Environmental Management Plan (Marine Ecology) for Dredging and Dredged Material Disposal

Hay Point Coal Terminal Expansion Phase 3 (HPX3)

BM Alliance Coal Operations Pty Ltd

EPBC Approval No: EPBC 2009/4759
GBRMPA Marine Parks Permit: G10/16868.1
GBRMPA Sea Dumping Permit No: 10/02

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1. Introduction

This document constitutes the Environmental Management Plan (Marine Ecology) (EMP) for dredging and dredged material disposal operations to be undertaken for the Hay Point Coal Terminal Expansion Phase 3 (HPX3) project, which is being undertaken by BHP Billiton Mitsubishi Alliance Coal Operations Pty Ltd (BMA).

1.1 Purpose and Scope

The purpose of this EMP is to:

1. Detail the management measures to be implemented to minimise potential environmental impacts from dredging and dredged material disposal activities to be undertaken as part of the HPX3 project; and
2. Detail the monitoring activities to be undertaken to document the implementation and effectiveness of these measures as well as the responses of ecological communities in the project area.

The EMP specifically addresses Terms of Reference for the project Environmental Management Plan that have been issued by the Great Barrier Reef Marine Park Authority (GBRMPA), an Environmental Protection and Biodiversity Conservation Act (EPBC) approval condition, and, more broadly, requirements under other applicable legislation and regulatory approvals as well as BMA and Hay Point Coal Terminal (HPCT) policies and procedures.

The performance objectives, actions, and procedures detailed in this EMP may be amended during course of project on the basis of new information and experience, subject to approval by the relevant authorities.

1.2 Approvals

The *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* requires assessment and approval for any activity that has, or is likely to have, a significant impact on a matter of national environmental significance (such an activity is deemed a "Controlled Action"). BMA submitted an EPBC Referral on 24 February 2010, and received approval under the EPBC Act on 14 May 2010 (EPBC 2009/4759). This approval allows the expansion of the current Hay Point Coal Terminal to increase its capacity from 44 million tonnes per annum (Mtpa) to 75 Mtpa. The EPBC approval includes blasting, dredging, and offshore disposal of material, land reclamation, and infrastructure construction, as described in the original referral.

Commonwealth legislation also requires that an approved Sea Dumping Permit be obtained prior to disposal of dredge spoil resulting from the Hay Point Coal Terminal expansion, pursuant to the *Environment Protection (Sea Dumping) Act 1981*. BMA applied for and was granted Sea Dumping Permit No. 10/02 on 7 May 2010. This permit allows BMA to load, for the purpose of dumping, up to a maximum of 155,000 *in situ* m^3 of dredge spoil material associated with capital dredging of Berth 3 at the Port of Hay Point, Queensland, to a disposal ground, as defined in Appendix 1 of the permit.

Due to the location of the proposed works and disposal site, a Marine Parks Permit is also required for entry to, and use of for the purposes of dumping up to a maximum of 155,000 *in situ* m^3 of dredge spoil material within the designated primary and secondary spoil disposal areas. Marine Parks Permit No. G10/16868.1 was granted to BMA on 7 May 2010 and stipulates that all activities be undertaken in accordance with the permit conditions and related project documents.

Amendments to the Sea Dumping Permit No. 10/02 and Marine Parks Permit No. G10/16868.1, to increase the maximum volume of material to be disposed of within the designated primary and secondary spoil disposal areas to 185,000 *in situ* m^3, were approved on 24 August 2011.

Conditions set for all of the above approvals and permits stipulate the requirement for the development of an EMP, and that no dredging activities occur prior to the approval of the EMP by the Managing Agency. This EMP serves to satisfy these conditions of approval.

1.3 Project Overview

BMA is currently carrying out detailed engineering investigations necessary to facilitate an expansion in throughput at the HPCT from approximately 44 Mtpa to 55 Mtpa through the following activities:

1. Construction of a new berth (Berth 3) and shiploader (Shiploader 3, SL3).
2. Construction of two new outloading trestle conveyors on a new offshore trestle complete with access roadway.
3. Construction of offshore link conveyors to existing Berths 1 and 2, and Berth 3 from the new outloading trestle conveyors.
4. Demolition and removal of the existing outloading conveyors, including the existing trestle and roadway structure.
5. Reclamation of land to the northeast of the existing stockyard area to facilitate the construction of the new onshore outloading systems.
6. Construction of two new onshore outloading systems, associated transfer towers and a surge bin to feed the new trestle conveyors, generally constructed on the reclaimed land area.
7. Demolition of the two existing onshore outloading systems, including conveyors, transfer towers and surge bins.
8. Modification of existing stockyard conveyors to feed the new onshore outloading systems, by extension of their head ends and construction of new transfer towers.
9. Construction of onshore inloading facilities to provide a link from existing rail Dumpstation 2 to the existing Stockyard Line 1.
10. Site infrastructure works including roads, drainage systems, electrical and water services.

1.4 Description of Works

Berth 3 is located approximately 100 m south of the existing Berth 1, and has the dimensions 460 X 71 m (620 X 145 m including the apron area) and a declared depth of -19 m LAT (-14.9 LAT for the apron; Figure 1). Construction of Berth 3 will require the removal of approximately 275,000 m³ of material. The material consists of a surface layer of soft alluvial clays and loose sands, underlain by a layer of stiff residual clays and some gravels, and then by extremely weathered (XW) rock, with the rock being progressively less weathered down the profile until fresh rock is encountered at the base of the dredging profile in some areas of Berth 3.

The material will be removed by backhoe dredge. Harder rock in deeper portions of some parts of the berth will require pre-treatment by drilling and blasting before it can be removed by the backhoe dredge.

Up to 185,000 m³ of the material, consisting of the soft sediments, residual clays and gravels, and some less competent XW rock, will be loaded into split-hopper barges and disposed of at sea within the General Use Zone of the Great Barrier Reef Marine Park (GBRMP). The remaining competent XW rock and shot rock from drilling and blasting will be loaded onto flat-top barges for transport and onshore disposal. Additional information regarding the dredging and disposal methodology is provided in Section 5.

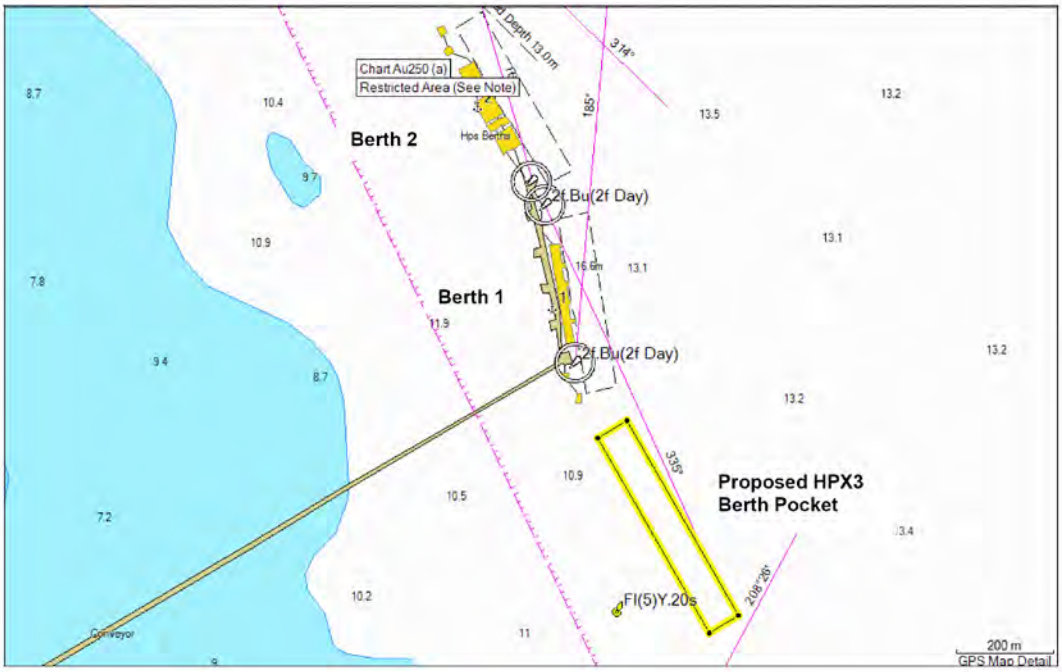

Figure 1 Location of Proposed HPX3 Berth 3

2. Existing Environment

The Port of Hay Point is located 28 km south of Mackay (Figure 2). The Port lies within the Great Barrier Reef World Heritage Area (GBRWHA) and adjacent to the GBRMP, with port limits extending into the GBRMP. The Port does not border any National Parks. The location for the ocean disposal of dredged material lies in the General Use zone of the GBRMP.

The main subtidal habitats around Hay Point and the existing spoil ground are open sandy bottom, rocky reefs, coral reefs, and seagrasses. Benthic surveys of the general port area have been conducted by Rasheed *et al*. (2004), Chartrand *et al*. (2008), Koskela Group (2009) and SKM (2009).

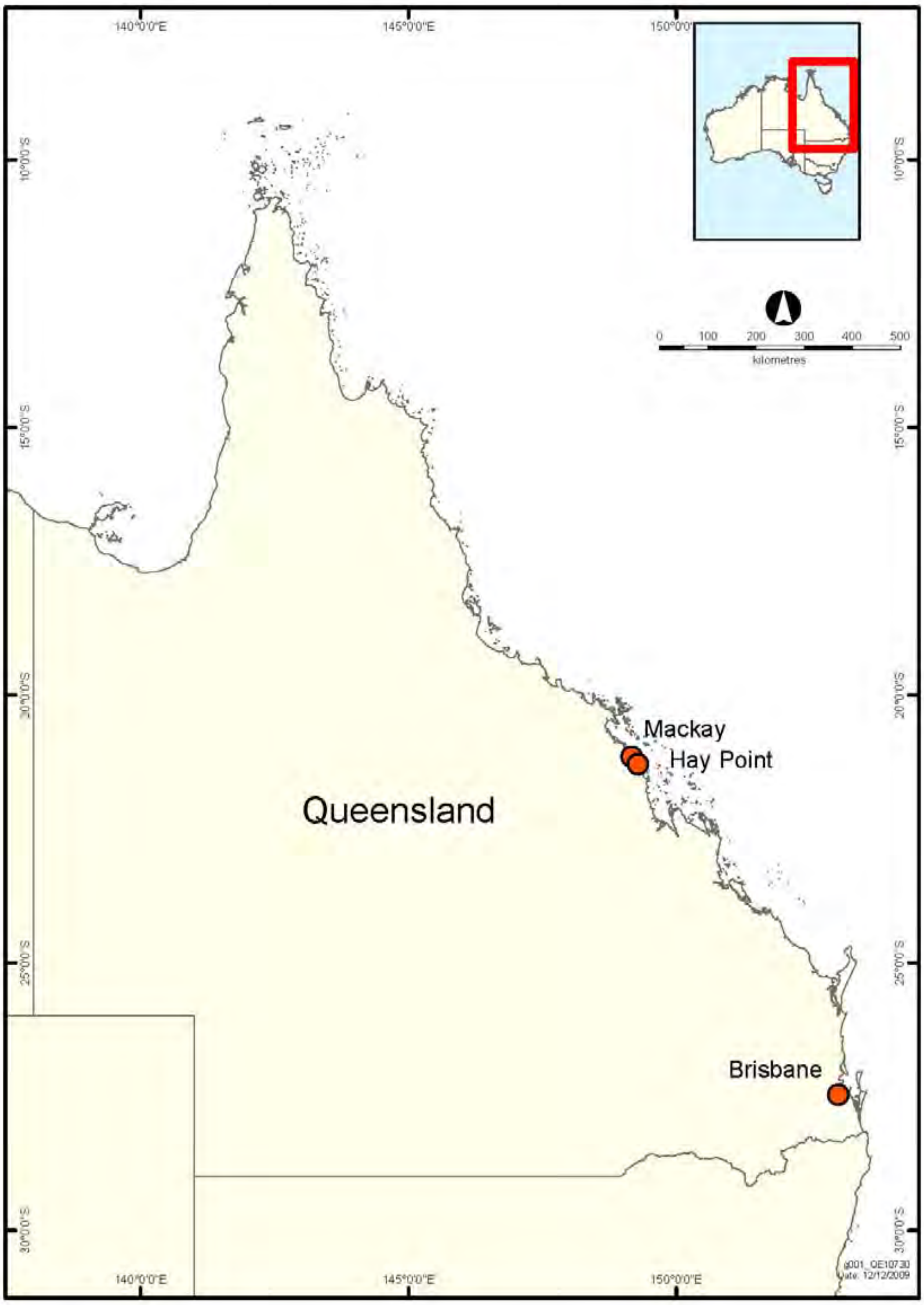

Figure 2 Location of Hay Point, Queensland, Australia

2.1 Soft Bottom Habitat

The seabed in the Port of Hay Point is predominantly open sandy substrate with sparse benthic epifauna (Rasheed *et al*. 2004, Chartrand *et al*. 2008, Koskela Group 2009). Fauna identified on the soft bottoms includes soft corals, echinoids, ascidians, bivalves, and bryozoans (Rasheed *et al*. 2004, Chartrand *et al*. 2008). No high-density benthic invertebrate communities have been identified on soft bottoms. The mean coverage of macroalgae on the existing spoil ground as a whole (labelled as "proposed spoil ground" in Figure 3) is less than 1.5%, although some individual transects had macroalgal cover as high as 17% (Koskela Group 2009).

2.1.1 Seagrass communities

Halophila and *Halodule* are the only seagrass genera recorded in the vicinity of Hay Point (Chartrand *et al*. 2008; Koskela Group 2009; PCQ 2002; Rasheed *et al*. 2004). Marsh and Lawler (2001) noted the ephemeral nature of these seagrasses, which is borne out by monitoring at Hay Point. Seagrasses found in the Hay Point/Dalrymple Bay area between 1993 and 2001 consisted of a small patch of *Halophila* off the northeast side of Dudgeon Point and scattered patches of *Halophila* and *Halodule* on the north side of Round Top Island (PCQ 2002; Rasheed *et al*. 2004). A detailed survey in 2004, however, found extensive areas of low-density *Halophila* (Rasheed *et al*. 2004).

Baseline surveys for the 2006 Port of Hay Point capital dredging found greatly reduced seagrass abundance in 2005, and no seagrass in March 2006 (Chartrand *et al*. 2008). *Halophila* re-established in some places in 2007, after the completion of the capital dredging, but continues to be highly ephemeral. No seagrass was recorded in surveys in February and June 2008 (Chartrand *et al*. 2008). The most recent surveys, conducted in May to August 2009 (Koskela Group 2009), found patchy areas of seagrass around the periphery in offshore areas, including the periphery of the existing spoil ground, as well as in inshore areas (Figure 4). Seagrass cover in various sections of the areas surveyed was no more than 1.4%, although individual transects had cover as high as 31% (Koskela Group 2009). All the seagrass observed in offshore areas was *Halophila decipiens*. Inshore seagrass communities were also dominated by *H. decipiens* (Figure 4) (1% mean seagrass cover) around the port and in the boundary of the spoil ground (Koskela Group 2009c). A recent video survey, however, has identified some sparse cover of *H. Decipiens*, but four patches of *Halodule uninervis* were observed.

The ephemeral nature and low density of seagrasses in the area suggest that these seagrass habitats are of limited direct value for commercial or recreational fish species. These characteristics may also limit other environmental values of seagrasses, including absorption of nutrients from coastal runoff and stabilising sediments.

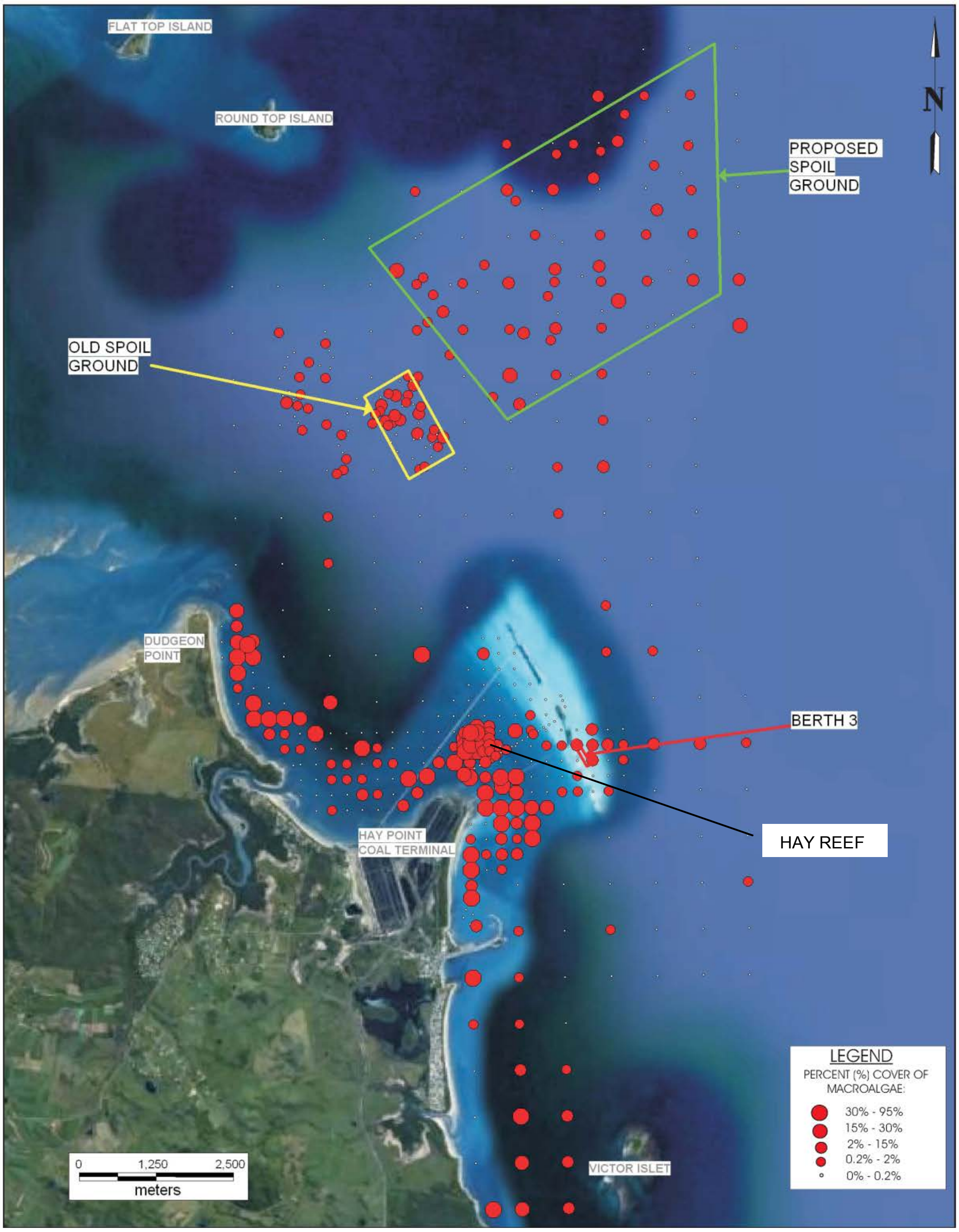

Figure 3 Percent cover of macroalgae in the Port of Hay Point and spoil ground (Koskela Group 2009)

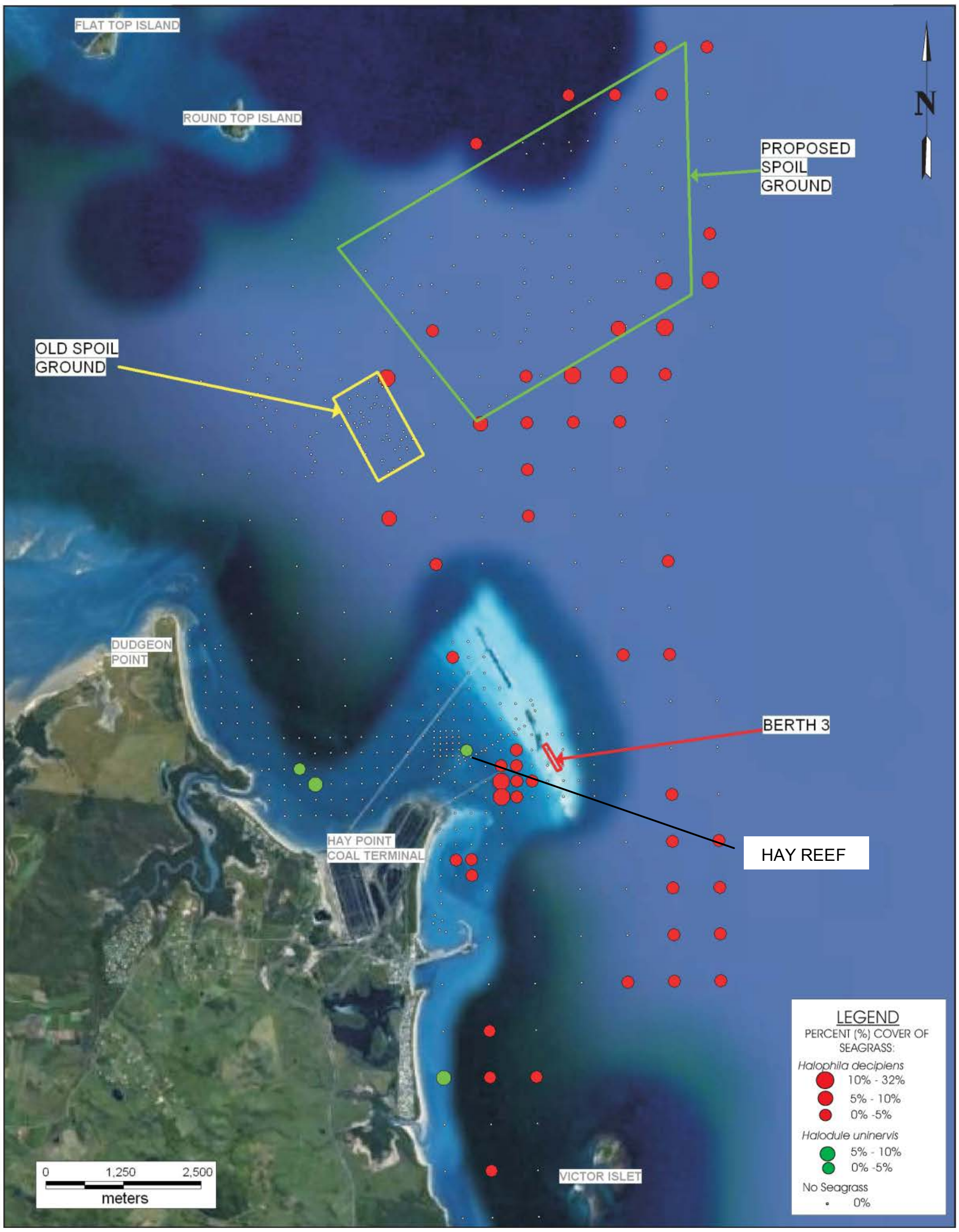

Figure 4 Percent cover of seagrass in the Port of Hay Point and spoil ground (Koskela Group 2009)

2.1.2 Infauna Communities

An infauna study was conducted in November 2009 to characterise the infauna communities and particle size distribution of sediments in the Port of Hay Point in relation to previous dredge spoil disposal (BMA 2009a). A large Van Veen grab was used to collect sediment samples in three locations: the existing spoil ground, the old spoil ground used prior to the 2006 capital dredging, and an unu sed area adjacent to the old spoil ground (Figure 5). Twenty-four grab samples were collected at randomly located sites within each location. In the existing spoil ground, which is considerably larger than the other two locations, a stratified random sampling design was used, with eight samples collected at randomly located sites within three sub-areas (Figure 5). Each grab retrieved sediment from an area of the seabed of approximately 0.1 m^2 to a depth of at least 10 cm, with a volume of approximately 10 litres. Particle size distribution was determined for a sub-sample of each grab sample, and the infauna in the rest of the sample were counted and identified to the family level.

A total of 143 families of infauna was collected, dominated by gastropod molluscs, crustaceans, and polychaete worms, which is typical of tropical infauna communities (Alongi 1990). The mean family richness and total abundance (number of individuals) per sample are presented in Table 1. Univariate Analysis of Variance (ANOVA) showed that infauna abundance on the existing and old spoil grounds was significantly less than that in the area not previously used for spoil disposal. Family richness was not significantly different in the three areas.

Analysis of Similarity (ANOSIM) of the data found a significant difference in the family composition of the infauna communities in the three locations. The faunal composition by family is graphically presented in a two-dimensional, non-metric multi-dimensional scaling (MDS) plot based on the similarity matrix between the sampling locations (Figure 6).

The MDS seeks to graphically represent the dissimilarities (or conversely, similarities) among sites in the composition of their infauna communities. The axes are synthetic axes derived from linear combinations of the original variables (infauna abundances by family) that explain the highest possible amount of variability in the data. The first axis depicts the main direction of linear variation, the second axis the greatest possible residual variation after the removal of the trended linear variation accounted for by the first, and so on. Thus the axis are arbitrary, all that matters on an MDS plot is which point is closest to which others. MDS analysis can be performed in up to N-1 dimensions, where N is the number of sites, but in practice interpretation in more than three dimensions is difficult.

This difference is not visually pronounced in the two-dimensional, non-metric MDS plot shown in Figure 6, but the relatively high stress level (0.25) indicates that the two-dimensional projection does not accurately represent the grouping of data in more dimensions. This plot shows how similar the infauna is between sampling stations.

The closer the points on the plot are, the more similar the infauna community is at those sampling stations. There is no indication that the observed differences in infaunal assemblages were associated with variation in particle size distribution of the sediments, as can be seen when the percentage of gravel in the sediment is overlain on the MDS plot (Figure 7). Similar results are obtained when the percentage of other fractions (sand, mud) are overlain on the plot (BMA 2009a).

Table 1 Mean family richness and total abundance in number of individuals per sample

Parameter	Existing Spoil Ground	Old Spoil Ground	Adjacent Area
	1–3 years since dumping	**5 years since dumping**	**Never dumped on**
Mean family richness (± SE)	16 ± 1.1	18 ± 1.3	20 ± 1.4
Mean number of individuals (± SE)	34 ± 2.6	38 ± 4.4	54 ± 6.2

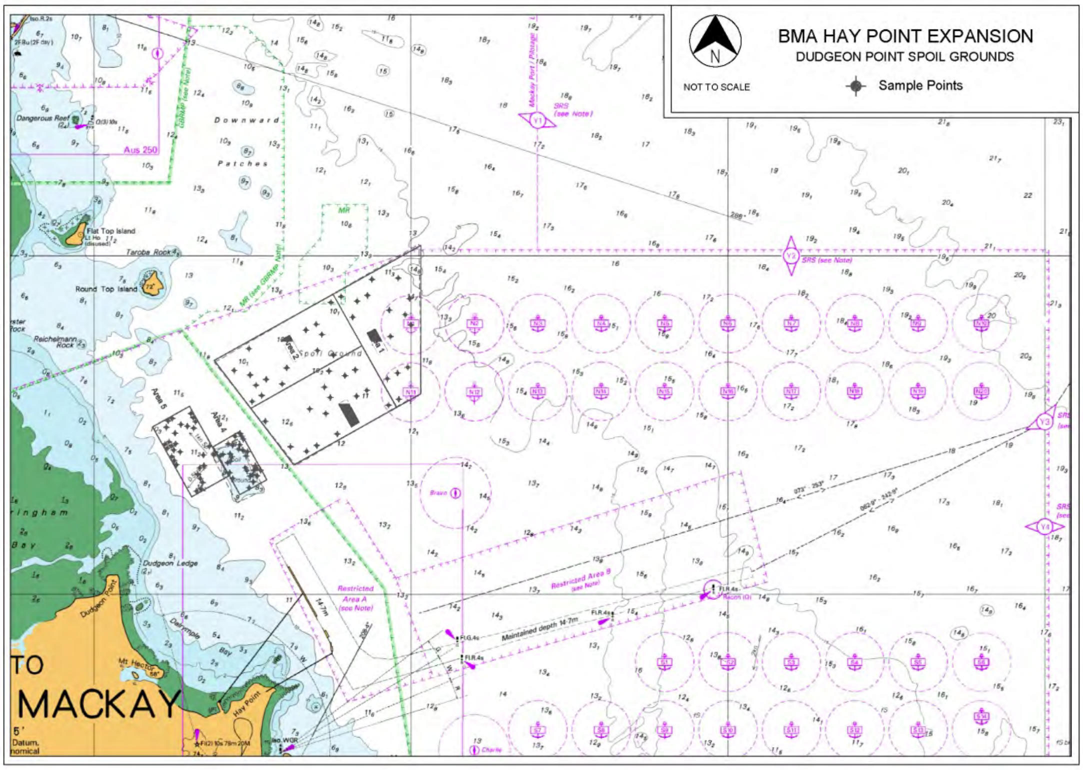

Figure 5 Infauna survey sampling locations. The marked locations show all 30 planned sampling locations but due to bad weather only 24 randomly selected sites within each location)

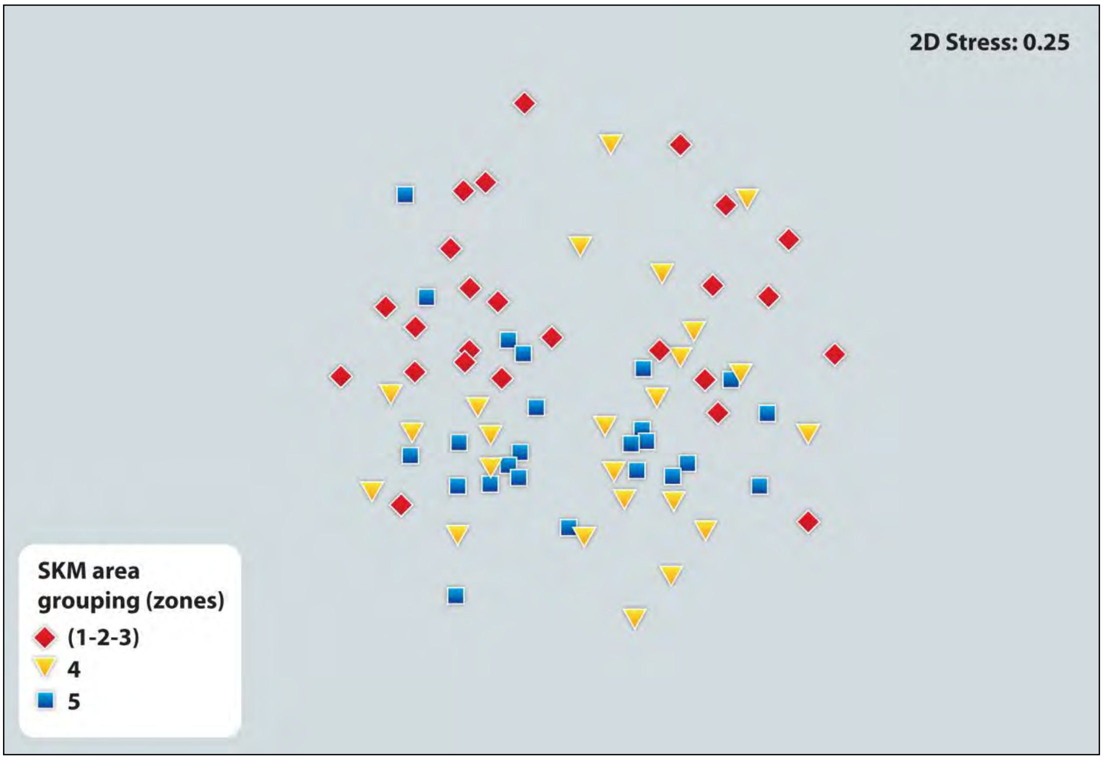

Figure 6 MDS comparison of infaunal communities at the five sampling zones. Zones 1,2, and 3 are the existing spoil ground, zone 4 is the old spoil ground, and zone 5 is the area adjacent to the old spoil ground (see Figure 5; BMA 2009a)

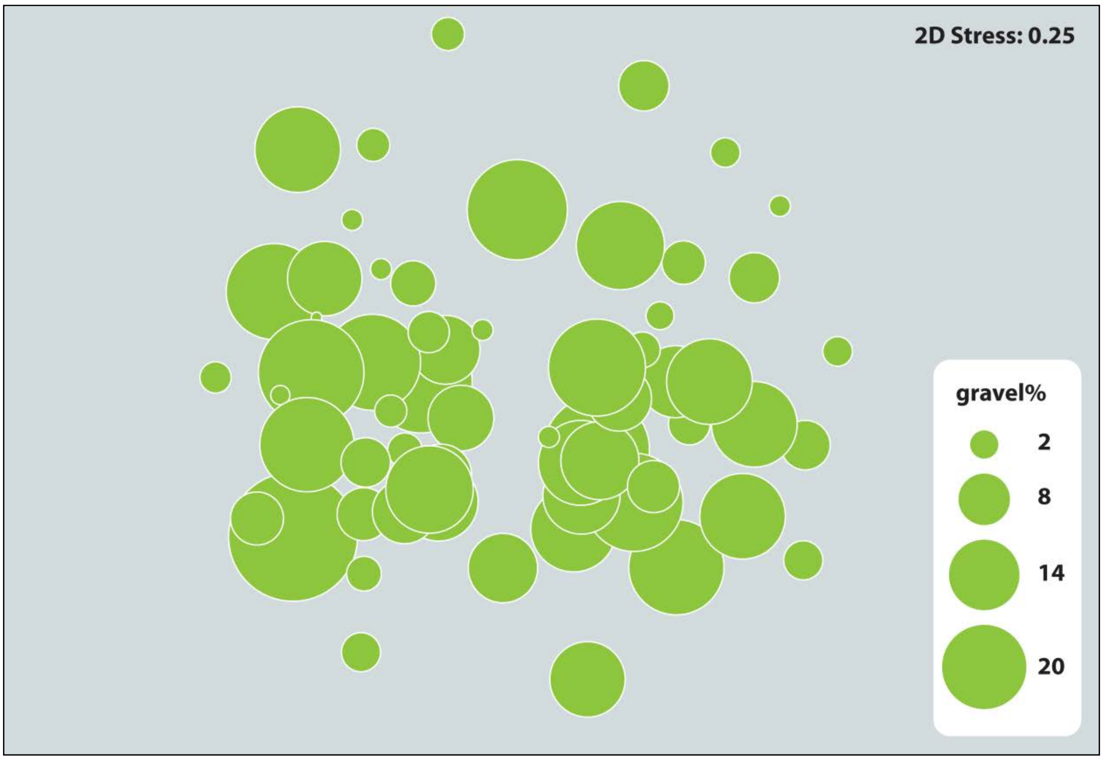

Figure 7 MDS comparison of infauna communities related to percentage of gravel in sediment (BMA 2009a)

2.2 Rocky Reef Habitats

Rocky subtidal areas along the coast have significant cover of macroalgae, with some macroinvertebrates including corals (Koskela Group 2009c). Fringing rocky reefs have been identified at Hay Reef, located approximately 300 m offshore between the conveyor structures, at Victor Island, approximately 2.1 km southeast of the port boundary, and at Round Top and Flat Top Islands, approximately 6 and 8 km, respectively, north of the port boundary (GHD 2005, Koskela Group 2009).

2.2.1 Macroalgae

Koskela Group (2009) observed high (21 – 34%) macroalgal cover on the inshore rocky reefs of Hay Point, Hay Reef and Dudgeon Point, and on the gravelly seabed between Victor Islet and the mainland (see Figure 3) 6%) and in offshore areas (0.5 – 1.8%). The existing spoil ground had the highest macroalgal cover of the offshore areas surveyed, at 1.8% and had individual transects with as much as 17% cover (Koskela Group 2009). Common macroalgae included brown algae (*Sargassum* spp., *Hormophysa triquetra*, *Dictyopteris australis*, *Lobophora*, *Padina* and *Dictyota* spp.) and green algae (*Halimeda discoidea* and *Caulerpa cupressoides*). Macroalgae were a dominant community type in the subtidal parts of Hay Reef, with turf algae (filamentous and foliose alga) dominant on the intertidal reef top (Koskela Group 2009). Turf algae were also abundant on the subtidal rocky reef seaward of Hay Point.

2.2.2 Coral Communities

The hard coral communities at Victor Islet and Round Top and Flat Top Islands at generally have low to moderate cover, with mean cover at each island ranging from 9% to 29% (GHD 2005). Coral cover was significantly different among the three islands, being highest at Round Top and Lowest at Flat Top. GHD (2005) attributed these differences to the ambient turbidity regimes around the islands, with turbidity being lowest at Round Top Island. Coral cover was highest on the south eastern sides of the islands and was substantially less on the sheltered north western sides.

Koskela Group (2009) found hard cover ranging from 0 – 60% at Hay Reef, with a mean of 16% on the north east side and only 1.3% on the south west side (Figure 8). Koskela Group (2009) also found patchy, moderate coral cover up to 23% on rocky reef areas west and south of the HPCT trestle, seaward of Hay Point, and Dudgeon Point. The coral communities on the islands and inshore reefs are generally similar, and dominated by relatively sediment-tolerant species characteristic of turbid inshore habitats on the Great Barrier Reef, including species of encrusting *Montipora,* tabulate *Acropora*, *Psammocora*, *Turbinaria*, *Pocillopora*, *Porites*, *Goniopora, Favia*, *Cyphastrea*, *Echinopora, Moseleya*, *Echinophyllia*, *Galaxea*, and *Symphyllia*.

Macroinvertebrate communities other than hard corals are variable in diversity and abundance on the inshore and island rocky reefs. The invertebrate assemblages are dominated by sediment-tolerant species that are common in turbid coastal reef environments, but otherwise relatively uncommon on reefs of the Great Barrier Reef (GBR; GHD 2005, Koskela Group 2009). These include filter-feeding soft corals, sea fans, sponges, ascidians, and hydroids.

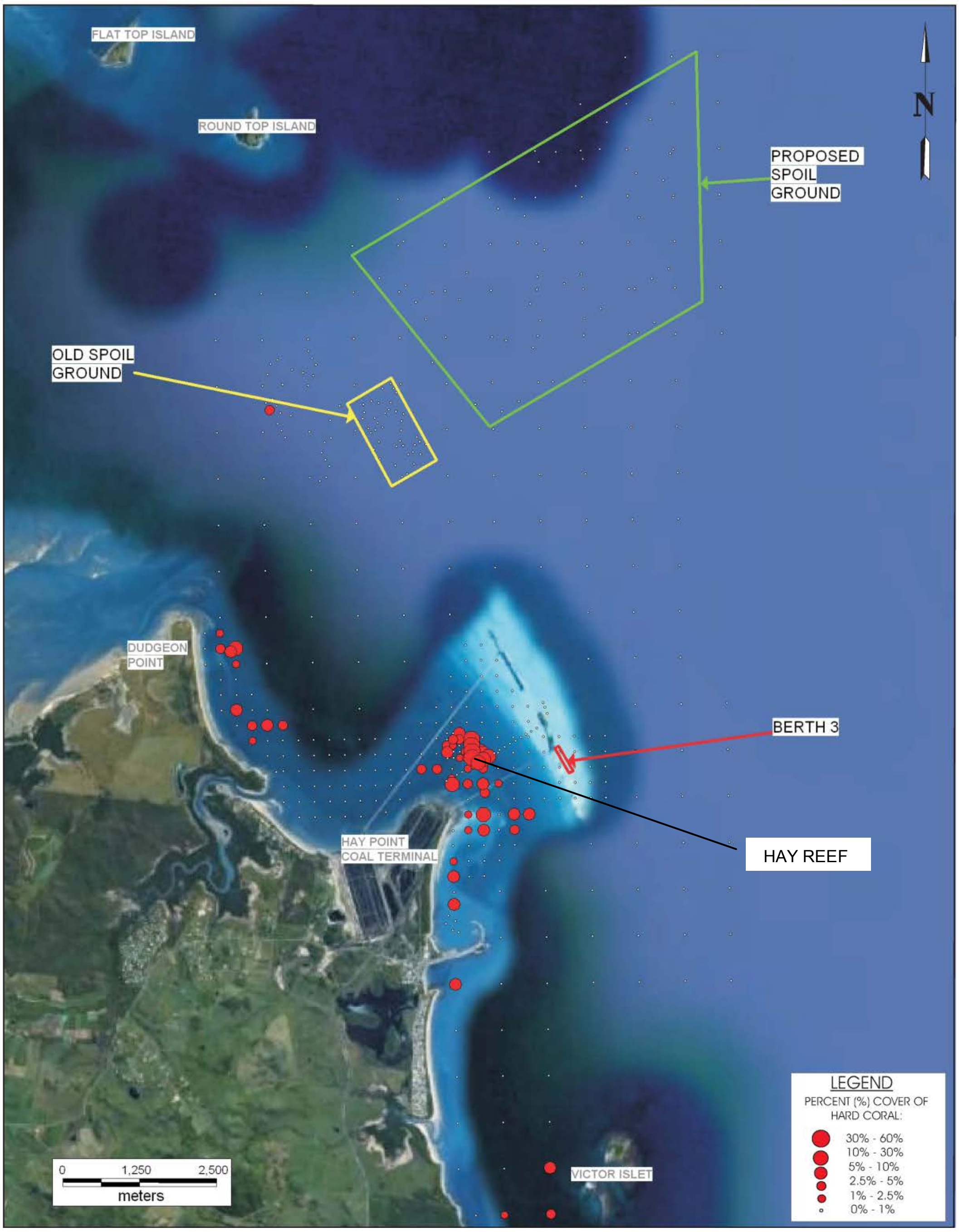

Figure 8 Percent cover of hard coral in the Port of Hay Point and spoil ground (Koskela Group 2009)

2.3 Fishes

Between 2006 and 2008, Chartrand *et al*. (2008) recorded 32 fish species in eight beam-trawl surveys of three sand-bottom sites north of HPCT. Cardinalfishes (Family Apogonidae) and the spotfin tongue sole (*Cynoglossus maculipinnis*) dominated the fish community. Fish abundance was very low compared to denser inshore seagrass habitats sampled elsewhere. The recent drop-camera survey indicated that fish abundance and diversity are also low on open sandy bottoms between the loading berths and shore (R. Koskela, pers. comm.), although data on fishes in these areas are not reported in the survey results (Koskela Group 2009).

The abundance and diversity of fishes in reef habitats in the area are considerably higher than on open sandy bottoms. GHD (2005) recorded 71 fish species in a survey of the fringing reefs at Victor Islet, Round Top Island, and Flat Top Island. This is a relatively low fish diversity compared to offshore GBR reefs, but typical of inshore fringing reefs (GHD, 2005; Williams, 1982). The fish community was dominated by typical inshore species including wrasses, damselfishes, an angelfish (*Chaetodontontoplus duboulayi*), a butterflyfish (*Chaetodon aureofasciatus*), and the stripey snapper (*Lutjanus carponotatus*). The fish fauna at Hay Reef has a similar fish fauna (Koskela Group, 2009).

The fish fauna associated with the wharf pylons and other marine structures at the existing HPCT conveyor and berths has not yet been surveyed, but is understood to be more abundant (R. Koskela, pers. comm.).

2.4 Sea Turtles

The EPBC Protected Matters Search Tool lists all six species of marine turtle that occur in Queensland as potentially occurring in the Hay Point area. The Mackay/Hay Point area is a low-density nesting area for flatback (*Natator depressus*), green (*Chelonia mydas*), and loggerhead (*Caretta caretta*) turtles (Connell Hatch 2009). Flatback turtles are the most common nesting turtles in the area. Nesting of the three species of turtle may occur between mid-October to early April. Peak nesting in flatbacks occurs in late November and early December. Nesting peaks in loggerheads in December, and in greens from late December to early January. Hatchlings emerge between December and April (GBRMPA, 2009), with each species having a slightly different hatching period.

In Queensland, hawksbill turtles (*Eretmochelys imbricata*) are only known to nest north of Princess Charlotte Bay (Dobbs, 2001; Limpus, 2009a), and olive or Pacific ridleys (*Lepidochelys olivacea*) only in the Gulf of Carpentaria (Limpus, 2008). There is only a single record of leatherback turtle (*Dermochelys coriacea*) nesting in Mackay (Limpus, 2009b) and the Mackay District Turtle Watch has not recorded leatherback nesting in the area since 1993 (Connell Hatch, 2009).

Bell (2003) observed green turtles in Dalrymple Bay, probably feeding on algae growing on rocky substrates. Green turtles have recently also been observed around Hay Reef, again apparently feeding on algae on rocks (Koskela Group, 2009). Other turtle species may occasionally forage in the area but there are no records of this. Despite the limited recorded observations of feeding sea turtles, the area’s reefs and seagrasses may represent an important feeding ground for sea turtles.

2.5 Marine Mammals

A search of the EPBC Act Protected Matters Search Tool identified 13 species of marine mammal occurring or potentially occurring within the Mackay region. Of the 13 species listed 12 species are cetaceans and one species is the dugong (*Dugong dugon*).

The 12 cetacean species listed by the EPBC Protected Matters Search Tool include five whales and seven dolphins. The humpback whale (*Megaptera novaeangliae*) is the whale species most likely to occur in the general area of the Project, as the other whale listed whales species are uncommon in the area and/or typically occur in oceanic waters offshore. Humpbacks migrate north along the east coast of Australia from summer feeding grounds in Antarctica to breeding areas in the Great Barrier Reef (GBR) lagoon. Humpbacks migrate northward offshore of the Mackay region from about June to August, with a peak in July, and southward during August, September, and October (Vang, 2002).

The dolphin species most likely to occur in the Hay Point area are the Indian Ocean bottlenose dolphin (*Tursiops aduncus*, also known as the Indo-Pacific bottlenose dolphin), pantropical spotted dolphin (*Stenella attenuata*), Indo-Pacific humpback dolphin (*Sousa chinensis*), and possibly the Australian snubfin dolphin (*Orcaella heinsohni*). The Australian snubfin dolphin was formerly considered a form of the Irrawaddy dolphin (*Orcaella brevirostrus*), and is still reported as such by the EPBC Protected Matters Search Tool, but was described as a new species on the basis of genetic and morphological evidence

(Beaseley *et al.* 2005). Dolphins are highly mobile species whose presence in the Project area is unpredictable and likely to be infrequent (WBM, 2004).

Dugongs are also known to occur in the area. Dugongs are long-lived, slow-reproducing marine mammals that inhabit shallow tropical waters, particularly in association with seagrass beds, their primary food source. The dugong is listed as vulnerable to extinction in the IUCN Red Book (IUCN 2008) and is considered threatened throughout most of its former global range (Marsh *et al.* 2002). Australian dugong populations are considered relatively healthy compared to some other countries, but the dugong is a listed marine species and migratory marine species under the EPBC Act. In Queensland, dugongs are most abundant in Torres Strait and the Far Northern section of the GBR (Grech and Marsh 2007). The Hinchinbrook Island area, Cleveland Bay, Shoalwater Bay, Hervey Bay, and Moreton Bay are the most important dugong habitat areas in central and southern Queensland. Dugong Protection Areas (DPAs) have been established under the *Queensland Nature Conservation Act 1992* and the *Queensland Fisheries Act 1994* to reduce dugong mortality from entanglement in fishing nets. The nearest of these to HPCT are the Sand Bay DPA, about 45 km to the north along the coast, and the Llewellyn Bay and Ince Bay DPAs, about 15 km and 23 km to the south, respectively

The Hay Point area is not known to be an important habitat area for dugongs. Environmental Impact Statements for previous expansions at Hay Point reported that there have been few dugong sightings (URS, 2000; GHD 2005). Aerial surveys of dugong populations in 1987, 1992, 1994, and 1999 (Marsh 1989; Marsh *et al.* 1996; Marsh & Lawler 2001) failed to record a single dugong in an area extending 35 km and 10 km due north and south, respectively, of HPX Berth 3. Dugongs do occur in the Mackay/Hay Point area but there does not appear to be a resident population, and dugongs in the Project area are likely to be in transit. Dugongs have been recorded moving up and down the Queensland coast over distances of tens to hundreds of kilometres over periods of days to weeks and even greater distances over months, although many individuals are more sedentary (Marsh *et al.* 1999; Marsh, 2000; Sheppard *et al.* 2006). One individual was electronically tracked moving to Hay Point from Shoalwater Bay, 220 km to the south (A.R. Preen, pers. comm., cited in Marsh *et al.* 1999). Seagrass communities in the Hay Point region may provide a seasonal food source for any dugong passing through the area, particularly during the normal high season of late spring and summer (Rasheed *et al*. 2004).

2.6 Intertidal

The tidal range at Hay Point is approximately 7 m (Koskela Group 2009). Extensive areas of shoreline on the north-western side of Hay Point, and the area around the Tug Harbour, have been modified by port development. Most of the east side of Hay Point north of the Tug Harbour is a sand beach, backed by dune vegetation as noted above.

The intertidal zone at Hay Point is a continuous rock platform consisting of gravel to boulder sized rocks and is approximately 100 m wide (Koskela Group 2009). The lower intertidal is primarily bare rock with no macroalgae or macroinvertebrates, while the upper intertidal is mostly sparse, shrubby mangroves, with only two areas of continuous mangrove trees. Five mangrove species have been recorded in the rocky intertidal area at Hay Point (Koskela Group 2009). There are also two small areas of muddy sediment extending seaward from the beach. More extensive areas of mangrove line Louisa Creek (GHD 2005, Koskela Group 2009). The mangrove fringe in Louisa Creek is approximately 20 m wide, and includes 10 recorded mangrove species (Koskela Group 2009).

2.7 Introduced Marine Species

Several introduced marine species (IMS) surveys have been conducted at Hay Point. A baseline IMS survey conducted in 1997 focused on habitats likely to be colonised by IMS (Figure 9), using a variety of IMS-targeted and general sampling techniques (Hewitt *et al*. 1998). The survey included a site at the existing spoil ground that was used to dispose of shot rock generated by expansion of the Dalrymple Bay Coal Terminal (DBCT) in 1993. The survey did not detect any IMS listed on the (then) Australian Ballast Water Management

Advisory Committee pest species list. Some other introduced or cryptogenic species (species that cannot be definitely categorised as introduced or native) were identified. None of these species, however, appear on the current Domestic CCIMPE Trigger List (the alert list of IMS not yet known in Australia, or established in Australia but not yet widespread; Commonwealth of Australia 2006).

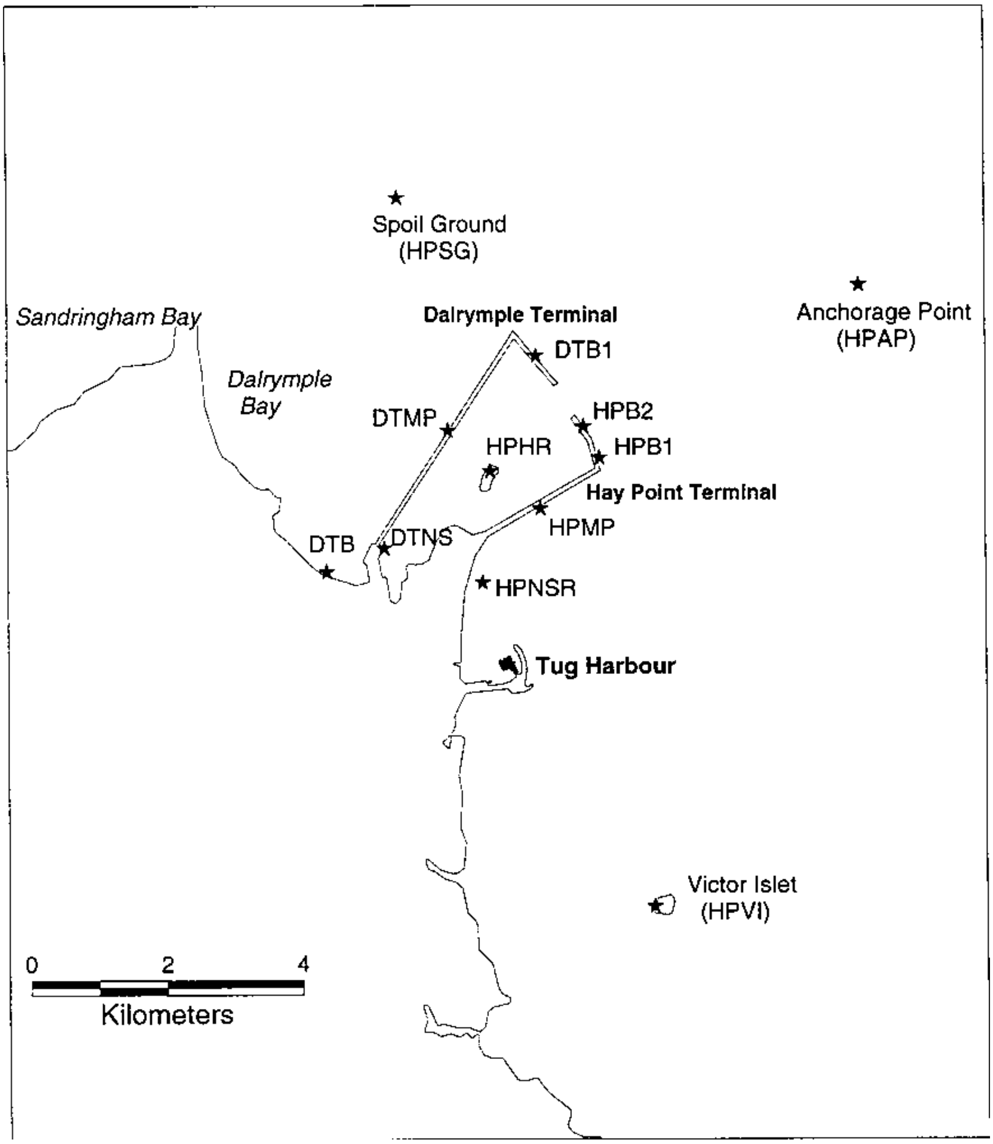

Figure 9 Baseline IMS survey locations in 1997 (Hewitt *et al*. 1998)

Rasheed *et al*.'s (2004) benthic macroinvertebrate survey included the existing shipping berths at Dalrymple Bay and Hay Point, the departure channel, the old ocean disposal site used for the 1993 DBCT expansion and subsequent maintenance dredging, and the disposal site that was later used in the 2006 capital dredging. The survey did not directly target IMS, but a comparison of the list of species recorded by Rasheed *et al*. (2004) with the CCIMPE Trigger List (Commonwealth of Australia 2006) indicated that it is unlikely that any were IMS of concern. In some cases, Rasheed *et al*. (2004) did not record identifications to sufficient taxonomic resolution to rule out the organism being on the CCIMPE Trigger List. However, the authors have conducted numerous targeted IMS surveys (e.g., McKenna *et al*. 2008; Rasheed *et al*. 2003, Stafford *et al*. 2007), and are intimately familiar with, and always look for and r ecord, IMS of concern, so that if present they would have been r ecorded (M. Rasheed, pers. comm., 20 July 2009).

Targeted IMS surveys were also conducted at Hay Point in 2006 and 2007 (see Figure 10) in conjunction with the 2006 capital dredging works (Stafford *et al*. 2007). The surveys were conducted before and after dredging and focused on dredging areas and the ocean disposal site. Stafford *et al*. (2007) established a targeted list of IMS on the basis of published information. Species were excluded from the list based on their environmental tolerances and whether conditions at Hay Point are suitable for their establishment. Collected specimens were also referenced against “species of concern” from the CCIMPE Trigger List (Commonwealth of Australia 2006). No targeted IMS or species of concern were detected in these surveys.

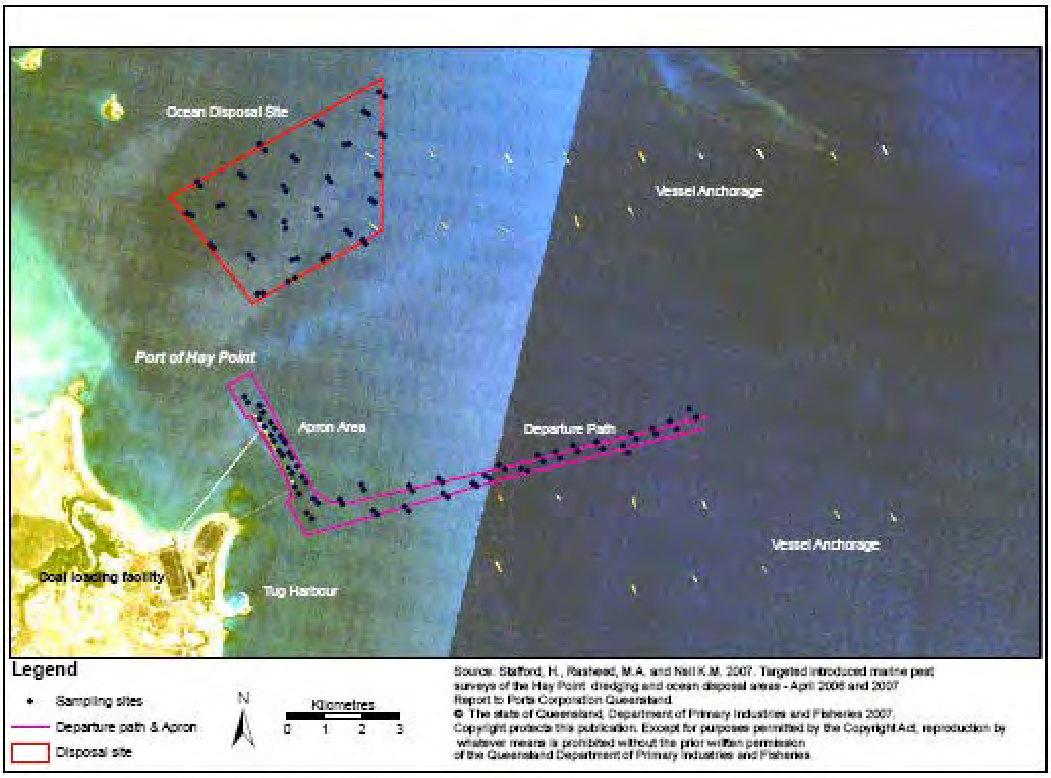

Figure 10 IMS sampling sites at the Port of Hay Point in 2006 and 2007 (Stafford *et al*. 2007)

3. Communication and Engagement

Communications and stakeholder engagement will continue throughout the project, in accordance with BMA policy and as recommended in the National Assessment Guidelines for Dredging (NAGD; Commonwealth of Australia 2009). The aim of the communications and stakeholder engagement program is to provide a t wo-way information channel for stakeholders, build consensus among stakeholders, obtain stakeholder input into technical matters, and resolve issues. Engagement and consultation will occur both through a broader community engagement process for the entire HPX3 project and through a dredging-specific Management Review Group (MRG).

3.1 Community Engagement

BMA is committed to the communities in which it operates, and has a number of company policies, standards and targets relating to its performance within the community. BMA's community relations approach aims to:

1. Enhance BMA's reputation and improve community relationships;
2. Positively impact on employee morale;
3. Comply with the BHP Billiton Charter, Community Standard, Health, Safety, Environment and Community (HSEC) Standard, and align with internationally recognised standards including ISO 14001; and
4. Improve the liveability and sustainability of the communities in which we live and operate.

BMA has developed a detailed Community Engagement Plan for all aspects of the HPX3 project, including aspects related to dredging and dredged material disposal, based on the principles shown in Table 2.

Table 2 Principles of Community Engagement for the HPX3 Project

Community Engagement Principles	
Open and transparent process	The community engagement methodology will adopt an open and transparent approach to informing stakeholders of BMA's objectives and activities, and will demonstrate how stakeholder input has been considered.
Responsive	Stakeholder ideas, issues and opportunities will be identified and documented through established communication channels and face-to-face consultation. This will involve an open, two-way process. BMA will acknowledge receipt of stakeholder feedback and 'close the loop' with stakeholders at the end of an engagement period by informing stakeholders how their input was considered.
Timely Dissemination	Information will be disseminated taking into account the time stakeholders will need to understand it and respond appropriately. Information dissemination will also be timely in order to manage any misinformation or rumours that may arise.
Accountability	BMA will demonstrate integrity and be accountable to stakeholders during the engagement process and commitments will be made in good faith. Accountability will occur through the reporting of outcomes, periodic evaluation of the engagement process and the achievement of objectives.

The Community Engagement Plan:

1. Identifies the key stakeholders and the issues of relevance to them. Stakeholders include local residents and landowners, traditional owners and indigenous groups, non-governmental organisations, local regional councils, Queensland and federal government agencies, police and emergency services, suppliers and contractors, BMA employees, and the media;

2. Establishes a number of mechanisms for information dissemination including static and mobile displays, regular updates of the Growth Projects website, newsletters, fact sheet, and direct correspondence with identified stakeholders.
3. Provides a formal procedure for responding to written correspondence from stakeholders, including acknowledgement of receipt within two working days, entry of the issues raised into a Stakeholder Management database, and notification of relevant members of the HPX3 project team; and
4. Provides a 24-hour free-call hotline (1800 078 797) and email address (enquiries@bmacoal.com.au) for community members, landowners, and other stakeholders to contact the BMA Growth Projects team to obtain information and raise issues of concern.

BMA has an existing community reference group, the Environment Community Consultation Audit (ECCA), which deals with all environmental aspects of HPCT.

3.2 Establishment of a Dredging and Disposal Management Review Group

A MRG for dredging and spoil disposal activities will be established to provide ongoing technical advice prior to, during, and following completion of dredging and disposal activities.

3.3 Roles of the MRG

The role of the MRG is to review the outcomes of the monitoring programme and determine appropriate action in the event of a management response being triggered, including:

1. Provide continuity of direction and effort in protecting the local environment;
2. Review ongoing monitoring and management and make recommendations as necessary/as appropriate regarding measures to improve environmental performance;
3. Interpret monitoring results to determine whether Management Response Trigger events are related to dredging or spoil disposal activities;
4. Recommend appropriate management or mitigation measures to use in the event that Management Response Trigger events are detected; and
5. Any other aspects of dredging and spoil disposal management and monitoring requested by BMA, GBRMPA or DoE.

3.4 Composition of the MRG

The MRG membership will have representatives from the following groups:

1. Great Barrier Reef Marine Park Authority (GBRMPA);
2. Department of Environment (DoE; formerly Department of Sustainability, Environment, Water, Population and Communities, SEWPaC);
3. Department of Environment and Heritage Protection (DEHP; formerly Department of Environment and Resource Management, DERM);
4. Department of Agriculture, Fisheries and Forestry (DAFF; formerly Department of Employment, Economic Development and Innovation, DEEDI);
5. North Queensland Bulk Ports (NQBP);
6. Maritime Safety Queensland (MSQ);
7. BHP Billiton Mitsubishi Alliance (BMA);
8. Dredging Contractor;
9. Bechtel Construction Contractor;
10. An independent coral scientist with experience of dredging operations;
11. An independent seagrass scientist with experience of dredging operations;
12. Environmental Site Supervisor (ESS); and
13. Lead Marine Environmental Consultant.

BMA will coordinate and facilitate meetings of the MRG.

3.5 MRG Meetings

3.5.1 Kickoff Meeting

As soon as practicable after environmental approval is obtained for the project, a kickoff meeting will be convened which will:

1. Provide an introduction to the project and general approaches to environmental monitoring and management; and
2. Provide feedback on management and monitoring plans.

3.5.2 Pre-dredging Meetings

Prior to the commencement of dredging and spoil disposal, meetings of the MRG will be convened to present key environmental issues identified in the approvals process and the initial approaches to environmental monitoring and management for dredging and disposal activities.

3.5.3 Meetings during Dredging Operations

A meeting will be convened three weeks after commencement of dredging. At that meeting the first two weeks of data will be provided to the MRG, together with a description of trends and management actions undertaken in response to any trigger events, along with ESS observations. This information will be circulated to the group at least two business days prior to the meeting

Meetings of the MRG will be convened regularly during dredging to address the interpretation of monitoring result exceedances, appropriate management or mitigation measures if required and any other aspects of dredging and spoil disposal management and monitoring requested by BMA, GBRMPA or DoE. At least some of these meetings will likely be via teleconference in recognition of the need for rapid responses.

3.5.4 Final Review Workshop

Once the consolidated results of the monitoring and management program have been prepared, the MRG will re-convene to review the findings. A report will be prepared and provided to BMA, GBRMPA and DoE.

4. Environmental Monitoring and Management

BHP Billiton Metallurgical coal is the largest supplier of seaborne traded coking coal. BMA is owned (50%) and operated by BHPBilliton.

BHP Billiton (BHPB) operates under the BHPB Charter. The BHPB Charter value of Sustainability, which means putting health and safety first, being environmentally responsible and supporting our communities, underpins everything we do. BHPB achieves Sustainability when *everyone*:

1. Takes responsibility for the health, safety and welfare of self and others and takes the necessary action to minimise environmental impacts;
2. Identifies and understands relevant health, safety, environment and community risks; and
3. Builds and maintains meaningful, long-term relationships with internal and external stakeholders:

BMA is committed to sustainable development. The dredging contractor must work with a similar commitment, which will be achieved through three key strategies:

1. Environmental awareness training for all employees;
2. Continuing research and development targeting emissions reductions, improved energy efficiencies and waste minimisation; and
3. Environmental transparency and adherence to all State and local environmental standards.

The BHP Billiton Charter is shown in Figure 11.

bhpbilliton
resourcing the future

Our Charter

We are BHP Billiton, a leading global resources company.

Our purpose is to create long-term shareholder value through the discovery, acquisition, development and marketing of natural resources.

Our strategy is to own and operate large, long-life, low-cost, expandable, upstream assets diversified by commodity, geography and market.

Our Values

Sustainability
Putting health and safety first, being environmentally responsible and supporting our communities.

Integrity
Doing what is right and doing what we say we will do.

Respect
Embracing openness, trust, teamwork, diversity and relationships that are mutually beneficial.

Performance
Achieving superior business results by stretching our capabilities.

Simplicity
Focusing our efforts on the things that matter most.

Accountability
Defining and accepting responsibility and delivering on our commitments.

We are successful when:

Our people start each day with a sense of purpose and end the day with a sense of accomplishment.

Our communities, customers and suppliers value their relationships with us.

Our asset portfolio is world-class and sustainably developed.

Our operational discipline and financial strength enables our future growth.

Our shareholders receive a superior return on their investment.

Andrew J Mackenzie

Andrew Mackenzie
Chief Executive Officer

May 2013

Figure 11 BHP Billiton Charter

4.1 Management Structure

4.1.1 Environmental Site Supervisor

The role of the Environmental Site Supervisor (ESS) is as follows:

1. The ESS means the person(s) from time to time nominated in writing by the GBRMPA to BMA;
2. The ESS reports to the Managing Agencies (GBRMPA and DEHP);
3. The ESS's function is to undertake the supervision of works authorised under Marine Parks Permit G10/16868.1 and Sea Dumping Permit No: 10/02 to ensure compliance with approval conditions, including the EMP, as approved by the Managing Agencies from time to time. Supervision works shall include, but not be limited to:
    a. visual assessments of dredge spoil size and cross-checks of observed dredge spoil size and spoil disposal areas, including the auditing of vessel logs;
    b. visual assessments of sediment plumes, their size, position, and orientation;
    c. the recording of weather, wind conditions and currents; and the observation and recording of plant environmental performance.
4. The ESS shall ensure that appropriate action is taken where works are likely to be in breach or are in breach of the Marine Parks Permit G10/16868.1 and Sea Dumping Permit No: 10/02 approval conditions. Appropriate action includes notification to BMA's nominated on-site liaison officer (the BMA ES, Sara James) that a breach may have occurred and advising the GBRMPA Delegate(s) that a breach may have occurred and recommending the cessation, suspension, or modification of activities. The ESS shall provide input to the process of modification to the conduct of works so as to mitigate or avoid the occurrence of any non-conformance resulting or likely to result from the unmodified conduct of the works; and
5. The ESS shall attend, and where appropriate, provide reports to the MRG.

4.1.2 Project Personnel

During dredging and blasting, the overall management of the development shall be under the supervision of the BMA Project Manager (BMAPM) with day-to-day control of the project under the Project Manager (PM). This person shall delegate as necessary to the Construction Manager (CM) to direct the Contractor Project Manager (CPM), who then manages the Foremen and Subcontractors. The CM and the CPM shall liaise with the Environmental Superintendent (ES) to ensure environmental issues are being correctly managed. The ES shall ensure that all operational staff have been trained in environmental awareness and the requirements of this EMP and all related policies, plans, and procedures. The ES (Sara James) is also the 24-hour on-site liaison for the ESS to contact as and when required.

The 24 hour site contact details are:

- Sara James (ES), phone: 0488 250 453
- Tony Baker (OFAM), phone: 0428 697 433

The management structure illustrated in Figure 12 has been chosen to provide a clear chain of authority for the implementation of this EMP. From this structure a clear set of environmental responsibilities, accountabilities and authorities has been developed for key roles and are summarised below.

Hay Point Coal Terminal Manager (HPCTM)
1. Day to day management of the Hay Point Coal Terminal

BMA Project Director (BMAPD)
1. Manages the project and its execution
2. Ensures the expansion needs of Hay Point Services are satisfied in accordance with approved implementation plan

BMA Owner's Site Representative (OSR)

1. Reports to the BMAPD
2. Responsible for the day-to-day management of site activities in coordination with the CM
3. Reviews Environmental Events
4. Monitors EMP implementation

BMA Environmental Superintendent (ES)

1. Reports to the BMA HSE Manager (HSEM)
2. Reviews compliance with permits and management plans
3. Facilitates MRG Meetings
4. Monitors environmental performance
5. Participates in community consultation
6. Undertakes liaison with relevant Government bodies and other authorities or interested parties
7. Provides environmental advice to project team during construction
8. Provides monitoring results to DEHP, North Queensland Bulk Ports Corporation Limited (NQBP) (formerly Ports Corporation of Queensland) and Mackay Regional Council (MRC), Maritime Safety Queensland (MSQ) and Department of Environment (DoE) when requested
9. Monitors complaints and reports the status of complaints to OSR
10. Ensures corrective action has occurred within a reasonable timeframe
11. Approves the training programme
12. Maintains a master copy of this EMP containing a record of the completed actions, monitoring, and reports supplied by the Construction Supervision staff
13. Coordinates staff when necessary to implement and monitor the actions contained in this EMP
14. Reviews and updates environmental management plans

Hay Point Services Environmental Advisor (EA)

1. Reports to the HPCTM
2. Responsible for managing the day-to-day environmental issues associated with operating the HPCT
3. Involved in environmental issues during the construction phase as required

Construction Manager (CM)

1. Reports to the PM
2. Responsible for the day-to-day management of site activities
3. Reviews Environmental Events
4. Monitors EMP implementation

Senior Environmental Advisor (SEA)

1. Reports to the SHE Manager (SHEM)
2. Responsible for monitoring and reporting contractor's compliance with the EMP, and incident investigations as required
3. Conducts regular site inspections and audits
4. Reviews Monthly Environmental Report from Contractor(s)
5. Ensures any non-conformances are followed up and corrected
6. Ensures monitoring specified in this EMP is undertaken
7. Ensures all reports and monitoring records are kept onsite and can be located easily
8. Arranges regular environmental auditing at the construction site(s)
9. Reviews and approves Contractor's detailed Environmental Management Plans associated with dredging and blasting operations
10. Ensures audits are undertaken on the implementation of this EMP
11. Ensures all Project Staff are trained in environmental awareness, site issues and the actions contained in this EMP
12. Conducts environmental site inductions
13. Responsible for the day-to-day management of the overall project
14. Maintains a register of inducted personnel

Marine Area Superintendent (MAS)

1. Reports to the CM
2. Ensures all project staff are appropriately briefed on the requirements of this EMP prior to starting any construction works
3. Maintains a record of all training undertaken for project employees and gives a copy of records to the CM
4. Provides copies of this EMP and the project Environmental Management Plan (EMP) to all relevant Project Staff with nominated responsibilities under this EMP
5. Maintains a copy of this EMP and the project EMP containing a record of completed actions, monitoring records, reports etc, which are to be made available during audits
6. Monitors performance by regularly reviewing monitoring results and complaints received
7. Addresses complaints received in accordance with this EMP (in accordance with the ES)
8. Identification and reporting of non-conformances to the CM, also reports any other environmental issues which may arise during construction
9. Develops and/or implements corrective actions required as a result of monitoring undertaken, complaints received or required under an external audit
10. Onsite monitoring and reporting as required by this EMP

Dredging and Blasting Superintendent (DBS)

1. Reports to the MAS
2. Conducts regular site inspections and audits of the dredging and blasting operations
3. Ensures activities are in compliance with EMP
4. Provides data for regulatory reporting and audits
5. Supervises dredging and blasting operations

Dredging Supervisor (DSV)

1. Reports to the DBS
2. Undertakes visual observations of plumes during all dredging operations
3. Undertakes visual observations for marine animals during dredging operations

Drill and Blast Supervisor (DBSV)

1. Reports to the DBS
2. Coordinates marine fauna observers activities with operational activities

Blast Observer (BO)

1. Responsible for supervising and communicating with visual and passive acoustic monitoring teams
2. Enters all visual and acoustic marine fauna detection/monitoring information, including species, numbers of individuals, time and location of detection and behaviour, into a marine tracking and detection database

Boat-Based Observers (BBOs)

1. Report to the BO
2. Responsible for performing visual monitoring of the Exclusion Zone and deploying mobile hydrophones for passive acoustic monitoring during blasting operations

Ground Observers (GBOs)

1. Report to the BO
2. Responsible for performing visual monitoring of the Exclusion Zone

Contractor Project Manager (CPM)

1. Reports to the CM through the MAS
2. Represents the Contractor and oversees any Subcontractors and Foremen
3. Obtains necessary approvals not obtained by the project
4. Ensures all contractor staff (including Subcontractors) are appropriately briefed on the requirements of this EMP prior to starting any construction works
5. Maintains a record of all training undertaken for contractor employees and gives a copy of records to the CM
6. Provides copies of this EMP and their own Environmental Management Plan (EMP) to all relevant Staff with nominated responsibilities under this EMP

7. Maintains a copy of this EMP and their own EMP containing a record of completed actions, monitoring records, reports etc, which are to be made available during audits
8. Monitors performance by regularly reviewing monitoring results and complaints received
9. Addresses complaints received in accordance with this EMP (in conjunction with the ES)
10. Identification and reporting of non-conformances to the CM, also reports any other environmental issues which may arise during construction
11. Develops and/or implements corrective actions required as a result of monitoring undertaken, complaints received or required under an external audit
12. Onsite monitoring and reporting as required by this EMP

Contractor Monitoring Coordinator (CMC)

1. Reports to the CPM
2. Responsible for supervising the blast operation
3. Responsible for communicating with visual and passive acoustic monitoring teams through the BO
4. Responsible for the Go/No-Go decision process for blasting

Foremen and Subcontractors (F&S)

1. Implementation of actions in accordance with this EMP or as directed by the CPM or DBS

In addition to the operational personnel described above, implementation of the monitoring and research components of this EMP will be performed by scientific personnel, who may be staff of a sub-consultant or scientific institution. The BMAPM will ensure that all scientific personnel involved in the implementation of this EMP are experienced, qualified, and appropriate to carry out their assigned duties. The BMAPM will also ensure that all such personnel are adequately trained to perform their duties and understand the requirements of this EMP and all related environmental management plans and procedures.

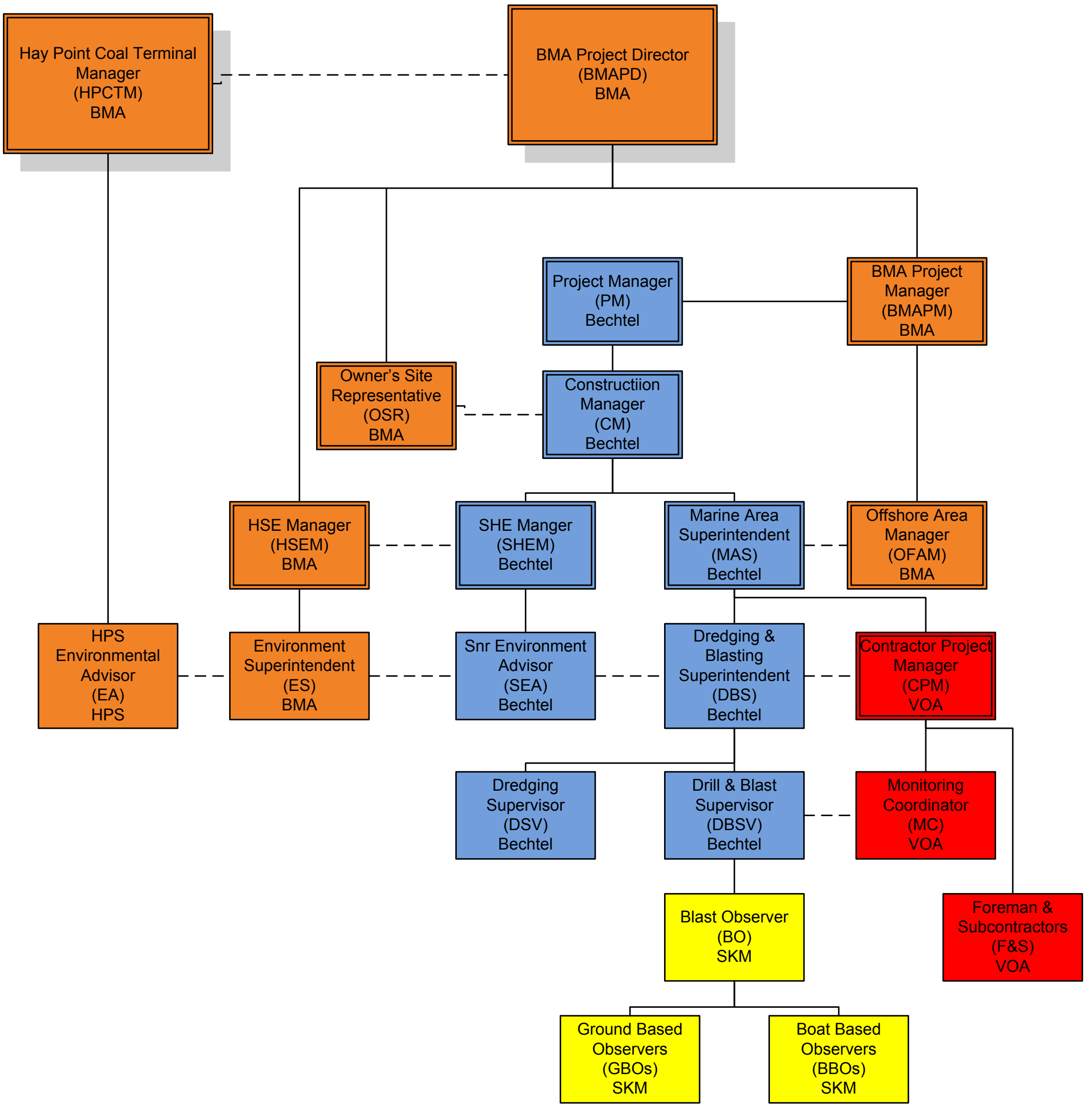

Figure 12 Environmental management structure for the HPX3 project

4.2 Relationship to Other Management Plans

This EMP operates in the framework of the BHBP Charter and Sustainable Development Policy, as well as the HPCT Environmental Policy and Management System and the HPX HSEC Management Plan (Figure 13). The EMP also aligns with four additional environmental management plans have been developed to address specific components and activities of the HPX3 project and describe specific performance objectives, actions and procedures to be carried out to minimise the potential environmental impacts from the activities of contractors engaged in the respective components of the project.

The plan most relevant to this EMP is the Dredging and Blasting Environmental Management Plan (DBEMP), which is fully aligned with this EMP. The other plans, the Construction Management Plan (CEMP), Reclamation Environmental Management Plan (REMP), and Decommissioning Environmental Management Plan (DEMP), are also aligned with this EMP in terms of management structure and approach, but do not relate to dredging and disposal activities. The management plans use a risk-based approach that is consistent with the SEMS.

The plans are written as stand-alone, dynamic documents to increase their usability, and will be reviewed by the relevant parties and updated regularly to reflect potential changes in processes, controls and procedures. Where a contractor's work covers routine and non-routine activities not stipulated in the environmental management plans, it is the responsibility of the contractor(s) to identify the environmental aspects associated with these activities and develop appropriate environmental plans to address the activities. A brief description (purpose and overview) of each management plan is provided below.

The DBEMP, CEMP, REMP, and DEMP are the benchmarks for measuring the effectiveness of environmental protection and management during the different phases of the project. This will be achieved by specifying monitoring, reporting, and auditing requirements, with nominated responsibilities and timing to ensure that the identified performance objectives are met. In addition, the plans make provisions for unforeseen events by outlining corrective actions that may be implemented in such situations.

4.2.1 Dredging and Blasting Environmental Management Plan (DBEMP)

Purpose

The DBEMP details the specific performance objectives, actions and procedures to be carried out during the dredging and blasting for the Berth 3 pocket and apron area to minimise potential environmental impacts. The DBEMP is the key reference document that identifies actions and commitments to be followed by the project team during the Berth 3 dredging and blasting activities.

The DBEMP is based on findings of the studies that have been undertaken as part of the HPCT Berth Pocket Dredging Environmental Assessment Report (EAR) prepared in 2005, the EPBC Referral for the Project submitted to DoE in February 2009 and with further documentation provided to DoE in July 2009.

Overview

The DBEMP defines the environmental issues of the HPX3 development by addressing the following:

1. Environmental policies of Hay Point Services and the dredging and blasting contractor(s);
2. Environmental responsibilities;
3. Environmental site induction;
4. Environmental monitoring;
5. Environmental reporting;
6. Environmental incidents/complaints;
7. Environmental audits; and
8. A management plan for each relevant environmental element.

BMA
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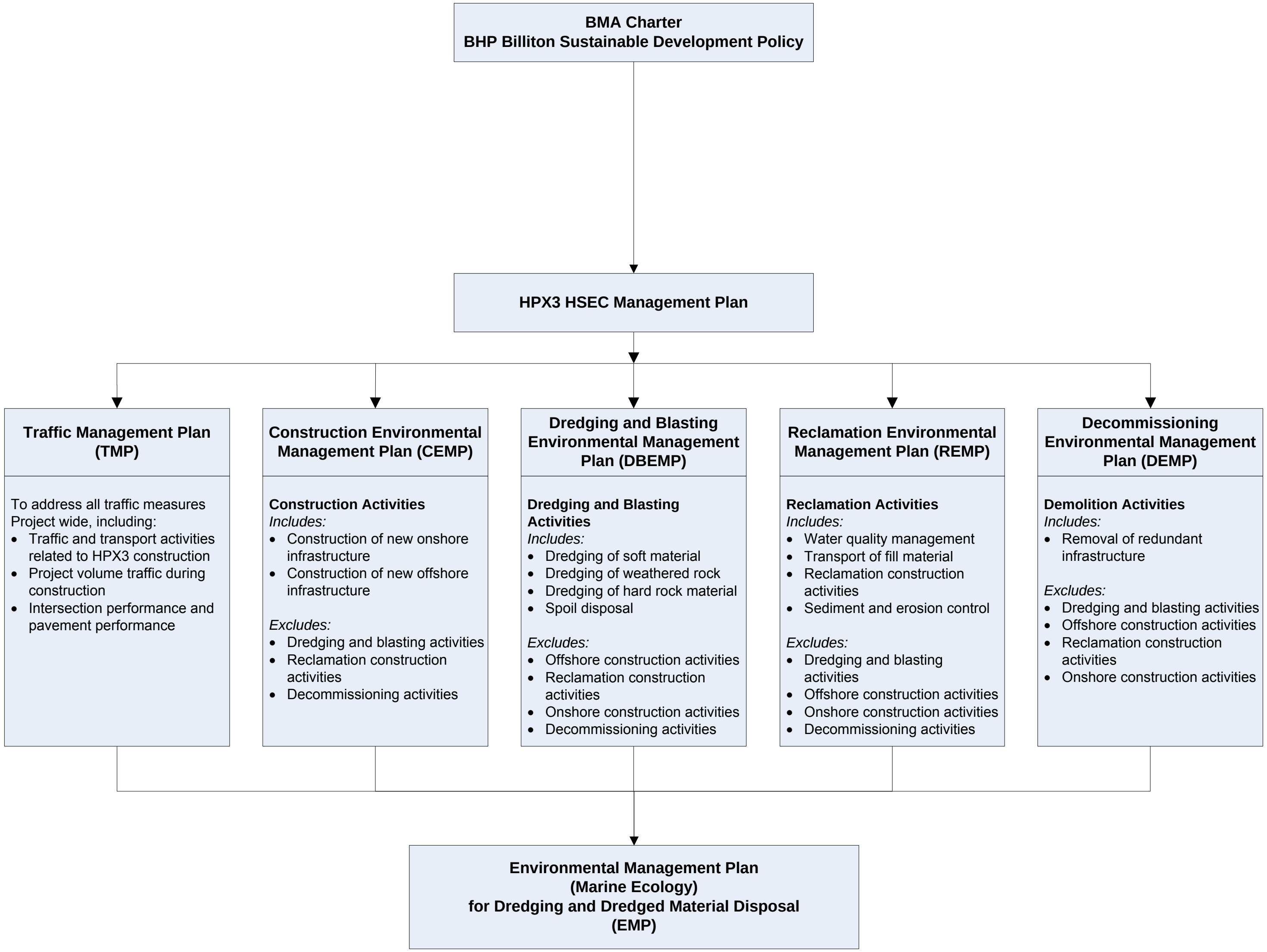


Figure 13 Relationship of the EMP to other environmental plans and policies

4.2.2 Construction Environmental Management Plan (CEMP)

Purpose

The CEMP details the specific performance objectives, actions, and procedures to be carried out during the construction phase, except the dredging phase, of the HPX3 project to minimise potential environmental impacts. The CEMP is the key reference document that identifies actions and commitments to be followed by the project team during construction.

Overview

The CEMP defines the environmental issues of the HPX3 by addressing the following outlined below. Each element is outlined in the attached CEMP document.

1. The environmental policies of Hay Point Services and the construction contractor
2. Environmental responsibilities
3. Environmental site induction
4. Environmental monitoring
5. Environmental reporting
6. Environmental incidents/complaints
7. Environmental audits
8. A management plan for each relevant environmental element

4.2.3 Reclamation Environmental Management Plan (REMP)

Purpose

The REMP details the specific performance objectives, actions, and procedures to be carried out to minimise potential environmental impacts while undertaking the reclamation. It is the key reference document that identifies actions and commitments to be followed by the project team during reclamation.

Overview

This will be a chieved by specifying monitoring, reporting and auditing requirements, with nominated responsibilities and timing to ensure necessary performance objectives are met. This will be achieved by the means of addressing the following below. Each of the elements is outlined in the attached REMP.

1. Environmental responsibilities
2. Environmental site induction
3. Environmental monitoring
4. Environmental reporting
5. Environmental incidents/complaints
6. A management plan for each relevant environmental element

4.2.4 Decommissioning Environmental Management Plan (DEMP)

Purpose

The DEMP details the specific environmental performance objectives, actions, and procedures during the decommissioning of the existing trestle and associated infrastructure at HPCT to minimise potential environmental impacts. The DEMP is the key reference document that identifies actions and commitments to be followed by the project team. It is the benchmark for measuring the effectiveness of environmental protection and management during the decommissioning works.

Overview

The purpose of environmental management during the decommissioning process of the existing trestle and its' associated structures is to minimise and mitigate potential environmental impacts through planned and programmed implementation of appropriate control measures.

Where the contractors' work covers routine and non routine activities not stipulated in this DEMP, it is the responsibility of the decommissioning contractor(s) to identify the environmental aspects associated with these activities and develop appropriate environmental plans to address these activities.

This DEMP defines the environmental issues of the development by addressing the following:

1. The environmental policies of Hay Point Services and the decommissioning and demolition contractor(s);
2. Environmental responsibilities;
3. Environmental site induction;
4. Environmental monitoring;
5. Environmental reporting;
6. Environmental incidents/complaints;
7. Environmental audits;
8. A management plan for each decommissioning activity;
9. A community consultation management plan; and
10. An emergency management plan.

5. Dredging and Disposal Methodology and Management

The dredging and disposal methodology and management measures to be implemented for the HPX3 project are designed to comply with the conditions of amended Marine Parks Permit G10/16868 and EPBC approval no. EPBC 2009/4759 stipulating that:

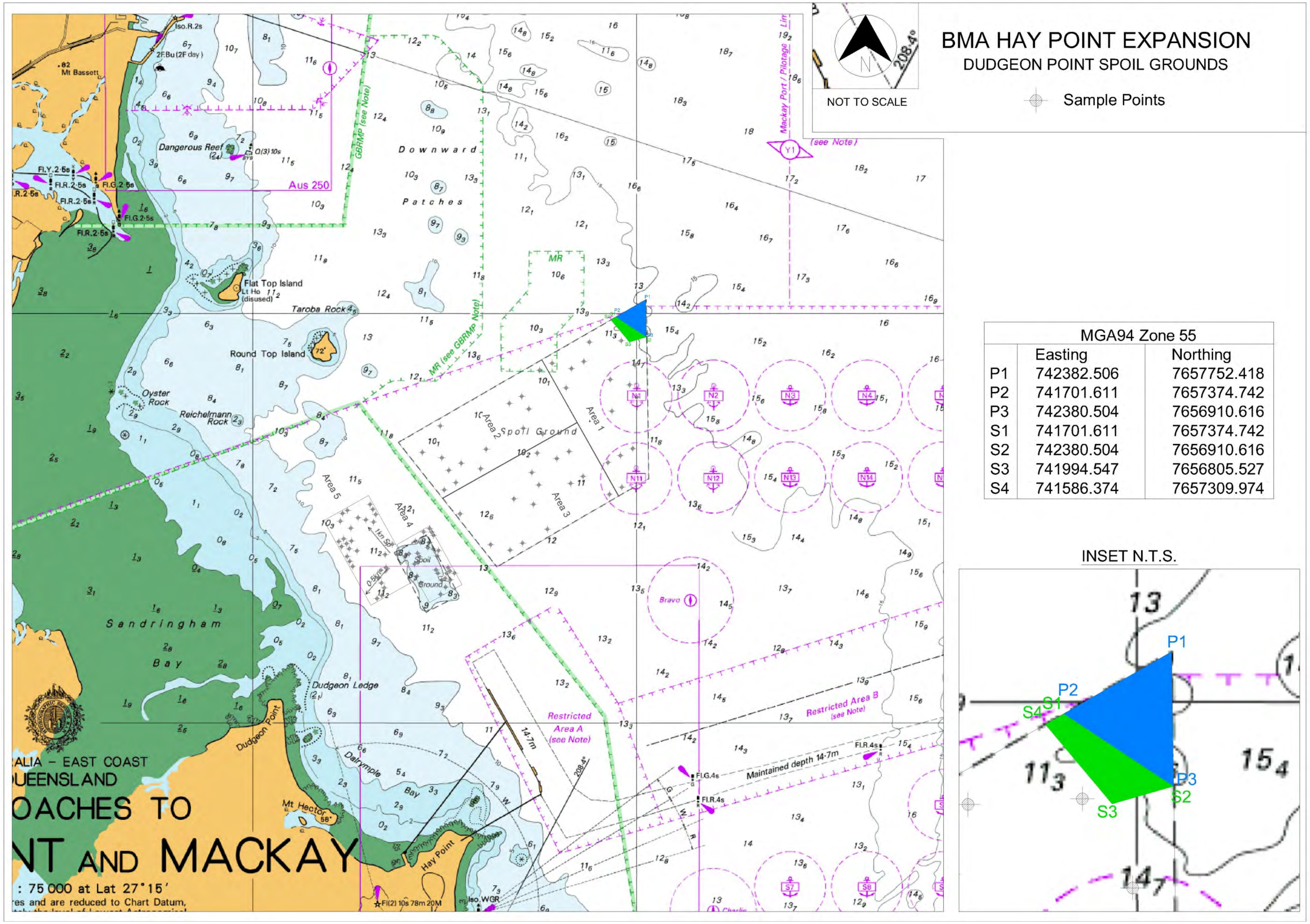
1. A maximum volume of 185,000 *in situ* m^3 of material to be disposed of in the defined disposal site;
2. Material that is greater than 400 mm in any dimension must not be disposed of in the defined Primary Disposal Area, but instead must be disposed of in the defined Secondary Disposal Area;
3. Within 36 months of completion of disposal activities, material > 400 mm must be reprocessed to reduce its size to less than 400 mm, or removed from the Marine Park; and
4. Dredging and reprocessing are to be conducted between the months of April and November.

In addition, the dredging methodology for the HPX3 project aims to:

1. Minimise sediment plume mobilisation;
2. Minimise any impacts of dredging operations on marine life and water quality; and
3. Reduce the potential impacts from noise generated by dredge equipment

The Primary Disposal Area and Secondary Disposal Area as defined in the Marine Parks permit are shown in blue and green, respectively, in Figure 14.

The offshore disposal areas will be used for disposal of alluvial material and XW rock that is unsuitable for re-use. More competent XW material and drill-and-blast material will be taken to shore for beneficial re-use.



	Easting	Northing
P1	742382.506	7657752.418
P2	741701.611	7657374.742
P3	742380.504	7656910.616
S1	741701.611	7657374.742
S2	742380.504	7656910.616
S3	741994.547	7656805.527
S4	741586.374	7657309.974

Figure 14 Location of approved disposal sites for HPX3 dredged material

(The Primary Disposal Area is shown in blue and bounded by points P1 – P3, the Secondary Disposal Area is shown in green and bounded by points S1 – S4)

5.1 Dredging Methodology and Equipment

5.1.1 General approach to removal of material

Soil investigations have revealed that the material to be dr edged consists of three main types:

1. Alluvial material – typically consisting of sand, gravel and clay;
2. XW rock and stiff clays; and
3. Competent weathered rock and fresh rock requiring drill and blast pre-treatment.

The plant and equipment to be used in the dredging works are as follows:

1. Backhoe Dredge (BHD) (towed by tug) – for all dredging works
2. 2 x 1,000 t Split Hopper Barges (towed by tugs) – for offshore disposal of material
3. Self Elevating Platform (SEP) – for drill-and-blast works
4. 2 x Flat Top Barges – for onshore disposal of material
5. Survey and personnel transport vessels – in support of all dredging works
6. Towed Mechanical Plough –for reprocessing of material in the spoil ground
7. Mechanical rake – for reprocessing of material in the spoil ground
8. Grab or Backhoe Dredge – for reprocessing of material in the spoil ground

All plant and equipment used in connection with activities authorised under Marine Parks Permit G10/16868.1 and Sea Dumping Permit No. 10/02 will be maintained and operated in a proper and efficient manner.

All material will be removed using the BHD, which is a mechanical excavator mounted on a rotating turret on a specialised barge. At the work site, the BHD lowers vertical legs called spuds to the seabed to provide a stable and secure working platform. As the dredge works, it gradually moves back along a rail system, the spud carrier. When the dredge reaches the end of the spud carrier, it raises the spuds, re-positions, and the process repeats. Each of these spud carriage movements propels the BHD into the face of the excavation by approximately 10 m, and the width of the excavation will measure approximately 20 m as the excavator works in an arc extending back to the working spud.

The rock layer needs to be pre-treated by drilling and blasting (where drilling and charging of holes occurs from the SEP), before the backhoe dredge can remove this material. The drill and blasted rock will be disposed of directly onshore. To minimise the amount of drilling and explosives needed for the blasting of the rock layer, the material overlaying the rock will be removed first. The material overlaying the rock is called the overburden layer and consists of alluvial material and XW material. It is expected that the full depth of the overburden will be removed in one pass of the BHD. This implies that the full range of material types is likely to be encountered over a relatively short distance and time frame in most of the dredging areas (described in detail below).

A preliminary dredge area plan is indicated in Figure 15 below based on existing inferred geotechnical information, and is subject to change pending the extent and nature of material actually encountered. An ongoing two-week look ahead will be made available as work progresses, supported by geotechnical predictions of materials to be dredged.

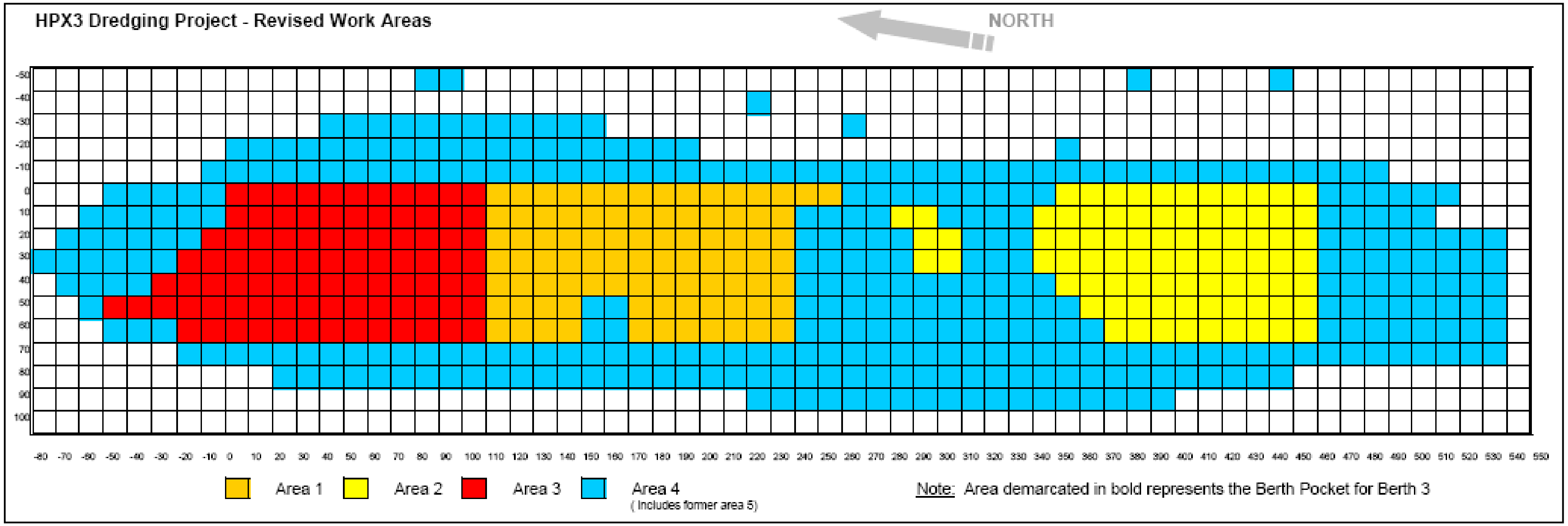


Figure 15 Preliminary Dredge Area Plan

Rock is found in two main locations – Areas 1 and 3 to the north and Areas 2 and 4 to the south. It is anticipated that pre-treatment by drill and blast will not be n ecessary within Area 5.

The backhoe dredge will commence dredging in the northern section first, removing the alluvial layer followed by the weathered rock layer from Area 1. Once both layers have been removed, the dredge will be relocated to the southern section in Area 2 where the process will be repeated.

The drill-and-blast rig will commence operations at the southern end of Area 1 onc e the overburden has been removed. Thereafter the drill and blast operation will generally follow the sequence of the removal of the overburden, which will from time to time be interrupted to enable the removal of blast rock by the BHD for transport to shore. A tentative sequence for this process is summarised below and is subject to change pending the nature and extent of materials encountered and respective production rates achieved:

The planned sequence for the removal of overburden and blast rock by BHD is in Table 3.

Table 3 Preliminary Milestone Schedule

Revised Forecast Milestone Schedule based on change in sequence of work areas

	Backhoe Dredge Works					Drill & Blast Works			
#	Activity	Area	Days	Start	Finish	Area	Days	Start	Finish
0	Set Up		**2**	**24-May-10**	**25-May-10**				
1	Overburden	Area 1	**74**	**26-May-10**	**07-Aug-10**	Area 1	31	**12-Aug-10**	11-Sep-10
2	Overburden	Area 3	**6**	**08-Aug-10**	**13-Aug-10**	Area 3	35	12-Sep-10	16-Oct-10
3	Overburden	Area 2a	**3**	**14-Aug-10**	**16-Aug-10**	Area 2a	2	17-Oct-10	18-Oct-10
4	Overburden	Area 2b	15	**17-Aug-10**	31-Aug-10	Area 2b	28	19-Oct-10	15-Nov-10
5	Blast Rock	Area 1	21	01-Sep-10	21-Sep-10				
6	Blast Rock	Area 3	48	22-Sep-10	08-Nov-10				
8	Blast Rock	Area 2a	1	09-Nov-10	09-Nov-10				
9	Blast Rock	Area 2b	21	10-Nov-10	30-Nov-10				
9	Blast Rock	Area 2b#	17	01-Apr-11	17-Apr-11				
10	Overburden	Area 4	81	18-Apr-11	07-Jul-11				
11	Contingency	-	27	08-Jul-11	03-Aug-11				

Note: 1) Start date assumed 24 May 2010
2) Durations & sequence to be revised once production rates are assessed on site
3) Updated Milestone Schedule to be issued monthly for planning purposes

The anticipated methodology developed for dredging the upper layers of material or the overburden (non drill-and-blast) is based on the decision tree show in Figure 16. Two levels of visual control and decision making are to be applied during the dredge processes. The first level of control is the responsibility of the backhoe operator, who will make an assessment of the content of the dredge bucket and again when discharging the contents into the dump barge.

The second level of control is carried out by the dump barge observers, who in collaboration with backhoe operator, makes the final decision where a fully laden barge will discharge, either at the designated primary or secondary disposal areas. This assessment is made from what is observed within the split-hopper barge during the loading process. The dump barge observers will also be trained to determine when to commence loading material onto flat top barges (i.e. when the material dredged is deemed suitable for onshore disposal). The process of bringing suitable dredged rock onshore will commence once the temporary causeway at the tug harbour is constructed using competent material won from pre-treated blast rock.

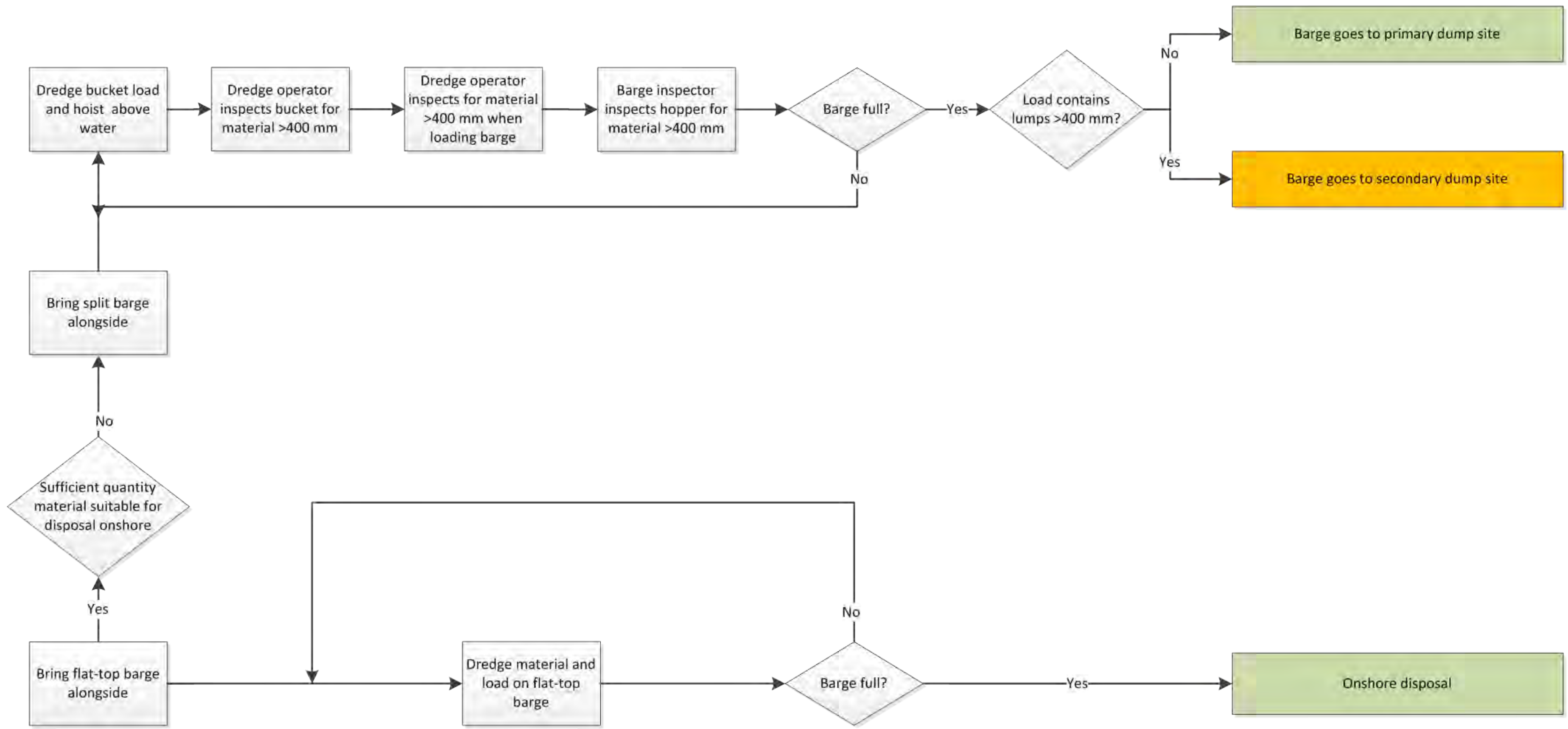


Figure 16 Spoil disposal decision tree

The sands, gravels and clays contained within the upper alluvial horizons are likely to break down in size relatively easily during the dredging and/or barge loading process. On the other hand it is expected that the intermediate layers comprising stiff clays and XW rock will include a mixture of material – material < 400 mm; material >400 mm but deemed unsuitable for onshore disposal; and material that is suitable for onshore disposal. The following methodology is designed to cater for all these possibilities:

Equipment used:
1. Backhoe dredger with two split-hopper barges along side
2. Split-hopper barge 1 is for disposal of material of less than 400 mm dimension
3. Split-hopper barge 2 is for disposal of material of more than 400 mm dimension
4. Flattop barge on standby.

Method:
1. Dredge a bucket and hoist above water
2. Dredge operator to inspect bucket for material >400 mm and during loading into barge
3. Barge inspector to inspect barge hopper for material >400 mm during loading and on completion
4. When barge full, dredge operator and barge inspector to confirm whether load includes material >400 mm
5. If load does not include material >400 mm, barge shall go to primary dump
6. If load includes material >400 mm, barge shall go to secondary dump
7. If a stratum of material deemed suitable for onshore disposal is encountered that is of sufficient thickness and continuity to make targeted dredging practical, the flat-top barge will be brought alongside for loading and land disposal.
8. Dredging recommences as per step 1.

The exact dredging methodology employed may vary depending upon the actual conditions encountered on site.

5.2 Spoil Disposal and Management

5.2.1 Barge Movements

Once a barge is full, it will de-berth from the BHD, be towed to the disposal site and return to be moored alongside the dredge for reloading. Depending on weather and current conditions, it is expected that a typical round trip for the barge will be in the order of two to three hours. Expected loading times are in the order of four hours, and it is expected that three or four barge loads will be disposed of per day.

5.2.2 Control of Offshore Volume

A bathymetric survey of the area to be dredged will be conducted prior to commencement of the dredging works, and regular progress surveys will be conducted during the dredging operations. The frequency of these surveys depends on the progress of works, but will be at least once per week weather permitting. The volume calculation to determine the *in-situ* volumes disposed at the sea disposal site will be performed by calculating the difference in levels between the pre-dredge survey and the most recent progress survey. Total volumes calculated are to be adjusted to take into account the measured tonnages of competent rock excavated directly using the BHD, and transported onshore by flat top barge. An average agreed bulked density for this rock is to be used to calculate the *in-situ* volumetric equivalent. The *in-situ* volumetric equivalent will be deducted from the total volume calculated from the differences in survey levels.

The surveys will be conducting using Real Time Kinematic (RTK) GPS for horizontal and vertical control, and multibeam depth sounding for vertical measurements. The survey data will be processed and can give 3D presentations of the area dredged as illustrated in Figure 17.

A copy of the initial survey (prior to the commencement of works) of the area to be dredged will be provided to the Managing Agencies, the ESS and the MRG. In addition, *in-situ* volume calculations based on the initial bathymetric survey and progress surveys will be provided. The results of bathymetric surveys prior to the commencement of dredging and following completion of dredging in each dredging season will be u sed to generate plots of the changes in depth in the dredged area. Additional reporting, in the format required to facilitate annual reporting to the International Maritime Organisation will also be provided as defined in the Sea Dumping Permit No. 10/02 (condition 33).

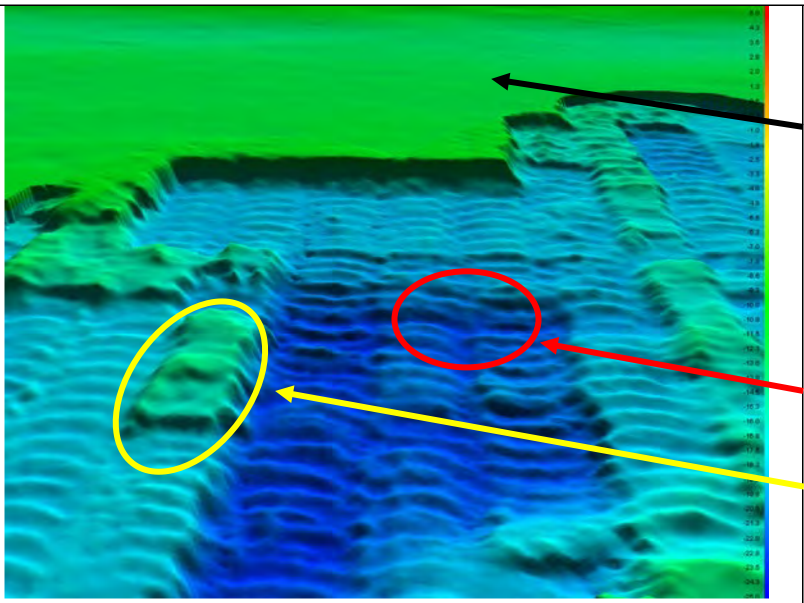


Figure 17 Example of survey method used to determine *in situ* dredged volume

3D Progress survey presentation

Green:
Untouched seabed

Various shades of blue: indicate the dredged area to various depth levels

Dredger: Grab dredger
Tracks of grab are clearly visible via the ridges

High spots left behind are visible in blue green

5.2.3 Bathymetry of Area to be Dredged and Disposal Ground

Bathymetric surveys of the Dredge Spoil Disposal Ground will also be conducted, using multibeam sonar as described in Section 5.2.2. Surveys will be conducted prior to the commencement of disposal activities and after the completion of disposal activities in each dredging season. The pre- and post-disposal surveys will be used to produce plots of changes in depth as a result of disposal activities and to estimate the amount of disposed material retained on the disposal ground.

5.2.4 Surveys of the Disposal Ground Seabed Characteristics

Surveys will be conducted of the physical characteristics of the seabed in the disposal ground after the completion of disposal activities using a combination of sidescan sonar and towed video transects. This is the most efficient way to determine the distribution of large material (> 400 mm) on the spoil ground after disposal. Sidescan sonar is an effective target detection method in shallow waters. It uses sound waves to produce near-photo like images of the texture of the seafloor (Figure 18).

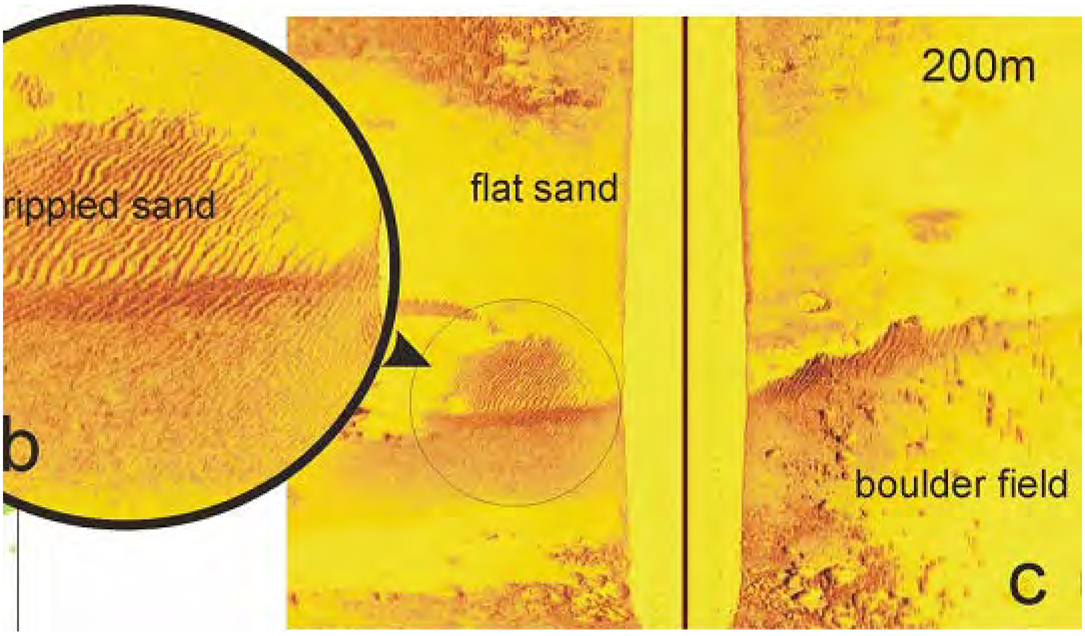


Figure 18 Example of sidescan sonar image

The sonar transponders are either towed behind or attached to a survey vessel and the backscatter returns are recorded to produce images of the seafloor in a swath on each side of the vessel. The width of the swath, or range, depends on the water depth and the frequency of the unit. Swaths are generally narrower in shallow water. High-frequency sonars provide high-resolution imagery for small target detection in shallow water, with a narrower range than lower-frequency units. Objects on the seafloor, such as rocks and reefs, can be identified and their size estimated from the shadows they produce on the sidescan image. This method is highly suited to determine the size of material on the spoil disposal site. The sonar is interfaced with surface unit software and GPS to mosaic and geo-reference the imagery.

Both the primary and secondary disposal areas (Figure 14) will be surveyed in their entirety prior to dredging, and within two months of the completion of offshore disposal. The expected cell resolution (pixel size) of the resultant mapping is <100 mm, therefore this method is highly suited to detecting features >400 mm.

A high-frequency (725 kHz) sonar will be used. The final cell resolution will depend on the water depth, the frequency of 'pings' from the sonar, the range, and the vessel speed. To produce the high cell resolutions required for this survey, the range of seabed mapped either side of the sonar will be reduced to <100 m with approximately 20% overlapping coverage. Overlapping coverage of sidescan the swaths will prevent loss of image quality due to attenuation of the signal, and possible distortion of bottom features. This can result from rough sea conditions (e.g., Figure 19), but can also result from the sonar operating with a limited range in shallow waters. Overlapping coverage will reduce this effect, as will surveying in calm conditions at low vessel speeds.

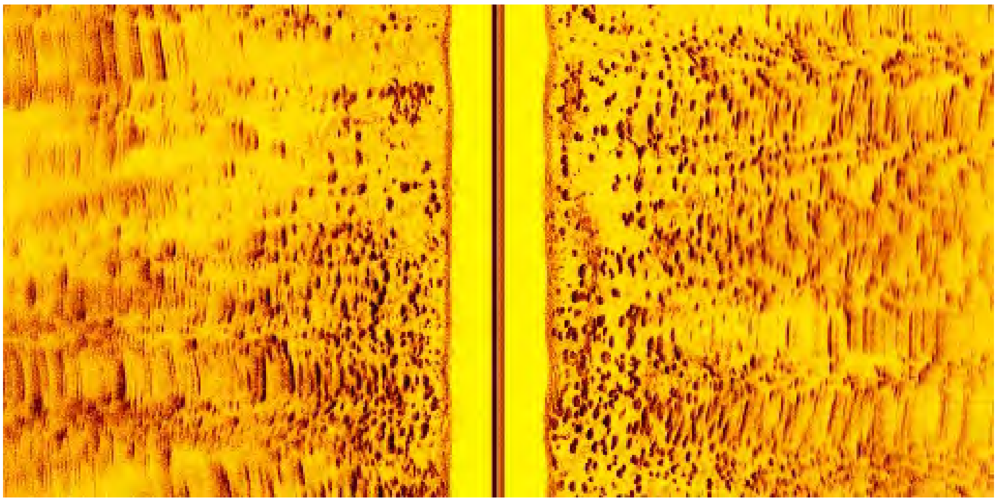


Figure 19 Example of image attenuation on the outer edges of a sidescan sonar image of seagrass hummocks in shallow water, caused by excess movement of the sidescan in rough weather (Penrose *et al*., 2005)

The final geo-referenced sidescan image mosaics will be imported into a GIS system and reviewed to detect and determine the location of areas potentially having material >400 mm on the seabed.

Substrate characteristics at the disposal site will then be verified using towed video transects that target the identified areas of special interest. Laser pointers will be used to provide a size scale, and video analysis software will be used to classify the substrate material size. In addition to towed video transects targeted to areas identified in the sonar images as potentially including material >400 mm, random transects of other areas of the disposal site will be conducted to verify the utility of the sidescan survey images in assessing seabed characteristics.

5.2.5 Reprocessing or Removal of Oversize Material

Any areas that the post-disposal seabed surveys identify as containing material >400 mm from HPX3 disposal activities will be treated in two stages. The first stage will entail seabed levelling of high spots created by the dumping process using a towed mechanical plough, followed by the raking of oversize material into stockpiles for later retrieval. During the second stage, the oversize material will be lifted from the seabed and either reworked (reprocessed) into material < 400 mm before returning the material back to the seabed or removing it and taking it to shore for disposal.

5.2.6 Reprocessing Completion Criteria and Verification

High-resolution sonar surveys of the HPX3 spoil ground including the Primary and Secondary Disposal Areas will be conducted during reprocessing and no later than two months after practical completion of the reprocessing works. An "in-survey' will be conducted prior to the commencement of final reprocessing in 2014 to determine areas of the spoil ground that require further reprocessing after reprocessing operations that were conducted in 2013, based on a completion criterion of ≤10 items of oversized material per hectare. The in-survey will a Multibeam Echo Sounder (MBES) concurrently with sidescan sonar (SSS), which is consistent with good practice in acoustic surveys of the seabed, for example for navigation hazards (NOAA, 2013; USACE, 2004), drilling hazards (OGP, 2013), seabed classification (Penrose *et al.* 2005) and marine archaeology (Plets *et al.* 2013). The minimum specifications for the in-survey will be as follows:

1. Real-Time Kinematic (RTK) GPS positioning providing positional precision of ≤5 cm
2. MBES specifications:
    a. Frequency of 400 Hz or greater

   b. Beam width of 1° x 1° or narrower
   c. Complete (200%) bottom coverage
   d. Maximum swath of three times water depth, with minimum overlap of 100% from adjacent lines
   e. Line spacing ≤25 m
   f. Bathymetric grid resolution of 0.25 m
   g. At least 95% of bathymetric grid nodes populated with at least five soundings
   h. Vessel speed ≤6 knots
3. SSS specifications:
   a. Frequency of 400 Hz or greater
   b. 100% bottom coverage
   c. Line spacing ≤25 m
   d. Range scale set to provide full overlap of nadir region of adjacent lines
   e. Towfish operated at a height above the bottom between 10 – 20% of range scale in use
   f. Vessel speed such that objects ≥400 mm are ensonified by at least 3 pings per pass, expected to be 2.5 – 3.5 knots
   g. SSS line spacing of 25 m
   h. Daily confidence (quality assurance) checks, targeting a known seabed feature consisting of a 400 X 400 mm target deployed adjacent to the survey area and recovered on completion

These specifications for the survey are consistent with NOAA (2013) and IHO (2008) standards, but have been modified to provide for reliable detection of objects >400 mm (the highest resolution specified in NOAA, 2013 and IHO, 2008 is the detection of features of 1 m^3).

In addition to determining areas of the spoil ground requiring further reprocessing, the in-survey will be used to compare the reliability of oversized target detection using MBES alone to MBES in conjunction with SSS. Using MBES alone to confirm compliance with the completion criterion allows the sonar to be deployed from the reprocessing vessel, so that oversize material can be targeted and the effectiveness of reprocessing monitored during the reprocessing operations. SSS cannot be deployed from the reprocessing vessel because SSS requires a slower towing speed and less ship noise than the reprocessing vessel can achieve. Should the in-survey demonstrate that MBES alone provides reliable detection of oversized material, BMA will provide a report to GBRMPA and request that subsequent compliance surveys are conducted using only MBES.

Sections of the spoil ground will be surveyed when reprocessing in that area is considered to be complete. A cell-by-cell count of oversize targets detected in the 1-hectare (100 X 100 m) grid shown in Figure 20 will be made. If no cells with a density of more than 10 items/ha of material >400 mm are identified by the surveys, the reprocessing will be complete. If the survey does detect areas of material >400 mm at a density of 10 items/ha or more , final reprocessing will be conducted. If necessary, any ambiguity regarding targets (for example, distinguishing aggregations of smaller material from a single larger target) will be resolved by field validation. Validation methods may include:

1. Diver survey
2. Underwater video or drop-camera survey
3. Additional SSS survey using bottom-deployed sidescan equipment, for example using a system that can be deployed on a tripod on the bottom in close proximity to targets requiring further validation to produce very high-resolution imagery

The validation methods will be selected on the basis of results of the high-resolution sonar survey. BMA may elect to reprocess some areas without validation studies.

BMA will report of results of the high-resolution sonar surveys, and any resulting validation surveys, to GBRMPA for approval. If areas with >10 items/ha of oversized material are identified, the report will include a final clearance plan specifying locations that require final reprocessing.

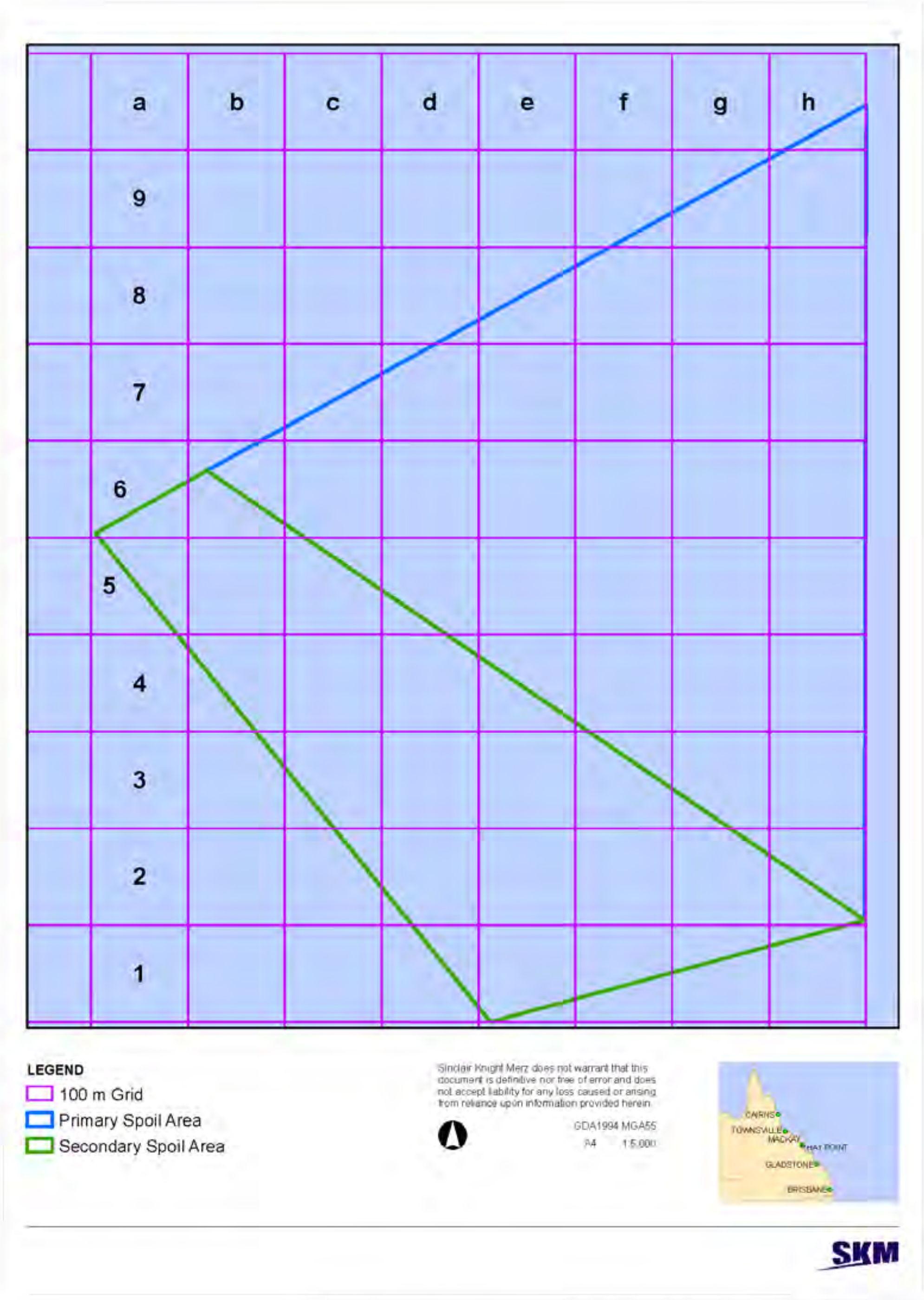


Figure 20 One-hectare grid superimposed over HPX3 spoil ground to determine number of items of oversized material per hectare

Final reprocessing will be completed in accordance with the GBRMPA-approved clearance plan. MBES imagery will be recorded before and after final reprocessing at all of the locations specified in the final clearance plan. A report including before/after MBES imagery documenting the completed reprocessing, and GPS vessel tracks during reprocessing in relation to specified locations in the final clearance plan, will be submitted to GBRMPA. Georeferenced MBES imagery and vessel tracks will also be provided in electronic format.

The verification process for the completion of reprocessing in accordance with the completion criterion is summarised in Figure 21.

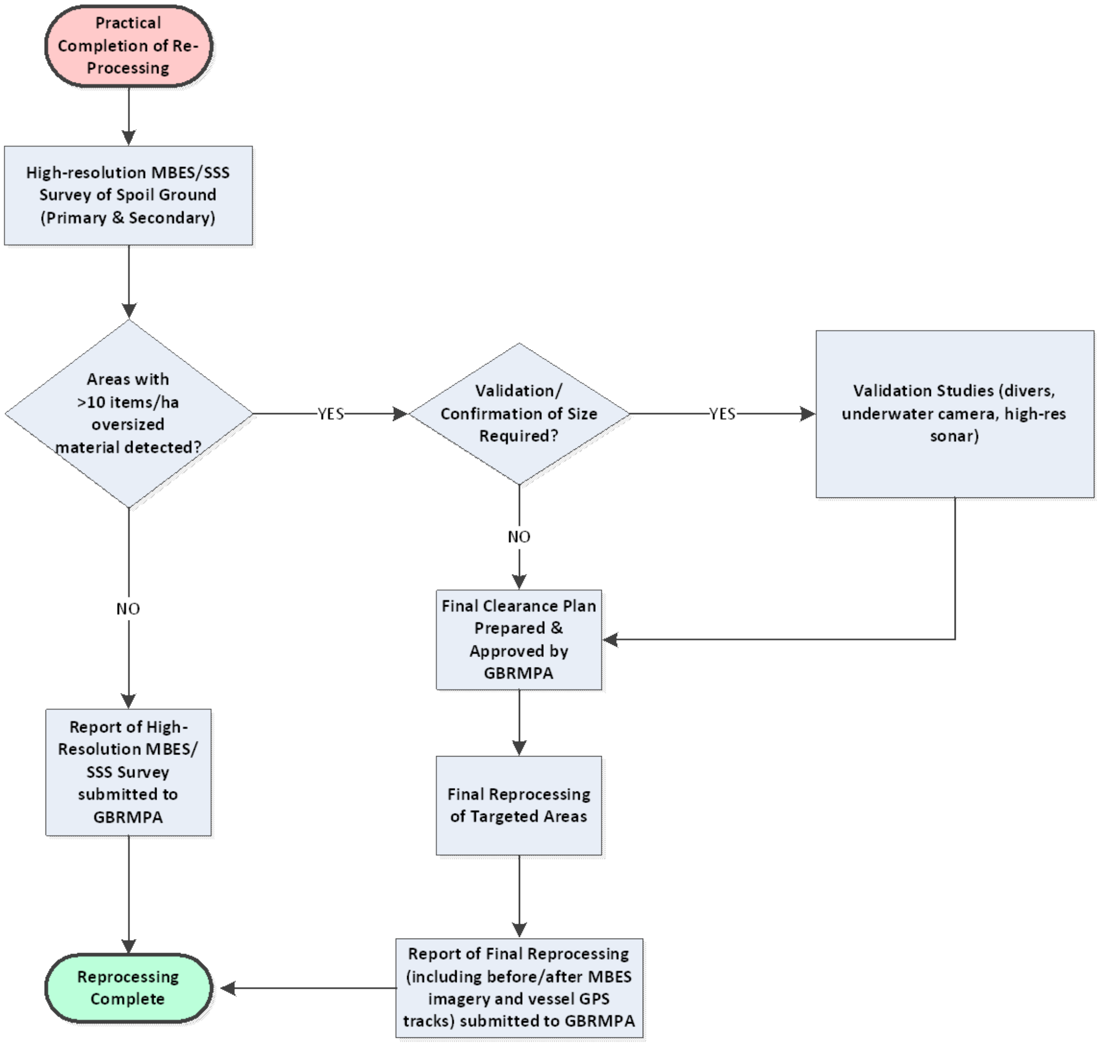


Figure 21 Process for verifying compliance with the completion criterion of no more than 10 items/ha over 400 mm in size

6. Water Quality Monitoring and Management

6.1 Objectives

To ensure that changes in water quality are managed so as to minimise adverse impact on benthic communities surrounding the dredging and disposal sites, including coral and seagrass communities.

6.2 Summary of Potential Impacts

Dredging and disposal operations will mobilise sediment into the water column, forming turbid plumes that will move with the prevailing currents. The dredge plumes will cause increased concentrations of suspended solids (SS), resulting in increased turbidity and light attenuation, and therefore reduced light penetration. Sediment plumes also alter light quality as well as quantity, in particular a shift toward the yellow portion of the light spectrum, which is not used as efficiently by photosynthetic organisms as other part of the spectrum of photosynthetically active radiation (PAR). Increased sediment deposition may also occur in areas exposed to the plumes that have a depositional sedimentary regime. Degradation of water quality, light quantity and quality, and sedimentation have the potential to adversely affect photosynthetic benthic organisms, in particular seagrasses and corals as described in Sections10.3 and 7.2.

Currents in the Hay Point area are predominantly tide-driven, and flow parallel to the coast, to the south-south-east on the flood tide and to the north-north-west on the ebb (GHD 2005), and this is the expected direction of plume movement. Satellite imagery from the 2006 capital dredging campaign confirms this pattern (Figure 22).

The risk of adverse impacts from turbid plumes is considered low given that:

1. Loss of coral cover at potentially impacted monitoring sites on the nearby islands following the 2006 capital dredging campaign was low and commensurate with changes observed at reference sites;
2. The dredging campaign for HPX3 involves a much small volume of dredged material and will extend over a shorter duration than the 2006 dredging; and
3. Satellite imagery from the 2006 campaign shows that turbid plumes from dredging in the apron area near the plumes typically do not move inshore in the direction of Hay Reef.

6.3 Performance Indicators

Numeric performance indicators for turbidity at Hay Reef (see Section 6.5.4).

6.4 Personnel

The BMAPM will ensure that the water quality monitoring described below is conducted by personnel who are experienced, qualified, and appropriate to carry out their duties, and are adequately trained in the methodologies and the requirements of this EMP and all related environmental management plans and procedures.

6.5 Monitoring and Management Program

The management of water quality to minimise adverse impacts from the mobilisation of sediments will incorporate the following components:

1. Proactive operational measures in dredging and disposal works to reduce sediment mobilisation;
2. Predictive modelling of Total Suspended Solids (TSS) levels and plume direction;
3. Vessel based monitoring to confirm modelling predictions and satellite estimates of TSS;
4. Visual observations of plume movement and dispersal; and
5. Reactive management based on continuous turbidity monitoring at Hay Reef.

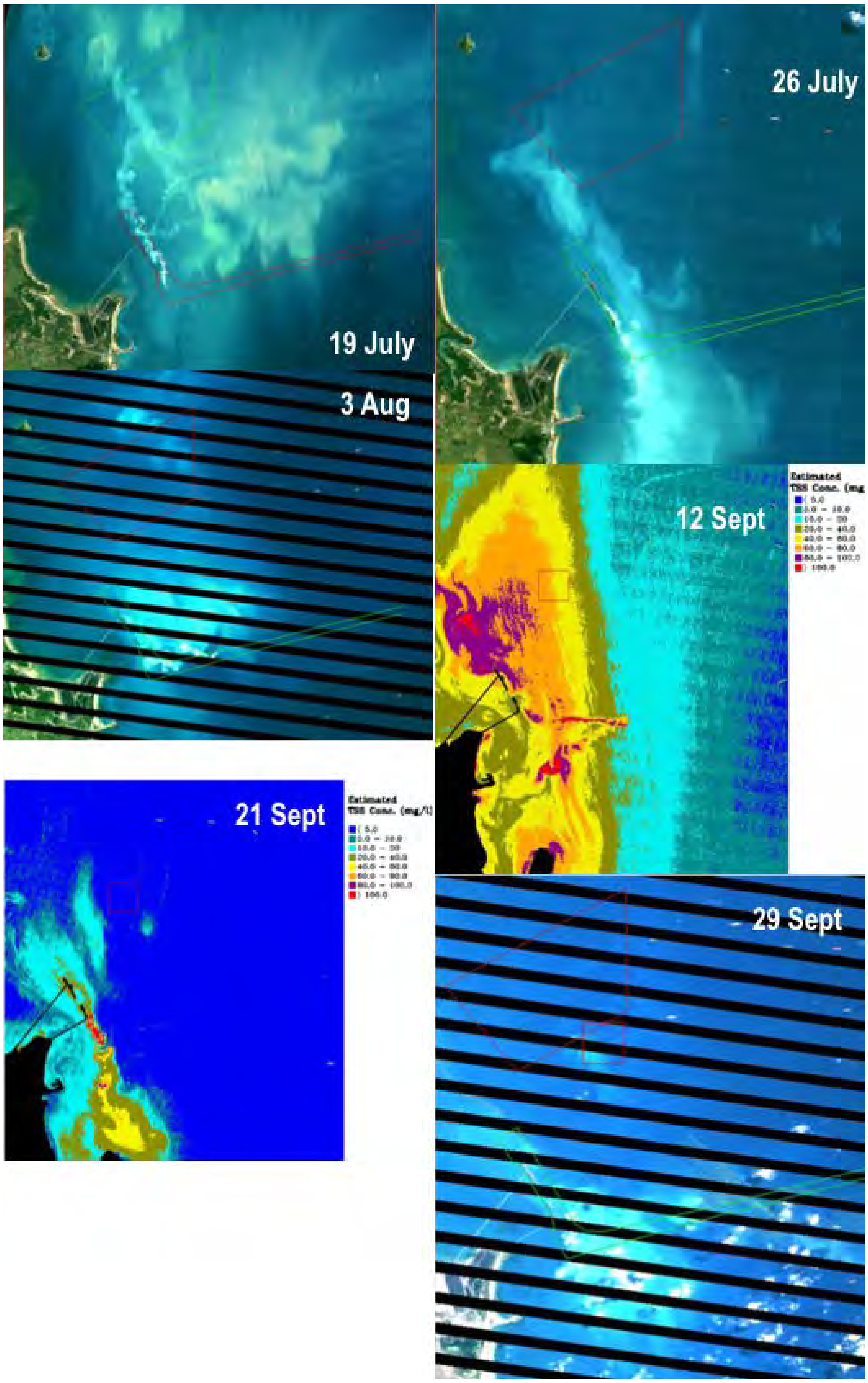


Figure 22 Landsat imagery of turbidity plumes during the 2006 capital dredging campaign. Figure shows a combination of raw images and model estimates of TTS. Red pixels are 100 mg/L, the darkest blue pixels are <5 mg/L

6.5.1 Proactive Management

Operational measures to reduce the generation of turbid plumes will be implemented during dredging and disposal operations and also during reprocessing of oversize material with a TSHD.

Dredging and Disposal Operations

The following management measures will be implemented throughout the dredging and spoil disposal program:

1. Operational procedures for dredging will be optimised to reduce the mobilisation and dispersion of suspended sediment. Such measures include:
   a. The use of a backhoe dredge, which is known to reduce turbidity generation relative to other types of dredge; and
   b. The operator will minimise spillage of material from the bucket into the surrounding water;
2. All dredging equipment and barges will be maintained in proper and efficient condition. Hopper door seals will be maintained in proper and efficient condition to ensure minimum loss of sediment during transport;
3. Disposal of dredged material will occur only within the designated disposal site; and
4. Hopper de-watering will be confined to the dredging and spoil disposal areas.

Spoil Reprocessing or Removal

The following management measures will be implemented throughout the reprocessing and removal program to minimise suspended sediment at the disposal site:

1. All dredging equipment will be maintained in 'proper and efficient' working order;
2. Reworked material that is returned to the seabed will be piped for discharge near the seafloor; and
3. Vessel-based plume monitoring will be conducted (see Section 6.5.3) during the trial period to validate the characteristics of any turbid plumes and to establish ongoing turbidity monitoring requirements.

6.5.2 Satellite Imagery

Satellite imagery across a range of tides, weather conditions, and dredging/disposal operations will be obtained using imagery from Landsat and/or MODIS satellites. Information that will be obtained from this imagery includes plume orientation, spatial coverage and TSS estimations (to be validated with boat based monitoring) as represented in Figure 22. Timing of imagery capture will depend on the availability of cloud-free weather conditions and satellite flight schedules.

6.5.3 Vessel-based Monitoring

Dredging Operations

Sediment plume forecasting will be conducted using a Mike21 numerical model to simulate expected plumes from dredging and disposal operations on the basis of forecast current conditions. Model predictions of the direction and spatial extent of plume dispersion, including predicted TSS concentrations at various distances from the dredge, will be generated for the following scenarios:

1. Peak ebb flow at spring tide;
2. Peak flood flow at spring tide;
3. Peak ebb flow at neap tide; and
4. Peak flood flow at spring tide.

Vessel-based water quality monitoring will be conducted in proximity to the area to be dredged to verify the modelled water quality values and validate satellite imagery of the associated sediment plumes.

The vessel-based monitoring program for dredging operations will consist of:

1. A suitable survey vessel will traverse a transect line perpendicular to the direction of the visual plume at a distance of 250 m downstream of the dredging operation.

2. Water quality sampling sites will be at 100 m intervals along the transect, and extend at least 250 m beyond the edges of the visible plume. There will also be a sampling site 250 m upstream of the dredge site, located approximately on the longitudinal axis of the visual plume. The location of sampling sites may be varied due to safety and port operations constraints. Sampling transects located a greater distance downstream would be likely to interfere with port operations, given the expected prevailing north to northeast direction of the plume;
3. At each site, turbidity, temperature, conductivity, and depth will be measured at 1 m above the seabed, the mid-point of the water column, and 1 m below the surface with a submersible water quality instrument;
4. If feasible, measurements of PAR will be collected in conjunction with the turbidity measurements;
5. Instruments will be intercalibrated with all other instrumentation used in the water quality program;
6. Water samples (one per survey) will be collected at each of the three depths at the mid-point of the transect and analysed for Total Suspended Solids (TSS) concentration to verify the relationship between TSS and turbidity (and if possible, PAR); and
7. At the commencement of dredging operations, the vessel-based monitoring will be conducted once per day during daylight hours, subject to weather conditions. The frequency of monitoring will be reviewed in consultation with the ESS and MRG after at least two weeks of dredging operations.

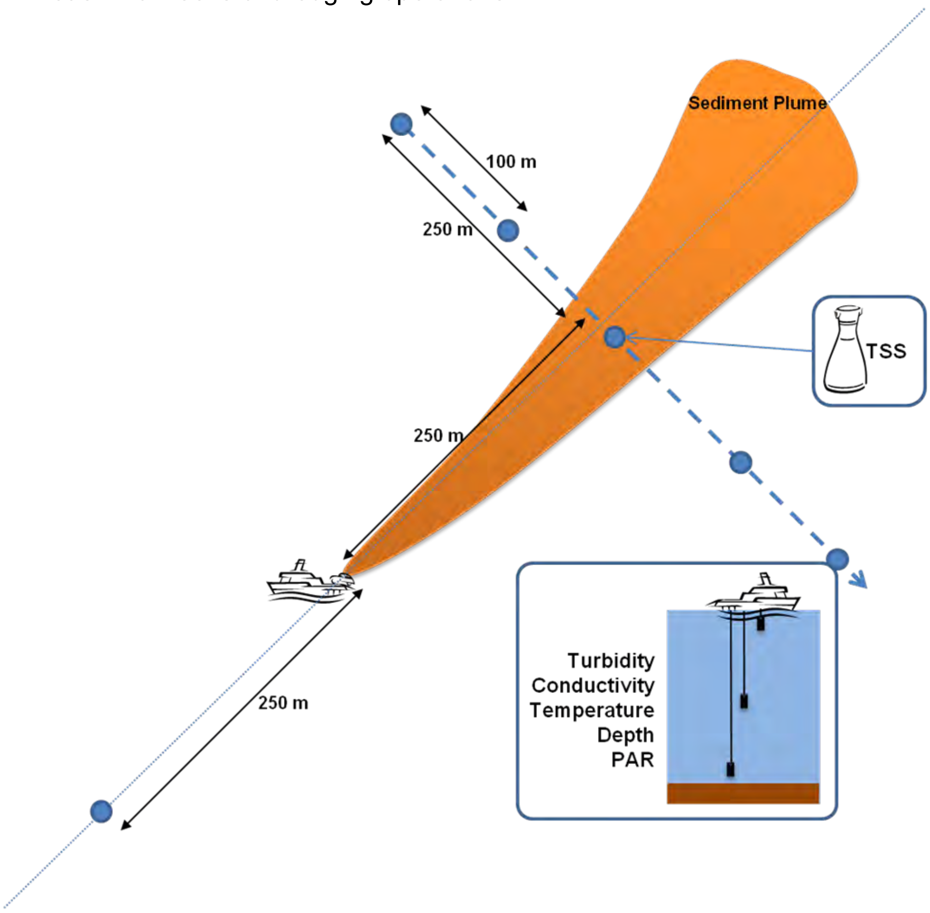


Figure 23 Conceptual diagram of vessel-based water quality monitoring procedure at dredging site

In addition, vessel-based monitoring will be conducted in conjunction with the capture of satellite imagery to ground-truth satellite estimates of turbidity and/or TSS concentrations. This ground truthing will occur across a r ange of tides, weather conditions, and dredging/disposal operations.

The results of vessel-based monitoring will be reported to the ESS weekly and will be presented in relation to predicted MIKE 21 v alues, and turbidity and TSS levels estimated from satellite imagery, when it is available. Once an acceptable relationship has been established between satellite imagery and vessel based turbidity/TSS monitoring, the need for vessel-based monitoring will be reviewed in consultation with the MRG and Managing Agencies.

Oversize Material Reprocessing/Removal

Vessel-based turbidity monitoring will also be conducted during Phase 1 of the reprocessing/removal trials, and during the discharge of reworked material to the seabed if it occurs, to determine the levels of turbidity generated and establish ongoing monitoring requirements. The focus of monitoring will be on near-seabed plumes given the expectation that any plumes generated will be concentrated near the bottom. Vessel-based monitoring previously demonstrated that backhoe dredging generates insignificant levels of turbidity (BMA 2011).

Initially, the monitoring will aim to detect near-seabed turbidity plumes as indicated by turbidity levels higher than background in the area immediately downstream of the reprocessing/removal activities. The vessel will commence near-bottom profiling with a submersible water quality instrument as close to the reprocessing/removal operations as operational considerations, in particular vessel safety, allow. Background levels will be determined from turbidity measurements before the commencement and/or upstream of the reprocessing/removal activities, depending on operational considerations.

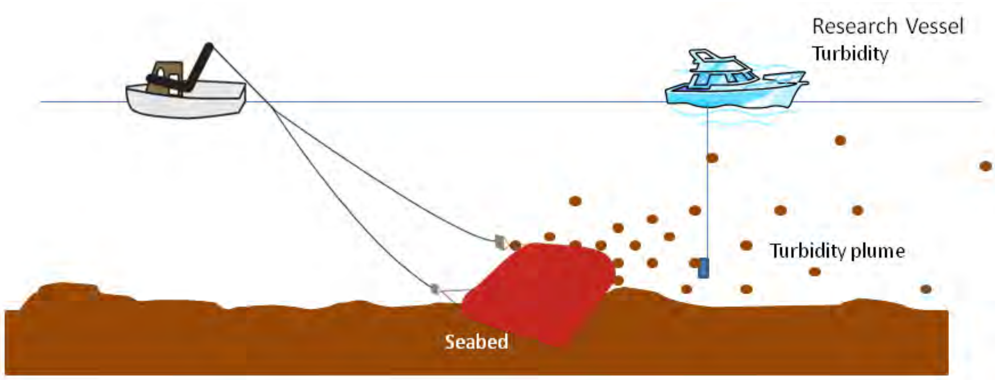


Figure 24 Conceptual diagram of vessel-based turbidity monitoring procedure during Phase 1 of reprocessing/removal

If a sediment plume is detected, turbidity, conductivity, temperature and depth will be measured at at 1 m above the seabed, the mid-point of the water column, and 1 m below the surface along transects running both parallel and perpendicular to the direction of current flow to characterise the spatial extent and depth distribution of the plume. Vessel-based water quality monitoring will be conducted for seven days of reprocessing/removal operations commencing on, or as soon as possible after, their commencement, subject to sea conditions and safety considerations. Requirements for continued monitoring will be determined in consultation with the MRG, through correspondence and/or teleconference, based on the results of initial monitoring.

6.5.4 Visual Plume Monitoring

Visual plume monitoring will be r egularly undertaken by crew of the dredge and du mp barges. Records of visual observations of turbidity plumes generated by dredging and disposal activities will include:

1. Name of person recording the observations;
2. Date, time, and location of observations (including GPS coordinates for observations at dump sites);
3. Weather conditions (wind speed and direction, rainfall, visibility);

4. Sea state (swell size and direction, tidal stage);
5. Plume characteristics (water colour, direction of movement, estimate of distance of dissipation); and
6. Additional comments (e.g. oil slicks, rubbish etc).

A report of visual plume monitoring results will be provided to the ESS on a fortnightly basis.

6.5.5 Continuous Monitoring and Reactive Management at Coral Reef Sites

Water quality monitoring and management in relation to potential turbid plume impacts on coral communities will be based on telemetered, in situ water quality loggers developed by James Cook University of North Queensland (JCU). The loggers will be deployed at two inshore reef locations (see Table 4 and Figure 25):

Inshore rocky reef communities:
1. Hay Reef (Inshore Impact); and
2. Freshwater Point (Inshore Reference).

Loggers were deployed at four additional locations during the 2010 dredging season and subsequently decommissioned:

1. Dudgeon Reef (Inshore Reference)
2. Round Top Island (Island Impact);
3. Victor Islet (Island Impact); and
4. Slade Island (Island Reference).

Table 4 Summary of water quality logger locations

Location	Code	Position
Hay Reef	L01	S21° 16.042′; E149°18.092′
Dudgeon Reef	L02	S21° 15.211′; E149° 15.889′
Victor Islet	L03	S21° 19.146′; E149° 19.451′
Round Top Island	L04	S21° 10.641′; E149° 15.965′
Slade Islet	L05	S21° 05.694′; E149° 14.610′
Freshwater Point	L06	S21° 24.897′; E149° 20.167′
Datum: WGS 84		

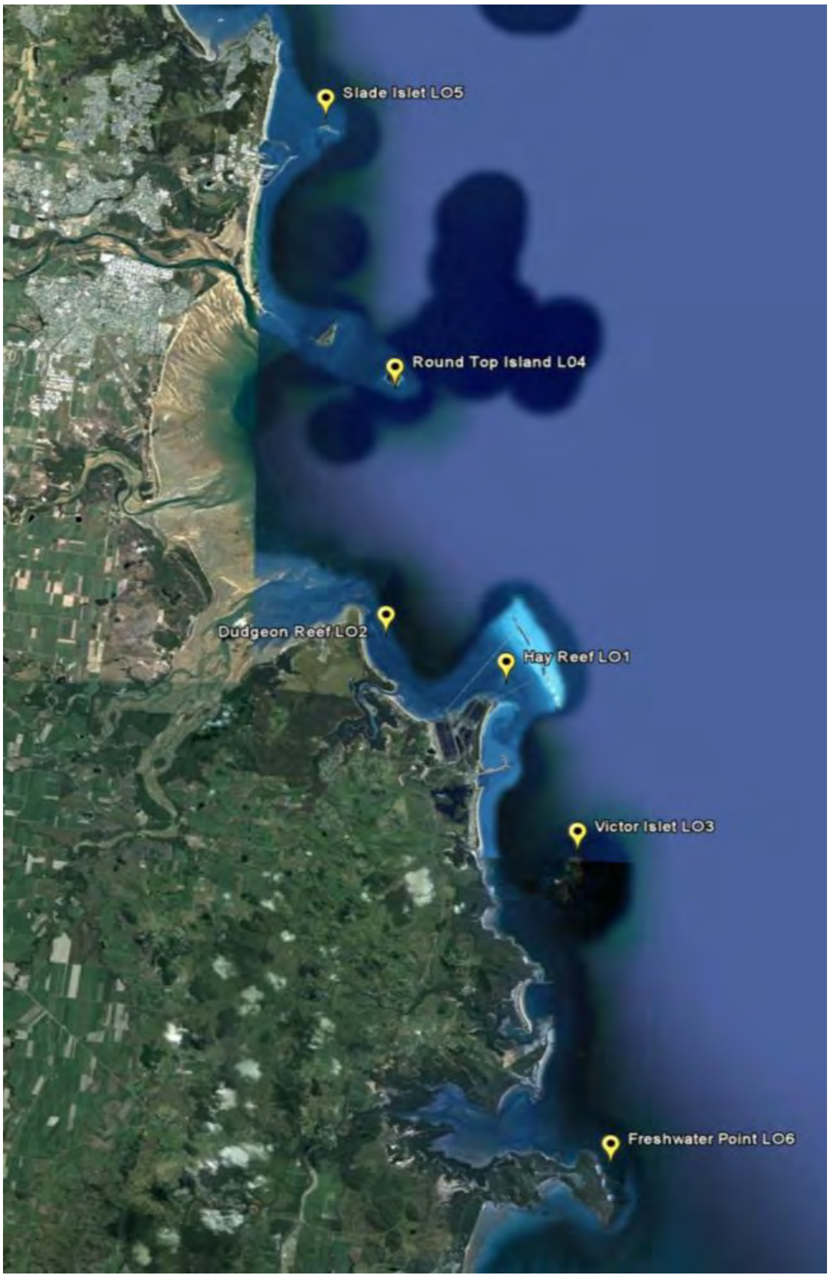


Figure 25 Map of water quality logger locations

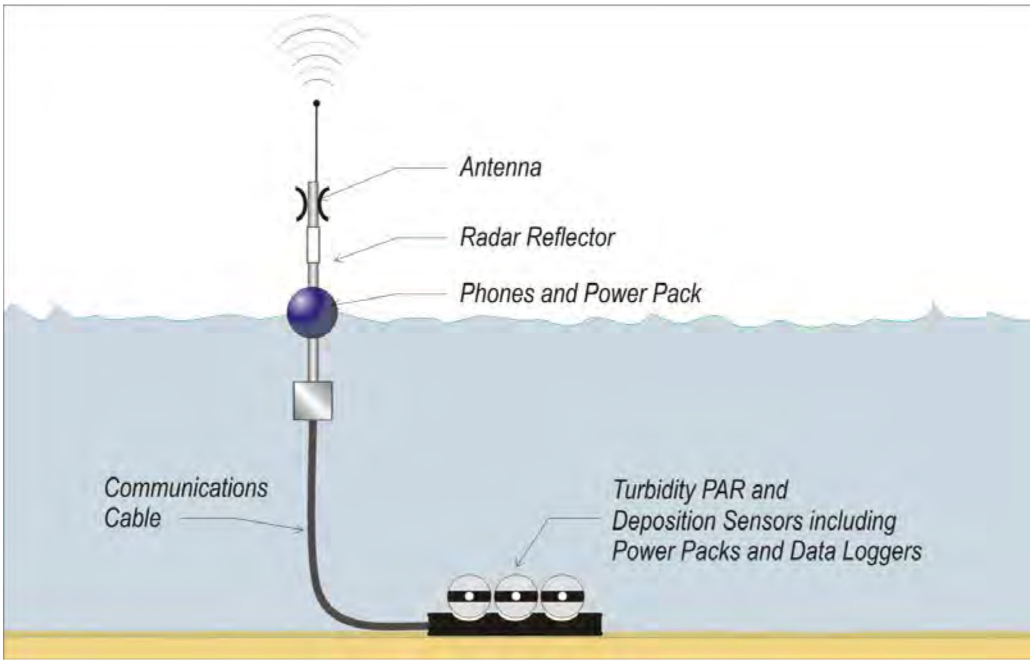


Figure 26 Schematic diagram of Telemetry-Based Water Quality Loggers (Courtesy James Cook University of North Queensland)

The loggers measure turbidity, PAR, and sediment deposition every 10 minutes. Data are transmitted to the JCU server at 12-hour intervals, where the data are quality controlled to remove unreliable data caused by, for example, obvious instrument failure or fouling, and the quality-controlled data will be relayed to the HPX3 monitoring team on the next day. In the event of a failure of the telemetry system, the loggers function as “dumb” loggers, logging data internally for download upon retrieval from the seabed. JCU will immediately notify the HPX3 monitoring team of telemetry failure, and a field team will be mobilised to service the telemetry system and download monitoring data within 48 hours, or as soon thereafter as weather permits.

Water Quality Trigger Levels at Hay Reef

The WQTLs for turbidity at Hay Reef is based on a **6-hour rolling median of 110 NTU** during daylight hours (6 am – 6 pm).

Any occurrence of the 6-hour rolling median above 110 NTU at Hay Reef will be considered a daily trigger and if 4 daily triggers are measured within any consecutive 7-day period, this will be considered a Management Response Trigger.

Reactive Management

The results of water quality monitoring at Hay Reef (including time-series graphs of data) will be reported to the ESS weekly, except if the WQTL is exceeded. Exceedances will be reported to the ESS as soon as possible, and not later than 24 hours after receiving the data. The WQTLs serve as an alert that turbidity is approaching the limits of the range of natural variation, but do not provide direct evidence either that the elevated turbidity is due to dredging or that it will necessarily result in coral stress.

Exceedances at Hay Reef will result in the following actions as outlined in Table 5 and illustrated in Figure 27. An exceedance of a WQTL will trigger:

Table 5 Turbidity trigger level exceedance action plan.

Action Number	Action Description	Responsibility

1	An immediate review of dredging and/or disposal activities will be undertaken to identify if operations have been in accordance with this EMP and other relevant EMPs. If not, immediate corrective action will be taken to ensure that operations comply with all applicable environmental management plans and procedures;	BMA in conjunction with Bechtel and Van Oord
2	A review of operations, in consultation with the ESS and MRG members, to identify and implement any opportunities for improvement;	BMA in conjunction with ESS and MRG.
3	A data review to ensure that the investigation trigger does not reflect data anomalies or errors in data entry and analysis. In the event that the investigation trigger is an artefact of unreliable data or analytical error, the investigation trigger will be considered a false exceedance. The monitoring process will be reviewed and any necessary corrective action will be implemented and reported to the ESS;	Lead Marine Environmental Consultant in conjunction with James Cook University and Koskela Group.
4	If the investigation trigger is not a false exceedance, an investigation of the likely cause of the elevated turbidity, in active consultation with the ESS and members of the MRG. The investigation will take into account such factors as: • The location of dredging and disposal operations; • The extent of visible plumes and results of vessel-based monitoring around the operations; • Tide, weather, and current conditions; • The number and locations of affected sites, including whether elevated turbidity is also observed at reference sites; • The characteristics of sediment samples collected at the logger locations.	Lead Marine Environmental Consultant in conjunction with BMA, ESS, MRG
5	Additional management actions will be identified and implemented as soon as possible in consultation with the ESS and MRG. These actions potentially include such measures as temporary re-location of the dredge or restricted operations during daylight hours or certain weather and current conditions. In an extreme situation it may be necessary to stand down dredging operations until corrective measures are agreed and implemented.	BMA in conjunction with ESS and MRG
6	If consideration of factors listed for action 4 indicate that dredging and disposal activities are a likely cause of the Management Response Trigger, the Coral Health Reactive Monitoring and Management Process will be triggered (See Section 10.6)	

Management trigger values will be reviewed after the first two weeks of dredging operations and as necessary thereafter.

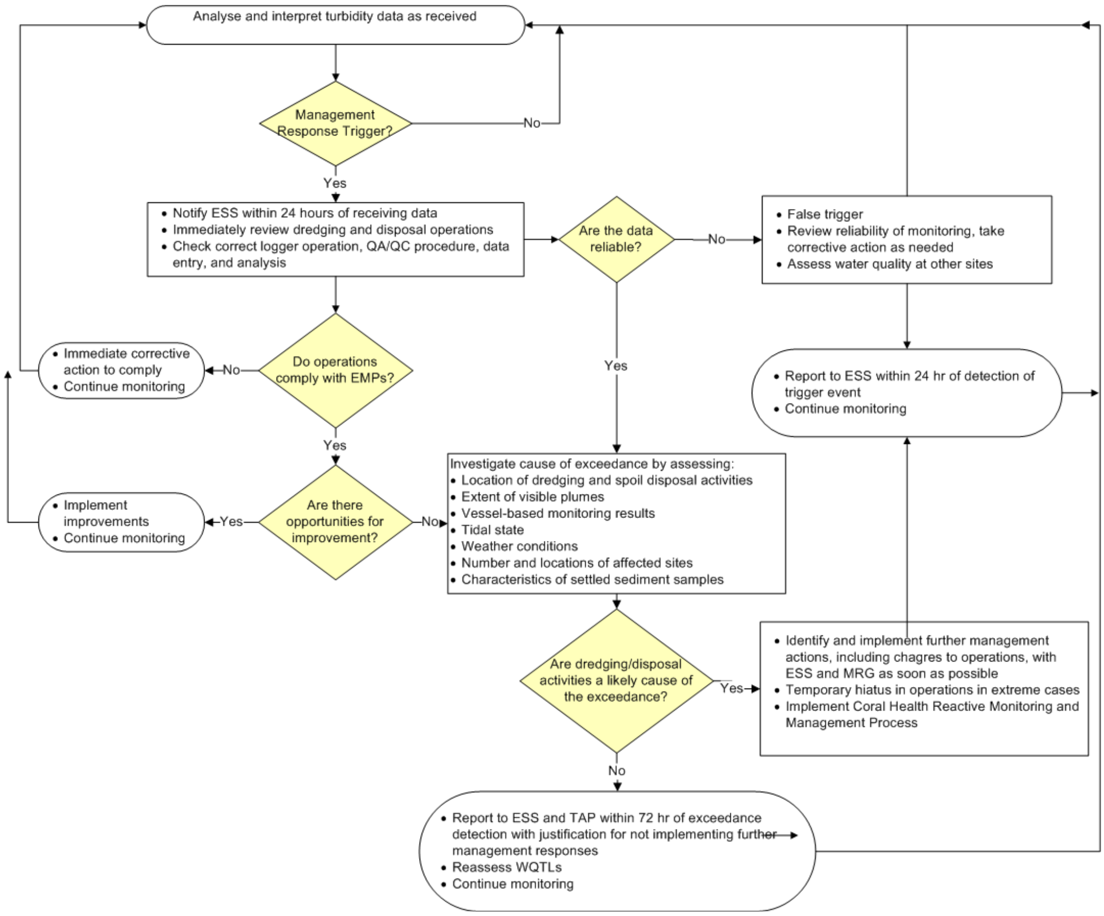


Figure 27 Water quality monitoring and management process at coral sites

6.6 Data Quality Statement

Daily provision of logger data from James Cook University to SKM will be accompanied by a data quality statement that will include the following meta-information:

1. Data download time and date;
2. Quality assurance checks and outcomes (outliers, errors etc);
3. Data calibration procedure;
4. Personnel performing QA checks; and
5. Other miscellaneous information about logger status and maintenance schedule.

7. Seagrass Monitoring and Research

7.1 Objectives

A seagrass monitoring and research program will be established for the HPX3 project. Seagrass monitoring and research will not be conducted as a reactive monitoring and management program for several reasons, which include:

1. Dredging operations for the HPX3 project are expected to commence in late summer to early winter, when the dominant seagrass in the area, *Halophila decipiens*, is not expected to be present based on historical monitoring information (Chartrand *et al*. 2008; M. Rasheed, pers. comm.);
2. The minimum light requirements of H. decipiens are very poorly known in relation to intensity, duration, critical periods, or spectral quality;
3. Limited data are available to describe the ambient light regime in deep seagrass habitats surrounding the dredging and disposal sites;
4. Historical information (Chartrand et al. 2008 and studies cited therein) show that H. decipiens abundance and spatial distribution are highly variable seasonally, inter-annually, and spatially; and
5. The environmental drivers of this variability, mechanisms of recruitment, and determinants of the resilience of the deep seagrass communities in the Hay Point region and elsewhere are poorly understood, though to a large extent probably related to light.

This lack of understanding of the temporal and spatial dynamics of deep seagrass communities, and their sensitivities and resilience to dredging-related stresses, makes it impossible to establish WQTLs or seagrass stress/damage indicators for reactive monitoring, and the fact that dredging will commence at a time when the seagrass is not present rules out impact monitoring based on abundance and distribution.

Therefore, the HPX3 seagrass monitoring and research program has been designed to address these gaps in knowledge to provide key information for decision making and adaptive environmental management in relation to future dredging projects in the Hay Point area and elsewhere. The objectives of the seagrass monitoring and research program are to:

1. Improve understanding of the scale and duration of impacts of dredging programs on deep seagrass communities;
2. Monitor post-dredging recruitment of seagrass communities in areas directly affected by the disposal of dredged material disposal in the HPX3 and previous dredging campaigns, as well as areas not directly affected by previous dumping;
3. Extend knowledge of the broad-scale distribution of deep seagrass communities in the Hay Point area;
4. Determine the relative importance of the locally deposited seed bank as opposed to seeds arriving from other areas in seasonal recruitment of H. decipiens and potentially other seagrass species in the Hay Point region;
5. Investigate the environmental cues, particularly light, that drive the observed seasonal pattern of decline and recovery; and
6. Increase knowledge of deep seagrass light requirements and stress indicators for application in future reactive monitoring programs.

7.2 Summary of Potential Impacts

Dredging can increase the turbidity and rate of sedimentation within an area; this can have both direct and indirect effects on seagrasses within the local area. Potential impacts of dredging and spoil disposal on deep seagrass communities include:

1. Effects of dredging and disposal on seagrass communities present in the area prior to the commencement of dredging. Because seagrass is not expected to be present at the commencement of dredging, such impacts are highly unlikely, but potentially include:
    a. Direct removal of seagrasses in the dredging footprint;

   b. Smothering of seagrass communities in the disposal footprint or adjacent areas subject to high levels of disposal-induced sedimentation.
   c. Decreased seagrass growth or reproduction
   d. Reduced spatial distribution
2. Direct permanent loss of seagrass habitat in the footprint of Berth 3 including apron area from dredging and subsequent port operations. This impact is certain to occur, but is unavoidable and considered negligible because of the small area affected area and its low habitat value;
3. Alteration of habitat at the disposal site from the dumping of dredged material. This could reduce the seasonal recruitment to the site on an unknown time scale depending on the suitability of the altered substrate for seagrasses and the sources of propagules for recruitment; and
4. Inhibition of the seasonal recruitment, growth, and reproduction of seagrasses in areas adjacent to the disposal site and dredge area during the dredging campaign due to reduced light levels and/or increased sedimentation. These effects could persist into subsequent years if recruitment is highly dependent on a local seed bank.

7.3 Performance Indicators

1. Spatial distribution and magnitude of seasonal recruitment of deepwater seagrass communities following dredging operations, in relation to HPX3 and previous spoil disposal operations;
2. Amount of increased knowledge of the scale and duration of impacts from disposal of dredged material on deep seagrass communities;
3. Amount of increased knowledge of the drivers of seasonal dynamics of deepwater seagrass communities;
4. Development of tools for monitoring and managing dredging-related impact on deepwater seagrass communities.

7.4 Personnel

The BMAPM will ensure that the seagrass monitoring and research tasks described below are conducted by personnel who are experienced, qualified, and appropriate to carry out their duties, and are adequately trained in the methodologies and requirements of this EMP and all related environmental management plans and procedures. The monitoring tasks may be carried out by a suitably qualified sub-consultant or an appropriate scientific research institution. The research tasks will be conducted by an appropriate scientific research institution.

7.5 Monitoring and Research Program

The seagrass monitoring and research program for the HPX3 project consists of four components:

1. Broad-scale mapping of deep seagrass communities in the Hay Point area;
2. Detailed monitoring of dredge spoil impact and recovery in relation to long-term trends in seasonal recruitment;
3. Investigations of deepwater seagrass recruitment and seasonal senescence in relation to light, temperature, and sources of recruitment/seed bank dynamics; and
4. Determining minimum light requirements of deepwater seagrass (Halophila decipiens and Halophila spinulosa) to find appropriate light trigger levels during dredging projects.

7.5.1 Broad-Scale Mapping

Broad-scale benthic habitat mapping of the Hay Point area will be carried out by an appropriate scientific research institution, possibly in collaboration with a suitably qualified consultant. The survey methodology will be that of Rasheed *et al.* (2004), potentially with minor amendments to reflect improvements in video, computer, GIS, and other technologies. This methodology consists of:

1. Towed video transects using an underwater video camera mounted on a towed sled, with a real-time video monitor on the surface. Transects will consist of four-minute tows as a speed of approximately 1 kn, providing a transect length of approximately 100 m;
2. Collection of macroinvertebrate, macroalgal, and seagrass samples in a net 600 mm wide and 250 mm deep, with 10 mm mesh size attached to the video sled; and
3. Collection of sediment samples using a 0.0625 m^2 van Veen grab.

For each transect, the following data will be recorded:

1. The position of all samples and video transects, using differential GPS (dGPS);
2. Seagrass biomass, as calibrated visual estimates from grabbed video frames using the method of Rasheed et al. (2004) as adapted from Mellors (1991);
3. Seagrass species composition, based on identifications from video and samples according to Kuo and McComb (1989);
4. Epibenthic macroinvertebrates, identified to the lowest taxonomic level possible from video footage and samples collected. For each transect and macroinvertebrate community density category will be assigned on the basis of video footage as follows:
    a. Open substrate: predominantly bare substrate with occasional, isolated individuals
    b. Low density: individuals observed on-screen <10% of the time
    c. Medium density: individuals observed on-screen 10-80% of the time
    d. High density: individuals observed on-screen >80% of the time
    e. In addition to invertebrate community density, any observations of IMS on the Domestic CCIMPE Trigger List will be recorded and reported;
5. Macroalgal abundance, based on visually estimated percent cover, and species composition, based on video and sample identifications according to Cribb (1996). Macroalgae will also be categorised into the following five morphological types after
    a. Erect non-calcareous macroalgae
    b. Erect calcareous algae
    c. Filamentous algae
    d. Encrusting algae
    e. Turf mat algae;
6. Visual characteristics of sediment grab samples will be recorded qualitatively as shell grit, rock or gravel, coarse, medium or fine sand, and mud; and
7. Particle size distribution of the sediment samples will be determined by sieving.

Survey data will be analysed in a Geographic Information System (GIS) to produce maps of seagrass, algal, and macroinvertebrate community types such as the examples in Figure 28 and Figure 29.

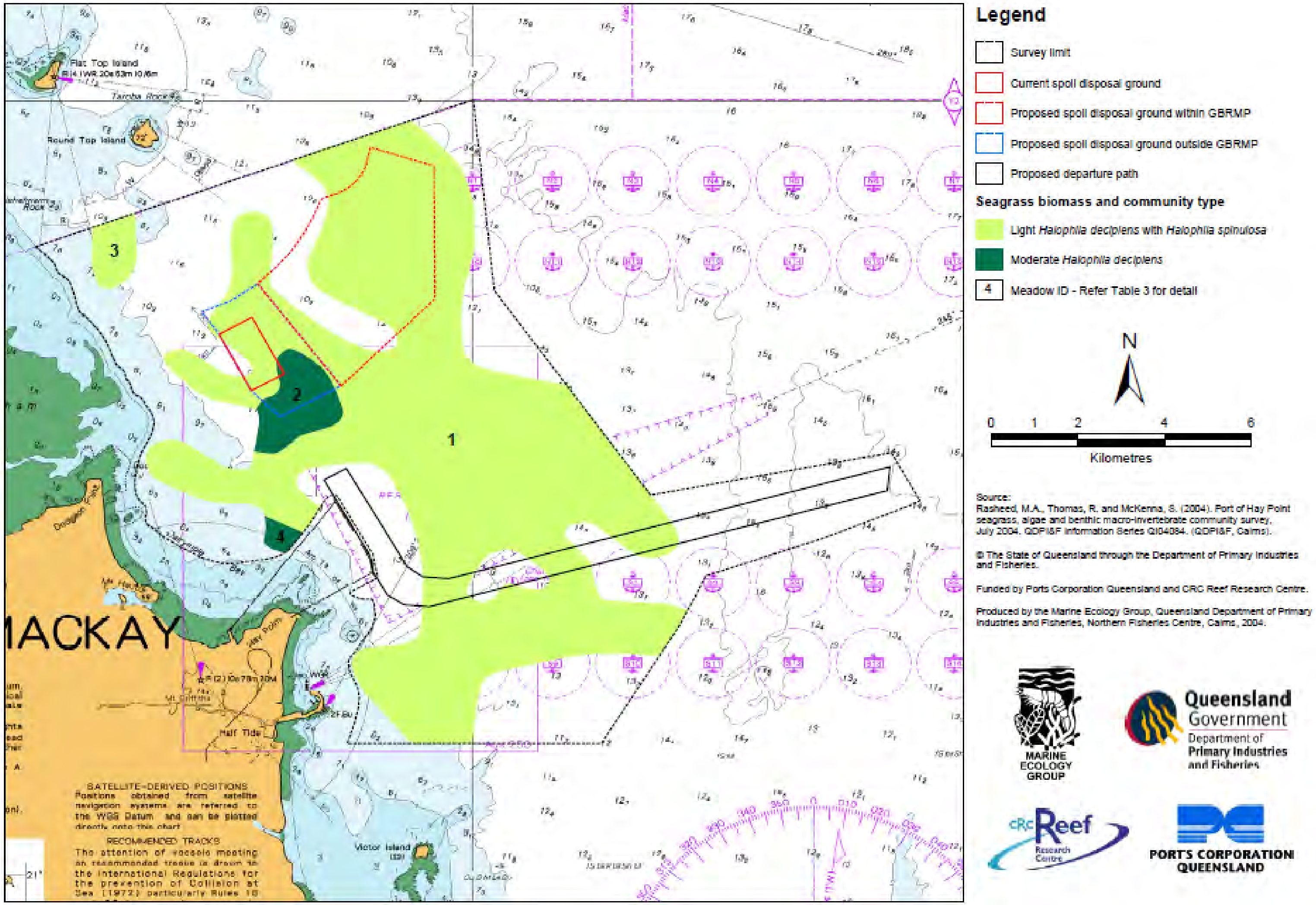


Figure 28 Example map of seagrass biomass and community types (Rasheed *et al*. 2004)

BMA
BHP Billiton Mitsubishi Alliance

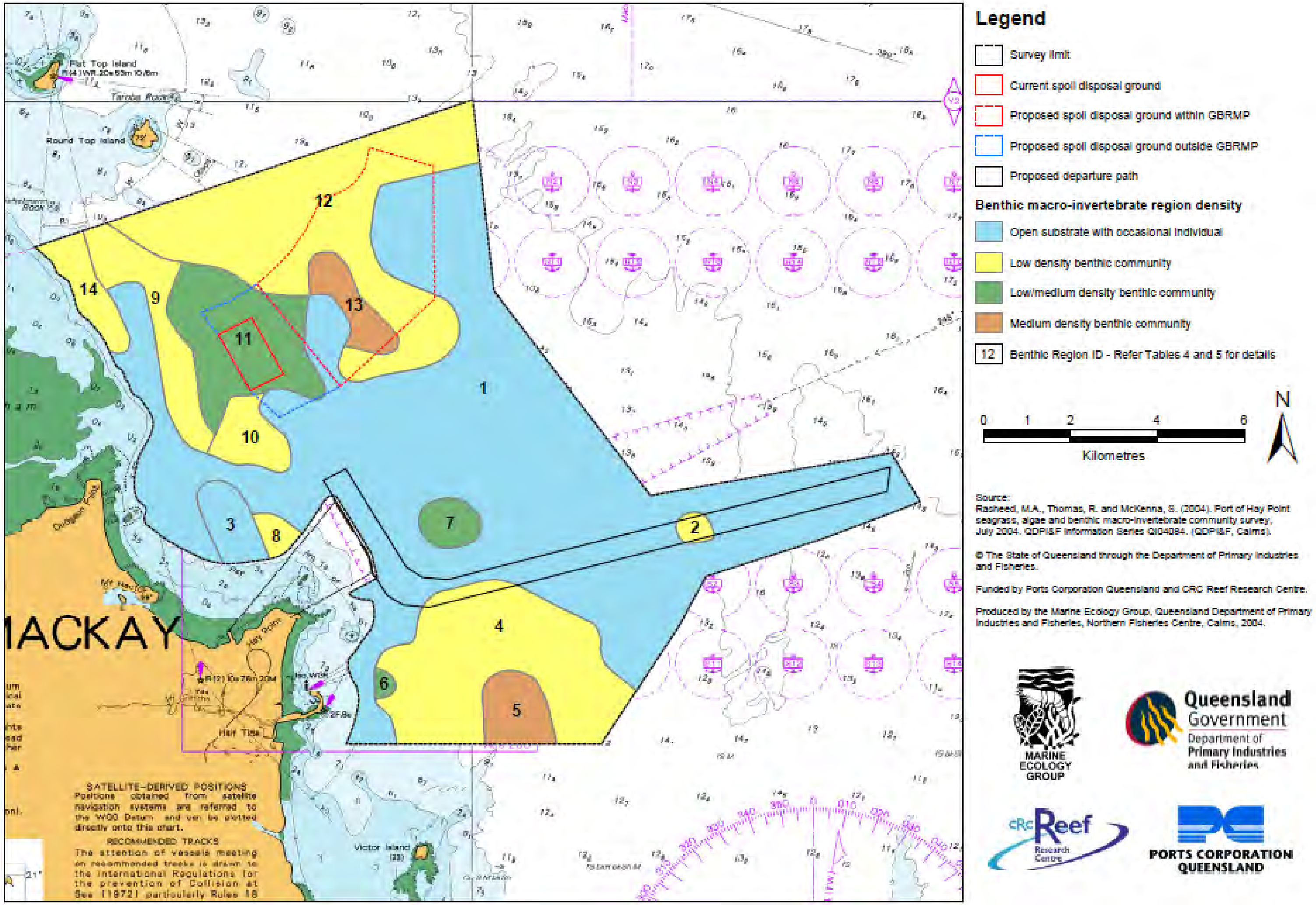


Figure 29 Example map of benthic macroinvertebrate community density and benthic regions (Rasheed *et al*. 2004)

Because the designated disposal site lies at the north east corner of the area mapped by Rasheed *et al*. (2004), the area to be mapped will be extended 2 km to the north and east.

Broad-scale mapping will be conducted in September or October 2010, subject to weather conditions, which is the expected time of peak abundance of *H*. *decipiens* in the Hay Point area. The mapping will be repeated on three occasions:

1. Directly after completion of disposal operations (Year 1, expected to be 2011);
2. Two years after completion of disposal operations (Year 3, expected to be 2013); and
3. Five years after completion of disposal operations (Year 6, expected to be 2016).

7.5.2 Detailed Impact and Recovery Monitoring

Detailed monitoring of seagrass impact and recovery will be conducted by a suitably qualified sub-consultant, with consultation and review by an appropriate research institution. The monitoring programme will use the methodology of the historical monitoring program for the 2006 capital dredging, as described by Chartrand *et al*. (2008). This method uses a stratified approach in which three permanent replicate blocks are established within each monitoring site (Figure 30). Within each block, three randomly-located video transects are conducted, along with sled net and grab sampling, as described in Section 7.5.1.

The historical monitoring sites shown in Figure 30 will be maintained, to build upon the long-term record and link new results to historical trends. In addition, three additional sites will be established to monitor temporal trends of impact and recovery in relation to spoil disposal, as follows:

1. One site within the HPX3 spoil ground;
2. One site outside of the HPX3 spoil ground, but within the disposal ground used for the 2006 capital dredging. This will be in addition to the spoil ground site shown in Figure 30, and the site and a surrounding buffer will be quarantined from future disposal of dredged material for the five-year life of this monitoring program. If possible, the site will be located within the quarantined area for the infauna monitoring program (see Figure 31), provided that a suitable site can be located with similar habitat characteristics, especially depth, to those in the HPX3 disposal site and away from potential disturbance by the infauna sampling program. If not, this site will be established elsewhere in the 2006 spoil ground and quarantined by arrangement with NQBP; and
3. One site with similar habitat characteristics to the HPX3 spoil ground, especially depth, but unaffected by spoil disposal.

The newly established monitoring sites will be surveyed quarterly, with surveys undertaken, subject to weather conditions, in January, April, July, and October of each year. This schedule is designed to capture the key transition points in the seasonal cycle of *H*. *decipiens* based on available knowledge. The monitoring will commence directly after the completion of disposal operations and continue for a period of five years.

Surveys of the historical monitoring sites shown in Figure 30 will be conducted in conjunction with the quarterly surveys of the newly established monitoring sites, but at a reduced frequency, as follows to incorporate known seasonal variations:

1. Initial survey October or November 2010;
2. Approximately six months after, expected to be in conjunction with the April 2011 quarterly survey;
3. Approximately twelve months after the initial survey, expected to be in conjunction with the October 2012 quarterly survey; and
4. Annually thereafter for five years after the initially survey, in conjunction with the October quarterly surveys.

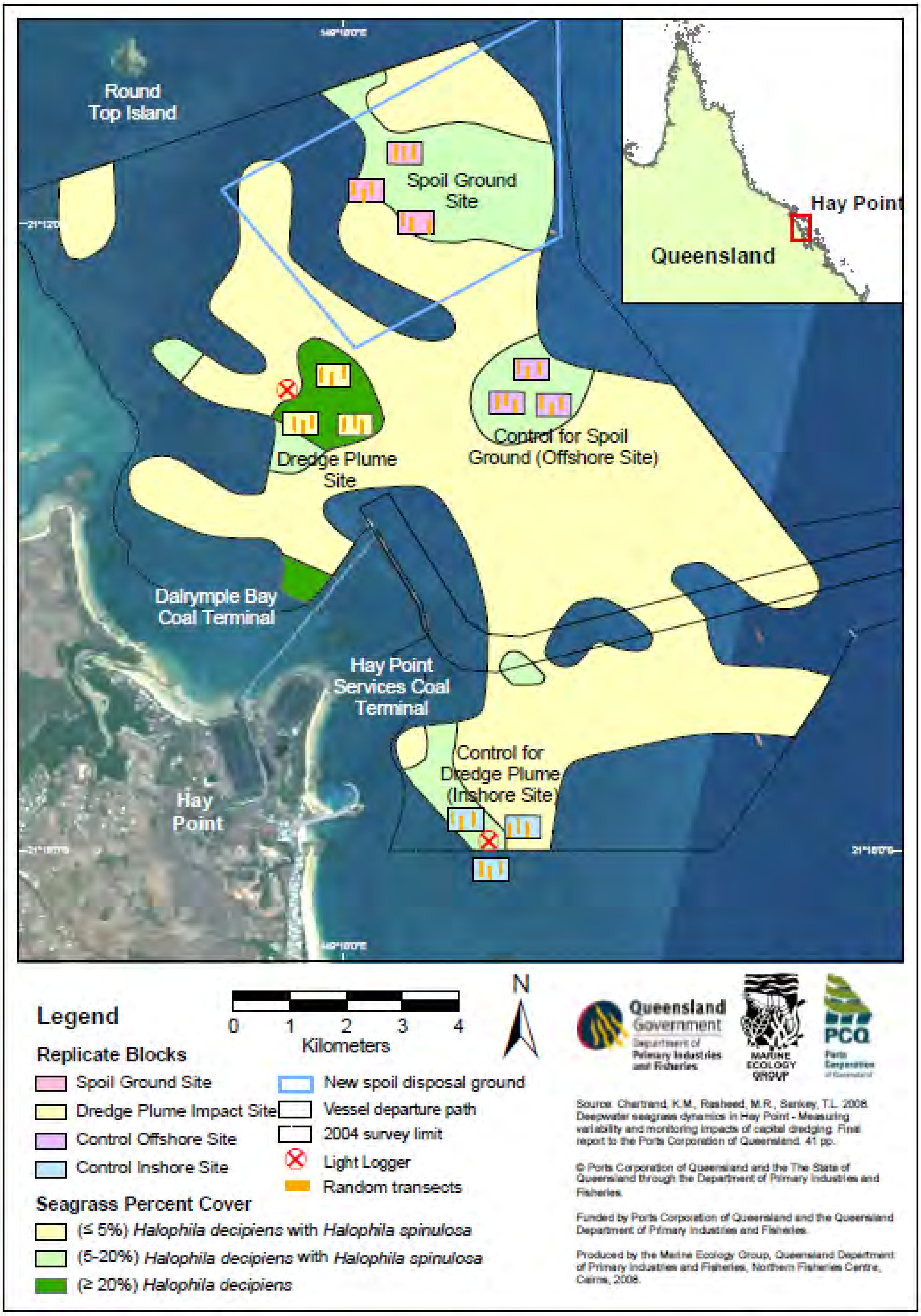


Figure 30 Sampling design used in seagrass monitoring for the 2006 capital dredging project (Chartrand *et al.* 2008)

7.5.3 Deepwater Seagrass Recruitment and Seasonal Senescence

The HPX3 deepwater seagrass dynamics research program will be designed and conducted by an appropriate scientific research institution. Detailed design of the research program is in progress, but the research program will incorporate the elements described below. Understanding the large natural changes in deepwater seagrass, and the drivers of change, is critical in determining potential impacts from dredging. The research program will be established at two sites, one at Hay Point and the second at another location in North

Queensland carefully selected so that the results are applicable to the monitoring and management of deepwater seagrass communities at Hay Point. The reason for having a second location is due to logistic considerations such as ease of access, seagrass variability, and prevailing weather conditions at Hay Point potentially compromising the ability of the program to be successfully conducted at that site alone.

The objectives of the research program focus on the critical seasonal transition periods of decline, typically from December-February each year, and recruitment, typically from June-August. Elements of the research will include:

1. Measuring changes to the light environment including the deployment of benthic PAR loggers at sites where seagrass communities are known to be present. The loggers will also record data on other environmental cues such as temperature;
2. The measurement in relation to light and temperature climate of a suite of seagrass health indicators such as, shoot density, biomass, reproductive status, and below ground energy stores at permanently established transects; and
3. Assessment of the seed bank status and recruitment of seeds and fruits into the seagrass meadows.

The program will be conducted over 3 years to allow for inter-annual variability in recruitment and loss and to provide appropriate temporal replication. It is proposed to begin the assessments in May 2011 to pick up the expected seasonal recruitment of seagrasses.

7.5.4 Minimum Light Requirements for Deepwater Seagrasses

The HPX3 research minimum light requirements (MLR) for deepwater seagrasses will be designed and conducted by an appropriate scientific research institution or collaboration between institutions. The program will build on information collected in the recruitment and seasonal senescence research program to establish a set of minimum seagrass light requirements that can be used to develop appropriate trigger levels for dredging-related turbidity. Deepwater seagrass species from the sites selected in the recruitment and seasonal senescence program will be collected and taken to the laboratory for a series of manipulative experiments. Determination of the MLR of a species requires accurate measurements of (1) photosynthetic inputs and (2) the respiratory demand of the whole plant. Measuring the photosynthetic productivity includes an accurate measure of the absorptance capacity of the plant (percent of ambient light absorbed), as well as the efficiency with which this light is converted into useful energy through the photosynthetic pathway.

Manipulative experiments will be conducted under laboratory and/or mesocosm conditions that allow the key species *H. decipiens* and *H. spinulosa* to be grown under conditions where light quality, quantity and exposure durations, as well as other environmental variables such as temperature and salinity, can be controlled.

Assessments of the key variables to effectively measure photosynthetic output, including absorptance, respiration/oxygen production, carbon flux, and efficiency of the photosynthetic pathway, will be used to assess the health and productivity of seagrasses under the various experimental conditions. This information will be used to develop a range and duration of acceptable light conditions for maintaining deepwater seagrass health that can be used to inform future dredge mitigation strategies.

In addition to determining MLR, the experiments, combined with information collected in the recruitment and seasonal senescence program, will be used to develop a toolkit for the assessment of sub-lethal indicators for seagrass stress that might be applied in dredging mitigation strategies. These include the use of morphological measurements and physiological changes and indicators, such as the determination of electron transport rate (ETR) via pulse amplitude modulated (PAM) fluorometry and assessment of changes in leaf pigment (e.g., xanthophylls).

It is anticipated that the MLR studies would begin shortly after the establishment of the study sites for the recruitment and seasonal senescence program and run for a period of 3 years.

8. Benthic Infauna Monitoring

8.1 Objectives

To investigate long-term trends in recovery of benthic infauna communities from spoil disposal at the HPX3 spoil ground and 2006 disposal ground outside the HPX3 spoil ground in relation to an area not directly affected by spoil disposal.

8.2 Summary of Potential Impacts

Benthic infauna communities will be directly removed in the dredging footprint of the new Berth 3 and apron area and, although some infauna will almost certainly recolonise the berth and apron areas, major impacts are inevitable due to the major changes in habitat that will result from dredging and ongoing operation of the ship loading facilities. These impacts are considered acceptable given the relatively small area affected and its designation for port use. The infauna monitoring program for the HPX3 project will not investigate impacts on infauna in and surround the Berth 3 area, but will instead focus on impacts in the GBRMP that result from spoil disposal.

The potential impacts on infauna communities from HPX3 spoil disposal include:

1. Burial of infauna on the disposal site. Mortality of infauna at the disposal site due to burial is unavoidable. Three processes will contribute to the recovery of infauna communities at the disposal site:
    a. Upward migration of buried infauna to more superficial layers of the sediment. This will depend on the depth of spoil deposition and is unlikely to occur if infauna are buried deeper than about 50 cm
    b. Migration of infauna into the disposal site from surrounding areas. Mobile species are most likely to migrate. The time scales, distances, and variability of such migration across taxa are poorly understood
    c. Larval settlement of new recruits to the disposal site. Temporal and spatial patterns of recruitment across taxa are poorly understood; and
2. Long-term alteration of benthic habitat that could result from spoil disposal. The climax community structure of infauna communities, as well as the recovery processes described above, is highly dependent upon characteristics of the sedimentary habitat such as particle size distribution, physical structure, and biogeochemical characteristics such as organic carbon content.

8.3 Performance Indicators

1. Differential patterns of change in infauna abundance, diversity, and community structure across sites with different spoil disposal histories;
2. Amount of increased knowledge of nature and spatial and temporal scales of effects of spoil disposal on infauna communities.

8.4 Personnel

The BMAPM will ensure that the infauna monitoring program is conducted by personnel who are experienced, qualified, and appropriate to carry out their duties, and are adequately trained in the methodologies and requirements of this EMP and all related environmental management plans and procedures.

8.5 Monitoring Program

The benthic infauna monitoring program will collect and analyse data on the abundance and community structure of infauna communities in relation to the history of spoil disposal and physical habitat characteristics.

Sampling Design

The sampling design for the infauna monitoring program is shown in Figure 31. The design is based on sampling infauna communities, at varying spatial scales, from three areas:

1. Within the HPX3 spoil ground;
2. Outside of the HPX3 spoil ground, but within the disposal ground used for the 2006 capital dredging. A 500 m buffer around this area will be quarantined from future disposal of dredged material for the five-year life of this monitoring program; this arrangement has been agreed with NQBP; and
3. An area with similar habitat characteristics to the HPX3 spoil ground, especially depth, but unaffected by spoil disposal.

These areas will be sampled within the HPX 3 disposal site, and at increasing distance from the disposal site along three axes (Figure 31); which will not necessarily be linear or oriented to the points of the compass for reasons described below, as follows:

1. One axis to the north, the expected direction of sediment plumes from disposal;
2. One axis to the southwest, within the 2006 spoil ground. The alignment of this axis has been selected so that sampling sites are on known areas of spoil disposal in 2006, while optimising the area of the permitted NQBP spoil ground to be quarantined from future disposal over the life of this monitoring program;
3. One axis to the southeast, perpendicular to the expected direction of plume dispersal (see Figure 31). These sites have been selected on the basis of being away from the expected direction of plume propagation, while also being outside of designated anchorages so as to minimise potential disturbance from ship anchors and ensure access to monitoring sites when necessary. It is expected that the selected sampling sites shown in Figure 31 will be comparable to the HPX3 disposal site in depth and, as far as possible, other habitat characteristics. The selection of alternatives is constrained by the locations of designated anchorages, but if preliminary information obtained from sampling indicates that these locations do not provide suitable comparisons, alternative sites will be selected in consultation with the ESS and MRG.

In addition to the sampling location within the HPX3 disposal site as show in Figure 31, sampling locations (represented by circles in Figure 31) will be established along each axis at 250 m outside the HPX3 spoil ground and a further 1.5 km away. At each location (circles in Figure 31) there will be four sampling sites, oriented to the points of the compass as shown in Figure 31. Because ten relatively large grab samples will be collected at each site, as described below, the survey vessel will be relocated 25 m to the east after the first five grab samples are collected at each site in order to minimise the probability of resampling the same parcel of the seabed.

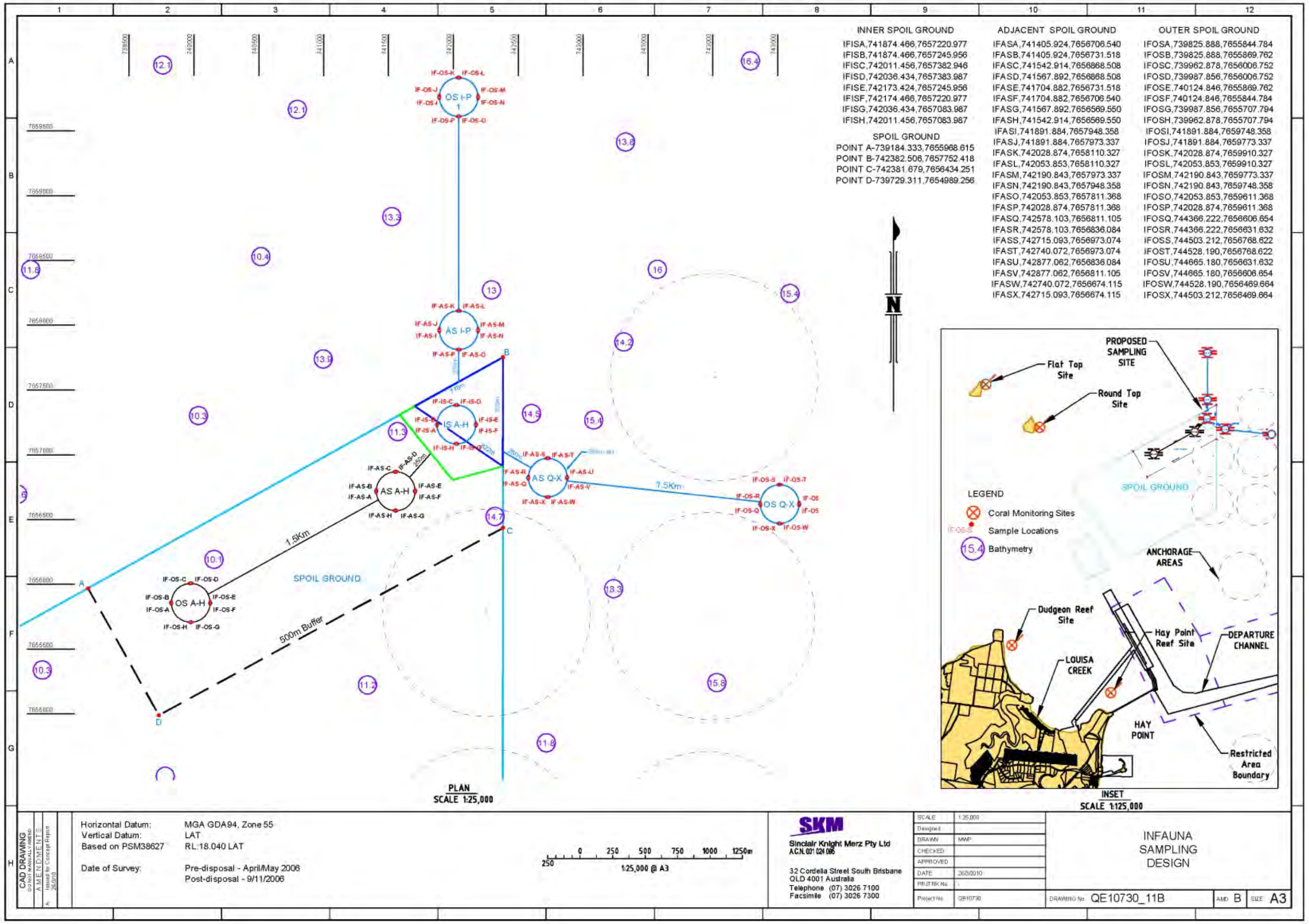


Figure 31 Sampling design for infauna monitoring. The area bounded by points A, B, C, and D will be quarantined from future spoil disposal through the life of the monitoring program.

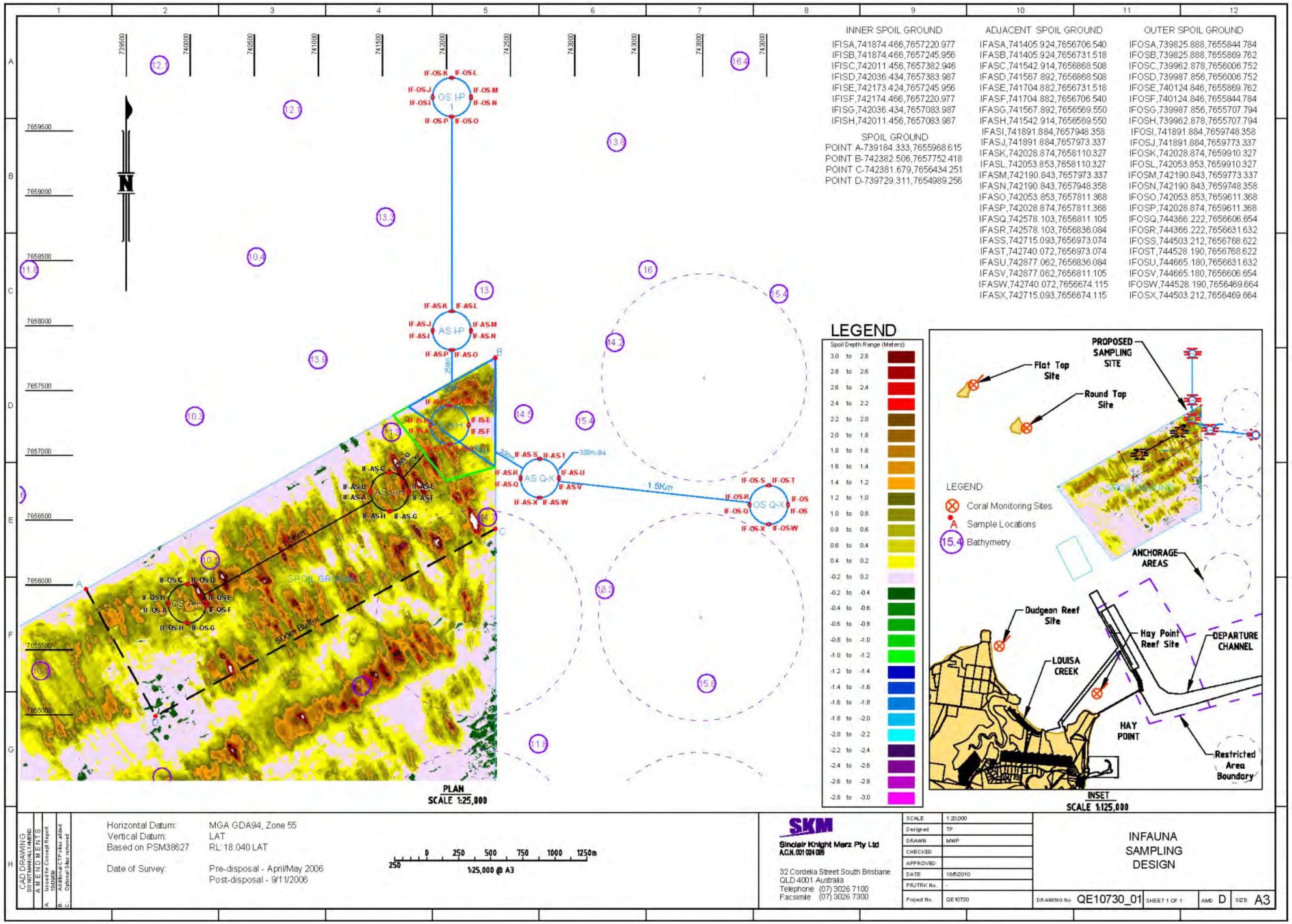


Figure 32 Infauna sampling design overlain on difference plot of pre- versus post-disposal bathymetry of the spoil ground in the 2006 capital dredging campaign to show the monitoring locations in relation to past spoil disposal. Colours from yellow to maroon indicate increasing depths of spoil after the completion of works

Sampling and Data Collection

At each site, sediment samples will be collected using a van Veen grab with a gape o f 0.1 m^2. This is a larger grab and heavier grab than typically used in studies of shallow-water infauna and has been selected to ensure that the grab can be deployed to the bottom in strong currents and also to achieve deeper penetration into the sediments to better characterise the physical nature of the habitat. The grab is expected to typically sample to at least 10 cm in the sediment.

A total of 10 grabs will be collected at each site. Eight of these will be for infauna analysis and two will be samples to characterise the physical nature of the habitat. Thus, a total of total of 280 grabs samples will be collected during each infauna survey (Table 6).

Table 6 Number of grab samples to be collected per survey

Sample Type	Number of locations	Number of sites within each location	Replicates per site	Total grab samples
Infauna	7	4	8	224
PSD/TOC	7	4	2	56
Total			**10**	**280**

The infauna samples will be will be sieved through a 1 mm screen, and material retained on the screen preserved and delivered to the laboratory, where the samples will be rinsed and sorted. Infauna will be counted and identified to family level. Identification to family is recommended by the NAGD (Commonwealth of Australia 2009). A reference collection will be maintained by the laboratory, and voucher specimens lodged with the Queensland Museum.

The samples for physical habitat characterisation will be representatively sub-sampled in the field, and the sub-samples sent to the laboratory for analysis of PSD and TOC.

The number of replicate infauna samples is based on preliminary data from the survey in November 2009 (BMA 2009). A family accumulation curve, that is, the increase in the total number of families collected as a function of the number of samples, levels off at approximately seven to eight replicate samples (Figure 33).Similar results were obtained from other area. This indicates that eight replicates are sufficient to adequately characterise the infauna communities.

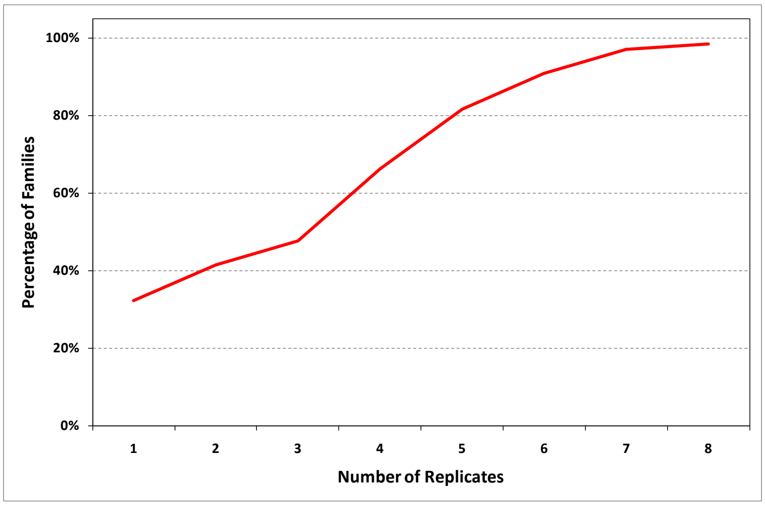


Figure 33 Family accumulation curve from infauna sampling in the area of the HPX3 disposal site

Data Analysis

Data from the infauna monitoring will be analysed to investigate:

1. Temporal trends in the recovery of infauna communities as a function of spoil disposal history at the sampling sites and distance from the HPX3 disposal site; and
2. Relationships between recovery trends and physical characteristics of the habitat.

Data will be analysed using univariate and multivariate statistical methods. Data variances will initially be tested (Levene test, Dytham 2003), and if heterogeneous, the data will be will be transformed accordingly (Underwood 1981). Univariate analysis of variances (ANOVA) will be performed on total abundance and family richness as a function of sampling axis and distance from the HPX3 disposal site. Correlation analysis (Dytham 2003, Sokal and Rohlf 2003) will be used to investigate relationships between the faunal attributes and the abiotic variables. Multivariate analyses will be used to examine community structure across sites and in relation to physical characteristics of the habitat. Non-metric multi-dimensional scaling Clarke and Warwick (1994) will be used to visualise potential differences in community structure across sites, the significance of which will be tested by analysis of similarity (ANOSIM).Similarity percentage contribution analysis will be performed to identify taxonomic group contributions. Additionally, the RELATE and BIOENV procedures (Clarke and Warwick 1994) will be used to test for relationships among similarity matrices based on relative infauna abundances and measured environmental variables, and the correlation between the faunal composition similarity structures and physical habitat characteristics, respectively.

Frequency of Monitoring

The infauna surveys will be conducted:

1. Prior to the commencement of dredging and disposal surveys;
2. Within two months of completion of disposal activities. Note that this before-after comparison in relation to disposal activities accords with the recommendations of the NAGD (Commonwealth of Australia 2009); and
3. Annually until five years after completion of disposal activities.

9. IMS Monitoring and Management

The HPX3 monitoring and management program for introduced marine species has two components:

1. Risk assessments and inspections of all vessels and immersible equipment used for HPX3 dredging; and
2. Targeted IMS monitoring of the disposal site.

9.1 Objectives

To prevent the establishment of IMS in Hay Point waters and to provide early detection of new incursions at the HPX3 disposal site to provide for prompt control measures.

9.2 Summary of Potential Impacts

Introduced marine species are marine biota that are translocated into waters outside of their natural geographical range and subsequently settle, survive and spread. These species have the potential to cause irreversible impacts to the composition and function of the ecosystem through competition, predation, and/or pest and disease introduction, resulting in a combination of environmental, social and/or economic impacts.

9.3 Performance Indicators

1. All vessels and dredging plant used for the HPX3 project are subjected to IMS risk assessments, and if indicated IMS inspections before arrival at site;
2. Any vessels and equipment found to harbour IMS are appropriately cleaned to eradicate the IMS before proceeding to site;
3. No populations of IMS are established on the HPX3 disposal site; and
4. In the event that IMS do recruit to the HPX3 disposal site, they are detected early so that effective control measures can prevent the establishment and spread of their population.

9.4 Personnel

The BMAPM will ensure that all IMS risk assessments, vessel inspections, and field surveys are conducted by personnel who are experienced, qualified, and appropriate to carry out their duties, and are adequately trained in the methodologies and requirements of this EMP and all related environmental management plans and procedures.

9.5 Vessel IMS Inspections

The key areas requiring IMS management on dr edge vessels and associated immersible equipment include:

1. Biofouling on vessel hulls and other external niche areas such as propulsion units, steering gear and thruster tunnels;
2. Biofouling of vessels' internal niches such as seawater systems , anchor cable lockers ballast tanks and bilge spaces;
3. Biofouling on immersible equipment, including but not limited to dredging equipment, cutters, ladders, ROVs, and deck mounted tender vessels;
4. Residual sediments; and
5. Ballast water.

The classification of stages of biofouling used in IMS assessment is shown in Figure 34. Figure 35 shows the IMS Management Strategy in relation to dredging vessels and immersible equipment.

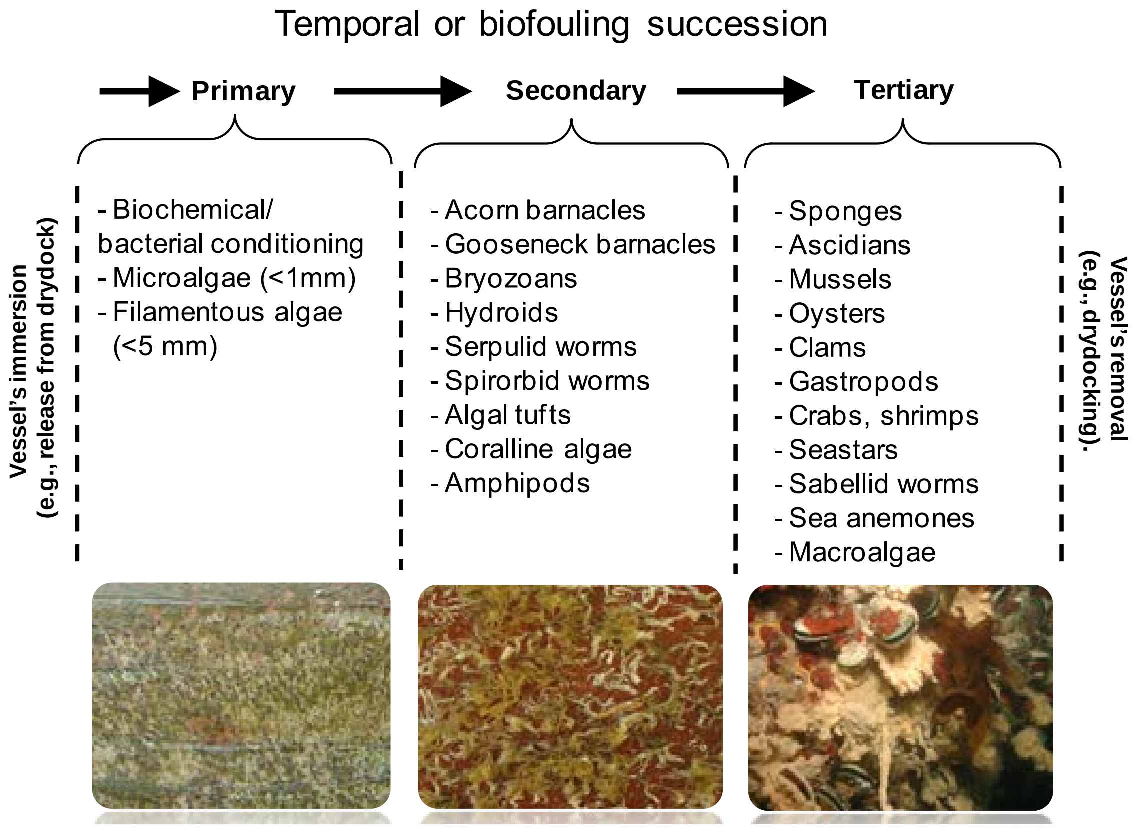


Figure 34 Stages of succession of fouling organisms used in IMS assessment

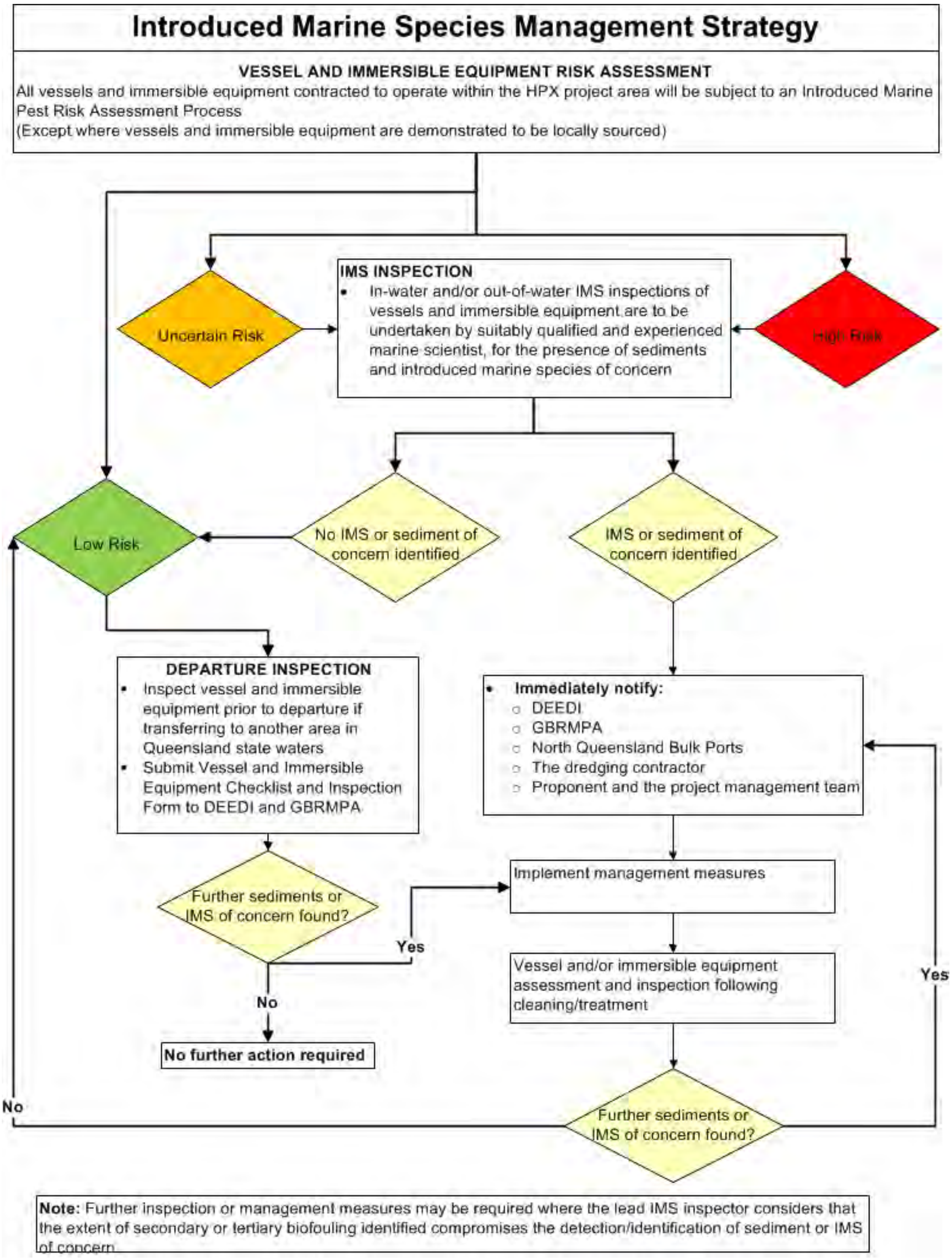


Figure 35 IMS vessel management strategy

9.5.1 Vessel and Immersible Equipment IMS Risk Assessment

A detailed risk assessment procedure has been developed that is consistent with the *National System for the Prevention and Management of Marine Pest Incursions* (the *National System*) Guidelines. This procedure will be applied to all vessels and immersible equipment used for the HPX3 dredging campaign to assess the risk of IMS introduction. The risk assessment will be undertaken prior to the identified vessel and/or immersible equipment entering the waters of the GBRMP or engaging in dredging and spoil disposal activities in the HPX3 project area.

The objective of the risk assessment is to identify the individual level of IMS threat a contracted vessel or its immersible equipment poses. This will allow BMA to select the most appropriate vessels and immersible equipment and establish management measures to mitigate identified threats to an acceptable low level.

The three risk categories used in the risk assessment are:

1. Low: low likelihood of IMS – no additional management measures required;
2. Uncertain: likelihood of IMS is not apparent – precautionary approach adopted, additional management measures required; and
3. High: identified as a potential risk – additional management measures required.

The key factors to be considered in the risk assessment include:

1. Vessel type;
2. Inspection history;
3. Presence and age of fouling control coating;
4. Presence or absence of internal treatment systems;
5. Internal treatment history;
6. Previous climatic region(s) of operation;
7. Stationary or slow periods of operation and climatic region;
8. Type of vessel activity;
9. Vessel desiccation period during mobilisation; and
10. Adherence to AQIS ballast water requirements.

The outcomes of the risk assessment will determine whether or not an IMS vessel inspection is required prior to the vessel or immersible equipment mobilisation to site.

9.5.2 Inspection Procedure

Where IMS inspection is established as the most appropriate course of action, a systematic out-of-water or in-water inspection of the vessel and/or immersible equipment will be undertaken to inspect for sediment or biofouling containing IMS of concern. The IMS inspection will include an inspection of the vessel's general hull and associated niche areas, an internal inspection of the vessel's seawater systems, and a topside inspection of high-risk wet areas including immersible equipment.

The inspection should be undertaken within seven days of the final vessel departure for the HPX3 project area.

A suitably qualified marine scientist with experience in biofouling inspections will lead all IMS inspections. In-water inspections must be conducted with adequate visibility, as determined by the Lead IMS Inspector. The method for in-water inspections is at the discretion of the Lead IMS Inspector and may include, but is not limited to:

1. The Lead IMS Inspector undertaking physical inspection; and/or
2. The Lead IMS Inspector remotely directing divers to undertake the inspection using live audio and visual communications.

Systematic inspections of the external and internal vessel areas will determine:

1. Presence, extent, and condition of the fouling control coating (FCC) on submersed external areas;
2. Presence, number, and type of niche areas,
3. Presence of internal biofouling control systems;
4. Presence of sediment;
5. Extent of biofouling; and
6. Presence of IMS of concern.

External hull inspections will include:

1. Anodes;
2. General hull areas;
3. Bow and stern thrusters;
4. Main propulsion units;
5. Seawater inlets and outlets; and
6. Transducer and steering gear.

Internal vessel inspections will include:

1. Bilge spaces and ballast tanks;
2. Anchor cable lockers; and
3. Internal seawater systems such as cooling water, reverse osmosis, and fire fighting systems.

Topside inspections will include:

1. Topside wet areas;
2. Anchors and anchor winch gear; and
3. Immersible equipment such as dredging equipment, cutters, ladders, ROVs, and deck-mounted tender vessels.

Where possible, video and/or still images will be taken of all key areas of the vessel, including external and internal areas inspected.

At the completion of the vessel inspection, the Vessel and Immersible Equipment Checklist and Inspection Form must be completed, signed by the Lead IMS Inspector and faxed or emailed to the BMA Environmental Superintendent as soon as possible but within 24 hours of completing the inspection.

In-water inspections may need to be followed by an out-of-water inspection or other management measures, where the in-water inspection detects an IMS of concern or where there are high levels of secondary or tertiary biofouling to the extent that detection/identification of IMS of concern cannot be achieved with confidence. This requirement will be determined by the Lead IMS Inspector.

In the event that known or suspected IMS are found on vessels in Australian waters, a photograph or video image showing the species will be taken and a sample collected and sent for expert taxonomic identification. It should be noted, however, that the management strategy presented above will apply when suspected marine pests are identified and implementation of the strategy will not be delayed pending taxonomic identification.

9.5.3 Reporting

At the conclusion of the vessel and immersible equipment risk assessment process, and if necessary cleaning, treatment and re-inspection, all relevant documentation will be compiled and submitted to GBRMPA for approval prior to the identified vessel and/or equipment entering the waters of the GBRMP or being dispatched from a location within the GBRMP with the purpose of engaging in dredging and spoil disposal activities in the HPX3 project area. This documentation may include:

1. Vessel history, including FCC certification and cleaning and maintenance history documentation;
2. A copy of the completed risk assessment for each vessel and item of immersible equipment;
3. A copy of the completed Vessel and Immersible Equipment Inspection Checklist and Inspection Form signed by the Lead IMS Inspector;
4. A copy of the final IMS inspection report, including photographs; and
5. Correspondence detailing actions undertaken following the initial risk assessment and any following management activities.

9.6 Targeted Field Surveys for IMS at the Disposal Site

Until recently, IMS surveys in Australia have followed the CSIRO-CRIMP survey approach (Hewitt & Martin 1996). On the advice of the National Introduced Marine Pests Coordination Group (NIMPCG), the CSIRO-CRIMP survey approach was modified, from a general survey of all marine growth, towards a targeted IMS survey approach. The modifications are part of the overall development of the *National System*. This has resulted in a more efficient survey approach that is considered more appropriate and cost-effective in fulfilling IMS monitoring and detection requirements.

The primary monitoring objectives of the *National System*, as per the Marine Pest Monitoring Manual (Version 1) (NIMPCG 2006a) are to:

1. Detect new incursions of established target species at a given location i.e. species already established elsewhere in Australia or New Zealand but not recorded at that location; and
2. Detect target species not previously recorded in Australia or New Zealand that are known to be pests elsewhere.

Secondary monitoring objectives are to:

1. Detect species that appear to have clear impacts or invasive characteristics; and
2. Identify high-risk times and/or optimum times for sampling target species (e.g. time of year when a species is present in the water column).

9.6.1 Methodology

The methods chosen for the surveys are based on the current National Monitoring Guidelines (NIMPCG 2006a and NIMPCG 2006b).

The ability of IMS to establish in exotic locations is limited by species-specific salinity and temperature tolerances. As part of the *National System*, the NIMPCG has developed a Monitoring Design Excel Template (MDET) to assist in IMS survey design. Based on environmental conditions, including temperature and salinity, habitat types, and method preferences, MDET provides a list of target IMS species and guidance on a species- and habitat-specific sampling design. MDET combines several sampling methods to ensure compliance with the *National System* objectives. However, it is up to the end user to make the final determination of the most appropriate method(s). Not all potential methods are included in the MDET. MDET outputs of recommended target IMS of concern and survey methodology for the Hay Point area are shown in Table 7.

BMA (2009c) also identified a list of species that could potentially establish at Hay Point, which included two species, the chameleon goby (*Tridentiger trigonocephalus*) and the thin lip mullet (*Liza ramada*), that are not listed in the current national target species monitoring list and the revised CCIMPE Trigger List, and thus not identified as target species of concern by MDET. The IMS surveys will target these two species as well as those on the MDET list in Table 7.

MD*Et al*so calculates sample size requirements for different sampling techniques, based on environmental (salinity, temperature) and habitat information for a specific location. The IMS field surveys for HPX3 will be conducted at the approved disposal site (see Figure 14). Some information is available on the substrate in the survey area, which indicates there may be a relatively high proportion of gravelly substrate (Aurecon Hatch 2009). Hard substrates are also a particular concern identified by GBRMPA with respect to IMS establishment, and therefore the habitat information input to MDET emphasised the occurrence of hard substrate. The MDET-recommended total lengths of visual transects therefore emphasise hard substrate (Table 8), but all substrate types in the area will be surveyed and the relative representation of hard versus soft substrate surveyed may be adjusted in the field to reflect the nature of the habitat.

Table 7 Targeted IMS of concern and relevant sampling methods as provided by MDET

Identified Species of Concern	In water visual (Diver)	Core
Alexandrium catenella		X
Alexandrium minutum		X
Alexandrium monilatum		X
Alexandrium tamarense		X
Asterias amurensis	X	
Bonnemaisonia hamifera	X	
Beroe ovate	X	
Carcinus maenas	X	
Caulerpa racemosa	X	
Caulerpa taxifolia	X	
Charybdis japonica	X	
Codium fragile spp. tomentosoides	X	
Crassostrea gigas	X	
Crepidula fornicata	X	
Didemnum spp.	X	
Dinophysis norvegica		X
Ensis directus	X	
Eriocheir sinensis	X	
Grateloupia turuturu	X	
Gymnodinium catenatum		X
Hemigrapsus sanguineus	X	
Hemigrapsus takanoi/penicillatus	X	
Hydroides dianthus	X	
Mnemiopsis leidyi	X	
Musculista senhousia	X	
Mya arenaria	X	
Mytilopsis sallei	X	
Perna perna	X	
Perna viridis	X	
Pfiesteria piscicida		X
Rapana venosa	X	
Rhithropanopeus harrisii	X	
Sabella spallanzanii	X	
Undaria pinnatifida	X	
Varicorbula gibba	X	
Womersleyella setacea	X	

Table 8 MDET-recommended total length of diver visual transects in the HPX3 disposal site

Dominant Habitat Type	Depth	Distance/area Surveyed
Hard horizontal	17 m	1000 m
Pelagic horizontal	17 m	200 m

Soft horizontal	17 m	100 m

In-Water Diving Visual Surveys

Scientific divers will work in pairs, inspecting subtidal habitats at various depths incorporating all identified habitats (Figure 36). In-water visual surveys are to be conducted at various locations within the survey area, focusing on hard substrata, adjacent soft habitats and the surrounding water column, for identified target IMS.

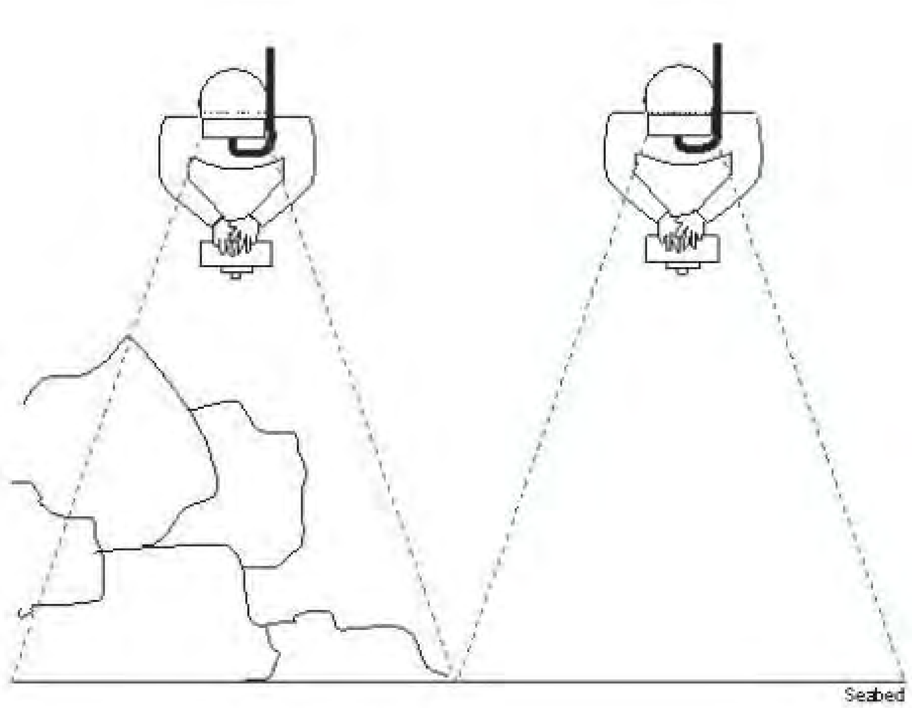


Figure 36 Schematic representation of the in-water diving survey procedure

Seabed Sediment Coring

Sediment cores will be taken in the survey areas using cylindrical PVC pipe cores (Figure 37). The sediment cores will be used to sample the sediment for dormant cysts that would not be detected by visual surveys. The number of cores taken in each of the survey areas was determined based on the identified spatial extent of soft sub-tidal habitats. Cores will be taken by divers at random locations in the vicinity of the visual transects. After the cores are collected, they will be capped, returned to the surface, and stored intact in a cool, dark environment prior to laboratory analysis for the presence and identification of spores and cysts.

While MDET only identified the requirement of a single core, additional cores will be taken from suitable substrates.

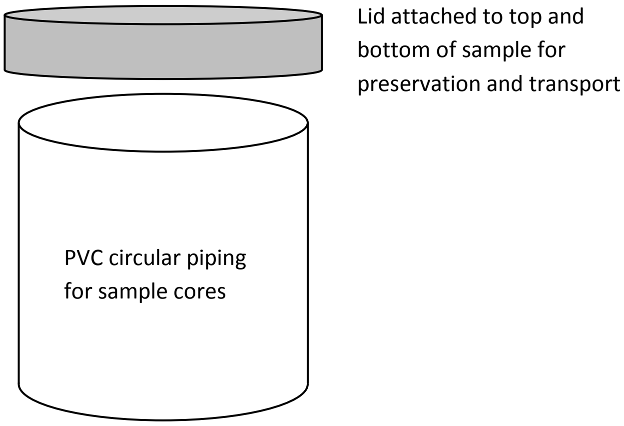


Figure 37 Schematic representation of sediment core to be used in the IMS surveys

The post-disposal survey will be repeated on the following intervals or until the spoil ground is dumped upon again:

9.6.2 Monitoring and Management

Targeted IMS surveys of the HPX3 disposal site will be conducted:

1. Prior to commencement of spoil disposal;
2. Two months after completion of spoil disposal;
3. Six months after completion of spoil disposal;
4. Twelve months after completion of spoil disposal; and
5. Annually thereafter up to five years after completion of spoil disposal.

If IMS are detected in and survey, DAFF and GBRMPA will be immediately notified, and eradication and control measures agreed and implemented. Measures for eradication and control will be highly dependent on the species detected, its location, and the extent of the infestation, and it is impossible to specify the best control measures in advance.

10. Coral Monitoring and Management

10.1 Objective

To ensure that impacts to coral communities are minimised and kept within the limits of acceptable loss.

10.2 Background

Dredging operations are expected to mobilise sediment into the water column. This sediment will migrate with the prevailing currents resulting in a dredge plume. The migration of this dredge plume will cause increased turbidity, light attenuation (reduced light penetration) and sediment deposition. However, the high current velocities that prevail around the rocky reefs of Hay Point are expected to afford them some protection from such impacts. Dredge plumes generally flow away from the inshore areas of Hay Point. A potential risk to this community is the mobilisation of sediment plumes associated with dewatering and stormwater runoff from the reclamation.

10.3 Summary of Potential Impacts

Potential impacts which may occur to coral during the HP3X project include:

1. Death or injury due to smothering, increase in nutrients and physical damage;
2. Decreased growth rates;
3. Bleaching; and
4. Reduction in species diversity and abundance.

10.4 Key Performance Indicators

Key performance indicators are as follows:

1. Percentage cover of corals; and
2. Coral health and mortality.

10.5 Monitoring Methods

Coral monitoring will be undertaken at the same locations where water quality loggers are deployed, as follows:

Inshore rocky reef communities:
1. Hay Reef (Inshore Impact);
2. Freshwater Point (Inshore Reference).

10.5.1 Pre-dredging and Disposal Coral Survey

Prior to the commencement of dredging and disposal, or as soon as possible thereafter, a baseline survey will be conducted to establish the monitoring sites and gather baseline data. Each location will be surveyed using towed video to determine the most suitable long-term coral monitoring site. At these sites, ten 20 m, permanent video transects will be set up in a grid pattern covering the densest area of coral cover. Permanent transects will be recorded using video and analysed for percent cover. In addition, 40 to 50 individual coral colonies of at least two coral genera that are sensitive to light deprivation/sedimentation will be tagged. The tagged colonies will be photographed for baseline coral colour and mortality.

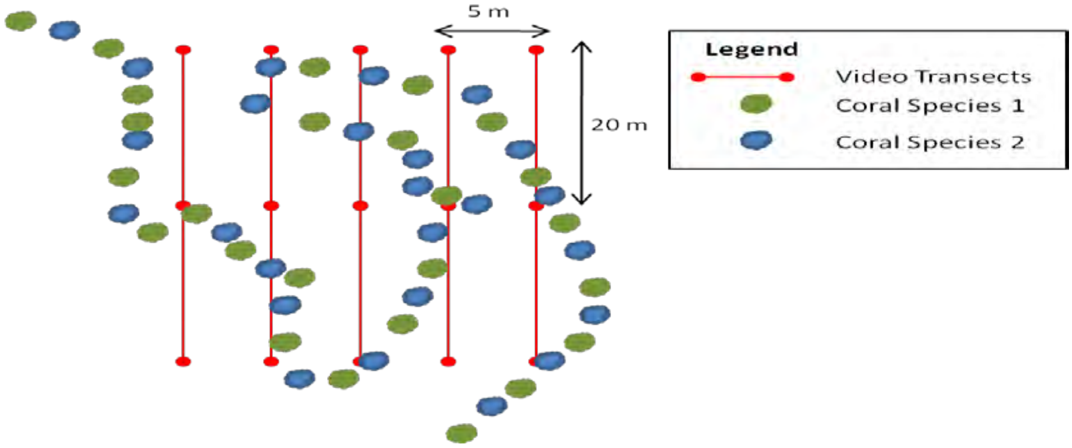


Figure 38 Indicative design of coral monitoring site

10.5.2 Percent Cover

Each of the ten 20 m, permanent video transects will be established within the determined area of reef to measure the percentage coral cover at each site (Figure 38). The benthic community, approximately 50 cm wide along the tape will be recorded onto video tape for subsequent analysis of percentage cover of the major coral morphological groups. The video recording provides a permanent record for archive, and allows an improved appreciation of overall ecosystem condition.

Video transect analysis will be undertaken prior to dredging and disposal and post-dredging and disposal thereby giving an estimate of any change to cover and community structure.

10.5.3 Coral Health

A rapid response coral health assessment is required once water quality trigger values are exceeded. This form of monitoring will quickly determine if the coral colonies being monitored are being stressed by dredging and spoil disposal activities and trigger a more detailed assessment whilst management is initiated. When stressed, corals change colour as a result of discharging their symbiotic algae (zooxanthellae) and in the most severe form this is called coral bleaching. During a bleaching event the brownish algae disappear from the tissue of the corals leading to the observed colour change. This loss of the 'nutrient factory' in corals may lead to death of the coral or the coral may slowly recover. Many stressful environmental conditions such as heat stress and light deprivation can lead to bleaching.

The ColourWatch program (www.coralwatch.org) has developed a chart that can be used to document colour change. The colour chart is based on the actual colours of bleached and healthy corals. Each colour square corresponds to a concentration of symbionts contained in the coral tissue (see Figure 39). The concentration of symbionts is directly linked to the health of the coral.

During the baseline program the tagged corals will be scored using the colour chart, noting the score of the lightest and darkest area of each individual colony. For each coral colony, the observer will also score the percent cover of sediment, percent newly dead coral, presence or absence of mucous, percent algal cover and incidence of disease, Should the water quality trigger values be exceeded at a given monitoring site then the corals will be quickly re-scored. If the mean colour value or the corals at the site has decreased to 2 or more units, then a more detailed coral assessment will take place using the methods described below for coral mortality.

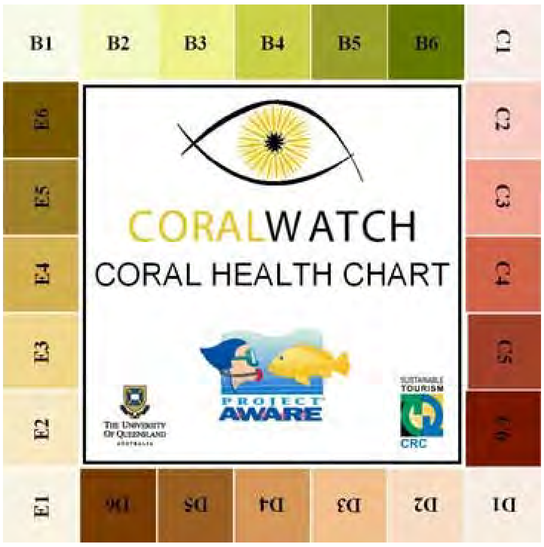


Figure 39 Coral watch chart

10.5.4 Coral Mortality

Each of the tagged coral colonies photographed prior to dredging and disposal will provide the baseline coral condition. If triggered by decreased coral health, the coral colonies will be re-photographed for assessment. The method proposed to quantify coral mortality will be coral point count (CPCe) which allows areas affected (bleaching or mortality) to be traced and quantified and expressed as a percentage of the coral colony surface. The average of the percentage coral morality at each site will be offset by the mortality measured at the reference sites to provide a net mortality estimate which can be attributed to dredging and disposal activities.

The net coral mortality at each site will be compared to the following three levels of trigger values:

1. Level 1: <5% net detectable mortality
2. Level 2: 5–10% net detectable mortality
3. Level 3: >10% net detectable mortality

If these triggers are exceeded then management options will be implemented as directed by the MRG. Indicative management is provided in Section 10.6 below.

10.6 Coral Health Reactive Monitoring and Management

Management will depend on establishing that the exceedances are attributable to dredging and disposal activities.

If management triggers exceeded were directly attributable to dredging and spoil disposal activities, or no clear evidence provided to suggest otherwise, then appropriate mitigation measure and management responses will be implemented in consultation with the MRG. In addition, regular coral monitoring will continue until completion of dredging and disposal activities.

However, if management triggers are exceeded and clear evidence provided to demonstrate that it is not directly attributable to dredging and spoil disposal activities then the following management will take place:

Level 1 & 2 – Provision of a report to MRG with a continuation of dredging and spoil disposal.

Level 3 – Provision of a report to MRG and GBRMPA and authorisation will be sought to continue dredging and spoil disposal.

A number of management measures can be implemented once a decrease in coral health or coral mortality is detected depending upon the nature of the water quality exceedance and the severity of the observed impact. The measures may be used in isolation or combination and will be applied in consultation with the MRG. The following is a list of potential management measures that can be used to minimise or mitigate water quality exceedances that are leading to the impact:

1. Reduce overflow from the hopper barges.
2. Deploy a silt curtain around the dredge.
3. Use tides to reduce the potential for plumes to impact on sensitive areas.
4. Reduce dredging and dumping during daylight hours.

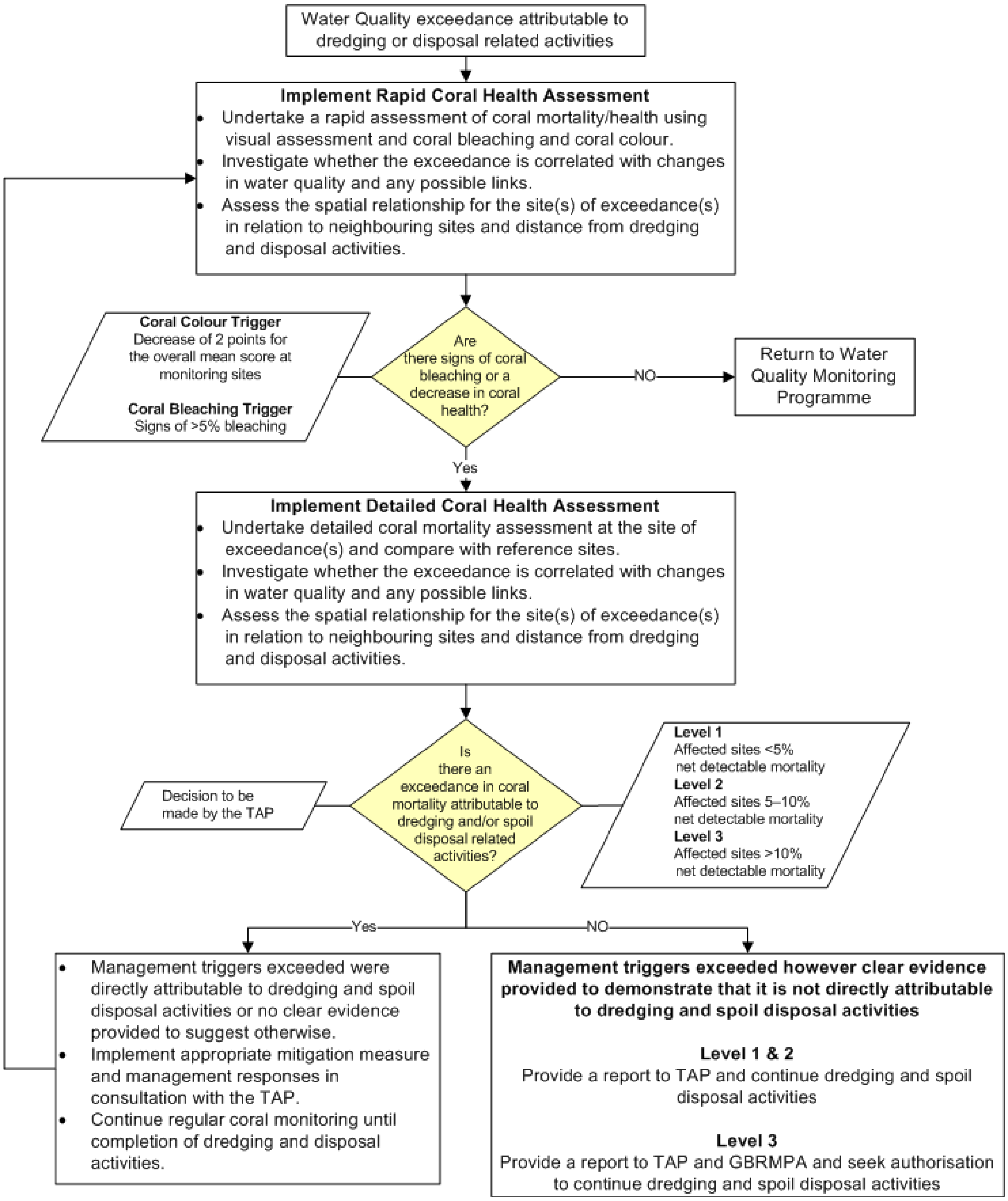


Figure 40 Coral health monitoring and management process

11. Protected Species

11.1 Objectives

To ensure that protected marine species are not adversely affected by dredging and spoil disposal for the HPX3 project.

11.2 Summary of Potential Impacts

Dredging and spoil disposal have the potential to harm marine mammals and turtles through physical interactions with the vessels and dredge head. Such interactions are considered unlikely due to the use of a backhoe dredge at a fixed location, which marine mammals and turtles are unlikely to approach. Interactions with the dredging plant during spoil reprocessing and removal are also considered unlikely because the reprocessing will occur outside of the turtle nesting season and well away from likely turtle habitats. Physical interactions between dredging plant and marine mammals are uncommon due to avoidance behaviour.

Artificial lighting is known to disorient nesting female turtles and turtle hatchlings, but because the Hay Point dredging season is timed to avoid marine turtle nesting and hatching periods no such effects of artificial lighting on dredging plant are expected.

Underwater pressure waves and noise from blasting could have adverse impacts on marine mammals and sea turtles in the vicinity of the blasting site. These have been assessed in detail on the basis of acoustic modelling by SKM (2009), and mitigation measures including trained fauna observers and exclusion zones (2 km for marine mammals, 1,150 m for marine turtles) are including in the DBEMP in accordance with draft conditions issued by DoE for approval under the EPBC Act.

11.3 Performance Indicators

No injury or mortality to marine mammals or sea turtles.

11.4 Management Actions

Although limited interaction with protected fauna is expected, the following management actions will be implemented:

1. Before undertaking dredging, dumping or reprocessing/removal activities, a marine fauna observer or trained crew member must visually monitor, using binoculars, a zone of 300 m around the site of the activities (the monitoring zone) for cetaceans, dugongs and turtles;
2. Dredging, spoil disposal and reprocessing/removal activities must cease, or relocate to another site, if dugongs, turtles, or cetaceans are observed within 300 m of the activities being undertaken;
3. If any of these species are sighted in the monitoring zone, the activities must not commence until the animal is observed to leave the monitoring zone, or until 20 minutes after the last sighting within the monitoring zone, or the vessel is to move to another area to undertake the activities, and visually monitor the monitoring zone prior to undertaking the activities at the new location;
4. All vessels will comply with the EPBC Regulations 2000 Part 8 – Interaction with Cetaceans and Whale Watching whilst vessels are in transit; and
5. Should any injured or dead cetaceans, dugongs or turtles be discovered attributable to dredging related activities, complete shut-down of all activity must immediately occur and remain in effect until a review of procedures is undertaken and alternative and/or additional management measures have been approved by regulators.

11.5 Management Actions – Dredging and Blasting

Management actions for dredging and blasting, and in particular management actions associated with the protection of protected marine species in relation to drilling and blasting operations, are detailed in the Dredging and Blasting Management Plan (DBEMP).

11.6 Reporting

The dredging contractor and all personnel involved in the HPX3 monitoring program will keep a r ecord of sightings of protected marine species and report them to the ES. All observations of cetaceans, dugongs and turtles within the monitoring zone will be reported fortnightly to the ESS.

If a cetacean, dugong or marine turtle is killed or injured the following reporting procedure must be followed:

1. The injury or death must be reported to the 1300 ANIMAL hotline (1300 264 625) via the ES;
2. The dredging contractor must immediately report the incident to the ESS and ES;
3. The death or injury of the animal must be verbally reported within 24 hours to Queensland Parks and Wildlife Services (QPWS), DEHP, DAFF, DoE, and GBRMPA; and
4. A written incident report detailing the species injured, location where the incident occurred or the animal was found, nature of the injuries, and circumstances surrounding the incident will be provided to QPWS, DAFF, DEHP,DoE, and GBRMPA within five working days.

12. Waste Management

12.1.1 Objectives

To ensure the environmentally sound handling and disposal of all wastes generated by or associated with dredging and spoil disposal operations.

12.1.2 Performance Indicators

1. All waste materials are handled and disposed of in a safe and environmentally sound manner;
2. No wastes from dredging plant and facilities are disposed of to the marine environment.

12.1.3 Management Measures

Waste management measures will include:

1. All domestic, toxic, and hazardous wastes, oils and petroleum hydrocarbons, empty drums and other containers, and any other waste materials will be collected, handled, stored, and disposed of in accordance with existing HPCT and Port of Hay Point waste management policies and procedures;
2. The dredging contractor will endeavour to minimise waste generation from equipment consumables, packaging, and the like;
3. The dredging contractor is to ensure that adequate toilet facilities are provided on the dredge and other vessels. All wastes, including grey water, are to be contained on board and legally disposed of on land;
4. If there is a sewage treatment plant onboard the dredge or any other vessels, it must comply with Section 50A (4) of the *Transport Operations (Marine Pollution) Act 1995* (QLD), namely:

5. If treated sewage is discharged from a prescribed ship into coastal waters, each culpable person for the discharge commits an offence, unless each of the following applies:
    a. the ship is operating a sewage treatment plant approved by the IMO;
    b. the test results of the treatment system are stated in the ship's International Sewage Pollution Prevention Certificate;
    c. the effluent does not produce visible floating solids or discolour the surrounding water.

6. Waste is to be minimised and segregated during mobilisation, installation, execution and demobilisation stages of the project.

13. Hydrocarbons and Other Hazardous Substances

13.1.1 Objectives

To ensure the environmentally sound storage, handling and disposal of hydrocarbons and other hazardous substances associated with all dredging and spoil operations, in order to eliminate environmental risks such as accidental spillage.

13.1.2 Performance Indicators

1. All hydrocarbons and hazardous substances are stored, handled and disposed of in a safe and environmentally sound manner;
2. Prevent accidental spills or leaks of hydrocarbons or hazardous substances to occur.

13.1.3 Management Measures

Hydrocarbon and hazardous substances management measures will include:

1. All staff to be adequately trained and licensed, and adhere to correct procedures and protocols when handling and using hydrocarbons and hazardous substances;
2. Fuel deliveries and transfers will be conducted by a licensed contractor;
3. Equipment used to store, handle, transfer or dispose of hydrocarbons and hazardous waste will be visually inspected prior to use;
4. Any spills on vessels are to be contained, cleaned up using a spill response kit, and sent to shore for disposal in accordance with HPCT procedures;
5. Oil Spill Contingency Plans and response strategies to be prepared, and implemented in the event of spillage;
6. Fuel transfers and fuel levels will be monitored;
7. Hydrocarbon storage areas on deck will be bunded with 110% of the total capacity of hydrocarbons stored;
8. Spill kits will be provided, located in close proximity to all storage and operational areas, and maintained in proper and efficient working condition;
9. Sufficient oil containment and/or absorptive booms will be available;
10. The use of grease on moving parts will be minimised;
11. Risk assessments to be completed prior to commencement of operations and tasks, detailing possible threats, consequences and mitigation measures implemented so risks are eliminated or sufficiently reduced;
12. Any non-conformance will be immediately reported to the relevant authorities
13. Any oil spills must be reported to the GBRMPA Marine Incident Response pager (07 3830 4919) Quote: “Oil Spill”.

In the event of a spill or emergency, the following corrective actions will apply:

1. Oil Spill Contingency Plans and response strategies to be implemented;
2. Outflow of substance to be prevented, controlled or stopped from the source and the spread of substance stopped;
3. The Port Control Centre (call sign “Hay Point VTS”), the BMAPM, and the ES will be notified as soon as practicable. VTS will coordinate spill response and notification procedures in conjunction with the Regional Harbour Master;
4. Determine and act upon threats to human health and safety and coastal or marine resources/habitats;
5. The cause and source of a spill to be investigated and identified;
6. Procedures relating to the storage, handling and disposal of hydrocarbons and hazardous substances to be reviewed;
7. Procedures to be updated and staff informed of amendments, if required.

14. Emergency Planning and Response

The DBEMP provides an Emergency Management Plan including objectives, performance criteria, reporting and corrective actions. These include:

1. Immediate notification of all relevant parties;
2. Coordination of responses with relevant authorities;
3. Delivery of incident and corrective action reports; and
4. In the event of an oil or chemical spill, implementation of the existing First-strike Oil Spill Response Plan.

In addition, the Dredging Contractor will ensure that cleanups, tie-down procedures, and measures to prevent damage to any temporary facilities and amenities are implemented in response to cyclone alerts during dredging operations.

14.1.1 Objectives

To ensure that emergency plans are prepared in order to identify potential risks, prevent incidents before they occur and respond to emergencies promptly and effectively, with no harm to people or the environment.

14.1.2 Performance Indicators

1. The health and safety of people and the environment is maintained and not compromised;
2. In the event of an emergency, responses are carried out according to the emergency plans and procedures, in a timely and effective manner;
3. Any incidents including near misses are reported and appropriately responded to.

14.1.3 Management Measures

Emergency planning and response measures will include:

1. All staff will be properly trained in emergency procedures relevant to their positions;
2. All personnel will be made aware of tropical cyclone dangers, response procedures and emergency evacuation plans;
3. All personnel will be made aware of emergency fire and spill plans and procedures;
4. Dredging and spoil disposal operations are to be conducted in compliance with procedures to avoid the occurrence of emergency situations;
5. Weather forecasts will be regularly monitored, with particular attention to synoptic situations, wind speed, gale warnings, wave heights and period, swell heights, and visibility;
6. Staff and crew are to be familiar with cyclone responses and procedures;
7. Emergency equipment (e.g., life saving gear, emergency power, emergency communications) must be visually checked and maintained in working order;
8. Loose equipment on vessel decks is to be kept to a minimum;
9. During the cyclone season, sea-towage equipment is to be readily available, explosives and detonators are to be transported to shore, loose items are to be stowed or secured when not in use, covers vents and hatches are to be ready for immediate installation, oil drums are to be brought ashore, stored below deck or properly secured;
10. Emergency kits will be available and kept in good condition on all vessels.

In the event of an emergency the following corrective actions will include:

1. Appropriate warnings are to be disclosed to all personnel in the event of a cyclone or emergency;
2. The State Emergency Service (SES) and the Bureau of Meteorology's (BOM) alerts and warnings are to be monitored and addressed (e.g. alert stages and actions required in the event of severe weather emergencies);
3. In the event of a cyclone, ships in the pilotage area are to be notified, maintain continuous awareness of advice and forecasts, broadcast warnings / information /

directions via appropriate channels, be prepared to relocate vessels at short notice and comply with the vessel traffic management procedures;
4. If a cyclone alert occurs during dredging operations, cleanups, tie-down procedures and preventative measures are to be implemented to prevent damage to temporary facilities and amenities;
5. Tropical cyclone track and threat maps are to be utilised in conjunction with weather warnings and advice when monitoring cyclone activity;
6. Vessels and personnel are to adhere to warnings and directions in the event of an emergency
7. Battery-operated radios are to be available in the event of mains power disruption;
8. Subsequent to an emergency, all personnel are to ensure their safety, only proceed outside when advised it is safe to do so, inspect equipment and plant when appropriate and report any damages.

In the event of an environmental incident or environmental risk the following actions will include:
1. If at any time during the course of dumping activities, an environmental incident occurs or an environmental risk, other than those detailed in the EMP, is identified, all measures must be taken immediately by BMA to mitigate the risk or impact.
2. BMA must notify GBRMPA of any environmental incident or an environmental risk as soon as practicable after becoming aware of the incident or risk. The notification must include details of the incident or risk, the measures taken to mitigate the risk or impact, the success of those measures in addressing the incident or risk, and any additional measures proposed to be taken.
3. Notifications must be made by telephoning GBRMPA. Written details of the notification must be provided to GBRMPA within 48 hours after the occurrence of an oil spill, or within 24 hours of the time at which other types of environmental incident occur.

14.1.4 Emergency Contacts

The contact procedure for non-medical and medical emergencies is outlined in Figure 41 and Figure 42 respectively. The 24-hour site contacts are described below:

- Sara James (ES), phone: 0488 769 046
- Tony Baker (BMAPM), phone: 0428 697 433.

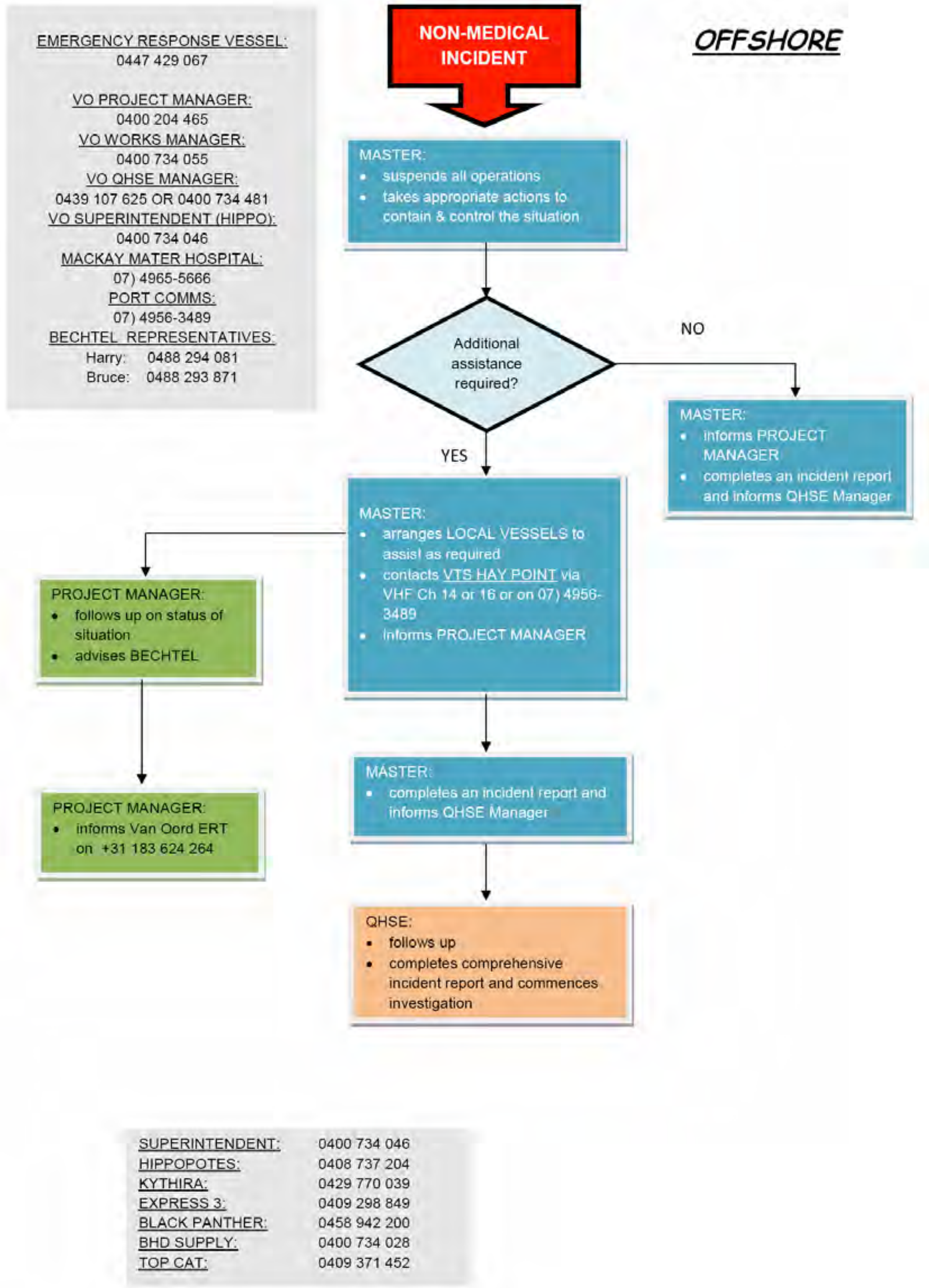


Figure 41 Non-medical emergency contact procedure

BMA

BHP Billiton Mitsubishi Alliance

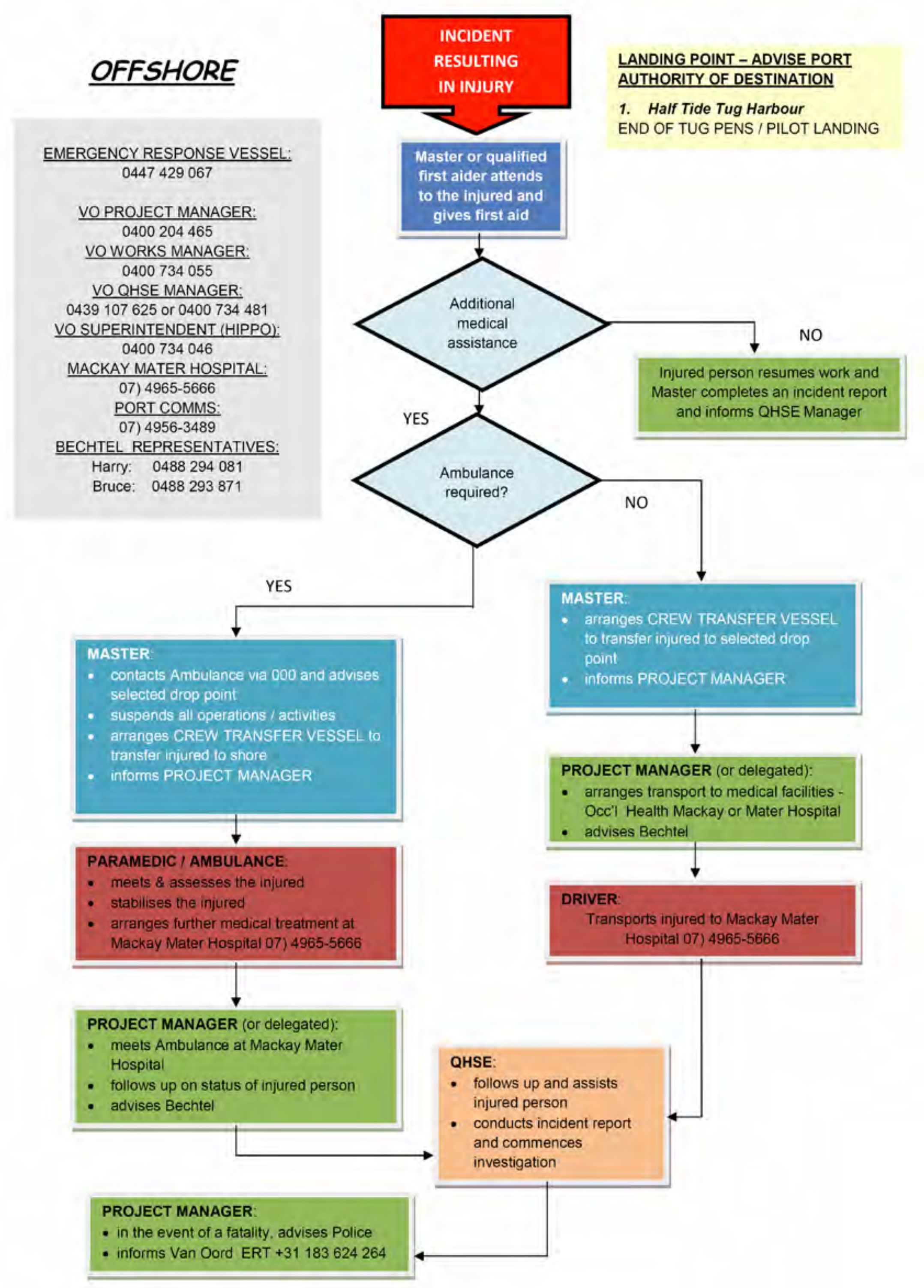


Figure 42 Medical emergency contact procedure

15. Documentation and Reporting

15.1 Data Ownership

All data collected as part of the EMP is to be jointly owned by BMA and the Managing Agencies and may be made available by either party without reference to each other.

15.2 Disposal Logs

The dredging contractor will provide weekly plotting sheets of a certified record of the disposal barges' logs that detail:

1. The times and dates of when each dumping run is commenced and finished;
2. The position, determined by GPS, of the vessel at the beginning and end of each dumping run, with the inclusion of the path of the dumping run; and
3. The volume of dredged material, in cubic metres, dumped for each run.

In addition, the dredging contractor will maintain a log of the running total of the volume of dredged material dumped compared with the total amount authorised under this permit.

BMA will retain these records for a period of at least four years following the completion of disposal activities, and made available for verification and audit purposes upon request.

15.3 Reporting Requirements

Agency reporting requirements under this EMP and the relevant approvals are listed in Table 9.

Table 9 Agency reporting requirements

Element	EMP Section	Approval Condition	Information Reported	Report To	Timing
Operational schedule in relation to material removal	5.1.1	MPP 18 SDP 24	Two-week projection of materials to be encountered during dredging works	GBRMPA	Prior to commencement of works and fortnightly thereafter during dredging operations
Commencement and completion of dumping activities		SDP 26	Notification of commencement and completion of dumping activities	GBRMPA	In writing 48 hours prior to commencement and 24 hours prior to completion
Control of offshore volume; Changes in bathymetry	5.2.2, 5.2.3	SDP 29 MPP 11	Plot of bathymetry of area to be dredged and Dredge Spoil Disposal Ground	GBRMPA ESS MRG	Before commencement of works
Control of offshore volume	5.2.2, 5.2.3	MPP 12	1. Bathymetric surveys of berth pocket and apron 2. Calculated in situ volume dredged 3. Calculated volume disposed onshore and offshore	GBRMPA ESS	At least fortnightly during dredging operations
Visual dredge plumes	6.5.4		Observations of visual turbidity plumes from dredging and disposal	ESS	Fortnightly during dredging operations
Summary information for annual report to International Maritime Organization	5.2.2	SDP 33	Completed form at Appendix 2 of Sea Dumping Permit No. 10/2	DoE, GBRMPA	By January 31 2011 (for offshore disposal conducted in 2010); By January 31 2012 (if any offshore disposal is conducted in 2011)

Final bathymetry	5.2.3	SDP 30	Digital plots of bathymetry pre-dredging and post-disposal of area to be dredged and disposal ground	Royal Australian Navy Hydrographer	Within two months of post-disposal bathymetric survey (which is to be undertaken within two months of completion of all dumping activities)
Material >400 mm on disposal ground after disposal	5.2.4	SDP 29	Pre- and post-disposal surveys of physical characteristics of seabed	GBRMPA	Within two months of post-disposal seabed characteristics survey (to be completed within two months of completion of all dumping activities
Final report on dredged material disposal	5.2.3, 5.2.4	SDP 31	1. Plot(s) (chart(s)) of change in bathymetry at the disposal ground 2. Plots (chart(s)) of change in bathymetry at the area dredged 3. Calculated *in situ* volume of dredge spoil dumped 4 Calculated volume of material that appears to be retained on the spoil ground, with written commentary 5. Identification of need to reprocess or remove material >400 mm 6. If reprocessing is required, a program of works detailing how and when it will occur	GBRMPA	Within two months of post-disposal bathymetric and seabed characteristics surveys (which is to be undertaken within two months of completion of all dumping activities)
Need for reprocessing		SDP 32	Requirements for reprocessing and program of works	GBRMPA	Within two months of post-disposal bathymetric and seabed surveys (which is to be undertaken within two months of completion of all dumping activities)

Material >400 mm on disposal ground after reprocessing (if required)	5.2.6		1. Post-reprocessing surveys of physical characteristics of seabed 2. Final clearance plan if required	GBRMPA	Within two months of completion of reprocessing (which is to be undertaken within 36 months of completion of all disposal activities)
Final clearance	5.2.6		1. MBES imagery of areas requiring final reprocessing after completion 2. GPS tracks of reprocessing vessel		Within 30 days of completion of final clearance
Water quality during dredging activities - no Management Response Trigger	6.5.3		1. Vessel-based monitoring results 2. Logger results from coral reef sites 3. Satellite imagery with ground-truthing for TSS and turbidity when available	GBRMPA ESS MRG	Fortnightly during dredging operations
Water quality during reprocessing/removal activities - no Management Response Trigger	6.5.3		1. Vessel-based monitoring results	GBRMPA	Within one week of completion of the initial seven days of monitoring active reprocessing/removal operations
Water quality – if Management Response Trigger occurs	6.5.4		Notification of Management Response Trigger event	ESS	Within 24 hours of receipt of data
Water quality – if Management Response Trigger occurs	6.5.4		Report on data reliability and potential causes of trigger event	ESS	Within 72 hours of detection of trigger event

Seagrass – broad scale mapping	7.5.1		Survey and mapping results	GBRMPA DEHP DAFF	Within three months of completion of mapping surveys to be undertaken as follows: 1. September/October of year of completion of disposal activities (Year 1) 2. September/October two years after disposal (Year 3) 3. September/October four years after disposal (Year 5)
Seagrass and macroinvertebrates – Detailed Impact and Recovery Monitoring	7.5.2		Results of quarterly monitoring of long-term monitoring sites	GBRMPA DEHP DAFF	Annually by 28 February from year of completion of disposal activities (Year 1) to five years thereafter (Year 5)
Seagrass research	7.5.3, 7.5.4		Results of recruitment, seasonal senescence, and minimum light requirements research	GBRMPA DEHP DAFF BMA	1. Detailed research program: 31 December 2010 2. Progress report: 31 January 2012 3. Final report: 31 January 2013
Seagrass monitoring and research summary	7	EPBC 3g	Summary of annual monitoring and research activities	GBRMPA DoE DEHP DAFF	Annually as part of ecological monitoring summary report by 28 February from year of completion of disposal activities (Year 1) to five years thereafter (Year 5)

Infauna communities	8	EPBC 3g	Summary of annual infauna monitoring results	GBRMPA DoE DEHP DAFF	Annually as part of ecological monitoring summary report by 28 February from ear of completion of disposal activities (Year 1) to five years thereafter (Year 5)
IMS – vessels	9.5		1. IMS Vessel Risk Assessments 2. IMS Vessel Inspection Reports as required	GBRMPA	Prior to entry of vessels and submersible equipment into GBRMP
IMS – disposal ground – no IMS of concern detected	9.6	EPBC 3g	Results of targeted IMS surveys	GBRMPA DEHWA DAFF	Annually as part of ecological monitoring summary report by 28 February from year of completion of disposal activities (Year 1) to five years thereafter (Year 5)
IMS – disposal ground –IMS concern detected	9.6		Results of targeted IMS surveys with written commentary on detections	GBRMPA DAFF	Within 24 ho urs of detection
Coral reefs	10		Results of coral reef monitoring	GBRMPA	Within three months of completion of final surveys to be undertaken as follows: 1. prior to the commencement of dredging operations 2. within two months of the completion of dredging operations

Protected species – sightings	11.6		Reports of sighting of cetaceans, dugongs, or turtles within the 300 m monitoring zone around dredge vessels	ES ESS	Fortnightly Fortnightly
Protected species – injury or death	11.5	SDP 40	Any observations of injured or dead cetacean, dugong, or turtle	1300 ANIMAL hotline (1300 264 625) QPWS, DAFF, DEHP, DoE, GBRMPA,	Immediately (verbal) Within 24 hr (verbal) Within five working days (written)
Protected Species		EPBC 11	Report if scale of impact to any EPBC listed species changes	Minister for EPBC Act	Within 10 business days of becoming aware of the new information
Oil spills	13.1.3		Report of incident	GBRMPA Marine Incident Response pager (07 3830 4919 Quote: “Oil spill” Port Control Centre (call sign “Hay Point VTS” BMPAPM, ES Report to DoE	As soon as practicable As soon as practicable

Environmental incident (including oil spills)	14.1.3	SDP 34, 35, 36	Notification of incident (may be by telephone) including: 1. Details of incident or risk 2. Mitigation measures taken 3. Success of those measures 4. Any additional proposed measures	GBRMPA DoE	As soon as practicable
			Written Incident Report including: 1. Details of incident or risk 2. Mitigation measures taken 3. Success of those measures 4. Any additional proposed measures	GBRMPA DoE	Within 48 hours of the incident (oil spills) Within 24 h ours of the incident (other incidents)
Independent Audit		SDP 41, 42, 43	Report of independent audit of compliance with approval conditions of SD Permit	GBRMPA	Within two months of commencement Following completion
		EPBC 9	Report of independent audit of conditions of EPBC approval	DoE	Within three years of commencement

16. Training

16.1.1 Objectives

To ensure that all staff are adequately trained prior to undertaking any activities associated with the Hay Point Coal Terminal Expansion Project operations.

16.1.2 Performance Indicators

1. All personnel hold up-to-date training certifications and have been inducted into site procedures and management plans and procedures;
2. All operational staff have been trained in environmental awareness and the requirements of this EMP and all related policies, plans, procedures and permits;
3. All personnel are appropriately trained to carry out their duties; and
4. All personnel carry out their duties correctly and effectively.

16.1.3 Training

1. All personnel will be required to attend a site-specific induction that includes training in relevant environmental management plans and procedures;
2. All personnel will be briefed on the specific requirements of this EMP and related management plans and procedures in relation to their assigned tasks;
3. All personnel performing the tasks described in this EMP will be appropriately experience, qualified, and appropriate to the task;
4. Personnel will receive specific training in the scientific and technical aspects of their assigned tasks as needed;
5. Relevant staff and crew will be trained in procedures for handling and storing fuel, other hydrocarbons, and other hazardous materials; and
6. Certified copies of all permits and copies of the most current approved EMPs will be available on site and on all vessels.

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