Barton Park Precinct - Wetlands Environmental Management Plan

Bayside Council

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Abbreviations

Abbreviation	Description
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
BC Act	NSW *Biodiversity Conservation Act 2016*
CBD	Central Business District
CEMP	Construction Environmental Management Plan
Coastal Management SEPP	*State Environmental Planning Policy (Coastal Management) 2018*
Cooks Cove SREP	*Sydney Regional Environmental Plan No. 33 – Cooks Cove*
DA	Development Application
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and the Environment
EES	Environment, Energy and Science
ELA	Eco Logical Australia Pty Ltd
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FFA	Flora and Fauna Assessment
FM Act	NSW *Fisheries Management Act 1994*
KFH	Key Fish Habitat
LGA	Local Government Area
MNES	Matters of National Environmental Significance
PCTs	Plant Community Types
REF	Review of Environmental Factors
SDS	Safety Data Sheets
SoEE	Statement of Environmental Effects
TECs	Threatened Ecological Communities
WEMP	Wetlands Environmental Management Plan
WoNS	Weeds of National Significance

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1. Introduction

1.1. Project Background

Eco Logical Australia Pty Ltd (ELA) was engaged by Bayside Council to prepare a Wetlands Environmental Management Plan (WEMP) to support the proposed delivery of the Barton Park Precinct Masterplan. The overall objective of the Project is to provide an environmentally safe and accessible open space and recreational facility which in turn, will encourage people to be more physically and socially active and improve health outcomes and enhance the overall liveability of the Local Government Area (LGA).

Barton Park, located at 88-96 Bestic Street, Banksia to the west of Sydney Airport and 10 km south of the Sydney Central Business District (CBD; Figure 1-1), is currently utilised for active recreation. The proposed works will upgrade the outdated facilities of the park and provide amenities that meet the community's needs.

Generally, the works proposed will consist of:

- Four sporting fields
- Four tennis courts
- Two multi-use courts
- Training field
- Play space
- A grandstand
- Four carparks (totally approximately 241 car spaces)
- Football and tennis clubhouses and amenities
- Fitness park
- Walking / cycling pathways
- Other associated infrastructure.

The Project is subject to two approval pathways, being:

1. A local Development Application (DA) under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction of the proposed grandstand, with Bayside Council as the approval authority and assessed within a Statement of Environmental Effects (SoEE).
2. An activity under Part 5 of the EP&A Act for all other works, with Bayside Council as the determining authority and assessed within a Review of Environmental Factors (REF).

Adjacent to the Masterplan boundary is Landing Lights Wetland, a unique wetland environment that provides habitat for federal and state-listed threatened species, including migratory birds. This WEMP has been prepared to facilitate the ongoing protection and enhancement of Landing Lights Wetland during construction and operational phases of the Barton Park Precinct Masterplan works.

1.2. Key Terms

The following terminology is used throughout this WEMP and displayed in Figure 1-1.

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- **Barton Park** refers to 88-96 Bestic Street, Banksia (Lot 100 DP 1228008, Lot 1 DP 576148 and Road Reserve)
- **Proposed Works Footprint** refers to areas of Barton Park in which construction and fill and capping are proposed
- **Wetland Management Area** refers to the areas in Barton Park to which this WEMP applies. It includes the Landing Lights Wetland, vegetation alongside Muddy Creek and surrounding native vegetation which would not be removed as part of the Barton Park Precinct redevelopment.

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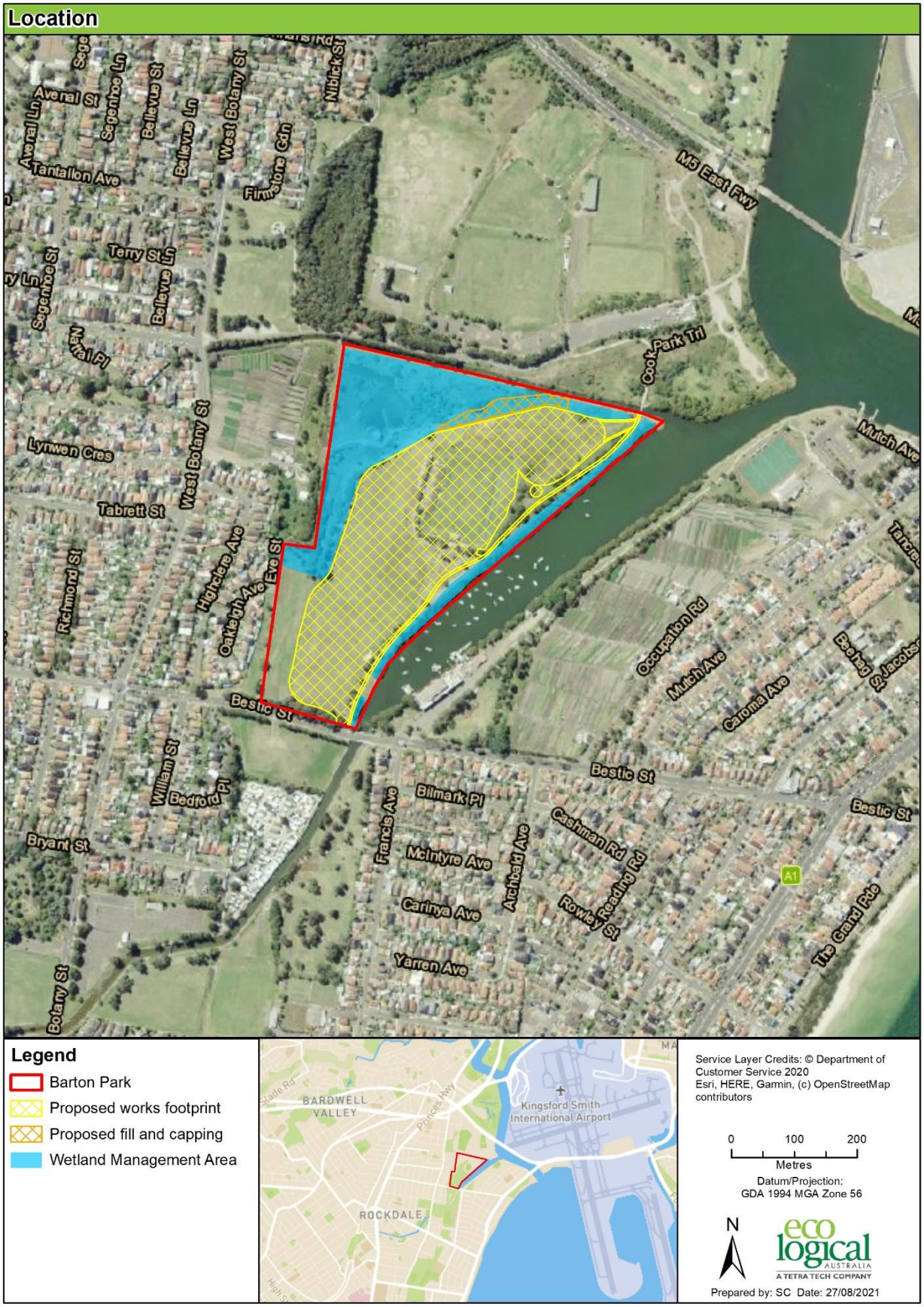

Figure 1-1: Location of Barton Park Precinct proposed works and land subject to this WEMP

1.3. Purpose of this Management Plan

The Project is located within the Cooks Cove site and is therefore subject to the *Sydney Regional Environmental Plan No. 33 – Cooks Cove* (Cooks Cove SREP). In accordance with Clause 17(1) of the Cooks Cove SREP, consent must not be granted for any development on land within the Cooks Cove site until after the consent authority has taken into consideration a WEMP.

The Landing Lights Wetland and mangroves alongside Muddy Creek are mapped on the *State Environmental Planning Policy (Coastal Management) 2018* (Coastal Management SEPP) as Coastal Wetland and Proximity to Coastal Wetlands.

The WEMP is to be served to the Department of Planning, Industry and the Environment (DPIE) – Environment, Energy and Science (EES) division and the Department of Primary Industries (DPI) – Fisheries.

In accordance with Clause 17(3) of the Cooks Cove SREP, the WEMP must include a description of the location of existing and proposed wetlands, including areas considered to be significant, and proposals as outlined in Table 1-1.

Table 1-1: incompliance with Clause 17(3) of the Cooks Cove SREP)

Clause 17(3) of the Cooks Cove SREP	Addressed
a. implementation of wetlands environmental management principles	Section 5
b. protection of threatened species, populations and ecological communities	Section 4
c. protection of aquatic and fish nursery habitats	Section 4
d. protection of migrating bird populations and their habitats	Section 4
e. the interrelationship of the golf course and any buffer or treatment required to prevent or reduce run-off and nutrient loads from the fairways entering the wetlands,	Section 4
f. the impact of the proposed development on tidal flows inundating the wetlands,	Section 4
g. the impact of the development on the ecological significance of the Cooks River and Muddy Creek and the wetlands within the site,	Section 4
h. measures to minimise adverse environmental impacts of development, including the provision of— *i. compensatory wetland habitats, and* *ii. vegetated riparian buffers around wetlands to mitigate the impact of human disturbance on native fauna, and* *iii. vegetated riparian buffers around wetlands to enhance appropriate terrestrial habitat,*	Sections 4 and 5
i. establishment in riparian areas of appropriate local native plant species propagated, where possible, from locally genetic stock	Sections 4 and 5

1.4. Objectives of the Wetlands Environmental Management Plan

The objectives of the WEMP are to:

- Minimise or eliminate construction and operational impacts associated with the Barton Park Precinct Masterplan on the adjacent Landing Lights Wetland and its inhabitants, as well as the riparian habitat alongside Muddy Creek wetland and its inhabitants
- Control the abundance and distribution of weeds entering the Landing Lights Wetland

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- Protect aquatic habitats within the area subject to this WEMP
- Improve habitat for threatened species known to inhabit Landing Lights Wetland such as amphibians and migratory birds
- Outline opportunities to expand known State and Commonwealth listed Threatened Ecological Communities (TECs) adjacent to the Barton Park Precinct Masterplan such as:
    - Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
    - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
    - Sydney Freshwater Wetlands in the Sydney Basin Bioregion
- Minimise ongoing operational impacts from stormwater overland flow from Barton Park into Landing Lights Wetland and Muddy Creek.

1.5. Management Principles

A set of management principles have been developed to ensure the WEMP area is managed according to best practice. These principles are based on the guiding principles in the NSW Wetlands Policy (DECCW 2010), the objectives of the *Coastal Management Act 2016* and the aims of the Coastal Management SEPP, and are designed to foster the protection, conservation and enhancement of the area subject to this WEMP.

- The wetland area is a significant part of the Barton Park Precinct
- Maintain the natural distribution of water to and from the wetland, including tidal flows
- Land management practices should maintain or improve wetland habitat and ecosystem services
- Rehabilitate the Landing Lights Wetlands and improve ecological processes
- The current spatial extent of the Landing Lights Wetlands is the minimum extent to be maintained, with opportunities to expand the Landing Lights Wetlands to be investigated
- Management of the Landing Lights Wetlands is to involve cooperation between Bayside Council, DPI – NSW Fisheries and local bird watching community groups
- Continue to review management practices to keep up to date with best practices.

The management strategies and actions in this WEMP have been prepared in accordance with the above principles.

2. Legislative Context

Legislation relevant to this WEMP is outlined in Table 2-1.

Table 2-1: Legislative context

Legislation	Relevance
	Commonwealth
Environment Protection and Biodiversity Conservation Act 1999	The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects Matters of National Environmental Significance (MNES), such as threatened species and ecological communities, migratory species (protected under international agreements), and National Heritage places (among others). Any actions that will or are likely to have a significant impact on the MNES require referral and approval from the Australian Government Environment Minister. Significant impacts are defined by the Commonwealth for MNES. The following MNES have been identified within and near the Wetland Management Area: • *Botaurus poiciloptilus* (Australasian Bittern) • *Calidris acuminata* (Sharp-tailed Sandpiper) • *Calidris alba* (Sanderling) • *Calidris canutus* (Red Knot) • *Calidris Ferruginea* (Curlew Sandpiper) • *Calidris tenuirostris* (Great Knot) • *Charadrius mongolus* (Lesser Sand-plover) • *Hirundapus caudacutus* (White-throated Needletail) • *Limosa limosa* (Black-tailed Godwit) • *Numenius madagascariensis* (Eastern Curlew) • *Chalinolobus dwyeri* (Large-eared Pied-Bat) • *Pteropus poliocephalus* (Grey-headed Flying-fox) • *Litoria* aurea (Green and Golden Bell Frog) A separate management plan for Green and Golden Bell Frog has been prepared (ELA 2021b).
	State
Fisheries Management Act 1994	The *Fisheries Management Act 1994* (FM Act) provides for the protection, conservation and recovery of threatened species defined under the Act. It also makes provisions for the management of threats to threatened species, populations and ecological communities defined under the Act, as well as the protection of fish and fish habitat in general. Both Muddy Creek and the Landing Lights Wetland are considered Key Fish Habitat (KFH). However, the proposed works do not involve harm to marine vegetation, dredging, reclamation or obstruction of fish passage, so no approval from NSW Fisheries is required for works. The listing of these areas as KFH highlights the importance of the aquatic ecosystems.
Biodiversity Conservation Act 2016	The *Biodiversity Conservation Act 2016* (BC Act) seeks to conserve biological diversity at bioregional and State scales; to maintain the diversity and quality of ecosystems and enhance their capacity to adapt to change and provide for the needs of future generations; to assess the extinction risk of species and ecological communities and identify key threatening processes through an independent and rigorous scientific process; and to establish a framework to avoid, minimise and offset the impacts of proposed development and land use change on biodiversity.

Legislation	Relevance
	The following species were considered likely to occur or use habitat within the Wetland Management Area: • *Anthochaera phrygia* (Regent Honeyeater) • *Artamus cyanopterus cyanopterus* (Dusky Woodswallow) • *Glossopsitta pusilla* (Little Lorikeet) • *Lathamus discolor* (Swift Parrot) • *Anseranas semipalmata* (Magpie Goose) • Australasian Bittern • Curlew Sandpiper • Great Knot • Lesser Sand-plover • *Epthianura albifrons* (White-fronted Chat) • *Haematopus fuliginosus* (Sooty Oystercatcher) • White-throated Needletail • *Ixobrychus flavicollis* (Black Bittern) • Black-tailed Godwit • Large-eared Pied-Bat • *Myotis Macropus* (Southern Myotis) • Green and Golden Bell Frog • *Pandion cristatus* (Eastern Osprey).
	Environmental Planning Instruments
State Environmental Planning Policy (Coastal Management) 2018	The Coastal Management SEPP aims to manage development within coastal zones and protect the environmental assets of the coast. In accordance with Section 5 of the *Coastal Management Act 2016*, the term coastal zone is defined as any area of land that is comprised of the following coastal management areas: • Coastal wetlands and littoral rainforests • Coastal vulnerability areas • Coastal environment areas • Coastal use areas. In accordance with the NSW Department of Planning and Environment Coastal Management SEPP Interactive Map, the Wetlands Management Area is mapped as Coastal Wetlands and Proximity Area for Coastal Wetlands (Figure 2-1).
State Regional Environmental Plan No 33 - Cooks Cove	Barton Park is located within the Cooks Cove site as defined by the Cooks Cove SREP. In accordance with Clause 17(1a) to the SREP, consent must not be granted for any development on land within the Cooks Cove site until after the consent authority has taken into consideration a WEMP. The Plan must be served to the Director-General of the Department of Environment and Conservation (now DPIE), Director General of NSW Fisheries and updated following written comments from DPIE within 40 days after the date of service. The requirements of a WEMP in accordance with Clause 17(5) of the Cooks Cove SREP and their relevant section(s) in this plan are presented in Table 1-1 above.

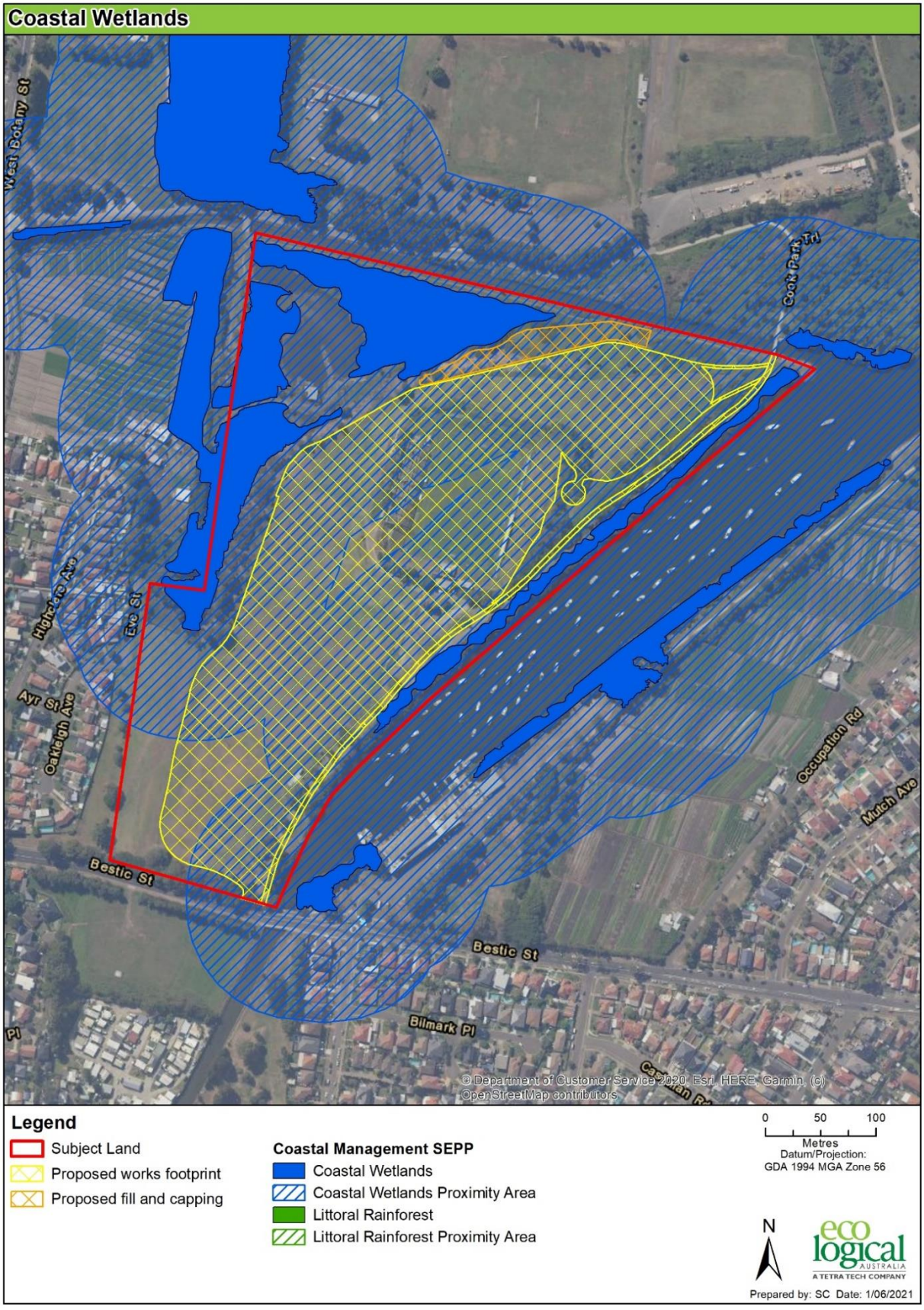

Figure 2-1: Mapped Coastal Wetlands within and adjacent to Barton Park

3. Description of the Environment

3.1. Cooks River Catchment

The Cooks River is a 23 km-long urban waterway, which starts at Graf Park, Yagoona and travels north-west through to Chullora. The River then turns south-west before flowing into Botany Bay at Kyeemagh, next to Kingsford Smith airport (Cooks River Alliance 2017).

The Cooks River catchment is highly urbanised and serves as part of a stormwater system for the surrounding urban areas. Most of the River is a concrete channel and many of its tributaries have also been converted to concrete or brick-lined channels. The Cooks River has suffered extreme degradation due to sewerage, industrial and domestic waste, stormwater pollution and rubbish dumping. Dredging and artificial channel modifications have also severely impacted on the natural landscape of the river (Cooks River Alliance 2017).

Barton Park is in the Spring Street and Muddy Creek sub-catchment. The topography of the catchment is relatively flat with the upper reaches of the Muddy Creek catchment generally sloping in a south-easterly direction with the lower reaches draining north east towards the Cooks River.

The Spring Street Drain has a peak elevation of 55.5 m Australian Height Datum (AHD) with the catchment draining eastwards. The topography of the former land fill site impedes natural drainage which acts as a barrier for natural water flows from the west and exacerbates the impact of tides and flood waters along the banks of Muddy Creek along the east (Bayside Council 2020).

3.2. Hydrology and Flooding

The typography of Barton Park is uneven but the predominate structure is from the former landfill waste mass situated in the middle of the site. Surface water flows follow the local relief and flows to Muddy Creek or the Landing Lights Wetland. There is a drainage line that conveys flows along the western portion of the site to the Landing Lights Wetland. The regional direction of groundwater flow is towards the Cooks River (CES 2017). Spring Street Wetland, Spring Street Drain and the Landing Lights Wetland are local groundwater sinks along with the Cooks River and Muddy Creek. Groundwater associated with the site is unconfined. This is contributed to the filled land and underlying unconsolidated sediments. There are no registered groundwater extraction bores on the site. There are five registered groundwater bores on properties to the west (hydraulically upstream) of Barton Park and four bores to the south-east. Groundwater is impacted with contaminates derived from anoxic and anaerobic waste degradation (primarily ammonia) and leachate.

Council has notated the site as being affected by the 1% Annual Exceedance Probability (AEP) flood. This means that there is 1% (1 in 100) chance of a flood of this magnitude or higher occurring in any one year. The flood levels for a 1% AEP flood event range from 1.66 m AHD to 2.11 m AHD, this is the height of the flood water. Figure 3-1 shows the distribution of flooding in a 1% AEP event. The park and playing field are not impacted due to the local typography in particular the raised area associated to the former landfill waste mass. The surface elevation of this area is approximately 3.5 m to 4.5 m above AHD. Some surface flooding would occur in south eastern portion of the old football stadium and the shared pathway is prone to inundation from Muddy Creek. Additionally, surface flooding occurs in localised areas in relation to the undulating surface and mounds caused by the land fill waste mass.

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3.3. Water Quality

The NSW Water Quality and River Flow Objectives are the agreed environmental values and long-term goals for NSW's surface waters and set water quality and river flow objectives for major catchments including the Cooks River (DECCW 2006). These objectives mapped the catchment of the Cooks River as predominantly containing waterways affected by urban development as well as estuaries. The supporting information behind these objectives identifies that some of the aquatic ecosystems within this catchment are considerably modified and that the extent of tidal flushing will significantly influence water quality (DECCW 2006).

The quality of the water in the adjacent Cooks River, Muddy Creek and Landing Lights Wetland is low due to previous industrial uses in the area such as the landfill and urban runoff (Edison Environmental 2020). Bed sediments of these waterways are considered organic-rich, which further impacts the water quality of these bodies. The Landing Lights Wetland has high concentration of these sediments which is also likely to constitute a source of ammonia at low tide. Leachate from the old landfill impacts the groundwater of the site and produces ammonia (Edison Environmental 2020).

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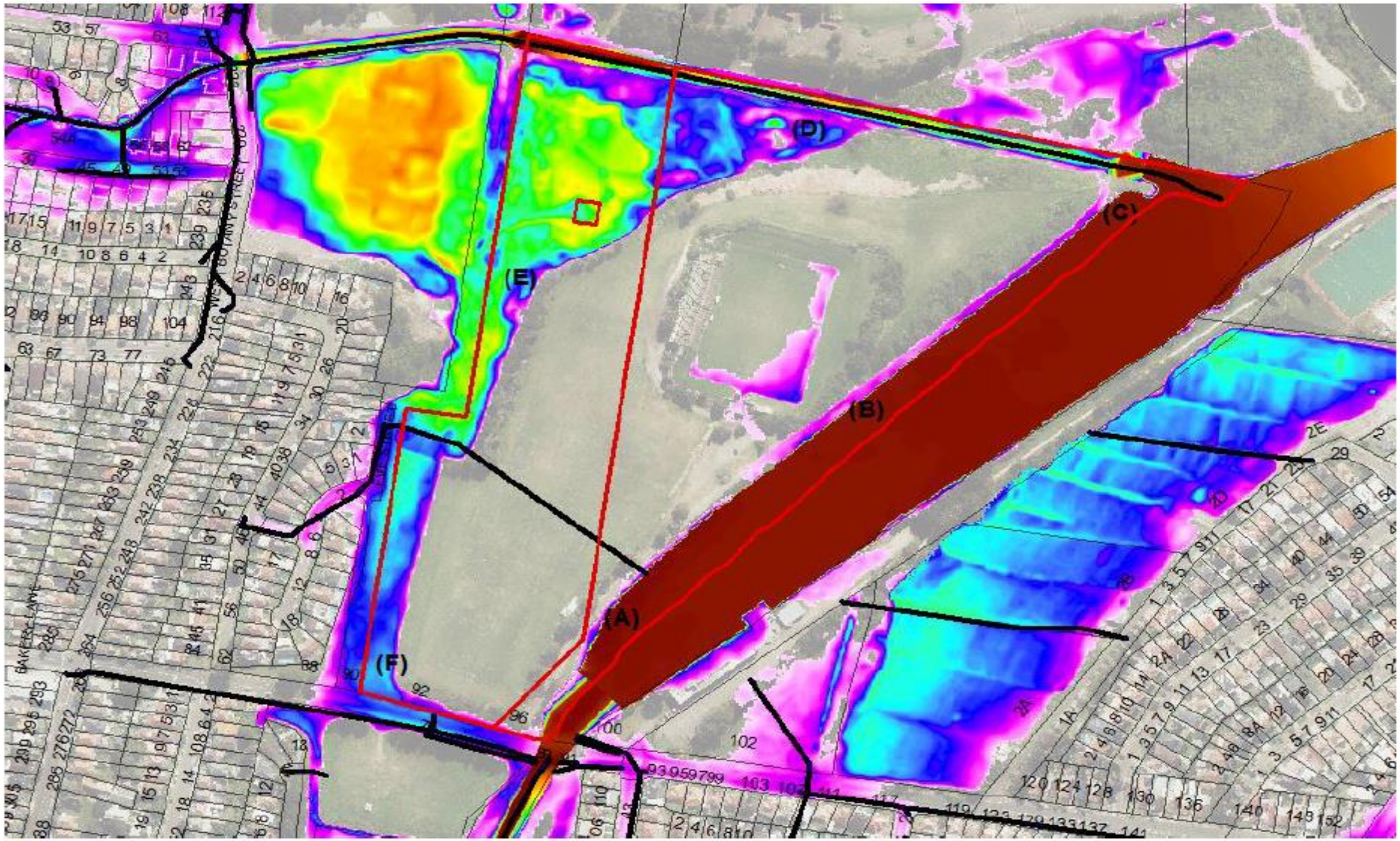

Figure 3-1: Extent of 1% AEP Flooding (dark pink graduating to brown indicates greater depth of water and pale pink indicates shallower depth) (Bayside Council, 2021)

3.4. Muddy Creek and Key Fish Habitat

Muddy Creek is a tributary of the Cooks River and is predominantly a second order watercourse (in accordance with the Strahler System) alongside the study area, which flows in a north-easterly direction and drains to a tidally flushed estuary. The Creek is popular with anglers and is lined with large boulders, preventing bank erosion. A thin strip of vegetation exists along the east and western banks, with predominantly native canopy species such as mangroves and *Casuarina* sp. observed growing along the banks.

Muddy Creek is also mapped as KFH by DPI Fisheries (Figure 3-2). The *Policy and guidelines for fish habitat conservation and management* (Fairfull 2013) identifies three types of KFH, as shown in Table 3-1. As Muddy Creek is lined by mangroves, it would be considered Type 1 KFH.

Table 3-1: Types of Key Fish Habitat and sensitivity levels (from Fairfull, 2013)

Key Fish Habitat Type	Sensitivity	Example
Type 1	Highly sensitive	Coastal Management SEPP wetlands, freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants
Type 2	Moderately sensitive	Mangroves, stable intertidal sand/mud flats, coastal and estuarine sandy beaches with large populations of infauna
Type 3	Minimally sensitive	Coastal and freshwater habitats not included in TYPES 1 or 2, ephemeral aquatic habitat not supporting native aquatic or wetland vegetation

3.5. Coastal Wetlands

As shown in Figure 2-1, Barton Park contains areas mapped as 'Coastal Wetlands' and 'Proximity to Coastal Wetlands' under the Coastal Management SEPP. Barton Park is also mapped as being within the Coastal Use Area and Coastal Environment Area.

The area mapped as Coastal Wetland in Figure 2-1 would be considered Type 1 KFH according to Table 3-1. The *Policy and guidelines for fish habitat conservation and management* (Fairfull 2013) outline that a minimum buffer width of 50 – 100 m should be incorporated for development adjacent to Type 1 KFH. The Policy also states that where a buffer zone of at least 50 m is physically unachievable due to land availability constraints, the available buffer width must be maximised to achieve protection of Type 1 and 2 marine vegetation.

The area adjacent to the Coastal Wetlands within the subject land is a mown grass area that is highly degraded and contains contaminated material as a result of the area previously being used as a landfill site. Council will instate a 20 m buffer between the edge of Landing Lights Wetland and the development area. Land beyond this 20 m buffer has already been developed and it is not practical to widen this buffer. Measures to protect the wetland from development are discussed in Section 4.

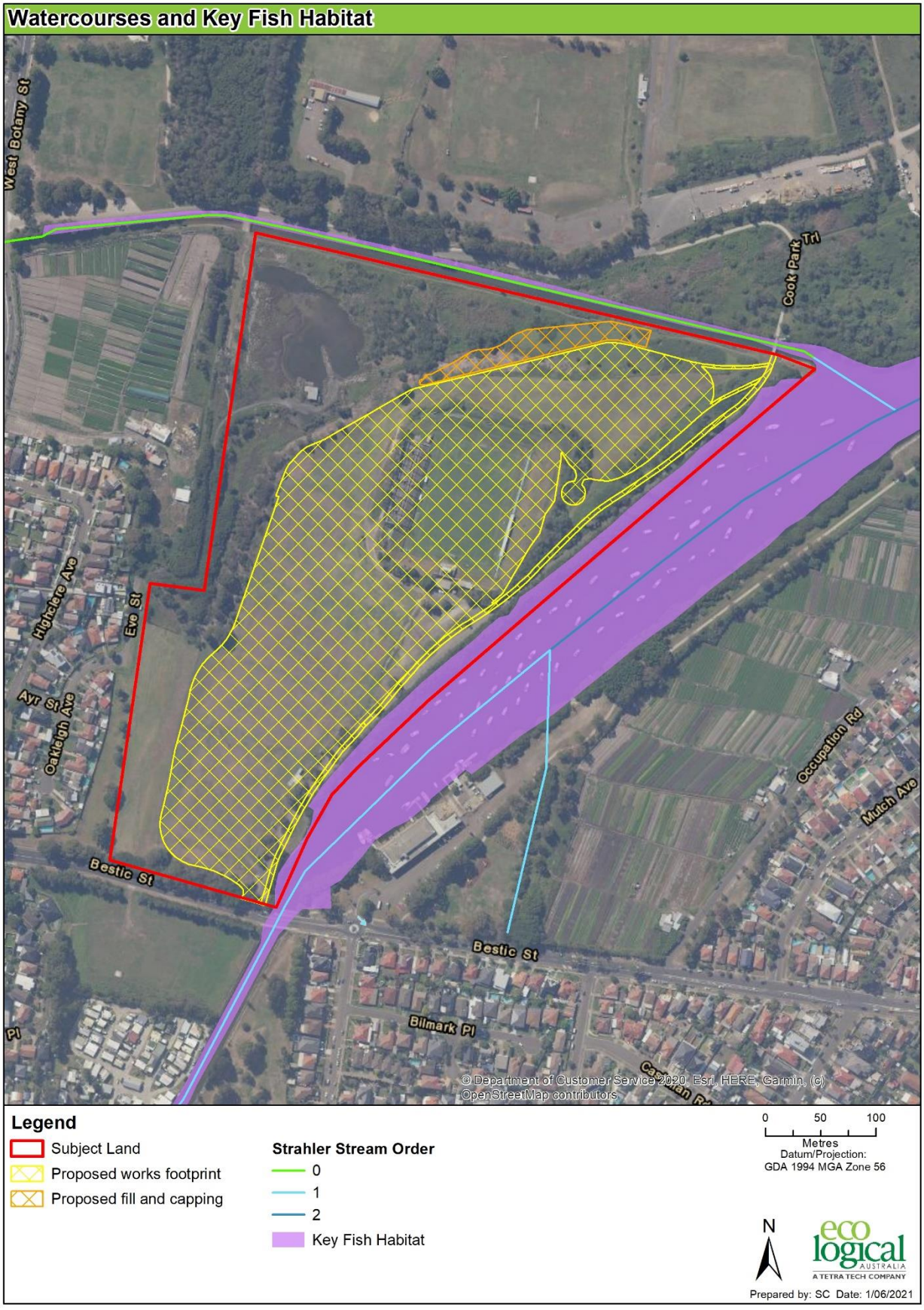

Figure 3-2: Mapped watercourses (Strahler stream order) and Key Fish Habitat within and adjacent to Barton Park

3.6. Vegetation Communities

Previous vegetation mapping identified the following vegetation types and Plant Community Types (PCTs) within Wetland Management Area (DPIE 2016):

- **PCT 920:** Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (Estuarine Mangrove Forest)
- **PCT 1126:** Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (Estuarine Saltmarsh)
- **PCT 1234:** Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (Estuarine Swamp Oak Forest)
- **PCT 1808:** Common Reed on the margins of estuaries and brackish lagoons along the New South Wales coastline (Estuarine Reedland)
- Urban exotic/native.

Field survey validated the above PCTs within the Wetland Management Area, however identified Weeds and native plantings where the Urban exotic/native community had been mapped by DPIE (Figure 3-3). Each vegetation type is described below in Table 3-2 to Table 3-6**Error! Reference source not found.**.

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Table 3-2: PCT 920 description

PCT 920: Estuarine Mangrove Forest	
Associated TEC	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
BC Act Conservation Status	Endangered*
EPBC Act Conservation Status	Vulnerable**
Vegetation Description	Occurrences of PCT 920 dominated the eastern boundary of the Wetland Management Area abutting Muddy Creek, with another smaller patch present along the western boundary of Landing Lights Wetland (Figure 3-3). PCT 920 was characterised by a canopy dominated by *Avicennia marina* var. *australasica* (Grey Mangrove), with *Casuarina glauca* (Swamp Oak). Midstorey was relatively sparse and comprised *Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle) (likely from plantings) and exotic species *Lantana camara* (Lantana) and *Opuntia monacantha* (Drooping Pear). The groundcover present was a mixture of native and exotic species and included species such as *Tetragonia tetragonioides* (New Zealand Spinach), *Solanum nigrum* (Blackberry Nightshade), *Panicum antidotale* (Giant Panic Grass), *Bidens pilosa* (Cobbler's Peg), *Chloris gayana* (Rhodes Grass) and *Eragrostis curvula* (African Love Grass) *Occurrences of PCT 920 within the Wetland Management Area did not meet the definition for the endangered *Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, as described in the BC Act Final Determination, due to the absence of characteristic vascular species and dominance of *A. marina* var *australasica*. **Occurrences of PCT 920 within the Wetland Management Area did not meet the definition for vulnerable *Subtropical and Temperate Coastal Saltmarsh*, as described in the EPBC Act Conservation Advice, because it did not meet the following key diagnostic characteristics: • "Consists of dense to patchy areas of characteristic coastal saltmarsh plant species (i.e., salt-tolerant herbs, succulent shrubs or grasses, that may also include bare sediment as part of the mosaic). Proportional cover by tree canopy such as mangroves, Melaleucas or Casuarinas is not greater than 50% nor is proportional ground cover by seagrass greater than 50%"
Photo	

Table 3-3: PCT 1126 description

PCT 1126: Estuarine Saltmarsh	
Associated TEC	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
BC Act Conservation Status	Endangered
EPBC Act Conservation Status	Vulnerable
Vegetation Description	Occurrences of PCT 1126 within the Landing Lights Wetland were present along the western boundary (Figure 3-3). As is characteristic of this PCT, occurrences of PCT 1126 within the Landing Lights Wetland largely lacked a canopy. *C. glauca* and *A. marina* var. *australasica* saplings were scattered throughout the midstorey. These areas were dominated by a mix of native and exotic groundcover species, including *Suaeda australis* (Seablite) and *Sarcocornia quinqueflora* (Samphire) and *Juncus acutus* (Spiny Rush). Weeds were also present within the saltmarsh and includes species such as *Asparagus aethiopicus* (Asparagus Fern), *Stenotaphrum secundatum* (Buffalo Grass), *Atriplex patula, Vinca major* (Greater Periwinkle), *Lantana camara*, *Cynodon dactylon* (Couch), *Hydrocotyle bonariensis* (Kurnell Curse), *Solidago canadensis* var. *scabra* (Golden Rod) and *Medicago polymorpha* (Burr Medic). PCT 1126 within Landing Lights Wetland met the description and key diagnostic characteristics for *Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, as set out by the Final Determination and Conservation Advice. This ecological community is listed as endangered under the BC Act and vulnerable under the EPBC Act, under the name *Subtropical and Temperate Coastal Saltmarsh*.
Photo	

Table 3-4: PCT 1234 description

PCT 1234: Estuarine Swamp Oak Forest	
Associated TEC	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
BC Act Conservation Status	Endangered
EPBC Act Conservation Status	Not Listed
Vegetation Description	One small occurrence of PCT 1234 was identified south of the waterbody present in the Landing Lights Wetland (Figure 3-3). PCT 1234 contained similar species as vegetation identified as PCT 1126, however PCT 1234 differed in that it was dominated by stands of *C. glauca* regrowth. PCT 1234 within the Wetland Management Area met the description for *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* as set out by the Final Determination. This TEC is listed as endangered under the BC Act as well as the EPBC Act, under the name *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*. PCT 1234 within the Wetland Management Area met the key diagnostic and condition thresholds for the Federally listed TEC in Category C condition because it was greater than 0.5 ha, less than 2 ha and had a predominantly native understorey.
Photo	

Table 3-5: PCT 1808 description

PCT 1808: Estuarine Reedland	
Associated TEC	Sydney Freshwater Wetlands in the Sydney Basin Bioregion
BC Act Conservation Status	Endangered
EPBC Act Conservation Status	Not Listed
Vegetation Description	The largest occurrence of PCT 1808 within the Wetland Management Area was adjacent to the waterbody in the Landing Lights Wetland, with a smaller patch present along the western boundary (Figure 3-3). As is characteristic of this PCT, occurrences of PCT 1808 within the Wetland Management Area lacked a canopy. The midstorey and groundcover were dominated by a mix of native *Phragmites australis* (Common Reed), and exotic species *Paspalum dilatatum* (Paspalum), *Cynodon dactylon*, *Pennisetum clandestinum* (Kikuyu), *Foeniculum vulgare* (Fennel), *Eragrostis curvula*, *Cestrum parqui* (Green Cestrum), *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) and *Lantana camara*. According to the BioNet Vegetation Classification, PCT 1808 can be associated with two TECs, *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin* and *South East Corner Bioregions* (listed as endangered under the BC Act) and *Sydney Freshwater Wetlands in the Sydney Basin Bioregion* (listed as endangered under the BC Act and not listed under the EPBC Act). Occurrences of PCT 1808 within the Wetland Management Area met the description for *Sydney Freshwater Wetlands* as set out by the Final Determination. However, occurrences of PCT 1808 within the Wetland Management Area did not meet the description for *Swamp Oak Floodplain Forest* as set out by the Final Determination, because the PCT did not have a dominant tree canopy. This TEC is also listed under the EPBC Act, however PCT 1808 is not associated with the Federally listed TEC.
Photo	

Table 3-6: Weeds and Native Plantings description

Weeds and Native Plantings	
Associated TEC	N/A
BC Act Conservation Status	-
EPBC Act Conservation Status	-
Vegetation Description	Weeds and native plantings were prevalent throughout the Wetland Management Area. Dominant weed species included *Lantana camara*, *Pennisetum s clandestinum* and *Cestrum parqui*. Vegetation identified as weeds and native plantings did not conform to a PCT or TEC.
Photo	

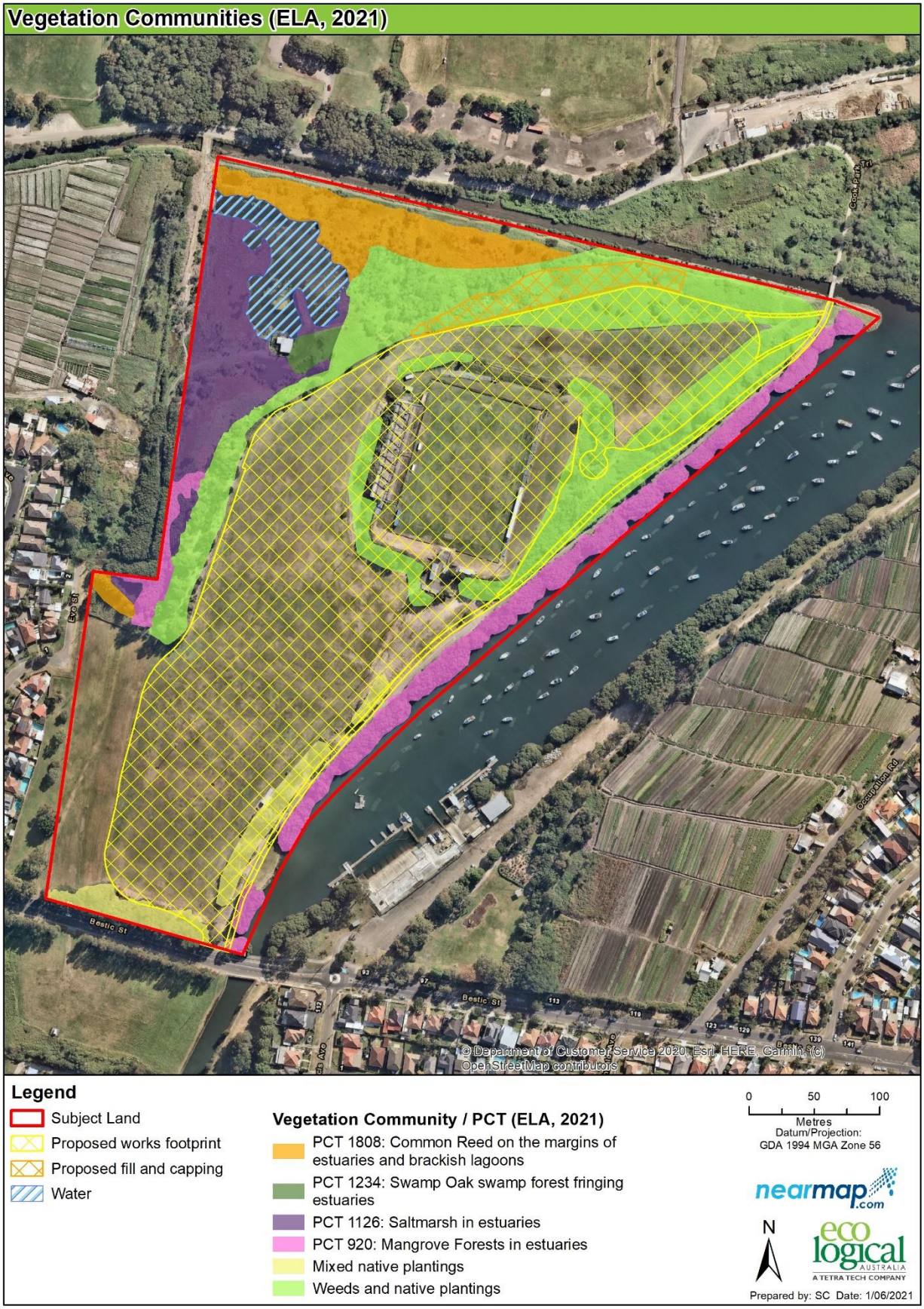

Figure 3-3: Validated vegetation communities within Barton Park (ELA, 2021)

3.7. Priority Weeds and Weeds of National Significance (WoNS)

Of the weeds identified during the field survey within the Wetland Management Area, three species are listed as a state priority weed, two are listed as regional priority level weeds and the remaining 11 weeds are listed as other weeds of regional concern. The weeds present, their priority listing under the Act, their associated asset / value at risk and whether they are Weeds of National Significance (WoNS), are presented in Table 3-7.

Table 3-7: State level determined priority weeds and other weeds of concern present

Scientific name	Common name	WoNS	Priority Weed Obligation
State Level Priority Weeds			
Asparagus aethiopicus	Ground Asparagus	Yes	Asset protection
Lantana camara	Lantana	Yes	Asset protection
Opuntia monacantha	Drooping Pear	Yes	Asset protection
Regional Priority Level Weed			
Cestrum parqui	Green Cestrum	No	Asset protection
Olea europaea subsp. *cuspidata*	African Olive	No	Containment
Other Priority Weeds			
Acacia saligna	Golden Wreath Wattle	No	Other regional weeds
Acetosa sagittata	Turkey Rhubarb	No	Other regional weeds
Ageratina riparia	Mistflower	No	Other regional weeds
Araujia sericifera	Moth Vine	No	Other regional weeds
Celtis australis		No	Other regional weeds
Cenchrus clandestinus	Kikuyu	No	Other regional weeds
Chloris gayana	Rhodes Grass	No	Other regional weeds
Eragrostis curvula	African Lovegrass	No	Other regional weeds
Ipomoea indica	Morning Glory	No	Other regional weeds
Juncus acutus	Spiny Rush	No	Other regional weeds
Parietaria judaica	Asthma Weed	No	Other regional weeds

3.8. Threatened Flora and Fauna

The search for threatened species using the Protected Matters Search Tool and BioNet (Atlas of NSW Wildlife) (within a 10 km buffer around Barton Park) and the review of literature resulted in a list of 16 threatened ecological communities, 24 threatened flora species and 88 threatened or migratory fauna species, some of which are shown in Figure 3-4.

Figure 3-4: Previously recorded threatened species within the vicinity of Barton Park

3.8.1. Threatened flora

Two *Syzygium paniculatum* (Magenta Lilly Pilly) individuals were identified within the Wetland Management Area during survey. *S. paniculatum* is listed as endangered under the BC Act and vulnerable under the EPBC Act. However, the natural habitat for this species is restricted to remnant stands of littoral rainforest, which were not observed within the Wetland Management Area. Horticultural varieties of this species are regularly planted throughout Sydney. The *S. paniculatum* species identified within the Wetland Management Area were horticultural specimens and therefore do not require further assessment.

No habitat for threatened flora species was identified within the Wetland Management Area.

3.8.2. Threatened fauna

No threatened fauna species were observed within the Wetland Management Area during survey.

A list of threatened fauna known to occur (from previous records) within the Wetland Management Area or identified as likely or having the potential to occur within the Wetland Management Area was compiled based on a review of the existing literature and habitat assessments conducted as part of the field survey and is within Appendix A of the Flora and Fauna Assessment (FFA) (ELA 2021a). This list is presented in Table 3-8.

Table 3-8: Fauna species known from the subject land, or considered likely/potentially occurring within the Wetland Management Area

Scientific name	Common name	BC Act listing	EPBC Act listing	Available habitat
Frogs				
Crinia tinnula	Wallum Froglet	Vulnerable	Not listed	Waterbodies and surrounding vegetation
Litoria aurea	Green and Golden Bell Frog	Endangered	Vulnerable	Waterbodies and surrounding vegetation
Woodland Birds				
Anthochaera phrygia	Regent Honeyeater	Critically endangered	Critically endangered	Presence of feed trees, particularly *Corymbia maculata* (Spotted Gum)
Artamus cyanopterus cyanopterus	Dusky Woodswallow	Vulnerable	Not listed	Native vegetation, particularly Eucalypts
Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable	Not listed	Native vegetation, particularly Eucalypts
Glossopsitta pusilla	Little Lorikeet	Vulnerable	Not listed	Native vegetation, particularly Eucalypts
Lathamus discolor	Swift Parrot	Endangered	Critically endangered	Presence of autumn-winter feed trees, particularly Eucalypts
Wetland Birds				
Anseranas semipalmata	Magpie Goose	Vulnerable	Not listed	Wetlands
Botaurus poiciloptilus	Australasian Bittern	Endangered	Endangered	Wetlands
Burhinus grallarius	Bush Stone-curlew	Endangered	Not listed	Wetlands, saltmarsh and surrounding vegetation

Scientific name	Common name	BC Act listing	EPBC Act listing	Available habitat
Calidris acuminata	Sharp-tailed Sandpiper	Not listed	Migratory	Wetlands
Calidris alba	Sanderling	Vulnerable	Migratory	Wetlands
Calidris canutus	Red Knot	Not listed	Endangered; Migratory	Wetlands
Calidris ferruginea	Curlew Sandpiper	Endangered	Critically endangered, Migratory	Wetlands
Calidris tenuirostris	Great Knot	Vulnerable	Critically endangered, Migratory	Wetlands
Charadrius mongolus	Lesser Sand-plover	Vulnerable	Endangered, Migratory	Wetlands
Epthianura albifrons	White-fronted Chat	Vulnerable	Not listed	Wetlands
Haematopus fuliginosus	Sooty Oystercatcher	Vulnerable	Not listed	Wetlands
Haematopus longirostris	Pied Oystercatcher	Endangered	Not listed	Wetlands
Hirundapus caudacutus	White-throated Needletail	Not listed	Migratory	Wooded areas and wetlands
Ixobrychus flavicollis	Black Bittern	Vulnerable	Not listed	Wetlands
Limosa limosa	Black-tailed Godwit	Vulnerable	Migratory	Wetlands
Numenius madagascariensis	Eastern Curlew	Not listed	Critically endangered, Migratory	Wetlands
		Bats		
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Vulnerable	Potential roosting habitat in *Petrochelidon ariel* (Fairy Martin) mud nests
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable	Presence of feed trees, including *Corymbia maculata* (Spotted Gum) and *Melaleuca quinquenervia* (Broad-leaved Paperbark).

4. Management Plan

Management measures have been proposed to avoid and reduce impacts to the Wetland Management Area and Muddy Creek as a result of the construction and operation of the new Barton Park precinct. Where relevant, these measures are to be incorporated into the Construction Environmental Management Plan (CEMP) for construction works associated with both the Barton Park Precinct Masterplan and into any ongoing internal Operation Plans managed by Bayside Council. The measures are to be implemented by the Construction Contractor and Bayside Council.

4.1. Construction Mitigation and Management Measures

Management measures relating to construction activities associated with the Barton Park Masterplan are outlined in Table 4-1. These measures should be considered as a minimum requirement and implementation is the responsibility of the Construction Contractor and Bayside Council.

Table 4-1: Construction mitigation and management measures

Measure	Action	Outcome	Timing	Responsibility
Define the works boundary	Clear delineation of the works footprint. Mark and check, with surveyor's pegs and equipment, to ensure that the minimum area of take is adopted. Clearing and / or soil disturbance is only to occur within approved areas. Erect a temporary fence line along edge of works footprint to prevent accidental encroachment into protected areas.	Accidental clearing of vegetation and disturbance of wetland areas avoided	Prior to commencement of and during construction works	Construction Contractor
Protect water quality and aquatic habitat of Landing Lights Wetland and Muddy Creek	Install erosion and sediment controls as per the 'Blue Book' Soils and Construction, Managing Urban Stormwater (Landcom, 2004) with reference to Chapter 5 'Erosion Control: Management of Water' Blue Book. Sediment fences are to be trenched into the ground outside of the wetland areas, to prevent any sediment-laden water entering these areas. Maintain these controls at least weekly and after heavy rain.	Turbid water does not enter Landing Lights Wetland or Muddy Creek	Prior to commencement of and during construction works	Construction Contractor
Protect threatened and migratory birds	Plan works for between April and August when migratory bird species are in fewer numbers.	Avoid impacts to migratory bird species	During construction works	Construction Contractor

Measure	Action	Outcome	Timing	Responsibility
Create vegetated buffer between Landing Lights Wetland and proposed works footprint	Establish vegetated buffer between north and north western side of proposed sports fields and Landing Lights Wetland, as described in Section 5. Select plant species that grow to no more than 5 m tall to protect flight paths of migratory and shore birds.	Vegetated buffer between Landing Lights Wetland and proposed works footprint to prevent poor quality water, nutrients and exotic flora species from entering Landing Lights Wetland.	During construction works	Construction Contractor
Contaminant controls and spill prevention	Controls for the Wetland Management Area include the following: • Store all chemicals (e.g., fuel, oil) offsite. If required to be stored onsite, store chemicals in appropriate bunding/storage systems, outside of the wetland management area and only for short periods • Ensure appropriate spill kits, are present onsite • Ensure all equipment is in good working order • Carry associated Safety Data Sheets (SDS) for all chemicals • Do not use any chemicals that are labelled as 'Class 9 Environmentally hazardous' as part of the proposed activities • Do not stockpile rubbish or store chemicals near native vegetation or waterways • Limit the use of fuel, chemicals and herbicides near Landing Lights Wetland and Muddy Creek.	Input of sediment-laden flow and/or contaminants avoided	During construction works	Construction Contractor
Light spill management	Undertake works during daylight hours only	Avoidance of light spill	During construction works	Construction Contractor
Use local native seed stock within area subject to WEMP	• Collect seed from local provenance species. Groundcovers and shrubs should be collected from within 5 km of the Wetland Management Area. If seed is not available within 5 km, this radius can be extended to a maximum of 10 km • Where the species identified in Appendix A cannot be sourced, they may be substituted for other suitable species as approved by a suitably qualified ecologist • Only use wild native species. Plants are not to be substituted with horticultural varieties under any circumstances.	Revegetation completed using local provenance stock	During construction works	Construction Contractor

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Measure	Action	Outcome	Timing	Responsibility
	Record keeping of seed collection and planting locations is to follow the Flora Bank guidelines (Mortlock 2000). This is important for this site as future revegetation works across surrounding areas are likely to draw on seed sources created through these revegetation works.			
Control spread of weeds and pathogens	• Wash down equipment and vehicles prior to and after use, to manage the introduction and spread of weed propagules • Thoroughly clean all equipment of soil and weed propagules prior to entry into the subject land • Remove Priority weeds using best management practices (including appropriate controls to prevent impacts to threatened species) prior to removal of native vegetation. Remove weed propagules offsite • Bag and remove all weed propagules offsite, preferably the same day and dispose of at designated green waste facility.	Spread of exotic species into Wetlands Management Area avoided	During construction works	Construction Contractor

4.2. Ongoing / Operational Mitigation and Management Measures

Management measures relating to the ongoing operation and maintenance associated with the Barton Park Precinct Masterplan are outlined in Table 4-2. These measures should be considered as a minimum requirement and implementation is the responsibility of the Construction Contractor and Bayside Council. Mitigation and management measures have been identified for a period of five years, after which the WEMP is to be reviewed,

Table 4-2: Ongoing / operational mitigation and management measures

Measure	Action	Outcome	Timing	Responsibility
Weed management	Weed management is to consist of the following actions, as outlined in Section 5.3: • Removal of Priority Weeds using best management practices (including appropriate controls to prevent impacts to threatened species) prior to removal of native vegetation. Remove weed propagules offsite • Bagging and removal of all weed propagules offsite, preferably the same day and dispose of at designated green waste facility • Consideration of the implementation of a Weed Management Plan and revegetation works program • Continuation of bush regeneration activities in Landing Lights Wetland, as organised by Bayside Council.	Habitat degradation by weeds avoided	For a period of five years after construction commences	Bayside Council
Protect extent of saltmarsh vegetation community	Remove mangrove seedlings growing in saltmarsh	No reduction in extent of saltmarsh vegetation community	For a period of five years after construction commences	Bayside Council
Enhance habitat within Landing Lights Wetland	Habitat enhancement is to consist of the following: • Revegetation and weed control in each management zone as outlined in Appendix A • Ensure connectivity throughout corridors or 'habitat islands' made up of structured vegetation, boulders and/or logs, suitable for sheltering.	Habitat connectivity and function maintained	For a period of five years after construction commences	Bayside Council
Informative signage	Install and maintain signage detailing the importance of the Landing Lights Wetland to local biodiversity including fish and migratory birds.	Raised awareness of importance of wetland habitat for biodiversity and ecosystem	For a period of five years after construction commences	Bayside Council

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Measure	Action	Outcome	Timing	Responsibility
		services and protection of migratory and shorebird habitat.		
Management of water quality entering Landing Lights Wetland and Muddy Creek.	Construct rain gardens and grassed swales to treat overland flow from Barton Park before it enters Landing Lights Wetland and Muddy Creek.	Improved water quality entering Landing Lights Wetland and Muddy Creek	For a period of five years after construction commences	Bayside Council
Light spill management	• Utilise directional lighting to avoid light spill into the Landing Lights Wetland after daylight hours • Switch off or dim lights outside of operational hours to reduce potential impacts to inhabitants of Landing Lights Wetland • Manage artificial lights using motion sensors and timers • Aim light onto the exact surface area requiring illumination. Use shielding on lights to prevent light spill into the atmosphere and outside the footprint of the target area • Avoid lights containing short wavelength, violet / blue light and white LEDs • Avoid high intensity light of any colour • Maintain a dark zone around Landing Lights Wetland.	Reduction of light spill	For a period of five years after construction commences	Construction Contractor

5. Implementation

5.1. Supervising Ecologist

Implementation of the WEMP is to be under the supervision of a restoration ecologist. The ecologist is to have a minimum of five years' experience in managing restoration sites, including saltmarsh restoration sites, have a relevant university degree and/or have completed TAFE Certificate III in Land Management and have membership of the Association of Australian Bush Regenerators (or the prerequisite qualifications and experience for membership). The restoration ecologist should seek advice from an experienced aquatic ecologist and other specialists as required.

The supervising restoration ecologist will assess and report to Bayside Council on the following matters during implementation of the WEMP. During the construction phase of the project, the restoration ecologist will report to Council every two months, and then on a six-monthly basis until the five year term of the WEMP is complete. The restoration ecologist will report on:

- Erosion and sediment controls
- Protection of retained vegetation including mangroves
- Rubbish
- Effectiveness of weed control
- Mulch depth
- Planting survival.

5.2. Timeframe and Performance Criteria

The WEMP will have a minimum five-year timeframe. Performance criteria have been set for the establishment and maintenance phases of the WEMP. Any major departures from the WEMP or change to performance criteria must be approved in writing by Bayside Council.

5.2.1. Performance Criteria for WEMP

Completion of the initial five-year term of the WEMP will require demonstrated achievement of the following:

- No sediment runoff into the Wetland Management Area and Muddy Creek
- 80% of weeds have been removed from designated areas
- No rubbish is evident within each management zone
- An initial round of native plantings has occurred with 80% survival rate within each vegetation management zone where applicable six months after planting.

5.3. Weed Control

While not desirable from an ecological perspective, some woody weeds such as Lantana are providing habitat to small birds and animals. Therefore, removal of Lantana should only take place once compensatory habitat has been established.

Staged bush regeneration techniques will remove weeds on within all zones to minimise the risk of soil instability. The principles of bush regeneration and techniques to trigger natural regeneration are to be

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in accordance with the Bradley Method and other techniques described in Buchanan (2000). Details of specific weed control techniques to be used such as cut and paint, scrape and paint, herbicide spraying and hand weeding are given in Brodie (1999) and outlined below for different types of weeds found in the Wetland Management Area. Priority weed species should be targeted first.

Dying weeds will be left in situ to reduce the risk of soil instability. Exotic species should be removed by hand where possible and herbicide use should be restricted to a minimum. Herbicide use should occur during the active growing season for plants to encourage the chemical uptake into the plant. The selection of herbicides should also consider the type of weed, the location and the risk of spray drift damaging native vegetation, in particular saltmarsh, mangrove and swamp oak vegetation. Where non-selective herbicides are required for use, glyphosate is the most suitable. If herbicides are required to be used near waterways, a glyphosate-based herbicide formulated for use near waterways should be used (e.g. RoundUp© Biactive™).

5.3.1. Weed Management Techniques

A selection of the best suited weed control method within the site depends on factors including:

- The species or combination of weeds being targeted
- The density of the weeds and the density of desired native plants and risk of non-target impacts
- Resources available (time, labour, equipment and finances)
- Access restrictions (e.g. inundated areas)
- Proximity to sensitive receptors (aquatic habitat)
- Weather conditions of the day.

Registration and records of herbicide use must be kept in accordance with the NSW *Pesticide Regulation 2009.*

ANNUAL GRASSES

Annual grasses should be hand removed or spot sprayed where isolated or in low concentrations. Larger patches of annual grasses may be slashed/brush cut in late spring to early summer, after flowering, but prior to seed set. For most species, slashing/brush cutting prior to late spring through to early summer will promote vigorous growth and should not occur. However, some annual grasses can grow and produce seed at any time of the year dependent on climatic conditions such as high rainfall and warm temperatures. Monitoring of annual species should be undertaken and if new growth occurs, the same treatment will be applied to the new growth to prevent seed production. Individual plants should be hand removed. All propagative vegetative material removed should be bagged, removed from site and disposed of at a registered green waste facility.

PERENNIAL GRASSES

Perennial grasses, such as *Pennisetum clandestinum* (Kikuyu) or *Chloris gayana* (Rhodes grass) should be hand removed where isolated or in low concentrations. Larger patches may be slashed prior to seed production in summer or autumn (depending on the growth cycle of the species) and the regrowth spot-sprayed 2-3 weeks later when it is actively growing and approximately 10 cm in length. Monitoring of these species will occur and if new seed production occurs, the same treatment is to be applied again as required. However, slashing will not reduce the presence of exotic grasses on its own and must always be combined with targeted removal to reduce densities and allow for native regeneration. Individual

plants should be hand removed. All propagative vegetative material removed should be bagged, removed from site and disposed of at a registered green waste facility.

WOODY WEEDS

Primary control of trees such as *Acacia saligna* and *Olea europaea* subsp. *cuspidata* should be cut at the base and then painted with a non-selective herbicide. This involves using a hand drill to make several holes around the circumference of the base of the tree. These holes should then be filled with a non-selective herbicide. The target species will die in-situ which will provide ground stability around the area.

This will ensure the weed is treated whilst still providing temporary ground stabilisation and habitat. If other woody weeds invade the site these will be controlled by the cut and paint or drill and fill method using a non-selective herbicide. The most appropriate method to be used depends on the size of the individual to be removed and will be determined by the bush regeneration contractor. Primary weed control should use techniques that will not encourage flushes of secondary weed growth. All seedlings of woody weeds will be hand pulled or spot-sprayed with a non-selective herbicide.

HERBACEOUS WEEDS

Herbaceous weeds, such as *Bidens pilosa* and *Parietaria judaica* should be hand pulled prior to flowering. Where large swaths of these species occur, they should be sprayed using a non-selective herbicide. If high densities of mature stands occur, weeds may be slashed first using a brush cutter and any subsequent regrowth sprayed. Regular monitoring of these species will be required to prevent seed production. All vegetative material that is pulled out and has the potential to regrow if deposited on ground will be bagged and removed from site.

5.4. Plant Supply and Installation

Maintenance of existing vegetation communities, revegetation in degraded areas of the Wetland Management Area and the creation of a vegetated buffer between the Landing Lights Wetland and the proposed works footprint are expected to be the main methods of protecting and conserving the Wetland Management Area. Figure 5-1 shows the location of each of the vegetation management zones, with different on-ground maintenance requirements for each zone as outlined below.

ZONE 1: SALTMARSH

Weed species of concern in Zone 1 include species such as *Asparagus aethiopicus* (Asparagus Fern), *Stenotaphrum secundatum* (Buffalo Grass), *Atriplex patula, Vinca major* (Greater Periwinkle), *Lantana camara* (Lantana), *Cynodon dactylon* (Couch), Hydrocotyle *bonariensis* (Kurnell Curse), *Solidago canadensis* var. *scabra* (Golden Rod) and *Medicago polymorpha* (Burr Medic).

Any mangrove seedlings that begin growing in saltmarsh area should be removed. Discuss with NSW Fisheries the possibility of removing larger mangrove plants that are encroaching on the edge of saltmarsh.

Undertake planting of saltmarsh species (see Appendix A) following weed removal. Plants should be planted in clumps to facilitate creation of habitat pockets.

ZONE 2 AND ZONE 6: MANGROVES

Weed species of concern in Zones 2 and 6 include *Lantana camara* (Lantana) and *Opuntia monacantha* (Drooping Pear). Care should be taken when planning for Lantana removal to ensure that adequate habitat for small birds is available elsewhere before the Lantana is removed. Alternatively, cut and paint the Lantana and leave in situ to facilitate habitat.

No planting is proposed in Zones 2 and 6 due to the established mangrove community within this area.

ZONE 3: WEEDS AND NATIVE PLANTINGS

Weed species of concern in Zone 3 include *Lantana camara*, *Pennisetum s clandestinum* and *Cestrum parqui*. This zone will be densely revegetated following weed removal and remediation of the proposed fill and capping area.

No canopy trees will be planted in this zone to prevent impacts to migratory birds

ZONE 4: COMMON REED

Weed species of concern in Zone 4 include *Lantana camara*, *Pennisetum s clandestinum, Eragrostis curvula* and *Paspalum dilatatum, Cestrum parqui* and *Gomphocarpus fruticosus.* Planting of species from the Estuarine Reedland vegetation community (Appendix A) should take place within this zone.

ZONE 5: SWAMP OAK FOREST

The weed species of concern in Zone 5 is *Lantana camara*. Planting of species from the Swamp Oak Forest vegetation community (Appendix A) should take place within this zone.

Figure 5-1: Wetland Management Zones

5.4.1. Plant Supply

Plants supplied for this project should be of local provenance where possible and confirmation will be needed regarding the origin of plants supplied. Planting of Hiko for shrub species and Hiko or Viro cells for grasses and other groundcover species is the preferred method. Where possible, saltmarsh plants for intertidal areas should be supplied as Forestry tubes to reduce the risk of plants being washed away. Details of pot sizes are provided in Section 6.

Saltmarsh plants must be salt hardened before they leave the nursery. This can be achieved using pool salt mix at 30 ppm or 30 grams of salt per litre of fresh water. When plants are delivered to site and kept ready to plant, they will continue to be watered with salt water.

5.4.2. Planting Method

Planting should be done via a low impact method such as hand digging or hand auger. The holes dug for each plant should be at least 1.5x the width and 2x the depth of the root ball.

5.4.3. Irrigation of Non-Tidal Plants

Water crystals or wetting agents should be added to each plant hole (where applicable). This will increase the water holding capacity of the soil and reduce watering schedules especially in difficult to access locations. Initial irrigation of the tubestock is not needed if plantings are completed immediately before sufficient rainfall. Otherwise, watering immediately after planting is critical to get a good establishment rate.

All plants in the non-tidal zone should be watered at least twice after planting to increase survival rates of revegetation. Further watering will occur if deemed necessary by the Construction Contractor depending on rainfall after the planting has occurred and season of planting.

5.4.4. Saltmarsh Irrigation

Saltmarsh species, which will have been 'hardened off' by the plant supplier, will be irrigated by hand with saltwater following planting to assist with establishment. Irrigation with salt water will also assist with controlling terrestrial weeds in saltmarsh areas.

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6. Monitoring and Reporting

The Construction Contractor will monitor the vegetation for changes over time. Information gained through the monitoring and reporting process will identify works that have and have not been successful, and the reasons for their success or failure.

The aim of monitoring is to measure the effectiveness of the control actions being undertaken to achieve the desired outcome. It will identify non-conformance and provide the contractor with the information to plan corrective actions. Information derived from the results of monitoring will also be used in adaptive management (i.e., learning from experience to inform future priorities and work plans). For example, seasonal changes promote booms of particular weed species.

Finally, monitoring and reporting will help determine and quantify the costs related to weed management and the cost effectiveness of the WEMP.

6.1. Vegetation Monitoring

Monitoring will be undertaken by visual assessments and photo monitoring. Monitoring will need to be implemented prior to works commencing to establish a benchmark for performance, and to occur on an annual basis until the completion of the five-year term of the WEMP.

A number of photo monitoring points will be established across the site to provide a visual reference of changes in the vegetation and performance of wetland works. This will be undertaken prior to the commencement of works and at the beginning of each summer season. The lead supervisor will:

- Set up 10 photo points across the site with the following number of photo-points in each zone
    - Zone 1: 2
    - Zone 2: 1
    - Zone 3: 3
    - Zone 4: 1
    - Zone 5: 1
    - Zone 6: 2
- Mark the photo point with a six-foot star picket and map the location of each photo point
- Take a digital photo of each photo point with the whole length of the star picket visible in the photo to act as a reference point
- Organise the digital photos logically with each image labelled with a unique reference number indicating the location of the photo point, the direction of the photo and the date the photo is taken.

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Table 6-1: Monitoring requirements to assess effectiveness of ongoing mitigation and management measures

What monitored	How monitored	Where	Who monitors	Threshold Trigger	Action Response
Water quality	Establish monitoring regime for water quality improvement structures Monitor plant growth in rain garden and swale. Replace plants when necessary Clear out gross pollutants that have accumulated in swales and rain gardens Remove accumulated sediment from the surface of the rain gardens and swales. Monitor for sediment accumulation after heavy rainfall Follow design recommendations for rain garden and filter	Across Barton Park	Suitably qualified aquatic ecologist	Visible accumulation of sediment and/or gross pollutants in raingardens and swales	Review maintenance schedule of raingardens and swales and arrange maintenance or cleaning as per construction contractor's guidelines to allow these features to function as designed.
Weed presence	Annual survey for weed coverage/percentage in wetland management area	Wetland Management Area	Suitably qualified ecologist or Council Environment Officer	More than 10% increase on previous year's coverage of priority weed in any management zone	Review vegetation maintenance contracts to see if focus has moved from any particular zone Assess funding allocation to works within the zone/s affected and consider additional funding sources Reconsider focus of vegetation maintenance actions in these zone/s to prioritise weed suppression.

What monitored	How monitored	Where	Who monitors	Threshold Trigger	Action Response
Revegetation success	3 monthly survey following initial planting for the first year, then annual survey	Wetland Management Area	Suitably qualified ecologist or Council Environment Officer	More than 10% dieback of planted tubestock observed at each monitoring survey	Review vegetation maintenance reports to determine if maintenance or watering of these areas has been continuous. Plant replacement tubestock and undertake regular maintenance including watering.
Water quantity	Visual assessment of overland flow paths	Wetland Management Area	Bayside Council Stormwater Engineer	Signs of erosion on edge of wetland, including rills on slope above wetland, eroded sediment in wetland	Inspect all outlet points onto oval and wetland

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6.2. Reporting

A report will be prepared every six months for the first two years and then annually thereafter until the end of the five-year period. The reporting period will begin after preliminary works have been approved and signed off. This report should include:

- The time period the report relates to
- Qualifications and experience of contractors
- Certification of seed and local provenance stock
- A summary of works carried out within the period including:
    - Date and time of site visits
    - Works completed on the site at each visit
    - A table detailing total person hours for each task carried out on site
    - Methods of weeding undertaken and details of herbicide use
    - Numbers of tubestock planted if applicable
    - Methods implemented for Assisted Natural Regeneration
- Photo monitoring results to date
- A description of any problems encountered in implementing the works outlined in this WEMP and how they were overcome
- Any observations made, including new plant species recorded (native and weed species), comments on rates of regeneration and any problems which impact on the implementation of the WEMP
- If applicable, the results of the implementation work in relation to the relevant performance criteria.

This annual report will highlight the effectiveness of the program and identify any changes needed to improve (i.e., changes to weed control techniques, types of herbicides used or weed priority) weed management. Annual reporting will be crucial in determining whether the actions being implemented are having the desired effect or if alternative weed control techniques (for the particular weed species) are required.

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Appendix A Suggested Species List for Planting

Stratum	Species	Common name	Zone1	Zone3	Zone 4	Zone 5
Midstorey	*Backhousia myrtifolia*	Grey Myrtle		x		
	Goodenia ovata			x		x
	Myoporum acuminatum	Boobialla		x		x
Groundcover						
	Apium prostratum	Sea Celery			x	
	Juncus krausii	Sea Rush	x	x	x	x
	Atriplex australasica					x
	Baumea juncea			x	x	x
	Samolus repens	Creeping Brookweed	x		x	
	Sarcocornia quinqueflora		x			x
	Suaeda australis		x			
	Sporobolus virginicus					x
	Phragmites australis	Common Reed			x	

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