March 2009

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ALBANY IRON ORE PROJECT
ALBANY PORT EXPANSION PROPOSAL
PUBLIC ENVIRONMENTAL REVIEW

DREDGE AND LAND RECLAMMATION EMP

Albany Port Authority
EPA Assessment No 1594

Document Status					
Rev No.	Author	Reviewer	Approved for Issue		
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Figures

1 DOCUMENT PURPOSE AND STRUCTURE

This Dredge and Land Reclamation Environmental Management Plan (DLREMP) has been prepared for the Albany Port Authority (APA), Albany Port Expansion Proposal. This DLREMP addresses the requirements of the EPBC Act and the *Environment Protection (Sea Dumping) Act 1981*.

The structure of this document is as follows:

Section 2 provides an overview of the scope of the management plan and the impacts requiring management.

Section 3 is an outline of the Project scope.

Section 4 provides a summary of the existing environment.

Section 5 outlines the APA's approach to risk management and the Project risk assessment.

Section 6 provides the framework for applying relevant guidelines to the protection of aquatic ecosystems

Section 7 outlines the potential impacts, objectives and targets, and proposed management actions for each aspect requiring management.

Section 8 outlines the proposed monitoring programmes.

Sections 9 and 10 summarises the contingency plans and stakeholder consultation undertaken for the Project.

Sections 11 and 12 outline the Albany Port Expansion Proposals commitments to comply with auditing requirements, review and revise the management plan as required and report monitoring programme results.

2 SCOPE

The APA Albany Port Expansion Proposal involves dredging to widen the existing channel into Princess Royal Harbour and extending the channel into King George Sound to facilitate the access of Cape size vessels to the port. Dredging activities are anticipated to generate up to 12 Mm^3 of dredge material of which approximately 0.3 Mm^3 will be used for the land reclamation. The excess dredged material will be placed at an offshore disposal site. Land reclamation of up to 9.0 ha of Princess Royal Harbour is proposed to construct a new berth (berth 7) and provide an area sufficient to accommodate the concentrate storage facility and ship loading infrastructure required for the Southdown Magnetite Proposal. This dredging and land reclamation environmental management plan addresses potential environmental impacts and management procedures associated with:

- dredging in Princess Royal Harbour;
- dredging in King George Sound;
- land reclamation in Albany Port; and
- offshore disposal of excess dredge material.

The APA Albany Port Expansion Proposal will be managed in relation to the following aspects of the marine environment and will be considered in the context of the Environmental Quality Management Framework (ANZECC / ARMCANZ, (2000), EPA (2000), Government of WA (2004)):

- turbidity (water quality);
- mobilisation of heavy metals/nutrients (water quality);
- hydrocarbon spills;
- commercial industry;
- terrestrial vegetation and flora;
- benthic primary producer habitat (BPPH);
- cetaceans and pinnipeds;
- quarantine practices;
- noise; and
- harbour access.

This management plan forms a part of the operational control procedures for the APA Environmental Management System which is aligned to the international standard ISO 14001:2004.

3 PROJECT DESCRIPTION

3.1 CONTEXT

The APA Albany Port Expansion Proposal (EPA assessment No 1594) will allow passage for Cape size vessels into the Harbour and provide the requisite port area that will be required for Grange Resources Limited (Grange) to accommodate infrastructure for a new magnetite mine proposal (EPA assessment No 1596).

The project footprint and co-ordinates of the proposed channel, land reclamation area and offshore disposal site for dredged material are identified in Figure 3.1 and Figure 3.2.

A summary of the key characteristics associated with the Port Expansion Proposal is provided in Table 3-1.

Table 3-1: Key Characteristics of the Port Expansion Proposal.

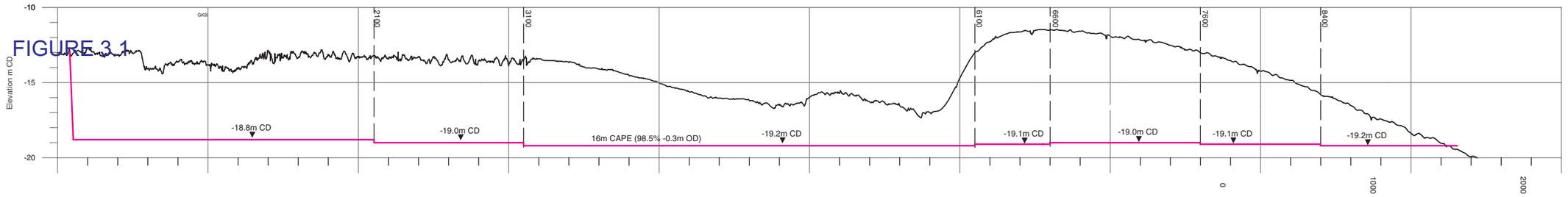
Key Aspect	Description
Dredging	
Dredging timetable	300,000 cum for the initial berth pocket by CSD over a 3 month period, and 11.7 Million cubic metre shipping channel over a 20 week period any time of the year with a targeted commencement date from 2009.
Total area to be dredged	247.7 ha
Total quantity of dredge material to be generated	Up to12 million cubic metres
Dredge methods	Cutter Suction Dredge (CSD) for the initial berth pocket area and Trailer Suction Hopper Dredge (TSHD) for the remainder of the dredging task. No blasting is required.
Contaminated material	All dredge material has been deemed ‘suitable for unconfined sea disposal’ in accordance with NODGDM (2002).
Land Reclamation Area	
Area	Up to 9.00 ha
Height	+4m CD
Construction of sea wall	Continuous rock armoured sea wall, lined with geotextile filter cloth
Clearing	nil
Offshore Disposal Area	
Disposal location	In deep water within King George Sound
Disposal footprint	250 ha
Disposal depth	Finished depth -35m CD
Disturbance Footprint	
Total Albany Port Expansion Proposal disturbance footprint	506.7 ha

PRELIMINARY

J.Bailey 26/06/2008 16/06/2008

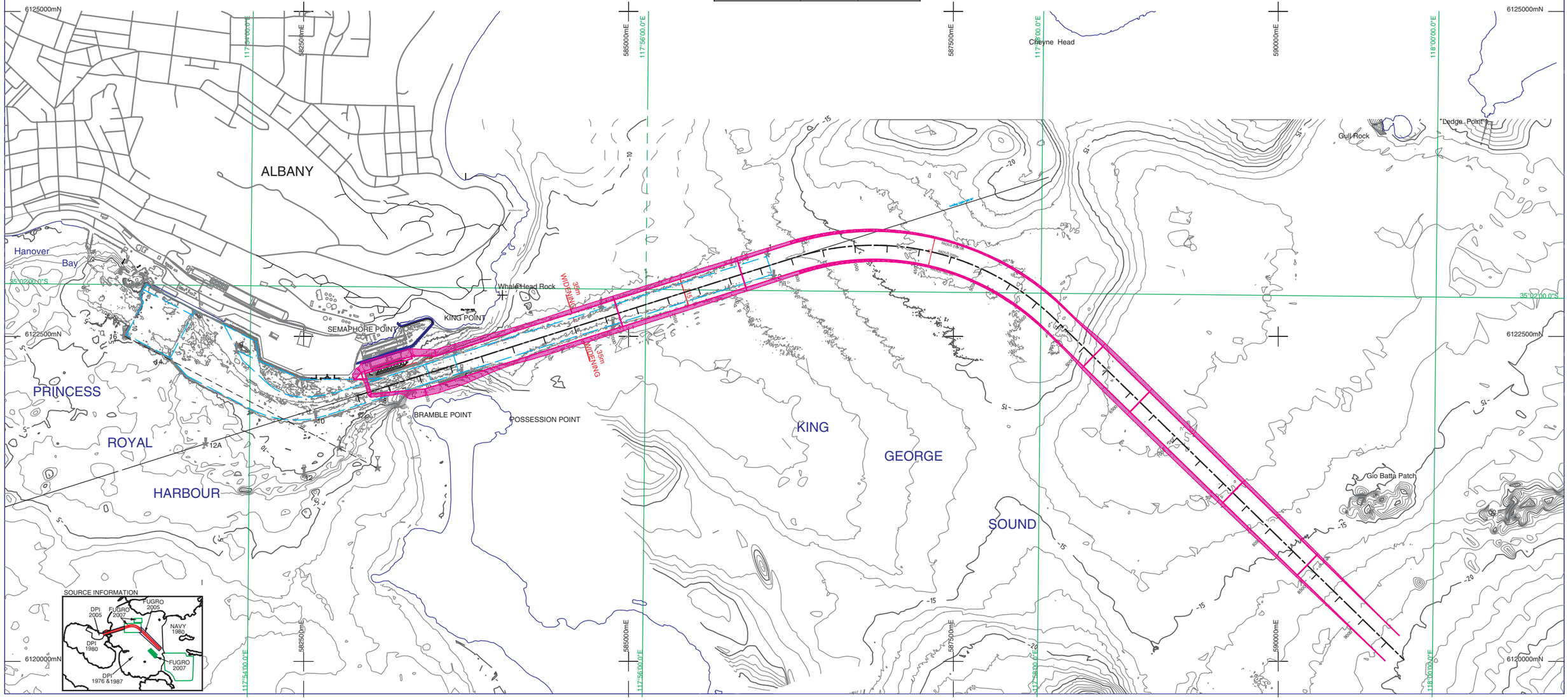
20/04/2008 GKB

FIGURE 3.1



INCLUDES 300mm OVERDREDGE

	VOL m^3	AREA ha
16m CAPE (98.47%)	12,000,000	246.0



B	07/07/2008	TEXT CORRECTIONS	SM	
A		ISSUED INTERNAL REVIEW & USE		
REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL

ORIG SIZE A1

ARCHIVE JFA-1183-29-1C.DGN, JFA-118STOP-15000-V8.DGN, ALB CHAN DES 98-47% od + 1m 0608 ALBANY-COMB-0407.DTM

PROJECT No

NOTES

SCALE 1 : 15000

500 0 1000 METRES

DATUM

VERTICAL ALBANY WHARF - LWM ALBANY WHICH IS 4.010m BELOW PWD BM HR2 AND 0.771m BELOW A.H.D

HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

GDA

ACTION	NAME	SIGNATURE	DATE
ENGINEER			
DRAWN	G.Bebbington		
ENGINEER CHECK	R.Mocke		
CARTOGRAPHY CHECK	C. Livingstone		
APPROVED PROJECT MGR			

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GRANGE RESOURCES LIMITED

GRANGE RESOURCES - SOUTHDOWN PROJECT
ALBANY PORT EXPANSION
CONCEPT CHANNEL
CAPE SIZE

FIGURE 3.1

DRAWING NUMBER

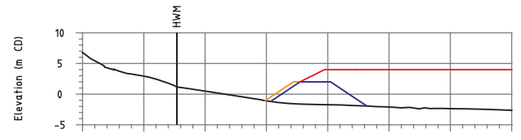
REVN

582750mE
583000mE
583250mE
583500mE
583750mE

HWM (0.4m AHD)

AA

PROFILE



SECTION AA

KING POINT

FILL RL
min 4.00m CD
min 3.23m AHD

6122500mN

SEMAPHORE POINT

USEABLE SURFACE
AREA = 7.36ha

℄ CONVEYOR

PROPOSED BERTH 7

-19.0 CD

28

79

50

5

DESIGN
-16.5 CD

DESIGN
-16.0 CD

6122250mN

BERTH 6

DESIGN
-12.2 CD

7

6

DESIGN
-16.0 CD

DESIGN
-12.2 CD

PROPOSED CHANNEL
TOELINE

1.0m CD — 0.229m AHD

0.771m CD — 0.0m AHD

-0.771m AHD

0.0m CHART DATUM (CD)
LOW WATER MARK ALBANY

8

EXISTING CHANNEL
TOELINE

6122000mN

582750mE
583000mE
583500mE
583750mE

C	07/07/2008	NEW CHANNEL	SM	
	20/07/2007	ISSUED FOR COMMENT		

A1

1 - JETTY, VESSEL AND ONSHORE PLANT DETAILS SCHEMATIC ONLY

SCALE 1 : 1500

10 0 150 METRES

DATUM VERTICAL — LWM ALBANY WHICH IS 4.010m BELOW PWD BM HR2 AND 0.771m BELOW A.H.D.

HORIZONTAL

GDA

ENGINEER	R.Mocke		20/07/2007
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ENGINEERING CHECK	B.Brodie-Hall		
CARTOGRAPHY CHECK	G.Bebbington		

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GRANGE RESOURCES LIMITED

GRANGE RESOURCES - SOUTHDOWN PROJECT
ALBANY PORT DEVELOPMENT
DRAIN OPTION
CONCEPT B BERTH LOCATION FIGURE 3.2

JFA-1257-16-2C.DGN

DRAWING NUMBER

REV

3.2 LAND TENURE

The APA has jurisdiction over approximately 90 ha of land, all the waters and sea bed of Princess Royal Harbour (excluding the area around the Town Jetty) and all of King George Sound to an imaginary line running from Limestone Head to Breaksea Lighthouse and then to Herald Point. This equates to a total area of approximately 12 000 ha.

King George Sound is designated as waters within the limits of the State, with the line of demarcation being the port limits between Herald Point- Michaelmas Island - Breaksea Island - Bald Head. The proposed dredge footprint falls within the limits of the State, however the proposed offshore disposal site is either partially or entirely within Australian waters and under the jurisdiction of the Federal Department of the Environment, Water Heritage and the Arts (DEWHA).

Amendments to the regional planning scheme or the town planning scheme may be required for the proposal in relation to the zoning of the land reclamation area. The APA will liaise with the City of Albany regarding the development as required. All existing port land is zoned Port Industrial Use.

Land Reclamation Area

Two designs of land reclamation were considered. The first land reclamation area was to be constructed to abut the adjacent Mount Adelaide A Class Reserve 27068. The initial design concept excised +4.0 m CD will encroach into the reserve. This will require clearing of 0.78 ha of A Class Reserve of which 0.31 ha is remnant vegetation. Due to the level of concern over the impacts to Mount Adelaide Reserve from a variety of stakeholders, the proponent have developed and committed to an alternative land reclamation area that has no interaction with the A Class Reserve.

This configuration involves contouring the land reclamation area on the eastern end of the landward face from +4.0 m AHD to the low water mark, creating a rocky tidal pool extending from the low water mark (-0.4m AHD) up to the high water mark (+0.4m AHD) in this area (Figure 3.2 The landward face of the reclamation area would be constructed with a rock scour protection layer to prevent erosion. A short swale drain will also be constructed, extending into the port reserve up to the +4.0m AHD contour near the western end of the rocky tidal pool. Stormwater from the A Class Reserve would naturally flow into the intertidal area. The swale drain will also convey clean stormwater runoff from the vegetated area only of the port land into the rocky tidal pool. Stormwater from the land reclamation area would be retained on site and infiltrated in situ until such time that the Grange (EPA Assessment No. 1596) construct their approved stormwater infrastructure. This alternative design will not have any additional impact on BPPH

Indigenous Tenure

Grange and the APA have engaged the Albany Indigenous Heritage Reference Group throughout the planning and design phase of the proposed works and will address specific stakeholder concerns during the construction and operation phase of the proposal. The Albany Port was proclaimed in 1949 thereby extinguishing Native Title for all of Princess Royal Harbour, King George Sound water and seabed.

The land adjacent to the Port is covered by two registered Native Title claims, the:

- Southern Noongar (Tribunal Number WC96/109); and the
- Wagyl Kaip (Tribunal Number WC98/070).

Under the Future Acts regime, any agency planning to undertake an act that has the potential to affect native title, need to consider the requirements of the *Native Title Act 1993*, including acknowledging the claimants right of consultation and right to negotiate. Any developments impacting the land adjacent to the Port, including the land reclamation area, must engage with the claimants' representative.

3.3 DREDGING

As the construction of the new berth is one of the Albany Iron Ore project's critical activities, the dredging works associated with the reclamation of the new berth has been separated out as a discrete event. It is planned for this work to be undertaken using a Cutter Suction Dredge (CSD), to remove 0.3 Mm^3, of material to create the initial berth pocket. This work will be undertaken over a three month period independent of season.

The CSD will be used to cut a batter profile at the proposed berth 7, and the southern side of the channel. It is intended that material dredged by the CSD will be pumped directly into the land reclamation area.

Dredging of the remainder of the berth pocket, any additional material to complete the reclamation and the channel will be undertaken by a Trailer Suction Hopper Dredge (TSHD), potentially as a separate event. It is anticipated that up 11.7 mm^3 of material will be dredged via the THSD program. This work will occur over a four and a half to seven month period when all regulatory approvals, financial close and the appropriate dredge equipment is available. The targeted commencement date is during the calendar year 2009.

The TSHD will go through cycles of four consecutive operations:

- Dredging in the channel.
- Sailing full to the offshore disposal site.
- Placement of dredge material at the offshore disposal site.
- Sailing empty to resume the cycle.

The dredging operations will continue 24 hours a day and 7 days a week as weather permits. Dredge operators will maintain a log of the dredge path, volumes dredged and disposal position.

3.4 LAND RECLAMATION

Construction

Dredged material will be pumped into the land reclamation area (approximately 0.3 mm^3) via the CSD.

Up to 0.09 mm^3 of this material may not be geotechnically suitable for use in the land reclamation. This material (which may be potentially acid forming due to the potential presence of some peat) will be selectively dredged and temporarily stored on land in a contained area if the CSD program is in fact independent of the THSD program. The segregated material will be tested for potential acid forming materials and treated as per Department of Environment and Conservation guidelines. Run off from this material will drain into a contained sump and be treated in-line with the appropriate guidelines. The treated material will be removed and disposed to the offshore disposal site during channel dredging works in the advent that the CSD program is run independently of the main THSD program.

The reclamation area will be completely bunded and subdivided into a number of cell arrays via internal bunding. Dredged sandy material may be pumped into the reclamation area initially to construct the internal bunds. One cell array will be filled prior to overflowing to the next with the excess water entering the successive settlement areas to maximise settlement and allowing the slurry to settle over a period of time and to control the turbidity of return water via a sluice/ weir box arrangement (JFA Consultants Pty Ltd, 2005).

The land reclamation area will be protected on the seaward face by a continuous rock armoured seawall. The armouring for berth 7 will be granite. The seawall will be formed by progressively end tipping core material onto the seabed from the easterly end of the existing seawall at berth 6 out toward the foreshore west of King Point. The seaward face will be progressively protected by placing two layers of armour extending to the seafloor. Prior to commencement of reclamation, the landward face of the core material will be faced with small rock to fill the voids and a geotextile filter cloth will be laid from the top of the core to the seafloor. This will reduce swell penetration of the seawall and prevent the return of dredged material back into the harbour.

Earthmoving equipment will be used on the reclamation area to create bunds and carry out final levelling of the reclamation area to the required profiles. Sand will be stockpiled above the design level of +4.0 m CD towards the end of the reclamation in order to retain a sufficient settlement area for return water. Following completion of the dredging, the stockpiled material will be used to backfill the remaining settlement area. A final graded fall of approximately 1% will be trimmed back to the central area of the reclaim that will ensure any interim surface water accumulations infiltrate *in situ*. This final trim and grade will ensure that stormwater is ameliorated in the interim until the construction of an adequate stormwater system is implemented by Grange under the Works Approval for their portside infrastructure.

Facilities

Existing services run along Princess Royal Drive and have the capacity to service the proposed Southdown Magnetite infrastructure. Connection to all utility services will be under the responsibility of Grange Resources Ltd. (EPA Assessment Number 1596).

3.5 OFFSHORE DISPOSAL

The preferred offshore disposal site is located in deep water within King George Sound in South Channel (centre co-ordinates: 35º 04’ 55”S, 118º 01’40”E, radius 900 m). An application for a Sea Dumping Permit has been submitted to DEWHA under the *Environment Protection (Sea Dumping) Act 1981*.

Dredged material will be disposed at the site such that the final finished depths will be below -35 m CD. Re-suspension of dredge material at the preferred offshore disposal site has been modelled (Figure 7-11, Figure 7-13, Figure 7-15). Disposal at this depth is considered stable and not capable of being re-suspended through current, or storm action. Deep disposal ensures that the likelihood of sediment re-suspension is minimal and therefore; protects the marine flora and fauna from secondary impacts. The average depth of dredged material after disposal will be between 3.5 m and 6.5 m above the existing seabed and have a total footprint of approximately 250 ha.

To assist in locating the offshore disposal site the dredge will be equipped with a DGPS navigation system.

4 EXISTING ENVIRONMENT

4.1 CURRENT USE

Albany Port Authority is located at 85 Brunswick Road, Albany WA, 6330. The proposed reclamation site is situated between the existing berth 6 and King Point along the northern shore of the entrance to Princess Royal Harbour. The main trade through the Port are all export products including woodchips, wheat, barley and canola.

The Albany Port dredging activities will occur wholly within APA land and waters with the exception of the offshore disposal site that lay partially in Commonwealth waters. The APA has exclusive control of the Albany Port and is responsible for the development, maintenance and preservation of all property vested in the authority.

An alternate land reclamation design has been developed and committed to so as to avoid interaction with the Mt Adelaide A Class Reserve. The area between the low water mark and the high water mark to the east of the Port is Crown Land, with the area above the high water mark part of the Mt Adelaide A Class Reserve number 27068.

The proposed dredge channel will be situated through Princess Royal Harbour and King George Sound. These waters are used by both commercial and non-commercial craft. Commercial craft include cargo vessels, eco-tourism vessels and occasional cruise ships. Recreational divers and fisherman also use the area. In King George Sound there are 12 aquaculture licences located 3-4 km south and west of the proposed shipping channel and one aquaculture licence 3 km west of the proposed offshore disposal site. These sea based sites are used to cultivate mussels on long lines. All aquaculture areas are owned and leased out to licence holders by the Albany Port Authority.

The Port of Albany was established through dredging and reclamation programmes in the vicinity of the Port Jetty. Most of the northern shore of Princess Royal Harbour has been reclaimed to facilitate industrial land for the City of Albany, with much of this area now utilised for industrial and recreational purposes.

4.2 OCEANOGRAPHY AND HYDRODYNAMICS

The dominant influence on the circulation in the waters of King George Sound and Princess Royal Harbour is the local wind. Tides are relatively weak at Albany and vary from diurnal to semi-diurnal throughout the year with a spring tidal range of approximately 1.1 m. Water levels are also influenced by the weather systems, with wind driven setup resulting from sustained winds in King George Sound that at times can be readily transmitted into Princess Royal Harbour.

Modelling conducted by Mills and Brady (1985) of wind driven water circulation in Princess Royal Harbour indicated that west to north-west winds in winter generate predominantly anti-clockwise circulation. During summer, however, winds from the south to south-east sector generate a predominantly anti-clockwise circulation in King George Sound, and winds from the east to north-east sector generate a predominantly clockwise circulation in King George Sound (GEMS, 2007).

The broad high latitude westerly flow over the Southern and Indian Oceans produces a highly energetic wave climate at the south-west corner of the continent. However, the south-easterly to easterly aspect of King George Sound provides a significant level of protection to these waves. During winter, sustained strong westerly winds generate what appears to be a shelf wave along the continental shelf outside King George Sound resulting in current speeds over 1 knot at depths of 40 m (GEMS, 2007).

Dredging will result in the creation of turbid plumes within King George Sound and Princess Royal Harbour for the duration of the dredge programme. Although the plumes will be spatially and temporally intermittent, they will increase the light attenuating capacity of the water column and impact the visual amenity of the Albany waters.

Sample plots showing predicted suspended sediment plumes during the dredging programme (Figure 4.1 to Figure 4.3) depict variations that are likely to occur as a result of changes to dredge location, tidal phase and wind strength and direction during the proposed works. In the following figures:

- The plots show dredging induced turbidity in isolation and the colour codes were chosen to distinguish the different range in turbidity concentrations. This is not an indication of water coloration.
- The turbidity levels were derived at each model grid point by scanning the water column from surface to bottom for the grid cell with the highest turbidity rather than averaging over the water column. The results show the highest turbidity levels found across the grid (i.e. the worst case scenario) and are therefore, conservative.

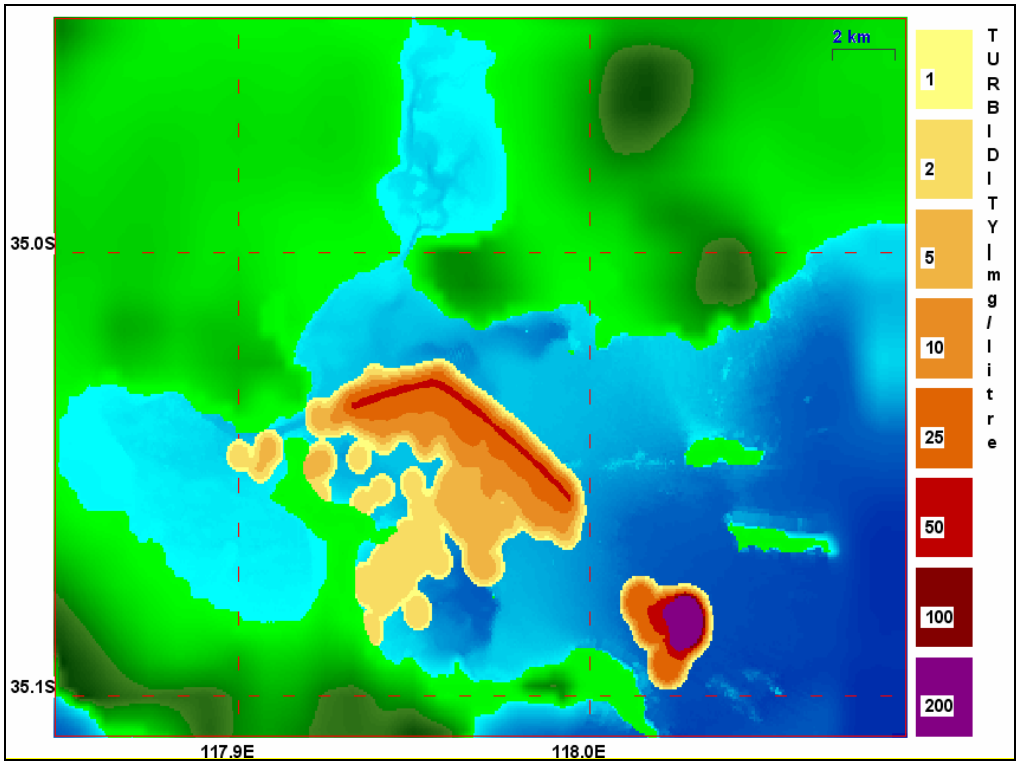


Figure 4.1 – Sample Plot of Total Suspended Particles during Dredging Showing the Effects of Anti-clockwise Circulation in King George Sound during South-Easterly Winds (March to June).

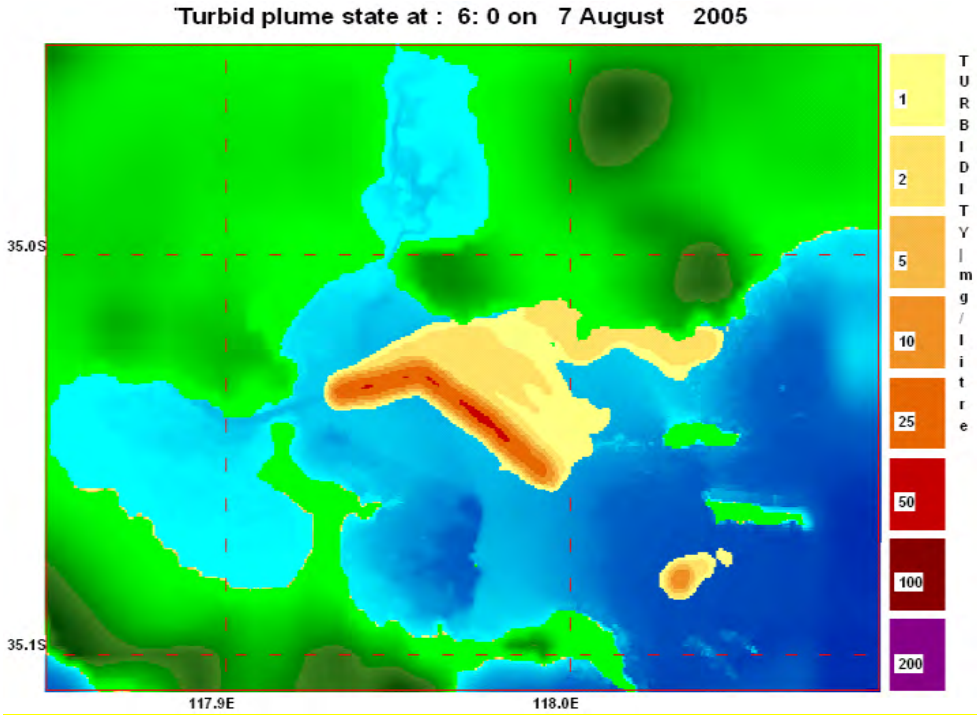


Figure 4.2 – Sample Plot of Total Suspended Solids during Dredging Showing the Effects of Circulation in King George Sound during Westerly Winds (July to October

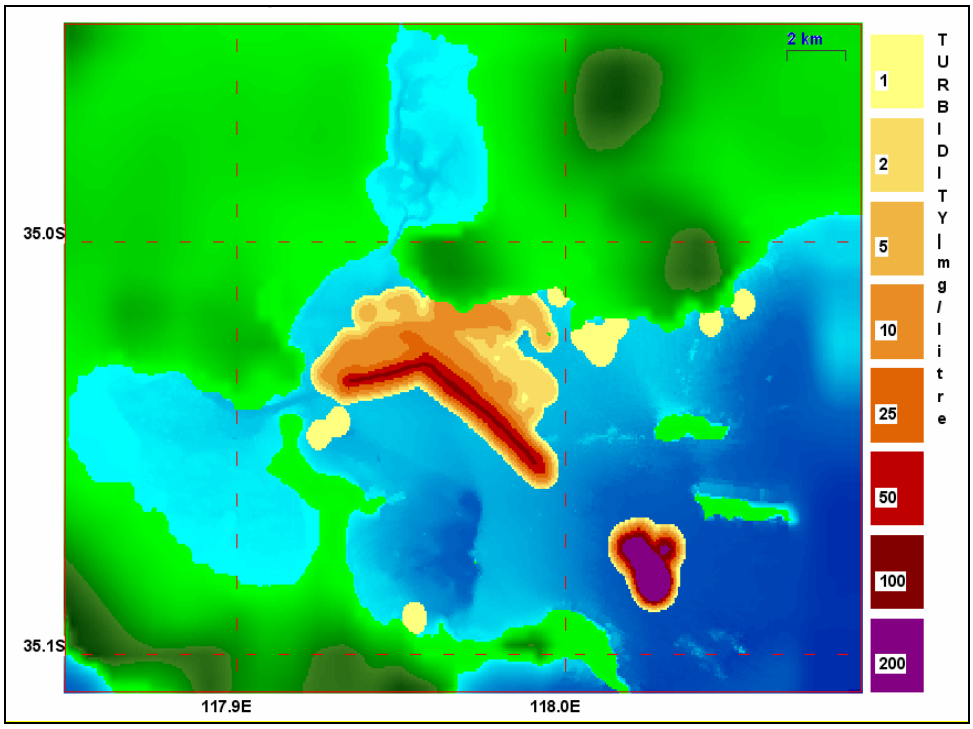


Figure 4.3 – Sample Plot of Total Suspended Particles during Dredging Showing the Effects of Clockwise Circulation in King George Sound during North-Easterly Winds (November to February).

Sedimentation associated with the dredging will be restricted to the dredge channel and the offshore disposal area. Simulations of sediment accumulation at the preferred disposal area over time indicate that sediments placed at this site will be largely non-dispersive and will not re-enter King George Sound; minimising the potential risks to benthic habitats, recreational areas, aquaculture and fisheries.

4.3 SEDIMENT AND WATER QUALITY

The sediment in the area to be dredged has the following characteristics:

- depth of unconsolidated dredge material (8-10 m); and
- particle size composition (medium to fine silica sand and some fine silt).

Sediment sampling by SKM (2007) has demonstrated that the majority of sediments in King George Sound are not contaminated with tributyltin or organics (organochlorine pesticides, polycyclic aromatic hydrocarbons and polychlorinated biphenyls).

Mercury and Silver

Mercury and silver in some localised sites were found to be above the NODGDM Screening Level in surface and sub-surface sediments of Dredge Area 3 (Figure 4.5 and Figure 4.6), with mercury concentrations found to be 0.4 mg/kg in surface sediments (0-0.5 m) and 0.3 mg/kg in sub-surface sediments (0.5-1.0 m), compared to a Screening Level of 0.15 mg/kg. Mercury present in Dredge Area 3 was confined to the surface sediment (0-1 m). Silver concentrations were found to be marginally above the Screening Level of 1.0 mg/kg, with concentrations of 1.2 mg/kg in both surface and sub-surface sediments.

The bioavailability of these metals was subsequently determined by measuring pore water concentrations. Mercury levels exceeded the ANZECC/ARMCANZ 99% level of habitat protection but not the 95% level of habitat protection. This means that the bioavailability of the mercury in the sediment is such that the 95% of species in the zone of impact are expected to be protected. The level of habitat prescribed for Inner Harbour areas is 90% while that for Outer Harbour areas is generally higher at 95%. Silver bioavailability, expressed as the concentration of the metal in pore water, was found to be below the level of detection and below the ANZECC/ARMCANZ 99% level of habitat protection. The levels of silver and mercury detected in the sediments are within the relevant criteria for habitat protection. The levels detected pose no environmental risk according to the NODGDM, 2002 administered by DEWHA and as such, are suitable for unconfined offshore disposal.

Nutrients

A seam of geotechnically unsuitable material was interpreted in the entrance to Princess Royal Harbour during geotechnical work undertaken by JFA. The quantity of unsuitable material that requires dredging has been calculated to be 87, 000m^3. This material may be potentially acid forming if placed on land and allowed to oxidise unmanaged.

Sampling for nutrients in the sediments in the entrance to Princess Royal Harbour indicated that total nitrogen and total phosphorus levels were marginally above detection levels. Analysis of ammonium in elutriates prepared from nutrient rich sediment collected from the entrance to Princess Royal Harbour indicated that neat elutriate does not exceed the 99% level of habitat protection and therefore is not toxic to marine biota.

The levels of nitrogen and phosphorus in the neat elutriate, however, exceeded the ANZECC/ARMCANZ guideline default trigger values for chemical stressors for south-west Australia inshore marine waters, with a 40 fold dilution required to reduce the nutrient levels (primarily ammonium) within guideline levels. A two fold dilution is anticipated for the actual dredge discharge concentrations into the reclamation area, with modelling (Figure 4.4, GEMS, 2007) indicating that a 20 fold dilution is likely to occur within 60 m of the seawall by the tidal and wind driven mixing in the area. No chronic effects from nutrients liberated during the reclamation programme are anticipated due to the short duration of the CSD dredging and reclamation activity (4 weeks of CSD dredging, 3-4 week pause for reclamation

/ piling founding & 4-5 weeks CSD to establish the minimum workable area required for staging of construction).

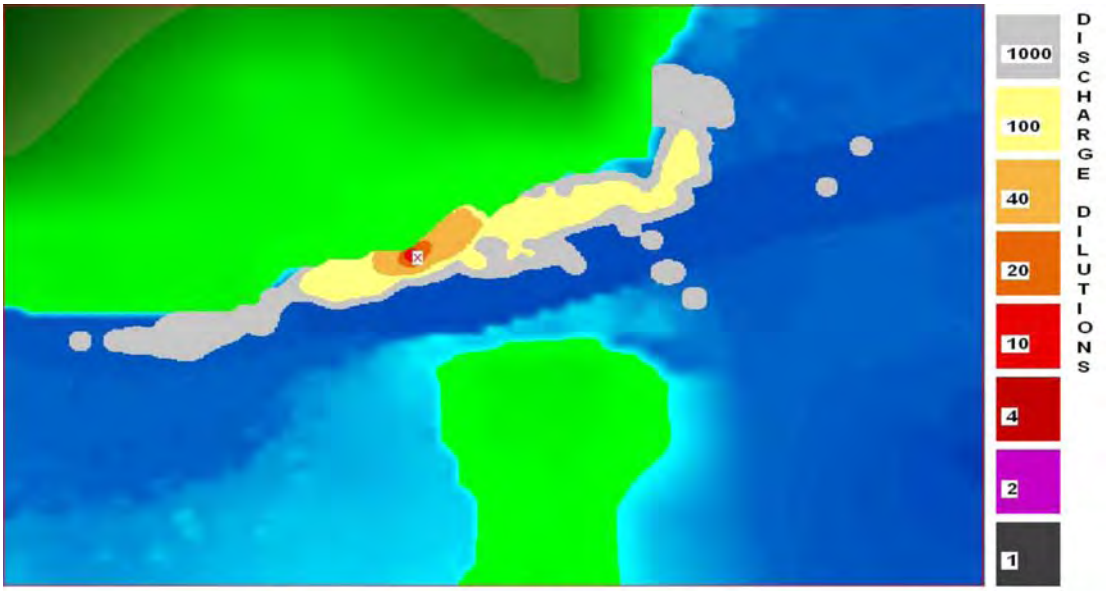
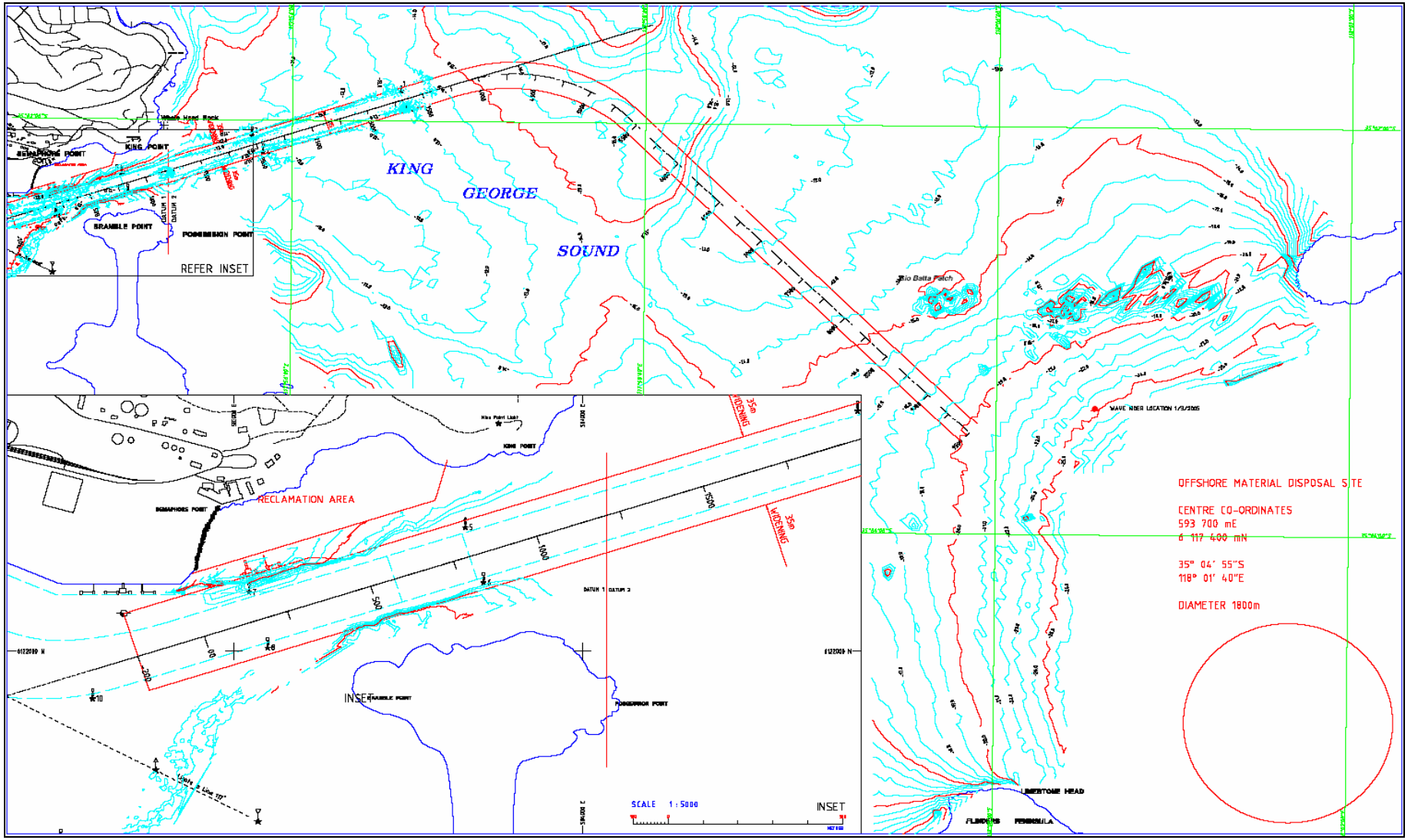
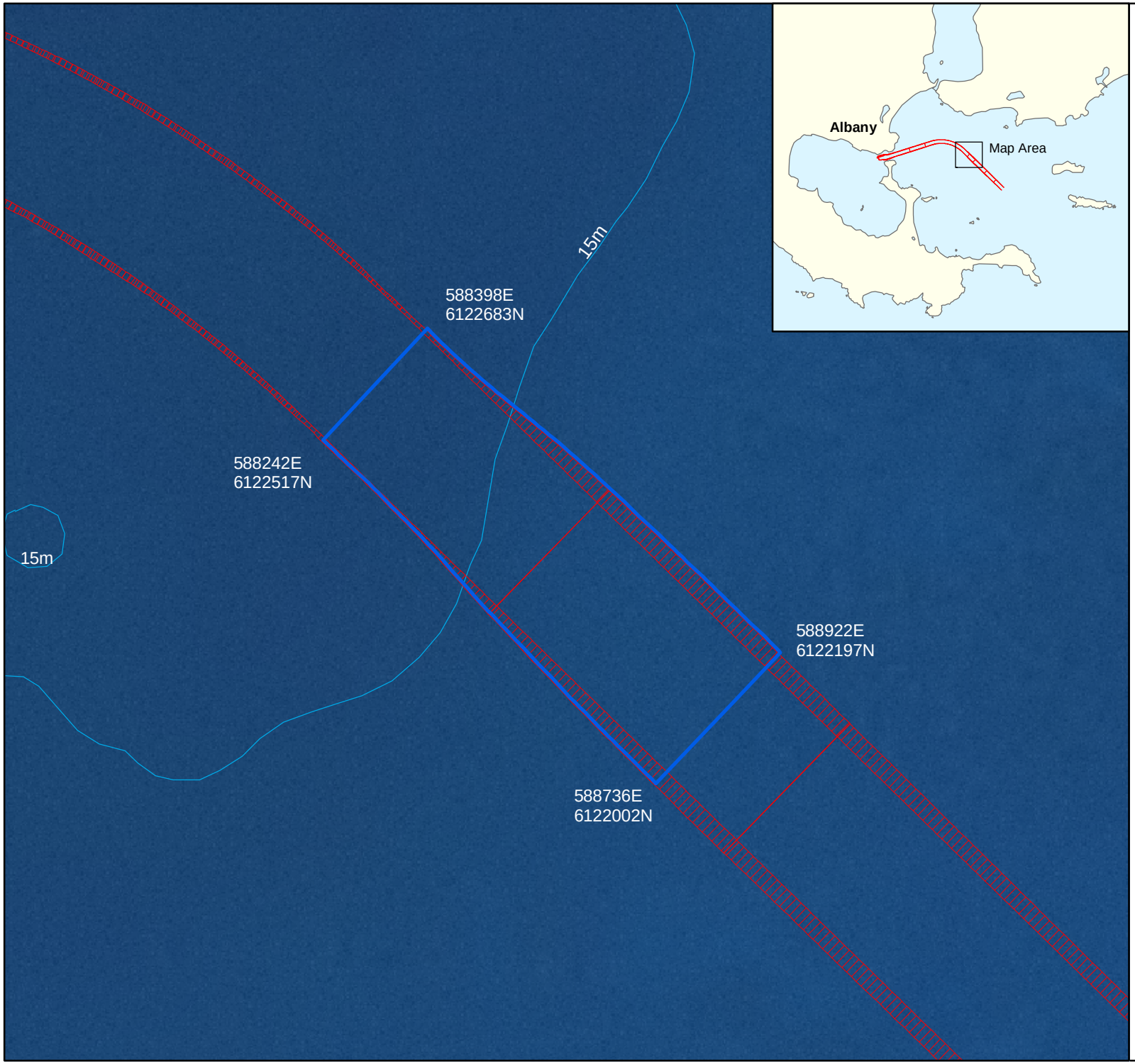


Figure 4.4 – Dilution Rates of Particles Released Through the Seawall

The Project is likely to disturb existing deposits of geotechnically unsuitable material that may contain some nutrients, but will not introduce any additional nutrients which may pose a risk to microbial water quality. Inputs from stormwater or river discharge into the Harbour during rainfall events may result in elevated microbial levels. However, these inputs are not project specific and it is anticipated that these influxes will be diluted through natural flushing in King George Sound.

Figure 4.5 – Location of Dredge Areas, 1, 2 and 3





N

Area of Contamination Requiring Removal FIG 4.6

SamplingLocations

Channel and Disposal

0 50 100 200 300 400 Metres

Scale - 1:8,000

SINCLAIR KNIGHT MERZ SKM

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4.4 TERRESTRIAL VEGETATION AND FLORA

The land reclamation area has been designed to have no interaction with the A Class Reserve and therefore; no clearing will be required.

4.5 BENTHIC PRIMARY PRODUCER HABITAT

Management Unit 1: Seagrass in the land reclamation area is dominated by *Posidonia australis* with a little *P. sinuosa,* whereas the seagrass on the south side of the channel is a dense meadow of mixed seagrass dominated by *P. sinuosa* and *P. australis*. Dredging and land reclamation activities will permanently remove 0.36 ha (0.01% of Management Unit 1) of this BPPH. Additional BPP may be lost permanently or temporarily through elevated TSS associated with dredging, as detailed in Section 7.2.1.

A small sub-tidal granite rock pile (approximately 10 m in diameter) lies in the north east corner of the proposed land reclamation area and would be buried during reclamation. The water depth is approximately 3–4 m and the rock reaches to just below the surface at low tide. Presently the rock has a macroalgal community dominated by *Ecklonia radiata* with an under-story of red algae and *Ulva* sp. The invertebrate community associated with the rock is sparse and is likely a reflection of periodic sand inundation by resuspended sediment during storm events. On a regional scale, the rock is on the lower end of the ecological significance when compared to the adjacent rocky shoreline as well as the wider King George Sound and offshore Islands. The protection afforded in the small embayment along with the sandy seabed leads to conditions less conducive to macroalgal and invertebrate communities flourishing.

Management Unit 2: The proposed channel is predominantly comprised of fine sand with no sessile benthic flora or fauna. The exceptions to this are as follows:

- sea pens (Sarcoptilus grandis) that occur on the seabed along the northern batter of Ataturk entrance between King Point and Vancouver Peninsula; and
- sparse clumps of Posidonia coriacea were found at varying densities in dredge areas 2 and 3.

A map of BPPH in Princess Royal Harbour and King George Sound is provided in Figure 4.7. Dredging of the channel within King George Sound will permanently remove 11.79 ha (1.44% of Management Unit 2) of this BPPH. Additional BPP may be lost permanently or temporarily through elevated TSS associated with dredging, as detailed in Section 7.2.1.

The hard coral colonies of Gio Batta Patch and Michaelmas Reef are situated within King George sound and adjacent to the large offshore Islands (Michaelmas Island and Breaksea Island). The area is fished recreationally as well as frequented by SCUBA divers; however, the site is prone to swell and is often turbid.

These reefs were not included in habitat mapping or BPPH calculations as their density in any given location was less than 1% cover. These reefs are not anticipated to be impacted by the dredging or the associated turbidity.

Management Unit 3: Video recording at the preferred disposal area indicates that the seabed is flat with fine sand and very sparsely distributed epifauna. The epifauna observed in the area included; sponges (unidentified species), sea pens (*Sarcoptilus grandis*), colonial ascidian (*Sycozoa* sp.), southern blue-spotted flathead (*Platycephalus speculator*) and sand dollar (unidentified species) (SKM, 2007).

The most numerous epifauna were the small oval sponges that were attached to dead shells or rocky material by stalks. All of the epifauna observed are widely distributed in the region and none are rare or endangered (SKM, 2007).

Management Units

Three management units for Benthic Primary Producer Habitat (BPPH) have been identified in consultation with the EPA and potential impact on BPPH has been estimated (Figure 4.7). The three management units are:

- Management unit 1 - 28.9 km² or 2,889.2 ha (Princess Royal Harbour, contains a small section of the channel and the land reclamation area).
- Management unit 2 - 65.4 km² or 6,540.9 ha (Inner King George Sound, contains the proposed dredged areas and habitat that could potentially be affected by dredging).
- Management unit 3 - 54.8 km² or 5,478.8 ha (Outer King George Sound, contains offshore islands and shoreline areas potentially affected by offshore disposal of dredged material.

The current and historical total areas of BPPH in each Management Unit are presented in Table 4.1. These figures are based on studies of BPPH habitat mapping and ground truthing (SKM, 2007).

Table 4.1 – Benthic Primary Producer Habitat Area

Management Unit	Bare Sand (ha)		Seagrass (ha)		Macroalgae (ha)		Total (Historical)
	Historical	Present	Historical	Present	Historical	Present	
1. Princess Royal Harbour	0.0	1,453.9	2889.0	1,385.0	0.2	0.2	2889.2
2. Inner King George Sound	5,702.4	5,702.4	817.5	817.5	21.0	21.0	6,540.9
3. Outer King George Sound	5,243.5	5,243.5	3.0	3.0	232.3	232.3	5,478.8

Corals are not included in the table as the two reefs Gio Batta Patch and Michaelmas Reef comprise less than 1% of BPPH.

The categories for marine ecosystem protection and the EPASU recommended cumulative loss threshold of BPPH within the three management Units are as follows:

- Management Unit 1: Category F; 0% net damage/loss (+ Offsets).
- Management Unit 2: Category D; 5%.
- Management Unit 3: Category C; 2%.

Potential impacts to seagrasses from dredging and the associated turbidity is presented in Section 7.2.

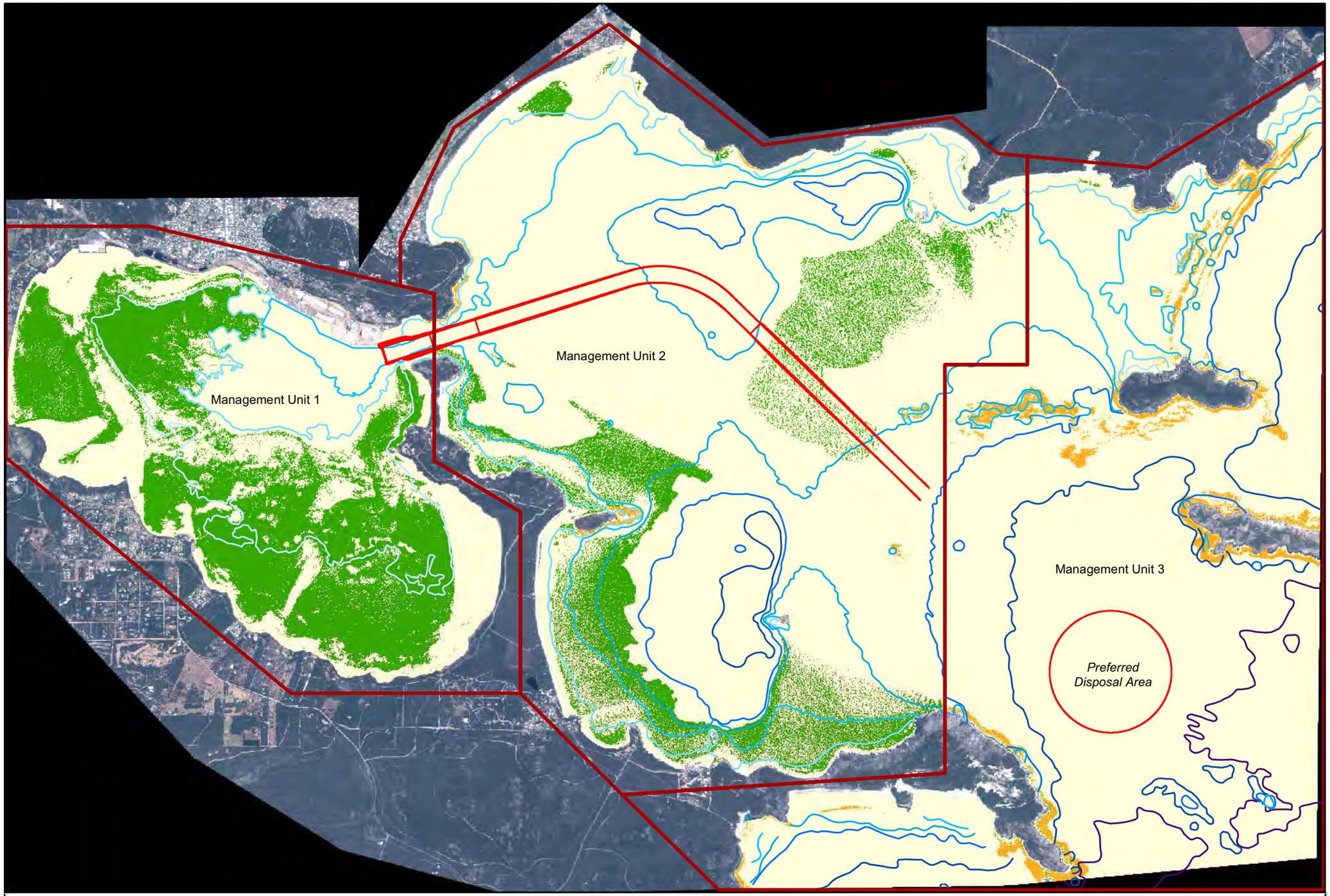


Figure 4.7
Benthic Primary Producer Habitat Map of Princess Royal Harbour and King George Sound

4.6 MARINE FAUNA

A search of the WA Museum *Faunabase* identified 203 species of fish occurring in the marine environment of Princess Royal Harbour, Oyster Harbour and King George Sound. The purse-seine fishery for pilchards, however, comprises approximately 97% of the total fish catch in the Albany area. Mussels (*Mytilus edulis*) are also farmed in the Albany harbours by collecting wild spat that is then attached to long lines to grow-out to market size (Department to Fisheries, 2005). There are 12 APA leases and Department of Fisheries (DoF) licences issued to aquaculturists in King George Sound. There is a very limited specimen shell collection fishery (one known active licence holder) that operates around the south coast and on occasions within Management Unit 3.

The coastal areas from Albany to the Great Australian Bight are migratory paths and breeding areas for cetaceans, including the Southern right whale (*Eubalaena australis)* and the Humpback whale (*Megaptera novaeangliae*) both of which are protected under the *EBPC Act (1999*). The bottle nose dolphin (*Tursiops truncates)* and the common dolphin (*Delphinus delphis)* also frequent Albany waters, and seals and sea-lions are found along the southern coast and on the islands off the coast of Albany.

A CSIRO survey for introduced species in the Port and adjacent coast was undertaken in February 1996. Three species listed under the ABWMAC schedule of introduced species were recorded as present in both the Princess Royal Harbour and Oyster Harbour. The species identified in the survey were the Mediterranean fanworm (*Sabella spallanzanii*) a species of toxic dinoflagellate (*Gymnodinium catenatum)* and the Pacific oyster (*Crassostrea gigas)*. Other introduced species recorded in the survey included the ascidian tunicate (*Ascidiella aspersa*) and three species of bryozoan (*Cryptosula pallasiana) (Bugula flabellate*) and (*Bugula neritina)* (CRIMP, 1997).

4.7 NOISE

Land uses adjoining APA land consist of industrial, residential and bush reserve. Approximate distances from residential lots to the berths at the port are outlined in Table 4.2.

Table 4.2 – Approximate Distance between Port use and Residential Lots on Brunswick Rd

Industry	**Existing distance between port use and residential lots on Brunswick Road (approximately)**
Bulk material loading or unloading	~ 630 m from berth 3
Fuel importation	~ 680 m from berth 2
Fuel storage	~ 485 m
Grain cleaning (no milling)	~ 740 m
Incineration	~ 540 m

The potential noise impacts of dredging and construction of the berth 7 at the Albany Port, 3 km to the south-east of the city centre, has been assessed (Vipac 2006).

Noise Modelling

Noise assessment results for construction noise received at nearest residential (R1) and commercial (R2) noise sensitive sites are presented in Table 4.3, with the location of R1 and R2 presented in Figure 4.8

It is anticipated that unless additional management controls are implemented, the EPA noise regulation criteria will be exceeded during all stages of construction at the nearest commercial premises, and during pile driving only at the nearest residential premises.

Pile driving activity is anticipated to be the main cause of noise emissions with respect to the EPA noise regulation criteria. The impulsive nature of this activity will increase emissions above those presented in Table 4.3 below. However, the duration of these activities is limited to several weeks during construction only.

The second most dominant noise source will be the dozer used during reclamation. If piling and dozer noise are omitted, most noise exceedances will be eliminated.

Noise from truck movements during construction will not lead to increased impacts on identified sensitive receptors.

Table 4.3 – Summary of Predicted Noise Emissions

	R1 (Residential)		R2 (Commercial)	
	SPL	Exceedance	SPL	Exceedance
Pile Driving only	60.0	3.0	77.8	17.8
Stage 1	50.6	-6.4	67.6	7.6
Stage 2	52.9	-4.1	69.7	9.7
Stage 3	50.3	-6.7	68.0	8.0

R1 is nearest residential site with influencing circle
R2 is nearest industrial site

Figure 4.8 – Location of Nearest Noise Sensitive Sites.

Noise and Cetaceans

There are two potential sources of noise from the project that may impact cetaceans; these are noise emissions as a result of pile driving (post dredging) and emissions from dredging.

The impact of noise disturbance from either source on whales in the short and long term is unknown (DEH, 2001). The "Guidelines on minimising acoustic disturbance to marine fauna' (DOIR, 1997) state that:

"Toothed whales (e.g. dolphins and pilot whales) are considered to hear sound at a wide range of frequencies, from as low as 75 – 125 Hz up to 105 – 150 KHz. However, their best sensitivity under experimental conditions, has been observed at frequencies between 10 and 100 KHz. There is little overlap between the frequency at which these smaller toothed whales hear and the predominant sound frequencies produced by seismic shots (10 – 300 Hz). The largest toothed whale, the Sperm whale, is considered to have low frequency hearing more like the baleen whales. Unlike toothed whales, baleen whales (e.g. Humpback whales, Right whales), are believed to have sensitive hearing at low frequencies, inferred from their anatomical characteristics. Baleen whales produce underwater sounds at frequencies ranging from 12 Hz up to 8 KHz, although predominantly below 1 KHz. There is considerable overlap between the frequencies of sounds produced by baleen whales and frequencies produced by seismic shots, and the potential for disturbance of baleen whales from seismic survey activities is considered higher than the potential for disturbance of toothed whales. Behavioural responses including changes in respiration rates and avoidance of the seismic vessel have been observed. Sudden turning on of the seismic source can elicit a startle response, even with the whale up to 3 km from the source. However, the startle response is not observed with continual firing of the source."

Noise generated from dredging activity is typically around 167 dB in intensity and at a frequency heard by whales which, due to the attenuation properties of seawater drops to 150 dB within 5 m from the vessel (Peter Morrison, *pers. comm*.). The guideline for minimising acoustic disturbance for seismic activity (DOIR, 1997) is 150 dB at a distance no greater than 3 km. Thus, dredging noise is unlikely to adversely affect the larger whales commonly sighted in Albany waters (for example Southern right whales and Humpbacks).

Noise emitted from pile driving will be intermittent, and is likely to be of a higher frequency. Pile driving could potentially impact species that are sensitive to higher frequencies (P. Morrison, *pers. comm.*)

4.8 DUST

Negligible impacts from dust are expected as no clearing will take place and material deposited at the land reclamation area will be wet and maintained in a damp state.

4.9 HERITAGE

King Point Lighthouse is listed as a Registered Place and the King George Sound/ Princess Royal Harbour Marine Area is an Indicative Place (Register of the National Estate Database). There are no sites within the proposal footprint listed on Register of Heritage Places or the City of Albany Municipal Inventory List, and no registered Aboriginal sites recorded within the footprint of the proposal. The proposed works will not impact known shipwrecks in the Albany area.

Unexploded live or inert munitions potentially lie on the floor of King George Sound, and may be further investigated in consultation with appropriately qualified consultants who are likely to enlist the use of a magnetometer to aid amelioration and removal.

5 RISK MANAGEMENT

The management of impacts associated with project activities are based on a risk management framework aligned to Australian Standard 4360:2004 Risk Management. This involves:

- Identification of project activities that may interact with the project environment.
- Implementing controls to reduce risk of impacts.
- Monitoring the effectiveness of controls.

A risk assessment of activities and potential impacts of the APA Port Expansion Proposal was conducted within the risk management framework (Appendix 1), to create a Risk Register (Table 5.1).

The key project activities of the proposal were identified. The pathways (or events) that may cause impacts to the environment were determined, and their associated potential impacts listed.

The risk of the impacts occurring was analysed by determining the consequence severity of the impacts and the likelihood of consequences being realised. The severity of the consequences was determined using a Consequence Severity Table (Table 13-1). The likelihood of an impact resulting from a pathway was determined with a Likelihood Ranking Table (Table 13-2). The level of risk was determined using a Risk Matrix (Table 13-3), which determines the level of risk by the point at which the consequence severity and likelihood / probability rankings intercept in the Risk Matrix.

To prevent or minimise the impacts, controls are placed on the pathways in this order of priority:

- Elimination of the activity.
- Substitution with a lower risk activity.
- Engineering solutions to reduce the impact of the event.
- Implementation of administrative procedures to control the activity.
- Clean up or remediation measures to mitigate impacts after an event.

The management strategies that will be implemented to control dredging and land reclamation activities are described in Section 7.

Performance indicators are selected parameters that provide indications of the effectiveness of the management strategies. These indicators have been translated to performance targets and are stated alongside the management strategies.

Monitoring programmes (Section 8) have been designed to track selected parameters and to determine if performance targets are, or will be, met for activities.

In addition, the APA Environmental Management System (APA EMS) which is aligned with ISO 14001 will enable the project to systematically comply with legal and other requirements, identify and control environmental risks, provide adequate and competent resources for environmental management, monitor performance and correct non-conforming situations.

Table 5.1 – Albany Port Expansion Proposal (EPA Assessment No. 1594), Risk Assessment Register

Activity	Pathway for impact	Potential impact on the environment	Aspect	Consequence Severity	Likelihood	Risk
Vessel mobilisation	Inadequate hygiene/quarantine practices	• Introduction of marine species may cause a reduction in biodiversity. • Threats to aquaculture and recreational fishing.	Quarantine Practices	3	E	M
Vessel movements	Increased vessel traffic	• Collision with cetaceans. • Harbour/port congestion may restrict commercial/recreational access to harbour.	Marine Fauna Harbour Access	2	D	L
	Vessel collision	• Uncontained hydrocarbon spill leading to widespread contamination of marine waters resulting in impacts on commercial industries (fisheries/aquaculture) and a decrease in the health of BPPH.	Harbour Access Ecosystem Health	5	E	S
	Refuelling and hydrocarbon handling	• Minor spills without detectable impact to the environment	Ecosystem Health	1	B	M
	Dredging Noise	• Nuisance/disturbance to residents and local business.	Noise	2	D	M
	Vessel	• Potential noise from the dredge and allied vessels will be no greater than the levels already experienced in King George Sound and Princess Royal Harbour with a range of marine – based commercial activities e.g. commercial fishing and tour operators.	Noise	2	D	M
	Pilling	• Potential noise impacts to cetaceans from piling will be minimised by the use of soft starts that give any cetaceans subject to such noise a chance to clear the area prior to full operation and therefore; avoidance of full construction noise exposure that may cause the marine fauna any displeasure. Soft starts will not commence whilst a cetacean is within 300m of the piling area.	Noise	2	D	M

Activity	Pathway for impact	Potential impact on the environment	Aspect	Consequence Severity	Likelihood	Risk
Dredging (includes actual dredging and movements of dredge vessels)	Increased turbidity (increased light attenuation)	• Reduction of seagrass health in King George Sound beyond a level that is recoverable, leading to permanent loss of seagrasses predicted to be 'temporarily lost'.	Ecosystem Health BPPH	4	D	S
		• Decrease in phytoplankton productivity resulting in reduction in food availability to marine fauna for the duration of the dredge programme.	Ecosystem Health Fishing and Aquaculture	3	C	S
		• Seasonal reduction in productivity of aquaculture (mussels/pilchards).	Fishing and Aquaculture	3	D	M
		• Intermittent reduction in visibility for recreational divers for the duration of the dredge programme.	Recreation and Aesthetics	1	C	L
	Increased turbidity (Sediment fallout)	• Loss of aquaculture crops affecting individual lease holders during the dredge programme.	Fishing and Aquaculture	3	D	M
		• Smothering of recreational dive sites.	Recreation and Aesthetics	1	E	L
	Mobilisation of heavy metals	• Sediment bound heavy metals may interact with marine fauna potentially resulting in bioaccumulation in food source.	Ecosystem Health	1	D	L
	Mobilisation of nutrients	• Remobilisation of sediment with high nutrient content may trigger abnormal epiphyte (algal) growth affecting seagrass health.	BPPH	3	D	M
	Dredging Noise	• Disruption to cetaceans.	Noise	1	D	L
	Disturbance of Heritage Sites	• Sedimentation of shipwrecks in the vicinity of the proposed Port expansion works. • Disturbance of currently un-identified sensitive material within the channel by the dredge.	Cultural and Spiritual Values	3	C	S

Activity	Pathway for impact	Potential impact on the environment	Aspect	Consequence Severity	Likelihood	Risk
Offshore disposal of dredge material (begins when dredge releases bottom doors)	Relocation of sediment containing heavy metals/ nutrients.	• Mobilisation of nutrient enriched sediment affecting ecosystem health.	Ecosystem Health	2	D	L
	Increased turbidity (increased light attenuation)	• Loss of pre-existing species contributing to ecosystem health within management unit 3.	Ecosystem Health	1	E	L
Land reclamation	Construction Noise	• Reduction in public amenity during construction works.	Noise	1	C	L
		• Noise levels, as a result of piling and construction activities, at the nearest commercial noise sensitive premises (R2)	Noise	2	A	S
	Temporary storage of potentially acid forming materials.	• Release of acid materials affecting marine ecosystem health.	Ecosystem Health	2	D	L

6 OBJECTIVES

The EPA objectives relevant to aspects of the Albany Port Expansion Proposal are outlined in Table 6.1. The risk assessment (Section 5) identified key project activities that may impact on environmental values. These environmental values have been aligned with EPA Objectives for the protection of these values listed in 'Guide to EIA Environmental Principles, Factors and Objectives' (EPA, 2004).

Table 6.1 – Project Aspects and EPA Objectives

Project Aspects	Related EPA Factor	EPA Environmental Objectives
Water Quality-Turbidity (Increased light attenuation and sediment deposition)	Marine Water Quality	To ensure that emissions (to water) do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.
Water Quality-Chemistry (Mobilisation of heavy metals/nutrients / acid forming material)	Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.
	Marine Water Quality	To ensure that emissions (to water) do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.
Hydrocarbons	Marine Water Quality	To ensure that emissions (to water) do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.
Benthic Primary Producer Habitat (BPPH)	Land (marine)	To maintain the integrity, ecological functions and environmental values of the seabed and coast.
	Flora	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.
Cetaceans	Risk	To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.
	Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.
Quarantine	Marine Water Quality	To ensure that emissions (to water) do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.
Noise	Noise	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.
Harbour Access	Recreation	To ensure that existing and planned recreational uses are not compromised.

In addition to the above, the potential impacts of the proposal on the marine sediment and water quality in the Albany Harbours have been considered in the context of the environmental quality management framework (EPA (2000), Government of WA (2004), Government of WA (2005), DoE (2006)) which is based on the National Water Quality Management Strategy and (NWQMS) (ANZECC and ARMCANZ, 2000) and supported by the principles of the National Strategy for Ecologically Sustainable Development (ESD Steering Committee, 1992). The framework for applying the guidelines to the protection of aquatic ecosystems is outlined in Figure 6.1.

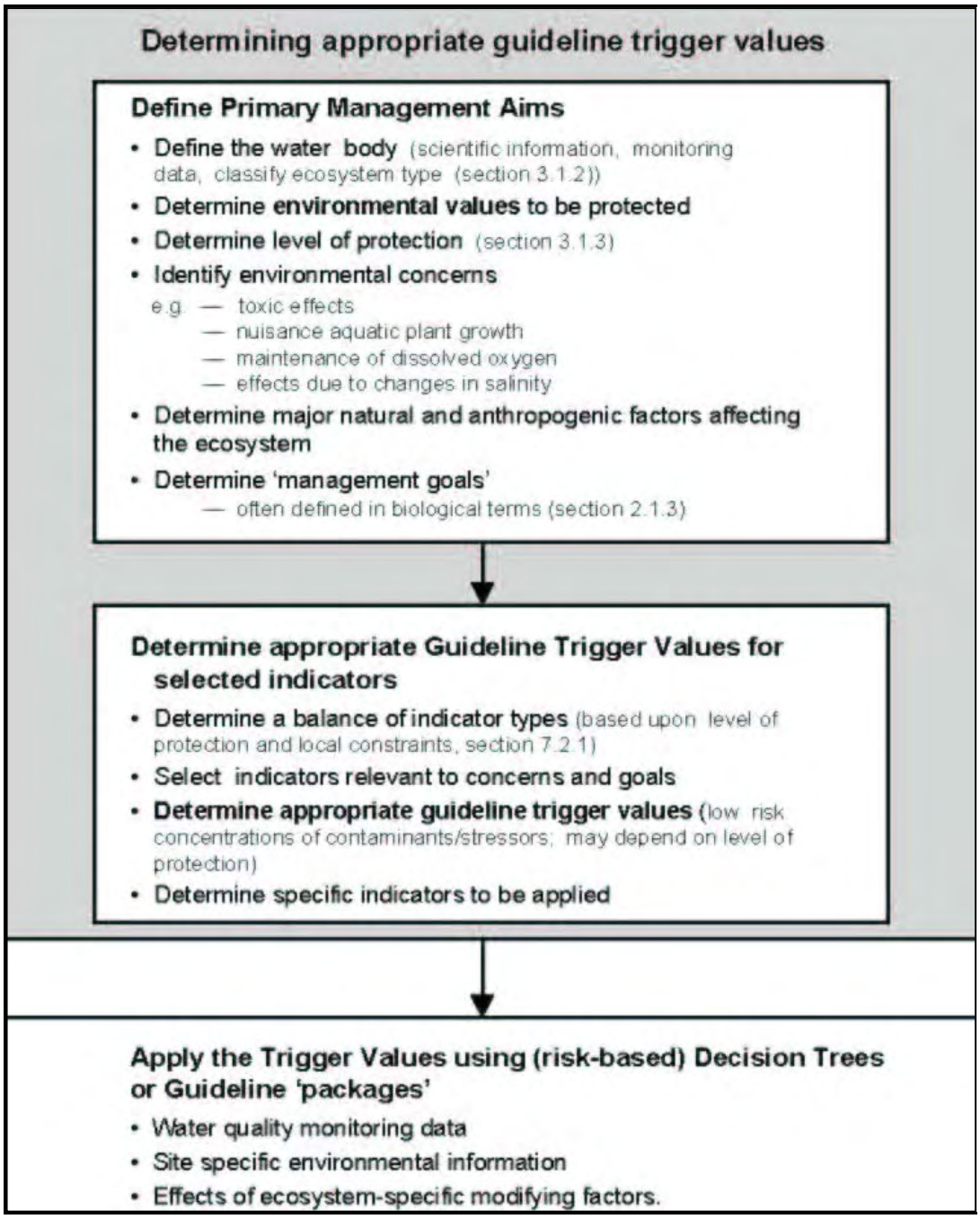


Figure 6.1 – Flow Chart of the Steps Involved in Applying the Guidelines for Protection of Aquatic Ecosystems

The objective of the environmental quality management framework is to protect the biodiversity, integrity and social uses, (both current and future) of marine ecosystems from the potential impacts of dredging, land reclamation and increased shipping in King George Sound and Princess Royal Harbour. The environmental quality management framework is a tiered approach with environmental values, environmental quality objectives and environmental quality criteria.

An environmental value is a 'particular value or use of the environment that is important for *a healthy ecosystem or for public use, welfare, safety or health which required protection from the effects of pollution, waste discharges and deposits'* (ANZECC and ARMCANZ, 2000).

The environmental values and their associated environmental quality objectives relevant to WA coastal waters and the Albany Port Expansion Proposal are outlined in Table 6.2

Table 6.2 – Environmental Values and Environmental Quality Objectives (DoE, 2006).

Environmental Values	**Environmental Quality Objectives**
Ecosystem Health	Maintain ecosystem integrity This means maintaining the structure (e.g. the variety and quantity of life forms) and functions (e.g. the food chains and nutrient cycles) of marine ecosystems).
Fishing and Aquaculture	Maintenance of aquatic life for human consumption. Maintenance of aquaculture.
Recreation and Aesthetics	Water quality is safe for primary contact recreational activities in the water (e.g. swimming) Water quality is safe for secondary contact recreational activities in the water (e.g. boating). Aesthetic values of the marine environment are protected.
Cultural and Spiritual	Cultural and spiritual values of the marine environment are protected.
Industrial Water Supply	Water quality is suitable for industrial purposes.

Environmental quality objectives represent specific goals that need to be achieved to protect the environmental values. Each environmental quality objective is supported by a set of quantitative environmental quality criteria, established to provide the environmental quality benchmarks against which environmental quality and environmental performance can be measured. The process for applying the guidelines to the protection of environmental values and determining appropriate trigger values is outlined in Figure 6.1.

7 MANAGEMENT PLAN

7.1 SEDIMENT AND WATER QUALITY

7.1.1 EPA Objectives

- To ensure that emissions (to water) do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.
- To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

The EPA objectives for sediment and water quality will be achieved through the implementation of the Environmental Quality Management Framework. The five environmental values relevant to dredging and land reclamation, addressed in the following Sections are:

- ecosystem health;
- fishing and aquaculture;
- recreation and aesthetics;
- cultural and spiritual values; and
- industrial water supply.

7.1.2 Ecosystem Health

7.1.2.1 Potential Impacts

Potential impacts from dredging and land reclamation are:

- Increased turbidity and sedimentation from dredging, land reclamation and disposal of excess dredge material affecting ecosystem health.
- Release and mobilisation of sediment bound contaminants and nutrients and their subsequent mobilisation in to the surrounding ecosystem from disturbance of polluted material.
- Increased vessel passage and new contamination from spills or accidental discharges such as spills of diesel, oil and grease.

7.1.2.2 Environmental Quality Objectives

- Maintain ecosystem integrity.
- Maintain the structure (e.g. the variety and quantity of life forms) and functions (e.g. the food chains and nutrient cycles) of marine ecosystems.

7.1.2.3 Implementation

Management Actions to Minimise Turbidity

Dredging will be conducted so as to minimise turbidity, however, if the turbid plumes significantly exceed the modelled impacts spatially or temporally, additional management strategies will be implemented as appropriate. Water quality monitoring is outlined in Section 8.1.

- The hydrodynamic and sedimentation characteristics of Princess Royal Harbour and King George Sound have been modelled on parameters identified in consultation with DEC.

Management of Dredge equipment- TSHD:

- Dredging operations will be sequenced to maximise under-keel clearance (reducing propeller wash) by dredging from shallower to deeper waters where possible.
- The suction heads at the end of the pipes will be kept above the seabed until the scheduled dredging area has been reached to prevent unnecessary sea bed disturbance.
- Dredges will be equipped with density monitors and on screen displays that enable the operator to precisely separate dredge material from seawater and divert dredge material into the hopper. A valve will allow excess seawater to be expelled with minimal sediment content, reducing the expulsion of dredged sediments back into the ocean.
- Overflow from the TSHD will occur via a submerged outlet located in the ships' hull below the waterline (approx 5–9 m below) reducing settlement time (by reducing the distance sediment travels from the dredge to the seabed).
- The TSHD will operate at a speed of 1 to 3 knots (depending on the dredge location, surrounding marine activities, sea conditions and material being dredged).
- A drag head will loosen the bottom material prior to suction and water jets may be employed to assist in loosening the sand. This will optimise the throughput and decrease the duration of the dredging programme.
- Density monitors inside the hopper will ensure maximum fill of the hopper and the dredge will be loaded to its maximum capacity before sailing full to the offshore disposal site to minimise the number of trips the dredge makes along the channel.
- When the hopper is fully loaded, the suction pipe(s) will be raised and the pumping system shut down. The suction pipe(s) will then be secured on deck during sail. This will prevent seabed disturbance during sailing cycles.
- During sailing the hopper will remain closed (with the watertight bottom doors) to prevent any seepage of dredged material from the vessel and potential loss of sediment during sailing cycles.

Where necessary, additional management options will be considered to minimise turbidity generation. The options have been incorporated into a staged monitoring plan outlined in Figure 8-1 and Figure 8-2. .

Additional management options for the TSHD include:

1. Maximise the level of the overflow valves in the hopper to ensure that the retention time of the slurry in the hopper is maximized.
2. Utilise favourable weather, tides and currents to minimise impacts from turbidity from dredging in sensitive areas (e.g. dredging at the entrance to Princess Royal Harbour on an ebb tide).
3. Reduce propeller wash by managing the loading sequence to dredge to progressively deeper water.
4. Minimise draining of excess water from the hopper whilst en route to the offshore disposal area (normally the TSHD would drain excess water to lighten the load in the hopper en route to the disposal site).
5. Implement temporary restrictions on the areas of the channel that can be dredged at any given time to suit turbidity measurements.
6. Reduce the amount of overflow dredging by reducing loading times; however this will result in a TSHD sailing to the dumpsite partially loaded and have major cost and schedule implications as the dredging production rate will be significantly reduced with a dramatic increase in dredging duration.

Management options for the CSD include:

1. Relocation of the dredge.
2. Deployment of a silt curtain at or prior to the return water outlet to minimise the turbidity of water discharged from the land reclamation area.
3. Install additional internal bunding in the land reclamation area to increase water retention time.
4. Reduce pumping rate.
5. Trial single shift operation.

A water quality monitoring plan with a staged approach to turbidity management is provided in Section 8.1

Land Reclamation Design:

- A sluice box (es) will be placed in the external bund of the reclamation area to allow the water level to be raised high enough in order to facilitate maximum settling capacities (removing heavy sediments from the return waters).
- Internal silt curtains may be installed between the weir box and points of infill and the breakwater lined with geotextile material to allow filtered discharge (of finer sediments) if required.
- A monitoring programme, outlined in Section 8.1 will be implemented to ensure that water quality targets will be maintained.

Water Quality Management Actions

Water quality may be impacted through the dredging of nutrient rich (potentially acid forming) material and material containing marginally elevated levels of mercury and silver.

Nutrients:

Investigations have identified that nutrient build up only occurs in the harbour area at relatively shallow depths. The potential impacts from disturbing this material through dredging will be managed by:

- The staged dredging programme the TSHD will remove the majority of the nutrient rich layers of sediment near the land reclamation area prior to the employment of the CSD.
- Overflow will not be achieved until the TSHD enters King George Sound, which is due to the direction of dredging thereby minimising the risk of overflow of the potentially high-nutrient water into Princess Royal Harbour. Overflow of potentially nutrient rich water in to King George Sound and disposal of this material at the disposal site is not anticipated to have any negative environmental impacts due to the small quantity of the material and the mixing capacity of King George Sound.
- Nutrient rich material will be taken directly to the offshore disposal site (if dredge is at full capacity) or to Dredge Area 3 for further loading (if not at full capacity).
- At the disposal site, subsequent loads of clean sediment will be placed around and on top of the sediment, covering the contaminated dredge material to prevent re-suspension and mobilisation of this material. This will reduce its availability to sediment biota.
- The CSD will pump material directly into the reclamation area which will be lined with geotextile fabric to further eliminate the likelihood of contaminants leaching into the harbour.
- A water quality monitoring programme (Section 8.1) will be implemented to ensure that water quality targets will be maintained. The monitoring programme will include the location of survey sites, frequency of data collection, and identify trigger values for the implementation of reactive management (action) to be enacted.

Heavy Metals:

Investigations have indicated that neither silver nor mercury identified in the sediments pose any environmental risk and as such the material has been deemed suitable for unconfined disposal to sea in-line with the NODGDM, 2002. The APA, however, will seek to reduce the risk of contamination even further through selective removal of the mercury contaminated sediment in the initial stages of dredging by:

- The dredging programme will be staged such that the TSHD will remove sediments containing elevated analytes from the identified area(s) prior to commencing systematic dredging of the remainder of the channel.
- No overflow from the TSHD will be permitted while removing the sediments containing elevated analytes (and subsequent journeys to the disposal site) to prevent mobilisation of the material along the channel.
- Sediments containing elevated analytes will be placed in the centre and at the bottom of the disposal area such that subsequent loads of clean sediment will be placed around and on top of the sediment to further limit their ability to become remobilised.
- Contaminant characterisation has been established through the DEW approved Sampling and Analysis Plans (SAP) and will be recovered by the dredge operators and managed as stated in previous points.

Management of Geotechnically Unsuitable Material:

- Geotechnically unsuitable material will be removed by the CSD and either temporarily stored on land or directly transported to the offshore disposal site depending on the concurrency or independence of the two dredging tasks (berth and channel). Offshore disposal will be carried out preferentially if dredging of the berth pocket coincides with that of the channel.
- Direct transport and disposal offshore removes the risk of acid generation from oxidation of potentially acid forming peaty material.
- If temporary storage on land is required, the material will first be placed in a confined and lined facility and tested for its acid generating potential.
- Acid forming materials, and its stormwater run off, will be laterally and vertically confined and treated with pH ameliorants according to DEC guidelines. The material will be tested for acid forming potential prior to off shore disposal.

Sediment Quality Management Actions

The sediment to be dredged has been characterised physically and chemically (SKM, 2007). Dredging and construction activities will be managed so as not to influence sediment quality.

Spill prevention:

- APA procedures for hydrocarbon management are already established and will be implemented in accordance with Australian Standard AS 3846 'The handling and transport of dangerous cargoes in port areas'.
- Hydrocarbons will be contained such that the material will be captured by a containment facility in the event of a breach in the primary container.
- Task based risk assessments shall be conducted prior to hydrocarbon transfer activities over water. This shall identify management actions to be implemented to prevent spills.

Spill clean up:

- Appropriate spill recovery equipment will be made available at work areas.
- Spills will be cleaned up as soon as practicable and reported as an incident.
- Contaminated materials created as a result of the spill will be contained, removed and disposed of appropriately.
- Personnel will be trained in spill recovery procedures.

Catastrophic Spills:

- Major spills will be managed in accordance with the Albany Port Authority Oil Spill Contingency Plan.

7.1.2.4 Performance Indicators

The performance indicators for the environmental value of 'ecosystem health' are the assigned environmental quality criteria. Environmental quality criteria take the form of numeric values or comparisons with reference sites. The three levels of ecosystem condition with increasing protection levels have been identified (ANZECC/ARMCANZ, 2000):

- highly disturbed ecosystems;
- slightly to moderately disturbed ecosystems; and
- high conservation/ecological value.

Boundaries for different levels of ecological protection (ANZECC/ARMCANZ, 2000) relevant to the Albany Port Expansion Proposal are presented in Figure 7.1.

Table 7-1: Levels of Ecological Protection and Environmental Quality Conditions.

Level of Ecological Protection	Environmental Quality Conditions (limit of acceptable change)	
	Contaminant concentration indicators	**Biological indicators**
High	To allow small changes in the quality of water, sediment or biota. Very low levels of contaminants.	No detectable change from natural variation in the diversity of species and biological communities, ecosystem processes and abundance of marine life.
Moderate	To allow moderate changes in the quality of water, sediment or biota. Elevated levels of contaminants.	Moderate changes from natural variation in the diversity of species and biological communities, ecosystem processes and abundance of marine life.

The outer portion of Princess Royal Harbour and King George Sound are slightly too moderately disturbed ecosystems. This area has been assigned a high level of ecological protection. The environmental quality guidelines relevant to this level of protection (ANZECC and ARMCANZ, 2000) to be implemented for the proposal are:

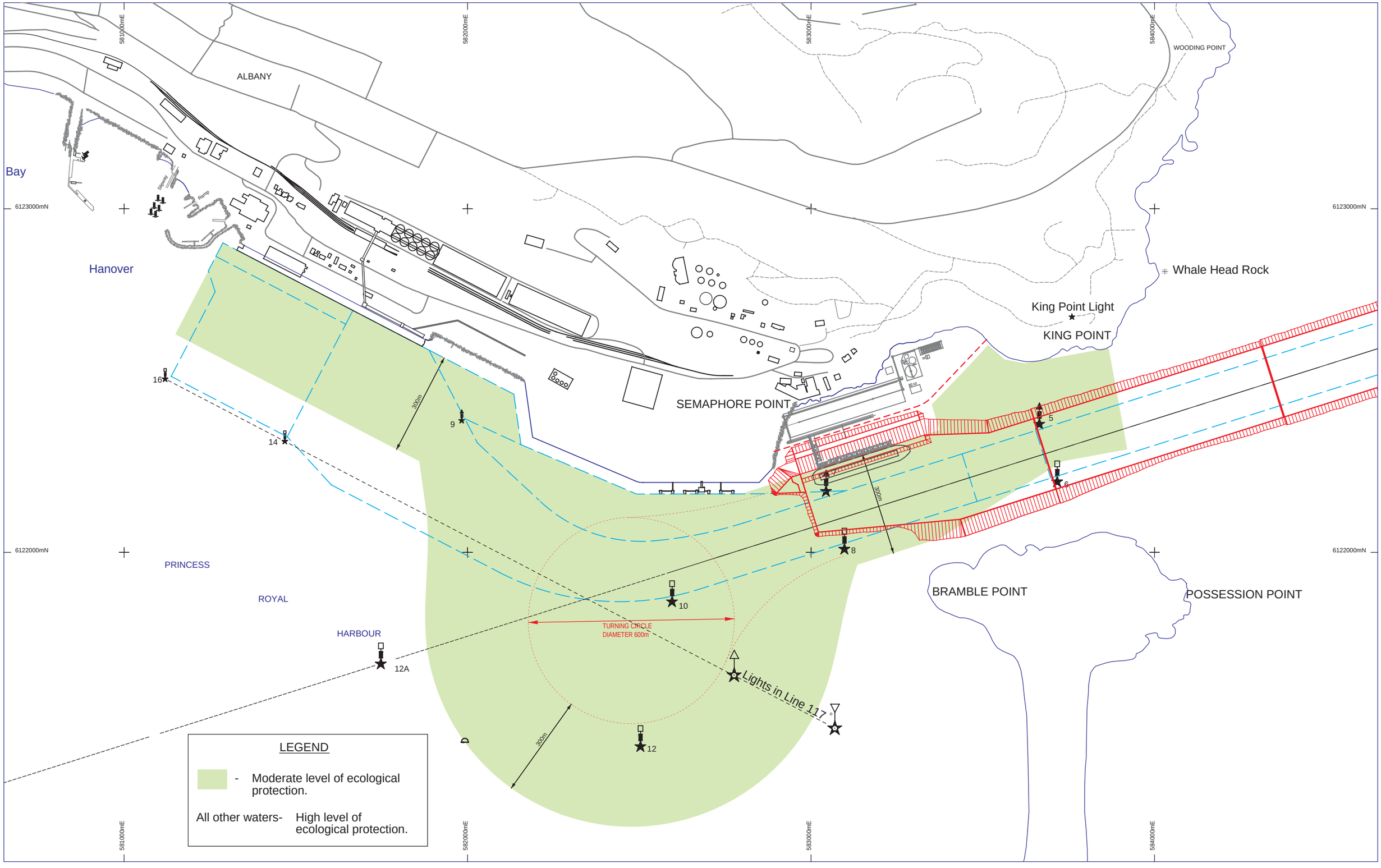
- The Interim Sediment Quality Guidelines (ISQG)-low guideline trigger levels for toxicants in sediments.
- Application of the recommended 95% species protection guideline triggers levels for toxicants in water.
- Low risk guideline trigger values for physical and chemical stressors will be defined as the 80th percentile of the data distribution for a suitable relatively unmodified reference site.

The inner harbour area of Albany Port is a highly disturbed ecosystem due to current and historic activities in the area. As such a low level of protection should be assigned to this area**.**

The environmental quality guidelines relevant to this level of protection (ANZECC and ARMCANZ, 2000) to be implemented in the inner harbour of Albany Port are:

- The ISQG – low guideline trigger levels for toxicants in sediments.
- Application of the default 90% species protection guideline trigger levels for toxicants in water.
- The 95th percentile of the data distribution for a suitable relatively unmodified reference site for the physical and chemical stressors.

BPPH health and distribution will be used as indicators of environmental performance during monitoring as outlined in Section 7.2.



A	16/03/2007	ISSUE FOR REVIEW	CL	
REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL

ORIG SIZE A3 | ARCHIVE JFA-1183-23-1.DGN, JFA-1183TOPO-10000.DGN, CHANNEL DESIGN-REVG 011106.DGN | PROJECT No

NOTES

SCALE 1 : 10000

500 0 2000

METRES

DATUM

VERTICAL LWM ALBANY WHICH IS 4.010m BELOW PWD BM HR2 AND 0.771m BELOW A.H.D.

HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

GDA

ACTION	NAME	SIGNATURE	DATE
DESIGNED	B.Brodie-Hall		16/03/2007
DRAWN	C.Livingstone		16/03/2007
DESIGN CHECK			
CARTOGRAPHY CHECK			
APPROVED PROJECT MGR			

BEBBCART

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GRANGE RESOURCES LIMITED

DRAWING NUMBER Figure 7.1

REVN A

7.1.3 Fishing and Aquaculture

7.1.3.1 Potential Impacts

Potential impacts from dredging and land reclamation are:

- Physio-chemical stress to marine fish and aquaculture species through the creation of short-term higher sediment loads in the water column.
- Bioaccumulation of contaminants in aquaculture species.
- Increase in biological contaminants including algal blooms, viruses and parasites.
- Reduction in habitat due to loss of benthic primary producer habitat.

7.1.3.2 Environmental Quality Objectives

- Maintenance of aquatic life for human consumption.
- Maintenance of aquaculture.

7.1.3.3 Implementation

The environmental quality criteria for fishing and aquaculture will be achieved through:

- Implementation of strategies to manage turbidity and mobilisation of contaminants and nutrients as outlined in Section 7.1.2.3.
- Preferential dredging of nutrient rich material and management of dredge overflow to minimise the release and concentration of nutrients necessary for algal blooms.
- Management of potential impacts to BPPH (Section 7.2.3) which provide habitat for commercial fisheries such as pilchards.

The potential for bioaccumulation of the sediment bound mercury in Dredge Area 3 in mussels within aquaculture leases is low due to the non-bioavailability of the mercury and the spatial separation of the contaminated material and the lease locations. Additionally, the contaminated material will be selectively dredged, transported to the disposal site and buried under clean material.

Regular water quality and product sampling and monitoring will be continued throughout the dredge programme and compared to existing monitoring data to ensure product quality is maintained.

7.1.3.4 Performance Indicators

Shellfish from the aquaculture leases within King George Sound will be of a quality compliant with the:

- Western Australian Shellfish Quality Assurance Program Operations Manual (Department of Fisheries, 2001).
- ANZFA Food Standards Code; Standard 1.4.1 Contaminants and Natural Toxicants.

7.1.4 Recreation and Aesthetics

7.1.4.1 Potential Impacts

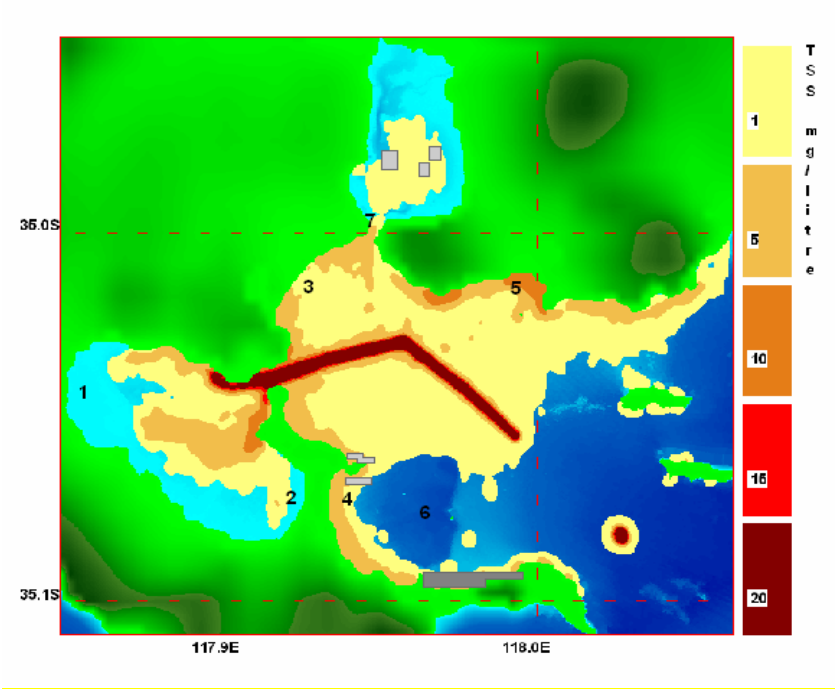
Turbidity

Sites within Princess Royal Harbour, Oyster Harbour and King George Sound utilised for primary contact recreational activities were identified. Modelling of average turbidity throughout the dredge programme (Figure 7-2 to Figure 7-4) indicates that a large portion of King George Sound will be subject to some influence of turbidity associated with the dredge programme, albeit at extremely low levels. The concentration of the plume zones of influence and impact will decrease considerably in a concentric manner away from the dredge, with the potential for build up and re-suspension of sediments along the shore-lines.

Turbidity associated with the proposal potentially has a range of social impacts, depending on the location, duration and sediment load of the plume. Potential impacts include:

- Increased turbidity associated with dredging causing:
    - Reduction in water quality at nearby beaches and dive wrecks.
    - Decreased visual amenity in Princess Royal Harbour and King George Sound.
    - Impacts to tourism.
- Decrease in microbial water quality at primary recreational sites.

The following figures depict the average turbidity over the whole dredge programme. For Figure 7-2 to Figure 7-4, the colour codes were chosen to distinguish the different range in turbidity concentrations. This is not an indication of water coloration.



Key:

Major Recreation Areas:

1. Shallows used by crabbers in season.

2. Shoal Bay area used by some swimmers and as a horse training facility.

3. Middleton Beach is the most populated area, utilised for water sport by locals and tourists.

4. Frenchman Bay beaches are popular swimming beaches.

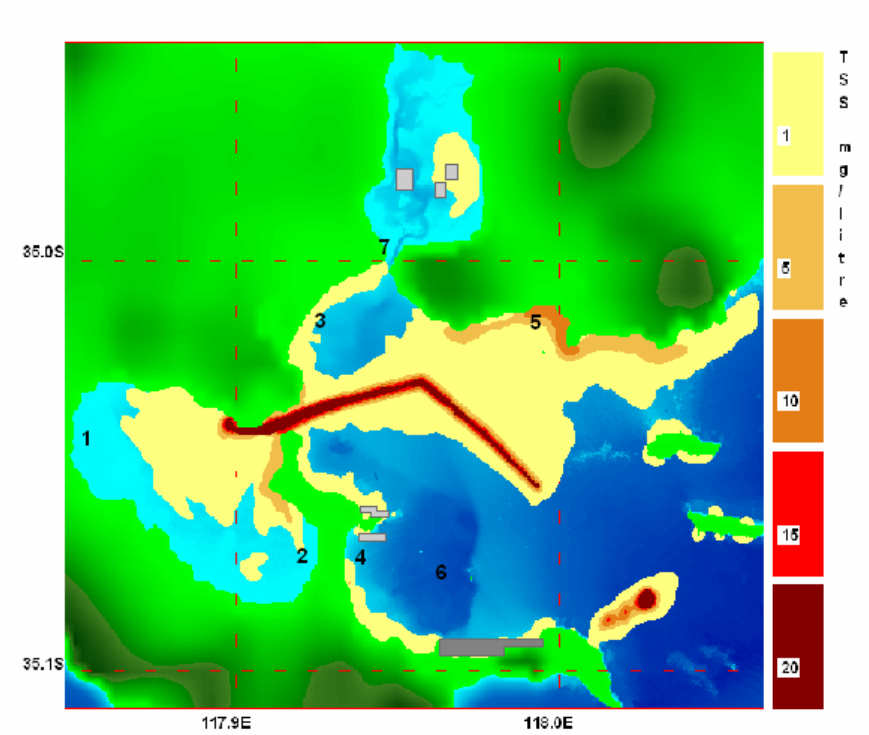
5. Gull Rock Beach is a popular swimming beach.

6. The HMAS Perth near Seal Island is a SCUBA site.

7. Emu Point and Oyster Harbour are utilised for swimming, fishing, kayaking and boating.

Approx locations of **Aquaculture Leases** are shown in grey.

Figure 7-2: Average turbidity (TSS) During the Dredge Programme Modelled from March to June.



Key:

Major Recreation Areas:

1. Shallows used by crabbers in season.

2. Shoal Bay area used by some swimmers and as a horse training facility.

3. Middleton Beach is the most populated area, utilised for water sport by locals and tourists.

4. Frenchman Bay beaches are popular swimming beaches.

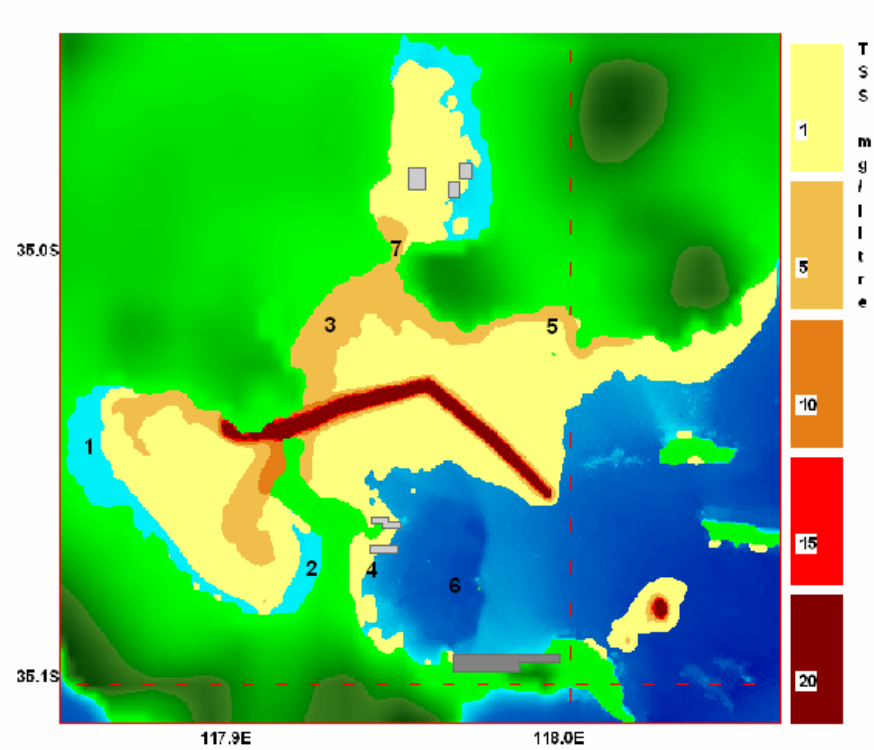
5. Gull Rock Beach is a popular swimming beach.

6. The HMAS Perth near Seal Island is a SCUBA site.

7. Emu Point and Oyster Harbour are utilised for swimming, fishing, kayaking and boating.

Approx locations of **Aquaculture Leases** are shown in grey.

Figure 7-3: Average turbidity (TSS) During the Dredge Programme Modelled from July to October.



Key:

Major Recreation Areas:

1. Shallows used by crabbers in season.

2. Shoal Bay area used by some swimmers and as a horse training facility.

3. Middleton Beach is the most populated area, utilised for water sport by locals and tourists.

4. Frenchman Bay beaches are popular swimming beaches.

5. Gull Rock Beach is a popular swimming beach.

6. The HMAS Perth near Seal Island is a SCUBA site.

7. Emu Point and Oyster Harbour are utilised for swimming, fishing, kayaking and boating.

Approx locations of **Aquaculture Leases** are shown in grey.

Figure 7-4: Average turbidity (TSS) During the Dredge Programme Modelled from November to February.

Impacts to the major recreational areas are as follows:

1, 2 & 6: The western end of Princess Royal Harbour, the Shoal Bay area and the HMAS Perth dive site and reefs will not be impacted by the turbidity.

3: Some of the beaches in Frenchman Bay will be exposed to an average turbidity of 1 mg/L during the July to October dredge scenario, with an average TSS of 5 mg/L anticipated during the March to June and November to February dredge scenarios.

4: Middleton Beach will be exposed to an average turbidity of between 1 mg/L and 5 mg/L during the March to June and November to February dredge scenarios, with less turbidity (average 1 mg/L) predicted during the July to October scenario.

5: Gull Rock Beach will be exposed to average TSS of 10 mg/L during the March to June and July to October scenarios, with less turbidity (average 5 mg/L) predicted during the November to February dredge scenario.

7. Emu Point and Oyster Harbour are utilised for swimming, fishing, kayaking and boating. Some portions of Oyster Harbour may be subjected to very occasional low TSS levels (average 1 mg/L) at various times throughout the dredge programme. This level of turbidity is highly unlikely to impact the ecosystems within Oyster Harbour as 1 mg/L represents half the ambient TSS levels (2 mg/L) measured in King George Sound (SKM, 2007).

Hydrodynamics

Currents: Impacts of changes to bathymetry and the increase of the cross-sectional area of the entrance to Princess Royal Harbour associated with dredging were modelled (GEMS, 2007). Modelling indicates that sea levels will not be impacted by the dredging and that the tidal water levels will remain almost exactly the same in both Princess Royal Harbour and King George Sound. Results also indicate that there will be no significant change in the current speeds in Princess Royal Harbour or the dredge channel after the dredging. However, there will be a small decrease in current speeds through the entrance of the Harbour associated with the increase in the cross sectional area. The mass flux or exchange into Princess Royal Harbour will increase slightly, which can be strongly argued is a nett environmental benefit to the historically eutrophied waterway.

Modelling of wave current directions before and after the construction of the land reclamation area and deepening of the channel do not indicate any material variations in current directions. Dredging and land reclamation therefore are not anticipated to alter alongshore erosion and sediment transport processes.

Flushing: A further investigation of the impacts of changes to the entrance channel to the flushing of Princess Royal Harbour was conducted (GEMS, 2007). Modelling indicates that the water exchange between Princess Royal Harbour and King George Sound will be slightly greater (approximately 6.9%) after dredging. As the flushing of Princess Royal Harbour will be maintained or slightly increased, positive improvements in water quality due to the increased flushing of Princess Royal Harbour can be expected.

Wave Climate: Potential impacts to tides and shoreline wave action from changes in the bathymetry of King George Sound through dredging of the shipping channel were also modelled. Results showed that wave heights off Middleton Beach were unchanged indicating that the proposal is not likely to result in changes to coastal processes and will not alter the existing pattern of seasonal erosion and accretion.

7.1.4.2 Environmental Quality Objectives

- Water quality is safe for primary contact recreational activities in the water (e.g. swimming).
- Water quality is safe for secondary contact recreational activities in the water (e.g. boating).
- Aesthetic values of the marine environment are protected.

7.1.4.3 Implementation

Water quality will be maintained throughout the proposed works through:

- Implementation of management strategies as described in Section 7.1.2.3.
- If required, a sampling programme will be established along Middleton Beach, Goode Beach and Emu Point to ensure that swimming beach water quality is maintained for recreational use and complies at all times with the National Health and Medical Research Council's Australian Guidelines for Recreational Use of Water.

Dredging and the disturbance of the peaty sediments in the entrance to Princess Royal Harbour is not anticipated to result in elevated microbial levels as the sediments are historical deep horizon deposits and do not contain fresh faecal matter.

7.1.4.4 Performance Indicators

Risks in recreational waters are outlined in Table 7-2. Water quality monitoring to assess microbial water quality will be conducted as required, using enterococci as an indicator organism to determine microbial assessment categories is outlined in Section 8.1.

Table 7-2: Environmental Quality Criteria for Recreational Water Quality

Characteristic	Potential Project Impact	Requirements from Guidelines for Management
Physical hazards (Such as floating or submerged objects that may lead to injury).	Dredging and land reclamation activities will not result in physical hazards in or around recreational water bodies.	Not Applicable, however, a notice to Mariners in-line with standard APA procedures will be issued and communicated.
Sun, heat and cold water temperature.	Dredging and land reclamation activities will not impact the temperature of the water.	Not Applicable.
Microbial quality (such as contamination with fresh faecal matter)	Disturbance of bottom sediments during dredging will not impact microbial water quality as the sediments are historical deposits and do not contain fresh faecal matter. Inputs from stormwater or river discharge into the Harbour during rainfall events may result in elevated microbial levels. It is anticipated that these influxes will be diluted through natural flushing in King George Sound.	Preventative risk management practices should be adopted to ensure that recreational waters are protected against direct contamination. The microbial quality of recreational water is categorised by a combination of sanitary inspection and microbial water-quality assessment.

Characteristic	Potential Project Impact	Requirements from Guidelines for Management
Cyanobacteria and algae in coastal and estuarine water	Dredging in the entrance to Princess Royal Harbour is likely to disturb sediment containing nutrients from historical land uses within the catchment. Large quantities of nutrients introduced into the marine environment have the potential to cause algal blooms, affecting recreational water quality and BPPH health. Dredge management strategies will be implemented to ensure significant concentrations of nutrients are not introduced into the marine environment.	Coastal and estuarine recreational water bodies should not exceed: • ≤1 cell/mL K. brevis and/or have history but no current presence of Lyngbya majuscula and/or Pfiesteria (Green level/surveillance mode); or • > 1–10 cells/mL K. brevis and/or have L. majuscula and/or Pfiesteria present in low numbers (Amber level/ alert mode); or • > 10 cells/mL K. brevis and/or have L. majuscula and/or Pfiesteria present in high numbers (Red level/action mode).
Dangerous aquatic organisms	Dredging and land reclamation activities will not result in the introduction or spread of dangerous aquatic organisms in recreational water bodies due to the implementation of quarantine measures.	Not Applicable.
Chemical Hazards (contamination with chemicals that are either toxic or irritating to the skin). **pH** (6.5 – 8.5) **Dissolved oxygen** (>80%)	Water and sediment contamination from accidental discharges will be minimised through the implementation of the Dredge and Land Reclamation Management Plan which outlines procedures to prevent and clean up spills. The spread of existing mercury and silver contamination will be minimised through management of the dredging operations.	Water contaminated with chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreational purposes. Recreational water should have a pH in the range 6.5–8.5 (a pH range of 5–9 is acceptable in recreational waters with very poor buffering capacity) and dissolved oxygen content greater than 80%.
Aesthetic Aspects (visible materials, or substances producing objectionable colour, odour, taste or turbidity, and substances and conditions that produce undesirable aquatic life).	Dredging will result in turbid plumes within King George Sound and at the entrance to Princess Royal Harbour for the duration of the dredge programme.	To protect the aesthetic quality of the water body, the natural visual clarity should not be significantly reduced.

7.1.5 Cultural and Spiritual Values

7.1.5.1 Potential Impacts

- Sedimentation of sensitive receptors, including shipwrecks in the vicinity of the proposed Port expansion works from increased turbidity.
- Disturbance of currently unidentified sensitive material in the channel by the dredge.

The locations of known shipwreck sites in Princess Royal Harbour and King George Sound are presented in Figure 7-5.

7.1.5.2 Environmental Quality Objectives

- Cultural and spiritual values of the marine environment are protected.

7.1.5.3 Implementation

The potential risk to culturally sensitive receptors from sedimentation and turbidity is considered low. None of the identified sensitive sites are situated in close proximity to the proposed dredge and reclamation footprint.

For the protection of currently un-identified sensitive material within the dredge channel:

- An operators' manual outlining appropriate triggers and actions and appropriate contact details in the event that culturally sensitive material is discovered in the dredge channel will be at the helm of each associated craft for the duration of the Project.
- The operators' manual will be communicated as part of the Dredging and Land Reclamation induction process.
- Should any potentially culturally sensitive material be discovered:
    - The dredge will stop work.
    - The site will be marked with DGPS and communicated to the delegated APA officer.
    - The dredge will move and re-commence work in a different portion of the channel.
    - The APA officer will consult with the relevant authority to delineate a temporary 'protection zone'.
    - The Department of Marine Archaeology or Department of Indigenous Affairs will be notified and a dive team mobilised to assess the site.
    - Dredging will not re-commence in the protection zone until authorised by the delegated APA officer in consultation with the appropriate stakeholders.

7.1.5.4 Performance Indicators

- Known sensitive receptors, such as ship wrecks are not impacted by the dredge programme.
- All discoveries of currently un-identified sensitive material are reported according to the operators' manual.

ecologia ENVIRONMENT

Location of known shipwrecks in Albany waters

Figure: 7.5
Project ID: 902

Drawn: SG
Date: 11/03/09

Image provided by the WA Department of Maritime Archaeology.

A4

7.1.6 Industrial Water Supply

7.1.6.1 Potential Impacts

Potential impacts to BPPH associated with dredging, offshore disposal and increased vessel traffic into the Port are:

- Transient impacts to marine water and sediment quality in King George Sound and Princess Royal Harbour.

7.1.6.2 Environmental Quality Objectives

- Water quality is suitable for industrial purposes.

7.1.6.3 Implementation

- Manage sediment and water quality as per Section 7.1.2.3.

It is not anticipated that industrial water supplies will be impacted by the proposal as dredging and land reclamation will have limited transient impacts to marine water and sediment quality in King George Sound and Princess Royal Harbour.

7.1.6.4 Performance Indicators

- Water quality is suitable for industrial purposes throughout the dredge programme.

7.2 BENTHIC PRIMARY PRODUCER HABITAT

7.2.1 Potential Impacts

Potential impacts to BPPH associated with dredging, offshore disposal and increased vessel traffic into the Port are:

- Direct removal or burial of marine and near shore habitats.
- Indirect loss of benthic primary producers (BPP) as a result of increased suspended solids and smothering.
- Introduction of and/or spread of exotic species due to inadequate ballast quarantine practices.

Management Unit 1:

Category F represents areas where cumulative loss thresholds have been significantly exceeded, and a 0% net damage/loss (+ Offsets) is recommended.

- Historically, there has been a loss of 52.06% seagrasses in Princess Royal Harbour.
- Direct impacts from dredging at the entrance to Princess Royal Harbour will result in a minimum permanent loss of 0.36 ha (0.01%) seagrass in Management Unit 1.
- Due to dredging and the associated turbidity, the Project is likely to result in the permanent loss of 0.01% (Best and Most Probable cases) to 0.02% (Worst Case) of BPPH in Princess Royal Harbour. These figures apply to all seasons of dredging.

As the recommended level of loss has been exceeded, the APA will offset seagrass loss in Princess Royal Harbour associated with the Project through maximising the re-planting or seed stock from seagrass that will be lost to achieve the greatest areal extent possible from the donor material in an appropriate location to minimise any loss and potentially increase seagrass cover in Princess Royal Harbour.

A small sub-tidal granite rock pile (approximately 10 m in diameter) lies in the north east corner of the proposed land reclamation area and would be buried during reclamation. The ecological significance of the rock pile is minimal given its size and its loss would have negligible impact on benthic primary producer habitat. The macroalgae present on the rock pile is similar to that which would colonise the seawall of the reclamation area and on this basis the macroalgal benthic primary producer habitat would increase and thus could be considered an offset for the loss of the rock community. Colonisation by macroalgae can be rapid with *Ecklonia radiata*, particularly with adjacent stands providing propagules, and establishment could be as short as a single growing season. Equally, the seawall will attract fish in greater numbers due to the greater physical size and quantity of habitat for colonisation than the rock, providing similar opportunities for the fishers who may visit the area.

Management Unit 2:

A Category D, 5% cumulative loss threshold has been applied to Management Unit 2.

- There has been no anthropogenic historical loss of seagrasses in this unit, apart from approximately 50 m2 at the old whaling station that is considered to be negligible for calculation purposes.

- Impacts from dredging in the channel (Management Unit 2) will result in varying degrees of impacts in different seasons based on differing minimum light requirement tolerances (Table 7-3) .

Table 7-3: BPPH Impacts for combined CSD and TSHD Dredging

Loss scenarios		Management Unit 2		
		MLR (%)		
		8.5	10	14
July to October	Best case	1.44%	1.44%	1.44%
	Most probable case	2.03%	2.03%	2.03%
	Worst case	3.42%	3.43%	9.16%
November to February	Best case	1.44%	1.44%	1.44%
	Most probable case	1.97%	1.97%	1.97%
	Worst case	9.70%	9.73%	17.39%
March to June	Best case	1.44%	1.44%	1.44%
	Most probable case	1.95%	1.95%	1.95%
	Worst case	3.18%	3.18%	3.21%

Definitions

Best case: This is the direct loss in the footprint of dredging and reclamation.
Most probable case: This is that predicted for the zones for Permanent Loss.
Worst case: This is a combination of that predicted for the zones for Permanent Loss and Temporary Loss/Damage.

It is not anticipated that permanent losses of seagrass associated with the dredge project will exceed the 5% threshold as measures will be implemented to minimise turbidity throughout the dredge programme (Section 7.1.2.3).

Dredging and associated turbidity are not anticipated to impact Gio Batta Patch or Michaelmas Reef (Figure 7-9.). Michaelmas Reef is not within the zone of predicted turbidity (Figure 7-2, Figure 7-3 and Figure 7-4) or sedimentation (Figure 7-11, Figure 7-13 and Figure 7-15) for any of the dredge scenarios. Gio Batta Patch, however, is located closer to the dredge channel. The sedimentation plots indicate that the reef may be exposed to bottom sediment loads of up to 1000 g/m^2 during the March to June (Figure 7-10) and July to October (Figure 7-12) dredging scenarios.

No environmental impacts are anticipated from the turbidity as the limestone reefs experience significant wave energy such that any sedimentation will be prevented. This is supported by observations (SKM, 2007) that the seabed in the vicinity of the reef is a flattened limestone pavement free of fine sediment and generally devoid of flora and encrusting fauna. Both reefs also experience significant wave energy which will prevent any sedimentation in the unlikely event of an influence.

Management Unit 3

A Category C, 2% cumulative loss threshold has been applied to Management Unit 3.

- There has been no anthropogenic historical loss of BPPH in this unit.
- No permanent or temporary loss of seagrass is expected in Management Unit 3.

The shoot density of seagrass and a visual assessment of the epiphyte load on seagrass will be used as indicators to assess BPP health.

7.2.2 Objectives and Targets

EPA Objectives:

- To maintain the integrity, ecological functions and environmental values of the seabed and coast.
- To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

Targets:

- Follow the intent of the guidelines set out in Guidance Statement No 29: Benthic Primary Producer Habitat Protection for WA's Marine Environment (EPA, 2004).
- In time, no nett loss of BPP in Princess Royal Harbour (Management Unit 1) as a result of the Project.
- Less than 5% total loss of BPP in inner King George Sound (Management Unit 2).
- No loss of BPP in outer King George Sound (Management Unit 3).

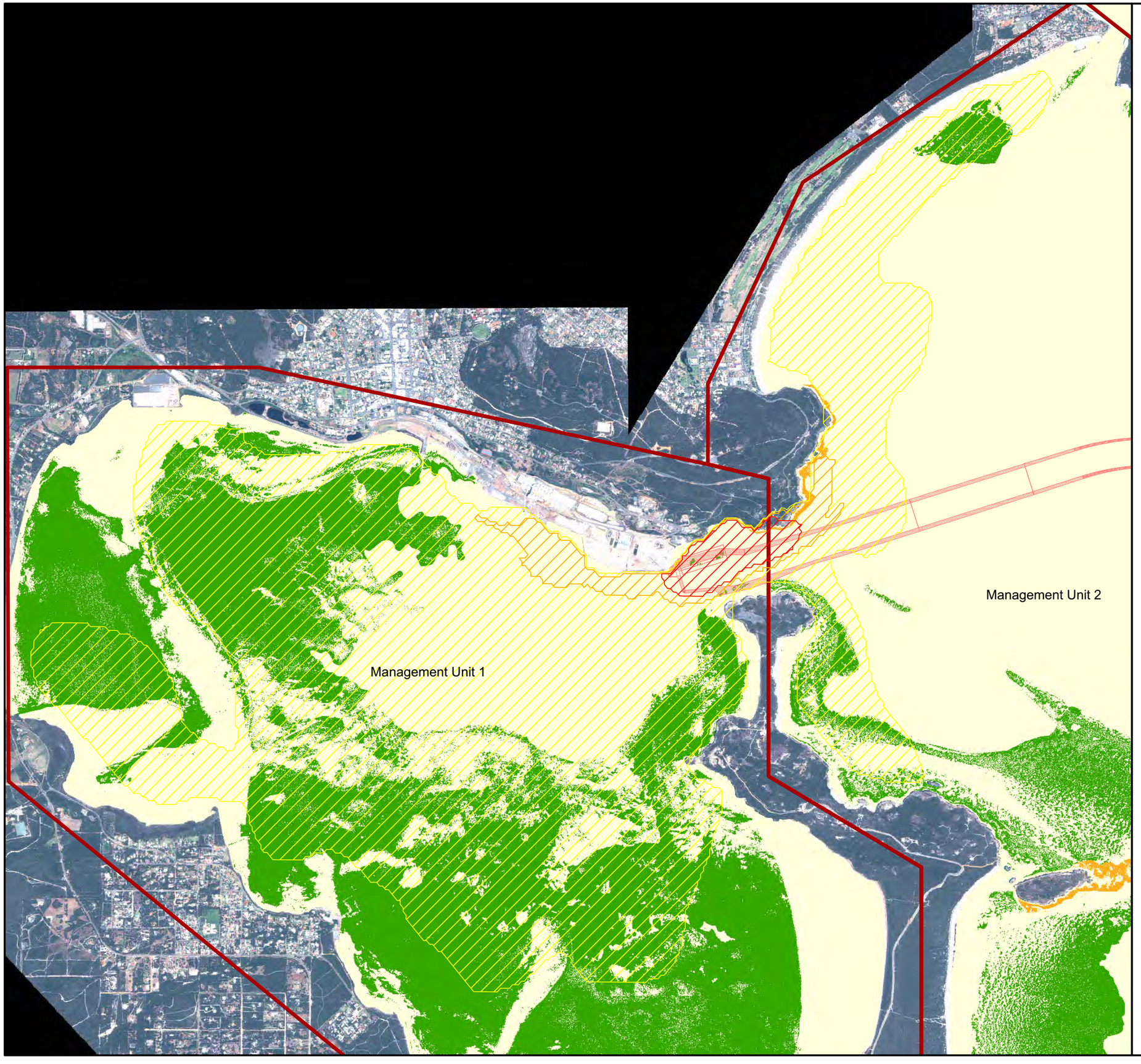


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FIG 7.6 Impact of Benthic Primary Producer Habitat of Princess Royal Harbour and King George Sound study area March to July

Management Areas
Channel and Disposal
Zone of Permanent Loss
Zone of Temporary Loss or Damage
Zone of Influence

Benthic Communities
Macroalgae
Seagrass
Sand

0 250 500 1,000 1,500 2,000
Metres

Scale -1:44,215

SINCLAIR KNIGHT MERZ
SKM

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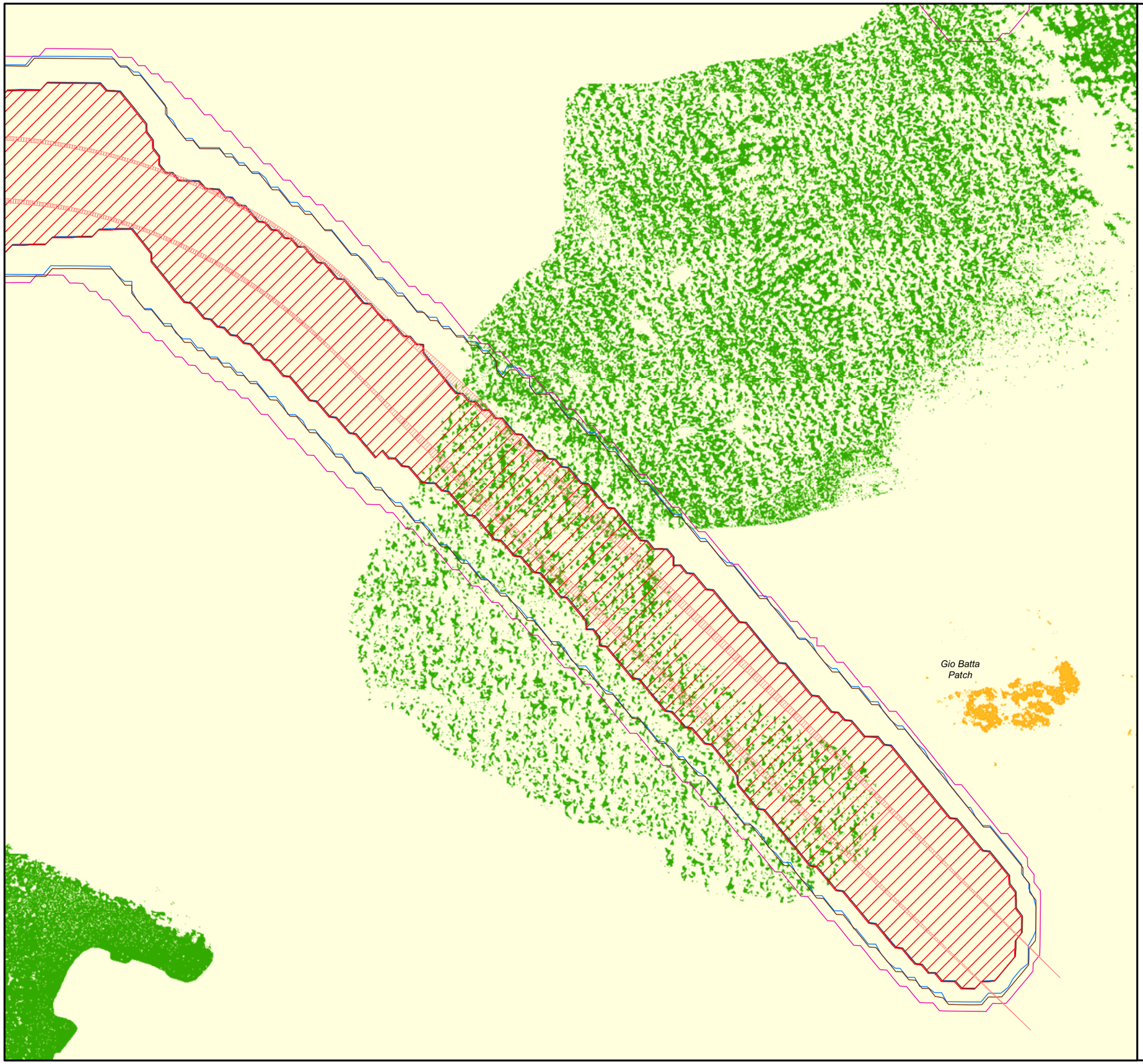

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FIG 7.7 Impact of Benthic Primary Producer Habitat of Princess Royal Harbour and King George Sound study area March to June

Channel and Disposal
Zone of Permanent Loss all ranges
Zone of Temporary Loss or Damage 8.5%
Zone of Temporary Loss or Damage 10%
Zone of Temporary Loss or Damage 14%

Benthic Communities
Macroalgae
Seagrass
Sand

Scale - 1:19,880

0 115 230 460 690 920
Metres

SKM

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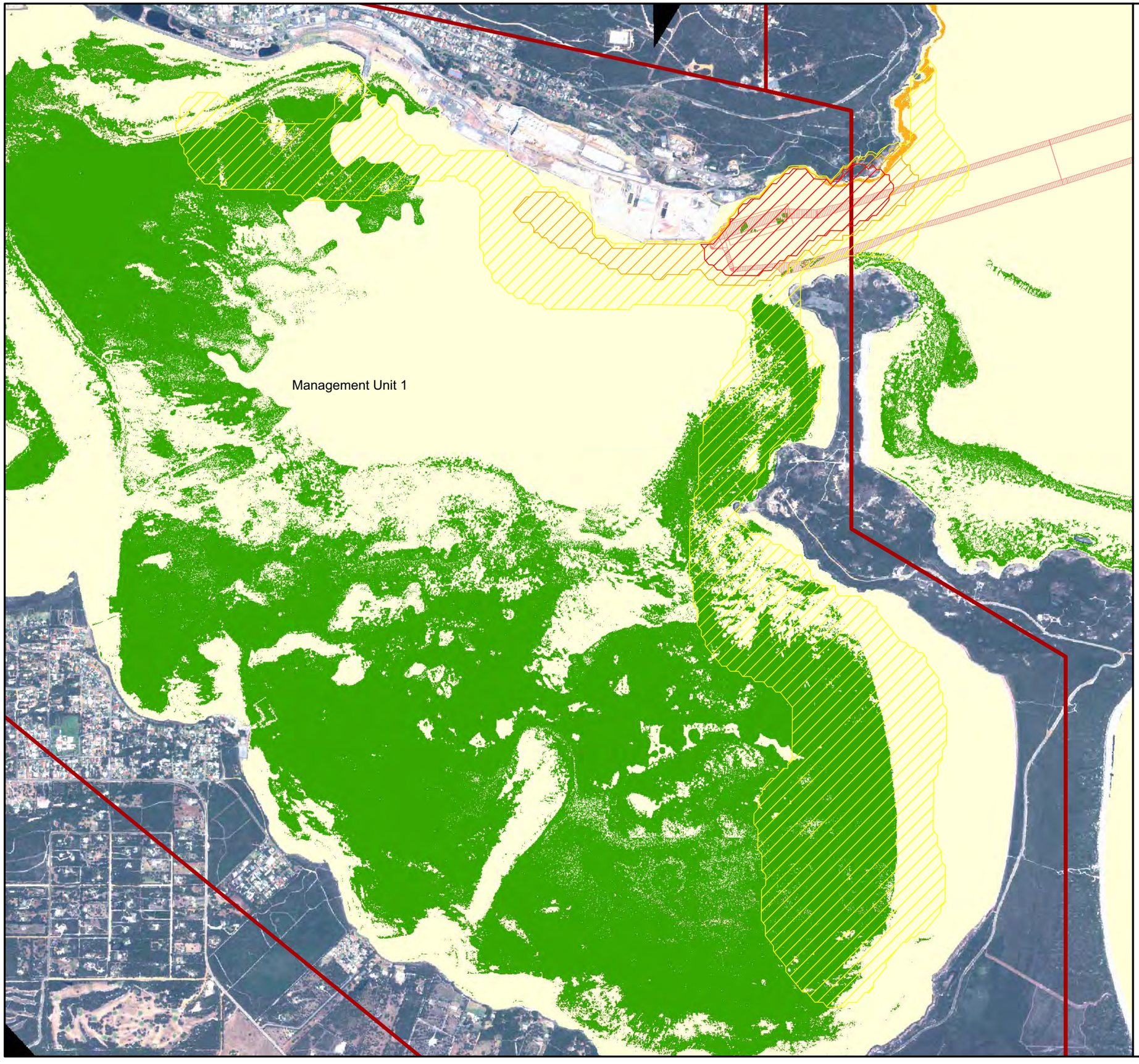

FIG 7.8 Impact of Benthic Primary Producer Habitat of Princess Royal Harbour and King George Sound study area July to October

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Management Areas
Channel and Disposal
Zone of Permanent Loss
Zone of Temporary Loss or Damage
Zone of Influence

Benthic Communities
Macroalgae
Seagrass
Sand

0 187.5 375 750 1,125 1,500
Metres

Scale -1:31,455

SINCLAIR KNIGHT MERZ
SKM

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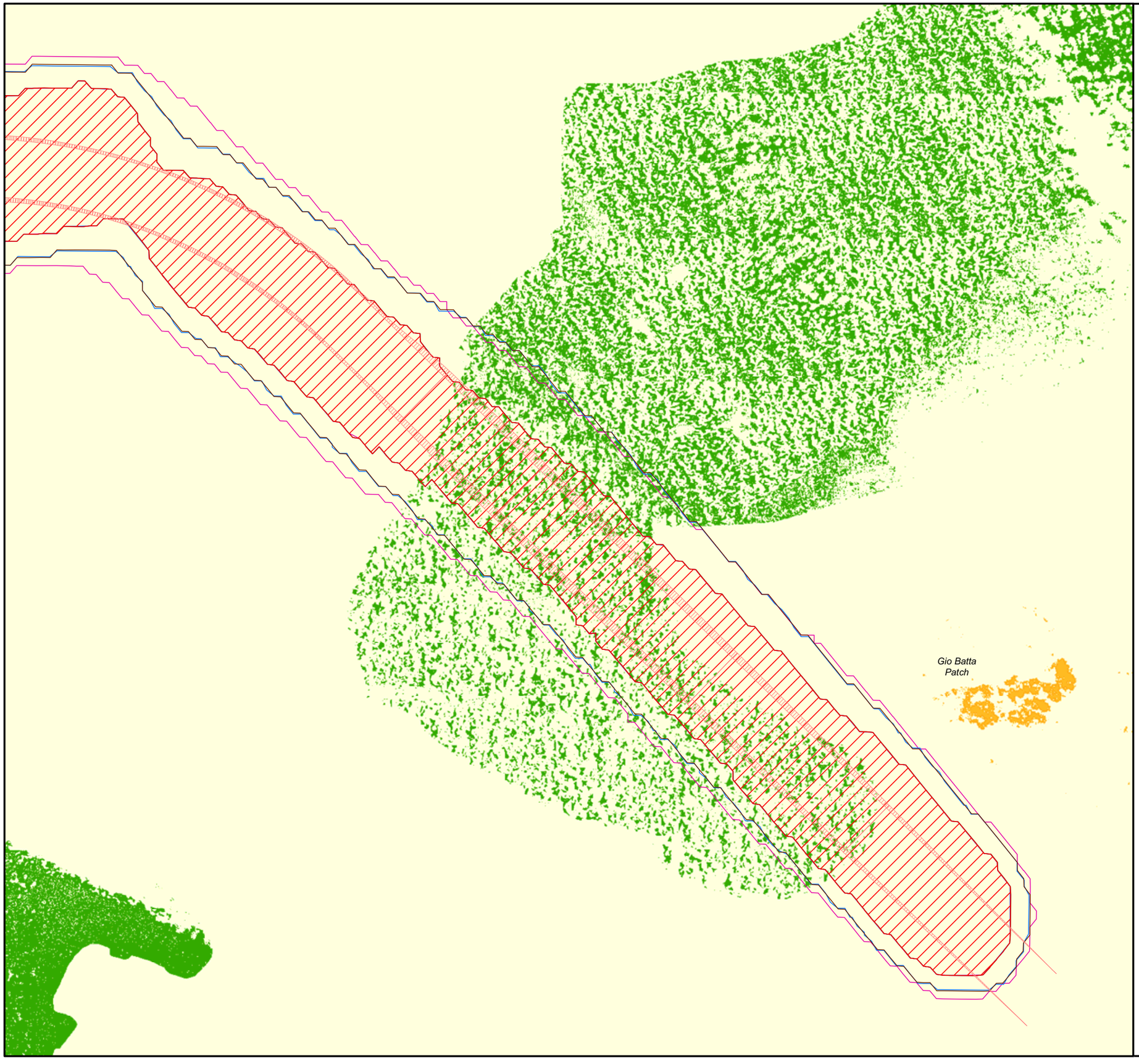

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FIG 7.9 Impact of Benthic Primary Producer Habitat of Princess Royal Harbour and King George Sound study area July to October

Channel and Disposal
Zone of Permanent Loss all ranges
Zone of Temporary Loss or Damage 8.5%
Zone of Temporary Loss or Damage 10%
Zone of Temporary Loss or Damage 14%

Benthic Communities
Macroalgae
Seagrass
Sand

Scale -1:19,880

0 105 210 420 630 840
Metres

SKM

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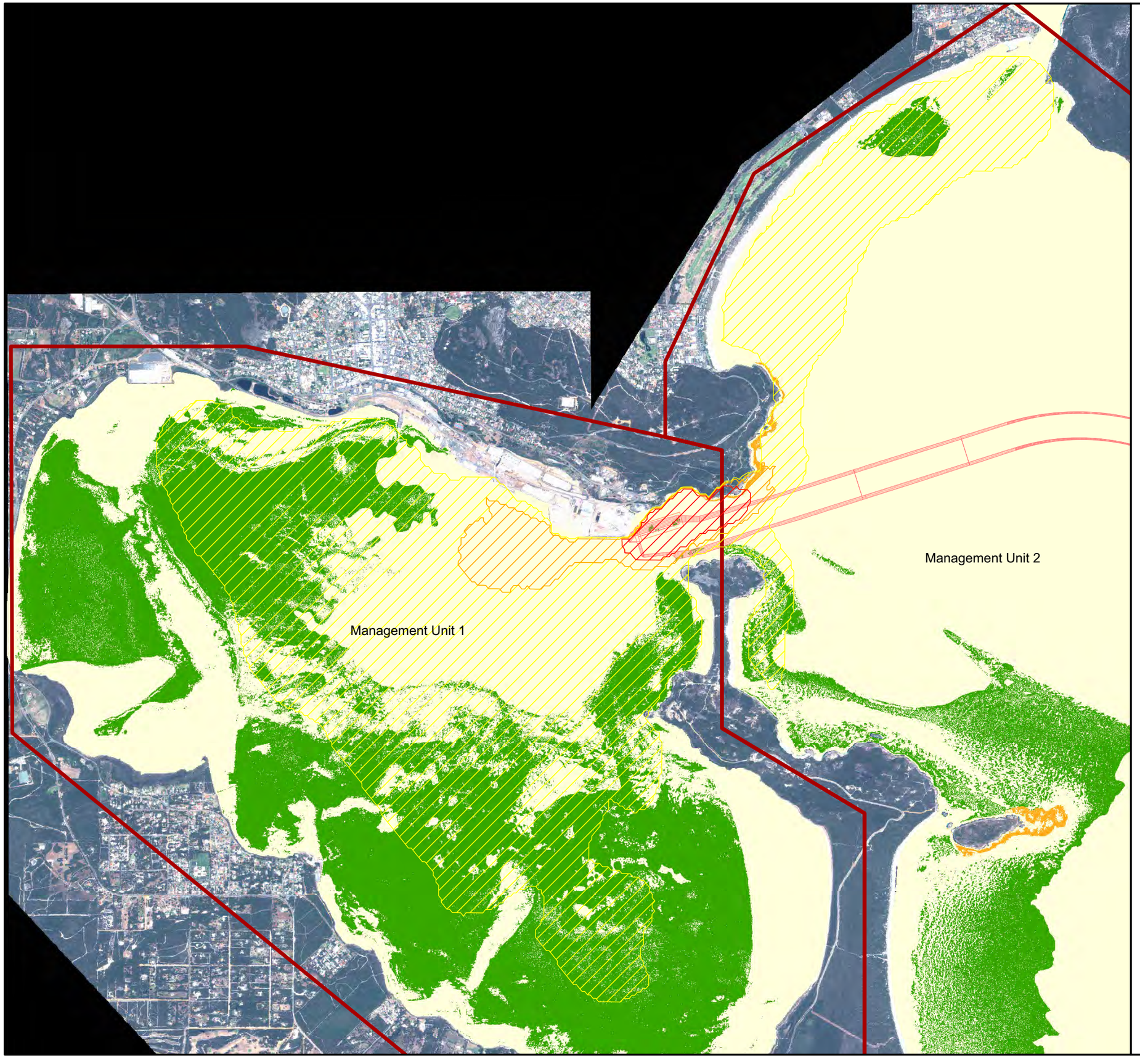

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FIG 7.10 Impact of Benthic Primary Producer Habitat of Princess Royal Harbour and King George Sound study area November to February

Management Areas
Channel and Disposal
Zone of Permanent Loss
Zone of Temporary Loss or Damage
Zone of Influence

Benthic Communities
Macroalgae
Seagrass
Sand

0 275 550 1,100 1,650 2,200
Metres

Scale -1:47,310

SINCLAIR KNIGHT MERZ
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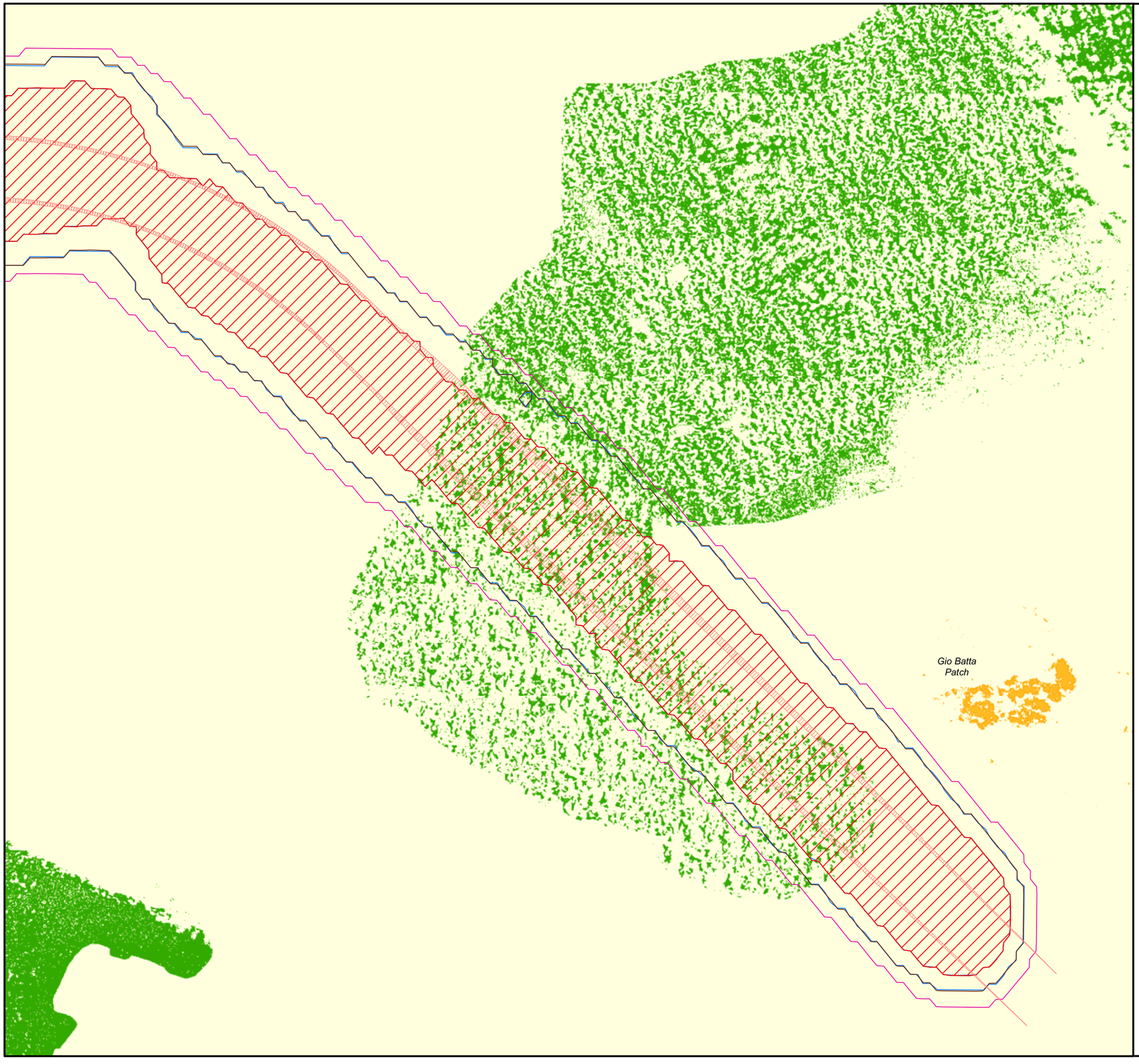

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FIG 7.11 Impact of Benthic Primary Producer Habitat of Princess Royal Harbour and King George Sound study area November to February

Channel and Disposal
Zone of Permanent Loss all ranges
Zone of Temporary Loss or Damage 8.5%
Zone of Temporary Loss or Damage 10%
Zone of Temporary Loss or Damage 14%

Benthic Communities
Macroalgae
Seagrass
Sand

Scale -1:19,880

0 120 240 480 720 960
Metres

SKM

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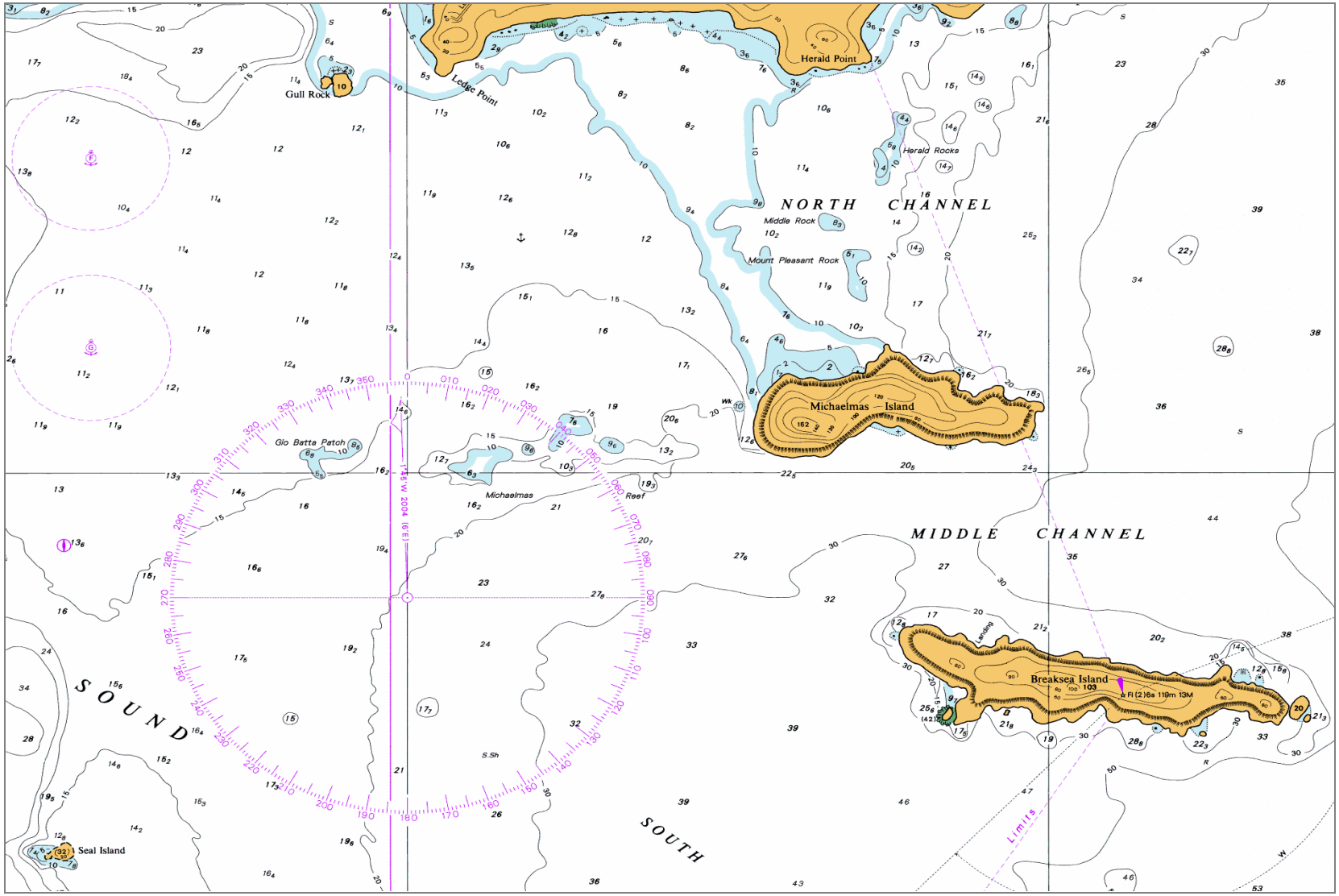
Figure 7-12: Location of Adjacent Reefs.



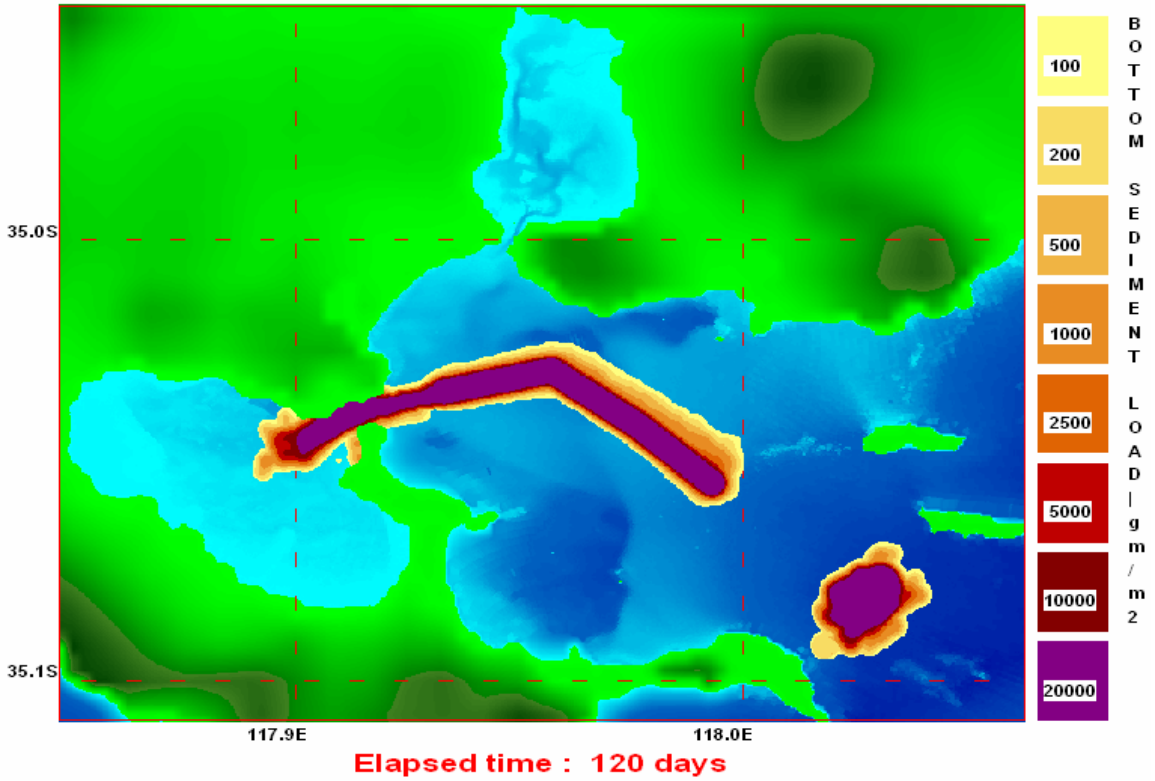


Figure 7-13: Sediment Accumulation (above 100gm/m^2) at the End of the Dredging Programme Starting in March.

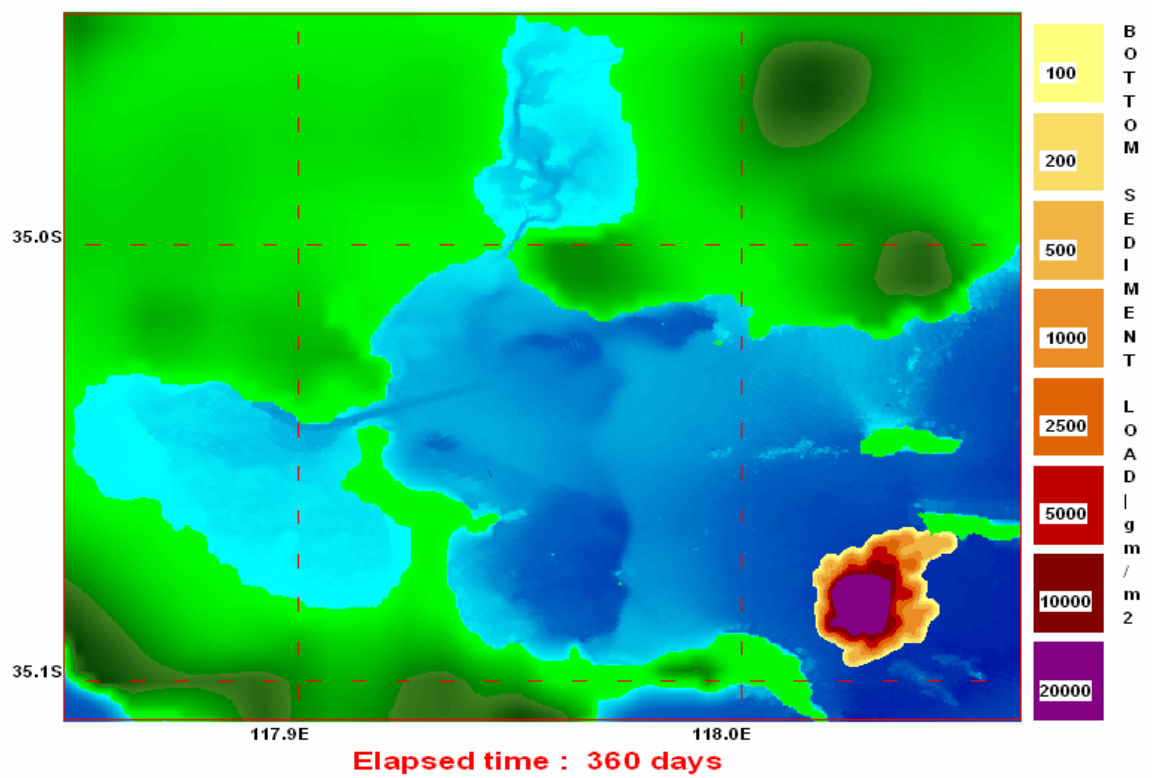


Figure 7-14: Sediment Accumulation (above 100gm/m^2) 12 Months after the Start of Dredging in March.

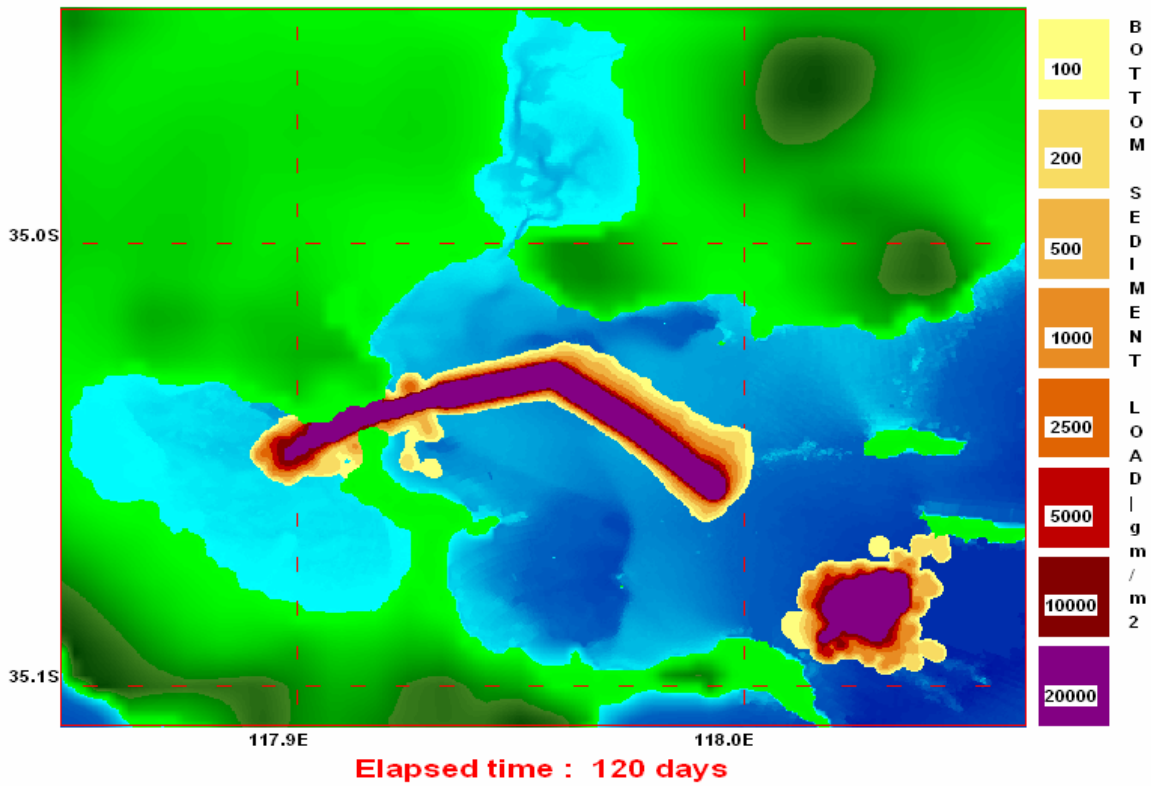


Figure 7-15: Sediment Accumulation (above 100gm/m^2) at the End of the Dredging Programme Started in July.

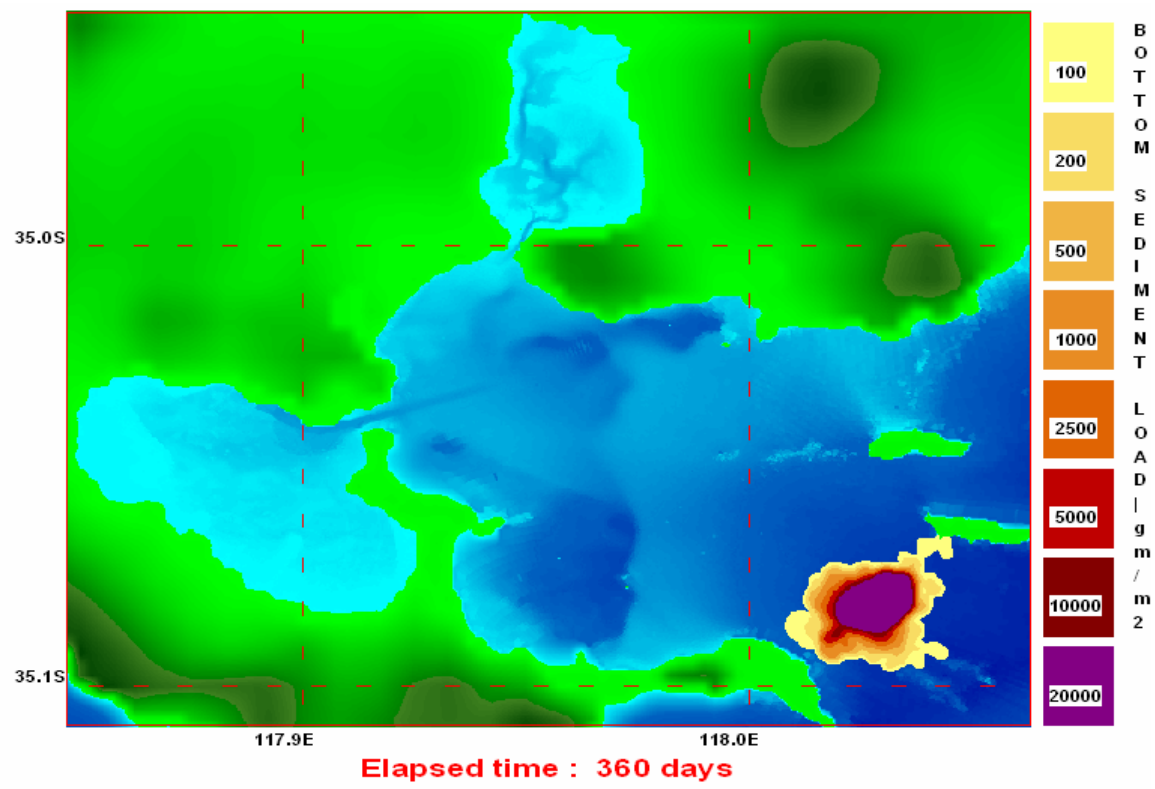


Figure 7-16: Sediment Accumulation (above 100gm/m^2) 12 Months after the Start of Dredging in July.

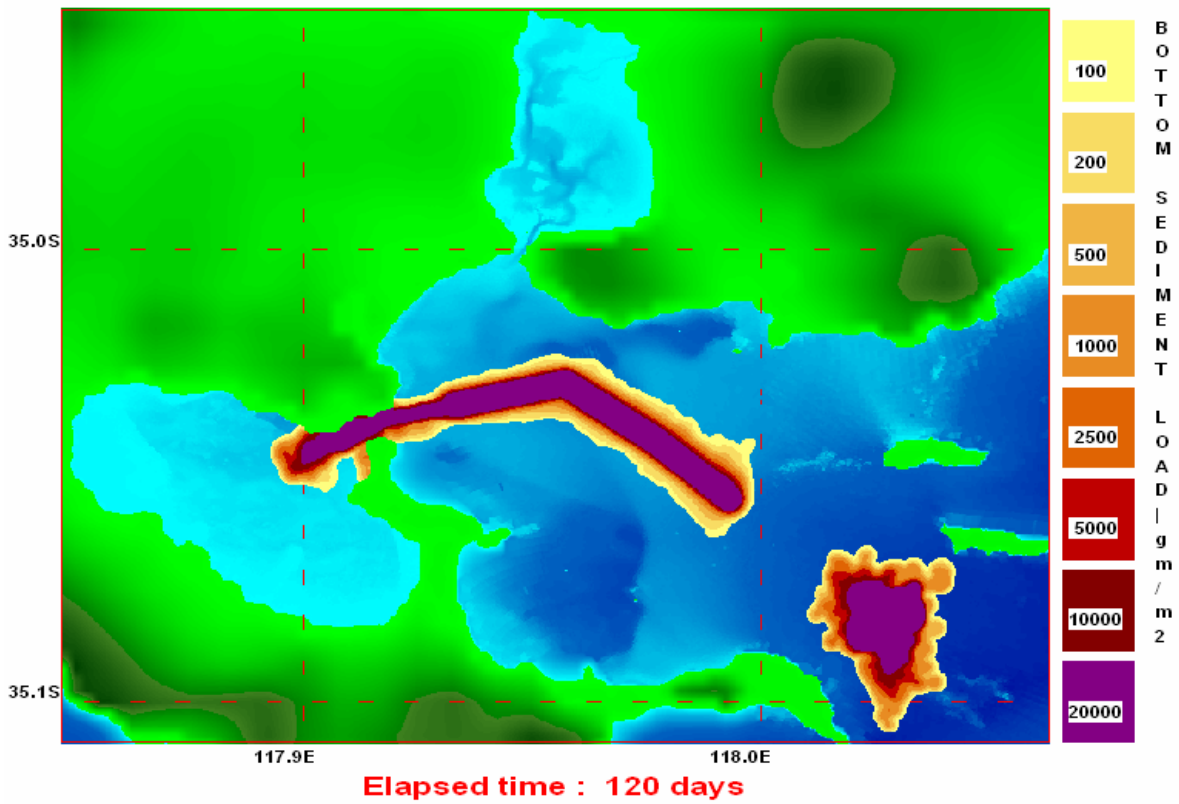


Figure 7-17: Sediment Accumulation (above 100gm/m^2) at the End of the Dredging Programme Starting in November.

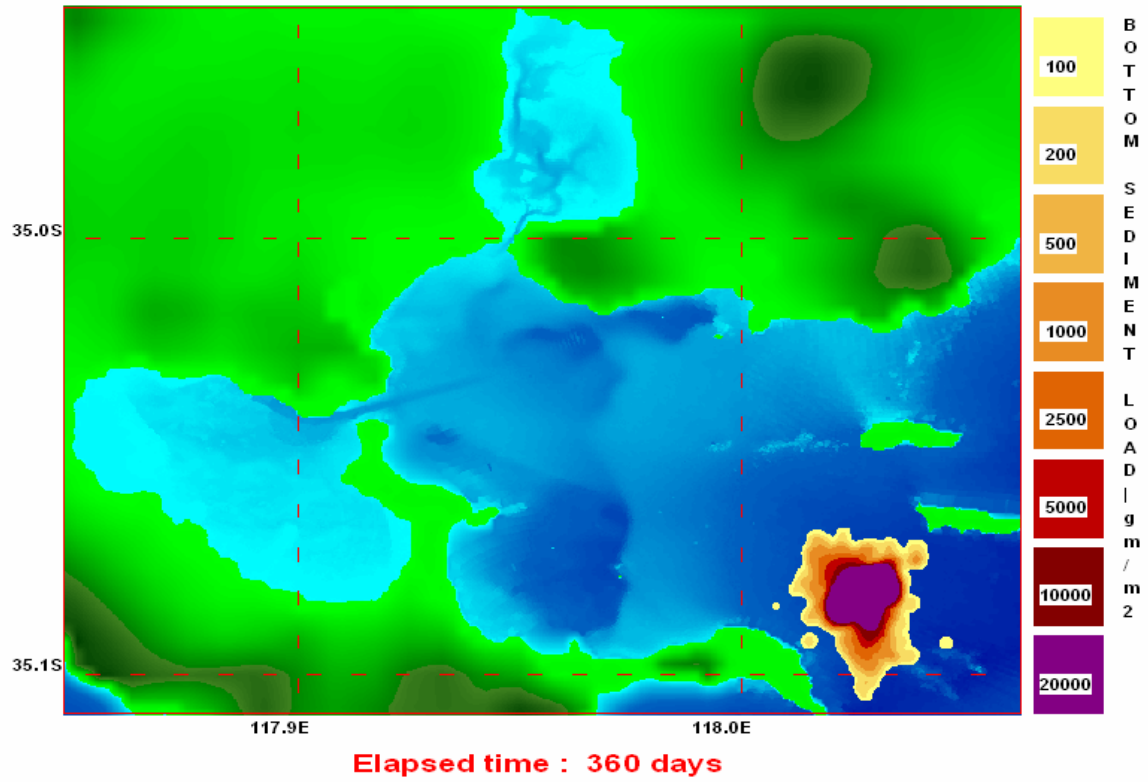


Figure 7-18: Sediment Accumulation (above 100gm/m^2) 12 Months after the Start of Dredging in November.

7.2.3 Implementation

Sediment and water quality will be managed as per Section 7.1.2.3.

- Management units and protection levels of BPPH have been prescribed by the DEC.
- The dredge channel, offshore disposal site, and monitoring site(s) co-ordinates will be accurately communicated to dredge operators and marked clearly on all maps used during the dredging operation.
- Dredge vessels and vessels used for the purpose of collecting monitoring data will be equipped with navigation systems to locate the approved footprint of the dredge channel, offshore disposal site and/or monitoring sites.
- Dredge operators will only operate the dredge engaging heads within the approved project footprint.
- Once the dredge timing has been secured, monitoring sites will be selected within the modelled zone of permanent loss, zone of temporary loss damage, zone of influence and at a minimum of two reference sites outside the predicted zone of impact.
- Indicators of seagrass health will be monitored (Section 8.2). The Seagrass Health Monitoring programme (Section 8.2) will include:
    - Establishment of baseline data prior to dredging operations
    - A data collection sample (at least once) during the dredging programme for comparison to baseline data as a precautionary measure.
    - Procedures for follow up data collection at the sample sites post-dredging activities at least two growing seasons later.
- The Water Quality Monitoring programme may trigger periodic monitoring of shoot density and epiphyte load (Section 8.2 and) throughout the dredge programme.
- The monitoring programme incorporates tiered management actions to reduce turbidity in response to measured decreases in seagrass shoot densities (Figure 8-1).
- Quarantine management strategies to prevent the introduction and/or spread of exotic species are outlined in Section 7.4.

7.2.4 Performance Indicators

- Management Unit 1: Maximum loss of 0.1% of seagrasses associated with dredging and land reclamation, with rehabilitation to ensure the Category F; 0% net damage/loss criteria are achieved.
- Management Unit 2: Losses of seagrasses associated with dredging and land reclamation do not exceed 5% (Category D).
- Management Unit 3: Losses of seagrasses associated with dredging and land reclamation do not exceed 2% (Category C).

7.3 MARINE FAUNA

7.3.1 Potential Impacts

Potential impacts to marine fauna associated with dredging, land reclamation, offshore disposal of excess dredge material and increased vessel traffic into the Port are:

- Increased turbidity reducing the penetration of light in the water column and potentially impacting the respiratory and feeding functions of invertebrates.
- Loss of habitat through impacts of increased suspended solids on BPPH (Section 7.2.1).
- Physical injury to cetaceans due to vessel strike.
- Habitat degradation and reduction.
- Introduction and/or spread of exotic marine organisms that can threaten biological diversity and cause disruption in ecosystem functioning.
- Noise

7.3.2 Objectives and Targets

EPA Objective:

- To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

Targets

- To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.
- Compliance with the Australian National Guidelines for Whale and Dolphin Watching (DEH, 2005).
- No cetacean strikes during the dredging programme.

7.3.3 Implementation

Pinnipeds

- Potential disturbance to normal feeding habits during dredging will be managed through minimising impacts to BPPH (Section 7.2.3) and water quality (Section 7.1.2.3).

Vessels

- Vessels associated with all phases of the project are considered prohibited vessels under the Australian National Guidelines for Whale and Dolphin Watching (DEH, 2005) and as such will not attempt to approach closer than 300 m to any whale or dolphin.
- No vessels will have trail lines or ropes.

- All vessels associated with project construction and dredging will keep a log on the vessel bridge to record cetaceans sighted during project works.
- All vessels used during dredging and reclamation will be capable of varying speeds in order to minimise the potential for cetacean collisions.

Cetacean Impact avoidance

Noise

- Potential noise impacts to cetaceans from piling will be minimised by the use of soft starts that give any cetaceans subject to such noise a chance to clear the area prior to full operation and therefore; avoidance of full construction noise exposure that may cause the marine fauna any displeasure. Soft starts will not commence whilst a cetacean is within 300m of the piling area.
- Potential noise from the dredge and allied vessels will be no greater than the levels already experienced in King George Sound and Princess Royal Harbour with a range of marine – based commercial activities e.g. commercial fishing and tour operators.
- Operation of dredging vessels will be constant, where possible; to reduce/eliminate intermittent vibration and sound emissions thought to disturb cetaceans.
- Surveillance of cetaceans will be maintained from vessels taking into consideration the vessels course and speed. At night the TSHD will maintain a watch on the bridge to avoid potential impacts with cetaceans.
- Cetacean sightings within King George Sound and Princess Royal Harbour will be recorded on the Environment Australia Whale and Dolphin Sighting Report form and submitted to the DEW and be reported to the harbour master.
- Start-up procedures shall include visual observations for the presence of cetaceans within King George Sound and Princess Royal Harbour.
- The TSHD will maintain minimum distance of 300 m from cetaceans where safe and possible to do so.
- In the event that a cetacean comes within 300 m of the TSHD all attempts at avoidance will be made unless avoidance causes a safety risk to the vessel and subsequent human lives.
- In the event that a cetacean comes within 300 m of the TSHD, the vessel's propellers will be disengaged (if safe to do so) until the cetacean has moved to a distance of at least 300 m.
- In the event that impact is unavoidable the TSHD will slow/ stop/ manoeuvre to cause least impact to the cetacean.
- Prior to commencing dumping activities, a dredge crewperson will maintain watch using binoculars from a location that has a field of vision radius of 300 m (monitoring zone).
- Dumping activities shall commence if no cetaceans have been observed within a 300m radius of the vessel for 10 minutes immediately prior to a dumping run.
- If a cetacean is sighted within a 300 m radius of the vessel at the dumping site, then activities will not commence until 10 minutes after the last cetacean has left the monitoring zone.

- The CSD is largely stationary and will be located at the entrance to Princess Royal Harbour. In the event that cetaceans come within 300 m of the CSD, the dredge will stop work until the cetacean(s) have moved to a distance beyond 300 m.

Habitat Requirements

Due to the management strategies outlined in Section 7.1.2.3, the only water quality impacts associated with the marine works will be a transient increase in turbidity during the dredging. The turbidity associated with the proposed works is anticipated to be temporary and highly localised.

It is anticipated that the Albany Port Expansion Project will have minimal impact on the overall status of cetaceans sighted in the area, as potential impacts are manageable, temporary and likely to only affect, if at all, a small proportion of their range and a small percentage of the cetacean population.

Quarantine

Quarantine management strategies to prevent the introduction and/or spread of exotic species are outlined in Section 7.4, Figure 7-16.

7.3.4 Performance Indicators

- No cetacean strikes during the dredging programme.
- All cetaceans sighted by dredge operators during project works recorded.
- All cetacean impact avoidance procedures followed.

7.4 QUARANTINE PRACTICES

7.4.1 Potential Impacts

The potential impact to marine fauna associated with the dredges and increased vessel traffic into the Port is the introduction of and/ or spread of exotic fauna species.

7.4.2 Objectives and Targets

EPA Objective:

- To ensure that emissions (to water) do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

Target:

- Compliance with the Australian Ballast Water Management Requirements (AQIS, 2001), the Australian Ballast Water Management Guidelines for International Shipping (AQIS, 1998) and the Code of Practice for antifouling and In-water Hull Cleaning and Maintenance (ANZECC, 2000).
- No introduction of marine pests from vessels.

7.4.3 Implementation

- A Marine Pest Management Strategy, outlined in Figure 7-19, will be implemented.
- Prior to mobilisation to site, all floating vessels selected for the project will be free of dredge material and marine pest species prior to entering Australian Waters. Dredging vessels will be inspected by a suitably qualified marine scientist in consultation with the DoF.
- The hull and all apparatus lowered into the water for dredging will be free of marine growth that is either exotic (non-Australian), non-indigenous to Western Australia, or a declared marine pest species by the Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE).
- All vessels arriving in Australia from international waters will submit a Quarantine Pre-Arrival Report to the AQIS 12 - 48 hours before arrival in Australia.
- Dredging vessels will be inspected by a suitably qualified marine scientist at the completion of dredging prior to departure from Albany waters.
- AQIS officers will inspect all vessels upon arrival and statements of adequate hygiene must be obtained before programme works commence.
- If the vessel has been cleaned and inspected in a dry dock immediately prior to arrival in an Australian Port and there is sufficient 'Proof of Freedom' of marine pests, then no further inspection is required until departure.
- The criteria of 'Proof of Freedom' is; no evidence of marine pests on area of the vessel. This criterion will be agreed with the DEC and DoF prior to the inspection.
- If 'Proof of Freedom' of marine pests is uncertain, then periodic inspections will be undertaken every month (± 3 days) during the dredging programme.
- All dredging vessels associated with the dredging programme will manage ballast water in accordance with AQIS requirements.
- Vessels will retain all ballast water records in a ballast water log.
- AQIS officers will conduct ballast water verification inspections on-board vessels to ensure compliance with the Australia's ballast water management requirements.
- Sediments from ballast tanks will not be discharged to Australian Waters.

7.4.4 Performance Indicators

- No introduction of marine pests from vessels associated with the dredging and land reclamation programme.

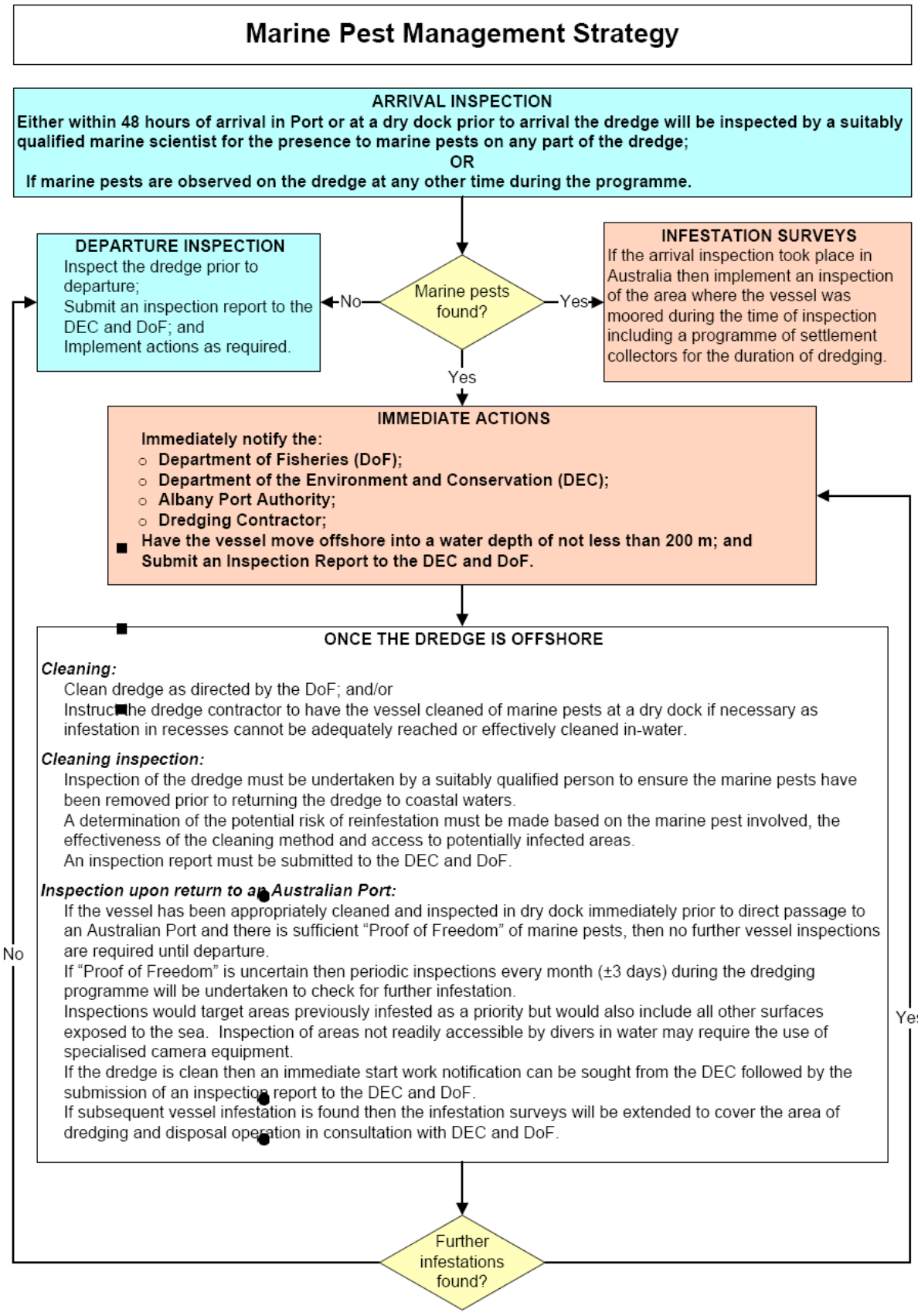


Figure 7-19: Marine Pest Management Strategy

7.5 NOISE

7.5.1 Potential Impacts

Noise from the land reclamation will be associated with the seawall construction, piling for the berth and from construction equipment including trucks and dozers.

7.5.2 Objectives and Targets

Targets

- To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.
- Construction in accordance with the Australian Standards 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites.
- Noise emissions are kept to a minimum.

7.5.3 Implementation

Sensitive Noise Receptors/Cetaceans

- Low-noise equipment will be selected wherever practicable. Silencers and mufflers will be used where necessary.
- Mobile plant will be maintained to ensure optimum operational output as per the manufactures specifications.
- Machines used intermittently will be shut down in intervening periods, or throttled down to a minimum.
- Piling will be scheduled between 7am and 7 pm, Monday to Saturday and not on public holidays.
- Should construction work outside of these hours be required, a specific Noise Management Plan will be submitted to the regional DEC for approval before the commencement of works.
- APA will assess other types of pile driving methods that have lower sound power.
- If required, soft start ups for pile drivers may be employed if cetaceans are present (this may involve a staged increase in the height at which the weight is dropped, thus gradually increasing the emission of noise from pile driving to warn cetaceans and allow them time to move away from the noise source).
- Identified sensitive receptors of noise will be notified of the time and duration of the noise emissions.
- Secondary treatment of residential noise receptors will be investigated and implemented in the advent of any unexpected exceedances.

Employees

- Employee noise exposure levels will be identified to determine exposure to noise in accordance the National Standard for Occupational Noise [NOHSC: 1007(2000)] as part of the Noise Management Strategy.
- Employees' exposure to noise will be managed appropriately in-line with all regulatory requirements.

7.5.4 Performance Indicators

- Minimal complaints received from Albany residents regarding construction noise.
- Albany residents informed of noise associated with proposed construction works.
- All Occupational Health and Safety requirements met.

7.6 HARBOUR ACCESS

7.6.1 Potential Impacts

The potential impact of increased vessels in the entrance to Princess Royal Harbour during dredging and land reclamation is restricted harbour access and conflict with existing users of the area.

7.6.2 Objectives and Targets

Target:

- To ensure that existing recreational uses are not compromised.
- To ensure that existing commercial uses and values are not compromised.

7.6.3 Implementation

- Commercial and recreational vessel passage in the vicinity of the dredging, reclamation and berth construction activities will be directed and managed by the APA Harbour Master.
- The APA Harbour Master will communicate information on vessel movements, time of day, and duration of activities to port users via broadcast and/or issuing a mariners' notice as required.
- Public notices will be communicated regularly to inform the community of key project information and progress.
- Public complaints will be documented, recorded and managed in accordance with the APA EMS.

7.6.4 Performance Indicators

- No vessel collisions.
- No public complaints about lack of information on accessibility.

8 MONITORING

The APA is the proponent for activities associated with the dredging, land reclamation and offshore disposal of dredge material. The APA will be responsible for conducting monitoring and implementing management responses in the event of trigger level breaches. All personnel conducting monitoring will be adequately trained.

Baseline Monitoring Programmes

Monitoring programs will be established 12 months prior to the commencement of main TSHD dredging activities to provide a set of baseline information.

Real Time Monitoring Programmes

Where possible and appropriate, real time monitoring will be conducted during the dredging campaigns and after dredging has been completed. This includes water quality monitoring, seagrass health monitoring and a tiered management system comprising six levels of management.

The objective of the monitoring program is to determine the actual areas of influence and impact, detect variations from modelling assumptions and predictions including sediment properties, determine impacts of variations if any, and to enable APA to act on and prevent significant impacts outside of approval conditions from occurring.

Hydrodynamic and dredge modelling have predicted three zones of potential impact to seagrasses (GEMS, 2007 and SKM, 2007) as follows:

Zone of Permanent Loss: is generally predicted as both:

- The area directly affected (e.g. the channel and disposal site).
- An area immediately about/surrounding the proposed dredging and disposal areas, which is indirectly affected (e.g. by smothering or light limitation) with a severity and duration such that impacts to biota and their habitats will be severe.

This zone defines the area where mortality of, and long term (i.e. months to years) damage to, biota and their habitats would be predicted.

Zone of Temporary Loss/Damage: this zone abuts and lies immediately outside of the Zone of Permanent Loss. Within this zone sub-lethal effects on key benthic biota would be predicted, but there should be no mortality of benthic biota and no long-term damage to, or modification of, the communities they form or the substrates on which they grow. The outer boundary of this zone is coincident with the inner boundary of the next zone – the 'Zone of influence'.

Zone of Influence: this zone is the area where, at some time during the proposed dredging activities, changes in sediment-related environmental quality levels which are outside natural ranges (e.g. median value beyond 80th percentiles of un-impacted reference distribution) might be expected; however, the intensity and duration is such that no detectible effects on benthic biota or their habitats are predicted.

Monitoring sites will be selected within each of the modelled zones and at a minimum of two reference sites outside the predicted zone of impact. Water quality monitoring will be undertaken on a daily basis, with periodic (fortnightly) seagrass health monitoring implemented if water quality exceeds threshold values for 14 consecutive days.

Data Collection

A data collection programme will be run during the dredging operation. Data collected will be used to run the DREDGE3D model in real time along side the actual dredging operation as a validation management tool.

The data will also be used to calibrate and verify the DREDGE3D model to ensure that the level of uncertainty of impact predictions for any future dredge works is reduced.

8.1 WATER QUALITY MONITORING PROGRAMME

Water quality monitoring will be undertaken at sites selected in consultation with the DEC from within the three identified impact zones and include at least two reference sites (Figure 7-6 to Figure 7-8). A flow chart summarising the ongoing and daily schedule of the Water Quality monitoring programme is included in Figure 8-1.

Water Quality Monitoring Overview

- Baseline information will be gathered at sampling sites within Management Units 1 and 2.
- Monitoring will involve placement of fixed data logging probes at two reference sites and at sites within the three identified impact zones to log profiles of selected parameters at each site.
- Monitoring of light attenuation will be undertaken on a daily basis with water chemistry and TSS measured on a weekly basis.
- Additional turbidity monitoring using Secchi disks will be undertaken as required to monitor any plumes migrating outside the predicted zones of impact.
- Baseline information will be compared to a precautionary mid- project sample and a post-activity sample to be completed at the end of the programme at least one growing season after dredging is complete.
- Sampling may include but is not limited to:
    - pH, salinity and temperature;
    - bioavailable nutrient load;
    - total nitrogen, nitrate/nitrite and ammonium;
    - total phosphorus and orthophosphate;
    - chlorophyll *a* concentration;
    - microbial water quality;
    - mercury and Silver; and
    - turbidity (NTU and secchi)
- A 14 day rolling average will be used to compare data from an impact site to the reference sites.
- Data for each parameter collected over a 24 hour period from the fixed data logging probes will be averaged for use in the 14 day rolling average.

- A tiered management approach has been developed with specific management actions developed for exceedances of the 80th percentile, the 95th percentile and the 99th percentile of the reference site threshold value (Figure 8.1).
- Water quality exceedances for 14 consecutive days will trigger the Seagrass health Monitoring Programme.

Nutrients

- Sediment layers known to be high in nutrients will be removed at the beginning of the dredging process by the TSHD.
- Phosphorus and orthophosphate will be monitored during dredging for land reclamation activities.
- Sampling sites will be identified in Management Unit 1.
- The sites will cover areas of potential contamination, areas of potential influence and reference sites located outside the predicted zone of influence.
- Baseline data will be collected by conducting a visual assessment of the epiphyte load on seagrass in Management Unit 1.
- In the event that phosphorus and orthophosphate trigger levels are reached the reactive monitoring programme (actions) will commence. This will include a visual inspection of seagrass shoot density and application of appropriate management options.

Recreational Waters

If dredging occurs during summer, or if an unexpected zone of influence transpires, an applicable sampling programme will be established along the length of Middleton and Goode Beaches to ensure that the swimming beach water quality complies at all times with the National Health and Medical Research Council's Australian Guidelines for Recreational Use of Water (2005).

- Sampling will focus on monitoring indicator organisms (enterococci) for microbial water quality.
- At least 20 samples will be collected during the monitoring period to ensure the microbial assessment category can be assigned. Sampling sites will be determined with advice from City of Albany's Health Services Branch and upstream / reference sites in Oyster and Princess Harbour will also be established to ensure that any detected samples are related to the influence of the dredge, as opposed to other sources.
- Samples will be collected weekly during popular swimming times such as school holidays, and the height of summer (December, January and February), and then reduced to fortnightly during the later part of the bathing season.
- A microbial assessment category will be assigned to each sampling location (expressed in terms of the 95th percentile of numbers of enterococci per 100ml). Each microbial assessment category of A, B, C or D (Table 8-1) represent different levels of health risk to a water user.

- Changes to microbial assessment categories at monitoring sites will be communicated to the public and trigger implementation of turbidity management strategies (Section 7.1.2.3).

In addition to the above, APA will consult City of Albany's Health Services Branch to formulate and/or supplement appropriate recreational water quality monitoring programs.

Table 8-1: Microbial Assessment Categories (NHMRC Guidelines, pg 75).

Category	95th percentile (enterococci)	Basis of derivation	Estimation of probability
A	≤ 40 /100mL	No illness seen in most epidemiological studies	GII risk: <1% AFRI risk: <0.3%
B	41-200 /100mL	200/100mL is above the illness threshold in most epidemiological studies	GII risk: 1-5% AFRI risk: 0.3-1.9%
C	201-500 /100mL	Substantial ↑ in risk of adverse effects where dose-response data available	GII risk: 5-10% AFRI risk: 1.9-3.9%
D	>500 /100mL	Significant risk of high levels of illness transmission	GII risk: >10% AFRI risk: >3.9%
GII: gastrointestinal illness AFRI: acute febrile respiratory illness			

Aquaculture

- Monitoring of water quality at sites in proximity to aquaculture leases will be conducted. This includes baseline as well as real time monitoring.
- The monitoring program will be designed to best supplement the existing WASQAP fish/aquaculture monitoring programmes and stock assessments. The agreed monitoring protocols will be developed with advice from DoF prior to ground disturbing activity.
- In addition to be above, APA will form a Dredge Management Group as part of ongoing engagement for the project. The group will include key stakeholder representatives and a DoF local Officer.

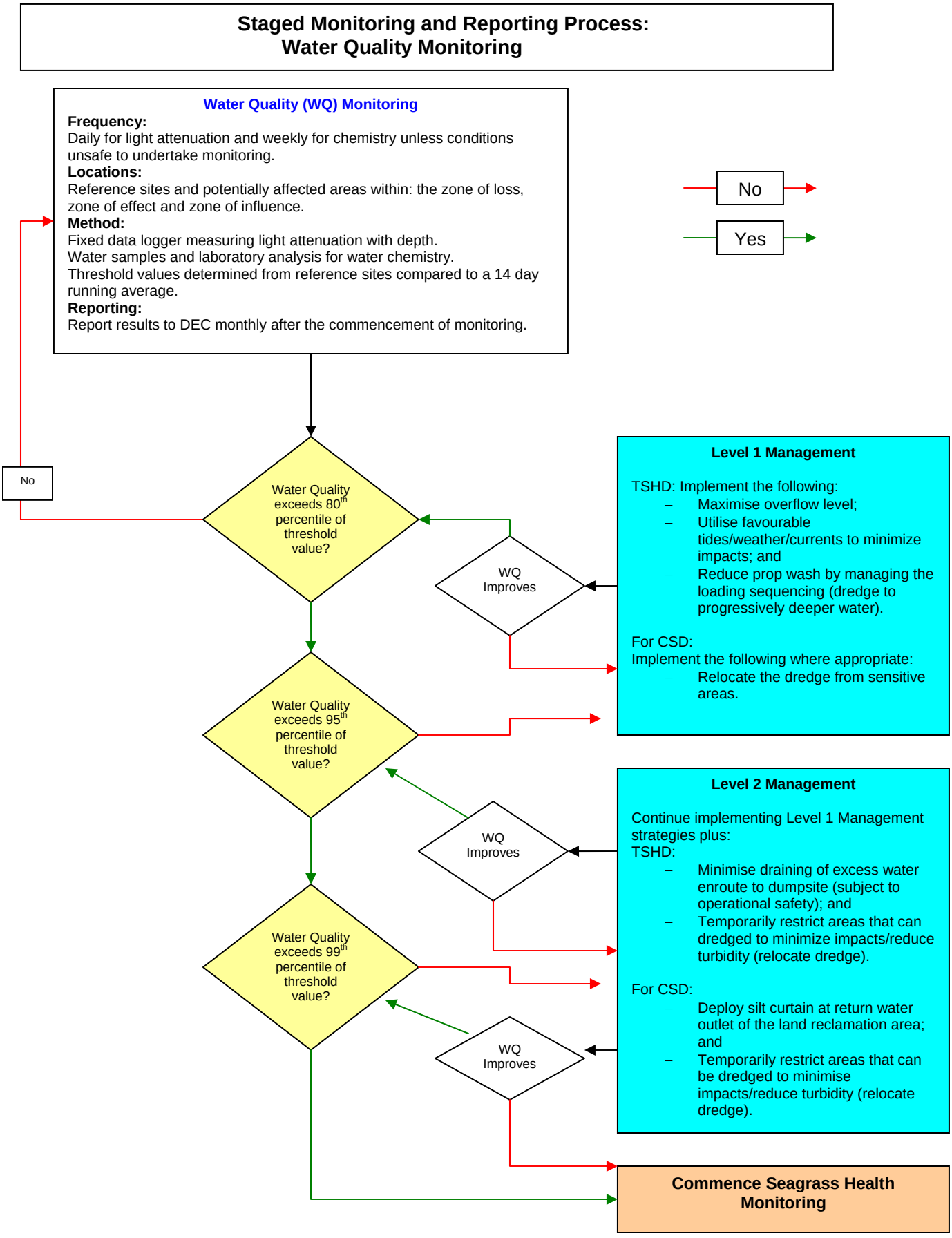


Figure 8.1: Monitoring and Reporting Process: Water Quality Monitoring

8.2 SEAGRASS HEALTH MONITORING PROGRAMME

The dominant BPP in Albany waters is seagrass. The Seagrass Health Monitoring Programme forms part of the overall Water Monitoring Programme (Figure 8.1 and Figure 8.2).

- Once the dredge timing has been scheduled, monitoring sites will be selected within the modelled zones of effect (permanent loss and temporary loss/damage), zone of influence and at a minimum of two reference sites outside the predicted zone of impact, in consultation with the DEC/DoW.
- Baseline data will be collected from the reference sites and the impact sites a minimum of 12 months prior to commencement of the main THSD dredging task.
- Shoot density and epiphyte load will be monitored at each site.
- As a precautionary measure, data will be collected from the monitoring sites at least once during the dredging programme for comparison to baseline data.
- If water quality triggers are exceeded for 14 consecutive days during dredging, seagrass monitoring will be undertaken periodically (fortnightly) until such time as the levels fall back below the trigger levels.
- Seagrass loss in the zone of effect and the zone of influence will be calculated as a percentage nett loss value. Seasonal variation at the reference sites will be taken into account by subtracting the average loss of seagrass shoot density at the reference sites (if any) from the losses within the predicted zones of impact.

Staged management actions will be implemented based on measured decreases in seagrass shoot density in consultation with the DEC/DoW (Figure 8-2) as follows:

- Should seagrass shoot density decrease by 50%, dredging will be ceased in that area, the DEC/DoW will be consulted and the Dredge Management Group will be convened.
- Data will be collected at the sample sites annually post-dredging for a minimum of two growing seasons, to determine the total loss of seagrasses associated with the Project. Results will be forwarded to the DEC/DoW.
- Monitoring results will be forwarded to the DEC/DoW on a regular basis as determined appropriate for the different parameters.
- In the event that a visual inspection of seagrass cannot be undertaken due to poor visibility, precautionary management options will be implemented.

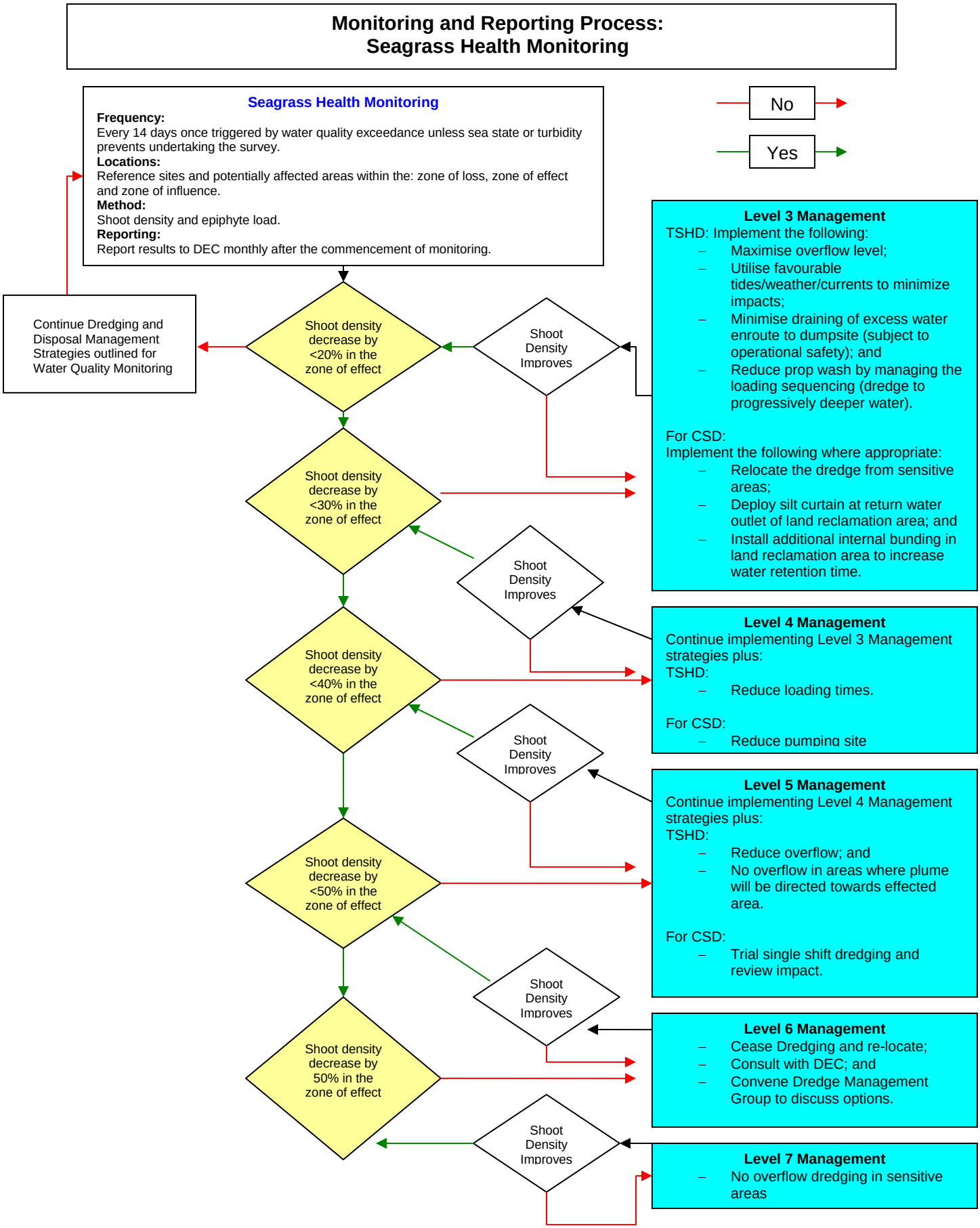


Figure 8.2: Monitoring and Reporting Process: Seagrass Health Monitoring

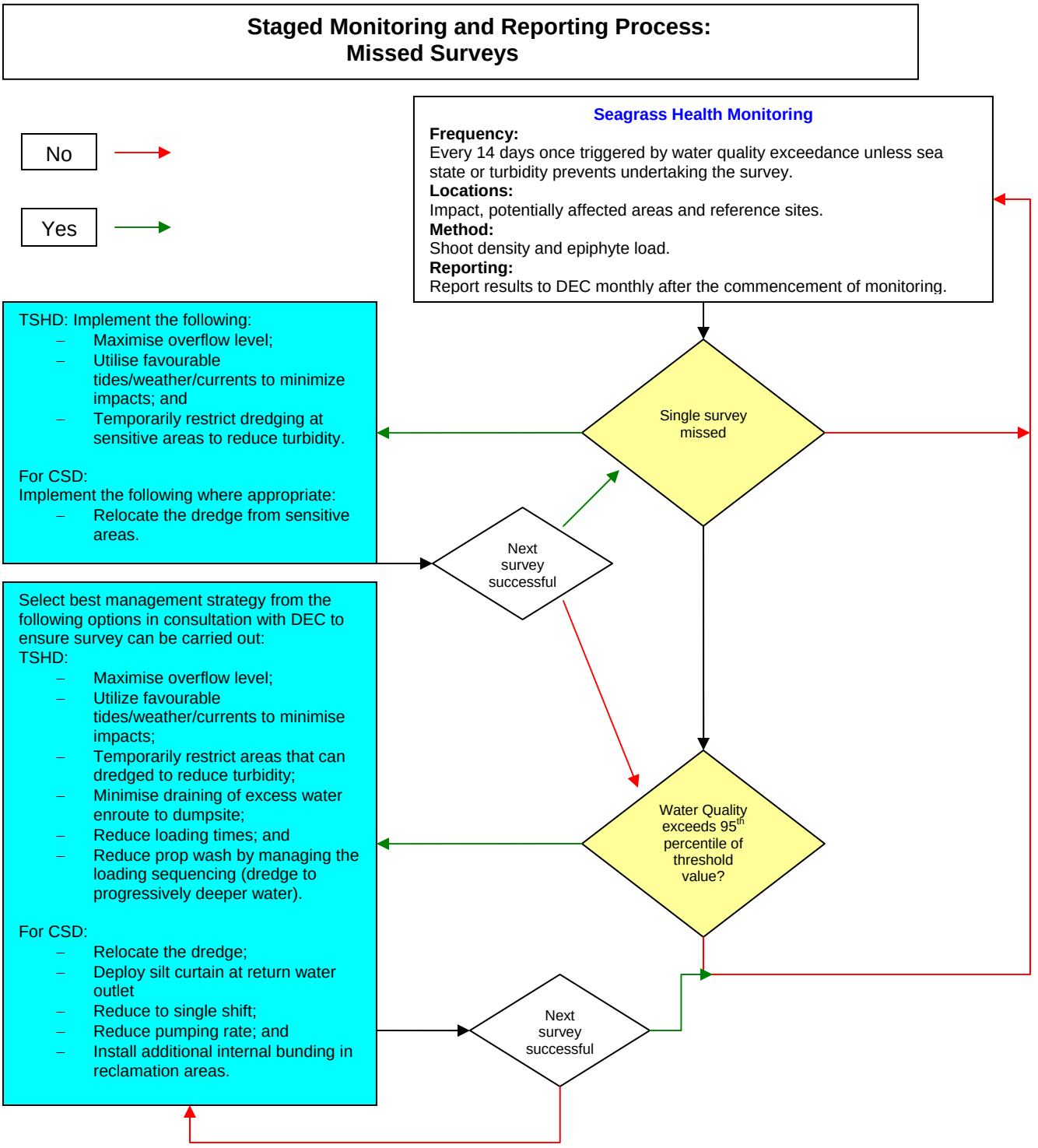


Figure 8.3: Monitoring and Reporting Process: Missed Surveys

8.3 DATA COLLECTION PROGRAMME

Data on TSS and light attenuation throughout the dredge programme will be measured as part of the Water Quality Monitoring Programme (Section 8.1) at a minimum of six locations within Princess Royal Harbour and King George Sound.

In addition, an Acoustic Doppler Current Profiler (ADCP) will be deployed at a key location within an appropriate zone to validate the dredge modelling. The ADCP will provide data on currents and a vertical profile of the turbidity at regular time intervals.

Data will be collected for the duration of the dredging operation to calibrate and verify the DREDGE3D model against the key response parameters of dredging and offshore disposal. Logged data will be used to model a hind cast /now cast of the actual dredging operation for comparison with model predictions. The predictive capabilities of this modelling will be used as a management tool for the dredging operation in the advent that the initial model predictions materially vary from the actual activities.

This process will provide additional data to ensure that the level of uncertainty of impact predictions for any future dredge works is reduced.

9 CONTINGENCIES

In the event that a trigger value is exceeded and indicates the need for a management response, APA will initiate a specific contingency plan, in consultation with DEC. APA's contingency will:

- Take immediate action to prevent the situation from becoming worse.
- Clean up and monitor the recovery of the affected area.
- Investigate the root cause of the incident.
- Revise management strategies to prevent recurrence of the event.

10 STAKEHOLDER CONSULTATION

Grange and the APA have been in consultation with key regulatory groups, non-government agencies and key stakeholders as well as the Albany and Wellstead communities since the commencement of the feasibility studies. The key stakeholders are presented in Table 10-1.

Table 10-1: Key Stakeholders.

Stakeholder Groups	
Albany Heritage Reference Group (Albany)	Department of Planning and Infrastructure (DPI, Perth and Albany)
Albany Maritime Heritage Association (Albany)	Department of Premier and Cabinet (DPC, Perth)
Aquaculture Council of WA (Perth)	Environmental Protection Authority (EPA, Perth)
City of Albany (Albany)	Environmental Protection Authority Services Unit (EPASU, Perth)
Department of Agriculture (Perth)	Great Southern Aquaculture Association (Albany)
Department of Environment and Conservation (Perth)	Great Southern Development Commission (GSDC, Albany)
Department of Environment and Conservation (Albany)	Main Roads Department
Department of the Environment and Water Resources (DEW, Canberra)	Marine Conservation Council Network (Perth)
Department of Health (DoH, Perth)	Public Transport Authority
Department of Indigenous Affairs (DIA, Albany)	Recreational Fishing Advisory Committee (Albany)
Department of Industry and Resources (DoIR, Perth)	South Coast Professional Fisherman's Association (Albany)
Department of Maritime Archaeology (Perth)	Water Corporation
Marine Stakeholders Group	Department of Water (Albany)
Western Australian Fishing Industry Council	Aquaculture Council of Western Australia

11 AUDITING AND REPORTING

As part of monitoring programme, visual inspections and quality monitoring for light attenuation will be conducted daily, with water chemistry monitored on a weekly basis (Figure 8-2). Results will be reported to the DEC/DoW monthly after commencement of monitoring.

Seagrass monitoring will be conducted prior to commencement of dredging, at the completion of dredging, and a minimum of once during the dredge operation. Seagrass health monitoring will be conducted every 14 days once triggered by water quality exceedances unless sea state or turbidity prevents undertaking the survey (Figure 8-1 and Figure 8-2) and will de-escalate when levels return back below the appropriate triggers. Results will be reported to the DEC monthly after commencement of monitoring.

Compliance with commitments outlined in this document will be internally audited by APA and subject to external audits by the relevant regulatory agencies, including the DEC, Department of Industry and Resources (DoIR) and Department of Water (DoW).

Results of performance and monitoring programmes will be reported to the DEC through annual performance reports and Compliance reports.

12 REVIEW AND REVISION

This management plan will be reviewed and revised in the event of changes to the project description or new requirements/legislation coming in to effect. A copy of the revised version will be sent to relevant regulatory authorities and resubmitted to the DEC for comments.

The review status of this document is provided on page (i) on the inside cover of this document.

13 REFERENCES

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A.1 Risk Assessment

Table 13-1: Consequence Severity Table.

Level		Consequence	Examples
1	Insignificant	No detectable impact to the existing environment.	Isolated incident of public complaint
			Small hydrocarbon spill.
2	Minor	Short term of localised impact	Reduction in access for recreation and visibility for recreational divers/smothering of heritage sites.
			Short term nuisance/disturbance to residents and local business from construction noise.
3	Moderate	Prolonged but recoverable impact on the environment and commercial industries.	Excess removal of seagrass that may not recover completely.
			Increased light attenuation causing decrease in health of BPPH.
			Increased light attenuation causing decrease in food (phytoplankton) availability.
			Vessel collision with cetacean resulting in death.
			Sediment plume causing reduced viability of commercial industry through deposition, visual impact and increased light attenuation (fisheries, aquaculture and tourism).
4	Major	Prolonged impact to the environment which may not be recoverable and threatens an ecological community, the conservation of a species or the sustained viability of commercial industries.	Introduction of marine pests that may reduce biodiversity.
			Removal of BPPH beyond the threshold required to maintain ecosystem health.
			Altered hydrodynamics resulting in changes to coastal erosion/deposition patterns.
5	Catastrophic	Non-recoverable change to existing environment leading to loss of endangered species or creation of human health risk	Human illness/death from contaminated food.
			Permanent loss of aquaculture and fishing industry viability.

Table 13-2: Likelihood Ranking Table.

Level		Likelihood
A	Almost certain	The incident is expected to occur most of the time (i.e. every time).
B	Likely	The incident will probably occur in most circumstances (i.e. regularly, weekly).
C	Moderate	The incident should occur at some time (i.e. quarterly)
D	Unlikely	The incident could occur at some time during the life of the project.
E	Rare	The incident may occur only in exceptional circumstances and may never happen.

Table 13-3: Risk Matrix.

Consequences

		1	2	3	4	5
Likelihood		Insignificant	Minor	Moderate	Major	Catastrophic
A	Almost certain	S	S	H	H	H
B	Likely	M	S	S	H	H
C	Moderate	L	M	S	H	H
D	Unlikely	L	L	M	S	H
E	Rare	L	L	M	M	S

Where:

H	High impact	Senior management involvement and planning needed and CALM/DoE must be consulted with.
S	Significant impact	Senior management attention needed and careful planning and implementation.
M	Moderate impact	Management responsibility must be specified.
L	Low impact	Manage by routine procedures.