Appendix D
Seagrass Risk Assessment

Maintenance Dredging at Stirling Naval base Garden Island WA

Review of the effects of shading on seagrass

Department of Defence

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Contents

1 Introduction

Light is a key resource and is critical for the growth and survival of seagrasses (Hemminga & Duarte 2000). Dredging can alter the light available to seagrasses, with reports of sublethal and lethal effects on seagrasses due to prolonged exposure to elevated turbidity and siltation resulting from dredging activities (e.g. Gordon et al. 1996, Cheshire et al. 2002). It is important to note, however, that elevated turbidity and siltation due to dredging will only result in adverse effects on seagrass if the turbidity generated is significantly larger than the natural variation in the area (Orpin et al. 2004) – severe storms create periods of suspended sediments. Similarly, commercial shipping and trawl fishing can create pulses of suspended sediments that reduce the incident light available to seagrasses.

In response to light reduction, seagrasses will employ mechanisms to balance the loss of carbon (Dennison & Alberte 1985). Physiological responses will generally occur first, followed by morphological responses (Collier et al. 2009, Lavery et al. 2009) and biomass loss if the light reduction persists. The nature of the response depends on the species, the environmental conditions and the intensity and duration of light reduction (Collier et al. 2009). The minimum light requirements of many seagrass species appears to be between 15% and 25% of the subsurface irradiance (SI) but some species – including some *Posidonia* spp. – can survive with as low as 3–8% of SI (Erftemeijer & Lewis 2006 and references therein).

2 Review of the effects of shading on seagrass

Within and near the Department of Defence proposed dredging project area, *Posidonia sinuosa* is the dominant seagrass species present (Geo Oceans 2015). *Posidonia australis* is present in occasional patches and small patches of *Amphibolis antarctica* exist next to the Armament Jetty (Geo Oceans 2015). Both genera are climax seagrass species (Shepherd & Robertson 1989, Stapel & Hemminga 1997).

Studies on *P. sinuosa* have shown that reductions in light availability lead to a reduction in shoot density and seagrass productivity (Gordon et al. 1994, Collier 2004, Mackey 2004, Lavery et al. 2009). *P. sinuosa* growing in monospecific patches in Cockburn Sound had a minimum light requirement of 8–14% of SI (Collier et al. 2009). When subjected to shading intensities of up to 95% of SI, shoot density was affected but plants persisted in all treatments after 198 days of shading (Collier et al. 2009). Under the high shade treatment, shoot density decreased by 82% within 105 days although 6% of shoots remained after 198 days (Collier et al. 2009). *P. sinuosa* in Princess Royal Harbour, Albany, that was subjected to heavy shading (80–99% of SI) for 148 days had shoot density and productivity around 10% of plants in unshaded plots (Gordon et al. 1994). In both studies, recovery of shoot density was slower that other parameters, remaining significantly reduced in moderately to heavily shaded treatments after 245 and 384 days of recovery, respectively (Gordon et al. 1994, Collier et al. 2009). These responses suggest that large reductions in light availability would lead to collapse of *Posidonia* seagrass meadows within ca. 2 years.

Less information is available on the response of *P. australis* to reduced light availability. A study in Jervis Bay, New South Wales, found that shading to less than 10% of SI for a 3-month period significantly lowered morphological parameters including leaf growth rate and shoot density, and that shading in early summer had a more severe effect than shading at the end of summer (Fitzpatrick & Kirkman 1995). Although some shoots persisted after 3 months of shading, shoot density showed no recovery after 17 months without shading (Fitzpatrick & Kirkman 1995).

The effects of reduced light availability on *Amphibolis* species is relatively well-documented for *A. griffithii* but less so for *A. antarctica*. Generally, however, *A. griffithii* and *A. antarctica* have been shown to have similar photosynthetic responses to irradiance (Masini & Manning 1997) and from this it is reasonable to assume their response to reduced light availability will be similar. In a study examining the interactive effects of timing, intensity and duration of shading on *A. griffithii* growing at Jurien Bay, the most obvious morphological response was leaf loss (Lavery et al. 2009). Moderate shading imposed at the end of summer for a 3-month period resulted in 57% loss of leaf biomass compared with no loss of leaf biomass when shading began at the end of winter (Lavery et al. 2009). Although this result may seem counterintuitive based on maximum carbohydrate reserves known to occur in seagrasses during summer (Collier et al. 2009), Lavery et al. (2009) attribute this result to seasonal differences in light requirements. During summer, the light requirement of seagrasses is much higher than during winter, so reduced light availability during summer and autumn creates a greater drawdown of carbohydrate reserves. Seagrasses will shed leaves to reduce this drawdown and to minimise self-shading (Collier et al. 2009). Recovery of *A. griffithii* seagrass meadows can take up to 10 months after the removal of light reduction (McMahon & Lavery 2008). Longer durations of shading had a greater effect with up to 99% loss after 9 months of heavy shading (Lavery et al. 2009), from which *A. griffithii* was unable to recover (McMahon et al. 2011). Importantly, there was no evidence that *A. griffithii* is more susceptible to shading than larger seagrasses such as *Posidonia* species, which is contrary to earlier views (Erftemeijer & Lewis 2006 and references therein).

3 Conclusion

In summary, the timing, intensity and duration of the onset of reduced light availability are important factors in seagrass survival (and recovery), which in turn will be influenced by the natural seasonal variation in carbohydrate reserves and minimum light requirements. Evidence in the literature suggests that all species (*P. sinuosa*, *P. australis* and *A. antarctica*) growing in the project area will be able to withstand short durations (3 months or less) of moderate to heavy shading events, regardless of the timing of the onset of reduced light availability. Effects may be evident, particularly in shoot density and leaf growth rate, but are unlikely to cause mortality. Longer durations of reduced light are likely to have significant effects on the ability of the seagrass to survive and recover to its previous state.

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Appendix E
Tidal currents at Dredge Areas

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HMAS Stirling Dredging

ADCP tidal currents and dredge disposal summary

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Contents

Introduction

Maintenance dredging is required at the Department of Defence HMAS Stirling port facilities, at Garden Island, Western Australia. Aurecon has been commissioned to support the Department of Defence on the dredging works. Maintenance dredging works are proposed at two sites on Garden Island - dredging of 4 berth and channel areas within the Careening Bay facilities on the south of the island, and dredging of 2 berth and channel areas at the Armament Wharf on the north-east of the island. The dredge material is proposed to be pumped to a designated offshore disposal location close to the two dredging locations.

The Garden Island dredging sites are shown below, and are detailed further in Section 2.2 of this memo.

Figure 1 Garden Island layout and dredging sites

As part of the commission, measurements and assessment of tidal currents at the two dredging sites has been undertaken, to inform the project on the magnitude and direction of tidal currents, and to provide information to support any dredging impact assessment. Measurements of tidal currents have been undertaken by the deployment of an Acoustic Doppler Current Profiler (ADCP) at both of the dredging sites.

A desktop assessment of the likelihood of tidal currents re-mobilising the dredge material disposed nearby on the seabed has also been undertaken. An assessment of dredge plume dispersion has not been undertaken.

This brief report summarises the ADCP deployment, the tidal current data, the results analysis of the tidal current data at each of the two sites and the desktop assessment of dredge disposal material being re-mobilised on the seabed.

Tidal current measurements

2.1 Method

Tidal currents have been measured by two ADCP instruments, deployed in a measurement campaign undertaken by Gardline Marine Sciences. The ADCP's were bottom mounted on the seabed, and recorded continuous tidal current magnitudes and directions throughout the water column.

ADCP 1 was deployed at Careening Bay, while ADCP 2 was deployed at Armament Wharf. ADCP 1 recorded tidal currents in 21 bins, with continuous tidal current measurements at 21 fixed heights through the water column. ADCP 2 recorded tidal currents at 13 fixed heights through the water column.

Gardline Marine Sciences completed the data processing and quality control checks on the data, and supplied the processed data in excel format. Tidal currents were reported upon by Gardline Marine Sciences at each measurement location, in 10-minute average durations and at each bin.

2.2 Locations

ADCP 1 was deployed in Careening Bay, towards the end of Parkes Wharf. The ADCP was located in approximately 11m water depth. The ADCP location was chosen as it was situated close to the three berth areas within Careening Bay requiring dredging, was situated in suitable water depth and was located outside of shipping navigation areas.

The berth areas requiring maintenance dredging are shown in the figure below (Areas A, B & C), as well as the ADCP location. The fourth berth area requiring a small amount of dredging in Careening Bay (Area D) is located in the adjacent small craft harbour.

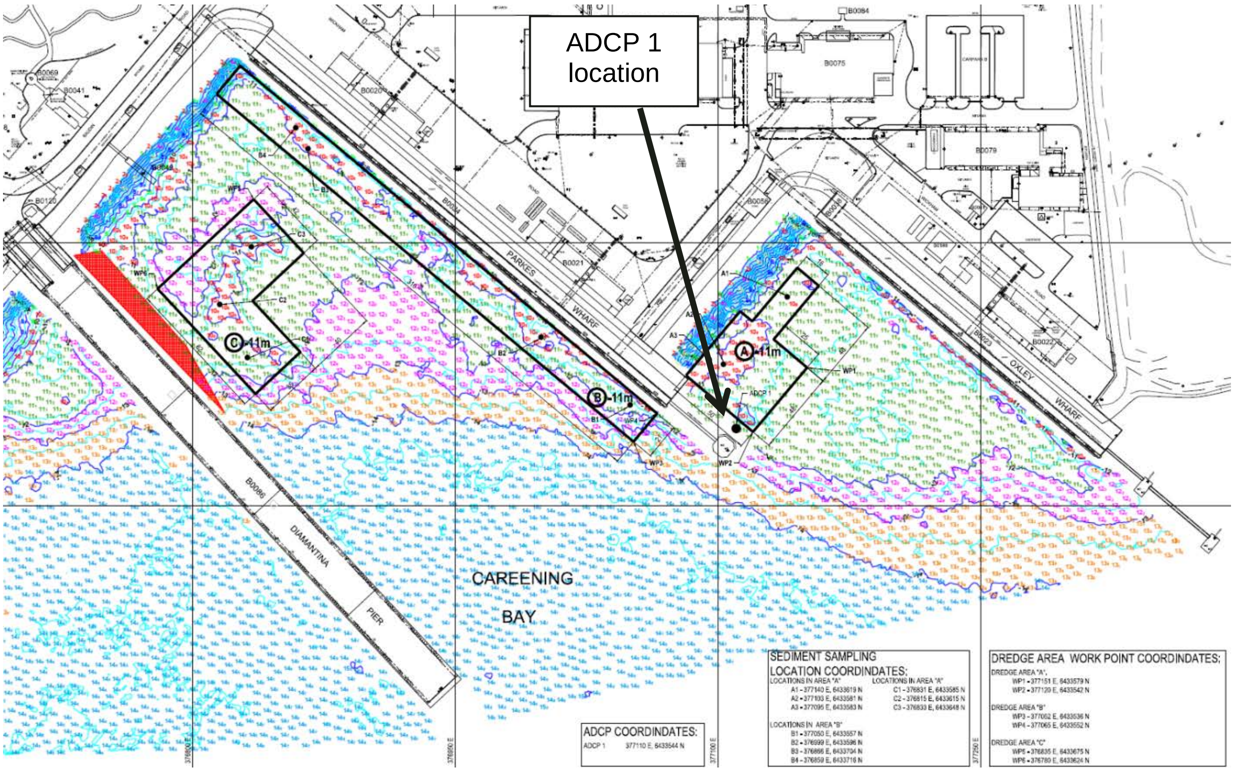

Figure 2 Careening Bay – dredging layout (areas A, B & C) and ADCP location

ADCP 2 was deployed at Armament Wharf, to the north of the wharf. The ADCP was located in approximately 11m water depth. The ADCP location was immediately adjacent to the required dredging areas, but in a location outside of shipping navigation areas.

The berth and navigation area requiring maintenance dredging is shown in the figure below (Areas F & G), as well as the ADCP location.

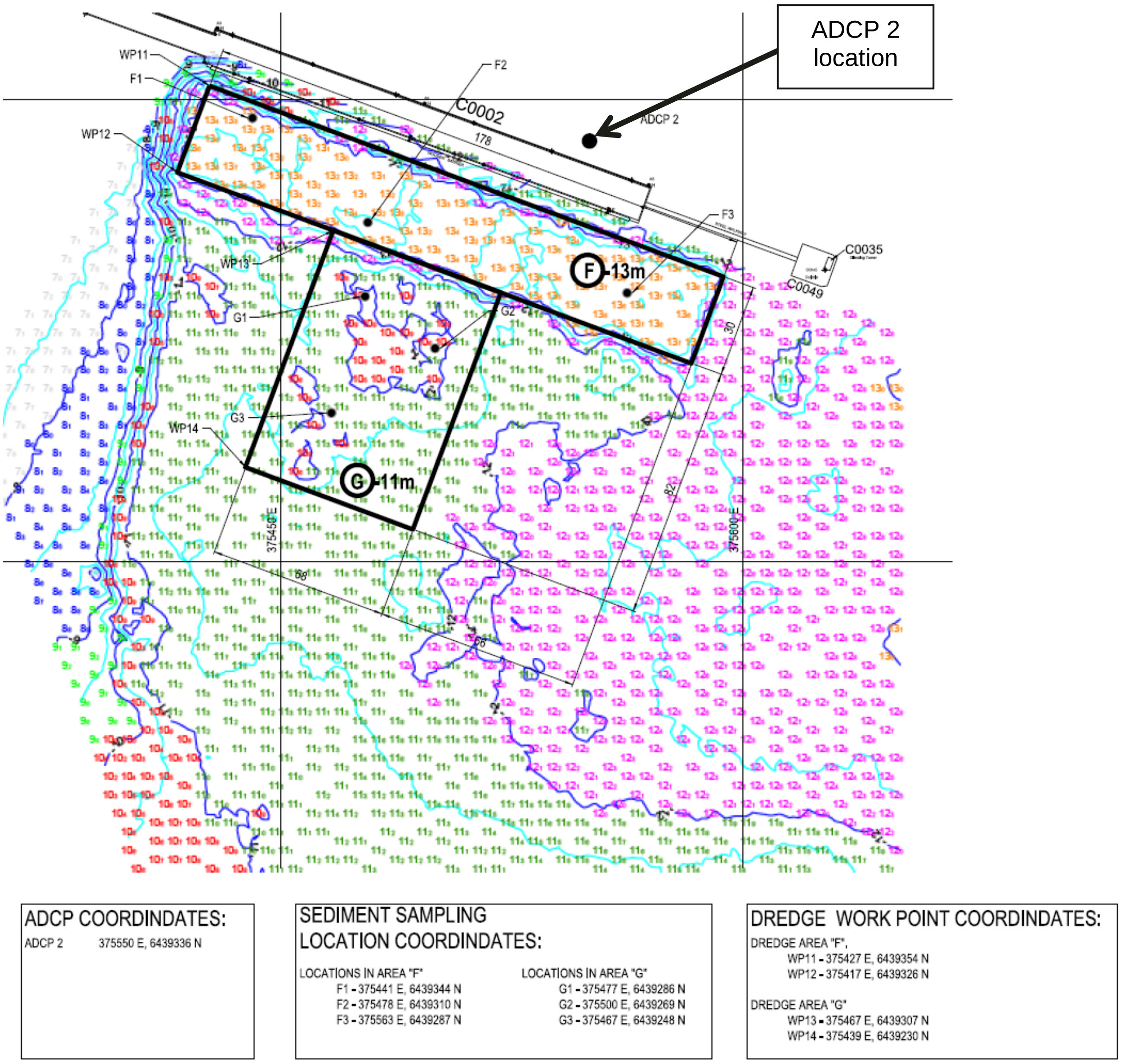

Figure 3 Armament Wharf – dredging layout (areas G & F) and ADCP location

Both ADCP locations are immediately adjacent to the required dredging areas, and the measured tidal currents are representative of the tidal currents which are expected to be experienced during the dredging works.

2.3 Duration

Tidal currents were measured over approximately 17 days, from the 1/5/2014 to 18/5/2015 at both sites.

Tidal currents results

An analysis of the depth-varying and depth-averaged currents has been performed. A summary of the tidal currents at each of the two sites is presented below.

It should be noted that the tidal range at the site is very small, with a maximum tidal range of only 1.2m, and a typical spring tidal range of less than 1.0m. Tides at the site are predominantly diurnal with small semi-diurnal effect during neap tides, with typically one high tide and one low tide per day. As a result of the small tidal range, tidal currents at the site are expected to be small.

3.1 Careening Bay - ADCP 1

The measured tidal currents at the ADCP1 location within Careening Bay are spread over a large range of directions but are of small velocity, with velocities typically less than 0.1m/s. Tidal currents in the upper part of the water column in particular appear highly variable, and current can be stronger in magnitude than at mid-water.

A summary of the measured depth-averaged tidal currents is shown below, on a tidal current rose. The direction shown is degrees True North, with direction current going to.

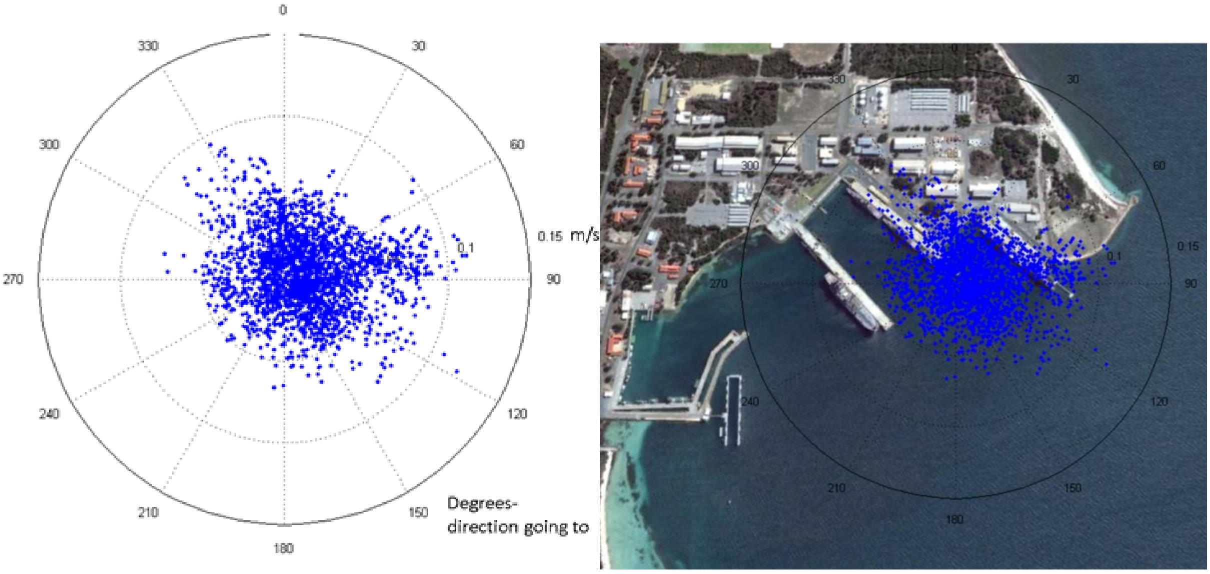

Figure 4 Measured tidal currents rose at ADCP 1 – Careening Bay – depth-averaged velocities

The mid-depth tidal currents are typically more uniform, with tidal currents up to 0.1m/s, and roughly aligned in an East-West direction. However these current directions do not appear to correlate strongly with the ebbing and flooding tide. A summary of the mid-depth tidal currents is shown below.

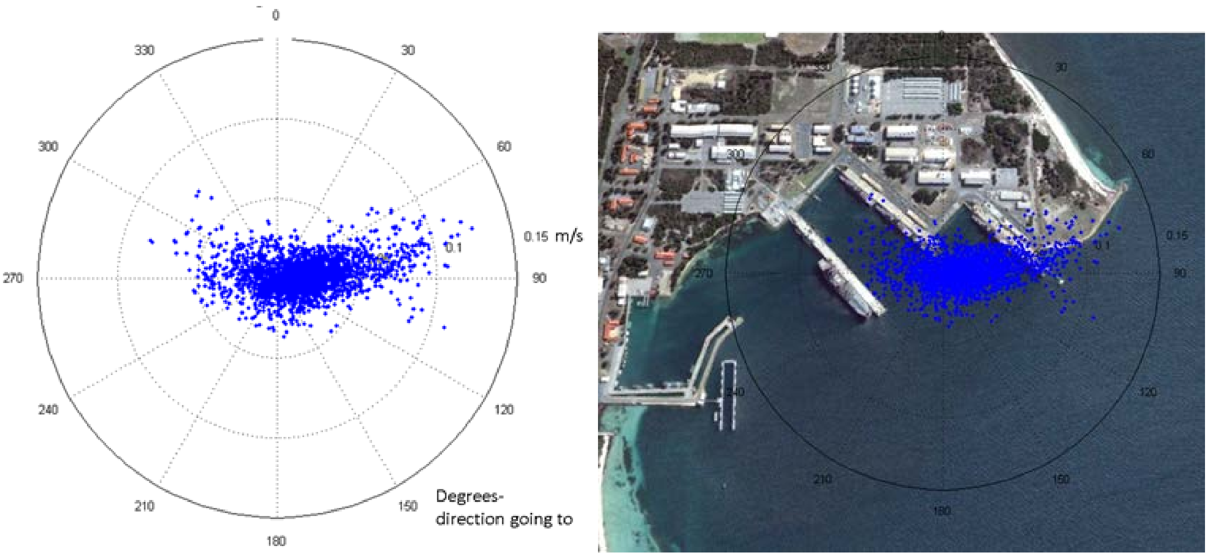

Figure 5 Measured tidal currents rose at ADCP 1 – Careening Bay – mid-depth velocities

Overall the tidal currents at the Careening Bay dredging site are variable but benign, with very small current velocities. The small tidal current velocities are due largely to the small tidal range at the site. The measured current direction appears variable, possibly due to the well sheltered location inside the port, and due to influences from wind driven currents, wave driven currents and vessel motions.

3.2 Armament Wharf - ADCP 2

The measured tidal currents at the ADCP 2 location are relatively uniform, and relatively omni-directional along the NNE-SSW direction. The dominant tidal currents are parallel to the shoreline and seabed bathymetry, with up to 0.2m/s current to the NNE during the ebb tide and up to approximately 0.3m/s to the SSW during the flood tide. Tidal currents of up to 0.1m/s can occur in other directions.

A summary of the depth-averaged tidal currents is shown below, shown on the tidal current rose. The direction shown is degrees True North, with direction current going to.

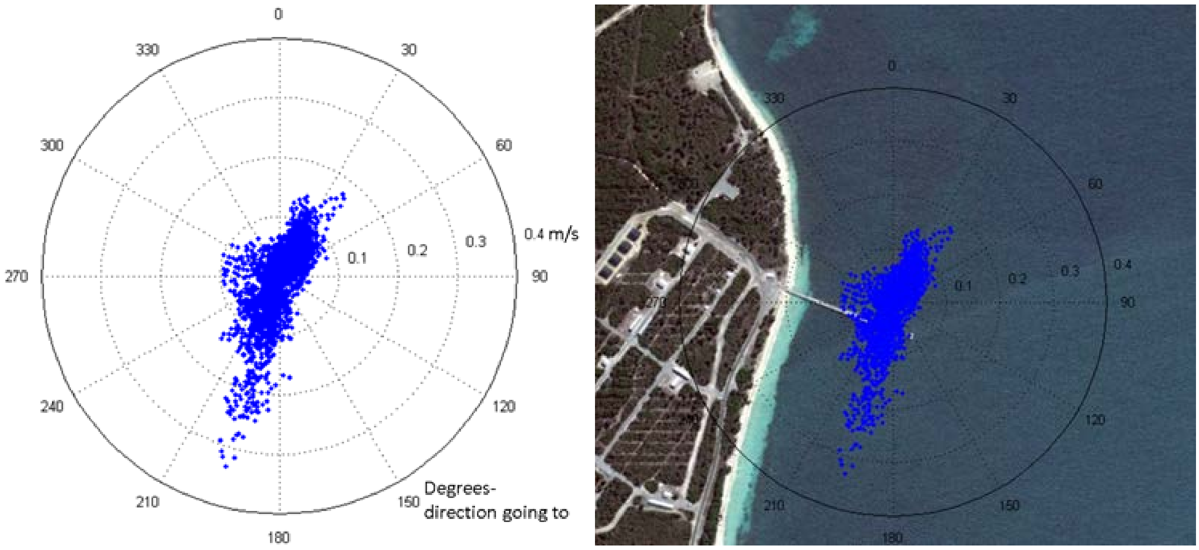

Figure 6 Measured tidal currents rose at ADCP 2 – Armament Wharf – depth averaged velocities

Overall the tidal currents at the Armament Wharf dredging site are of small velocity, typically less than 0.2-0.3m/s and parallel to shore. The small tidal currents are due largely to the small tidal range at the site.

Dredge disposal - sediment remobilisation

4.1 Background

The dredging may be undertaken via a cutter suction process, but the final dredging methodology will be finalised during further studies. Dredged material will be pumped some ~500m directly to the nearby offshore dredge disposal location, where the slurry will be deposited directly on the seabed to minimise dredge plume impacts. It is assumed that the discharge pipeline will be sunk on the seabed, in approximately 15m water depth, in order to minimise surface plume extents. An alternative contractor methodology may involve backhoe dredging, with disposal via a split hopper barge.

Due to the small volumes of dredge material, with total dredge volume less than 8,000m^3, the duration of dredging is expected to be very small. The Careening Bay dredging may take in the order of 2-4 days to be completed, while the Armament Wharf dredging may take approximately 4-6 days, but is dependent upon dredging equipment and methodology.

The proposed disposal sites are shown in the figure below.

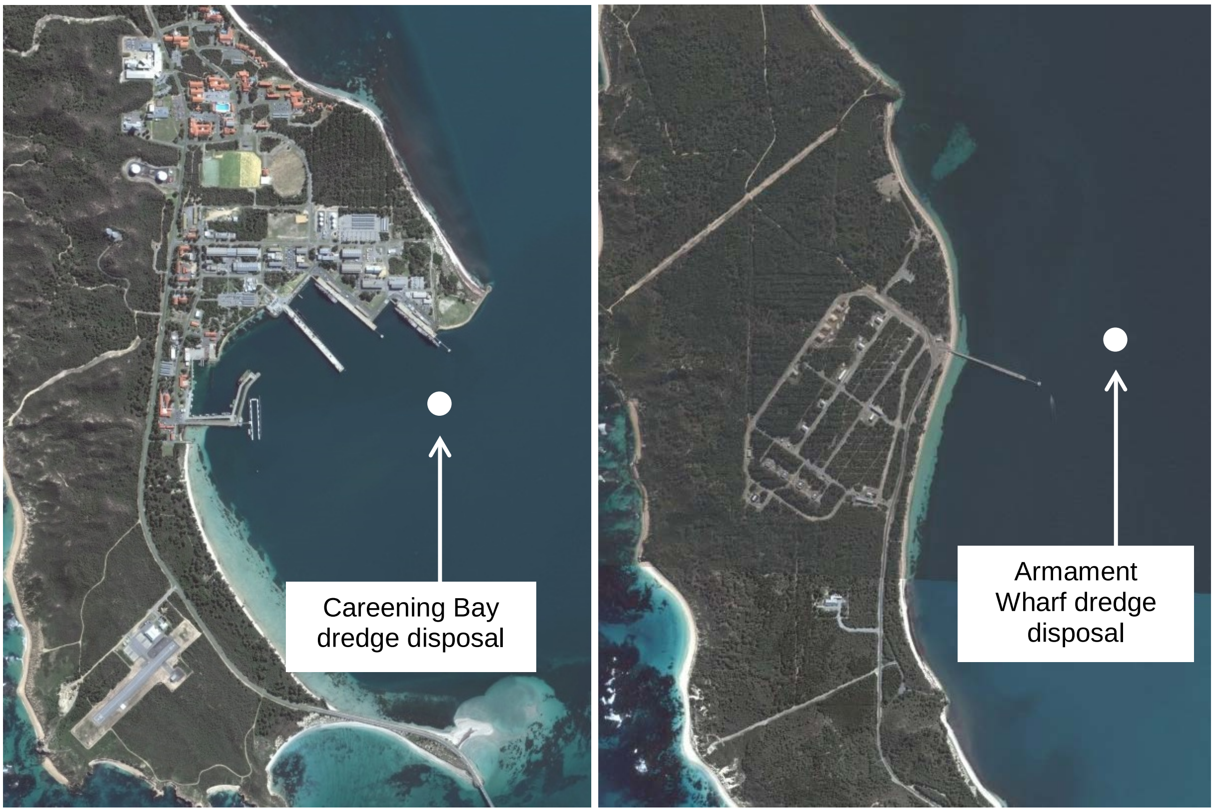

Figure 7 Proposed approximate dredge disposal locations

It is likely that an initial period of material movement may occur, as the material settles and disperses adjacent to the pumped outfall point. Once the dredged material has settled onto the seabed and stabilised after any initial material movements, environmental forces can re-mobilise the sediments. Typically waves in shallow water and moderate tidal currents can mobilise bed material, depending on the size and nature of the sediments. Sediments are mobilised when the bed shear stresses from forces exceed the critical shear stress required to mobilise the bed material.

A wave analysis has not been undertaken, but given the very protected nature of both disposal locations from swell and wind waves, and the relatively deep water depths compared to wave heights and wave lengths, waves are unlikely to mobilise sediment during ambient conditions. An analysis of the bed shear stresses generated by tidal currents at the site has been undertaken, to assess the likelihood of mobilisation of dredged material at the disposal location. This assessment is summarised below.

4.2 Material properties

Sediment sampling at the dredging sites has been undertaken, to provide information on the nature of the material to be dredged. Particle size distribution and density analysis of the collected sediments was undertaken at an ALS laboratory. A summary of the sediment samples and expected dredge material is shown below.

Table 1 Sediment properties

Location		D50 (mm)	Material breakdown (%)			
			Clay (<2µm)	Silt (2-60µm)	Sand (0.06-2mm)	Gravel (2-60mm)
Careening Bay-Area A	A1	0.15	7%	7%	86%	<1%
	A2	0.15	7%	2%	91%	<1%
	A3	0.13	7%	4%	89%	<1%
Careening Bay-Area B	B1	0.2	2%	1%	97%	<1%
	B2	0.15	7%	5%	88%	<1%
	B3	0.13	11%	6%	82%	1%
	B4	0.12	6%	4%	90%	<1%
Careening Bay-Area C	C1	0.13	7%	5%	88%	<1%
	C2	0.13	8%	5%	87%	<1%
	C3	0.18	6%	3%	91%	<1%
Careening Bay-Area D- not being dredged	D1	0.2	4%	1%	94%	1%
	D2	0.2	4%	1%	93%	2%
	D3	0.2	4%	1%	95%	<1%
Careening Bay-Area E	E1	0.2	3%	2%	94%	1%
	E2	0.23	3%	2%	92%	3%
	E3	0.2	5%	1%	93%	1%
Careering Bay Average	NA	0.16	5%	3%	91%	1%
Armament Wharf-Area F	F1	0.2	9%	9%	69%	13%
	F2	0.15	13%	9%	76%	2%
	F3	0.08	18%	17%	62%	3%
Armament Wharf-Area G	G2	0.2	14%	10%	71%	5%
	G3	0.23	13%	6%	56%	25%
Armament Wharf Average (Excl. G3)	NA	0.16	13%	11%	70%	6%

Typically the sediments at both sites are fine sand with a median grain size of ~0.16mm.

There is a difference in the material composition at both sites. The Careening Bay dredging material contains ~92% sand with ~8% of clayey silts, while the Armament Wharf material is more widely graded, containing ~76% gravelly-sand with ~11% of silt and ~13% of clay. The sample G3 at Armament Wharf also has a larger fraction of gravel in the gravelly sand.

4.3 Dredge disposal

The finer fraction of sediment is likely to have a very low fall velocity, and this material could stay in suspension and generate plumes during cutting and during dredge spoil disposal. The dredge material at the Careening Bay site has less than 8% silts and clays. Given the small volume of dredge volumes, the short dredging duration, the nature of the material and the method of disposal directly onto the seabed, significant turbid plumes are not expected at the Careening Bay site,

The dredge material at the Armament Wharf site has a higher portion of fines, with approximately 24% of silts and clays on average, and up to 35% in sample F3. The higher portion of fine materials has the potential to cause some turbid plumes. However it is assumed that the dredging methodology is such that material will be disposed on the seabed in a relatively undisturbed form, avoiding segregation and fluidisation of the material resulting in fluid mud.

There are known environmental receptors (seagrass) to the north of the dredging site in approximately 5m water depth, while there are no known environmental receptors to the south in the vicinity of the dredging site, or in the vicinity of the disposal location in the 15m water depth. Even in the case of some dredge plumes occurring and drifting north-westward to the receptors, these receptors will likely not be significantly impacted due to the very short duration of dredging.

4.4 Sediment bed mobilisation

Sediment erosion is primarily caused by turbulent shear stresses over the seabed. The bed shear stress is the frictional force per unit area applied by the flow on the bed surface. When the bed shear stress exceeds a critical value, sediments are mobilised from the seabed and can be transported in the form of bed load and/or suspended load. Freshly deposited material can be easily re-suspended whereas for old deposits, the critical bed shear stress can become higher in particular with consolidation, compaction, organic matter accumulation (shells/algae/seagrass, etc.) oxidation and/or calcification, which may increase significantly critical shear stresses on the seabed overtime.

An estimate of the critical bed shear stress versus particle size for narrow sorted Quartz grains (Soulsby, 1997) is presented in Figure 7. It can be seen that the finer lighter materials (silts and fine sand) are mobilised more readily than the coarser heavier materials (coarse sand).

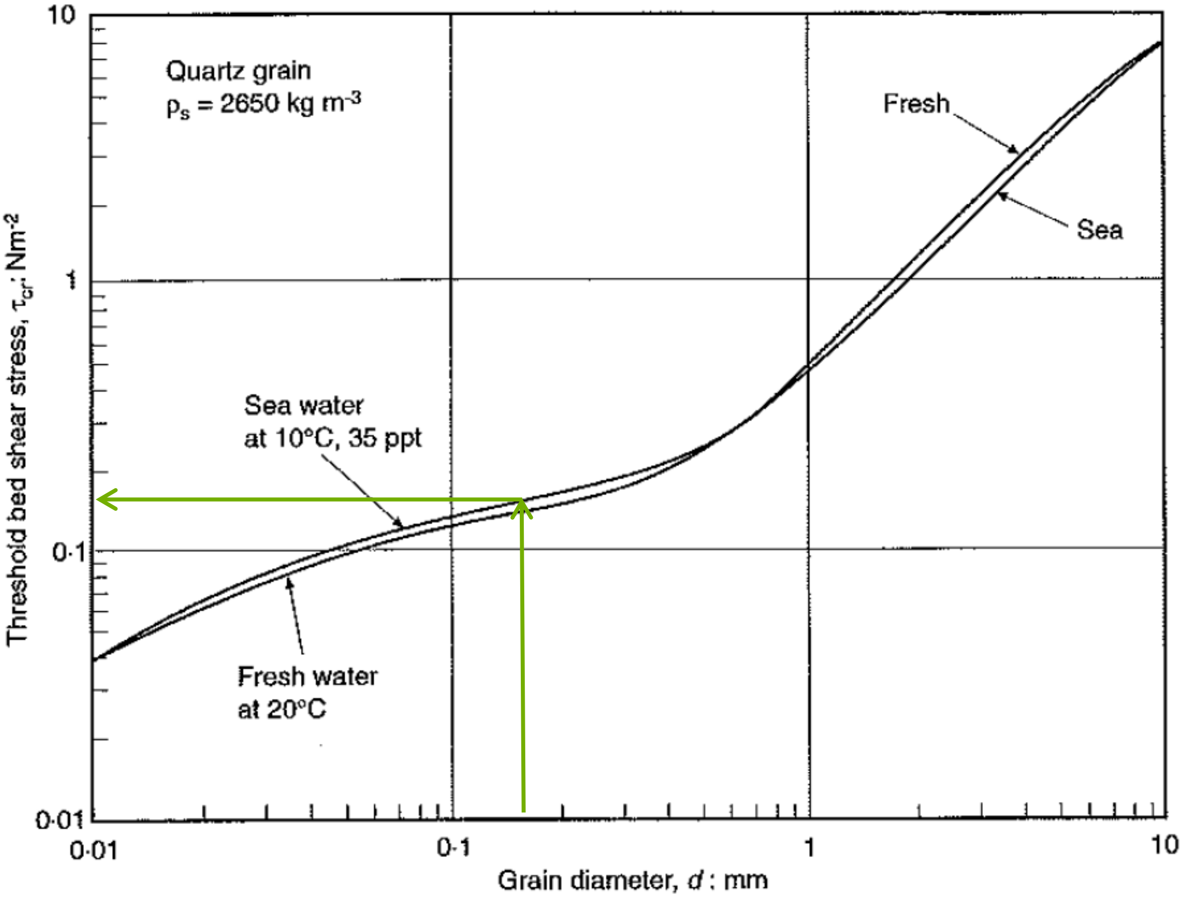

Figure 8 Critical bed shear stress for erosion estimate versus grain diameter (Soulsby, 1997)

Based on the median grain size of 0.2mm, the critical bed shear stress to mobilise the bed sediment is estimated to be in the order of approximately 0.15N/m^2 as shown above.

The bed shear stresses generated by the tidal currents are directly dependent upon bed velocities. An exceedance analysis of the measured tidal currents at each of the two ADCP sites has been undertaken, showing the occurrence and spread of velocities. The exceedance curves are shown below.

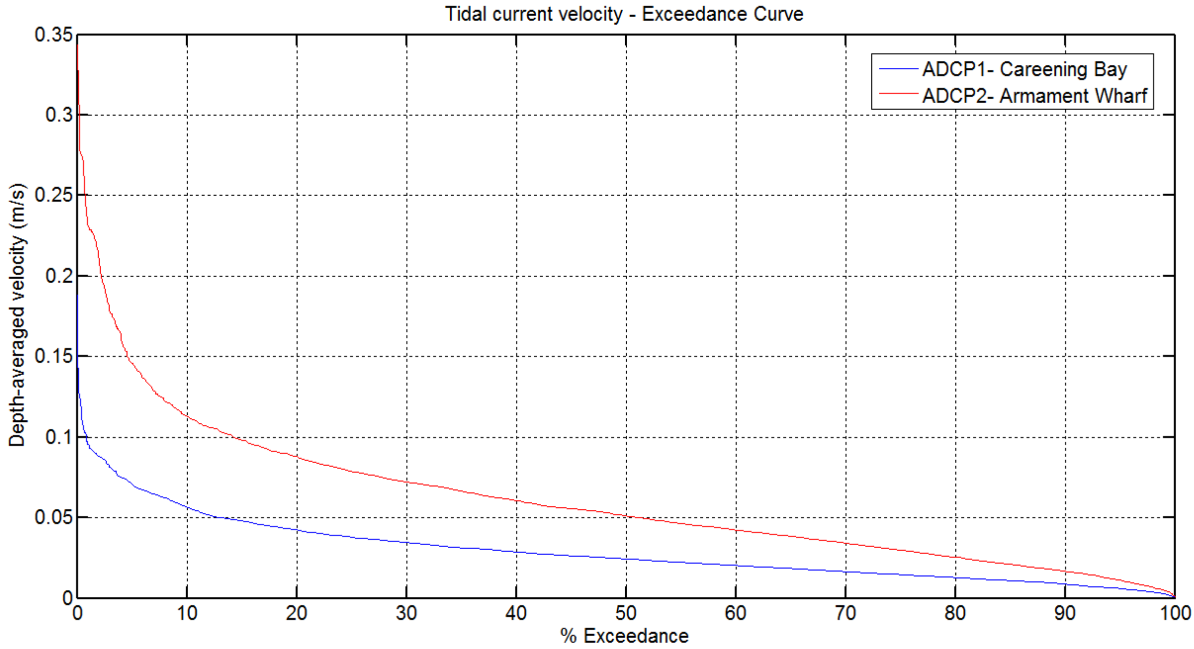

Figure 9 ADCP measured tidal currents – velocity exceedance curve

The upper recorded velocities (1% exceedance) of the measured ADCP data are:

- 0.1m/s – ADCP 1 – Careening Bay
- 0.23m/s – ADCP 2 – Armament Wharf

The ADCP2 data is located very close to the Armament Wharf dredge disposal location, and is in similar water depths and on the same exposed coastline. The ADCP2 tidal currents therefore apply to the dredge disposal site. The ADCP1 location is in a more sheltered location within Careening Bay than the more offshore Careening Bay disposal location. Tidal currents at the Careening Bay disposal site may be higher than the ADCP1 measurements, but are likely to be less than ADCP2. The tidal currents at the Careening Bay disposal site are assumed to be similar to the Armament Wharf site for the bed shear stress assessment, which is conservative.

The bed shear stresses generated by tidal currents have been calculated based on empirical bed friction and drag coefficient equations (Soulsby, 1997). The bed shear stresses generated at the disposal sites are approximately:

- Median tidal currents – 0.002N/m^2
- Upper recorded tidal currents – 0.04N/m^2

The upper recorded tidal current velocity of 0.23m/s (1% exceedance) generates a bed shear stress of 0.04N/m^2. This is much smaller than the threshold bed shear stress of 0.15N/m^2 estimated form the Soulsby Diagram. On that basis, seabed re-mobilisation is unlikely as long as the spoil is placed well intermixed. However, if the silt and clay fraction of spoil material become segregated from the remainder of the sediments this smaller material could be mobile.

This assessment on seabed mobility assumes that the in-situ placement will be such that the soil will not be segregated by the dredging process.

Summary

Maintenance dredging works are required at the HMAS Stirling port facilities on Garden Island, with dredging at two sites - Careening Bay and the Armament Wharf.

An assessment of the tidal currents at the two dredging sites has been undertaken, based on measured tidal currents from ADCP's. The assessment has only considered the measured ADCP data, and no water level analysis, harmonic analysis or wind-driven current analysis has been undertaken. A desktop assessment of the likelihood of tidal currents mobilising the dredge material disposed nearby on the seabed has also been undertaken.

The ADCP measurements at the Careening Bay dredging site show that the tidal currents at the site are slow and un-uniform. The measured current direction appears reasonably variable, and does not correlate well with the flooding or ebbing tide cycle, possibly due to the location inside the port, and possibly wind driven currents and vessel motions. The ADCP measurements at the Armament wharf dredging site show that the tidal currents at the site are relatively benign, with small currents velocities, typically less than 0.2-0.3m/s. Tidal currents at the site are predominantly parallel to the shoreline, and travel to the SSW during flood tide and NNE during ebb tide.

Overall the tidal currents at the site are small, owing to the small tidal range at the site. The site has a maximum tidal range of only 1.2m, and a typical spring tidal range of less than 1.0m.

Given the low tidal current velocities, moderate water depth and sandy nature of the material, regular or significant mobilisation of the disposed dredge material is not expected during ambient conditions at either of the two disposal sites as long as the dredging process is such that the material placed at the disposal site is not segregated. It is possible that some of the finer silts or clays may be mobilised by periods of the strongest tidal currents above 0.2m/s, if the silt and clay fraction of spoil material become segregated from the remainder of the sediments.

The dredging processes and dredge plumes have not been analysed in this assessment. The finer fraction of sediment is likely to have a very low fall velocity, and this material could stay in suspension and generate plumes during cutting and during dredge spoil disposal. Armament Wharf has a relatively high fraction of fine silts and clay and this site is more at risk of dredge plumes than Careering Bay. However it is assumed that the material will be dredged and disposed on the seabed in a relatively undisturbed form, avoiding segregation and fluidisation of the material.

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Appendix F
Additional Stakeholder Consultation Information

<u>Proposed maintenance dredging at Garden Island, WA – Department of Defence</u>

Department of Defence are proposing to undertaken maintenance dredging works at Garden Island. Aurecon are undertaking the environmental approvals process on behalf of the Department of Defence for this scope of works. The proposed maintenance dredging is of very short duration (approximately 7-14 days) and a very small quantity of material will be dredged (approximately 7,400m^3). All works are within naval waters where public access is restricted. We have already undertaken stakeholder meetings with both the Office of the Environmental Protection Authority (OEPA) and the Cockburn Sound Management Council (CSMC). Neither of these stakeholders raised any environmental issues or had any objections to the proposed activities. We are now undertaking the stakeholder consultation process with other stakeholders in the area such as yourselves.

Maintenance dredging is being undertaken to remove accumulated sediment and return areas beneath Garden Island wharves to navigable depth so vessels can continue to access Garden Island. Most dredging (~5,500m^3) will occur within the vicinity of the Armaments Wharf in Sulphur Bay, the remainder (~1,900m^3) will occur over four sites in Careening Bay.

<u>Sensitive receptors </u>identified include:

- Seagrass beds in Sulphur Bay
- Little Penguin colony in Careening Bay

<u>Relevant environmental issues</u> that have been identified include:

- Protection of Benthic Primary Producer Habitat (Seagrasses)
- Sediment contaminant status and disposal
- Water quality
- Protection of endangered marine fauna

<u>Investigations undertaken:</u>

- Sediment sampling – contamination levels of excavated materials are below the relevant guideline criteria and sediment can be disposed of into the deeper waters of Careening Bay/Sulphur Bay
- Benthic habitat mapping has confirmed that proposed dredge areas and disposal grounds and surrounds don't contain sensitive receptors
- Seagrass health risk assessment has been undertaken as well as Little Penguin ecology study by experts in these fields
- Tidal current monitoring and spoil stability assessment undertaken at each spoil disposal ground

<u>Impact assessment </u>– **target timing of dredging February/March 2016**

- <u>Very short dredging duration</u> at each location (dependent on final dredge equipment):
    - 3 - 5 days Careening Bay
    - 5 - 9 days Armaments Wharf

Which presents minimal risk to impact on seagrasses and marine fauna

- February is low abundance period for Little Penguins and high light availability period for seagrasses, with dredging not expected to significantly reduce available light
- Uncontaminated status of sediments presents minimal risk to recreational swimming and fishing (**bearing in mind all works are within naval waters where public access is restricted**)
- **Therefore impact not significant in any season**

<u>Management measures:</u>

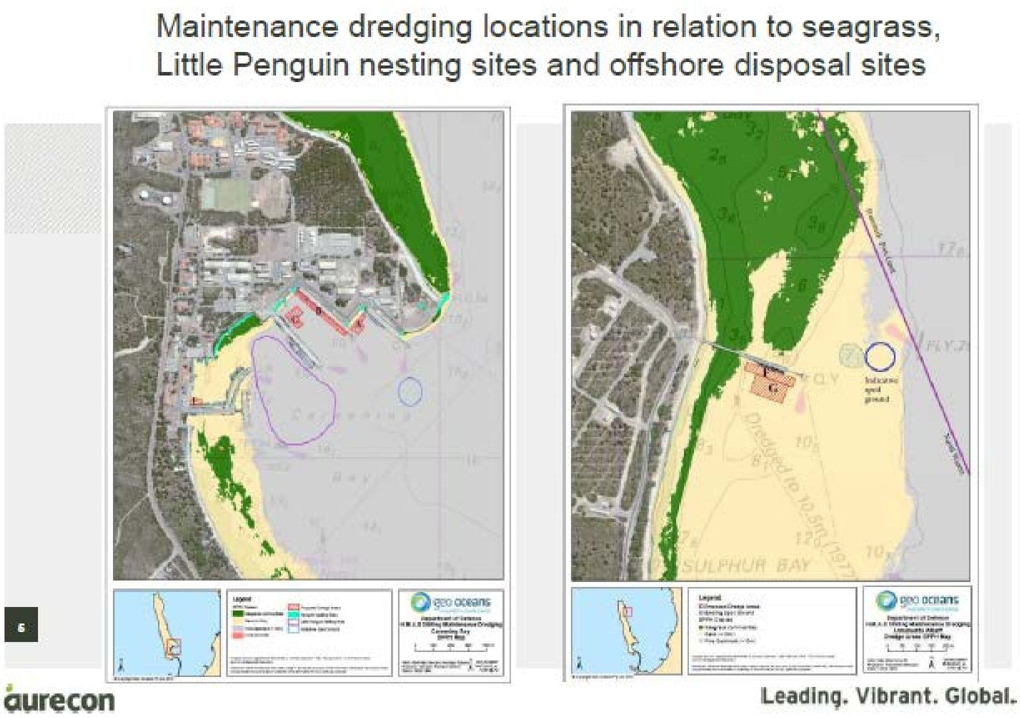
- Compliance monitoring of seagrass condition (before and after)
- Non-reactive water quality monitoring during dredging to confirm water fit for swimming, seafood suitable for consumption
- Notice to Mariners while dredging taking place and **restriction of access to recreational boaters**

- Marine fauna watch and daylight working hours to avoid interference with daily nocturnal penguin migrations
- Preparation of an Oil Spill Contingency Plan and Introduced Marine Pest Risk Assessment

We are now in the process of discussing the proposed works with key stakeholders before we submit the referral to the EPA. If anyone within your group has any concerns, would like more information on the proposed works or wants to raise any other environmental issues that are important to your group please don't hesitate to contact me.

At this stage the stakeholder consultation period will end on **Friday 31st of July** so if you could please provide any feedback by this date. If we do not hear from you we will assume there are no concerns or objections to the proposed activities.

We look forward to hearing from you.



Appendix G
DoD DEPA Environmental Protection Measures

Australian Government

Department of Defence
Estate and Infrastructure Group

Minute

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ENVIRONMENTAL ASSESSMENT REPORT FOR MAINTENANCE DREDGING AT GARDEN ISLAND WHARVES HMAS STIRLING, WA

Reference

A. Aurecon Australia Pty Ltd (2015a) *Maintenance Dredging of Garden Island Wharves at HMAS Stirling, Western Australia: Environmental Report*, prepared for Department of Defence (September, 2015).

B. Aurecon Australia Pty Ltd (2015b) *Sediment Characterisation Report, Garden Island* (July, 2015).

C. Geo Oceans (2015) *Garden Island Benthic Marine Habitat Study*, prepared for Aurecon (June, 2015).

D. Dr. Belinda Cannell (2015) *Ecology of Little Penguins in the Perth Metropolitan Region, with particular reference to the colony on Garden Island*, prepared for Aurecon (August, 2015).

E. Aurecon Australia Pty Ltd (2015c) *Maintenance Dredging at Stirling Naval Base Garden Island WA: Review of the effects of shading on seagrass*, prepared for Department of Defence (July, 2015).

Purpose

1. Under DI(G) 40-3 ADMIN, the Director of Environment Protection and Assessment (DEPA) is the Defence technical authority for determining compliance with the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act).

2. This Minute documents my decision about the environmental protection requirements for the completion of maintenance dredging at the Garden Island Wharves at HMAS Stirling, in Western Australia.

Project Background

3. HMAS Stirling (also known as Fleet Base West) is located on Garden Island, Western Australia (WA) approximately 35 kilometres south of Perth. It is the Royal Australian Navy's

(RAN) largest naval establishment, and provides operational and logistical support to surface fleet, submarines and aircraft stationed in WA.

4. A number of wharves utilised by the RAN have been subject to sediment build-up, and require maintenance dredging to return their berths to navigable depth.

5. The berths at Garden Island were originally created through dredging when the base was constructed in the 1970s. Since then, a number of dredging programs have been undertaken to maintain or increase the berth depths.

6. The current scope of works is limited to dredging at four locations at wharfs within Careening Bay at the southern end of the island; and two locations at the Armaments Wharf in Sulphur Bay, at the northeastern end of the island. Approximately 1,900m^3 of sediment will be removed from Careening Bay, and approximately 5,500m^3 from Sulphur Bay. These locations are shown in **Attachment B**.

7. Spoil material would be disposed at designated spoil grounds in deep water adjacent to each location (i.e. one spoil ground at Careening Bay, and one at Sulphur Bay).

8. Dredging and disposal will occur within declared Naval Waters, to which public access is restricted, however these areas remain under state jurisdiction as Internal Waters. As such, the Project Team will also need to meet any relevant requirements of the Western Australian Government to gain project approval.

Environmental Assessment

9. Aurecon prepared an Environmental Report (ER) for the Project, which included a desktop assessment, and a range of specialist studies, including:

- Sediment contaminant and physical characterisation study;
- Benthic habitat survey of dredging and disposal grounds;
- Review of the ecology of the little penguin colony in Careening Bay; and
- Tidal current data collection and spoil stability assessment.

10. The ER took into account matters of national environmental significance (MNES) and general environmental values (including heritage) as required by the EPBC Act and DoE's *Significant Impact Guidelines 1.1* and *1.2*.

Environmental Risks and Management

11. The ER considered the potential impacts of undertaking the activity. Although the project areas have been previously subject to disturbance, there are surrounding and interacting environmental values that must be considered.

12. The key environmental risks associated with the dredging activity are related to marine flora and fauna, particularly seagrass beds and little penguins (*Eudyptula minor*); and risks associated with the relocation of sediment, including contamination, invasive species, and water quality impacts.

Benthic Habitat

13. The seagrass communities around Garden Island have high ecological value. A benthic habitat survey has confirmed that no seagrass beds would be directly impacted by the dredging activities; however, an increase of sediment in the water column as a result of the disturbance has the potential to increase turbidity and shading, which could limit light availability for photosynthesis.

14. A review of the ecology of the local seagrass species confirmed that they are able to withstand extended periods (up to 3 months) of shading. Assessment of the tidal movements in the project areas, and likely sediment plumes from dredging, have shown that any turbidity generated would be localised and of short duration (hours to days).

15. The proposed spoil disposal grounds were also assessed in terms of existing substrate and tidal movements, to ensure that they would be retentive of the dredge material, and would not result in any additional impacts to flora or fauna. They were determined to be appropriate for the proposed use. The spoil disposal grounds are located within internal state waters, and as such, a sea dumping permit is not required.

Marine Fauna

16. A colony of little penguins reside at the rock walls in Careening Bay. They undertake daily migrations into Cockburn Sound to forage. While the works would not impact directly on their nesting habitat, it has the potential to impact on their daily movements. A local penguin expert has advised mitigation measures, particularly related to timing of works to ameliorate any impacts to the species. These are prescribed in **Attachment A**.

17. The dredging equipment itself also has the potential to physically injure marine species, as Cockburn Sound contains a range of marine mammals, birds, and turtles. The ER recommends use of a marine fauna spotter during works to minimise risk to any fauna from the activity.

Invasive Species

18. Relocation of sediment from a heavily trafficked wharf area, and use of dredging equipment also has the potential to introduce invasive marine species to an area. The WA Government's Department of Fisheries has a 'Vessel Check' risk assessment process that will be utilised to ensure dredging equipment is free of invasive species.

Contamination

19. A sediment characterisation study was undertaken to determine the suitability of dredged material for unconfined disposal into the deep waters of Cockburn Sound. Around 1,300 m^3 of material to be excavated from Careening Bay had detectable levels of antifouling paints (Tributyltin (TBT)), however subsequent elutriate testing confirmed that these levels were well below the triggers established by the *State Environmental (Cockburn Sound) Policy (2005)* and as such were suitable for unconfined disposal.

20. DEPA has taken into account matters of national environmental significance (MNES) and general environmental values as required by the EPBC Act, and has found that the ER has identified and assessed the likely impacts of the Project. The mitigation measures identified in the ER are considered appropriate and likely to be effective, and form the basis for the environmental protection measures specified in **Attachment A**.

Decision

21. Based on the available information, DEPA considers that dredging at the six specified locations, and disposal of dredged material at existing designated spoil grounds in Careening Bay and Sulphur Bay is not likely to have a significant impact on matters protected by the EPBC Act. Therefore, there is no requirement to refer the activity to the Environment Minister for assessment and approval.

22. DEPA requires that the proponent of the activity implement the environmental protection measures identified at **Attachment A**. These measures form an integral part of DEPA's environmental approval for the activity and may be subject to future compliance audit activities at anytime at DEPA's discretion.

Specific Conditions

23. The Project Office must implement the environmental protection measures identified in **Attachment A**.

24. Any variation to the conditions referenced in this EAR must be approved by DEPA.

25. The Project Office must keep DEPA and relevant DEIG REO informed of the progress of any environmental considerations relating to this project and DEPA must be notified if there are any changes to the scope or the construction site that have not received appropriate environmental consideration.

26. Should the Project Office become aware of any failure to comply with any of the conditions referenced in this EAR, that failure must be reported as an environmental incident in line with the reporting procedures on the Defence intranet Estate Incident Management through DEQMS (Defence Estate Quality Management System) at http://intranet.defence.gov.au/estatemanagement/lifecycle/IncidentManagement.

Lloyd Woodford
Director, Environmental Protection and Assessment
Environment and Engineering Branch

27 October 2015

Attachments:

A. Specific Environmental Protection Measures
B. Site Maps

SPECIFIC ENVIRONMENTAL PROTECTION MEASURES FOR MAINTENANCE DREDGING AT GARDEN ISLAND WHARVES HMAS STIRLING, WA

Table 1 specifies the Director of Environmental Protection and Assessment's (DEPA) minimum environmental protection measures for the conduct of maintenance dredging at HMAS Stirling in Western Australia. These measures are based on the recommendations from the ER prepared for the project by Aurecon in September 2015 (Reference A).

Implementing the measures will require consulting with relevant regional personnel such as the Senior Environmental Manager for Central and West and Regional Environmental Officers.

To ensure that environmental risks are appropriately managed and the project is undertaken in a manner consistent with legislative and Defence requirements, DEPA expects the environmental protection measures identified in **Table 1** to be implemented.

Table 1: Specific environmental protection measures for conduct of maintenance dredging at HMAS Stirling

Issue	Environmental protection measure
General	• Prepare and implement an Environmental Management Plan that includes induction, monitoring and reporting responsibilities. • Prepare an oil spill contingency plan.
Benthic Habitat	• Undertake pre and post activity monitoring of seagrass condition adjacent to the dredging area in Sulphur Bay. Timing and frequency of monitoring should include one event immediately prior to dredging, and one event within one month of dredging concluding. • Maintain a daily record of turbid plume dispersal direction. • Locate spoil disposal grounds at least 250m from seagrass habitat, and within deep (>15m) water.
Marine Fauna	• Ensure a marine fauna spotter is on board during all dredging works, and pause works if any animals appear at risk of harm from the dredging equipment. • Undertake dredging between February and August to avoid snapper and crab spawning periods in Cockburn Sound, as well as the little penguin's breeding season (see below).
Marine Fauna (Little Penguins)	• Do not undertake any works during Little Penguin breeding season (September to December). • If work is completed between February / March (preference): o Maintain daylight working hours. o Commence works one hour after sunrise, and cease one hour prior to sunset. • If work is completed between April to August: o Maintain nighttime working hours in Sulphur Bay. • Do not moor vessels or equipment overnight within penguin rafting area in Careening Bay. • Report any injury or death of Little Penguin as a result of the activity to the relevant State authorities and DEPA.
Invasive Species	• Undertake WA Department of Fisheries Vessel Check risk assessment on dredging equipment prior to entering Cockburn Sound.
Contamination	• Deposit dredge material from areas A and B (material contaminated with TBT) below material from areas C and E.

Figure 1: Careening Bay – showing dredge areas, spoil ground, little penguin rafting area and extent of seagrass communities

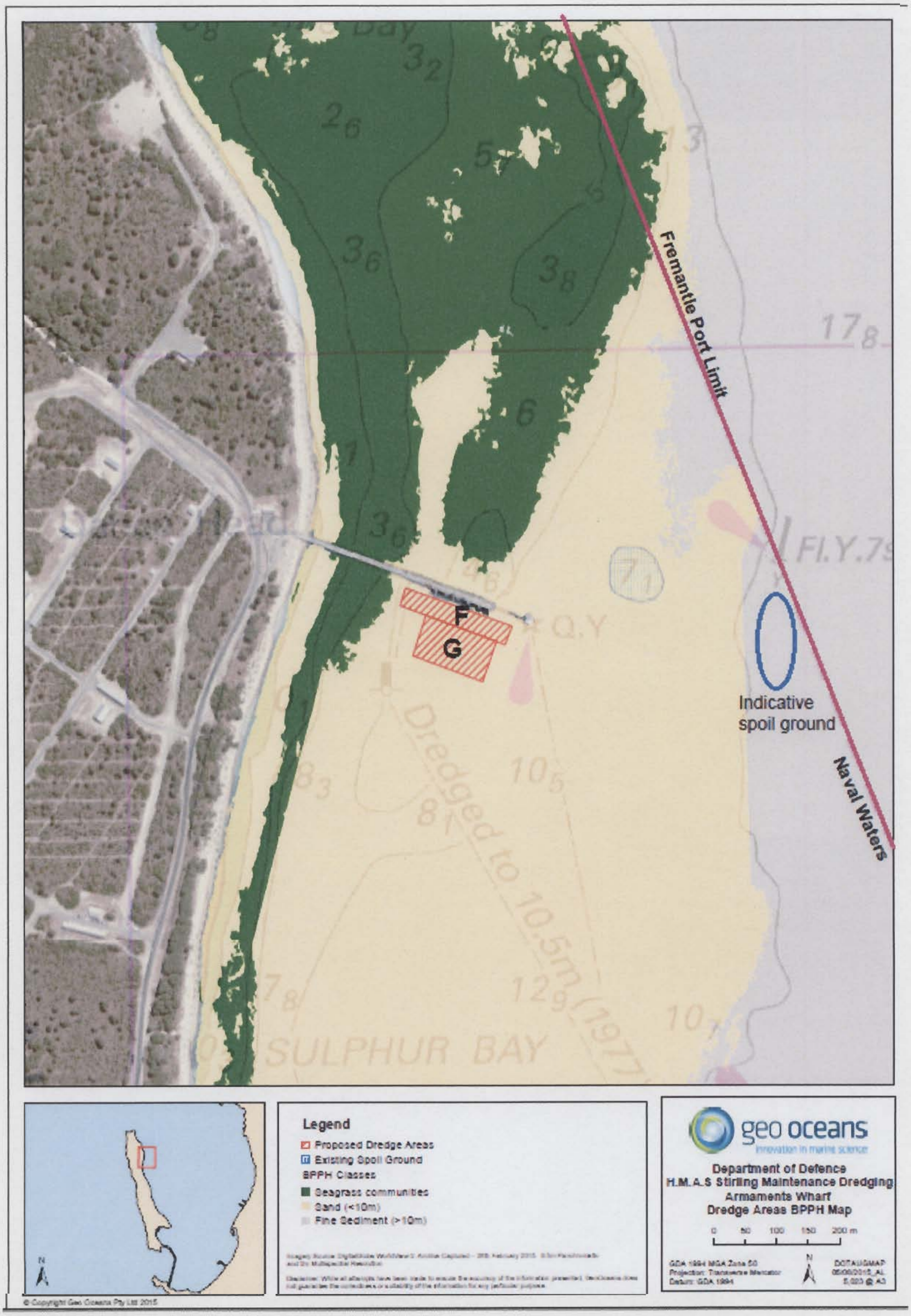

Figure 2: Sulphur Bay - showing dredge areas, spoil ground and extent of seagrass communities

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