Draft Northern Beaches Environment Study

Planning for our environment

October 2021

northern beaches council

Eastern spinebill
Image credit: John Taylor

Meridian Urban

Prepared in partnership between Meridian Urban Pty Ltd and Northern Beaches Council.

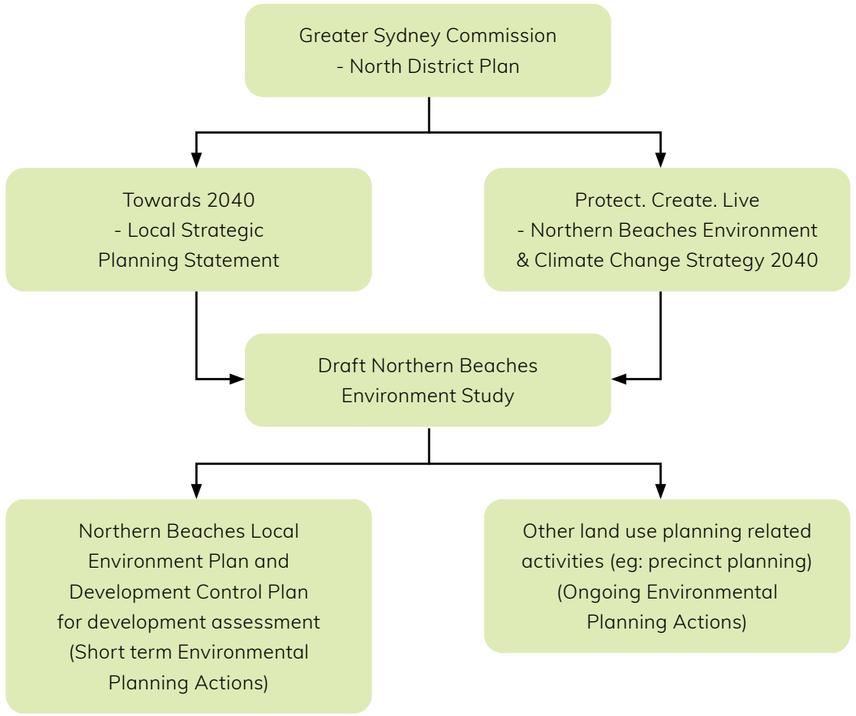
Cover image of Dee Why Headland, Northern Beaches Council. Image above of the Eastern Spinebill courtesy of John Taylor.

Contents

Executive Summary

The Draft Northern Beaches Environment Study is part of the framework to support the new Local Environment Plan, Development Control Plan and other development related activities and links closely to the North District Plan.

The Study recommends Environmental Planning Actions that will help to deliver the commitments within the Local Strategic Planning Statement - Towards 2040 and the Environment and Climate Change Strategy, 2040.



The study

- Describes the natural environment of the Northern Beaches including the bushland and biodiversity, coasts, catchments and waterways. These areas support an extensive variety of flora and fauna and contribute to the open space of the area.
- Describes the importance of open space and the connections between the natural and urban environment, the importance of energy and water efficiency as well as the impact of natural hazards and climate change. The study demonstrates that the area is exposed to significant natural hazard risk and these are likely to intensify as the climate changes.
- Describes the challenges, such as development, land clearing and recreation that may impact the natural environment.
- Discusses the opportunities in relation to future growth to enhance and protect the environment.
- Recommends environmental planning actions to be implemented either in the short term or in an ongoing timeframe. The short term actions will be delivered during the development of the new Local Environment Plan and Development Control Plan and the ongoing actions will be delivered as part of Council operations when addressing development related activities.

Health and valued coast and waterways

The coast and waterways are iconic and an intrinsic part of the Northern Beaches' lifestyle, valued for their beauty, supporting a wide variety of plants and animals and a range of recreational opportunities. Water is transported through the eight major catchments to a coastal lagoon; directly onto the beaches; into Sydney Harbour, the Hawkesbury River or Pittwater. The creeks and lagoons are part of an overall natural system and contribute to the green infrastructure that cools and adds beauty to the area.

Arguably some of the most iconic open coastline in the country, it is interspersed with 25 ocean beaches, 15 estuary beaches, four intertidal protected areas and five aquatic reserves across the 80 kilometres of coastline. The network of waterways, coastline, beaches, aquatic reserves, lagoons and creeks provides habitat for the region's rich biodiversity, supports threatened ecological communities and supports groundwater-dependent ecosystems.

Environmental Planning Actions

Summary	Timeframe for implementation
Assess and map freshwater habitats – finalise the assessment of watercourses, wetlands and riparian lands.	Short term
Protect and maintain watercourses, wetlands and riparian areas at current or improved condition from development impacts by reviewing current controls and where necessary developing and implementing new planning controls using appropriate setbacks and corridors based on environmental values and stream order.	Short term
Manage the threat to water quality and aquatic ecology – develop a water cycle strategy that identifies catchments according to risk, value and condition. Develop stormwater quality and quantity targets to protect water quality and aquatic ecology.	Short term
Develop and implement planning controls that integrate water sensitive urban design and stormwater controls to ensure development achieves the identified stormwater quality and quantity targets for each catchment and protects downstream water quality and aquatic ecology.	Short term
Ensure watercourses, wetlands and major stormwater, flood mitigation works, infrastructure is incorporated into public land in precincts to facilitate ease of maintenance, multifunctionality and optimal waterway health and amenity outcomes.	Ongoing
Protect natural assets including watercourses, wetlands and riparian lands, water quality and aquatic ecology by considering them early in the strategic planning process, such as during precinct planning.	Ongoing
Identify and protect coast and waterway areas of high environmental value within the local green grid.	Ongoing
Ensure that Councils recreation planning considers protection of high environmental value coast and waterway assets and ensures recreational activities and infrastructure within these areas are low impact.	Ongoing

Protected and enhanced bushland and biodiversity

Natural areas cover almost half of the Northern Beaches including 350 bushland reserves and three national parks. Native vegetation or bushland areas include important core habitat, linked by biodiversity corridors (also known as wildlife corridors) and cover 15,562 hectares. Of this 70% is within national parks, 19% is within private ownership and the remaining 11% is managed by Council. Bushland provides vital habitat to 540 animal species including iconic threatened species such as the Glossy Black Cockatoo and Eastern Pygmy Possums. Bushland supports 1460 native plant species including several threatened plants such as the critically endangered *Grevillea caleyi* and *Prosanthera marifolia*.

Environmental Planning Actions

Summary	Timeframe for implementation
Undertake technical studies to update and refine existing biodiversity mapping.	Short term
Incorporate updated biodiversity mapping developed in technical studies into the new local planning framework. This is to include a biodiversity map layer and provisions in the new LEP. More detailed controls will identify the extent and distribution of each biodiversity asset type (core habitat, biodiversity corridors, native vegetation or bushland and threatened biodiversity) in the new DCP.	Short term
Identify areas of high biodiversity significance as 'environmentally sensitive areas' in the new LEP and seek exemptions to applying State planning controls that override local controls tailored for sensitive environments.	Short term
Develop and implement new biodiversity planning controls that will require future developments to demonstrate a hierarchy of first avoiding then minimising direct impacts on bushland before offsetting is considered.	Short term
Develop and implement new biodiversity planning controls which will focus on minimising potential indirect impacts resulting from development such as considerations of future use, predation by domestic animals, light spillage, changes in hydrology and encroachment into natural areas.	Short term
Ensure natural assets including core habitats, threatened species habitats and native vegetation are considered early in the strategic planning process, such as during planning proposals, place plans or precinct plans.	Ongoing
Ensure Council's natural assets identified in planning proposals, place plans or precinct plans are appropriately funded.	Ongoing
Identify and protect areas of high biodiversity value within the local green grid. Ensure that Councils recreation planning considers protection of high biodiversity value assets and ensures recreational activities and infrastructure within these areas are low impact.	Ongoing
Investigate, develop and implement planning controls which support property owners to enhance bushland.	Ongoing
Identify options for funding the acquisition of land parcels with significant biodiversity values by way of the NSW Biodiversity Offsets Scheme.	Ongoing
Increase the availability of local offsets by providing incentives and/or assistance to property owners to conserve bushland.	Ongoing
Council will continue to advocate to the state government agencies to ensure biodiversity offsets are established and sourced locally.	Ongoing
Develop and implement planning controls in the new planning framework that restricts the planting of priority weeds and otherundesirable species in development as referenced in the Local Weed Management Plan.	Short term

Greener urban environments

Open space and the connections between the urban and natural environment contribute to our standard of living. Our waterways, beaches, bushland, open spaces and parks are integral to the liveability and wellbeing of our community. It is necessary to maintain and enhance these connections by designing our communities around nature using the 'green and blue' grid to keep urban areas cooler and enhance biodiversity and ecological resilience.

Environmental Planning Actions

Summary	Timeframe for implementation
Review, develop and integrate planning controls into the new planning framework that includes green infrastructure that provides for water treatment and retention, water sensitive urban design, urban cooling, ecosystem services and amenity and integrate it into built, landscaped and natural environments in strategic centres, employment hubs and areas subject to urban intensification.	Short term
Ensure built form controls maximise landscape open space at ground level, and where appropriate at upper levels.	Short term
Implement a best practice Urban Tree Canopy Plan for the LGA that includes tree canopy targets and prioritises local native tree species.	Ongoing
Incorporate within the new planning framework requirements for landscape open space, tree protection and replacement requirements.	Short term
Develop and integrate planning controls into the new planning framework that require building materials that help to mitigate urban heat.	Short term

A low-carbon community, with high energy, water and waste efficiency

The vision for life on the Northern Beaches over the next twenty years inherently involves the movement towards a society with lower levels of consumption, emissions and waste generation. This vision also includes encouraging a circular economy, increased use of active and public transport opportunities, and enhanced sustainable built environment outcomes. Living sustainably and efficiently in our environment is a core focus for Northern Beaches Council, business, community groups and households alike. Northern Beaches Council is committed to achieving net zero emissions across the community by 2050 from a baseline of around two million tonnes in 2016-2017. Targets have also been set to maintain or reduce community water consumption and waste to landfill by 2040.

Environmental Planning Actions

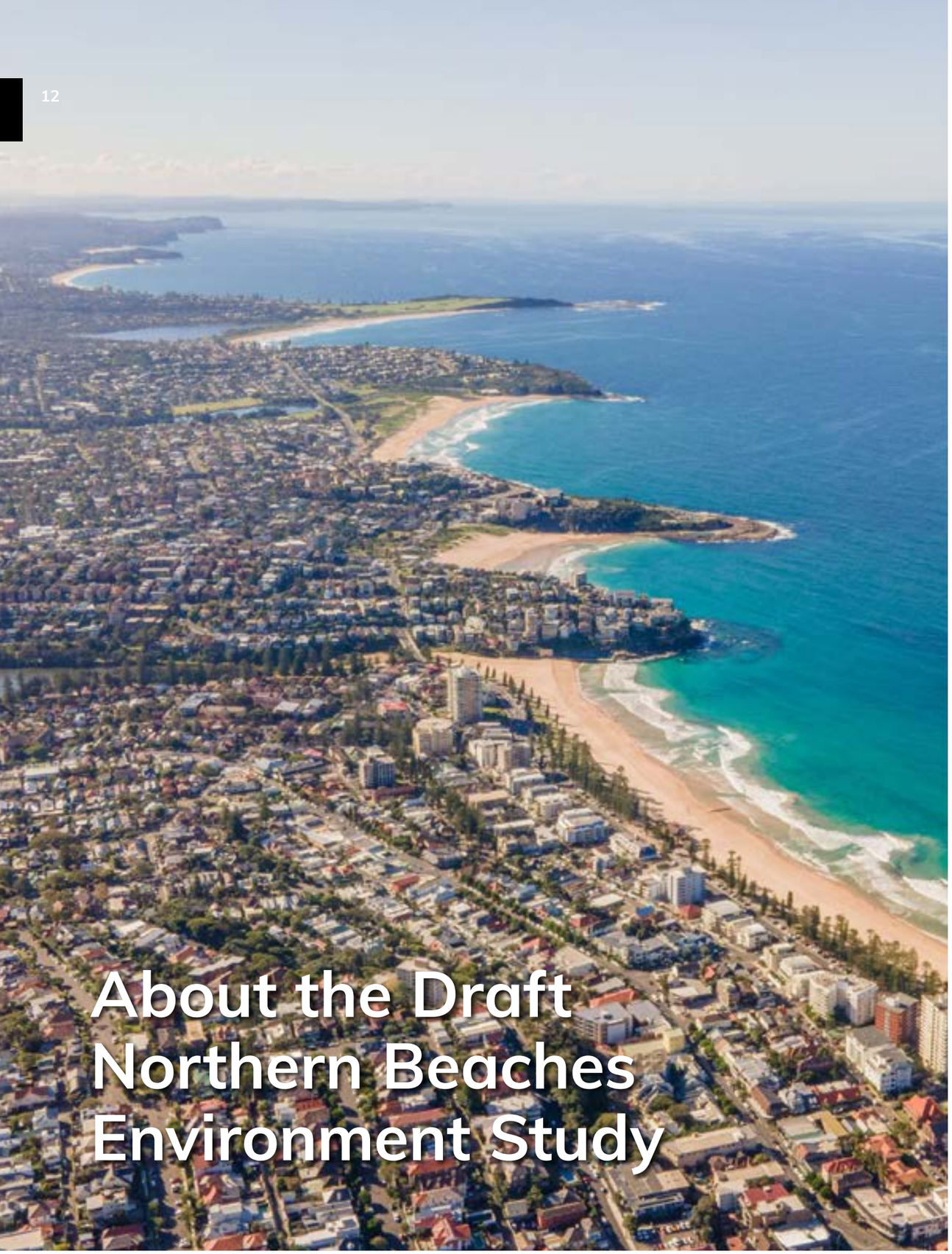
Summary	Timeframe for implementation
Deliver precinct plans and place plans as net zero carbon and high efficiency through integrating sustainability initiatives.	Ongoing
Consistent with NSW Waste and Sustainable Materials Strategy 2041 ensure planning controls provide opportunities for complementary businesses to co-locate in the Strategic Centres where they can beneficially re-use each other's by-products, reducing their waste and carbon footprints. Ensure sufficiently zoned land to enable the recycling, processing and disposal of waste generated within the LGA, and that existing waste facilities' land use is protected.	Ongoing
Ensure active transport connections are provided, including wide footpaths, safe cycling options, bus stops, shelters, bike racks and signage to support active and public transport in strategic centres and planning precincts. Ensure planning controls are included for bicycle parking and end of trip facilities to encourage healthy active lifestyles and help reduce reliance on private motor vehicles.	Short term
Reduce greenhouse gas emissions by advocating to the NSW State Government to increase BASIX requirements for residential developments including adopting net zero targets for multi-residential developments as defined in 'Planning for net zero energy buildings'	Short term
Review, develop and implement planning controls in the new planning framework to ensure efficient operational waste management.	Short term

Adapted to the impacts of natural and urban hazards and climate change

The proximity of urban areas to hazards such as waterways, coastal processes and bush fire prone vegetation places people, property and infrastructure at risk. This exposure will increase over time with population increase and projected changes in intensity and/or frequency of these events due to climate change. Almost 43,000 properties in the area are exposed to the most frequently experienced events - flood, coastal erosion and bushfire hazards. The challenge is building a resilient Northern Beaches by adopting risk-based approaches. There is a significant role for land use planning in providing effective protection to existing urban areas, whilst also ensuring that new development is not exposed to unacceptable levels of risk, does not create new risk and considers future climate change.

Environmental Planning Actions

Summary	Timeframe for implementation
Deliver resilient precinct plans and place plans that are designed with adaptive capacity to respond to shocks, chronic stressors and climate change.	Ongoing
Current and future natural hazard risks such as bushfire (including evacuation, egress or accessibility out of an area in an evacuation), flooding, coastal erosion and geotechnical risk must be considered early in the strategic planning process, including planning proposals, precinct and place plans. Future natural hazard risks will be determined by incorporating climate change projections as described by Adapt NSW, CSIRO or other peer reviewed projections in studies.	Short term
Undertake a risk-based assessment and develop maps for estuary planning levels for North Harbour, Middle Harbour and Cowan Creek according to the Coastal Management Act that identifies areas subject to current and future estuary inundation risk as consistent with those undertaken for the Pittwater Waterway. Develop planning controls that mitigate current and future risk.	Short term
Continue to identify flood prone land according to the NSW Governments Flood Prone Land Policy and Floodplain Management Manual (2005) and permit development that is compatible with the flood hazard and flood function of land considering the projected changes as a result of climate change.	Ongoing
Develop and integrate planning controls into the new planning framework using existing coastal hazard studies, such as the Coastal Zone Management Plans (Coastal Management Programs from Jan 2022) and the Identification of Coastal Hazard Risk Areas to Projected Sea Level Rise for the Manly Local Government Area.	Short term
Develop and integrate planning controls into the new planning framework that ensures all asset protection zones are contained within property boundaries as per Planning for Bushfire Protection, 2019.	Short term
Ensure that the ecological function of natural ecosystems is maintained and protected to enhance resilience to natural hazards and a changing climate.	Ongoing



About the Draft Northern Beaches Environment Study

1.0 About the Draft Northern Beaches Environment Study

Northern Beaches Council commissioned Meridian Urban to prepare the Northern Beaches Environment Study (the Study) for the Northern Beaches Local Government Area. The Study will also inform the development of the Northern Beaches Local Environment Plan (LEP) and Development Control Plan (DCP).

The Northern Beaches area has a unique character and diverse natural environmental values, which set it apart from other areas of the state and even Australia. In particular, the coast, bushland and waterways are highly valued by the community and contribute to the sense of place. The degree of connection between people and the natural environment, is one of the primary attractions of the Northern Beaches. Council has prepared the Study to help deliver the priorities and actions in its strategic documents including Towards 2040, the Community Strategic Plan as well as aspirations and commitments in the Northern Beaches Environment and Climate Change Strategy.

Towards 2040 was developed in accordance with the requirements of Section 3.9 of the Environmental Planning and Assessment Act 1979 to inform the development of Council's new LEP and DCP. Towards 2040 aligns closely to the strategic direction set out in the North District Plan and the Greater Sydney Plan. The North District Plan provides a 20-year plan to manage growth while enhancing Greater Sydney's liveability, productivity and sustainability into the future.

The vision adopted in Towards 2040 clearly emphasises the importance of the natural environ of the Northern Beaches.

Towards 2040 has defined the vision for the future. *In 2040, the Northern Beaches has a stunning coastal and bushland environment, an enriched and contemporary coastal character and better connections to the North District and the rest of Greater Sydney. The natural environment is healthy and highly valued by residents and visitors alike. There is a range of housing to accommodate the whole community and we continue to pursue design excellence and sustainability outcomes in built forms. It offers a thriving local economy and a sustainable mix of employment and industrial lands and vibrant and enlivened centres. The healthy and active community can easily access artistic, creative, sporting and recreational opportunities and the services and facilities that support their health and wellbeing.*

The Study:

- Describes the natural environment of the northern beaches including the bushland and biodiversity, coasts, catchments and waterways;
- Describes the importance of open space and the connections between the natural and urban environment; the importance of energy and water efficiency as well as the impact of natural hazards and climate change;
- Describes the challenges that may impact the natural environment and discusses opportunities in relation to future growth;
- Recommends environmental planning actions to help deliver five planning priorities adopted in Towards 2040; and
- Supports the development of the LEP and DCP.

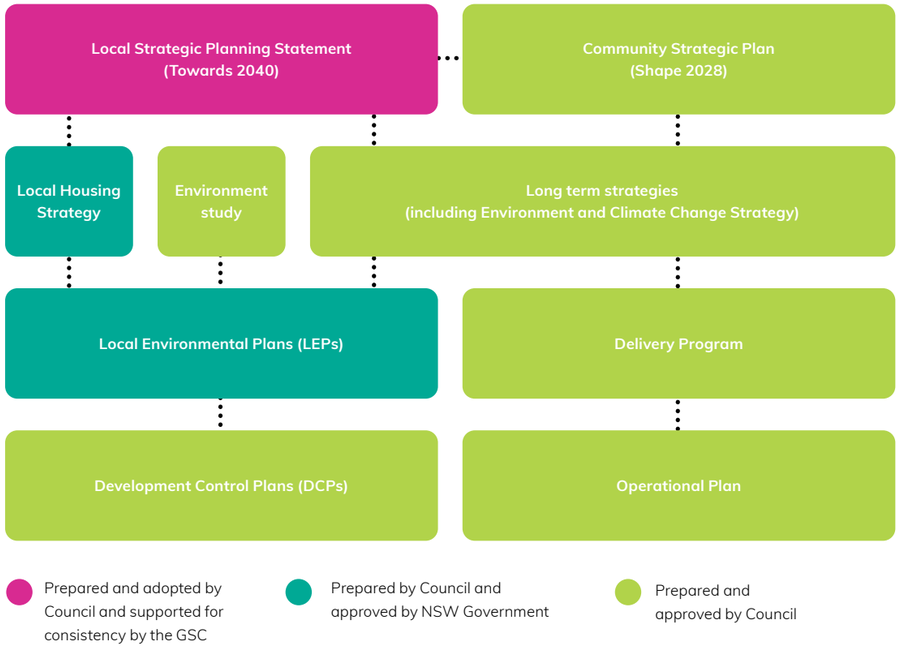
1.1 Strategic Framework

In addition to Towards 2040, Council has also adopted the *Community Strategic Plan – Shape 2028* and the Northern Beaches Environment and Climate Change Strategy *2040 – Protect. Create. Live* (ECC Strategy). These documents contain outcomes, aspirations and commitments for the environment and sustainability on the Northern Beaches. The Study is closely aligned with the strategic direction within each of these documents. The relationship between these strategic documents are shown below.

Shape 2028 was adopted following extensive community consultation. The local community places a high level of importance on environmental protection and sustainability, which resulted in these being reflected in two of the eight pillars of Shape 2028. Accordingly, it is important that future growth is planned and managed in a way that is consistent with these values. These two pillars are:

Protection of the environment
We aspire to protect the natural and built environment from the risks and impacts of global and local pressures.

Environmental sustainability
We aspire to be leaders in managing our resources sustainably and for the long term to ensure that development is balanced with our lifestyle and environment.



The Study also aligns with the ECC strategy to help shape and balance future growth through the new planning framework. The ECC strategy is built around three major directions: Protect, Create, Live.

The ECC Strategy commits to protecting the natural environment through strategic land-use planning and development controls, ensuring local planning controls ensuring development is sustainably designed and built, integrating the local green grid into planning instruments and supporting green infrastructure through our planning instruments.

Protect
We will protect and enhance our natural environment.

Create
The places, parks, structures, district urban landscapes, homes, neighbourhoods and the connections between them will be built sustainably to protect our environment.

Live
We will live sustainability everyday to reduce our waste generation and resource use. We will prepare for the current and future impacts of natural hazards and climate change.

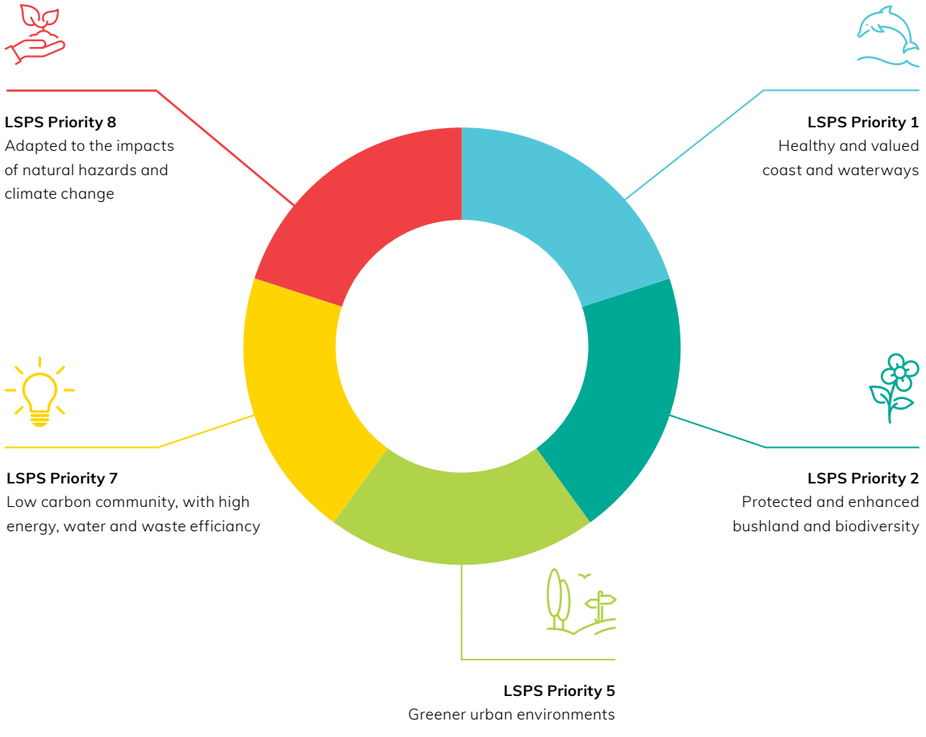
Image credit: Victoria Adair

1.2 Planning Priorities

The Study recommends environmental planning actions for the protection and enhancement of the environment spanning five identified Sustainability planning priorities adopted in Towards 2040. For each planning priority, the Study includes:

- The Towards 2040 principles;
- A description of the characteristics of the planning priority;
- The challenges and opportunities; and
- Environmental planning actions to help deliver the planning priority that demonstrate the link to the Towards 2040 actions and the outcomes of the ECC Strategy.
- Timeframes for implementation being Short Term (<3 years) or Ongoing.

LSPS Sustainability planning priorities discussed within this study



Healthy and valued coast and waterways

LSPS Priority 1

2.0 Healthy and valued coast and waterways

The coast and waterways are iconic and an intrinsic part of the Northern Beaches' lifestyle for their scenic views and for the vast array of passive and active recreational opportunities they support. Water is transported from every part of the area to a coastal lagoon; directly onto the beaches; into Sydney Harbour, the Hawkesbury River or Pittwater. The creeks and lagoons are part of an overall natural system and contribute to the green infrastructure that cools and greens the area.

The LSPS principles for Priority 1 will guide future planning decisions to protect and enhance the Northern Beaches highly valued coast and waterways. These principles are:

- Promote development that maintains or restores the community's uses and values of waterways. Where these values are achieved in a waterway, they should be protected; and where they are not being achieved, all activities should work towards their achievement over time.
- Protect and enhance ecological condition of the coastal areas, catchments, waterways and their riparian areas.
- Improve the quality of water discharged to beaches, waterways, riparian areas and bushland.
- Promote integrated water cycle management and integrate water sensitive urban design measures into the built form.
- Conserve watercourses or restore them where possible.
- Encourage water efficiency, water re-use or alternative water sources to reduce potable water use.
- Protect and enhance sustainable recreation at beaches, lagoons, watercourses, wetlands and surrounding riparian or natural areas without compromising the integrity of environmentally sensitive aquatic and riparian habitats.

The coast, creeks and lagoons shape the landscape and character of the Northern Beaches. The natural features including the major catchments and waterways are shown in Figure 1 and with more detailed maps shown in Appendix 1.

The network of waterways, coastline, beaches, aquatic reserves, lagoons and creeks provide habitat for the regions' biodiversity, support threatened ecological communities and support coastal, marine and groundwater-dependent ecosystems. They also receive discharged stormwater and wastewater.

Our waterways perform essential environmental services, distributing and filtering nutrients, enabling groundwater dependent ecosystems to thrive, providing habitat for aquatic and riparian species, supporting the conveyance of rainfall, cooling urban areas and providing recreational and scenic enjoyment. Waterways provide essential habitat for both aquatic animals and terrestrial fauna including threatened and endangered species such as the Hairy pipefish and the Bush stone curlew, as well as a number of migratory birds protected by international agreements, including native species such as the Eastern osprey and Glossy black cockatoo.

Climate change is expected to impact the coastline with more damaging coastal storms and a higher sea level. The natural flow patterns of the LGA's waterways are expected to change due to extreme flooding and prolonged periods of drought (Towards 2040).

2.1 Coast and Estuaries

The coastline extends 40 kilometres from North Head at Manly to Barrenjoey at Palm Beach, and for 80 kilometres when including Pittwater estuary and Sydney Harbour. Arguably some of the most iconic open coastline in the country, it is interspersed with 25 ocean beaches that are important locally, nationally and internationally.

The coast supports a rich biodiversity of plants and animals, including those within five aquatic reserves and four intertidal protected areas.

The area includes a World Surfing Reserve at Manly, National Surfing Reserves at Manly-Freshwater and North Narrabeen and 27 coastal and public rockpools.

25
Ocean Beaches

Avalon, Bilgola, Bungan, Collaroy, Dee Why, Fishermans, Freshwater, Long Reef, Manly, Mona Vale, Narrabeen, Newport, North Avalon, North Curl Curl, North Narrabeen, North Palm, North Steyne, Palm, Queenscliff, Shelley, South Curl Curl, South Narrabeen, Turimetta, Warriewood, Whale.

15
Estuary Beaches

Clareville, Clontarf, Fairlight, Forty Baskets, Great Mackeral, Paradise, Sandy, Snapperman, Station, Little Manly Manly Cove, Dalwood, Sandy Bay, Currawong, Bayview.

8
Major Catchments

Hawkesbury River (Cowan Creek), Pittwater, Coastal Catchments, Narrabeen, Dee Why, Curl Curl, Manly, Sydney Harbour.

4
Intertidal Protected Areas

Bungan Head, Mona Vale Head, Dee Why Head, Shelly Beach Headland.

3
Major Estuaries

Hawkesbury River, Pittwater, Sydney Harbour.

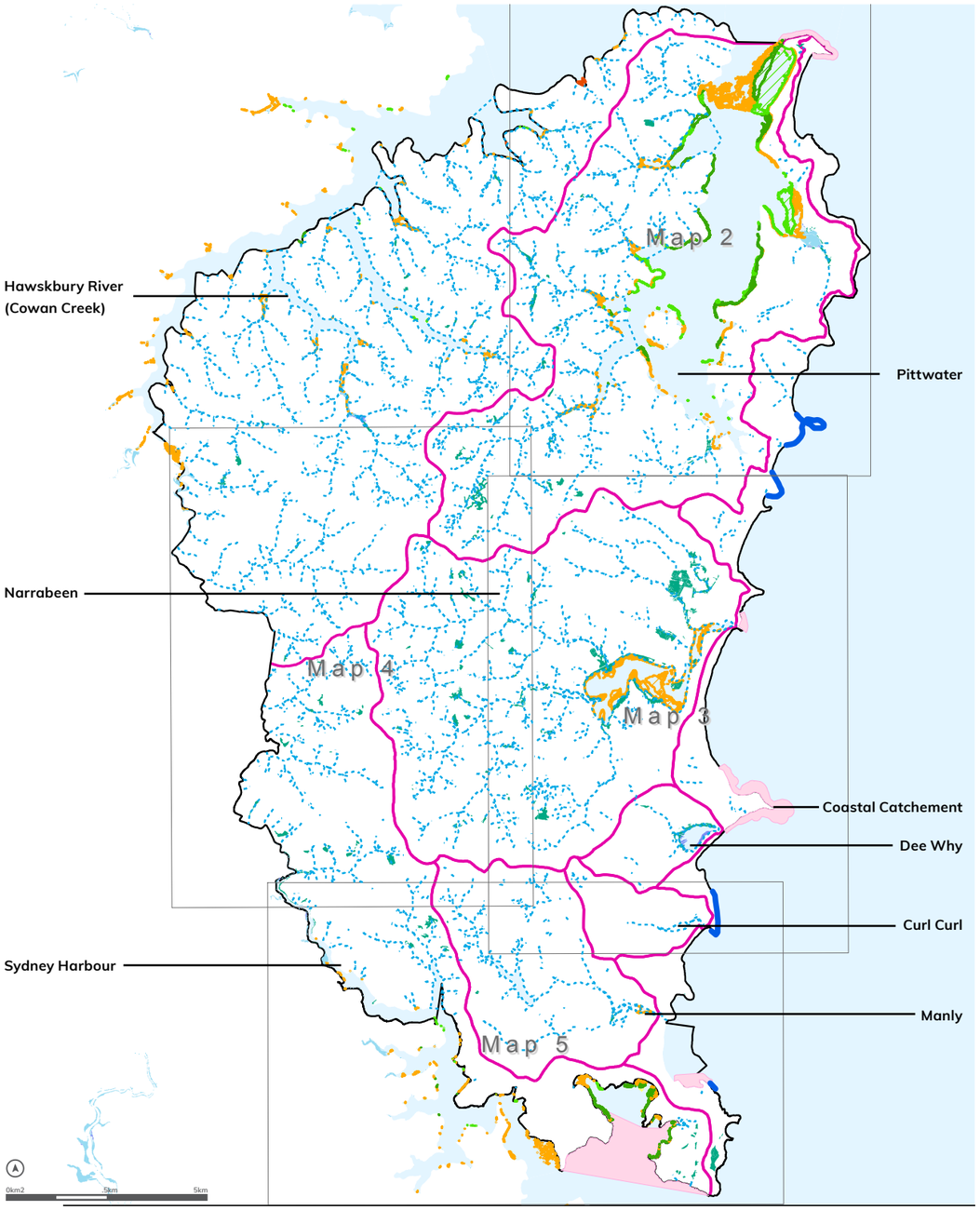
5
Coastal Lagoons

Manly, Curl Curl, Dee Why, Narrabeen, Great Mackeral.

5
Aquatic Reserves

Barrenjoey Head, Narrabeen Head, Long Reef, Cabbage Tree Bay, North Harbour.

Figure 1: Major catchments, waterway features and estuarine macrophytes



2.1.1 Coastal Headlands

Coastal headlands at Barrenjoey, Avalon, Bangalley, Bilgola, Bungan, Mona Vale, Warriewood, Long Reef, Dee Why/Curl Curl, Queenscliff and North Head form a stunning natural feature and clear distinction between the sandy beaches. These headlands were formed during the Triassic Age (199 to 251 million years ago), from a sequence of sedimentary rocks including interbedded sandstones, siltstones and claystone formations.

2.1.2 Coastal Dunes

Coastal dunes form a large part of the coastal environment within the LGA and are one of the key natural assets (Cardno, 2018). Of the 25 beaches, 17 have coastal dune systems covering an area of more than 61 hectares. These dunes are located at Palm, Whale, Avalon, Bilgola, Newport, Bungan, Mona Vale Basin, Mona Vale, Warriewood, Turimetta, North Narrabeen, South Narrabeen, Fishermans, Long Reef, Dee Why, Curl Curl and Freshwater Beaches. In 2018, an assessment found that the condition of these dunes ranges from poor to good. The dune condition assessment considered geomorphology (formations), flora species, weed cover and proportion of blowout areas. The dunes are managed through a series of bush regeneration contracts to maintain and improve the condition.

2.1.3 Estuaries

The Northern Beaches region is rich in estuarine environments containing diverse ecosystems that form the foundation of the coastal food chain. Fifteen beaches within Pittwater and Sydney Harbour are key recreational areas for the community. Key features of the coast that sets the Northern Beaches apart from many other coastal landscapes are the coastal lagoons, estuaries that are known as 'Intermittently Open and Closed Lake or Lagoons' (ICOLLs) and the drowned river valley estuaries of the Hawkesbury River and Sydney Harbour Catchments and Pittwater. Both support extensive aquatic and riparian habitats and species and are highly utilised for recreation and valued by the community.

The incised nature of Pittwater, the Hawkesbury River and Sydney Harbour mean that wetlands can only form on low lying fluvial deltas. These wetlands support mangroves, seagrasses, saltmarsh and sandflats across the area and provide essential source of food and habitat for both aquatic fauna and migratory birds. These habitats are sensitive to disturbance and are extremely important for the survival of many aquatic and terrestrial species.

Nine threatened species listed under the Fisheries Management Act (FMA), 1994 have been identified to have or potentially have occurred in the LGA (Table 1, Appendix 2). These include the Whites Seahorse, the Greynurse Shark and the seagrass *Posidonia australis*. In addition, the FMA identifies a number of listed protected species that occur or are likely to occur in the LGA or adjacent waters (Table 2, Appendix 2). Marine vegetation, including seagrass beds are listed as Key Fish Habitat.

2.1.4 Estuarine Macrophytes

The Northern Beaches is rich in a range of estuarine macrophytes including seagrasses, mangroves and coastal saltmarsh. They play a vital role in the nutrient cycling from sediments to the food chain and provide habitat for aquatic macroinvertebrates, fish and birds of the estuaries.

2.1.4.1 Seagrasses

Seagrass beds are found in Pittwater, Sydney Harbour, Cabbage Tree Bay and Narrabeen Lagoon (see Figure 1). While the area of seagrass can vary, recent mapping estimates an area of 285ha in the LGA. Three species of seagrass occur in the area including *Posidonia australis*, *Zostera Capricornia* and *Halophila ovalis*. The sensitive *P.australis* (strapweed) is often found growing in association with *Z.capricorni* (eelgrass), but at slightly greater water depths. *H.ovalis* (paddleweed) is commonly found in mixed beds with both *Z.capricorni* and *P.australis*.

2.1.4.2 Mangroves

Mangroves, an important estuarine macrophyte, are present throughout the LGA and cover an area of 27 ha. Mangroves provide habitat and food and act as a buffer; reducing erosion and maintaining water quality.

The two species of mangroves present in the area are the Grey Mangrove *Avicennia marina* and the River Mangrove *Aegiceras corniculatum*. The largest area of mangroves in the LGA is in the Careel Bay area, which has increased three-fold over the past 50 years coinciding with a substantial decline in coastal saltmarsh. Diversity of macrofauna in mangrove forests adjacent to saltmarsh has been found to be greater than in mangroves that do not border saltmarsh (Yerman *et al,* 2004).

2.1.4.3 Saltmarsh

Coastal saltmarsh is recognised as a threatened ecological community under the NSW *Biodiversity Conservation Act, 2016* and is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*. Approximately, 11ha of coastal saltmarsh was identified in the LGA through recent mapping by DPI (2020). This community is found at Dee Why Lagoon Wildlife Refuge, Winnererremy Bay, Careel Bay, Refuge Cove, Saltpan Cove and Winji Jimmi Bay (Figure 1). Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently and intermittently open to the sea. Saltmarsh occupies the high tide zone on sheltered foreshores and species composition will vary depending on the elevation and frequency of inundation. As with mangroves, coastal saltmarsh has historically been undervalued and considered by many to be boggy swamps and wastelands and as a result many have been drained, reclaimed, become degraded or completely lost.

Coastal Saltmarsh provides four very important and basic roles; provides habitat, provides food, acts as a buffer and filter of nutrients and is a carbon sink. Saltmarsh provides habitat and shelter for fish, juveniles and smaller fish species, especially when inundated. These areas also provide habitat for many other fauna species including, birds, bats and aquatic and terrestrial insects and invertebrates. They can also provide an important summer feeding and roosting area for migratory wader birds.

Some of the plant species found in Coastal saltmarsh include; *Baumea juncea* (bare twig-rush), *Juncus kraussii* (sea rush), *Sporobolus virginicus* (marine couch), *Ficinia nodosa* (knobby club-rush), *Samolus repens* (creeping brookweed), *Suaeda australis* (austral seablite) and *Zoysia macrantha* (prickly couch).

2.1.5 Habitats of local conservation significance for waterbirds

Careel Bay provides habitat of high local conservation significance for a variety of waterbirds. These include migratory waders from the Northern Hemisphere such as the Eastern Curlew, Whimbrel and Bar-tailed Godwit. Australia has an international obligation to protect these species and their habitat under several international agreements including the Japan-Australia and China-Australia Migratory Birds Agreements and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention). The apparent decline since 1972 in the numbers and variety of migratory waders using Careel Bay must be viewed with some concern. “The most significant of the migratory waders recorded at Careel Bay is the Eastern Curlew. The majority of the world population comes to Australia. It is not rare but it is generally considered a species of special concern, with declining numbers being recorded at several sites in Australia” (Smith and Smith 1997 in Careel Bay Plan of Management).

Another important habitat for migratory waterbird species occurs at Dee Why and Long Reef. This is complimented by the Long Reef Aquatic Reserve that covers approximately 60 hectares offshore, providing important foraging and roosting habitat. The significance of this area is recognised at a national level by its listing on the Register of the National Estate. Dee Why Wildlife Refuge is surrounded by native vegetation including a variety of wetland and other plant communities which provide better, more secluded and more varied habitat for waterbirds than the nearby Curl Curl and Manly Lagoons. Approximately 86 native waterbird species have been recorded at Dee Why Lagoon. This includes ten waterbirds which are threatened species in NSW. A number of waterbirds use the lagoon as a temporary stopover location during migratory or nomadic movements, including in times of drought, which establishes its conservation significance at both the state and national levels.

2.1.6 Aquatic Reserves

The primary objective of aquatic reserves is to conserve biodiversity, or particular components of biodiversity (such as specific ecosystems, communities or species), in a specified area of the marine estate. Intertidal protected areas (IPAs) have been established to protect selected rocky habitats and intertidal species.

The Narrabeen Head Aquatic Reserve encompasses the foreshore from the southern end of Turimetta Beach to the ocean baths at Narrabeen Head, and extends offshore. The proximity of Narrabeen Lagoon gives rise to a combination of estuarine and oceanic influences which supports a wide variety of marine life, including threatened species.

The Cabbage Tree Bay Aquatic Reserve covers approximate 20 hectares including the entire bay, the rocky shores and beaches from the southern end of Manly Beach to the northern end of the Shelly Beach Headland. This highly protected reserve makes this a popular dive and snorkelling spot with a huge variety of marine species and seven types of habitat.

The Barrenjoey Head aquatic reserve covers approximately 30 hectares including the rocky shore around Barrenjoey Head, extending from the northern end of Palm Beach around Barrenjoey Head to the northern end of Station Beach, and out to 100m offshore. The reserve is focused on conserving marine biodiversity of the rocky shore fringing Barrenjoey Headland. The rocky shore has a diversity of habitats and associated marine life, including four of the five types of habitats described for NSW rocky shores (platform, crevice, rock-pool and boulder habitats).

North Harbour (Sydney) Aquatic Reserve is located between North Head and Dobroyd Head in the northern part of Sydney Harbour, covering an area of approximately 260 hectares. Historically, the reserve was the site of some of the first marine specimen collecting conducted in the 1830s by the superintendent of the Quarantine Station. The aquatic reserve includes a variety of habitats, including rocky shores, sandy beaches, nearshore reefs, sandy seabed and harbour waters up to around 20 m deep.

2.1.7 Coastal Lagoons

The coastal lagoons include Narrabeen, Manly, Dee Why, Curl Curl and Great Mackeral (Figure 1). The largest of these is Narrabeen Lagoon with a surface area of 2km^2 and catchment area of 55km^2. The lagoons support a variety of species and are a highly valued recreational assets, especially for Narrabeen Lagoon.

To understand ecological condition, water quality has been monitored in four of the coastal lagoons since 2012 and commenced in Pittwater in 2017 in accordance with NSW State Government Monitoring, Evaluating and Reporting (MER) Program. The MER Program uses measurements of chlorophyll-a and turbidity to form the basis of water quality grades as they provide an effective measure of the short-term response of estuary ecosystem health in response to a range of likely pressures and their management. The estuarine water quality grades are shown in Table 1. A grade of A represents very good condition scaling to F representing very poor condition. Water quality varies according to changes in climatic conditions as well as changes in land-use and catchment practices and as such long-term monitoring is essential.

Table 1: Estuarine Water Quality

	Overall water quality grade							
Location	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**	**18/19**	**19/20**
Curl Curl Lagoon	F	C	D	D	C	C	F	C
Dee Why Lagoon	B	B	C	B	B	C	B	B
Manly Lagoon	D	C	C	D	D	C	C	D
Narrabeen Lagoon	B	B	C	B	B	C	B	B
Pittwater	na	na	na	na	na	A	A	A

Source: NSW DPIE in partnership with NBC.

Table 2: Northern Beaches Catchment Characteristics

Catchment	Catchment size (km2)	Major tributaries	Key natural features	Key land uses
Hawkesbury River (Cowan Creek)	72	Kierans, Duffys, Smiths, Cowan, and Coal and Candle Creeks	Kuring-gai Chase NP; Dundundra Falls Reserve; Dardabong Reserve	National park, peri-urban and rural settlements. Associated activities in this area include equine activities, nurseries, larger rural land holdings
Pittwater	51	Pittwater estuary, McCarrs, Wirreanda, Cicada Glen and Careel Creeks	Kuring-gai Chase NP incl. Barrenjoey Headland, Katandra Bushland Sanctuary, Stapleton Reserve, Angophora Reserve, McKay Reserve	Residential, marinas including >3,600 moorings, small commercial centres, light industrial, national parks, bushland
Coastal catchments	13	Minor creeks flowing directly to the coast	Coastal beaches, headlands, aquatic reserves and wildlife refuges, rockpools, Sydney Harbour National Park	Residential, commercial centres of Manly, Mona Vale, Newport, Freshwater
Narrabeen	55	Narrabeen, Five Mile, Deep, Middle, South, Oxford, Wheeler, Snake, Mullet Creeks, Narrabeen Lagoon	Narrabeen Lagoon, Garigal National Park, Warriewood Wetlands, Ingleside Chase Reserve, Irrawong Bushland Reserve, Irrawong Waterfall, Heydon Reserve	Residential, open space, rural, landfill, national parks
Dee Why	5.7	Dee Why Creek, Dee Why Lagoon	Dee Why Lagoon Wildlife Refuge, Dee Why Park, Stony Range Regional Botanic Garden, Wingala Reserve	Residential, commercial, industrial
Curl Curl	4.4	Curl Curl Lagoon, Greendale Creek	Curl Curl Lagoon, John Fisher Park, Flora and Ritchie Roberts Reserve	Open space (former landfill sites), residential, industrial
Manly	18	Curl Curl (Manly), Brookvale, Burnt Bridge Creeks, Manly Dam, Manly Lagoon	Manly Dam Reservoir and parklands, Allenby Park, Mermaid Pool, Reserves	Open space (some former landfill sites), residential, commercial (Warringah Mall), industrial, bushland
Sydney Harbour	35	Middle Harbour, Bare, Carrolls, Frenchs, Bate, Bantry Bay Creeks	Garigal and Sydney Harbour National Parks, The Cascades, Dobroyd Head, North Harbour Reserve, North Head	Business Park, waste management and former landfill site, recreational mountain bike park, residential, bushland

2.2 Catchments and Creeks

Catchments are areas of land bounded by hills where water flows over the landscape, into creeks and down into the soil, eventually finding its way to a waterbody.

Catchments are physical systems which draw together both terrestrial (land-based) and aquatic (water-based) features. These important systems are mutually reliant. An impact or change in one part of the system has flow-on effects to the rest of the system, either positively or negatively. The Northern Beaches is naturally defined by seven major catchments and the coastal catchments (Figure 1).

The characteristics of the eight catchments of the Northern Beaches are the shown in Table 2.

Curl Curl Lagoon

2.2.1 Creeks

Creek systems are the critical component of our natural environment – the natural 'blue grid'. Creeks and the associated riparian zones support a high diversity of plants and animals, provide wildlife corridors between larger bushland reserves, reduce impacts from stormwater runoff and pollution, provide a cooling effect in urban areas and provide recreational opportunities for the community.

Creeks provide habitat and channel water to the highly valued receiving waters. More than half of the creeks are within National Parks. Around 100 kilometre of creeks are on private land and the remaining 150 kilometre are under Council management. Incorporated into this network are freshwater wetlands and coastal upland swamps that provide valuable habitat and are important in regulating water flow within the catchment.

Coastal Upland Swamp in the Sydney Bioregion and Freshwater Wetlands on Coastal Floodplains are listed as threatened ecological communities under the NSW *Biodiversity Conservation Act, 2016*. Within the LGA there are many relatively small coastal upland swamps covering an area of approximately 19ha, with most of these occurring along Middle and Deep Creeks and at Warriewood Wetlands.

Across the Northern Beaches, some creeks are in near pristine condition including Deep, McCarrs and Smiths Creeks and the upper reaches of Wheeler Creek. However, in most catchments, development has resulted in:

- changes to creek flows, including increased stormwater, flood frequencies and artificial barriers to flow such as weirs/culverts;
- increased sediment loads and bank erosion;
- a decline in water quality including increased nutrient, toxicant, sediment and litter; and
- clearing of vegetation and invasion by weeds in and around the creeks.

Virtually all creeks within the area are at risk of further degradation. The level of risk varies widely, as does the sensitivity of creeks to further change. One feature is common to all creeks – they flow into receiving waters that are highly valued – the coastal lagoons, beaches and the estuaries of Sydney Harbour and the Hawkesbury River. Each of these is under stress from pollutants conveyed by the creeks.

Several creeks (such as Snake Creek) have development in the upper reaches and also flow into national parks or reserves and finally into sensitive estuarine waters. Most of these are highly modified in the urban and rural areas but are in good condition in the national parks or reserves. There is a risk that this group of creeks is at the point where any increase in flows or pollutants from the catchment could result in significant deterioration in the national park sections.

Many creeks in the urban areas have been degraded in significant – and possibly irreversible ways – due to historical catchment development leading to the alteration of creek floodplains and creek flows. However, while they have been degraded ecologically some of these areas can provide highly valued recreational opportunities such as walking or riding trails.

The Green Grid is a network that seeks to combine hydrological, ecological and urban resilience through a network of green Infrastructure. The Blue Grid comprises the hydrological elements of the Green Grid, including the region's waterways and water-dependent ecosystems with high ecological value.

2.2.2 Groundwater
Groundwater in the broad sense is all water that occurs below the land surface. It is an integral part of the "water cycle" (or "hydrologic cycle") and interacts directly with the water present on the earth's surface. Groundwater provides significant contributions to creeks, wetlands and swamps, being an ongoing source of water during seasonally dry periods. It also maintains the dynamics of estuarine and near-shore marine water bodies, contributing inflows of fresh water to otherwise saline environments. As such, protection of groundwater and groundwater dependent ecosystems is essential.

2.2.3 High quality catchments
Creeks, and their catchments were assessed under a range of criteria to determine their overall condition as either Group A, B or C catchments. Group A catchments are 'high quality catchments' having high landscape and ecological value and will degrade quickly if even minor changes occur (such as weed growth, vegetation clearing or urban development). The following catchments have been defined as high quality catchments in the Northern Beaches Water Management for Development Policy (2021): Oxford, Bare, Deep, Kierans, Duffys, Smiths, Cottage Point, Wirreanda, Cicada Glen, Deep, Wheeler and Curl Curl Creeks.

These high quality catchments typically have low imperviousness (hard surfaces) and are commonly less developed. When urban development occurs, the increase in hard surfaces including buildings, roads driveways and the like increases the catchment imperviousness. When impervious surfaces make up more than 10% of a catchment, waterway health is impacted (MWH, 2004). Urban development, that increases hard surfaces, impacts both the quantity and quality of stormwater runoff.

Impervious surfaces contribute to poor waterway health in the following ways:

- They can disrupt the natural water cycle, preventing water from infiltrating into the ground and replenishing groundwater:
  - In coastal groundwater aquifers, this increases saltwater intrusion and impacts vegetation health.
  - Lower groundwater contributions to base flows in creeks means they are more likely to cease flow in dry periods.
- They can change the flow regime, increasing flows during low rainfall events and increasing peak flows in high rainfall events. This can have a number of impacts on:
  - flooding
  - the fauna community present (some require permanent water and others are naturally adapted to periods without flow, and it can impact lifecycle activities such as spawning)
  - aquatic and riparian vegetation
  - water quality
  - erosion/sedimentation
  - supporting the invasions and success of exotic and introduced species.
- They can increase heat, which directly impacts flora and fauna health and increases the heat of our waterways, which then increases algal growth and changes the species diversity. Directly associated to this is the relationship between increase in impervious surfaces and loss of vegetation that provides shade to waterways.

2.3.1 Asset management
There is an opportunity to consider waterways, or the natural blue grid, as an infrastructure asset – a 'blue asset' to be integrated into decision making to protect environmentally sensitive waterways and address the cumulative impact of land management decisions.

2.3.2 Vegetation management
Maintaining coastal vegetation on dunes and coastal headlands through planned bush regeneration activities provides habitat for flora and fauna as well as building the resilience of these systems to coastal processes

2.3.3 Water quality
Protecting the natural blue grid across the Northern Beaches will support and enhance water quality and aquatic and terrestrial ecosystems, as well as address the cumulative impact of land management decisions, especially in more natural catchments such as Narrabeen, and the Hawkesbury River. These catchments are particularly vulnerable to increased urban development not only because of the sensitive nature of receiving waters and environments but also the relatively natural state of their catchment headwaters.

One of the biggest challenges facing waterways is the impact of poor water quality and sedimentation as a direct result of increased urbanisation.

The impact of changing land uses, increasing connected impervious surfaces and land clearing, especially in riparian zones, continues to place pressure on water quality and the health of important ecosystems and aquatic habitats including mangroves, saltmarshes and seagrasses, which support aquatic and terrestrial flora and fauna. It can also impact on the ability for waterways and lagoons to be utilised for valued recreational purposes.

Coastal boardwalk view to Long Reef Beach and Dee Why

2.3.4 Stormwater and overland flow

Waterway systems, including creeks, have historically been seen as merely a way to transport away nuisance water. This has led to extensive constructed stormwater networks which saw a preference for straightening creek lines and lining some channels with concrete. Northern Beaches Council has a stormwater network that incorporates over 600 kilometre of stormwater pipes. The network of waterways, drainage paths and the coast should be viewed as a connected and dependent network which contributes to community liveability.

The changes to the waterway system through piping has increased the velocity of flows, which itself impacts the aquatic ecology and streambank stabilisation. These increased velocities carry pollutants, elevated nutrient levels, sediment, litter and plastics into and along creeks and waterways and to lagoons and the ocean.

Catchment and waterway rehabilitation and restoration is important for improving the overall health of waterways, protecting and enhancing their intrinsic natural values, and slowing down the flow of water thus improving overall water quality before it enters receiving waters. Rehabilitation and restoration activities include bank stabilisation, erosion control, riparian habitat restoration and stormwater quality improvement devices. Another key mechanism to protect waterways from urban impacts is to 'disconnect' the stormwater drainage infrastructure from the receiving waterway.

Within urbanised catchments such as Dee Why and Curl Curl, stormwater run-off can be controlled and treated before entering local waterways, protecting them from increased flow and excess nutrient and sediment loads. Improving water quality and flow characteristics along the system can enhance overall waterway health. This can be achieved through introducing stormwater controls which are tailored to the receiving waters. This is particularly important for sensitive receiving waters.

2.3.5 Recreational use

Sustainable recreational use of water-based environments of the Northern Beaches is an essential component of waterway management and ensures the longevity of valued environments over generations. It is essential in maintaining cultural identity, lifestyle values, and it is also key to supporting a healthy, robust and diverse local economy.

With an increasing population and associated growth in the LGA, there is potential for negative impacts on waterways and the coast. To ensure protection of the environment is balanced with recreation, sensitive areas where recreation is not sustainable needs to be identified.

It may also be appropriate for degraded natural areas to be reconfigured as passive or active recreational areas, as has occurred around Curl Curl Lagoon. Further, management of natural areas, such as dunes and riparian lands management provides an opportunity to increase the resilience of these areas.

Environmental Planning Actions
LSPS Priority 1

Healthy and valued coast and waterways

The following environmental planning actions have been developed to deliver the LSPS planning priorities. These will also help to achieve the outcomes of the ECC Strategy.

LSPS Action	ECC Strategy	Environmental Planning Actions	Timeframe
Implement Environment and Climate Strategy Protect.Create.Live and develop associated action plans for coastal areas and waterways. Prepare a stormwater quality management plan to guide implementation of the risk-based framework, identify stormwater quality targes, and prioritise public and private stormwater infrastructure needs. Develop LEP and DCP controls that incorporate the findings of the above studies, including stormwater quality targets; integrated water cycle management (including water sensitive urban design); coastal management programs; protection of riparian areas; coastal hazard management and criteria for environmentally friendly sea walls. Investigate the feasibility of local green grid projects: • a continuous foreshore path around the Pittwater waterway • a new boat ramp on Pittwater to cater for medium to larger boats • naturalisation of creeks at Dee Why, Mona Vale and Avalon • new aquatic reserves for areas of high biodiversity value, in addition to better management of existing aquatic reserves and marine estates • opportunities for non-motorised water sports launching, storage and utilisation	Protect our waterways with strategic land-use planning and development controls including water sensitive urban design. Reduce pollution entering our coastal environment using best practice source controls, treatment measures and best practice detection systems. Work to allow coastal processes to naturally shape the coastal environment, whilst preserving the natural character through policies, strategic land use planning and development controls.	1.1 Assess and map freshwater habitats - Finalise the assessment of watercourses, wetlands and riparian lands. Use these assessments to incorporate the outcomes of this review into a new, comprehensive map that consistently categorises watercourses, wetlands and riparian lands (including corridors and buffers) for inclusion in the new planning framework. 1.2 Develop planning controls for freshwater habitats - Protect and maintain watercourses, wetlands and riparian areas at current or improved condition from development impacts by reviewing current controls and where necessary developing and implementing new planning controls using appropriate setbacks and corridors based on environmental value and stream order. Examples may include different controls depending on categories, buffers and higher environmental value areas. Consider innovative approaches or alternative solutions to enhancement of riparian areas, such as rehabilitation of offset areas. 1.3 Manage the threat to water quality and aquatic ecology - Complete a water cycle strategy that identifies catchments according to risk, value and condition. Develop stormwater quality and quantity targets to protect water quality and aquatic ecology. 1.4 Develop planning controls to protect water quality and aquatic ecology - Develop and implement planning controls that integrate water sensitive urban design and stormwater controls to ensure development achieves the identified stormwater quality and quantity targets for each catchment and protects downstream water quality and aquatic ecology. Examples may include landscape and rainwater reuse controls for all catchments with the objective of increasing infiltration and stormwater quantity reduction, which has multiple water cycle and waterway benefits. 1.5 Ensure watercourses, wetlands and major stormwater, flood mitigation works, infrastructure are incorporated into public land in precincts to facilitate ease of maintenance, multifunctionality and optimal waterway health and amenity outcomes. 1.6 Protect natural assets including watercourses, wetlands and riparian lands, water quality and aquatic ecology by considering them early in the strategic planning process, such as during precinct planning.	Short Term Short Term Short Term Short Term Ongoing Ongoing
Prepare an open space and recreation strategy and map a local green grid that supports environmentally sustainable access to the coast and waterways where appropriate.	Improve and manage sustainable recreational access whilst protecting environmentally sensitive lands.	1.7 Identify and protect coast and waterway areas of high environmental value within the local green grid. 1.8 Ensure that Councils recreation planning considers protection of high environmental value coast and waterway assets and ensures recreational activities and infrastructure within these areas are low impact.	Ongoing Ongoing

Grevillea calyei
Image credit: Ben Fallowfield

Protected and enhanced bushland and biodiversity

LSPS Priority 2

3.0 Protected and enhanced bushland and biodiversity

Natural areas cover almost half of the Northern Beaches including 350 bushland reserves and three national parks. Native vegetation or bushland areas include important core habitat areas, linked by biodiversity corridors (also known as wildlife corridors).

The principles for Towards 2040 Priority 2 will guide future planning decisions to protect and enhance bushland and biodiversity of the Northern Beaches include:

- Protect core areas and areas of high environmental value from urban development.
- Conserve and restore threatened species habitat.
- Retain native vegetation and maintain or enhance ecological functions in core areas and wildlife corridors (connection zones).
- Ensure future developments avoid, then minimise impacts on bushland before offsetting is considered.
- Increase the availability of local biodiversity offsets.
- Shape decisions for future bushland and biodiversity management around the consequences of climate change, including the need for increased bush fire risk mitigation and pest species management.
- Plant locally native species.
- Protect and enhance sustainable recreation in bushland reserves and natural areas without compromising the integrity of environmentally sensitive areas.

Core Habitat Areas, Biodiversity Corridors

According to GANSW (2020), core habitat areas of bushland and waterways are the least disturbed and the most biodiverse, representative of the structure, function, and composition of natural areas. Protection and management of these aras is imporatnta to protect biodiversity and ensure long-term stability of ecosystem functions.

Protection and management of these areas is important to conserve biodiversity and ensure long-term stability of ecosystem functions.

Biodiversity Corridors (also known as wildlife corridors or Connection Zones) – are areas that support urban habitat and the movement of wildlife between core habitat areas of bushland or waterways. Connection zones support genetic dispersal, ecological function and resilience and can include vegetated riparian corridors, street trees, ponds, rocky outcrops, parks and gardens. They are areas where most city dwellers interact with nature (GA, 2020).

Various published studies have long demonstrated the importance of larger patches of native vegetation (or core habitats) for the conservation of biodiversity (see Rosenzweig 1995, Watson et al, 2018).

Important core habitats are typically the larger patches of native vegetation and include Council managed reserves such as Manly Dam, Allenby Park, Ingleside Chase Reserve and three state-managed national parks. Core habitats are also located on private land including one of Sydney's largest unreserved areas of bushland stretching from Middle Creek at Narrabeen Lagoon west to Belrose and south west to Frenchs Forest.

Smaller bushland remnants outside of larger core habitat areas remain critical for the conservation of biodiversity on the Northern Beaches and underpin the 'bush and beach' identity. Smaller bushland remnants often form part of biodiversity corridors and can act as 'stepping-stones' that allow flora and fauna movement across the landscape and support genetic dispersal.

Bushland provides vital habitat for iconic threatened species including Glossy Black cockatoo and Eastern Pygmy Possums as well as the more common fauna like Sugar Glider and Swamp Wallaby. Many other threatened fauna species also occur locally, including the Barking Owl, Little Penguin, Red-crowned Toadlet, Grey-headed Flying-fox and Eastern Osprey. A complete list of threatened fauna recorded on the Northern Beaches is provided in Appendix 2. There are many other species that persist on the Northern Beaches that are considered locally significant because, although once common, their populations have significantly declined in the area.

The Northern Beaches is also home to a number of threatened plants such as the critically endangered Caley's Grevillea – *Grevillea caleyi* and Seaforth Mintbush – *Prostanthera mariifolia.* The distribution of these two plant species is almost entirely limited to the Northern Beaches. A complete list of threatened plants recorded on the Northern Beaches is provided in Appendix 2.

Both the natural and urban areas have their place in enhancing biodiversity and supporting the habitat of threatened species on the Northern Beaches. Urban habitats including parks, tree lined streets and even backyards remain important features of the landscape which contribute to connectivity that is crucial for the persistence of biodiversity.

Healthy bushland and biodiversity and connected and accessible natural environments across the Northern Beaches also contribute to community health and wellbeing, provides visual amenity and recreation and supports economic diversity, including increased revenue for tourism and other related industries.

Studies and analysis are currently underway to review and map core habitat and corridor areas of the LGA. From existing information, core habitat areas are mostly within council reserves and in larger landholdings. Areas of remnant bushland were generally identified as core habitats if larger than 3.5ha.

15,562ha
Bushland

10,900ha
National Parks

2,960ha
Private Ownership

1,700ha
Council Management

3
National Parks
Kuring-gai Chase
Garigal
Sydney Harbour

540
Animal Species

1460
Native Plant Species

48
Plant Community Types

13
Threatened Ecological Communities

78
Threatened Species

50
Wildlife Protection Areas

3.1 Native vegetation and plant community types of the Northern Beaches

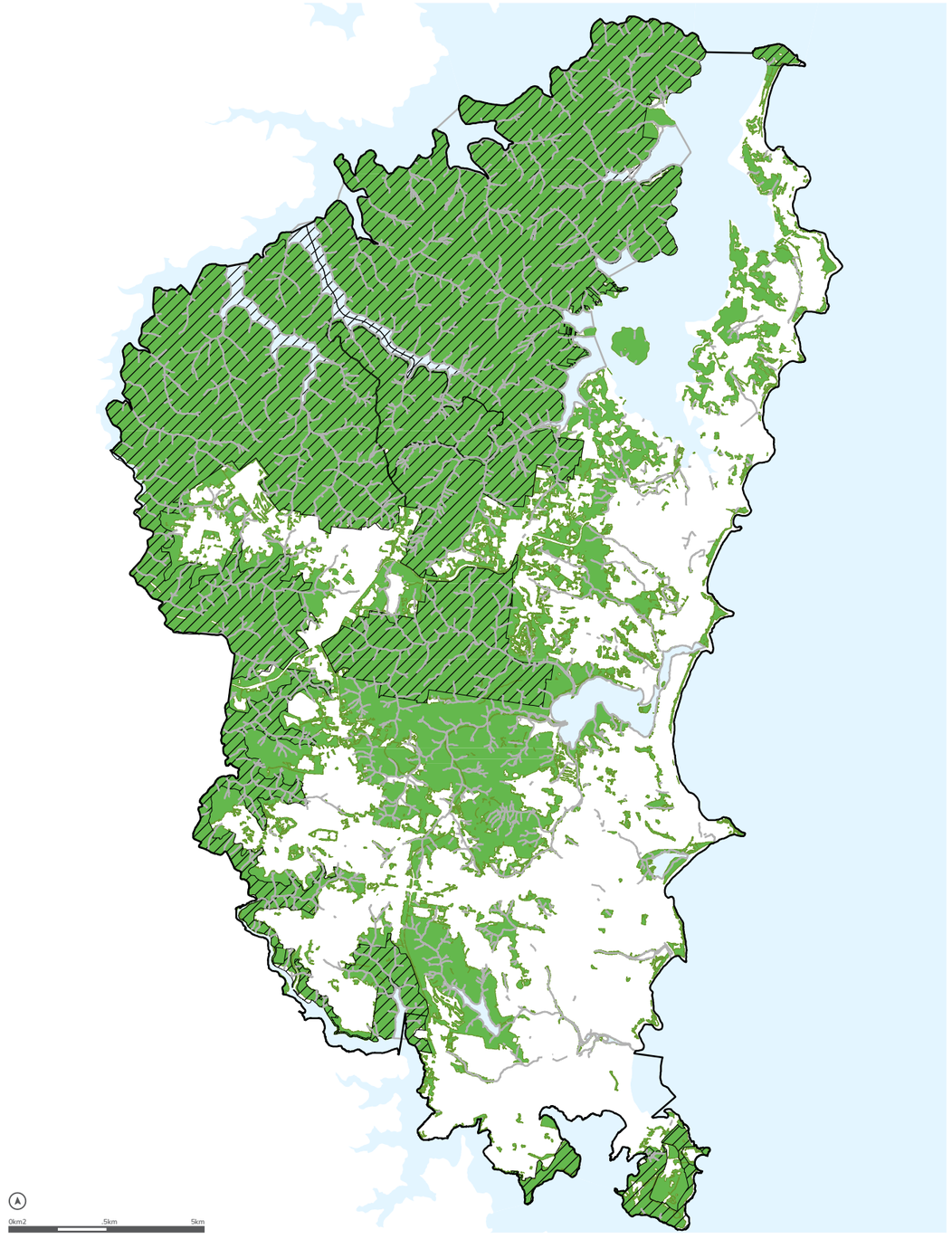
Core habitat and corridors have been based on extisting native vegetation cover across the Northern Beaches. In 2016 the former NSW Office of Environment and Heritage released mapping of native vegetation and plant community types for the entire Sydney Metropolitan Area. The mapping identifies 79 plant communities occurring across the Sydney Metropolitan Area (OEH 2016), of which 48 are mapped on the Northern Beaches.

The OEH 2016 vegetation mapping also identifies 13 threatened ecological communities occurring on the Northern Beaches (Table 3, Appendix 2). Threatened ecological communities are now substantially cleared with remaining areas afforded additional protections under the NSW *Biodiversity Conservation Act 2016* and *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. Well known threatened ecological communities on the Northern Beaches include Pittwater Spotted Gum Forest, Duffys Forest, Coastal Saltmarsh and Sydney Freshwater Wetlands. Draft mapping by SMEC (2021) has refined and updated the mapping of threatened ecological communities across the LGA.

An updated draft map of native vegetation cover (Figure 2) for the Northern Beaches has also recently been prepared by Council staff based on the OEH 2016 mapping. The large areas of clearing required for the various road upgrades and infrastructure projects have been excluded from the mapping.

Flannel Flower
Actinotus helianthi

Figure 2: Draft map of native vegetation of the Northern Beaches



3.2 Threatened Species

Where plants and animals are assessed as being at risk of extinction, state and federal legislation may identify them as 'threatened species'. Relevant state (NSW *Biodiversity Conservation Act, 2016*) and federal legislation (*Environment Protection and Biodiversity Conservation, Act, 1999*) has been implemented with the intent of protecting threatened species. A species may be identified as threatened if there is a reduction in its population size, it has a restricted geographical distribution, or there are few mature individuals.

Sixty nine threatened species have been identified as likely to have occurred in the LGA. Of these 18 are threatened plant species that have been mapped as valid records across the LGA along with 51 threatened fauna species (based on quality review of records provided in Table 3, Appendix 2).

Review of threatened species sightings records (accessed via NSW Bionet, April 2021) for the Northern Beaches, suggests that local populations of some threatened fauna such as Eastern Pygmy-possum, Giant Burrowing Frog and Heath Monitor are now largely confined

Eastern Pygmy-possum

to large patches of native vegetation or core habitats and may now be extinct from smaller more fragmented areas. Fragmentation and loss of habitat are likely to be the main contributors to the local extinction of Koala and Squirrel Glider populations once known from parts of the Northern Beaches (see for example the published study on the decline of local Koala's by Smith and Smith 1990). This highlights the importance of minimising the loss of native vegetation and associated core habitat areas.

Biodiversity corridors include smaller patches of native vegetation which remain important to the conservation of some highly mobile threatened fauna such as the iconic Powerful Owl. Powerful Owls have been identified nesting in old growth hollow bearing trees within some smaller patches of native vegetation, but forage across the more leafy Northern Beaches suburbs at night. Some of the largest known populations of the critically endangered plant Caley's Grevillea occur in small patches of native vegetation and ongoing protection and management of biodiversity corridors will be required in order to maintain local populations of these species.

Osprey
Image credit: John Taylor

3.3 Challenges and Opportunities

3.3.1 Council managed bushland

In addition to its intrinsic values, there is the opportunity to consider bushland as a form of green infrastructure or natural 'green' assets that provide for the conservation of biodiversity. Managing bushland as a natural asset provides opportunities for these areas to be better integrated into Councils Asset Management System.

3.3.2 Land use planning

The largest tracts of bushland outside national parks occur across larger Council managed reserves. However, bushland within private land holdings also form a considerable proportion of the remaining bushland on the Northern Beaches. It is therefore recognised that the conservation of bushland on private land plays an important role in maintaining the overall bushland identity of the Northern Beaches.

Land use planning allocates land for development, determines setbacks, decides densities and proximities and sets conditions for environmental management for new projects. It must also ensure that people are safe and have adequate access to services and open space.

Land use planning can help ensure new developments are designed to avoid and minimise impacts upon bushland and biodiversity in the first instance. When impacts cannot be avoided, the NSW biodiversity offsets scheme can provide for permanent protection and ongoing management of retained bushland. Unfortunately, offset sites are typically located away from the Northern Beaches where land is cheaper. There are opportunities to increase the availability of local offsets in order to support the long-term retention of bushland and biodiversity on the Northern Beaches.

As discussed further in the following sections, land use planning has the potential to increase land clearing and loss of biodiversity. Increasing population densities close to bushland areas also has indirect impacts such as the increased presence of domestic predators (e.g. cats), increased recreational pressures (e.g. mountain biking) and increased light pollution. Mitigating these indirect impacts represents an ongoing challenge to land managers.

Narrabeen Lagoon Trail

3.3.3 Land clearing

Local bushland is under continual pressure from existing and expanding development, with land clearing and associated habitat loss one of the greatest known threats to biodiversity. Development pressures are reducing the amount and quality of bushland, increasing edge effect degradation, weed invasion, fauna predation and habitat fragmentation.

In assessing areas for new development, a focus should be placed on areas that do not require or increase clearing (such as prioritising infill development) to protect areas with important environmental values. This should be coupled with improved development design criteria that protect and enhance bushland and biodiversity through the use of buffers, setbacks, and environmental management activities where appropriate.

3.3.4 Connectivity

Protecting corridors and connectivity between core habitat areas is important in order to maintain safe wildlife passage, provide buffers between natural bushland and urban areas, and help protect against the encroachment of invasive species. A key opportunity exists to consolidate and support connections between core habitats across the Northern Beaches LGA.

Corridors can include natural corridors (i.e. riparian vegetation along watercourses), corridors of remnant vegetation (i.e. vegetation remaining after clearing of the surrounding area), planted corridors (i.e. deliberately created either as wildlife corridors or riparian buffer zones) and remnant and planted tree canopy (such as in parks or golf courses). A network of corridors provides the opportunity to link otherwise isolated patches of remnant bushland, which will assist in the conservation of biodiversity. Wildlife corridors can help decrease the likelihood of local extinction and prevent inbreeding, provide increased foraging area for species with large ranges, provide refuge from predators such as domestic pets, widen the variety of habitat available, provide refuge from disturbed habitat (e.g. fire affected bushland), and provide visual amenity within urban areas.

The metropolitan rural areas support areas of diverse habitat and biodiversity, contributing to the wider green grid and environmental attributes of the Northern Beaches. In some cases, they provide important buffer areas between bushland and urban areas. In other areas, such as the Oxford Falls Valley, they can contribute to local core habitat areas and provide links to surrounding bushland and national parks forming part of regionally important wildlife corridors.

Smaller areas of bushland are in public and private land holdings spread across the Northern Beaches, forming a valuable network of local wildlife corridors. The role of 'backyard bushland' plays an important role in conservation of a wide range of species.

3.3.5 Recreational use

Quality, quantity and access to passive and active open space is a growing need as communities continue to urbanise and there is an increase in population. Natural bushland areas provide visual amenity and recreational opportunities contributes to community wellbeing. However, uncontrolled recreation in high value conservation areas across the Northern Beaches leads to a range of impacts on the quality of bushland and its biodiversity. Uncontrolled recreational access can result in pollution, site disturbance and damage, weed invasion and fauna predation. Council also incurs costs of restoration of areas impacted by uncontrolled recreation.

Recreational use of urban and peri-urban bushland on the Northern Beaches is popular for a range of recreational pursuits including walking, running, horse riding and mountain bike riding. Each of these activities is often exclusionary, where the trails may not be safely utilised by the different user groups at the same time.

The growing popularity of mountain bike riding on the Northern Beaches has resulted in a substantial network of both formal and informal (unauthorised) trails through natural areas. The impacts of mountain biking can differ from those of other recreational activities as trail construction often includes the use of trail technical features such as jumps, bridges and mounds. On formalised trails, it has proven difficult to prevent the ongoing construction of informally created side trails. The associated environmental impacts of the trails and technical features includes vegetation clearing, bush rock removal, soil erosion, pollution, weed spread and wildlife disturbance (see review by Pickering et al, 2010). Substantial funding is needed for ecologically sustainable trail construction and for the ongoing maintenance of such trails.

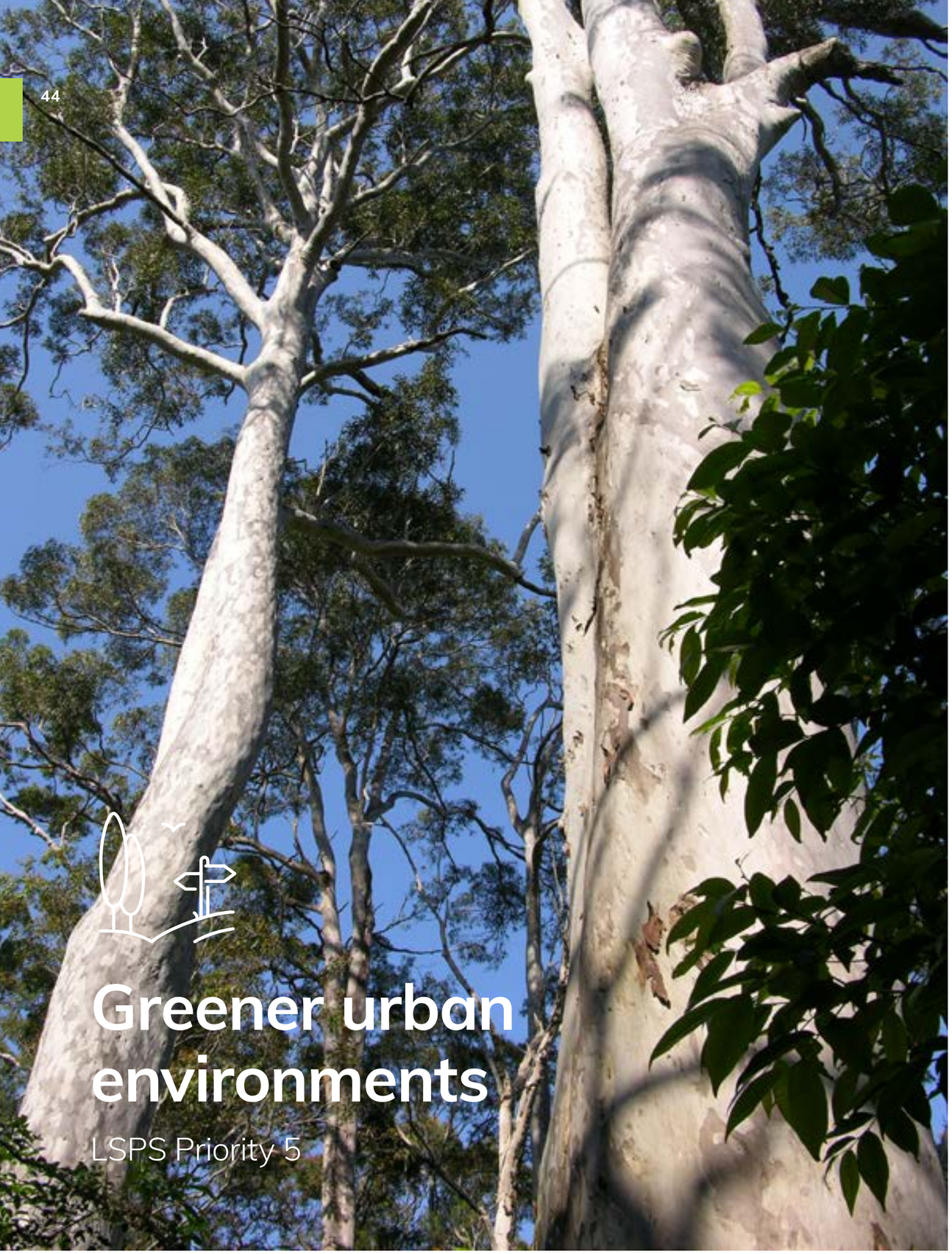
The challenge is to protect the natural environment while providing sustainable access for recreation and enjoyment. Opportunities to overcome this are likely to be in the form of more formalised sustainable recreational activities in locations with the objective to reduce the impost placed on bushland areas. This may involve clearly identifying environmentally sensitive areas as well as identifying areas that may be suitable for sustainable recreation and allocating sufficient resources for management.

Environmental Planning Actions
LSPS Priority 2

Protected and enhanced bushland and biodiversity

The following environmental planning actions have been developed to deliver the LSPS planning priorities. These will also help to achieve the outcomes of the ECC Strategy.

LSPS Action	ECC Strategy	Environmental Planning Actions	Timeframe
Prepare a biodiversity planning analysis to identify core, threatened and connection zones (wildlife corridors) and to support a strategic urban biodiversity framework. Prepare LEP and DCP controls that protect bushland and biodiversity, including the findings of technical studies; use of environmental protection zones and designating environmentally sensitive areas; and work with the Department of Planning, Infrastructure and Environment on the application of State policies.	Protect our bushland anwd its associated biodiversity through strategic land-use planning and development controls. Prepare and implement a strategic approach to biodiversity land management and use this to inform our strategic land use planning and development controls.	2.1 Undertake technical studies to update and refine existing biodiversity mapping. This will include new mapping which identifies important biodiversity assets including core habitats (large areas of mostly intact habitat), biodiversity corridors (also known as wildlife corridors), threatened ecological communities and threatened species habitats. Use best available information, strategies and guidance to inform these studies such the Bushland and Waterways section of the NSW Government Architects Office draft 2020 Greener Places Design Guide, existing NSW Government mapping of native vegetation (OEH 2016), threatened ecological communities and threatened biodiversity. Refinement of the mapping including improvements in accuracy will also be based on expert review, local knowledge, review of existing updated information and on ground surveys as required.	Short Term
		2.2 Incorporate updated biodiversity mapping developed in technical studies into the new local planning framework. This is to include a biodiversity map layer and provisions in the new LEP. More detailed controls will identify the extent and distribution of each biodiversity asset type (core habitat, biodiversity corridors, native vegetation or bushland and threatened biodiversity) in the new DCP.	Short Term
		2.3 Identify areas of high biodiversity significance as 'environmentally sensitive areas' in the new LEP and seek exemptions to the application of State planning controls that override local controls tailored for sensitive environments.	Short Term
		2.4 Develop and implement new biodiversity planning controls that will require future developments to demonstrate a hierarchy of first avoiding then minimising direct impacts on bushland before offsetting is considered. Where feasible, new developments are to be located within areas which are already cleared and / or disturbed in order to demonstrate avoidance of impacts. The design of new developments should demonstrate that impacts have been minimised by avoiding tree and native vegetation loss, including for the consideration of any required bush fire Asset Protection Zones.	Short Term
		2.5 Develop and implement new biodiversity planning controls which will focus on minimising potential indirect impacts resulting from development such as considerations of future use, predation by domestic animals, light spillage, changes in hydrology and encroachment into natural areas.	Short Term
Embed green infrastructure into the NSW planning system and make funding available through development contributions, rate reductions or levies.	Identify, design and deliver priority local green grid corridors, connections and shared uses. We will integrate this into our planning instruments.	2.6 Ensure natural assets including core habitats, threatened species habitats and native vegetation are considered early in the strategic planning process, such as during planning proposals, place plans or precinct plans.	Ongoing
		2.7 Ensure Council's natural assets identified in planning proposals, place plans or precinct plans are appropriately funded (eg: through the development contributions process) in a similar manner to built assets and infrastructure. Council will develop systems to support and facilitate this.	Ongoing
Prepare an open space and recreation strategy and map a local green grid that supports environmentally sustainable access to the bushland where appropriate.	Improve and manage sustainable recreational access whilst protecting environmentally sensitive lands.	2.8 Identify and protect areas of high biodiversity value within the local green grid.	Ongoing
		2.9 Ensure that Councils recreation planning considers protection of high biodiversity value assets and ensures recreational activities and infrastructure within these areas are low impact.	Ongoing
Investigate options for funding, acquisition and reservation of urban tree canopy and bushland with biodiversity, habitat, recreational and scenic value, including incentives or assistance to private property owners.		2.10 Investigate, develop and implement planning controls which support property owners to enhance bushland. For planning proposals, this may include proactive engagement in negotiations with developers and landowners to seek innovative solutions for conservation and management of retained bushland, and/or pathways to accept dedication of the land to Council, such as adjustments to planning requirements in exchange for preservation of bushland on site.	Short Term
		2.11 Identify options for funding the acquisition of land parcels with significant biodiversity values by way of the NSW Biodiversity Offsets Scheme. For example, this may include offsetting Council land and allocating any additional funds that are generated toward the acquisition of high biodiversity value land for conservation purposes.	Ongoing
		2.12 Increase the availability of local offsets by providing incentives and/or assistance to property owners to conserve bushland. Incentives for local offsets may include provision of technical expertise free of charge for provision of offset site feasibility assessments over larger local land holdings with high biodiversity values. Where development impacts cannot be further avoided and minimised, biodiversity offsets may be considered. Where biodiversity offsets are proposed outside of the Northern Beaches Local Government Area, Council may require an increased offsetting obligation in accordance with Part 7.13 (4) of the NSW Biodiversity Conservation Act 2016.	Ongoing
		2.13 Council will continue to advocate to the state government agencies to ensure biodiversity offsets are established and sourced locally. For example, when state led construction activities or rezoning is proposed, Council will seek offset obligations to be established and sourced on the Northern Beaches.	Ongoing
Provide a consistent approach in the assessment, compliance and management of threats to bushland and biodiversity resulting from invasive species including weeds and pest animals.		2.14 Develop and implement planning controls in the new planning framework that restrict the planting of priority weeds and other undesirable species in development as referenced in the Local Weed Management Plan https://files.northernbeaches.nsw.gov.au/sites/default/files/documents/general-information/weed-management/northernbeachescouncillocalpriorityweedmanagementplan.PDF.	Short Term



Greener urban environments

LSPS Priority 5

Open space and the connections between the urban and natural environment contribute to our standard of living. Our waterways, beaches, bushland, open spaces and parks are integral to the liveability and wellbeing of our community. It is necessary to maintain and enhance these connections by designing our communities around nature using the 'green and blue' grid to keep urban areas cooler and enhance biodiversity and ecological resilience.

The Towards 2040 principles for *Priority 5: Greener Urban Environments* will guide future planning decisions. The principles include:

- Create a resilient, healthy and interconnected urban tree canopy across the Northern Beaches.
- Protect, maintain and enhance the existing tree canopy, including mature trees.
- Provide a diverse range of species of varying families and genera, prioritising local native tree, shrub and ground cover species.
- Offset tree canopy loss by planting a minimum of two trees for any one tree removed from public and private land.
- Integrate the design of green, blue and grey infrastructure in support of the urban tree canopy.
- Reduce exposure to UV radiation and the urban heat island effect by increasing the urban tree canopy and green cover, incorporating water sensitive design and improving infrastructure and building design.

The urban tree canopy is a form of green infrastructure that helps to mitigate urban heat, manage temperature increases associated with climate change, heatwaves, urban heat island effect and protection from UV radiation. Shady streets also enhance visitor experience, reduce energy costs and add appeal for retail, business and office developments.

The Northern Beaches has one of the highest urban tree canopy coverages in Sydney, with overall coverage estimated at 39%. Tree-lined streets, urban bushland and tree cover on private land, are components of the urban tree canopy.

What is urban tree canopy?

Urban tree canopy refers to all trees on public and private land within urban areas. This comprises a variety of tree types such as exotics, natives, deciduous trees, and evergreens occupying a range of environments from busy city centres to regional main streets and suburbs.

On the Northern Beaches, our urban tree canopy refers to the tree canopy in urbanised environments outside of National Parks and rural and bushland areas.

Every 10% increase in tree canopy can reduce land surface temperatures by **1˚C**

The tree canopy cover for street trees in the Northern Beaches is **39%**

4.1 Benefits of a Greener Urban Environment

The ‘green and blue’ grid across the urban environment is critical to the liveability and the environment of the Northern Beaches. They are just as important as roads, car parks, water and buildings.

Connections across the natural environment, whether it be bushland, waterways, lagoons or coastal environments, are essential for biodiversity and ecological resilience. This includes backyard bushland connectivity which enables native fauna to migrate throughout the region.

The green and blue grid is also important for urban areas of higher density, where, over time, bushland has become fragmented and where the value of native species plantings can increase native fauna habitat.

The Northern Beaches coastal lagoons contribute to maintaining and enhancing the blue-green grid connections. Narrabeen, Manly, Curl Curl and Dee Why Lagoons provide important wildlife habitat and refuges. The lagoons and their riparian lands also support and provide recreational opportunities for the surrounding communities.

Connections to the green and blue grid is fundamental from a human health perspective, supporting active, physical lifestyles and mental health outcomes. The lifestyle benefits associated with natural environment connections is one of the hallmarks of life on the Northern Beaches. Protecting and enhancing these assets goes well beyond their intrinsic benefits.

The urban tree canopy also supports cleaner air and water, provides local habitat and reduces the urban heat island effect. Trees remove fine particles from the air and help insulate against urban noise pollution, particularly important along busy roads.

4.2 Heat

Extreme heat events have killed more Australians in the past 200 years than any other climate (i.e. natural) hazard (Coates 1996). With an increase in population, urbanisation, ageing and climate change, the health impacts of extreme heat are likely to increase, with those most affected likely to come from vulnerable groups in our communities (NSW OEH, 2016).

Heatwaves will become more frequent as the climate changes and a problem like urban heat cannot be eliminated. An overall increase in temperature means that current extreme heat events will become hotter, more frequent, with increased duration and therefore more severe.

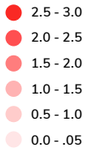
The NSW OEH (2014) has presented a snapshot of the expected temperature changes in Sydney:

- In the period from 2020–2039, maximum temperatures are projected to increase by between 0.3–1.0 degrees C; and
- By 2070, the maximum temperatures are projected to increase by 1.6–2.5 degrees C.

In addition, it is expected that the Northern Beaches will experience an additional four hot days each year by 2030 and 11 additional hot days by 2070. Hot days are defined as days with a maximum temperature over 35 degrees C. The increase in hot days will be more pronounced in areas away from the coast.

Change in annual mean temperature (°C)
1990-2009 to 2020-2039

Change in annual mean temperature (°C)
1990-2009 to 2060-2079



4.3 Challenges and Opportunities

Communities should be sensitively designed within the natural environment to build resilience to heat and allow natural processes help to improve liveability of the urban environment. In addition, the shade is integral to creating welcoming places for people.

The Greater Sydney Green Grid concept is visionary and displays solid principles about the importance of open space, landscape character and natural processes that benefit cities and towns. The resulting advantages which emerge with striving for a greener urban environment include:

- combatting the urban heat island effect with natural shade and cooling;
- assisting storm water quality, drainage and absorption;
- contributing to improved air quality;
- increasing habitat and safe corridors for wildlife;
- increasing resilience to climate change; and
- enhancing opportunities for environmental awareness and social activity through bush care and community gardens.

4.3.1 Urbanisation

Urbanisation can disconnect people and the natural environment. It can also lead to a loss of tree canopy and increase localised temperatures that contribute to the urban heat island effect.

Urban consolidation will help avoid unnecessary land clearing, habitat loss and further fragmentation of ecologically valuable areas of bushland and corridors. However, this will likely also translate to an increase in the density of development of existing and emerging strategic centres such as Dee Why, Manly and Frenchs Forest.

Incorporating greener urban environment principles across these centres will help maintain the natural environmental character of the Northern Beaches, and the connectivity of corridors and environments throughout these areas.

The rehabilitation and revegetation of creeks and waterways is a key opportunity to re-establish network connectivity and enhance open space and water quality outcomes, at a regional scale. Supplementing these opportunities with urban backyard connections recognises the important environmental services these connected networks play in the function of cities.

4.3.2 Urban heat island effect

A key issue of urbanised environments is associated higher temperatures as materials and surfaces such as concrete and bitumen absorb heat. Treeless urban areas generally have higher temperatures than the surrounding vegetated urban areas which give them an island appearance in heat maps leading to the name urban heat island effect (UHI).

As noted, as a result of climate change, it is expected that there will be an increase in temperature in the area in both the near (2030) and far (2070) future.

Strategic centres and employment hubs of Mona Vale, Brookvale, Dee Why and Frenchs Forest and along major entry and transport routes of Pittwater Road, some parts of Barrenjoey Road and Condamine Street are particularly susceptible to the urban heat island effect. In these locations for example, the urban tree canopy coverage is about 11 per cent, with some areas as low as four per cent.

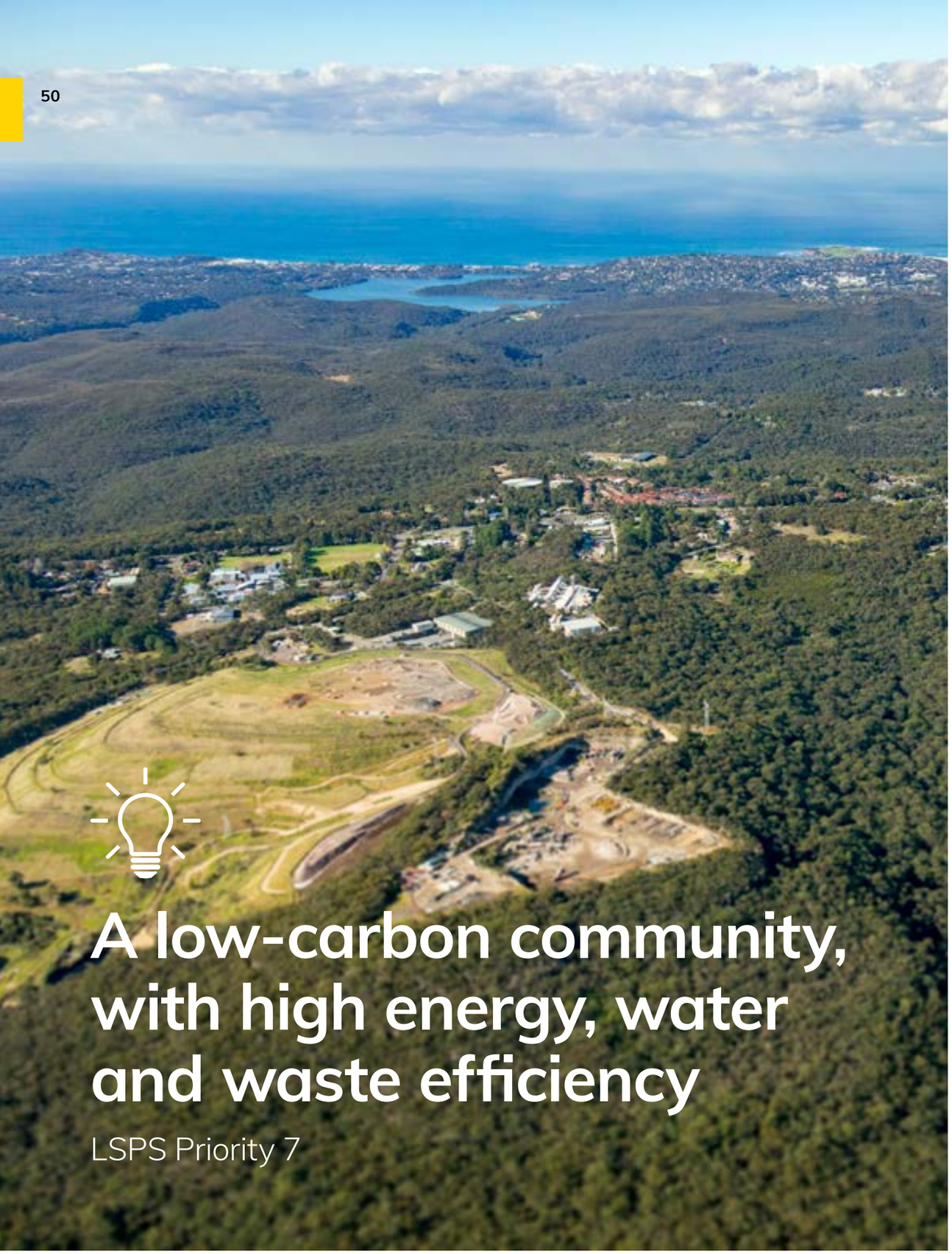
Increasing the urban tree canopy or other green infrastructure, such as green walls, green roofs or water sensitive urban design, across our urban areas will help to cool the urban environment.

Environmental Planning Actions
LSPS Priority 5

Greener urban environments

The following environmental planning actions have been developed to deliver the LSPS planning priorities. These will also help to achieve the outcomes of the ECC Strategy.

LSPS Action	ECC Strategy	Environmental Planning Actions	Timeframe
Implement the Urban Tree Canopy Plan, including the protection of trees and tree-lined areas. Prepare design guidelines and develop LEP and DCP controls for urban tree canopy, urban heat and UV radiation. Tree canopy to be addressed by tree replacement ratio, deep soil requirements, landscaped area requirements and increased front of building setbacks in road corridors. Urban heat to be addressed by the requirements for roof colours, cool pavements, wind circulation, green roofs, green walls and water sensitive urban design. UV radiation to be addressed by well-designed built and natural shade. Investigate the feasibility of Greater Sydney Green Grid projects, identify a local green grid and protect and enhance these grids in the new planning framework.	Implement relevant tree plans and strategies, including finalising and implementing the Draft Northern Beaches Council Urban Tree Canopy Plan 2019 to protect and enhance our urban trees. Key directions in the plan include protecting urban trees, maintaining tree canopy covers, improving tree health and diversity and inspiring the community to protect and enhance urban trees. Select tree canopy species that complement the local natural environment. Support, encourage and enable green infrastructure development, including vertical and roof gardens through our planning instruments and regulations. Identify, design and deliver priority local green grid corridors, connections and shared uses. We will integrate this into our planning instruments.	5.1 Review, develop and integrate planning controls into the new planning framework that includes green infrastructure that provides for water treatment and retention, water sensitive urban design, urban cooling, ecosystem services and amenity and integrate it into built, landscaped and natural environments in strategic centres, employment hubs and areas subject to urban intensification.	Short Term
		5.2 Ensure built form controls maximise landscape open space at ground level, and where appropriate at upper levels (through green roofs and green walls) with adequate soil volumes to enable landscaping and tree canopy planting.	Short Term
		5.3 Implement a best practice Urban Tree Canopy Plan for the LGA that includes tree canopy targets and prioritises local native tree species.	Ongoing
		5.4 Incorporate within the new planning framework requirements for landscape open space, tree protection and replacement requirements.	Short Term
		5.5 Develop and integrate planning controls into the new planning framework that require building materials that help to mitigate urban heat including requirements for lighter coloured roofs, cool pavements and wind circulation.	Short Term



A low-carbon community, with high energy, water and waste efficiency

LSPS Priority 7

5.0 A low-carbon community, with high energy, water and waste efficiency

The vision for life on the Northern Beaches over the next twenty years inherently involves the movement towards a society with lower levels of consumption, emissions and waste generation. This vision also includes encouraging a circular economy, increased use of active and public transport opportunities, and enhanced sustainable built environment outcomes. The Towards 2040 principles for Priority 7 will guide future planning decisions. These principles include:

- Ensure new developments and retrofits demonstrate improved building standards and the achievement of a low-carbon development with high-efficiency in energy, water and waste.
- Reduce carbon emissions.
- Support precinct scale efficiency initiatives.
- Reduce the volume of waste to landfill and waste transport requirements.
- Maximise re-use and recycling to support a circular economy.
- Support smart technology and infrastructure.
- Increase the uptake of renewable energy.
- Increase alternative water supplies to decrease dependency on distributed potable water.

Living sustainably and efficiently in our environment is a core focus for Northern Beaches Council, business, community groups and households alike (NBC, 2020; NBC, 2017). Northern Beaches Council is committed to achieving net zero emissions across the community by 2050. Targets have also been set to maintain or reduce community water consumption by 2040.

In the 2016-17 baseline year, around two million tonnes of greenhouse gases were emitted by the Northern Beaches community from electricity, transport, waste and gas. Overall, over half these emissions were from electricity and about a third from transport. 63 per cent of emissions were from residential activities, and 37 per cent from non-residential activities.

Buildings are a major energy consumer and account for almost a quarter of Australia's carbon emissions (ASBEC, 2016). Land use planning plays a significant role in delivering a low carbon community in new developments and renewals. Building more efficient homes and workplaces are key to reducing carbon emissions and Council aspires for all new buildings being net zero emissions by 2030.

How the built environment functions and encourages sustainable community behaviours provides a key opportunity to support efficiency and sustainability goals.

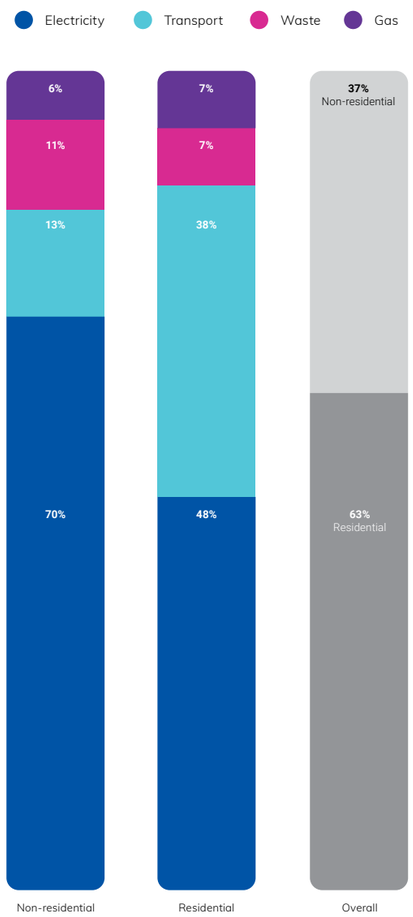
The contribution to emissions is higher from transport for the residential sector than non-residential. Of note, over 60 per cent of the region's journeys to work are in cars.

The community carbon emissions data clearly demonstrates that per capita emissions are lower in areas of higher density such as Manly, Dee Why and Narrabeen compared to suburbs of lower density. This is in part due to the emissions that result from increased use of private transport.

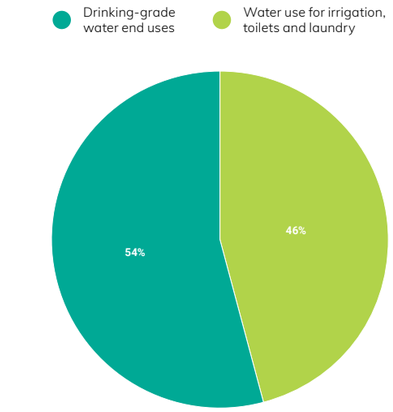
In 2016–17 the total potable water consumption for the LGA was more than 23ML. The residential sector is responsible for the majority of water consumption for the region. Further analysis determined that 46% of residential water use is for non-potable use including irrigation, toilets and laundry. This presents opportunities for reductions through water reuse measures such as rainwater tanks and recycled water system.

Council also has adopted commitments to divert 85% of waste from landfill and reducing the rate of waste generation per person by 2040. In 2016-17, the domestic waste service disposed of over 60,000 tonnes of waste to landfill corresponding to 227kg per person. This has reduced by over 30% in 19/20 due to improvements in the waste service.

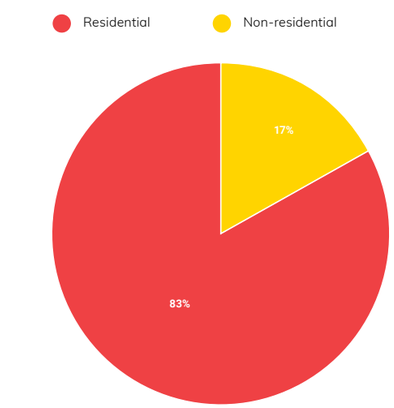
Carbon emissions



Potable water consumption in the Northern Beaches by the grade of end use



Potable water consumption by sector



Northern Beaches Council as a sustainability leader

- 2020 winner of the prestigious Keep Australia Beautiful 'Sustainable Cities Award'
- Silver partner of the NSW Government's Sustainability Advantage program.
- Lighting upgrades at buildings, car parks and sports fields, heating and cooling system upgrades.
- 900kw of solar power installations on Council buildings, including Cromer and Balgowlah depots.
- Low-energy LED residential streetlights that reduce carbon emissions by 3,000 tonnes a year.
- Smarter, greener, safer, cleaner waste collection service that reduces emissions.
- Cromer Park Water Harvesting Scheme, recapturing and treating water through a bio-retention system and UV filtration then using it for irrigation, capturing herbicides and fertilisers on site.
- Setting an ambitious target for half of all homes to be powered by solar by 2030.
- Made the switch to 100% renewable electricity from 1 January 2021.
- Installed 265kw of solar power on the Manly Andrew Boy Charlton Pool, one of the largest systems on the on Northern Beaches.

5.1 Challenges and Opportunities

5.1.1 Encouraging development efficiencies

As adopted in Northern Beaches community strategic plan 'We aspire to be leaders in managing resources sustainably and for the long term to ensure that development is balanced with our lifestyle and environment'. This includes ensuring that existing and future development improves efficiency in the areas of energy, water and waste. Designing a built environment with a zero-carbon emissions footprint is the challenge.

Local efforts that contribute to a net zero emissions region can be delivered through:

- a zero carbon focus;
- a water and waste-wise community;
- a sustainable built form;
- an efficient, compact settlement pattern; and
- a connected community with transport options.

In addition to local efforts, a state and national approach to achieving net zero emissions is also required that will involve both the government and non-government sectors. An example of this is the NSW Net Zero Plan Stage 1: 2020 – 2030 which is the foundation for NSW's action on climate change and goal to reach net zero emissions by 2050. It outlines the NSW Government's plan to grow the economy, create jobs and reduce emissions over the next decade.

Opportunities can be fostered through improvements to building standards and retrofitting requirements to increase building efficiency and reduce resource consumption. In this area, Council has been advocating for beyond BASIX, to increase building sustainability measures. Focusing on more compact settlements with diverse housing designs reduces reliance on private vehicles and supports active and public transport.

Facilitation of smarter infrastructure and technologies can support daily activities; support a transition to a circular economy that will maximise reuse, repair and recycling of products and materials. Capitalising on precinct-scale efficiencies aids sharing of consumption, harvesting and recycling across multiple buildings or land uses within defined areas of proximity.

The development of Frenchs Forest as a Green Star community is a key opportunity to consider the integration of each of these elements.

Redevelopment in existing strategic centres, whilst more challenging, is also a significant opportunity to transition our carbon emissions profile more holistically. This includes the consideration of sustainability and efficiency in every aspect from settlement pattern design to parking, landscaping, and building fit-out.

Within new developments and renewal of existing there are opportunities to encourage and support circular design to reduce carbon-intensive materials and increase recycling. This includes designing infrastructure, products and entire precincts so that they rely on fewer raw materials, are more durable and can be easily repaired and use more recycled content and recovered energy. We can design out waste by reducing resource consumption through using reclaimed/re-manufactured materials over new, selecting products based on the assessment of the embodied carbon content, sustainable manufacturing processes, ethical and sustainable supply chain, durability and end of life disposal. We can encourage and support the consideration of life-cycle of materials used in construction through consideration of different designs in buildings which enable efficient reuse and recycling and through digital record keeping of material in new buildings and infrastructure

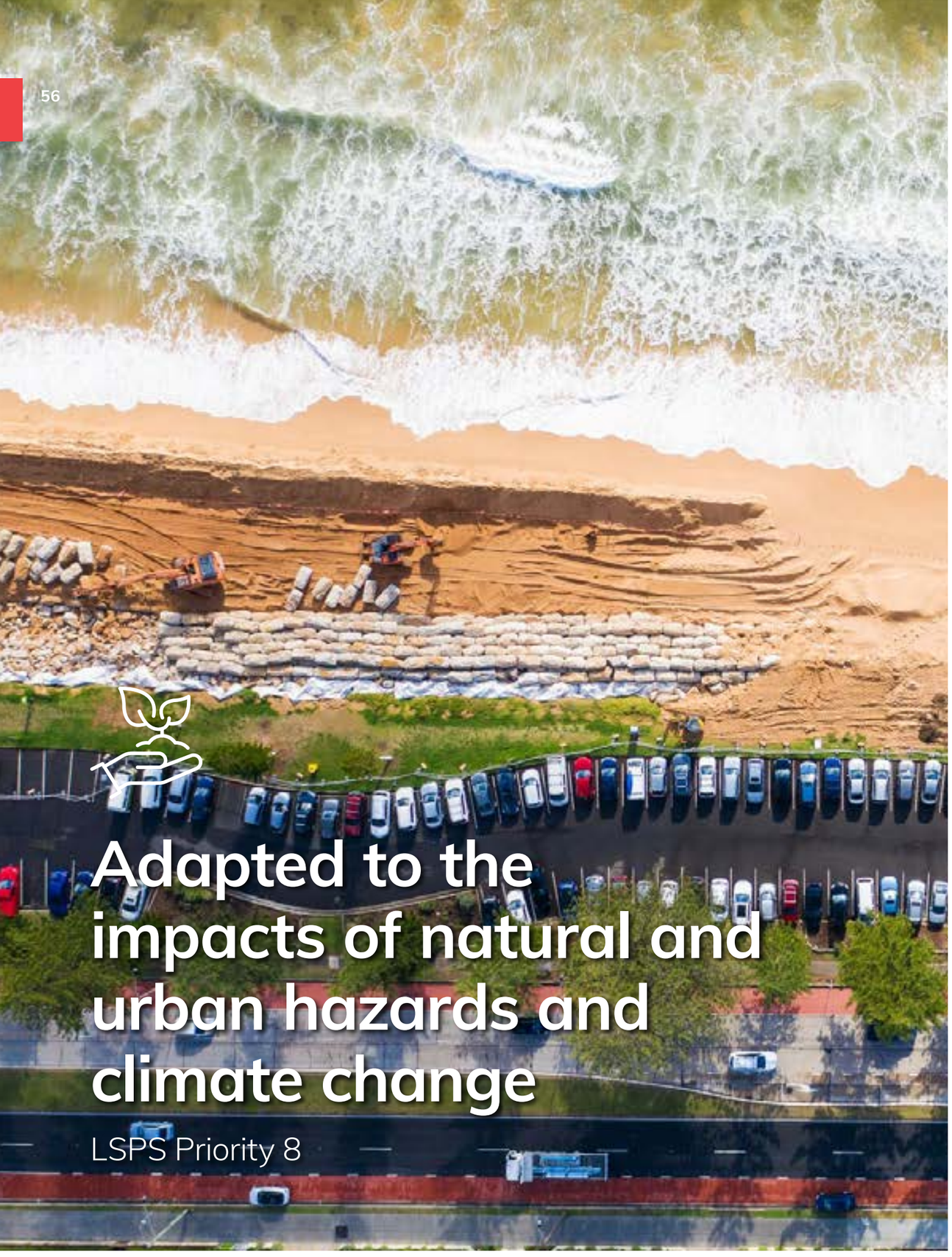
How land use planning and built environment outcomes can contribute towards reduced car parking requirements, increased car share opportunities, more compact settlements and sustainable businesses and industries will remain at the forefront of planning and related processes on the Northern Beaches for the next twenty years, and beyond.

Environmental Planning Actions
LSPS Priority 7

A low-carbon community, with high energy, water and waste efficiency

The following environmental planning actions have been developed to deliver the LSPS planning priorities. These will also help to achieve the outcomes of the ECC Strategy.

LSPS Action	ECC Strategy	Environmental Planning Actions	Timeframe
Deliver Frenchs Forest strategic centre as a low-carbon, high-efficiency precinct and a Green Star Community. Identify opportunities for precinct-scale efficiencies, renewable energy projects, circular economy outcomes, compact settlements, smart technology and infrastructure and better building standards and retrofits in the environment study, employment study and local housing strategy. Develop LEP and DCP controls to improve energy, water and waste efficiencies in new developments in strategic centres, employment hubs and areas subject to urban intensification to provide an independent sustainability certificate such as the Green Star Rating Tool, Passive House or a recognised equivalent (threshold to be developed). Improve building standards for residential and non-residential buildings and relevant infrastructure, support the push for net zero carbon buildings, and monitor progress.	Seek out, support and encourage precinct scale solutions to reducing resource use. Support and encourage renovations, retrofits and refurbishments to lower energy and water use in our community, including driving conversion to renewable energy, especially solar panels. Help our community to understand the benefits of building sustainably. Improve local planning controls to ensure residential and non-residential buildings and infrastructure are sustainably built and designed. Encourage state and federal government to rapidly drive down emissions, water use and other pollution through actions such as better building standards for residential and non-residential buildings and relevant infrastructure: e.g. increasing BASIX and implementing standards for non-residential development.	7.1 Deliver precinct plans and place plans as net zero carbon and high efficiency through integrating sustainability initiatives. This could be achieved, for example, through ensuring the precinct incorporates high passive design performance, is electric and supports a diversity and integrated system of renewable energy supply, sustainable and resilient construction materials are designed into the precinct, lifecycle of materials is considered and waste is designed out to reduce resource consumption. Advocate to the NSW State Government to ensure the Design and Place SEPP delivers precincts with net zero operational emissions by 2030 and includes a pathway and targets to reducing embodied carbon emissions by 2050.	Ongoing
		7.2 Consistent with NSW Waste and Sustainable Materials Strategy 2041 ensure planning controls provide opportunities for complementary businesses to co-locate in the Strategic Centres (Frenchs Forest, Brookvale, Dee Why, Manly and Mona Vale) where they can beneficially re-use each other's by-products, reducing their waste and carbon footprints. Ensure sufficiently zoned land to enable the recycling, processing and disposal of waste generated within the LGA, and that existing waste facilities' land use is protected.	Ongoing
		7.3 Ensure active transport connections are provided, including wide footpaths, safe cycling options, bus stops, shelters, bike racks and signage to support active and public transport in strategic centres and planning precincts. Ensure planning controls are included for bicycle parking and end of trip facilities to encourage healthy active lifestyles and help reduce reliance on private motor vehicles.	Short Term
		7.4 Reduce greenhouse gas emissions by advocating to the NSW State Government to increase BASIX requirements for residential developments including adopting net zero targets for multi-residential developments as defined in 'Planning for net zero energy buildings' (City of Sydney et al, 2021). Adopt net zero targets in the new planning framework for office, hotel, mixed use and shopping centres in line with the 'Planning for net zero energy buildings' (City of Sydney et al, 2021). Encourage and promote leading sustainability ratings for development such as net zero buildings, Green Star Homes and Passive House.	Short Term
		7.5 Review, develop and implement planning controls in the new planning framework to ensure efficient operational waste management. For example, by requiring a waste management plan to show how the construction/demolition will minimise waste generation, maximise use of recycled content or reusable materials, and how the operation of the building will enable efficient and safe waste collection, stream separation, reduce consumption of energy, water and materials.	Short Term



Adapted to the impacts of natural and urban hazards and climate change

LSPS Priority 8

6.0 Adapted to the impacts of natural and urban hazards and climate change

The proximity of urban areas to hazards such as waterways, coastal processes and bush fire prone vegetation places people, property and infrastructure at risk. This exposure will increase over time with population increase together with projected changes in intensity and/or frequency of these events as a result of climate change.

The Towards 2040 principles for Priority 8 will guide the future planning framework and include:

- Minimise risk to public health and safety from urban hazards and natural hazards.
- Reduce risk to life and property.
- Support initiatives that respond to climate change.
- Avoid intensification of development, inappropriate development and incompatible land uses in areas exposed to natural and urban hazards.
- Within high risk areas, avoid developments that rely on performance-based solutions, are difficult to evacuate or would be occupied by at risk members of the community.
- Mitigate exposure to UV radiation, the UHI effect and extreme heat.
- Improve resilience to climate change in both natural and built assets.
- Balance urban tree canopy programs and bushland restoration with natural hazard risk.
- Manage risks associated with sea-level rise for coastlines and beach landscapes.
- Minimise water, air and noise pollution, soil and groundwater contamination and its discharge to the environment.
- Minimise adverse impacts from development in environmentally sensitive areas.

The Northern Beaches is exposed to significant natural hazard risk with a track record of events, including the 1966 storms; 1974 coastal erosion; 1994 bush fires impacting Terrey Hills, Ingleside and Elanora Heights; significant flash flooding events and the 2016 east coast low which brought flooding and coastal erosion. These natural occurrences will continue as the climate changes and are likely to intensify. Our collective exposure to natural hazard risk has, and will continue, to shape how we live in this dynamic environment.

Flooding, coastal erosion and bush fire hazards are among the most frequently experienced events.

22,454
Properties exposed to flood hazard

20,039
Properties exposed to bush fire hazard

455
Properties exposed to coastal hazard

6.1.1 Flood

The Northern Beaches is characterised by a series a plateaus and steep escarpments draining to coastal floodplains before discharging directly to the ocean or through a number coastal lagoons. This topography creates a risk of flash flooding or longer duration flooding from coastal lagoons. Both types of flooding can create a risk to life and property.

Rainfall conditions required to produce peak flooding conditions vary across the Northern Beaches with intense thunderstorms critical in small steep catchments, and longer east coast lows responsible for the worst flooding in Narrabeen and Manly Lagoons.

Around 22,000 properties on the Northern Beaches are identified as being at some risk of flooding. This is approximately 20% of all properties on the Northern Beaches.

The areas with the highest flood exposure tend to be those surrounding the major coastal lagoons, Narrabeen, Dee Why, Curl Curl and Manly. This Lagoon flooding occurs when creeks and stormwater networks drain into

Flooding in Narrabeen Lagoon

the lagoon and water cannot escape quickly enough. This generally occurs during major storms with high rainfall runoff, where the escape of floodwaters is impeded by the build-up of sand at the entrance and/or high ocean levels, resulting in flooding on the surrounding floodplain. Tide, storm surge, wave movement and the state of the entrance berm can all have a significant impact on flooding. Council manages the entrances of Narrabeen, Dee Why, Curl Curl and Manly Lagoons to reduce the risk of flooding, however the risk can still remain high.

A number of the Northern Beaches commercial centres are also located within low lying floodplains and are at risk of flash flooding. These include Avalon, Newport, Dee Why, Brookvale and Manly Vale.

Council maintains and operates the Northern Beaches Flood Information Network, which includes rain fall, water level and flow gauges with the data published on a public webpage. Specific gauges have threshold levels which if exceeded trigger SMS alerts to key Council staff and emergency response agencies.

6.1.2 Coastal processes and hazards

The coastline of the Northern Beaches is iconic however it also comprises stretches of beach which rate among the highest risk locations in Australia. Collaroy-Narrabeen Beach is exposed to a range of complex coastal processes, as well as coastal hazards. The complexity of this hazard, coupled with flood risk, places the Narrabeen Peninsula in a complex situation which requires an appropriate land use response that reflects the compounding nature of risk exposure in this location, into the future.

Natural coastal processes which occur along the Northern Beaches coastline include both offshore and nearshore wave climates and wave run-up, elevated water levels due to astronomical tides, storm surge and wave setup and sediment transportation.

Coastline hazards can include damage from storm events involving beach erosion, beach rotation, shoreline recession, slope instability and coastal inundation.

6.1.3 Coastal Inundation

Coastal inundation is a coastline hazard that particularly impacts estuarine areas of the LGA. Coastal inundation is one aspect of coastal hazard as defined by the NSW *Coastal Management Act 2016*. Inundation of the coastal zone can be caused by large waves and elevated water levels associated with a range of coastal and oceanographic process responses to severe storms.

The foreshore estuarine areas around Sydney Harbour, Pittwater and Cowan Creek are subject to coastal inundation. Council currently has defined estuary planning levels for the Pittwater estuary that incorporates projected sea level rise. Council is currently undertaking technical studies to define estuary planning levels for Sydney Harbour and Cowan Creek areas within the LGA. These studies have been undertaken in accordance with the methods used in the adopted Pittwater Estuary Planning Levels study.

Coastal erosion

6.1.4 Bush fire

Bush fire is a frequent occurrence in parts of the LGA, and whilst this is of higher risk in the areas associated with our national parks, the Northern Beaches is home to a large number of bushland reserves and corridors which can give rise to increased risk profiles within urban areas.

Bushland areas in the upper reaches of the catchment are bush fire prone, with vegetation connectivity potentially enabling the transition of fire toward urban areas at Elanora Heights and Warriewood, as well as throughout the Belrose and Oxford Falls Valley areas and towards Cromer. Ember attack under extreme conditions could also see bush fire impact well into urban areas and more isolated reserves.

Council manages bush fire risks on Council land in accordance with any Bush Fire Risk Management Plan prepared by the Northern Beaches Bush Fire Risk Management Committee. This risk planning ensures that appropriate treatments are in place to manage bush fire risks across the landscape irrespective of tenure.

Council has also prepared a Bush Fire Prone Land Map (BFPLM) which was certified by the NSW Rural Fire Service in 2020. This map identifies land that is potentially at threat from bush fire attack with more than 20,000 homes exposed to bush fire prone land throughout the LGA. It also triggers additional planning and development controls on bush fire prone land for new development or building work.

New development or building work on land identified as bush fire prone must comply with the requirements of the NSW Rural Fire Service's Planning for Bush Fire Protection (2019). This document outlines bush fire protection measures that may be required for new development, such as construction standards, asset protection zones, infrastucture and emergency access. Further details regarding construction standards are detailed in Australian Standard AS 3959-2009 'Construction of buildings in bush fire prone areas.

However, the Australian landscape is not only prone to fire, but requires it to regenerate. Whilst bush fire protection policy articulates how development can occur within certain bush fire prone areas, there remain strategic considerations which also must be identified. These include the potential impact of land clearing on sensitive environments and threatened ecological communities, and the cascading risk of landscape erosion, poor water quality and exacerbated weed and feral animal incursion into sensitive environments. The ability for whole-of-community evacuation is also a necessary strategic consideration.

Figure 3 illustrates at a strategic level, those areas of the Northern Beaches where resilience to natural hazard events may be a particular focus. This includes hazards such as flood, bush fire, coastal impacts (storm surge, coastal erosion, etc), as well as exposure to urban heat and climate-related events.

6.1.5 Geotechnical hazards

The Northern Beaches is characterised by a variety of underlying geological conditions with a large coastline comprising of stretches of beach separated by coastal cliff zones, rising up via steep slopes to the rocky plateaus and crests all with different inherent risks and hazards. Risks include subsidence, landslip, hydrological risks and rock falls all of which pose a serious threat to life and property if not managed effectively.

It is important to note that it is ultimately the land owners responsibility to manage geotechnical risks that are present on their site, however Council has a responsibility to ensure that development within the LGA takes into consideration the geotechnical risks associated with the applicable site and surrounding area. The primary method of geotechnical risk management in the Northern Beaches LGA is through the application of geotechnical conditions and controls as set out in a Geotechnical Report supporting a Development Application. Council is currently undertaking a study and preparing a map to provide a geotechnical classification to all parcels of land within the LGA that reflect the underlying geotechnical conditions and will provide the requirements that need to be submitted with a Development Application so as to ensure adequate due diligence is undertaken and ongoing risk mitigation measures are implemented.

Image credit: Fire & Rescue NSW

6.2 Challenges and Opportunities

6.2.1 Climate change

The impact of climate change is likely to be a significant challenge on the Northern Beaches, but also represents an opportunity to adapt and do things differently. Australia's climate has warmed by over 1.44 ± 0.24 ^{O}C since 1910 (BOM and CSIRO, 2020 State of the Climate 2020) and national climate projections indicate that Australia's climate will change further over the coming decades. As a result, Australia is expected to experience:

- Further increase in temperatures, with more hot days over 35 ^{O}C
- Ongoing sea level rise
- More intense heavy rainfall throughout Australia, particularly for short-duration extreme rainfall events
- A decrease in cool-season rainfall across many regions of southern Australia, with more time spent in drought
- An increase in the number of high fire weather danger days and a longer fire season for southern and eastern Australia
- Fewer tropical cyclones, but a greater proportion of high-intensity storms, with ongoing large variations from year to year.

One of the foremost climate-related issues is the impact of coastal hazards into the future. The Northern Beaches coastline may be impacted in the future as the sea level rises, beach erosion increases and the impact of severe storms places pressure on coastal environments and development. Planning now for these impacts is essential and provides the opportunity to embark upon new processes and approaches to protect our coastal environments.

Sea level rise will impact ecosystems, such as mangroves and saltmarsh, which will need to migrate upslope to remain within the ranges to which they are adapted. Seagrass may also be affected, as it is also adapted to a certain range in water depth. These species will be sustained at higher water levels where foreshore land is available to migrate into.

There are potential impacts of sea level rise upon future development and re-development including the construction or reconstruction of foreshore structures such as seawalls, marinas, jetties and boat ramps. Groundwater tables which are likely to rise as sea levels rise will need to be considered in future development.

Whilst rainfall is predicted to lessen into the future, the incidence of severe storms leading to flash flooding may increase. Currently, flood risk is one of the major hazards experienced across the Northern Beaches and the impact of climate change may increase the number of properties affected by flooding.

The challenge for planning is to build a resilient Northern Beaches, by adopting risk-based approaches. There is a significant role for land use planning in providing effective protection to existing urban areas, whilst also ensuring that new development is not exposed to unacceptable levels of risk, does not create new risk and considers future climate changes.

6.2.2 Urban expansion

The expansion of urban areas into locations where hazards are present has led to an increased level of exposure across Australia and internationally.

The pressure of growth, growing populations, and the desire to live in scenic and iconic locations can drive urban expansion and development into sensitive environments, and increase residents, property and infrastructure to the impact of hazards

Urban expansion is one of the core drivers of increased hazard exposure, loss and damage in Australia.

6.2.3 Natural processes

Natural hazards are in fact natural processes. Floodplains have been carved along lagoon systems and waterways over millennia. In fact, waterways and their ecosystems play a pivotal role in helping to protect the landscape and the built environment from natural hazards such as flooding and storm surge.

When considering the impact of climate change, focus should also include protecting and maintaining the ecological function of waterways and the coast to enhance the resilience and capacity of natural waterways to adapt to climate change and protect people, infrastructure and biodiversity from the impacts. This can include the re-introduction or enhancement of natural systems and processes which offer hazard attenuation.

Well-managed ecosystems can reduce the impact of many natural hazards, such as flooding, landslides and storm surges. The extent to which an ecosystem can buffer against extreme events depends on the ecosystem's health and the intensity of the event. According to the World Bank (2004), investments in preventative measures, including in maintaining healthy ecosystems, are seven times more effective than the costs incurred by disasters (Australian Government website).

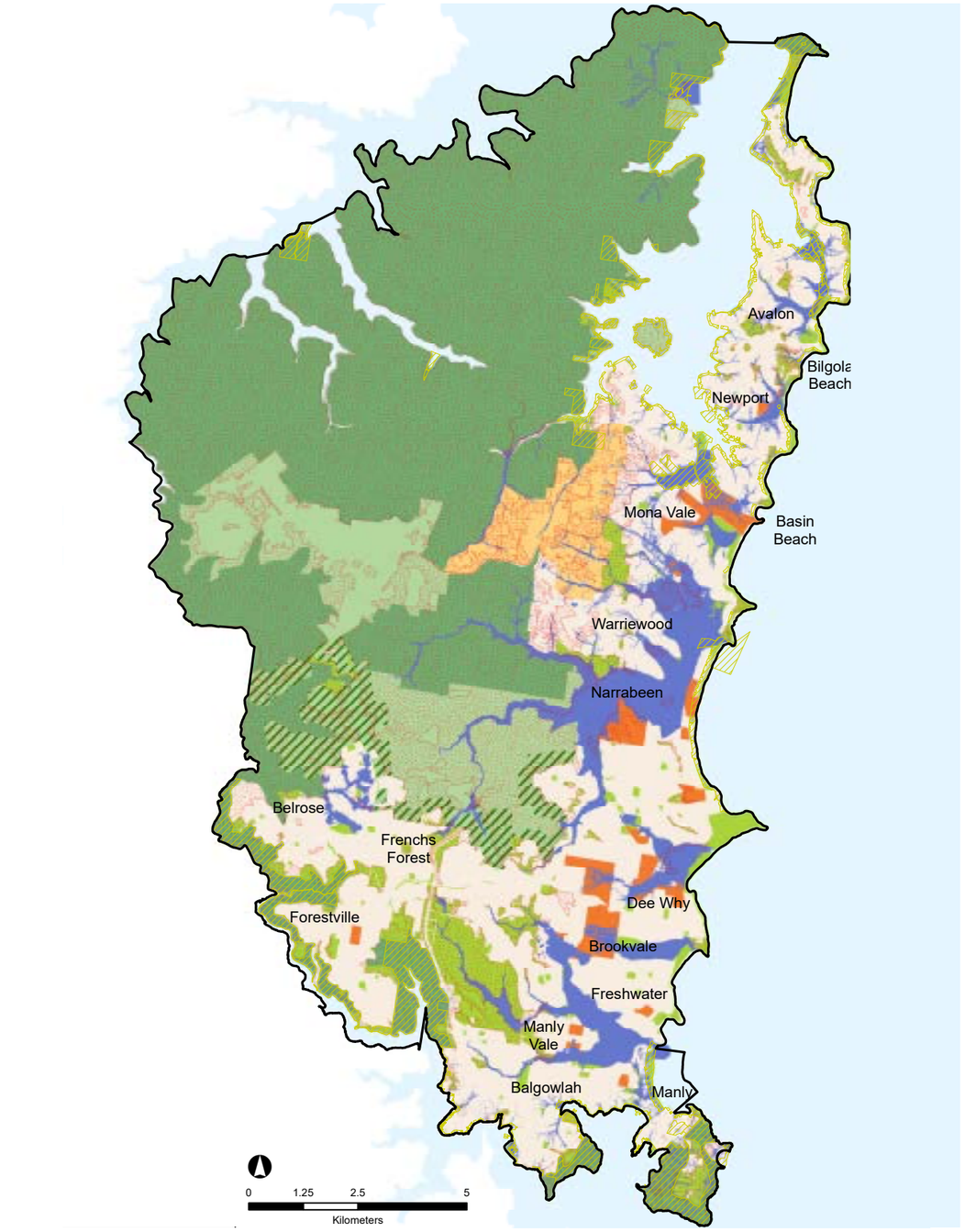
Coastlines are also dynamic. They are a function of many different processes including wave and tide processes, sediment movement and beach rotation. Protection of and maintaining coastal vegetation across dunes and coastal headlands, and mangrove and riparian rehabilitation, through planned and community-led bush regeneration activities will enhance flora and fauna habitat connectivity, as well as enhance resilience to hazards and climate change.

Shallow wetland areas, particularly the Careel Bay wetlands, will face increasing competition for space within surrounding urban areas, as saltmarsh and mangrove species attempt to migrate upslope to remain within their tidal limits.

Fire is essential to many landscapes in the LGA. One of the key approaches in managing bush fire is the inclusion of buffer areas, as well as fuel load reduction, or prescribed burning. However, whilst some of our plants require fire to germinate their seeds, too frequent fire, or not frequent enough, prevents them growing to flower and setting seed, which could significantly alter our natural bushland and diminish the diversity of fauna it supports.

A resilient community and environment embrace these processes and adapts to them. Through shared responsibility across the community and in conjunction with resilience measures and construction that is planned to be more resistant there will be an increase in the collective ability to endure, withstand and 'bounce forward' from natural hazard shocks can be enhanced.

Figure 3: Northern Beaches snapshot of natural hazards including impacts of climate change



Environmental Planning Actions
LSPS Priority 8

Adapted to the impacts of natural and urban hazards and climate change
The following environmental planning actions have been developed to deliver the LSPS planning priorities. These will also help to achieve the outcomes of the ECC Strategy.

LSPS Action	ECC Strategy	Environmental Planning Actions	Timeframe
Identify where to limit the intensification of development in areas exposed to hazards including bush fire prone areas for both risk minimisation and environmental protection. Identify where to limit the intensification of development in areas exposed to hazards including bush fire prone areas for both risk minimisation and environmental protection. Undertake studies including constraints, coastal hazards and flood mapping and develop LEP and DCP controls to restrict development in high-risk hazard areas. Prepare a climate change action plan for the LGA and a climate change adaptation plan for Frenchs Forest Strategic Centre.	Continue to identify properties affected by natural hazards to ensure strategies are in place to reduce their impact. Continue to identify properties affected by natural hazards to ensure strategies are in place to reduce their impact. Continually incorporate best available climate change and natural hazard knowledge and practices, including innovative solutions, into our strategic land use planning, development controls, construction and operations.	8.1 Deliver resilient precinct plans and place plans that are designed with adaptive capacity to respond to shocks, chronic stresses and climate change. This could be achieved, for example, through ensuring the precinct incorporates resilient design and / or construction materials. In addition, incorporate high levels of resilience by ensuring continuous energy, water, data supply even during extreme events like drought, heat waves or storms. Advocate to the NSW State Government to ensure the Design and Place SEPP delivers resilient precincts that can respond to shocks, stresses and climate change.	Ongoing
		8.2 Current and future natural hazard risks such as bushfire (including evacuation, egress or accessibility out of an area in an evacuation), flooding, coastal erosion and geotechnical risk must be considered early in the strategic planning process, including planning proposals, precinct and place plans. Future natural hazard risks will be determined by incorporating climate change projections as described by Adapt NSW, CSIRO or other peer reviewed projections in studies.	Short Term
		8.3 Undertake a risk-based assessment and develop maps for estuary planning levels for North Harbour, Middle Harbour and Cowan Creek in accordance with the Coastal Management Act that identifies areas subject to current and future estuary inundation risk as consistent with those undertaken for the Pittwater Waterway. Develop planning controls that mitigate current and future risk. For example, no impact to coastal processes, minimum floor levels, and use of inundation compatible materials and design.	Short Term
		8.4 Continue to identify flood prone land in accordance with the NSW Governments Flood Prone Land Policy and Floodplain Management Manual (2005) and permit development that is compatible with the flood hazard and flood function of land considering the projected changes as a result of climate change.	Ongoing
		8.5 Develop and integrate planning controls into the new planning framework using existing coastal hazard studies, such as the Coastal Zone Management Plans (Coastal Management Programs from Jan 2022) and the Identification of Coastal Hazard Risk Areas to Projected Sea Level Rise for the Manly Local Government Area.	Short Term
		8.6 Develop and integrate planning controls into the new planning framework that ensures all asset protection zones are contained within property boundaries as per Planning for Bushfire Protection, 2019.	Short Term
		8.7 Ensure that the ecological function of natural ecosystems is maintained and protected to enhance resilience to natural hazards and a changing climate. For example, through maintaining coastal vegetation, creek rehabilitation or best practice fire management.	Ongoing

The Study was prepared to inform the development of the Northern Beaches LEP and DCP and will help Council to deliver five sustainability planning priorities and Councils vision for the future of the Northern Beaches.

The Study has described the natural environment from the coastline, estuaries and coastal lagoons to the native vegetation and bushland corridors. These areas support an extensive variety of flora and fauna and contribute to the open space of the area. The Study has also demonstrated that the area is exposed to significant natural hazard risk and these are likely to intensify as the climate changes. This and other challenges such as development, land clearing and recreation will put pressure on the natural environment of the Northern Beaches.

The environmental planning actions recommended within the Study will guide the development of the new planning framework to address the challenges on the environment of future growth. In addition, the actions also provide opportunities to enhance and protect the environment, create better connections between the urban and natural environments and build and develop with consideration for sustainable and resilient outcomes.

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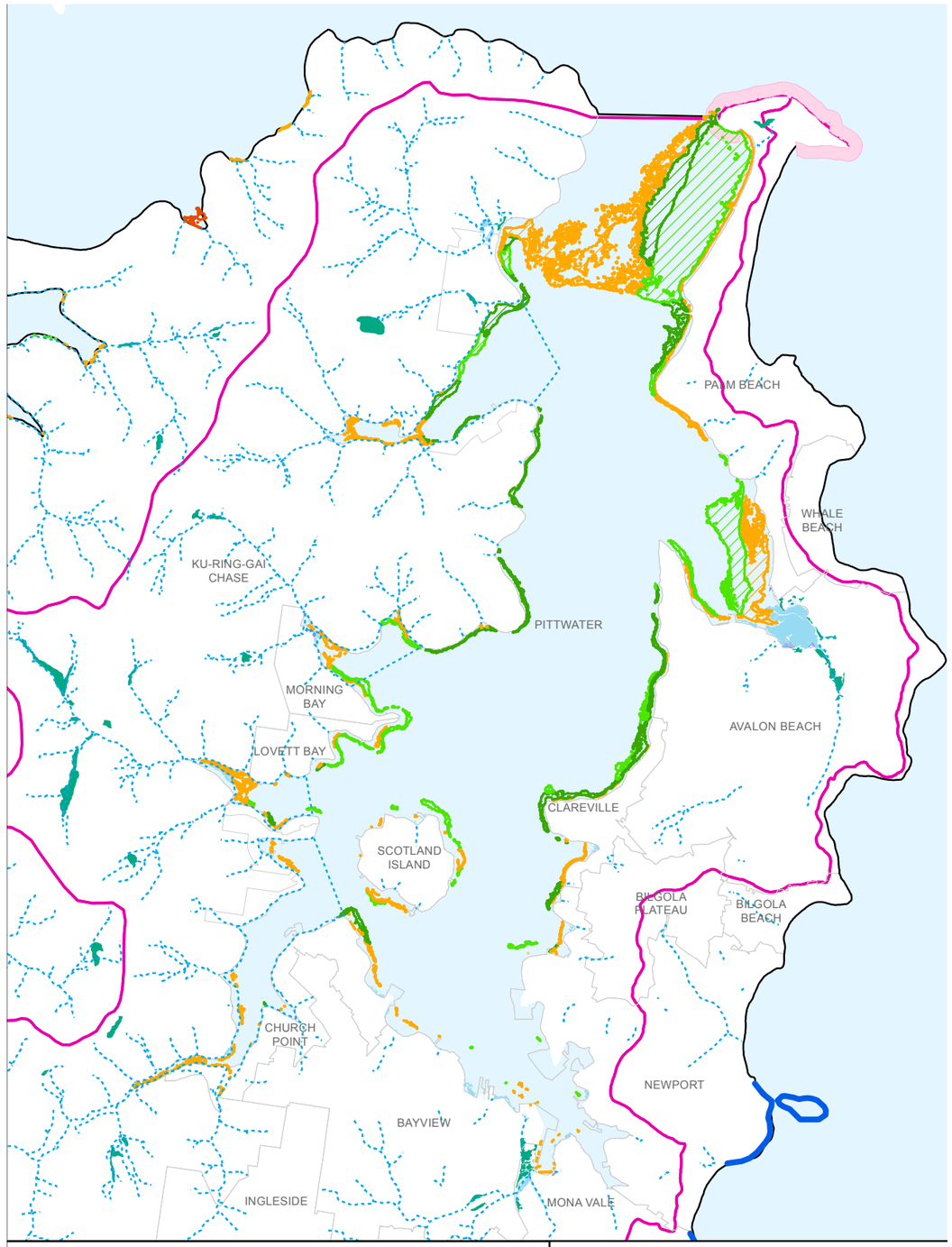
Appendix 1

Maps

Map 2: Major catchments, waterway features and estuarine macrophytes



Map 2: Catchments, waterways and NSW Estuarine Macrophytes map

- Watercourse
- Catchment Boundary
- Intertidal Protected Zone
- Wetlands
- Aquatic Reserves
- Posidonia
- Posidonia - Sparse
- Posidonia/Zostera
- Zostera
- Zostera/Halophila
- Mangrove
- Mangrove/Saltmarsh
- Saltmarsh
- Halophila
- Ruppia

Scale (A4) - 1:43,000
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Date Printed: 29/06/2021
Produced By: Spatial Information

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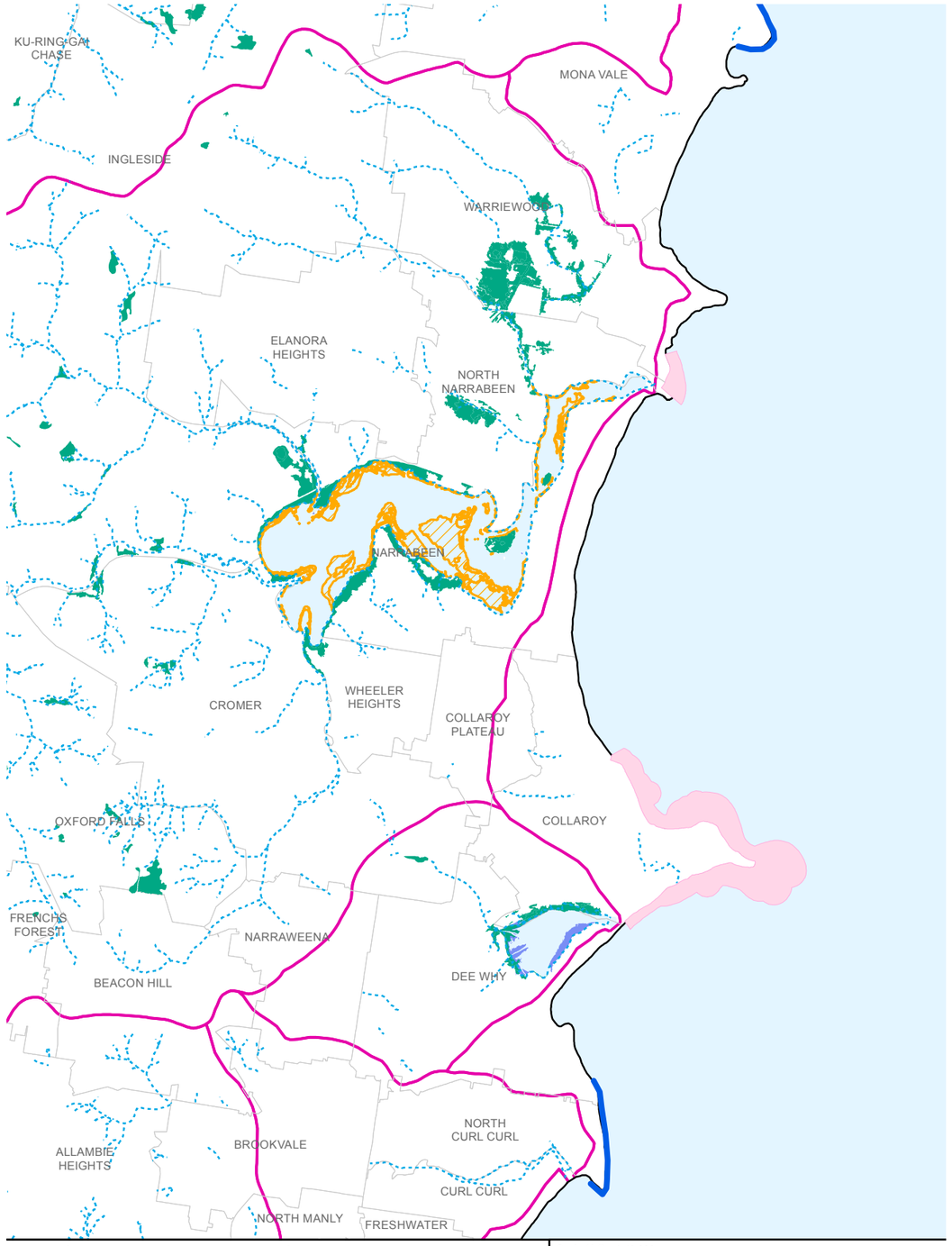
Map 3: Major catchments, waterway features and estuarine macrophytes



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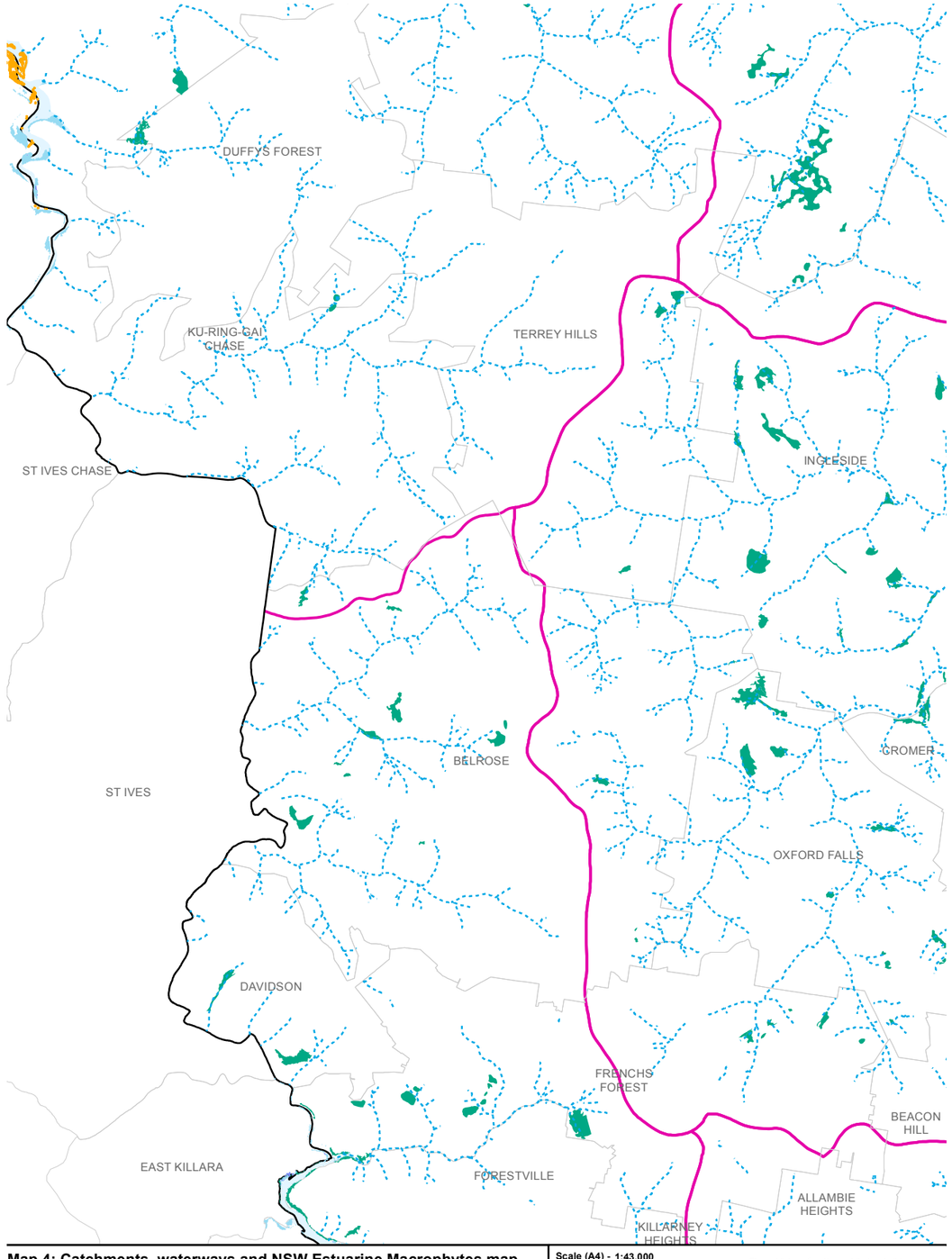
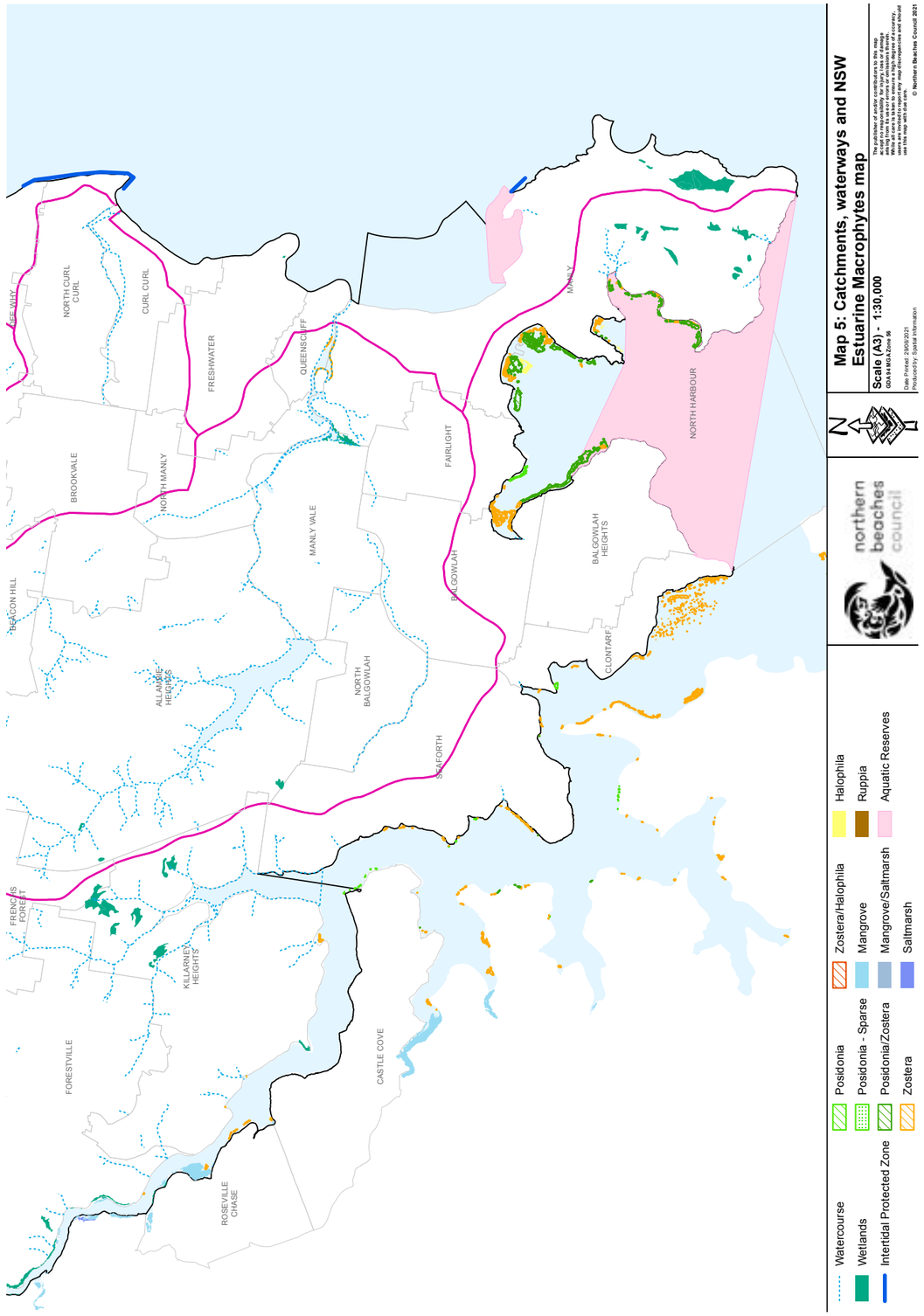
Map 4: Major catchments, waterway features and estuarine macrophytes



Map 5: Major catchments, waterway features and estuarine macrophytes



Appendix 2

Plant community types, threatened ecological communities and threatened species of the Northern Beaches

Table 1: Threatened species as listed under the Fisheries Management Act, 1994 within the Northern Beaches and adjacent waters

Common Name	Scientific Name	Status	Notes
Greynurse Shark	*Carcharias taurus*	Critically Endangered	
Adams Emerald Dragonfly	*Archaeophya adamsi*	Endangered	Potential distribution includes greater Sydney region. Only small number of adults collected from a few sites – closest of which to LGA is Hornsby.
Cauliflower Soft Coral	*Dendronephthya australis*	Endangered	Possibly within the LGA. Known population in Brisbane Water, Hawkesbury and isolated individuals observed in Sydney Harbour.
Scalloped Hammerhead Shark	*Sphyrna lewini*	Endangered	
White's Seahorse	*Hippocampus whitei*	Endangered	
Black Rockcod	*Epinephelus daemelii*	Vulnerable	
Great Hammerhead Shark	*Sphyrna mokarran*	Vulnerable	
White Shark	*Carcharodon carcharias*	Vulnerable	
Posidonia australis seagrass populations	*Posidonia australis*	Endangered Population	Pittwater and Sydney Harbour two of six populations listed

Table 2: Protected species listed under the Fisheries Management Act, 1994

Common Name	Scientific Name	Status	Notes
Bluefish	*Girella cyanea*	Listed Protected Fish Species	Uncommon in coastal NSW waters preferring offshore islands and reefs
Eastern Blue Devil Fish	*Paraplesiops bleekeri*	Listed Protected Fish Species	
Elegant Wrasse	*Anampses elegans*	Listed Protected Fish Species	Uncommon in coastal NSW waters preferring offshore islands and reefs
Estuary Cod	*Epinephelus coioides*	Listed Protected Fish Species	
Queensland Groper	*Epinephelus lanceolantus*	Listed Protected Fish Species	Unlikely but Sydney is listed as southern-most extent of east coast distribution.
Herbsts Nurse Shark	*Odontaspis ferox*	Listed Protected Fish Species	Unlikely. Has been recorded in NSW but typically in deeper (ie offshore) waters.
Pipefish, Pipehorse, Seadragon, Seahorse, Ghostpipefish (All Syngnathids – listed below)	Listed Protected Fish Species		
Girdled pipefish	*Festucalex cinctus*	Listed Protected Fish Species	
Tiger pipefish	*Filicampus tigris*	Listed Protected Fish Species	
Upside-down pipefish	*Heraldia nocturna*	Listed Protected Fish Species	

Table 2 continued

Common Name	Scientific Name	Status	Notes
Beady pipefish	*Hippichthys penicillus*	Listed Protected Fish Species	
Big-belly seahorse	*Hippocampus abdominalis*	Listed Protected Fish Species	
White's seahorse	*Hippocampus whitei*	Listed Protected Fish Species	
Crested pipefish	*Histocampus briggsii*	Listed Protected Fish Species	
Javelin pipefish	*Lissocampus runa*	Listed Protected Fish Species	
Sawtooth pipefish	*Maroubra perserrata*	Listed Protected Fish Species	
Red pipefish	*Notiocampus ruber*	Listed Protected Fish Species	
Weedy seadragon	*Phyllopteryx taeniolatus*	Listed Protected Fish Species	
Spiny pipefish	*Solegnathus spinosissimus*	Listed Protected Fish Species	
Robust ghost pipefish	*Solenostomus cyanopterus*	Listed Protected Fish Species	
Ornate ghost pipefish	*Solenostomus paradoxus*	Listed Protected Fish Species	
Spotted pipefish	*Stigmatopora argus*	Listed Protected Fish Species	
Widebody pipefish	*Stigmatopora nigra*	Listed Protected Fish Species	
Double-end pipefish	*Syngnathoides biaculeatus*	Listed Protected Fish Species	
Bentstick pipefish	*Trachyrhamphus bicoarctatus*	Listed Protected Fish Species	
Hairy pipefish	*Urocampus carinirostris*	Listed Protected Fish Species	
Mother-of-pearl pipefish	*Vanacampus margaritifer*	Listed Protected Fish Species	

Table 3: Plant community types and threatened ecological communities of the Northern Beaches

Plant Community Type – OEH 2016	NSW Threatened Ecological Community – Biodiversity Conservation Act, 2016	Commonwealth – Threatened Ecological Community – Environment Protection and Biodiversity Conservation Act, 1999
Coastal Enriched Sandstone Dry Forest		
Coastal Sandstone Foreshores Forest		
Coastal Sandstone Riparian Forest		
Coastal Sandstone Gully Forest		
Hornsby Enriched Sandstone Exposed Woodland		
Sydney North Exposed Sandstone Woodland		

Table 3 continued

Plant Community Type – OEH 2016	NSW Threatened Ecological Community – Biodiversity Conservation Act, 2016	Commonwealth – Threatened Ecological Community – Environment Protection and Biodiversity Conservation Act, 1999
Sydney Ironstone Bloodwood-Silvertop Ash Forest	Duffys Forest Ecological Community	
Coastal Sand Bangalay Forest	Bangalay Sand Forest	
Hawkesbury River Escarpment Dry Forest		
Coastal Alluvial Bangalay Forest	River-flat Eucalypt Forest on Coastal Floodplains	Coastal floodplain eucalypt forest of eastern Australia
Coastal Flats Swamp Mahogany Forest	Swamp Sclerophyll Forest on Coastal Floodplains	
Coastal Freshwater Swamp Forest	Swamp Sclerophyll Forest on Coastal Floodplains	
Coastal Sand Swamp Mahogany Forest	Swamp Sclerophyll Forest on Coastal Floodplains	
Riverflat Paperbark Swamp Forest	Swamp Sclerophyll Forest on Coastal Floodplains	
Estuarine Swamp Oak Forest	Swamp Oak Floodplain Forest	Coastal Swamp Oak Forest
Coastal Swamp Paperbark-Swamp Oak Scrub	Swamp Oak Floodplain Forest	Coastal Swamp Oak Forest
Sandstone Cliff-face Soak		
Coastal Upland Damp Heath Swamp	Coastal Upland Swamp	Coastal Upland Swamp
Coastal Upland Wet Heath Swamp	Coastal Upland Swamp	Coastal Upland Swamp
Coastal Freshwater Wetland	Freshwater Wetlands on Coastal Floodplains	
Estuarine Reedland	Swamp Oak Floodplain Forest	Swamp Oak Floodplain Forest
Coastal Sand Swamp Scrub	Freshwater Wetlands on Coastal Floodplains	
Beach Spinifex Grassla		
Coastal Headland Grassland	Themeda grassland on seacliffs and coastal headlands	
Coastal Headland Clay Heath		
Coastal Sand Tea-tree-Banksia Scrub		
Coastal Sand Mantle Heath	Eastern Suburbs Banksia Scrub	Eastern Suburbs Banksia Scrub
Coastal Foredune Wattle Scrub		
Coastal Headland Banksia Heath		
Coastal Headland Cliffline Scrub		
Coastal Sandstone Heath-Mallee		
Coastal Sandstone Rock Plate Heath		

Table 3 continued

Plant Community Type – OEH 2016	NSW Threatened Ecological Community – Biodiversity Conservation Act, 2016	Commonwealth – Threatened Ecological Community – Environment Protection and Biodiversity Conservation Act, 1999
Coastal Clifftop Marsh		
Coastal Sandstone Gallery Rainforest		
Coastal Warm Temperate Rainforest		
Coastal Dune Littoral Rainforest	Littoral Rainforest	Littoral Rainforest
Coastal Escarpment Littoral Rainforest	Littoral Rainforest	Littoral Rainforest
Coastal Headland Littoral Thicket	Littoral Rainforest	Littoral Rainforest
Estuarine Mangrove Forest		
Estuarine Saltmarsh	Coastal Saltmarsh	Coastal Saltmarsh
Seagrass Meadows		
Coastal Enriched Sandstone Moist Forest		
Coastal Shale-Sandstone Forest		
Pittwater Spotted Gum Forest	Pittwater Spotted Gum Forest	
Central Coast Escarpment Moist Forest		
Central Coast Escarpment Dry Forest		
Coastal Diatreme Forest		
Coastal Flats Tall Moist Forest		

Table 4: Threatened species of the Northern Beaches as listed under the NSW *Biodiversity Conservation Act, 2016* and/or the Commonwealth Environment Protection and *Biodiversity Conservation Act, 1999*

Scientific Name	Common Name	NSW status	Commonwealth status	Records
Heleioporus australiacus	Giant Burrowing Frog	V,P	V	41
Pseudophryne australis	Red-crowned Toadlet	V,P		128
^Dasyornis brachypterus	Eastern Bristlebird	E1,P,2	E	1
^^Lophoictinia isura	Square-tailed Kite	V,P,3		8
^^Pandion cristatus	Eastern Osprey	V,P,3		19
Haliaeetus leucogaster	White-bellied Sea-Eagle	V,P		29
Hieraaetus morphnoides	Little Eagle	V,P		9
Hirundapus caudacutus	White-throated Needletail	P	V,C,J,K	8

CE - critically endangered, E - Endangered, V - Vulnerable, P - Protected

Table 4 continued

Scientific Name	Common Name	NSW status	Commonwealth status	Records
Botaurus poiciloptilus	Australasian Bittern	E1,P	E	2
Ixobrychus flavicollis	Black Bittern	V,P		13
Burhinus grallarius	Bush Stone-curlew	E1,P		15
Esacus magnirostris	Beach Stone-curlew	E4A,P		2
^^Callocephalon fimbriatum	Gang-gang Cockatoo	V,P,3		3
^Calyptorhynchus lathami	Glossy Black-Cockatoo	V,P,2		85
Ptilinopus regina	Rose-crowned Fruit-Dove	V,P		6
Ptilinopus superbus	Superb Fruit-Dove	V,P		4
Haematopus fuliginosus	Sooty Oystercatcher	V,P		3
Haematopus longirostris	Pied Oystercatcher	E1,P		2
Anthochaera phrygia	Regent Honeyeater	E4A,P	CE	33
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V,P		1
Daphoenositta chrysoptera	Varied Sittella	V,P		4
Petroica boodang	Scarlet Robin	V,P		2
^^Lathamus discolor	Swift Parrot	E1,P,3	CE	16
^^Neophema pulchella	Turquoise Parrot	V,P,3		2
Glossopsitta pusilla	Little Lorikeet	V,P		13
Rostratula australis	Australian Painted Snipe	E1,P	E	2
Numenius madagascariensis	Eastern Curlew	P	CE,C,J,K	4
Xenus cinereus	Terek Sandpiper	V,P	C,J,K	2
^^Ninox connivens	Barking Owl	V,P,3		31
^^Ninox strenua	Powerful Owl	V,P,3		712
^^Tyto novaehollandiae	Masked Owl	V,P,3		7
^^Tyto tenebricosa	Sooty Owl	V,P,3		2
Cercartetus nanus	Eastern Pygmy-possum	V,P		841
Dasyurus maculatus	Spotted-tailed Quoll	V,P	E	6
Eudyptula minor	Little Penguin	EP		968
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V,P		2
Macropus parma	Parma Wallaby	V,P		1

Table 4 continued

Scientific Name	Common Name	NSW status	Commonwealth status	Records
Miniopterus australis	Little Bent-winged Bat	V,P		84
Miniopterus orianae oceanensis	Large Bent-winged Bat	V,P		204
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V,P		22
Perameles nasuta	Long Nosed Bandicoot, North Head	EP		2,867
Pseudomys novaehollandiae	New Holland Mouse	P	V	5
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E1,P	E	48
Petaurus norfolcensis	Squirrel Glider	V,P EP		2
Phascolarctos cinereus	Koala	V,P EP	V	90
Pteropus poliocephalus	Grey-headed Flying-fox	V,P	V	375
Chalinolobus dwyeri	Large-eared Pied Bat	V,P	V	28
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V,P		1
Myotis macropus	Southern Myotis	V,P		71
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P		6
Vespadelus troughtoni	Eastern Cave Bat	V,P		2
Varanus rosenbergi	Rosenberg's Goanna	V,P		101
Meridolum maryae	Maroubra Woodland Snail	V		?
Tetratheca glandulosa		V		67
Epacris purpurascens var. purpurascens		V		65
Chamaesyce psammogeton	Sand Spurge	E1		7
Acacia terminalis subsp. Eastern Sydney	Sunshine wattle	E1	E	12
^^Grammitis stenophylla	Narrow-leaf Finger Fern	E1,3		1
^^Prostanthera marifolia	Seaforth Mintbush	E4A,3	CE	60
Lasiopetalum joyceae		V	V	7
^^Callistemon linearifolius	Netted Bottle Brush	V,3		3
Eucalyptus camfieldii	Camfield's Stringybark	V	V	6
Leptospermum deanei		V	V	24
Melaleuca deanei	Deane's Paperbark	V	V	1

Table 4 continued

Scientific Name	Common Name	NSW status	Commonwealth status	Records
Rhodamnia rubescens	Scrub Turpentine	E4A		25
Syzygium paniculatum	Magenta Lilly Pilly	E1	V	19
^Genoplesium baueri	Bauer's Midge Orchid	E1,P,2	E	5
^Microtis angusii	Angus's Onion Orchid	E1,P,2	E	171
^^Grevillea caleyi	Caley's Grevillea	E4A,3	CE	525
Asterolasia elegans		E1	E	1
Pimelea curviflora var. curviflora		V	V	23

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