabular *Acropora*, *Lobophyllia* and *Turbinaria* spp. (2–10% in patches) with occasional *Porites* bommies.

*CR = Subtidal coral communities on biogenic reefs. SG = Subtidal seagrass communities, MA = Subtidal macro algal communities, FF = Sessile benthic filter feeder communities, REC = recreational/aesthetic

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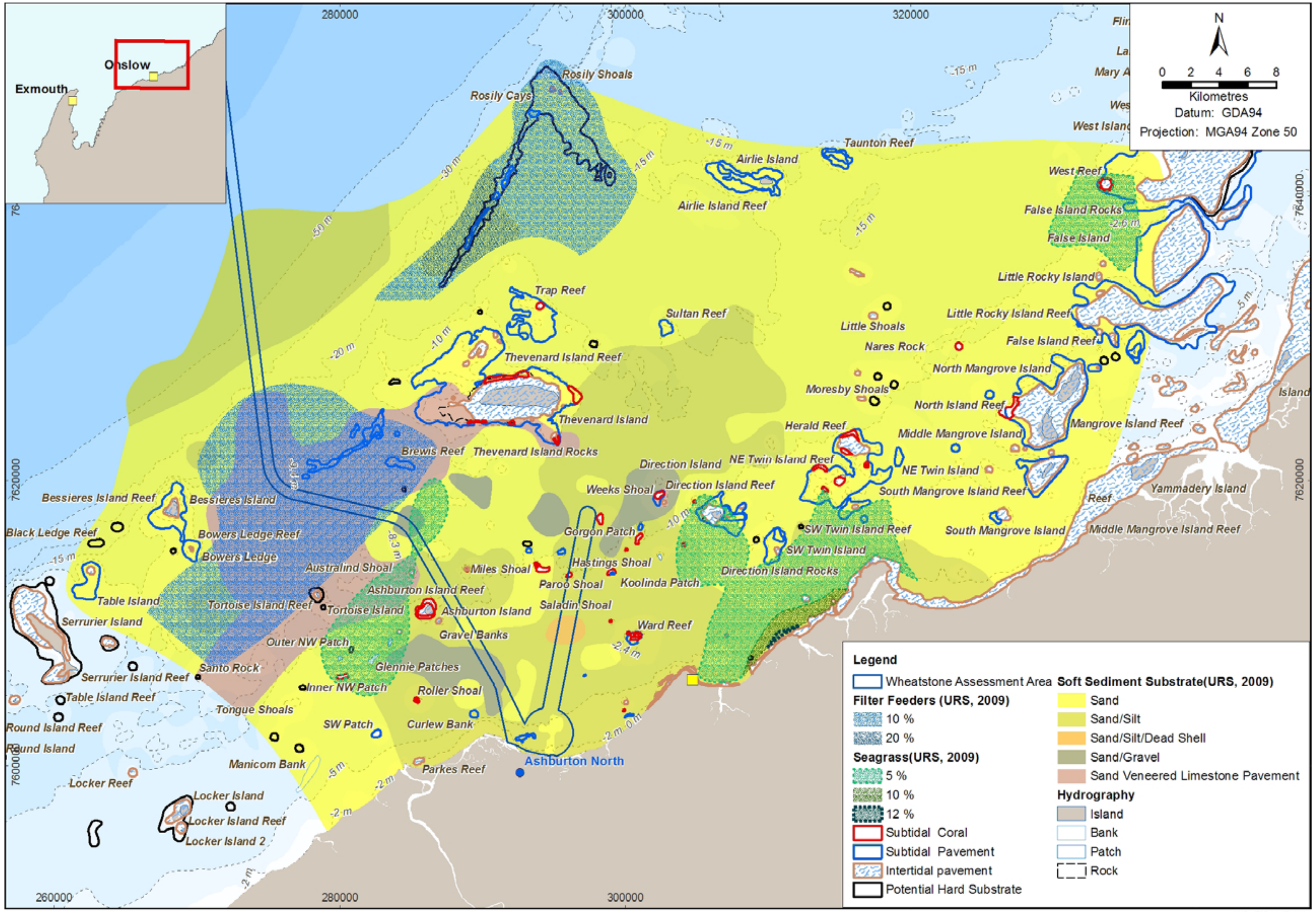

Figure 6-1: Marine Habitat Map

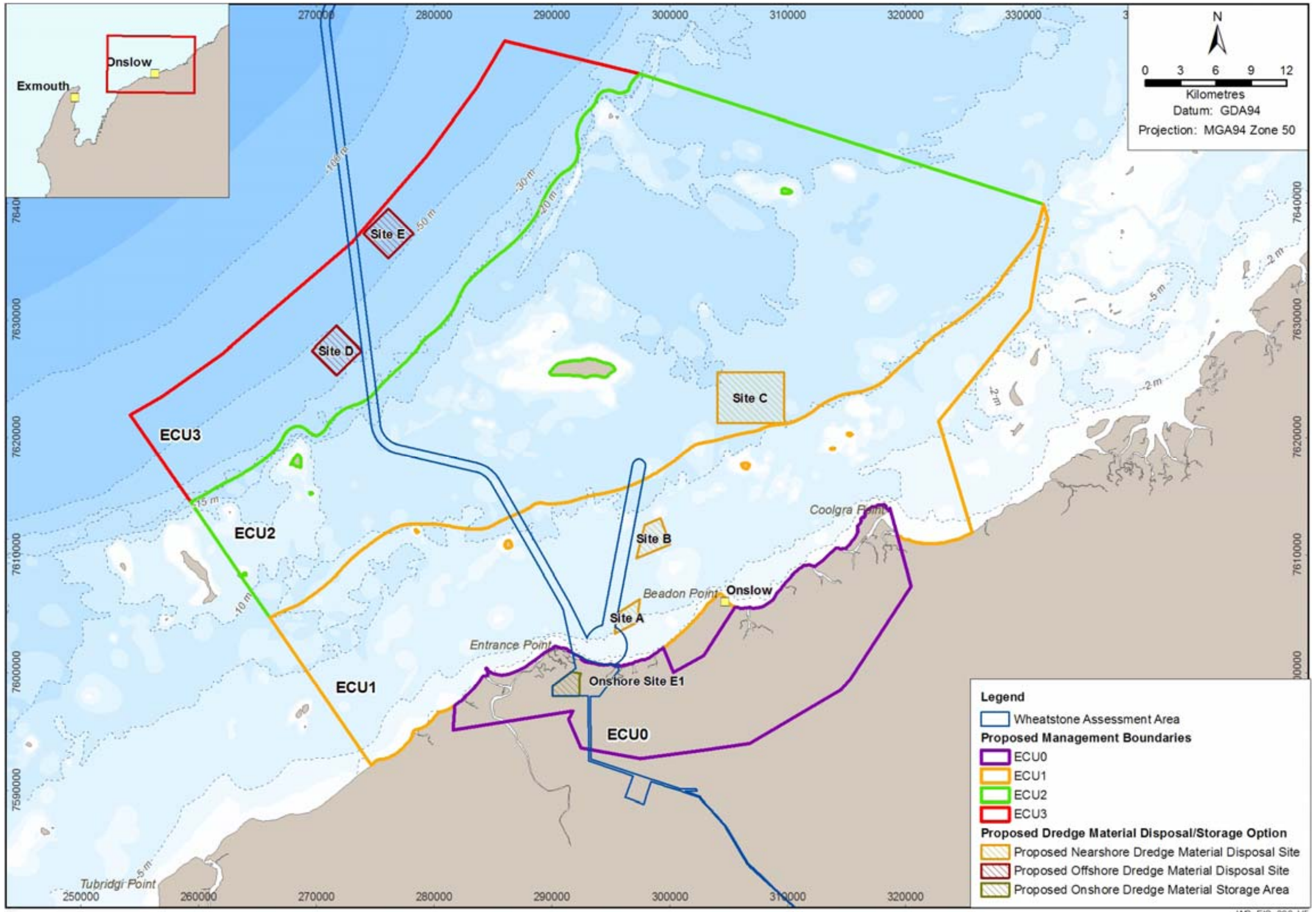

Figure 6-2: Ecosystem Units Defined for the Wheatstone Project

6.5.1.1 Hard Coral

In the immediate vicinity of the Project Area, coral communities are in low abundance, restricted to a small number located on the fringes of the platforms that surround the offshore islands.

Field survey results within the vicinity of the proposed Project Area indicate that hard coral density varied between 30 and 70% live coral cover (MScience 2009a). However, sites were selected in areas of highest coral cover and therefore these results are not representative of the entire Project Area. The higher cover areas were dominated by spreading corals such as plate *Montipora* and tabulate *Acropora* spp. A gradient in coral communities was evident from inshore to offshore reefs, with the inshore zone dominated by *Montipora* spp. and the offshore zone dominated by *Acropora* spp. A transition zone between the inshore and offshore zones was evident and consisted of mixed community types with abundant *Montipora* corals but other corals, including *Acropora,* were found to be dominant. A relationship between coral cover and diversity was found with diversity decreasing as coral cover increased, as many sites were dominated by a cover of plate *Montipora* corals.

6.5.1.2 Seagrass

Temporal variability in distribution, density and biomass can occur as a result of seasonal cycles and inter-annual change due to sporadic environmental events and natural variation. The abundance and distribution of tropical seagrass species can vary greatly in response to seasonal changes in water quality (turbidity, light penetration) and conditions (wave action, temperature) (Lanyon and Marsh 1995; Short et al. 2001; Loneragan et al. 2003; Duarte et al. 2006). Inter-annual differences in seagrass biomass, distribution and abundance can be attributed to regional-scale changes in climate (Collier and Waycott 2009).

Seagrasses are important primary producers but their sparse distribution in the Pilbara Nearshore bioregion means that they make only a small contribution to benthic primary production when compared to mangroves and macroalgae (URS 2009a).

No known meadows of perennial seagrass genera, such as *Thalassodendron* or *Enhalus* spp., occur in the nearshore Project Area. The area is characterised by ephemeral species such as *Halophila* spp. Paling (1990) surveyed subtidal areas off Onslow and found seagrass was absent from most sites. He noted only ‘rare’ patches of *Halophila decipiens*. Around the islands offshore from Onslow, species of a number of genera (e.g. *Halophila*, *Halodule* and *Syringodium*) are known to occur on the shallow intertidal platforms and in the lee of small reefs, while *Thalassodendron* is sparsely distributed in the shallow macroalgal meadows that occur to the west of Thevenard Island (URS 2009a). Seagrasses recorded in surveys of the Project Area were sparsely distributed (when encountered), occurring in small patches.

6.5.1.3 Macroalgae

For the most part, macroalgae in Western Australia do not exhibit a pronounced seasonality. However the brown algal genus, *Sargassum,* is reported to undergo annual growth and reproductive cycles and based on observations in nearby Pilbara locations is likely that intertidal and shallow subtidal *Sargassum* species undergo a seasonal succession with peak growth and reproduction over summer (URS 2009)

Macroalgae are present on many shallow shoals and platforms that surround the offshore islands (e.g. Thevenard, Twin Islands). Macroalgae in the Project Area include large brown algae of the genera *Sargassum*, *Padina* and *Dictyopteris*, and red algae of

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the genera *Gracilaria* and *Laurencia*. Less common are green algae of the genera *Halimeda* and *Caulerpa* (URS 2009a).

6.5.1.4 Sponge and Whip Gardens

Sessile filter feeders (including soft corals, sponges and ascidians) are common on the sand veneered pavement that dominates the inner shelf and consequently are one of the most widespread sessile benthic communities present.

6.5.1.5 Intertidal Habitats

Two major types of BPPH are recognised in the intertidal marine areas, namely mangroves (and associated high tidal mudflat) and algal mats.

Within the nearshore Project Area, mangroves occupy the mainland intertidal zone between the high neap- and spring-tide levels. Mangroves in the area occur mostly within river mouth and tidal creek systems, where they form nearly continuous ribbons of vegetation, fringing the channels. These mangroves are protected and partially isolated from the sea by barrier dune systems. Areas of mangroves also occur along the outer, coastal shoreline on the western and northern sides of Coolgra Point (URS 2009b).

Landward of the mangroves, large areas of high tidal mudflats commonly extend to the hinterland margin or merge with supra-tidal salt flats. These mudflats areas are not inundated by daily tides. Two habitat types were recorded on the high tidal mudflats:

- bioturbated mudflats, devoid of macro-vegetation
- samphire flats, dominated by halophytic shrubs and with some crab burrows.

6.5.2 Marine Fauna

6.5.2.1 Overview

Fourteen threatened marine fauna species occur, or could occur, in the nearshore or offshore Project Areas. These include one bird, four marine mammals, six reptiles and three sharks/rays as shown in **Table 6-2**.

In addition to these species, a number of migratory marine mammals and birds that are also protected under the *EPBC Act (*Cth*)* may occur in the Project Area including cetacean species (whales and dolphins), the dugong, migratory seabirds and wetland birds.

Table 6-2: Threatened Marine Fauna Potentially Inhabiting the Project Area

Scientific Name	Common Name	*EPBC Act* (Cth) Conservation Status	*Wildlife Conservation Act* Status
Birds			
Macronectes giganteus	Southern giant petrel	Endangered	Rare
Mammals			
Balaenoptera musculus	Blue whale	Endangered	Rare
Balaenoptera musculus brevicauda	Pygmy blue whale	Endangered	
Eubalaena australis	Southern right whale	Endangered	Rare
Megaptera novaeangliae	Humpback whale	Vulnerable	Rare

Scientific Name	Common Name	*EPBC Act* (Cth) Conservation Status	*Wildlife Conservation Act* Status
Reptiles			
Caretta caretta	Loggerhead turtle	Endangered	
Chelonia mydas	Green turtle	Vulnerable	Rare
Dermochelys coriacea	Leatherback turtle	Vulnerable	Rare
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Rare
Natator depressus	Flatback turtle	Vulnerable	Rare
Crocodylus porosus	Saltwater crocodile	Protected	
Sharks			
Rhincodon typus	Whale shark	Vulnerable	
Pristis zijsron	Green sawfish	Vulnerable	Rare
Pristis clavata	Dwarf sawfish	Vulnerable	Rare

6.5.2.2 Marine Turtles

Green (*Chelonia mydas*) and flatback turtles (*Natator depressus*) are known to occur in the Project Area during sensitive life-history phases (e.g. mating, nesting and inter-nesting) and may be present in the area year-round (RPS 2010). Loggerhead (*Caretta caretta*) and hawksbill turtles (*Eretmochelys imbricata*) are less abundant and their distribution in the area is not well known. Leatherback turtles (*Dermochelys coriacea*) have not been recorded in the Project Area, nor are they known to nest in the general area.

Surveys have recorded nesting activity by a combination of flatback and green turtles on the large (Serrurier and Thevenard) and moderate sized (Bessieres, Locker and Ashburton) islands. Smaller islands such as Tortoise Island had very small areas of suitable nesting habitat, and very low density nesting activity. Other smaller islands such as Flat, Table, Direction and the Twin Islands had small areas of suitable habitat, with moderate levels of nesting activity (Pendoley Environmental 2009). There was low density of nesting activity observed on the mainland beaches, with large sections of beach apparently having no nesting activity at all (Pendoley Environmental 2009; RPS 2010).

Juvenile green turtles were observed around the islands. These animals are likely to be residents at their foraging grounds. Foraging green turtles are likely to be found in seagrass and algal habitats near the Project Area and may also utilise coastal mangrove habitats (Pendoley Environmental 2009). A total of 1,091 turtles were sighted during the aerial surveys from mid-May to late December, off the west Pilbara conducted by CWR (2009).

6.5.2.3 Marine Mammals

The Pilbara region supports migratory, transient and resident marine mammals such as whales, dolphins and dugongs, all of which are EPBC listed. Many of these are protected under Commonwealth law because they are listed on international treaties to which Australia is a signatory.

Baleen Whales

Four species migratory cetaceans, including humpback whales (*Megaptera novaeangliae*), pygmy blue whales (*Balaenoptera musculus brevicauda*), Bryde's whales (*Balaenoptera edeni*) and minke whales (*Balaenoptera acutorostrata*) are known to occur in the Project Area.

Humpback whales are known to move through the region on their northern and southern migrations to and from the Kimberley between June and October. Aerial surveys beginning in May 2009 found northbound humpback whales were concentrated seaward of Thevenard Island and over the continental slope, on average 49 km offshore (CWR 2009). The southbound migration found whales on average 36 km offshore with cows and calves predominantly resting inshore of the 50 m isobath. The data indicate that the area does not have the same importance for resting as Exmouth Gulf or for calving as Camden Sound.

Noise loggers identified pygmy blue whales, dwarf minke whales and Bryde's whales in the offshore waters although none of the species were recorded in the shallow waters near the Project Area. Antarctic minke whales, blue whales and southern right whales were not recorded during the field surveys and are unlikely to be present within the Project Area due to their preference for colder waters.

Dolphins and Toothed Whales
Coastal dolphin species that could occur in the Project Area include the Indo-Pacific humpback dolphin (*Sousa chinensis*) and bottlenose dolphins (*Tursiops* sp.). Little is known of the population structure, movement patterns or ecology of these species within the Project Area. Recent aerial surveys recorded dolphin species within the Project Area although positive identification of dolphins to species level was not possible. However, it is inferred that the Indo-Pacific humpback dolphin and bottlenose dolphins were present (CWR 2009). It can be expected that these coastal dolphin species may be present in shallow and nearshore waters of the Project Area at any time. All coastal species typically occur in low numbers and are widely dispersed, which is in accordance with previous documentation of these species in the Pilbara region (Prince 2001). It is likely that the Indo-Pacific humpback dolphin will move between different shallow water estuaries and inlets along the coast.

Dugongs
Dugongs (*Dugong dugon*) are found within the region and within the Project Area. Dugongs tend to occur in wide shallow bays, mangrove channels and in the lee of large inshore islands. Shallow waters such as tidal banks and estuaries have also been reported as sites for calving (Oceanwise 2005). While dugongs are found in the Project Area, it is not considered to be a favoured habitat due to the lack of extensive seagrass habitats and limited open water. From the available aerial survey data, it is expected that at least some dugongs are resident in the area year-round but with seasonal variation in densities (CWR 2010). Dugongs were predominantly sighted in the south-western portion of the study area (i.e. towards Exmouth Gulf) and in water depths less than 10 m. This is suggestive of a link to the known populations and possibly to food sources in that area (CWR 2009). Dugongs were often sighted over or near to known areas of seagrass and macroalgae, as identified during benthic surveys of the area (URS 2009a).

6.5.2.4 Migratory Waterbirds

Review of Faunabase (now Fauna Map [WA Museum]), the Birds Australia Atlas Database, the DEC Threatened and Priority Fauna Database, and the EPBC Protected Matters Search Tool indicate that up to 38 migratory waterbird species may frequent the Onslow locality. Bamford (2009) has recorded 26 of these species in the Onslow locality, and those not observed are likely to only occur as infrequent visitors to the area. Of these 26 species, the counts for numbers of waterbird species are all well below any criterion of international significance, except for the common tern (*Sterna hirundo*). The subspecies *Sterna hirundo* ssp. *longipennis* breeds in northern Asia and spends the non-breeding period in south-eastern Asia and northern Australia, and has a minimum population estimate of 25,000 (Scott and Delaney 2002). Three migratory species, the whimbrel (*Numenius phaeopus*), eastern curlew (*Numenius madagascariensis*) and sanderling (*Calidris alba*), may be present in regionally important numbers at the Ashburton River delta, Beadon Creek and Town Beach. However, these are again based on uncertain and conservative estimates of regional populations (Bamford et al. 2008) and these areas are outside of the Project Area. Bamford (2009) concluded that the Project Area and surrounds does not support important numbers of migratory waterbirds.

6.5.2.5 Introduced Marine Species

The National Introduced Marine Pests Coordination Group (NIMPCG 2006) has developed a target list of 55 pest species of concern to Australia. None of these species have been recorded in the Project Area, or elsewhere in the Pilbara Nearshore or Pilbara Offshore bioregions (Huisman et al. 2008).

One introduced marine species, the barnacle *Megabalanus tintinnabulum*, has been recorded in Onslow (Huisman et al. 2008). This species is not considered a “pest” and has been recorded at several other WA ports.

6.6 Social and Economic Environment

The land and sea area surrounding the proposed Project Area has a number of uses and values, including commercial, heritage, environmental conservation, and recreational. The following section provides a brief overview of the sea use and recreational values of the proposed project area.

6.6.1 Sea Use Values

6.6.1.1 Commercial Fisheries

The waters off the Pilbara coast are home to many managed commercial fisheries including prawn, demersal scalefish, demersal finfish, mackerel, oyster and several types of tuna. The fisheries in closest proximity to Onslow are managed by the Department of Fisheries (DoF), and include:

- Onslow and Nickel Bay Prawn Managed Fisheries (ONPMF);
- Pilbara Managed Trap Fishery;
- North Coast Blue Swimmer Fishery; Pearl Oyster Managed Fishery
- Pilbara Line Fishery;
- Mackerel Managed Fishery;
- Specimen Shell Managed Fishery; and
- Marine Aquarium Fish Managed Fishery.

The ONPMF is a combination of three areas and four associated Size Management Fish Grounds (SMFG) totalling 39 748 km^2. Construction of the proposed Project, including dredging a material offloading facility and construction of an LNG and condensate jetty, would most directly affect Area 1(the mouth of the Ashburton River), which also includes the Ashburton SMFG.

6.6.1.2 Pearling

Onslow was one of the earliest commercial pearling centres in WA since the commencement of the State's commercial pearling industry during the nineteenth century. Since 1992, the health of wild oyster stock (the basis for pearl farm production) and the market price of WA pearls have been controlled by a production (output) quota. Quota units are allocated to licence holders (572 units existed in 2006) with one quota unit normally allowing 1000 shells (though there may be annual variations). The major licence and quota holders operate out of Broome.

6.6.1.3 Oil and Gas Production Facilities

Oil is produced from a number of small fields located in shallow waters offshore from Onslow. These include the Saladin, Coaster, Roller and Skate fields. Further offshore, are the BHP Billiton operated Griffin oilfield, the Chevron operated Barrow Island facility and the Gorgon gas field development, as well as Apache's Varanus Island operations.

Key island facilities for oil and gas processing, storage and shipping facilities are located on Barrow, Thevenard, Airlie and Varanus Islands. Gas gathering pipelines from the Griffin and Roller fields come ashore west of Onslow, near Urala Station. A new structure plan is being developed for Onslow to complement the proposed Ashburton North Hydrocarbon Precinct, which was endorsed in December 2008 to support further opportunities for gas processing plants development in the area. The Ashburton North Hydrocarbon Precinct would cover approximately 8000 ha and include the proposed Project, BHP Billiton/Apache Macedon Domgas plant and the ExxonMobil/BHP Billiton Scarborough LNG plant. The Ashburton North Hydrocarbon Precinct would have optimal access to the coast, a buffer of about 12 km from the Onslow town site and would accommodate various gas-related industrial land uses.

6.6.1.4 Shipping

Onslow and the surrounding area is currently not a high density shipping channel. Greater shipping activities occur in neighbouring locations including Exmouth, Dampier and Port Hedland (Australian Maritime Safety Authority 2008).

6.6.2 Recreational Values

Coastal recreational value, within and adjacent to the Project area, has been determined by a values and land use assessment study (URS 2009c). The areas of highest value and/or use identified in this study included the Ashburton River, Four Mile Creek, Hooley Creek, Sunset Beach, Sunrise Beach, Onslow Town Beach and Beadon Creek. The high value areas that may be affected by changed coastal processes include the Hooley to Four Mile Creek complex (fishing, boating and crabbing); Sunset Beach (four-wheel driving); and Onslow Town Beach (walking). It is important to note that not all of the values identified in the high value areas by the values and land use study (URS 2009c) would be adversely affected by changed coastal processes.

7.0 SEDIMENT PLUME MODELLING AND DEVELOPMENT OF IMPACT ZONES

This section to be updated when revised trunkline modelling results are received

7.1 Tolerance Limits

Tolerance limits for both turbidity and sedimentation rates have been established for various receptors including hard coral, seagrass and recreational values. Tolerance limits have been established for both the nearshore (ECU1) and offshore waters (ECU2) to reflect the different natural turbidity climate of these areas (refer to **Section 6.5.1** for description of the four major Ecosystem Units ECUs) (DHI, 2010).

The tolerance limits and the process followed to establish these limits are detailed in the EIS/ERMP document and its technical appendices.

The tolerance limits for turbidity and sedimentation rates established for hard coral are detailed in **Table 7-2**, **Table 7-3**, **Table 7-4** and **Table 7-5**.

Table 7-1: Definition of Impact Zones for Suspended Sediment Impacts on Corals Applicable for Nearshore Waters within 5 m isobath in ECU1 during Summer and Winter Only.

Zone	Definitions
Total Mortality	Excess SSC >25 mg/l for more than 20% of the time
Partial Mortality	Excess SSC >25 mg/l for 5–20% of the time; OR Excess SSC >10 mg/l for more than 20% of the time; OR Excess SSC >5 mg/l for more than 50% of the time.
Influence	Excess SSC >25 mg/l for 1–5% of the time; OR Excess SSC >10 mg/l for 1–20% of the time; OR Excess SSC >5 mg/l for 5–50% of the time.
No Impact	Excess SSC >25 mg/l for less than 1% of the time; OR Excess SSC >10 mg/l for less than 1% of the time; OR Excess SSC >5 mg/l for less than 5% of the time.

Table 7-2: Definition of Impact Zones for Suspended Sediment Impacts on Corals Applicable for Offshore Waters (beyond 5 m isobath) for All seasons and for Nearshore Waters (within 5 m isobath) during Transitional Periods Only.

Zone	Definitions
Total Mortality	Excess SSC >25 mg/l for more than 10% of the time; OR Excess SSC >10 mg/l for more than 25% of the time.
Partial Mortality	Excess SSC >25 mg/l for 2.5–10% of the time; OR Excess SSC >10 mg/l for more than 10–25% of the time; OR Excess SSC >5 mg/l for more than 25% of the time.
Influence	Excess SSC >25 mg/l for 0.5–2.5% of the time; OR Excess SSC >10 mg/l for .05–10% of the time; OR Excess SSC >5 mg/l for 2.5–25% of the time.
No Impact	Excess SSC >25 mg/l for less than 0.5% of the time; OR Excess SSC >10 mg/l for less than 0.5% of the time; OR Excess SSC >5 mg/l for less than 2.5% of the time.

Table 7-3: Definition of Impact Zones for Sedimentation Impact on Corals Applicable for Nearshore Waters within 5 m isobath in ECU1 during Summer and Winter Only.

Zone	Definitions
Total Mortality	Sedimentation >0.5 kg/m^2/day (> 17.5 mm/14 day*)
Partial Mortality	Sedimentation 0.1–0.5 kg/m^2/day (3.5 – 17.5mm/14 day*)
Influence	Sedimentation 0.025–0.1 kg/m^2/day (0.9 – 3.5mm/14 day*)
No Impact	Sedimentation <0.025 kg/m^2/day (<0.9mm/14 day*)

*conversion from kg/m^2/day to mm/14 days assumes an initial deposition dry density of 400kg/m^3

Table 7-4: Definition of Impact Zones for Sedimentation Impact on Corals Applicable for Offshore Waters (beyond 5 m isobath) for All Seasons and for Nearshore Waters (within 5 m isobath) during Transitional Periods Only.

Zone	Definitions
Total Mortality	Sedimentation >kg/m^2/day (> 7.0mm/14 day*)
Partial Mortality	Sedimentation 0.05–0.2 kg/m^2/day (1.7 – 7.0mm/14 day*)
Influence	Sedimentation 0.01–0.05 kg/m^2/day (0.3 – 1.7mm/14 day*)
No Impact	Sedimentation <0.01 kg/m^2/day (<0.3mm/14 day*)

*conversion from kg/m^2/day to mm/14 days assumes an initial deposition dry density of 400kg/m^3

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7.2 Sediment Plume Modelling

To be updated when revised trunkline modelling results are received

The modelling provides predictions of turbidity and sedimentation patterns associated with the proposed dredging and dredge material placement. Sediment plume modelling has considered two climatic conditions (strong and representative drift), three seasons (summer, winter and transitional periods) and two spill estimates (realistic and worst case) for the trunkline installation, covering the full range of dredging equipment and dredged material placement sites. The assessment case, as described in **Section 4.0** has been used to model the turbidity plume. This assessment represents the most conservative case with the maximum pre-lay trenching and sand backfill and therefore is likely to represent the greatest extent of environmental impacts.

7.2.1 Modelled Scenarios

7.2.1.1 Dredging Scenarios

Pipeline Trenching Scenario 1

- ♦ CSD dredging of the pipeline trench adjacent to Ashburton Island with pumping to an adjacent hopper barge overflow, for transport to Placement Site D.

Pipeline Trenching Scenario 2

- ♦ CSD dredging of the pipeline trench adjacent to Ashburton Island with pumping to an adjacent hopper barge overflow, for transport to Placement Site D.

7.2.1.2 Climatic Scenarios

The Wheatstone area has dominant summer and winter conditions with wind-driven net currents that cause the sediment plumes to travel in a predominant direction. Due to the variable climatic component, a number of scenarios with best estimates of “representative” and “strong” conditions are required to develop an estimate of possible impacts. There is also significant variability throughout the “calm” seasonal period occurring in April and May, therefore there are two representative calm periods to capture this variability. The six climatic scenarios, based on real wind data, are presented in **Table 7-6**. The most complete wind records available for the Project Area are from 2006 and 2007 and comparison to previous years indicate that these two years followed fairly typical patterns, although 2006 encompassed cyclonic events and 2007 had higher than average winds in January. The wind records from 2007 were selected for modelling purposes.

Table 7-5: Climatic Scenarios

Condition Period	Period
Summer A	January 2007
Summer B	February 2007
Winter A	June 2007
Winter B	July 2007
Transition A	April 2007
Transition B	May 2007

7.2.1.3 Sediment Spill

In order to capture the uncertainty during the impact assessment stage of the Project regarding the rate of sediment spill from the various dredging, onshore and offshore material placement activities, upper and lower bound estimates have been developed for each spill source simulated in the model. These are referred to as ‘High Spill’ and ‘Low

Spill' scenarios in this report, with the High Spill scenarios considered to be a conservative "worst case" over-estimate of likely sediment release rates, and the Low Spill scenarios considered to be realistic estimate of "most probable" sediment release from the proposed program.

The difference between the high and low spill rates for each scenario is documented in DHI (2010a).

7.2.2 Modelling Results

The detailed modelling results for each scenario are presented in DHI (2010) and discussed in EIS/ERMP documentation. The results are presented within this Draft DSDMP to provide context for the management strategies presented in **Section 8.0** and the monitoring program presented in **Section 9.0**.

The CSD dredging along the trunkline route releases a relatively narrow plume of suspended sediment that extends a considerable distance (in the order of 5–10 km) from the dredging location. However, the CSD dredging of the pipeline route would move relatively quickly along the route and over the 14-day modelling duration the CSD would have moved approximately 2 km along the pipeline route.

The Impact Zones are only based on modelling of the two most sensitive locations along the pipeline route therefore a conservative approach has been used in determining the boundaries. The actual zones of impact are expected to be significantly smaller.

7.3 Definition of Impact Zones used within DSDMP

Impact zones were initially developed based on the recommended approach of the OEPA Marine Ecosystem Branch (MEB), which uses four categories of classification. A description of the impact zones initially developed is provided in **Table 7-1** (columns 1 and 2). Refer to the EIS/ERMP document prepared for the Project for further details on the establishment of these zones.

The initial modelling and BPPH loss assessment calculations undertaken and presented in the EIS/ERMP were based on EPA Guidance Statement No 29: Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment (EPA 2004). However, this has now been superseded by Environmental Assessment Guideline #3: Protection of Benthic Primary Producer Habitats In Western Australia's Marine Environment (EPA 2009). The monitoring and management programs described within this DSDMP have been based on both EAG #3 (EPA 2009) and Draft Environmental Assessment Guideline #7: Marine Dredging Proposals (EPA 2010).

There are slight differences between the zones presented in the EIS/ERMP (colums 1 and 2 of **Table 7-1**) and the definitions used for monitoring and management within the DSDMP (columns 3 and 4 of **Table 7-1**) due to differences in definitions contained within new versus superseded Guidance Statement, however, generally the Zone of Total Mortality and Partial Mortality correspond to the Zone of High Impact and Moderate Impact and the Zone of Influence and Zone of No Impact correspond exactly between definitions used in the EIS/ERMP and those used the DSDMP.

Table 7-6: Definition of Impact Zones

HOLD zones being redefined will include in subsequent revision

EIS/ERMP Definitions (as per GS29)		DSDMP Definitions (as per EAG3 and Draft EAG7)	
Zone	**Definition**	**Zone**	**Definition**
Zone of Total Mortality	An area within which key receptors are predicted to suffer total or substantial mortality (>50%), and where loss of structural function is predicted to occur.	**Zone of High Impact**	An area within which BPPH or the BPP communities that they support are predicted to suffer permanent impacts (not recoverable within 5yrs) as a result of direct or indirect impacts attributable to dredging or placement activities.
Zone of Partial Mortality	An area within which key receptors are predicted to suffer partial mortality (up to 50% loss close to the channel and <1% loss at the extremes). Mortality will occur within the area, but will not include all individuals. The outer border will be drawn so that no mortality will be predicted to occur immediately outside of this zone.	**Zone of Moderate Impact**	An area within which non-permanent impacts (recoverable within 5 yrs) are predicted to occur as a result of dredging or placement activities. In order to provide a quantifiable level of impact, this zone has been defined within the DSDMP as an area within which 70% of hard corals will remain unimpacted (up to 30% mortality of corals may occur). See Section 8.1.3 for supporting arguments.
Zone of Influence	Outside the outer boundary of the Zone of Partial Mortality there may be influence from the dredge plume at low levels (for example sub-lethal impacts on key receptors, turbidity may be visible or very light sedimentation may occur) but this is predicted to be unlikely to have any material and/or measurable impact on the key receptors.	**Zone of Influence**	Outside the outer boundary of the Zone of Partial Mortality there may be influence from the dredge plume at low levels (for example sub-lethal impacts on key receptors, turbidity may be visible or very light sedimentation may occur) but this is predicted to be unlikely to have any material and/or measurable impact on the key receptors.
No Impact	Beyond the outer boundary of the Zone of Influence, there will be an unbounded area where there is no detectable influence on turbidity and sedimentation rates from the dredging. This area would be suitable for locating reference sites.	**No Impact**	Beyond the outer boundary of the Zone of Influence, there will be an unbounded area where there is no detectable influence on turbidity and sedimentation rates from the dredging. This area would be suitable for locating reference sites.

Differences between the definitions used within the EIS/ERMP and those adopted for the DSDMP include:

The Zone of Total Mortality included areas where 50% to 100% of hard corals were predicted to suffer mortality, whereas the corresponding Zone of High Impact includes areas where permanent (not recoverable within 5yrs) impacts are predicted to occur. For the purposes of this DSDMP, this definition includes areas where from 30% to 100% mortality of hard corals is predicted, or where permanent changes to the underlying habitat may occur. Taking this into consideration, Saladdin Shoal and End of Channel

Shoal have now been included within this zone since there is a possibility that >30% mortality of corals will occur at these reefs.

The Zone of Partial Mortality included areas where <1% up to 50% of corals were predicted to suffer mortality, whereas the Zone of Moderate Impact includes an area where non-permanent impacts are predicted to occur (defined within the DSDMP as 70% of corals unimpacted, or conversely, up to 30% mortality of hard corals may occur). Based on a range of evidence from modelling predictions and outcomes from recent dredging projects, three reefs (Gorgon Patch, Hastings Reef and Paroo Shoal) have the potential to suffer some mortality that may be considered non-permanent. Therefore, these three reef areas have been included within the Zone of Moderate Impact.

7.4 Predicted Impacts from Dredging

HOLD BPPH Loss being recalculated

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8.0 ENVIRONMENTAL MANAGEMENT

The management and mitigation measures presented within this section are conceptual and are to be confirmed by the project stakeholders prior to the document finalisation

8.1 Water Quality and Benthic Primary Producer Habitat Management

8.1.1 Background

8.1.1.1 Overview

Trunkline dredging activities have the potential to affect water quality through the suspension of sediments which may increase turbidity, with the potential for subsequent impacts to receptors. Of particular concern is the potential impacts to Benthic Primary Producers (BPP) as a result of a reduction in light availability caused by elevated turbidity. Dredging activities also have the potential to affect Benthic Primary Producer Habitat (BPPH) and BPP through the direct removal of habitat (such as the clearing of mangroves or removal of coral habitat) as well as the potential smothering of habitat by sediments suspended during dredging and dredge material placement activities.

Due to the links between monitoring and management of water quality BPPH, these elements are addressed together in this section.

Water quality will be monitored to assist with inferring the cause of any changes observed in coral health. Water quality may also provide an early warning of potential impacts to BPPH.

Key BPPH described within this section to be monitored and managed include mangroves as well as subtidal BPPH and associated communities (using hard corals as a representative indicator of potential impacts to all subtidal BPPH).

In the event that Wheatstone Trunkline dredging and Wheatstone Capital dredging occur concurrently, the monitoring and management of water quality and BPPH outlined in the DSDMP for the Capital Dredge and Disposal Program (SKM 2010) will override that presented here and should be referred to.

8.1.2 Management of Subtidal BPPH

As described in **Section 6.5**, subtidal BPPH that may potentially be affected by the dredging activities include habitat supporting hard corals, seagrass and macroalgae. Hard corals are considered to be the most sensitive to the impacts of excessive turbidity caused by the dredging and placement activities. Subsequently, hard corals will be monitored and managed as conservative indicators of any potential impacts to subtidal BPPH.

Potential impacts to seagrasses and macroalgae are considered temporary (EAG#3 definition: recoverable within 5 years; EPA 2009) since the dominant seagrasses and macroalgae within the proposed project area (e.g. *Halophila* spp. seagrasses and *Sargassum* spp. macroalgae) are species that have been reported to be highly variable in space and time. These characteristics do not lend these species to responsive monitoring and management, which calls for precision and confidence in the detection of change and the ability to infer the cause of that change. Instead, hard corals have been chosen as representative indicators of potential impacts to seagrasses and macroalgae since hard corals are believed to be generally more sensitive to impacts of elevated sedimentation and turbidity. In addition, hard coral communities are considered likely to be more through time in the Pilbara than macroalgae and seagrasses, which suggests these organisms can be monitored more easily for a responsive monitoring and management program.

While seagrasses and macroalgae will not be monitored directly for the purposes of responsive management, the potential for detection of permanent losses of these BPP that are attributable to dredging will be assessed through an Impact Monitoring Program (described in **Section 9.2**) that will examine the areal extent of potential impacts using a before versus after, control versus impact design.

8.1.2.1 Outcome-Based Approach for Management of BPPH

Outcome–Based Conditions have been developed that are aimed at protecting the majority of BPPH within the proposed project area, recognising that some unavoidable impacts to BPPH are likely to occur within, and in close proximity to, the proposed dredging and material placement footprints (within the Zones of High Impact and Moderate Impact).

Outcome-Based Conditions have been developed to protect BPPH from dredging and dredge material placement impacts at all recognised ‘Important Reef Areas’ that are within or in close proximity to the influence of dredging or dredge material placement activities, including at Serrurier, Bessieres, Thevanard and Airlie Islands.

Outcome-Based Conditions have also been developed to protect all BPPH from dredging impacts within the Zone of Influence.

While, it is predicted by the modelling interrogations that some BPP within the Zone of Moderate Impact may suffer partial mortality, Conditions require that no permanent losses of BPPH occur within this Zone as per EAG#7 (EPA 2010).

The two Outcome-Based Conditions relating to the management of BPPH are listed in **Section 8.1.3**.

8.1.2.2 Responsive Monitoring and Management Approach

A tiered, responsive monitoring and management approach will be implemented in order to minimise the likelihood that any potential impacts to BPPH (attributable to dredging activities) will exceed the allowable limits described in the Outcome-Based Conditions (**Section 8.1.2**). The responsive monitoring and management approach will involve the collection of data on water quality and coral health. These data will be assessed against precautionary water quality early warning criteria and coral health management triggers.

An exceedance of water quality early warning criteria would prompt the prioritisation of coral health monitoring at sites where the exceedance(s) of water quality criteria occurred.

An exceedance of coral health management triggers would prompt the implementation of management measures to minimise the likelihood that impacts to BPPH will exceed the limits of allowable loss stated in the Outcome-Based Conditions.

Gross sedimentation rates will be monitored at all water quality and coral health monitoring sites to assist in the interpretation of potential impacts to BPPH (see **Section 9.1.3**). Gross sedimentation data will not, however, be formally assessed against management triggers for the following reasons:

i) Gross sedimentation data (collected using sediment traps) will only provide a relative, rather than absolute measure of potential impacts to corals. Sediment is likely to be deposited and removed regularly in the existing macro-tidal environment, hence it is net rather than gross sedimentation rates which determine the potential for impacts to occur.

ii) While net sedimentation would provide a better indication of potential impacts to corals, net sedimentation is not able to be measured accurately using existing technology and data could not be compared against management triggers.

Net sedimentation may also be monitored adjacent to coral health monitoring sites using a simplified approach such as a graduated marker peg, against which measured changes in levels of sediment accumulation at any given time may be assessed. If this method proves to be reliable, these data may also be used to infer the cause of any changes in coral health that may be observed.

Water quality and coral health monitoring methods are described in Section 9.1. Water quality and coral health monitoring associated with the Trunkline Dredging program will only be undertaken only the Zone of Influence as there no significant coral BPP has been identified within the Zones of High Impact and Moderate Impact. While Ashburton Island lies within the Zone of Moderate Impact it has been classified as an ‘Influence’ site for the purposes of monitoring and management as ‘no net average detectable mortality of corals’ will be permitted at this site.

Zone of Influence

Monitoring of water quality and coral health will be undertaken on a frequent basis (within the first year, fortnightly downloading of water quality data (collected at 30 minute intervals) and fortnightly collection of coral health data) at representative sites located within the Zone of Influence (**Figure 9-1**). Water quality and coral health data collected from sites within the Zone of Influence will be assessed against trigger criteria described in **Table 8-1** following the procedures outlined in **Figures 8-1 and 8-2**.

Water quality trigger criteria within the Zone of Influence (Level 1 Trigger) are based on the 99th%ile of turbidity values (intensity, duration and frequency) experienced by BPP naturally. These will be established using data collected during the baseline period and trigger values will be finalised upon completion of the baseline water quality monitoring program (prior to the commencement of dredging activities). Preliminary water quality trigger criteria will be established prior to the commencement of dredging operations. However, it is likely that these criteria will need to be revised if further water quality and coral health data become available during the dredging program that allow predictive relationships between water quality and coral to be established, or if it is found that the initial criteria do not capture the natural range of baseline turbidity values and hence are being frequently exceeded due to natural turbidity events.

The Level 2 trigger criteria within the Zone of Influence is based on a precautionary level of sub-lethal change in coral health (>20% average net bleaching) prior to mortality being detected. A variety of stressors can result in the phenomenon referred to as ‘coral bleaching’ or the expulsion of photosynthetic endosymbionts from coral tissue, including thermal stress, deprivation of light and sedimentation (Jones et al 1998; Hoegh-Guldberg 1999, Anthony et al. 2007). There is usually a time-lag between bleaching and subsequent coral mortality, the timing of which is influenced by the intensity and duration of the stress (Glynn 1996; Anthony et al 2007). High rates of heterotrophy, high levels of endogenous lipid reserves and rapid recovery of the endosymbiont populations are critical factors in the ongoing survival of the coral post-bleaching (Anthony et al 2009).

Since bleaching is generally a precursor to coral mortality, an exceedance of the Level 2 trigger criteria that is attributable to dredging would lead to the implementation of management measures that would minimise the likelihood of non-compliance with the Outcome-Based Condition of ‘no average net detectable coral mortality’.

The Level 3 trigger criteria within the Zone of Influence corresponds to the allowable limits of the Outcome-Based Condition for this zone: ‘no average net detectable coral mortality’, an exceedance of which (attributable to dredging) would result in a cessation of activities that led to the impact.

Table 8-1 Zone of Influence Water Quality and Coral Health Trigger Criteria

Level 1	Level 2	Level 3
Exceedence of water quality criteria[1]	>20% average[2] net[3] coral bleaching attributable to dredging or dredge material placement activities	Average[2] net[3] detectable coral mortality attributable to dredging or dredge material placement activities

[1]Water quality criteria (turbidity) will be established prior to dredging using the full baseline water quality data set combined with existing information on coral tolerance thresholds to altered turbidity. Criteria will be established based on the intensity, duration and frequency (i-d-f) of turbidity values experienced during baseline conditions.
[2]Average refers to the average mortality of corals across a number of sites (at least 3) in areas where water quality exceedances have occurred.
[3]Net refers to the difference between levels of mortality recorded at the potential impact and reference sites, to enable differentiation of potential dredging impacts from natural variation.

Important Reef Areas

No impacts to water quality or BPPH are predicted to occur within ‘Important Reef Areas’ (Serrurier and Thevenard Islands) as a result of Trunkline dredging. These reef areas have been defined as ‘important’ due to their ecological, conservation or social value, as described within Section 6.3 of the EIS/ERMP (Chevron 2010).

As a precautionary measure, coral health mon No impacts to water quality or BPPH are predicted to occur within ‘Important Reef Areas’ (Serrurier, Thevenard and Airlie Islands). These reef areas have been defined as ‘important’ due to their ecological, conservation or social value, as described within Section 6.3 of the EIS/ERMP (Chevron 2010).

No impacts to benthic habitats are predicted to occur at these Important Reef Areas as a result of dredging or material placement activities. Serrurier and Airlie Islands lie wholly outside the Zone of Influence, while Thevenard Island lies partly outside and partly within the Zone of Influence.

Monitoring sites will be established at these reefs and used primarily as Reference sites. However, this monitoring will also be used to maintain surveillance on any impacts that may occur as a result of dredging or material placement activities.

Coral health monitoring itoring and downloading of water quality data (collected at 30 minute intervals) will be undertaken at these reefs on an infrequent basis (initially every 3 months) following methods outlined in **Section 9.1**. However, if turbid plumes associated with either dredging or material placement are observed to extend to these ‘Important Reef Areas’, as detected using daily satellite or aerial imagery or data from *in-situ* water quality loggers, the frequency of coral health monitoring and water quality data downloading will be increased to fortnightly in areas where the plume is observed to occur, in order to closely monitor any potential impacts to coral health, until such time as water quality returns to normal in these areas.

Sites at Thevenard and Serrurier Islands will also be used as Reference Sites in trigger assessments for a subset of potential impact sites within the Zone of Influence.

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8.1.3 BPPH and Water Quality Management Measures

Management Area: **Management of Subtidal BPPH (Hard Coral)**

Performance Objective:

To comply with the draft Outcome-Based Condition XX as follows:

HOLD - Draft OBC pending finalisation

1. There will be no permanent[1] impacts to Benthic Primary Producer Habitat (BPPH) beyond the predicted boundary of the Zone of High Impact (shown in Figure XX) as a result of dredging of the trunkline and placement of dredged material.

2. Within the predicted Zone of Influence (shown in Figure XX), there will be no average[2] net[3] detectable[4] impacts to BPPH (represented as no average[2] net[3] detectable[4] mortality of hard corals) as a result of the trunkline and placement of dredged material.

Notes:

1. ''Permanent' impacts to BPPH will be represented as net detectable impacts to hard coral BPP (as an indicator of other BPP types) and their underlying habitat that unlikely to recover within a period of 5 years (EPA 2009). These areas of permanent impact are likely to result from direct physical removal or smothering of habitat or indirect impacts through light reduction that would not allow recovery within a 5 year period from the cessation of marine construction activities. Whilst previous Ministerial Conditions have stipulated the allowable limits of BPPH loss as a hectare value, differences in methods used to map versus monitor changes in BPPH consistently yield different hectare values and each method has an inherent level of sampling error rendering the accurate assessment of compliance with this condition unworkable. To avoid the errors associated with estimating areas of loss, the Outcome-Based approach proposed for the Wheatstone Project stipulates a boundary based on spatial coordinates, beyond which no permanent impacts to BPPH are permitted. This boundary will be delineated on a map and corresponds to the outer limit of the predicted Zone of High Impact.

2. <Hold – Draft pending finalisation of OBC> 'Average' refers to the averaging of changes observed across a number of reefs to avoid pseudoreplication. When assessing data against management trigger levels, an estimate of the change in partial mortality of hard corals within the ZoMI will be based on an average recorded across three reefs. For the Zone of Influence, levels of partial mortality and bleaching will be averaged across all reefs where monitoring sites are established that lie within this zone.

3. 'Net' refers to the difference between changes in coral health recorded at impact sites minus the change observed over the same period at associated reference sites.

1. *4. 'Detectable' refers to the smallest ecologically significant effect size, based on the proposed monitoring method, level of replication and whether the observed change is greater than natural variation (as recorded during baseline studies and reported in published accounts within the Pilbara Region). An objective framework for determining the smallest ecologically significant effect size is described*

within Section 9.4.4 of the DSDMP.

Management:

The water quality and BPPH management framework is described below and illustrated in **Figure 8-1** and **Figure 8-2**.

Overview

The management of water quality and associated potential impacts on sensitive BPPH will be managed via:

- Preventive management including:
  - General preventive management measures to be applied whenever practicable during the dredging and dredge material management activities.
- Responsive monitoring and management, including:
  - Continuous water quality monitoring within representative areas where hard coral communities occur.
  - Coral health monitoring within the Zone of Influence, with an associated tiered management response.

Preventative Monitoring and Management

General Preventive Management

- TSHDs will be fitted with a turbidity reducing valve within the overflow pipe.
- Diffusers will be utilised during dredge material placement via the CSD. **[HOLD type of diffuser required]**
- Where reasonably practicable the works will be managed to optimise the under-keel clearance of the TSHD to reduce sediment re-suspension via propeller wash.
- During sediment transport by the TSHD and barges, the level of the overflow pipe will be raised to its highest point to ensure minimum spillage.
- Hopper doors on the TSHD and barges will be maintained to ensure minimum loss of sediment during transport.
- Well-maintained and properly calibrated dredging equipment will be utilised.
- Hopper dewatering will be confined to areas away from sensitive receptors where reasonably practical.
- A restriction of overflow from the TSHD should occur in the Restricted Overflow Areas (**Figure 8-3**) when sensitive receptors are at risk. The areas will vary depending on conditions and dredging operations.
- Impacts on BPPH will be limited by limiting anchoring by construction vessels within established ‘no anchoring areas’.
- A buffer of 0.5nm will be maintained around coral reefs (as illustrated in **Figure 8-4**) to limit stress associated with resuspension of sedimentation from propeller wash..
- The TSHD overflow will be calibrated to the green valve.

In the event that dredging occurs concurrently with the Trunkline Dredging Campaign additional management measures will be implemented, including the following:

- Avoiding overlapping plumes from other dredging activities, either by avoiding simultaneous dredging and/or dredging in areas along the same plume extension direction
- Targeting seasons with the least risk of impacts, e.g. summer conditions when dredging east of Ashburton Island.
- Reducing total sediment release and release rates, e.g. through the choice of methodology or adapting methods of release reduction during

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the pipe laying.

Responsive Monitoring and Management Procedures

Responsive monitoring and associated tiered responsive management will be implemented to manage any potential impacts that increased turbidity may have on sensitive BPPH.

Responsive monitoring and management (**Figure 8-1** and **Figure 8-2**) will consist of water quality and coral health monitoring to be carried out throughout the dredging program and following completion of dredging.

A tiered management response program associated with water quality and coral health monitoring will include assessment of monitoring data against trigger criteria (as per **Figure 8-1** and **Figure 8-2**), with trigger criteria established to minimise impacts on BPPH (**Section 8.1.2**).

Water Quality Monitoring – Sensitive Receptors

Continuous (30 minute interval data collection) water quality monitoring will be undertaken at all coral health monitoring sites throughout the duration of the dredging and dredge material placement works. Continuous water quality monitoring will be achieved through the use of *in-situ* water quality data logging instruments which will be downloaded on a fortnightly to 3-monthly basis, depending on the location and objective of the monitoring site. Refer to **Section 9.1** for further details of the water quality monitoring program. The results of the water quality monitoring will be:

- Used to assist inferring the cause of any observed impacts to coral health.
- Compared to water quality trigger levels within the Zone of Influence (**Section 8.1.2**), an exceedance of which would trigger a prioritisation of coral health monitoring during the next survey round at sites that are within the vicinity or direction of the water quality exceedance(s), following the procedure in **Figure 8-1**.

Coral Health Monitoring and Responsive Management

Coral health monitoring will consist of:

- Monitoring of coral health at 7 sites within the Zone of Influence on a fortnightly basis.
- Monitoring of coral health at 2 sites within Important Reef Areas (Serrurier and Thevenard islands) on a less frequent basis (e.g. 3 monthly), increasing to fortnightly monitoring at site(s) where a detectable plume has been observed to extend to these areas.

  Monitoring of 3 reference sites (including the 2 Important Reef Area sites listed above) on an as-needs basis. Monitoring of coral health at reference sites may be required fortnightly in the event that trigger levels are approached or exceeded at potential impact sites, while less frequent monitoring (e.g. 3-monthly) may be sufficient if trigger levels are not being approached or exceeded, in which case data from previous months may be conservatively used in trigger assessments.

Refer to **Section 9.1.4** for further details of the coral health monitoring program.

The coral health trigger levels that will be applied are provided in **Section 8.1.2.2**.

Potential Responsive Management Measures

The following measures will be considered for implementation in the event that any Level 1, 2 or 3 coral health management trigger is exceeded (as per **Section 8.1.2.2**). It should be noted that the selection of the most appropriate management measure will be made based on the impact observed, including its temporal and spatial scale, metocean conditions, and the planned future dredging operations. Management measures that may be considered include:

	♦ Prioritise coral health monitoring in subsequent rounds at sites in the vicinity or direction of where exceedance(s) were detected (i.e. monitoring of sites within the vicinity or direction of the exceedance(s) will be monitored first in subsequent rounds). ♦ Increase the frequency of coral health monitoring at sites in the vicinity or direction of where exceedance(s) were detected if not already monitored fortnightly. ♦ Apply tidal or seasonal windows for dredging sections of the dredging area. ♦ Redefine the zones in the channel where overflow by the TSHD is allowed. ♦ Move dredging operation to another location or temporarily cease in dredging activities. ♦ Reduce or stop overflow. ♦ Reduce or modify the production of the CSD. ♦ Increase the minimum under keel clearance for the TSHD when dredging in areas where propeller wash is a significant source of turbidity. ♦ Optimise material placement based on met-ocean conditions and location of affected BPPH. ♦ Reduce operations.
Monitoring:	♦ Responsive Monitoring (**Section 9.1**) ♦ Impact Monitoring (**Section 9.2**)
Reporting:	♦ Monthly Monitoring Reports to the DEC (**Section 10**)
Risk Assessment	♦ Refer to **Appendix A** for the Risk Assessment Table. The Residual Risk rating for impacts on BPPH from the indirect impacts of the dredging and dredge material management activities is high.

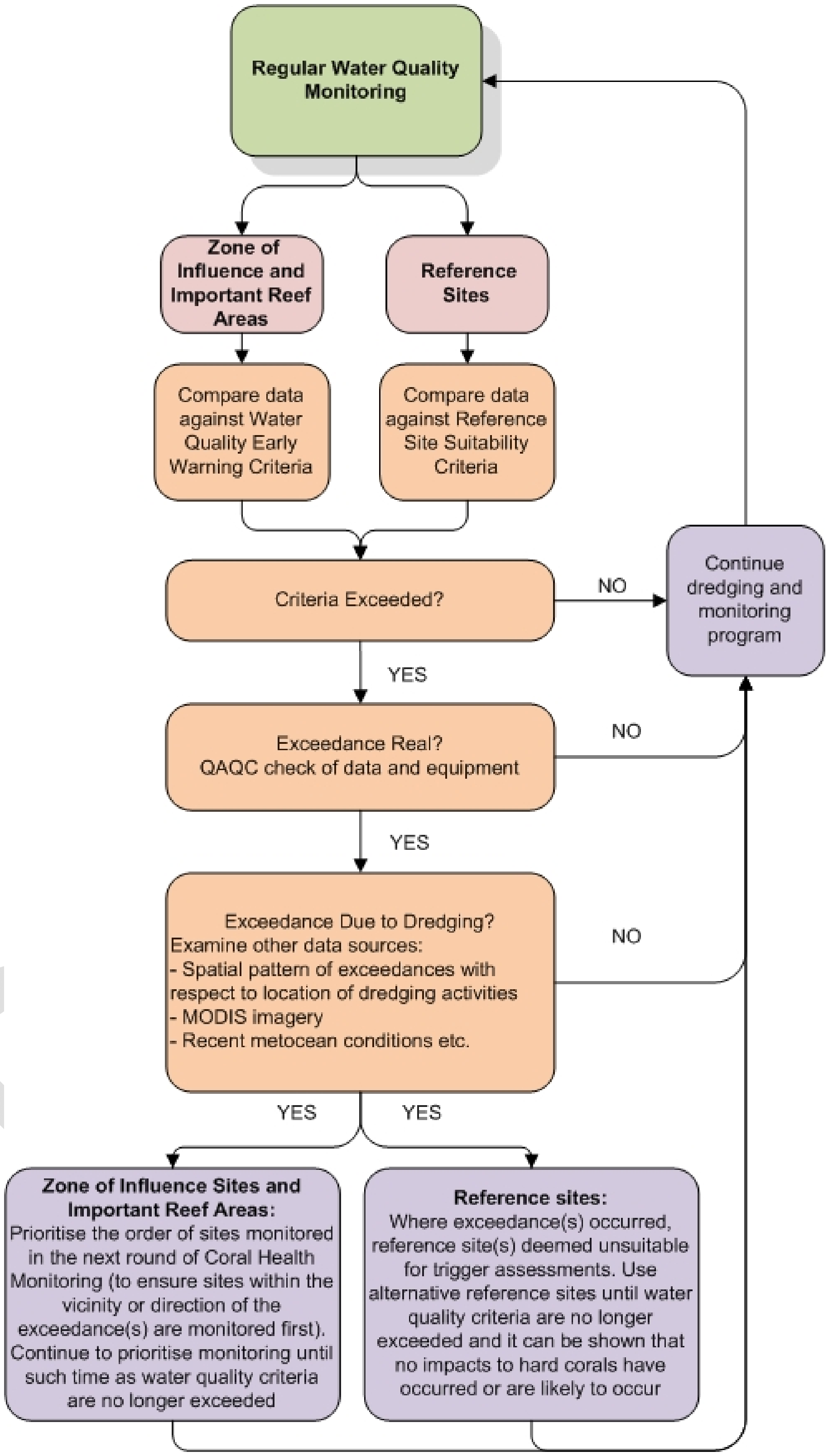

Figure 8-1: Water Quality Monitoring and Management Procedure. Note: Water Quality Early Warning Criteria will be finalised prior to dredging and will be developed based on upper percentiles of intensity-duration-frequencies of baseline data.

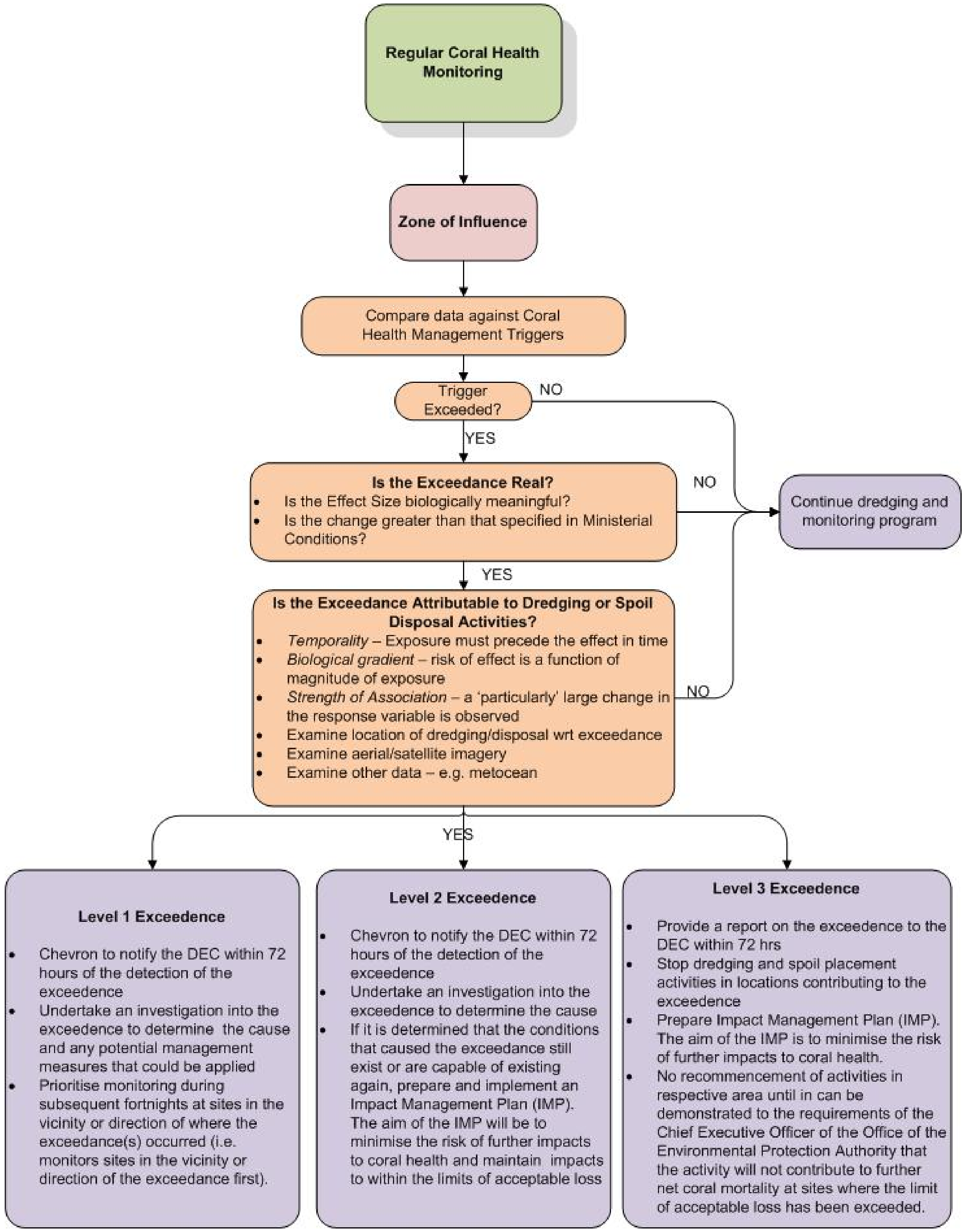

Figure 8-2: Coral Health Monitoring and Management Procedure

HOLD – FIGURE OF RESTRICTED OVERFLOW FOR TRUNKLINE DREDGING

Figure 8-3: Trailing Suction Hopper Dredge (TSHD) Restricted Overflow Areas.

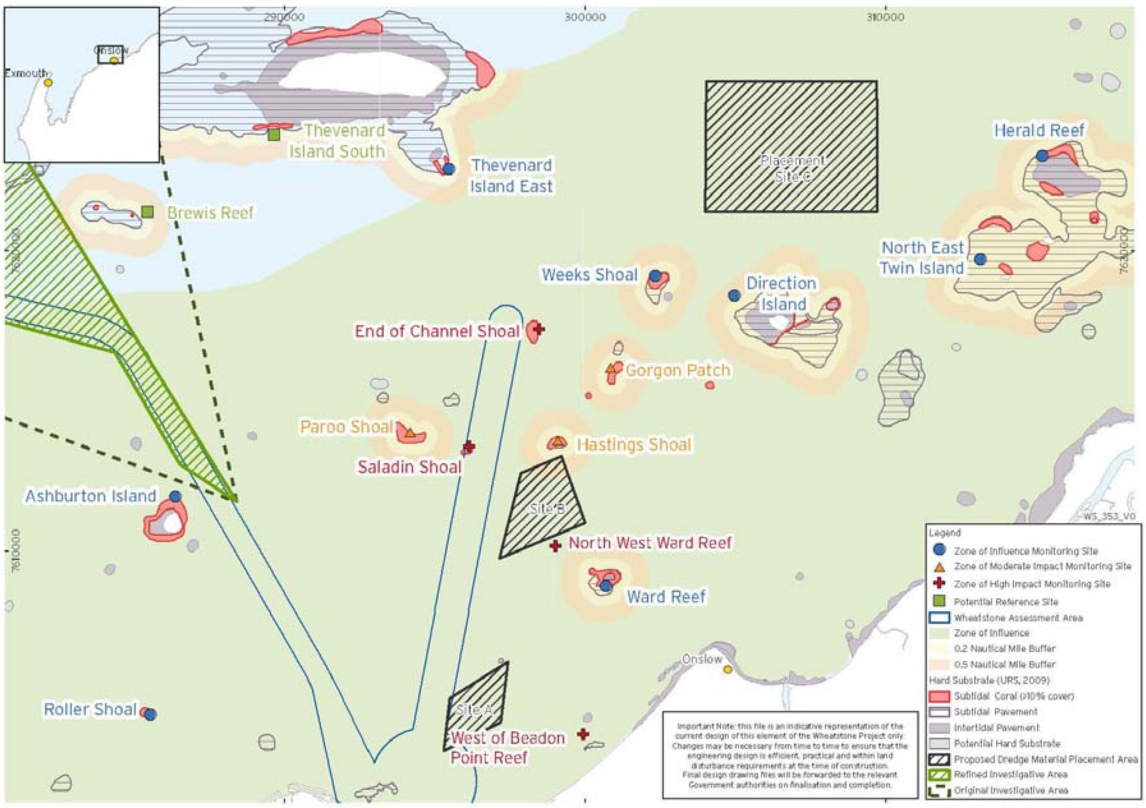

Figure 8-4: Location of coral reefs wtih 0.5nm buffer.

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8.2 Marine Fauna Management

8.2.1 Background

8.2.1.1 Marine Mammals

Refer to **Section 6.5.2.3** for details on marine mammals that may be present within the Project Area. The management of marine mammals will focus on the species most likely to be sighted whales, particularly humpback whales, and dugongs) and will primarily involve observation and avoidance measures to minimise the risk of vessel interaction with both whales and dolphins. Note that with respect to dolphins, their mobility and intelligence means the risk of impact is negligible; interactions will be managed in accordance with the requirements for cetacean interactions specified under Part 8 of the EPBC Regulations 2000 (Cth)

8.2.1.2 Marine Turtles

Refer to **Section 6.5.2** for details on turtle species that may be present within the Project Area. The management of turtles will primarily involve measures to minimise the risk of entrapment/entrainment of the turtles within the dragheads of the TSHD.

8.2.2 Management: Whales, Dolphins, Dugongs and Turtles

Management Area:	**Marine Fauna Management (Whales, Dolphins, Dugongs and Turtles)**
Performance Objective:	To comply with Outcome based Ministerial Condition XX as follows: *“The Proponent will manage its dredging activities during the construction phase of the Project to reduce, as far as reasonably practicable, Project-attributable impacts on marine fauna.* *The Proponent will manage its construction and operational workforce to reduce, as far as reasonably practicable, potential impacts on marine fauna associated with workforce recreational activities.”*
Management:	Impacts to marine fauna (whales, dolphins, dugongs and marine turtles) from increased turbidity and sedimentation (e.g. direct behavioural impacts or indirect impacts through alteration of foraging habitats) are managed via **Section 8.1** ♦ Prior to commencement of dredging and dredge material placement, selected crew will receive training in marine fauna observations. ♦ Personnel trained in marine fauna observations will be present on dredge vessels, during daylight hours. ♦ Personnel trained in marine fauna observations will be used to monitor key activities. ♦ All Project vessels will keep a log of observed in-water incidents or reporting’s of injured/dead marine fauna. ♦ Any deaths of marine fauna listed under Section 14(2)(ba) of the *Wildlife Conservation Act (1950)* will be reported to the DEC. <u>Striking impact on Whales, Dolphins and Dugongs</u> ♦ Whales and dugong observations and response procedures including application of 300 m observation zone and 100 m exclusion zone will be implemented during dredging and dredge material placement works as outlined in **Figure 8-4.** If calves are present the exclusion zone will be extended to 300 m. ♦ Dolphin observations and response procedures including the application of a 100 m observation zone will be implemented during dredging and dredge material placement works as outlined in **Figure 8-4.**

	♦ Dredge vessels associated with trunkline prelay dredging will transit along the corridors when working at the shorecrossing location out to KP3 and will utilise more direct routes, that avoid sensitive receptors, when working beyond this point (**Figure 8-6**). ♦ The presence of cetaceans/dugongs in or near exclusion zones established for key dredging and construction activities will be recorded. ♦ All sightings of whales, dolphins or dugongs that result in management measures being implemented will be recorded. ♦ A trained crew member will maintain a watch, during daylight hours, for whales, dolphins and dugongs while any dredge is on route to and from the dredge area to dredge material placement sites. If sighted, direction/speed will be adjusted to avoid impact (within the safety constraints of the vessel). ♦ A trained crew member will maintain a watch, during daylight hours, for whales, dolphins and dugongs during dredge operations. ♦ Management of cetacean interactions will be in accordance with the requirements for cetacean interactions specified under Part 8 of the EPBC Regulations 2000 (Cth) and the Australian National Guidelines for Whale and Dolphin Watching. <u>Entrainment impacts on Marine Turtles</u> ♦ When operating with less than 5 m under-keel clearance, the dredge will initially move slowly through the area before commencing dredging so that the noise and vibration alerts marine turtles in the vicinity and encourages them to leave. This will only be applied on dredging in new areas and not once the work area has been established. ♦ Dredge pumps will be stopped as soon as practicably possible after completion of dredging and where practical the draghead will remain within 0.5 m of the seabed until the dredge pump is stopped. ♦ Tickler chains on the draghead of the TSHD will be used as a management mitigation approach to reduce turtle entrainment. When initiating dredging, suction through dragheads will be initiated just long enough to prime the pumps, prior to drag heads engaging the seabed. ♦ Overflow screens will be used on TSHDs to visually assess for turtles and turtle remains associated with entrainment during dredging. ♦ A framework has been developed to limit the risk of turtle entrainment (**Appendix B**) <u>Lighting impacts on Marine Turtles</u> ♦ Mooring at night will not take place at night during Nov-April, the turtle nesting season, within 1.5 km of nesting beaches (See Figure 8-7). <u>Workforce recreational impacts on Marine Turtles</u> ♦ The Proponent will provide marine fauna aerial sighting data (as presented in the EIS/ERMP) for DEC planning purposes in the Onslow region ♦ Boats and recreational vehicles will not be permitted within the workforce accommodation village or on the access road from the Onslow Road ♦ Conservation and induction programs will be established to ensure staff/contractors are informed of DEC rules relating to offshore nature reserves.
Monitoring:	♦ Water quality monitoring (**Section 9.1**). ♦ Whale, dolphin, dugong and marine turtle observations throughout the works.
Reporting:	♦ Whale, dolphin, dugong and marine turtle sightings resulting in management measures being implemented will be recorded.

	♦ Marine mammal injury or mortality incidents will be reported to the DEC and DSEWPAC.
Risk Assessment :	Refer to **Appendix A** for a summary of relevant risk assessment outcomes and Section 8.0 of the EIS/ERMP for further detail on risk assessment outcomes.

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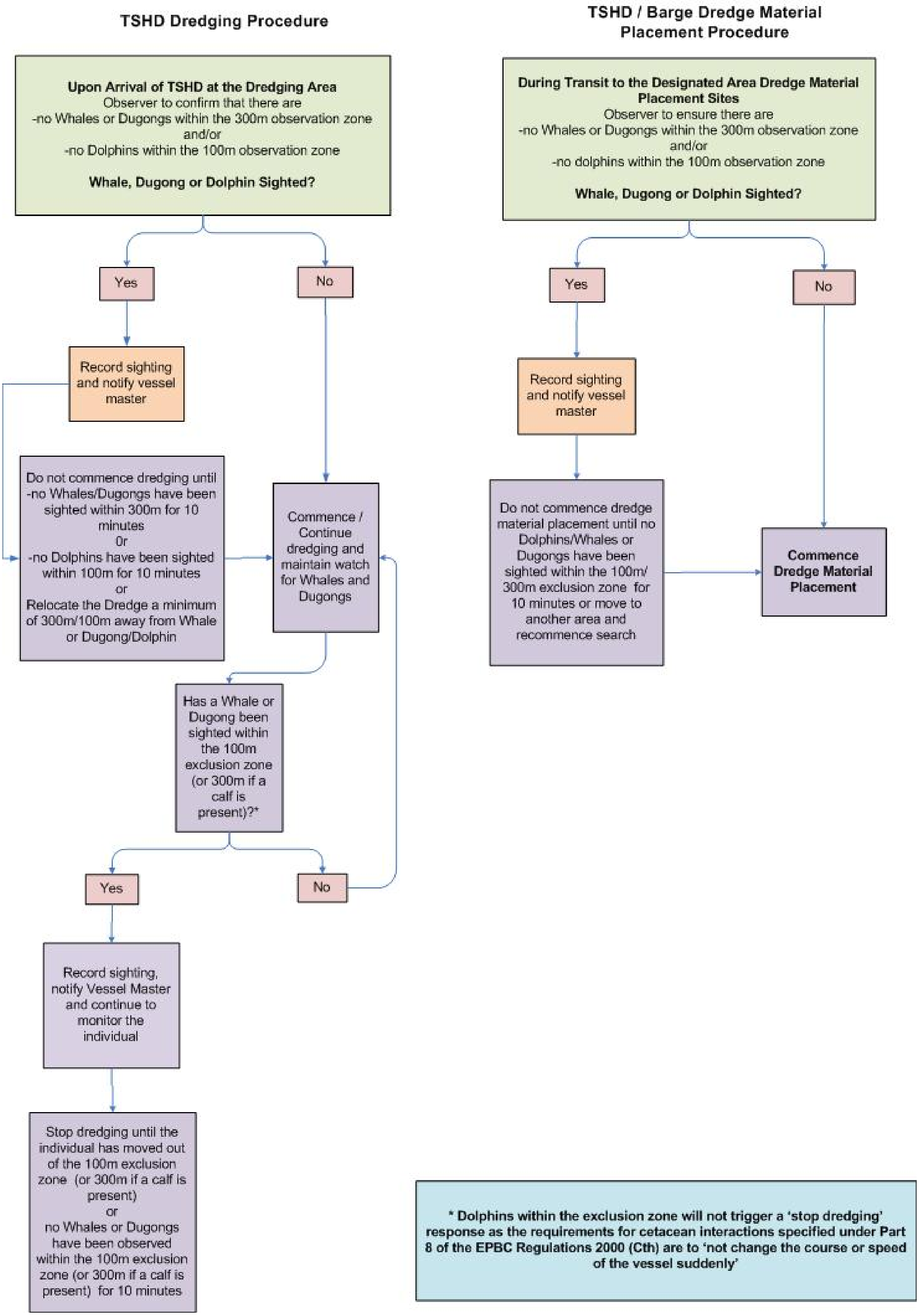

Figure 8-5: Whale, Dolphin and Dugong Interaction Procedures

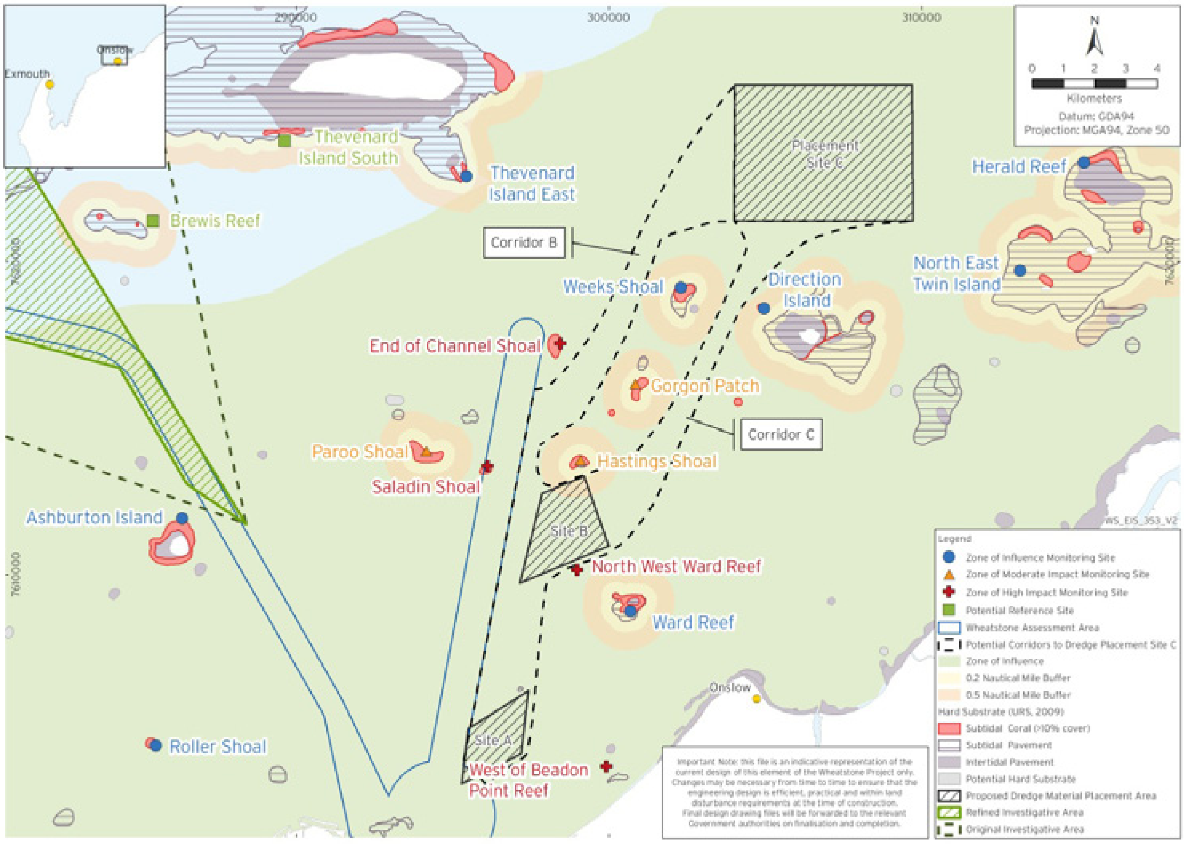

Figure 8-6: Designated transit routes to Placement Site C.

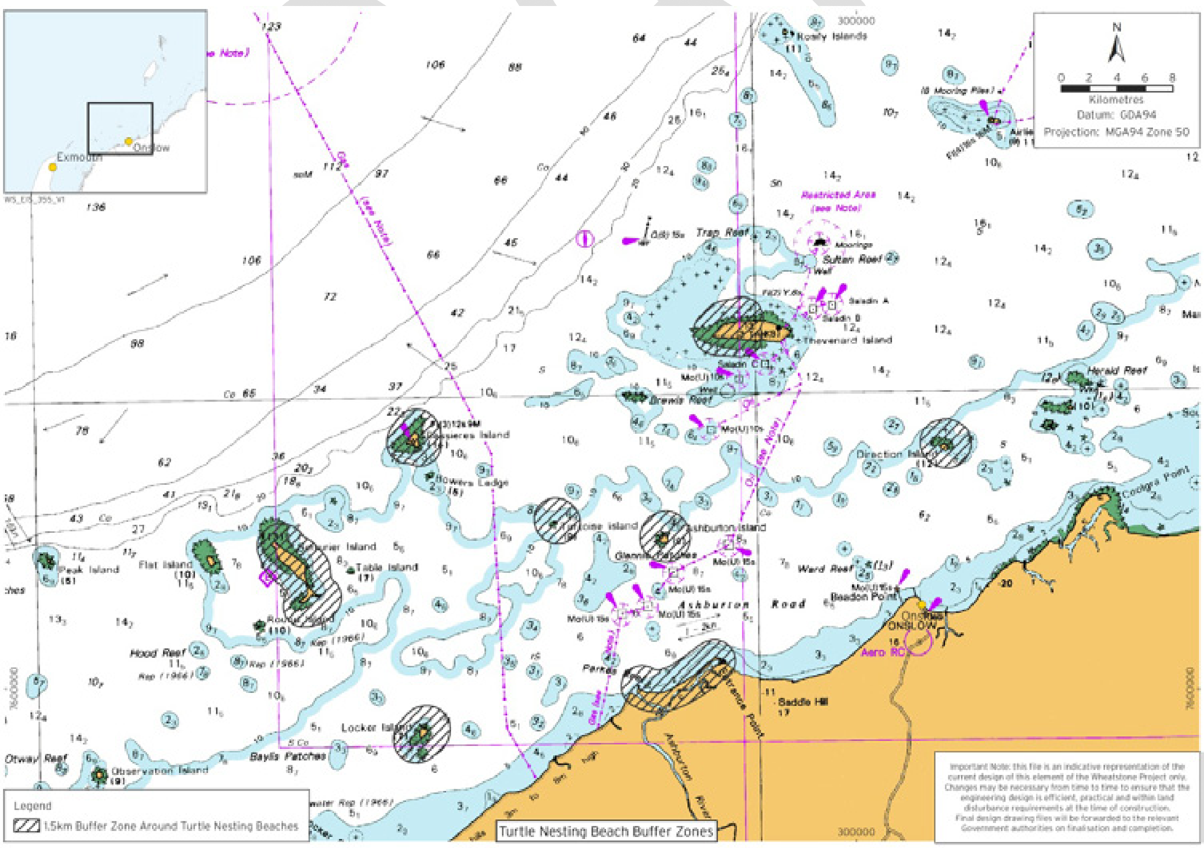

Figure 8-7: Lighted vessel exclusion zones around turtle nesting beaches (1.5km buffer).

8.3 Introduced Marine Pest Management

8.3.1 Background

Introduced marine pests are biota that are translocated into water outside of their natural distribution ranges, settle and survive in the new area and subsequently form a component of the habitat into which they spread and compete for space and resources with naturally occurring species.

As construction vessels are generally mobilised to Western Australian dredging projects from areas outside of the applicable bioregion, they present a key risk pathway as a vector for the introduction of marine pests. Common high risk niche areas capable of translocating invasive marine species on dredge vessels and dredge associated vessels include:

- ballast tanks
- vessel hull and external niches (e.g. propellers, thrusters)
- internal seawater systems(e.g. seachests and seawater strainers)
- immersible equipment including dredge equipment (trailing pipes, dragheads and anchors) and
- ballast water and sediments.

8.3.2 Management: Introduced Marine Pests

Management Area:	**Introduced Marine Pests (IMP) Management**
Performance Objective:	To comply with Outcome Based Ministerial Condition XX as follows: "*The proponent will manage the dredging and dredge material management works so as to prevent the introduction to and establishment of marine pests in the waters adjacent to the proposal'*
Management:	Mobilisation Procedure The primary focus for the management of introduced marine pests (IMP) will be to reduce the risk of IMP introduction by dredging and support vessels prior to their mobilisation to the project. To achieve this, the construction vessel mobilisation procedure, where reasonably practicable, shall be implemented as follows: ♦ All dredging and support vessels will be subjected to a risk assessment to determine if the vessel presents a low, high or uncertain risk as a vector for IMP. The risk assessment will be based on the vessel's origin, recent history and vessel maintenance since the previous fouling control coating application (FCC) and whether it will be undertaking a direct sail from its point of origin. ♦ All dredging and support vessels determined to be uncertain or high risk will be subjected to a pre-mobilisation inspection and will not be mobilised until the vessel is assessed as being a low IMP risk. In the event that IMP are identified on the vessel during the pre-mobilisation inspection, the vessel will undergo treatment and re-inspection to the satisfaction of the DoF. ♦ Those vessels which do not mobilise immediately and directly to the operational area may be subject to additional risk assessments and management requirements which may include arrival inspection within 48 hours of arrival on site. ♦ Vessel inspections will be undertaken as detailed in **Section 9.3.** ♦ The Revised Coordinating Committee for Introduced Marine Pest Emergencies (CCIMPE) Trigger List (2006) will be used as the basis for the identification of an invasive marine species. However, inspection and

	management response may be undertaken with respect to unlisted species. ♦ All dredges will comply with the Australian Quarantine regulations 2000 and will comply with the AQIS mandatory ballast water requirements. <u>Contingency Management</u> In the event that IMP are identified on a dredging or support vessels during the arrival inspection or at any time on site: ♦ The DoF and DEC will be notified. ♦ The dredging or support vessel will be moved offshore as soon as practicably possible. Within vessel operating constraints, the vessel should be moved to offshore waters greater than 12 nm from shore or to a water depth greater than 50 m. ♦ The dredging or support vessel will not be permitted to return to site until it has undergone treatment and re-inspection to confirm that the vessel is a low risk. The mobilisation procedure described above will be required to be followed including the mandatory arrival inspection with 48 hours of arrival on site. ♦ A detailed response plan including monitoring and control measures will be developed and implemented. This plan will aim to determine if the identified species has become established and if measures to control the species are required.
Monitoring:	♦ Pre-mobilisation and arrival IMP inspections as required (**Section 9.3**). ♦ Monitoring program to determine establishment of IMP to be developed in the event that IMP are identified during construction vessel inspections.
Reporting:	Specific details of the requirements of these reports are included in **Section 8.0** of the EIS/ERMP. ♦ Construction vessel risk assessment provided to DoF/DEC prior to mobilisation of vessel. ♦ Vessel inspection checklist provided to DoF/DEC of any construction vessel inspection. ♦ Pre-mobilisation “Assessment Report” for all construction vessels, including results of risk assessment, vessel history and IMP inspection results to the DoF/DEC. ♦ Incident report to be provided to the DoF/DEC in the event that IMP are identified on a construction vessel within Western Australian State Waters. ♦ Report requirements associated with the IMP response plan will be determined.
Risk Assessment :	Refer to **Appendix A** for a summary of relevant risk assessment outcomes and Section 8.0 of the EIS/ERMP for further detail on risk assessment outcomes.

8.4 Dredge Material Placement Area Management

8.4.1 Background

The nearshore and offshore dredge material placement areas that will be utilised are shown in **Figure 4-6**. Currently the preferred dredge material placement areas for the trunkline installation are site C and site D. The management of environmental impacts associated with the placement of dredged material are covered in **Section 8.1**(Water Quality and Benthic Primary Producer Habitat Management).

The requirements with respect to the management of the dredge material placement area and offshore dredge material placement activities will be specified in the SDP.

8.4.2 Management: Dredge Material Placement Area

Management Area:	**Dredge Material Placement Area Management**
Performance Objective:	To undertake the dredging and dredge material management activities in accordance with the requirements of the SDP.

Management:	Compliance with the requirements of SDP including:
	♦ Establish by Differential Global Positioning System (DGPS) that immediately prior to dredge material placement, the vessel is within the approved dredge material placement area.
	♦ Any dredge used in connection with the dredge material placement activities and any associated towing vessels must comply with the relevant state, national or international standards with respect to seaworthiness, safety and environmental requirements, or any rules or conditions laid down by the certifying classification society, and be capable of disposing dredged material at the dredge material placement locations in accordance with the SDP.
	♦ Marine mammal management procedures as detailed in **Section 8.2** will be followed during dredge material placement activities.
	♦ Records comprising either weekly plotting sheets or a certified extract of the ship's log will be retained (for verification and auditing purpose), which detail:
	  ♦ The times and dates of when each dredge material placement run is commenced and finished
	  ♦ The position (as determined by DGPS) of the vessel at the beginning and end of each dredge material placement run, with the inclusion of the path of each dredge material placement run.
	  ♦ The volume of dredge material (in cubic metres) moved to the placement area and quantity in dry tonnes for the specified operational period. These quantities will be compared with the total amount permitted under the SDP.

Monitoring:	A bathymetric survey of the dredge material placement areas will be undertaken: ♦ Prior to the commencement of dredging. ♦ Within two months of the completion of all dredge material placement activities authorised under the SDP.
Reporting:	♦ Within two months of the final bathymetric survey a digital copy of each of the bathymetric surveys will be provided to the Royal Australian Navy hydrographer.

	♦ To facilitate annual reporting to the International Maritime Organisation (IMO), the proponent will report to the DSEWPAC by 31st January each year, including on the day of the expiry of the SDP or completion of all dredging under the SDP, information as specified in Schedule 2 of the SDP.
Risk Assessment:	Refer to **Appendix A** for a summary of relevant risk assessment outcomes and Section 8.0 of the EIS/ERMP for further detail on risk assessment outcomes

8.5 Waste Management

8.5.1 Background

The unintentional or uncontrolled release of waste material (solid, liquid, hazardous and sewage wastes) can adversely impact on the marine environment. The discharge of wastes into the marine environment is regulated by the *Protection of the Sea* (*Prevention of Pollution from Ships) Act 1983* (Cth) which is based on the MARPOL 73/78 Convention Annex IV (sewage) and Annex V (Garbage) to which Australia is a signatory.

The management of wastes will be undertaken in accordance with the Wheatstone Project Waste Management Plan (WMP).

8.5.2 Management: Waste Management

Management Area:	**Waste Management**
Performance Objective:	Minimise the risk of impact on the marine environment as a result of waste materials generated by the dredging and dredge material management activities
Management:	♦ Implementation of Wheatstone Project WMP. ♦ Adherence to the requirements of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and MARPOL 73/78 Convention Annex IV (sewage) and Annex V (Garbage).
Monitoring:	Not Applicable.
Reporting:	As per the Wheatstone Project WMP.
Risk Assessment:	Refer to **Appendix A** for a summary of relevant risk assessment outcomes and Section 8.0 of the EIS/ERMP for further detail on risk assessment outcomes

8.6 Hydrocarbon Management

8.6.1 Background

The operation of vessels engaged in the dredge program and in support of the program requires adherence to a number of standards in relation to effective minimisation of the risk of hydrocarbon spills and the mitigation of spills into the marine environment.

Hydrocarbons (including diesel fuel, hydraulic oils, engine oils, greases and lubricants) are used and handled everyday during the dredging operations. The accidental release of these substances presents a potential risk to the environment. The main potential sources of release of hydrocarbons into the marine environment are:

- grease
- diesel spills during refuelling (bunkering)
- hydraulic oil spills due to equipment failure (e.g. burst hydraulic hose)
- incorrect storage and handling of hydrocarbons
- release of oily bilge waters
- contaminated deck wash.

8.6.2 Management: Hydrocarbons

Management Area:	**Hydrocarbon Management**
Performance Objective:	Minimise the risk of impacts to the marine environment as a result of accidental spills of hydrocarbons from dredging and support vessels.

Management:	♦ Hazardous material storage areas will be designed to handle the volumes and operating conditions specifically required for each substance, including product identification, transportation, storage, control and loss prevention (e.g. bunding and drainage).
	♦ Industry standards, port authority and pollution prevention regulations will be adhered to during refuelling, transfer, storage and handling of hazardous materials (e.g. bunding, level gauges, overflow protection, drainage systems and hardstands).
	♦ Hazardous materials (including hazardous waste) will be stored in appropriately labelled drums or tanks. Complete up to date list of MSDSs will be available and stored with relevant products.
	♦ The hydraulic oil system will be of a high quality, well maintained and regularly inspected.
	♦ The main hydraulic system on each dredging vessel will be equipped with standard low pressure alarms and shut down systems to minimise hydrocarbon loss in the event of a burst hydraulic hose.
	♦ Detailed refuelling procedures will be developed by the dredge contractor prior to commencement of work on site and will include the following requirements:
	  ♦ Fuel transfer to occur in accordance with port authority and pollution regulations;
	  ♦ Specific safety boundaries used when refuelling;
	  ♦ Requirement of refuelling to be undertaken in fair weather conditions to reduce risk of spills;
	  ♦ Requirement for open communication channels to be maintained during refuelling;
	  ♦ Instructions for visual monitoring; and
	  ♦ Emergency response procedures.
	♦ Personnel involved with refuelling or fuel transfer will be trained in their roles, functions and responsibility, including emergency response prior to

	engaging in refuelling or fuel transfer. ♦ All vessels greater than 400 gross tonnage will have bilge oil/water separators that comply with the requirements of Annex I of MARPOL 73/78 and Part II of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1993* (Cth) to ensure that oil concentrations in discharges are less than 15 ppm. ♦ Drainage from decks and work areas with potential for oil, grease or hydrocarbon contamination will be collected and processed through an oil/water separator and managed according to International Oil Pollution Prevention (IOPP) procedures prior to discharge or stored for onshore placement. ♦ Sufficient and appropriate equipment, materials and resources will be available to: ♦ prevent spills to marine environment from working machinery (e.g. spill trays, one-way valves or other spill prevention features); ♦ respond to spills to the marine environment; and ♦ respond to spills to ground (on board vessels). ♦ The dredge contractor will comply with and align spill response preparedness with the Oil Spill Contingency Plan (OSCP). ♦ All relevant personnel will be trained in spill response and reporting. ♦ All vessels will have a current International Oil Pollution Prevention Certificate (IOPP) issued by the State in which the vessel is registered and an approved Shipboard Oil Pollution Emergency Plan (SOPEP). ♦ If vessel does not have an existing approved SOPEP the vessel will prepare a vessel specific Spill Contingency Plan (SCP) that bridges to the Chevron OSCP to ensure an effective, integrated response to any spill. ♦ Onboard spills will be contained and cleaned up immediately and will not be washed overboard. Product MSDSs will be adhered to during clean-up.
Monitoring:	♦ Audits of each vessel hydrocarbon handling procedures and equipment including spill kits will be undertaken on a regular ongoing basis.
Reporting:	♦ Spills will be documented and reported in accordance with the Chevron Incident Reporting Procedure.
Risk Assessment:	Refer to **Appendix A** for a summary of relevant risk assessment outcomes and Section 8.0 of the EIS/ERMP for further detail on risk assessment outcomes

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9.0 MONITORING AND INSPECTION PROGRAMS

There are two monitoring programs and one inspection program associated with the Wheatstone Trunkline dredging, comprising:

- Responsive monitoring;
- Impact monitoring; and
- Introduced marine pest inspections.

A responsive monitoring program will be used to monitor and manage potential impacts of the Trunkline dredging activities on water quality and BPPH health. This program will use the health of corals as an indicator for the health of subtidal BPPH. The program will consist of data collection on water quality (NTU, temperature) and the health of hard corals (percent live tissue, percent bleached)to be assessed against management trigger criteria. Any exceedance of trigger criteria would prompt the implementation of further monitoring and/or management measures to minimise the likelihood of non-compliance with BPPH Outcome-Based Conditions.

BPPH Impact Monitoring will be undertaken to investigate whether permanent losses of BPPH that can be attributed to Trunkline dredging activities are within the boundary of the Zone of High Impact (as per Outcome-Based Condition X.X, **Appendix X.X** and shown in **Figure X.X**
<**Hold** to be updated pending finalisation of the OBC>.
This monitoring will consist of an assessment of subtidal (including hard coral BPPH) and intertidal (including mangroves) BPPH. Subtidal Impact monitoring will also assess the nature of these losses, where possible, in terms of changes to BPP communities and underlying habitat and the potential for recovery of any changes that extend beyond approved boundaries.

9.1 Responsive Monitoring and Management

Throughout the Trunkline dredging period, monitoring will be undertaken to assess any potential impacts of the dredging activities on water quality and coral health. The Responsive Monitoring Program will consist of the collection of data on water quality and coral health to be formally assessed against management triggers as outlined in **Section 8.1.2** and to assist with inferring the cause any changes that may occur. Responsive monitoring will also be reliant upon data collected during the baseline period in order to establish initial trigger values that reflect the level of natural variation in parameters that occur naturally, as observed during baseline conditions, and related to this, an estimate of ecological significance.

This section outlines the monitoring and management measures that may be undertaken as part of a responsive monitoring strategy. In the event that Capital Dredging and Trunkline Dredging occur concurrently please refer to the DSDMP for the Capital Dredge and Disposal Program (SKM 2010) for the full monitoring program, since the Capital Dredge and Disposal Program Responsive Monitoring would completely replace that described here.

9.1.1 Monitoring Site Locations

Eleven sites are proposed to be monitored in the responsive monitoring program. Indicative sites are listed in **Table 9-1** and their locations are shown on **Figure 9-1**. The location and number of these sites will be revised prior to finalisation of the DSDMP.

For a full description of BPP communities present at sites that have been surveyed to date, see Appendix N7 of the EIS/ERMP.

Zone of High Impact and Moderate Impact Sites

There are no coral reefs located within the Zones of High and Moderate Impact for Trunkline dredging. Hence, no coral health and water quality monitoring sites have been established within these zones.

Zone of Influence Sites

Seven sites within the Zone of Influence will be monitored in order to minimise the likelihood of an exceedance of zero net mortality. The sites have been selected along the length of the trunkline to serve as potential ‘indicators’ where any potential impacts may be detected and management measures initiated before impacts extend further afield.

Thevenard Island South has been identified as an additional Zone of Influence monitoring site in the event that the original trunkline route, as modelled, is moved to the east. In the event that the trunkline route is moved east, the predicted sediment plume is also likely to move and result in the extent of the Zone of Influence reaching the Thevenard Island South monitoring site.

Monitoring of coral health will be undertaken on a fortnightly basis at all eight sites in order to assess potential changes in coral health that may be attributable to the dredging of the channel. Data on coral bleaching and mortality will be assessed against tiered management triggers, as described in **Section 8.1**.

Water quality data (turbidity) will be collected at all eight sites within the Zone of Influence to be assessed against a Level 1 management trigger for this zone, as described in **Section 8.1**. Additional water quality data (benthic light availability and temperature) as well as gross sedimentation data will be collected at these sites to assist in interpreting the cause(s) of any observed changes in coral health. Water quality data (turbidity, benthic light availability and temperature) will be collected at 30 minute intervals using *in-situ* loggers and data will be downloaded on a fortnightly basis. Gross sedimentation data will be collected using sediment traps which will be emptied on a fortnightly basis.

Table 9-1: Coral and water quality monitoring sites

Zone/Type	Name	Parameters	Monitoring Frequency	Reporting Frequency	Corresponding Reference
Influence	Ward Reef	Live coral Bleached coral Turbidity (NTU) Gross Sedimentation Temperature	Fortnightly	Monthly	R1, Weeks Shoal
Influence	Roller Shoal				
Influence	Paroo Shoals				
Influence	Thevenard Island South				Thevenard Island East, Serrurier Island
Influence	Bessieres Island				
Influence	Brewis Reef				
Influence	Ashburton Island				
Reference	Thevenard Island East	Live coral Bleached coral Turbidity (NTU) Gross Sedimentation Temperature	3 monthly (or as required)	Monthly	Not applicable
Reference	Serrurier Island				
Reference (pseudo[1])	R1 (West of Locker)				
Reference	Weeks Shoal				

[1] 'Pseudo' Reference sites are sites located within the Zone of Influence but towards the outer boundary of this Zone. Changes in water quality at these sites are expected to be minimal and impacts to coral health are unlikely. The conditions under which these sites will be considered appropriate reference sites is defined in **Section 9.2.1**.

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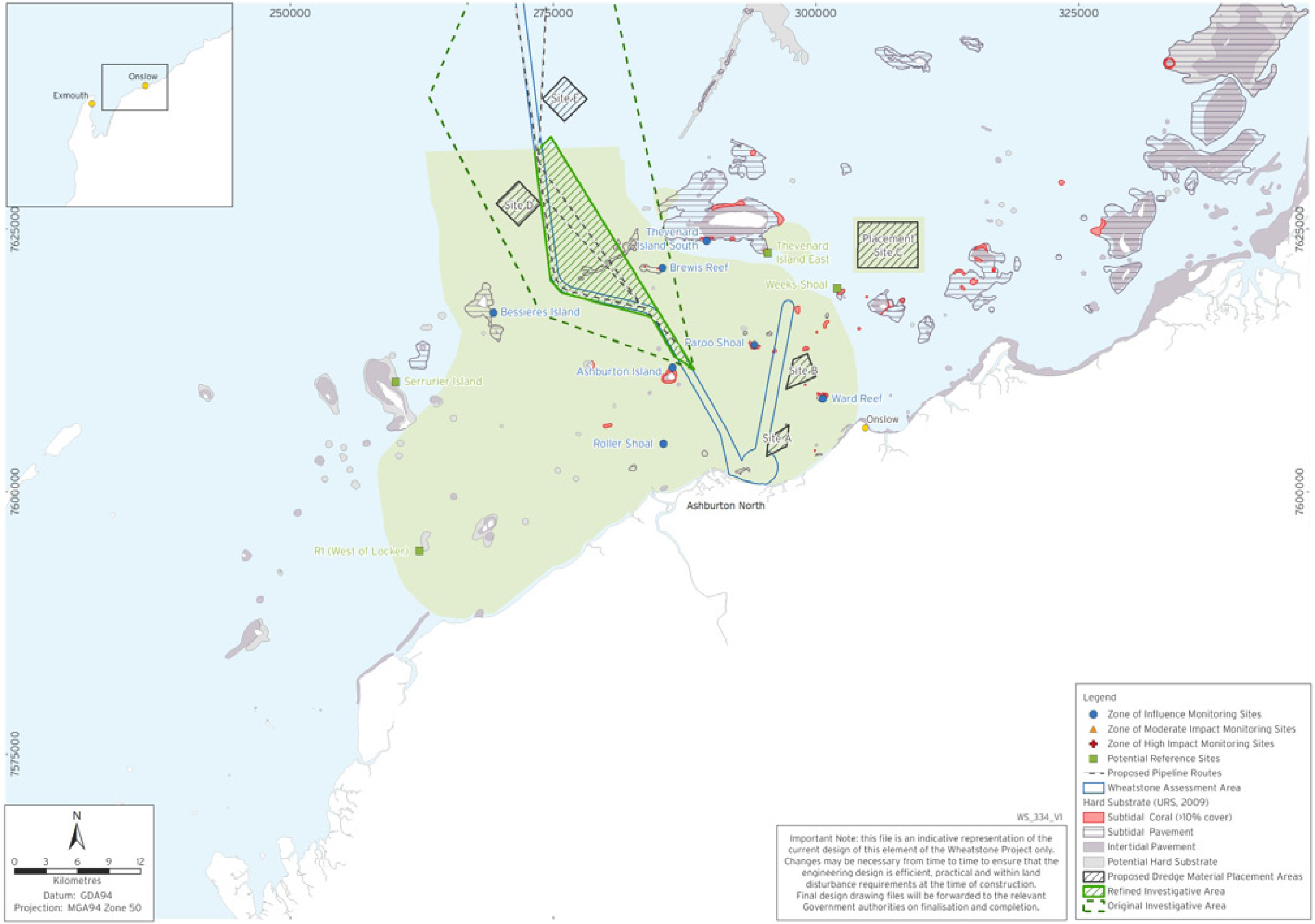

Figure 9-1 Indicative Coral Health and Water Quality Monitoring Sites during a Scenario when Trunkline Dredging Only is Occurring

<Hold – indicative only at this stage>

Reference Sites and Important Reef Areas

The EPA provides guidance within EAG#3 (EPA 2009b) and Draft EAG#7 (EPA 2010) on the establishment of reference sites for the purpose of monitoring potential impacts to BPPH. This guidance recommends the location of reference sites outside the predicted influence of development activities. In addition to this, reference sites should be as comparable as possible to potential impact sites in order to effectively use data from reference sites to infer whether any 'real' or 'net' change has occurred at impacts sites that may be attributable to development activities as opposed to natural variation.

Three out of the four reference sites (including sites located within Important Reef Areas) have been located outside of the Zone of Influence however for the proposed trunkline dredging campaign, the predicted Zone of Influence will extend a considerable distance west t of the dredge location (see EIS Section 8.3). There are no reference locations outside this zone that are directly comparable to nearshore monitoring sites, Paroo Shoals, Roller Shoals and Ward reef located within the Zones of Influence.

A fourth reference site has been chosen for inshore 'impact' sites that will be located within the Zone of Influence but towards the outer boundary of this zone. At the outer edge of the Zone of Influence, only minor and occasional elevations in turbidity are predicted to occur and no impacts to corals are expected, rendering these sites suitable as references.

This site (Site R1) has been called a 'pseudo' reference site and is located within an area to the West of Locker Island. This sites is predicted to experience only minor perturbations from background water quality during dredging, for brief periods during only one out of three seasons (see **Figure 9-2**). These perturbations in water quality are predicted to be insufficient to cause any impacts to coral health that might deem these sites unsuitable as references.

Water quality will be monitored at this site and conservative turbidity criteria (that are well below the tolerance thresholds of corals) <**Hold** – turbidity criteria yet to be established> will be used to determine whether this site is likely to continue to remain free from impacts of dredging. If these criteria are breached, this site would no longer be considered a suitable reference, and sub-optimal sites further afield or a reduced set of reference sites would be used.

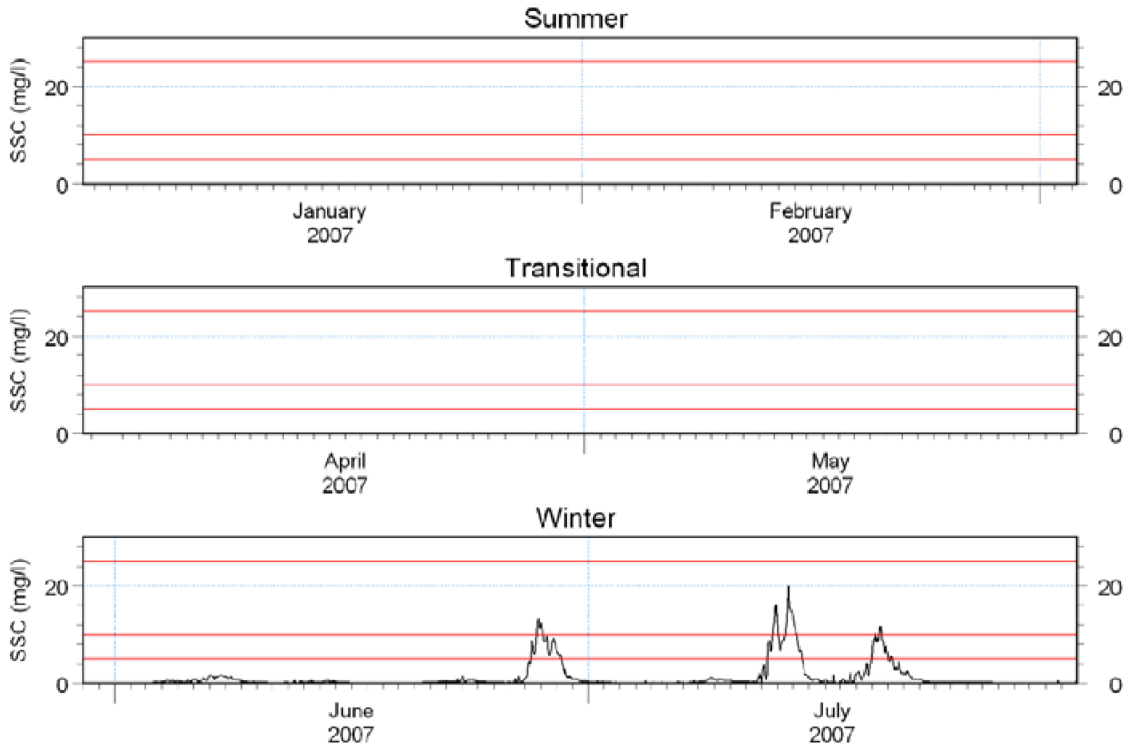

Figure 9-2 Predicted SSC concentrations at pseudo-reference site R1 (for location refer to Figure 9-1) throughout dredging scenario 5. Red lines correspond to SSC levels of 5mg/L, 10mg/L and 25 mg/L above background. X-axis scale in days.

Monitoring of coral health will be carried out on an as-needs basis. Monitoring of reference sites may be required fortnightly in the event that trigger levels are approached or exceeded at potential impact sites, while less frequent monitoring (e.g. 3-monthly) may be sufficient if trigger levels are not being approached or exceeded, in which case data from previous months may be conservatively used in trigger assessments. .

Water quality data (turbidity, benthic light availability and temperature) and gross sedimentation data will be collected at reference sites to provide background data that can assist in determining whether changes observed at comparable ‘impact’ sites are widespread and likely to be natural, or spatially restricted, and potentially due to dredging activities. Water quality data (turbidity, benthic light availability and temperature) will be collected at 30 minute intervals using *in-situ* loggers and data will be downloaded on an infrequent (e.g. 3-monthly) basis. Gross sedimentation data will be collected using sediment traps which will be emptied on an infrequent (e.g. 3-monthly) basis.

The frequency of data collection and downloading at some reference sites may be increased as required in the event of an exceedance(s) at comparable ‘impact’ sites in order to provide recent data to infer the cause of the exceedance(s).

9.1.2 Water Quality Monitoring

9.1.2.1 Objectives and Approach

The key objective of the water quality monitoring component of the responsive monitoring program is to provide data to infer the cause of any observed changes in coral health. Water quality data will also be used within the Zone of Influence as an early warning of potential impacts to hard coral communities due to dredging activities.

9.1.2.2 Parameters

Water quality parameters that will be measured at monitoring sites during the responsive monitoring program include the following:

Turbidity (measured in nephelometric turbidity units - NTU)
Turbidity provides an indirect measure of the alteration of the light climate received by BPP communities that may be a result of the natural suspension and movement of sediments and/or the suspension and movement of sediments caused by dredging.

Benthic light climate (photosynthetically active radiation – PAR)
The quanta of light received by BPP, measured in PAR, is a direct measure of potential impacts to BPP as a result of altered water quality. However, this measure must also be combined with turbidity data in order to determine whether changes in light climate are a consequence of the suspension and movement of sediments caused by dredging.

Water Temperature
Water temperature will not be significantly affected by dredging. However, there have been recorded instances in the Pilbara region of changes in coral health, including bleaching and partial morality, due to natural thermal anomalies (MScience 2008). Therefore, temperature will be recorded at all coral monitoring sites in order to differentiate potential dredging impacts on coral health from natural thermal anomaly events.

Metocean Conditions
Measurements of metocean conditions (e.g. wave height, current speed, current direction) will be undertaken at a representative range of monitoring sites and used in the interpretation of changes in water quality and coral health. These measurements will be used to identify important relationships between metocean conditions, dredging activity and location, and any subsequent impacts to water quality and coral health.

Satellite Imagery or aerial photography

<**Hold** – need to confirm type and frequency of data to be collected>

9.1.2.3 Data Analysis

All data will be subjected to rigorous quality assurance and quality control (QA/QC) procedures. Due to issues with bio-fouling of equipment, a regular maintenance schedule is likely to be implemented and all loggers likely to be retrieved, downloaded, cleaned and redeployed or replaced as necessary to maintain the quality of data collected. Prior to the analysis of water quality data to review potential exceedance of trigger levels, a preliminary check of data integrity is likely to be undertaken and anomalous data removed using an objective function, following guidance outlined in ANZECC and ARMCANZ (2000).

Water quality data collected within the Zone of Influence will be assessed against water quality management trigger criteria (as per **Section 8.1**). Data from the Zone of Influence will also be compared against reference site data to assist in inferring whether the exceedance was due to natural variation or potential dredging impacts.

9.1.3 Gross Sedimentation Monitoring

9.1.3.1 Objectives and Approach

The main objective of monitoring gross sedimentation rates is to assist in understanding potential impacts of dredging activities on sedimentation regimes at monitoring sites, and to infer potential impacts on sensitive BPP receptors. It is likely that permanent sedimentation impacts to BPPH, if any, will occur in areas within close proximity to dredging where there is a fallout of coarse sediments. Therefore, sedimentation monitoring will provide evidence of whether potential impacts within these areas were caused by dredging or other factors.

There are no formal management triggers associated with sedimentation monitoring. Due to the highly dynamic sedimentation regimes that occur in the Pilbara region through the influence of tidal currents and waves, data on gross sedimentation rates collected using sediment traps are likely to only provide broad estimates of sedimentation and may not accurately portray the actual accumulation of sediments and potential impacts on BPP communities. In this regard, data on net sedimentation rates would be more useful for management purposes. However, instruments that measure net sedimentation rates are still in early development and all known systems are unreliable. Therefore, data collected by these instruments would not be suitable for management purposes. Gross sedimentation monitoring will therefore be used only to provide a broad understanding of potential changes in sedimentation regimes caused by dredging activities and interpretation of potential changes in coral health, along with other types of data.

9.1.3.2 Data Collection

Gross sedimentation rates will be monitored using sediment traps deployed at a selection of monitoring sites where sedimentation impacts are most likely at sites within the Zone of Influence that are in close proximity to Trunkline dredging. These traps will be retrieved and emptied on a routine basis during the responsive monitoring program. Sediment will be sent to a laboratory for analysis of total sediment weight and occasionally throughout the program (e.g. on a 3-monthly) particle size distribution (PSD) will also be analysed. If instruments become available during the dredging program that accurately measure net sedimentation rates, then it is possible that these instruments may substitute sediment traps or be added to the program.

Net sedimentation may be monitored adjacent to coral health monitoring sites using a simplified approach such as a gradated marker peg, against which measured changes in levels of sediment accumulation at any given time may be assessed. If this method proves to be reliable, these data may also be used to infer the cause of any changes in coral health that may be observed.

9.1.3.3 Reporting and Analysis

Organic and inorganic fractions of the particulate matter in sediment traps can be measured in the laboratory to assess whether the majority of the sediment is organic (not dredge-related) or inorganic (possibly dredge-related). Seasonally or when required, PSD analysis can be undertaken on the material within the sediment traps to relate sediment data to material suspended by dredging activities. Data will be summarised and reported together with water quality monitoring data at monthly intervals.

9.1.4 Coral Health Monitoring

9.1.4.1 Objectives and Approach

The objectives of coral health monitoring are to detect potential changes in coral health and to infer whether these changes are a result of dredging and placement activities or natural variation. To achieve these objectives, coral health data will be collected on a fortnightly basis at sites located within the Zone of Influence and compared against management trigger criteria, an exceedance of which would prompt the implementation of management measures to limit further impacts. Since no coral reefs occur within the Zone of Moderate and High Impact, coral health monitoring will not be undertaken within these Zones.

It is possible that the frequency of Responsive coral health monitoring may be reduced (in consultation with regulatory authorities) if predictive relationships between water quality and coral health can be developed and water quality criteria can be used reliably and with sufficient precaution to trigger more frequent coral health monitoring if required.

A prioritisation of coral health monitoring will occur in the event of exceedance(s) of any management triggers that are attributable to dredging or placement activities, through the processes detailed in **Section 8.1**. The aim of this prioritisation would be to undertake coral health monitoring firstly at sites in the vicinity or direction of the site (s) of the observed exceedance(s). This would provide a more rapid response to detect and management potential impacts to coral health, or to provide greater power to detect changes through the monitoring of a greater number of sites in the vicinity of the exceedance in the instance that not all sites can be monitored during a survey round (e.g. due to poor weather).

9.1.4.2 Parameters

The key coral health parameters that will be monitored and used in assessment against management triggers are percent cover of living coral tissue and the percent of colonies that are bleached (tissue is white but still intact).

Other qualitative parameters that will be measured to provide diagnostic information to interpret changes in coral communities include:

- mucus production; and
- sediment cover.

However, since the assessment of these parameters can be subjective and there are no clear relationships established in the literature between these parameters and subsequent levels of mortality, data collected on these parameters will not be formally assessed against management trigger criteria.

Data collection

Coral health monitoring is likely to consist of a combination of qualitative and quantitative measures, however, management decisions will be based on quantitative measures only. At each monitoring site, coral colonies and/or coral communities will be inspected and photographed. The number of colonies to be assessed at each monitoring site will be determined through power analyses of baseline data. The species targeted for monitoring at each site may be selected on the basis of their dominance, an initial appraisal of health, and that the size of colonies will be conducive to photography and analysis. A pilot study will be undertaken to determine if it is possible to obtain an appropriate level of power (e.g. power = 0.8) for detecting change in coral health using diver-less monitoring methods, and if so, these methods may be adopted in preference to diver-based methods. In addition, baseline data will be used to determine an appropriate effect size, based on observed rates of natural variability and ecological significance.

Quantitative Indicators – Coral Mortality

Coral mortality will be recorded for all cases where there is no live tissue and/or subsequent algal growth or sediment accumulation has occurred over the surface of the coral. Coral bleaching will be recorded where there is still live tissue present, but that tissue has turned white.

Coral mortality is likely to be assessed by analysing each coral photo with Coral Point Counter with Excel Extensions (CPCe) (Kohler & Gill 2006). This software was developed by NOVA South Eastern University (Boca Raton, Florida) in conjunction with the U.S. National Oceanographic and Atmospheric Administration (NOAA) and has been routinely used to estimate mortality (scored as percentage cover) on recent Pilbara dredging projects. This application is used to estimate the percentage of living coral tissue within each photographed colony. Measures on individual colonies can then be grouped to assess potential changes in coral condition on assemblages and regional scales over time.

Qualitative Measures

A general qualitative visual assessment of coral health will also be undertaken on each coral colony by a trained observer before the colony is photographed to provide contextual information for changes that may be observed in later digital analysis. This may involve the assessment of the production of mucus (presence/absence), sediment presence/absence, evidence of bleaching and any other evidence of sub-lethal stress. Each colony may be compared to a reference photograph taken prior to dredging (baseline), to make a qualitative assessment of an adverse change in coral health.

Data analysis

Hold – To be updated pending finalisation of the OBC

9.2 Impact Monitoring

HOLD – these methods will be updated pending finalisation of the OBC

9.2.1 Objectives and Approach

The objectives of the Impact Monitoring Program are to:

- ♦ Determine the spatial extent of any permanent losses of key BPP and permanent changes to underlying BPPH that are attributable to both direct and indirect impacts of dredging and dredge material placement activities.
- ♦ Confirm whether the spatial extent of any permanent losses exceeds the boundary of the Zone of High Impact (shown in **Figure X.X**).
- ♦ Where permanent impacts extend beyond the boundary of the predicted Zone of High Impact, provide data on the likelihood of recovery of communities that have been impacted beyond that predicted and approved.

Following the requirements of EAG#3 (EPA 2009b) and Condition X.X <hold>, an assessment of BPPH is required prior to and following development activities to provide an estimate of the areal extent of BPPH loss that is attributable to the development. The Impact Monitoring Program will involve the collection of data on the spatial extent and condition of key subtidal BPPH types and associated BPP communities within the Project Area before and after the completion of dredging and dredge material placement activities. Key BPPH types to be examined include those supporting hard corals and seagrasses. In addition, the non-BPP group, filter feeders, will also be assessed before and after the completion of dredging and dredge material placement activities since they have a wide-ranging distribution within the project area and occur in close proximity to the proposed trunkline dredging activities.

9.2.2 Data collection

9.2.2.1 Hard Coral BPPH

Hard corals are located predominately on the fringes of the platforms that surround offshore islands, as well as on submerged shoals, and percent cover of corals, where they occur, ranges up to 70%. Corals are located elsewhere in the Project Area but distribution is patchy and percent cover is low (range approximately 0 to 10%).

The loss of hard coral will be assessed through the collection of data on hard coral BPPH from all monitoring sites used for the responsive monitoring program. Since sites will be located at the majority of coral reef areas present in the area, data on hard coral BPPH collected from these sites can be extrapolated to reflect losses throughout each zone. This will involve comparing BPPH condition (e.g. level of sedimentation and disturbance) and the level of hard coral mortality prior to and post-dredging activities at monitoring sites within the Zones of High Impact, Moderate Impact and Influence and calibrating these losses against natural changes observed at reference sites.

Sampling at sites will be undertaken using remote (non-diver) methods, such as towed video. Methods will include the collection of data using high resolution video or still photography that can be analysed through digital analysis to quantify coral cover, and levels of mortality. In addition, the spatial extent of permanent impacts to the underlying BPPH will be assessed through the comparison of sedimentation levels and availability of suitable substrate pre- versus post-dredging.

9.2.2.2 Seagrass BPPH

Seagrass communities within the project area are largely sparse in nature and consist mostly of ephemeral species such as *Halophila spinulosa*, *H. decipiens*, and *H. ovalis* (URS 2009e). No known meadows of perennial seagrass genera, such as *Thalassodendron* or *Enhalus* occur in the nearshore project area. Distribution of seagrasses is patchy immediately west of Ashburton Island, north-west of Onslow and at West Reef (**Figure 6-1**). Within these areas, seagrass patches occupy a space of a few square meters to tens of square meters, but the patches are not contiguous. These patches consist predominantly of subtidal *Halophila* spp.

Since seagrass distribution is patchy and communities are temporally dynamic, data will be collected from transects stratified within known patches along a gradient radiating outwards from the dredging footprint within the Zones of High Impact and Moderate Impact as well as from sites where seagrass are known to occur within the Zone of Influence, north-east of Onslow.

Data on the spatial extent of any permanent changes in seagrass associated with dredging will be collected through the use of towed video or other non-diver methods that incorporate a wide spatial coverage in order to account for the patchiness of seagrass distribution. Recorded images will be sampled quantitatively using digital analysis software to provide measures of seagrass cover, such as shoot/leaf counts and percent cover.

To infer whether dredging has been the cause of any changes observed, a before-after/control-impact sampling design will be used that incorporates suitable control and impact sites. As per the Responsive Monitoring Program, some reference sites may need to be placed within the Zone of Influence in order to assess ecologically comparable communities. An examination of water quality data and satellite/aerial imagery collected during the dredging program will be used to infer whether these sites are ‘true’ reference sites or may have been influenced by dredging activities. However, since sites within the Zone of High Impact and Moderate Impact will be established radiating outward from dredging footprints, data can also be examined using a gradient approach, which is not necessarily reliant on reference site data to infer the cause of any observed changes.

Following the guidance of EAG#3 (EPA 2009b), where permanent impacts are found to extend beyond approved limits (beyond the boundary of the Zone of High Impact) the likelihood of recovery of seagrass communities and BPPH will be assessed through the following measures: i) the presence of seagrass seeds will be assessed through grab samples in areas where impacts have occurred to determine the possibility for recovery; and ii) the particle size distribution of sediments will be assessed in areas where seagrass have been impacted to determine whether BPPH has been altered and is likely or unlikely to support recolonisation by seagrasses.

9.2.2.3 Filter feeders

Sessile filter feeders are common on the sand veneered pavement that dominates the inner shelf of the Wheatstone Area. Filter feeders were identified north of Tortoise Island extending from the 10 m contour to the 20 m contour and occur in low to moderate densities (10 to 20% cover of substratum).

Filter feeder cover will be assessed along representative transects radiating outwards from the dredging footprint within the Zone of High Impact and Zone of Moderate Impact. Data collected using this method will be used to infer the spatial extent of permanent impacts to filter feeders and to assess the predicted impacts from the dredge plume. If permanent impacts are detected within the Zone of Moderate Impact, transects will also be assessed within the Zone of Influence to determine whether any impacts to filter feeders have occurred.

Data on the scale and distribution filter feeders will be collected through the use of towed video or other non-diver methods that incorporate a wide spatial coverage. Recorded footage or images will be sampled quantitatively using digital analysis software to provide measures of filter feeder cover and presence/absence of taxonomic groups. Data will also be gathered on changes to underlying habitat through measures such as sediment cover or observed physical disturbance to habitat.

Reference sites and the gradient approach will be used to infer whether any temporal changes are due to dredging and dredge placement activities, as described above in **Section 9.5.2.2**.

9.2.3 Analysis and Reporting

Data on hard coral, seagrass and filter feeder permanent losses will be extracted from video footage frame grabs or digital still photographs using a digital analysis program (e.g. Coral Point Count with Excel extensions: CPCe; Kohler et al. 2006). Since the objective of Impact Monitoring is to assess permanent loss, images will also be analysed to quantify any damage or change to underlying habitat using measures such as sediment cover or observed physical disturbance.

A report on the baseline condition of subtidal BPPH report will be compiled. A final report will also be produced that details any changes in BPPH pre- versus post-dredging activities.

9.3 Introduced Marine Pests (IMP) – Inspections

9.3.1 Overview

The dredge vessels' mobilisation procedure requires a pre-mobilisation inspection of any vessel considered to be an uncertain or high risk vector for IMP. The risk assessment for vessels will be undertaken as per the form contained in Appendix XXX.

to be developed

9.3.2 Inspection Requirements

IMP inspections will be undertaken by a suitably qualified person with experience in the identification of IMP and in the inspection of construction vessels. All inspections will be undertaken either in 'dry dock' or via 'in water' inspection, with sufficient visibility.

The Revised Coordinating Committee for Introduced Marine Pest Emergencies (CCIMPE) Trigger List (2006) will be used as the basis for the identification of a marine species as an invasive pest, noting the potential presence of other unlisted species, demonstrating invasive characteristics or otherwise of concern. Other species not currently on these lists that are commonly accepted to have the potential to become invasive in some environments will be considered accordingly.

Inspections to examine the occurrence or risk of IMP will involve:

- an inspection of the vessel hull including the external niche areas
- an inspection of the internal niches including accessible ballast tanks, bilge spaces, anchor chain/cables locker, internal seawater systems
- an inspection of the topside wet areas including immersible equipment/dredge equipment (trailing pipes, dragheads and anchors).

Each of these items will be visually inspected and video/photographs will be taken of all niche areas and any species of concern. The ballast water logs will also be inspected to confirm compliance with the AQIS Mandatory Ballast Water Requirements.

In the event that a known or suspected IMP of concern are identified, a photograph or video image showing the species will be taken, including the full extent of the fouling clearly visible and a sample will be taken and sent for expert taxonomic identification. The contingency management measures presented in **Section 8.3** will be implemented when suspected IMP are identified and will not be dependent on the taxonomic identification due to the time required for taxonomic study.

9.3.3 Reporting

An inspection checklist will be completed for each inspection. This checklist, including a statement from the inspector providing an assessment on the status of the vessel in terms of risk, will be forwarded to the DEC and DoF prior to the commencement of the vessel's operation. An inspection report detailing the risk assessment, ballast water records and the results of the inspection will be provided to DEC and DoF.

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10.0 REPORTING, REVIEWS AND CORRECTIVE ACTIONS

to be populated once all management approaches agreed

10.1 Reporting for the Dredging and Spoil Disposal Management Plan

Table 10-1summarises the regulatory reporting requirements associated with the dredging and dredge material placement activities.

Table 10-1: Reporting requirements for dredging and dredge material placement activities

Report	Contents	Frequency/Timing	Recipient
Monthly Coral Health and Water Quality Reports	Results of the coral health and water quality fortnightly surveys (two surveys included in each report)	10 business days following after the second field trip	EPA/DSEWPaC
Annual Coral Health and Coral Water Quality Report	Annual summary report of the water quality and coral health monitoring data collected during the dredging monitoring period	Annually	EPA/DSEWPaC
Final Water Quality / Coral Health Report	Summary report of the water quality and coral health monitoring data collected during the dredging and post dredging monitoring period	Upon completion of monitoring program	EPA/DSEWPaC
BPPH Monitoring Report	Comparison of pre and post dredging survey results, in relation to Ministerial Conditions	Upon completion of the dredging program	EPA/DSEWPaC
Marine Pest Inspection Checklists	Checklist completed during vessel inspections including assessment of vessel pest status.	48 hours after inspection	DoF
Marine Pest Inspection Report	Report on vessel inspection including vessel history.	10 days after inspection	DoF
Spoil Ground bathymetry	Bathymetry of placement sites after material placement has been completed	As per requirements of SDP	DSEWPaC

	including written commentary on volume of sediment retained.		
IMO Reporting	Permit details. Details on the quantity and type of sediment disposed.	As per requirements of SDP	DSEWPaC

Report	Contents	Frequency/Timing	Recipient
Notification of Coral Health Trigger – Level 1	Details of exceedance and management actions	Within 4 days of exceedance identification	EPA/DSEWPaC
Notification of Coral Health Trigger – Level 2	Details of exceedance and management actions	Within 4 days of exceedance identification	EPA/DSEWPaC
Notification of Coral Health Trigger – Level 3	Details of exceedance and management actions	Within 4 days of exceedance identification	EPA/DSEWPaC
Marine Fauna Incident Report	Details of incident involving injury or mortality to turtle or marine mammals attributable to dredging	Per occasion (within 24 hours of incident)	EPA/DSEWPaC

10.2 Reviews of DSDMP

Hold – to be completed in finalised DSDMP

10.3 Corrective Actions

Hold – to be completed in finalised DSDMP

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Appendix A Summary Table of Risk Assessment Outcomes

Table 11-1- Summary of some of the residual risks to marine water and sediment quality, BPPH and marine fauna due to proposed trunkline construction and associated activities (refer to section 8 of the EIS/ERMP for full detail on all marine risk assessment outcomes).

Aspect and Activity	Potential Impacts	Residual Risk			Confidence Level
		*C	*L	*RR	
Trunkline trenching and stabilisation					
Marine water and sediment quality	Turbidity and light attenuation	**4**	**2**	**Medium**	**Reasonable:** Available information is adequate
BPPH	Indirect disturbance to the seabed from increased turbidity, sedimentation and light attenuation leading to loss of BPPH in exceedance of acceptable levels	**4**	**2**	**Medium**	**Reasonable:** Available information is adequate
Trunkline shore crossing by microtunnelling					
Marine water and sediment quality	Turbidity and light attenuation	**6**	**2**	**Low**	**Reasonable:** Available information is adequate
BPPH	No impact predicted	**6**	**2**	**Low**	**Reasonable:** Available information is adequate
Construction dredging of the channel, trunkline and berthing area					
BPPH	Direct loss of subtidal BPPH through removal within project area	**6**	**1**	**Low**	**Reasonable to High:** Modelling conducted but calibration shows occasional aberration from occurrences. Excellent survey data.
	Indirect impact to BPPH due to increased turbidity, sedimentation and light attenuation leading to loss of BPPH in excess of acceptable levels as defined in EPA guidelines	**4**	**1**	**High**	**Reasonable to High:** Modelling conducted but calibration shows occasional aberration from occurrences. Excellent survey data.
Marine Fauna	Entrainment of marine fauna (particularly juvenile turtles) resting on the sea bed	**4**	**3**	**Low**	**Reasonable:** short-term monitoring data available
Construction dredging for channel, trunkline and MOF and placement of dredged material at sea					
Marine Fauna	Loss of or disturbance to critical habitat used by protected marine fauna. Disturbance of fauna causing avoidance of area by protected marine fauna.	**5**	**4**	**Very Low**	**Reasonable:** Short-term monitoring results available. Modelling conducted but calibration shows occasional aberration from occurrences
Construction of PLF and trunkline, rock placement and anchor placement					

Aspect and Activity	Potential Impacts	Residual Risk			Confidence Level
		*C	*L	*RR	
Marine Fauna	Loss of, or disturbance to, habitat critical to marine fauna from seabed disturbance during nearshore construction	**5**	**2**	**Low**	**Reasonable:** Short-term monitoring results available.
Placement of Dredge material nearshore and offshore					
Marine water and sediment quality	Increased turbidity and light attenuation exceeds agreed water quality targets .	**4**	**2**	**Medium**	**High:** Modelling conducted and calibration shows good adherence to real occurrences
BPPH	Direct loss of sub-tidal BPPH due to placement of dredge material offshore	**6**	**1**	**Low**	**Reasonable to high:** Modelling conducted but calibration shows occasional aberration from occurrences. Excellent survey data.
	Indirect impact on BPPH and habitats due to increased turbidity, sedimentation and light attenuation	**4**	**2**	**Medium**	**Reasonable to High:** Modelling conducted but calibration shows occasional aberration from occurrences. Excellent survey data.
Shipping movements during construction					
Marine water and sediment quality	Accumulation of anti-fouling paints in marine sediments	**4**	**3**	**Low**	**Reasonable:** Available information is adequate
BPPH	Toxicity effect of anit-foulants on BPPH. Introduction of marine pests	**5**	**3**	**Low**	**High:** Several expert investigations/studies
Marine Fauna	Injury to, or fatality of protected marine fauna due to interactions with vessels. Changes to migratory patterns, foraging, breeding behaviour of protected fauna as a result of disturbance.	**4**	**3**	**Low**	**Reasonable:** Short-term monitoring results available
	Introduction of marine pest species. Loss of diversity	**5**	**3**	**Low**	**Reasonable:** Available information adequate
	Loss of biodiversity. Breach of marine biosecurity. Introduction of diseases and pathogens to aquaculture operations and commercial recreational fisheries.	**2**	**5**	**Low**	**Reasonable:** Available information is adequate.
Discharge of Ballast water					
BPPH	Adverse impacts on the marine environment. Introduction of marine pests	**5**	**3**	**Low**	**High:** Several expert investigations/studies
Nearshore leaks and spills					
Marine water and sediment quality	Degradation of marine water and sediment quality	**2**	**4**	**Medium**	**Reasonable:** Modelling conducted but calibration shows occasional aberration from occurrences.
BPPH	Mortality of BPPH due to refuelling work boats,	**1**	**5**	**Medium**	**Reasonable:** Modelling

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Aspect and Activity	Potential Impacts	Residual Risk			Confidence Level
		*C	*L	*RR	
	condensate spill during loading				conducted but calibration shows occasional aberration from occurrences.
Marine Fauna	Loss of, or disturbance to, habitat critical to marine fauna	**4**	**4**	**Low**	**Reasonable:** Modelling conducted but calibration shows occasional aberration from occurrences.
	Disturbance to protected marine fauna. Toxicity effects to protected marine fauna	**3**	**4**	**Low**	**Reasonable:** Modelling conducted but calibration shows occasional aberration from occurrences.
	Smothering and/or oiling of marine fauna	**3**	**4**	**Low**	**Reasonable:** Modelling conducted but calibration shows occasional aberration from occurrences.
	Smothering and/or oiling of marine fauna	**3**	**4**	**Low**	**Reasonable:** Modelling conducted but calibration shows occasional aberration from occurrences.
Noise and vibration from construction activities					
Marine Fauna	Altered distribution of fauna due to avoidance of area during noisy construction activities (piling, dredging, drilling) and behavioural effects to protected marine fauna	**4**	**3**	**Low**	**Reasonable:** Short-term monitoring results available./
Physical presence of the PLF, MOF and trunkline and offshore production facilities					
Marine Fauna	Change to behaviour of protected marine fauna (including seabirds), impacts on migratory patterns, nesting and feeding, and loss and disturbance to habitats	**5**	**4**	**Very Low**	**Reasonable** to High: Short-term monitoring results available. Some long-term monitoring results available.
Creation of artificial habitat					
Marine Fauna	Changes in the abundance for some species of fish. Change in the abundance and diversity of protected marine fauna from the creation of artificial habitat	**6**	**3**	**Very Low**	**Low:** Available information is inadequate

* C = consequence, L = likelihood, RR= residual risk rating

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Appendix B Framework to Limit Risk of Entrainment Related Mortality during the Wheatstone Dredging Campaign

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Framework to Limit Risk of Entrainment Related Mortality during the Wheatstone Dredging Campaign

Background

Dredging represents an entrainment risk to marine turtles as they rest and forage on the seabed, particularly juvenile turtles, due to their weaker swimming ability and inability to escape the dredge suction.

Wheatstone proposes to monitor and manage the risk of turtle entrainment during the dredging program using two approaches:

- Incident investigation Reporting
- Adaptive management

Incident investigation reporting is a method Chevron uses to record and assesses the cause of injuries to its workforce. It is also used to identify lessons-learned and forms the basis for recommendations to further limit the risk of injury. Chevron proposes to use the same principles to investigate turtle entrainment events and use the investigation results, along with other criteria, to guide future action, e.g. additional mitigation measures, to minimise the risk of entrainment to turtles.

In addition to incident investigation reporting, an adaptive management framework will be adopted to formalise the assessment of current and future entrainment mitigation measures. The basic tenet of adaptive management is: Plan – Implement – Monitor – Learn. The adaptive management approach will help ensure the assessment of entrainment mitigation measures remains objective and transparent.

Advantages of this framework are:

- It avoids the need to specify an arbitrary rate of entrainment that has no biological justification.
- Each entrainment event is investigated.
- It uses a variety of criteria to decide when to act and what further action is warranted.
- It provides greater certainty for proponents and regulators.

The proposed approach includes six key steps which are described below. Figure 1 conceptualises the process.

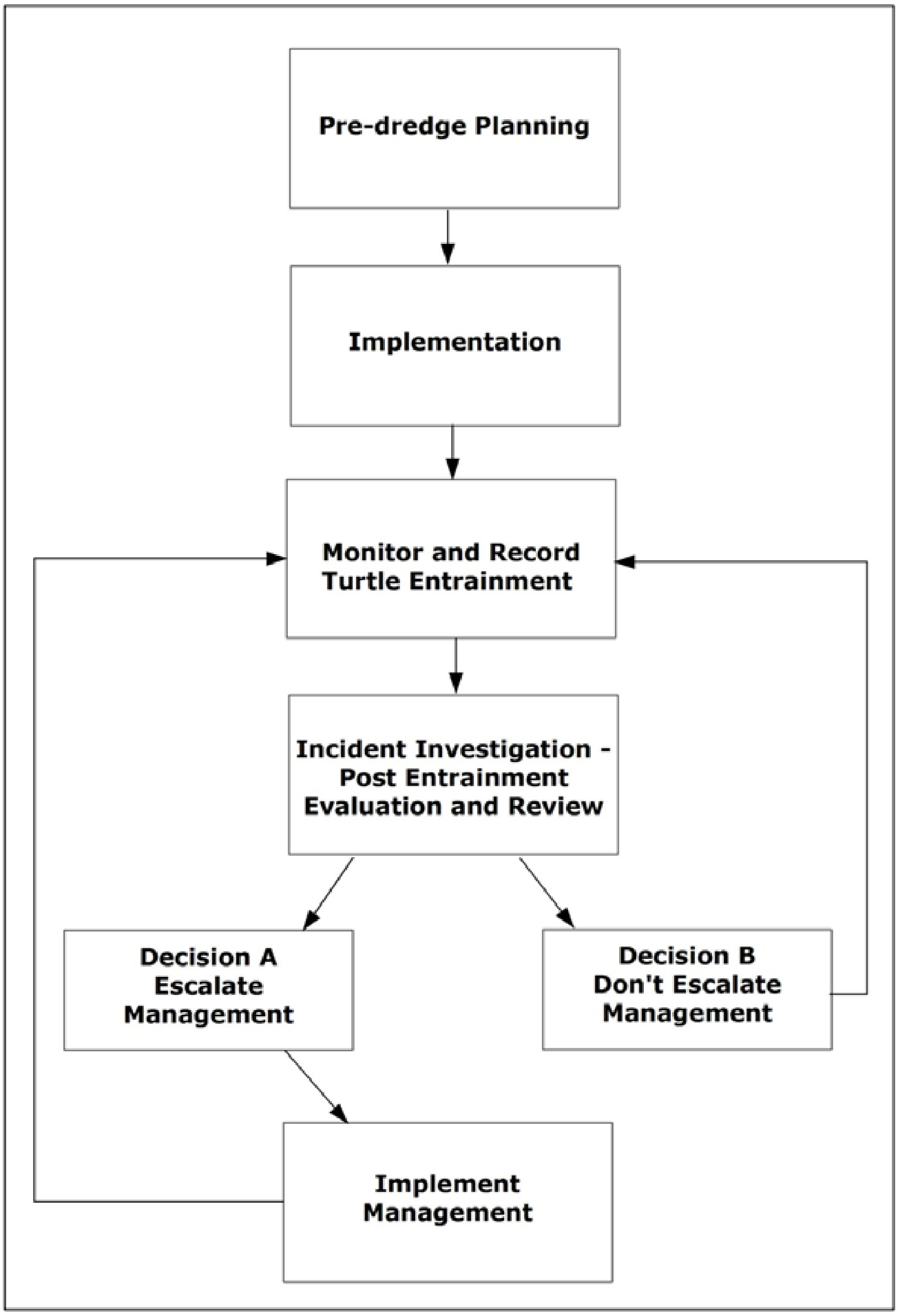

Figure 1: Key Steps in the Proposed Wheatstone Framework to Reduce the Risk and Rate of Turtle Entrainment

Step 1 Pre-dredge Planning

This step is undertaken prior to dredging and includes specifying management objectives, roles and responsibilities, and mitigation actions to reduce risk of entrainment.

Determine specific management objectives:

- Reduce or prevent turtle entrainment.
- Monitor turtle entrainment.
- Assess current mitigation measures to reduce entrainment.
- Adaptively manage to identify and implement further measures to reduce risk of entrainment.

Baseline Information

Little nesting for flatback and green turtles was recorded on the mainland, the closest nesting beach to the Ashburton North Site is approximately 4 km to the west. Surveys did record medium to high nesting activity, by both flatback and green turtles, on the large (Serrurier and Thevanard) and moderate sized (Bessieres, Locker and Ashburton) islands while low levels of nesting activity were recorded on the smaller islands (Flat, Table, Direction and Twin).

Green turtles are not expected to be present in the proposed shipping dredging channel as they generally stay within a few kilometres of their nesting beach during their inter-nesting period, predominantly around offshore reefs and habitats, including reefs around islands. Inter-nesting flatbacks are at risk as flatbacks nesting at Ashburton Island are known to spend at least part of the inter-nesting period in the area of the proposed shipping channel. Foraging surveys undertaken in 2009 indicated no juvenile flatback turtles were recorded during the foraging survey, indicating the project is not a foraging area for these turtles. Aerial surveys confirm that turtles occur only in low densities in the proposed dredge footprint.

The risk of entrainment during the dredging operation is considered low, however Chevron intends on undertaking a conservative approach to ensure risks associated with the dredging operation are minimised.

Roles and Responsibilities

Wheatstone will establish roles, responsibilities and authorities to ensure appropriate people with the correct skills and knowledge are included in decisions making and incident evaluation. The number of people involved in decision making and incident reporting depends on the complexity of the incident and the skills needed to determine cause. Proposed roles and responsibilities for the duration of the dredging operation are provided in Table 1.

In line with the Chevron Incident Investigative Procedure, the following roles are to be considered during incident evaluation:

- A trained facilitator

- The employee(s) or contractor(s) involved in the incident
- The supervisor of the people involved in the incident
- Specialists or subject matter experts, if appropriate. Specialists could include the following people:
    - Company representative
    - Turtle research consultant
    - Equipment inspectors
    - Maintenance mechanics
    - Emergency response specialists

Table 1: Roles and Responsibilities

Role	**Responsibility**
Pre-dredge Planning	
Vessel crew	• Undertake fauna/turtle observation training • Installation of required equipment to reduce turtle entrainment and monitor for incidents
Wheatstone Environmental Advisors	• Development of management/mitigation strategies and objectives • Development of training packages
Trained crew member	• Assist with fauna training and observations • Provides input to inductions on fauna observations
Implementation	
Vessel Captain	• Ensure adequate reporting for marine observations and incidents
Vessel Crew	• Assists observing for turtles as per training
Wheatstone dredging representative	• Ensures implementation of Dredging and Spoil Disposal Management and Monitoring Plan
Trained crew member	• Records all turtle injuries and mortalities • Records all turtle observations
Site Environmental Advisor	• Co-ordinates environmental aspects of dredging and disposal • Assists with fauna training, observations and inductions
Monitor and Record Turtle Entrainment	
Trained crew member	• Record all observations in daily vessel log • Record all injuries or mortalities • Report all incidents
Vessel Captain	• Ensure all incidences are adequately reported
Incident Investigation	
A trained facilitator	• Facilitate incident investigation
The employee(s) or contractor(s) involved in the incident	• Participate in investigation
The supervisor of the people involved in the incident	• Participate in investigation
Specialists or subject matter experts	• Provides advice on alternative mitigation measures

Role	Responsibility
Implement Management	
Vessel Captain	• Ensures that any new recommendations for mitigation or management measures are implemented
Wheatstone dredging representative	• Co-ordinates operational aspects of dredging and disposal
Site Environmental Advisor	• Co-ordinates environmental aspects of dredging and disposal

Chevron has committed to the following management action to reduce risk of turtle entrainment:

1. Prior to the commencement of dredging, selected crew will receive training, which will include details on procedures in the event of turtle sightings, injury or death;
2. When operating with less than 5 m under-keel clearance, the dredge will initially move slowly through the area before commencing dredging so that the noise and vibration alerts marine turtles in the vicinity and encourage them to leave;
3. When initiating dredging, suction through dragheads will be initiated just long enough to prime the pumps, prior to drag heads engaging the seabed;
4. Dredge pumps will be stopped as soon as possible after completion of dredging and, where practical, the draghead remain within 0.5m of the seabed until the dredge pump has stopped;
5. Crew members trained to make observations of marine fauna on dredge vessels;
6. Tickler chains on draghead,
7. Screens on the overflow to allow for visual assessment if turtles have been entrained, and
8. Release of healthy entrained turtles back to the marine environment.

Step 2 Implementation

The following steps will be implemented to achieve the defined objectives:

- Check mitigation actions are in place before dredging.
- Ensure dredge staff are trained (see Action 1 above).

Chevron or their contractors will implement a monitoring program which will include the monitoring of the TSHD overflow screens to ensure in the event of a turtle fatality, the remains are collected and the incident reported and investigated. It is envisioned that identification of a turtle fatality will be by inspection at the conclusion of each dredging cycle by a suitably trained person.

Step 3 Monitor and Record Turtle Entrainment

Monitor and measure against objective.

Table 2: Proposed Monitoring Requirements

Monitoring Requirement	**Method**	**Responsibility**	**Monitoring Frequency**
Turtle Observations/ assessment of sea turtle presence	From-vessel observations	Trained crew member	Daily in vessel log
Turtle injury and mortality	Visual inspections of dredge dragheads	Trained crew member	End of each dredge cycle
	Visual inspections of overflow screens	Trained crew member	End of each dredge cycle
Adaptive Management Framework	Monitor effectiveness	Wheatstone Environmental Advisors	Annually

If turtle is entrained, go to Step 4.

Step 4 Incident Investigation – Post Entrainment Evaluation and Review

Complete *Turtle Entrainment Incident Investigation Report (*See ***Table 3*** *for Table of Content)*

The investigation should include:

- Identifying cause and effect
- Reviewing existing management controls and evaluate management effectiveness
- Documenting lessons learned
- Feeding new information back into the process
- Recommending follow-up action (Step 5)

Forward Incident Investigation Report to DEC for Review within 48 hr.

Step 5 Decide Whether to Escalate Management or Continue to Monitor Only

Deciding whether to escalate management will depend on:

- the effectiveness of current mitigation (has it worked)
- consequence of mortality event on local turtle population
- changes in dredge location and schedule

Further to the above, the following will be considered when reviewing management effectiveness: time since last entrainment (project level rate of entrainment); location in relation to nesting beach or foraging areas (e.g. reef); species and size (adult or juvenile) entrained; number and density of turtles caught; timing (mating, foraging and inter-nesting period); were controls correctly implemented; weather and conditions; and dredge status before the incident occurred (normal operations, startup, shutdown, maintenance).

Evaluate the potential consequence of the mortality event on local population of turtles and whether there is a need to escalate management. If it is deemed that additional mitigation measures are not required, the proponent will demonstrate that the risk of entrainment is as low as reasonably practical.

If escalation is deemed warranted, go to Step 6.

Step 6 Implement Management

Implement new management action.

Continue to monitor entrain after implementation of new mitigation (go back to Step 3).

Table 3: Proposed table of content for *Turtle Entrainment Incident Investigation Report*

Table of Contents	
Executive Summary	
1.0	Background Information
2.0	Timeline
3.0	Findings and Causes
4.0	Lessons Learned
5.0	Action Items
6.0	Attachments including photographs

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