Port Macquarie-Hastings Council

Annual Report

2008-2009

PART B:
State of the Environment Report
# Table of Contents

Port Macquarie-Hastings at a Glance .......................................................... 2
About SoE 2008-2009 .................................................................................. 3
Chapter 1 – Towards Ecological Sustainability ........................................ 4
  1.0 Assessing Progress ............................................................................. 4
  1.1 What is Ecologically Sustainable Development? ............................. 6
  1.2 Community Involvement in Environmental Monitoring .................. 6
Chapter 2 – Human Settlement ................................................................ 7
  2.1 Population and Settlement Patterns ................................................... 7
  2.2 Urban Water ...................................................................................... 9
  2.3 Transport .......................................................................................... 11
  2.4 Waste Management ........................................................................ 13
  2.5 Heritage .......................................................................................... 21
  2.6 Amenity .......................................................................................... 24
Chapter 3 – Atmosphere .......................................................................... 30
  3.1 Global Warming and Energy Consumption ...................................... 30
  3.2 Urban Air Quality ............................................................................ 37
Chapter 4 – Land ..................................................................................... 40
  Land Use Changes .................................................................................. 40
  Soil Erosion .......................................................................................... 43
  Acid Sulfate Soils .................................................................................. 45
  4.4 Land Contamination ........................................................................ 49
Chapter 5 – Water ................................................................................... 52
  5.1 Surface Water Extraction .................................................................. 52
  5.2 Groundwater Extraction .................................................................. 55
  5.3 Water Quality and Riverine Ecosystem Health ................................. 57
Chapter 6 – Biodiversity .......................................................................... 65
  6.1 Terrestrial Ecosystems and Species Diversity ................................... 65
  6.2 Native Vegetation Clearing ................................................................. 67
  Introduced Terrestrial Species ................................................................. 70
  Fire ......................................................................................................... 72
  6.5 Aquatic Ecosystems and Species Diversity ....................................... 73
  6.6 Introduced Aquatic Species ................................................................. 76
  6.7 Aquatic Harvesting ......................................................................... 77
Glossary ..................................................................................................... 80
References ................................................................................................ 81
Port Macquarie-Hastings at a Glance

The Port Macquarie-Hastings local government area (LGA) lies within the North Coast Region of New South Wales. The North Coast Region is the most biologically diverse area in NSW (Native Vegetation Advisory Council of NSW, 1999). It is also one of the fastest growing regions in NSW.

The LGA covers an area of 3,693 sq km and is located 420 kilometres north of Sydney and 510 kilometres south of Brisbane. The Pacific Highway and the North Coast Rail Line bisect the area north to south and the Oxley Highway bisects the area east to west. State Forests and National Parks occupy a large proportion of the area.

The Pacific Ocean in the east, with a coastline of some 84 kilometres and the Great Dividing Range in the west, provide the natural boundaries to the area. The northern boundary is shared with the Kempsey Shire and runs from Point Plomer on the coast west to the Great Divide. The southern boundary is shared with the City of Greater Taree and commences at Diamond Head on the coast and again runs west to the hinterland. The western boundary is shared with the Walcha Shire Council area. The area has two main river systems, the Hastings and Camden Haven Rivers.

The topography of the area is diverse ranging from sand dunes, coastal wetlands, flood plains and rugged mountain regions. The area is known for having an ideal temperate climate, with the maximum daily temperatures rarely going above 30°C or below 15°C.

The 2006 population for the Port Macquarie-Hastings LGA was estimated at 71,573, and is anticipated to grow to 104,000 by the year 2030. The estimated population as at June 2008 was 73,870. The area has the second highest population (after the Tweed) in the North Coast Region.

The area has many small localities and villages in addition to three main townships. Situated on the coast, Port Macquarie is the largest town with a population of about 42,000 people and serves as a major tourist destination in addition to being the major regional centre for the area.

The township of Wauchope, 21 kilometres or 20 minutes by car from Port Macquarie, serves as the regional centre for the inland area, particularly for the rural communities and the associated agricultural industries. Wauchope has an estimated population of about 6,000 people.

The villages of Lake Cathie and Bonny Hills maximise the natural attributes of their location. The population of the area is approximately 5,600 and is growing rapidly.

The Camden Haven is located in the south of the LGA (population approximately 8,800) and includes the towns of Kendall, Kew, North Haven, West Haven, Dunbogan and Laurieton. It is mainly a retirement area and tourist destination, with Laurieton as the main service centre.

Smaller rural population centres and surrounding villages include the Comboyne Plateau (Comboyne, Comboyne West) and Rural Villages (Beechwood, Ellenborough, Long Flat, Pappinbarra, Hollisdale, Upper Pappinbarra, Bellangry, Pembroke, Ballengarra, Rollands Plains, Upper Rollands Plains, Telegraph Point). The rural population of the LGA is about 9,400 persons.
About SoE 2008-2009

Purpose


The Local Government Act 1993 requires Council to prepare a comprehensive SoE the year ending after each election of the council, and a supplementary SoE report must be prepared in intervening years.

The SoE Report forms part of Council’s Annual Report and is an important component of the Management Plan preparation and decision making process. The role of SoE reporting is depicted below.

Management Planning and Annual Reporting Cycle

The Report

The 2008-2009 SoE Report is a comprehensive report and has been structured under the following headings:

- Toward Ecological Sustainability
- Human Settlement
- Atmosphere
- Land
- Water
- Biodiversity

Under each heading, issues are reported on using the State-Pressure-Response-Future model, including the discussion of trends comparing this reporting period to the 2003-2004 (last comprehensive) reporting period.

Tables showing indicator data attempt to provide data from previous comprehensive reporting years, 1998/99 and 2003/04, and updated data for the 2008/09 year. Graphical data displays are based upon the entire data set relevant to that indicator.

Chapter 1 – Towards Ecological Sustainability

1.0 Assessing Progress

An inherent purpose of State of the Environment reporting is to enable the assessment of progress towards ecological sustainability and focus strategies and actions required to improve environmental performance and ecological systems. This chapter attempts to provide a ‘snap-shot’ of Port Macquarie-Hastings Council’s progress toward ecological sustainability on the basis of the data presented in this report.

The Port Macquarie-Hastings is progressing towards ecological sustainability in a number of areas. Examples of specific areas include:

- Waste reduction and recycling
- Waste water reuse
- Water supply demand management
- Acid sulfate soils remediation
- Strategic land use planning
- Residential sector energy and water efficiency
- Biodiversity Management

The following key strategies will require continued support:

- Hastings Drought Management Plan
- Hastings & Camden Haven Reclaimed Water Project
- Resources Efficiency and Sustainability Strategy 2007 (Waste)
- Port Macquarie-Hastings Local Growth Management Strategy
- Urban Growth Strategies
- Camden Haven Urban Growth Strategy 2003
- Greenhouse Action Strategy 2003
- Environmental Restoration Programs
- Estuary Management Plans
- Regional and Local Cycleway Plans
- Community Strategic Plan

Table 1.1 draws together specific issues identified in this Report as requiring action to ensure that the Port Macquarie-Hastings LGA stays on the road towards ecological sustainability. These issues have been identified on the basis that:

- Indicator data reveals increasing levels of environmental pressure; and/or
- Indicator data reveals inadequate outcomes are being achieved; and/or
- The level or adequacy of responses currently being implemented.
Table 1.1 – Priority Issues for Council’s Management Plan

<table>
<thead>
<tr>
<th>Issue</th>
<th>Recommended Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human Settlement</strong></td>
<td></td>
</tr>
<tr>
<td>Population growth</td>
<td>Identify critical constraints to green field and infill development sites within the LGA through the preparation of a Local Growth Management Strategy.</td>
</tr>
<tr>
<td>Wastewater Management</td>
<td>Implementation of Village Sewerage Schemes</td>
</tr>
<tr>
<td></td>
<td>Increased monitoring of on-site sewage management systems</td>
</tr>
<tr>
<td><strong>Atmosphere</strong></td>
<td></td>
</tr>
<tr>
<td>Global Warming &amp; Energy Consumption</td>
<td>Increase the use of renewable energy in Council facilities, fleet and plant</td>
</tr>
<tr>
<td>Urban Air Quality</td>
<td>Strategically plan for effective Public Transport Systems</td>
</tr>
<tr>
<td><strong>Land</strong></td>
<td></td>
</tr>
<tr>
<td>Land use</td>
<td>Increased enforcement of erosion and sediment controls on construction sites</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td></td>
</tr>
<tr>
<td>Water Quality &amp; Riverine Ecosystem Health</td>
<td>Investigate more holistic water quality and riverine health assessment techniques</td>
</tr>
<tr>
<td></td>
<td>Increased emphasis and funding for best practise maintenance of gravel roads</td>
</tr>
<tr>
<td><strong>Biodiversity</strong></td>
<td></td>
</tr>
<tr>
<td>Terrestrial Ecosystems &amp; Species Diversity</td>
<td>Development of a Biodiversity Strategy</td>
</tr>
<tr>
<td></td>
<td>Implement strategic planning controls to manage and protect koala populations</td>
</tr>
<tr>
<td>Introduced Species</td>
<td>Increased funding for Weed Control Programs on private and public land</td>
</tr>
<tr>
<td></td>
<td>Increase of Feral Animal control activity</td>
</tr>
</tbody>
</table>

The issues identified in Table 1.1 will be considered for incorporation into future Management Plans.
1.1 What Is Ecologically Sustainable Development?

Ecologically sustainable development (ESD) means an approach to using, conserving and enhancing natural resources so that ecological processes, on which all life depends, are maintained, and the total quality of life, now and in the future, is improved (COAG 1992).

ESD represents our commitment to future generations. The application of ESD principles will help to ensure that we pass on a world with sustainable natural resources and with minimal environmental damage to our children and our children’s children. This concept underlies the principle of inter-generational equity which is one of the fundamental principles of ESD.

The long term maintenance of sustainability involves efficient and equitable use of resources and proper management of pollution and waste. Sustainability can only be achieved through cooperation and community support at the local, regional, national and global level. Ecologically sustainable development goes further by recognising the dependence of all living beings on the maintenance of the complex and dynamic systems of living organisms and their natural environment, (State of the Environment Guidelines 1999).

1.2 Community Involvement in Environmental Monitoring

The community plays an important role in environmental management and monitoring. In recognition of this role, this report draws on data from various community groups and provides information of community activities in managing restoring and monitoring the local environment. The information is not exhaustive in this respect, but aims to highlight particular issues associated with community involvement and recognise its importance.

In the 2008-2009 Report, reference is made to a number of community groups and their activities including:

- Landcare groups throughout the area
- Local schools
- The Koala Preservation Society
- Local oyster growing industries
- Hastings Valley Conservation Hunting Group
Chapter 2 – Human Settlement

2.1 Population and Settlement Patterns

Pressure

Demands for infrastructure, including housing, energy, water, transport and waste disposal, are increasing as the population grows. Supplying this infrastructure results in changes to land uses and other impacts on the environment. Sound planning can minimise and manage these impacts.

In the coastal regions, population growth continues to exert strong pressure on the environment, with such impacts as a loss of ecosystems, and sedimentation and nutrient pollution in coastal lakes and estuaries. This is in addition to the growing impacts of climate change, such as rising sea levels, faced by these areas (DECC, 2006).

State

The 2006 Census (ABS) identified the total resident population for the Port Macquarie-Hastings LGA 71,284. The data, presented as Figure 2.2.1, shows the population growth trend for the LGA using the 2001 and 2006 Census figures and estimated June 2008 figure of 73,870.

The coastal regions of NSW (excluding metropolitan areas) experienced a 1.3% growth between 2001 & 2005 (DECC, 2006)

The Port Macquarie-Hastings growth area experienced a growth rate of 1.7% between 2001 & 2006. This is higher than the state average of 1.3% (ABS, 2006) for the coastal regions of NSW (excluding metropolitan areas) (DECC, 2006). Population growth in the Port Macquarie-Hastings continues to be amongst the highest growth rates in regional NSW.

Further detailed information on the population and demographics of the Port Macquarie-Hastings can be found in the Community Profile at http://www.id.com.au/profile/Default.aspx?id=231.
Pressures on the environment and our natural resources are driven by population growth and the demand it creates. The trend line shown in the above graphic is used extensively in this report to relate trends in other indicator data to population increase.

Responses

Council and government are strategically planning for sustainable population growth. A number of strategic planning, infrastructure and management strategies are being implemented to cater for sustainable population growth in the Port Macquarie-Hastings LGA including:

- Hastings Drought Management Plan
- Hastings & Camden Haven Reclaimed Water Project
- Resources Efficiency and Sustainability Strategy 2007 (Waste)
- Port Macquarie-Hastings Local Growth Management Strategy
- Urban Growth Strategies
- Camden Haven Urban Growth Strategy 2003
- Greenhouse Action Strategy 2003
- Environmental Restoration Programs
- Estuary Management Plans
- Regional and Local Cycleway Plans
- Community Strategic Plan

In addition to broader strategies, Council is currently preparing detailed plans to ensure sustainable growth in the major urban expansion areas at Wauchope, Lake Cathie/Bonny Hills (Area 14), Thrumster (west of Port Macquarie) and for the Camden Haven between Lakewood and Kew (Area 14).

Despite the above, the long-term capacity of the LGA to sustain population growth needs to be studied. The NSW Department of Planning has completed the Mid North Coast Regional Plan. This initiative identifies both current and potential future urban investigation areas for residential, industrial and commercial development and sets targets for development and settlement on a regional basis. This work will be supported by a Local Growth Management
Strategy which is currently under preparation. The Local Growth Management Strategy will look in detail at constraints and opportunities in identified growth areas to ensure future development adheres to the principles of Ecologically Sustainable Development.

Future

Both urban and coastal long-term growth trends will require vigilance to limit the depletion of natural resources, such as biodiversity, native vegetation and riparian zones, green and open spaces, prime agricultural soils, and forests, as well as the generation of waste. Improving land-use management and planning policies has the potential to reduce the environmental impacts of the expansion of urban and coastal settlement to more sustainable levels (DECC, 2006).

Successful planning for future growth will depend upon sound local planning frameworks that recognise and link with planning in a regional context. The preparation of the Local Growth Management Strategy and Biodiversity Strategy for the Port Macquarie-Hastings are key steps in this process.

2.2 Urban Water

Pressure

Safe and reliable water services are essential to support a growing NSW population and associated economic activities. The rising demand for water is a significant environmental issue as it puts catchments under considerable pressure (DECC, 2006).

There are a number of critical pressures on water supply infrastructure including, population growth, drought and the need for sustainable environmental flows. There are also concerns about the impact of climate change on urban water supply and local catchments.

State

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>Potable water usage per property (KL)</td>
<td>248</td>
<td>230</td>
<td>181</td>
</tr>
<tr>
<td>Pressure</td>
<td>Annual per capita potable water use (KL)*</td>
<td>86</td>
<td>84</td>
<td>73</td>
</tr>
<tr>
<td>Pressure</td>
<td>Annual volume of water used for potable purposes (ML)</td>
<td>5,336</td>
<td>5,839</td>
<td>5,447</td>
</tr>
<tr>
<td>Response</td>
<td>Volume Treated effluent reused (ML)</td>
<td>26</td>
<td>249</td>
<td>274</td>
</tr>
<tr>
<td>Pressure</td>
<td>Number of water restriction breaches reported to Council</td>
<td>NEW INDICATOR</td>
<td>92</td>
<td>15</td>
</tr>
</tbody>
</table>

* Per capita data based on total LGA population for consistency of annual figure

A continued reduction in per capita demand caused by consumer education, mandatory water conservation measures and the introduction of a more significant ‘user-pays’ water pricing system is evident as shown by Figure 2.2.2.

The total volume of water used for potable purposes remains lower than the 2004-2005 volume. This reduction is more significant than it may appear, given that the reduction has occurred despite population growth.
On a per property basis, water consumption fell by a further 3% during 2008-2009 to 181KL. The data demonstrates the commitment of Council and the community to responsible use of water resources.

**Responses**

Port Macquarie-Hastings Council has implemented a number of significant responses to urban water management. Responses aim to provide a secure water supply while valuing the water resource and minimising impacts on the environment as a result of water abstraction. The following responses are relevant:

- Continuation of the two tier “user pays” water pricing that reflects the value of the water resource
- Commissioning of the Port Macquarie Reclaimed Water Plant and “lilac pipe” dual reticulation system that supplies reclaimed water to commercial premises and irrigate many open space areas including sports fields
- Construction of a reclaimed water reticulation network between Port Macquarie and the Camden Haven to link existing and future reclaimed water supply infrastructure at sewerage treatment plants and the Port Macquarie Reclaimed Water Plant.
- Ongoing comprehensive biological monitoring of the lower freshwater reaches and upper estuary of the Hastings River to assess impacts of river abstraction during drought conditions.
- Comprehensive public & school education
- Demand management including mandatory water conservation measures
- Water sensitive urban design
- Improvements to the existing water supply system
- Continuation of the Home Water Saver Rebate Scheme

**Figure 2.2.1 – Potable Water Use Trends**

![Graph showing potable water use trends from 1999-2000 to 2008-2009](image)
Future

Successful management of urban water into the future will rely on the implementation of Integrated Water Cycle Management systems that maximise the use of water resources while minimising the environmental impacts of water consumption. Critical aspects of Integrated Water Cycle Management including reclaimed water use, water sensitive urban design and potable water demand management, need to become the norm. Government, business and the community need to embrace sustainable water management and work together to secure ecologically sustainable water management.

2.3 Transport

Pressure

Transport involves the movement of both people and freight. It facilitates access to jobs, education, markets, leisure and other services, and thus plays a key role in the economy (DECC, 2006).

Transport and travel have major environmental and other costs including:
Consumption of significant amounts of non-renewable resources (especially fossil fuels)
Producing of air pollution and greenhouse gas emissions
Noise, visual and other impacts on urban amenity
Runoff from roads impacting upon water quality
Impacts on biodiversity as a result of fragmentation of natural ecosystems by roads
State

The most available and reliable indicator of transport impacts for the Port Macquarie-Hastings area is the number of registered motor vehicles in the LGA. The data reported below is sourced from Roads & Traffic Authority (RTA) reporting.

Figure 2.3.1 compares registered vehicle trends with local population growth. The number of registered vehicles is increasing in line with population growth over time. Although only a surrogate environmental indicator, this data supports the anecdotal evidence that impacts associated with transport and transport infrastructure would be increasing. Just how significant the local impacts on air quality, biodiversity and water quality is more difficult to quantify.

Responses

Responses implemented by Council in relation to transport issues include:

- Continuation with Council’s local cycleway program
- Ensuring provision for public bus transport into urban design
- Increasing the number of fuel efficient vehicles in the Council fleet

Figure 2.3.1 – Registered Vehicles in the Port Macquarie-Hastings LGA

Future

The major constraint to reducing the reliance on private motor vehicle use in the Port Macquarie-Hastings area is the lack of an accessible public transport system. This is a typical situation in non-metropolitan areas where generally, there is insufficient critical mass of population to justify an economically viable public transport system.

Despite the above, strategic actions such as identifying corridors for future modes of public transport, e.g. light rail, can be pursued. In addition, government and the community need to continue to recognise the environmental costs associated with reliance on the private motor vehicle and move towards more sustainable transport options.
It is likely that factors such as increasing fuel costs and future carbon taxation will assist in changing attitudes and facilitate behavioural changes such as the use of more fuel efficient vehicles and car pooling activities.

### 2.4 Waste Management

#### 2.4.1 Solid Waste

**Pressure**

Adverse impacts on the environment and public health can arise at many points in the life cycle of waste: at the site of generation, during transport and disposal, and from recycling and reuse activities. These impacts include pollution of surface and ground water, air pollution, generation of greenhouse gases, contamination of land, and noise, odours and other impacts on local amenity. They can also include separate impacts on the local amenity from the transport of waste. Community concerns over potential environmental impacts make the siting of new landfills difficult in developed areas, while the siting of landfills in remote locations increases transport costs and energy use (DEC, 2003).

Locally, the growth in population that has and is predicted to occur in the LGA results in pressures being placed on the environment, economy and infrastructure. An issue where this can be clearly demonstrated is that of solid waste generation.

**State**

<table>
<thead>
<tr>
<th>Table 2.4.1.1 – Indicators for Solid Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td>Response</td>
</tr>
</tbody>
</table>

* Per capita data based on total LGA population for consistency of annual figure
* Information not available

Solid waste management trends are provided in Table 2.4.1.1 and Figure 2.4.1.1.

Waste generation is primarily influenced by population growth. Despite population growth in the Port Macquarie Hastings LGA, total solid waste volumes generated over the last decade have remained stable with an overall reduction in the per capita solid waste generation. Solid waste recycling has also shown an increasing trend.
Responses

Responses to solid waste management implemented by Port Macquarie-Hastings Council include:
- Implementation of a comprehensive kerbside waste collection system including household waste, organics and recyclables collection.
- The operation of best practise waste recovery through the Organic Resource Recovery Facility and Materials Recovery Facility at the Cairncross Waste Management Facility.
- Operation of a best practise management landfill at the Cairncross Waste Management Facility.
- Remediation of closed landfill sites.
- Development of ‘waste plans’ for construction and demolition industries.
- Participation in the regional Midwaste group.

Future

Managing waste is one of the greatest environmental issues facing the community today. The challenge is to reduce our wastes and in the process, to build business opportunities for recycling, composting and the recovery of wastes, which would otherwise be sent to landfill.
The NSW Waste Avoidance and Resource Recovery Strategy 2003 provides a framework for reducing waste and making better use of our resources. The Strategy identifies four key areas where we must achieve outcomes:

- Avoiding and preventing waste;
- Increased use of renewable and recovered materials;
- Reducing toxicity in products and materials; and
- Reducing litter and illegal dumping.

Port Macquarie-Hastings Council is setting an ambitious goal of eliminating all waste to landfill by the year 2020. This goal will be pursued through Council’s Resource Efficiency and Sustainability Strategy 2007.

We must all play our part for this plan to work. Householders, businesses, industry, construction workers, schools and others must all do their bit to reduce waste. In the long run, the achievements we make will not only be measured in dollars but also by the quality of the environment that we leave our children.

Port Macquarie-Hastings Council has a clear vision for waste management. This vision is that the community will:

- Have a changed attitude to viewing wastes as a resource rather than a problem.
- Adjust their buying and living habits to minimise the amount of waste they produce.
- Have created an environment for developing innovative solutions to avoid generating waste.
- Have created cost-effective methods for recovering resources so that materials can be reused, recycled or reprocessed into valuable products.
- Have created business opportunities dealing in unwanted materials.
- Take pride in being a community that has a commitment to waste reduction.
2.4.2 Liquid Waste

Pressure

The increase in population is equally relevant to the generation of liquid wastes. Once generated, liquid wastes require collection and disposal. The major pressures associated with this issue relate to:

- The provision and management of collection and treatment infrastructure
- The impact of the discharge of liquid waste to the environment.

State

<table>
<thead>
<tr>
<th>Table 2.4.2.1 – Indicators for Liquid Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td>State</td>
</tr>
</tbody>
</table>

* Per capita data based on total LGA population for consistency of annual figure
** Information not available

Reticulated Sewerage System

Figure 2.4.2.1 shows the trends in treated wastewater volumes since 1998. Volumes of wastewater treated and discharged are heavily influenced by stormwater infiltration. Following the trend of the previous 12 months, a high volume of effluent was generated during 2008-2009. This result being attributed to the continuation of wetter conditions during the period.

Figure 2.4.2.2 shows a return to higher levels of effluent reuse during 2007-2008 despite it being a relatively wet year (when traditional forms of reuse are not viable e.g. irrigation). This trend is attributable to the operation of the Port Macquarie Reclaimed Water Treatment Plant. It is expected that a further increase in reclaimed water use will occur as a result of the full commissioning of the facility and the supply of reclaimed water to commercial users.
Figure 2.4.2.1 – Volumes of Wastewater Treated and Discharged from STPs

- Volume of wastewater received at sewage treatment plants (ML)
- Volume of treated wastewater discharged from reticulated sewage systems to receiving waters (ML)
- Population
- Linear (Population)
On-Site Sewage Management

The number of on-site sewage management systems continues to grow (refer figure 2.4.2.3). This is a direct reflection of increasing rural and rural residential development and improved monitoring of on-site sewage management systems by Council. The reduction of the number of systems in 2003-2004 represents an update of the total number of systems following the commissioning of the Kew Kendall Sewerage treatment Plant.

Inspections of aerated wastewater treatment systems by service contractors continue to increase as a result in the growth in number of these systems and a more efficient monitoring and regulatory regime implemented by Council.

The number of inspections by Council officers decreased in 2006-2007. The total annual number of inspections represents only a small percentage of the total number of on-site sewage management systems in the LGA. Many systems, particularly in the outlying rural areas have not been inspected to date.
Figure 2.4.2.3 – On-Site Sewage Management State

![Graph showing number of systems and inspections over years](image)

- Total No. of on-site sewerage management systems (e.g. septic tanks)
- No. of inspections of on-site sewerage management systems by Council
- No. of inspections of on-site sewerage management systems by AWTS contractors

**Trade Waste**

The number of trade waste systems installed to prevent the discharge of harmful substances to the sewerage system is growing at a low rate and is a reflection on the growth of commercial and industrial development in the LGA. Trends are depicted in Figure 2.4.2.4. The number of compliance inspections carried out by council has decreased due to staff availability. Inspections are, however, based on a risk management approach where inspections effort is concentrated on high risk trade waste generating premises.
Responses

Reticulated Sewerage System

Recent responses include:

- Continued development of the Hydraulic Model of the reticulation and delivery networks of the sewerage schemes. The model provides important operational data and drives new rehabilitation and capital works projects to meet the continuing pressure from development on the system
- Supply of reclaimed water from the Port Macquarie Reclaimed Water Treatment plant to commercial users in Port Macquarie, reducing both potable demand on the Water Supply and environmental discharge volumes into Kooloonbung Creek from the Port Macquarie Sewerage Scheme
- Continued development and construction of the Southern Effluent Pipeline to distribute and beneficially reuse effluent from the Lake Cathie/Bonny Hills STP to existing and future reuse markets in the southern sector of the LGA
- Development of the Camden Haven sewerage scheme Surcharge Reduction report and associated works to reduce the frequency of surcharges from the network into the Camden Haven River and its effect on the local oyster industry

On-Site Sewage Management

Implementation of the Port Macquarie-Hastings On-Site Sewage Management Plan including:

- Routine compliance inspections for on-site sewage management systems using a risk based approach
- Monitoring of aerated wastewater treatment systems (AWTS) servicing
- Use of GIS based Soil Risk Mapping throughout the Port Macquarie-Hastings local government area reflecting risk of effluent disposal from OSM systems
- Providing pre-purchase inspections upon request for prospective property purchasers
- Continued development of village reticulated sewerage schemes as a replacement for high-risk village on-site sewage management systems. A construction timeline for 5
villages has been adopted, with the commencement of the Herons Creek and Beechwood Systems proposed for the 2009/2010 financial year.

**Trade Waste**
Responses to trade waste issues include:

- Formal program for inspections of trade waste systems
- Approval and regulation of proposed systems to ensure acceptable treatment standards are maintained
- Provision of advice and information to business and industry in relation to trade waste management
- Investigation and enforcement of breaches of trade waste management approvals
- Transfer of the Trade Waste responsibilities from the Approvals and Regulatory Group to the Sewerage Section of Council.

**Future**
As stated in Section 2.4.1, managing waste is one of the greatest environmental issues facing the community today. The principles that relate to reducing solid waste are relevant to liquid wastes. The future to addressing liquid waste issues is to:

- Encourage community attitudes to having treated effluent seen as a resource rather than a problem.
- Increasing effluent reuse through dual reticulation systems in growth areas.
- Ensuring no net increase in effluent discharge to receiving waters.

2.5 **Heritage**

**Pressure**
As with other areas there are a number of factors that affect the conservation of significant heritage places. These include:

- Development of rural areas for suburban housing
- Intensification of development in established areas and subdivision of existing allotments
- Lack of knowledge or appreciation of conservation values of heritage places
- Inappropriate alterations and additions and lack of maintenance
- Increasing land values
- Lack of funding, resources and/or appropriate expertise to properly care for heritage places (Hastings Council, 2003).

The term 'heritage' encompasses all those places, objects, customs and traditions that communities have inherited from the past and wish to preserve for current and future generations. Heritage values differ among and between individuals and groups with different cultural backgrounds. A diverse range of heritage values is recognised across NSW.

For management purposes, heritage is divided into the sub-categories of 'cultural' and 'natural' heritage. Distinguishing between cultural and natural heritage is often difficult because they can be elaborately intertwined. Aboriginal people have always had culturally specific associations with natural landscapes, making their culture inseparable from nature. The cultural dimensions of the natural environment have now also become a common experience of many non-Aboriginal people in NSW, including families with long-standing
connections to rural properties through successive generations. This dichotomy can create challenges for heritage managers.

The Valuing the Priceless report commissioned by the Heritage Chairs and Officials of Australia and New Zealand in 2005 revealed that 93% of Australians believe that it is important to protect heritage places even though they may never visit them (DECC, 2006).

State

Table 2.5.1 – Indicators for Heritage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>No. of protected non-Aboriginal heritage items</td>
<td>132</td>
<td>153</td>
<td>159</td>
</tr>
<tr>
<td>Response</td>
<td>No. of protected Aboriginal heritage items</td>
<td>198</td>
<td>385</td>
<td>459</td>
</tr>
</tbody>
</table>

A review of the records pertaining to sites of non-Aboriginal Heritage reveals that 159 sites are currently protected under a variety of mechanisms. These sites include built, archaeological and natural sites.

Information supplied by the Department of Environment and Climate Change reveals that there were an additional 6 sites of Aboriginal heritage afforded a legal conservation status during 2008-2009. These sites are classified as artefacts. Two sites were recorded as being destroyed during 2008-2009.

Responses

Port Macquarie-Hastings Council continues its approach of proactive heritage conservation as shown by the following responses:

- **European Heritage**
  - Addition of three new sites to the Hastings Local Environment Plan being; the Kendal School Masters Residence, the Pembroke Community Hall; and archaeological ruins under the Glasshouse and adjacent Hay Street
  - Conservation work on monuments within Port Macquarie’s Second Burying Ground (1824-1886), bringing the total number of graves benefiting from restoration work to fifty three (53) since 2005
  - Secured grant funding from the NSW Heritage Office for various heritage activities
  - Funding to property owners to carry out repairs, maintenance or to re-instate missing items to their heritage listed property
  - Continued development of the Hastings Heritage Strategy with a view to replacing with a new Heritage Plan 2009-2013
  - Continued the Heritage Advisory Service that assists Council and the community to implement appropriate measures to conserve and present local heritage
Aboriginal Heritage

Continued development of the draft Aboriginal Heritage Strategy
Completed development of the Reconciliation Action Plan (contains an Aboriginal Heritage component)
Aboriginal heritage assessment as part of the development assessment process
Aboriginal heritage awareness during Heritage Week
Aboriginal heritage consultation and partnership regarding the upgrade of Pacific Highway; Coopernook to Heron's Creek
Completion of Stage 1 Thomas Dick Photographic Collection highlighting Aboriginal cultural heritage in the Hastings

Future

Increased diversity of heritage items on lists and registers reflects growing community recognition and awareness of heritage, but current data systems and management processes do not allow for a systematic assessment of their condition. Monitoring procedures need to be piloted and reviewed to provide agencies and organisations with better management tools.

Maintaining traditional uses or adapting new uses of old buildings can contribute to sustainability but this may require upgrades that compromise their heritage values. This tension may be partially eased by the new template for LEPs, which includes heritage in the broad framework of issues that need to be addressed in local government decision-making.

Other changes under recent reforms to planning include the facilitation of critical infrastructure projects that will no longer require approval under the Heritage Act 1977. It is too soon to determine the impact of this change.

The Two Ways Together Culture and Heritage Action Plan recognises the need to broaden Aboriginal cultural heritage assessments beyond the current impact assessment for developments and archaeological surveys. The plan aims to address this issue through new Aboriginal heritage assessment and planning guidelines for use by agencies and local government (NSW Government 2003).

The Valuing the Priceless report revealed that 93% of Australians believe that it is important to protect heritage places (Allen Consulting Group 2005). At the same time an inquiry into historic heritage by the Productivity Commission revealed some concern that this wider public interest needs to be balanced against the rights and financial responsibilities of private owners of heritage properties. This should see the issue of appropriate levels of public investment in heritage conservation receive increased attention in coming years (DECC, 2006).
2.6 Amenity

The term 'amenity' relates to the qualities, characteristics and attributes people value about a place and which contribute to their quality of life. Urban or residential amenity encompasses a wide range of attributes and values which change over time and with cultural and socio-economic status. Accordingly, the attributes of amenity which people seek and appreciate often vary according to individual values and locations.

The amenity of urban or residential areas is provided by elements such as the physical landscape or streetscape, areas of vegetation, and public and private open space for recreation, such as parks, reserves and gardens. Other important elements of urban design include the scale and dominance of buildings, the presence of heritage places, views and outlooks, privacy, physical safety, accessibility, and levels of noise and odour (DECC, 2006).

2.6.1 Noise impacts

Pressure

Noise pollution can be defined as unwanted noise that unreasonably intrudes on daily activities. In urban areas, noise pollution has many sources, most of which is associated with urban living: road, rail and air transport; industrial noise; and neighbourhood and recreational noise. A number of factors contribute to problems of high noise levels including:

- increasing population, particularly where it involves expanding urbanisation into former rural areas, and urban consolidation with incompatible adjacent land uses
- increasing volumes of road, rail and air traffic
- planning schemes that result in noise-based land-use conflicts.

The level of annoyance or discomfort depends on the type, timing, duration and frequency of noise or if the disturbance is out of the ordinary, that is, where it differs from the 'background' noise.

The impact of noise on human health has emerged as an increasingly significant issue that justifies stronger management efforts in the future. There is now sufficient evidence internationally that community noise may pose a general public health risk, although further research is needed to assess more fully the impact of environmental noise on public health (enHealth Council 2004).

Local councils, DECC and NSW Police all receive complaints about noise. As a result, the data on complaints received by Council in figure 2.6.1.1 should be considered indicative only. Complaints are not regarded as an accurate measure of the impact of noise and typically understate it. For example, most European Union countries are now mapping noise in urban areas of more than 250,000 people to develop a better indicator of environmental noise levels and trends (DECC, 2006).

Major noise sources

Road traffic

Road traffic noise is one of the most widespread and growing environmental problems in urban NSW. In 1994 the NSW Road Traffic Noise Taskforce reported that road traffic noise has become a major urban environmental problem because:
• Historically, land use planning has not been well integrated with transport planning, allowing residential developments and major transport corridors to occur in close proximity without appropriate buffer zones or treatment to buildings
• There has been an increasing community reliance on road transportation, and a reluctance to implement or accept partial solutions involving greater use of public transport
• Traffic on many existing roads through built-up areas has increased well beyond expectations prevailing during planning or construction of the roadways
• Potential solutions, apart from new vehicle noise standards are complex, often costly, and require coordinated actions by a number of agencies and the community
• While there is high community awareness of the problem, there is a general lack of understanding of its extent and possible solutions.

The impact of road traffic noise on the community depends on various factors such as road location and design, land use planning measures, building design, vehicle standards and driver behaviour (DEC, 2003).

Neighbourhood & domestic noise
In the Hastings LGA, the major sources of neighbourhood/domestic noise include barking dogs (by far the major source), air conditioners, power tools (pool pumps, lawn mowers etc), building construction and commercial noise in residential/business fringe areas.

Noise from barking dogs is of particular concern because it is unpredictable and often happens repeatedly. Noise from trail bikes is an emerging problem in rural-residential and urban fringe areas.

Incompatible land use
Generally the determination of land use zoning includes the separation of activities that are incompatible due to noise levels. For example, heavy industrial areas will be separated from residential areas by light industrial, recreational facilitates and/or retail activities. However, changing land uses over many decades and earlier inappropriate zoning controls have resulted in unacceptable noise levels for some areas and uses.

The Department of Urban Affairs and Planning (DUAP) has developed environmental impact statement guidelines for major developments which address siting issues, for which noise generation is a consideration, in addition to ensuring noise impact assessment is carried out as part of the assessment process. The Industrial Noise Policy (DEC) is an important tool for assessing and planning for the noise impacts of industrial/commercial development.

State

Table 2.6.1.1 – Indicators for Noise

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>No. of noise complaints: Total</td>
<td>537</td>
<td>460</td>
<td>699</td>
</tr>
<tr>
<td>Pressure</td>
<td>No. of noise complaints: Domestic (excl. barking dogs)</td>
<td>97</td>
<td>81</td>
<td>49</td>
</tr>
<tr>
<td>Pressure</td>
<td>No. of noise complaints: barking dogs</td>
<td>402</td>
<td>332</td>
<td>630</td>
</tr>
<tr>
<td>Pressure</td>
<td>No. of noise complaints: building sites - working outside hours</td>
<td>13</td>
<td>29</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 2.6.1.1 provides details of the number and nature of noise complaints received by Port Macquarie-Hastings Council. The overall number of noise complaints received increased since 2003-2004 due primarily to an increase in complaints regarding of barking dogs.

Increases in the number of vehicles in the LGA are also an indicator of increase transport noise. Figure 2.3.1 is relevant in this respect, showing vehicle registrations are growing inline with local population.

Figure 2.6.1.1 – Noise complaints received by Council

Responses

Port Macquarie-Hastings Council has a number of responses to the issue of noise, including:

Ensuring that new development proposals comply with relevant acoustical requirements
The assessment of rezoning proposals to ensure that noise problems do not arise as a result of landuse changes
The investigation and resolution of noise complaints
The development of educational/informational initiatives (e.g. pamphlets)
Noise assessment as part of the planning and design of new road infrastructure
Cycleway construction to reduce reliance on motor vehicles and hence reduce traffic noise
Airport planning to ensure surrounding land uses comply with airport noise forecast requirements

Future

State and local governments will need to coordinate strategies to ensure that land-use compatibility is considered in all future planning processes to prevent generating new sources of noise and odour that have an adverse impact on public health and amenity. Where development proposals have already been granted to locate residential areas and industry close to one another, careful siting of less sensitive land uses, such as commercial developments next to major noise sources and the establishment of buffer zones, can help minimise conflicts and retain amenity.
Existing Government noise management strategies, such as the *NSW Industrial Noise Policy* (EPA 2000) and *Environmental Criteria for Road Traffic Noise* (EPA 1999), need to be linked to planning controls to ensure best practice mitigation and management measures for noise-generating land uses and activities (DECC, 2006).

### 2.6.2 Odour

**Pressure**

Increasing population growth and urban development in the Hastings has resulted in residential areas encroaching on areas once only used for agricultural or industrial activities. The expansion of residential development has resulted in the loss of buffer zones created to minimise land-use conflicts between housing and agriculture and industry. Odour problems are considered one such conflict, with sources such as abattoirs, piggeries, poultry farms, sewage treatment plants, landfills and chemical manufacturing plants causing amenity problems. Odours can also be associated with the natural processes in wetland systems in the coastal strip.

Odours are difficult to regulate as individuals can react differently to them and they come from a large range of sources. Additionally, climatic or seasonal conditions, such as very calm weather, can worsen their impacts, even at long distances from their source.

Odour impacts often arise from inappropriate land-use decisions that allow residential areas to grow around established rural odour-generating activities or, in the reverse scenario, that site odour-generating activities close to existing residential areas. Abattoirs, piggeries, cattle feedlots, poultry farms, sewage treatment plants, landfills, charcoal chicken shops and smash repairers can cause odour problems. Conflicts resulting from planning decisions can arise as the planning processes under the *Environmental Planning and Assessment Act 1979* are not properly equipped to handle this amenity issue.

Odours are the largest source of complaints to DEC Environment Line: they accounted for 33.4% of the total in 2004–05, which is approximately 75% of the total of 4316 air pollution complaints made (compared with 80% and 4248 in 2002–03). The majority of complaints about odour are generally from areas on the urban–rural interface and from regional centres outside Sydney.

Local councils are believed to receive the most complaints about odour, but a consolidation of data on the number of complaints they process is not available. The data trends on complaints received only by DEC should therefore be considered indicative only (DECC, 2006).

### State

**Table 2.6.2.1 – Indicators for Odour**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>No. Complaints (total)</td>
<td>78</td>
<td>49</td>
<td>34</td>
</tr>
<tr>
<td>Pressure</td>
<td>- Domestic</td>
<td>10</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Pressure</td>
<td>- Commercial/industrial</td>
<td>13</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Pressure</td>
<td>- Sewerage Treatment Plants &amp; pump stations</td>
<td>43</td>
<td>29</td>
<td>9</td>
</tr>
</tbody>
</table>
Odour complaints received by Council show a downward trend since 2000. The most significant reduction is associated with complaints about odour from sewage treatment plants and sewage pump stations. This reduction is likely to be the result of improved odour control at sewage treatment plants and cleaning practices at sewage pump stations. It should also be noted that many complaints about odour from sewerage infrastructure are often attributed to other sources of odour, such as decomposing organic matter in wetlands that are located nearby. This has the potential to skew past results and impact on the variability of complaint statistics.

Responses

Port Macquarie-Hastings Council has a number of responses to the issue of odour, including:

Ensuring that new development proposals comply with relevant environmental standards
The assessment of rezoning proposals to ensure that odour problems do not arise as a result of landuse changes
The investigation and resolution of odour complaints
Odour assessment as part of the planning and design of new sewerage treatment infrastructure
Continuous improvement of sewerage infrastructure operations
Best practise waste management and landfill management

Future

State and local governments will need to coordinate strategies to ensure that land-use compatibility is considered in all future planning processes to prevent generating new sources of noise and odour that have an adverse impact on public health and amenity. Where development proposals have already been granted to locate residential areas and industry close to one another, careful siting of less sensitive land uses, such as commercial...
developments next to major noise sources and the establishment of buffer zones, can help minimise conflicts and retain amenity (DECC, 2006).
Chapter 3 – Atmosphere

3.1 Global Warming and Energy Consumption

Pressure

The greenhouse effect is a natural phenomenon, however human activities are increasing the level of greenhouse gases (with the exception of water vapour) in the atmosphere. This increase in concentration of greenhouse gases in the atmosphere is resulting in what is known as the enhanced greenhouse effect, or global warming as depicted below. Global warming may have a profound effect on our planet by changing rainfall patterns, raising the sea level, modifying natural ecosystems and affecting agricultural conditions worldwide.

Major sources of greenhouse gases include:
- Road transport
- Industrial emissions
- Land clearing
- Agriculture
- Electricity generation by coal fired power stations
- Methane production from animals and wastes production (landfilling, sewage treatment)

Figure 3.1.1 – The Enhanced Greenhouse Effect

Energy Consumption

Energy is essential to the functioning of an advanced industrial society. NSW has a reliable and secure energy infrastructure and relatively low prices. Most of the energy used in NSW is made from fossil fuels, such as coal, with adverse impacts on the environment throughout the production and supply chain. Energy consumption is the major source of greenhouse emissions and has the largest overall environmental impact from human activities.
Population increase and development will continue to increase energy demand. The absence of alternative energy supplies in the Hastings, such as natural gas, places further pressure and reliance on traditional energy supplies (DEC, 2003).

**Fossil fuels currently provide 95% of the State's primary energy needs and the demand for energy continues to grow – both factors that have a significant impact on the environment.**

Decisions on technologies and fuel sources to meet future energy demands, particularly electricity generation, will have significant environmental consequences for NSW. A shift to lower emission electricity generation, such as gas-fired power stations and renewable energy sources, as well as greater pursuit of energy efficiency and demand management, will reduce the negative environmental impacts of energy use.

'Energy' in this section refers to the stationary energy sector (transport is dealt with separately in Human Settlement 2.4). It covers:

- energy industries (electricity generation, petroleum refining, gas processing and solid-fuel manufacturing)
- direct production of energy for the manufacturing and construction industries
- energy use by other sectors, including commercial and residential
- fuel use by agricultural, fisheries and forestry equipment
- mining activities that contribute fuel to the above sectors.

The stationary energy sector is the single largest source of greenhouse gas emissions: it contributes around 48% of the State's total emissions, the majority of which (approximately 77%) comes from the generation of electricity (AGO 2006a). The sector also, is a major source of regional air pollutants, such as oxides of nitrogen (NOx), sulfur oxides (SOx), fine particles and heavy metals; consumes large quantities of fresh water and generates large quantities of waste ash. Of the activities covered by the stationary energy sector, electricity production has by far the largest overall impact on the environment (Atmosphere 3.1).

Demand for electricity and other energy sources continues to rise, driven by population increase and economic growth (DECC, 2006)
There is no new indicator information for global warming available for 2008-2009. However, Table 3.1.1, Figure 3.1.1 and 3.1.2 provides indicator data on both community emissions and Council’s corporate emissions to 2007.

**Figure 3.1.1 - LGA Greenhouse Emissions**
This data reflect that emissions are increasing at a higher rate than population growth despite local energy efficiency and emissions abatement initiatives. This rate of increase reflects Australians energy consumption as among the highest in the developed world and that a significant change in culture is required to combat the effects of climate change.

Figure 3.1.3 shows predicted trends in electricity consumption under three growth scenarios. Rising electricity demand in NSW is being driven by population and economic growth and changes in people's behaviour and lifestyles. As real incomes have risen so too have levels of material consumption. For example, NSW households with air conditioners rose from 31% in 1994 to 54% in 2005, and the number of homes with more than one cooling unit in operation also increased. The ownership of dishwashers also jumped from 25% to 43% over the same period (DECC, 2006).
Figure 3.1.3: Actual growth and predicted trends in electricity consumption for three scenarios

Figure 3.1.4 shows emissions abatement between 1999 and 2007 in the community sector and for Council’s corporate operations resulting from local emissions abatement activity. Community abatement between 1999 and 2003 comprised of reductions in energy demand resulting from the introduction of energy efficiency standards in new residential buildings. The significant increases from 2004-2005 onwards result from kerbside organic waste recycling initiatives in the community.

Abatement from Council’s corporate activities are a combination of energy efficiency improvements in public facilities and the purchasing of green power across a number of sites.

It should be noted that Council’s corporate abatement performance can be considered somewhat better than indicated by Figure 3.1.3. Abatement for the period between 2006 and 2008 also include around 5.8 gigawatts of renewable energy that cannot be accredited as Greenpower because the generation facilities that produce this power existed prior to the commencement of the NSW Greenhouse Gas Abatement Scheme.

In 2007/2008, council purchased 27% renewable electricity across all sites, of which only 8% can be accredited as Greenpower.
Responses

Council’s responses to global warming are based upon its participation in the Cities for Climate Protection Program and its Greenhouse Action Strategy. Specific responses implemented include:

- Purchasing renewable energy. In 2007-2008 Council purchased 27% renewable energy across all operations (cost about $78,000) reducing greenhouse gas emissions by about 5,000 tonnes of CO2. (of this renewable energy, 1.4 gigawatts was accredited green power equating to 1,400 tonnes greenhouse gases savings)
- Implementation of a Fleet Sustainability Policy resulting in a 3% reduction in CO2 emission from Council’s fleet between 2004 and 2007
- Negotiating with Country Energy to implement an energy efficient streetlighting plan.
- Investigation of carbon trading opportunities associated with organic waste management
- Greenwaste composting, saving 40,000 tonnes of CO2 by reducing the amount of greenwaste going to landfill.
- Partnership with Envirosaver Program to retrofit energy efficient lighting and AAA shower roses in residential dwellings

Previous greenhouse abatement activities include:

- Major energy efficiency upgrading at Council’s Port Macquarie, Laurieton and Wauchope offices and libraries saving 15% on energy consumption and over 200 tonnes of CO2 annually. Ongoing energy efficiency measures being implemented in council buildings
- Energy efficiency upgrade of Bonny Hills caravan park hot water system, saving 135 tonnes of CO2 annually.
- Power factor correction in large electricity using sites
• Converting to energy-efficient office equipment, saving over 20 tonnes of CO₂ annually
• Activating Energy Star features on all PCs as a default setting and replacement all CRT screens with LCD models

Carried out a Fleet Sustainability Study which led to changes to Council's Motor Vehicle Policy and an increase in the number of fuel efficient vehicles in the fleet. (in 06/07 33% reduction in number of large 6 cylinder vehicles, 100% increase in mid size 4 cylinder vehicles, 243% increase in small 4 cylinder vehicles (including 9 small 4cyl diesel vehicles), 1 hybrid vehicle, Converting 4 cylinder 2wd utilities from petrol to diesel models (8))

• Trials of biodiesel in selected plant with a view to using this fuel as a petrodiesel substitute
• Trialling load based aeration controls at the PM STP to reduce energy consumption.
• Shelley Beach Amenities Solar Power Project
• Introducing energy-efficiency standards in residential development (prior to BASIX)
• WaterWise Programs
• Production of a Household Greenhouse Information Package and distribution at events and in mail outs
• Promoting energy efficiency and renewable energy on Council’s website
• Promoting community energy efficient lighting

Despite the implementation of greenhouse abatement responses through the Greenhouse Action Strategy, emissions have continued to grow significantly from Council’s corporate operations and in the wider community. In both sectors, the growth in emissions is higher than the growth in population indicating that a combination of growth and a trend of increasing consumption are driving emissions growth. Council is therefore in the process of developing a revised strategy that will examine:

• Abatement Issues
• Increased emphasis on site/facility based renewable energy generation systems
• Increased renewable energy purchasing
• Street lighting energy efficiency gains
• Further fleet/plant efficiency improvements and use of renewable fuels
• Adaptation Issues
• Mapping sea level rise scenarios
• Determining consistent sea level rise planning levels
• Climate Change Risk Assessment (determining at risk infrastructure and services)
• Developing and Implementing a Climate Change Adaption Plan

**Future**

Tackling the impacts of the stationary energy sector is fundamental to addressing greenhouse gas emissions and climate change. It is also a key sector to target to reduce air pollution in NSW.
### 3.2 Urban Air Quality

**Pressure**

Pressures on air quality in the Hastings LGA come from a variety of sources. These include:

- Backyard burning
- Domestic solid fuel home heaters
- Hazard reduction burning
- Bushfires
- Subdivision burn-offs
- Rural pasture burn-offs
- Quarrying
- Development/construction activity
- Motor vehicles
- Rural industries (e.g. dairies, piggeries, feedlots, use of fertilizers, etc).

The major pollutants from these sources include:

- Particulate matter from burning activities, wind blown dust and motor vehicles.
- Sulphur dioxide, nitrogen oxides, lead, carbon monoxide and hydrocarbons from motor vehicles.

In rural areas the pollutant of primary concern is airborne particulate matter. Air quality standards for particles can be exceeded due to agricultural and hazard-reduction burning, bushfires, the use of solid-fuel heaters, and dust storms.

Air pollution can cause a wide range of health symptoms, from coughing, wheezing and shortness of breath, to more serious impacts for those with pre-existing respiratory and cardiac conditions, such as asthma attacks, hospital admission and premature death. It has been estimated that air pollution from motor vehicles alone accounts for more than 500 early deaths in the Sydney Region per annum and over 1000 hospital admissions (BTRE 2005). Exposure to high concentrations of air pollution over many years is associated with reduced life expectancy and increased incidence of lung cancer (Pope et al. 2002; Nafstad et al. 2004). The health costs of ambient air pollution in the greater metropolitan region (GMR) have been estimated to be between $1.0 billion and $8.4 billion per annum (DEC 2005). In Sydney, the health costs of motor-vehicle emissions alone are estimated to be between $600 million and $1.5 billion per annum (BTRE 2005). Apart from their impact on human health, some air pollutants can also damage flora, fauna and the built environment.

In 1998 the National Environment Protection Council (NEPC) set ambient air quality standards and goals for six pollutants in the AAQ NEPM which aim to provide adequate protection for the health of the Australian population. There are five primary pollutants (particles, carbon monoxide, sulfur dioxide, nitrogen dioxide and lead) and one secondary pollutant (ozone) (NEPC 1998). Primary pollutants are those emitted directly from various sources and secondary pollutants are formed by the reactions of other pollutants (although particles and nitrogen dioxide can be either primary or secondary pollutants).

To measure compliance, NSW has a comprehensive air quality monitoring and reporting capability that more than meets the requirements of the AAQ NEPM (see EPA 2001). Governments have committed to achieve these air quality goals by 2008.

The primary emissions of interest arise from both natural processes (biogenic) and a wide range of human activities (anthropogenic). Anthropogenic emissions are usefully categorised...
by the type of activity, and the NSW Air Emissions Inventory, now being developed by DEC, identifies five main source categories: domestic, commercial, industrial, off-road mobile and on-road mobile (DECC, 2006).

State

Table 3.2.1 – Indicators for Urban Air Quality

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>No. of EPA licensed premises</td>
<td>23</td>
<td>18</td>
<td>23</td>
</tr>
<tr>
<td>Pressure</td>
<td>Total No. of air quality complaints</td>
<td>72</td>
<td>87</td>
<td>70</td>
</tr>
<tr>
<td>Pressure</td>
<td>No. of air quality complaints - backyard burning</td>
<td>**</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Pressure</td>
<td>No. of air quality complaints – other</td>
<td>**</td>
<td>65</td>
<td>65</td>
</tr>
</tbody>
</table>

Data relating to the number of air quality related complaints received are shown in the Table 3.2.1 and Figure 3.2.1. The number of air pollution complaints received decreased during 2008-2009, continuing a general downward trend since 2001-2002.

Figure 3.2.1 – Air Pollution Complaint Trends

The number of motor vehicles registered in the Port Macquarie-Hastings is a surrogate indicator of air quality given that transport is known to be a major contributor to air pollution. Trends in motor vehicle registrations are shown in Figure 2.3.1.

Responses

Responses to air quality issues initiated by Port Macquarie-Hastings Council include:

- Ensuring new and existing developments adopt appropriate management practices
- Responding to complaints and distribution of educational material relating to air pollution issues such as solid fuel home heaters
- Prohibition on the burning of waste in non-rural areas and regulating the burning of vegetation wastes in all areas of the LGA
- Best practise waste management and landfill management
• Constructing cycleways

Future

The forecast growth in NSW's population and in private and commercial vehicle travel will require a renewed focus on motor vehicle emissions. A strong emphasis on integrated land use and transport planning, including public transport planning, is needed. An increased uptake of hybrid vehicle technologies (Australian Government 2005b) will also help to achieve reductions in motor vehicle emissions.

The level of understanding of the health impacts of air pollution is also improving. A review of the AAQ NEPM commenced in 2005 with a decision on whether to revise the standards likely in 2008. If revised standards are introduced, they may require further efforts to reduce emissions.

It is likely that weather patterns for NSW will continue to change due to global climate change (see Atmosphere 3.1), with associated changes to air quality in metropolitan and regional areas. Increased temperatures would result in a longer season for elevated concentrations of ozone. Changes to rainfall and temperature may increase the frequency of bushfire-related pollution events, and shifts in weather patterns may increase the number of calm days, resulting in more days of elevated particle concentrations (CSIRO 2003b) (DECC, 2006).
Chapter 4 – Land

Land Use Changes

Pressure

Much of the land degradation in NSW today is the result of changes to land cover and land use during the first 100–150 years of European settlement. Native woody vegetation once covered 65% of the State (Keith, 2002). This was extensively cleared in eastern and central NSW, primarily for the establishment of crops and pastures, but also for the development of urban areas, plantation forests, mining areas, and communication and infrastructure corridors (EPA, 2000a). These changes were often encouraged by government directives and incentives and have provided significant social and economic benefits. However, they also altered the physical, chemical, biotic and hydrologic balances in the landscape, accelerating the degradation of soils (DEC, 2003).

This overview of changes taking place in NSW rural land-use systems and their relationship to landscape health introduces more detailed discussions of landscape, soil and contamination issues through the rest of the chapter. Other changes in land use – such as the irreversible loss of rural land resources to urban and peri-urban activities, the loss of ecosystem integrity, and vegetation clearing are mentioned in passing, but these issues are covered in more detail in Human Settlement 2.1, Biodiversity 6.1 and Biodiversity 6.2, respectively.

The extent and nature of land-use change does not directly indicate landscape health, but it does provide an important context for understanding the pressures that lead to land degradation, and it can also be a useful surrogate for other, more intractable indicators of landscape condition (NLWRA 2005). In particular, knowledge of land capability and land-management practices can increase the value of land use as an indicator of landscape and soil health.

Healthy soils provide ecosystem services that are fundamental to landscape health, and that also underpin the productivity of agricultural land. Although soil is technically a renewable resource, soil renewal rates are very slow, and in human time frames soil is effectively non-renewable.

Extensive modification of the landscape for uses such as agriculture, urban development and infrastructure has altered the physical, chemical, biotic and hydrologic balances and dynamics in the landscape. In turn this has placed severe stress on soils, water and vegetation, leading to a decline in landscape health. For land degradation processes such as dryland salinity, there is a timelag before the effects become evident, and these will continue to unfold over the next few decades (see Land 4.3). Some of the land degradation processes have long-term or irreversible consequences, such as soil loss from accelerated erosion, subsoil sodicity and subsoil acidity. Other forms of degradation, such as nutrient decline and surface soil acidification, can be remediated if addressed early, but at considerable private and public cost (Lockwood et al. 2003) (DECC, 2006).
State

Land Use

Figure 4.1.1 shows that the number of rateable residential and business properties are steadily growing. The number of rateable farmland properties has decreased, but as a result of administrative rating changes rather than a specific reduction in farmland.

This data demonstrates the increase in urban landuse, but is likely to understate the reduction in rural land resulting from urban growth. A review of land use area information is needed to better quantify landuse changes.

Figure 4.1.1 – Property Use Trends

Development

Figure 4.1.2 shows a breakdown of the development applications received and processed by Council. The data shows a trend of decreasing approvals since 1999-2000 in the Port Macquarie-Hastings. This trend is consistent with the economic conditions associated with the property and housing industries of the period. However, these rates of development are still considered high when compared to other regional areas.

Figure 4.1.3 provides a graphical break down of the volume and type of development approvals issued.

The demographic and urban landuse information that is available demonstrates that the growth in urban landuse continues to be the most significant in the coastal ‘strip’.
Responses

Response to land use changes are implemented through a variety of strategic planning tools including:

- Hastings Urban Growth Strategy
- Camden Haven Urban Growth Strategy
- Wauchope Urban Growth Strategy
• Rural Residential Release Strategy
• Industrial Lands Strategy

These strategies are complimented by infrastructure strategies such as the Hastings Effluent Management Strategy, the Hastings Drought Management Plan and Hastings Waste Management Strategy that over arch numerous specific projects aimed at servicing sustainable urban growth.

A major planning initiative for directing land uses within the LGA will be via the preparation of the Port Macquarie-Hastings Local Growth Management Strategy. The aim of the strategy is to prepare a comprehensive planning strategy to support sustainable growth of the local government area over the next 25 years to 2031.

Future

The future framework for land use planning in the LGA will be based on the principles of Ecologically Sustainable Development (ESD). The process will entail the integration of: the Mid North Coast Regional Strategy; significant planning studies, local growth strategies, policies; and new planning study and community and stakeholder consultation. This will achieve State goals for reform of the planning system as well as establish a long term environmental planning framework for Council.

Soil Erosion

Pressure

Soil erosion by water and wind is a natural process that can be greatly accelerated by poor land-management practices. Soil erosion is a critical issue because soil is effectively a non-renewable resource (see Land 4.1), and soil health underpins the functioning of natural and agricultural landscape systems.

Many of Australia's soils are particularly susceptible to erosion if their protective ground cover is removed. In NSW, past soil and water management practices during urban development, forestry, agriculture and mining, as well as other disturbances of the soil, have greatly accelerated natural rates of soil erosion by reducing vegetation cover, which has increased runoff and reduced resistance to water and wind erosion (Edwards & Zierholz 2000). The potential for soil erosion by water is highest in landscapes with high rainfall intensity, steep slopes and inherently erodible soils. Wind erosion is potentially more of a hazard in the Western Division of NSW, in some cropping zones, particularly where land is allowed to remain fallow, and also in coastal sand dune areas. The potential for soil erosion increases during high-intensity, episodic rainfall or wind events, especially when these follow events that cause ground-cover depletion, such as droughts or bushfires.

Soil erosion leads to a loss of topsoil, organic matter and nutrients. It also degrades soil structure and decreases water storage capacity, thus reducing fertility and the availability of water to plant roots. Soil erosion is therefore a major threat to biodiversity. Soil erosion can degrade floodplains, riverine and coastal water quality, and aquatic ecosystems by significantly increasing sediment and nutrient loads (see Water 5.1 and Water 5.3). The costs to the community of restoration works and the decline in agricultural productivity from soil erosion are hard to quantify (DECC, 2006).
Table 4.2.1 - Indicators for Soil Erosion

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>Erosion &amp; sediment control - building sites - complaints</td>
<td>New Indicator</td>
<td>9</td>
<td>32</td>
</tr>
<tr>
<td>Response</td>
<td>Erosion &amp; sediment - building sites - warnings issued</td>
<td>New Indicator</td>
<td>30</td>
<td>23</td>
</tr>
<tr>
<td>Response</td>
<td>S&amp;E control - building sites - fines issued</td>
<td>New Indicator</td>
<td>11</td>
<td>6</td>
</tr>
</tbody>
</table>

The surrogate indicators in Table 4.2.1 are used to infer soil erosion impacts in the urban landscape. Soil erosion from development, building and subdivisions, has localised impacts on land and in receiving waters. Table 4.2.1 contains data on the number of complaints and enforcement activity relating to this issue. The data indicates a continued increase in complaints relating to erosion and sediment control on building sites and decrease in enforcement activity.

Broad scale erosion is not a significant issue in the LGA. A high level of woody vegetation cover (71%) minimises broad scale erosion potential. However, the Department of Natural Resources (DNR) have identified eight sub-catchments affected by land degradation (Taylor, 2000), being Bellangry, Bulga Plateau, Comboyne, Red Hill, Seaview, Stewarts River, Tilbaroo, and Upper Rollands Plain. Principle forms of land degradation affecting these sub-catchments are gully and riverbank erosion.

Within these eight sub-catchments a total of 45.7 km of riverbank erosion has been identified. Additional riverbank erosion is prominent in the estuarine reaches of the Maria River, Hastings River and Stingray Creek.

In addition to the above coastal erosion issues exist at Town Beach, Port Macquarie and Lake Cathie. Erosion at these locations is caused by the prevailing wave climate and weather patterns and is being enhanced by climate change induced sea level rise. The available photogrammetric data has indicated that the beach at Lake Cathie is undergoing long term recession at a rate of between 0.1 and 0.3 m/year. Allowing for factors influencing this recession, such as climate change that has already occurred, a conservative allowance has been made for historic long term recession of 0.2 m/year.

Responses

A number of different responses have been implemented by Port Macquarie-Hastings Council to reduce soil erosion including:

- Stream bank erosion projects in partnership with the Department of Natural Resources, Landcare and the Northern Rivers Catchment Management Authority. A significant project being the remediation of river bed erosion on the Wilson River at Rollands Plains. 34.5km of riverbank have been remediated since 2006.
- Implementation of targeted river reach remediation works on the Camden Haven and Hastings Rivers.
- Implementation of Council’s Best Practice Management Guideline For Gravel Road Maintenance to minimise off-site water pollution for differing soil type zones, rainfall zones and road gradients
- River bank protection works at Googley’s Lagoon, Dunbogan
- Installation of rock protection and dune reconstruction at Town Beach in accordance with the Town Beach Coastal Zone Management Plan
Preparation of a Coastal Hazard Study and commencement of a Coastline Management Study to identify coastal erosion risks and solutions at Lake Cathie

Future

Climate change may result in an increased frequency and intensity of drought, bushfire and storms in NSW, with ground cover becoming more difficult to maintain, leading to increased soil erosion. The Government, landholders and the community need to plan for the greater erosion risks associated with natural events and adopt management practices that are more appropriate. New approaches that include measures for environmental recovery in drought packages are a start only, and need to be strengthened.

An update of potential erosion rates may soon be possible from advances in discriminating different types of ground cover using satellite imagery and data about land-use and land-management practices (currently in preparation at national and catchment scales). This should allow CMAs to better target local and regional investment (see Land 4.1). However, knowledge is needed of the trends in actual degradation from erosion for determining whether investment is actually improving environmental outcomes and making progress towards statewide targets.

The reduction of soil erosion rates will require the wider adoption of sustainable land management, better preparation for droughts, and the remediation of past degradation. The wider adoption of more-sustainable practices will also assist in addressing a number of other land-management issues, including land clearing, riparian vegetation management, dryland salinisation, soil structure decline and soil acidification. Taken together these measures to reduce soil erosion will help deliver multiple outcomes towards soil health, biodiversity and river health (DECC, 2006).

The prognosis for a future sea level rise, as a result of global warming, could increase the rate of long term coastal recession. The NSW Government has recently adopted benchmarks for sea level rise to be considered for planning purposes throughout NSW. These benchmarks are based on a broad suite of scientific data, including the upper range of projections from the Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC 2007), and research by CSIRO. These benchmarks require sea level rises of 0.4 m to 2050 and 0.9 m to 2100 to be considered for coastal planning purposes throughout NSW.

Acid Sulfate Soils

Pressure

In NSW coastal areas, land disturbance is also inducing soils to become acid, but by a mechanism quite different from that acting on inland acid soils. Many low-lying coastal areas contain acid sulfate soils, the common name given to naturally occurring sediments and soils containing iron sulfides (principally iron sulfide or iron disulfide or their precursors). The exposure to the sulfide in these soils to oxygen by drainage or excavation leads to the generation of sulfuric acid.

Potential acid sulfate soils contain iron sulfides within a layer of waterlogged soil. The drainage or excavation of potentially acid sulfate soils exposes the iron sulfides to the air, and the sulfides are oxidized to sulfuric acid (Sammut & Lines-Kelly, 1999). This acid may alter the physical structure of the soil and damage vegetation growing in the soil. Acid drainage water may also be produced. This may affect water quality and have significant impacts on riverine and estuarine biota. It can also corrode infrastructure assets such as bridges and culverts.
The artificial drainage of coastal floodplains, has led to the seasonal discharge of acid groundwater into the estuaries following heavy rains. During extreme events, whole sections of the Estuary may be acidified leading to large fish kills and acidic aluminium-rich plumes such as in the Maria River and Fernbank Creek. Acid sulfate soil runoff has contributed to the decline of oyster yields of up to 60% and the abandonment of oyster farms in the Maria River.

Figure 4.3.1 - Acid Discharge Plume into the Hastings River from the Partridge Creek System

The role of drainage networks and floodgates

In order to raise agricultural production and to mitigate the effects of floods on the broader community, eastern Australia governments in the 1960s and 70s encouraged and funded the dramatic alteration of floodplain hydrology through flood mitigation and drainage policies (White et al, 1997; Tulau, 1999). Combined with one-way floodgates, drainage systems prevent tidal ingress and provide a means for flood mitigation control by removing water of low-lying areas quickly. Consequently floodplain drainage times have been reduced from 100 to 5 days (White et al, 1997) enabling pastures to be established.

The Upper Maria Flood Mitigation Project is an example with the unsuccessful aim of improving pastures in landscapes with an elevation below 1M AHD (Smith, 1999a). Resultantly, the tidal Maria River Floodplain is extensively engineered with 104.47 kilometres of drains and over 50 tidal attenuating structures in operation. Drainage networks are made up of large flood mitigation drains, smaller farmer-built drains and field drains that feed into trunk drains. Over 63% of drains in the Maria River are potentially penetrating ASS layers, providing a direct means of pyrite oxidation and acid groundwater export (Aaso, 1999/2000).

‘Acidified groundwater provides the bulk contribution to an acid discharge event during seasonal wet weather, as large stores of acidic water are displaced into drains and eventually into estuaries. An acid discharge event, frequently as a result of drought breaking rains is typified by several hundreds of tons of sulfuric acid being discharged into an estuary and degrading water quality for weeks (Sammut et al, 1994; Wilson et al, 1994).
Indicator data in Table 4.3.1 focuses on remedial action as a surrogate measure of acid sulfate soil impact reductions. Based on monitoring and recent research (Johnson et al., 2004) it is approximated that between 60 and 80% reduction in acid discharge has occurred at remediated drains.

Impact reductions resulting from the implementation of remediation projects include:

- Reductions in the duration and frequency of acid discharges from remediated drainage networks
- Remediation of acid scalded land
- Remediation and maintenance of backswamp environments

**Responses**

All 60 known acid discharging drains have been remediated at a cost of $1.35M over a six-year period. All five ‘hotspots’ in the Hastings and Camden Haven catchments have been remediated or are in partial remediation. A total of 940 hectares of wetlands has been rehabilitated using a wet pasture management to promote vegetation regrowth and contain acidic groundwater. A total of 5,380ha of floodplain land is under voluntary agreements for acid sulfate soil management. Figure 4.3.1 provides examples of the type of remediation work that has been implemented and Figure 4.3.2 provides a graphical representation of completed remediation work.

**Future**

Ongoing monitoring of Partridge Creek Hotspot and general estuarine health is to continue. Monitoring will allow Council to continually assess the efficacy of remedial works and allow adaptive management to take place where required. Council will continue to provide on-farm advice and information on ASS and best management practices.
Figure 4.3.1 - Acid Sulfate Soil Remediation, Pre & Post Works at Rossglen

Acid scald at Rossglen Wetlands prior to remediation

Rossglen Wetlands remediated and natural hydrology restored

Figure 4.3.2 - Acid Sulfate Soil Remediation Works

Legend

- Artificial Drainage
- Remediation Structures
- Remediated wetlands / wet pasture
- Land under Plans of Management
4.4 Land Contamination

Pressure

In contrast to other types of land degradation, land contamination is almost entirely caused by human activity, with the minor exception of the naturally high levels of elements found near ore bodies. Land contamination is mainly caused by some form of industry, but it can also be found on residential properties, following the flaking of lead-based paints or excessive pesticide use.

The following is a list of typical contaminating land uses found in the Hastings LGA:

- Abattoirs
- Contaminated Fill
- Electricity Sub-Station
- Firing Range
- Fuel Storage Sites
- Orchard/Market Garden/Nursery
- Railway Yards
- Sewage Treatment Plants
- Scrap Yards
- Timber Mills
- Timber Treatment Sites
- Waste Management Sites

Some recent and historical land-use activities have resulted in the contamination of land and waterways by hazardous chemicals and wastes. Land contamination can have significant environmental, social and economic consequences, including the degradation of groundwater, surface waters and sediments; contaminant uptake by plants and animals; and potential human exposure to contamination.

For example, the operation of the former ICI facility (Orica Industrial Park) on the Botany Sands Aquifer has led to the contamination of this important aquifer and has prevented residents and industry from using large areas of the groundwater resource. The contaminated groundwater is being remediated at significant cost.

Contamination can spread, affecting other areas, water resources and dependent biota. For example, in February 2006, the government prohibited all commercial fishing in Port Jackson (Sydney Harbour) and its tributaries until 2011 because elevated levels of dioxin had been detected in finfish and prawns. This has had economic effects on the livelihood of commercial fishers who previously used Sydney Harbour as a fishing ground. The dioxin contamination in Sydney Harbour is considered primarily to result from the production of herbicides and other chemicals in Rhodes, adjacent to Homebush Bay, and the placement of waste materials at two sites on the Rhodes Peninsula between 1949 and 1976. The estimated cost of remediating Homebush Bay and adjacent land is estimated to be $120 million. In 1997 the NSW Government committed $21 million for the removal and destruction of contamination from parts of the bay, and a commercial venture is contributing approximately $100 million towards the land remediation (see Water 5.7).
Contamination of land can reduce land value and restrict the suitability of the land for more sensitive land uses. Remediation may be required to make the land suitable for its proposed use, a process that is often expensive and can take many years from initial investigation to final validation (DECC, 2006).

State

Table 4.4.1 - Indicators for Land Contamination

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>No. of potentially contaminated sites</td>
<td>165</td>
<td>157</td>
<td>157</td>
</tr>
<tr>
<td>State</td>
<td>No. of DEC confirmed contaminated sites</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>State</td>
<td>No. of sites under investigation by DEC</td>
<td>14</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4.4.1 above shows contaminated land statistics from Council’s geographical information systems. There has been an overall decrease in contaminated site on Council’s records since 1999-2000 as a result of remediation works and/or consolidation of lots.

There are currently no sites in the LGA listed or under investigation by the Department of Environment and Conservation pursuant to the Contaminated Land Management Act.

Responses

Port Macquarie-Hastings Council implements a number of responses to land contamination including:

- Regulation of land contamination under Protection of the Environment Operations Act 1997
- Management of land contamination risk associated with landuse changes and development proposals
- Maintaining information systems on the number and nature of contaminated sites with the LGA
- Notifying prospective land purchasers of land contamination status using s149 Certificates

Future

Continued State and local government cooperation will be needed to ensure contaminated sites are adequately identified, appropriately regulated with respect to the risk of the contamination, and satisfactorily remediated to ensure the land is suitable for the proposed land uses. Due to the introduction of stronger environmental legislation and the licensing of industrial activities, it is unlikely that the number of new contaminated sites being created will increase dramatically. However, the prevention of new contamination requires continued vigilance by the operators and regulators of activities that may cause contamination of land. SEPP 55 continues to play a key role in preventing contaminated land from being used for a more sensitive land use without appropriate investigation and, if required, remediation.

Remediation of existing sites will ultimately reduce the number of DEC-regulated sites, although it is likely that more sites remain to be identified. The most significant class of ongoing legacy sites (in both number and degree) is derelict mines.

Data on contaminated sites managed through the planning and development approval process is held by individual councils and is not coordinated by a central agency. Data collation is needed on all contaminated sites managed through local governments or State agencies to allow full reporting on the state of the environment in NSW (DECC, 2006).
Chapter 5 – Water

5.1 Surface Water Extraction

Pressure

The extraction of vast amounts of surface water is placing stress on both river health and the reliability of water supply in NSW. It is now widely recognised that this rate of extraction is not sustainable.

The natural flow patterns of rivers are highly variable. These patterns are essential for maintaining biodiversity and the health of other water-dependent ecosystems, such as wetlands, floodplains and riparian zones. Because flow is one of the key factors determining freshwater ecosystem health and water quality, it is widely used as a measure of aquatic condition. Taking water away and modifying flow patterns can cause fundamental damage to river health.

Locally, population increases affect directly in the increased amount of water extracted. The impacts of modified flows in local rivers include:

- Degraded water quality
- Reduced riverine habitat
- Reduced flooding of riparian zones, floodplains and wetlands
- An increase in algal blooms; and
- Erosion of river channels.

The natural flow patterns of NSW rivers are highly variable. These patterns are essential for maintaining biodiversity and the health of other water-dependent ecosystems, such as wetlands, floodplains and riparian zones. Because flow is one of the key factors determining freshwater ecosystem health, together with water quality, it is widely used as a measure of aquatic condition. Taking water away from rivers and modifying flow patterns can cause fundamental damage to river health.

The natural flows of many NSW river systems have been substantially modified over the past century to meet economic and social demands for water (consumptive uses and flood mitigation) within rural and urban areas. A study of NSW river condition found that 87% of the nearly 11,000 kilometres of river lengths assessed for hydrological modification in NSW had altered hydrologic regimes (NLWRA 2001). Regulation of flow and the extraction of water for use affect the whole flow regime by:

- reducing the amount, and changing the timing, of flood peak flows, thus reducing the depth, duration and frequency of wetland and floodplain inundation
- reducing the frequency of ‘drowning out’ of barriers to fish passage
- reducing the frequency of small rises in the river (‘frehes’)
- causing persistent low flows, preventing natural drying out of some riverine habitats
- changing seasonal patterns by having higher flows than natural during dry times
- changing the distribution of flows across the landscape.

Additionally, water released from storages can be poorer quality – too cold, deoxygenated or contaminated by metals and other pollutants (see Water 5.3).
The impacts of modified flows in NSW include (Kingsford 2000):

- degraded water quality
- reduced riverine habitat quality
- decline of native biota, including aquatic vegetation, floodplain forests, fish, waterbirds and invertebrates
- modified habitat conditions favouring introduced species over native species
- an increase in algal blooms
- erosion of river channels
- reduced frequency and magnitude of sediment renewal on the floodplain, thereby lowering soil fertility
- reduced breeding and recruitment opportunities (for example, for native fish and waterbirds).

These impacts have affected aquatic ecosystems (see Water 5.1) and the diversity of habitats and species (see Biodiversity 6.6 and Biodiversity 6.7).

The major challenge for water managers is to determine how to maintain or restore ecological health in rivers and on floodplains while meeting the social and economic needs of the community for urban, industrial and irrigation water use (DECC, 2006).

**State**

**Table 5.1.1 – Indicators for Surface Water Abstraction**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>Total water demand from local rivers for potable supply (ML)</td>
<td>5,153</td>
<td>6,503.2</td>
<td>5,877</td>
</tr>
<tr>
<td>Pressure</td>
<td>Annual water demand from Hastings River by Council for potable supply (ML)</td>
<td>5,079</td>
<td>6,420.4</td>
<td>5,802</td>
</tr>
<tr>
<td>Pressure</td>
<td>Annual water demand from Thone River by Council for potable supply (ML)</td>
<td>31</td>
<td>31.1</td>
<td>21.7</td>
</tr>
<tr>
<td>Pressure</td>
<td>Annual water demand from Wilson River by Council for potable supply (ML)</td>
<td>43</td>
<td>51.5</td>
<td>53.4</td>
</tr>
<tr>
<td>Pressure</td>
<td>Number of surface water licences</td>
<td>298</td>
<td>345</td>
<td>322 (2007-2008)</td>
</tr>
<tr>
<td>Pressure</td>
<td>Allocation (ML/yr) for surface water licences excluding Town Water Supply</td>
<td>New Indicator</td>
<td>11,792</td>
<td>11,802 (2007-2008)</td>
</tr>
</tbody>
</table>

**Port Macquarie-Hastings Council Water Supply System**

Data in Table 5.1.1 and Figure 5.1.1 show that the total water extraction trend fluctuates depending on river flow, rainfall conditions and water volumes in storages. A total of 785 Megalitres of stored water in the two off stream storage dams supplemented town water supply during 2008/09. However, it is important to note that the per capita water consumption decreased by 3% in 2008/09 following a 7.8% decrease in 2007/08 (Refer table 2.2.1). This overall decrease in water town demand is in response to community education program, the user pays water charging structure and permanent water conservation measures.
Other Water Abstraction

The Department of Water & Energy has provided data on the number of water licences and water allocations in the LGA during 2007/2008. The total number of surface water licences is 322 a slight decline on 2003-2004 total of 345, while the total number ground water licences increased significantly from 1012 in 2003-2004 to 1157 in 2007-2008. Surface water allocations, excluding town are similar to 2003/2004 allocations at 11,802ML/year.

Responses

Port Macquarie-Hastings Council has implemented a range of responses in relation to surface water abstraction including:

Utilisation of Cowarra Dam. This facility allows for sustainable river abstraction by allowing Council to rely on dam water during low flow conditions instead of river pumping Biological monitoring of the lower freshwater reaches and upper estuary of the Hastings River to assess impacts of river abstraction during drought conditions.

- Commencement of the Hastings Platypus Awareness and Conservation Team (PACT). The primary aim of the team is to prevent the accidental drowning of platypuses (and other air breathing wildlife) in yabby traps and instil a strong community desire to protect and care for these environments.
Participation in the Hastings Water Users Group to ensure a holistic approach to surface water abstraction management
Continuation of two tier “User Pays” water charges that reflect water use and encourage water conservation
(See also the Urban Water Section in the Human Settlement Chapter 2)

The Department of Natural Resources manages a suite of responses to river water abstraction based around the framework provided by the Water Act 1912 and the Water Management Act 2000.

Future

The impact of water-sharing plans is expected to be positive for the environment. However, the expected drying of south-eastern Australia due to climate change is a major risk factor for environmental flow regimes and, therefore, for the health of riverine ecosystems, because it is likely to increase the frequency of dry years. The CSIRO estimates that climate change could reduce water resources in the Murray–Darling Basin by about 5%, or by more than 1000 GL each year within 20 years (Van Dijk et al. 2006). Other risk factors for flow regimes are afforestation programs, groundwater extraction, changes to irrigation water management, farm dams and bushfires.

It is probable that additional measures will be needed to increase the environmental share of water to ensure ecologically sustainable water use.

Improvements to the health of aquatic ecosystems from environmental flows would be maximised if complemented by actions in land management to protect water quality and riverine, wetland and floodplain habitats, and by continued work to reduce the impacts of instream structures on water quality and fish passage (see Water 5.1) (DECC, 2006).

5.2 Groundwater Extraction

Pressure

Groundwater is used for activities such as irrigation, drinking, stock watering, and domestic and industrial purposes. Extraction potentially places pressure on this important resource by inducing more saline water into an aquifer, and reducing base flows to waterways. Natural and induced recharge processes that return rainfall and other surface waters to aquifers alleviate this pressure.

NSW has most of the larger fresh groundwater resources within Australia suitable for human uses. Many ecosystems in NSW also depend on groundwater for their ongoing health and maintenance. These include surface water bodies, such as wetlands, rivers and lakes, which may be highly connected to groundwater, and also some terrestrial ecosystems.

Groundwater is a vital resource, particularly where surface water supplies are limited or unreliable through dry years. More than 200 towns in NSW use groundwater as their principal water supply, and many regional economies rely on its availability. Approximately 11% of the water used in NSW for drinking, irrigation, watering stock, and domestic and industrial purposes comes from groundwater sources.

Changes in climatic conditions affect the amount of groundwater used. Extraction may increase substantially in times of drought to offset the lack of surface water, while in periods of high rainfall, groundwater will recharge more and be used less. The intent of groundwater management plans (see ‘Response to the issue’) is to manage the resource to a long-term
sustainable yield. This means that over-extraction in times of drought for one or a few years would be permitted, providing that extraction levels drop back below the sustainable yield after the drought period to allow water levels to recover. This natural flexibility of groundwater systems provides for a reliable and secure water resource.

However, continued over-extraction of groundwater places pressure on the integrity of the aquifer and on any dependent aquatic and terrestrial ecosystems because it can:

- reduce base flows to rivers and decrease the water available to other groundwater-dependent ecosystems
- alter water quality by allowing saline water to intrude into an aquifer
- in extreme cases lead to land subsidence, as well as a reduction in the amount of groundwater available for future extraction. (DECC, 2006)

**State**

Data in Figure 5.2.1 shows that the number of groundwater bores licensed in 2007-2008 is continuing an increasing trend since 2000.

Data on abstraction volumes are not available so alternatively, data on groundwater bore allocations is provided as a broad indicator. This information does not include allocations for the majority of bore licences, which are small users including domestic or stock watering licences. The information can therefore only be considered a general indicator of groundwater use.

**Figure 5.2.1 – Groundwater Extraction Trends**

```
Year  Groundwater Allocations (ML/year)  No. Groundwater Licences
1999-2000  600  0
2000-2001  1200  200
2001-2002  2000  1000
2002-2003  3000  2000
2003-2004  4000  4000
2004-2005  5000  6000
2005-2006  6000  8000
2006-2007  7000  10000
2007-2008  8000  12000
```

**Responses**

Responses that relate to groundwater abstraction are implemented primarily by the NSW Department of Natural Resources who regulate groundwater management under the Water
Management Act. The following responses from Port Macquarie-Hastings Council are also relevant:

Consideration of groundwater issues as part of the development control and land use planning process.
Implementation of Water Sensitive Urban Design principles into new urban development.
Incorporation of ‘deep soil zones’ requirements into development control plans to allow for stormwater infiltration and groundwater recharge in urban areas.

Future

Current knowledge of groundwater recharge and availability is based on estimates using the available data and conceptual models of groundwater systems and recharge. Continued monitoring of extraction will improve the basis of these models and enable greater accuracy when setting extraction limits.

More comprehensive metering needs to be available for extraction in groundwater management areas in NSW. Currently, irrigation and high-yield bores must be metered, but in many groundwater management areas meter readings are not reported. Although the quality of data about groundwater use has improved, more information is needed to fully assess the status of groundwater extraction and manage any subsequent impacts on resource security.

The connections between groundwater and surface water systems need to be better understood. The potential for managing very closely linked systems as a single resource needs to be further developed. There is a risk that more stringent limits on the use of surface water will put more pressure on groundwater as a substitute source.

A better understanding of groundwater-dependent ecosystems is required (see also Biodiversity 6.6). Little is known about the fauna and flora that live within aquifers, or about the volume or water levels they require. This makes it difficult to manage groundwater systems appropriately for conserving dependent biota. In many cases, aquatic ecosystems depend on a certain water level being maintained in the upper, shallow aquifers (DECC, 2006).

5.3 Water Quality and Riverine Ecosystem Health

Pressure

Aquatic systems form a key part of the Hastings environment with major watercourses accounting for 2,193 hectares or 0.6% of the local government area. These watercourses form a variety of functions. Water is drawn from various waterways to provide for land use activities; the most significant being drinking water and agricultural irrigation. However, the pattern of human demands on water resources does not necessarily reflect the natural pattern of flow through aquatic environments. The same activities that place demands on water quantity may also put pressure on water quality.
Point Source Discharges

Point sources discharge a variety of loads and pollutants to estuarine and marine environments. These point sources include sewage outfalls, urban stormwater drains and industrial outfalls and acid sulfate soil drainage. Discharges from coastal sewage treatment plant (STP) outfalls can degrade estuarine and marine environments. The effluent discharged can affect the distribution of local flora and fauna surrounding discharge points and also degrade recreational water quality. Although this wastewater is generally treated to remove pathogens and other pollutants before discharge, it usually contains phosphorus and nitrogen (depending on the level of treatment available) leading to elevated levels of these nutrients downstream of the discharge point. These can contribute to excessive growth of aquatic macrophytes and algal blooms (eutrophication), which can affect water quality and waterway users. Some forms of blue-green algae also generate toxins that can affect stock and humans when ingested.

Other water quality impacts are caused by overflows of untreated effluent when sewerage pipe capacity is exceeded, typically during wet weather. Point sources such as STP discharges affect river flow patterns as well as water quality by contributing significant volumes of water, especially during relatively dry periods.

The ongoing monitoring and reporting of discharges from coastal point sources allows:

- The determination of whether pollutant loads are increasing or decreasing over time
- Valuable information to be obtained on the need for improved effluent treatment and the efficacy of catchment management approaches.
Non-point or Diffuse Sources

Non-point pollution include run-off after rain, which collects pollutants over a wide area and, to a lesser extent, contributions from the atmosphere to the water by direct deposition or rainfall. As rain falls it may accumulate particulate matter and absorb gases.

In urban areas, stormwater run-off typically contains litter, bacteria, pesticides, metals, sediment, oils and grease, some of which are sources of excess nutrients. The sources of these pollutants are road surfaces, small industrial and commercial premises, parks, gardens and households. Studies have shown that urban stormwater contains heavy metals, especially lead. Urban stormwater contaminated with sewage overflows and animal faeces has also been implicated as a significant source of bacterial contamination of beaches and recreational waterways after rain. There is also developing concern about the presence of other compounds, such as pharmaceuticals (Kolpin et al. 2002; Khan & Ongerth 2005), in wastewater discharges although there is limited knowledge and understanding of the possible impacts of these on the health of aquatic ecosystems.

In rural areas, diffuse pollution can include sediments, nutrients and pesticides. The sources of these pollutants are agricultural enterprises (broad acre cropping, irrigation farming, livestock grazing and intensive livestock industries), forestry and unsealed roads. The relative contributions from different sources are listed in the National Pollutant Inventory.

Studies have shown that run-off from agricultural enterprises contains pesticides that can contaminate rivers and sediments. Grazing in riparian zones and on steep slopes also contributes to nutrient and sediment pollution of rural creeks and rivers while run-off from unsealed roads and forestry is a major source of sediments.

Clearing of Riparian Vegetation

The loss of riparian vegetation (vegetation on or near the riverbank) significantly impacts of the stability of riverbanks by the removal of root systems and woody debris that help armor riverbanks against floods. This process leads to increased sediment and nutrient loads in local waterways from the erosion of these unstable riverbanks. Stock access to waterways and the mechanical removal of riparian vegetation are the main factors contributing to the degradation of riparian vegetation.

Marine and estuarine waters support dynamic ecosystems, contain valuable natural resources, and have important environmental values. The quality of these waters can be affected by pollution from point sources, diffuse sources, spills from shipping accidents, land-based spills that reach coastal waters, and discharges from vessels. Pollution can occur directly or via rivers that flow into these coastal waters. However, oceanographic conditions such as upwellings are the main influence in determining marine water quality.

The concentration of people and industry in coastal NSW means that much wastewater is discharged by sewage treatment plants (STPs) into marine and estuarine environments. Discharges can affect water quality and degrade marine and estuarine environments. Estuaries or coastal lakes are much more sensitive to pollution than the ocean because there is less tidal flushing by clean ocean water.

Urban runoff is another significant source of pollution for estuaries and near-coastal marine environments. Runoff from urban areas is generally contaminated with sediment, nutrients, hydrocarbons, heavy metals, pathogens, and other toxic, and occasionally persistent, chemicals. This contamination originates from roads, sewer overflows, spills, industrial
activities, building sites and other sources. Runoff from rural areas may also contain sediments, nutrients, and pesticides and herbicides. The impacts on receiving waters are the same as for point-source discharges – reduced diversity of species, loss of pollution-sensitive species, and high levels of persistent toxicants in sediments and marine species.

River regulation may also affect coastal water quality, particularly estuaries and coastal lakes, by reducing the high flows needed to disperse pollutants and sediment. This can interfere with the chemical, biological and physical interactions between marine and freshwater ecosystems and cause pollutants to accumulate in estuaries.

Algal levels, as measured by chlorophyll-a, had remained stable from the 1980s to 2001 (Ajani et al. 2001a), although reports of visible blooms (‘red tides’) appeared to be increasing (Ajani et al. 2001b). In NSW coastal waters, algal blooms are natural phenomena that occur when cold, nutrient-rich water from deep areas off the continental slope are forced to the surface by oceanographic processes. Blooms often originate north of Sydney where changes in continental slope topography and orientation promote uplifting and upwelling of water towards the ocean surface. Nutrients from the deep then become available to algae in the surface zone of the otherwise nutrient-poor waters of the East Australian Current. The combination of sunlight and nutrients favours the rapid growth of algal blooms, which are then pushed shoreward by wind or current to converge and form visible blooms on local beaches and within frequently used waterways.

One of the greatest threats to healthy estuaries in NSW is the growth of nuisance algae and the consequent loss of seagrass due to overgrowth and shading. Excessive algal growth and loss of seagrass have been strongly linked to increased nutrient production in coastal catchments. Analysis of past satellite images for Wallis Lake has shown a pattern of less seagrass and more algae as development in the catchment increases (Dekker et al. 2005).

Major pollution incidents have a range of sources. These include shipping accidents resulting in oil or chemical spills, spills on land that drain to marine and estuarine waters, release of sewage from vessels, and ballast-water discharges containing marine pests. (DECC, 2006).

State

Figures 5.3.1 and 5.3.2 show the proportion of water samples collected and analysed by Council that failed to meet ANZECC water quality criteria. Nutrients include various forms of nitrogen and phosphorus and chlorophyll; and physicochemical parameters include water quality indicators such as dissolved oxygen, suspended solids, pH and salinity.

The results show a significant variability in the relationship between ambient water quality, both estuarine and fresh water, and the ANZECC water quality criteria. This variability is not unusual given the various conditions (e.g. wet periods, dry periods, during rainfall etc.) represented by the data and the variability of water quality in differing parts of the catchments.

Despite the above, the following observations are relevant:

- Water quality trends generally reflect trends in the El Nino Southern Ossiciation Index, (ENSO). With lower number of ANZECC guidelines exceedences occurring during the dry, El Nino years, and vice versa for wet La Nina years. The ongoing trend that nutrient water quality criteria are more frequently exceeded than physicochemical criteria still holds true.
While the data does indicate that water quality fails to meet specific water quality criteria for varying proportions of samples, it should be recognised that the ANZECC criteria are ‘generic’ for south-eastern Australian waterways and therefore do recognise specific local geomorphologic characteristics that influence ambient water quality. It is also important to recognise that many of the ANZECC criteria exceedences are only minor (within an order of magnitude) and in general terms, river and stream water quality in the Port Macquarie-Hastings area is in a good state.

Freshwater quality data for both physio-chemical and nutrients indicates no discernable trend form that of 2004 and earlier.

Whilst traditional water quality monitoring is generally useful for determining pollution, it has limited value in determining the health of an aquatic ecosystem without detailed assessment of ecosystem response to altered water quality.

A response to this limitation, benthic habitat mapping of the Hastings River and Camden Haven Estuaries was undertaken by Southern Cross University during February 2006 (Maher et al, 2007). Habitat within the Hastings River Estuary was found to be dominated by channel sediments, comprising of marine sands in the lower estuary and fluvial sands and gravel in the upper estuary. The Camden Haven Estuary had extensive seagrass beds accounting for nearly 40% of the total instream benthic habitat. Three seagrass species are found within the Camden Haven Estuary, Zostera capricorni, Halophila australis and Ruppia megacarpa. Benthic and pelagic productivity measurements and macrofauna surveys were undertaken seasonally from winter 2006 to autumn 2007. Benthic productivity in both estuaries showed distinct seasonality with the lowest productivity in winter and highest in summer. Temperature appears to be the driving factor in this seasonality as light and nutrient supply were generally optimal throughout all seasons. Benthic productivity was approximately 10 times higher in seagrass communities than non-seagrass communities and as such, these areas are extremely important in terms of total estuarine productivity. Pelagic productivity also showed distinct seasonality with the highest productivity occurring during summer. Negligible winter pelagic productivity was observed in the Hastings River estuary, suggesting that benthic productivity and terrestrial inputs is sustaining the higher trophic levels during winter. Macrofauna surveys showed distinct differences in community structure between seagrass and non-seagrass areas. Highest species abundance and diversity were generally found at seagrass and intertidal sand shoal sites, with general trend towards lower diversity and abundance at deeper sites with muddy sediments.

Both the Hastings River and Camden Haven Estuaries appear to be extremely healthy in terms of benthic habitats, productivity and macrofaunal abundance and diversity. From the results obtained during this study the Camden Haven Estuary has some of the most extensive seagrass communities in NSW on an areal basis indicating that in general the health of the estuarine ecosystem is excellent. The Hastings River has considerable less seagrass coverage due to the geomorphology of the estuary; however seagrass is present in the lower estuary where conditions allow. Productivity in the Camden Haven Estuary is dominated by benthic primary production with seagrass communities contributing significantly. Other important benthic habitats are the subtidal mud shoals within Queens and Watson Taylors Lakes. Within the Hastings River Estuary seagrass habitats are limited to the lower estuary, and contribute to ~50% of annual benthic productivity. Due to the high volume to surface area ratio of the Hastings River Estuary annual pelagic productivity is ~2 times higher than benthic productivity, however some skewing of the results may have been caused by the occurrence of a „red-weed“ bloom during summer. Figure 31 shows a conceptual model of benthic and pelagic processes within the Hastings River Estuary. Figure 32 shows a conceptual model of processes within the Camden Haven Estuary. A key difference between the two estuarine systems is the geomorphology, this has a direct impact upon the key habitat areas. Within the Camden Haven Estuary large shallow lakes dominate
instream habitat allowing for extensive seagrass beds to thrive. These areas are very susceptible to changes in estuarine conditions. For example an increase in sediment transport from the upper catchment could decrease seagrass coverage significantly, changing the trophic structure of the estuary as a whole, which would have implications for both commercial and recreational fisheries. In the Hastings River Estuary seagrasses are limited to shallow areas in the lower estuary and are more likely to be damaged by physical processes such as erosion. Pelagic productivity is proportionally more important in the Hastings River Estuary, consequently factors such as nutrient imports are key issues to maintain the current balance between benthic and pelagic production.

Figure 5.3.1 – Comparison of Water Quality with ANZECC criteria for Nutrients
Responses

A number of responses to water quality and riparian ecosystem health are implemented by Council, NSW Government Agencies, Landcare and other community groups. Relevant responses for 2008-2009 include:

- Acid sulfate soil remediation works as discussed in Section 4.2
- Water quality monitoring in freshwater and estuarine reaches of waterways within the LGA
- Implementation of river remediation works along 3 kms of riparian zone across the LGA, in both estuarine and freshwater areas.
- Installation of stormwater quality improvement devices under Council’s Urban Stormwater Management Plan
- Continued development of an integrated water quality database to ensure efficient use an acquisition of water quality data
- Enforcement of water pollution laws and development regulations
- Implementation of education and awareness campaigns relating to water pollution prevention, stormwater management and water conservation
- Implementation of a program, in partnership with the local oyster industry, to remove tar based oyster production equipment from the Hastings & Camden Haven River estuaries for disposal and landfill
- Monitoring of water quality in the Hastings and Camden Haven River Estuaries by local oyster growers under the NSW Shellfish Quality Assurance Plan.

In Partnership with DECCW and the NRCMA, Council is currently exploring funding opportunities to undertake a comprehensive ecosystem health monitoring program which encompasses all aspects of estuarine and river health. The program is based on the
successful S/E Queensland model and will provide catchment specific health assessment which will integrate into the NSW MER program.

Future

Diffuse water pollution remains an area requiring further attention, both for on-farm practices (such as reducing runoff from cropped lands and controlling stock access to waterways) and urban catchments. A continued focus will be on controlling water quality at source (that is, preventing water pollution). Water Sensitive Urban Design (WSUD) projects which are being introduced in urban areas will assist in preventing diffuse water pollution.
Chapter 6 – Biodiversity

6.1 Terrestrial Ecosystems and Species Diversity

Pressure

The modification of landscapes by humans though habitat loss, fragmentation, degradation and climate change are the principal drivers for loss in biodiversity.

State

The Port Macquarie –Hastings LGA is a topographically and geologically diverse area located at the confluence of tropical and temperate biogeographic zones and thus exhibiting a high level of ecological diversity at both the species and community levels. Vegetation communities range from saline wetlands through to heathlands, forested wetlands, wet and dry sclerophyll forests, while rainforest areas include examples of all of the recognised subformations (Hopkins et al. 2009). At least 1,677 flora species and 475 native fauna species occur in the LGA, along with 164 native vegetation communities. Of these, at least 31 flora species, 67 fauna species and 8 plant communities are threatened with extinction to varying degrees. Additionally, the coastal portion of the LGA supports a koala population of State significance, and plays a supporting role in the maintenance of several World Heritage listed properties (Hopkins et al. 2009).

Table 6.1.1 – Indicators for Terrestrial Ecosystems and Species Diversity

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>Area of LGA conserved in NPWS estate (%)</td>
<td>*</td>
<td>24.7</td>
<td>24.7</td>
</tr>
<tr>
<td>State</td>
<td>No. of threatened fauna/flora species in the LGA (Threatened Species Conservation Act 1998)</td>
<td>*</td>
<td>118</td>
<td>124</td>
</tr>
<tr>
<td>State</td>
<td>Koala mortality and morbidity (admissions to Koala Hospital)</td>
<td>139</td>
<td>214</td>
<td>209</td>
</tr>
<tr>
<td>Response</td>
<td>No. biodiversity conservation/ restoration projects implemented*</td>
<td>*</td>
<td>15</td>
<td>31</td>
</tr>
</tbody>
</table>

* Based on projects through Council and Landcare
* Information not available.

Table 6.1.1 presents the indicators for terrestrial ecosystem and species diversity relevant to the Port Macquarie-Hastings LGA.

A significant proportion of the LGA remains protected in National Parks estate.

Koala morbidity and mortality, measured as admissions to the Port Macquarie Koala Hospital. Data shows an increasing trend of admissions is evident since 1998 as shown in Figure 6.1.1. Increased admission for the 2008-09 year were primarily due to dog attacks. The figures reveal that impacts on Koalas (as a sentinel species for urban impacts on native species) continue to be significant and are generally in line with human population growth and subsequent urban expansion.
Responses

Threats to terrestrial ecosystems and species diversity are management locally by a number of organisations including Council, Landcare, Department of Environment Climate Change and Water, Northern Rivers Catchment Management Authority, Department of Natural Resources, Friends of Kooloonbung Creek, Koala Hospital, Conservation Volunteers Australia and other community groups. Responses include:

- Implementation of site specific restoration programs
- Implementation of targeted river reach remediation works on the Camden Haven and Hastings Rivers resulting in the implementation of management actions along 3km of riparian zone during 2008-2009.
- Implementation of education programs
- Implementation of planning laws and local planning instruments to protect terrestrial ecosystems and species diversity from inappropriate development
- Cane Toad round up in areas of known toad habitat
- Green & Golden Bell Frog Surveys and habitat development plan through a Landcare/Council/DEC partnership project
- Feral animal and weed control (see Section 6.3)
• Operation of the Koala Hospital and associated programs by the Koala Preservation Society Inc.
• Tree planting initiatives on public land in partnership with local schools, Council and Landcare
• Development of a database of Koala Plans of Management to enable the ongoing monitoring of Plan compliance
• Development of an in-house bush regeneration team to work on priority public bushland areas.
• Review of Councils Managed Public Bushland Areas and development of site action plans
• Restructure of Council’s operations to employ an Ecologist.
• Preparation of a Local Growth Management Strategy to plan for urban growth.
• Vegetation mapping and the commencement of a LGA-wide biodiversity strategy

Future

Future Biodiversity initiatives include

Development of an LGA-wide Koala Plan of Management
Provide an annual allocation of Council funds to support an in-house bush regeneration team to regenerate Council Reserves that are currently unmanaged.
Completion of the Biodiversity Strategy

6.2 Native Vegetation Clearing

Pressure

Broad scale clearance and severe modification of native vegetation is the major human activity causing the loss and fragmentation of habitat. The incremental loss of vegetation associated with small-scale clearing/modification contributes to habitat loss at a chronic level.

Population growth and associated development continues to be a major cause of native vegetation loss. Of significance in recent times, is the impact of the bushfire protection legislation that requires buffer zones around urban development. These requirements and the pressures from the development industry to maximise lot yields threatened to increase the significance of native vegetation loss associated with development.

It is important that Council closely monitor the potential for the incremental loss of vegetation in urban areas. Such loss of vegetation in residential areas has a significant potential to impact on species such as the koala, which are under increasing pressure in developed areas.

Since European arrival, there has been extensive clearing of native vegetation for human settlement, industry and agriculture. Clearing is generally irreversible due to subsequent land uses. It displaces the majority of native biota and leads to ongoing habitat degradation
through the effects of fragmentation. Clearing is therefore widely accepted to be the main driver of vegetation decline.

Clearing of native vegetation, with the associated destruction of habitat, has been identified as the process that represents the greatest single threat to biodiversity in NSW (Coutts-Smith & Downey 2006). It has been listed as a key threatening process under both the Threatened Species Conservation Act 1995 and the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth). (DECC, 2006)

State

Table 6.2.1 – Indicators for Native Vegetation Clearing

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Extent of woody vegetation cover (% of land area in LGA)</td>
<td>72</td>
<td>71</td>
<td>not available</td>
</tr>
</tbody>
</table>

While data for 2008-2009 was not available information previously supplied by the Department of Environment Conservation Climate Change and Water indicates a 1.2% decrease in woody vegetation cover in the LGA over a seven year period to 2007-2008. This equates to an approximate loss of 44km² of woody vegetation from the LGA since 1998.

Responses

A range of organisations including Port Macquarie-Hastings Council, Department of Natural Resources, Department of Environment & Conservation, Northern Rivers Catchment Management Authority, Landcare and other community organisations implement responses to native vegetation clearing, including:

- Assessment of habitat issues through the development control process for new developments by Council
- Regulation of native vegetation clearing through the Native Vegetation Conservation Act by the NRCMA
- Implementation of the Tree Preservation Order by Council.
- Requiring supplementary planting where significant or Koala food trees have been approved for removal under the TPO
- Planting of native trees by Council in wildlife corridors in parks and reserves on an ad hoc basis
- Continued its support of local Landcare projects through Council’s Environment Levy allocations.
- Revegetation projects by Council, Landcare, local schools and other community organisations
- Property vegetation planning for rural landholders by NRCMA
- Revegetation work by individual landowners
Future

The preparation of a Biodiversity Strategy and the Port Macquarie Hastings Local growth Management Strategy will assist in the control of vegetation clearing and the identification of priority areas for restoration.
Introduced Terrestrial Species

Pressure

Introduced plants and animals have a variety of adverse impacts on natural ecosystems and native species. They have caused extensive damage to native ecosystems and contributed to extinctions and the decline of many native taxa by preying on wildlife and competing with native species. In addition, the presence of introduced species can significantly degrade and reduce habitats, by damaging soil and watercourses, spreading weeds, and carrying diseases. These disturbed environments may become even more vulnerable to invasion by other exotic species. When a species is introduced into a new environment, it is no longer subject to its former natural population constraints, such as predation, competition, parasitism and disease, and this may give it an advantage over local species (DEC, 2003).

Numerous exotic species of plants and animals have been introduced into the Australian environment since European settlement and these species have a high social and economic cost in addition to the environmental cost.

Invasive exotic pests are among the greatest threats to biodiversity throughout Australia. In NSW, they have been identified as a threat to 657 (or 70%) of the 946 species, populations and communities listed under the Threatened Species Conservation Act 1995 (TSC Act) (Figure 6.1). This is more than any other process including the destruction and disturbance of native vegetation (Coutts-Smith & Downey 2006).

Over 2800 species of exotic plants and 81 species of exotic vertebrates have established wild populations in Australia (Bomford & Hart 2002; Groves et al. 2003). The impacts of the red fox have been particularly conspicuous: the spread of foxes across Australia coincided with regional declines and extinctions of a raft of native fauna, while their persistence has caused the failure of many efforts to recover native species (Christensen 1980; Friend 1990; Short et al. 1992; Dickman 1996; Short 1998).

Invasive weeds have been estimated to cost $4 billion per year in lost production, weed control and other impacts, while estimates for the cost of invasive animals stand at $720 million (McLeod 2004; Sinden et al. 2004) (DECC, 2006).

State

Table 6.3.1 – Indicators for Introduced Terrestrial Species

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>No. of introduced animal species</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Pressure</td>
<td>No. of introduced plant species</td>
<td>138</td>
<td>142</td>
<td>151</td>
</tr>
<tr>
<td>Response</td>
<td>No. of declared noxious weeds</td>
<td>**</td>
<td>22</td>
<td>32</td>
</tr>
<tr>
<td>Pressure</td>
<td>No. of complaints regarding noxious weeds</td>
<td>**</td>
<td>27</td>
<td>8</td>
</tr>
</tbody>
</table>

Trends in introduced terrestrial species indicators are provided in Table 6.3.1. Trends have remained relatively stable but still indicate a significant introduced species problem in the Port Macquarie-Hastings LGA.

An additional weed was discovered in the LGA (Asparagus falcatus) and Chinese Celtis was declared noxious during 2008-2009 reporting period.
Responses

A number of organisations are responsible for implementing responses to reduce the impact of introduced species in local biodiversity including Port Macquarie-Hastings Council, Department of Environment Conservation Climate Change and Water, Department of Primary Industries, Department of Environment and Conservation, Landcare and other community based groups. The following are responses implemented during 2008-2009:

- Bitou Bush control projects in partnership between Council, Landcare and the Department of Environment & Conservation, including aerial spraying and biological control
- Inspection and treatment of over 640 km of roadside for Giant Parramatta Grass
- Salvinia infestations on private lands have been controlled on a number of properties using a combination of mechanical, chemical and biological control methods
- Riparian weed control works on 50 sites focusing on Madeira Vine and Catsclaw Creeper have continued during 2008/2009 in locations such as Ellenborough, Wauchope, Long Flat and Lake Cathie.
- Council officers carried out approximately 400 on-ground inspections of rural properties and aerial inspections were conducted both along the coastal fringe and along the Hastings, Ellenborough, Maria, Wilson and Thone Rivers, covering approximately 350 properties
- Council has continued educational and awareness activities including; general advice to landholders, inspection of 20 retail outlets (e.g. pet shops, rural suppliers) with reference to the sale of potential aquatic weeds, production of 4,000 weed control calendars, awareness advertising in Town & Country newspaper supplement, a display at the Wauchope Alternate Farming Field Day, a field day on Giant Parramatta Grass and general presentations to local schools and Landcare groups to promote weed management
- Council has continued to play an active role in the development and implementation of the strategies prepared in weed control plans through the Mid North Coast Weeds Advisory Committee (e.g., Bitou Bush, Grounse Bush etc) including the development of new Class 4 weed control fact sheets as required by the new Noxious Weeds Act
- Landcare have continued to address weed infestations through a range of projects.

Council in partnership with the Hastings Valley Conservation Hunting Club and the NSW Game Council (DPI) continued implementation feral animal control programs on Council land at Thrumster and the Port Macquarie Waste Management Facility site targeting feral deer, feral cats, foxes and wild dogs.

Hastings Valley Conservation Hunting Club and the NSW Game Council (DPI) continued implementation feral animal control programs in partnership with landholders on private land. Council and Landcare have commenced an Indian Myna trapping program, harnessing the energy of volunteers through the Landcare network.

In partnership with Landcare and other volunteers groups, Council continues to work on managing 560 ha of public bushland areas for the control of environmental weeds.

Future

The preparation and implementation of threat abatement plans, such as those for the fox and bitou bush, provide a model for better strategic management of widespread invasive species to protect biodiversity. The incorporation of monitoring programs is essential to provide feedback on the effectiveness of on-ground programs.

Further research, particularly on biological controls, is required to enable broadscale control of widespread species.
With the growth in global trade, it is inevitable that new and potentially invasive species will continue to arrive in NSW. Prevention and eradication of new arrivals is critical to avoid further additions to the current array of widespread invasive species.

Response to unplanned arrivals could be improved by more clearly defining the responsibilities of relevant public authorities. It is imperative to establish a comprehensive and integrated framework across all levels of government to ensure consistency of approach in all phases in the introduction and spread of invasive species.

The preparation of AusBIOSEC, the Australian Biosecurity System for Primary Production and the Environment, is an opportunity to coordinate actions to reduce the environmental and agricultural impacts of invasive species. NSW is actively participating in the development of this strategy.

Further measures should be developed to prevent introductions of potentially invasive species by the agricultural, horticultural and aquarium industries, and the wider community. The use of native species should be encouraged wherever possible (DECC, 2006).

Fire

Pressure

Fire has been present on the Australian continent for millions of years and is a key factor in plant and animal population dynamics in most ecological communities in NSW. Many Australian animals and plants have evolved not only to survive, but also to benefit from the effects of fire. A substantial proportion of the NSW flora depends on fire to assist in reproductive processes.

In Australia, fire has been managed since the earliest human presence. Although the fire regimes practised by Aboriginal people before European arrival are not fully understood by the scientific community, it is evident that the pattern of fire in the landscape has changed in the past 200 years (Williams et al. 2001). The introduction of individual property ownership and the need to protect stock and assets has altered fire regimes across a variety of landscapes in NSW (DECC, 2006).

State

Table 6.4.1 – Indicators for Fire

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Area affected by major bushfire (ha)</td>
<td>Nil</td>
<td>Nil</td>
<td>1,537</td>
</tr>
<tr>
<td>Pressure</td>
<td>No. Permits issued by RFS for hazard reduction burning</td>
<td>1007</td>
<td>649</td>
<td>414</td>
</tr>
</tbody>
</table>

Data listed in Table 6.4.1 attempts to provide insight into trends associated with fire related impacts on biodiversity in the LGA. Since 2002-2003, 5,239 of the local area have been affected by major bushfire (1,374 Ha in 2006-2007 and 2,328 in 2007-2008 and 1537 ha in 2008-2009). This is a relatively minor area representing about 1% of the LGA.

The Rural Fire Service has provided data on the number of permits issued for hazard reduction burning. This data is used to assist in understanding the potential local impact of fire on biodiversity. Data on permits for burning that have the potential to impact on biodiversity have declined since 2003-2004. It is likely that the introduction of tighter laws controlling native vegetation removal and the burning of waste vegetation in conjunction with
dry conditions (high fire hazard) during recent years have impacted on the number of permit applications over this period.

**Responses**

Responses to the impact of fire on biodiversity are implemented by the Rural Fire Service through the provisions of the Rural Fires Act 1997, which require an environmental assessment of hazard reduction works with the aim of protecting areas of high conservation value and threatened species.

**Future**

The incidence of high fire-risk days – and consequently the frequency of wild fire – is expected to rise due to climate change. The number of days when it is safe to conduct hazard-reduction burning may also be reduced. The impact on biodiversity of drier conditions, more frequent wild fires and reduced opportunities for hazard-reduction burning need to be factored into the development of appropriate fire management techniques.

Fire management strategies will increasingly be based on better knowledge of fire behaviour and ecology, and better techniques for fire suppression. This will enable us to counteract, to some extent, the effects of climate change.

Fire patterns have generally been approached as a natural response by fire to unnatural fire management regimes. Evidence is now emerging that, particularly near more populated areas, the pattern of fire is largely not of natural causes. The incidence of arson and knowledge of the behavioural patterns of arsonists should be incorporated into fire management strategies.

It is imperative that new and ongoing research into all aspects of fire behaviour and ecology, and fire management and suppression is supported to enhance our capacity for living with fire.

There is considerable scope for better maintenance and use of the data and information that is collected about fire, and more could be collected. Alignment of data held by agencies is desirable to improve the consistency of figures reported. Information could be used more effectively, leading to more sophisticated analyses of wild fire patterns and effects, and particularly in decision-support and related applications for fighting fires, managing hazards and associated environmental impacts (DECC, 2006).

### 6.5 Aquatic Ecosystems and Species Diversity

**Pressure**

The main threat to the health, abundance and diversity of fish in NSW is the destruction of their habitat.

Urban development associated with heavily populated areas has altered marine environments, such as rocky and coral reefs, riverbanks and sandy beaches.

Agriculture, urban and industrial development in estuarine areas has impacted on mangrove, seagrass, saltmarsh and coastal lagoon communities through land clearance, agriculture, dredging, reclamation and waterfront development. Some communities, such as the seagrass *Posidonia australis* (strapweed), are of particular concern because they don't readily recolonise an area once they've been eliminated from it (NSW SoE, 2003). Acidic
discharges from drained acid sulfate soils have had a significant local impact on the aquatic environment of the Hastings and Maria Rivers.

In freshwater environments, land use has caused fish populations to decline through the removal of vegetation from riverbanks, wetlands and floodplains, increased sediment, nutrients and pollutants into streams, and the removal of organic matter and snags from rivers.

Many fish need to travel a long way to survive, escape predators and competitors, and breed and rear in different waters. Many are stopped from migrating by barriers, such as dams, weirs, floodgates and road crossings.

Human activities that destroy aquatic vegetation, block channels and waterways, and disturb the balance between sediment and water flows in rivers and estuaries all contribute to the destruction of fish habitat (NSW Fisheries, 2004).

Aquatic ecosystems are important from an ecological, economic and social perspective. The State's freshwater ecosystems provide important 'ecosystem services' including acting as breeding grounds for fish, protecting catchment water quality, recycling nutrients, filtering pollution, providing recreational and educational opportunities, protecting foreshores, mitigating floods, and regulating groundwater.

NSW coastal waters have high biodiversity because of the wide range of oceanic, shoreline and estuarine habitats they contain. These varied environments also provide many important ecosystem services, including absorbing pollution, preventing coastal and seabed erosion, maintaining coastal water quality, and acting as breeding grounds for fish.

Many species depend on healthy aquatic ecosystems from the local through to the international scale. NSW has 11 wetlands that are recognised as internationally significant with their listing under the Ramsar Convention. In addition, many inland and coastal sites support migratory bird species and are therefore protected under various international agreements, such as the Japan–Australia Migratory Bird Agreement (JAMBA) and China–Australia Migratory Bird Agreement (CAMBA).

Internationally, the degradation and loss of wetlands has been more rapid than that of most other ecosystems. The status of both freshwater and coastal wetland species is deteriorating faster than those of other ecosystems (Millennium Ecosystem Assessment 2005b) (DECC, 2006).

Aquatic species play a crucial role in maintaining ecological processes. Loss of species diversity weakens natural ecosystems and diminishes ecosystem services, which can have significant ecological, economic and social impacts (DECC, 2006).

**State**

**Table 6.5.1 – Indicators for Aquatic Ecosystems and Species Diversity**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Number of aquatic endangered and vulnerable species</td>
<td>New Indicator</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
Table 6.5.1 shows that the number of aquatic endangered and vulnerable species has remained stable since 2003-2004. Threatened aquatic species that are known to occur in the area include the Black Cod, Great White Shark, Grey Nurse Shark, Oxleyan Pygmy Perch and the Green Sawfish.

Responses

Responses to manage and protect aquatic ecosystems and aquatic species diversity are principally implemented by NSW Department of Primary Industries (Fisheries) through the Fisheries Management Act and various recovery plans and marine reservation systems. The following activities of Port Macquarie-Hastings Council are indirect responses:

- Implementation of development and landuse planning controls that prevent impacts of landuse on aquatic environments, eg, setbacks to waterways, water pollution controls, stormwater treatment
- Implementation of stormwater quality management strategies
- Implementation of Estuary Management Plans that include actions to protect the aquatic environment
- Water pollution regulation and education

Future

The existing information on wetlands is broad and generalised. There is a need for a comprehensive inventory of wetland habitats, including their condition and extent, to ensure that rare types are properly identified and protected. A definitive typology is a pre-requisite for conservation planning and wetlands need to be afforded greater protection within the terrestrial reserve system.

Continued commitment to the water reform process is essential. More water needs to be purchased to ensure that sufficient is available for environmental flows when and where needed. Further research is also needed into the management of environmental flows in regulated rivers so that they best replicate natural conditions and maximise ecological benefits.

Planning should commence now for reduced river flows in the future due to climate change, and how to accommodate environmental flows in the changed conditions. The impact on coastal ecosystems of a rise in sea levels should also be factored into future management plans.

Better management of pollution from diffuse sources and stormwater is needed to maintain the condition of coastal lakes and estuaries. New tools and controls are being developed to manage runoff into sensitive coastal ecosystems that are under pressure from population growth along the coast.

The capacity to monitor the status and condition of marine and coastal ecosystems is expected to be enhanced through the NSW Monitoring, Evaluation and Reporting Strategy of the NRM program (DECC, 2006).

New and innovative reforms and techniques are being introduced to enhance the conservation of biodiversity but it is still too early to assess their effectiveness in addressing issues that are pervasive and long-standing. In many cases significant trends will only become clear over a longer time frame, and it will require sustained commitment and perseverance to achieve results.
There has been a fundamental shift in focus from recovering individual threatened species – an approach which is largely reactive – to more pro-actively addressing the threats and drivers of biodiversity decline.

In conjunction, a greater emphasis is now being placed on endangered ecological communities rather than individual threatened species. This focus on species assemblages and threatening processes will maximise the benefits for all species, not only those that are listed as threatened.

The threat abatement plans that have already been developed establish a model for the future management of threatening processes. The Priorities Action Statements will establish priorities and provide overall guidance about where effort should be directed, while the monitoring of threat abatement plans will enable programs to be refined.

An expansion of the fish habitat protection process is desirable to ensure that all species are covered.

New models should be developed for government, stakeholders and the community to work together to advance the protection of aquatic species and restoration of habitats.

Monitoring of aquatic species diversity presents substantial challenges and there is little data available to assess the status of species. A targeted program that surveys species on an ongoing basis is urgently needed to support future monitoring and reporting requirements for SoE and the NRM Program, and to better target those species in real need of protection.

Knowledge of poorly understood groups, such as invertebrates and algae, should be enhanced to better inform conservation processes and assessments (DECC, 2006).

### 6.6 Introduced Aquatic Species

#### Pressure

The introduction of exotic species can have substantial impacts on native species. These include degradation of habitat, predation by the introduced species, competition for food, the introduction of disease, and displacement of native species. Introduced plant and fish species have had widespread impacts on the biota of inland waters.

The presence of exotic species can also have considerable economic and social impacts on activities in the aquatic environment. These may have to be stopped or modified to prevent movement of the species into new areas, where they may threaten commercial species and uses (DECC, 2006).

#### State

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>No. Introduced Aquatic Species*</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

*Aquatic animals only, relevant plant species included in Terrestrial indicators

Three introduced fish species have been identified in Hastings freshwater systems. These are carp (*Cyprinus carpio*), mosquito fish (*Gambusia holbrooki*) and Goldfish (*Carassius auratus*). In addition the Pacific Oyster (*Crassostrea gigas*), a bivalve mollusc, is found in the estuaries of the LGA. Information on the true extent of introduced aquatic species (eg, ballast water introductions in marine environments) is not currently available.

Photo: NSW Fisheries

Common name: Mosquito fish
Scientific Name: *Gambusia holbrooki*
Size: Females to about 60 mm, males to about 35 mm
Responses

Responses to manage and prevent further exotic introductions are principally implemented by NSW Department of Primary Industries. Local responses implemented by Council in relation to aquatic weeds are addressed in conjunction with terrestrial weed control initiatives as outlined in Section 6.3.

Future

With the growth in global trade, it is inevitable that new and potentially invasive species will continue to arrive in NSW. Prevention and eradication of new arrivals is critical in order to avoid further additions to the current array of widespread invasive species.

The preparation and implementation of threat abatement plans provides a model for better strategic management of invasive species. Incorporating monitoring programs into the plans will provide feedback on the effectiveness of on-ground programs.

The preparation of AusBIOSEC, the Australian Biosecurity System for Primary Production and the Environment, will provide an opportunity to integrate all relevant plans and actions addressing the environmental impacts of invasive species across all levels of government.

Measures are now in place that afford some control over the introduction of marine species from overseas via ballast water, but some refinement may be needed in the future. Hull fouling is less well controlled.

Populations of marine pests that are already established can be spread along the coast by coastal shipping and recreational boating. Management by operators of ballast and bilge waters, and hull and anchor condition may be required.

Measures should be developed to prevent the inadvertent introduction of exotic fish and aquatic weeds into native ecosystems from the aquaculture and aquarium industries. In particular, care is needed in the disposal of wastewater and surplus stock.

Further research is needed into methods for identifying new arrivals and better techniques for suppressing or controlling the species that are already here (DECC, 2006).

6.7 Aquatic Harvesting

Pressure

Overfishing poses a serious threat to the health of both marine and freshwater ecosystems and is an important pressure on aquatic biodiversity in NSW. Over-exploitation can lead to reduced biodiversity and even local extinctions. It is now widely recognised that lakes, rivers, estuaries and oceans can be fished out, with considerable economic and social impact (NSW Fisheries, 1999).

Fisheries resources have a wide-ranging natural variability in population size, structure, condition and extent. Fluctuating fish populations and catches have also been attributed to human intervention through habitat modification, pollution and over-fishing. The variability of fisheries resources makes them difficult to manage. Insufficient information about the life cycles and ecology of fish has resulted in full or over-exploitation, especially of commercial species, across Australia (Yencken & Wilkinson 2000).
State

Indicators of aquatic harvesting activity are a potential measure of the ability of the Hastings & Camden Haven River estuaries to support a sustainable commercial fishery. It can also be used, with caution, as an indicator of estuary health. A lack of data on catch effort is a limitation to this indicator.

NSW Department of Primary Industries data on oyster production is shown in Figure 6.7.1. Statistics for 2008-2009 were not available for the preparation of this report. The data reveals a drop in production in the 2007-2008 year. The main reason for this drop in harvest includes the conversion from plate oyster to seed production.

Figure 6.7.1 – Indicators for Aquatic Harvesting

![Oyster Production Graph]

Responses

Responses relevant to this issue are implemented by a number of agencies including Council, NSW Fisheries and NSW Food Authority and are generally associated with water quality protection as detailed above in Chapter 5.

Future

There has been a significant effort to regulate commercial fishing and stabilise the harvest of aquatic resources in NSW, and refinement of the framework is ongoing. However, it will take some time to measure the statewide benefits to fish stocks from the extensive reforms to commercial and recreational fishing.

The stresses on available resources are likely to increase because of improvements in the technologies used to harvest fish, as well as coastal development, which has the potential to degrade fish habitat.

Efforts should continue to assist commercial operators to adjust fishing practices so they minimise impacts on stocks and non-target species and to ensure the development of commercial and recreational fisheries that are ecologically sustainable. Such policies are being developed and implemented through fishery management strategies and environmental assessments of all commercial fishing activities.

An ongoing commitment is required to continue, and improve, the monitoring of fish stocks to ensure that all fisheries are managed sustainably.
Growth in aquaculture developments can reduce the pressures on some fish stocks but must be managed carefully to prevent or minimise their own impacts on the environment.

Commitment to the development of a network of aquatic protected areas should be maintained as this is an internationally recognised strategy to protect aquatic biodiversity, and has also been shown to enhance the stock levels of some fish over time (DECC, 2006).
Glossary

ABS    Australian Bureau of Statistics
ANZECC Australian and New Zealand Environment Conservation Council
ASS    Acid Sulfate Soils
AWTS   Aerated wastewater treatment system
DCP    Development Control Plan, which, under the Environmental Planning and Assessment Act 1979, is a detailed policy of Council to support control of development together with LEPs.
DECC   NSW Department of Environment and Climate Change
DNR    NSW Department of Natural Resources (formerly part of DIPNR)
DoP    NSW Department of Planning
EPA    NSW Environment Protection Authority
GIS    Geographical information system
HUGS   Hastings Urban Growth Strategy 2001
KL     Kilolitres (1000 litres)
LEP    Local Environmental Plan
LGA    Local government area
ML     Megalitres (million litres)
NPWS   NSW National Parks & Wildlife Service
NRCMA  Northern Rivers Catchment Management Authority
OSM    On-site sewage management system
RTA    NSW Roads & Traffic Authority
SoE    State of the Environment
SQID   Stormwater Quality Improvement Device
STP    Sewerage Treatment Plant
TPO    Tree Preservation Order
References


Id Informed Decisions, 2007, Census Based Status Report


NSW Department of Environment & Conservation, 2003, Who Cares About the Environment in 2003?

NSW Department of Local Government, 2005, Comparative Information on NSW Local Government Councils, NSW DLG, Sydney, 2005


