Bays West Sub-precincts Masterplan Ecology and Biodiversity

Department of Planning and Environment

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Project Manager	Meredith Henderson
Prepared by	Meredith Henderson
Reviewed by	David Bonjer
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Template 2.8.1

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Abbreviations

Abbreviation	Description
BC Act	*Biodiversity Conservation Act 2016*
DPIE	Department of Planning and Environment
ELA	Eco Logical Australia Pty Ltd
FM Act	*Fisheries Management Act 1994*
OEH	Office of Environment and Heritage (now part of DPE)
PCT	Plant Community Type

1. What are the Bays West Sub-precincts?

1.1. Where are the sub-precincts?

There are two sub-precincts that form Stage 1 of the Bays West Precinct. These are the White Bay Power Station and Robert Street sub-precincts. They are located on the south-eastern edge of the Balmain peninsula, and to the west of Glebe Island, with a foreshore along White Bay.

This area is central to the renewal of the precinct holding both the White Bay Power Station and the Metro Station. Currently the area is closed to the public, apart from the street frontage along Robert Street.

1.2. Strategic context?

1.2.1. Bays West Strategic Place Framework

The Bays West Strategic Place Framework (DPIE 2021a) outlines a vision for the place, which reflects and respects Country:

> *'Bays West will represent a new kind of Sydney urbanism that respects and celebrates Country.*
>
> *It will build on its natural, cultural, maritime and industrial stories to shape an innovative and sustainable new place for living, recreation and working.*
>
> *New activities, places, connections and destinations will enrich Bays West's character and meaning over time through built form and public spaces that embrace its natural and cultural heritage.' (DPIE 2021a)*

Part of the vision is to embrace the natural heritage of the precinct, of which the White Bay Power Station and Robert Street Sub-precincts are part.

1.2.2. Connecting with Country Draft Framework

The Connecting with Country Draft Framework is a framework intended to inform the planning, design, and delivery of projects in NSW. The framework is not prescriptive nor formulaic, rather it provides paths, principles and commitments to working collaboratively, putting Country and Aboriginal perspective first.

Three long-term strategic goals:

- Reduce the impacts of natural events such as fire, drought and flooding through sustainable land and water use practices
- Value and respect Aboriginal cultural knowledge with Aboriginal people co-leading design and development of all NSW infrastructure projects
- Ensure Country is cared for appropriately and sensitive sites are protected by **Aboriginal people having access to their homelands to continue their cultural practices**.

1.3. Purpose of this report

This report has been produced to support the Masterplan process for Stage 1 of the Bays West sub-precincts. This Biodiversity Report aims to:

- Outline existing environment in terms of biodiversity in the White Bay Power Station and Robert Street sub-precincts
- Reflect on the current ideas and thinking regarding Connecting with Country
- Identify the opportunities likely to be available for biodiversity in the White Bay Power Station and Robert Street sub-precincts
- Present some practical principles to apply to the site to improve biodiversity outcomes.

2. What is the biodiversity vision?

2.1. Place strategy

Bangawarra, the First Nations cultural consultants, (DPIE 2021a) identified a strong connection of freshwater and saltwater, reflected in the creeks and waterways that flow over the Bays West Precinct and the Harbour. In the White Bay Power Station and Robert Street sub-precincts, there are the remnants of a waterway, which is seen as overland flow from the Balmain Peninsula.

The Place Strategy identifies that significant shifts need to occur when considering any renewal of the sub-precincts. The emphasis has been placed on the quality of the natural environment at Bays West.

2.2. Short term vision

- Provide open space within the sub-precincts which connect the community with nature.
- Make use of water across the landscape and incorporate this with the landscape of the open space
- Provide unique environments for the remaining fauna in and near the precinct
- Provide for an increased urban canopy
- Connect green spaces within the sub-precincts to those outside.

2.3. Medium- and long-term vision

- Develop now the ability to provide expanded marinescapes in the future
- Water quality is improved that facilitates colonisation of a range of marine flora and fauna
- Provide for planned retreat with thriving intertidal and saltmarsh communities present at the foreshore
- The open space is resilient to changes in climate.

2.4. White Bay Power Station (and Metro) and Robert Street Sub-Precincts Draft Urban Design Framework and Public Domain Concept Master Plan

The Bays West Urban Design Framework (DPIE 2021b) contains an overarching vision for place, which includes:

> New **activities, places, connections** and **destinations** will enrich Bays West's **character** and meaning over time through **built form and public spaces** that embrace its **natural and cultural heritage**.

One of the four directions for the design of place and spaces seeks to '*promote biodiversity and improve water quality in the harbour whilst restoring and expanding the green and blue natural systems'*.

Application to the White Bay Power Station (and Metro) and Robert Street Sub-Precincts include performance considerations which seek to:

- create space for local flora and fauna within water zones
- provide greater protections for seahorse habitat

- reinstate and protect original creek corridors
- extend blue / green corridors through the site
- deliver a strong and connected canopy through the streets
- allow for terrestrial new habitat created for native fauna
- create water-based new habitats for native fauna
- allow for protection and habitat creation for the seahorse habitat in White Bay
- ensure that landscape areas are dominated by native endemic planting
- enable complete ecology establishment via low, mid and upper canopy elements.

The above design considerations are reflected in the Draft Master Plan and Urban Design Framework, which specifically includes:

- use of native species in landscaping to reflect communities that may have existed prior to clearing
- use of stormwater to provide a freshwater environment which could be used by microbats for foraging
- creation of interpreted aquatic habitats to include bioretention / water quality improvements for overland flow from the land to marine environments
- allowing for an interpreted shoreline and using plants consistent with estuarine saltmarsh which could allow for tidal movements onto the land and considers future climate / sea level rise
- provision of augmented fauna habitats
- provision of dense planting of urban canopy to connect learning environments and provide a level of habitat connectivity where this is currently absent.

3. What is currently present in the sub-precinct?

3.1. Geology and soils

Based on geology maps and place strategy, the land on which the sub-precincts sit is fill, or reworked soil, with a small area of intertidal flat at the foreshore (Chapman et al. 2009). Abutting the site is extensive Hawkesbury sandstone. The Hawkesbury sandstone would have been from the Wianamatta Group and of medium to coarse-grained quartz sandstone with very minor shale and laminite lenses (Herbert 1983).

3.2. Vegetation

The vegetation present in the sub-precinct is highly modified and not likely to reflect the vegetation that would have occurred prior to clearing. Therefore, to visualise what may have once occurred, examining several research reports and papers is required. Hints to what may have been present is based on looking at geology, position in the landscape, proximity to the coast, elevation and surrogate sites in areas that may be relatively 'intact', such as in Sydney Harbour National Park, or local reserves. Several vegetation mapping studies have occurred in the Sydney region. These regional mapping studies have informed the likely vegetation types that would have occurred in the sub-precincts.

The presumed vegetation pattern on the site would have consisted Sandstone Heaths, Woodlands and Forests (Benson and Howell 1994). That study describes Sydney Sandstone Gully Forest as having a widespread distribution and found on Hawkesbury sandstone of the coast. While there are three sub-units mapped by Benson and Howell (1994), the most likely vegetation that could have occurred in the sub-precincts is the Open forest/woodland *Eucalyptus piperita-Angophora costata – Eucalyptus pilularis* sub-unit.

The equivalent map unit described by Tozer et al. (2005) is Coastal Sandstone Gully Forest. That report (Tozer et al. 2005) describe this type as an open eucalypt forest with a diverse shrub layer, with a ground cover dominated by sedges, and found in lower slopes of sandstone gullies. This further relates to the contemporary plant community type (PCT) Coastal Sandstone Foreshores Forest. This PCT is described in the Bionet Vegetation Classification data, and in the mapping project carried out by the then Office of Environment and Heritage (OEH 2013). In the 2013 report, it is described as found on sheltered sandstone slopes along the foreshores of Sydney's major waterways and coastal escarpments. It is an open forest with a moist shrub layer and a ground cover of ferns, rushes and grasses. The flora of this community has a maritime influence given its exposure to prevailing sea breezes.

While there may have been small scale variation and some small areas of saltmarsh or even riparian vegetation, the Coastal Sandstone Foreshores Forest is likely to have been the dominant vegetation type across the sub-precincts.

3.3. Threatened terrestrial species

A search of the Bionet threatened species records show that there are very few threatened species within 1 km of the sub-precincts. All but one of the species was a mobile and relatively widespread species. There were 10 threatened fauna and one threatened flora record within 1 km of the sub-precincts.

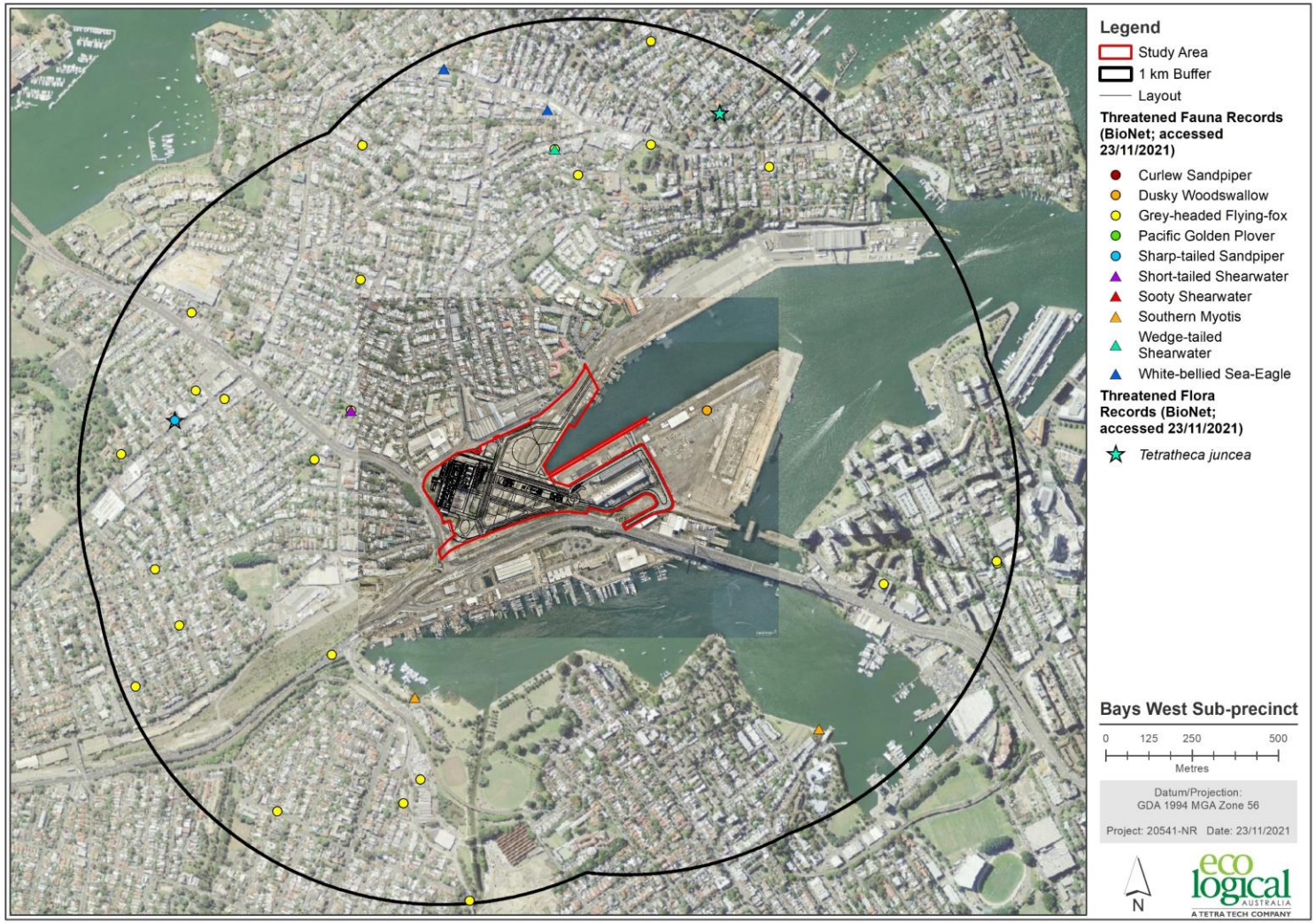

Figure 1: Bionet (2021) records of threatened terrestrial species within 1 km of the sub-precincts

Between 2014 and 2016, ELA carried out several surveys and studies either in the sub-precinct or close to it. As part of these surveys, ELA detected microchiropteran bat species, including two threatened species at White Bay Power Station. Microchiropteran bats (or microbats) are small bats ranging in weight from 3 g to about 40 g. They are diverse in both Australia and NSW, comprising about 39% of all mammal species in NSW. Microbats require roosts, with some species using tree hollows while others use caves, culverts, buildings, tunnels and bridges.

ELA detected two threatened and two non-threatened bats on the White Bay Power Station part of the sub-precincts in 2016. The species are outlined in Table 1

Table 1: Microbat species found at the White Bay Power Station (ELA 2016)

Species	Common name	BC Act listing	General species comments (not site specific to White Bay)
Chalinolobus gouldii	Gould's Wattled Bat	Not listed	Gould's Wattled Bats roost in hollows in old trees, occasionally in ceilings or basements of buildings. They roost together in colonies of around 30 bats, sometimes smaller and other times larger. Gould's Wattled Bat feed on a variety of insects, including scarab beetles, caterpillars, crickets and moths, depending on the time of year (Churchill 2008).
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat	Vulnerable	This species forages from just above the tree canopy, to many times the canopy height in forested areas, and will utilise open areas where it is known to forage at lower levels. Moths appear to be the main dietary component. Though individuals often use numerous roosts, it congregates in large numbers at a small number of nursery caves to breed and hibernate. Although roosting primarily occurs in caves, it has also been recorded in mines, culverts, stormwater channels, buildings, and occasionally tree-hollows
Mormopterus ridei	Eastern Freetail Bat	Not listed	Colonies of several hundred individuals have been recorded in NSW and they prefer to roost in tree hollows. Living along the eastern seaboard means their habitat preferences lean towards rainforest, tall open forests, woodlands, riparian open forest and dry sclerophyll forests. They tend to fly in open spaces between trees as they hunt for bugs, flies, beetles, moths and spiders (Churchill 2008).
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	Vulnerable	Roosting individually or in groups of up to six, they generally roost in tree hollows, but in treeless areas they are known to utilise buildings and even mammal burrows. This species has been observed 'resting' on the walls of buildings in the broad daylight (Richards 2008). They will forage in most habitats throughout their very wide range, including areas with and without trees and appear to defend an aerial territory (DPIE 2021c).

Figure 2: Results of threatened bat survey at the White Bay Power Station (ELA 2016)

All the species detected were found outside the buildings. Detectors placed inside parts of the White Bay Power Station did not record presence of microbats. However, it should be noted that the surveys were not exhaustive and not carried out over multiple seasons. Bats can use sites infrequently. Hollow roosting microbats tend to exhibit dynamic roost usage where multiple [up to ten or more (Brad Law pers. comm., 2011)] hollow-bearing trees are used at any one time for maternity and winter roosts, with bats moving between them each night or every few nights.

3.4. Threatened marine species

A search of the *Fisheries Management Act 1994* (FM Act) revealed that five threatened marine fish and one endangered marine flora population were recorded within 1 km of the sub-precincts (Table 2).

Table 2: List of marine threatened species and population within 1 k of the sub-precincts

Type	Species name	Common name	BC/FM Act Status	EPBC Status	Use of site
Bony Fish	*Epinephelus daemelii*	Black Rockcod	V	V	No suitable habitat present, eg rock overhangs, crevices or caves. Much of the current shoreline is artificial and constructed cement walls.
	Hippocampus whitei	White's Seahorse	E		Present under jetty / near pylon on opposite side of White Bay, few macroalgae plants on piles.
Shark	*Carcharias taurus*	Grey Nurse Shark	E4A	CE	Limited suitable habitat
	Carcharodon carcharias	Great White Shark	V	V	
Ray	*Pristis zijsron*	Green Sawfish	E4	V	Presumed extinct in NSW
Seagrass	*Posidonia australis* - Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie populations	Posidonia australis	E2		No plants observed – waters in White Bay too deep for these meadows to persist

Of the six matters listed under the FM Act, only one is known to have been recently present near the sub-precincts. *Hippocampus whitei* (White's Seahorse), was recorded in White Bay. This species is listed as endangered under the FM Act. It is understood to have been found under a wooden jetty on the opposite side of White Bay to the power station. This fish lives in protected areas usually within a dense marine flora habitat. Such habitats occur on submerged objects including swimming nets and jetty pylons. Threats to the species includes removal of this habitat in events such as net cleaning or sedimentation, which kills marine plants.

4. What could be created on the site?

4.1. Renovation not restoration

Typical restoration would rely on making improvements to the existing elements of the natural heritage on a site. There is little to restore, so a new way of thinking could be used to approach the biodiversity opportunities on this site. Much in the way that a house can be renovated, the sub-precincts have 'the bones' that lend itself to adding new elements in the land- and seascapes.

4.2. Elements of previous habitats

As discussed in section 3.2, there are hints as to the vegetation that may have once inhabited the sub-precincts. There is an opportunity to draw on the presumed vegetation types and to add others that may reflect the current landforms. These have been summarised in Table 3.

Table 3: Potential plant community types, their main elements and where they can be used (species source data OEH 2013)

Plant community type	Canopy species	Mid stratum species	Ground cover species	Where might this be used in the sub-precinct
PCT 1778 Coastal Sandstone Foreshores Forest	*Angophora costata, Eucalyptus botryoides, Banksia integrifolia, Eucalyptus piperita, Eucalyptus pilularis*	*Glochidion ferdinandi, Pittosporum undulatum, Allocasuarina littoralis, Breynia oblongifolia, Notelaea longifolia, Dodonaea triquetra, Elaeocarpus reticulatus, Polyscias sambucifolia, Acacia longifolia, Myrsine variabilis*	*Dianella caerulea, Pteridium esculentum, Lomandra longifolia, Entolasia stricta, Imperata cylindrica* var. *major, Microlaena stipoides* var. *stipoides, Poa affinis, Themeda triandra, Xanthorrhoea arborea, Lepidosperma laterale, Pratia purpurascens*	Elements could be used in the open space between Robert Street and the foreshore

PCT 1778 (source Bionet Vegetation Classification data set)

PCT 1127 Sandstone Cliff-face Soak	Not usually present	*Baeckea linifolia, Callicoma serratifolia, Ceratopetalum*	*Bauera rubioides, Drosera peltata, Drosera spatulata,*	Along the sandstone 'cliff' faces where sandstone ledges

Plant community type	Canopy species	Mid stratum species	Ground cover species	Where might this be used in the sub-precinct
		apetalum, *Tristaniopsis laurina*	*Adiantum aethiopicum*, *Adiantum hispidulum*, *Blechnum ambiguum*, *Blechnum wattsii*, *Christella dentata*, *Gleichenia dicarpa*, *Gleichenia rupestris*, *Selaginella uliginosa*	have been modified and there are seep zones
				
			PCT 1127 (source Bionet Vegetation Classification data set)	
PCT 1126 Estuarine Saltmarsh	Not usually present	Not usually present, but can include: Aegiceras *corniculatum*, *Avicennia marina*, *Casuarina glauca*, *Rhagodia candolleana*	*Samolus repens*, *Sarcocornia quinqueflora*, *Sporobolus virginicus*, *Juncus kraussii*, *Suaeda australis* and *Tetragonia tetragonioides*	In the proposed tidal area adjacent to the foreshore
				
			PCT 1126 (source Bionet Vegetation Classification data set)	
PCT 1913 Seagrass Meadows	Not usually present	Not usually present	*Zostera capricorni*, *Zostera muelleri*, *Heterozostera tasmanica*, *Halophila*	In the future, if the seabed changes and depth within White Bay is reduced, then a

Plant community type	Canopy species	Mid stratum species	Ground cover species	Where might this be used in the sub-precinct
			ovalis, Halophila decipiens, Halophila australis, Posidonia australis	seagrass meadow is a potential community that could be created. Currently these meadows are not present in White Bay.

4.3. Stepping stones

There is an opportunity to create linking habitats via stepping stones from within to outside the sub-precincts. Currently habitat connectivity is absent terrestrially and mediated by the working port, bathyscape and water quality in the marine environment. Lack of habitat connectivity was identified as one of the key biodiversity threats in the City of Sydney Urban Ecology Strategic Action Plan (City of Sydney 2014). While the Bays West sub-precincts were not identified as key priority sites, inclusion of connecting habitat would contribute to the overall urban ecology targets in the City.

The landscape design could consider the inclusion of smaller areas of native plants, representative of previous elements (see Table 3) across the open space and other areas in the sub-precincts. While in the past larger corridors and remnant patches of vegetation have been considered the ideal, in a highly spatially constrained area, this is not possible nor practical if other land uses are to be achieved.

4.4. Water across the land

The site has a challenge of managing stormwater that forms an overland flow across the site. Creative use of the water flowing off the built form and transforming that in three ways that integrates with the Connecting with Country vision for this element on the site:

- Use of stormwater to provide a freshwater environment which could be used by microbats for foraging
- Creation of interpreted aquatic habitats to include bioretention / water quality improvements for overland flow from the land to marine environments
- Allowing for an interpreted shoreline and using plants consistent with estuarine saltmarsh which could allow for tidal movements onto the land and considers future climate / sea level rise.

Improvements in the quality of water exiting the site into the Harbour should be a key consideration of planning the landscaping and other bio-systems.

4.5. Seahorse hotels

The University of Sydney carried out research to identify if temporary 'accommodation' for *Hippocampus whitei* (White's Seahorse) would be effective (Simpson et al. 2020). The researchers tested three different models of 'hotel'. They found that White's Seahorse had no preference for hotel type, they will inhabit the hotels and overall, the hotels could be a useful tool in providing supplementary habitat in places where there are none (Simpson et al. 2020). The approach taken by the researchers could be adopted as part of the improvements to biodiversity goals for the Bays West sub-precincts.

The seahorse hotels were primarily designed to encourage occupancy by seahorse populations, however they may benefit other species. The hotels comprise open structures, like wide gauge netting. This netting allows for the recruitment of macroalgae and marine flora, thus increasing marine biodiversity in a small area. Increasing structural complexity in the benthic environment is thought to provide better protection and more available food resources for a range of marine fauna .

4.6. Bats in buildings

The presence of native microbats in buildings is both a challenge and an opportunity. Since the buildings at the White Bay Power Station are not intended to be demolished, there is an opportunity to manage any populations that may be using the buildings and to potentially provide additional, robust habitat. Recent examples of how to manage microbats in built structures have included:

- Provision of compensatory habitat
- Management of bats to carry out construction
- Intention to retain roosting habitat within structures
- Develop new microbat habitat within structures.

Ideally, if microbats are found within the buildings, retention of the roosting habitat and / or provision of additional habitat within the structures would be better outcomes than exclusion or provision of bat boxes. This is because bat boxes can be colonised by undesirable and abundant species such as European Honeybees, Common Myna and Noisy Miner. Bat roosts are usually occupied because they have very specific temperature, light and humidity conditions, which can be difficult to mimic in bat boxes.

4.7. Delight in the small

The planned open space in the sub-precincts is relatively small when compared with remnant native landscapes (e.g. 1.7 ha in the sub-precincts, 16,000 ha Royal National Park). The scale of the planned open space will limit what can be achieved regarding attracting native species. Species that are uncommon in urban areas could be attracted to the sub-precincts with planting appropriate species and providing other habitat elements:

- Microbats with the provision of additional habitat and water
- Small birds, such as Superb Fairy-wren, New Holland Honeyeater and Silvereye with the provision of shrubs and nectar producing flowers
- Reptiles such as Blue-tongue Lizard, Eastern Water Dragon through the provision of water, logs and leaf litter
- Native bees, beetles, moths and butterflies through the provision of shrubs and nectar producing flowers, grasses and sedges
- Marine fauna through the provision of colonising tiles in the sub-tidal environment and seahorse hotels.

4.8. Recommendations

The proposed Masterplan has great opportunity to improve biodiversity in the Bays West Sub-precinct. While there are few biodiversity values currently present, there is a chance that threatened bats and the endangered White's Seahorse may use or occupy the waters adjacent to the study area.

Implementation of the opportunities listed above will act to improve biodiversity and should be considered as the key biodiversity recommendation.

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Appendix A Plant Community Type Descriptions

The following descriptions have been taken from the report by OEH (2013).

COASTAL SANDSTONE FORESHORES FOREST

- Statewide Class: Sydney Coastal Dry Sclerophyll Forests
- NSW Plant Community Type: 1778

Description

Coastal Sandstone Foreshores Forest is found on sheltered sandstone slopes along the foreshores of Sydney's major waterways and coastal escarpments. It is an open forest with a moist shrub layer and a ground cover of ferns, rushes and grasses. The flora of this community has a maritime influence given its exposure to prevailing sea breezes. The canopy can be dominated by pure stands of smooth-barked apple (*Angophora costata*), though more regularly this is found in combination with other tree species. Localised patches of bangalay (*Eucalyptus botryoides*) and coast banksia (*Banksia integrifolia*) occur closest to the coast, whereas Sydney peppermint (*Eucalyptus piperita*) and blackbutt (*Eucalyptus pilularis*) prefer more protected locations and in the case of the latter some minor shale enrichment in the soil. A prominent layer of hardy mesic small trees and shrubs is present. These include sweet pittosporum (*Pittosporum undulatum*), cheese tree (*Glochidion ferdinandi*) and blueberry ash (*Elaeocarpus reticulatus*). In the suburban environment the proliferation of these species in the understorey at long unburnt sites has generated considerable debate, particularly as there appears to be strong correlation between time since fire and their density (Rose and Fairweather 1997). It is also appears that these species are more common in these littoral zones than in other sheltered sandstone forests situated further away from the coast.

This forest is restricted to sandstone soils derived from either Hawkesbury or Narrabeen geology. The distribution is coastal and requires a combination of low elevation (between two and 45 metres above sea level) and mean annual rainfall that exceeds 1100 millimetres per annum. It is noticeable that most sites are exposed to salt-laden winds. Samples are situated up to 10 kilometres from the coastline, but still in close proximity to major waterways.

Species found in the PCT are:

- *Acacia implexa*
- *Acacia linifolia*
- *Acacia longifolia*
- *Acacia suaveolens*
- *Acacia terminalis*
- *Acacia ulicifolia*
- *Allocasuarina littoralis*
- *Angophora costata*
- *Banksia integrifolia*
- *Billardiera scandens*
- *Breynia oblongifolia*

- *Callicoma serratifolia*
- *Calochlaena dubia*
- *Cassytha pubescens*
- *Ceratopetalum gummiferum*
- *Cissus hypoglauca*
- *Commelina cyanea*
- *Dianella caerulea*
- *Dianella revoluta*
- *Digitaria didactyla*
- *Digitaria parviflora*
- *Dillwynia retorta*
- *Dodonaea triquetra*
- *Elaeocarpus reticulatus*
- *Entolasia marginata*
- *Entolasia stricta*
- *Epacris longiflora*
- *Eragrostis brownii*
- *Eucalyptus botryoides*
- *Eucalyptus pilularis*
- *Eucalyptus piperita*
- *Eucalyptus resinifera* subsp*. resinifera*
- *Eustrephus latifolius*
- *Ficus rubiginosa*
- *Gahnia clarkei*
- *Geitonoplesium cymosum*
- *Glochidion ferdinandi*
- *Glycine clandestina*
- *Gonocarpus teucrioides*
- *Grevillea linearifolia*
- *Hakea dactyloides*
- *Hardenbergia violacea*
- *Hibbertia dentata*
- *Hypolepis muelleri*
- *Imperata cylindrica* var*. major*
- *Kennedia rubicunda*
- *Kunzea ambigua*
- *Leucopogon juniperinus*
- *Livistona australis*
- *Lomandra filiformis*
- *Lomandra gracilis*
- *Lomandra longifolia*
- *Lomandra obliqua*
- *Lomatia silaifolia*

- *Microlaena stipoides* var. *stipoides*
- *Monotoca elliptica*
- *Myrsine variabilis*
- *Notelaea longifolia*
- *Omalanthus nutans*
- *Opercularia aspera*
- *Oplismenus aemulus*
- *Oplismenus imbecillis*
- *Ozothamnus diosmifolius*
- *Pandorea pandorana*
- *Paspalidium distans*
- *Persoonia linearis*
- *Phyllanthus hirtellus*
- *Pittosporum revolutum*
- *Pittosporum undulatum*
- *Platylobium formosum*
- *Platysace lanceolata*
- *Poa affinis*
- *Polyscias sambucifolia*
- *Pratia purpurascens*
- *Pseuderanthemum variabile*
- *Pteridium esculentum*
- *Smilax glyciphylla*
- *Syncarpia glomulifera*
- *Themeda australis*
- *Xanthorrhoea arborea*
- *Xanthosia pilosa*
- *Xanthosia tridentata*
- *Zieria pilosa*
- *Zieria smithii*

SANDSTONE CLIFF-FACE SOAK

- Statewide Class Eastern Riverine Forests
- NSW Plant Community Type: 1127: Sandstone Cliff Soak Moist Shrubland of the Sydney Basin

Sandstone Cliff-face Soak (Tozer et al. 2010) is an open moist shrub community found amongst sandstone waterfalls and rock faces where underground seepage maintains year round moisture. It is widespread throughout the Sydney basin and has been recorded along the coast and up to 1000 metres above sea level (Tozer et al. 2010). The scattered shrub layer includes a mix of water-loving species such as flax-leaf heath myrtle (*Baeckea linifolia*) and the taller black wattle (*Callicoma serratifolia*), coachwood (*Ceratopetalum apetalum*) and water gums (*Tristaniopsis laurina, Tristania neriifolia*). One of the more distinctive shrubs is *Dracophyllum secundum,* a long slender-leaved species restricted to moist rock faces. Ferns are a feature of the rocky environment and at the two sample sites used for this project thirteen fern species were recorded. These range from the maidenhair ferns (*Adiantum* spp.) to

fan ferns (*Sticherus* spp.), coral ferns (*Gleichenia* spp.), water ferns (*Blechnum* spp.) and the large king fern (*Todea barbara*). Sundews (*Drosera* spp.) are also present on the rock face.

Sandstone Cliff-face Soak is often overlooked as a unique community because it is difficult to map. It is patchy in distribution and often occupies only small areas amongst sandstone gully forests, rainforests and riparian scrub. In urban environments patches are vulnerable to weed infestation.

Species found in the PCT are:

- *Adiantum aethiopicum*
- *Adiantum hispidulum*
- *Austromyrtus tenuifolia*
- *Baeckea linifolia*
- *Bauera rubioides*
- *Blechnum ambiguum*
- *Blechnum wattsii*
- *Callicoma serratifolia*
- *Ceratopetalum apetalum*
- *Christella dentata*
- *Dillwynia retorta*
- *Doodia caudata*
- *Dracophyllum secundum*
- *Drosera binata*
- *Drosera peltata*
- *Drosera spatulata*
- *Empodisma minus*
- *Epacris crassifolia*
- *Epacris microphylla*
- *Epacris obtusifolia*
- *Epacris pulchella*
- *Eucalyptus longifolia*
- *Ficus rubiginosa*
- *Gleichenia dicarpa*
- *Gleichenia rupestris*
- *Gonocarpus teucrioides*
- *Histiopteris incisa*
- *Hypolepis muelleri*
- *Juncus continuus*
- *Kunzea ambigua*
- *Lepidosperma filiforme*
- *Leucopogon amplexicaulis*
- *Leucopogon microphyllus*
- *Lobelia anceps*
- *Logania albiflora*

- *Psilotum nudum*
- *Pultenaea retusa*
- *Schoenus brevifolius*
- *Selaginella uliginosa*
- *Sprengelia incarnata*
- *Sticherus flabellatus* var. *flabellatus*
- *Stylidium productum*
- *Styphelia tubiflora*
- *Todea barbara*
- *Tristania neriifolia*

ESTUARINE SALTMARSH

- Statewide Class Saltmarshes
- NSW Plant Community Type: 1126: Saltmarsh in Estuaries of the Sydney Basin and South East Corner

Saltmarshes consist of low succulent herbs and rushes on tidally inundated land. These marshes form plains that adjoin open water and mangroves. Throughout the marsh salinity varies greatly according to tidal influence, evaporation and fresh water accumulation. Some of the areas are flooded regularly, while at slightly higher elevations flooding is rare. After rain fresh water accumulates and adds extra water to the marsh, leaving pools of standing water when the tide recedes. Chenopod species dominate areas more frequently inundated by the tides, while sea rush (*Juncus kraussii*) occupies the more elevated terrestrial margin. Local scalds occur in small depressions where intensely saline deposits accumulate from the evaporation of tidal waters preventing the growth of any plants at all (Keith 2004).

Like many estuarine vegetation communities, large areas have been reclaimed for industrial, recreational and urban land use. Many examples that remain in Sydney are small in size, highly fragmented and patchy in distribution. *Samolus repens, Sarcocornia quinqueflora, Sporobolus virginicus, Juncus kraussii, Suaeda australis* and *Tetragonia tetragonioides* form the dominant species when mangroves are controlled.

Species found in the PCT are:

- *Aegiceras corniculatum*
- *Avicennia marina* subsp. *australasica*
- *Baumea juncea*
- *Casuarina glauca*
- *Ficinia nodosa*
- *Juncus kraussii* subsp. *australiensis*
- *Phragmites australis*
- *Samolus repens*
- *Sarcocornia quinqueflora* subsp.*quinqueflora*
- *Suaeda australis*
- *Tetragonia tetragonioides*

- *Triglochin striata.*

SEAGRASS MEADOWS

- Statewide Class: Seagrass Meadows
- NSW Plant Community Type: 1913

Seagrass Meadows are marine vegetation in estuaries and lagoons. Seagrass meadows here cover four separate genera, each of which may dominate individual patches at discrete locations. The most widespread are eelgrass species in the family Zosteraceae. *Zostera capricorni* is most common. Seagrass (*Posidonia australis*) is the largest of the seagrasses in the study area and has a more restricted distribution. It prefers the lower reaches of river systems where there is large tidal exchange (West et al. 1985). It was once common in Botany Bay but the original cover is smaller in area since the exposure to wave action has been increased following dredging (Watford and Williams 1998). Sea wracks (*Halophila* spp.) are less common again and have been recorded growing in combination with eelgrass at Towra Point and in Penrhyn Bay.

Seagrass Meadows are found on estuaries and lagoons of the Hacking, Georges and Parramatta rivers. Coastal lagoon systems at Dee Why and Narrabeen Lakes also support Seagrass Meadows (Smith and Smith 2005). No formal sampling of Seagrass Meadows was carried out for this project. The recent work by DPI (2009) was incorporated into the mapping.

Species found in the PCT are:

- *Zostera capricorni*
- *Zostera muelleri*
- *Heterozostera tasmanica*
- *Halophila ovalis*
- *Halophila decipiens*
- *Halophila australis*
- *Posidonia australis.*

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