NEWCASTLE CATCHMENT CHARACTERISTICS

Climate

Newcastle experiences a moderate, warm, temperate climate. Mean temperature and rainfall readings are shown in Table 8.

Table 8: Temperature and Rainfall Data for the Newcastle Area (Maryville).

Annual Mean Maximum Temperature	22.8˚C
Annual Mean Minimum Temperature	14.1˚C
Mean Annual Rainfall	1106.7mm/year
Mean Number of Rain Days/Year	132 days

Soils

Most of the Newcastle Local Government Area lies on the Lower Hunter Plain and Awaba Hills physiographic regions. Matthei (1995) described the regions as below:

Lower Hunter Plain

The soils of the Lower Hunter Plain are predominantly Prairie Soils, some Chernozems and Brown Clays, with Humic Gleys in the lower Hunter delta. Solonchacks occur on the tidal flats. The dominant soil landscapes are Hamilton (hm), and Beresfield (be).

Awaba Hills

The soils of the Awaba Hills region are Yellow Podzolic, Soils and Soloths, with some red Podzolic Soils and Brown Podzolic Soils on upper slopes and some Lithosols and Bleached Loams on resistant parent material. In the Newcastle LGA, the dominant soil types of the Awaba Hills Region are Killingworth (ki), Cockle Creek (cc), and Cedar Hill (ce).

Table 9: Description of the dominant soil landscapes in the Lower Hunter Plain.

	Hamilton (hm)	Beresfield (be)
Soil Landscape Group	Residual- Deep soils have formed from in situ weathering of parent material.	Residual- Deep soils have formed from in situ weathering of parent material.
Landscape	Level to gently undulating well-drained plain on Quaternary deposits in the Hunter Plain Region. Slopes are <2%, elevation is up to 12m, local relief is <1m. Completely cleared.	Undulating low hills and rises on Permian sediments. Slope gradients 3- 15% Local relief to 50m. Partially cleared tall- open forest.
Soils	Deep, well drained weak Podzols, with some deep, well-drained Brown Podzolic Soils on fans.	Moderately deep (<120cm), moderately well to imperfectly drained. Yellow Podozolic Soils and brown Soloths occur on crests, with moderately deep, well drained Red Podozolic soils and red Soloths on upper slopes, moderately well to imperfectly drained brown Soloths and yellow Soloths on sideslopes and deep, imperfectly to poorly drained Yellow Podzolic Soils yellow Soloths and Gleyed Podozolic Soils on lower slopes.
Qualities and Limitations	Wind erosion hazard, ground water pollution hazard, strong acidity, non-cohesive soils.	High foundation hazard, water erosion hazard, Mine Subsidence District, seasonal waterlogging and high run-on on localised lower slopes, highly acidic soils with low fertility. Table 8: Description of the dominant soil landscapes in the Lower Hunter Plain. Residual- Deep soils have formed from in situ weathering of parent material. Level to gently undulating well-drained plain on Quaternary deposits in the Hunter Plain Region. Slopes are <2%, elevation is up to 12m, local relief is <1m. Completely cleared. Deep, well drained weak Podzols, with some deep, well-drained Brown Podzolic Soils on fans. Wind erosion hazard, ground water pollution hazard, strong acidity, non-cohesive soils.

Table 10: Description of the dominant soil landscapes of the Awaba Hills Region

	Killingworth (ki)	Cockle Creek (cc)	Cedar Hill (ce)
Soil Landscape Group	Erosional- Primarily sculpted by erosive action of running water. Soil depth is usually shallow, and its origin is variable and complex. Soil is either absent, derived from in situ weathered bedrock or from water washed parent material.	Alluvial- Formed by deposition along rivers and streams. Parent material is alluvium. Landscapes include floodplains and alluvial deposit.	Colluvial- Affected by mass movement. Parent material consists of colluvial mass movement debris.
Landscape	Undulating to rolling hills and low hills on the Newcastle Coal Measures. Elevation 50-160m, local relief 30-100m, slopes are 3-20%. Predominantly uncleared tall open forest.	Narrow floodplains, alluvial fan deposits and broad delta deposits. Slope gradients are 0-2%, elevation is <1-50m, local relief is <1m. Cleared open forest.	Rolling to steep rises on siltstones and sandstones. Local relief is up to 100m, elevation is up to 100m, slopes are 15-40%. Cleared tall open forest.
Soils	Shallow to moderately deep, well to imperfectly drained Yellow Podozolic Soils, yellow Soloths, Gleyed Podzolic Soils and Gleyed Soloths on crests and slopes, with shallow, well drained Structured Loams, Bleached Loams and Lithosols on some crests.	Deep, imperfectly to poorly drained yellow Soloths, and Yellow Podzolic Soils on floodplains, deep moderately well to poorly drained Yellow Earths and Grey Earths on delta and fan deposits, with deep, imperfectly to well-drained Yellow Podzolic Soils.	Moderately deep to deep, well to imperfectly drained Brown Podzolic Soils, and moderately deep, well drained Structured Loams.
Quantities and Limitations	High water erosion hazard, Mine Subsidence District, foundation hazard, shallow soils (localised), seasonal waterlogging (localised), sodic, dispersible soils of low wet strength, very strongly acid soils of low fertility.	Flood hazard, water erosion hazard, localised permanently high water-tables and periodic to permanent waterlogging, high run-on, acid, infertile sodic/dispersible soils of low wet strength.	High mass movement hazard, high foundation hazard, steep slopes, Mine Subsidence District, acid soils.

Geology

The geology of the Newcastle area is very complex. The most important feature is the Hunter Fault, a zone of thrust faults trending in a north westerly direction which passes beneath the deep Quaternary sediments of the coastal plain. The Hunter Fault is the boundary between the Permian sediments of the Sydney Basin and Carboniferous system that outcrops to the north-east.

The Newcastle Coal Measures consist of a basal formation overlain by four subgroups; Waratah Sandstone - cross-laminated grey brown sandstone at the base; Lambton Subgroup - coal, sandstone, shale, minor conglomerate; Adamstown Subgroup - massive conglomerate, tuff, coal and shale; Boolaroo Subgroup - irregular coal seams, tuff, sandstone and shale. (Adopted from Matthei, 1995).

Topography

The land form and natural drainage patterns of the City result from two major influences. Firstly, the Hunter River and associated flat, poorly drained alluvial and estuarine deposits and secondly, the outcrop of sedimentary rocks forming a series of ridges and spurs primarily along the southern sector of the LGA boundary.

Notable features include:

- A series of steep-sided ridges and spurs with well defined drainage lines along the southern sector;
- Undulating landform generally in the central sector, extending from Jesmond to Shortland and Waratah with defined natural drainage lines generally modified;
- Isolated hills formed by sedimentary outcrops immediately south of Newcastle Central Business District (CBD), these include Obelisk Hill and Shephard's Hill;
- Flat low-lying landforms, including reclaimed swamp areas and estuarine deposits to the west and south-west of Newcastle CBD, with extensive man-made drainage channels;
- Flat areas of Stockton Peninsula formed by levelling coastal sand dunes;
- Flat low-lying alluvial deposits forming Hexham Swamp; and
- Undulating landform on sedimentary rocks along the western sector of the LGA.

The rate of soil loss through erosion is related to the length and the gradient of the slope segment within the catchments.

Figure 6 shows the Newcastle Local Government Area featuring topography of the region defined by 10 metre contour intervals, within the confines of the data available. Significant waterways, the Hunter River estuary and coastline, and the major transport links are also noted.

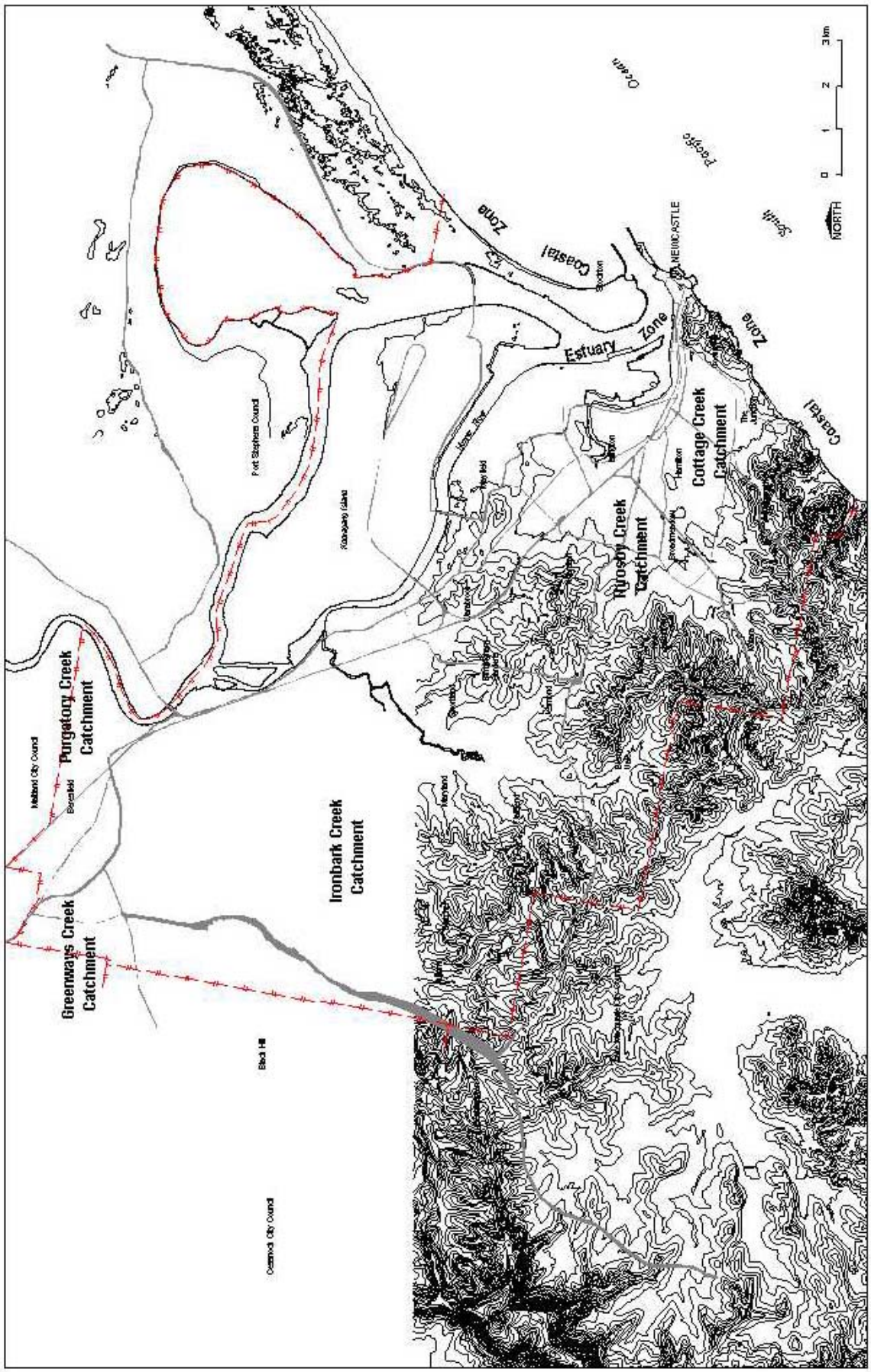
Hydrology

CEPA (1993) indicate that with the urbanisation of the catchment, major irreversible impacts on hydrology occur. This change increases with the proportion of the catchment converted to impervious surfaces such as roofs, roadways and other paved areas.

Land clearing reduces the opportunity for local ponding of surface water and the installation of gutters, pipes and concrete channels also contributes to hydrological change.

Compared with the run-off from a forested catchment (2%), the percentage of run-off from an urban catchment may be as high as 98 - 100%.

Figure 6: Newcastle Catchment Characteristics



Urban development can have the following effects on hydrology:

- Increased run-off volume due to impervious surfaces, resulting in a higher volume of water reaching drains and water bodies;
- Reduced flow resistance, resulting in "flash-floods" and reducing the time taken to reach peak flow by 50 - 90%;
- High velocity flows wash off and transport a higher amount of solid material into the receiving waters;
- Higher volumes and velocity of run-off can transport many more pollutants into the receiving waters; and
- The timing, quantity and quality of dry weather discharges are altered due to lower levels of groundwater recharge.

Vegetation

There are four broad vegetation communities remaining in the City, covering about 40% of the LGA. They include wetlands, remnant bushland, grasslands and coastal grasses.

- *Terrestrial - the surface of the catchments.*

There are only a few pockets of remnant bushland in the City, including:

- Blackbutt Reserve in the head waters of Throsby Creek catchment
- George McGregor Park and Jesmond Bushland at the headwaters of Ironbark catchment
- the Wentworth Creek sub-catchment at Fletcher, just west of Maryland, within the Ironbark Creek catchment

Glenrock State Recreation Area is also an ecologically valuable site and will be addressed in the catchment-based, stormwater management planning process by Lake Macquarie City Council.

Other scattered areas exist in the western half of the City and the south west of Beresfield in the Blackhill locality. Many of these areas are known or likely to provide habitat for some rare plants and animals. Some small isolated packets of littoral and riverine rainforest still survive in these areas.

Scattered grasslands are located on the fringes of Hexham Swamp and the western fringes of Kooragang Island. Scattered tree cover is common in these areas, lending to its scenic appeal and providing habitat for birds, bats and arboreal mammals. Coastal grasses are the least well represented of the four main vegetation communities found in the City. (Newcastle Land Use Strategy, 1995)

Figure 7 shows the flora and fauna habitat distribution throughout Newcastle City. This map was adapted from the Newcastle Land Use Strategy (1995).

- *Riparian - surrounding the waterways and drainage channels*

The waterways that flow through the city in their lower reaches are predominantly formed concrete channels, with little if any ecological integrity or value. Proposals to de-formalise some sections of the concrete drainage channels, to reinstate vegetation and landforms of similar structure to natural riparian habitats, has been a source of discussion within the Catchment Management Committees and community groups.

Riparian Zone

Council's Creek Assessment Process (CAP) has mapped the creek and riparian zone condition of 48 km or approx. 50% of the estimated natural waterways in the City to date The CAP is primarily a condition audit that is due to be completed in 2005. Data collated from the audit will be incorporated within Councils GIS/Asset database so that prioritization for works can be completed" (see Figure 8).

Those drainage lines still in a natural condition within the LGA, often suffer from exotic weed infestation and streambed and bank erosion. Successful re-introduction of native species within the riparian zones will greatly enhance the opportunities for increased "urban biodiversity".

Wetlands

About half the natural vegetation areas of the City are covered by wetland communities, comprising mangrove forests and salt and fresh water marshes. Most of the wetlands are in Hexham Swamp, on the edge of Fullerton Cove and on Kooragang Island. Much of the wetlands are protected in Nature Reserves managed by the National Parks and Wildlife Service.

The wetlands are considered to be some of the most important in NSW, providing habitat for rare and endangered species of birds and mammals, as well as providing valuable fish breeding and feeding within the extensive mangrove forests on the southern shores of the Hunter River. Many kinds of birds visit the wetlands during trans global migration to roost and feed. Many native species are protected by agreements made by Australia with Japan and China and provisions of the National Parks and Wildlife Act. Kooragang and Hexham Wetlands are recognised as internationally significant wetlands under the United Nations Ramsar Convention. Improvements to wetlands are planned throughout Newcastle City, including Kooragang Islands Rehabilitation Project and the Ironbark and Throsby Creek TCM strategies.

Perhaps the most significant area of aquatic habitat in the Newcastle area is Hexham Swamp and Ironbark Creek. The Ironbark Creek TCM Strategy included a description of aquatic fauna in the creek and much of the following is taken from that document.

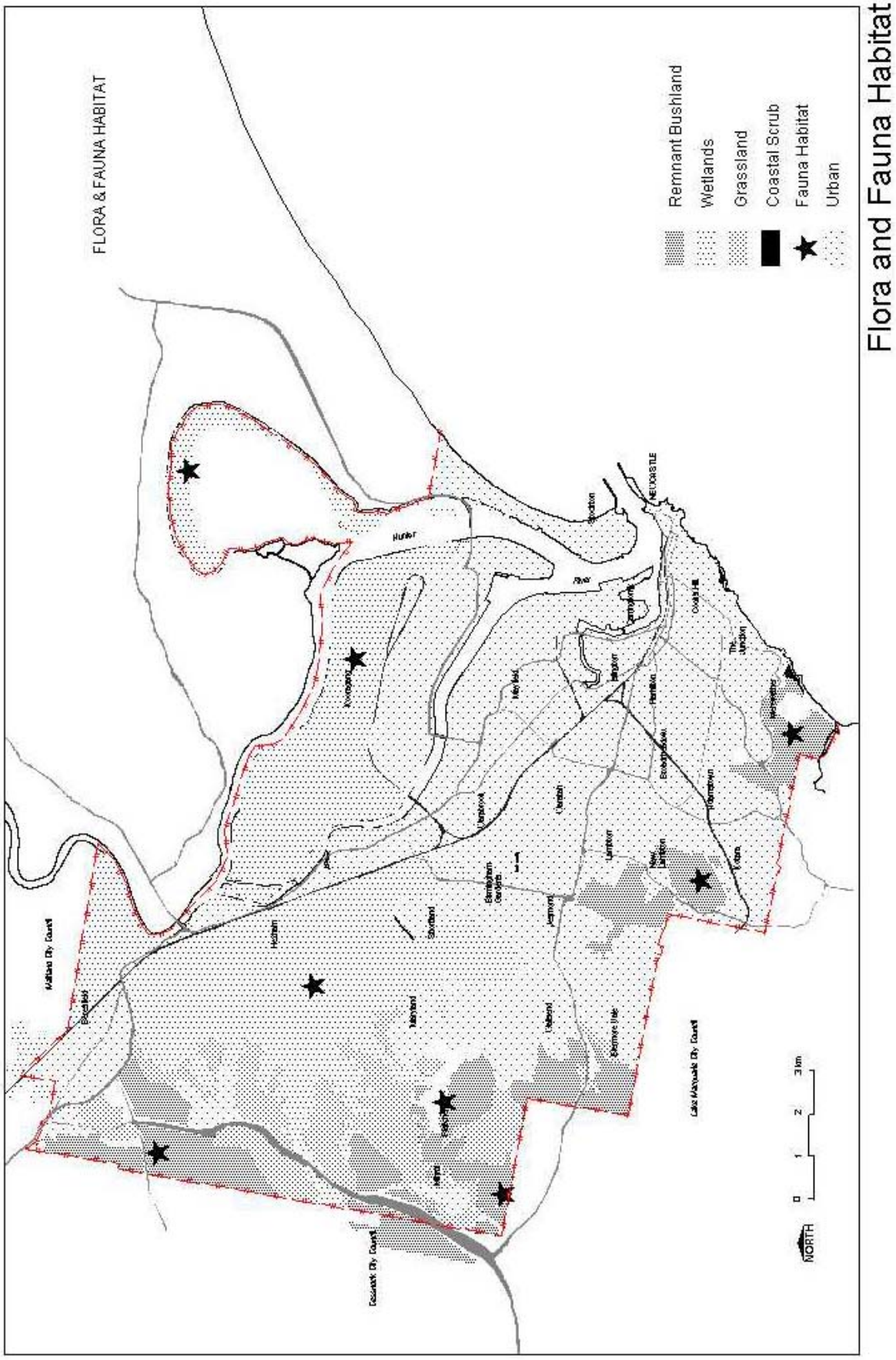
A 12 month study by Shephard (1992, in Ironbark TCM, 1996) found 32 species of fish and six species of prawn and shrimp. Of the fish, 11 species were freshwater, 20 saltwater and one euryhalline (sea mullet). When compared with nearby Moscheto Creek a saltwater system, Shephard (1992) classified Ironbark Creek as a freshwater system in terms of composition of fish species and numbers of each species. The mangrove areas in Ironbark Creek were dominated by non-commercial freshwater species such as gobies, gudgeons, the introduced mosquito fish and juveniles of sea mullet.

The Throsby Creek TCM Strategy (1989) described the existing environment in the downstream sections of Throsby Creek as a degraded aquatic environment with a depleted fishery, subject to closures on the taking of fish and invertebrates due to a perceived risk of contamination. Water quality investigations indicated that the creek could support a richer aquatic flora and fauna and with appropriate rehabilitation and management, particularly of the inter-tidal and foreshore zones could become a viable, dynamic ecosystem with enhanced habitat qualities.

The Throsby TCM Strategy stated that the re-establishment of estuarine inter-tidal flora and fauna would improve the ecosystem and benefit the long term health of the creek.

Photo 9:
This shows the Stockton sand spit area that provides valuable habitat for migratory waders, located beside the northern end of Stockton Bridge.

Figure 7: Flora and Fauna Habitat



Water Quality

In general terms, not enough data has been generated to give any trends, however based on various studies: erosion and sedimentation; gross pollutants; nutrients: heavy metals; litter and microbiological contamination are the major pollutants within the City's waterways. These are typical urban stormwater characteristics. Anecdotal evidence from Clean-Up day sites such as the mangrove area of Throsby Creek, also indicates a limited litter load might be washed upstream on the tide from the Harbour with the find of foreign language labels plastic bottes.

Urban runoff contains a complex mixture of pollutants including hydrocarbons from roads, chemicals from tyres, detergents, animal excrement, garbage and many unknown contaminants. For example researchers from the University of Newcastle detected trace levels of abietic acid, a contaminant derived from tyres, in the tissue of the marine gastropod Austrocochlea constricta from a site within Newcastle Harbour. A study conducted by Riley (1999) indicated that the major source of alphiatic hydrocarbons (acid) and the metal cadmium, lead and iron in urbanised environments is from road stormwater runoff, where surface deposition of oil, spilled fuel and exhaust emissions allow increased loading of creeks and rivers. (Hunter Estuary Data Compilation Report, Jan 1999.)

Levels of heavy metals in the tissues of oysters deployed for a 3 month period in the entrance to Newcastle Harbour were significantly higher than those found in the tissues of organisms deployed in the entrance of Port Stephens (EPA, 1995). The likely source of contamination is industrial effluent, as well as residential stormwater, discharged into the Hunter Estuary.

Sewer surcharge from Hunter Water Corporation’s wastewater transportation system is the subject of performance based on the number of sewer overflow events, where private properties are affected, not exceeding 6,500/ year. The year to date result (as at February 2005) showed 2565 sewer overflow events where private properties were affected. Sewer surcharges or overflows are generally related to either tree root blockages or wet weather conditions.

Dry weather surcharges are predominantly the result of tree root blockages and are generally very localised in nature, so environmental impact is usually limited. To address this problem Hunter Water adopts a number of maintenance practices including:

- Use of water jetting to clear blockages. This is carried out in conjunction with a camera inspection *(by closed circuit television)* to ensure the blockage has been removed;
- Where appropriate full replacement of the failed assets; and
- Where replacement is not warranted the use of chemical root treatment to minimise the opportunity for regrowth of tree roots.

Wet weather surcharges are predominantly caused by ingress of stormwater into the sewerage system. This can be caused by a number of factors with major ones being:

- General surface flooding covering access points *(eg manholes, shafts, yardsinks)* and allowing stormwater into the system;
- Illegal connection of stormwater *(eg off roofs*) into the sewerage system;
- Infiltration of groundwater into the sewerage system via cracked pipes; and faulty joints in the Corporation’s sewers and in privately owned house drains.

To address wet weather surcharges Hunter Water has embarked on a significant investigation and capital rehabilitation/upgrade program. This is geared at precisely measuring current system performance, identifying deficiencies and determining remedial actions. This is a long term program of works as the sewerage system is an integrated one. It has to be reviewed holistically or else remedial works might simply move the problem from one location to another.

Hunter water’s licences for wastewater effluent discharge quality now incorporate load levels. All Newcastle wastewater plants have recently (as at February 2005) complied with their EPA license load targets for BOD, NFR, pH, Grease, Total Nitrogen, Ammonia, Total Phosphorous and Fecol Coliforms.

All beaches also complied with these guidelines.

Land Use

Table 11 below summarises the generic landuse within the City, as at 1998. This breakdown of land use zones has remained unchanged over the last few years.

The population in Newcastle is 131,300 (ABS, 1996). The LGA covers 210 sq km comprising some 56,351 properties that attract Council rates.

Table 11: Landuse Zoning in Newcastle - by Percentage and Area
(State of Environment Report, NCC 1998)

Land Use	1998 AREA (ha)	1998 %
Industrial	3,609	17.0
Commercial	200	1.0
Recreational	701	3.5
Urban Bushland	690	3.0
Wetlands	4,210	19.5
Future Urban	1,060	5.0
Rural	1,254	6.0
Mining	1,310	6.5
Total	**21,300**	**100.0**

The Lower Hunter Housing Market Study (1993) undertaken for the NSW Department of Planning found adequate land would be available to accommodate an additional 200,000 people in the Lower Hunter. The Government's policy document "Cities for the 21st Century" (DUAP, 1995) predicts an additional 145,000 people will move from Sydney to the Lower Hunter. Sustaining this extra growth will require over 30,000 additional dwellings and 40,000 jobs beyond current baseline projections.

The predicted population growth will increase demand on potable water and increase the rate of urbanisation and development in the region. Such development can impact on the health of the catchments and their creek systems through siltation, nutrient and other contaminant loading as a result of urban runoff and sewage discharge. Newcastle's growth is mainly occurring to the west of the City within the Ironbark Creek catchment. The area between Maryland and Minmi has a forecast population of 25,000 people within 20-30 years. The clearing of land for urban development will create significant pressure on the aquatic systems within the catchments.

Photo 10:
Highland County is one of the new residential subdivisions within the Wallsend - Minmi growth corridor. In-line water quality control structures such as this pond and outlet structure may provide some water quality improvement, however integrated, at-source control measures (within the lot scale) could provide more sustainable, long term outcomes for the community and the creek.