SUTHERLAND SHIRE WATERCOURSE ASSESSMENT & REHABILITATION PRIORITISATION

VOLUME 2

CHAPTER 2

GEORGES RIVER CATCHMENT PROFILE

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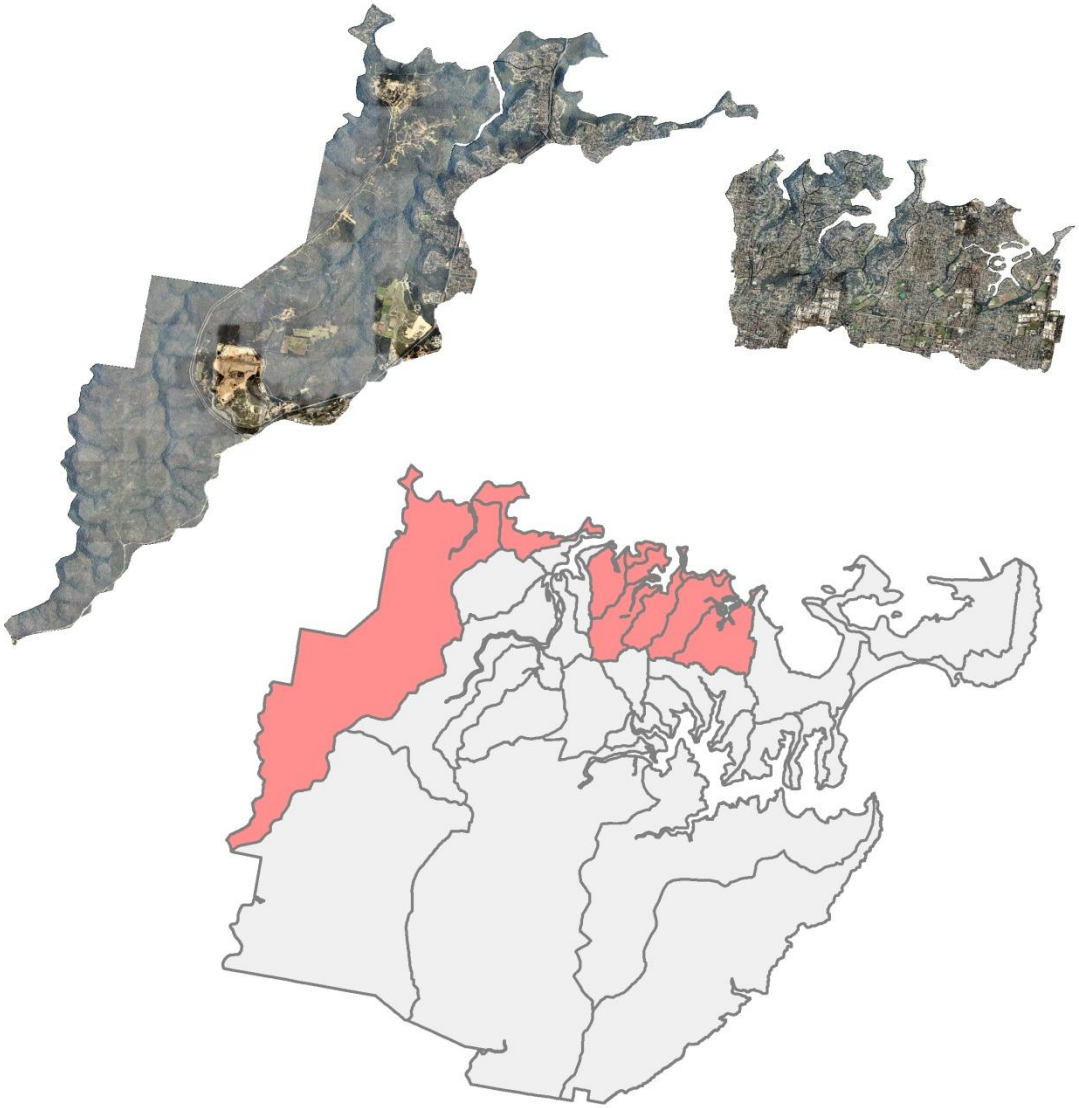
Chapter 2 GEORGES RIVER CATCHMENT

CATCHMENT OVERVIEW

CATCHMENT AREA: 59.92 KM^2



WATERWAYS

SUMMARY OF DRAINAGE SYSTEM

The Georges River catchment includes ten sub-catchments:

MILL CREEK

GREAT MOON BAY

CARINA BAY

CORONATION BAY

OYSTER BAY (WEST)

OYSTER CREEK

KANGAROO POINT

OYSTER BAY

GWAWLEY CREEK

SYLVANIA WATERS

MAJOR NAMED WATERWAYS:	CARINA CREEK
	MILL CREEK
	BARDENS CREEK
	OYSTER GULLY
	OYSTER CREEK
	GWAWLEY CREEK
	DEADMANS CREEK
	SYLVANIA WATERS
TOTAL LENGTH OF MAPPED WATERWAYS:	55.4 KMs
PRIMARY CREEKS:	1.3 KMs
SECOND ORDER CREEKS:	32.3 KMs
FIRST ORDER & MINOR DRAINAGE LINES:	18.7 KMs
OPEN DRAINS:	3.1 KMs
NUMBER OF SQIDS:	42

GEOLOGY, GEOMORPHOLOGY AND SOILS

GEOLOGY AND GEOMORPHOLOGY

The area in which the lower reaches of Georges River are situated form part of the coastal plateau/valley system typical of the Sydney region. It consists mainly of Hawkesbury sandstone over which a thin capping of Wianamatta shale occurs on isolated ridges at Alfords Point and Revesby.

Laterite residuals are frequently found on ridges above the shale and sandstone, although much of the original laterite profile has been removed by erosion and mineral extraction. The plateau is dissected giving rise to a landform with deep, narrow valleys, steep hillslopes and small river flats.

Soils occurring on the plateau tops are shallow sands. They are uniformly coarse, sandy textured and rarely deeper than 6Omm. Rocky outcrops are common and topsoil development minimal. Soils on the hillslopes are thin and sandy but increase in depth and fertility on more level terrain. Swamp soils on the tidal flats support mangroves and other wetland communities.

The plateau and hillslope areas are highly erodible if disturbed. Residential development at Alfords Point has released increased volumes of sediment into local watercourses.

SOILS

The main soil landscapes present in Georges River catchment are Gymea (gy), Hawkesbury (ha), Lucas Heights (lh), Mangrove Creek (mc), and Disturbed Terrain (xx). These are described in more detail below.

As part of the assessment process, Urban Land Capability and Rural Land Capability classes were determined for these soil landscapes. Urban capability is the ability of an area of land to support a particular intensity of urban development without serious erosion and sedimentation occurring during construction, and possible instability and drainage problems in the long term. For soil landscapes in Georges River catchment these are as follows:

- Gymea: low to moderate capability for urban development
- Hawkesbury: not capable of urban development
- Lucas Heights: high capability for urban development
- Mangrove Creek: not capable of urban development
- Disturbed Terrains are areas of land that have been highly modified through removal, disturbance or burial of the original soils as a result of human activities, and to a depth of 1m

In many parts of Sutherland Shire, areas classified as “not capable of urban development” have been extensively urbanised. These areas have experienced cracking of roads and buildings, sedimentation of streams, blocked drains and flooding.

Rural capability is the ability of an area to sustain permanent agricultural or pastoral production without permanent damage. Land which is used beyond its rural capability will deteriorate rapidly, resulting in permanent loss of soil resources. For soil landscapes in Georges River catchment the following assessments were made:

- Gymea: not capable of regular cultivation or grazing
- Hawkesbury: not capable of regular cultivation or grazing
- Lucas Heights: capable of grazing
- Mangrove Creek: not capable of regular cultivation or grazing

Much of the land in this part of Sutherland Shire was cleared for grazing, with some minor market gardening. The legacy of this early development is seriously depleted soil resources. The soil landscapes listed above are described in the following sections:

Gymea (gy): Undulating to rolling rises and low hills on Hawkesbury Sandstone with local relief 20-80m, slopes 10-25%, and rock outcrops <25%. Broad convex crests, moderately inclined side slopes with wide benches, localised rock outcrop on low broken scarps. Vegetation includes extensively cleared open forest (dry sclerophyll) and eucalypt woodland. Soils are shallow to moderately deep (30-100cm) Yellow Earths and Earthy Sands on crests and insides of benches, shallow (<20cm)Siliceous Sands on leading edges of benches, localised Gleyed Podzolic Soils and Yellow Podzolic Soils on shale lenses, and shallow to moderately deep (<1m) Siliceous Sands and Leached Sands along drainage lines. Limitations for use of these soils include localised steep slopes, high soil erosion hazard, rocky outcrops, shallow highly permeable soil and very low soil fertility (Hazelton & Tille, 1990).

Hawkesbury (ha): Rugged, rolling to very steep hills on Hawkesbury Sandstone with local relief 100-200m, slopes >25%, and surface rock >50%. Narrow crests and ridges, narrow incised valleys, steep sideslopes with narrow rocky benches, broken scarps and boulders. Vegetation is mostly uncleared eucalypt woodland, open forest (dry sclerophyll) and tall open forest (wet sclerophyll). Soils are shallow (<50cm) discontinuous Lithosols/Siliceous Sands associated with rocky outcrops, Earthy Sands, Yellow Earths and locally deep sands on inside of benches and along joints and fractures, localised Yellow and Red Podzolic Soils associated with shale lenses, and Siliceous Sands on narrow valley flats. Limitations for use include extreme soil erosion hazard, mass movement (rock fall) hazard, steep slopes, rocky outcrops, shallow, stony, highly permeable soil, and very low soil fertility (Hazelton & Tille, 1990).

Lucas Heights (lh): Gently undulating crests, ridges and plateau surfaces of the Mittagong Formation with alternating bands of shale and fine-grained sandstones. Local relief is 10-50m, and slopes <10%. Rock outcropping is absent. Vegetation comprises extensively to completely cleared dry sclerophyll low open forest and low woodland. Soils are moderately deep (50-150cm) hardsetting Yellow Podzolic Soils and Yellow Soloths on ridges and plateau surfaces, Lateritic Podzolic Soils on crests, Yellow Earths on shoulders of plateaus and ridges,

and Earthy Sands in valley flats. Limitations for use include stoniness, hardsetting surfaces, and low soil fertility (Hazelton & Tille, 1990).

Mangrove Creek (mc): Level to gently undulating tidal flats/mudflats, mangrove and saltmarsh on Quarternary Marine sediments. Local relief and elevation is <3m, slope gradients <3%. Regularly inundated by tidal waters. Vegetation includes mangrove open scrub, saltmarsh herbfield, sedgeland and low open forest. Soils are deep (>2m) waterlogged Calcareous Sands and Siliceous Sands on mangrove flats, with deep (>2m) Calcareous Sands, occasional Siliceous Sands and Humic Gley Soils on saltmarsh and forest flats. Use of these soils is limited by regular tidal flooding and water logging, acid sulphate potential, saline soils, and very low soil fertility (Hazelton & Tille, 1990).

Disturbed Terrain (xx): Occurs within other landscapes and is mapped as xx. The topography varies from level plains to undulating terrain, and has been disturbed by human activity to a depth of at least 1m. The original soil has been removed, greatly disturbed or buried. Most of these areas have been levelled to slopes of <5%. Landfill includes oils, rock, building and waste material, and the original vegetation has been completely cleared. Limitations for this soil 'type' are dependent on the nature of fill material, and may result in a mass movement hazard (subsidence), soil impermeability leading to poor drainage, low fertility and toxic material (Hazelton & Tille, 1990).

SUMMARY OF CONTAMINATION ISSUES

The Georges River catchment is one of the most highly urbanised catchments in Australia. Whilst this means that lots of people get to experience and enjoy the river, it also means that there are many different issues that are impacting upon the health of the catchment.

The major sources of pollution to the Georges River Estuary are stormwater runoff from urban areas including roads and open spaces, wet weather sewer overflows, past contamination of land and sediment, and stormwater runoff from rural lands. These sources put metals, oils, grease, toxic organic compounds and high levels of nutrients in the river. Contaminants found in bottom sediments have resulted in commercial and recreational fishing bans in the lower reaches. An oyster industry previously operated but was stopped due to oyster disease. In addition, poor water quality after heavy rains compromises swimming and boating activities. Increased runoff from impervious surfaces, the removal of upland swamps, groundwater extractions and past dredging have modified the volume and pattern of the river flows.

LAND USE

HISTORIC LAND USE

The scenic character of the Georges River is defined by its highly diverse geography. Between the extensive sandstone bushland of its headwaters to the urbanised environment of its conjunction with Botany Bay, the river passes through cleared low-lying land in its middle reaches, before passing into the steep Hawkesbury sandstone topography of the Georges River National Park.

The varied geology and topography has determined the evolution of land uses and built form in the river corridor and some of the most evident changes to scenic values. While parts of the river corridor, such as the national park, the Holsworthy river frontage or tributaries such as Mill Creek remain in pristine scenic and environmental condition, the progressive urbanisation of the river corridor and its catchment have brought about changes to the river's scenery that continue to threaten its integrity.

The Georges River was historically an important transport route from Botany Bay to Liverpool. However, access across the river was restricted to the 19th-century railway bridge at Como and a punt at the eastern end of the park at Lugarno. Although the Sutherland area to the south was established in the mid- to late-19th century, the focus of activity remained on the river for more than 100 years.

Since the Second World War, the relatively scattered low developments on the bushland stretches of the river have given way to more substantial estates on the ridges and progressive intensification of lot development from ridge to shore. The nature of new development seems random in location, extent and character, bearing little direct relationship to the river, unlike historic focal points such as the Lugarno Punt crossing or the development of Como with the presence of the railway station.

In the last 30 years ridge top developments have flourished at Barden Ridge, Illawong and Alfords Point areas on the southern side of the river, and at Picnic Point and Revesby Heights on the northern side. The bushland that was not built on, now protected in the national park, is in a narrow strip between the river and the first ridges, with 'extensions' into the urban areas where there are major streams such as Mill Creek in Sutherland Shire, or Yeramba Lagoon in Bankstown City Council area.

The low-lying floodplain upstream of Sandy Point has long been cleared of vegetation for agricultural and sand extraction. Although built form on this stretch is less evident (in part because of topography), the quality of much development on the foreshore, the absence of any clear river focus of foreshore reserves or river access, and the increasing problem of bank erosion convey a sense of a neglected riverine landscape.

The headwaters of the Georges River have long been unaffected by any substantive residential development. However recent subdivisions in Wedderburn, Minto and Appin are beginning to change the rural landscape of this part of the river. Unless carefully controlled,

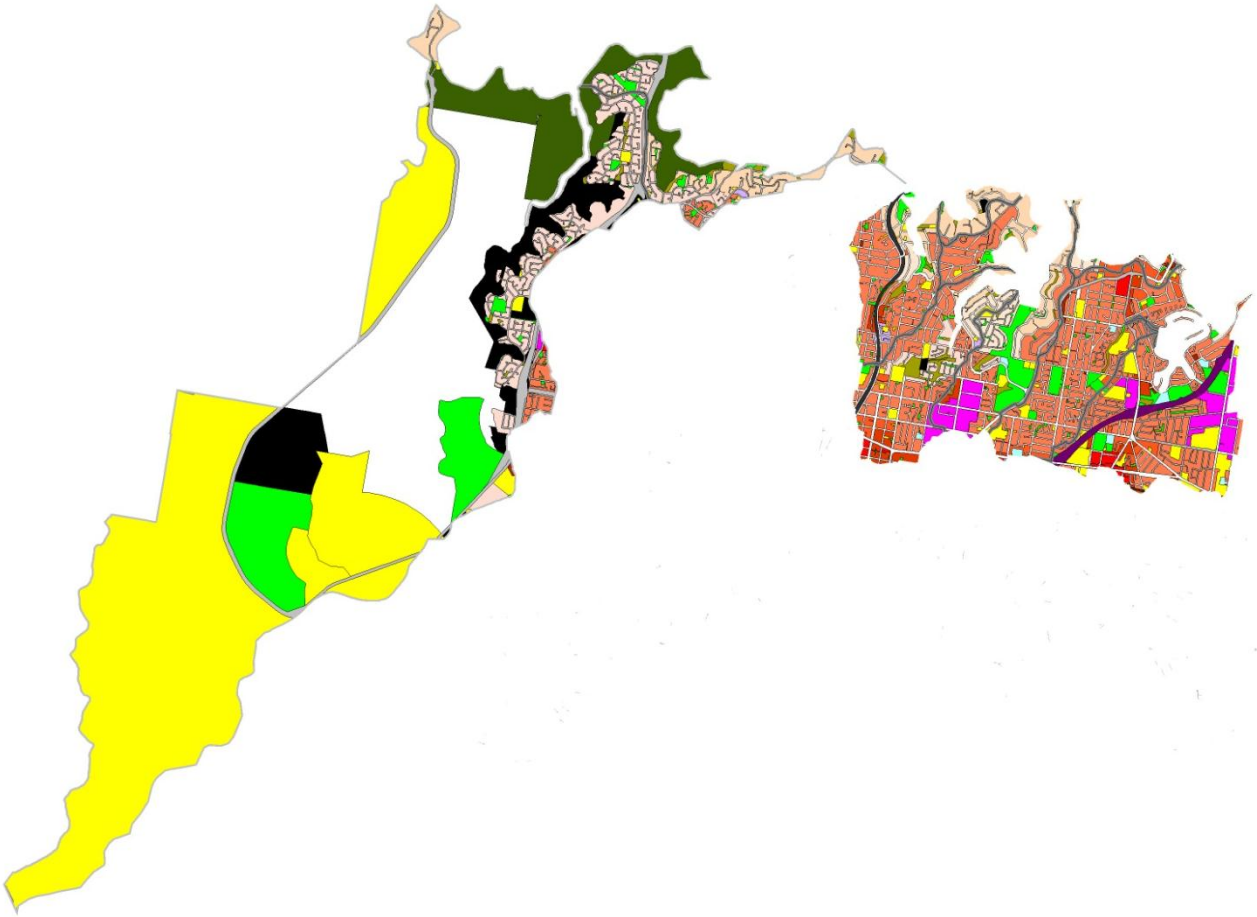
many of the environmental effects of this development will also have a bearing on the downstream landscape.

The principal scenic change in the bays and foreshore of the lower river is intensive development on long existing properties. In many cases up to three buildings may now occupy a lot that once contained a single dwelling. Management of many of the foreshore reserves along the Georges River does not conserve its exceptional bushland. Likewise the army do not appear to be accountable for the environmental or visual impacts of foreshore erosion created by exercises on the river, such as between Pleasure Point and Sandy Point. In some areas such as Sylvania and Sans Souci, the cultural landscape of Sydney suburbia has mostly obliterated the natural landscape.

Figure 1. (a) Como, Georges River, 1900; (b) Fisherman's hut, Como, 1900.

Figure 2. (a) Como Pleasure Grounds, 1910; (b) Como, Georges River, 1910.

CURRENT LAND USE



ZONING CLASS LEP 2006

- Aquatic Reserves
- Arterial Road
- Deferred Matter
- Employment
- Environmental Housing Bushland
- Environmental Housing Scenic Quality
- Environmental Housing Sensitive Land
- Environmental Protection Low Impact Rural
- Environmental Protection Water Catchment
- Environmental Protection Waterways
- Excluded
- Local Centre
- Local Housing
- Mixed Use Kirrawee
- Multiple Dwelling A
- Multiple Dwelling B
- National Park Reserve and Recreation Area
- Neighbourhood Centre
- Private Recreation
- Public Open Space
- Public Open Space Bushland
- Railway
- Road
- Special Uses
- Transport Reservation
- Urban Centre

CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	284.40	5%	0%	0.00
Environmental Housing Sensitive Land	1103.72	19%	43%	474.60
Environmental Housing Scenic Quality	98.59	2%	57%	56.20
Environmental Housing Bushland	75.22	1%	57%	42.88
Local Housing	842.72	15%	51%	429.79
Multiple Dwelling A	82.62	1%	64%	52.87
Multiple Dwelling B	44.50	1%	64%	28.48
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	19.26	0%	94%	18.10
Local Centre	6.71	0%	88%	5.90
Neighbourhood Centre	5.17	0%	86%	4.45
Employment	89.69	2%	95%	85.21
Special Uses	108.99	2%	30%	32.70
Public Open Space	1920.01	33%	5%	96.00
Public Open Space Bushland	320.50	6%	0%	0.00
Private Recreation	19.19	0%	5%	0.96
Environmental Protection Waterways	1.59	0%	0%	0.00
Aquatic Reserves	0.31	0%	0%	0.00
National Park Reserve and Recreation Area	104.32	2%	0%	0.00
Railway	225.48	4%	33%	74.41
Arterial Road/Road	437.63	8%	66%	288.83
Transport Reservation	201.24	3%	5%	10.06
TOTALS	5991.88	104%	28%	1701.44

VEGETATION COMMUNITIES

The Georges River flows through a very varied landscape from the almost fully urbanised lower coastal reaches through to the steep sided heavily wooded upper reaches near Appin. Vegetation communities in the catchment are primarily influenced by the distribution of shale (Cumberland Plain) and sandstone (Woronora Plateau) geologies. The vegetation of the Georges River catchment can be grouped into the following categories based on their underlying soils:

- **Shale communities** - Frequently dominated by *Eucalyptus moluccana*, *Eucalyptus tereticornis*, *Eucalyptus saligna*, *Eucalyptus pilularis* and *Eucalyptus crebra*.
- **Shale/sandstone transitional communities** - dominated by *Eucalyptus punctata*, *Eucalyptus fibrosa*, *Eucalyptus paniculata*, *Angophora bakeri* and *Melaleuca nodosa*. Some examples of shale/sandstone transition communities can be seen at Ingleburn and Minto Heights in the upper reaches of the Georges River Catchment.
- **Communities on Tertiary Alluvium** - dominated by *Eucalyptus moluccana*, *Eucalyptus fibrosa*, *Eucalyptus longifolia*, *Eucalyptus eugenioides* and *Melaleuca nodosa*.
- **Riparian communities** - dominated by *Casuarina glauca*, *Angophora floribunda*, *Eucalyptus amplifolia*, *Eucalyptus botryoides*, and various *Melaleuca* spp.
- **Sandstone communities** - dominated by *Angophora costata*, *Eucalyptus piperita*, *Corymbia gummifera*, and *Eucalyptus sclerophylla*, and *Banksia serrata*. A good example of a sandstone community can be found in the Georges River National Park.
- **Estuarine communities** - These include mangrove and Salt Marsh communities. Dominated by *Avicennia marina*, and *Sarcocornia quinqueflora*. Excellent mangrove and salt marsh ecosystems can be found right along the lower reaches of the river to Botany Bay.
- **Freshwater Communities** - *Melaleuca linariifolia*, *Melaleuca styphelioides* and *Casuarina glauca*, and ground species including *Juncus usitatus* and *Persicaria* spp are dominant in occasionally inundated areas, with *Eleocharis sphacelata* and *Ludwigia peploides* in permanent wetlands.

VEGETATION COMMUNITIES IDENTIFIED

The following vegetation communities have been mapped in the Georges River catchment by Sutherland Shire Council:

- Sydney Sandstone Ridgetop Woodland
- Sydney Sandstone Gully Forest
- Sydney Turpentine Ironbark Forest
- Riverflat Eucalypt Forest
- Shale/Sandstone Transition Forest
- Ironstone Woodland
- Woronora Plateau Dry Ironstone Heath
- O'Hares Creek Shale Forest Complex

- Swamp Oak Floodplain Forest
- Coastal Saltmarsh
- Mangrove
- Sydney Sandstone Heath

A brief description of these communities has been extracted from the Sydney Metropolitan CMA's draft Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area, Volume 2: Vegetation Community Profiles (SMCMA, 2009). These are presented below.

Estuarine Swamp Oak Forest

In the succession from mangroves and saltmarsh to terrestrial sclerophyll and mesophyll forests and woodlands, Estuarine Swamp Oak Forest occurs as the initial community above tidal influence. It fringes the margins of saline waterbodies that include rivers, lagoons and tidal lakes. Swamp oak (Casuarina glauca) forms dense monospecific stands above a thick ground cover of salt tolerant herbs, rushes and sedges. The shrub layer is low growing and sparse comprising a mix of terrestrial species while others typical of wetlands. It is a community of relatively low species diversity.

Estuarine Swamp Oak Forest is widespread along the coast of the Sydney Basin where it is rarely found at elevations above two meters above sea level. Waterfront urban and industrial development has occurred on areas likely to have once been occupied by this community. Typically land infill has been used to reclaim estuarine environments to make use of flat accessible lands. Remaining areas often support a conspicuous cover of exotic species such as lantana (*Lantana camara*) and buffalo grass (*Stenotaphrum secundatum*).

Coastal Sandstone Foreshores Forest (Sydney Sandstone Ridgetop Woodland)

Coastal Sandstone Foreshores Forest is found on sheltered sandstone slopes found along the foreshores of Sydney's major waterways and coastal escarpments. It is an open forest with a moist shrub layer and ground cover of ferns, rushes and grasses. The flora of this community has a maritime influence given its exposure to prevailing sea breezes. The canopy can be dominated by pure stands of smooth-barked apple (*Angophora costata*) though more regularly is found in combination with other tree species. Localised patches of bangalay (*Eucalyptus botryoides*) and coast banksia (*Banksia integrifolia* subsp. *integrifolia*) occur closest to the coast, whereas Sydney peppermint (*Eucalyptus piperita*) and blackbutt (*Eucalyptus pilularis*) prefer more protected locations and in the case of the latter, some minor shale enrichment in the soil.

A prominent layer of hardy mesic small trees and shrubs is present. These include sweet pittosporum (*Pittosporum undulatum*), cheese tree (*Glochidion ferdinandi*) and blueberry ash (*Elaeocarpus reticulatus*). In the suburban environment, the proliferation of these species in the understorey at long unburnt sites has generated considerable debate, particularly as there appears to be strong correlation between time since fire and their density (Rose & Fairweather 1997). It is also appears that these species are more common in

these littoral zones than other sheltered sandstone forests situated further away from the coast.

This forest is restricted to sandstone soils derived from either the Hawkesbury or Narrabeen geology. The distribution is coastal and requires a combination of low elevation between 2-45 metres above sea level and mean annual rainfall that exceeds 1100 mm per annum. It is noticeable that most sites are exposed to salt laden winds that are carried across the coastal plain before hitting the Collaroy and Narrabeen escarpments, or across the waters of the harbour and the Georges and Hacking Rivers.

Clearing for urban development has occurred across the range of the community. Weed infestation is widespread in stands close to urban margins. Fire is likely to have been excluded for long periods of time and many stands are isolated within dense urban land uses. The absence of fire may be preferentially encouraging some mesic woody species over pyrophytic species. Dieback arising from Phytophora is severely affecting stands in the Sydney Harbour area.

Coastal Sandstone Gully Moist Heath (Sydney Sandstone Gully Forest)

Coastal Sandstone Gully Moist Heath is a low to moderately tall woodland and forest with a closed wet heath layer found on sandstone gullies and sandy drainage lines. The canopy is open to sparse featuring eucalypts such as red bloodwood (*Corymbia gummifera*), smooth-barked apple (*Angophora costata*) and Sydney peppermint (*Eucalyptus piperita*). More prominent is the dense diverse heath layer that may include several different species of banksias, hakeas, tea-trees and casuarinas. Also found within the heath layer are mesic plants such as black wattle (*Callicoma serratifolia*) and blueberry ash (*Elaeocarpus reticulatus*). Permanent water from rock seepage or creek lines encourages a range of fern species including coral fern (*Gleichenia dicarpa*) and sedges (*Empodisma minus*).

The distribution of the community is restricted to high rainfall zones along the coast where mean annual rainfall exceeds 1250mm per annum. The soils are generally very infertile rocky siliceous sandstones and sandstone colluvium associated with the Lambert soil landscape in northern Sydney and the Hawkesbury Sandstone Soil Landscape in the South of Sydney. Similar heaths might be expected to occur north of the study area in the hinterland of the Central Coast although no evidence is available from systematic site data available to this project. Broader regional classifications include this unit within coastal sandstone gully forest complexes.

Clearing is likely to have had limited affect on the distribution of the community because of the infertile soils and precipitous nature of the habitat. Current threats are likely to arise from local weed invasion from upstream developments, frequent fire and trail riding.

Estuarine Mangrove Forest

Stands of Mangroves form a low closed to open forest on mudflats found along Sydney's harbour, river coves and estuaries. There are two mangrove species found in Sydney. Grey mangrove (*Avicennia marina*) is the taller and more common, often seen in pure stands. It

comprises very few species other than the canopy, with the understorey mostly an open mudflat sometimes with scattered saltmarsh herbs. The second mangrove species is river mangrove (*Aegiceras corniculatum*). It is more often a small tree or shrub found scattered amongst swathes of grey mangrove or along upper reaches of coastal riverbanks. It occurs where freshwater influences from runoff or rivers cause lower salinity levels in water inundating the mudflats.

Sea level rise associated with climate change poses a significant threat to the current distribution to Estuarine Mangrove Forest in the Sydney basin. While the species appears to be an aggressive recoloniser, opportunities for re-establishment in Sydney are constrained by built environments and steep sandstone banks. Current threats include ongoing recreation pressures, pollution arising from oil spills and outfalls and reclamation.

Hinterland Flats Eucalypt Forest (River Flat Eucalypt Forest)

Hinterland Flats Eucalypt Forest is a tall open eucalypt forest with a scattered mesic shrub layer and a grassy and herbaceous ground cover. It occurs predominantly along the sandy riverbanks of the Georges River and its tributaries. It also occurs on gentle narrowly incised valleys that drain the north western Woronora Plateau west from the Woronora River. It is dominated by both bangalay (*Eucalyptus botryoides*) and its hybrid with Sydney blue gum (*Eucalyptus saligna X botryoides*) where at its tallest it may reach over 35 metres in height.

An open layer of small trees features a number of wattles of which coast myall (*Acacia binervia*) is most common. The hardy rainforest trees grey myrtle (*Backhousia myrtifolia*) and sweet pittosporum occur (*Pittosporum undulatum*). On the banks of the Georges River the small tree layer may include dense stands of the exotic small-leaved privet (*Ligustrum sinense*). Smaller shrubs may have a reduced cover and diversity as a result. Invariably however the taller bracken fern (*Pteridium esculentum*) occurs above an abundant cover of grasses.

Hinterland Flats Eucalypt Forest is situated on gullies that are slightly protected by the incised drainage channel. These are more elevated alluvial systems with a greater proportion of sandy material in the soil than the true broad floodplains of the Georges River and Western Sydney. It is restricted to elevations between 9 and 15 metres above sea level and mean annual rainfall between 850 and 950 millimetres. It is known to occur elsewhere on the Nepean River although regional classifications include it as part of the Cumberland Riverflat Forests.

Threats are high. Clearing is unlikely to have depleted this forest as extensively as other river-flat forests given the narrow areas of habitat and less fertile soils. However urban and industrial land use surrounds most stands and a large proportion of remnants are now characterised by a diverse and abundant cover of invasive weeds. Altered drainage patterns, water pollutions, increased sedimentation and frequent fire remain pervasive threats.

Estuarine Saltmarsh

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

Sea-level rise from climate change represents the greatest threat to the long term persistence of the Saltmarsh community. Small rises will permanently inundate these intertidal zones. Reclamation has altered the landscape of estuarine environments. Heavy recreational pressure, rubbish dumping, invasion by weeds and sedimentation are ongoing threats to the community (Keith 2004). Infestation of saltmarsh plains by the exotic sharp rush (*Juncus acutus*) is prevalent in some areas of the Georges River (Pickthall et al. 2004).

Coastal Tea-Tree Banksia Scrub (Sydney Sandstone Heath)

Coastal Tea-tree-Banksia Scrub is a littoral heath and scrub that occupies headlands, coastal foredunes and beach ridges near the open ocean. Typically it comprises a dense cover of coast tea-tree (Leptospermum laevigatum) and coast banksia (Banksia integrifolia subsp. integrifolia). The height of the scrub varies considerably in response to exposure to prevailing winds. This can result in a dramatically different visual appearance between patches. Despite the exposed locations there is usually some development of a soil profile as a result of clay influence in a sandstone headland or sheltering and protection from leeward scrubs on dune systems. This is sufficient to support some waxy-leaved and eucalypt species that otherwise prefer more sheltered environments in the littoral zone. These species may share or penetrate the canopy, but in the case of the former are more likely to be found amongst a shrub layer of hardy coast loving plants.

The distribution of the scrub forms a small and patchy distribution along the coastal zone of the Sydney region between Port Stephens and Wollongong. Elsewhere it is found on the NSW south coast.

Hinterland Sandstone Transition Grey Gum Forest (Shale/Sandstone Transition Forest)

This transitional shale-sandstone forest is primarily found on the broad ridges associated with Mittagong Formation sandstone in the western stretches of the Woronora Plateau between Appin and Holsworthy. These bedrocks form interbanding layers of shale and sandstone material that erode to a sandy soil with a gentle shale influence. Often the presence of shale soil is not obvious as sites often include sandstone benching or outcropping. Described elsewhere as Upper Georges River Sandstone Woodland it forms a

moderately tall open eucalypt forest dominated by grey gum (*Eucalyptus punctata*) and red bloodwood (*Corymbia gummifera*) with one of a number of stringybarks (commonly *Eucalyptus oblonga*) as a regular associate. A sparse small tree layer of casuarina (*Allocasuarina littoralis*/*Allocasuarina torulosa*) is common. Local stands of blackbutt (*Eucalyptus pilularis*) are found close to residual shale caps or near sheltered slopes and gullies or at the narrowing end of broad Mittagong sandstone ridges.

The understorey is typically shrubby with a diverse mix of plants common on sandstone soils including wattles, tea-trees, banksias and geebungs. Unlike sandstone woodlands however, the ground layer supports a relatively number of grass species of which kangaroo grass (*Themeda australis*) and spear grass (*Austrostipa pubescens*) are indicative of the presence of shale in the soil.

Hinterland Grey Gum-Bloodwood Transition Forest is restricted to a narrow band of rainfall of 850-1050 millimetres per annum at elevations between 23 and 275 metres above sea level (Tozer 2003). It is most extensive within the Campbelltown and Liverpool LGAs. Outside of the SMCMA it occurs on the fringes of the Cumberland Plain in Northwestern Sydney and the lower Blue Mountains.

Threats are moderate. Past clearing has depleted about one third of its original extent (Tozer et al. 2006). Remaining areas are contiguous along the ridges on either side of the Georges and Nepean Rivers in Campbelltown where there are increasing urban pressures. Existing stands are under continuous pressure from physical damage arising from recreational activities, rubbish dumping, grazing, mowing and weed invasion (NSW Scientific Committee 1998a). Frequent fire is also likely to represent an emerging threat.

Sydney Ironstone Bloodwood-Silvertop Ash Forest (Ironstone Woodland)

Known as Duffys Forest in some vegetation classifications (Benson & Howell 1994a; Smith & Smith 2000) this community forms a component of the shrubby forests and woodlands of coastal Sydney sandstone environments. The exception with this assemblage is its close association with rust coloured ironstone mantles layered above sandstone ridgelines in combination with mean annual rainfall above 1100mm. It features a low to moderately tall eucalypt cover of red bloodwood (*Corymbia gummifera*), silvertop ash (*Eucalyptus sieberi*) and stringybark (*Eucalyptus capitellata* /*Eucalyptus oblonga*) on flat to gently sloping terrain. Broad-leaved scribbly gums (*Eucalyptus haemastoma*) and smooth-barked apple (*Angophora costata*) are not uncommon at sites although they rarely dominate.

The shrub layer is particularly diverse amongst the Proteaceae family. This means there are often multiple species of banksias, hakea, persoonia and grevillea present at a site. A moderate cover of grasses and forbs are found on the forest floor. The range in elevation parameters for the community varies between 100 and 300 metres above sea level. The thickness of the ironstone mantle may vary considerably across different sites and in some instances maybe completely eroded. Invariably however almost all sites appear to have minor or absent rock outcropping.

The extensive though fragmented distribution of the community across the lateritic soils of the Duffys Forest and northern beaches hinterland gave rise to the use of the suburb name in the classification nomenclature. However it is clear that a large area of lateritic ironstone is also present between Bulli and Sutherland in southern Sydney where environmental conditions mirror those found to the north. Samples confirm that vegetation assemblages found here form a combined vegetation community formerly thought restricted to the northern hinterland.

Ironstone mantles are likely to have been preferentially cleared for orchards and smaller agricultural pursuits during early settlement where arable, flat land and good rainfall were sought after. Significant areas have since been removed for urban subdivisions. Localised impacts include numerous gravel pits exploiting the laterite for road building. Remaining areas are highly fragmented and threatened by weed invasion, rubbish dumping, high fire frequency and trail erosion.

Woronora Sandstone Mallee-Heath Woodland (Woronora Plateau Dry Ironstone Heath)

High annual rainfall (>1200mm) associated with the eastern Woronora Plateau combines with skeletal rocky or ironstone soils to support this distinctive tall mallee heath-woodland. Most sites are characterised by a widely spaced canopy of eucalypt species many of which are found elsewhere in sandstone woodlands however in this community are found growing in a mallee form. However it is the multiple slender stems of several 'true' mallee species such as the yellow-top ash (*Eucalyptus luehmanniana*) and *Eucalyptus apiculata* and that can help distinguish this community where it may found alongside scribbly gum (*Eucalyptus racemosa*/*Eucalyptus haemastoma*), red bloodwood (*Corymbia gummifera*) and silver-top ash (*Eucalyptus sieberi*).

A diverse and thickly growing heath dominates the understorey with banksias prominent. Heath-leaved banksia (*Banksia ericifolia* subsp. *ericifolia*) is particularly characteristic. A moderate cover of grasses and sedges are present on the damp poorly drained sandy loams. The ground cover vegetation mixes with small fragments of the rust coloured ironstone rock to form a thin mantle above the soil.

The community is restricted to the eastern Woronora Plateau where it forms localised stands north from Dharawal NR and Woronora Special Area to Waterfall and Engadine. It can be found on or near poorly drained headwaters, perimeters of upland swamps and rocky exposed slopes. Few threats appear to persist for this community given its occurrence throughout protected areas of the eastern Woronora Plateau. Impacts are likely to be localised where mining or gravel extraction occurs or where illegal trail bike riding occurs.

O'Hares Creek Shale Forest Complex

O'Hares Creek Shale Forest is dominated by tall Sydney peppermint (*Eucalyptus piperita*), white stringybark (*Eucalyptus globoidea*) and smooth-barked apple (*Angophora costata*). It is an open forest with a sparse tall shrub and small tree layer that may comprise a number of wattle species that including two-veined hickory (*Acacia binervata*). Smaller shrubs are

similarly sparse with banksias, peas and geebungs more commonly recorded. The ground cover however is very dense and often marked by an impressive cushion of ferns, lilies and rushes. Some sites will include clumps of the conspicuous Gymea lily (*Doryanthes excelsa*).

This forest community is associated with the reddish brown clay soils that form flat to gently sloping residual capping above sandstone bedrock around Darkes Forest on the Woronora Plateau. The community is naturally restricted in extent occurring between Cataract Special Area and Appin Road to Helensburgh. It persists within a narrow mean annual rainfall band of between 950mm and 1100mm and between elevations of 350 and 450 meters above sea level.

The largest patches of shale capping supporting this forest have largely been cleared for agriculture, most notably at Darkes Forest and Helensburgh. Clay quarry operations have excavated a number of smaller patches while the Appin Road dissects a once significant area. Timber cutting is likely to have once targeted the tall straight trees found on these sites.

Sydney Turpentine Ironbark Forest

Sydney Turpentine-Ironbark Forest is a tall open forest found on shale and shale enriched sandstone soils on the coast and hinterland of Sydney. It has been extensively cleared but was once widely distributed between Sutherland and the Hornsby Plateau with outlying examples found on shale rich deposits at Campbelltown, Menai, Kurrajong and Heathcote. The primary distribution of this forest occurs in areas receiving between 900 and 1250 millimetres of mean annual rainfall and at elevations between 10 and 180 metres above sea level.

The forest is characterised by an open layer of mesic and sclerophyllous shrubs and small trees with a grassy ground cover. The composition of the canopy is variable depending on location and substrate. Typically it is recognised by an upper stratum of turpentine (*Syncarpia glomulifera*), red mahogany (*Eucalyptus resinifera*) and various ironbarks species (of which *Eucalyptus paniculata* most often recorded). On the north shore these forests are found on shale enriched sheltered sandstone slopes where ironbark species are far less frequently recorded. Instead blackbutt (*Eucalyptus pilularis*) is more common.

Current distribution for Sydney Turpentine Ironbark Forest are remnants which are small and scattered. Identified threats include clearing, physical damage from recreational activities, rubbish dumping, grazing, mowing, weed invasion.

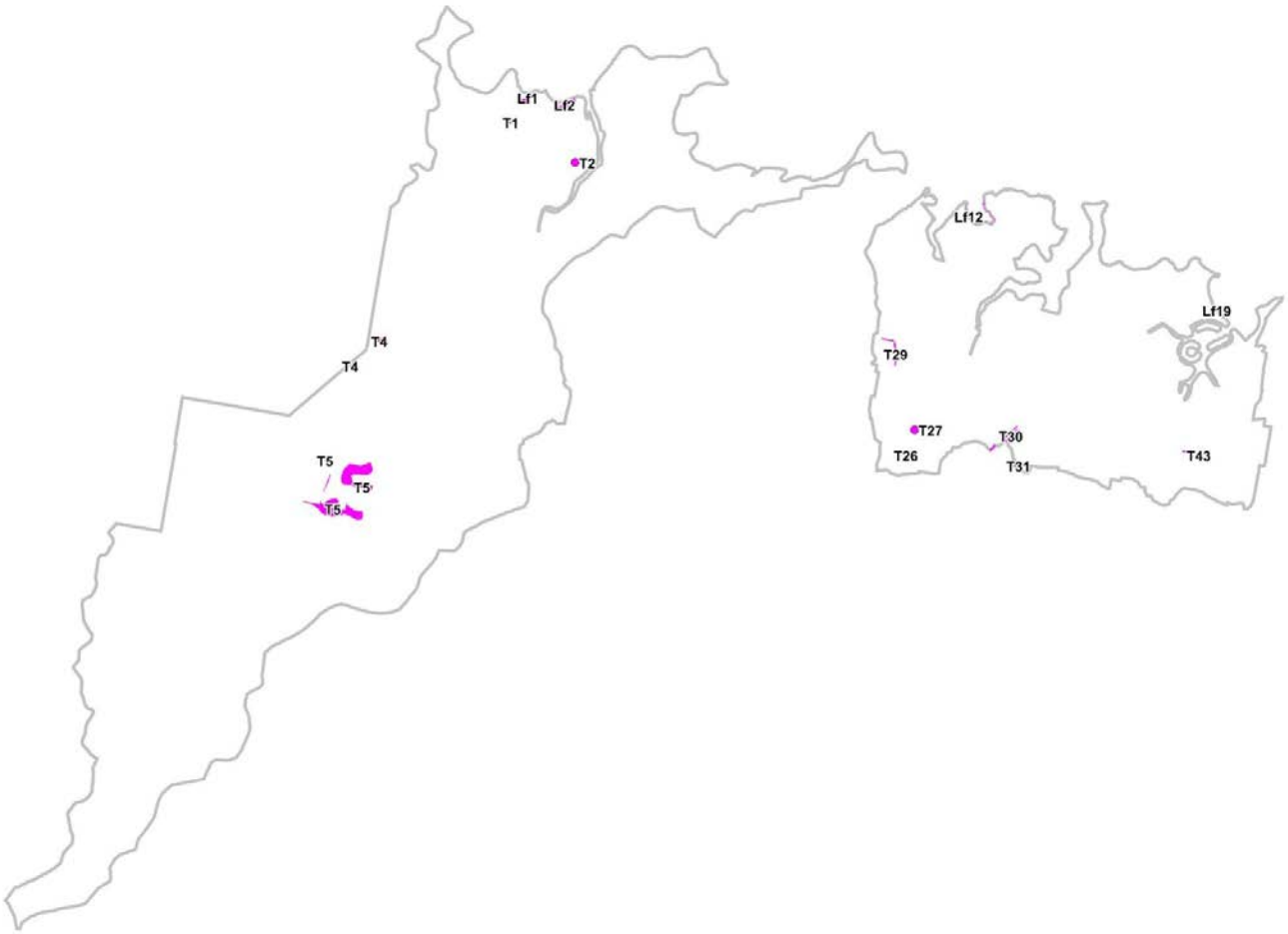
SIGNIFICANT VEGETATION

MAPPED VEGETATION COMMUNITIES OF GEORGES RIVER CATCHMENT

12.39	HECTARES	COASTAL SALTMARSH
38.54	HECTARES	IRONSTONE WOODLAND
18.69	HECTARES	MANGROVE
9.44	HECTARES	O'HARES CREEK SHALE FOREST COMPLEX
0.38	HECTARES	PAPERBARK MAHOGANY FOREST
6.59	HECTARES	RIPARIAN SCRUB
21.18	HECTARES	RIVER-FLAT EUCALYPT FOREST
112.99	HECTARES	SHALE/SANDSTONE TRANSITION FOREST
12.58	HECTARES	SHALE/SANDSTONE TRANSITION FOREST - DEGRADED
9.32	HECTARES	SWAMP OAK FLOODPLAIN FOREST
753.34	HECTARES	SYDNEY SANDSTONE GULLY FOREST
95.74	HECTARES	SYDNEY SANDSTONE HEATH
807.73	HECTARES	SYDNEY SANDSTONE RIDGETOP WOODLAND
9.97	HECTARES	SYDNEY SANDSTONE RIDGETOP WOODLAND - DEGRADED
34.73	HECTARES	SYDNEY TURPENTINE IRONBARK FOREST
34.06	HECTARES	SYDNEY TURPENTINE IRONBARK FOREST - DEGRADED
31.98	HECTARES	WORONORA PLATEAU DRY IRONSTONE HEATH

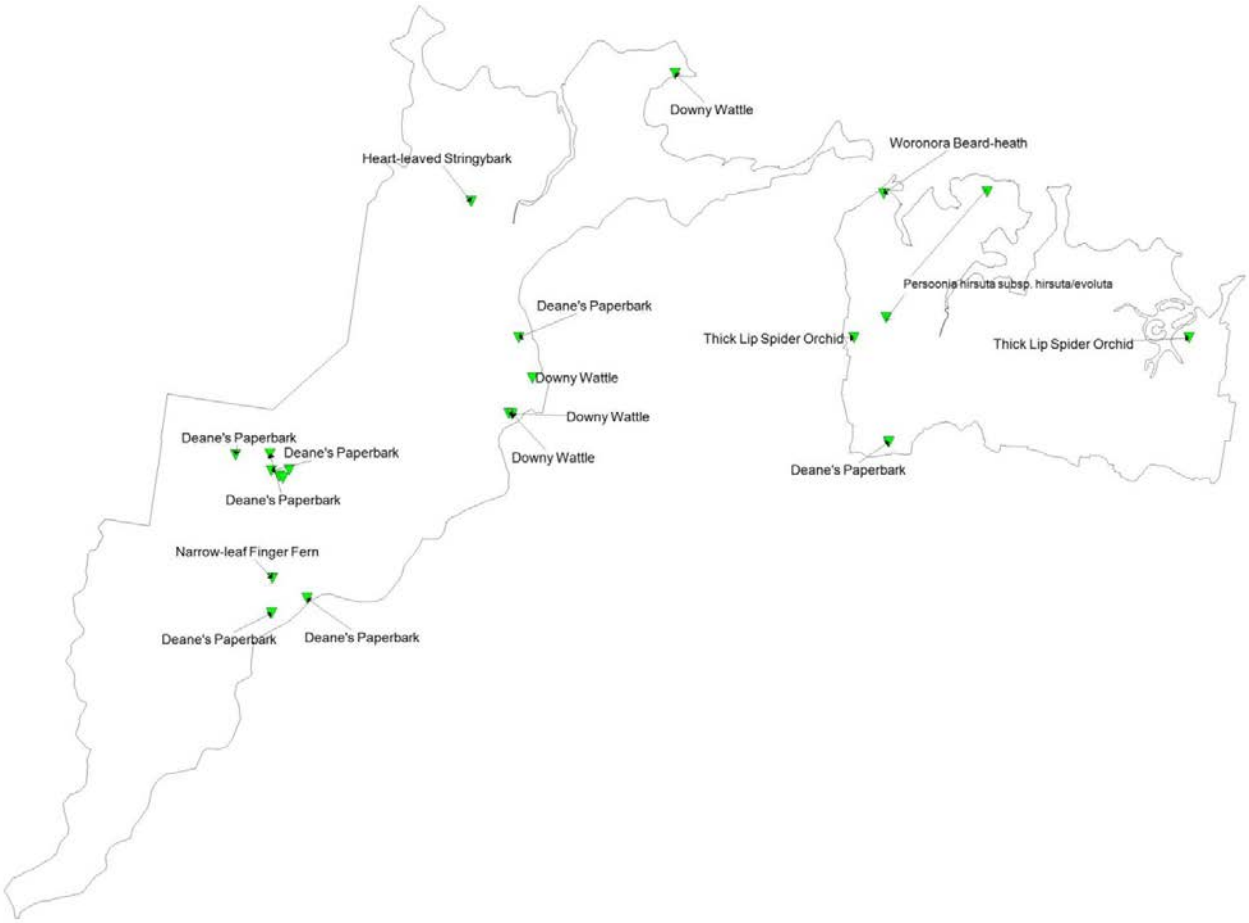
LEP 2006 SIGNIFICANT VEGETATION

LEP TAG	NAME	CLASS
T26	Eucalyptus microcorys_Pilularis_Saligna	Significant Group of Trees or Vegetation
T27	Eucalyptus Pilularis_Blackbut	Significant Group of Trees or Vegetation
T31	Eucalyptus	Significant Group of Trees or Vegetation
T5	Scattered Eucalyptus fibrosa_Ironbark	Significant Group of Trees or Vegetation
T4	Scattered Eucalyptus squamosa	Significant Group of Trees or Vegetation
T1	Scattered Eucalyptus maculata_Spotted Gum	Significant Group of Trees or Vegetation
T2	Angophora Costata X Bakerii	Significant Group of Trees or Vegetation
T30	Eucalyptus microcorys_Blackbut	Significant Group of Trees or Vegetation
T26	Eucalyptus microcorys_Pilularis_Saligna	Significant Group of Trees or Vegetation
T27	Eucalyptus Pilularis_Blackbut	Significant Group of Trees or Vegetation
T43	Melaleuca quingvenervia_Paper bark	Significant Group of Trees or Vegetation
T42	Eucalyptus racemosa	Significant Group of Trees or Vegetation



THREATENED SPECIES: FLORA RECORDS

SCIENTIFIC NAME	COMMON NAME	LEGAL_ STATUS
Melaleuca deanei	Deane's Paperbark	V
Acacia pubescens	Downy Wattle	V
Eucalyptus camfieldii	Heart-leaved Stringybark	V
Grammitis stenophylla	Narrow-leaf Finger Fern	E1
Caladenia tessellata	Thick Lip Spider Orchid	E1
Leucopogon exolasius	Woronora Beard-heath	V
Persoonia hirsuta subsp. hirsuta		E1
Persoonia hirsuta subsp. hirsuta/evoluta		E1



THREATENED SPECIES: FAUNA RECORDS

Records of threatened bird species in Georges River catchment during the last 30 years include (from NSW Wildlife Atlas, 2011; accessed March, 2011):

SCIENTIFIC NAME	COMMON NAME	LEGAL STATUS
Cacatua leadbeateri	Major Mitchell's Cockatoo	V
Haematopus longirostris	Pied Oystercatcher	E1
Sterna albifrons	Little Tern	E1
Lathamus discolor	Swift Parrot	E1
Calidris tenuirostris	Great Knot	V
Ninox strenua	Powerful Owl	V

Records of threatened mammal species in Georges River catchment during the last 30 years include (from NSW Wildlife Atlas, 2011; accessed March, 2011):

SCIENTIFIC NAME	COMMON NAME	LEGAL STATUS
Dasyurus maculatus	Spotted-tailed Quoll	V
Mormopterus norfolkensis	Eastern Freetail-bat	V
Petaurus australis	Yellow-bellied Glider	V
Phascolarctos cinereus	Koala	V

There were no records of threatened frog, reptile and invertebrate species in Georges River catchment during the last 30 years (from NSW Wildlife Atlas, 2011; accessed March, 2011).

THREATENING PROCESSES

SUMMARY OF IMPACTS

Like many highly urbanised catchments, there are a number of threatening processes that impact the catchment:

- Poor quality stormwater
- Environmental and noxious weeds
- Introduced animals
- Soil disturbance leading to erosion and sedimentation of waterways

Water in the stormwater system flows directly from the drains to creeks and rivers. In some cases the water is partially filtered and treated by stormwater treatment devices, however most of the time the water remains untreated, so that anything that gets washed down the drains such as oil, litter and pesticides ends up in the river. Weeds, soil and mulch can also easily be washed away in rain.

Weeds have a significant impact on catchments and are a threat to native flora and fauna as well as the health of waterways. Weeds act to:

- Smother and out-compete native plants
- Destroy the habitat of native animals
- Reduce water quality
- Choke waterways.

Most weeds that are in bushland areas have escaped from backyards. Their seeds and cuttings are carried by the wind or animals, or even swept away with the stormwater when it rains. Frequently, prunings, cuttings and grass clippings are dumped in the bushland, allowing weeds to quickly invade and spread. Environmental weeds have few predators and usually produce vast quantities of seed, and so out-compete or smother native plants. They are particularly successful in disturbed areas where soil nutrient levels are high, such as areas affected by stormwater pollution or the fringes of bushland areas bordering residential properties.

The Georges River Catchment is threatened by many introduced animals. Cats and foxes are a big threat to native animals, preying on birds, small mammals and reptiles. Deer, rabbits and some birds also impact on the catchment to varying degrees including damaging vegetation, causing erosion. In many of the freshwater ponds and wetlands in the Georges River catchment European Carp and Mosquito Fish (*Gambusia holbrooki*) cause significant damage. Mosquito Fish (also known as the Plague Minnow) can live in most aquatic conditions and once in a waterbody, are extremely difficult to remove. It is currently illegal to release gambusia into ANY waterbody in NSW. Despite the impacts of this fish on the natural environment, gambusia are still sold in pet shops as feeder fish or to put into backyard ponds. Carp also impact the health of freshwater aquatic ecosystems by increasing water turbidity and nutrient concentrations, destroying aquatic plants, and potentially causing the recurrence of toxic blue-green algae blooms. They breed rapidly, eliminating native fish, tadpoles and other small lifeforms.

When the ground is left bare by human activities including clearing, building (and related activities) and vehicle use such as 4WDs and trail bikes the soil is easily washed away when it rains. Examples of this can be seen between Sandy Point and Alfords Point as sediment from the ridges washes into Mill Creek and then into the Georges River. This erosion removes the fertile topsoil and the soil that is washed into waterways can contain plant nutrients, minerals, organic matter and seeds. It can also contain pesticides and toxic heavy metals. When soil, sand, dust, cement, paint and building debris reach the waterways, they can:

- increase the risk of flooding;
- block drains;
- spread weeds to bushland;
- result in algal blooms;
- cause health problems for swimmers;
- smother and suffocate water plants and animals and impact on their ability to reproduce.

CARINA BAY SUBCATCHMENT

CATCHMENT AREA: 2.4 KM^2

SUBURBS: COMO
JANNALI
OYSTER BAY

WATERWAYS

MAJOR NAMED WATERWAYS: CARINA CREEK

TOTAL LENGTH OF MAPPED WATERWAYS: 3.42 KMs

PRIMARY ORDER CREEKS: 0 KMs

SECOND ORDER CREEKS: 2.50 KMs

FIRST ORDER & MINOR DRAINAGE LINES: 0.61 KMs

OPEN DRAINS: 0.31 KMs

WATER QUALITY ASSESSMENT

As part of their Strategic Water Quality Monitoring Plan, Sutherland Shire Council commenced monitoring water quality in a number of streams across the shire. Trends in water quality data collected from each stream were assessed and ranked against the ANZECC 2000 guidelines for recreational water quality in urban streams (SSC, 2004).

Samples were analysed summer and winter for between three and seven years at each site. This data has been interpreted here to give a brief historic summary of water quality in the subcatchment. First and last reported values for each parameter were assessed as higher (+) than the ANZECC 2000 guideline value, lower (-) than the guideline value, or equivalent (=) to the guideline value. The overall trend during the survey period was identified as increasing (↑) or decreasing (↓). This provides an indication whether management actions are having a positive effect on water quality, and whether further actions are required, for example, a parameter that exceeds the guideline value at the start of the survey period may still exceed it at the end of the period, but have shown significant improvements during the reporting period.

Three sites were sampled in Carina Bay subcatchment:

1. Tivoli Esplanade Como

PARAMETER	NH3	BOD	Cu	Pb	Zn
SUMMER 95 +/- ANZECC 2000 values	+	+	-	-	-
SUMMER 00 +/- ANZECC 2000 values	-	-	+	-	-
TREND ↓↑	↓	↓	↑	↑	↓
PARAMETER	**Enterococci**	**Grease**	**TN**	**TP**	**TSS**
SUMMER 95 +/- ANZECC 2000 values	+	=	-	-	-
SUMMER 00 +/- ANZECC	+	-	+	-	-

2000 values					
TREND ↓↑	↑	↓	↑	↓	↓

A number of parameters showed an increase in values during the survey period, notably enterococci, total nitrogen and heavy metals, some of which were consistently outside ANZECC 2000 guideline values. Decreases in values for other parameters were reported, a number of which were within guideline values at the end of the survey period.

2. Carina Bay Reserve Como

PARAMETER	NH3	BOD	Cu	Pb	Zn
SUMMER 95 +/- ANZECC 2000 values	+	+	+	+	=
WINTER 02 +/- ANZECC 2000 values	+	-	+	-	-
TREND ↓↑	↓	↓	↓	↓	↓
PARAMETER	**Enterococci**	**Grease**	**TN**	**TP**	**TSS**
SUMMER 95 +/- ANZECC 2000 values	-	+	+	-	+
WINTER 02 +/- ANZECC 2000 values	-	-	-	-	-
TREND ↓↑	↑	↓	↓	↓	↓

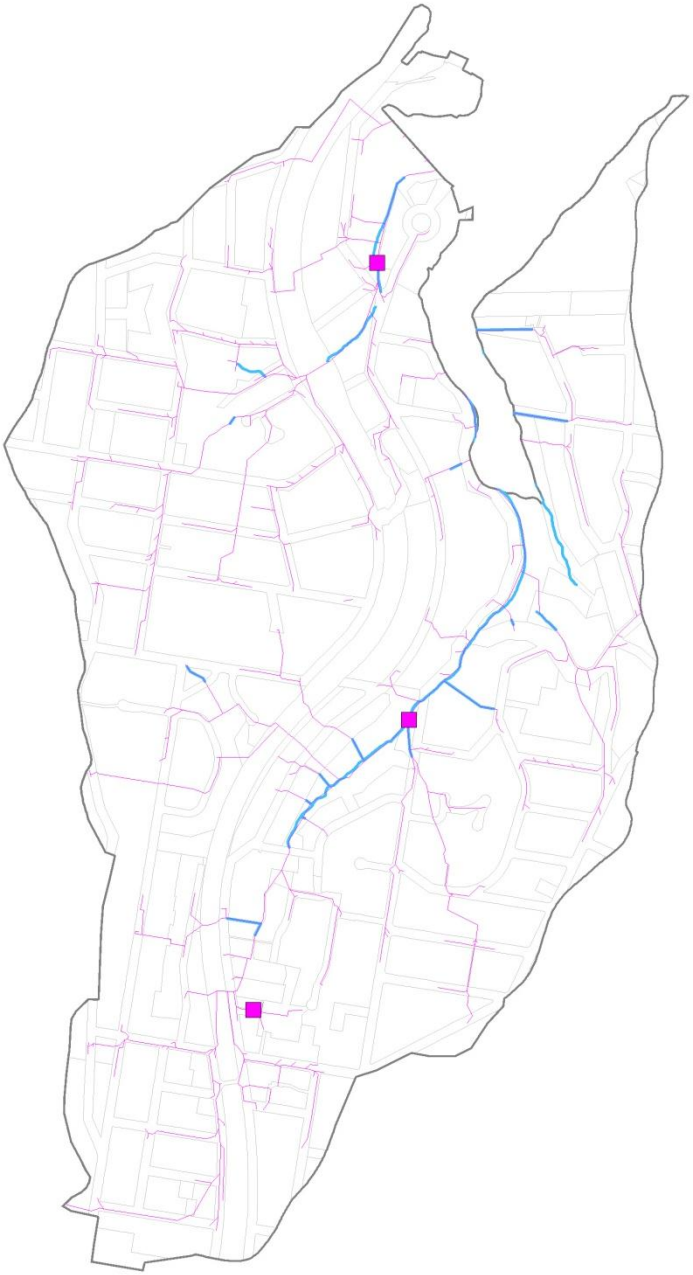
A reduction in values was recorded for most parameters sampled except enterococci, with the result that most parameters, except ammonia and copper were reported to be within ANZECC 2000 guideline limits at the end of the survey period.

3. Scylla Bay Como

PARAMETER	NH3	BOD	Cu	Pb	Zn
SUMMER 95 +/- ANZECC 2000 values	+	+	+	+	=
WINTER 02 +/- ANZECC 2000 values	-	-	-	-	-
TREND ↓↑	↓	↓	↓	↓	↓
PARAMETER	**Enterococci**	**Grease**	**TN**	**TP**	**TSS**
SUMMER 95 +/- ANZECC 2000 values	-	+	+	-	+
WINTER 02 +/- ANZECC 2000 values	-	-	+	-	-
TREND ↓↑	↑	↓	↑	↓	↓

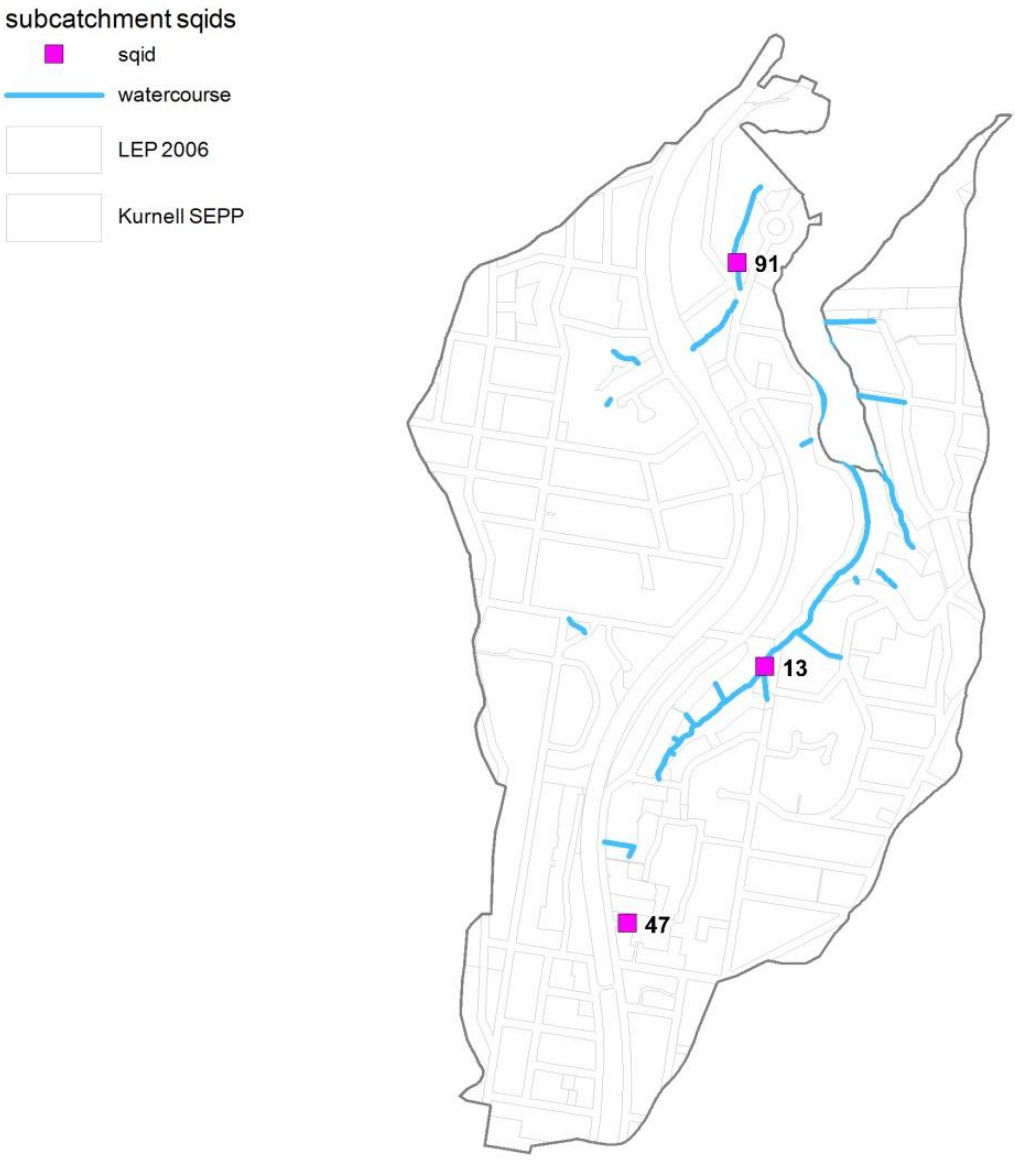
A reduction in values was recorded for most parameters sampled except enterococci and total nitrogen, all parameters except total nitrogen were reported to be within ANZECC 2000 guideline limits at the end of the survey period.

RETICULATED STORMWATER SYSTEM



LOCATION OF SQIDS

ID	DEVICE CATEGORY	DEVICE TYPE	LOCATION	SITE DESCRIPTION	SUBURB	APPROX. CATCHMENT
91	GPT	CDS	Cremona Road	Near Loretta Avenue	Como	59.2 Ha
13	GPT	GPT	Wattle Road	Carina Creek	Jannali	94.8 Ha
47	GPT	Humeceptor	Railway Crescent	Jannali Carpark	Jannali	1.35 Ha



GEOLOGY, GEOMORPHOLOGY AND SOILS

GEOLOGY

Carina Bay subcatchment soil landscapes include Hawkesbury Soil Landscape (ha) around foreshores. Areas immediately behind the foreshores are Gymea Soil Landscape (gy), with minor areas of Disturbed Terrain Soil Landscape (xx) (from Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet Map and Report; see summary explanations in Geology and Soils section for Georges River catchment).

TOPOGRAPHY

Around one third of the subcatchment is under 25m AHD, and one third over 75m AHD, with the rest in between. Maximum elevation is in the southern part of the subcatchment, where it reaches 83m AHD.

ASS/PASS, URBAN SALINITY

LEP (00 &06) CLASS	HECTARES
CLASS 1	.15
CLASS 2	3.22
CLASS 4	2.09
CLASS 5	132.60

Small areas of Class 2 ASS are located in Carina Bay and Scylla Bay Reserves, in marine areas. A small area of Class 4 ASS is also located in Carina Bay Reserve in the marine area. The Class 5 ASS is found in a broad band around the foreshores of the subcatchment.

OTHER CONTAMINATION ISSUES

None noted

LAND USE

HISTORIC LAND USE

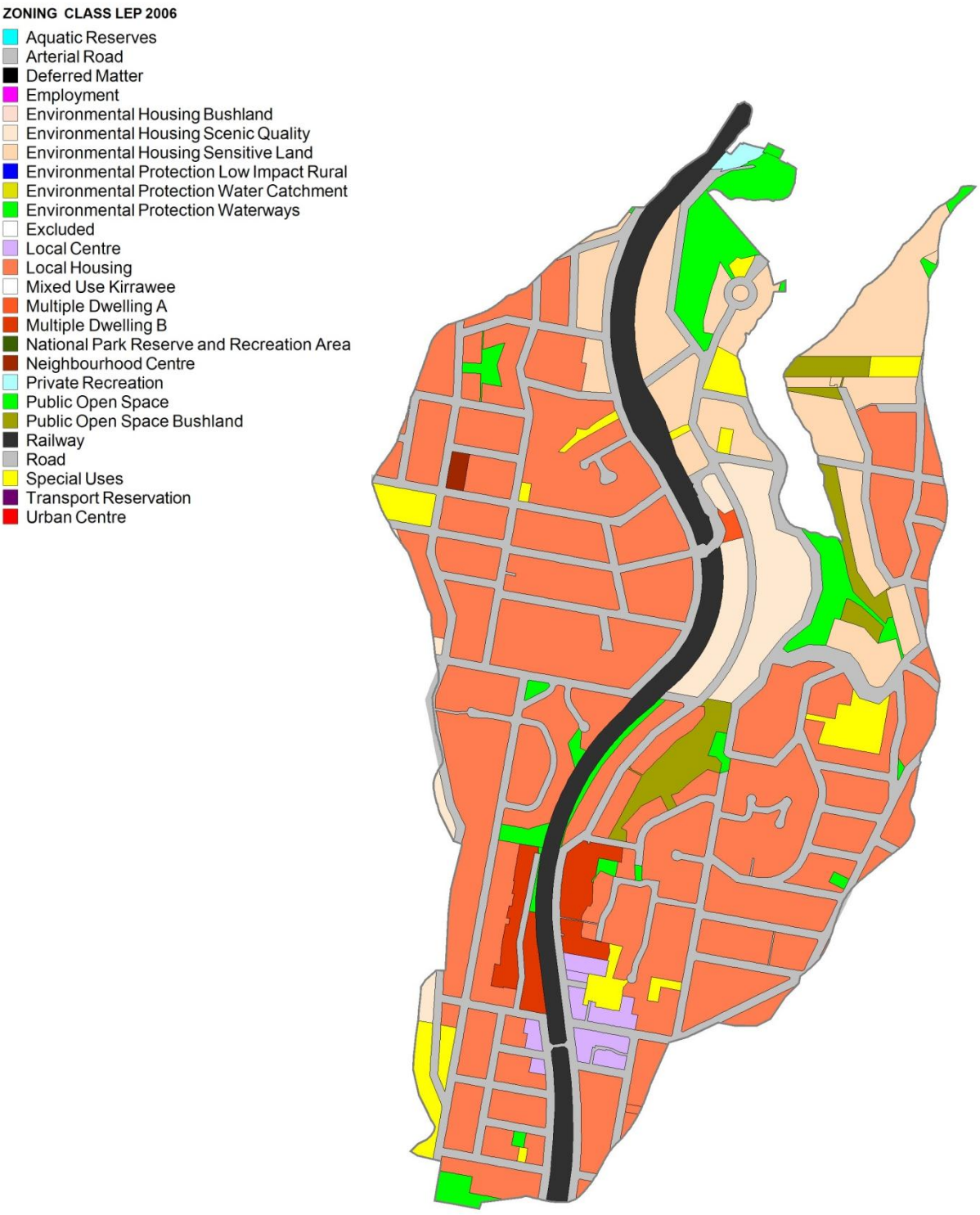
Carina Bay drains the catchment mainly represented by the suburb of Como. James Murphy, who bored for coal on Thomas Holt's Sutherland estate, founded and named Como, probably for its similarity with Lake Como in Italy (Lawrence, 1997). He built Como House, an alpine style timber house that became a popular boarding house after his death. Murphy also established the Como Pleasure Grounds, an important park and recreational area. Bordering Georges River, the Pleasure Grounds included terraced garden walks with small summer houses and picnic tables, a swimming pool, boat shed, communal pavilion and dance hall. At the summit of the property, a large garden house had views over the bushland and river.

James Murphy became manager for Thomas Holt, and he built Como House as accommodation for fetters engaged in the railway construction. A bustling railway camp sprang up between Scylla Bay and Carina Bay, housing around 600 people who were employed in constructing a railway bridge and water pipeline across Woronora River. The railway camp was subsequently moved to Heathcote, and Como House was converted to a

hotel. The area was slow to develop and there was confusion over its character. Surrounding villages were steadfastly rural while the poor soils meant that this part of the Shire was billed as urban residential subdivisions from the beginning (Jackson, 2006).

After the destruction of Como House in 1969 the land was subdivided. The Como Pleasure Grounds survive in the shadows of the railway bridges. Today, there are old fig trees that predate European settlement, with barbeque facilities and playground equipment, and a marina beside the swimming pool.

CURRENT LAND USE



CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	0.00	0%	0%	0.00
Environmental Housing Sensitive Land	23.24	10%	43%	9.99
Environmental Housing Scenic Quality	9.56	4%	57%	5.45
Environmental Housing Bushland		0%	57%	0.00
Local Housing	106.45	44%	51%	54.29
Multiple Dwelling A	0.29	0%	64%	0.18
Multiple Dwelling B	4.63	2%	64%	2.97
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	0.00	0%	94%	0.00
Local Centre	2.75	1%	88%	2.42
Neighbourhood Centre	0.39	0%	86%	0.34
Employment	0.00	0%	95%	0.00
Special Uses	8.16	3%	30%	2.45
Public Open Space	11.42	5%	5%	0.57
Public Open Space Bushland	6.01	3%	0%	0.00
Private Recreation	0.47	0%	5%	0.02
Environmental Protection Waterways	0.17	0%	0%	0.00
Aquatic Reserves	0.00	0%	0%	0.00
National Park Reserve and Recreation Area	0.00	0%	0%	0.00
Railway	14.43	6%	33%	4.76
Arterial Road/Road	52.40	22%	66%	34.58
Transport Reservation	0.00	0%	5%	0.00
TOTALS	240.38	100%	49%	118.03

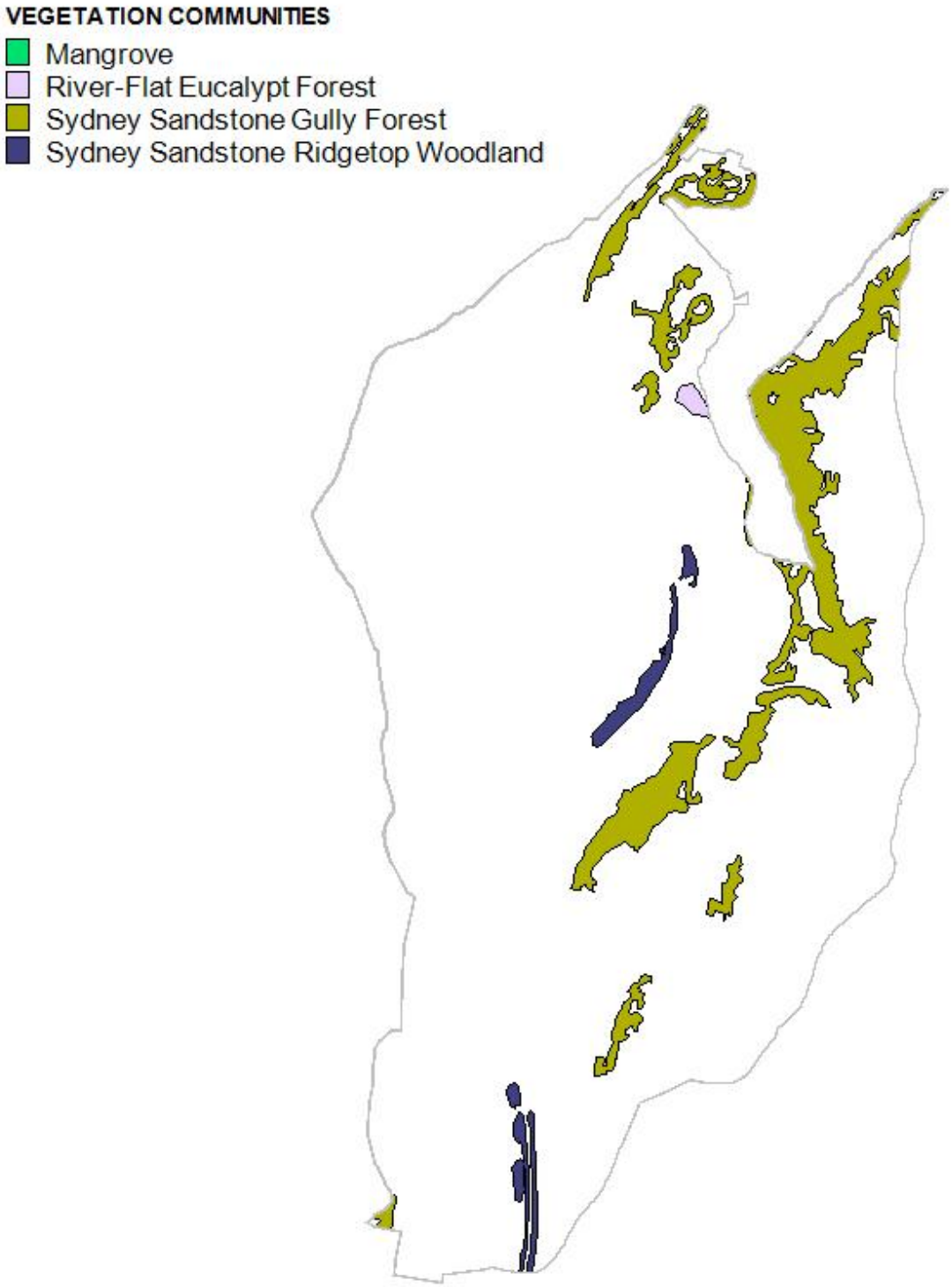
VEGETATION COMMUNITIES

MAPPED VEGETATION COMMUNITIES

0.08 HECTARES MANGROVE
20.08 HECTARES SYDNEY SANDSTONE GULLY FOREST
2.47 HECTARES SYDNEY SANDSTONE RIDGETOP WOODLAND
0.37 HECTARES RIVER-FLAT EUCALYPT FOREST

LEP 2006 SIGNIFICANT VEGETATION

LEP TAG	NAME	CLASS
T28	Lophostemon confertus_Cultural Plantings	Significant Group of Trees or Vegetation
T29	Eucalyptus microcorys_Blackbut	Significant Group of Trees or Vegetation



BUSHLAND RESERVES AND RESTORATION

Reserves

1) Greenweb Core areas

- Carina Bay Reserve
- Carina Bay foreshores
- Tivoli Esplanade
- Honeysuckle Reserve

2) Greenweb Support areas

- Riverview Rd
- Green Point Rd
- Jannali Cres/Honeysuckle St
- Novara Cres/Bega Rd/Wattle Rd

3) Greenweb Restoration areas

- Railway corridor
- Railway cres/Charles Pl/Wattle Rd/Box Rd/Robert St/White St
- Como Reserve
- Scylla Bay Reserve
- Verona Ra/Cremona Rd

Bushcare Groups

- Carina Bay Reseve
- Honeysuckle Reserve

THREATENING PROCESSES

INSTREAM IMPACTS

- Loss of riparian habitat
- Degradation of riparian habitat
- Loss of emergent vegetation
- Removal of large woody debris
- Loss or reduction of allochthonous material as a stream input
- Loss or reduction of shading of stream
- Changes to the proportion of catchment impervious surface
- Changes to infiltration patterns
- Construction of dams and other impediments to flow
- Draining of wetland areas
- Channelization
- Modification of channel bedform

- Modification of bank configuration
- Pipe replacement of channel
- Erosion
- Sedimentation
- Point source pollution
- Non-point (diffuse) source pollution
- Increased nutrient loads
- Introduction of toxic compounds
- Introduction of oils and organobenzenes
- Introduction of herbicides and pesticides in runoff
- Reduction of light penetration
- Algal bloom
- Emergent aquatic weeds
- Floating aquatic weeds
- Change in temperature regime
- Barriers to fish passage
- Change to hydrological flow regimes
- Change to pH through mobilisation of ASS/PASS
- Stormwater deposition of litter
- Dumping of rubbish
- Increased allocthonous inputs immediately following fire or clearing
- Increased peak discharges associated with storm flows
- Decreased baseflows
- Diseases from untreated or poorly treated sewage
- Reduction in water through extraction
- Introduction of invasive species including
    - Gambusia
    - Carp
    - Cane Toads
    - Koi Carp (goldfish)

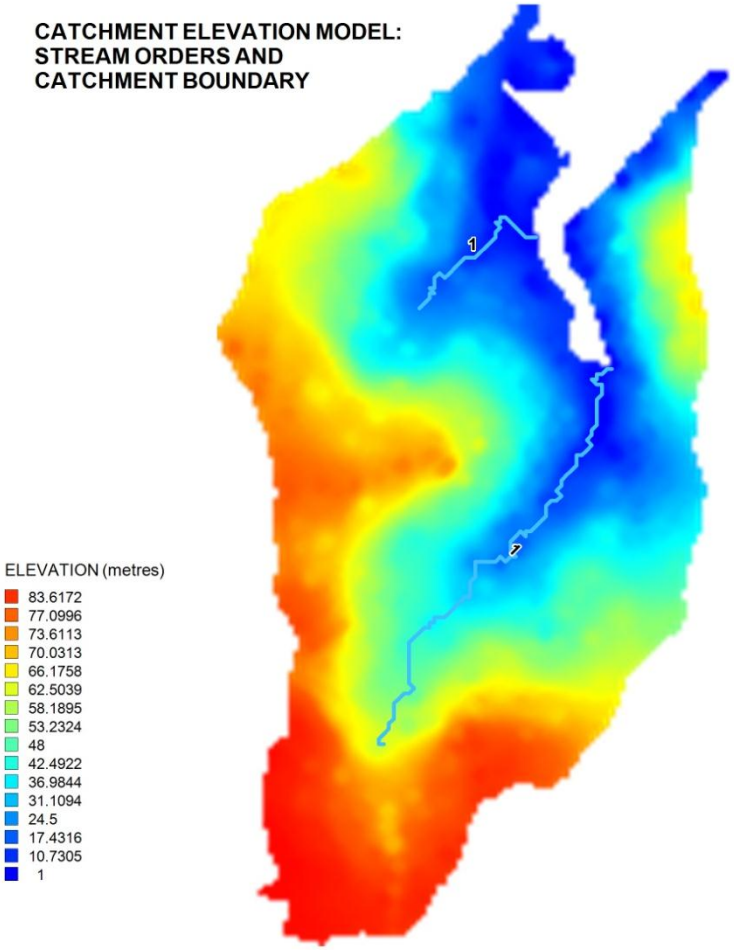
RIPARIAN IMPACTS

- Invasion by weeds
- Loss of species through replacement by others
- Loss of diversity (reduction in species numbers)
- Loss of habitat quality
- Disturbance from pedestrian access
- Disturbance from vehicle access
- Disturbance from excessive use by stock or other animals
- Clearing of vegetation
- Deliberate introduction of exotic plant species
- Selective removal of vegetation including

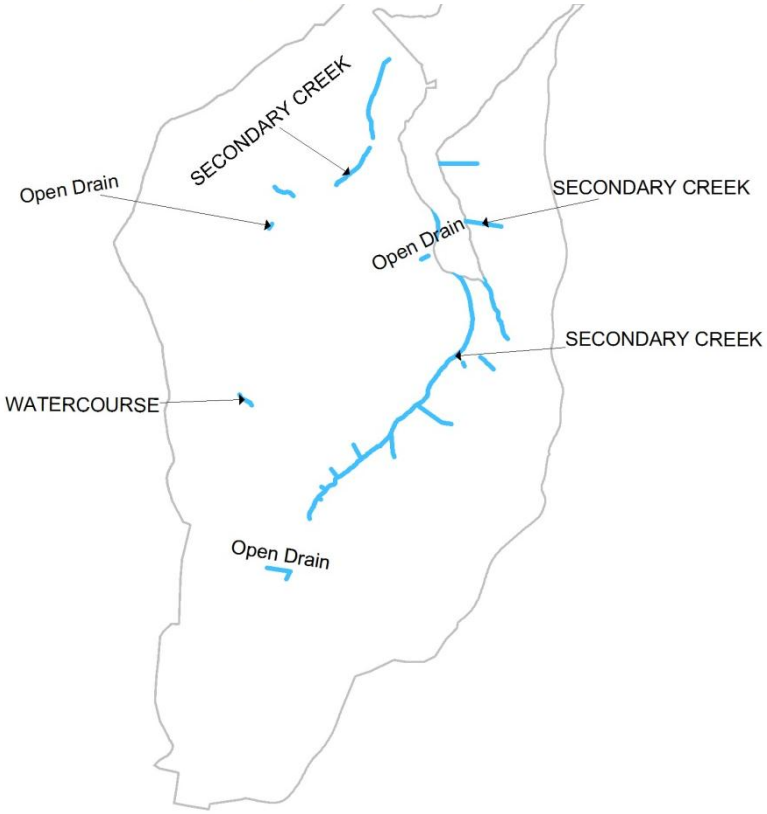
    - Loss of canopy
    - Loss of shrub layer
    - Loss of groundcover species
- Removal of habitat elements including
    - Loss of leaf litter
    - Loss of fallen timber
    - Loss of standing dead trees
    - Loss of rocks
    - Loss of microhabitat architecture
- Dumping of rubbish
- Littering
- Vandalism including
    - Damage to plants
    - Damage to abiotic habitat elements
    - Injured or killed animals
- Inappropriate fire regime
- Erosion
- Sedimentation
- Plant diseases including
    - Phytophthora (dieback)
    - Myrtle rust
    - Smut
    - Common rust
    - Mistletoes
- Feral animals including
    - Foxes
    - Rabbits
    - Deer
    - Cane Toads
    - Wild pigs
    - Feral cats
    - Introduced birds

RECREATED WATERWAYS MAP

CATCHMENT ELEVATION MODEL: STREAM ORDERS AND CATCHMENT BOUNDARY



CURRENTLY MAPPED WATERWAYS AND CATCHMENT BOUNDARY



CORONATION BAY SUBCATCHMENT

SUBCATCHMENT OVERVIEW

CATCHMENT AREA: 0.50 KM^2

SUBURBS: OYSTER BAY
JANNALI

WATERWAYS

MAJOR NAMED WATERWAYS: NIL

TOTAL LENGTH OF MAPPED WATERWAYS: 0.38 KMs

PRIMARY ORDER CREEKS: 0 KMs

SECOND ORDER CREEKS: 0 KMs

OPEN DRAINS/MINOR DRAINAGE LINES: 0.38 KMs

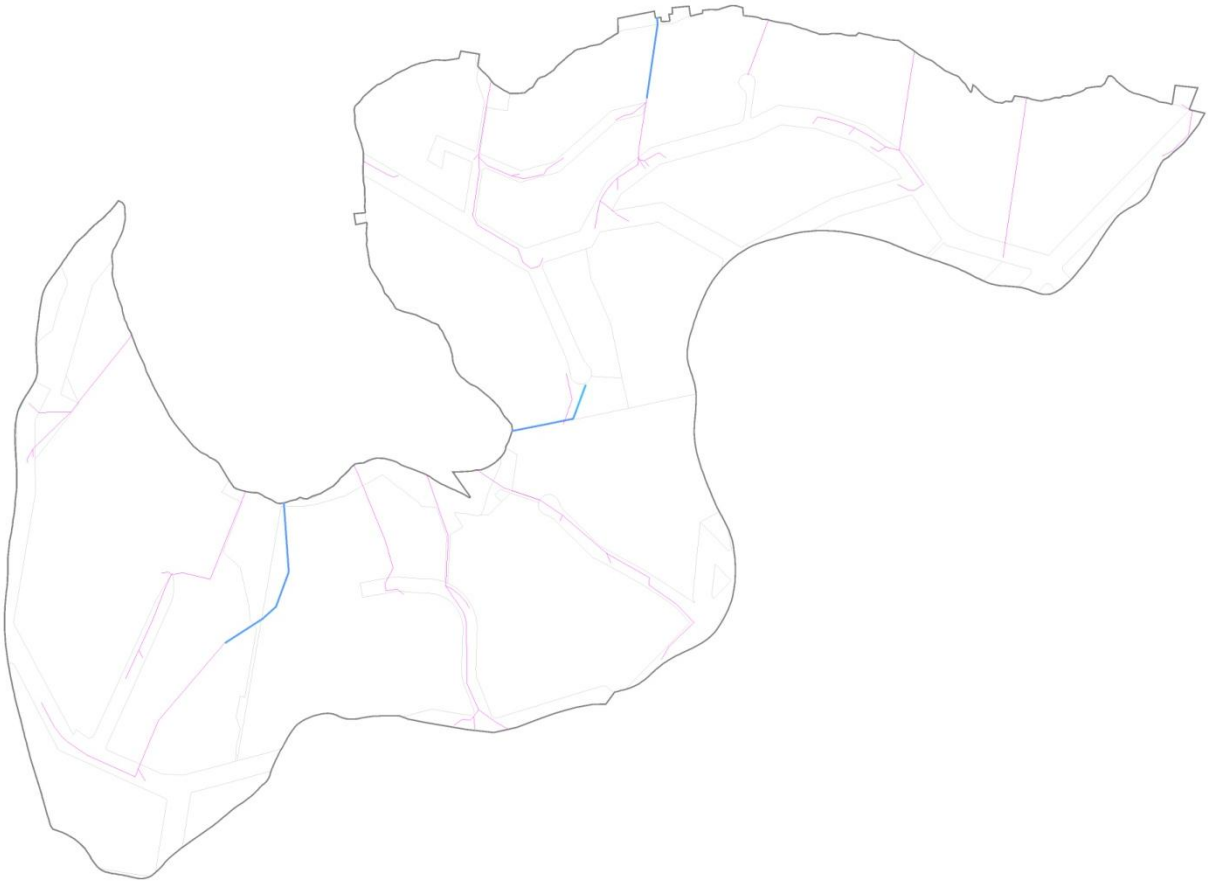
WATER QUALITY ASSESSMENT

As part of their Strategic Water Quality Monitoring Plan, Sutherland Shire Council commenced monitoring water quality in a number of streams across the shire. Trends in water quality data collected from each stream were assessed and ranked against the ANZECC 2000 guidelines for recreational water quality in urban streams (SSC, 2004).

Samples were analysed summer and winter for between three and seven years at each site. This data has been interpreted here to give a brief historic summary of water quality in the subcatchment. First and last reported values for each parameter were assessed as higher (+) than the ANZECC 2000 guideline value, lower (-) than the guideline value, or equivalent (=) to the guideline value. The overall trend during the survey period was identified as increasing (↑) or decreasing (↓). This provides an indication whether management actions are having a positive effect on water quality, and whether further actions are required, for example, a parameter that exceeds the guideline value at the start of the survey period may still exceed it at the end of the period, but have shown significant improvements during the reporting period.

No sites sampled in this subcatchment

RETICULATED STORMWATER SYSTEM



LOCATION OF SQIDS

NIL IN CATCHMENT

GEOMORPHIC SETTING

GEOLOGY, GEOMORPHOLOGY AND SOILS

Coronation Bay subcatchment soil landscapes include Hawkesbury Soil Landscape (ha) around headland foreshores. Areas immediately behind the foreshores, and the rest of the catchment are Gymea Soil Landscape (gy) (from Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet Map and Report; see summary explanations in Geology and Soils section for Georges River catchment).

TOPOGRAPHY

Land around the foreshores of the subcatchment reaches an altitude of 20m AHD. Highest parts of the subcatchment are in the southwestern corner, where it ranges from 50-60m AHD. Most of the subcatchment is in between these altitudes.

ASS/PASS, URBAN SALINITY

LEP (00 &06) CLASS	HECTARES
CLASS 1	0.19
CLASS 2	0.16
CLASS 5	49.78

Small areas of Class 1 and 2 ASS are in intertidal areas, while the Class 5 ASS covers a band of land around the foreshores of the subcatchment.

OTHER CONTAMINATION ISSUES

None noted

LAND USE

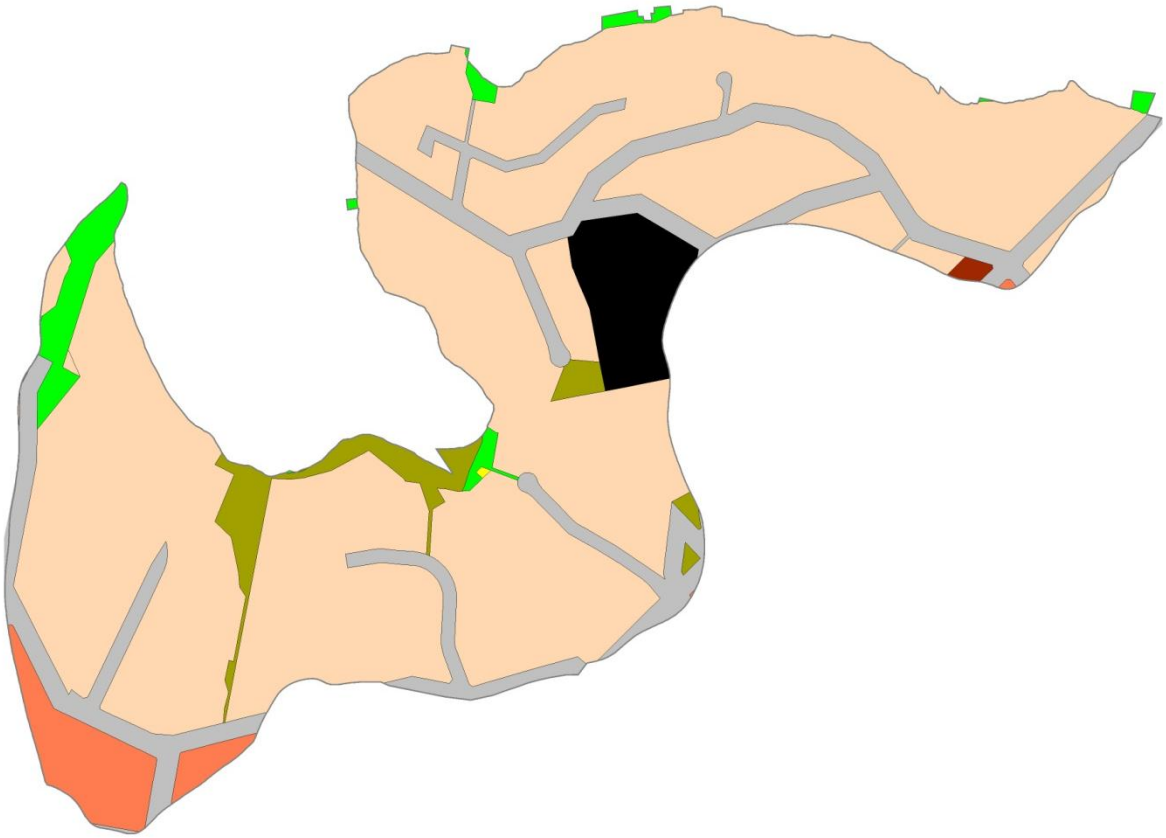
HISTORIC LAND USE

Coronation Bay subcatchment drains land around Green Point, and parts of Como and Oyster Bay. Like nearby areas, Green Point was originally part of the Sutherland-Holt Estate. Thomas Holt employed Robert Cooper Walker as a manager, and he described Green Point as an extraordinary shaped point of considerable size which was rocky and with little feed (Florence & Gardiner, 2001). Given its poor future for agriculture and grazing, the decision was made early to subdivide this part of the Shire, and in 1886 Holt began to sell off blocks around the newly constructed Como railway station.

The ferry and railway lines both brought tourists to the area for many years, and the paddle wheelers of the 1890s were very popular. Hotels and stores soon followed, and bungalows sprang up along the shores of the Georges River. Population in the area fluctuated, with a construction camp established at Como for the Illawarra railway, although in time the workers and their families moved on to the next jobs.

Businesses in the area were hit hard by the Depression, like the rest of the Shire. Como was seen as an affordable place to live and people continued to move to the area despite the primitive conditions: roads were poorly formed or absent, transport was disorganised and one general store existed in the whole of the Como area. Descriptions of the area in the 1960s commented on the quality of the natural bushland setting, and the abundance of native birds and wildflowers. A considerable extent of natural bushland is retained in the area around Coronation Bay even today.

CURRENT LAND USE



ZONING CLASS LEP 2006

- Aquatic Reserves
- Arterial Road
- Deferred Matter
- Employment
- Environmental Housing Bushland
- Environmental Housing Scenic Quality
- Environmental Housing Sensitive Land
- Environmental Protection Low Impact Rural
- Environmental Protection Water Catchment
- Environmental Protection Waterways
- Excluded
- Local Centre
- Local Housing
- Mixed Use Kirrawee
- Multiple Dwelling A
- Multiple Dwelling B
- National Park Reserve and Recreation Area
- Neighbourhood Centre
- Private Recreation
- Public Open Space
- Public Open Space Bushland
- Railway
- Road
- Special Uses
- Transport Reservation
- Urban Centre

CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	1.84	4%	0%	0.00
Environmental Housing Sensitive Land	36.81	74%	43%	15.83
Environmental Housing Scenic Quality	0.00	0%	57%	0.00
Environmental Housing Bushland	0.00	0%	57%	0.00
Local Housing	1.73	3%	51%	0.88
Multiple Dwelling A	0.00	0%	64%	0.00
Multiple Dwelling B	0.00	0%	64%	0.00
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	0.00	0%	94%	0.00
Local Centre	0.00	0%	88%	0.00
Neighbourhood Centre	0.09	0%	86%	0.08
Employment	0.00	0%	95%	0.00
Special Uses	0.01	0%	30%	0.00
Public Open Space	1.06	2%	5%	0.05
Public Open Space Bushland	1.49	3%	0%	0.00
Private Recreation	0.00	0%	5%	0.00
Environmental Protection Waterways	0.19	0%	0%	0.00
Aquatic Reserves	0.00	0%	0%	0.00
National Park Reserve and Recreation Area	0.00	0%	0%	0.00
Railway	0.00	0%	33%	0.00
Arterial Road/Road	6.91	14%	66%	4.56
Transport Reservation	0.00	0%	5%	0.00
TOTALS	50.13	100%	43%	21.40

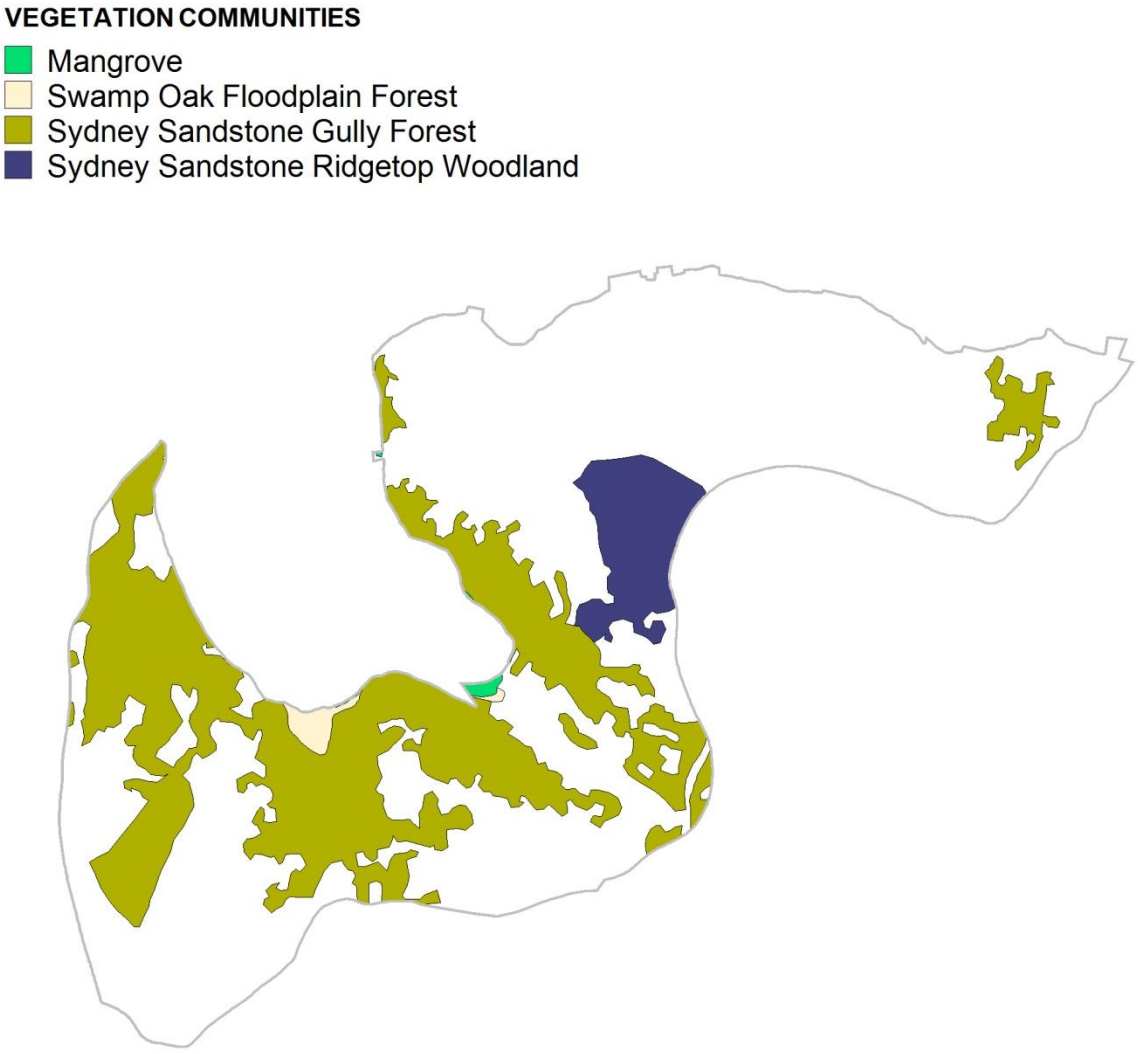
VEGETATION COMMUNITIES

MAPPED VEGETATION COMMUNITIES

0.12	HECTARES	MANGROVE
0.29	HECTARES	SWAMP OAK FLOODPLAIN FOREST
14.13	HECTARES	SYDNEY SANDSTONE GULLY FOREST
2.13	HECTARES	SYDNEY SANDSTONE RIDGETOP WOODLAND

LEP 2006 SIGNIFICANT VEGETATION

NIL



BUSHLAND RESERVES AND RESTORATION

Reserves

1) Greenweb Core areas

- Tiranna Pl/Caravan Head Rd
- Coronation Bay foreshores
- Shipwright Pl
- Green Point Rd

2) Greenweb Support areas

- Georges River Cres/Tiranna Pl
- Glenhaven Pl/Caravan Head Rd
- Farrer Pl/Caravan Head Rd
- Shipwright Pl/
- Green Point Rd

3) Greenweb Restoration areas

- None noted

Bushcare Groups

- Caravan Head Bushland Reserve
- Farrer Place Reserve
- Riverhaven Reserve
- Juvenis Avenue Reserve
- Green Point Road Reserve

THREATENING PROCESSES

INSTREAM IMPACTS

- Loss of riparian habitat
- Degradation of riparian habitat
- Loss of emergent vegetation
- Removal of large woody debris
- Loss or reduction of allochthonous material as a stream input
- Loss or reduction of shading of stream
- Changes to the proportion of catchment impervious surface
- Changes to infiltration patterns
- Construction of dams and other impediments to flow
- Draining of wetland areas
- Channelization
- Modification of channel bedform

- Modification of bank configuration
- Pipe replacement of channel
- Erosion
- Sedimentation
- Point source pollution
- Non-point (diffuse) source pollution
- Increased nutrient loads
- Introduction of toxic compounds
- Introduction of oils and organobenzenes
- Introduction of herbicides and pesticides in runoff
- Reduction of light penetration
- Algal bloom
- Emergent aquatic weeds
- Floating aquatic weeds
- Change in temperature regime
- Barriers to fish passage
- Change to hydrological flow regimes
- Change to pH through mobilisation of ASS/PASS
- Stormwater deposition of litter
- Dumping of rubbish
- Increased allocthonous inputs immediately following fire or clearing
- Increased peak discharges associated with storm flows
- Decreased baseflows
- Diseases from untreated or poorly treated sewage
- Reduction in water through extraction
- Introduction of invasive species including
    - Gambusia
    - Carp
    - Cane Toads
    - Koi Carp (goldfish)

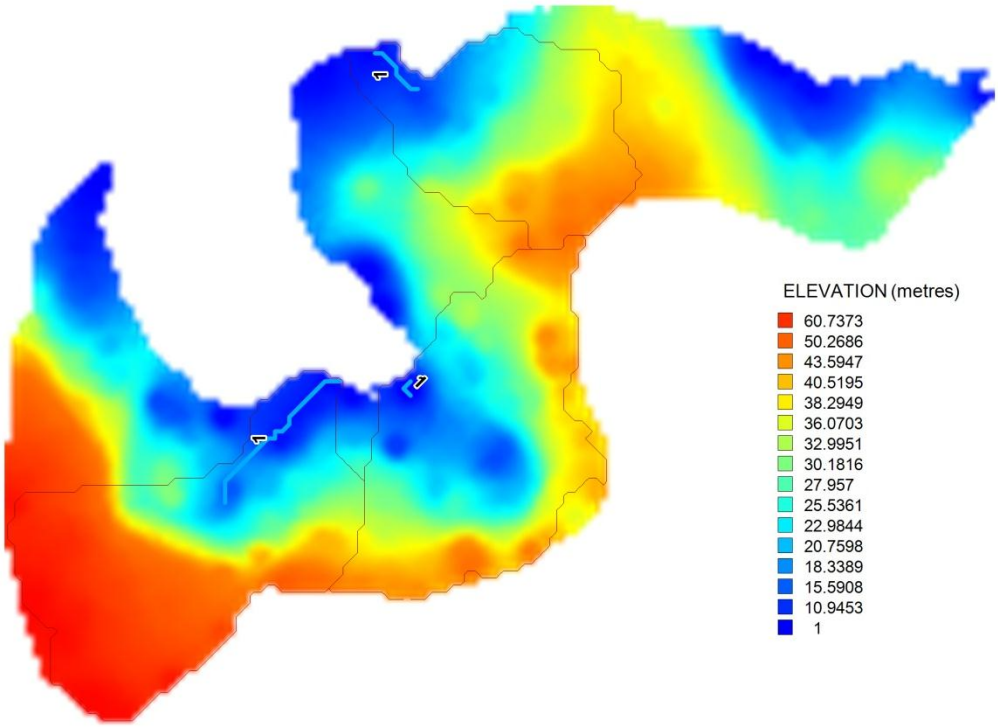
RIPARIAN IMPACTS

- Invasion by weeds
- Loss of species through replacement by others
- Loss of diversity (reduction in species numbers)
- Loss of habitat quality
- Disturbance from pedestrian access
- Disturbance from vehicle access
- Disturbance from excessive use by stock or other animals
- Clearing of vegetation
- Deliberate introduction of exotic plant species
- Selective removal of vegetation including

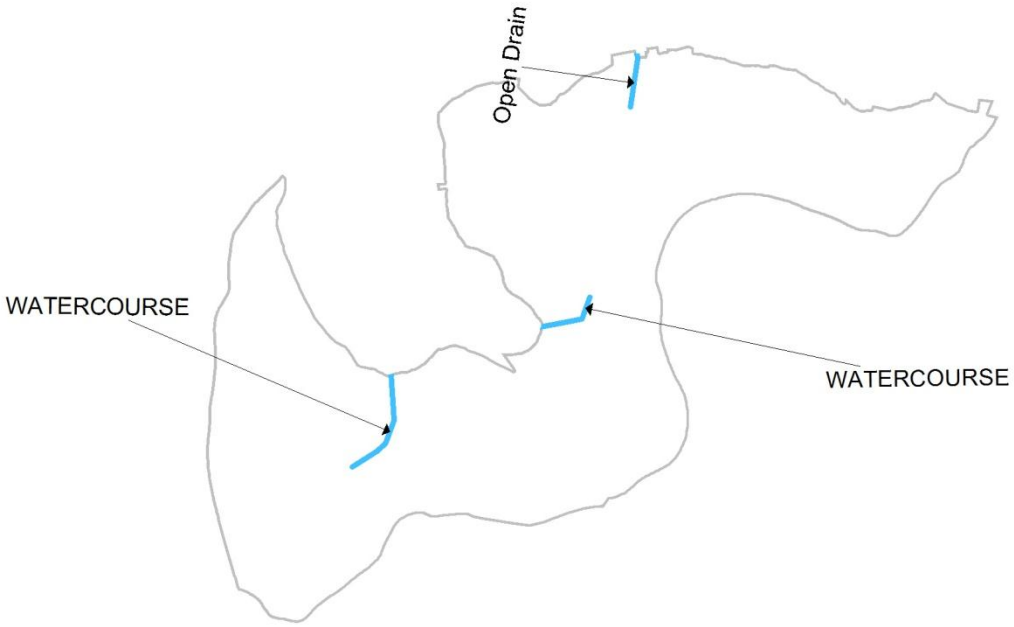
    - Loss of canopy
    - Loss of shrub layer
    - Loss of groundcover species
- Removal of habitat elements including
    - Loss of leaf litter
    - Loss of fallen timber
    - Loss of standing dead trees
    - Loss of rocks
    - Loss of microhabitat architecture
- Dumping of rubbish
- Littering
- Vandalism including
    - Damage to plants
    - Damage to abiotic habitat elements
    - Injured or killed animals
- Inappropriate fire regime
- Erosion
- Sedimentation
- Plant diseases including
    - Phytophthora (dieback)
    - Myrtle rust
    - Smut
    - Common rust
    - Mistletoes
- Feral animals including
    - Foxes
    - Rabbits
    - Deer
    - Cane Toads
    - Wild pigs
    - Feral cats
    - Introduced birds

RECREATED WATERWAYS MAP

CATCHMENT ELEVATION MODEL: STREAM ORDERS AND CATCHMENT BOUNDARIES



CURRENTLY MAPPED WATERWAYS AND CATCHMENT BOUNDARY

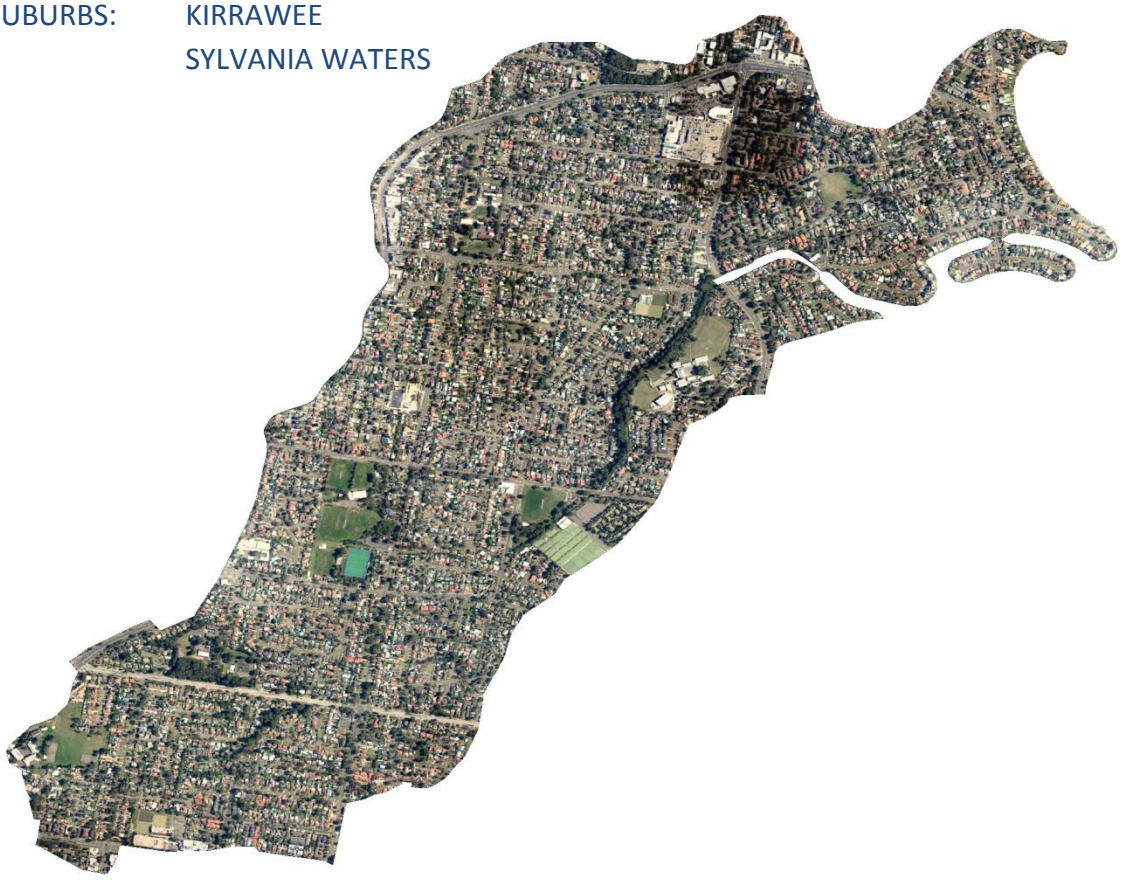


GWAWLEY SUBCATCHMENT

SUBCATCHMENT OVERVIEW

CATCHMENT AREA: 3.78 KM^2

SUBURBS: KIRRAWEE
SYLVANIA WATERS



WATERWAYS

MAJOR NAMED WATERWAYS: GWAWLEY CREEK

TOTAL LENGTH OF MAPPED WATERWAYS: 1.22 KMs

PRIMARY ORDER CREEKS: 0 KMs

SECOND ORDER CREEKS: 1.10 KMs

OPEN DRAINS/MINOR DRAINAGE LINES: 0.12 KMs

WATER QUALITY ASSESSMENT

As part of their Strategic Water Quality Monitoring Plan, Sutherland Shire Council commenced monitoring water quality in a number of streams across the shire. Trends in water quality data collected from each stream were assessed and ranked against the ANZECC 2000 guidelines for recreational water quality in urban streams (SSC, 2004).

Samples were analysed summer and winter for between three and seven years at each site. This data has been interpreted here to give a brief historic summary of water quality in the subcatchment. First and last reported values for each parameter were assessed as higher (+) than the ANZECC 2000 guideline value, lower (-) than the guideline value, or equivalent (=) to the guideline value. The overall trend during the survey period was identified as increasing (↑) or decreasing (↓). This provides an indication whether management actions are having a positive effect on water quality, and whether further actions are required, for example, a parameter that exceeds the guideline value at the start of the survey period may still exceed it at the end of the period, but have shown significant improvements during the reporting period.

One site was sampled in the Gwawley Creek subcatchment:

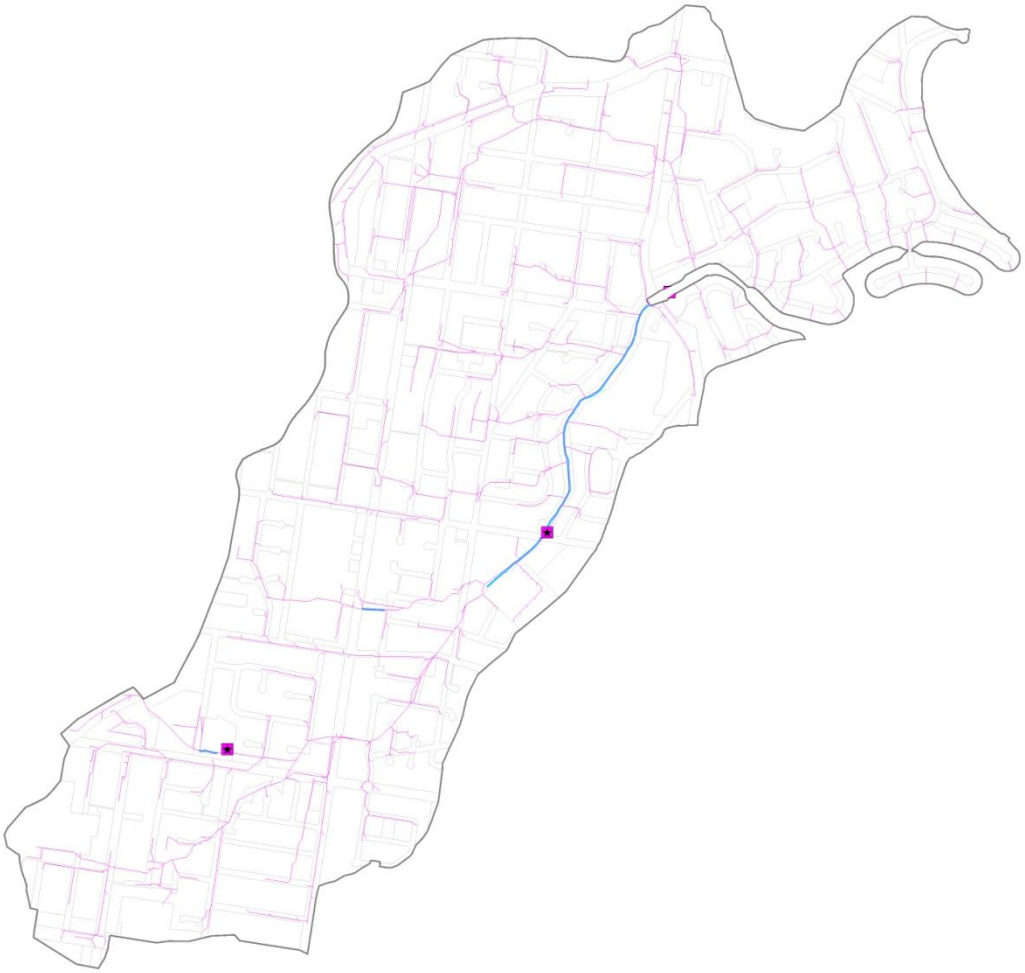
1. Gwawley Creek, upstream of Port Hacking Rd

PARAMETER	NH3	BOD	Cu	Pb	Zn
SUMMER 95 +/- ANZECC 2000 values	+	+	+	+	=
WINTER 02 +/- ANZECC 2000 values	+	=	+	-	=
TREND ↓↑	↑	↓	↓	↓	=
PARAMETER	**Enterococci**	**Grease**	**TN**	**TP**	**TSS**
SUMMER 95 +/- ANZECC 2000 values	-	+	+	-	+

WINTER 02 +/- ANZECC 2000 values	-	-	+	-	-
TREND ↓↑	↓	↓	↑	↑	↓

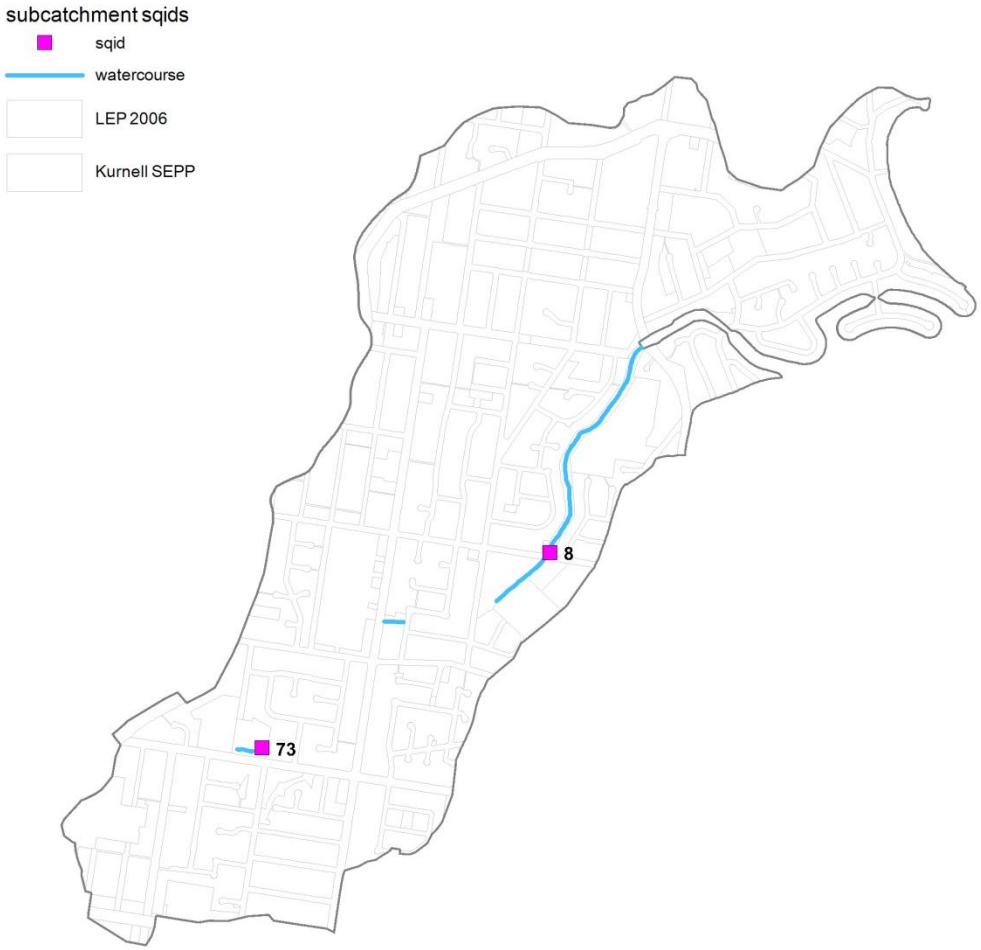
Very little improvement was noted for parameters sampled, other than BOD, copper, lead, grease,enterococci, and total suspended solids. A number of these were within ANZECC 2000 guidelines ranges at the end of the survey period.

RETICULATED STORMWATER SYSTEM



LOCATION OF SQIDS

ID	DEVICE CATEGORY	DEVICE TYPE	LOCATION	SITE DESCRIPTION	SUBURB	APPROX. CATCHMENT
73	Wetland	Wetland	The Boulevarde	Council Plant Nursery	Kirrawee	0.8 Ha
8	GPT	Trash Rack	Box Road	Gwawley Creek	Sylvania	145 Ha



GEOMORPHIC SETTING

GEOLOGY, GEOMORPHOLOGY AND SOILS

Gwawley Creek subcatchment soil landscapes include Disturbed Terrain Soil Landscape (xx) around the foreshores and areas immediately behind them, and in the drainage lines upstream. Minor areas of Gymea Soil Landscape (gy) remains around the edges of the subcatchment (from Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet Map and Report; see summary explanations in Geology and Soils section for Georges River catchment).

TOPOGRAPHY

Around one third of the catchment has an altitude less than 14m AHD, including areas around the foreshores and main drainage lines. Another third has an altitude greater than 50m AHD, with the highest point in the southwestern corner at 63m.

ASS/PASS, URBAN SALINITY

LEP (00 &06) CLASS	HECTARES
CLASS 1	0.13
CLASS 2	22.09
CLASS 3	4.53
CLASS 5	120.24

Class 2 ASS areas are mainly on reclaimed land around the foreshores, with a small area of Class 3 ASS adjoining. Class 5 ASS is located in a band around the foreshores, behind the Class 2 ASS.

OTHER CONTAMINATION ISSUES

None noted

LAND USE

HISTORIC LAND USE

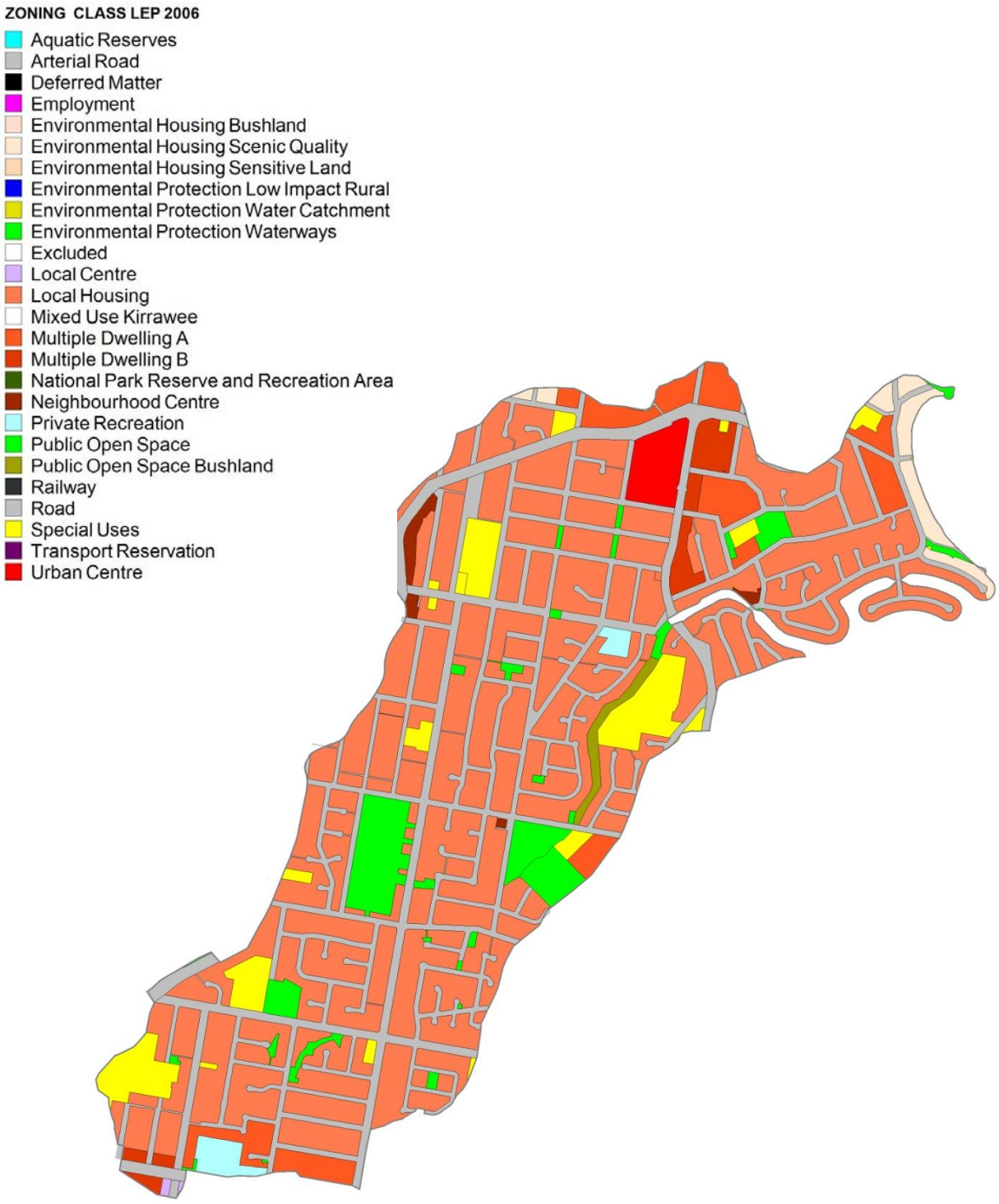
Gwawley Creek drains north through the suburb of Sylvania, discharging to Georges River, and then Botany Bay. John Connell had 180 acres in the area, where he cleared and fenced 28 acres and built a modest stone cottage at Sandy Point. He kept cows and chickens, and sold these in Sydney markets along with fruit from his orchard. The area was described as having good stands of eucalypt timber, including stringybark, bloodwood, mahogany and banksias (Lawrence, 1997).

Sylvania later became part of Thomas Holt's estate in 1882, and he built Sutherland House, also at Sandy Point. The village of Sylvania had begun to grow, and there were a dozen houses and two shops, and around 20 children attended an informal school on the veranda of a local house. The area was first known as Horse Rock Point, but the "Gateway to the Shire" was described as having "such a lovely sylvan setting" and became known as Sylvania (Lawrence, 1997). In its early days it was a rural area with market gardens, orchards, and Samways Dairy. Hancock's market garden was located near the swimming hole on Gwawley

Creek, where local children were tempted by the fruit. He later turned the place into an orchid nursery.

In 1925 the Sandy Point Estate opened and each lot had water frontage. Despite this the area was still isolated and little development occurred until the 1950s. By the 1980s the area was fully developed with residential dwellings and modern shopping facilities, and continues to grow today.

CURRENT LAND USE



CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	0.00	0%	0%	0.00
Environmental Housing Sensitive Land		0%	43%	0.00
Environmental Housing Scenic Quality	6.28	2%	57%	3.58
Environmental Housing Bushland	0.00	0%	57%	0.00
Local Housing	201.52	53%	51%	102.77
Multiple Dwelling A	19.34	5%	64%	12.38
Multiple Dwelling B	6.07	2%	64%	3.89
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	4.98	1%	94%	4.68
Local Centre	0.28	0%	88%	0.25
Neighbourhood Centre	2.07	1%	86%	1.78
Employment	0.00	0%	95%	0.00
Special Uses	21.31	6%	30%	6.39
Public Open Space	19.82	5%	5%	0.99
Public Open Space Bushland	2.17	1%	0%	0.00
Private Recreation	3.42	1%	5%	0.17
Environmental Protection Waterways	0.14	0%	0%	0.00
Aquatic Reserves	0.00	0%	0%	0.00
National Park Reserve and Recreation Area	0.00	0%	0%	0.00
Railway	0.00	0%	33%	0.00
Arterial Road/Road	90.63	24%	66%	59.81
Transport Reservation	0.00	0%	5%	0.00
TOTALS	378.03	100%	52%	196.69

VEGETATION COMMUNITIES

MAPPED VEGETATION COMMUNITIES

0.012295443 HECTARES MANGROVE

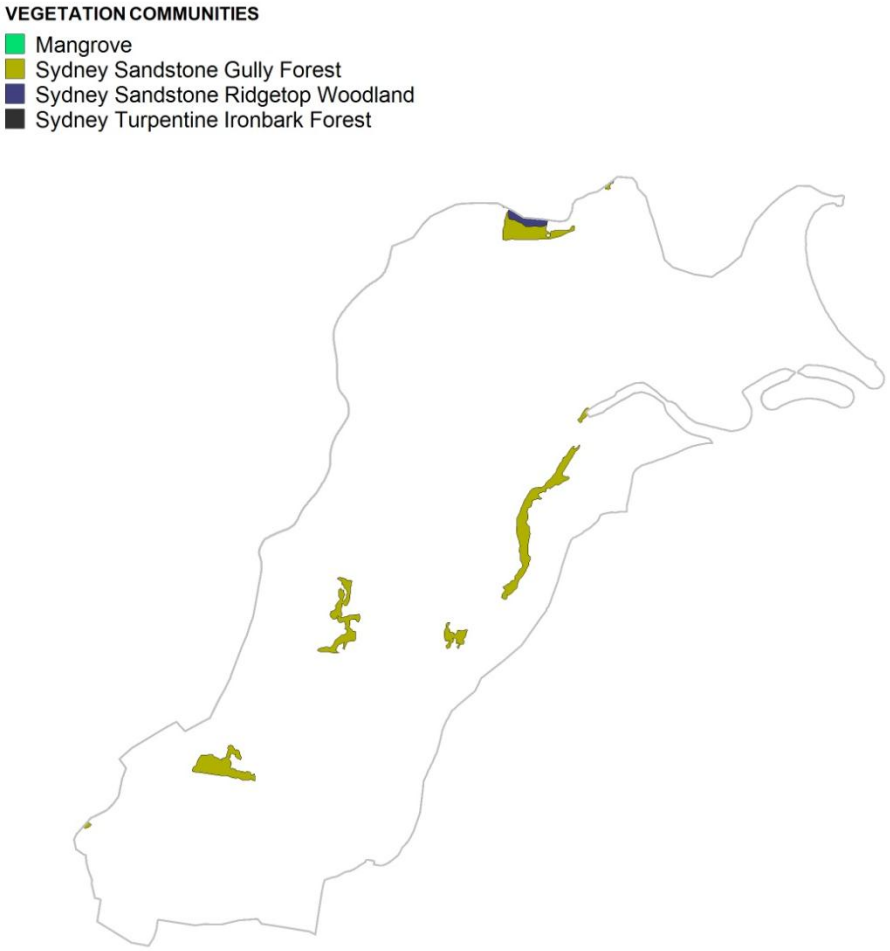
6.8817325 HECTARES SYDNEY SANDSTONE GULLY FOREST

0.525575 HECTARES SYDNEY SANDSTONE RIDGETOP WOODLAND

0.02143421 HECTARES SYDNEY TURPENTINE IRONBARK FOREST

LEP 2006 SIGNIFICANT VEGETATION

LEP TAG	NAME	CLASS
T31	Eucalyptus	Significant Group of Trees or Vegetation



BUSHLAND RESERVES AND RESTORATION

Reserves

1) Greenweb Core areas

- Gwawley Creek (between Box Rd and Port Hacking Rd)

2) Greenweb Support areas

- Leichhardt Cres/Gilbert St/Bellingara Rd/Macarthur St/Box Rd

3) Greenweb Restoration areas

- Correa Oval
- Bellingara Netball Courts
- Correa St/Correa Lane/Sylvania Rd/Amaroo St/Princes Hwy

Bushcare Groups

- Gwawley Creek

THREATENING PROCESSES

INSTREAM IMPACTS

- Loss of riparian habitat
- Degradation of riparian habitat
- Loss of emergent vegetation
- Removal of large woody debris
- Loss or reduction of allochthonous material as a stream input
- Loss or reduction of shading of stream
- Changes to the proportion of catchment impervious surface
- Changes to infiltration patterns
- Construction of dams and other impediments to flow
- Draining of wetland areas
- Channelization
- Modification of channel bedform
- Modification of bank configuration
- Pipe replacement of channel
- Erosion
- Sedimentation
- Point source pollution
- Non-point (diffuse) source pollution
- Increased nutrient loads
- Introduction of toxic compounds

- Introduction of oils and organobenzenes
- Introduction of herbicides and pesticides in runoff
- Reduction of light penetration
- Algal bloom
- Emergent aquatic weeds
- Floating aquatic weeds
- Change in temperature regime
- Barriers to fish passage
- Change to hydrological flow regimes
- Change to pH through mobilisation of ASS/PASS
- Stormwater deposition of litter
- Dumping of rubbish
- Increased allocthonous inputs immediately following fire or clearing
- Increased peak discharges associated with storm flows
- Decreased baseflows
- Diseases from untreated or poorly treated sewage
- Reduction in water through extraction
- Introduction of invasive species including
    - Gambusia
    - Carp
    - Cane Toads
    - Koi Carp (goldfish)

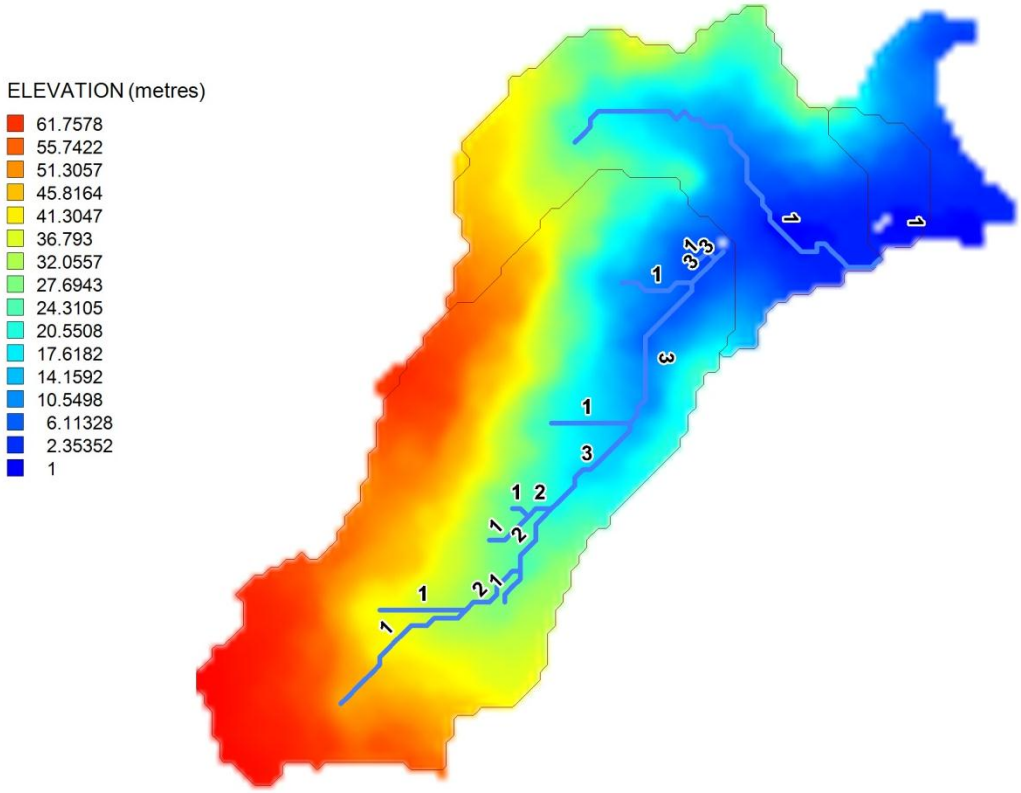
RIPARIAN IMPACTS

- Invasion by weeds
- Loss of species through replacement by others
- Loss of diversity (reduction in species numbers)
- Loss of habitat quality
- Disturbance from pedestrian access
- Disturbance from vehicle access
- Disturbance from excessive use by stock or other animals
- Clearing of vegetation
- Deliberate introduction of exotic plant species
- Selective removal of vegetation including
    - Loss of canopy
    - Loss of shrub layer
    - Loss of groundcover species
- Removal of habitat elements including
    - Loss of leaf litter
    - Loss of fallen timber
    - Loss of standing dead trees
    - Loss of rocks

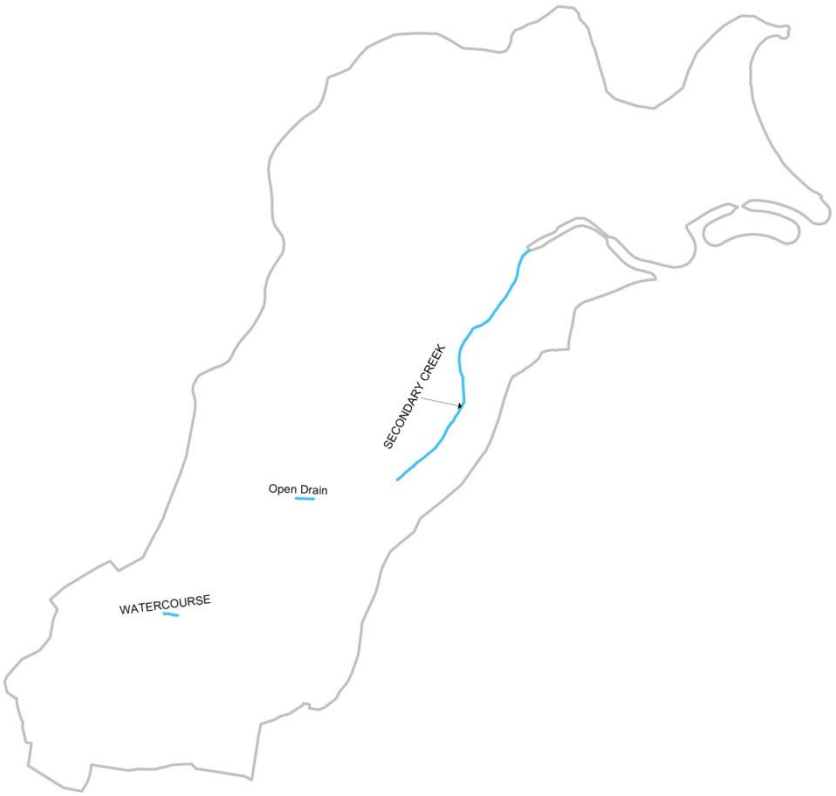
    - Loss of microhabitat architecture
- Dumping of rubbish
- Littering
- Vandalism including
    - Damage to plants
    - Damage to abiotic habitat elements
    - Injured or killed animals
- Inappropriate fire regime
- Erosion
- Sedimentation
- Plant diseases including
    - Phytophthora (dieback)
    - Myrtle rust
    - Smut
    - Common rust
    - Mistletoes
- Feral animals including
    - Foxes
    - Rabbits
    - Deer
    - Cane Toads
    - Wild pigs
    - Feral cats
    - Introduced birds

RECREATED WATERWAYS MAP

CATCHMENT ELEVATION MODEL: STREAM ORDERS AND CATCHMENT BOUNDARIES



CURRENTLY MAPPED WATERWAYS AND CATCHMENT BOUNDARY

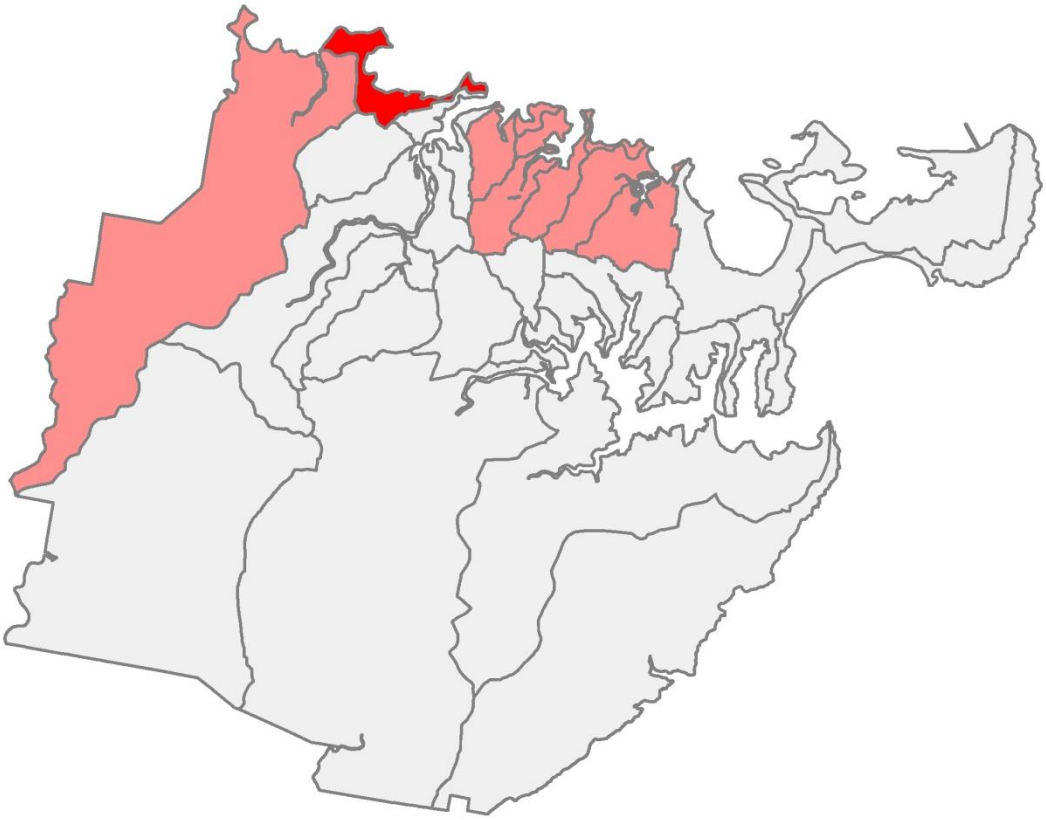


GREAT MOON BAY SUBCATCHMENT

SUBCATCHMENT OVERVIEW

CATCHMENT AREA: 3.02 KM^2

SUBURBS: ALFORDS POINT
SUTHERLAND
ILLAWONG



WATERWAYS

MAJOR NAMED WATERWAYS: NIL

TOTAL LENGTH OF MAPPED WATERWAYS: 5.10 KMs

PRIMARY ORDER CREEKS: 0 KMs

SECOND ORDER CREEKS: 1.12 KMs

OPEN DRAINS/MINOR DRAINAGE LINES: 3.98 KMs

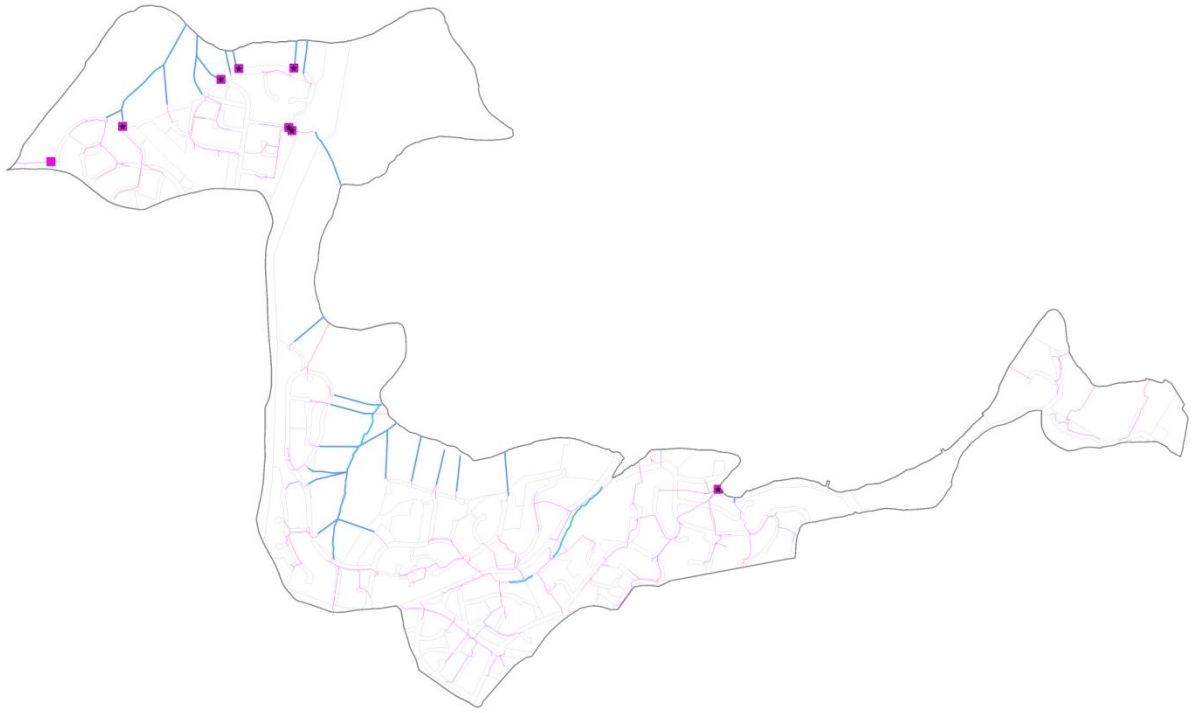
WATER QUALITY ASSESSMENT

As part of their Strategic Water Quality Monitoring Plan, Sutherland Shire Council commenced monitoring water quality in a number of streams across the shire. Trends in water quality data collected from each stream were assessed and ranked against the ANZECC 2000 guidelines for recreational water quality in urban streams (SSC, 2004).

Samples were analysed summer and winter for between three and seven years at each site. This data has been interpreted here to give a brief historic summary of water quality in the subcatchment. First and last reported values for each parameter were assessed as higher (+) than the ANZECC 2000 guideline value, lower (-) than the guideline value, or equivalent (=) to the guideline value. The overall trend during the survey period was identified as increasing (↑) or decreasing (↓). This provides an indication whether management actions are having a positive effect on water quality, and whether further actions are required, for example, a parameter that exceeds the guideline value at the start of the survey period may still exceed it at the end of the period, but have shown significant improvements during the reporting period.

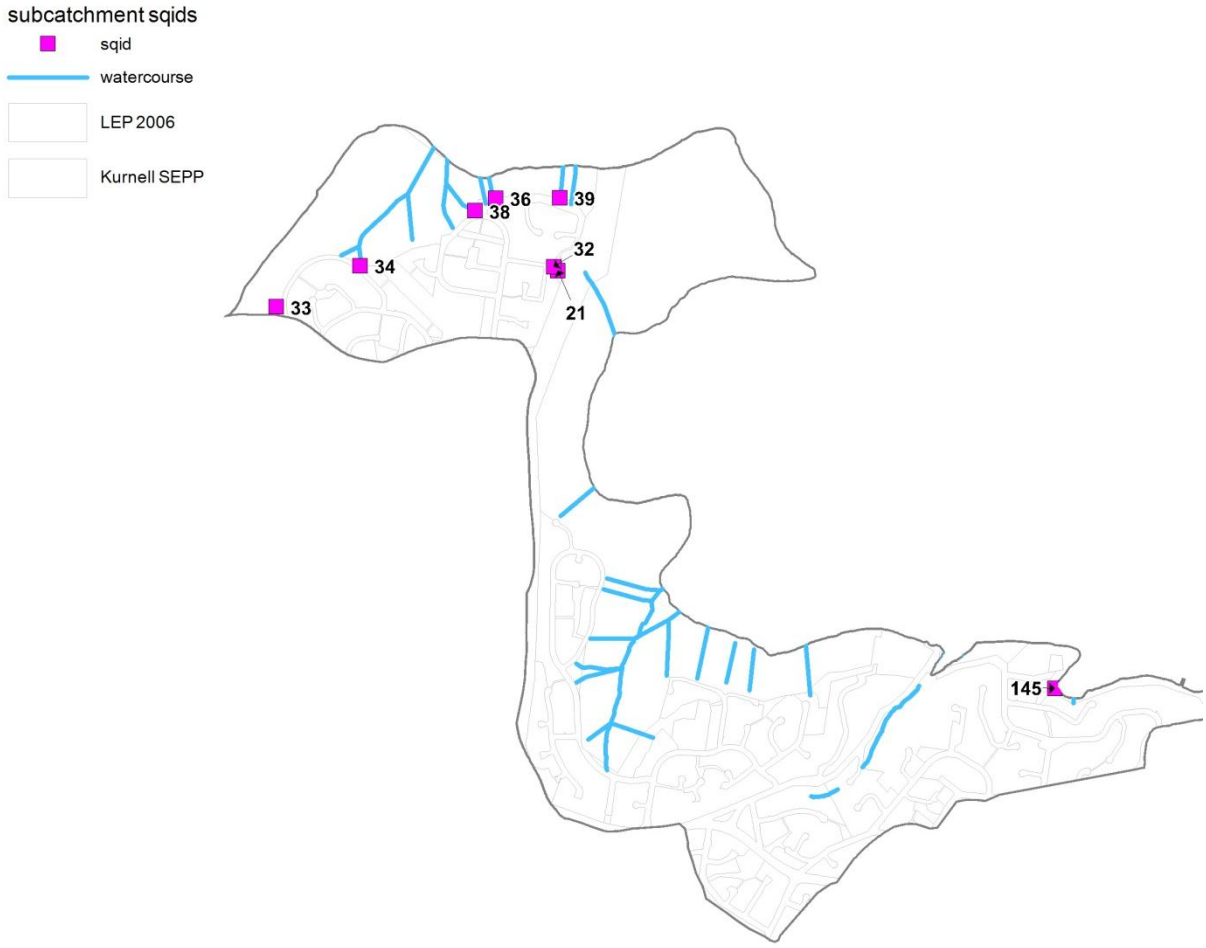
No sites sampled in this subcatchment

RETICULATED STORMWATER SYSTEM



LOCATION OF SQIDS

ID	DEVICE CATEGORY	DEVICE TYPE	LOCATION	SITE DESCRIPTION	SUBURB	APPROX. CATCHMENT
21	GPT - Other	Silt Trap	Cameron Place	Bushland	Illawong	0.02 Ha
32	GPT - Other	Silt Trap	Marlock Place	Bushland	Illawong	4 Ha
34	GPT - Other	Silt Trap	Moonah Road	Bushland	Alfords Point	4.4 Ha
36	GPT - Other	Silt Trap	Stringybark Place	Bushland	Alfords Point	0.4 Ha
38	GPT - Other	Silt Trap	Casuarina Road	Stringybark Place (at entrance)	Alfords Point	1 Ha
39	GPT - Other	Silt Trap	Stringybark Place	Bushland	Alfords Point	2.1 Ha
145	GPT - Other	Silt Trap	Burley Close	Public open space	Illawong	19.5 Ha



GEOMORPHIC SETTING

GEOLOGY, GEOMORPHOLOGY AND SOILS

Great Moon Bay subcatchment soil landscapes include Hawkesbury Soil Landscape (ha) along foreshores, and the remainder of the subcatchment soils are all Lucas Heights Soil Landscape (lh) (from Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet Map and Report; see summary explanations in Geology and Soils section for Georges River catchment).

TOPOGRAPHY

This subcatchment has steep foreshores along a lengthy river frontage, rising quickly to 25m AHD. Further inland is a large plateau area with an altitude above 80m AHD, rising to the highest point of 89m on the southern boundary.

ASS/PASS, URBAN SALINITY

LEP (00 &06) CLASS	HECTARES
CLASS 1	2.05
CLASS 2	6.89
CLASS 5	251.4

Several very small areas of Class 1 and 2 ASS are found in isolated patches along the river foreshores, while the Class 5 ASS is in a band directly behind the foreshores, and inland to 300m.

OTHER CONTAMINATION ISSUES

None noted

LAND USE

HISTORIC LAND USE

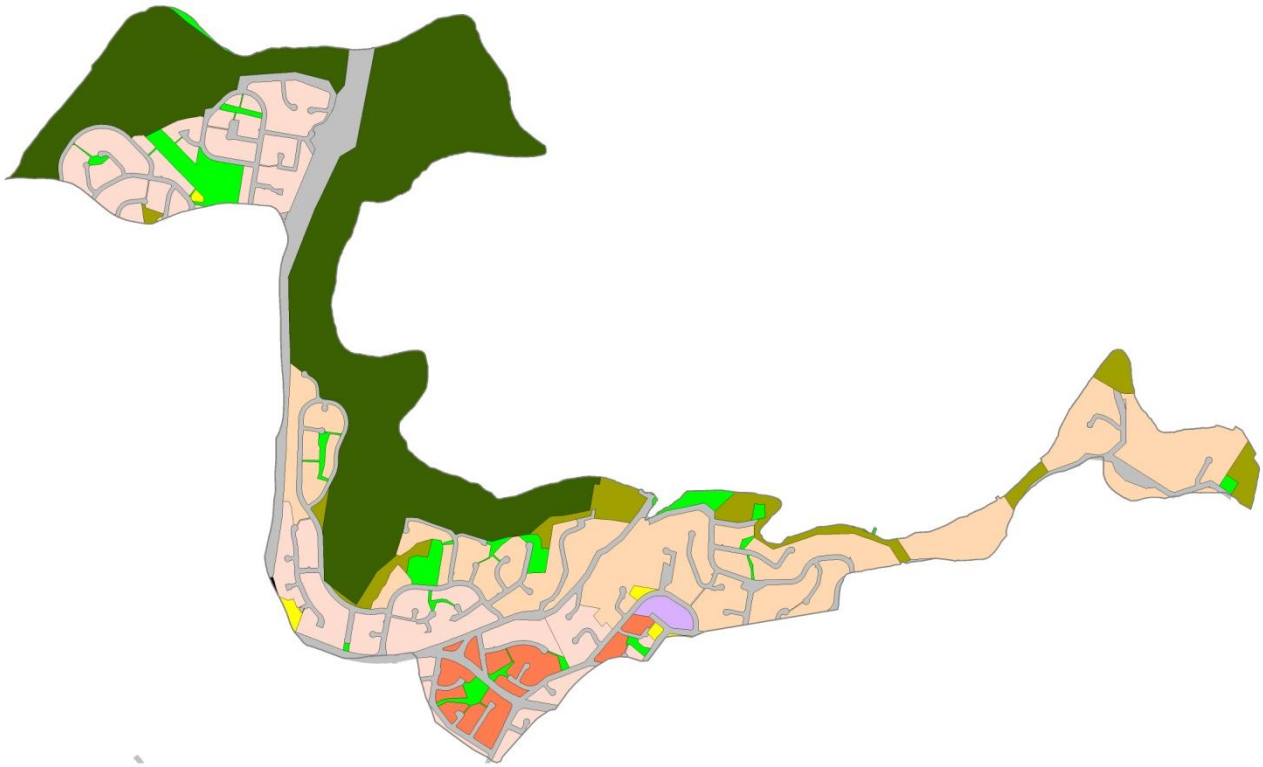
Alfords Point incorporates the western portion of Great Moon Bay subcatchment, while the eastern portion drains the western side of Illawong. The Alfords Point area, opposite the mouth of Salt Pan Creek, was recognised as one of the most important aboriginal meeting places in the Sydney basin. It was the site for arranging marriages, punishments and other ceremonies. Food was readily available, and blankets and clothing were later distributed to the indigenous people from this location.

Alfords Point was named for the early settler, James Alford, who was granted 20 hectares. James was brother to John Alford who received the land at nearby Sandy Point. Early settlers used a walking track made by local aboriginal people that stretched from present day Sydney to Salt Pan Creek. Alfords Point was one of the last areas of Sutherland Shire to become developed. The small community was isolated and surrounded by bushland, and an early priority was the formation of a local fire brigade in 1953.

In 1973 the Alfords Point bridge was opened, creating a major road linkage to the western part of Sutherland Shire, and opening this area for major development. In 1983 the Alfords Point Estate offered 1000 home sites in a planned subdivision that sought to retain much of the bushland around the Georges River and local creeks. After a heated battle a three kilometre stretch of land along the Georges River between Illawong and Sandy Point was transferred from the Department of Defence to National Parks and Wildlife Service to become part of the Georges River National Park.

The opening of the Alfords Point Bridge, and the more recent construction of the Bangor Bypass has seen suburbs in this area continue to grow. Judicious planning has meant that reasonable buffer zones of natural bushland have been retained around many of the waterways in the area, with positive benefits for the health of local streams and Georges River. Extensive bushland corridors

CURRENT LAND USE



ZONING CLASS LEP 2006

- Aquatic Reserves
- Arterial Road
- Deferred Matter
- Employment
- Environmental Housing Bushland
- Environmental Housing Scenic Quality
- Environmental Housing Sensitive Land
- Environmental Protection Low Impact Rural
- Environmental Protection Water Catchment
- Environmental Protection Waterways
- Excluded
- Local Centre
- Local Housing
- Mixed Use Kirrawee
- Multiple Dwelling A
- Multiple Dwelling B
- National Park Reserve and Recreation Area
- Neighbourhood Centre
- Private Recreation
- Public Open Space
- Public Open Space Bushland
- Railway
- Road
- Special Uses
- Transport Reservation
- Urban Centre

CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	0.07	0%	0%	0.00
Environmental Housing Sensitive Land	66.70	22%	43%	28.68
Environmental Housing Scenic Quality	0.00	0%	57%	0.00
Environmental Housing Bushland	45.45	15%	57%	25.91
Local Housing	8.81	3%	51%	4.49
Multiple Dwelling A	0.00	0%	64%	0.00
Multiple Dwelling B	0.00	0%	64%	0.00
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	0.00	0%	94%	0.00
Local Centre	1.56	1%	88%	1.37
Neighbourhood Centre	0.00	0%	86%	0.00
Employment	0.00	0%	95%	0.00
Special Uses	1.23	0%	30%	0.37
Public Open Space	11.49	4%	5%	0.57
Public Open Space Bushland	13.66	5%	0%	0.00
Private Recreation	0.00	0%	5%	0.00
Environmental Protection Waterways	0.51	0%	0%	0.00
Aquatic Reserves	0.00	0%	0%	0.00
National Park Reserve and Recreation Area	104.32	35%	0%	0.00
Railway	0.00	0%	33%	0.00
Arterial Road/Road	48.30	16%	66%	31.88
Transport Reservation	0.00	0%	5%	0.00
TOTALS	302.09	100%	31%	93.27

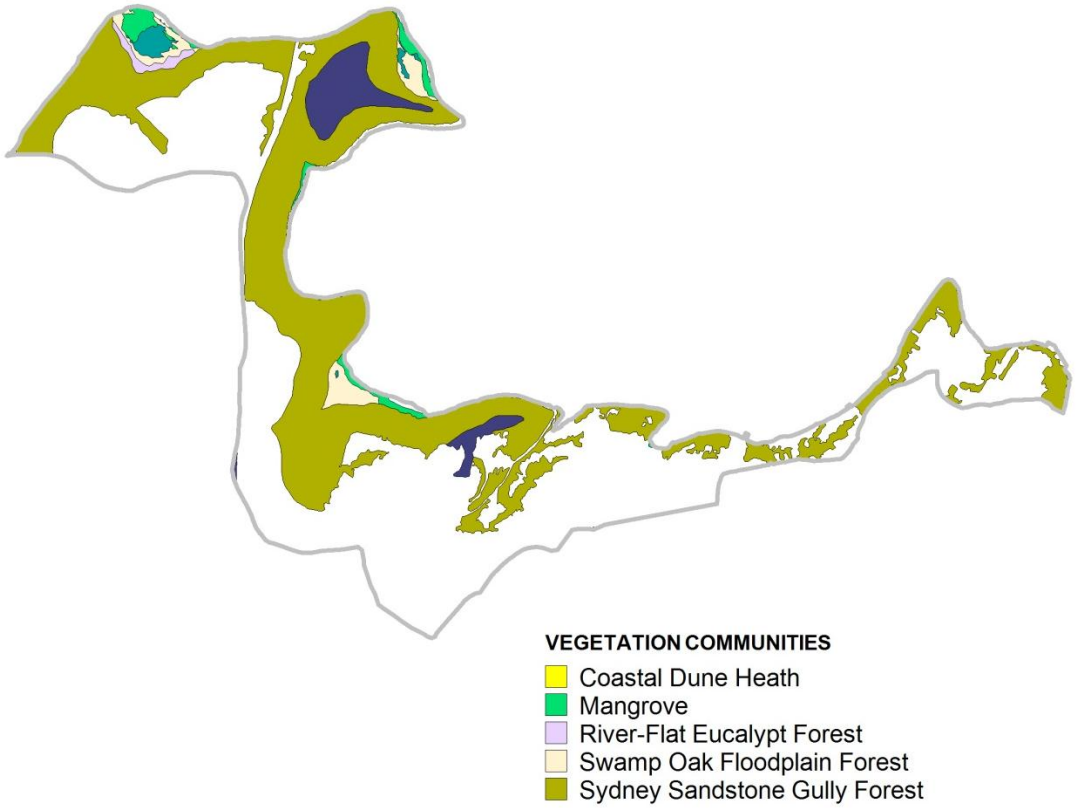
VEGETATION COMMUNITIES

MAPPED VEGETATION COMMUNITIES

2.07 HECTARES COASTAL SALTMARSH
5.03 HECTARES MANGROVE
1.42 HECTARES RIVER-FLAT EUCALYPT FOREST
5.76 HECTARES SWAMP OAK FLOODPLAIN FOREST
113.02 HECTARES SYDNEY SANDSTONE GULLY FOREST
11.57 HECTARES SYDNEY SANDSTONE RIDGETOP WOODLAND

LEP 2006 SIGNIFICANT VEGETATION

NIL



BUSHLAND RESERVES AND RESTORATION

Reserves

1) Greenweb Core areas

- Georges River National Park
- Georges River foreshores below Fowler Rd
- Foreshores around Weame Bay (Griffin Pde/Clough Ave)

2) Greenweb Support areas

- Fowler Rd/Bignell St/Cranbrook St
- Griffin Pde/Burley Cl/Clough Ave
- Regent Place
- Palmer Close
- Heritage Drive
- Maxwell Close

3) Greenweb Restoration areas

- Charlotte Pl/Old Ferry Rd/Hobart Pl/Bataan Cl/Lara Cl/Ocean Pl/Brisbane St/Fowler Rd

Bushcare Groups

- Louden Avenue Road Reserve
- Batavia Place Reserve

THREATENING PROCESSES

INSTREAM IMPACTS

- Loss of riparian habitat
- Degradation of riparian habitat
- Loss of emergent vegetation
- Removal of large woody debris
- Loss or reduction of allochthonous material as a stream input
- Loss or reduction of shading of stream
- Changes to the proportion of catchment impervious surface
- Changes to infiltration patterns
- Construction of dams and other impediments to flow
- Draining of wetland areas
- Channelization
- Modification of channel bedform
- Modification of bank configuration
- Pipe replacement of channel
- Erosion
- Sedimentation
- Point source pollution
- Non-point (diffuse) source pollution
- Increased nutrient loads
- Introduction of toxic compounds
- Introduction of oils and organobenzenes
- Introduction of herbicides and pesticides in runoff
- Reduction of light penetration
- Algal bloom
- Emergent aquatic weeds
- Floating aquatic weeds
- Change in temperature regime
- Barriers to fish passage
- Change to hydrological flow regimes

- Change to pH through mobilisation of ASS/PASS
- Stormwater deposition of litter
- Dumping of rubbish
- Increased allocthonous inputs immediately following fire or clearing
- Increased peak discharges associated with storm flows
- Decreased baseflows
- Diseases from untreated or poorly treated sewage
- Reduction in water through extraction
- Introduction of invasive species including
    - Gambusia
    - Carp
    - Cane Toads
    - Koi Carp (goldfish)

RIPARIAN IMPACTS

- Invasion by weeds
- Loss of species through replacement by others
- Loss of diversity (reduction in species numbers)
- Loss of habitat quality
- Disturbance from pedestrian access
- Disturbance from vehicle access
- Disturbance from excessive use by stock or other animals
- Clearing of vegetation
- Deliberate introduction of exotic plant species
- Selective removal of vegetation including
    - Loss of canopy
    - Loss of shrub layer
    - Loss of groundcover species
- Removal of habitat elements including
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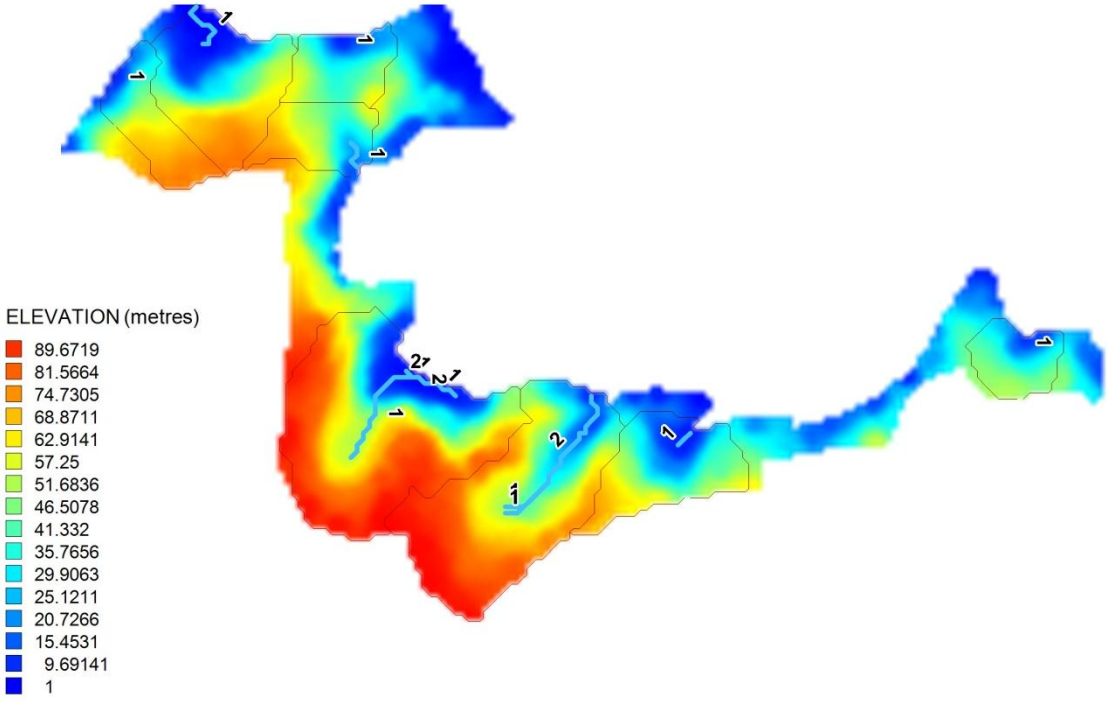
    - Loss of fallen timber
    - Loss of standing dead trees
    - Loss of rocks
    - Loss of microhabitat architecture
- Dumping of rubbish
- Littering
- Vandalism including
    - Damage to plants
    - Damage to abiotic habitat elements
    - Injured or killed animals
- Inappropriate fire regime
- Erosion

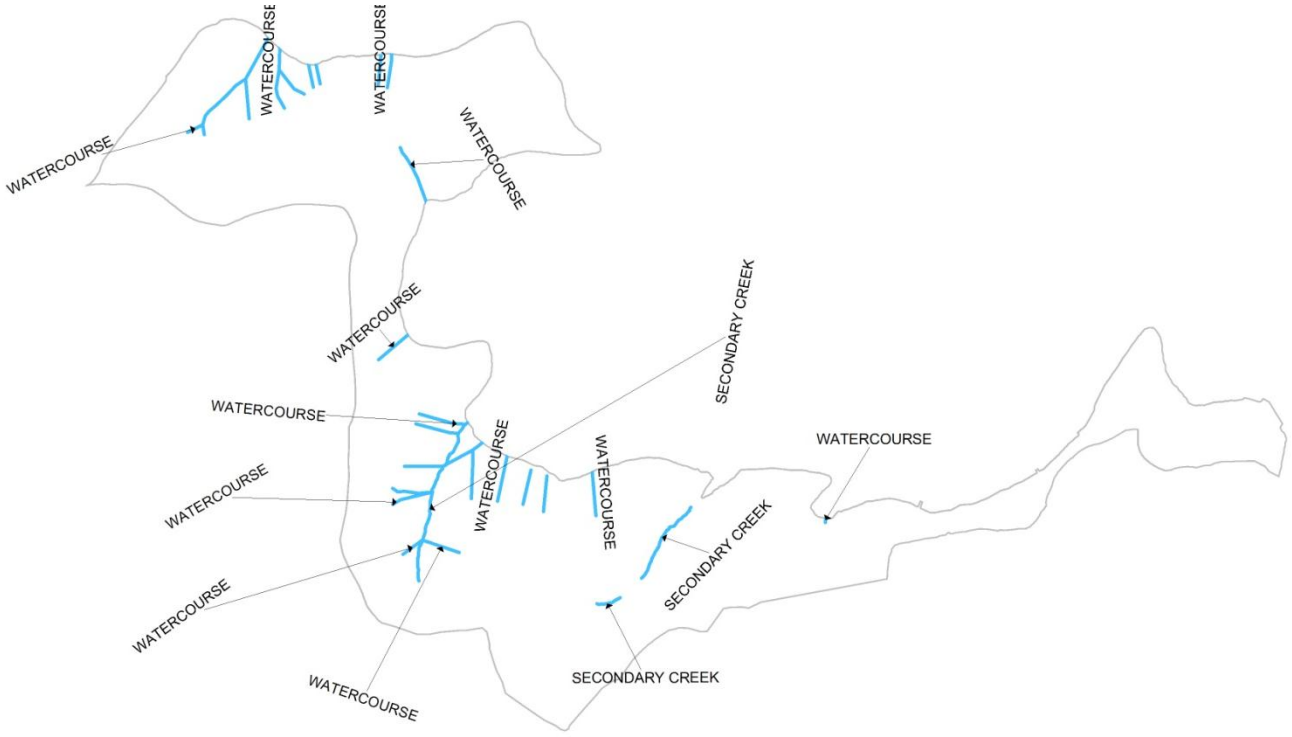
- Sedimentation
- Plant diseases including
    - Phytophthora (dieback)
    - Myrtle rust
    - Smut
    - Common rust
    - Mistletoes
- Feral animals including
    - Foxes
    - Rabbits
    - Deer
    - Cane Toads
    - Wild pigs
    - Feral cats
    - Introduced birds

RECREATED WATERWAYS MAP

CATCHMENT ELEVATION MODEL: STREAM ORDERS AND CATCHMENT BOUNDARIES



CURRENTLY MAPPED WATERWAYS AND CATCHMENT BOUNDARY

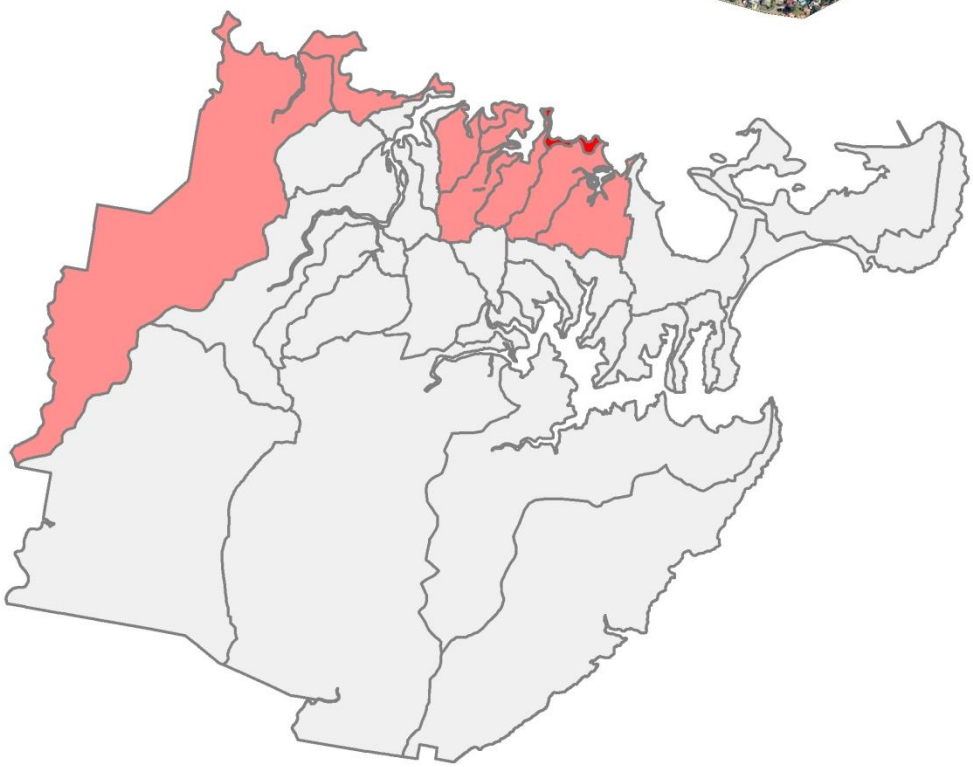


KANGAROO POINT SUBCATCHMENT

SUBCATCHMENT OVERVIEW

CATCHMENT AREA: 0.45 KM^2

SUBURBS: SYLVANIA



WATERWAYS

MAJOR NAMED WATERWAYS: NIL

TOTAL LENGTH OF MAPPED WATERWAYS: 0 KMs

PRIMARY ORDER CREEKS: 0 KMs

SECOND ORDER CREEKS: 0 KMs

OPEN DRAINS/MINOR DRAINAGE LINES: 0 KMs

WATER QUALITY ASSESSMENT

As part of their Strategic Water Quality Monitoring Plan, Sutherland Shire Council commenced monitoring water quality in a number of streams across the shire. Trends in water quality data collected from each stream were assessed and ranked against the ANZECC 2000 guidelines for recreational water quality in urban streams (SSC, 2004).

Samples were analysed summer and winter for between three and seven years at each site. This data has been interpreted here to give a brief historic summary of water quality in the subcatchment. First and last reported values for each parameter were assessed as higher (+) than the ANZECC 2000 guideline value, lower (-) than the guideline value, or equivalent (=) to the guideline value. The overall trend during the survey period was identified as increasing (↑) or decreasing (↓). This provides an indication whether management actions are having a positive effect on water quality, and whether further actions are required, for example, a parameter that exceeds the guideline value at the start of the survey period may still exceed it at the end of the period, but have shown significant improvements during the reporting period.

No sites sampled in this subcatchment

RETICULATED STORMWATER SYSTEM

LOCATION OF SQIDS

NIL IN CATCHMENT

GEOMORPHIC SETTING

GEOLOGY, GEOMORPHOLOGY AND SOILS

Kangaroo Point subcatchment soil landscapes are all Gymea Soil Landscape (gy) (from Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet Map and Report; see summary explanations in Geology and Soils section for Georges River catchment).

TOPOGRAPHY

Kangaroo Point subcatchment includes a low peninsula and foreshores with an altitude less than 20m. Highest point is in the southwestern corner of the subcatchment, at 34m AHD.

ASS/PASS, URBAN SALINITY

LEP (00 &06) CLASS	HECTARES
CLASS 5	44

All of Kangaroo Point and other foreshore areas have Class 5 ASS.

OTHER CONTAMINATION ISSUES

None noted

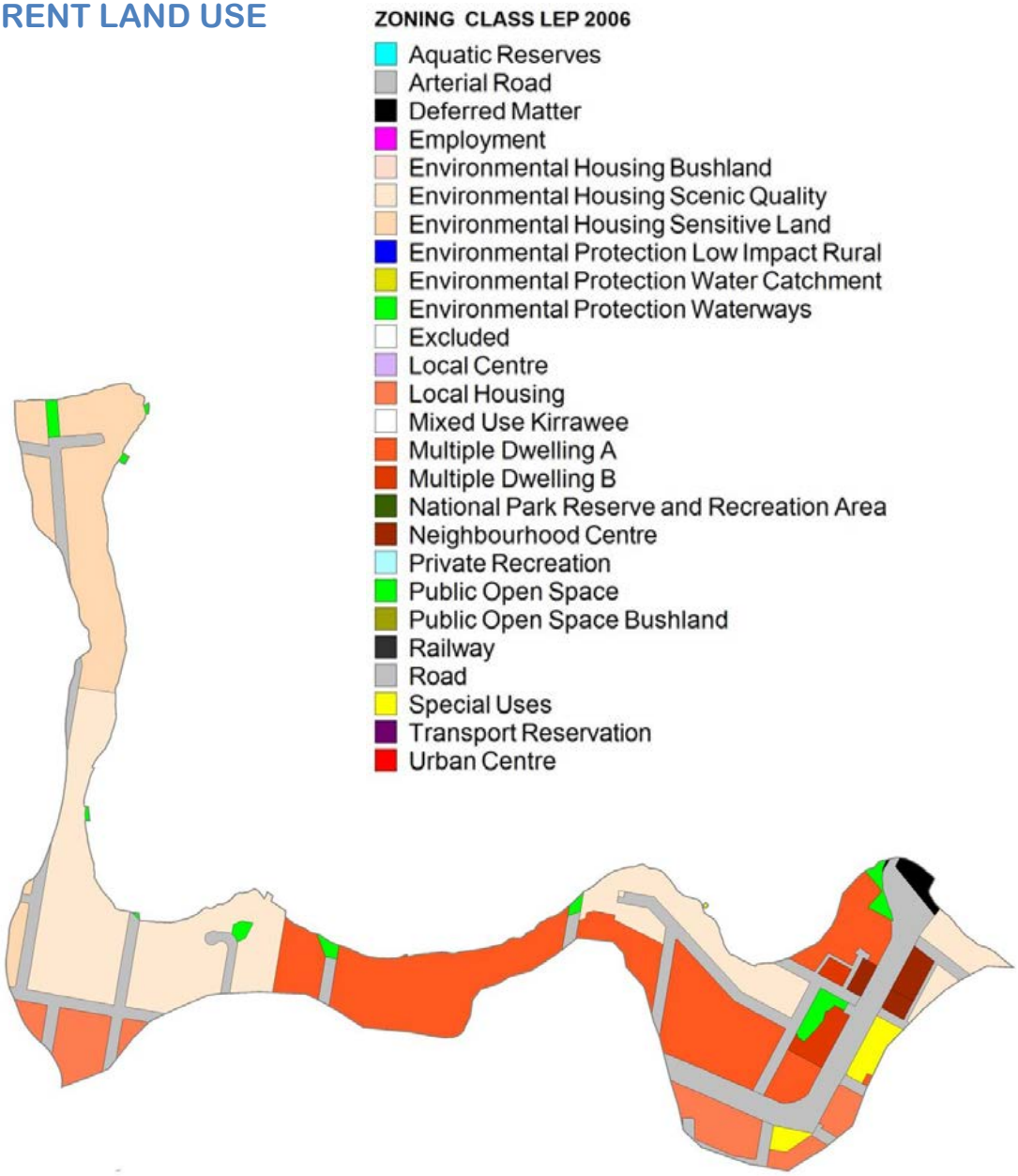
LAND USE

HISTORIC LAND USE

Development of Kangaroo Point was sporadic and lagged behind nearby areas such as Sylvania and Oyster Bay. In 1915 twelve waterfront lots were created along the foreshores. Twenty years later, complaints were still being made about the condition of the roads in the area. Scattered development took place until the 1950s when young families began to move to the area. By the early 1980s Kangaroo Point Rd was considered to be Sylvania's richest street (Lawrence, 1997), and soon after the area was declared a suburb in its own right. Due to greenbelt restrictions that were imposed in the 1950s, the area continues to retain much of its natural bushland, water views, native birds and animals, and prolific wildflowers in season.

Figure 3. Aerial photo of Kangaroo Point, July 1966.

CURRENT LAND USE



CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	0.31	1%	0%	0.00
Environmental Housing Sensitive Land	5.77	13%	43%	2.48
Environmental Housing Scenic Quality	12.38	28%	57%	7.06
Environmental Housing Bushland	0.00	0%	57%	0.00
Local Housing	3.25	7%	51%	1.66
Multiple Dwelling A	10.96	25%	64%	7.01
Multiple Dwelling B	0.64	1%	64%	0.41
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	0.00	0%	94%	0.00
Local Centre	0.00	0%	88%	0.00
Neighbourhood Centre	0.68	2%	86%	0.58
Employment	0.00	0%	95%	0.00
Special Uses	0.70	2%	30%	0.21
Public Open Space	0.84	2%	5%	0.04
Public Open Space Bushland	0.00	0%	0%	0.00
Private Recreation	0.00	0%	5%	0.00
Environmental Protection Waterways	0.08	0%	0%	0.00
Aquatic Reserves	0.00	0%	0%	0.00
National Park Reserve and Recreation Area	0.00	0%	0%	0.00
Railway	0.00	0%	33%	0.00
Arterial Road/Road	9.07	20%	66%	5.98
Transport Reservation	0.00	0%	5%	0.00
TOTALS	44.69	100%	57%	25.44

VEGETATION COMMUNITIES

MAPPED VEGETATION COMMUNITIES

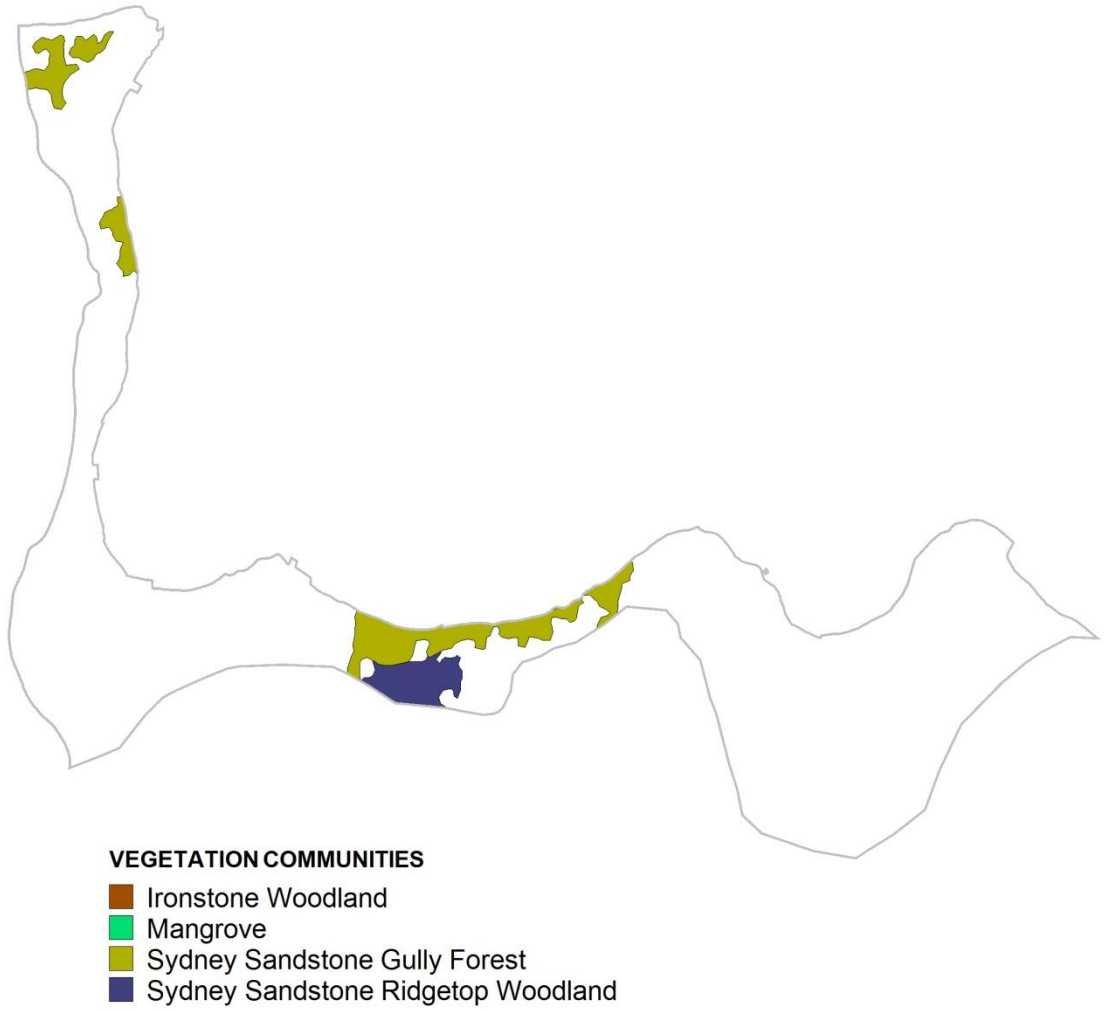
0.01 HECTARES MANGROVE

2.83 HECTARES SYDNEY SANDSTONE GULLY FOREST

0.92 HECTARES SYDNEY SANDSTONE RIDGETOP WOODLAND

LEP 2006 SIGNIFICANT VEGETATION

NIL



BUSHLAND RESERVES AND RESTORATION

Reserves

1) Greenweb Core areas

- Foreshore near Murralin Lane
- Princes Hwy near Correa St

2) Greenweb Support areas

- Tara St/Correa St

3) Greenweb Restoration areas

- Tara St/Leavesden Pl/Venetia St/Kangaroo Point Rd

Bushcare Groups

None noted

THREATENING PROCESSES

INSTREAM IMPACTS

- Loss of riparian habitat
- Degradation of riparian habitat
- Loss of emergent vegetation
- Removal of large woody debris
- Loss or reduction of allochthonous material as a stream input
- Loss or reduction of shading of stream
- Changes to the proportion of catchment impervious surface
- Changes to infiltration patterns
- Construction of dams and other impediments to flow
- Draining of wetland areas
- Channelization
- Modification of channel bedform
- Modification of bank configuration
- Pipe replacement of channel
- Erosion
- Sedimentation
- Point source pollution
- Non-point (diffuse) source pollution
- Increased nutrient loads
- Introduction of toxic compounds
- Introduction of oils and organobenzenes
- Introduction of herbicides and pesticides in runoff

- Reduction of light penetration
- Algal bloom
- Emergent aquatic weeds
- Floating aquatic weeds
- Change in temperature regime
- Barriers to fish passage
- Change to hydrological flow regimes
- Change to pH through mobilisation of ASS/PASS
- Stormwater deposition of litter
- Dumping of rubbish
- Increased allocthonous inputs immediately following fire or clearing
- Increased peak discharges associated with storm flows
- Decreased baseflows
- Diseases from untreated or poorly treated sewage
- Reduction in water through extraction
- Introduction of invasive species including
    - Gambusia
    - Carp
    - Cane Toads
    - Koi Carp (goldfish)

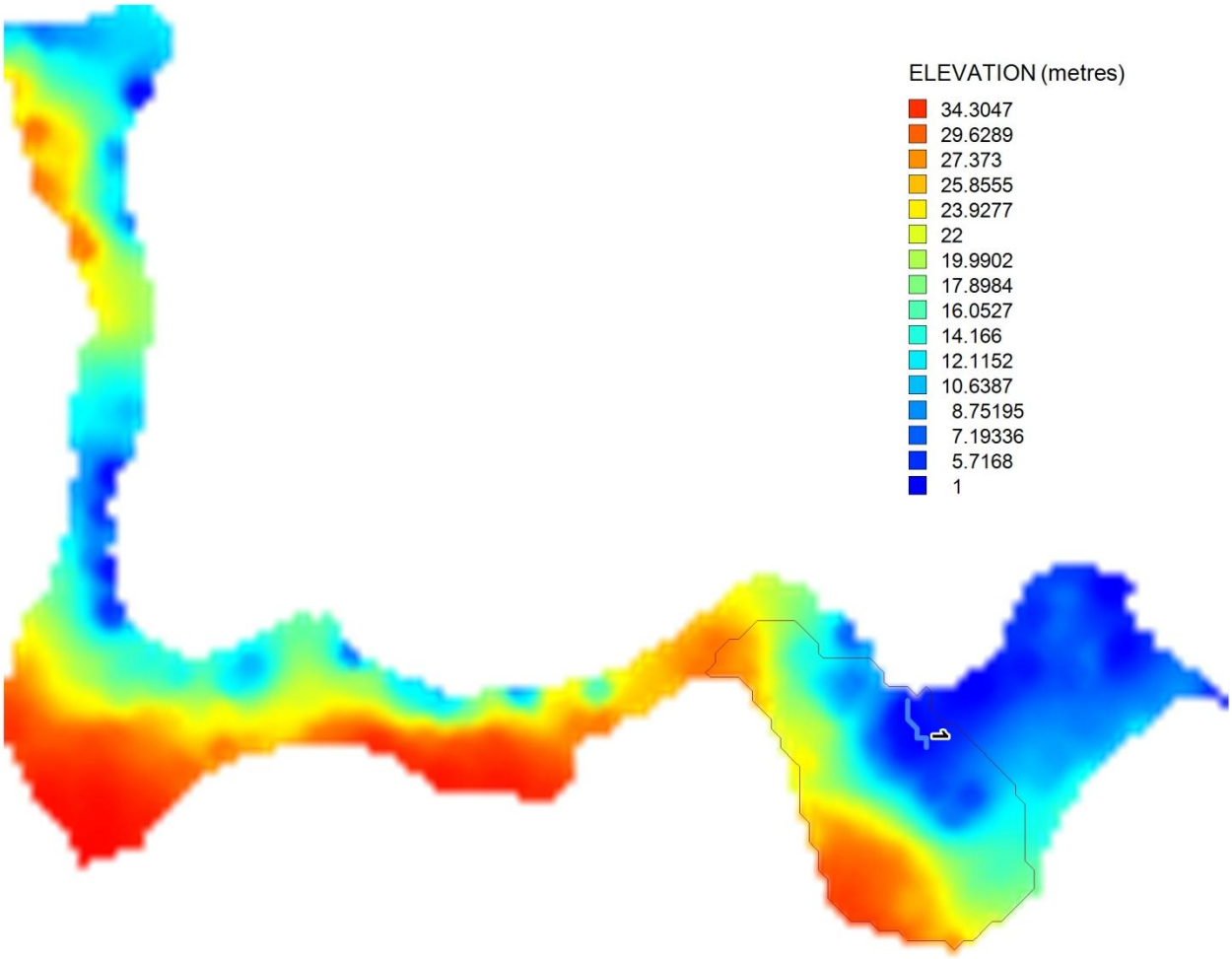
RIPARIAN IMPACTS

- Invasion by weeds
- Loss of species through replacement by others
- Loss of diversity (reduction in species numbers)
- Loss of habitat quality
- Disturbance from pedestrian access
- Disturbance from vehicle access
- Disturbance from excessive use by stock or other animals
- Clearing of vegetation
- Deliberate introduction of exotic plant species
- Selective removal of vegetation including
    - Loss of canopy
    - Loss of shrub layer
    - Loss of groundcover species
- Removal of habitat elements including
    - Loss of leaf litter
    - Loss of fallen timber
    - Loss of standing dead trees
    - Loss of rocks
    - Loss of microhabitat architecture
- Dumping of rubbish

- Littering
- Vandalism including
    - Damage to plants
    - Damage to abiotic habitat elements
    - Injured or killed animals
- Inappropriate fire regime
- Erosion
- Sedimentation
- Plant diseases including
    - Phytophthora (dieback)
    - Myrtle rust
    - Smut
    - Common rust
    - Mistletoes
- Feral animals including
    - Foxes
    - Rabbits
    - Deer
    - Cane Toads
    - Wild pigs
    - Feral cats
    - Introduced birds

RECREATED WATERWAYS MAP

CATCHMENT ELEVATION MODEL: STREAM ORDERS AND CATCHMENT BOUNDARIES

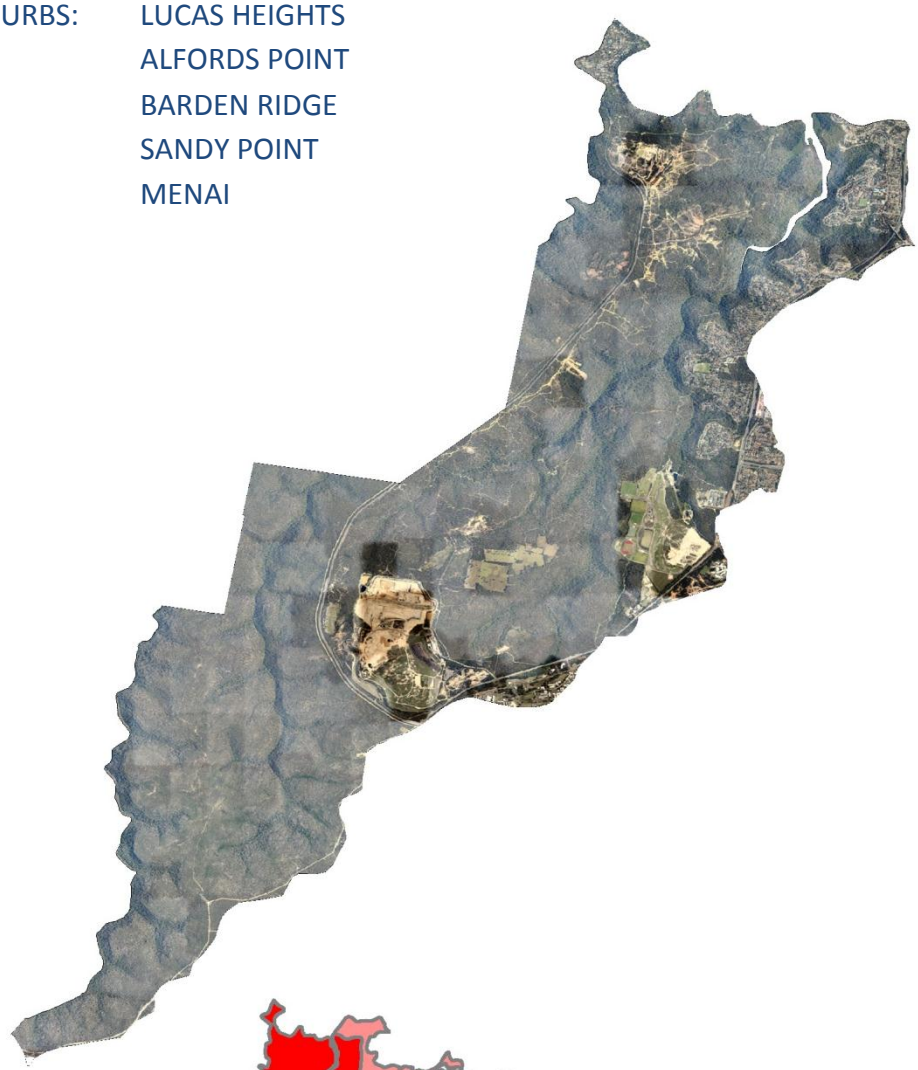


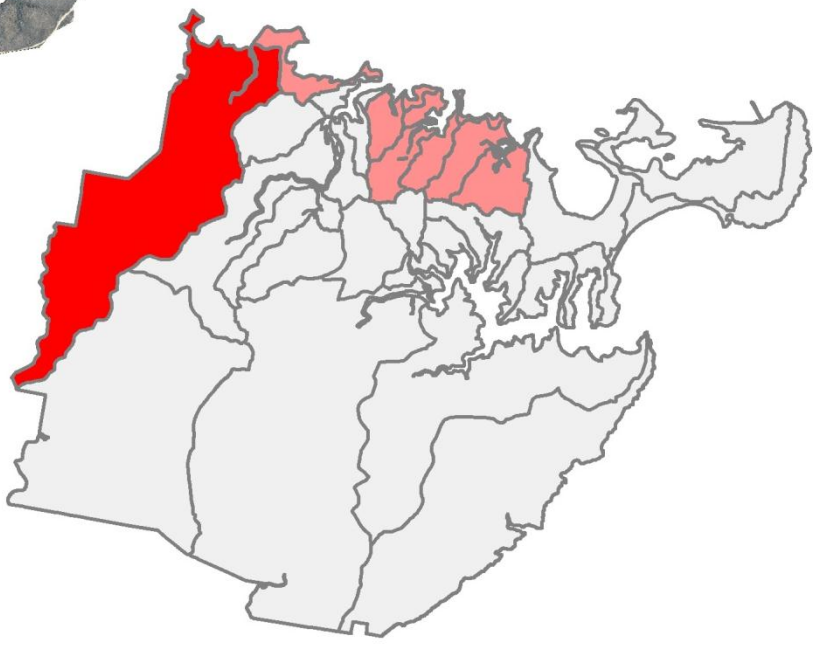
MILL CREEK SUBCATCHMENT

SUBCATCHMENT OVERVIEW

CATCHMENT AREA:

SUBURBS: LUCAS HEIGHTS
ALFORDS POINT
BARDEN RIDGE
SANDY POINT
MENAI





WATERWAYS

MAJOR NAMED WATERWAYS: MILL CREEK

BARDENS CREEK

DEADMANS CREEK

TOTAL LENGTH OF MAPPED WATERWAYS: 31.78 KMs

PRIMARY ORDER CREEKS: 0.09 KMs

SECOND ORDER CREEKS: 22.24 KMs

OPEN DRAINS/MINOR DRAINAGE LINES: 9.45 KMs

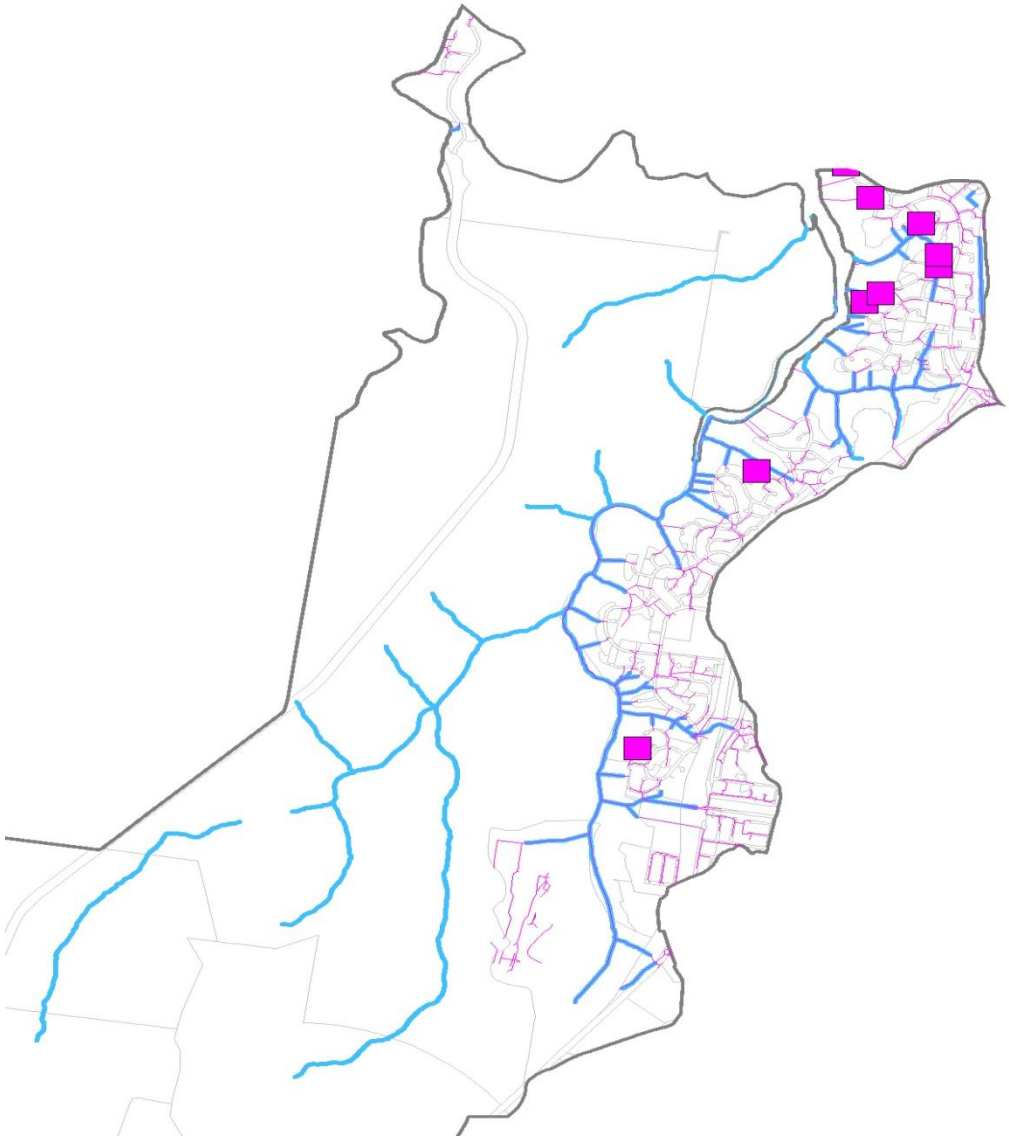
WATER QUALITY ASSESSMENT

As part of their Strategic Water Quality Monitoring Plan, Sutherland Shire Council commenced monitoring water quality in a number of streams across the shire. Trends in water quality data collected from each stream were assessed and ranked against the ANZECC 2000 guidelines for recreational water quality in urban streams (SSC, 2004).

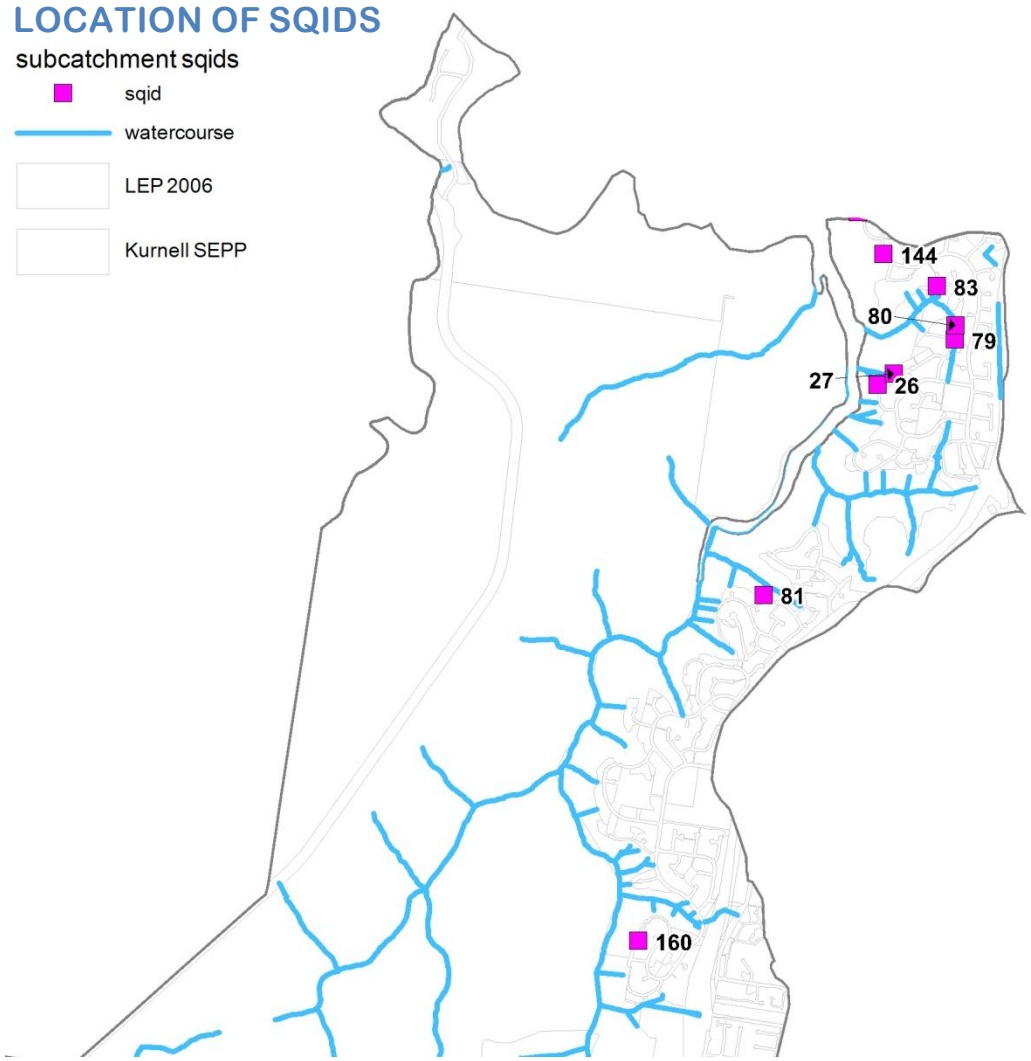
Samples were analysed summer and winter for between three and seven years at each site. This data has been interpreted here to give a brief historic summary of water quality in the subcatchment. First and last reported values for each parameter were assessed as higher (+) than the ANZECC 2000 guideline value, lower (-) than the guideline value, or equivalent (=) to the guideline value. The overall trend during the survey period was identified as increasing (↑) or decreasing (↓). This provides an indication whether management actions are having a positive effect on water quality, and whether further actions are required, for example, a parameter that exceeds the guideline value at the start of the survey period may still exceed it at the end of the period, but have shown significant improvements during the reporting period.

No sites sampled in this subcatchment

RETICULATED STORMWATER SYSTEM



LOCATION OF SQIDS



ID	DEVICE CATEGORY	DEVICE TYPE	LOCATION	SITE DESCRIPTION	SUBURB	APPROX. CATCHMENT
26	GPT - Other	Silt Trap	Lavender Place	Bushland	Alfords Point	1.4 Ha
27	GPT - Other	Silt Trap	Lavender Place	Bushland	Alfords Point	4.7 Ha
79	GPT - Other	Silt Trap	Needlebrush Close	Opposite Tamarind Place	Alfords Point	10.2 Ha
80	GPT - Other	Silt Trap	Needlebrush Close	Bushland	Alfords Point	0.7 Ha
81	GPT - Other	Silt Trap	Court Place	Bushland	Menai	1.3 Ha
83	GPT - Other	Silt Trap	Yorrel Close	Corner of Bottlebrush Place	Alfords Point	1.3 Ha
144	GPT - Other	Silt Trap	Brushwood Drive	Bushland	Alfords Point	1.5 Ha
160	GPT	Enviropod Stormfilter	Windle Place		Menai	2.4 Ha

GEOMORPHIC SETTING

GEOLOGY, GEOMORPHOLOGY AND SOILS

Mill Creek subcatchment soil landscapes include Hawkesbury Soil Landscape (ha) along foreshores and drainage lines, and the remainder of the subcatchment soils are Lucas Heights Soil Landscape (lh), with some areas of Disturbed Terrain Soil Landscape (xx) around Little Forest and towards Lucas Heights (from Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet Map and Report; see summary explanations in Geology and Soils section for Georges River catchment).

TOPOGRAPHY

Mill Creek is the largest subcatchment on Georges River. It includes multiple drainage lines where surrounding land rises quickly to 85m AHD, and large plateau areas in the south with a maximum height of 168m AHD.

ASS/PASS, URBAN SALINITY

LEP (00 &06) CLASS	HECTARES
CLASS 1	3.42
CLASS 2	25.09
CLASS3	13.94
CLASS 5	504.90

Class 1, 2 and 3 ASS are located around lower drainage areas of Mill Creek, much of which is tidal. Class 5 ASS areas form a band around the foreshores of Georges River and Mill Creek to a distance of 300m.

OTHER CONTAMINATION ISSUES

None noted

LAND USE

HISTORIC LAND USE

Mill Creek subcatchment is the largest along Georges River and located at the upstream extent within Sutherland Shire. Much of the catchment drains bushland north of Lucas Heights and Barden Ridge, and parts of Holsworthy military reserve. Lucas Heights was named after John Lucas who received a grant of 60 hectares on the Woronora River in 1825. Lucas was a miller by trade, and built a water driven mill to grind grain grown by local farmers who delivered bags of grain via the Georges River or the Woronora River. In 1972 local residents voted to change the name of the suburb to Barden Ridge, after Alfred Barden, a butcher who moved to Bottle Forest from Hurstville around 1920 (Jackson, 2006).

Despite the name change, most people still know the area as Lucas Heights, famous for the nuclear reactor operated by ANSTO. The reactor has caused an enormous controversy since its construction in 1958, and is a key potential impact for the area. As a result, an exclusion zone of 1.6km was established around the reactor site, and this has retained the natural

bushland of the area. The main purpose of the reactor is for scientific research and production of medical isotopes, and it has won a number of national and international awards.

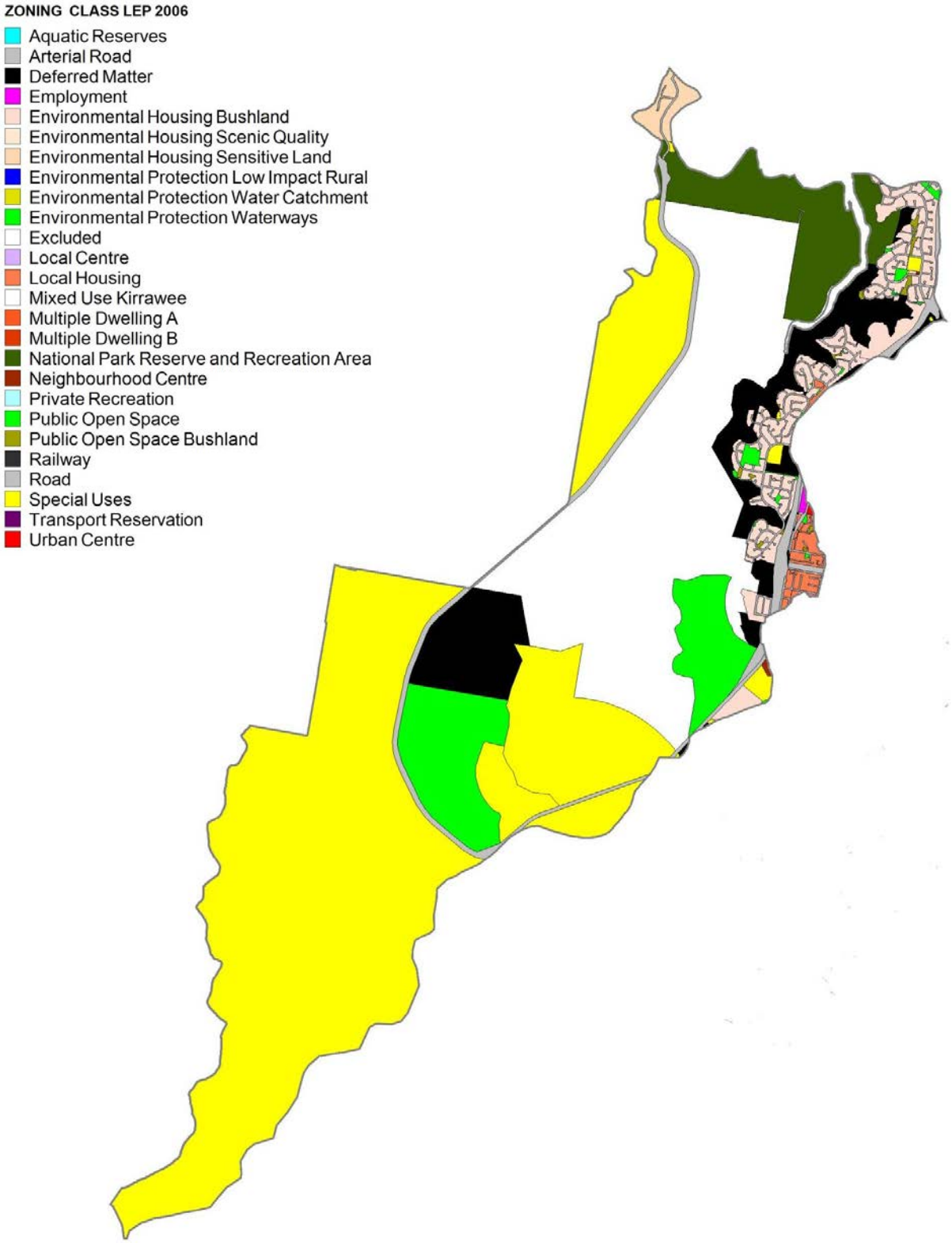
Sandy Point is at the western and upstream extent of the Mill Creek subcatchment. It was named after Matthew Flinders described it in 1795 as the only sandy point in a long stretch of the Georges River. Deadmans Creek nearby was originally known as Tudera Creek, which is aboriginal for “place of the many dead”, suggesting that the area was a burial ground or fighting ground (Jackson, 2006). There are many aboriginal sites remaining along this part of Georges River.

In 1821 John Alford was granted 24 hectares in the area, but died before taking up the land, and it was passed to Solomon Levey for a shilling in 1831. The demise of the local aboriginal population began with the construction of a dam across the Georges River at Liverpool, upstream from Sutherland Shire. The change in the flow of the river had a negative impact on the local environment, including the flora and fauna on which the aborigines survived. Subsequent industry polluted the water.

This part of the Georges River became popular with tourists in the 1890s, and they would visit the area by paddlewheel steamer. The steamer company owners developed a picnic area opposite Picnic Point and it was a popular destination into the early 20th century, although by 1910 tourist numbers were low and the park closed. In 1925 the Sandy Point Estate was established but sales were hindered by the absence of road access – at this time the only legal access was by water. Early homes were constructed without approval, generally from local timber and fibro shipped across from Picnic Point (Jackson, 2006).

The area was zoned as Green Belt and under the jurisdiction of Cumberland County Council at this time, but in 1954 it was transferred to Sutherland Council and the houses were allowed to stay. During the early 1950s locals organised road access to Heathcote Road, street lighting was established, and a public telephone was installed. In 1962 the water supply was connected to the area, and development began in earnest. The military base at Holsworthy owns much of the land surrounding Sandy Point, and this has helped to contain the development and retain a large area of natural bushland. As a result, much of the Mill Creek subcatchment is undeveloped today.

CURRENT LAND USE



CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	280.18	7%	0%	0.00
EXCLUDED	883.85	23%		0.00
Environmental Housing Sensitive Land	27.44	1%	43%	11.80
Environmental Housing Scenic Quality	0.00	0%	57%	0.00
Environmental Housing Bushland	167.52	4%	57%	95.49
Local Housing	25.94	1%	51%	13.23
Multiple Dwelling A	0.00	0%	64%	0.00
Multiple Dwelling B	0.00	0%	64%	0.00
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	0.75	0%	94%	0.71
Local Centre	0.00	0%	88%	0.00
Neighbourhood Centre	1.36	0%	86%	1.17
Employment	2.04	0%	95%	1.93
Special Uses	1795.21	47%	5%	89.76
Public Open Space	272.42	7%	5%	13.62
Public Open Space Bushland	5.89	0%	0%	0.00
Private Recreation	0.00	0%	5%	0.00
Environmental Protection Waterways	0.31	0%	0%	0.00
Aquatic Reserves	0.00	0%	0%	0.00
National Park Reserve and Recreation Area	205.63	5%	0%	0.00
Railway	0.00	0%	33%	0.00
Arterial Road/Road	166.66	4%	66%	109.99
Transport Reservation	0.00	0%	5%	0.00
TOTALS	**3835.19**	**100%**	**9%**	**337.70**

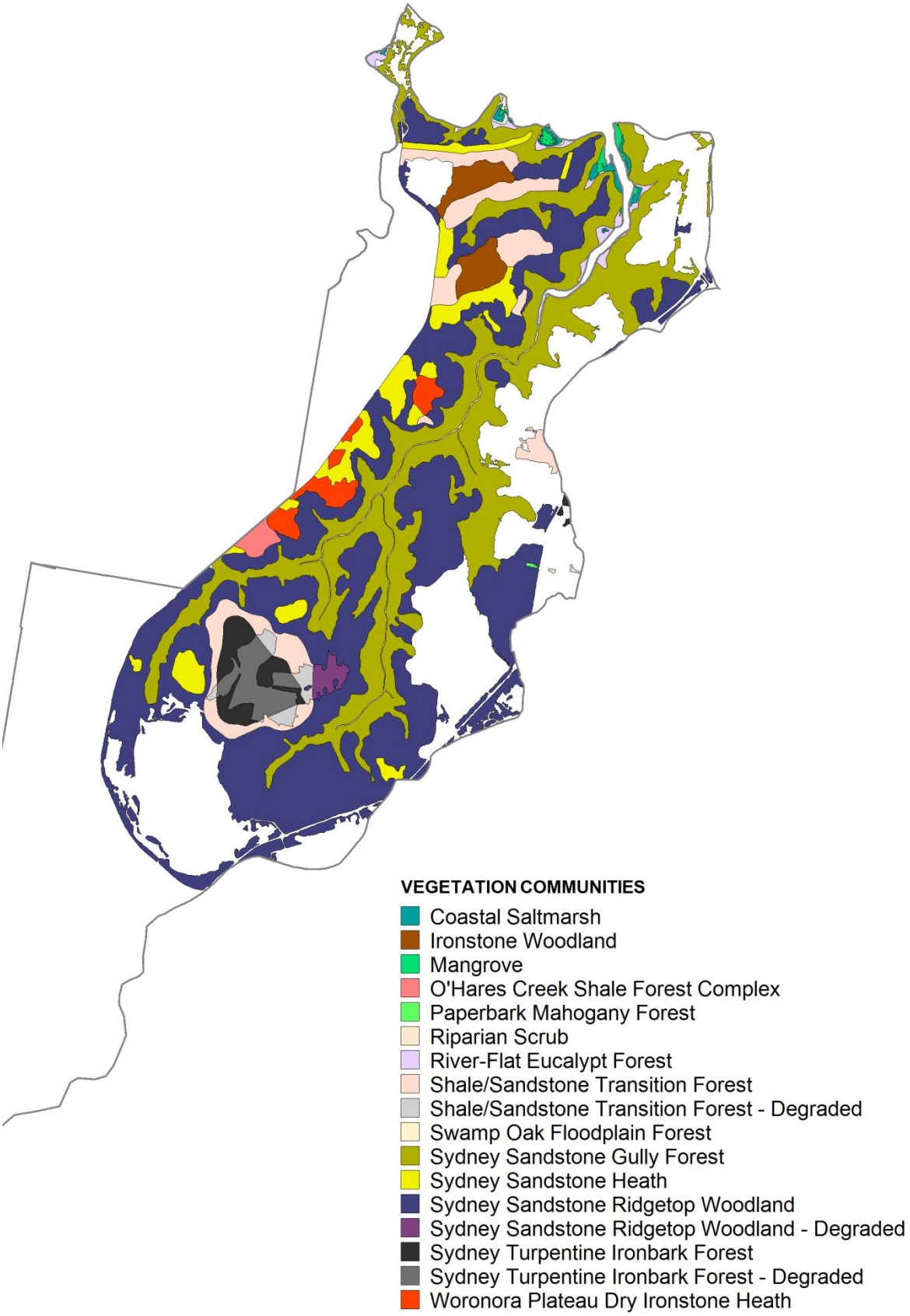
VEGETATION COMMUNITIES

MAPPED VEGETATION COMMUNITIES

8.99	HECTARES	COASTAL SALTMARSH
38.54	HECTARES	IRONSTONE WOODLAND
8.69	HECTARES	MANGROVE
14.77	HECTARES	O'HARES CREEK SHALE FOREST COMPLEX
0.38	HECTARES	PAPERBARK MAHOGANY FOREST
6.59	HECTARES	RIPARIAN SCRUB
14.77	HECTARES	RIVER-FLAT EUCALYPT FOREST
111.70	HECTARES	SHALE/SANDSTONE TRANSITION FOREST
12.58	HECTARES	SHALE/SANDSTONE TRANSITION FOREST - DEGRADED
2.22	HECTARES	SWAMP OAK FLOODPLAIN FOREST
532.60	HECTARES	SYDNEY SANDSTONE GULLY FOREST
95.74	HECTARES	SYDNEY SANDSTONE HEATH
776.14	HECTARES	SYDNEY SANDSTONE RIDGETOP WOODLAND
9.97	HECTARES	SYDNEY SANDSTONE RIDGETOP WOODLAND - DEGRADED
32.28	HECTARES	SYDNEY TURPENTINE IRONBARK FOREST
34.06	HECTARES	SYDNEY TURPENTINE IRONBARK FOREST - DEGRADED
31.98	HECTARES	WORONORA PLATEAU DRY IRONSTONE HEATH

LEP 2006 SIGNIFICANT VEGETATION

LEP TAG	NAME	CLASS
T5	Scattered Eucalyptus fibrosa_Ironbark	Significant Group of Trees or Vegetation
T4	Scattered Eucalyptus squamosa	Significant Group of Trees or Vegetation
T1	Scattered Eucalyptus maculata_Spotted Gum	Significant Group of Trees or Vegetation
T2	Angophora Costata X Bakerii	Significant Group of Trees or Vegetation


VEGETATION COMMUNITIES
Coastal Saltmarsh
Ironstone Woodland
Mangrove
O'Hares Creek Shale Forest Complex
Paperbark Mahogany Forest
Riparian Scrub
River-Flat Eucalypt Forest
Shale/Sandstone Transition Forest
Shale/Sandstone Transition Forest - Degraded
Swamp Oak Floodplain Forest
Sydney Sandstone Gully Forest
Sydney Sandstone Heath
Sydney Sandstone Ridgetop Woodland
Sydney Sandstone Ridgetop Woodland - Degraded
Sydney Turpentine Ironbark Forest
Sydney Turpentine Ironbark Forest - Degraded
Woronora Plateau Dry Ironstone Heath

BUSHLAND RESERVES AND RESTORATION

Reserves

1) Greenweb Core areas

- Georges River National Park
- Hall Drive Crown Reserve
- Heathcote National Park

2) Greenweb Support areas

- Kentia Place
- Moonah Rd
- Yorrel Cl/Melaleuca Pl/Paperbark Pl/Tamarind Pl/Blackwattle Pl
- Brushwood Dr/Angophora Pl
- Coachwood Cres/Royal Oak Dr/Angophora Pl
- Old Illawarra Rd/Alfords Point Rd/Monash Rd/Ferrier Dr
- Sedgeman Ave/Laver Ave/Hopman Ave/Bromwich Pl
- McKenzie Pl/Meckiff Cl
- Barnes Cres/Harvey Pl/Hall Dr/Barnes Cres/Buckle Reserve
- Landy Cres/Barry Rd
- New Illawarra Rd/Old Illawarra Rd
- Hall Dr/Windle Pl/Gould Pl
- Timbrey Circ/Ella Ave/Foster St/Nicholls Pde/Bonner Pl
- Recreation Drive
- Little Forest Road
- New Illawarra Rd/Heathcote Rd

3) Greenweb Restoration areas

- Casuarina Oval
- Old Illawarra Rd

Bushcare Groups

- Stringybark Place Reserve
- Mill Creek Crown Reserve
- Hall Drive Crown Reserve

THREATENING PROCESSES

INSTREAM IMPACTS

- Loss of riparian habitat
- Degradation of riparian habitat
- Loss of emergent vegetation

- Removal of large woody debris
- Loss or reduction of allochthonous material as a stream input
- Loss or reduction of shading of stream
- Changes to the proportion of catchment impervious surface
- Changes to infiltration patterns
- Construction of dams and other impediments to flow
- Draining of wetland areas
- Channelization
- Modification of channel bedform
- Modification of bank configuration
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- Erosion
- Sedimentation
- Point source pollution
- Non-point (diffuse) source pollution
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- Introduction of herbicides and pesticides in runoff
- Reduction of light penetration
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- Emergent aquatic weeds
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- Change in temperature regime
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- Change to hydrological flow regimes
- Change to pH through mobilisation of ASS/PASS
- Stormwater deposition of litter
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- Increased peak discharges associated with storm flows
- Decreased baseflows
- Diseases from untreated or poorly treated sewage
- Reduction in water through extraction
- Introduction of invasive species including
    - Gambusia
    - Carp
    - Cane Toads
    - Koi Carp (goldfish)

RIPARIAN IMPACTS

- Invasion by weeds

- Loss of species through replacement by others
- Loss of diversity (reduction in species numbers)
- Loss of habitat quality
- Disturbance from pedestrian access
- Disturbance from vehicle access
- Disturbance from excessive use by stock or other animals
- Clearing of vegetation
- Deliberate introduction of exotic plant species
- Selective removal of vegetation including
    - Loss of canopy
    - Loss of shrub layer
    - Loss of groundcover species
- Removal of habitat elements including
    - Loss of leaf litter
    - Loss of fallen timber
    - Loss of standing dead trees
    - Loss of rocks
    - Loss of microhabitat architecture
- Dumping of rubbish
- Littering
- Vandalism including
    - Damage to plants
    - Damage to abiotic habitat elements
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- Inappropriate fire regime
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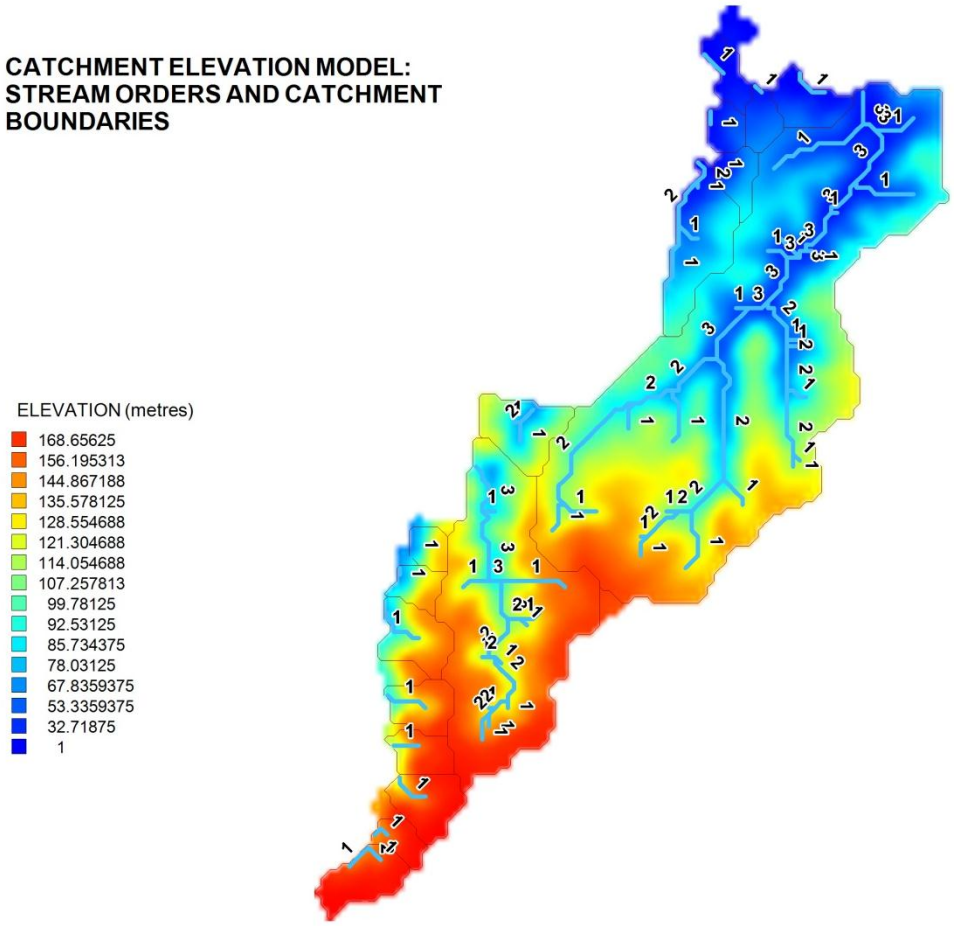
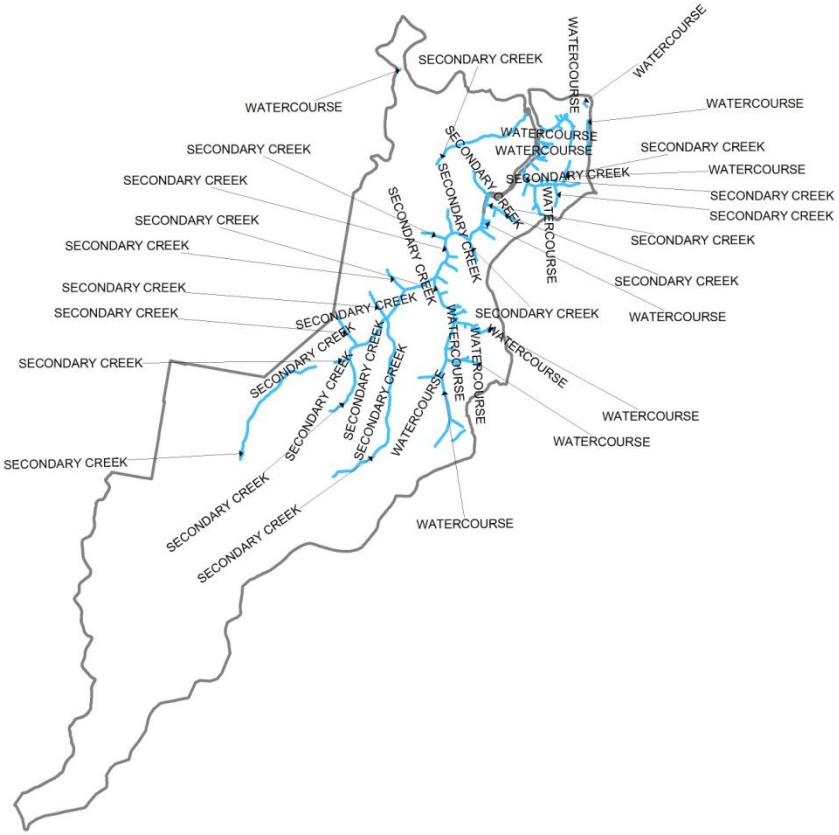
- Sedimentation
- Plant diseases including
    - Phytophthora (dieback)
    - Myrtle rust
    - Smut
    - Common rust
    - Mistletoes
- Feral animals including
    - Foxes
    - Rabbits
    - Deer
    - Cane Toads
    - Wild pigs
    - Feral cats
    - Introduced birds

RECREATED WATERWAYS MAP

CATCHMENT ELEVATION MODEL: STREAM ORDERS AND CATCHMENT BOUNDARIES



CURRENTLY MAPPED WATERWAYS AND CATCHMENT BOUNDARIES

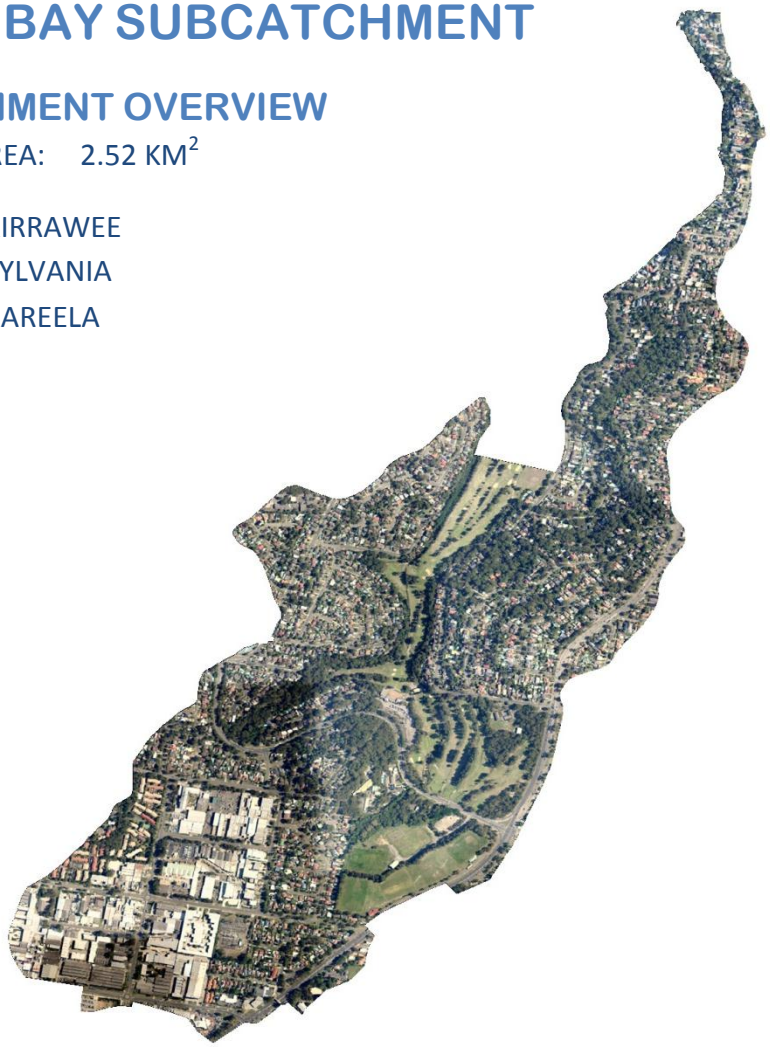


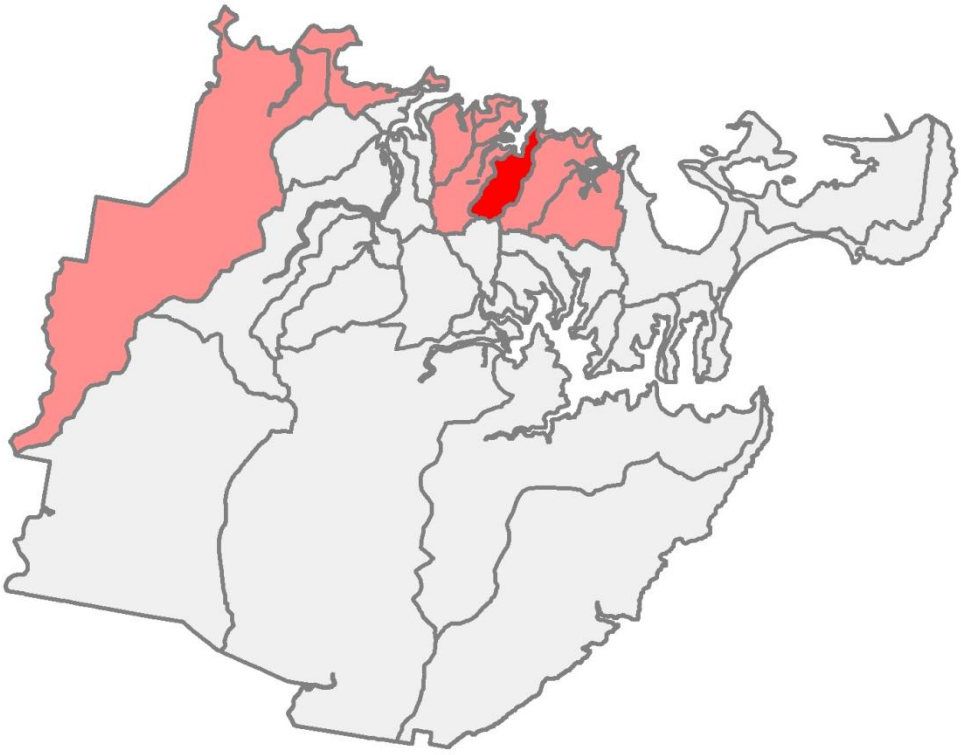
OYSTER BAY SUBCATCHMENT

SUBCATCHMENT OVERVIEW

CATCHMENT AREA: 2.52 KM^2

SUBURBS: KIRRAWEE
SYLVANIA
KAREELA





WATERWAYS

MAJOR NAMED WATERWAYS:

TOTAL LENGTH OF MAPPED WATERWAYS: 3.02 KMs

PRIMARY ORDER CREEKS: 0 KMs

SECOND ORDER CREEKS: 1.39 KMs

OPEN DRAINS/MINOR DRAINAGE LINES: 1.63 KMs

WATER QUALITY ASSESSMENT

As part of their Strategic Water Quality Monitoring Plan, Sutherland Shire Council commenced monitoring water quality in a number of streams across the shire. Trends in water quality data collected from each stream were assessed and ranked against the ANZECC 2000 guidelines for recreational water quality in urban streams (SSC, 2004).

Samples were analysed summer and winter for between three and seven years at each site. This data has been interpreted here to give a brief historic summary of water quality in the subcatchment. First and last reported values for each parameter were assessed as higher (+) than the ANZECC 2000 guideline value, lower (-) than the guideline value, or equivalent (=) to the guideline value. The overall trend during the survey period was identified as increasing (↑) or decreasing (↓). This provides an indication whether management actions are having a positive effect on water quality, and whether further actions are required, for example, a parameter that exceeds the guideline value at the start of the survey period may still exceed it at the end of the period, but have shown significant improvements during the reporting period.

One site was sampled in Oyster Bay subcatchment:

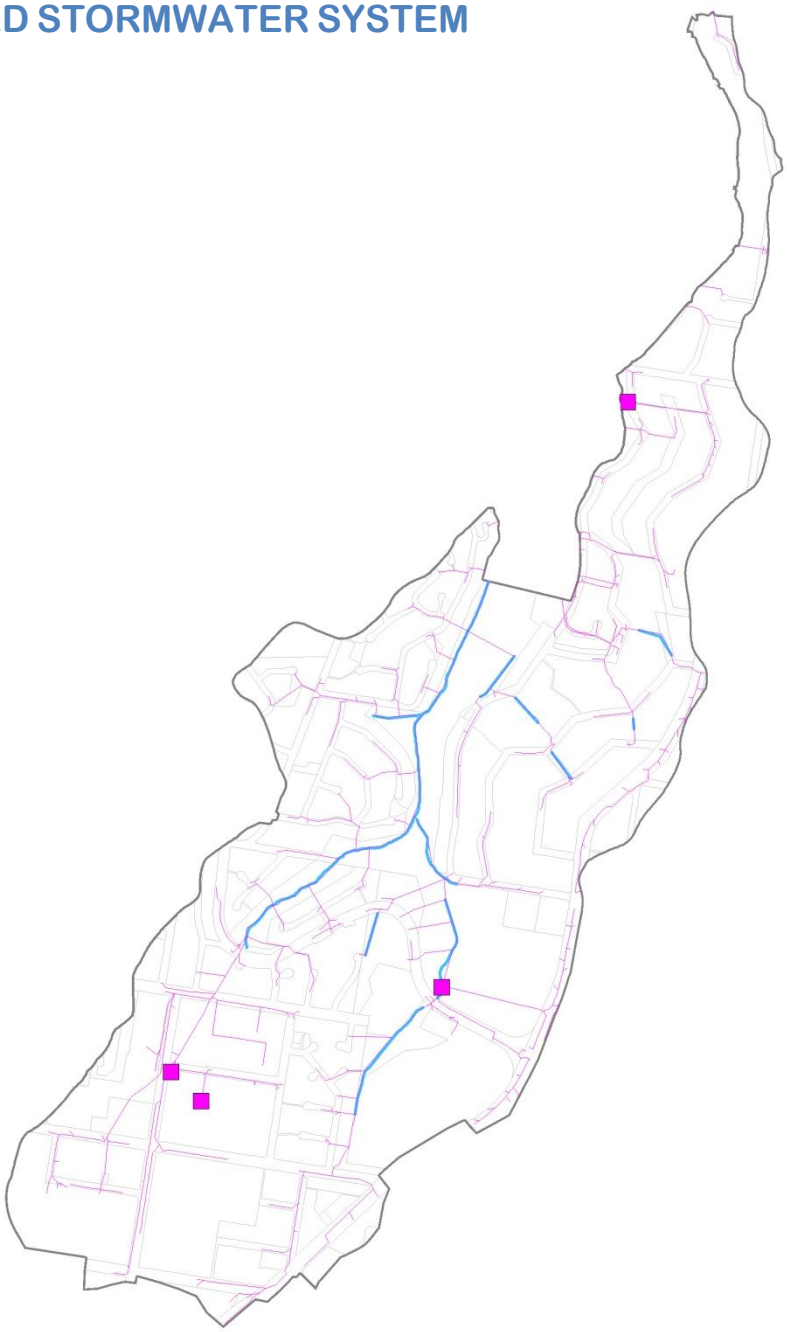
1. Kareela Golf Course

PARAMETER	NH3	BOD	Cu	Pb	Zn
SUMMER 95 +/- ANZECC 2000 values	+	+	+	+	+
WINTER 02 +/- ANZECC 2000 values	+	+	+	-	+
TREND ↓↑	↑	↓	↓	↓	↑
PARAMETER	**Enterococci**	**Grease**	**TN**	**TP**	**TSS**
SUMMER 95 +/- ANZECC 2000 values	-	+	+	-	+
WINTER 02 +/- ANZECC	-	-	+	-	+

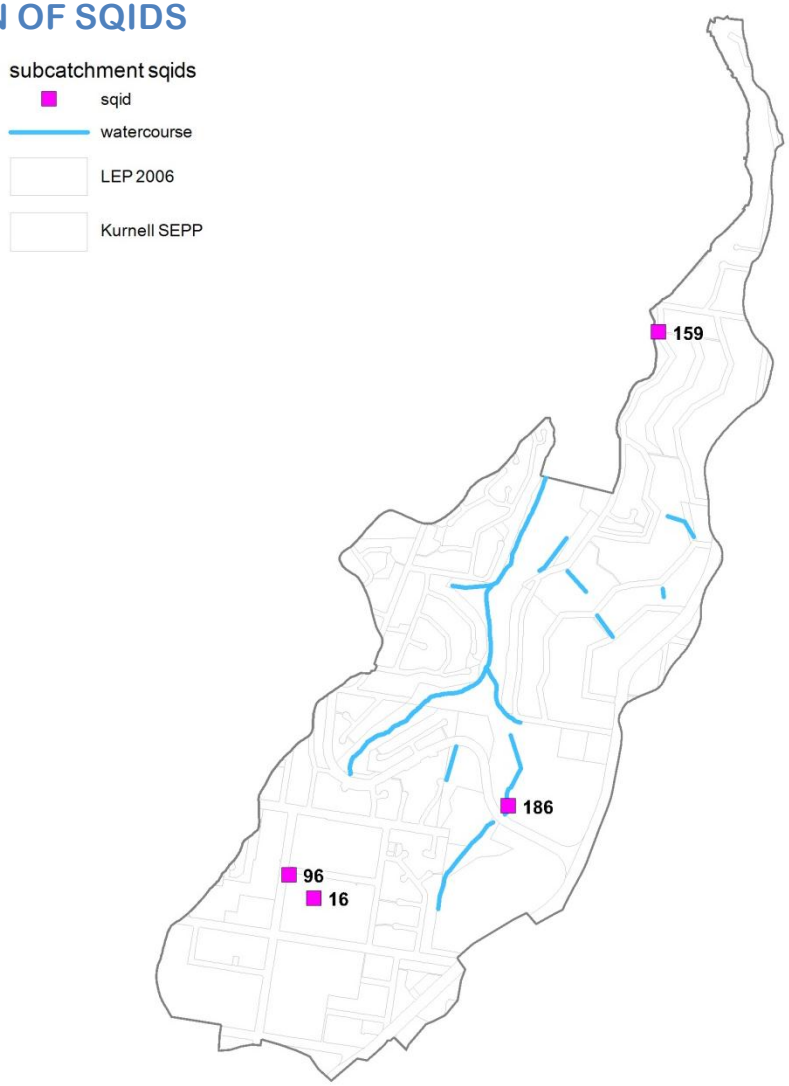
2000 values					
TREND ↓↑	↓	↓	↑	=	↓

A number of parameters showed an increase in values during the survey period, including ammonia, zinc, and total nitrogen. Decreases in values for other parameters were reported, a number of which were within ANZECC 2000 guideline values at the end of the survey period.

RETICULATED STORMWATER SYSTEM



LOCATION OF SQIDS



ID	DEVICE CATEGORY	DEVICE TYPE	LOCATION	SITE DESCRIPTION	SUBURB	APPROX. CATCHMENT
96	GPT - Other	Coalescing Plate Interceptors (CPI)	The Boulevarde	Bath Road Council Depot - NW corner of yard	Kirrawee	0.4 Ha
16	GPT - Other	Coalescing Plate Interceptors (CPI)	The Boulevarde	Council Depot Steamclean Bay	Kirrawee	0.2 Ha
159	GPT - Other	Trash Rack	The Esplanade		Sylvania	8.2 Ha
186	GPT - Other	Trash Rack	Bates Drive	Kareela Golf Course between 8 & 9 tee	Kareela	38 Ha

GEOMORPHIC SETTING

GEOLOGY, GEOMORPHOLOGY AND SOILS

Oyster Bay subcatchment soil landscapes include Mangrove Creek Soil Landscape (mc) along foreshores, and the remainder of the subcatchment soils are all Gymea Soil Landscape (gy) (from Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet Map and Report; see summary explanations in Geology and Soils section for Georges River catchment).

TOPOGRAPHY

Foreshore areas in Oyster Bay subcatchment reach an altitude of 20m AHD. A large plateau in the south is higher than 70m AHD with a maximum height of 77m.

ASS/PASS, URBAN SALINITY

LEP (00 &06) CLASS	HECTARES
CLASS 1	0.22
CLASS 2	0.72
CLASS 3	12.34
CLASS 5	135.27

Class 1, 2 and 3 ASS are located in isolated patches along the foreshores of the subcatchment, while the Class 5 ASS area is in a band around the foreshores, to a maximum of 300m.

OTHER CONTAMINATION ISSUES

None noted

LAND USE

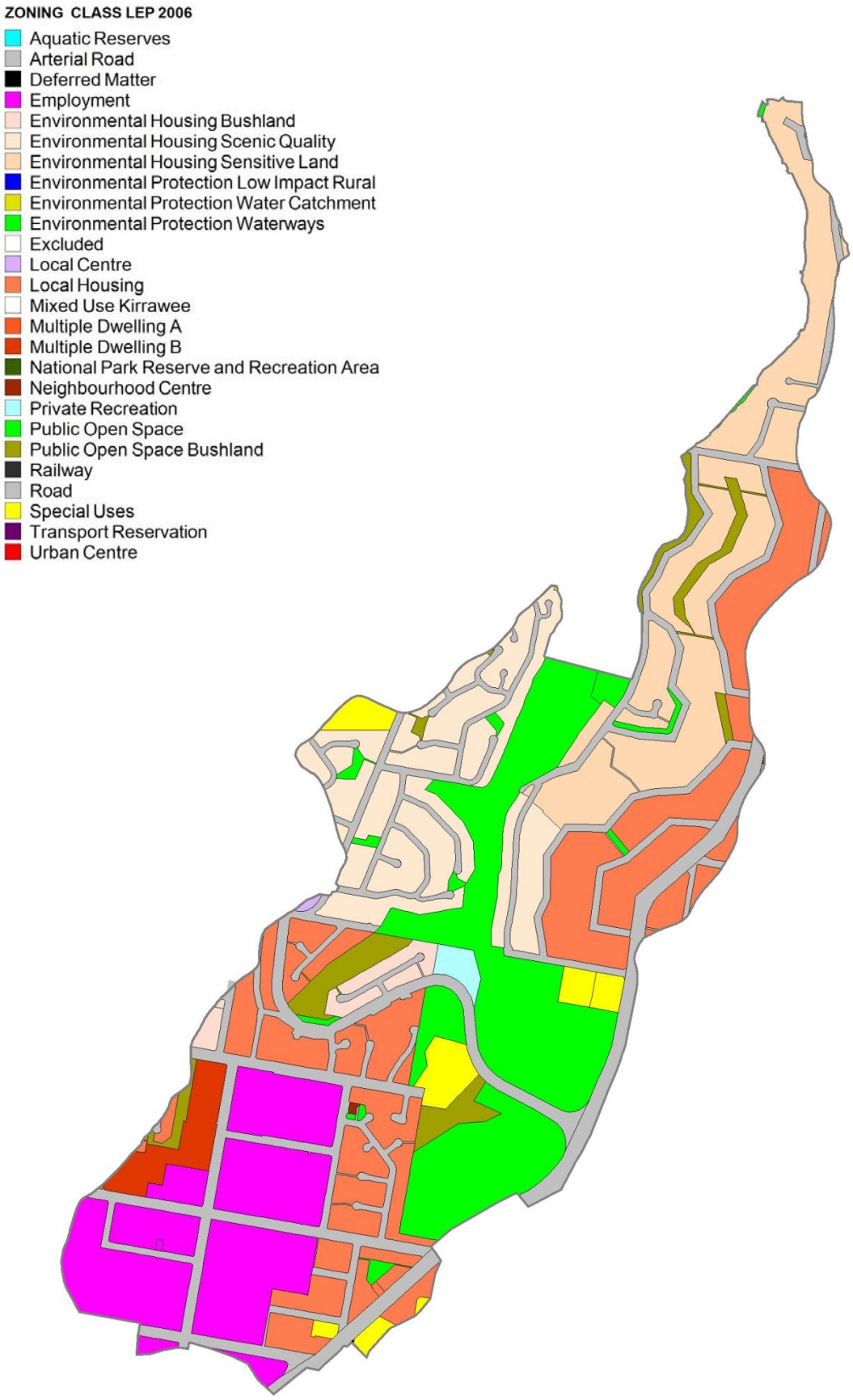
HISTORIC LAND USE

Oyster Bay was named for the plentiful supply of oysters, and the bay itself was known by this name since 1840. The village, and later suburb of Oyster Bay was not officially known by this name until 1933. The Oyster Bay subcatchment drains land that includes the suburb of Kareela, and the western part of Sylvania. Kareela was originally known as Salisbury until 1968, when it was renamed after the aboriginal word “kari-kari”, meaning fast, for the area’s strong south winds (Jackson, 2006). Development was slower here than elsewhere in the Shire, partly because of difficulties associated with access, partly because of its poor quality, and partly because of the potential for flooding in the low lying areas.

The history of this area is linked, like much of Sutherland Shire, with Thomas Holt. Holt planned to call the area Sylvanbrae, but it was known as Como until 1933. Ernie Edwards pioneered the oyster industry in the area in the 1880s. Subdivisions in the area began in 1910, but were hampered by council’s prohibition of tents on newly purchased blocks of land. In 1929 the Oyster Bay Progress Association was formed, and campaigned for new roads through the area. Members began a bus service, using a four-wheeled wagonette pulled by two horses. The association next campaigned for a school which opened in 1944, followed by a post office and telephone box. The area grew steadily during the 1950s and 1960s, and today shows the environmental legacy of this urban development.

Figure 4. Oyster Bay, circa 1888.

CURRENT LAND USE



CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	0.01	0%	0%	0.00
Environmental Housing Sensitive Land	32.15	13%	43%	13.82
Environmental Housing Scenic Quality	26.48	11%	57%	15.09
Environmental Housing Bushland	3.12	1%	57%	1.78
Local Housing	46.54	18%	51%	23.74
Multiple Dwelling A	0.00	0%	64%	0.00
Multiple Dwelling B	4.45	2%	64%	2.85
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	0.00	0%	94%	0.00
Local Centre	0.18	0%	88%	0.16
Neighbourhood Centre	0.10	0%	86%	0.08
Employment	32.54	13%	95%	30.91
Special Uses	6.53	3%	30%	1.96
Public Open Space	40.75	16%	5%	2.04
Public Open Space Bushland	8.21	3%	0%	0.00
Private Recreation	1.20	0%	5%	0.06
Environmental Protection Waterways	0.28	0%	0%	0.00
Aquatic Reserves	0.00	0%	0%	0.00
National Park Reserve and Recreation Area	0.00	0%	0%	0.00
Railway	0.00	0%	33%	0.00
Arterial Road/Road	49.78	20%	66%	32.85
Transport Reservation	0.00	0%	5%	0.00
TOTALS	**252.31**	**100%**	**50%**	**125.34**

VEGETATION COMMUNITIES

MAPPED VEGETATION COMMUNITIES

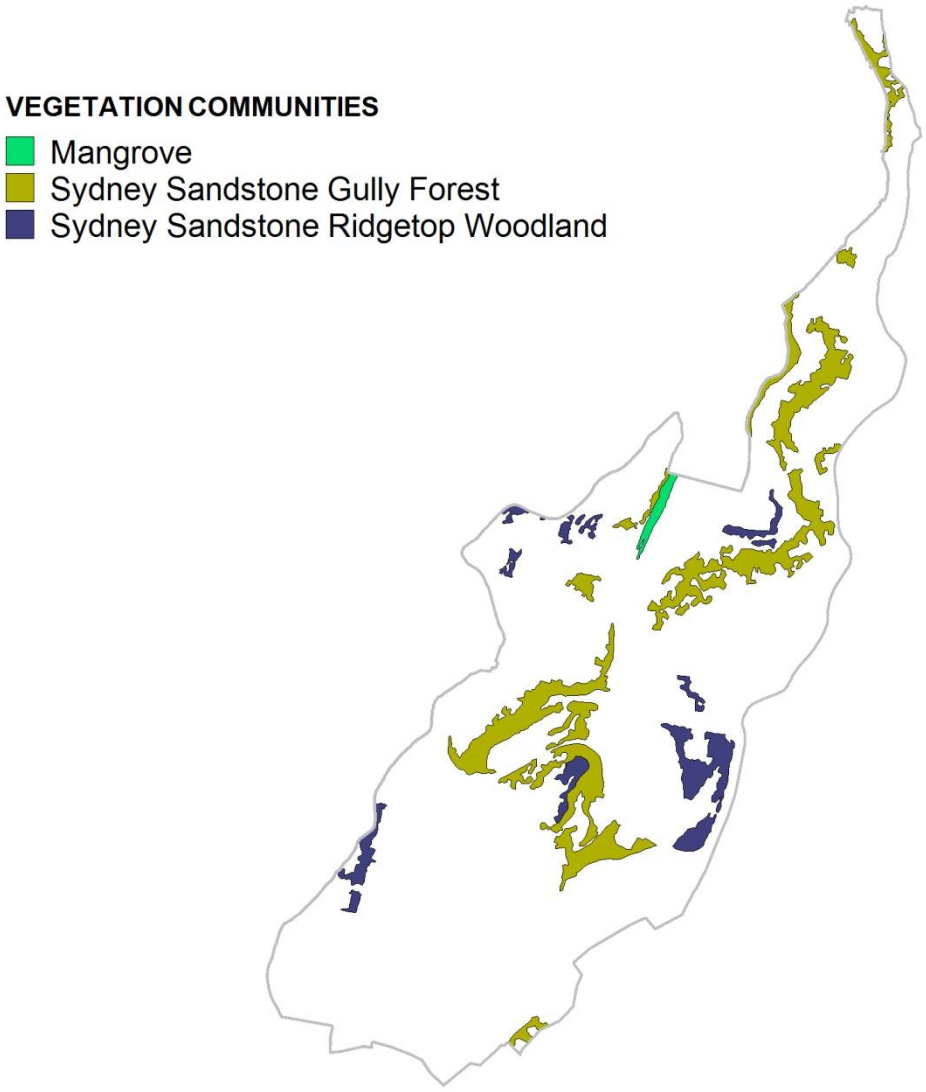
0.91 HECTARES MANGROVE

24.82 HECTARES SYDNEY SANDSTONE GULLY FOREST

7.97 HECTARES SYDNEY SANDSTONE RIDGETOP WOODLAND

LEP 2006 SIGNIFICANT VEGETATION

LEP TAG	NAME	CLASS
T30	Eucalyptus microcorys_Blackbut	Significant Group of Trees or Vegetation



BUSHLAND RESERVES AND RESTORATION

Reserves

1) Greenweb Core areas

- Young St Reserve

2) Greenweb Support areas

- Ingrid Rd/Moonbi Pl/Tradewinds Pl/Pascha Pl/Freya St
- Drysdale Pl/Kendal Pl

3) Greenweb Restoration areas

- Robvic Ave/The Esplanade/Young St/The Promenade/Moray Pl/Box Rd

Bushcare Groups

- The Esplanade, Sylvania
- Freya Street Reserve
- Ingrid Rd Reserve
- Kareela Golf Course
- Drysdale Place Reserve
- Joseph Banks Native Plants Reserve

THREATENING PROCESSES

INSTREAM IMPACTS

- Loss of riparian habitat
- Degradation of riparian habitat
- Loss of emergent vegetation
- Removal of large woody debris
- Loss or reduction of allochthonous material as a stream input
- Loss or reduction of shading of stream
- Changes to the proportion of catchment impervious surface
- Changes to infiltration patterns
- Construction of dams and other impediments to flow
- Draining of wetland areas
- Channelization
- Modification of channel bedform
- Modification of bank configuration
- Pipe replacement of channel
- Erosion
- Sedimentation

- Point source pollution
- Non-point (diffuse) source pollution
- Increased nutrient loads
- Introduction of toxic compounds
- Introduction of oils and organobenzenes
- Introduction of herbicides and pesticides in runoff
- Reduction of light penetration
- Algal bloom
- Emergent aquatic weeds
- Floating aquatic weeds
- Change in temperature regime
- Barriers to fish passage
- Change to hydrological flow regimes
- Change to pH through mobilisation of ASS/PASS
- Stormwater deposition of litter
- Dumping of rubbish
- Increased allocthonous inputs immediately following fire or clearing
- Increased peak discharges associated with storm flows
- Decreased baseflows
- Diseases from untreated or poorly treated sewage
- Reduction in water through extraction
- Introduction of invasive species including
    - Gambusia
    - Carp
    - Cane Toads
    - Koi Carp (goldfish)

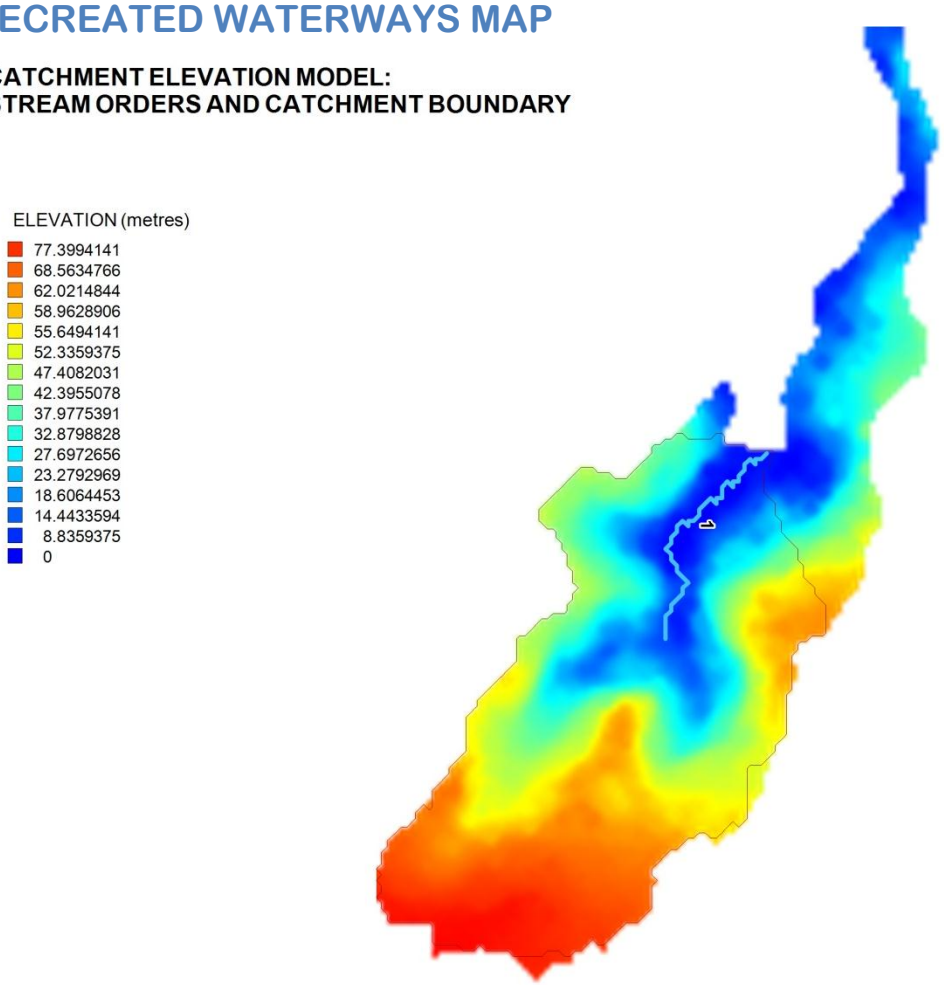
RIPARIAN IMPACTS

- Invasion by weeds
- Loss of species through replacement by others
- Loss of diversity (reduction in species numbers)
- Loss of habitat quality
- Disturbance from pedestrian access
- Disturbance from vehicle access
- Disturbance from excessive use by stock or other animals
- Clearing of vegetation
- Deliberate introduction of exotic plant species
- Selective removal of vegetation including
    - Loss of canopy
    - Loss of shrub layer
    - Loss of groundcover species
- Removal of habitat elements including

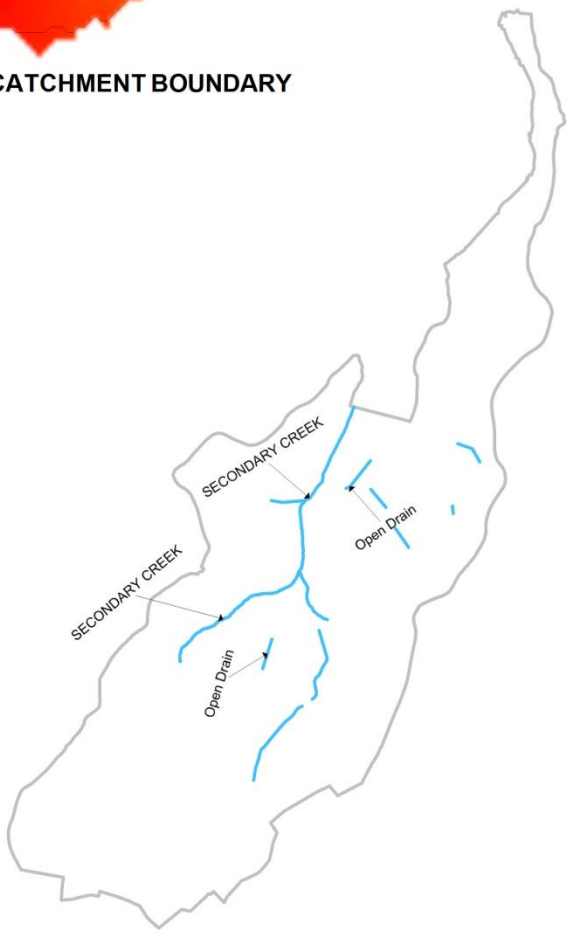
    - Loss of leaf litter
    - Loss of fallen timber
    - Loss of standing dead trees
    - Loss of rocks
    - Loss of microhabitat architecture
- Dumping of rubbish
- Littering
- Vandalism including
    - Damage to plants
    - Damage to abiotic habitat elements
    - Injured or killed animals
- Inappropriate fire regime
- Erosion
- Sedimentation
- Plant diseases including
    - Phytophthora (dieback)
    - Myrtle rust
    - Smut
    - Common rust
    - Mistletoes
- Feral animals including
    - Foxes
    - Rabbits
    - Deer
    - Cane Toads
    - Wild pigs
    - Feral cats
    - Introduced birds

RECREATED WATERWAYS MAP

CATCHMENT ELEVATION MODEL:
STREAM ORDERS AND CATCHMENT BOUNDARY



CURRENTLY MAPPED WATERWAYS AND CATCHMENT BOUNDARY

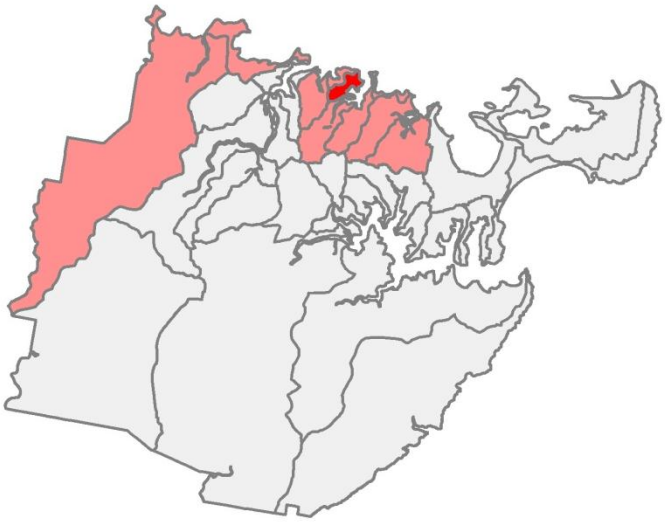


OYSTER BAY WEST SUBCATCHMENT

SUBCATCHMENT OVERVIEW

CATCHMENT AREA: 1.0 KM^2

SUBURBS: OYSTER BAY



WATERWAYS

MAJOR NAMED WATERWAYS: NIL

TOTAL LENGTH OF MAPPED WATERWAYS: 0.44 KMs

PRIMARY ORDER CREEKS: 0 KMs

SECOND ORDER CREEKS: 0 KMs

OPEN DRAINS/MINOR DRAINAGE LINES: 0.44 KMs

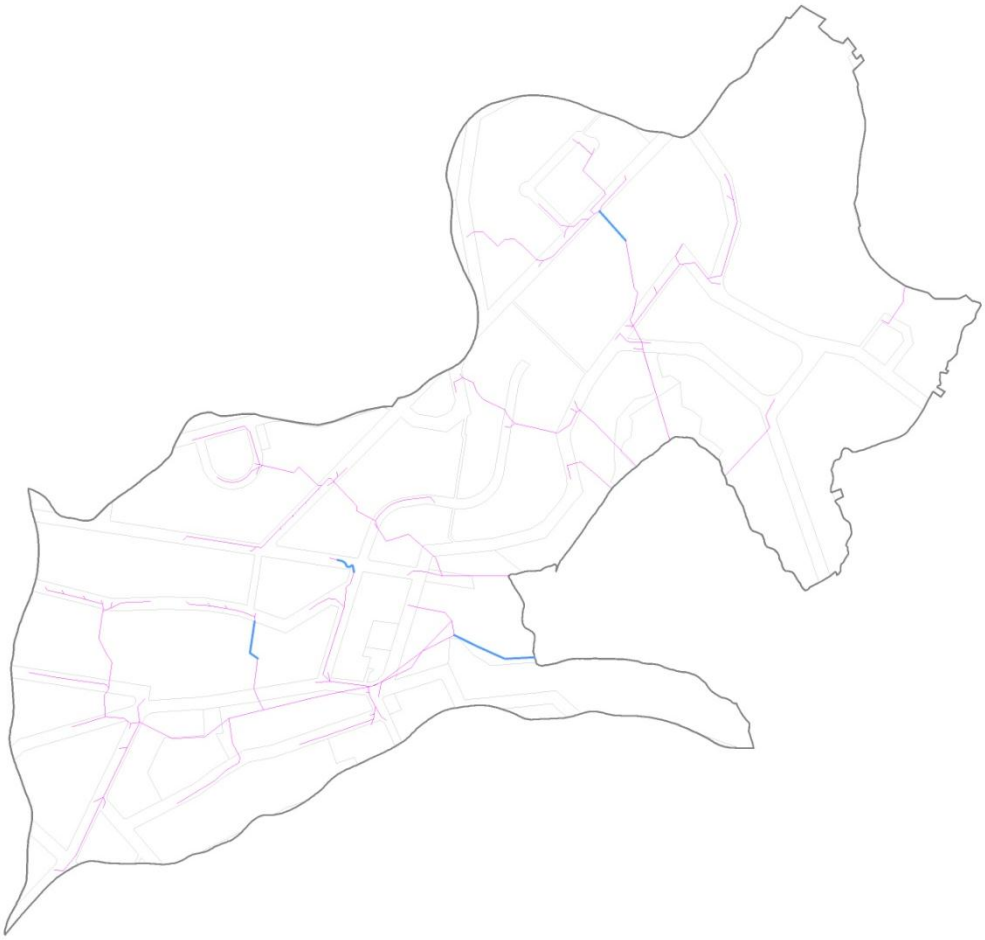
WATER QUALITY ASSESSMENT

As part of their Strategic Water Quality Monitoring Plan, Sutherland Shire Council commenced monitoring water quality in a number of streams across the shire. Trends in water quality data collected from each stream were assessed and ranked against the ANZECC 2000 guidelines for recreational water quality in urban streams (SSC, 2004).

Samples were analysed summer and winter for between three and seven years at each site. This data has been interpreted here to give a brief historic summary of water quality in the subcatchment. First and last reported values for each parameter were assessed as higher (+) than the ANZECC 2000 guideline value, lower (-) than the guideline value, or equivalent (=) to the guideline value. The overall trend during the survey period was identified as increasing (↑) or decreasing (↓). This provides an indication whether management actions are having a positive effect on water quality, and whether further actions are required, for example, a parameter that exceeds the guideline value at the start of the survey period may still exceed it at the end of the period, but have shown significant improvements during the reporting period.

No sites sampled in this subcatchment

RETICULATED STORMWATER SYSTEM



LOCATION OF SQIDS

NIL IN CATCHMENT

GEOMORPHIC SETTING

GEOLOGY, GEOMORPHOLOGY AND SOILS

Coronation Bay subcatchment soil landscapes include Mangrove Creek Soil Landscape (mc) around foreshores. Areas immediately behind the foreshores, and the rest of the catchment are Gymea Soil Landscape (gy), with minor areas of Hawkesbury Soil Landscape (ha) (from Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet Map and Report; see summary explanations in Geology and Soils section for Georges River catchment).

TOPOGRAPHY

Foreshore areas in the subcatchment have a maximum altitude of 10m AHD. A plateau area in the southwest is higher than 40m AHD, and with the highest point at 51m.

ASS/PASS, URBAN SALINITY

LEP (00 &06) CLASS	HECTARES
CLASS 1	18.75
CLASS 2	7.24
CLASS 5	34.10

Class 1 and 2 ASS is found in small patches around the foreshores, and the small area of Class 5 ASS is in a band along the foreshore.

OTHER CONTAMINATION ISSUES

None noted

LAND USE

HISTORIC LAND USE

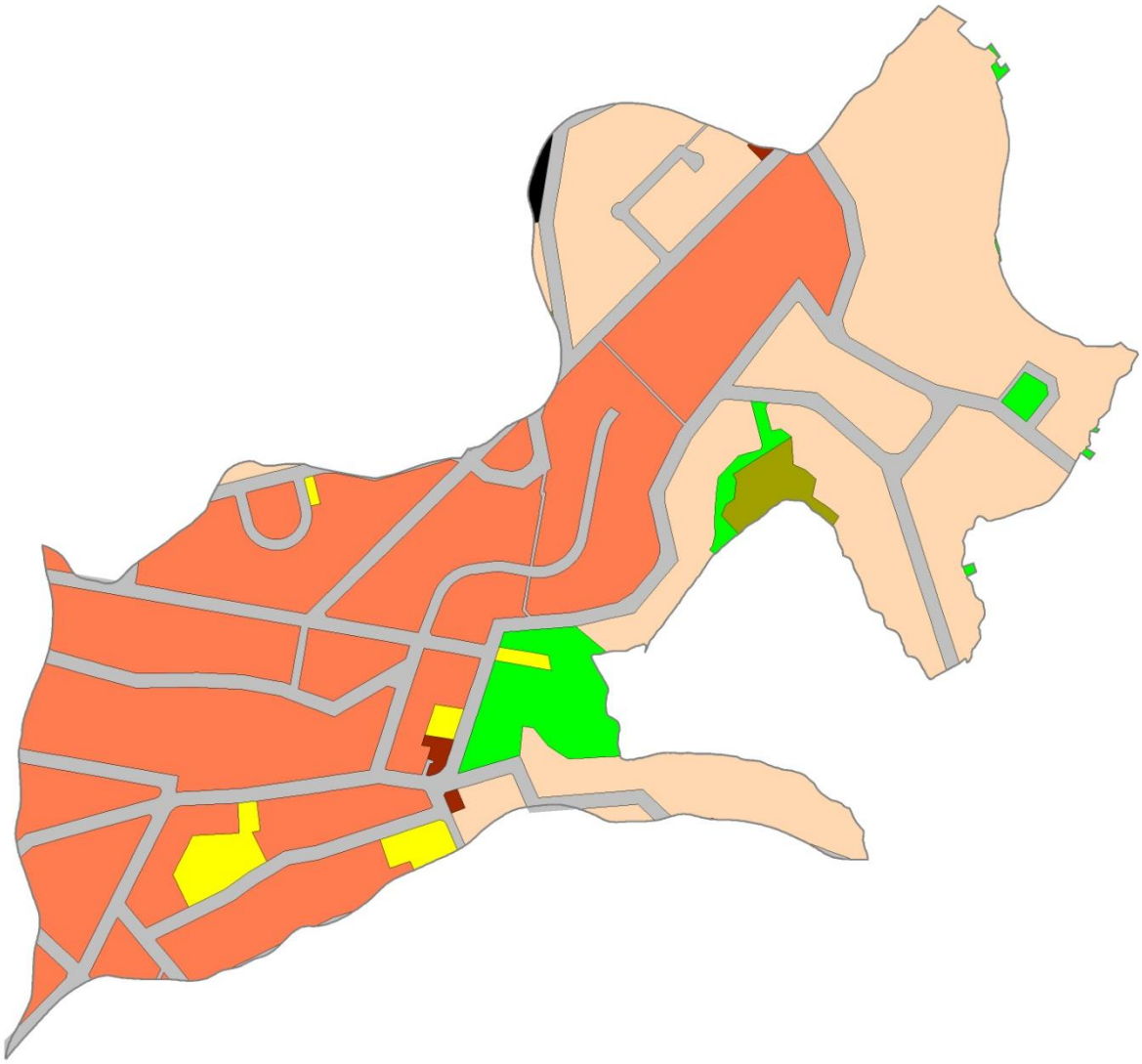
Oyster Bay West subcatchment includes the suburb of Oyster Bay itself and land west towards Como. The history of the two areas is strongly linked, even after the proclamation of the village of Oyster Bay in 1925. The area formed part of the Sutherland-Holt estate, originally called the South Botany Estate until 1868. At this time Robert Cooper Walker, a manager on Thomas Holt's estate, described the area included in the Oyster Bay Paddocks as having many trees that were ringbarked, and had been burnt to assist with clearing. In general, the land was scrubby and rocky (Florence & Gardiner, 2001).

Walker described a small freshwater creek with good grass feed around the banks. This was used as a water source for residents until the reticulated water service was connected in 1940. The bay had sandy beaches and crystal clear water, with sand flats covered by crabs at low tides, and plentiful stocks of fish and prawns, and yabbies in the streams. Until the late 1920s there were no constructed roads in Oyster Bay. A bush track led to Como railway station, and others led towards Jannali and Kareela. Many aboriginal middens were present on the shores of Oyster Bay. People would find large deposits of shells when digging in their yards. Rock carvings can still be seen at Caravan Head (Florence & Gardiner, 2001).

In the 1910s and early 1920s Oyster Bay was called "By The Water Estate" and was included in the suburb of Como. The first major subdivision was sold in 1911. Many purchasers erected tents on their blocks, leading to bans on tents on blocks with smaller frontages. Later subdivisions included the Getyunga Estate Como, sold in 1922 and Wards Estate, sold in 1936. Other major subdivisions included the Como Park Estate which was sold in 1928. Subdivisions continued until the early 1960s.

There were no shops in Oyster Bay until 1925. The introduction of a stage coach in 1932 from Oyster Bay to Como furthered commercial activity in the area. Fruit and vegetables were produced on a number of farms, and chickens and eggs were also sold. The South Bridge Tool and Instrument Company opened a factory in Oyster Bay in 1945, and made clippers and gauges, steel fences and garden furniture. A small shoe polish factory was also operated in the area (Florence & Gardiner, 2001).

CURRENT LAND USE



ZONING CLASS LEP 2006

- Aquatic Reserves
- Arterial Road
- Deferred Matter
- Employment
- Environmental Housing Bushland
- Environmental Housing Scenic Quality
- Environmental Housing Sensitive Land
- Environmental Protection Low Impact Rural
- Environmental Protection Water Catchment
- Environmental Protection Waterways
- Excluded
- Local Centre
- Local Housing
- Mixed Use Kirrawee
- Multiple Dwelling A
- Multiple Dwelling B
- National Park Reserve and Recreation Area
- Neighbourhood Centre
- Private Recreation
- Public Open Space
- Public Open Space Bushland
- Railway
- Road
- Special Uses
- Transport Reservation
- Urban Centre

CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	0.21	0%	0%	0.00
Environmental Housing Sensitive Land	33.79	34%	43%	14.53
Environmental Housing Scenic Quality	0.00	0%	57%	0.00
Environmental Housing Bushland	0.00	0%	57%	0.00
Local Housing	40.96	41%	51%	20.89
Multiple Dwelling A	0.00	0%	64%	0.00
Multiple Dwelling B	0.00	0%	64%	0.00
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	0.00	0%	94%	0.00
Local Centre	0.00	0%	88%	0.00
Neighbourhood Centre	0.26	0%	86%	0.22
Employment	0.00	0%	95%	0.00
Special Uses	1.87	2%	30%	0.56
Public Open Space	3.67	4%	5%	0.18
Public Open Space Bushland	0.98	1%	0%	0.00
Private Recreation	0.00	0%	5%	0.00
Environmental Protection Waterways	0.13	0%	0%	0.00
Aquatic Reserves	0.00	0%	0%	0.00
National Park Reserve and Recreation Area	0.00	0%	0%	0.00
Railway	0.00	0%	33%	0.00
Arterial Road/Road	17.59	18%	66%	11.61
Transport Reservation		0%	5%	0.00
TOTALS	99.46	100%	48%	47.99

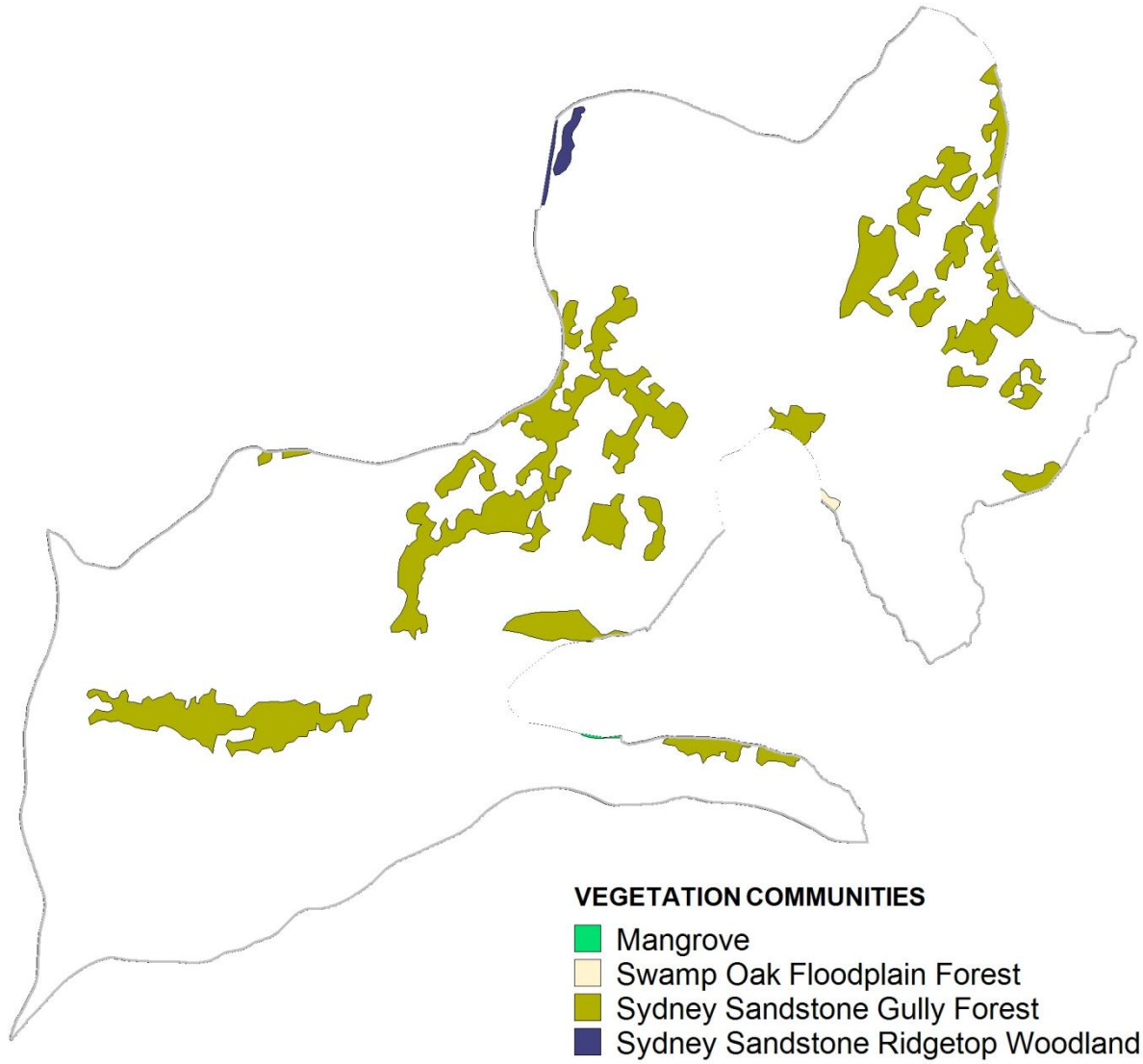
VEGETATION COMMUNITIES

MAPPED VEGETATION COMMUNITIES

0.11	HECTARES	MANGROVE
0.37	HECTARES	SWAMP OAK FLOODPLAIN FOREST
3.35	HECTARES	SYDNEY SANDSTONE GULLY FOREST
0.42	HECTARES	SYDNEY SANDSTONE RIDGETOP WOODLAND

LEP 2006 SIGNIFICANT VEGETATION

NIL



BUSHLAND RESERVES AND RESTORATION

Reserves

1) Greenweb Core areas

- None noted

2) Greenweb Support areas

- None noted

3) Greenweb Restoration areas

- Oyster Bay Rd/Como Rd/Carina Rd/Rickard Rd

Bushcare Groups

None noted

THREATENING PROCESSES

INSTREAM IMPACTS

- Loss of riparian habitat
- Degradation of riparian habitat
- Loss of emergent vegetation
- Removal of large woody debris
- Loss or reduction of allochthonous material as a stream input
- Loss or reduction of shading of stream
- Changes to the proportion of catchment impervious surface
- Changes to infiltration patterns
- Construction of dams and other impediments to flow
- Draining of wetland areas
- Channelization
- Modification of channel bedform
- Modification of bank configuration
- Pipe replacement of channel
- Erosion
- Sedimentation
- Point source pollution
- Non-point (diffuse) source pollution
- Increased nutrient loads
- Introduction of toxic compounds
- Introduction of oils and organobenzenes
- Introduction of herbicides and pesticides in runoff
- Reduction of light penetration

- Algal bloom
- Emergent aquatic weeds
- Floating aquatic weeds
- Change in temperature regime
- Barriers to fish passage
- Change to hydrological flow regimes
- Change to pH through mobilisation of ASS/PASS
- Stormwater deposition of litter
- Dumping of rubbish
- Increased allocthonous inputs immediately following fire or clearing
- Increased peak discharges associated with storm flows
- Decreased baseflows
- Diseases from untreated or poorly treated sewage
- Reduction in water through extraction
- Introduction of invasive species including
    - Gambusia
    - Carp
    - Cane Toads
    - Koi Carp (goldfish)

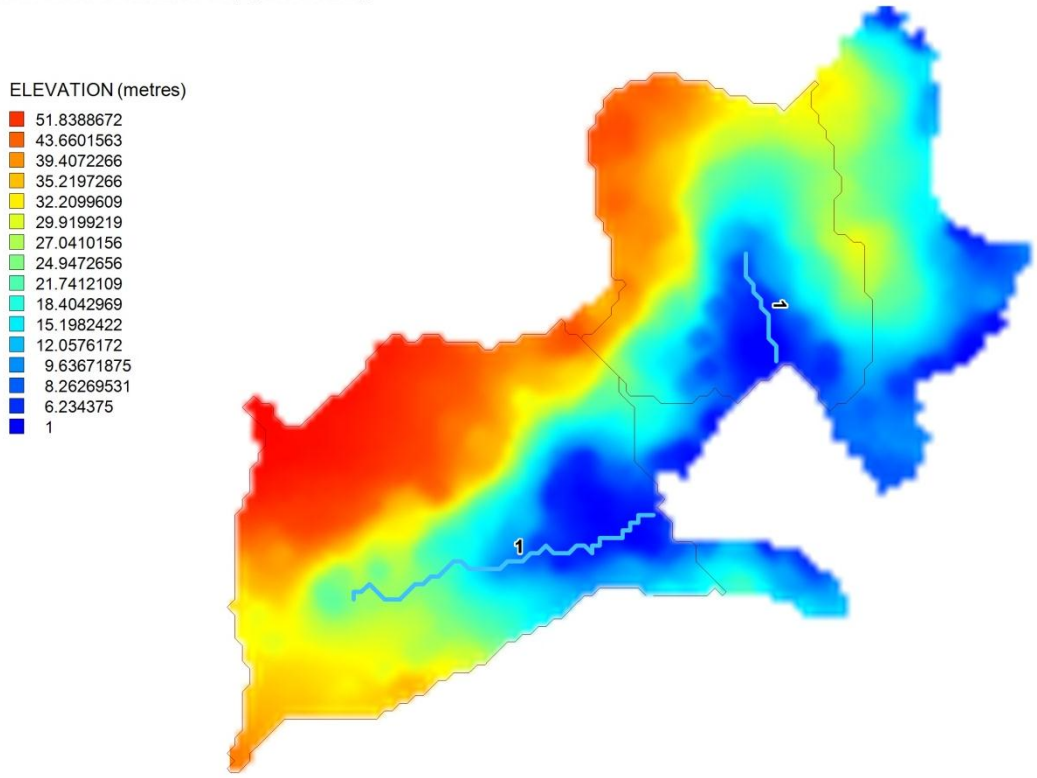
RIPARIAN IMPACTS

- Invasion by weeds
- Loss of species through replacement by others
- Loss of diversity (reduction in species numbers)
- Loss of habitat quality
- Disturbance from pedestrian access
- Disturbance from vehicle access
- Disturbance from excessive use by stock or other animals
- Clearing of vegetation
- Deliberate introduction of exotic plant species
- Selective removal of vegetation including
    - Loss of canopy
    - Loss of shrub layer
    - Loss of groundcover species
- Removal of habitat elements including
    - Loss of leaf litter
    - Loss of fallen timber
    - Loss of standing dead trees
    - Loss of rocks
    - Loss of microhabitat architecture
- Dumping of rubbish
- Littering

- Vandalism including
    - Damage to plants
    - Damage to abiotic habitat elements
    - Injured or killed animals
- Inappropriate fire regime
- Erosion
- Sedimentation
- Plant diseases including
    - Phytophthora (dieback)
    - Myrtle rust
    - Smut
    - Common rust
    - Mistletoes
- Feral animals including
    - Foxes
    - Rabbits
    - Deer
    - Cane Toads
    - Wild pigs
    - Feral cats
    - Introduced birds

RECREATED WATERWAYS MAP

CATCHMENT ELEVATION MODEL: STREAM ORDERS AND CATCHMENT BOUNDARIES



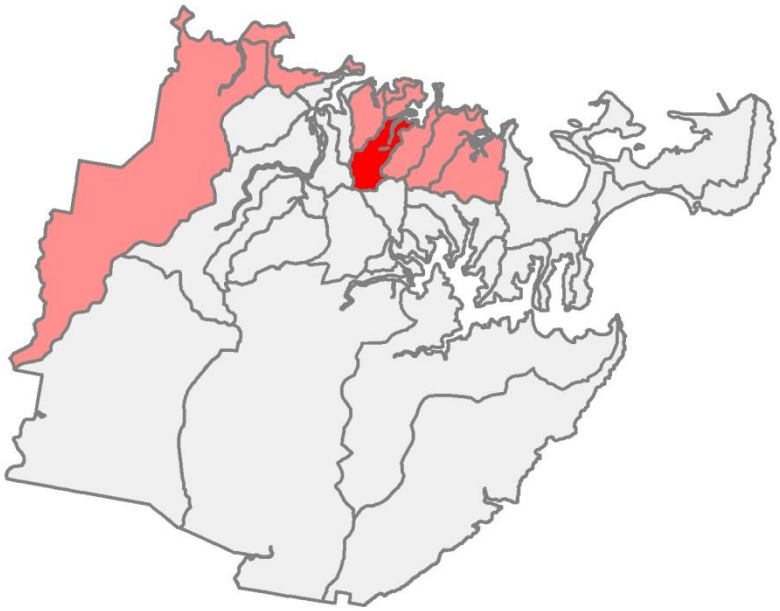
CURRENTLY MAPPED WATERWAYS AND CATCHMENT BOUNDARY

OYSTER CREEK SUBCATCHMENT

SUBCATCHMENT OVERVIEW

CATCHMENT AREA: 3.12 KM^2

SUBURBS: JANNALI
OYSTER BAY
KAREELA



WATERWAYS

MAJOR NAMED WATERWAYS: OYSTER GULLY

TOTAL LENGTH OF MAPPED WATERWAYS: 4.02 KMs

PRIMARY ORDER CREEKS: 0 KMs

SECOND ORDER CREEKS: 2.65 KMs

MINOR DRAINAGE LINES: 0.74 KMs

OPEN DRAINS 0.63 KMs

WATER QUALITY ASSESSMENT

As part of their Strategic Water Quality Monitoring Plan, Sutherland Shire Council commenced monitoring water quality in a number of streams across the shire. Trends in water quality data collected from each stream were assessed and ranked against the ANZECC 2000 guidelines for recreational water quality in urban streams (SSC, 2004).

Samples were analysed summer and winter for between three and seven years at each site. This data has been interpreted here to give a brief historic summary of water quality in the subcatchment. First and last reported values for each parameter were assessed as higher (+) than the ANZECC 2000 guideline value, lower (-) than the guideline value, or equivalent (=) to the guideline value. The overall trend during the survey period was identified as increasing (↑) or decreasing (↓). This provides an indication whether management actions are having a positive effect on water quality, and whether further actions are required, for example, a parameter that exceeds the guideline value at the start of the survey period may still exceed it at the end of the period, but have shown significant improvements during the reporting period.

One site was sampled at Oyster Creek:

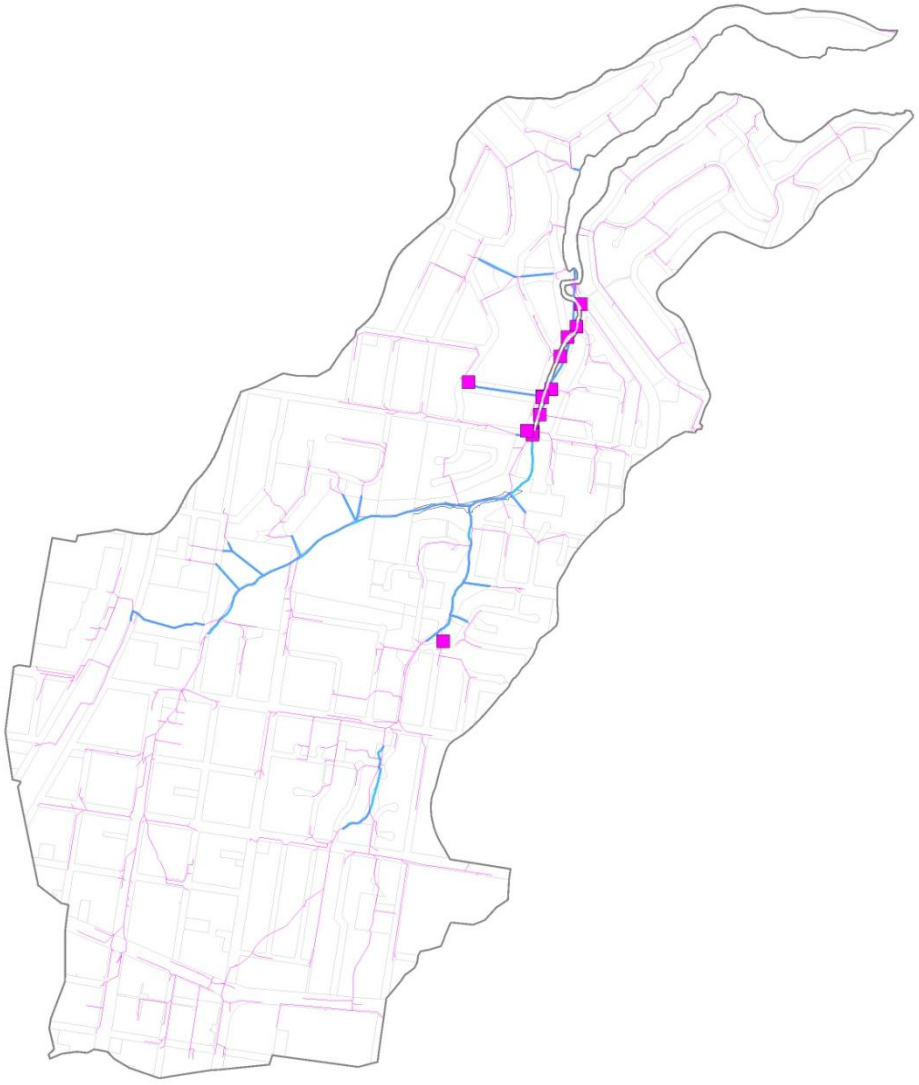
1. Oyster Bay West

PARAMETER	NH3	BOD	Cu	Pb	Zn
SUMMER 95 +/- ANZECC 2000 values	+	+	=	+	-
WINTER 02 +/- ANZECC 2000 values	+	-	+	-	-
TREND ↓↑	↓	↓	↑	↓	↓
PARAMETER	**Enterococci**	**Grease**	**TN**	**TP**	**TSS**
SUMMER 95 +/- ANZECC 2000 values	+	=	+	+	+

WINTER 02 +/- ANZECC 2000 values	-	-	-	-	-
TREND ↓↑	↓	↓	↓	↓	↓

A reduction in values was recorded for most parameters sampled, with the exception of copper, and most parameters, except copper and ammonia, were reported to be within ANZECC 2000 guideline limits at the end of the survey period.

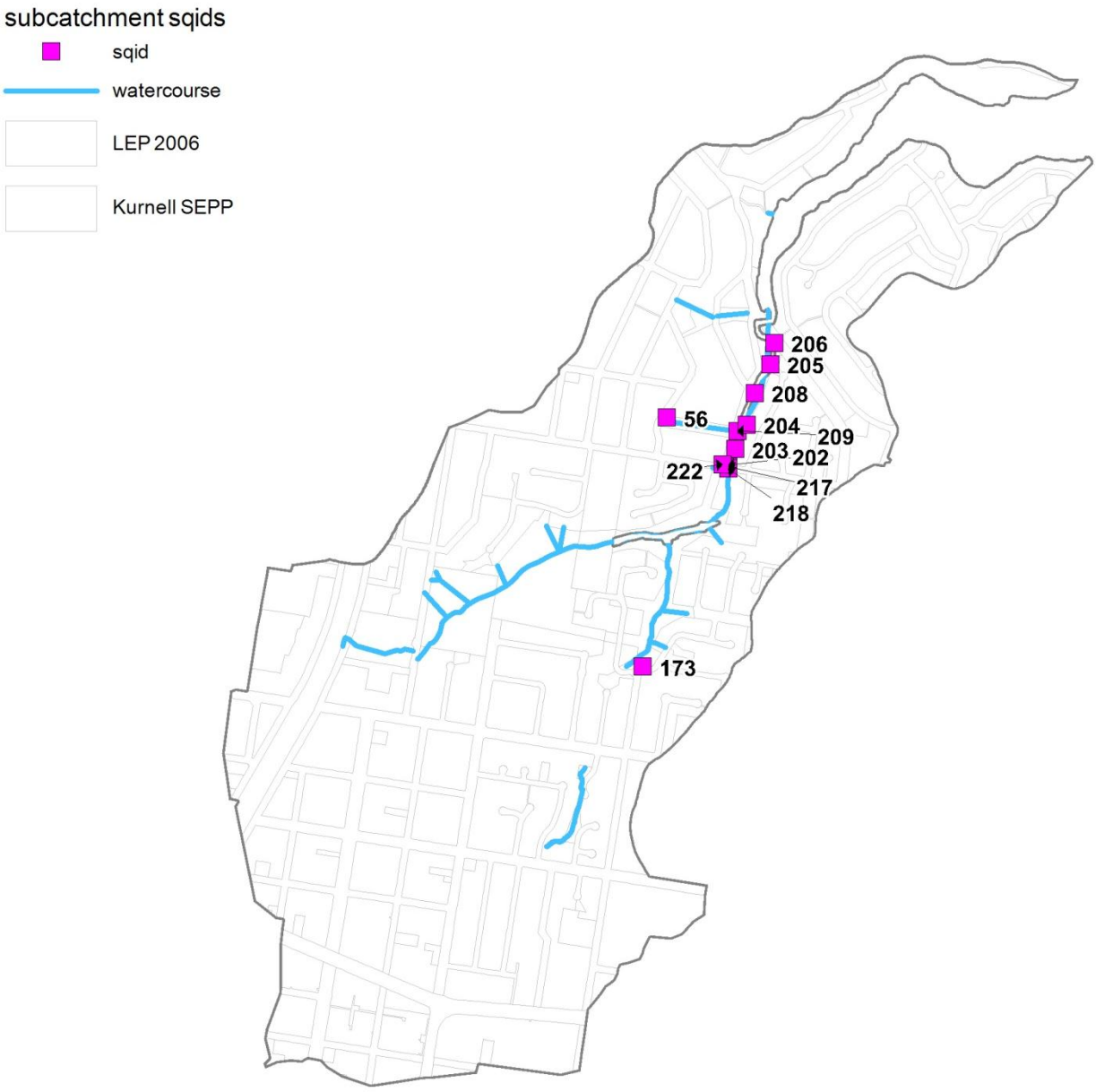
RETICULATED STORMWATER SYSTEM



LOCATION OF SQIDS

ID	DEVICE CATEGORY	DEVICE TYPE	LOCATION	SITE DESCRIPTION	SUBURB	APPROX. CATCHMENT
56	GPT - Other	Trash Rack	Ninth Avenue	Reserve	Jannali	5.7 Ha
173	GPT - Other	Ecosol GPT	Stirling Avenue	Reserve in residential area	Kirrawee	4.1 Ha
202	End of pipe trap	Nettech Device	Oyster Creek	Near footbridge crossing creek at end of Buderim Ave	Oyster Bay	5.9 Ha
203	End of pipe trap	Nettech Device	Oyster Creek	Behind No. 33 & 35 Buderim Ave	Oyster Bay	1.2 Ha
204	End of pipe trap	Nettech Device	Oyster Creek	Behind No. 23 & 25 Buderim Ave	Oyster Bay	1.4 Ha
205	End of pipe trap	Nettech Device	Oyster Creek	Behind 3R Buderim Ave	Oyster Bay	2.6 Ha
206	End of pipe trap	Nettech Device	Oyster Creek	Behind 3 Buderim Ave near Bates Dr Bridge	Oyster Bay	2 Ha
207	End of pipe trap	Nettech Device	Oyster Creek	Opposite 93 Carvers Rd	Oyster Bay	0.5 Ha
208	End of pipe trap	Nettech Device	Oyster Creek	Opposite 101 Carvers Rd	Oyster Bay	2.1 Ha
209	End of pipe trap	Nettech Device	Oyster Creek	Opposite 117R Carvers Rd	Oyster Bay	4.3 Ha
210	End of pipe trap	Nettech Device	Oyster Creek	Opposite 117R Carvers Rd	Oyster Bay	4.3 Ha
217	GPT - Other	Debris Deflector	Oyster Creek Footbridge	Under footbridge over Oyster Creek Box Rd	Oyster Bay	
218	GPT - Other	Sediment Trap	Oyster Creek	Behind footbridge at end of Box Road in Creek	Oyster Bay	
222	GPT	CDS	Carvers Road	near Box Road footbridge	Kareela	5 Ha

LOCATION OF SQIDS



GEOMORPHIC SETTING

GEOLOGY, GEOMORPHOLOGY AND SOILS

Oyster Creek subcatchment soil landscapes include Mangrove Creek Soil Landscape (mc) along foreshores and lower drainage areas, and the remainder of the subcatchment soils are all Gymea Soil Landscape (gy) (from Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet Map and Report; see summary explanations in Geology and Soils section for Georges River catchment).

TOPOGRAPHY

This small subcatchment has limited foreshores area. Lower points include major drainage lines, and reach a height of 27m AHD. A small plateau area in the southern part of the subcatchment is higher than 89m AHD, and reaches a maximum height of 101m.

ASS/PASS, URBAN SALINITY

LEP (00 &06) CLASS	HECTARES
CLASS 1	0.72
CLASS 2	0.68
CLASS 3	0.90
CLASS 5	93.87

Very small areas of Class 1, 2 and 3 ASS are found on foreshores, while Class 5 ASS is found in a band around the foreshores and major drainage lines.

OTHER CONTAMINATION ISSUES

None noted

LAND USE

HISTORIC LAND USE

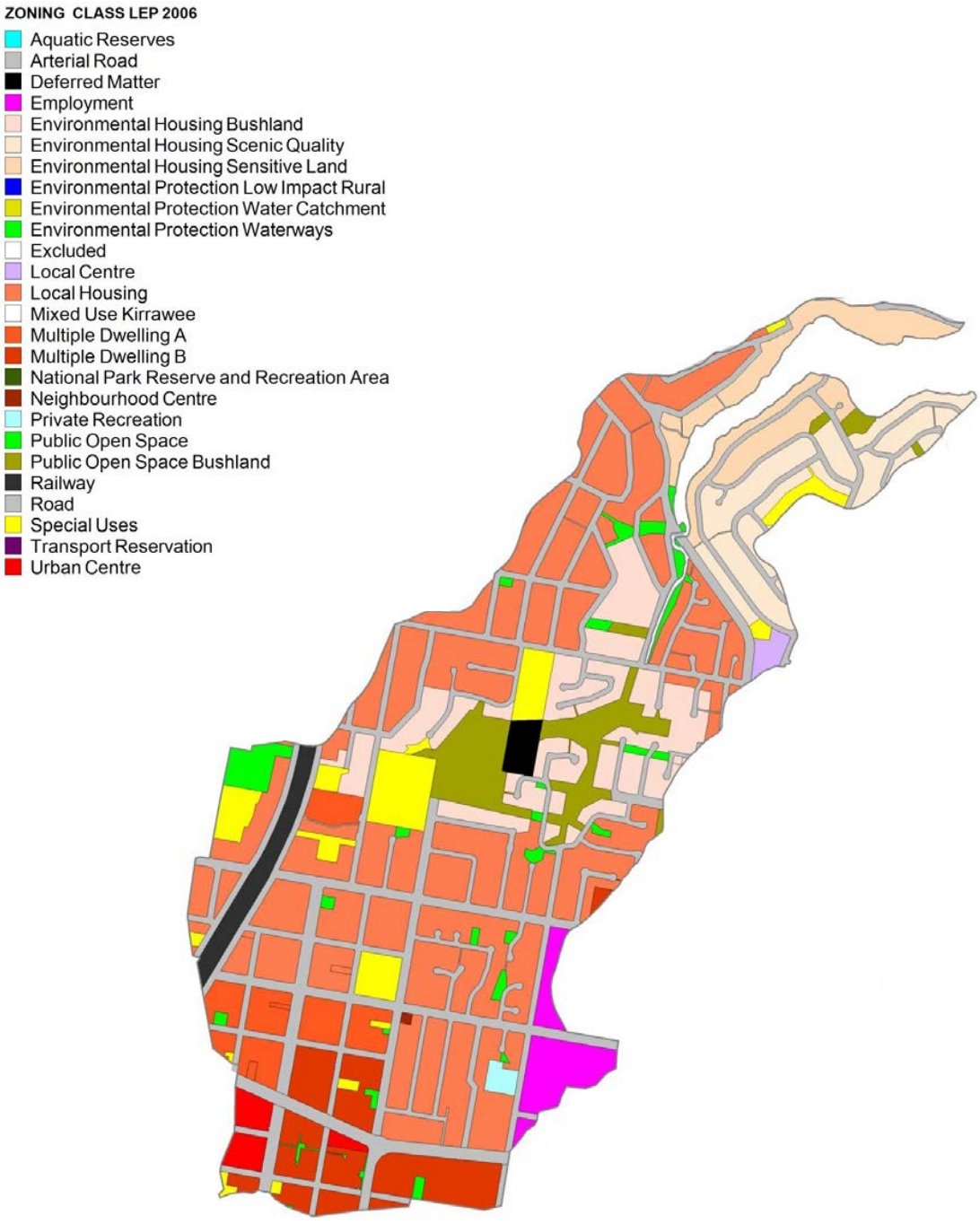
Oyster Creek subcatchment drains the area around the suburb of Jannali, named from an aboriginal word meaning “beautiful sunrise” (Jackson, 2006). Oyster Creek was originally called Kidd Creek, named after a forgotten local resident. For many years the only crossing for the creek was across a fallen log (Florence & Gardiner, 2001). A report in 1868 assessed much of the land around Oyster Creek and Jannali as too rocky and too poor for agriculture, as a result of which development in the area lagged behind other suburbs where there were better conditions for market gardening (Jackson, 2006). Around this time, Robert Cooper Walker described Oyster Creek as a small freshwater creek running into Oyster Bay with a small drop (around 20 feet) of good clear fresh water (Florence & Gardiner, 2001). Later descriptions mention a fairly deep waterhole from which people carried water to their homes in kerosene tins and stored it in 44 gallon drums.

The district began to grow with the arrival of the railway to Como in 1884. In 1887 the Intercolonial Investment Land and Building Company subdivided much of the western part of the subcatchment and sold it with the promise of a railway station at Jannali. While the station was not completed for 40 years, market gardeners moved to the area, starting with

Francis Woolf in 1916. Poor roads and transport links kept the area isolated although the arrival of the Congregational Church saw an influx of new residents.

Complaints from locals about flooding from the local creek highlighted other major issues for the area. Despite this, a shopping centre was constructed in 1936 and land to the east of the railway line was subdivided over the next few years. During the Depression unemployment was high in the Shire in general, and very high around Oyster Bay and Oyster Creek. Another wave of setters arrived in the post war years and ex-servicemen provided a ready supply of labour. Since then urban expansion has seen the ongoing development of this area, and today the natural environment has been largely removed.

CURRENT LAND USE



CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	1.77	1%	0%	0.00
Environmental Housing Sensitive Land	15.03	5%	43%	6.46
Environmental Housing Scenic Quality	16.46	5%	57%	9.38
Environmental Housing Bushland	26.65	9%	57%	15.19
Local Housing	100.25	32%	51%	51.13
Multiple Dwelling A	11.04	4%	64%	7.07
Multiple Dwelling B	17.55	6%	64%	11.23
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	3.18	1%	94%	2.99
Local Centre	1.18	0%	88%	1.04
Neighbourhood Centre	0.12	0%	86%	0.10
Employment	7.15	2%	95%	6.80
Special Uses	15.14	5%	30%	4.54
Public Open Space	7.04	2%	5%	0.35
Public Open Space Bushland	14.21	5%	0%	0.00
Private Recreation	0.90	0%	5%	0.05
Environmental Protection Waterways	0.07	0%	0%	0.00
Aquatic Reserves	0.00	0%	0%	0.00
National Park Reserve and Recreation Area	0.00	0%	0%	0.00
Railway	4.57	1%	33%	1.51
Arterial Road/Road	69.65	22%	66%	45.97
Transport Reservation		0%	5%	0.00
TOTALS	**311.96**	**100%**	**53%**	**163.80**

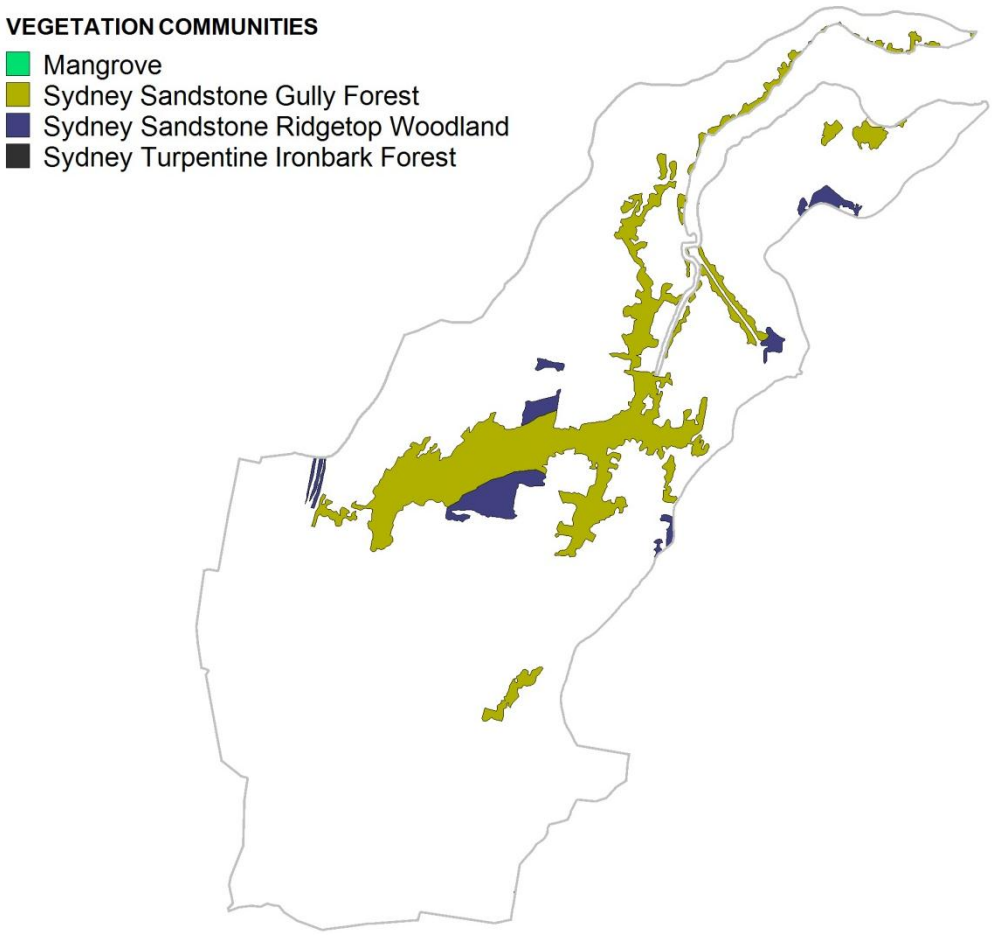
VEGETATION COMMUNITIES

MAPPED VEGETATION COMMUNITIES

0.03 HECTARES MANGROVE
29.04 HECTARES SYDNEY SANDSTONE GULLY FOREST
5.22 HECTARES SYDNEY SANDSTONE RIDGETOP WOODLAND
0.05 HECTARES SYDNEY TURPENTINE IRONBARK FOREST

LEP 2006 SIGNIFICANT VEGETATION

LEP TAG	NAME	CLASS
T26	Eucalyptus microcorys_Pilularis_Saligna	Significant Group of Trees or Vegetation
T27	Eucalyptus Pilularis_Blackbut	Significant Group of Trees or Vegetation



BUSHLAND RESERVES AND RESTORATION

Reserves

1) Greenweb Core areas

- Carvers Road/Box Road/Kingsbury Place Reserve
- Oyster Creek

2) Greenweb Support areas

- Box Rd/Ninth Ave/Sevenoaks Pl/Tunbridge Pl/Carvers Rd/Tenth Ave/The Circle/Loves Ave
- Freya St/Siandra Dr/Struen Marie St/Buderim Ave/Surrey Pl
- Anemone Pl/Tea Tree Pl/Mulga Pl/Magnolia St/Acacia Rd

3) Greenweb Restoration areas

- Argyle Pl/Inverness Pl
- Kiewa Pl/Birch Pl/Kenneth Ave/Princes Hwy/Acacia Rd

Bushcare Groups

- Ninth Avenue/Carvers Road Reserve
- Oyster Creek Gully
- Tea Tree Place Bushland

THREATENING PROCESSES

INSTREAM IMPACTS

- Loss of riparian habitat
- Degradation of riparian habitat
- Loss of emergent vegetation
- Removal of large woody debris
- Loss or reduction of allochthonous material as a stream input
- Loss or reduction of shading of stream
- Changes to the proportion of catchment impervious surface
- Changes to infiltration patterns
- Construction of dams and other impediments to flow
- Draining of wetland areas
- Channelization
- Modification of channel bedform
- Modification of bank configuration
- Pipe replacement of channel
- Erosion

- Sedimentation
- Point source pollution
- Non-point (diffuse) source pollution
- Increased nutrient loads
- Introduction of toxic compounds
- Introduction of oils and organobenzenes
- Introduction of herbicides and pesticides in runoff
- Reduction of light penetration
- Algal bloom
- Emergent aquatic weeds
- Floating aquatic weeds
- Change in temperature regime
- Barriers to fish passage
- Change to hydrological flow regimes
- Change to pH through mobilisation of ASS/PASS
- Stormwater deposition of litter
- Dumping of rubbish
- Increased allocthonous inputs immediately following fire or clearing
- Increased peak discharges associated with storm flows
- Decreased baseflows
- Diseases from untreated or poorly treated sewage
- Reduction in water through extraction
- Introduction of invasive species including
    - Gambusia
    - Carp
    - Cane Toads
    - Koi Carp (goldfish)

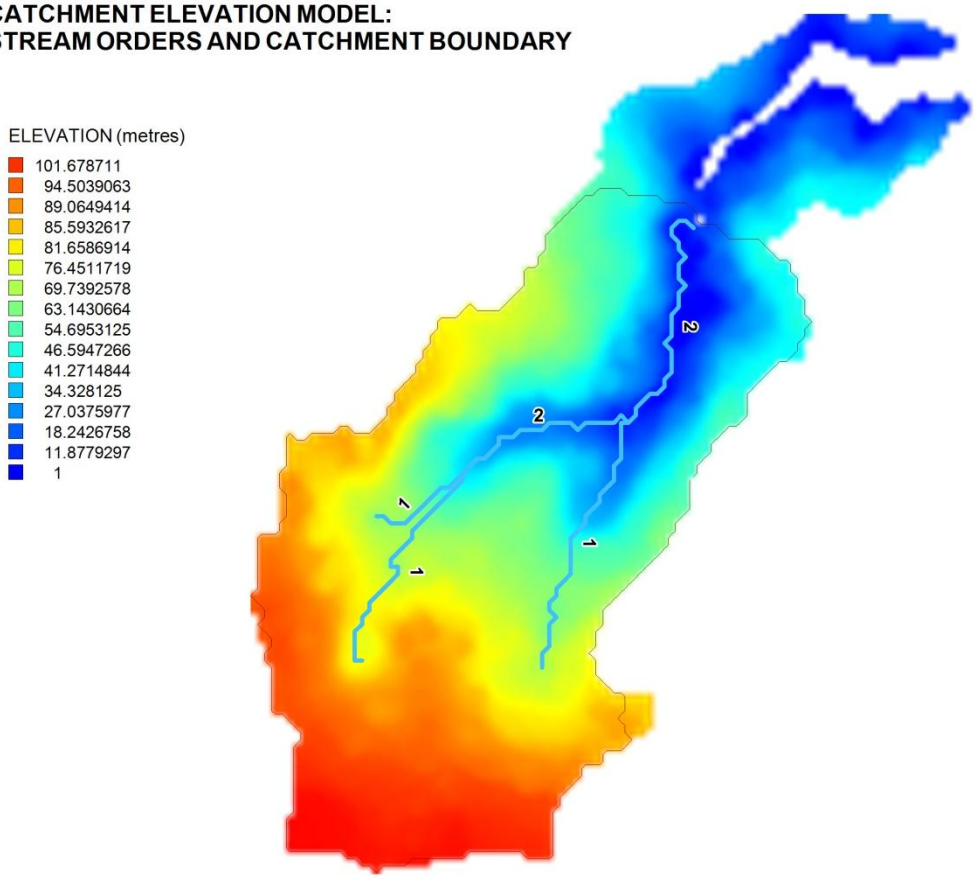
RIPARIAN IMPACTS

- Invasion by weeds
- Loss of species through replacement by others
- Loss of diversity (reduction in species numbers)
- Loss of habitat quality
- Disturbance from pedestrian access
- Disturbance from vehicle access
- Disturbance from excessive use by stock or other animals
- Clearing of vegetation
- Deliberate introduction of exotic plant species
- Selective removal of vegetation including
    - Loss of canopy
    - Loss of shrub layer
    - Loss of groundcover species

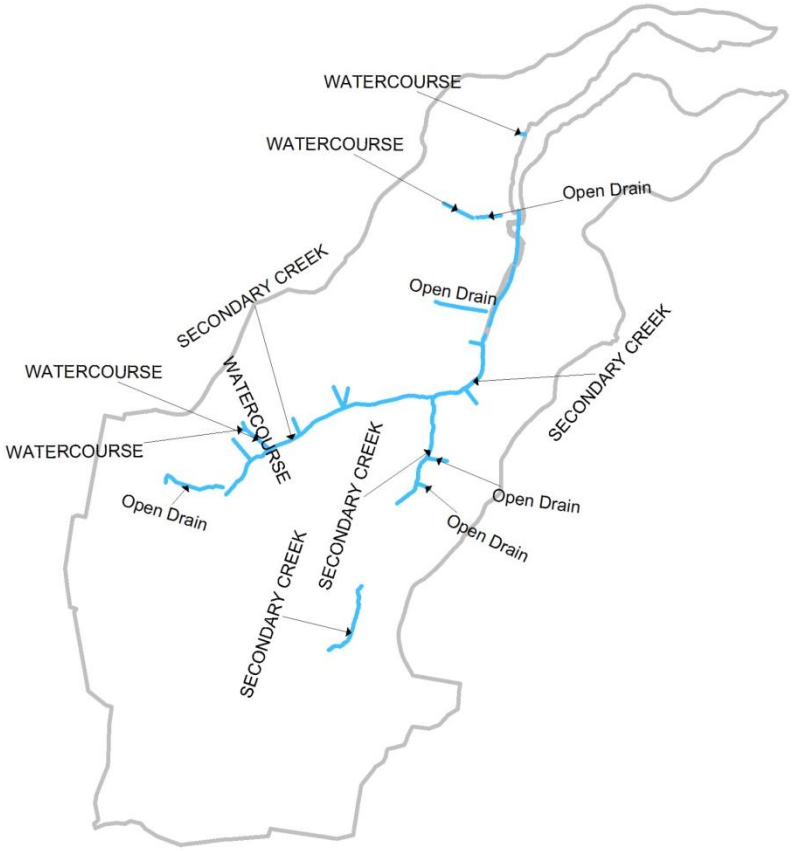
- Removal of habitat elements including
    - Loss of leaf litter
    - Loss of fallen timber
    - Loss of standing dead trees
    - Loss of rocks
    - Loss of microhabitat architecture
- Dumping of rubbish
- Littering
- Vandalism including
    - Damage to plants
    - Damage to abiotic habitat elements
    - Injured or killed animals
- Inappropriate fire regime
- Erosion
- Sedimentation
- Plant diseases including
    - Phytophthora (dieback)
    - Myrtle rust
    - Smut
    - Common rust
    - Mistletoes
- Feral animals including
    - Foxes
    - Rabbits
    - Deer
    - Cane Toads
    - Wild pigs
    - Feral cats
    - Introduced birds

RECREATED WATERWAYS MAP

CATCHMENT ELEVATION MODEL:
STREAM ORDERS AND CATCHMENT BOUNDARY



CURRENTLY MAPPED WATERWAYS AND CATCHMENT BOUNDARY

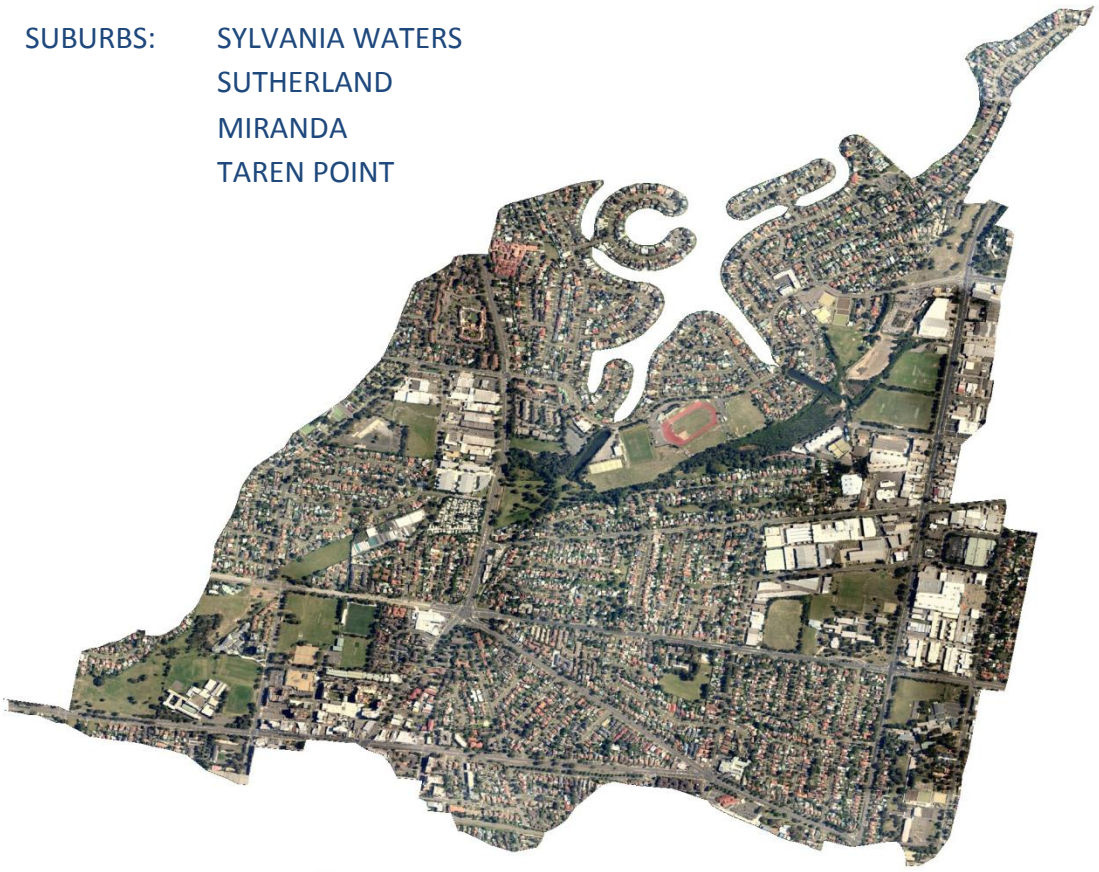


SYLVANIA WATERS SUBCATCHMENT

SUBCATCHMENT OVERVIEW

CATCHMENT AREA: 4.78 KM^2

SUBURBS: SYLVANIA WATERS
SUTHERLAND
MIRANDA
TAREN POINT



WATERWAYS

MAJOR NAMED WATERWAYS: SYLVANIA WATERS

TOTAL LENGTH OF MAPPED WATERWAYS: 3.93 KMs

PRIMARY ORDER CREEKS: 0 KMs

SECOND ORDER CREEKS: 1.04 KMs

MINOR DRAINAGE LINES: 1.27 KMs

OPEN DRAINS: 1.62KMs

WATER QUALITY ASSESSMENT

As part of their Strategic Water Quality Monitoring Plan, Sutherland Shire Council commenced monitoring water quality in a number of streams across the shire. Trends in water quality data collected from each stream were assessed and ranked against the ANZECC 2000 guidelines for recreational water quality in urban streams (SSC, 2004).

Samples were analysed summer and winter for between three and seven years at each site. This data has been interpreted here to give a brief historic summary of water quality in the subcatchment. First and last reported values for each parameter were assessed as higher (+) than the ANZECC 2000 guideline value, lower (-) than the guideline value, or equivalent (=) to the guideline value. The overall trend during the survey period was identified as increasing (↑) or decreasing (↓). This provides an indication whether management actions are having a positive effect on water quality, and whether further actions are required, for example, a parameter that exceeds the guideline value at the start of the survey period may still exceed it at the end of the period, but have shown significant improvements during the reporting period.

Two sites were sampled in Sylvania Waters subcatchment:

1. Silverwater Cres Miranda

PARAMETER	NH3	BOD	Cu	Pb	Zn
SUMMER 95 +/- ANZECC 2000 values	+	+	+	+	=
WINTER 02 +/- ANZECC 2000 values	+	+	+	-	+
TREND ↓↑	↑	↓	↓	↓	↑
PARAMETER	**Enterococci**	**Grease**	**TN**	**TP**	**TSS**
SUMMER 95 +/- ANZECC 2000 values	+	=	+	+	-

WINTER 02 +/- ANZECC 2000 values	+	-	+	+	-
TREND ↓↑	↑	↓	↑	↓	↓

An increase in values was reported for a number of parameters, and most parameters surveyed exceeded ANZECC 2000 guidelines at the end of the survey period.

2. Gwawley Park

PARAMETER	NH3	BOD	Cu	Pb	Zn
SUMMER 95 +/- ANZECC 2000 values	+	+	+	+	=
WINTER 02 +/- ANZECC 2000 values	=	+	+	-	-
TREND ↓↑	↓	↓	↓	↓	↓
PARAMETER	**Enterococci**	**Grease**	**TN**	**TP**	**TSS**
SUMMER 95 +/- ANZECC 2000 values	+	+	+	-	+
WINTER 02 +/- ANZECC 2000 values	+	-	-	-	-
TREND ↓↑	↑	↓	↓	=	↓

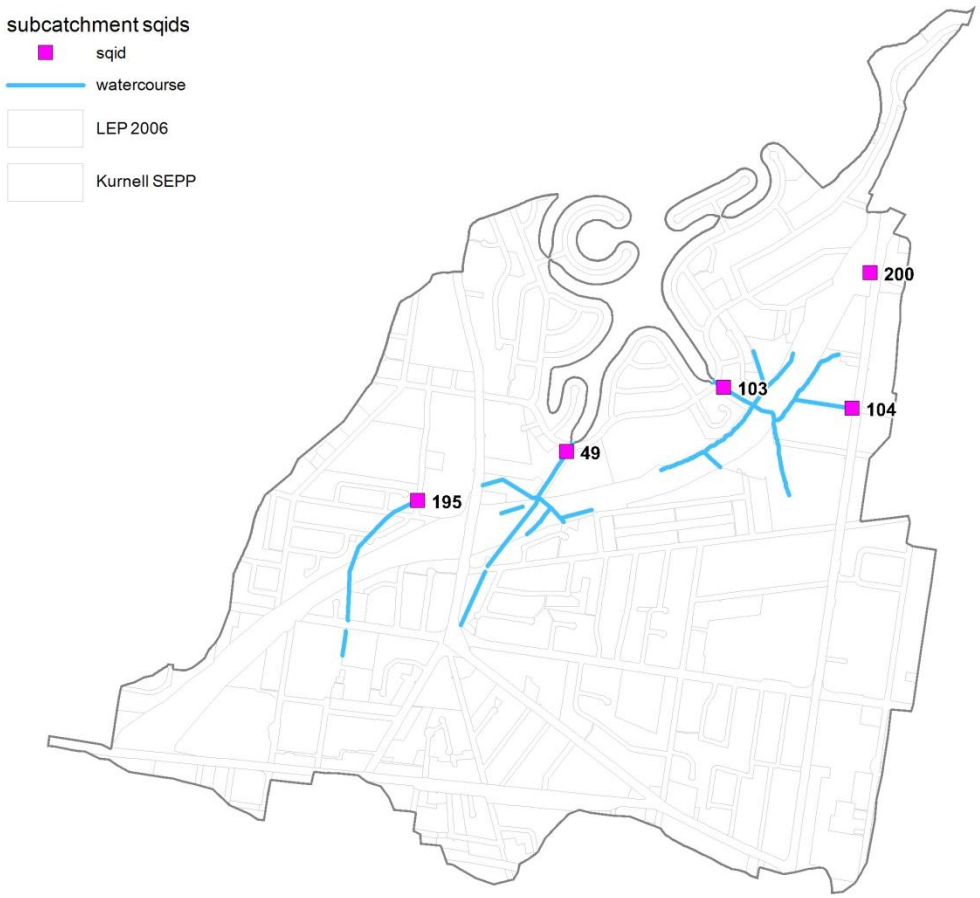
A number of parameters showed an increase in values during the survey period, including BOD, copper and enterococci which frequently exceeded ANZECC 2000 guideline values. Decreases in values for other parameters were reported, a number of which were within guideline values at the end of the survey period.

RETICULATED STORMWATER SYSTEM

LOCATION OF SQIDS

ID	DEVICE CATEGORY	DEVICE TYPE	LOCATION	SITE DESCRIPTION	SUBURB	APPROX. CATCHMENT
104	GPT - Other	Floating Litter Trap	Taren Point Road	Gwawley Park Channel	Taren Point	16.1 Ha
49	GPT - Other	Floating Litter Trap	Belgrave Esplanade	Next to Doltone House	Sylvania Waters	201 Ha
103	GPT - Other	Floating Litter Trap	Belgrave Esplanade	Bellinger Place Channel	Sylvania Waters	152 Ha
195	GPT - Other	Child Proof Grate	Kiama St	Southern end of Kiama St in reserve	Miranda	
200	GPT	Trash Rack	Crn Taren Pt & Holt Rd	103-111 Taren Point Road	TarenPoint	

LOCATION OF SQIDS



GEOMORPHIC SETTING

GEOLOGY, GEOMORPHOLOGY AND SOILS

Sylvania Waters subcatchment soil landscapes are all Disturbed Terrain Soil Landscape (xx) (from Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet Map and Report; see summary explanations in Geology and Soils section for Georges River catchment).

TOPOGRAPHY

Much of the land surface of Sylvania Waters subcatchment is on reclaimed land, and has a elevation of less than 3m AHD around all the foreshores areas. A plateau area in the southern part of the subcatchment is higher than 28m, with a maximum height of 39m AHD.

ASS/PASS, URBAN SALINITY

LEP (00 &06) CLASS	HECTARES
CLASS 1	3.10
CLASS 2	12.23
CLASS 3	114.35
CLASS 5	175.31

The comparatively large area of Class 3 ASS is symptomatic of the low elevation reclaimed land that forms much of Sylvania Waters. Class 5 ASS is found in a band around the original foreshores areas.

OTHER CONTAMINATION ISSUES

None noted

LAND USE

HISTORIC LAND USE

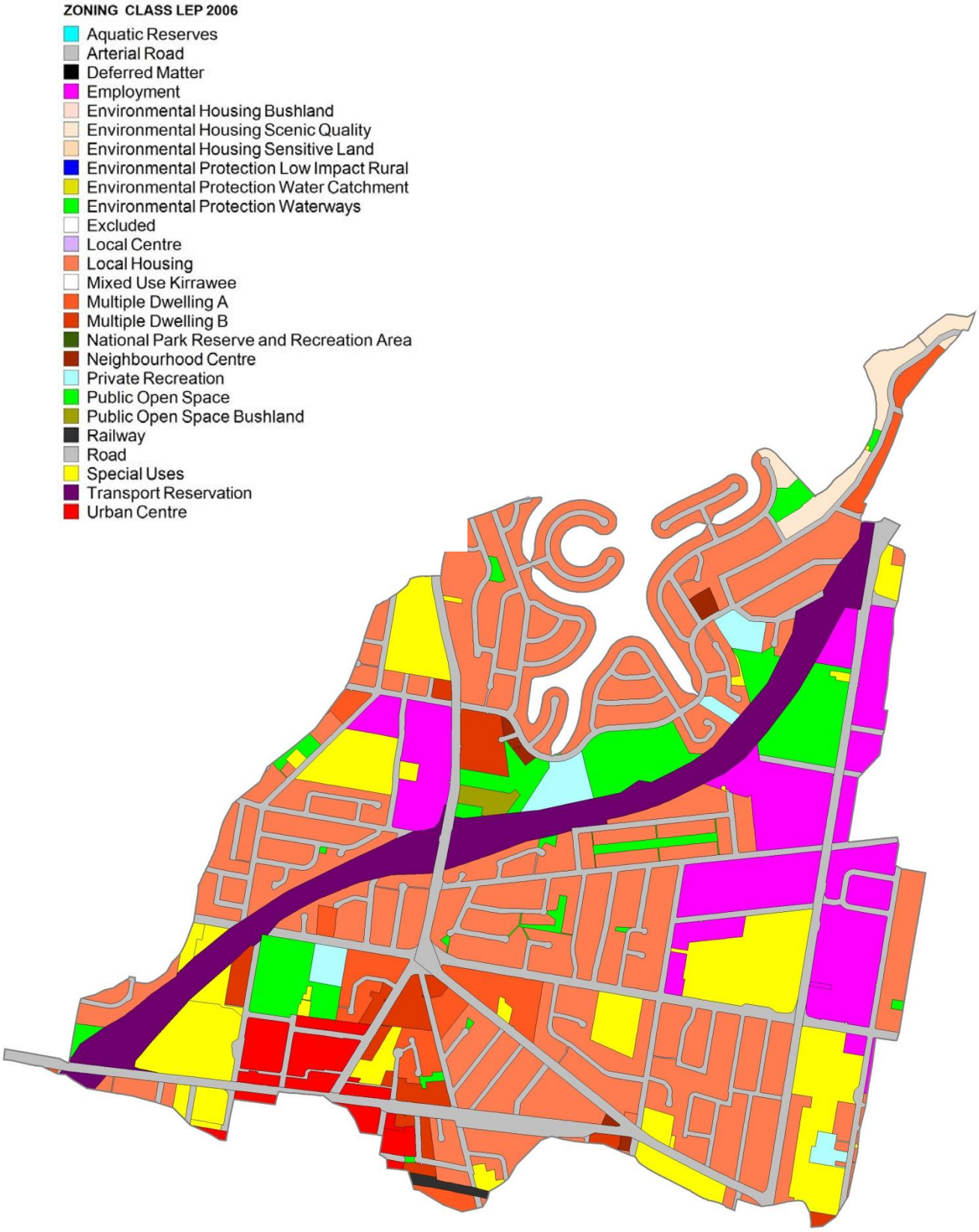
Sylvania was named for the beauty of its sylvan setting (Lawrence, 1997). In its very early days the area known as Sandy Point (in the middle of the subcatchment) was a notorious campsite for escaped convicts, bushrangers and runaway sailors (Jackson, 2006). The dense bush provided excellent cover to observe new arrivals, and leg irons dug up during excavations for Sylvania Waters is further evidence of their presence. In 1813 Gregory Blaxland was awarded a grant of 400 acres at Sylvania, and he built a house there. He later forfeited the land and it was granted to John Connell in 1821. The land was passed to Connell's grandson John Connell Laycock, along with extensive additions to the holdings.

Laycock's property was sold to Thomas Holt in 1868, and included most of the land around Sylvania Waters. He built a large sandstone house at Sylvania, named Sutherland House and completed in 1881, shortly before he left Sydney. In Gwawley Bay Thomas Holt planned and excavated a series of canals where he had acquired a freehold of approximately 180 acres of the waters of the bay. The canals were constructed in the marshy foreshores at the head of the bay and were to be used in Holt's oyster cultivation ventures. The canals, all in neat rows, were about 20 feet wide and four feet deep, with about 10 feet between each canal. There were several miles of canals, all emptying into the main channels (Lawrence, 1997).

In the 1920s the bay was owned by an oyster farming family, and then sold in the 1950s before being bought by a development syndicate in 1960. Sylvania Gardens P/L proposed to build a garden suburb, complete with waterways, recreation areas, living, school and industrial sites, roads and shops. Economic pressure resulted in changes to the plans, and three islands were created, all linked to the mainland by bridges and contained behind a five mile long retaining wall. Compared to other parts of the Shire the area has a long history of modification, both hydrological and terrestrial, with much of the catchment area cleared for market gardens and orchards, and small herds of sheep and cattle.

Figure 5. Aerial views of the construction of Sylvania Waters housing estate, July 1965.

CURRENT LAND USE



CATCHMENT IMPERVIOUS SURFACE (% AND DISTRIBUTION)

ZONING DESCRIPTOR	HECTARES	% CATCHMENT	POTENTIAL IMPERVIOUS	HECTARES IMPERVIOUS
Deferred Matter	0.00	0%	0%	0.00
Environmental Housing Sensitive Land	6.39	1%	43%	2.75
Environmental Housing Scenic Quality	0.00	0%	57%	0.00
Environmental Housing Bushland	0.00	0%	57%	0.00
Local Housing	165.70	17%	51%	84.51
Multiple Dwelling A	15.05	2%	64%	9.63
Multiple Dwelling B	11.16	1%	64%	7.14
Mixed Use Kirrawee	0.00	0%	64%	0.00
Urban Centre	11.09	1%	94%	10.43
Local Centre	0.00	0%	88%	0.00
Neighbourhood Centre	1.47	0%	86%	1.26
Employment	48.64	5%	95%	46.21
Special Uses	52.01	5%	30%	15.60
Public Open Space	28.71	3%	5%	1.44
Public Open Space Bushland	1.36	0%	0%	0.00
Private Recreation	7.32	1%	5%	0.37
Environmental Protection Waterways	0.01	0%	0%	0.00
Aquatic Reserves	0.00	0%	0%	0.00
National Park Reserve and Recreation Area	0.00	0%	0%	0.00
Railway	0.85	0%	33%	0.28
Arterial Road/Road	93.30	9%	66%	61.58
Transport Reservation	34.59	3%	5%	1.73
TOTALS	477.65	48%	51%	242.92

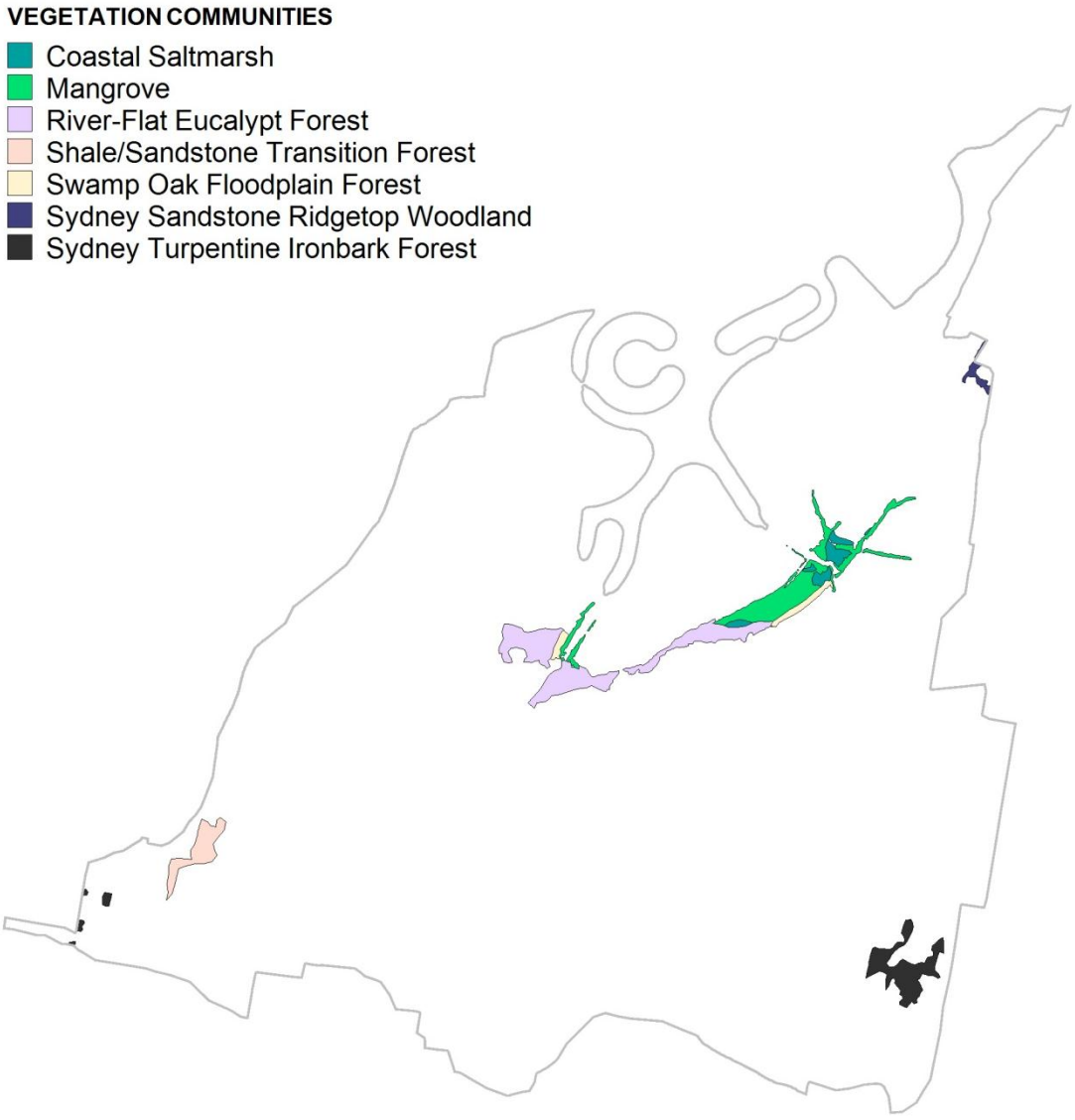
VEGETATION COMMUNITIES

MAPPED VEGETATION COMMUNITIES

0.89 HECTARES COASTAL SALTMARSH
3.64 HECTARES MANGROVE
4.61 HECTARES RIVER-FLAT EUCALYPT FOREST
1.29 HECTARES SHALE/SANDSTONE TRANSITION FOREST
0.59 HECTARES SWAMP OAK FLOODPLAIN FOREST
0.36 HECTARES SYDNEY SANDSTONE RIDGETOP WOODLAND
2.37 HECTARES SYDNEY TURPENTINE IRONBARK FOREST

LEP 2006 SIGNIFICANT VEGETATION

LEP TAG	NAME	CLASS
T43	Melaleuca quingvenervia_Paper bark	Significant Group of Trees or Vegetation
T42	Eucalyptus racemosa	Significant Group of Trees or Vegetation



BUSHLAND RESERVES AND RESTORATION

Reserves

1) Greenweb Core areas

- Sylvania Waters Field

2) Greenweb Support areas

- Sylvania Waters Field

3) Greenweb Restoration areas

- Gwawley Park
- Holt Rd/Curtis Ave/Belgrave Esp/Wollondilly Pl/Paroo Ave/Bellinger Pl
- Sylvania Waters Field
- Forshaw Field
- Captain Cook Golf Course
- Port Hacking Road Reserve/Bowral Ave/Wingello Rd/Kiama St

Bushcare Groups

- Port Hacking Road Reserve

THREATENING PROCESSES

INSTREAM IMPACTS

- Loss of riparian habitat
- Degradation of riparian habitat
- Loss of emergent vegetation
- Removal of large woody debris
- Loss or reduction of allochthonous material as a stream input
- Loss or reduction of shading of stream
- Changes to the proportion of catchment impervious surface
- Changes to infiltration patterns
- Construction of dams and other impediments to flow
- Draining of wetland areas
- Channelization
- Modification of channel bedform
- Modification of bank configuration
- Pipe replacement of channel
- Erosion
- Sedimentation
- Point source pollution

- Non-point (diffuse) source pollution
- Increased nutrient loads
- Introduction of toxic compounds
- Introduction of oils and organobenzenes
- Introduction of herbicides and pesticides in runoff
- Reduction of light penetration
- Algal bloom
- Emergent aquatic weeds
- Floating aquatic weeds
- Change in temperature regime
- Barriers to fish passage
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- Diseases from untreated or poorly treated sewage
- Reduction in water through extraction
- Introduction of invasive species including
    - Gambusia
    - Carp
    - Cane Toads
    - Koi Carp (goldfish)

RIPARIAN IMPACTS

- Invasion by weeds
- Loss of species through replacement by others
- Loss of diversity (reduction in species numbers)
- Loss of habitat quality
- Disturbance from pedestrian access
- Disturbance from vehicle access
- Disturbance from excessive use by stock or other animals
- Clearing of vegetation
- Deliberate introduction of exotic plant species
- Selective removal of vegetation including
    - Loss of canopy
    - Loss of shrub layer
    - Loss of groundcover species
- Removal of habitat elements including
    - Loss of leaf litter

    - Loss of fallen timber
    - Loss of standing dead trees
    - Loss of rocks
    - Loss of microhabitat architecture
- Dumping of rubbish
- Littering
- Vandalism including
    - Damage to plants
    - Damage to abiotic habitat elements
    - Injured or killed animals
- Inappropriate fire regime
- Erosion
- Sedimentation
- Plant diseases including
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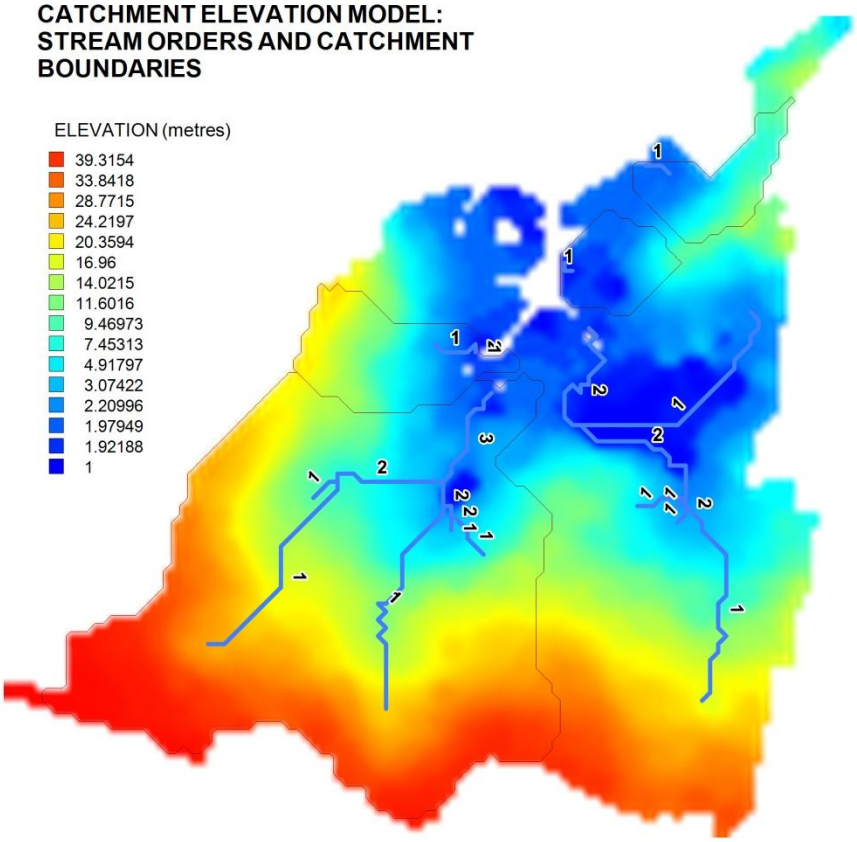
    - Myrtle rust
    - Smut
    - Common rust
    - Mistletoes
- Feral animals including
    - Foxes
    - Rabbits
    - Deer
    - Cane Toads
    - Wild pigs
    - Feral cats
    - Introduced birds

RECREATED WATERWAYS MAP

CATCHMENT ELEVATION MODEL: STREAM ORDERS AND CATCHMENT BOUNDARIES



CURRENT MAPPED WATERWAYS AND CATCHMENT BOUNDARIES