BMYS - Safe Harbour Project

Appendix F

Marine Ecology and Fossil Assessment

BMYS Safe Harbour Project

Marine Ecology & Fossil Bed Assessment

for

Beaumaris Motor Yacht Squadron (BMYS)

March 2009

Rev 0

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Executive Summary

The Beaumaris Motor Yacht Squadron (BMYS) proposes to construct a safe harbour for the launching, retrieval and storage of boats. The key features of the proposed redevelopment which will affect the marine environment is construction of two rock breakwaters and seabed reclamation in the area in front of the existing BMYS facilities.

Marine and coastal habitats and communities were investigated in January 2009. The survey included the nearshore environment adjacent to the existing facilities between the main boat ramp to the east and the remnants of Keefers jetty to the west and sites further offshore, to approximately 200 metres seaward of the main jetty. Inspections were also made to establish the presence of any species of conservation significance or introduced marine pests.

The field based assessment included a survey of rock revetments, piled structures, subtidal rocky reef and soft seabed habitat including seagrass. The nodule beds containing marine fossils of Miocene age exposed on the nearshore seabed were also investigated. The main habitat offshore from the existing BMYS facilities is sandy seabed with patchy seagrass and extensive areas of reef to the west and east of the site. The species noted were fairly typical of similar habitats elsewhere in northern Port Phillip Bay and predominantly the same species found in similar and habitat in the nearby Ricketts Point Marine Sanctuary.

No unique or threatened marine species or communities, as defined or listed under the *Victorian Flora and Fauna Guarantee Act* 1988 or the *Commonwealth Environment Protection and Biodiversity Conservation Act* 1999 were found during the investigation.

The only introduced species noted was the European Fan Worm, *Sabella spallanzanii.* A species of green alga *Codium fragile* which may be the introduced sub-species *tomentosoides* is also present in the shallow subtidal environment.

The nodule bed at the base of the cliffs is an area of particular geological significance and forms part of the Beaumaris Bay Fossil Site. From the survey, the subtidal area of the nodule bed along the shoreline is estimated to be between 0.1 to 0.2 ha in area and represents the remnants of the larger bed that was reclaimed by BMYS more than thirty years ago.

The proposed redevelopment will have the greatest impact on the the nearshore environment adjacent to the existing rock revetment. This is already a highly modified environment consisting of mobile sands of little obvious ecological value. Much of the area east of the existing jetty is subject to ongoing maintenance dredging every three to four years.

Reclamation and breakwater construction will result in loss of soft bed habitat which will be replaced by hard (artificial) reef habitat.

According to the plan for redevelopment, a section of the remaining exposed nodule bed at the western end of the BMYS site lies under the proposed construction footprint. However it is planned to avoid burial of the nodule bed by constructing a sheet pile wall (instead of a traditional rock wall) to connect the foreshore with the remainder of the breakwater and that the area in front of the new clubhouse will be constructed as a piled deck (instead of landfill) over the identified fossil nodule bed.

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1. Introduction

The Beaumaris Motor Yacht Squadron (BMYS) is located on the shores of Beaumaris Bay (**Figure 1**) within Port Phillip Bay east of Table Rock Point.

The BMYS is proposing to redevelop the existing club facilities to improve amenities and provide a safe harbour for the launching and retrieval and storage of boats. The key features of the proposed redevelopment which involve direct interaction with the marine environment are:

- the construction of a safe boat harbour
- construction of a surrounding rock wall breakwater
- seabed reclamation in the area in front of the existing BMYS facilities.

Figure 1 – Beaumaris Motor Yacht Squadron and Surrounds: Source Google Earth

1.1. Study Objectives

The Department of Sustainability and Environment (DSE) (letter Ref: 1204182, PLEPS 1154) requested that BMYS provide additional information about the proposed redevelopment so that an assessment of environmental, social cultural and economic costs and benefits of the proposal would be properly considered and assessed to ensure a sustainable outcome. This report considers the following information:

- Clarification of the significance of the Beaumaris Fossil Beds based on current information and any recommendations regarding future management and protection of the fossil beds
- A preliminary assessment of the local and nearby marine and foreshore environment to determine

the presence of any significant features or species that may be impacted upon by the proposal, including information on the possible options for avoidance/management of potential impacts.

1.2. Scope of Work

To address the requirements of DSE, Marine Science and Ecology Pty Ltd (MSE) was commissioned by BMYS to undertake a:

- a review of existing knowledge of the area and documentation of existing information relating to marine habitats, ecological values and threats to the marine ecosystem of Beaumaris Bay in the vicinity of the proposed development;
- a review of all existing information concerning the site as well as consultation with experts from Museum Victoria to ascertain the present significance of the fossil beds;
- a field inspection of the marine habitats within the vicinity of the proposed concept plan and immediate surrounds and documentation of the marine ecosystem values present in the study area including:
    - Provision of a habitat map
    - A list of dominant marine species including any exotic species
    - Identification of species and/or communities of conservation significance.
- an assessment of impacts relating to proposed reclamation and wave protection works, including:
    - A preliminary assessment of the impact of the proposal on significant environmental features (but not limited to) the Beaumaris Fossil Beds, the Ricketts Point Marine Sanctuary and the Beaumaris Bay aquaculture zone; and
    - Recommendations for management and mitigation measures to reduce or avoid any potential impacts.

2. Methods

Habitats and communities were investigated by marine scientists on the 25th January 2009.

The survey focused on the nearshore environment adjacent to the existing facilities between the main boat ramp to the east and the remnants of Keefers jetty to the west. Sites further offshore, to approximately 200 metres seaward of the main jetty were also surveyed.

Weather during the survey period was fine with a very light wind from the north. Visibility in the water was good but limited to 3-4 metres probably due to the strong winds experienced during the days before the survey.

Habitats were surveyed by a series of spot inspections and more detailed dive transects as shown in **Figure 2**. In total, 21 spot inspections were undertaken and 7 detailed underwater transects were completed as shown in the figure below.

- **Figure 2 –** Sites Inspected (dots) and Diver Transects (red line), January 2009

At each sampling point, GPS coordinates were recorded using a Garmin Map 76 GPS unit. Descriptions of seabed habitat and condition were documented at each of the sites and were then transferred onto a geo-referenced aerial image from which a habitat map was constructed.

3. Marine Environment

The following habitats were identified during the field based assessment:

- Rock Revetment
- Piled Structures
- Seagrass
- Subtidal Rocky Reef
- Soft Sediments

3.1. Rock Revetment

The entire length (~240 m) of the revetment bordering the hard standing BMYS property was examined from low water mark to the seabed. The depth of water along the foot of the revetment is approximately 1.5 m. The revetment consists of dumped basalt boulders mixed with loose bricks and building rubble (**Figure 3**). There are two double lane boat ramps on the revetment – one about halfway along, the other at the eastern end of the BMYS facilities.

Rock and Bricks at Base of Revetment

The green alga, *Caulerpa fragilie*

Figure 3 – Inshore Habitat, BMYS Jetty, January 2009

The revetment provides habitat for an algal and invertebrate community and small fish. Visually dominant species were a brown alga *Cystophora* sp., the green algae *Ulva lactuca* and *Codium ?fragile*. Invertebrates include sea urchins *Heliocidaris erythrogramma* the seastars *Mediastria calcar,* and *Coscinasterias muricata*. Larger gastropod species observed amongst the rocks were the abalone, *Haliotis rubra* and the turbo shell, *Turbo undulatus*. The calcareous tube worm *Galeolaria caespitosa* was abundant on rocky outcrops. Fish included numerous sweep, *Scorpis aequipinnus*, toadies, *Tetractenos glaber* and shoals of unidentified fry.

Less conspicuous species that were present amongst the rocks were small gastropods, limpets and mussels.

All species noted are common inhabitants of shallow water natural and artificial reef in the bay.

3.2. Piled Structures

A public jetty ~75 m long was reconstructed to its current form by BMYS in 1978, for use of pedestrians, fishers and boat embarkation. The jetty foots the revetment and the decking is supported by square section concrete piles.

The pilings below mid tide level support a prolific algal and invertebrate community. The assemblage includes a suite of species similar to those present on other shallow water jetties in Port Phillip Bay. The visually dominant species are briefly described below, a fuller description given in **Appendix A** and underwater images photographed during the survey are provided on a CD accompanying this report. The visually dominant species listed in the appendices and briefly described below represent only a fraction of the biotic population inhabiting the piles.

Visually dominant algae include the common brown kelp *Ecklonia radiata,* several green algal species e.g. *Ulva* sp. and *Caulerpa brownii* and unidentified small red turfing algal species.

Tube worm, *Galeolaria caespitosa*

Orange bryozoan, *Celleporaria* sp.

Abalone, *Haliotis rubra.*

Brown macroalga, *Ecklonia radiata*

- **Figure 4 –** Common Pile Flora and Fauna, BMYS Jetty, January 2009

Invertebrates include the encrusting tube worm *Galeolaria caespitosa*, at least seven species of crustose and

erect sponges (including *Tethya* sp.) encrusting bryozoans red *Mucropetraliella elleri* and orange *Celleporaria* sp. Hydroids included a cosmopolitan species, *Obelia dichotoma* and the endemic *Sertularia tenuis*; ascidians included *Pyura stolonifera* a species ubiquitous around the bay; molluscs included the commercially important blacklip abalone *Haliotis rubra*. A few individuals of the introduced tube worm *Sabella spallanzanii* were noted on the main jetty and on the timber piles at the small boat ramp; this species is widespread throughout the bay. Representative species are shown above in **Figure 4**.

Fish noted included juvenile sweep, *Scorpis aequipinnus*, and toadies *Tetractenos glaber*. Both are common shallow water bay species.

3.3. Offshore Reef

A line of reef passes almost parallel to the coast at approximately 70 m from shore at the east end of the BMYS area. It is much closer to shore at the western end of the site. The reef (depth 1.5 m at time of dive) is the surface expression of the Beaumaris monocline rising to near water level east and west of the BMYS property. The reef comprises hard ferruginous sandstone dissected into ledges about 0.5 m high with deep undercuts (**Figure 5**). Loose platy boulders eroded from the reef lie in hollows between the ledges.

Reef, ferruginous rock dissected into ledges

Reef with abundant macroalgal cover

Stony coral, ***Plesiastrea versipora***

Sponge, ***Tethya*** sp. and urchin ***Heliocidaris erythrogramma***

■ **Figure 5 –** Common Inshore Reef Species, west of BMYS, January 2009

The most extensive section of reef surveyed was at Site 5. The reef here supports an abundant flora of brown algae, including visually dominant tall plants of *Caulocystis uvifera*, *Cystophora* sp. and *Cystophora moniliformis*, the latter often heavily colonized by small brown species of epiphytic algae. Other, smaller brown algae include *Dictyopteris* sp., small curled *Padina* sp. and bluish *Dictyota* sp. Other species included abundant unidentified filamentous reds, these being the source of much of the offshore drifted material. Plants of the red alga *Heterosiphonia muelleri* were noted: Port Phillip Bay is the type locality for this species.

A full species list of algae was not prepared. Interestingly, the algal cover on the reef near Site 5 diminishes with proximity to shore until the seabed consists of silt covered boulders with very sparse and isolated patches of macroalgae.

The invertebrate fauna of the reef is rich and diverse, and is similar in species composition to that in similar habitats in the bay. The fauna living under the platy boulders is particularly rich, the dominants including the sponge *Tethya* sp. and several other unidentified species of sponge, the chiton *Ischnochiton variegatus*, juvenile abalone *Haliotis rubra*, the anemone *Anthothoe albocincta*, the sponge crab *Stimdromia lateralis* and juvenile echinoids *Heliocidaris erythrogramma*. Fish sheltering under and near the overhangs included the hulafish *Trachinops caudimaculatus*, the weed whiting *Neoodax balteatus*, the dragonet of the family Callionymidae and pygmy leatherjackets *Brachaluteres jacksoninaus.*

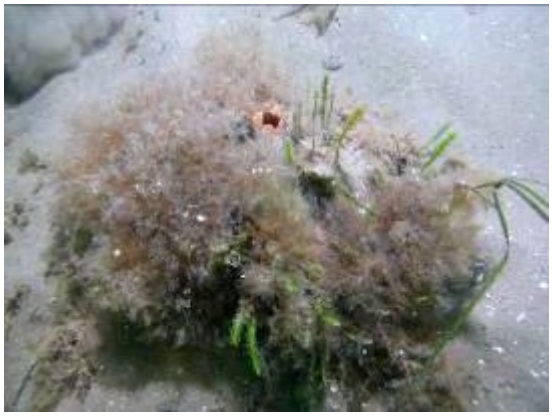
The shallow reef has a particularly rich biota in comparison with assemblages seen along the eastern coast of the bay. The high diversity and abundance is probably due to natural factors of shelter from northerly weather and, being at the base of steep cliffs, being comparatively inaccessible to the public.

3.4. Soft Sediments

The inshore environment between Sites 13 and 15 consists of fine to medium mobile sand. No epibenthic species were noted at the sites inspected. Infauna is also likely to be depauperate due to the mobile nature of the sand.

The offshore environment (at Sites 2 and 3) consists of open sandy bed comprising uniformly medium-grained sands with occasional patches of small scale ripples indicating mild wave motion. The sandy substrate is very clean with no organic inclusions when inspected to a depth of 5 cm.

Echiurid worm, *Ikeda* sp.



Ascidian, *Pyura stolonifera* covered in algae

Anemone, *Epiactis* sp.

Seastar Coscinasterias muricata.

Figure 6 Common Benthic Species, Beaumaris Bay, January 2009

The bed is mildly bioturbated by infaunal activity and supports a sparse cover of epibenthic species. Common species include the stalked ascidian, *Sycozoa pedunculata*, the echiurid worm, *Ikeda* sp. and the large tubiculous predatory polychaete *Diopatra aciculata*. The seagrass *Heterozostera nigricaulis* was also present at both sites, although cover was sparse and very patchy.

The very sparse distribution of the invertebrate epifauna is due to general absence of rock or shell fragments for attachment. The few epibenthic species were the large solitary ascidian, *Pyura stolonifera*, a sand-dwelling anemone *Epiactis* sp., the large eleven arm seastar *Coscinasterias muricata* and the worm *Myxicola infundibulum*. Representative species are shown in **Figure 6**.

The infauna was not sampled in this preliminary survey. Brief examination of the bed sediments indicated however that infaunal species and abundance would be similar to that in shallow sandy habitat elsewhere along the eastern coast of the bay.

3.5. Nodule Bed

The first part of the nodule bed extends intertidally along the short length of shoreline remaining between the site of the former Keefers boat shed and the western edge of the revetment. The bed at this location is

littered with debris including timber, bricks and pipes from the demolished boat shed. The bed in this location extends approximately 10 m seawards to about 1 m depth before passing into sandy bottom. It also extends approximately 15 – 20 m eastwards past the jetty and for a short distance seawards along the revetment. The total underwater exposure of the nodule bed is estimated as approximately 1,000 m^2.

The bed is covered by a thin veneer of silt but is easily traceable from the distinctively shaped nodules (**Figure 7**). The bed is also distinctive from the paucity of marine growth on the nodules, this probably being due to the small size and tendency of the nodules to tumble with water movement. Small pockets of seagrass also occur amongst the rubble but these are limited in extent due to the absence of suitable sandy bed.

- **Figure 7 –** Nodules collected from seabed west of jetty

3.6. Seagrass

Patches of the seagrass *Heterozostera nigricaulis* are widespread across the area, the patches being separated by expanses of clean slightly ripple-marked sand (**Figure 8**). Seagrass plants are sparsely distributed in the patches and are young with leaves only to 8 cm long. The rhizomes buried in the sand are healthy and actively growing at the time of the survey. Patches of medium to dense seagrass were seen from Sites 6 through to Site 9, although the seagrass leaves were relatively short. No seagrass detritus was found, indicating colonisation of the bed may be only seasonal, the plants regressing under unfavourable conditions. To investigate the depth distribution of seagrass, two additional sites were sampled further offshore. Site 20 at approximately 5.6 m depth had a medium cover of seagrass, whereas Site 21 in 6.5 m depth water was devoid of seagrass.

Seagrass *Heterozostera nigricaulis*

Rippled, sandy seabed

Figure 8 Benthic Habitat, Beaumaris Bay, January 2009

Heterozostera nigricaulis is a locally abundant subtidal seagrass in Port Phillip Bay, growing in shallow coastal habitat under favourable conditions of incident light and shelter from wave motion.

The seagrass leaves are lightly epiphytised by small species of filamentous red algae and newly settled colonies of the common seasonal bivalve *Electroma georgiana*.

3.7. Algae

Windrow drifts of a filamentous alga were present on some barren patches and among the seagrasses. The species of alga was not determined. Such drifts are common throughout Port Phillip Bay over summer months. The alga was abundant on adjacent shallow inshore reef and when detached, drifts seawards along the bottom.

Other algae included small plants of the green alga *Codium fragile* growing on old shell in the bed. The alga is provisionally identified as *C. fragile*. It is possible however that some plants may be the introduced *Codium fragile* ssp. *tomentosoides* from which it can be separated only by detailed taxonomic examination.

3.8. Fish

Most of the fish species observed were over the sections of inshore reef. These included the southern hulafish, *Trachinops caudimaculatus*, pygmy leatherjacket, *Brachaluteres jacksonianus*, weed whiting *Neoodax balteatus* and dusky morwong, *Dactylophora nigricans.* Other common species noted along the revetments were juvenile sweep, *Scorpis aequipinnus*, and the toadfish *Tetractenos glaber.*

3.9. Introduced Marine Pests

The only introduced species in the area was the European fan worm, *Sabella spallanzanii* which was present in small numbers on the piled structures at the jetty and the boat ramp (**Figure 9**).

Figure 9 European Fan Worm, *Sabella spallanzanii,* BMYS Boat Ramp, January 2009

3.10. Other Observations

The seabed opposite the main stormwater drain to the west of the BMYS property was also examined. The drain opens onto a section of beach immediately west of the reclaimed area. The beach is in generally poor condition with much litter and debris scattered above high water mark and in the shallows. From the beach, the sand grades into a bed of rubble as described in **Section 3.5.** With increasing distance from the drain, small patches of macroalgae and seagrass occur but are limited in area and cover. A small area of dead seagrass is most likely attributable to a pulse of freshwater from the drain.

4. Fossil Bed Assessment

The coastal cliffs and foreshore extending north-east from the Beaumaris Motor Yacht Squadron (BMYS) is an area of geological and geomorphological significance in Port Phillip Bay (Rosengren 1988, Bird 1993).

4.1. Geology

Research reports on the geology of the Beaumaris coastal cliffs are scattered throughout the scientific literature dating from Hall & Pritchard (1897) to the early 1990s. Some of these studies are briefly summarized in a report to the Museum of Victoria by McDonald (1990).

The Beaumaris cliffs are geologically unique in Port Phillip (Gill 1957). They comprise sands and sandstones ranging in age from the Miocene to Quaternary. An asymmetrical shallow pitching anticline with axis near the site of the former Keefers Boatshed forms coastal cliffs 15 m high. Near the junction of Charman and Beach Roads the anticline dips more steeply seawards at 20-25° as a monocline. The monocline is seen as an ironstone reef an outcrop following the coastline, approximately 75 m offshore.

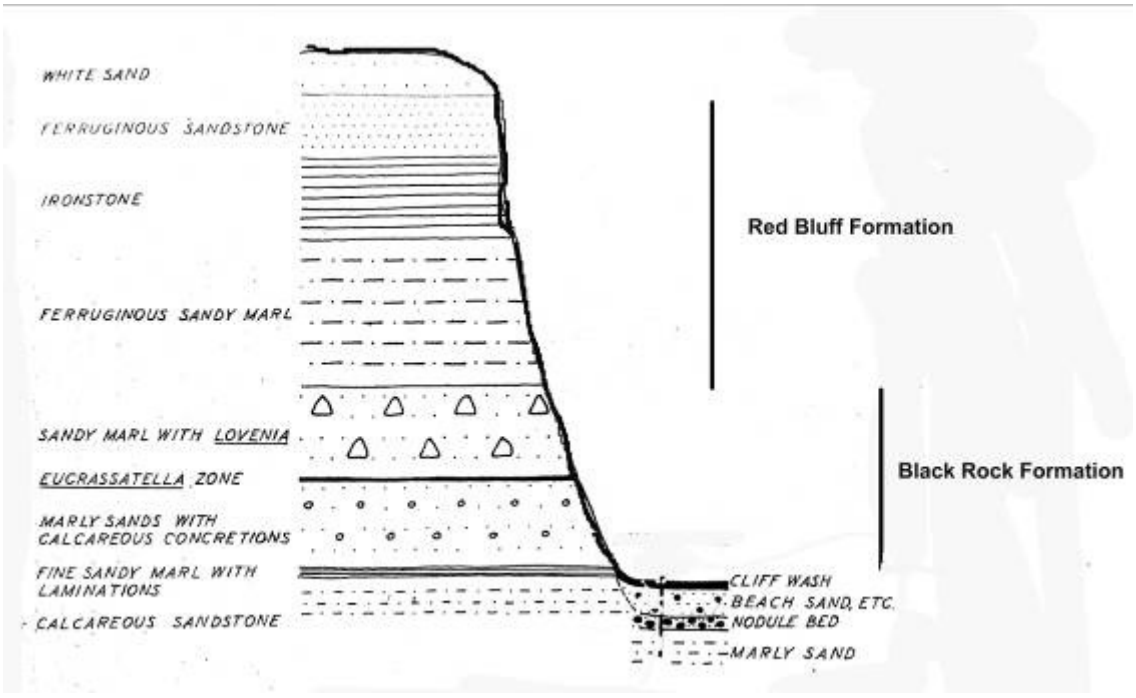


Figure 10 Section of sea cliff at Beaumaris near old Keefers Boatshed showing formations and fossiliferous nodule bed (after Gill 1957)

Overlying the Balcombian clays are rocks of Upper Miocene-Pliocene Cheltenhamian age. These comprise two thick formations – the underlying marine sandstones of the Black Rock Formation and the overlying fluviatile sandstones of the Red Bluff Formation. The type section of the Black Rock Formation is the cliff behind the site of the former Keefers boatshed immediately west of the BMYS fence (Gill 1957). The sandstone contains molluscan fossils and many fossils of the irregular echinoid *Lovenia woodsi.*

A disconformity (period of erosion) separates the top of the Black Rock Formation from the base of the overlying Red Bluff Formation. The Red Bluff Formation consists predominantly of fluviatile to lagoonal consolidated sands containing fossil leaves, wood and other terrestrial material (Gill 1957). The Red Bluff

sandstone is capped at the cliff top by a 2 m thick layer of white aeolian (wind blown) sands of Quaternary age, approximately 5000 years old (Gill 1957). According to Pritchard (1976) the sands also contain fragmentary recent molluscan shells and aboriginal middens.

The basement rock at water level along the cliffs comprises a thin layer of marine clays of Miocene Balcombian age overlain by a fossiliferous nodule bed. The clays contain a rich fossil molluscan fauna and the nodule bed contains reworked ferruginised and phosphatized fossils of shallow water origin (Gill 1957). Fossils in the nodule bed include at least 15 species of sharks' teeth (Kemp 1991) and fish bones many of which are not significantly different from species present in the bay today (Long 1991). The bed also contains fossil whale bones Pritchard (1976), seal bones (Fordyce 1991), some marsupial fossils Gill (1957), and penguin bones (Rich 1991).

4.2. Geomorphology

Marsden (1969) gave a detailed account engineering geology and geomorphology of the Mentone-Beaumaris coastline and made recommendations for control of cliff erosion to the Sandringham City Council. Undercutting of the Beaumaris cliffs and collapsed blocks were then a feature of the coastline, the blocks dissipating wave energy and contributing to slowing of erosion. Slippage and channelling in the soft Red Bluff Sandstone after rain, exacerbated by human activity was occurring along the cliffs. It was recommended fencing and replanting vegetation would help control erosion. Revegetation and fencing of the cliffs has now successfully reversed erosion.

4.3. Fossils

The fossiliferous nodule bed at the base of the cliffs is an area of particular geological significance. With the exception of the irregular echinoid *Lovenia woodsi* which weathers out of the matrix most of the embedded fossils are invisible on the surface of the nodules but can be seen when the nodules are broken..

From the survey, the subtidal area of the nodule bed along the shoreline (from the vicinity of Keefers eastwards along the revetment) is estimated to be between 0.1 to 0.2 ha. No assessment was made of how far the bed may extend seaward below the sand, but it would not extend further than the shallow offshore reef.

Reclamation in 1969 for the BMYS probably covered an area of approximately 1.4 ha of the nodule bed beneath the trailer park thus reducing the original exposure area by approximately ninety percent.

5. Preliminary Assessment of Impacts

The key features of the BMYS redevelopment that have the greatest potential to impact the marine environment are the proposed seabed reclamation and the construction of the rock breakwaters (**Figure 11)** to create a safe harbour.

5.1. Seabed Reclamation

The proposed reclamation will result in the infilling of less than 4,000 m^2 of seabed. The seabed proposed for reclamation lies within the east-west extent of the current BMYS footprint and is directly adjacent to the existing reclaimed area and rock revetment. Reclamation at the BMYS site was last undertaken in 1969.

Most, if not all of the proposed reclamation will result in the permanent loss of sandy seabed. The nearshore environment proposed to be reclaimed also includes a section of the fossiliferous nodule bed. The present bed is only a remnant of its former area, much of the original bed now being buried beneath the BMYS property. To avoid burial of the section of nodule bed that lies at the western end of the proposed redevelopment, the seabed will be covered by a piled deck structure and not infilled or buried. This section is in the vicinity of the proposed public access area labelled on the Concept Plan as a public kiosk.

Overall, the nearshore environment adjacent to the existing rock revetment is highly modified and consists of mobile sands with few ecological values. Much of the area east of the existing jetty is also subject to ongoing maintenance dredging every three to four years.

5.2. Shoreline Revetment

Reclamation will involve modification of the existing shoreline environment and replacement of the rock revetment. The loss of existing revetment will be replaced by an equivalent amount of substrate. However, the resultant habitat will differ from the existing habitat as the revetment will be enclosed within the harbour rather than exposed to the Bay.

5.3. Breakwater Construction

The estimated footprint area of the main breakwater is 0.88 ha and that of the eastern breakwater 0.32 ha giving a total breakwater footprint area of 1.2 ha. This area represents the total loss of existing soft bottom habitat from construction of the rock breakwaters.

The shorter breakwater to the east of the site will be constructed over an area of sand and extend from the main boat ramp to the east of the site to ~40 m seaward of the central boat ramp. This area of soft bed which will be permanently lost supports a community of infaunal species but no epibenthic species. Infaunal organisms are an important food resource for fish including flounder, whiting, flathead and snapper. However since much of the of the breakwater footprint will lie in shallow water usually entered only by flounder, direct loss of foraging grounds for these species is probably not significant.

The main breakwater to the west of the site will extend in a south easterly direction from the western edge of the existing BMYS site for a distance of ~150 m and enclose a total area of ~2.74 ha. The main breakwater will intersect an area of inshore reef (including a section of the nodule bed) close inshore; however most of the habitat affected by burial will be soft seabed. Some of this area also contains a sparse cover of patchy

seagrass.

To prevent burial of the nodule bed, construction of a sheet pile wall is proposed over a 20 m section of seabed. The sheet pile wall will connect the shoreline with the breakwater and will ensure that the nodule bed is not buried under the breakwater. The sheet pile wall thickness is only 12.7 mm; hence any impact on the seabed will be negligible.

It is understood that the breakwaters will be constructed from rough quarried basalt. This will provide new artificial reef for colonisation by local species including shallow water algae, invertebrates and fish. Reef communities are slower to recolonise and proceed to maturity than those of the soft bed. Colonisation will commence with formation of bacterial and micro-algal biofilms. Within months, the biofilm will induce settlement of pioneer invertebrates and algae following which the community will then progress to maturity over several years. At this later stage reef-dwelling fish are likely to take up residence, sheltering in crevices between boulders and foraging on invertebrates and algae. As there will be greater wave energy and thus better water turnover on the seaward side of the breakwaters the outer revetment will offer a more attractive habitat and will probably be colonised by a greater range of species of organisms than the inner walls. The inner revetments will be colonised by species favouring quieter water conditions.

Additional habitat will be provided by pilings and floating jetties and walkways within the harbour.

5.4. Dredging and Maintenance Dredging

No dredging is proposed for inside the harbour; however some minor dredging in the order of 3000 m^3 may be required in the proximity of the new ramp. This would be a one-off for the proposed redevelopment as the harbour is being designed for motor boats, not keeled boats which usually require deeper access. Maintenance dredging inside the harbour is unlikely to be required.

At this stage it is not envisaged that maintenance dredging will be required outside the entrance to the proposed harbour. It is estimated that approximately 1,000 m^3 of sand is transported annually west to east along the Beaumaris shoreline and will gradually accrete west of the western breakwater to form a beach. There is an existing pocket of beach in this current location which will gradually increase in size as the sand starts to accumulate against the rockwall. It is estimated to take decades before the sand starts to move around the breakwater (Atkins, G. *pers comm*.).

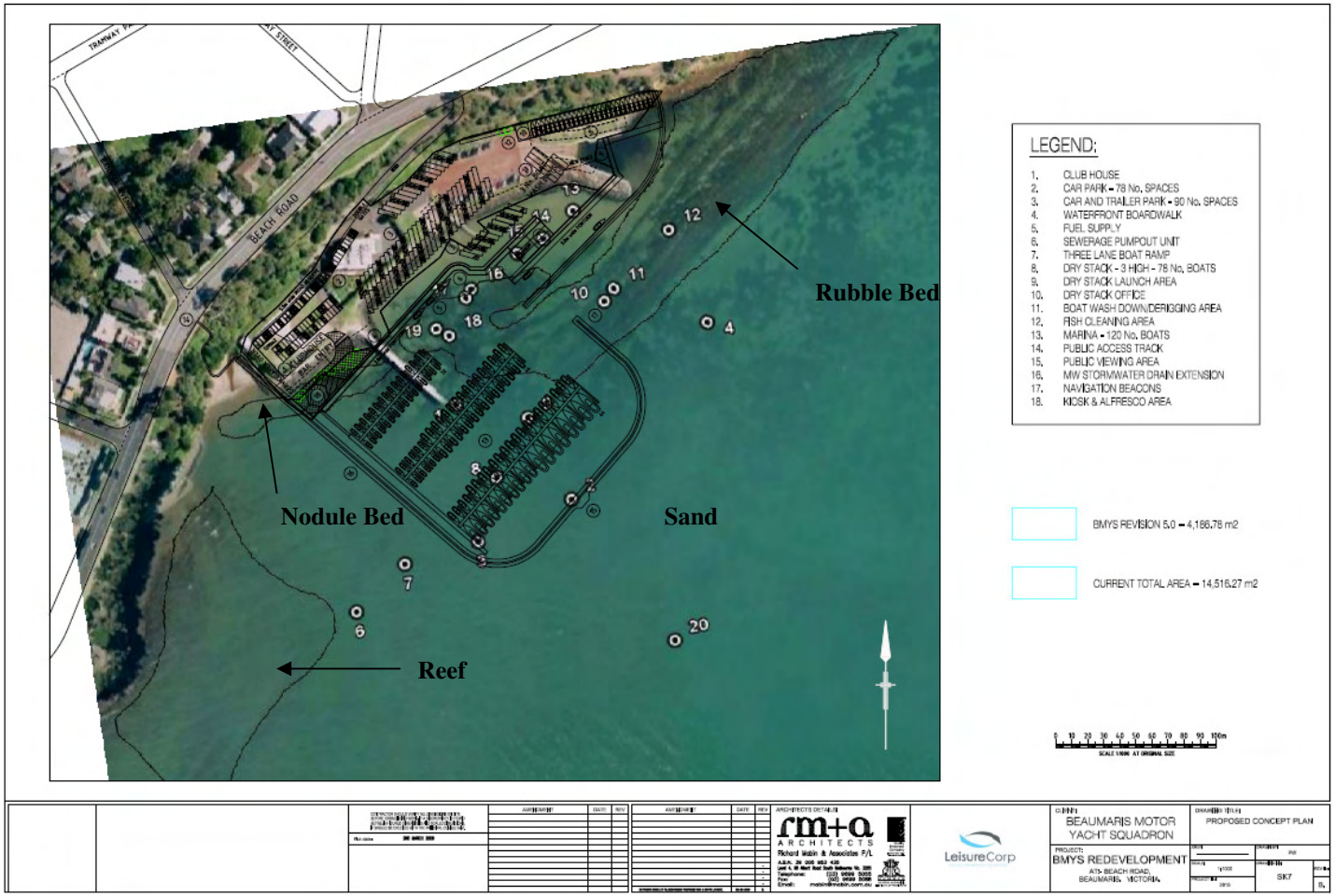


Figure 11 BMYS Proposed Redevelopment with Overlay of Habitats

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6. Key Considerations

6.1. Fossil Beds

The nodule bed is of international geological significance and forms part of the Beaumaris Bay Fossil Site as defined by ES01 within the Bayside Planning Scheme (see **Figure 12**). It is also on the Register of the National Estate, the area defined equivalent to that shown in the Planning Scheme which extends 250 m seaward of the foreshore. The coastal cliffs and foreshore northeast from the BMYS are also listed as sites of geological and geomorphological significance (Rosengren 1988).

The present bed is only a remnant of its former area, much of the original bed now being buried beneath the BMYS property. According to the plan for redevelopment, a section of nodule bed at the western end of the BMYS site lies within the proposed construction footprint; however burial of the nodule bed will be avoided by constructing:

- a sheet pile wall to connect the foreshore and the rock breakwater, and
- a piled deck area for access by pedestrians.

Figure 12 Environmental Significance Overlay, from Bayside Planning Scheme

These design features will ensure that the proposed reclamation and construction of breakwater does not result in burial of the exposed section of nodule bed.

6.2. Ricketts Point Marine Sanctuary

The Ricketts Point Marine Sanctuary covers an area of 115 hectares extends eastward from Quiet Corner to Table Rock Point for about 500 m offshore. The eastern boundary of the Sanctuary is approximately 600 m

south west of the BMYS (**Figure 13**).

The Sanctuary contains a diversity of habitats which are similar to those further east in Beaumaris Bay. There is an extensive intertidal and subtidal sandstone reef incorporating variety of microhabitats. Of the total 115 ha of the Marine Sanctuary, 90 ha has been classified as reef, 10 ha as sediment, <1 ha is seagrass and 15 ha is described as undefined habitat (Parks Victoria 2005).

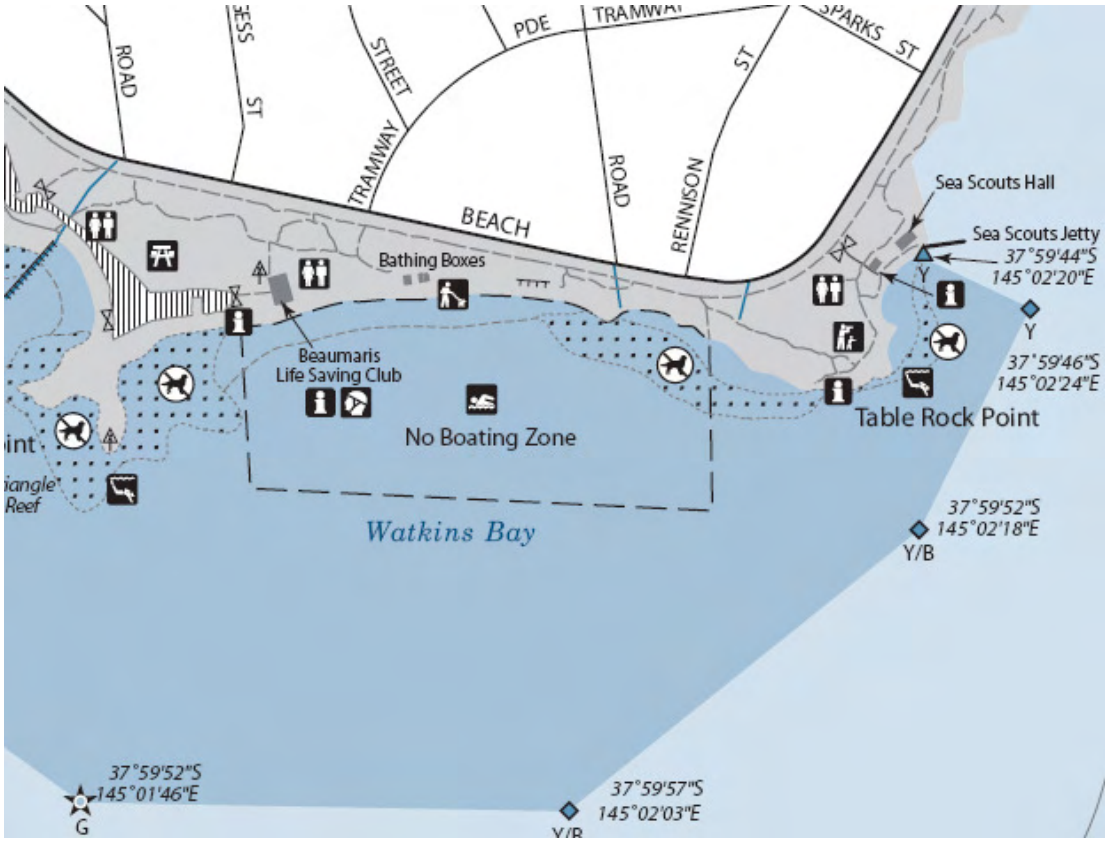

Figure 13 Eastern Section of Ricketts Point Marine Sanctuary

Construction and operation of the proposed redevelopment is unlikely to impact on the marine sanctuary. The greatest scope for impact is from possible indirect effects on coastal processes (and movement of sand) caused by the presence of the breakwater.

Assessment of coastal processes to date, indicate that net sediment movement is from west to east. The proposed redevelopment at BMYS is therefore unlikely to have an impact on the Sanctuary.

6.3. Beaumaris Aquaculture Fisheries Reserve (BAFR)

The BAFR is 25 ha (approximately 0.5 km by 0.5 km) in total area, which comprises the former Beaumaris aquaculture harvesting area (see **Figure 13**) approximately 0.4 km offshore and an extension of 19 ha approximately 0.6 km offshore (Fisheries Victoria 2005).

Mussel aquaculture has been undertaken in the existing 3 ha lease since the 1980s, however the current production status of the lease is unknown. The BAFR in Beaumaris Bay is subject to daily tidal flushing

that generates considerable mixing and exchange of water, however its proximity to the coast (and stormwater outlets) makes it vulnerable to contamination during periods of rain.

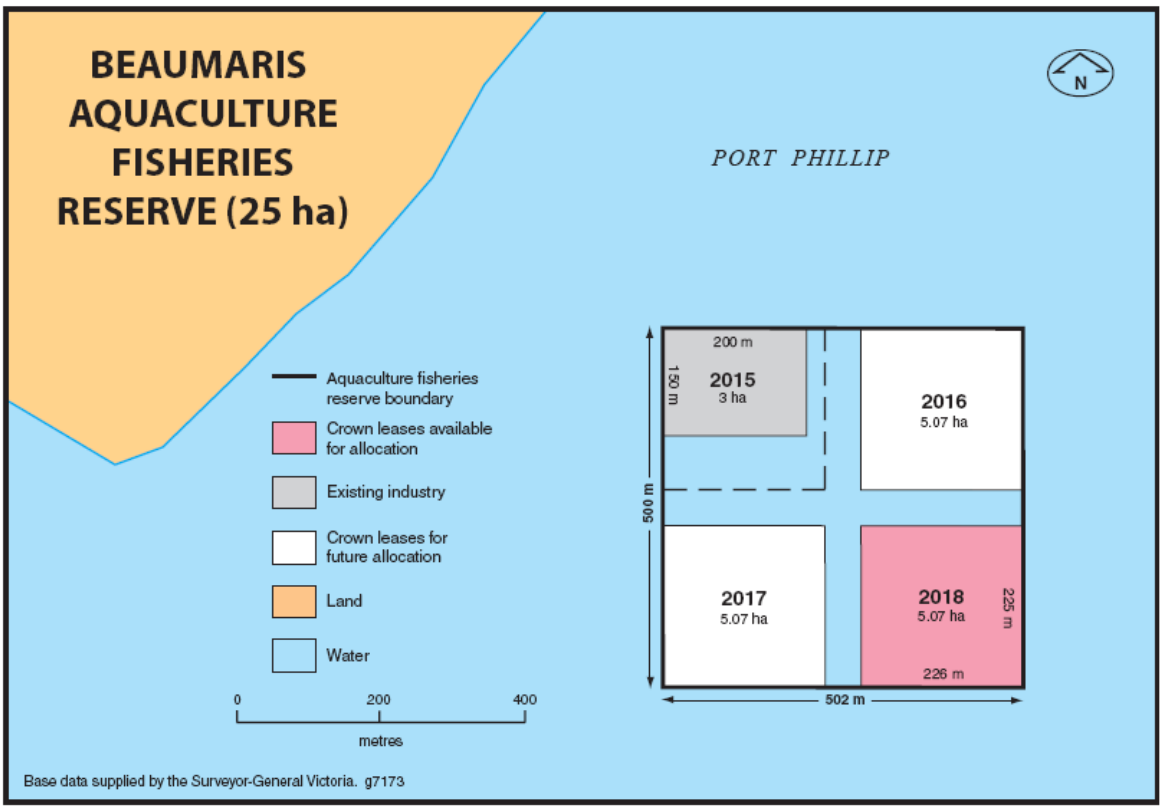

Figure 14 The BAFR showing existing lease and proposed areas for future allocation

The BAFR is located in close proximity to the Beaumaris Motor Yacht Squadron but is unlikely to be impacted by the proposed redevelopment. The greatest risk to BAFR operations will continue to be potential contamination from stormwater discharge.

6.4. Species and Communities of Significance

No unique or threatened marine species or communities, as defined or listed under the *Victorian Flora and Fauna Guarantee Act* 1988 or the *Commonwealth Environment Protection and Biodiversity Conservation Act* 1999 were found during the investigation.

Marine animals listed under the EPBC Act which may conceivably visit northern Port Phillip are the Great White Shark (*Carcharodon carcharius*), and the Humpback Whale (*Megaptera novaeangliae*) both listed as vulnerable. There are no recent records of sightings of these species in the Bayside coastal area.

6.5. Mitigation and Management

Any reclamation proposed should be limited to the eastern end of the site which is subject to ongoing deposition of sand and regular maintenance dredging.

No reclamation should be undertaken at the western end of the site, where the nodule bed is exposed. Use of decking instead of reclamation will avoid burial of the seabed and use of sheet piling over a twenty metre

section of seabed will reduce the footprint from construction of the rock breakwater.

Appendix A List of Common Species

Key: A = abundant, C = common, R = rare

Group	Species	Sandy Bed	Natural Reef	Revetment	Pilings
Seagrass	*Heterozostera nigricaulis*	Patchy Cover	-		-
Brown algae	*Cystophora* sp.	-	A	-	-
	Ecklonia radiata	-	A	C	C
	Caulocystis sp.	-	A	A	-
	Unidentified spp.	-	C	R	-
Green algae	*Codium ? fragile*.	R	C	C	C
	Ulva lactuca	-	C	A	C
	Caulerpa brownii	-	-	-	C
Red algae	Filamentous spp.	A in drift	A	R	-
Red turfing	Several spp.	-	-	-	C
Porifera	*Aplysilla rosea*	-	R	R	C
	Euryspongia sp.	-	-	-	R
	? *Mycale* spp.	-	R	-	C
	Tethya sp.	-	C	R	C
	Other sponge spp	-	C	C	A
Hydrozoa	*Obelia dichotoma*	-	-	-	C
	Sertilaria tenuis	-	R	-	R
Actiniaria	*Epiactis* sp.	R	-	-	-
	Anthothoe albocincta	-	R	R	R
Scleractinia	*Plesiastrea versipora*	-	C	R	C
Echiuridea	*Ikeda* sp.	R	-	-	-
Polychaeta	*Galeolaria caespitosa*	-	-	C	A
	Diopatra aciculata	R	-	-	-
	Sabella spallanzanii	-	-	R	R
Bryozoa	*Celleporaria* sp.	-	R	R	C
	Mucropetraliella elleri	-	-	R	A

Group	Species	Sandy Bed	Natural Reef	Revetment	Pilings
Gastropoda	*Haliotis rubra*	-	R	R	C
Limpets	*Patelloida alticostata*		C	C	A
	Notomacea flamer		C	C	A
Bivalvia	*Electroma georginana*	C (on seagrass)	-	-	-
	Mytilus galloprovincialis	-	-	-	C
Nudibranchia	*Ceratosoma brevicaudatum*	-	-	-	R
Echinodermata	*Coscinaasterias muricata*	R	R	-	R
	Meridiastra calcar	-	-	A	R
	Tosia australis	-	R	R	R
	Tosia magnifica	-	R	-	-
	Patiriella gunni	-	R	R	R
	Heliocidaris erythrogramma	-	A	A	A
Ascidiacia	*Pyura stolonifera*	R	C	C	C
	Botrylloides leachii	-	-	-	R
	Sycozoa pedunculata	C	-	-	-
Fish	*Scorpis aequipinnus*	-	R	C	C
	Tetractenos glaber	-	R	C	C
	Brachaluteres jacksonianus	-	C	-	-

Summary of Dominant Species

Soft Bed Offshore

Pyura stolonifera

A large solitary or colonial ascidian very common throughout the bay, often found attached to fragmental shell in sandy bed. The large leathery individuals provide micro-reef habitat for attachment of small algae and invertebrates.

Epiactis sp.

A moderately common anemone in sheltered sandy bed throughout the bay. Although large and large showy the species has not been scientifically identified to species.

Coscinasterias muricata

This large predatory eleven-armed seastar is very abundant thoughout the bay, ranging over sandy bed, reef and man-made structures. It feeds upon bivalve molluscs, especially mussels.

Ikeda sp.

An undescribed species of infaunal echiurid (unsegmented worm); lives deeply buried in the bed, extending a feeding proboscis over the sand. Moderately common in quiet, fine sandy habitat in the bay.

Reefy Substrate

Algae

Ecklonia radiata.

This is the commonest shallow water kelp in southern Australia Numerous healthy plants were present on jetty pilings and rocks in the surrounding bed.

Cystophora and *Caulocystis*

These large brown kelps were bundant on the natural offshore reef. Several species of both genera are common on sheltered shallow water reefs in the bay.

Filamentous Algae

Abundant small green and red turfing species were not identified. Most species are however common in shaded habitat on jetties in the bay.

Invertebrates

The jetty and boat ramp pilings support an invertebrate community comprising species common in similar habitat in the bay. Visually dominant species include:

Polychaetes

A few individuals of the introduced tubicolous worm *Sabella spallanzanii* were noted. This introduced worm is now common on hard substrate around the bay.

Galeolaria caespitosa

Large colonies of the encrusting calcareous tube building polychaete worm invest piles at mid tide level. The species is common throughout the bay.

Sponges

At least seven species of crustose and erect sponges including *Aplysilla rosea*, *Euryspongia* sp. and Mycale spp occur on jetty pilings and natural reef. These species are common in similar habitat throughout the bay.

Bryozoa

Red crustose *Mucropetraliella elleri* and large encrustations of yellow *Celleporaria* sp. were common on the jetty pilings. Both species colonize sheltered jetties around the bay.

Hydrozoa

Hydroids *Obelia dichotoma* and *Sertularia tenuis* were moderately common on jetty pilings. Both species are abundant in sheltered habitat in the bay.

Ascidians

Pyura stolonifera (see previous note) is a common colonizer of jetty piles and sandy rubble bed in the bay.

Botrylloides leachii

An encrusting compound ascidian common in sheltered habitat throughout the bay.

Gastropods

Haliotis rubra

Adult black lip abalone were present at the base of the piles. This commercial species is common in similar habitat in the bay.

Limpets

Patelloida and *Notomacea*

Both rock dwelling limpets are very common in shallow water habitat throughout the bay.

Fish

Sweep *Scorpis aequipinnus,* found around piles and shallow reef. The toady *Tetractenos glaber* is common in shallow water habitat throughout the bay.