Parramatta River Estuary Processes Study

Parramatta River Estuary Committee

October 2010

AECOM

Parramatta River Estuary

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Cover photograph: View from Kissing Point Park (Ryde LGA) looking south across Parramatta River to Concord Hospital Watergate (Canada Bay LGA)

Parramatta River Estuary

Processes Study

Prepared for

Parramatta River Estuary Committee

Prepared by

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			Name/Position	Signature
1	15-Feb-2010	Draft Final	Jay Stricker, Technical Director - Environment	Original signed
2	30-Aug-2010	Final Draft	Tim Summers, Associate Director	Original signed
3	21-Oct-2010	Final	Tim Summers, Associate Director	

Executive Summary

The Parramatta River Estuary Management Committee, represented by Parramatta City Council, engaged AECOM Australia Pty Ltd to undertake the Parramatta River Estuary Process Study. This study is an important component required for the development of an estuary management plan for the study area, as guided by the processes established by State Government in the NSW Estuary Management Policy.

The study area comprises the Parramatta River, which extends from Parramatta Weir to Clarkes Point, Woolwich in the north and Yurulbin Point, Birchgrove in the south, and tributary tidal waterways and bays. Local government areas (LGAs) which contain catchments draining into the study area and land that is contiguous with the estuary's waterways include: Leichhardt; Ashfield; City of Canada Bay; Strathfield; Auburn; Parramatta; Ryde; and Hunters Hill.

LGAs which drain into the study area but are located higher in the various catchments include: Marrickville; Burwood; Bankstown; Holroyd; Blacktown, and The Hills (formerly Baulkham Hills). Key non-local government stakeholders that are responsible for management of land and waterways within the study area include: the Department of Environment Climate Change and Water – Coast and Estuaries (DECCW); Sydney Metropolitan Catchment Management Authority (SM-CMA); NSW Maritime; Investment and Industry NSW (I&I NSW); NSW Health; Sydney Harbour Foreshore Authority; Sydney Water (SW); the NSW Roads and Traffic Authority (RTA); Sydney Olympic Park Authority (SOPA); the State Rail Authority (SRA) and the Shell Refinery.

Preceding the development of the Parramatta River Estuary Processes Study, a data compilation study was completed by Cardno Lawson and Treloar in 2008. The data compilation study identified a range of management issues, data gaps and recommendations for further studies, many of which formed the scope of works for this processes study.

Specific issues and management options relevant to each of the following aspects were investigated:

- Historical land-use changes by way of analysis of aerial photography taken in 1943 and present day;
- Stormwater management, with a focus on existing stormwater control devices, and catchments where such are required;
- Condition assessment of seawalls and prioritisation of where replacement or repairs of seawalls would provide opportunities for habitat creation;
- Natural shoreline erosion, which included conceptual options for managing erosion of mangroves upstream of Silverwater Bridge due to large vessel impacts;
- Condition assessment of foreshore facilities and prioritisation of where facilities require repairs or replacement; and
- Estuarine vegetation, including seagrass, mangroves, saltmarsh and riparian vegetation communities up to the 40m mean high water mark (MWHM).

Historical Land-Use Change

The estuary and its catchment have been exposed to persistent stress over the last two centuries due to historical and current anthropogenic impacts. Up until 1970 the Parramatta River was an open drain for industry in Sydney, and consequently the river's embankments and sediments are contaminated with a range of heavy metals and chemicals. Historically, industrial development has impacted upon the southern side of the harbour and river substantially more than the northern side due to well-established industrial development prior to the opening of the Sydney Harbour Bridge in 1932 (PCC 2008).

Contaminated sediments in the river resulted in a complete fishing ban in Homebush Bay (due to dioxin contamination) and a commercial fishing ban throughout the rest of Sydney Harbour and its tributaries, including the Parramatta River (2006).

Analysis of 1943 and present day photography, indicates that the majority of land reclamation in the study area occurred prior to 1943. A reduction of between 22% and 24% of the pre-European settlement foreshore length is reported (Birch and Taylor 2004, 2006), with major areas of land

reclamation (prior to 1943) located within Homebush Bay, Iron Cove Bay, Hen and Chicken Bay and the Auburn LGA.

The following trends since 1943 were identified during this study:

- Approximately 292 ha of land was reclaimed;
- Approximately one kilometre of foreshore was lost as a result of land reclamations;
- Large areas of agricultural land (mostly in the western areas of the catchment) have been subdivided for residential use, while other areas, more towards the east of the catchment have not altered greatly. This is due to the eastern areas of the catchment being well established as residential suburbs (such as Drummoyne, Hunters Hill, Concord and Balmain) prior to 1943;
- As expected there has been an increase in residential and commercial areas within the catchment. However, an additional trend was realised where development has decreased since 1943. In other words, areas once industrial, particularly along the foreshore, have since been redeveloped as residential and open space;
- Parramatta and Auburn LGAs contain the greatest areas of contemporary industrial land-use. Historically, Auburn LGA also exhibited large areas of industrial land use, and contains large areas of reclaimed land. Therefore, estuarine areas more likely to be adversely affected by industrial areas and leachate from land reclamation are located in Parramatta and Auburn LGAs (e.g. Parramatta River, Duck River, and Homebush Bay). It is noted that remediation of large areas of contaminated land has occurred as part of the redevelopment of Homebush Bay for the Sydney 2000 Olympic Games; and
- Other areas of potential concern include several bays in the City of Canada Bay LGA which have been truncated by land reclamation (e.g. Iron Cove Bay, Hen and Chicken Bay). The City of Canada Bay LGA also contains that part of Homebush Bay which continues to be remediated as part of the redevelopment of Rhodes for residential and commercial purposes.

Considerable research has been conducted, and continues, by Sydney University, in relation to contaminated sediments within the study area (Birch and Taylor 2004, Birch and Taylor 2006, McCready et al., 2006). Mean concentrations of heavy metals, organochlorine compounds and polycyclic aromatic hydrocarbons (PAHs) in surficial sediments of Port Jackson, including the study area, are among the highest reported in the world. Concentrations of all three classes of contaminant are highest in the upper reaches of embayments and tributaries, especially those on the southern shores of the estuary. These areas are typically:

- Close to the sources of contamination;
- Mantled in muddy sediments which have an affinity for pollutants; and
- Poorly flushed by tides and currents.

Birch and Taylor (2004) systematically identified ‘areas of concern’ using a combined Effects Range Median (ERM) quotient of 27 pollutants (in relation to possible biological effects), from which areas of the harbour were prioritised. The ERM is the level above which adverse biological effects occur frequently, or are predicted amongst most species to occur. The equivalent nomenclature in the ANZECC is the Interim Sediment Quality Guidelines – High (ISQG-H). In the Australian context, sediments with contamination concentrations exceeding ISQG– Low values automatically trigger additional environmental investigation.

High priority areas are where the probability of sedimentary toxicity is estimated to be the greatest. In the study area high priority areas are confined to small parts of Five Dock Bay, Iron Cove and the main channel of the river upstream of Hen and Chicken Bay. Medium to high priority areas with a lower probability of sediment toxicity include parts of the river, Homebush Bay, Iron Cove, and Five Dock. Medium-low-priority areas are located in the main channel of the central and lower harbours (Figure 1).

Prioritisation by Birch and Taylor (2004) is represented within environmental sensitivity mapping for the study area in Section 8.0 of this study. It is recommended that the suite of GIS data layers produced by researchers at Sydney University be sought by the Committee for incorporation into the project GIS database.

Stormwater Management

The study area has a highly urbanised catchment and as such water quality will continue to be a major environmental issue which the various Councils, regulatory authorities, and stakeholders will need to proactively manage.

The total catchment area draining to the study area is estimated at 25,367 ha, with the main sub-catchments including:

- Upper catchment to tidal extent of river at Parramatta Weir (10,884 ha);
- Duck River (4,531 ha);
- Homebush Bay (2,996 ha);
- Iron Cove Bay (1,814 ha);
- Hen and Chicken Bay (849 ha);
- Ponds Subiaco Creek system (846 ha); and
- Vineyard Creek (414 ha).

The remaining sub-catchments comprise smaller bays, creeks, and foreshore land draining via stormwater systems.

A key objective of this study was to consolidate available GIS data layers and gather additional data in relation to

(a) stormwater outlets draining to the estuary, and

(b) existing gross pollutant traps (pollution control devices, stormwater quality improvement devices, etc)

GIS stormwater drainage layers obtained from various Councils were merged into one layer and updated to illustrate any stormwater outlets found during field investigations that were not already mapped. Approximately 670 stormwater outlets discharge catchment runoff directly into the river its tributaries (including canals) and embayments.

Obtaining detail on existing gross pollutant traps operated in the study area (such as type, location, pollutants removed, cleaning regimes, etc) was constrained due to non-uniform data collection and reporting format between stakeholders.

It is recommended that consolidation of stormwater management activities and more uniform data collection and reporting format by all stakeholders be facilitated by the Committee. The present format provided in City of Canada Bay Council's SoE provides a baseline template from which an overarching format could be developed further by the Committee. Additional collection of maintenance frequency data is also required so the efficacy of gross pollutant trapping can be determined.

In the absence of comprehensive and consistent data relating to stormwater management devices, the following sub-catchments in the study area would preliminarily appear to warrant additional gross pollutant management:

- Duck River sub-catchments, including Clay Cliff Creek sub-catchment;
- Homebush Bay, upper catchment areas;
- Charity Creek;
- Glades Bay;
- Bedlam Bay;
- Yaralla Bay;
- Majors Bay;
- Hen and Chicken Bay;
- Five Dock Bay; and
- Iron Cove Bay: in particular the upper reaches of both Hawthorne Canal and Dobroyd Canal sub-catchments.

The study area's catchment is highly variable in character, and stormwater management must reflect this variation, i.e. ensuring that management activities and prioritisation of such are appropriately targeted.

Five stormwater management plans were prepared as an initiative driven by the former Environment Protection Authority in the late 1990s. These include the Duck River Stormwater Management Plan 1999 – reviewed in 2004; Homebush Bay Catchment Stormwater Management Plan 1999; Lower Parramatta River Stormwater Management Plan 1999; Mid Parramatta River Stormwater Management Plan 1999; and Upper Parramatta River Stormwater Management Plan 1999 – revised in 2002.

It is presently unclear as to what proportion of the recommendations made, in these plans, have been implemented. It is recommended that all of these plans be audited and that recommended actions be compared with actual Council completed projects. Identified gaps may then form the basis of future management considerations.

Seawalls

Seawalls have been constructed extensively along the study area's shoreline to protect foreshore assets, guard against inundation and support reclaimed parklands. These seawalls and other marine structures provide surfaces for colonisation by benthic organisms and have the potential to supplement natural habitat by supporting natural assemblages in terms of species composition and relative abundances (Derbyshire, 2006). More recently there has been a move to reintroduce intertidal habitat to urbanised estuaries and this study reports on the potential to do so in the Parramatta River Estuary.

Visual assessment of all seawalls (solid concrete, sandstone blocks, loose rubble revetment etc) along the foreshore was conducted to identify stretches of seawall requiring replacement or upgrading due to visual signs of degradation (e.g. cracking, landward subsidence, collapse).

An estimated 36 km of seawalls and 21 km of canals were inspected for this study. This represents approximately 45% of the total shoreline (approx. 136km). A total of 186 discrete sections of seawall and 162 discrete sections of tidally influenced canals were assessed within the following LGAs:

- Ashfield (seawalls: <1.0 km, canals: 4.5 km);
- Auburn (seawalls: 5.4 km);
- City of Canada Bay (seawalls: 16.2 km, canals: 7.2 km);
- Hunters Hill (seawalls: 2.2 km);
- Leichhardt (seawalls: 3.2 km; canals: 2.1 km);
- Parramatta (seawalls: 5.0 km);
- Ryde (seawalls: 3.0 km, canals 3.5km); and
- Strathfield (canals: 3.6 km).

To determine the most appropriate locations for habitat creation (as part of repairs or replacement), seawall sections that were found to be poor condition or had some form of major defect (i.e. categorised as 'failed') were further assessed and prioritised on the basis of the following:

(a) Existing function(s) of the seawall, and

(b) Future potential value each seawall section might provide following environmental enhancement works

The most common functions of seawalls in the study area are the provision of support for other foreshore structures and reclaimed land. Failure of seawalls that structurally support other foreshore facilities (e.g. pathways, jetties) may result in replacement costs of more than just the seawall, and also impact on aesthetics, public amenity and so on. Where seawalls protect reclaimed land, seawall failure may result in the liberation of 'potentially contaminated' landfill. This in turn would impact on water quality and aquatic biota. Furthermore, the potential for loss of land to the estuary may result where unconsolidated landfill is no longer supported.

Potential values were based on the function of the surrounding environment and therefore opportunities that could be capitalised on in the future (e.g. public access and use; recreation; education/interpretation).

Eighty four (84) seawall sections either categorised as 'poor' or 'failed' were assessed in this manner. Table 1 lists the 20 highest priority seawall sections which are considered the most appropriate locations for habitat creation.

Table 1.High priority seawall sections within the study area

Priority	Asset Name	Locality	LGA
High	CAN_S60	Mortlake Point, River South	Canada Bay
High	PAR_S16	Macarthur St Bridge, River South	Parramatta
High	RYD_S06	Morrison Bay, River North	Ryde
Medium-High	ASH_S03	Dobroyd Point, Iron Cove Bay	Ashfield
Medium-High	CAN_S23	Drummoyne, Five Dock Bay	Canada Bay
Medium-High	CAN_S63	Concord West, Yaralla Bay	Canada Bay
Medium-High	CAN_S66	Rocky Point, River South	Canada Bay
Medium-High	HUN_S11	Tarban Creek	Hunters Hill
Medium-High	LEI_S08	Balmain, Iron Cove Bay	Leichhardt
Medium-High	LEI_S09	King George Park, Iron Cove Bay	Leichhardt
Medium-High	LEI_S11	Callan Park, Iron Cove Bay	Leichhardt
Medium-High	LEI_S13	Callan Park, Iron Cove Bay	Leichhardt
Medium-High	LEI_S14	Callan Park, Iron Cove Bay	Leichhardt
Medium-High	LEI_S15	Callan Park, Iron Cove Bay	Leichhardt
Medium-High	LEI_S16	Leichhardt Park, Iron Cove Bay	Leichhardt
Medium-High	PAR_S06	Silverwater Bridge, River North	Parramatta
Medium-High	PAR_S09	Rydalmere Rail Bridge, River North	Parramatta
Medium-High	PAR_S17	Macarthur St Bridge, River South	Parramatta
Medium-High	RYD_S23	Meadowbank, River North	Ryde
Medium-High	RYD_S24	Meadowbank, River North	Ryde

Options to improve the environmental value of seawalls are provided in Section 4.0 of this study. These have been based on techniques provided in 'Environmentally Friendly Seawalls' guidelines produced by the NSW DECCW in conjunction with the SM-CMA (Wiecek, 2009) and AECOM project experience of similar scope and nature.

Natural Shoreline Erosion

Natural foreshore areas within the study area typically comprise beaches, rock platforms, vegetated shoreline and non-vegetated shoreline (i.e. mudflats). These areas may be vulnerable to short duration erosion events and longer term recession or accretion.

Episodic erosion of natural foreshores in the study area may be caused by severe storms, vessel wash, flooding, high tides and informal public access which over time destabilises banks. Longer term shoreline recession or accretion can be caused by changes to mean sea-level, sediment availability, and changes in river hydrodynamics due to foreshore and channel realignment and dredging.

Forty four (44) areas of foreshore erosion were found in the study area, which equates to approximately 13 km of shoreline (Table 2).

Table 2. Foreshore erosion in the study area.

LGA	Good	Poor	Failed	Total Length of Foreshore Erosion (m)
Auburn	0.0	0.0	572.8	572.8
Canada Bay	1,035.7	1,131.8	142.1	2,309.6
Parramatta	0.0	369.2	8,212.30	8,581.5
Ryde	962.6	721.8	111.0	1,795.4
Total Length	**1,998.3**	**2,222.8**	**9,038.2**	**13,259.3**

Approximately 70% (9.2 km) of shoreline exhibiting erosion is located upstream of Silverwater Bridge. This section of the river is characterised by a narrow channel, shallow water depths, banks vegetated with mangroves, and is subject to long wave durations from Rivercat movements.

The long wave period associated with Rivercat wash significantly limits the range of remedial options available. Environmentally favourable solutions, such as coir logs and jute matting are unsuitable for wave climates with wave periods larger than around three seconds, such as those created by wash from the Rivercat (i.e. on average approximately seven seconds).

Three options are proposed for remediation of eroding shorelines upstream of Silverwater Bridge:

1. The installation of two intermittent rows of sheet piling to retain intertidal exchange and maintain natural habitat. A porous rubble rock structure would be used between the pile wall segments to control water flow while providing channels for fish movement;
2. The installation of rock or concrete armour units would protect the shoreline to typical engineering detail including appropriate underlayers. This option has already been employed in the study area and elsewhere using A-Jack armour units; or
3. Installation of a slatted breakwater (vertical timber slats) to attenuate wave energy, with an alternate low wash (short wave period).

The advantages, disadvantages and environmental benefits or impacts are discussed in Section 6.0 of this study along with indicative sketches and initial cost estimates for each option. Additional erosion techniques are also discussed and recommended for areas of foreshore erosion where vessel wash is not a limiting factor. Such techniques include coir logs, low profile sills and revegetation.

Foreshore Facilities

As the region has moved away from its industrial past, the foreshore has been reclaimed for recreational uses with considerable investment at both the state and local government levels. The foreshore facilities are utilised in two distinct ways:

- Recreational boating purposes such as vessel launching/retrieval, temporary mooring and storage (facilities); and
- Foreshore recreational activities such as walking, jogging, fishing, family gatherings and picnics undertaken in foreshore parks.

Recreational facilities are prone to deterioration over time due to the chemically and physically dynamic environment in which they are located. In contrast with statically stable seawalls, facilities such as floating pontoons, wharves, jetties *inter alia* are themselves in constant flux due to hydrodynamic and climate influences, putting stress on the structural members and their connections.

Eighty four (84) facilities were visually assessed. Over half were found to be in good or excellent condition (i.e. 49 good, and 14 excellent). Eight facilities were found to have some form of major defect and 13 facilities were categorised as in poor condition (Table 3).

Table 3. Foreshore recreational facilities in the study area

LGA	Excellent	Good	Poor	Failed	Total
Auburn	1	3	2	3	**9**
Canada Bay	2	20	5	1	**28**
Hunters Hill	3	11	1	1	**16**
Leichhardt	3	6	-	1	**10**
Ryde	4	7	4	2	**17**
SOPA	1	2	1	-	**4**
Total	**14**	**49**	**13**	**8**	**84**

One of the most prominent issues associated with boating foreshore facilities is the lack of formal dinghy storage facilities. Dinghies are scattered along the foreshore, leaning against walls, rock shelves and trees. Informal access to these locations often results in the degradation of foreshore vegetation. Areas of both formal and informal dinghy storage were assessed during field investigations for this study.

Locations where formalised dinghy storage is required and management recommendations for all facilities assessed are discussed for the study area in Sections 6.0 and in the context of each LGA in Section 9.0 of this study.

Estuarine Vegetation

For the purpose of this study, estuarine vegetation is defined as that which is found in the sub-tidal zone, inter-tidal zone, and riparian vegetation which is contiguous with these zones. The scope of the vegetation assessment for this study includes riparian vegetation which is located up to 40m landward of the Mean High Water Mark (MHWM). However most vegetation within this zone is usually not considered 'estuarine' by definition, due to topography. A high proportion of vegetation within this zone has tolerance to salinity – but that which originates from sea spray, and not through tidal effects. These communities are defined as supra-tidal, and are less affected by threats and issues that impact upon estuarine vegetation, which are the focus of this study's vegetation assessment.

Estuarine vegetation communities in the study area include seagrasses, mangroves, saltmarsh, and Swamp-oak floodplain forest. Each one of these vegetation communities can tolerate salinity and, with the exception of Swamp-oak forest communities, have a tolerance to regular or permanent inundation. Other riparian vegetation communities present within the study area include Turpentine-ironbark forest, Coastal Sandstone Gully forest and Coastal Sandstone Ridgetop woodland.

Seagrasses and mangroves are protected under the *Fisheries Management Act 1994* (FM Act). Coastal saltmarsh, Swamp-oak floodplain forest, and Sydney turpentine-ironbark forest are listed as Endangered Ecological Community (EEC) in Part 3 of Schedule 1 of the *Threatened Species Conservation Act 1995* (TSC Act). Turpentine-ironbark forest is listed as a critically endangered ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Seagrasses

Seagrass cover in the study area was last mapped by West et al in 2004 and reassessed by West and Williams in 2008, with approximately 10.3 ha of seagrass habitat found in the study area. Field verification of seagrass habitat conducted for this study found the following:

- 9.2 ha of seagrass cover confirmed;
- 0.7 ha of seagrass cover unable to be verified;

- 0.3 ha of seagrass cover not evident on inspection; and
- 0.3 ha of previously unmapped seagrass cover found;

The net difference in seagrass cover from that mapped in 2004 is approximately 0.15 ha (or 1,500 m^2) which supports conclusions made by West and Williams (2008) that seagrass cover in Sydney Harbour has remained relatively static in the last 2 to 3 decades - following substantial loss in seagrass cover identified in comparison of 1970 and 2000 aerial photography (West et al 2004). Confirmed seagrass habitat is located in the following areas:

- 8.58 ha within waterways adjacent to the City of Canada Bay LGA which includes 0.3 ha of previously unmapped seagrass habitat;
- 0.62 ha within waterways adjacent to Leichhardt LGA. A number of previously mapped seagrass patches were not evident during field inspections (approximately 0.2 ha in Iron Cove Bay); and
- The remaining 0.06 ha located adjacent to the Ryde LGA, which includes a small increase in extent of cover found in Looking Glass Bay.

Verification of some areas of seagrass cover was not possible from boat-based field inspections due to the shallowness of mapped patches. Further land-based inspection undertaken was also constrained due to poor water clarity and / or high levels of sedimentation and excessive organic gross pollutants (mainly leaf litter).

Factors threatening existing seagrasses (extent and individual species) within the study area were identified as:

- Poor water quality:
  - excessive quantities of gross pollutants (sediment and organic materials blanketing seagrass, reducing light penetration, and /or inhibiting new growth in adjacent habitat),
  - elevated nutrients which promote algal and epiphytic growth on seagrass leaves (which in turn reduces light penetration), and
  - turbidity (which in turn reduces light penetration).
- Damage from water based recreational activities:
  - boat propellers, anchors (direct damage and uprooting plants),
  - watercraft launching (in particular dragging of non-motorised boats, surf skis etc directly damaging seagrass leaves and uprooting plants),
  - shading from jetties (which in turn reduces light availability); and
- Uncertainty of impacts from climate change (i.e. potential loss of habitat from sea level rise, increased storm activities).

The issue of greatest concern currently impacting on seagrass habitat is the quality of stormwater originating from various sub-catchments. This is particularly evident in the southern end of embayments (e.g. Iron Cove Bay, Hen and Chicken Bay, Five Dock Bay).

Mangroves

Mangrove communities in the study area are dominated by Grey mangrove (*Avicennia marina*), and less commonly River mangrove (*Aegiceras corniculatum*). Mangroves are the most widespread component of estuarine vegetation within the study area, although mangroves are believed to be more widely distributed and abundant in comparison to pre-European settlement along the Parramatta River (McLoughlin 2000).

Cumulatively the area in which mangroves occur within the study area is estimated at around 149 ha. The largest areas of mangrove stands occur within Homebush Bay and its tributaries (located within the Sydney Olympic Park) and thereafter along the river and its tributaries within the Parramatta LGA. Areas of mangroves within the study include:

- Sydney Olympic Park (63.8 ha)
- Parramatta LGA (40.0 ha)
- City of Canada Bay LGA (19.8 ha)
- Auburn LGA (13.2 ha)

- Ryde LGA (10.2 ha)
- Hunters Hill LGA (1.2 ha)
- Strathfield LGA (0.4 ha)
- Leichhardt LGA (<0.1ha)

Factors threatening mangroves within the study area were identified as:

- Local clearing and development activities;
- Poor water quality:
- Physical damage from watercraft;
- The use of informal access trails and other trampling effects;
- Ad hoc storage of non-motorised watercraft (e.g. dinghies) within mangrove areas;
- Deliberate lopping of tree limbs or poisoning of mangrove where such growth impinges on residential views; and
- Uncertainty of impacts from climate change (i.e. potential loss of habitat from sea level rise, increased storm activities).

Based on the presence of obvious impediments to landward migration, an estimated 78% of existing mangrove communities will potentially be impacted upon by sea level rise. Of further concern, is that areas in which mangroves have some potential to migrate landwards are presently occupied by endangered ecological communities (e.g. Saltmarsh and Swamp-oak floodplain forest).

Coastal Saltmarsh

Saltmarsh in the study area is estimated at around 23 ha. The largest areas of saltmarsh are located in Homebush Bay (Sydney Olympic Park) and thereafter within Mason Park Wetlands (Strathfield LGA), and along the river and its tributaries within Auburn LGA and Parramatta LGA respectively.

Areas of saltmarsh within the study area include:

- Sydney Olympic Park (18.6 ha);
- Mason Park Wetlands, Strathfield LGA (1.32 ha);
- Duck River and Wentworth Point, Hombush Bay, Auburn LGA (1.31 ha);
- Parramatta LGA (0.89 ha);
- City of Canada Bay LGA (0.72ha);
- Ryde LGA (0.26 ha); and
- Hunters Hill LGA (<0.02 ha)

Threats commonly cited that impact on saltmarsh communities and that are prevalent within the study area fall into the following categories:

- Altered hydrology and water quality;
- Interspecific competition;
- Weed infestations;
- Mowing;
- Rubbish/refuse dumping, litter;
- Access (trampling); and
- Sea level rise.

An estimated 65% of existing saltmarsh in the study area has some potential for landward migration, of which a large proportion is located within Newington Nature Reserve (Sydney Olympic Park). Tidal exchange influencing saltmarsh at this location is regulated by a weir which was purposely built to improve tidal flushing following a history of isolation from tidal flows entering these wetlands from the river.

The potential loss of 35% is significant when considered within the context of both the historical and more contemporary loss of saltmarsh. The relatively undefined impacts and timing of climate change

effects provides an impetus to ensure that the study area's estuarine vegetation is conserved and maintained in a healthy condition. Perhaps more importantly, the longer term survival of these communities warrants deliberate reinstatement or expansion of their existing extents wherever environmental conditions and existing land-uses are suitable.

Estuarine Riparian Vegetations

Approximately 70 ha of estuarine riparian vegetation occur in the study area, which includes approximately 30 ha of Swamp-oak floodplain forest and 22 ha of Sydney Turpentine-ironbark forest. The remaining estuarine vegetation is dominated by coastal-sandstone gully forest and ridgetop woodland.

Swamp-oak floodplain forest in the study area is located in the following LGAs:

- Sydney Olympic Park (18.2 ha);
- Parramatta LGA (5.5 ha);
- City of Canada Bay LGA (4.1 ha);
- Hunters Hill LGA (0.7 ha);
- Mason Park Wetlands, Strathfield LGA (0.7ha);
- Auburn LGA (0.4 ha);
- Leichhardt LGA (0.1 ha); and
- Ryde LGA (<0.1ha).

Sydney turpentine-ironbark forest in the study area is located in the following LGAs:

- Sydney Olympic Park (15.8 ha);
- Ryde LGA (1.6 ha).
- City of Canada Bay LGA (4.5 ha);

The main issues affecting riparian vegetation within the study area are:

- Infestations of introduced tree and shrub species, vines, and encroachment of grass species from adjacent open space areas;
- Access impacts (use of informal walking trails and trampling); and
- Sea level rise, which will also significantly limit the present extent of estuarine riparian vegetation where intertidal vegetation is able to migrate and tidal influences alter soil salinity and inundation frequencies.

The prioritisation of management actions (such as weed control programs) may be, by default, driven by the longer term recognition that some areas will be inundated and may not warrant dedication of typically scarce funding and resources.

GIS Compilation and Database

A key outcome of this study was to construct a spatial GIS database from which managers can interrogate all available physical, chemical and biological information on the study area.

A further objective of this task was to derive an environmental sensitivity map of the study area. This information shall establish the basis from which a Decision Support System (DSS) or tool can be developed at a later Stage (separate to this study).

Existing GIS data from a range of sources, including data collected as part of the data compilation study (Cardno Lawson and Treloar 2008), has been reviewed, standardised and incorporated into a project GIS database.

Environmental sensitivity mapping produced for this study includes the following values and threats:

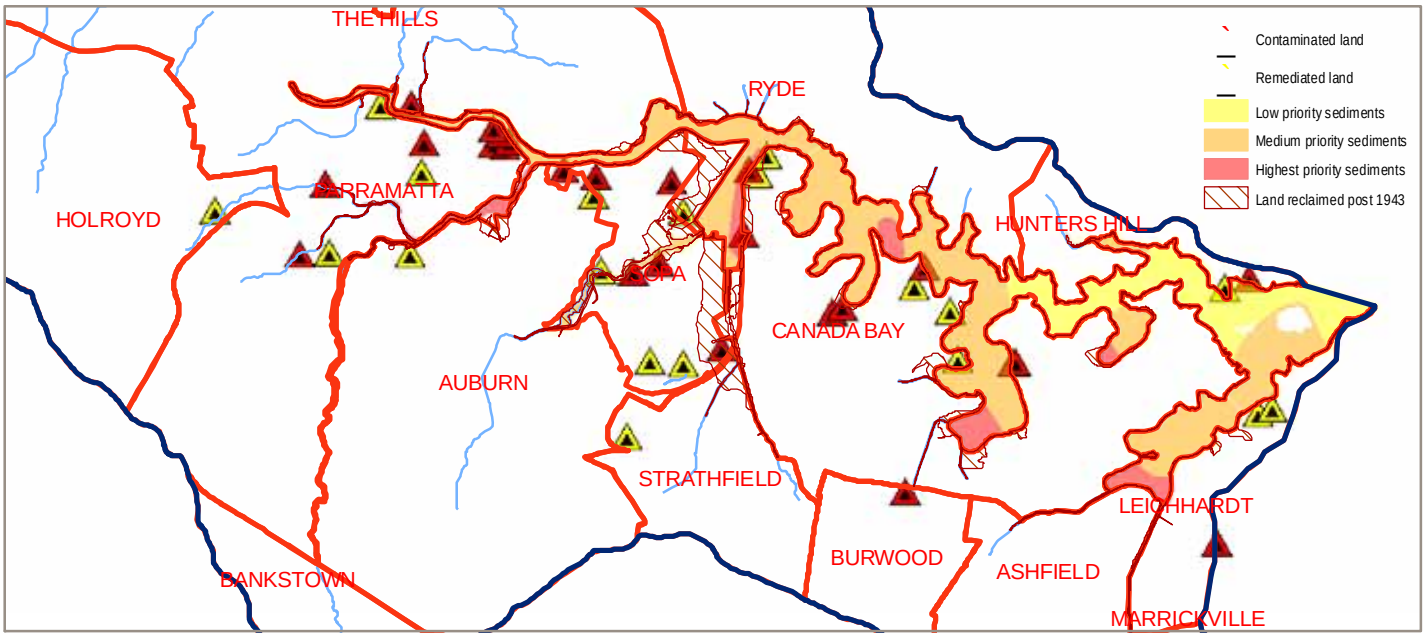
- Values:
  - public foreshore reserves,
  - seagrass habitat,
  - mangroves,
  - saltmarsh, and

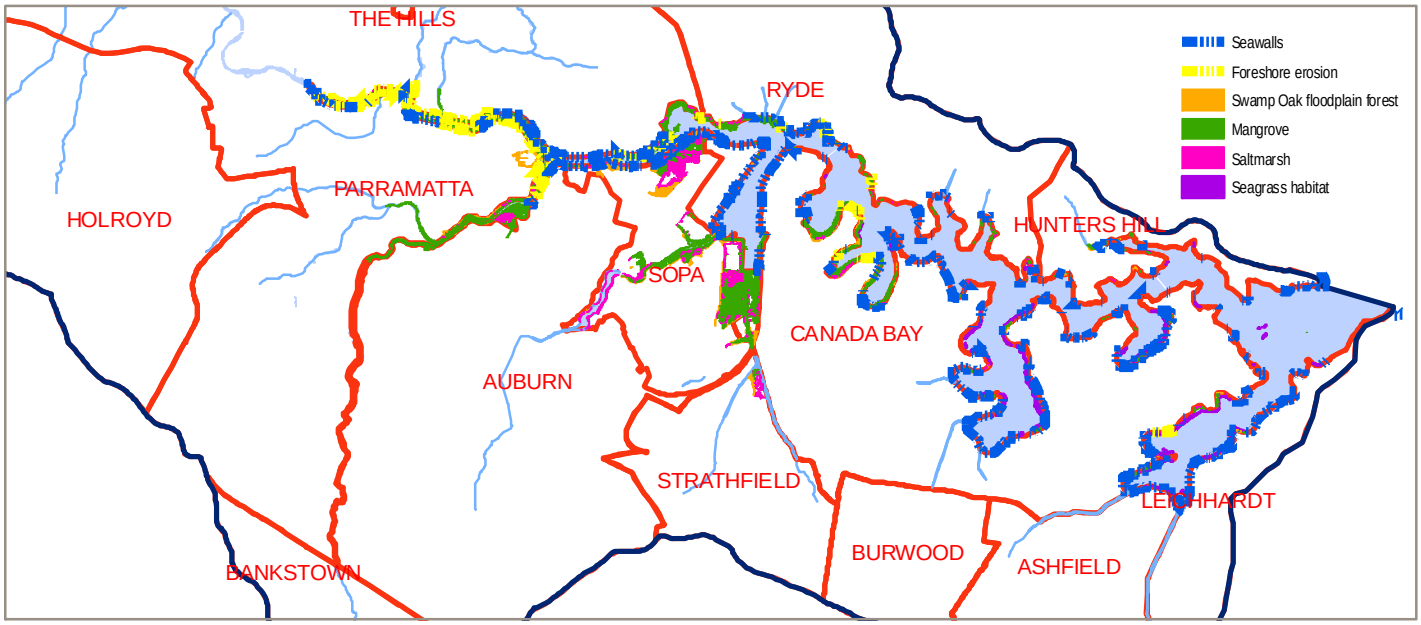
  - riparian endangered ecological communities.
- Potential threats:
  - reclaimed land and industrial land use,
  - gross pollutants in catchment runoff,
  - degrading seawalls,
  - foreshore erosion,
  - potential for sewer overflows,
  - contaminated sediments, and
  - contaminated lands.

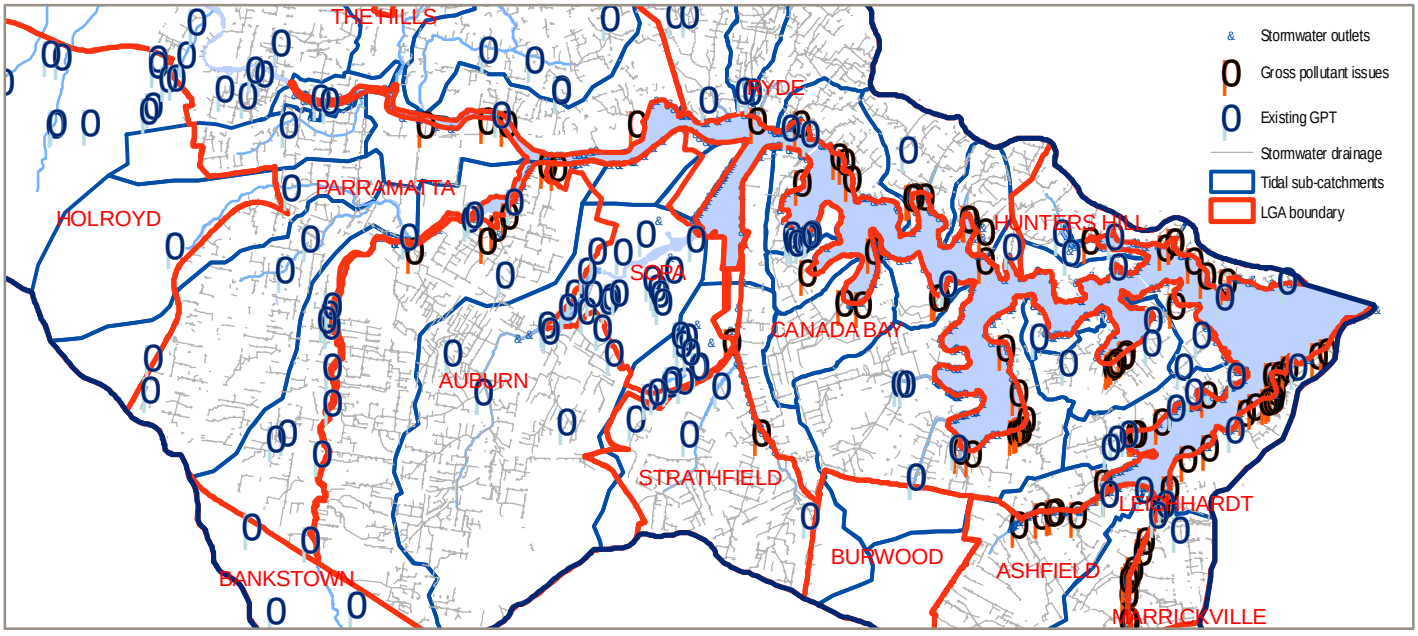
In preparing the environmental sensitivity map the following components were deliberately excluded:

- Riparian vegetation other than EECs: most of these communities are found at much higher elevations than estuarine vegetation, and therefore considered less vulnerable within the context of estuarine processes;
- Foreshore facilities: which are more localised and potential impacts are less obvious on a sub-catchment scale. Investigations for the study have also found that the prioritisation of foreshore facilities has necessarily been focused on public requirements and use, and less applicable to environmental sensitivity; and
- Seawalls and areas of foreshore erosion which are in good or excellent condition.

Figure 1 provides an overview of the various values and threats which are discussed throughout the study and illustrated further in Figures 8.1 to 8.4 (Section 8.0).







PARRAMATTA RIVER ESTUARY PROCESSES STUDY

ENVIRONMENTAL SENSITIVITY IDENTIFICATION

0 1.5 3 6 km

AUG 2010

60097281

Fig. **1**

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1.0 Introduction

1.1 Background

The Parramatta River Estuary Management Committee, represented by Parramatta City Council (PCC), engaged AECOM Australia Pty Ltd to undertake the Parramatta River Estuary Process Study. This study is an important component required for the development of a Management Plan for the Parramatta River Estuary. The development of Estuary Management Plans is guided within processes established by State Government in the NSW Estuary Management Policy.

The NSW Estuary Management Policy was created to achieve an integrated, balanced, responsible and ecologically sustainable use of the State's estuaries. The policy aims to promote cooperation between the NSW Government, Local Government, Catchment Management Authorities, landholders and estuary users in the development and implementation of Estuary Management Plans for each estuary throughout NSW.

The Parramatta River Estuary Processes Study intends to fulfil the third step of an eight step process recommended by the NSW Estuary Management Policy that will lead to the development of an Estuary Management Plan for the Parramatta River. This process is summarised below:

1. Form an Estuary Management Committee
   The Parramatta River Estuary Management Committee was established in 2006, and comprises a group made up of 11 member councils located in the Parramatta River catchment and other relevant agencies and stakeholders.
2. Assemble, compile and interpret existing data
   A Data Compilation Study was completed in 2008 (Cardno Lawson and Treloar, July 2008)[1]
3. Undertake an Estuary Processes Study
   This study
4. Undertake an Estuary Management Study
5. Prepare a draft Estuary Management Plan
6. Public review of the draft Estuary Management Plan
7. Adopt and implement the Estuary Management Plan, and
8. Monitor and review the management process as necessary.

1.2 Scope of Works

The study's scope of works is based primarily on the findings of the Parramatta River Estuary Data Compilation Study (Cardno Lawson and Treloar 2008) with a number of reporting requirements modelled from the City of Canada Bay Estuary Vegetation Management Plan (Earth Tech 2008).

Identified issues and data gaps, and further studies recommended Cardno Lawson and Treloar (2008) have been incorporated into the following three key tasks:

1. Historical aerial photo comparison study using GIS ortho-rectified imagery of the Parramatta River estuary catchment for the years 1943 and 2009;
2. Estuarine foreshore assessment and prioritisation study, with ground truthing to document the location, type, condition and prioritised actions for the following foreshore asset categories:
   - Stormwater outlets and GPTs,
   - Seawalls,
   - Foreshore erosion,
   - Key foreshore recreational assets and facilities; and
   - Estuarine and adjacent vegetation (riparian and terrestrial)
3. GIS compilation database development and reporting, including an environmental sensitivity analysis

[1] At the time of writing this report, the Data Compilation Study can be found at http//parramattariver.org.au/

1.3 Study Area

1.3.1 Overview

The Parramatta River Estuary is the largest of three tributaries that feed into Sydney Harbour. The Lane Cove River and the smaller Middle Harbour area the second and third contributing water bodies.

The study area comprises the Parramatta River, which extends from Parramatta Weir to Clarkes Point, Woolwich in the north and Yurulbin Point, Birchgrove in the south, and tributary tidal waterways (Figure 1-1). The study area also includes the river's tidal tributaries, bays, foreshores and adjacent lands of the river.

Cardno Lawson and Treloar (2008) reported the study area to contain approximately 46.6 km of public foreshore and 24.85 km of private foreshore. During this study, the total foreshore was estimated at approximately 135 km. However, this figure includes all tidal areas of the river's tributaries and canals.

While emphasis has been placed on the estuarine habitats and areas influencing these habitats, consideration is also given to the wider catchment areas where it is regarded as impacting on the estuarine processes and natural resources of the estuary.

1.3.2 Tenure

The Parramatta River catchment consists of numerous land uses including residential, commercial, environmental protection, education, industrial, open space and recreation and services, transport and communications. Land zoning, management and planning within the Parramatta River Estuary is governed by individual councils and moreover their Local Environmental Plans (LEP).

There are eight local government areas (LGA) with foreshore frontage in the study area. These are:

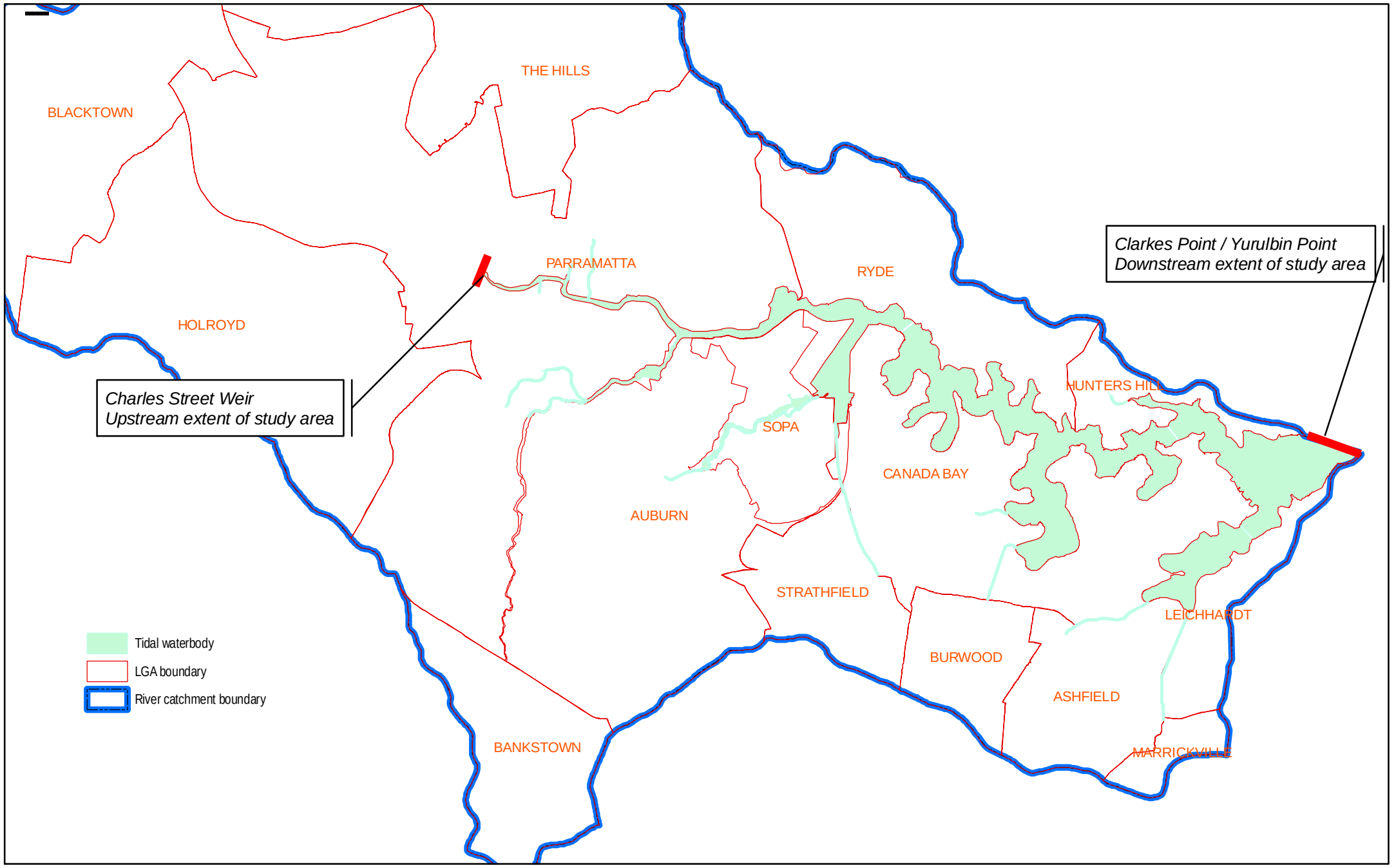
- Parramatta City Council;
- Leichhardt Municipal Council;
- Hunters Hill Council;
- City of Ryde Council;
- City of Canada Bay Council;
- Ashfield Municipal Council;
- Strathfield City Council; and
- Auburn Council.

There are a further five LGAs within the catchment. These are:

- Bankstown Council;
- Baulkham Hills Council;
- Blacktown City Council;
- Burwood Council; and
- Holroyd Council.

The diverse nature of estuarine processes results in the division of estuary management responsibilities between a number of government agencies. For example, the ownership and control of estuarine waterfront and submerged lands, is spread across a spectrum of private landholders, local Councils, trustees, the Crown and other New South Wales Government authorities. The NSW Estuary Management Process endeavours to provide a process by which estuary management plans are produced such that they are entirely consistent with the tenets of integrated waterway management and ecologically sustainable development (Cardno Lawson and Treloar 2008).

The NSW Government has a documented policy in relation to access to the harbour and river foreshores, including public access to intertidal lands where landowners have absolute waterfronts but where the waterfront is exposed at low tide. Moorings and jetties are the responsibility of NSW Maritime, who is also responsible for the management of the Harbour and river seabed in conjunction with the Department of Lands (Cardno Lawson and Treloar 2008).



PARRAMATTA RIVER ESTUARY PROCESS STUDY

STUDY AREA EXTENT

0 1 2 4 km

AUG 2010

60097281

Fig **1.1**