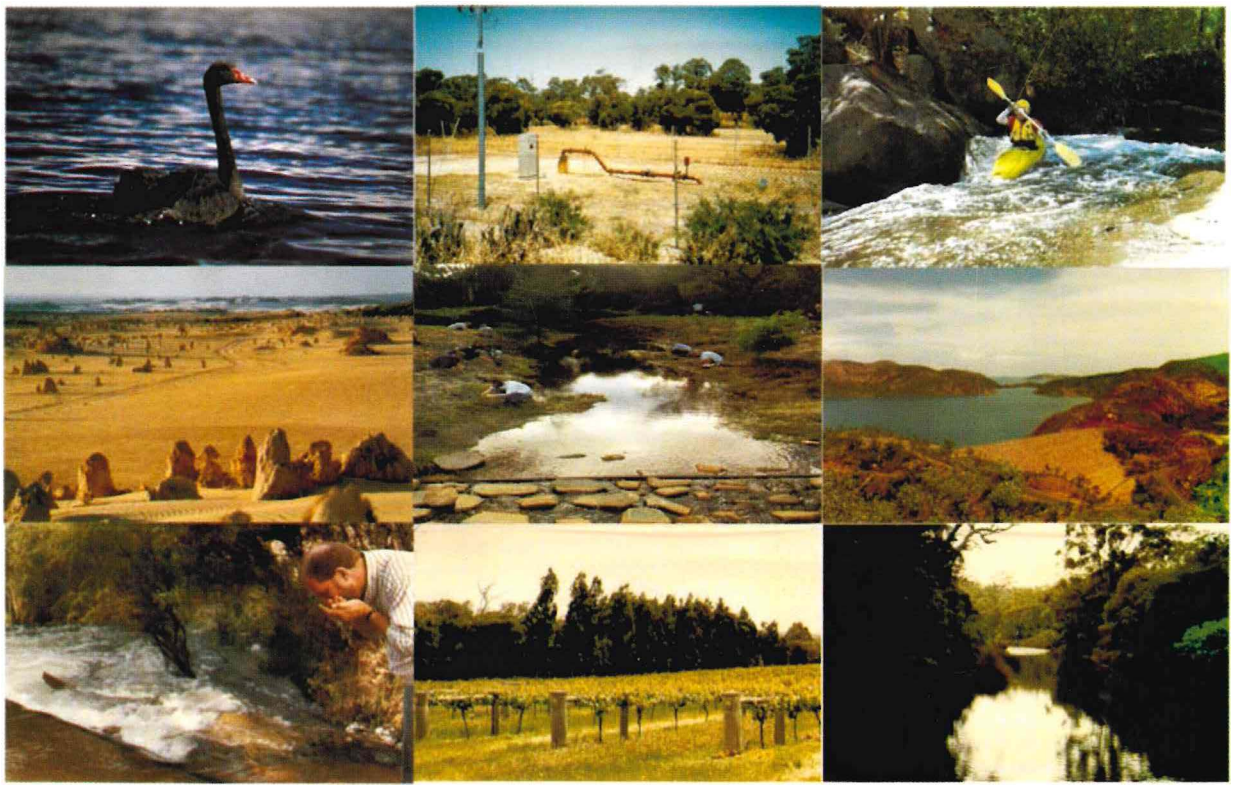
STATE WATER QUALITY MANAGEMENT STRATEGY

NO. 2



Implementation Plan: Status Report

SWQ 2

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IMPLEMENTATION PLAN: STATUS REPORT

REPORT NO SWQ 2

JULY 2003

Acknowledgments

This document was prepared under the direction of the State Water Quality Management Strategy Senior Review Panel. The Panel comprises of the Department of Agriculture, Department of Conservation and Land Management, Department of Health, Office of Water Regulation, Department of Industry and Resources, Department for Planning and Infrastructure, Ministry for Premier and Cabinet, Department of Fisheries, Department of Environmental Protection, Water Corporation and is chaired by the Water and Rivers Commission.

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Left to right: Black Swan (Cygnus atratus) Swan River, Gnangara production bore, Collie River, Cervantes Water Reserve, Bannister Creek revegetation, Lake Argyle Kununurra, Cranebrake Pool Margaret River, Vineyard Swan Valley, Margaret River.

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1 Introduction

1.1 Purpose

The process for implementation of the State Water Quality Management Strategy (SWQMS) in WA is described in the *State Water Quality Management Strategy: Process for Implementation* (SWQ No.1). The document identified nine key tasks for the implementation of the SWQMS, the fifth task is preparation of a State Water Quality Implementation Plan. Western Australia's implementation of the SWQMS (prepared to complement the National Water Quality Management Strategy) is subject to on-going assessment by the National Competition Council and this plan reflects existing initiatives to implement the SWQMS/NWQMS in Western Australia.

WA supported and helped develop the NWQMS and has been implementing its guidelines within the State since 1996. In the process of collating information for this implementation plan (SWQ No2), it became evident that WA had already recognised the NWQMS in several key government programs that are being implemented on ground. Therefore, this plan has developed into a status report of the existing initiatives to implement the NWQMS in Western Australia.

This plan has been developed under the direction of the Senior Review Panel and recognises the importance of water quality issues to the community. The plan considers the quality of water resources in Western Australia, major threats to water quality, and the strategies and actions currently in place to address deteriorating water quality in areas of most concern.

1.2 Background

The National Water Quality Management Strategy (NWQMS) was developed jointly by the Natural Resource Management Ministerial Council (NRMMC, formerly the Australian and New Zealand Environment and Conservation Council) and the Primary Industries Ministerial Council (PIMC, formerly the Agricultural and Resource Management Council of Australia and New Zealand), with input from the National Health and Medical Research Council (NHRMC). The NWQMS comprises a series of twenty-one guideline documents, the first of which was published in 1994. A complete list of the guidelines is included in Appendix A.

In April 1995 the Council of Australian Governments (COAG), of which the Government of Western Australia is a member, signed the Agreement to Implement the National Competition Policy and Related Reforms including the Water Reform Framework Agreement. The Water Reform Framework Agreement addressed a range of issues and, in relation to the environment, included a commitment "to support PIMC and NRMMC in their development of the National Water Quality Management Strategy, through the adoption of market-based and regulatory measures, including the establishment of appropriate water quality monitoring and catchment management policies and community consultation and awareness" (NCC, 1998). Further agreements reached by COAG in April 1995 linked National Competition Policy payments by the State Government to the implementation of agreed water reforms (NCC, 1998).

The NWQMS is being implemented in Western Australia through the SWQMS. This document forms part of this strategy. In addition to the NWQMS, development of the SWQMS was also guided by other national policies, principles, objectives and agreements to which the Government of Western Australia is a signatory. These included the InterGovernmental Agreement on the Environment (1992), National

Strategy for Ecologically Sustainable Development (1992) and National Strategy for the Conservation of Australia's Biological Diversity (1996). The SWQMS (GWA, 2001) will be similar to the NWQMS, in that it will comprise a series of documents.

The first document in the SWQMS series, No. 1 Framework for Implementation (report no. SWQ 1), was published in May 2001. The Framework for Implementation describes the guiding principles and supporting strategies for water quality management, and sets out a process for implementation comprising nine main tasks (Appendix B). The Framework for Implementation was developed under the guidance of a Senior Review Panel, chaired by the Water and Rivers Commission and comprising representatives of Department of Agriculture, Department of Conservation, Department of Environmental Protection, Water Corporation, Department of Health, Department of Industry and Resources, Department for Planning and Infrastructure, Department of Fisheries, Office of Water Regulation and a representative of the PIMC/NRMMC contact group (Appendix C).

1.3 State Water Quality Management Objective

As documented in the Framework for Implementation, Western Australia has adopted the policy objective of the NWQMS, namely *"...to achieve sustainable use of the Nation's water resources by protecting and enhancing their quality while maintaining economic and social development."*

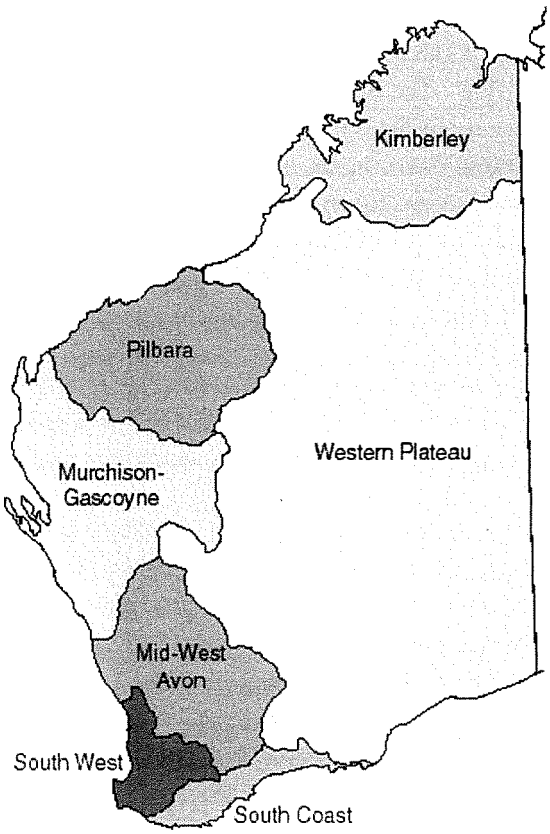
2 Overview of Water Resources in Western Australia

Australia is the driest inhabited continent, and has the least runoff to rivers as a percentage of the mean continental precipitation (WRC, unpublished). Western Australia covers several climatic regions and has a high degree of climatic variability across the State, which can lead to successive years of flood or drought (WRC, 2002).

Water or lack thereof, is a feature of the Western Australian landscape. The State is poorly endowed with perennial rivers and lakes, even in the relatively cool and wet south-west. This scarcity of water and its uneven distribution has contributed to the evolution of a great diversity of plants and animals, including plants that can tolerate, even thrive in, cycles of severe drought and flood (WRC, 2002).

The following section provides an overview of the State based on the seven regions as defined in the draft *A State of Water Resources Report for Western Australia* (WRC, unpublished). The regions represent a collective of surface drainage basins as defined by the Australian Water Resources Council (AWRC). Surface water drainage basins represent a catchment or watershed area from which a body of water receives its water. This section establishes a basis for understanding the water quality issues that are faced within different regions of the State. These issues are discussed in further detail in Section 2.2.

Figure 1 AWRC Water Regions



2.1.1 South Coast Region

The South Coast region stretches along the South Coast from the Esperance Coast Basin in the east to the Shannon River Basin in the west. Major settlements in the region include Esperance, Ravensthorpe, Albany, Gnowangerup, Mt Barker and Denmark. The Frankland River is the largest river by volume in the region, and the eighth largest in the State. Its mean annual flow of 200 gigalitres is equivalent to approximately two-thirds of the potable water supplied in Western Australia.

The region experiences a Mediterranean-type climate with hot, dry summers and cool, wet winters. Mean annual rainfall ranges from 1,400 mm in the west to 300 mm in the northeast. The topography of the region is generally flat, and dominated by the Stirling Ranges in the north. Rivers generally flow in a southerly or southwesterly direction and discharge into estuaries, most of which are permanently or intermittently closed to the ocean. There are twenty-six estuaries in the region. The Deep and Weld Rivers in the west of the region are in pristine condition.

The region is characterised by internal drainage, with many lakes present in areas underlain by Eocene Epoch sediments. Important wetland systems in the region include the Ramsar-listed Lake Warden System and the nationally recognised Lake Gore, Pink Lake and Lake Muir wetland systems.

Groundwater in the region is limited mainly to coastal sedimentary aquifers, with some fractured rock aquifers in the inland areas. The coastal aquifers are important from a regional perspective, as they are generally fresh and are highly allocated for town water supplies (WRC, unpublished).

2.1.2 South West Region

The South West region stretches from the Warren River Catchment in the southeast to the Swan Coastal River Basin in the north. The Blackwood River is the largest river in the region and fourth largest in the State, by total annual flow. The Blackwood River's mean annual flow of 925 gigalitres is approximately three times the volume of potable water supplied in the State. The Swan-Avon and Murray rivers are the second and third largest rivers in the region, with mean annual flows of 360 and 260 gigalitres respectively. The Swan-Avon River has the largest catchment area of any river system in Western Australia, covering almost 126,000 km^2, and is also the longest river in the South West region. Approximately 8,000 km^2 of the Avon River catchment is included in the South West region, while the remaining drier 118,000 km^2 is included in the Mid-West region.

The South West region experiences a Mediterranean-type climate characterised by cool, wet winters and hot, dry summers. Most of the rainfall occurs in the winter four-month period between May and August. Mean annual rainfall ranges from 1,300 mm in the west to less than 400 mm in the east.

The Swan Coastal Plain extends in a north-south direction, terminating to the east at the Darling Scarp and the Darling Plateau. The coastal plain is characterised by sandy soils and low-lying swampy land, in many places the water table is close to or at the surface giving rise to the many wetlands in the region. The plateau terrain ranges from gently undulating to hilly, and is dissected by streams rising locally and by rivers originating further inland. The Whicher Scarp begins at a junction with the Darling Scarp, and continues in a southerly then southwesterly direction, parallel to the coast. The Blackwood Plateau is bound by the Whicher Scarp to the northwest and the Darling Scarp to the east. It has a gently undulating surface, and much of the area is poorly drained and swampy.

There are thirty-one significant wetland systems in the South West region, of which seven are listed under the Ramsar Convention. The region also contains nine recognised estuaries, which suffer degrees of modification and degradation, as many drain urban and agricultural areas.

The region arguably contains the most severe pressures on water resources in the State. The majority of the population of Western Australia (90%) lives in the South West region, which includes the cities of Perth and Bunbury. The most significant and extensively exploited groundwater resources of the Perth Region are contained within the superficial, Mirrabooka, Leederville and Yarragadee aquifers. 60% of Perth's public water supply is from groundwater. The Perth Basin is only moderately developed, although some areas are locally highly allocated, such as the Gnangara mound (WRC, unpublished).

2.1.3 Mid-West Avon Region

The Mid-West region includes the upper portion of the Avon River catchment, the Moore and Hill River catchments and the Yarra Yarra and Ninghan Drainage Basins. Much of the Avon catchment only flows periodically, and is characterised by poorly defined drainage lines.

The Mid-West region covers a large area, over which the climate ranges from Mediterranean-type in the west to semi-arid in the east. The western portion experiences cool, wet winters and hot, dry summers, with annual rainfall ranging from 450 to 650 mm. Inland areas are subject to very hot, dry summers and cold, dry winters. Rainfall decreases in an easterly direction, with inland areas receiving less than 250 mm annually. Rainfall in these areas also tends to be more erratic and unreliable.

The western part of the Avon River Basin is characterised by incised river channels on the Darling Plateau, producing about 90% of the flow in the Avon River. Further east, the landscape changes to broad, flat valleys with numerous salt lake chains. The Moore and Hill River Basins contain both major drainage lines and ephemeral lake systems. The landscape is characterised by sandy coastal plain in the west, rising through the Gingin and Darling Scarps, to the Dandaragan and Yilgarn Plateaus to the east. The Coonderoo River connects the lake systems in the north of the basin to the Moore River. West of the Coonderoo River, drainage typically runs from east to west, with most creeks further inland draining internally to salt lakes. The Yarra Yarra and Ninghan Basins are internally draining systems with little well-defined drainage, and consist of small creeks feeding into salt lake systems. There are numerous wetland and lake systems throughout the region, of which ten are regarded as important systems. There are only two estuaries in the region, the Moore and Hill River Estuaries.

Groundwater resources of the coastal plain, particularly the aquifers of the northern Perth Basin, are under increasing demand (WRC, unpublished).

2.1.4 Murchison-Gascoyne Region

The Murchison-Gascoyne region stretches from the Greenough River Basin in the south to the Lyndon-Minilya River Basin in the north. Major settlements in the region include Dongara, Geraldton, Kalbarri, Carnarvon and Exmouth. The Gascoyne River is the longest river in Western Australia, arising in the inland eastern portion of the region, and extending approximately 800 km to the coast at Carnarvon. The Murchison River, further south near Kalbarri, is the second longest river in the State. The Gascoyne and Murchison Rivers are also the largest by volume in the region (fifth and ninth largest in the State), with mean annual flows of 680 and 150 gigalitres respectively.

Climate in the Murchison-Gascoyne Region ranges from Mediterranean-type in the south, with cool, wet winters and hot, dry summers, to arid with hot summers and mild winters in the northern and inland areas. Inland climatic conditions are typically more extreme than those experienced on the coast. Annual rainfall generally ranges between 200 and 500 mm, with the highest monthly average rainfall occurring between May and July. Northern areas of the region can also be subject to tropical cyclones, which typically occur between January and March bringing summer rainfall.

The Yilgarn Block, consisting primarily of gneisses and granites, covers much of the Murchison region. The sedimentary Perth Basin, consisting of sandstone, siltstone and shale, is located to the west. To the north of the Perth Basin, the sedimentary Carnarvon Basin covers much of the Gascoyne. The Carnarvon Basin generally slopes gently to the coast and is characterised by low relief, open drainage and gently undulating sand plains.

There are twelve recognised estuaries in the region. Eleven significant wetlands are recognised in the Murchison-Gascoyne region, of which two fall within the Shark Bay World Heritage Area.

Groundwater is a very important resource in the region, as it is the only source for public water supply, and is also used for irrigation in the Carnarvon area. Most of the groundwater used in the region originates from the Carnarvon Basin (WRC, unpublished).

2.1.5 Pilbara Region

The Pilbara region covers an area of over 200,000 km^2, from the Ashburton River catchment in the south to the De Grey River catchment in the north-east. Towns in the region include the major centres of Karratha and Port Hedland and a number of smaller mining towns. The region experiences extreme weather conditions from severe droughts to major floods resulting in highly variable river flows. The De Grey is the largest river by volume in the region, and the third largest in the State, with a mean annual flow of 1,000 gigalitres.

The region has a hot, semi-arid to arid climate with annual average rainfall ranging between 200 and 350 mm. However, annual rainfall recorded at stations in the Pilbara has ranged from less than 50 mm to more than 1,000 mm, illustrating the extremely variable nature of the region's rainfall. For most of the region rainfall occurs predominantly during the summer months, with the major falls resulting from cyclonic activity, raw bearing depressions, and to a lesser extent, winter thunderstorms. In the southern coastal area, winter rains resulting from southern low pressure systems are equally significant. However, in some years, winter rainfall can be widespread through the region, and may exceed summer rainfall.

The Pilbara region is within a geological province principally composed of hard sediments and igneous rocks. There are three distinct geographical formations: a coastal plain, inland ranges and an arid desert region. The region has moderately high relief, with the Hamersley Range being the highest in the State. The two major divides of river systems are the Hamersley and Chichester ranges. Rivers generally flow in a northerly direction north of the Chichester Range, and in a westerly direction south of the range. The region's rivers discharge through direct ocean outlets or disperse through marshy flats. There are twenty-four recognised estuaries or embayments in the Pilbara region. The De Grey River estuary is the largest shallow estuary in northwest Australia. Rivers crossing the coastal plain have extensive floodplains, and contribute significant recharge to groundwater resources.

Groundwater occurs throughout the region in basement rocks, sedimentary basins and superficial deposits. Most of the groundwater is located in fractured rock aquifers; however, both the sedimentary and fractured rock groundwater resources are important to the region, as they provide the majority of water supplied to towns and industry.

The Pilbara region contains seven recognised important wetlands, all of which are fresh except the Leslie Saltfields System near Port Hedland. The wetlands provide important dry season refuges (WRC, unpublished).

2.1.6 Kimberley Region

The Kimberley region extends from the Fitzroy River catchment in the west to the Ord River catchment in the east, and includes the towns of Broome, Derby, Wyndham and Kununurra. The Fitzroy River is by far the largest river, by volume, in Western Australia, with an estimated mean annual flow in excess of 9,000 gigalitres. The Ord River has the second largest volume in the State with a mean annual flow of approximately 3,000 gigalitres. The Ord River also has one of the largest catchments in the State, extending into the Northern Territory, and covering over 57,000 km^2. Lake Argyle, on the Ord River, is the largest reservoir in Western Australia and the second largest man-made lake in Australia, with a capacity of 10,760 gigalitres.

The Kimberley region has a semi-arid to tropical climate with two dominant seasons separated by short transitional periods. Warm tropical waters to the north of the region provide the energy source for most of the region's rainfall. Annual rainfall ranges from 350 mm in the south to over 1,400 mm in the remote northwest coastal area. About 90% of the rainfall occurs between November and April, with light and sporadic falls during the remainder of the year.

The region is divided into four distinct landform divisions. The North Kimberley division is predominantly a plateau comprising sandstone and siltstone, with some shale and volcanic rock. The Kimberley Plateau acts as a watershed with streams and rivers flowing to the ocean in the north and northwest. The Ordland and Fitzroyland divisions contain the region's principle drainage systems. The Ord River flows into the Cambridge Gulf near Wyndham. The Fitzroyland division contains the Fitzroy River and its tributaries, which drain northwest into King Sound south of Derby. The northwestern edge of the division contains the Devonian Reef System, which has been deeply incised and weathered to form gorges and caves. The Sandland division is located to the south of the region and contains areas of the Great Sandy and Tanami Deserts of the Northern Canning Basin.

Streamflow in the Kimberley region generally occurs over the wet season months, November to April inclusive, with little or no flow during the remainder of the year. The region occupies approximately 12% of Western Australia's total land area, but has almost 75% of the State's mean annual streamflow. The Kimberley region contains the largest number of pristine and near-pristine river systems in Western Australia and contains seventeen of the twenty-six identified pristine river systems in the State.

The Kimberley region contains ninety-two recognised estuaries or embayments, by far the largest number of any region in the State. Due to their remote locations, all but eleven of the estuaries are in near-pristine condition.

There are numerous wetlands in the region, of which fifteen are recognised as significant. Five of the wetlands are Ramsar-listed: Roebuck Bay, Lake Argyle, Lake Kununurra, Ord Estuary System and Parry Floodplain.

Groundwater resources are very important in the Kimberley region, as they constitute the source of most public water supplies. The largest sources of groundwater are located in the Kimberley and Halls Creek fractured rock provinces in the north of the region, and the Canning Basin in the west (WRC, unpublished).

2.1.7 Western Plateau Region

The Western Plateau region is the largest region in Western Australia, covering 56% of the State. The region is characterised by uncoordinated internal drainage, with almost no major riverine landform features. Desert landscapes dominate, with the Great Sandy, Gibson, Great Victoria and Nullarbor Plain

deserts located in the region. Three major sedimentary basins underlie the area with thick sedimentary deposits containing significant groundwater resources. These are the Canning, Officer and Eucla Basins which are the three largest groundwater basins in the State. The largest of these, the Canning Basin, extends into the Kimberley and Pilbara regions and has an estimated storage of 12,450,000 gigalitres of fresh-saline groundwater resources.

The entire region experiences a hot and arid climate. Rainfall ranges from less than 150 mm to 350 mm per year. Rain in the northern part of the region typically results from tropical summer cyclones. In the southern part of the region, rainfall generally results from cold frontal systems. Temperatures are extreme, with very hot summer days and near freezing winter nights.

The region has very few watercourses. Most are short and all are ephemeral, flowing very infrequently and only for short periods of time following heavy rain. All major rivers in the region are internally draining (i.e. do not drain to the coast). The Eucla and Canning Basins contain coastal areas; however, only minor creeks in these areas drain to the coast. The region has only four recognised estuaries, located on the northwest coast of the Sandy Desert Basin between the Pilbara and Kimberley regions, which are considered to be in near-pristine condition. There are two pristine rivers, Rudall River and Herbert Wash, and two near-pristine rivers, Savory Creek and Ponton Creek, in the Western Plateau Region.

There are a number of wetlands in the region, of which eighteen are considered significant. The two coastal wetlands, the Eighty Mile Beach System and Mandora Salt Marsh, are Ramsar listed.

Groundwater generally occurs in fractured rock provinces and palaeodrainage deposits in the west and sedimentary basins in the east of the region. Most of the towns and communities in the region rely wholly or partly on groundwater for town water supplies. In the Kalgoorlie region, saline and hypersaline groundwater is a significant resource for mining activities. The three major groundwater resources in the region are the Eucla, Officer and Canning Basins. Most of the groundwater is brackish to saline, although the Canning Basin contains some fresh groundwater resources (WRC, unpublished).

2.2 Key Water Resource Management Issues

The1998 *State of the Environment Report* (SoE 1998 Report) (GWA, 1998) divided the State into environmental regions. With resect to water resource management, the report identified three broad categories of concern:

- Inland water (groundwater, rivers, estuaries and wetlands);
- The marine environment; and
- The maintenance of biodiversity.

The report identified the following issues of concern within those categories:

- salinisation of inland waters;
- loss of fringing vegetation;
- eutrophication;
- sedimentation; and
- contamination of waters.

Issues affecting water resources were considered in greater depth in *Water WA 2001: A State of Water Resources Report for Western Australia*, prepared by the Water and Rivers Commission (unpublished). These issues are briefly discussed below.

2.2.1 Salinisation

Native vegetation has been cleared in large areas of the south west of Western Australia, and replaced by agricultural crops and pastures. Native vegetation utilises groundwater at a greater rate than crops or pastures. Removal of the native vegetation has thereby increased the amount of groundwater recharge in these areas, resulting in rising groundwater levels which in turn can cause waterlogging or salinisation of the land and discharge of saline water to waterways.

Salinisation of waterways can impact detrimentally on water supplies and lead to a loss of agricultural production, resulting in a loss of income from the land for the landholder and the State. Waterways and land affected by salinity may have reduced aesthetic value, as salt-impacted landscapes are dominated by dead vegetation or salt-tolerant species. Increased salinity can result in the loss of native vegetation, including fringing vegetation, and native fauna due to the loss of fresh water habitat. This in turn can negatively impact biodiversity (WRC, unpublished).

The salinity of many rivers in the South Coast, South West and Mid-West Avon regions has increased significantly over the years, and is likely to continue to increase in many cases. More than one-third (36%) of the southwest's previously divertible water resource has become brackish or saline and can no longer be used for potable water supply. A further 16% is of marginal quality (GWA, 2000).

2.2.2 Loss of Fringing Vegetation

Fringing vegetation, or vegetation adjacent to a waterbody, is important in maintaining channel stability, minimising erosion, providing shade and reducing nutrient and sediment concentrations in a waterbody. The widespread loss of native fringing vegetation is one of the most damaging changes inflicted upon inland waters (GWA, 1998). The primary cause of fringing vegetation loss is due to clearing. Fringing vegetation is also degraded or lost as a result of direct stock access to fringing zones (passive clearing), weed infestation and water quality issues such as salinity and nutrient enrichment (WRC, unpublished).

2.2.3 Nutrient Enrichment

Nutrient enrichment of waterways, often referred to as eutrophication, is an increase in the concentration of nutrients in a waterbody. While eutrophication is a slow natural process in some environments, its rate can be greatly accelerated by human activities. Nitrogen and phosphorus are the most important nutrients causing eutrophication.

Eutrophication can cause widespread death of aquatic animal and plant life, decrease diversity and cause algal and Cyanobacteria blooms which are unsightly, smell and are sometimes toxic. The availability of phosphorus is most often limiting and controls the occurrence of most algal blooms in inland waters in the south west of Western Australia. Nitrogen is available in sufficient quantities to support algal blooms in inland waters, however, the outflow of nitrogen-rich water from estuaries into coastal waters can cause eutrophication of the marine environment.

Generally, sandy soils do not hold nutrients and allow direct leaching of dissolved nutrients. Western Australia has soils of low fertility which support native plants that are adapted to low nutrient levels. In other areas, where soils are heavier and nutrients are bound to soil particles, soil erosion plays a leading role in eutrophication. The decay of organic matter in wetlands, streams, river pools and estuaries can

reduce oxygen levels in the water column and thereby trigger release of nutrients from sediments, thus exacerbating eutrophication (GWA, 1998).

Nutrient enrichment of groundwater can reduce the suitability for potable supply and impact on sensitive environments that receive groundwater flow, such as estuaries, wetlands and cave systems.

Primary causes of nutrient enrichment are intensive animal and horticultural industries, broad acre agriculture and wastewater discharges to receiving water bodies. Nutrient enrichment of groundwater is typically a result of excessive fertiliser usage, poor management of animal wastes and septic tanks in agricultural and urban areas (WRC, unpublished).

2.2.4 Erosion and Sedimentation of Waterways

Erosion and sedimentation of waterways are strongly linked with the loss of fringing vegetation, catchment clearing and floodplain degradation. Erosion and sedimentation are caused by changes in flow regimes and channel accommodation changes.

Erosion and sedimentation are naturally-occurring processes; however, the rates at which they occur can be accelerated by human activities. Sedimentation of waterways and wetlands occurs when soil becomes unstable and erodes from urban and agricultural catchments and the banks and beds of streams. Where fringing vegetation has been removed, river banks are particularly vulnerable to erosion. In the south west of the State, catchment run-off has increased where native vegetation has been cleared. The high peak flow rates that result erode the exposed soil, creating gullies and damaging stream channels. Wind can also disturb exposed soil and carry it into waterbodies. In the north of the State sedimentation rates are naturally high, but pastoral and some mining activities have accelerated the rate of erosion. The erosion of soil from agricultural land has a significant impact on the productivity of the land.

Where water flow decreases, sediment falls from suspension, covering vegetation and severely degrading the ecology of aquatic ecosystems. Eventually sediment can completely fill deep river pools. A similar process occurs in wetlands. Organic material, such as animal manure, can cause other problems as it decays, including decreasing the amount of oxygen available to sustain aquatic life (GWA, 1998).

2.2.5 Contamination

For the purposes of this document, 'contaminants' include chemical pollutants other than nutrients, salts and sediment, which are addressed in previous sections. The contamination of water resources can affect drinking water supplies, cause harm to plants and animals, restrict recreation such as boating and swimming, degrade aesthetic values and damage industries such as fisheries. Contamination by substances other than nutrients is generally from 'point sources' such as wastewater discharges from factories and intensive agricultural industries, chemical spills and leaking underground storage tanks.

The protection of groundwater resources from contamination is essential to ensure that the quality of groundwater is suitable for potable use, and to maintain the health of groundwater-dependent environments such as wetlands. The Swan Coastal Plain, containing most of the State's population and industrial activities, is extremely vulnerable to groundwater contamination due to the sandy nature of the soils, which allow contaminants to reach aquifers and affect groundwater quickly. Contamination of groundwater can also occur elsewhere in the State, from sources such as former industrial and landfill sites.

Groundwater contamination may extend between 100 and 2,000 metres from individual point sources (the extent of groundwater contamination is commonly referred to as the 'plume'), and can cause

environmental problems where it discharges to wetlands, waterways, estuaries and the marine environment. Where groundwater is used for potable supply, contamination can cause human health problems.

Waterways are susceptible to contamination from groundwater discharge, as well as direct contamination from effluent discharges or chemical spills. Estuaries and lakes are particularly sensitive to contamination because they are semi-enclosed water bodies where there is the potential for contaminants to remain in the water or sediments for long periods of time and to enter the food chain (WRC, unpublished).

2.2.6 Sustainable Use of Water Resources

Sustainable yield is defined as the rate of water extraction from a source that can be sustained on a long-term basis, without exceeding the rate of replenishment, after making provision for environmental and social values. This concept forms the basis of the Water and Rivers Commission's allocation, or sharing, of the State's water resources.

Large quantities of water are required for public water supplies, agriculture and industry. Industries such as mineral extraction and energy production, with a large water demand, are often located in arid areas of Western Australia where water is scarce. Careful management of the water resource is required to ensure that environmental values do not suffer due to development and an increased demand for water (WRC, unpublished).

2.3 Stakeholders in Water Resource Management

Water resource management is the shared responsibility of government, industry and the community. The Commonwealth, State and Local levels of Government have different roles specified in legislation, whereas the community, industry and land managers are in the forefront of management and recognise the values of water resources. These shared responsibilities need to be coordinated to achieve effective water resource management.

2.3.1 Commonwealth Government

Water quality management is coordinated at the policy level through the Council of Australian Governments, PIMC and NRMMC where national approaches are developed.

2.3.2 State Government

The State Government has the prime responsibility for water resource management in Western Australia. Water quality is not managed by any one agency, but many agencies working together in partnership with the community and industry. There are a variety of complementary processes that have evolved in a number of agencies to address various aspects of water quality management. Water quality management is achieved through the integration of agency roles and associated processes.

The State government agencies listed below have a role in achieving water quality management. Further details are provided in Appendix C.

- Department of Agriculture;
- Department of Conservation and Land Management;

- Department of Environmental Protection*;
- Water and Rivers Commission*;
- Department of Health;
- Department of Industry and Resources;
- Department for Planning and Infrastructure and Western Australian Planning Commission;
- Department of Fisheries;
- Department of Health Department;
- Office of Water Regulation; and
- Department of Fisheries.

2.3.2.1 Environmental Protection Authority

The Environmental Protection Authority (EPA) is an independent statutory authority and the government's primary adviser in relation to protecting Western Australia's environment and preventing, controlling and abating pollution. The EPA carries out a number of functions including environmental impact assessment, preparation of environmental protection policies, coordinating environmental protection activities, and providing information and advice. The EPA has a pivotal role in identifying environmental values, objectives and criteria, particularly as they relate to environmental water allocations. These functions are carried out in close relationship with agencies that have particular expertise in the relevant areas.

2.3.3 Local Government Authorities

Local Government's responsibilities are defined under the *Local Government Act 1995* and *the Town Planning and Development Act 1928*. It is the responsibility of Local Government to ensure appropriate land use, development and planning controls are administered through planning approvals in relation to their district town planning schemes. Ensuring land uses are compatible with water quality management objectives is critical to sustainability of Western Australia's water resources. Local Government has also operational responsibilities including waste management, road building and maintenance and the management of land owned or vested in the Local Government.

Members of Local Government are part of the community and have close contact with industry and community groups at the local level. Local Government involvement is important in developing and maintaining close communication networks to link the community and industry.

2.3.4 Natural Resource Management Groups

It is recognised that effective implementation of natural resource management activities at the regional level can only be undertaken through a partnership approach between government and community. In 2000 the Western Australian Government endorsed a "framework to assist in achieving sustainable natural resource management". This framework was jointly developed by the State Government and the chairs of the Regional Natural Resource Management (NRM) groups. The Framework outlines the mechanism for the development of partnership agreements between the government and community-based NRM groups.

* The Department of Environmental Protection and the Water and Rivers Commission are amalgamating to form a new agency, provisionally titled the Department of Environment.

At a regional level these groups coordinate and implement the on ground strategies which are supported by State and Commonwealth programs. These groups work with the community, farmers and with small and medium industries to manage their activities more sustainably.

These local groups are arranged into six regions:

- South Coast Regional Initiative Planning Team (SCRIPT);
- South West Catchments Council (SWCC);
- Northern Agricultural Catchments Council (NACC);
- Swan Catchment Council (SCC);
- Avon Catchments Council (ACC);
- Rangelands Natural Resource Management Coordinating Group.

2.3.5 Community and Industry

There are a number of existing community groups working at different levels within water catchments. The community has a pivotal role in developing water quality management strategies, objectives and goals. Community and industry involvement is critical to the determination of significant water resource values, the integration of social, economic and environmental factors and the effective implementation of any water quality management strategy or plan. Community and industry are encouraged to participate in the decision-making processes of government at the Local, State and Commonwealth levels.

2.4 Summary of Implementation Programs

Table 1 summarises the issues identified in the previous section relating the State's key water resources and the various statewide strategic plans that have been put in place to address these issues. It should be noted that under these strategies exist a number of local and regional initiatives and implementation plans which deal with specific areas. Section 3.0 will provide more detail on the role of these strategies in managing these water resource quality issues.

Table 1. Summary of Water Resource Management Priorities and Responses

Water Resource	Management Priorities	Responses	Lead Partners
Groundwater	Contamination of groundwater (microbes, chemicals & nutrients) Salinity Maintenance of drinking water quality	• New Legislation – *Contaminated Sites Bill* • National Action Plan for Salinity and Water Quality • State Salinity Strategy • Environmental Protection Policies • Statement of Planning Policies & land use planning mechanisms to manage water quality • Australian Drinking Water Guidelines	• DEP • GWA, NRM Regions • NRM Regions • EPA, DEP • DPI, WAPC, WRC, DEP, • WRC, DEP, HDWA
Rivers	Eutrophication Turbidity Loss of fringing vegetation Environmental Water Provisions Contamination Salinity Maintenance of drinking water	• Waterways WA Policy • National Action Plan for Salinity and Water Quality • Allocation Plans for surface water basins throughout the State that incorporate environmental water provisions • State Salinity Strategy • New Legislation – amendments to the *Environmental Protection Act 1986* • Australian Drinking Water Guidelines	• WRC • GWA, NRM Regions • WRC • GWA, NRM Regions • DEP • WRC, DEP, HDWA
Estuaries	Eutrophication Contamination Turbidity	• Waterways WA Policy • New Legislation – amendments to the *Environmental Protection Act 1986*	• WRC • DEP
Wetlands	Environmental Water Provisions Contamination Eutrophication	• New Legislation – amendments to the *Environmental Protection Act 1986* • Allocation Plans for groundwater basins throughout the State that incorporate environmental water provisions • Environmental Protection Policies • Statement of Planning Policies & land use planning mechanisms to manage water quality	• DEP • WRC • DEP, EPA • DPI, WAPC, WRC, DEP
Marine Environment	Contamination Habitat degradation	• Environmental Protection Policies • New Legislation – amendments to the *Environmental Protection Act 1986* • Adoption of PIMC & NRMMC guidelines • Legislation – *Conservation and Land Management Act 1984* to create new marine reserves	• DEP, EPA • DEP • DEP • CALM

3 Water Resource Management Initiatives

The NWQMS is implemented through several key strategies throughout the State. These strategies have spawned various regulatory and non-regulatory instruments to implement their programs such as guidelines, polices, planning instruments etc. The following section outlines the statewide strategies and resulting regulatory and non-regulatory instruments to implement the NWQMS in the State.

3.1 Natural Resource Management

Natural Resource Management (NRM) covers all matters to do with the use and management of air, land, water and vegetative resources and the maintenance of biodiversity. As shown in Figure 2, a Cabinet Standing Committee on Environmental Policy guides Cabinet on NRM and environmental matters. In addition, a Sustainability Policy Unit has been established which has recently released a Western Australian Draft State Sustainability Strategy for pubic consultation.

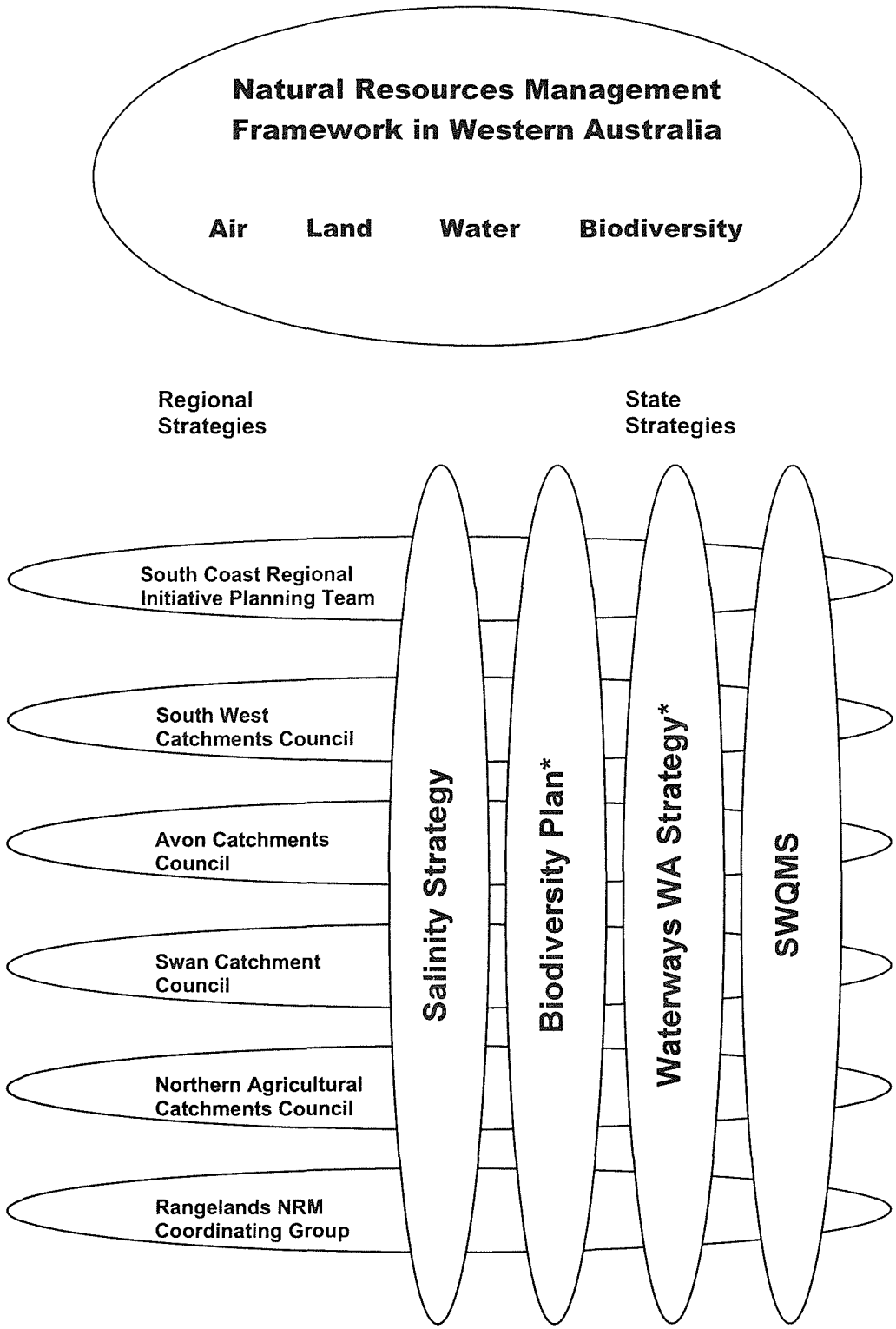
A recently formed NRM Council brings together community representatives and the 'NRM' government agency Directors from WRC, DEP, Conservation, Agriculture, Forest Products and Planning and Infrastructure. The NRM Council includes chairs of some of the six community based Regional NRM Councils, which head up the six NRM Regions in WA (see Section 2.3.4).

Each NRM Region has a number of Sub-regions, which are linked to smaller groups, such as catchment groups, land care districts and 'friends of' groups, and ultimately to individual landowners. The Regions are at different stages of development and maturity, with the Rangelands at the earliest stage.

Each NRM Region has prepared, or is in the process of preparing 'Regional NRM Strategies'. These strategies are in the process of being accredited by the State and Commonwealth Governments to receive funding in the future through extension of the Natural Heritage Trust (NHT 2) and the new National Action Plan for Salinity and Water Quality (NAP).

Through these regional strategies, the NWQMS guidelines are implemented on ground. The following examples illustrate some of the programs being carried out by these groups.

Figure 2 NRM framework within Western Australia



* Currently being developed.

3.2 Western Australian Draft State Sustainability Strategy

The Draft State Sustainability Strategy Framework (GWA, 2002a) consists of six long term visions for Western Australia, each with a goal and several priority areas for action. The National and State water Quality Strategy objectives are reflected in the document through the two key areas of *Sustainable use of Natural Resources* and *Sustainability and Settlements*.

The *Sustainable use of Natural Resources*, and in particular *Protecting Aquatic Systems* seeks to ensure the hydrological processes of all aquatic systems are understood and that community derived environmental values are set for each water system and that they are managed through Environmental Protection Policies and Statement of Planning Policies. The strategy seeks to:

- Improve understanding of aquatic systems;
- Protect aquatic systems of high environmental, scenic and heritage significance;
- Manage aquatic systems to agreed conditions for a range of environmental values;
- Incorporate social and cultural values when managing aquatic systems; and
- Increase community awareness and involvement in the management and protection of aquatic systems. (GWA, 2002a)

Sustainability and Settlements sets priority actions for our water future to "*...ensure water is used with care and is provided sustainably to meet needs...*" through:

- Reducing water consumption;
- Extending the responsibility for water supply to the planning system (water sensitive design) and to local government (Regional Councils) for groundwater supplies;
- Achieving significant waste water reuse; and
- Investigating long term innovative water supply options that have broad sustainability outcomes.

Many of these objectives are being addressed through current government, industry and community actions.

3.3 Salinity Initiatives

In 1996 the Government of Western Australia launched a Salinity Action Plan, which had a thirty-year vision for addressing dryland salinity in the State. In its response to the SoE 1998 Report, the State Government's proposed action to address the issue of salinisation of inland waters was to implement the Salinity Action Plan (GWA, 1999). This Action Plan formed the starting point for subsequent initiatives to address salinity. The State Salinity Council (SSC), representing key stakeholder groups with a role in salinity management, was formed in May 1997. In response to calls for the Salinity Action Plan to be more community-focussed, a revised plan was released as a draft for public comment in December 1998. Following considerable public input, the revised plan was developed further by the SSC, and published as The Salinity Strategy in March 2000 (GWA, 2000).

3.3.1 The Salinity Strategy

The Salinity Strategy (GWA, 2000) considered the causes and impacts of salinity, including biophysical, economic and social impacts. Impacts on water resources were considered under biophysical impacts, along with impacts on biodiversity and increased flood risk. The strategy aimed to reduce the impact of salinity in the south-west agricultural region of Western Australia. The strategy gave priority to the following actions:

- To manage recharge through:
  - changing land use practices;
  - protecting, improving and adding to remnant native vegetation;
  - revegetation with commercial deep-rooted perennials, especially tree crops;
  - revegetation with native species; and
  - catchment planning and management, including surface water management.
- To manage discharge by:
  - protecting, including and adding to remnant native vegetation;
  - revegetation with commercial deep-rooted perennials, especially tree crops;
  - productive use of saline land;
  - subsurface water management; and
  - catchment planning and management.
- To ensure a partnership approach through:
  - priority catchments to protect biodiversity, water quality, productive land and infrastructure;
  - community capacity building (locally-based professional support, training and knowledge networks);
  - State Salinity Council; and
  - catchment planning and management (GWA, 2000).

3.3.2 Salinity Taskforce

In May 2001, the formation of a Salinity Taskforce was announced by the Minister for the Environment and Heritage and Minister with Special Responsibility for Salinity, Dr Judy Edwards MLA. The Taskforce was charged with recommending future strategies to combat salinity that would provide a more targeted and cohesive response to Western Australia's salinity threat, and to review how salinity could be managed in the context of natural resources management.

The Taskforce concluded that there were three main actions that the State Government should be leading, and that these constituted a new position on salinity and its management:

- Protection of outstanding public assets from the consequences of salinity and other forms of resource degradation (e.g. water resource catchments, threatened high-value conservation areas or rural towns);
- Investment in and support for major actions on private land by developing new technologies and new industries (e.g. perennial plants for salinity prevention, salt tolerant plants for productive use of saline land or engineering options); and

- Support and incentives for planning, coordination and implementation of smaller on-ground works on private land (e.g. for water management and protection of biodiversity) (Frost et al., 2001).

The Taskforce supported the strategic direction and actions of the Salinity Strategy 2000, although recommended a shift in emphasis and additional strategic investment. The Taskforce's recommendations included finalisation of the SSC's Framework for Investment in Salinity Management, monitoring and evaluation programs addressing both baseline monitoring and evaluation of specific programs, the formation of an advisory Natural Resource Management Council for Land and Water to replace the SSC, and endorsement for the review of the status and future prospects of the catchments included in the Water Resource Recovery Catchment program (Frost et al., 2001).

In its response to the Salinity Taskforce's report (GWA, 2002b), the State Government concurred with the three main actions advocated by the Taskforce. The Government's Response addresses each of the Taskforce's recommendations, and describes its response to them. Relative funding priorities and responsibilities for implementation or coordination are assigned for each salinity management priority. Funding for recovery of key Water Resource Recovery Catchments is assigned a high priority (GWA, 2002b).

As the Taskforce Report and Government's response describe a revised strategic focus for salinity management, these documents should now be read together with the Salinity Action Plan and Salinity Strategy. In combination, these documents constitute Western Australia's implementation plan for addressing the issue of salinisation of inland water.

3.4 Waterways WA

In its response to the SoE 1998 Report, the State Government recognised the key role of the Waterways Western Australia Program in addressing issues such as the loss of fringing vegetation, nutrient enrichment and erosion and sedimentation (GWA, 1999). This statewide management program was intended to coordinate and build on existing knowledge and action in the management of waterways.

In 2000, the Water and Rivers Commission released the draft Waterways WA policy for comment, together with supporting information (WRC, 2000a and b).

The draft Waterways WA policy recognised the overarching nature of the integrated Natural Resource Management approach and positioned itself as a component within this framework (WRC, 2000b). The policy identified the following objectives for statewide waterways management:

- Improve understanding of waterways;
- Protect waterways of high environmental, scenic and heritage significance;
- Manage waterways to agreed conditions for a range of uses;
- Achieve economic benefits based on sustainable use of waterways and their catchments;
- Protect and enhance water quality and amenity;
- Protect social and cultural values when managing waterways; and
- Increase community awareness and involvement in the management and protection of waterways (WRC, 2000a).

The Water and Rivers Commission is in the process of developing a statewide Strategy for Waterways Management in WA. This strategy will further develop and refine initiatives for achieving the objectives for statewide waterways management. The strategy is due for release in 2003.

3.5 Regulatory Instruments

3.5.1 Land Use Planning Mechanisms

Section 5AA of the *Town Planning and Development Act 1928* provides for the preparation and adoption of Statements of Planning Policy (SPPs) by the Western Australian Planning Commission (WAPC). The WAPC and local governments must have 'due regard' to the provisions of SPPs when preparing or amending town planning schemes and when making decisions on planning matters. The Town Planning Appeal Tribunal is also required to take account of SPPs when determining appeals.

A number of existing SPPs are aimed at protecting specific water resources from contamination, nutrient enrichment and loss of fringing vegetation, including the *Peel-Harvey Coastal Plain Catchment Policy*, *Gnangara Mound Crown Land Policy*, *Jandakot Groundwater Protection* Policy and the recently released *Public Drinking Water Source Policy*. New draft SPPs relevant to the management of water resources were released for public comment in early 2002, and are currently being finalised. These draft SPPs are the *Environment and Natural Resources Policy*, the *Water Resources Policy* and the *State Coastal Planning Policy*.

3.5.2 Environmental Regulation

3.5.2.1 Environmental Protection Act

The *Environmental Protection Act 1986* is a legislative tool for achieving environmental resource protection and implementing the NWQMS and SWQMS in Western Australia. The Act establishes the Environmental Protection Authority (EPA) to undertake a variety of functions, including conducting environmental impact assessments, preparing Environmental Protection Policies (EPPs), and advising the Minister for the Environment and Heritage and the public on environmental matters generally. Once approved by the Minister and published in the Government Gazette, EPPs have the force of law.

A number of existing EPPs address water resource management issues, including nutrient enrichment, loss of fringing vegetation and contamination. These EPPs include *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*, *Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992*, *Environmental Protection (South West Agriculture Zone Wetlands) Policy 1998*, *Environmental Protection (Swan and Canning Rivers) Policy 1998*, and *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*.

Several draft EPPs under development also address water resource management issues, including *Draft Environmental Protection (Cockburn Sound) Policy 2001* and *Draft Environmental Protection (State Marine Waters) Policy*. The development of the draft Cockburn Sound EPP provides a particularly good example of implementation of the NWQMS in Western Australia through the identification of environmental values, environmental quality objectives and environmental quality criteria (see Section 4.1.1).

The *Environmental Protection Act 1986* also provides for environmental impact assessment of planning schemes and development proposals. Proposals and schemes approved by the Minister, after consideration of the EPA's advice, may be implemented subject to conditions.

Part V of the *Environmental Protection Act 1986* provides for the control of pollution, with particular reference to 'prescribed premises'. Works approvals are required to construct or alter prescribed premises, which also require a licence or registration to operate. These regulatory tools are used to set pollution control conditions and discharge limits.

Proposed amendments to the *Environmental Protection Act 1986* have been introduced to the State Parliament. These amendments introduce the concepts of environmental value, environmental harm and ecosystem health condition into Western Australian legislation and provide for a clearing permit system to control clearing of native vegetation.

3.5.2.2 Contaminated Sites Bill 2002

The *Contaminated Sites Bill 2002* has been developed to provide for the identification, recording, management and remediation of contaminated sites in Western Australia. The Bill requires the Department of Environmental Protection to establish and maintain a database of contaminated sites and classify of sites according to their contamination status. The Bill also provides powers to issue notices for investigation, clean up or abatement of immediate hazards posed by contaminated sites. The Bill was introduced into the Parliament in November 2002. It is anticipated that the *Contaminated Sites Bill 2002* will be passed before the end of 2003.

3.5.3 Water Resource Allocation

The WRC uses the water allocation process to determine the quantity of water which should be set aside for the environment and how the remaining water should be shared between industrial, agricultural and public water supply areas. The water allocation process involves a comprehensive system of water allocation planning and licensing of water use.

Allocation plans are currently being prepared at a range of scales and to different degrees of detail. They range from regional scale plans that can include several river basins or geological provinces, to plans that cover individual surface water or groundwater management areas. Allocation plans identify the water resources and water regimes to be protected and define the water use licensing policy for the area of application of the plan.

Allocation plans include:

- information on water resources of the area;
- evaluation of their values in meeting the needs of water dependent ecosystems, meeting the social and cultural needs of communities, and satisfying industrial, agricultural and public water supply demands;
- allocation decisions and licensing policy.

Decisions are based on:

- identifying key ecological, social and cultural values to be protected;
- describing water regimes or related criteria that must be met to ensure that environmental water provisions (EWPs) are protected;
- defining the quantities of water that can be sustainably diverted while maintaining EWPs; and
- indicating the share of the divertible water that can be licensed for agricultural, industrial or public water supply use.

The WRC implements its water allocation decisions and regulates the use of water through the powers assigned to it under the *Rights in Water and Irrigation Act 1914*.

3.6 Non-regulatory Instruments

Non-regulatory instruments are developed in close consultation with affected industry, community and government bodies and include such devises and codes and guidelines which when implemented contribute to the management of water resources through their protection and enhancement. Non-regulatory instruments aid self regulation of certain activities and can be used as conditions of regulatory instruments such as permits and licences.

3.6.1 EPA guidance statements

Guidance Statements are issued by the EPA to assist proponents, and the public to understand the minimum requirements for the protection of the environment that the EPA expects to be met during the assessment process. Proponents are always encouraged to do better than the minimum.

Guidance statements currently in draft that provide advice on water quality include: *Wetlands Protection, Groundwater Environmental Management Areas, Surface Run-off: Management of Industrial and Commercial Sites, Planning Schemes: Guidance for Assessment, and Waste: Liquid Hazardous Waste, Deep and Shallow Well Injection.*

Proponents who are able to demonstrate that they will meet or exceed the minimum requirements are likely to find that their assessment will be more straight forward and take less time. A proponent who wishes to deviate from the minimum level of performance in a Guidance Statement would be expected to put a well-researched and clear justification to the EPA arguing the need for the deviation.

3.6.2 Guidelines and Codes of Practices

Government, in partnership with relevant industry groups prepare environmental management guidelines and codes of practices. The aim of these guidelines and codes is to assist users in understanding environmental protection (especially water quality) needs and how to achieve best environmental practice in their businesses/industry.

Guidelines and codes are not regulatory tools by themselves but can be used as conditions of licences under Part V of the *Environmental Protection Act 1986*. Environmental Management Guidelines are currently available for viticulture, piggeries, stabling and agistment of horses, cattle feedlots, potatoes and vegetables, turf and mining and mineral processing. Guidelines in draft include broadacre horticulture, poultry and orchards.

4 State Water Quality Strategy in Action

The NWQMS is being implemented through a variety of programs, which are detailed in the previous section. The following case studies illustrate these various programs in action.

4.1.1 Cockburn Sound

Cockburn Sound, which is located 20 km south of the Perth-Fremantle area, is the most intensively used marine embayment in Western Australia. Cockburn Sound is highly valued by the community for recreational and commercial purposes such as swimming, sailing, fishing, aquaculture and tourism.

The hinterland of Cockburn Sound supports a full range of land uses including urban, rural, industrial, defence and nature conservation. These many, and sometimes competing, uses are placing increasing pressure on the Sound and they will intensify as the population in the catchment is expected to increase by over 30% within the next 10 years. The need to manage these complex, multiple uses and the associated environmental impacts has never been greater (CSMC, 2002).

In response, the Cockburn Sound Management Council (CSMC/the Management Council) was established in August 2000 to coordinate environmental planning and management of Cockburn Sound and its catchment. At the same time as the Management Council was formed, the Environmental Protection Authority commenced drafting an Environmental Protection Policy for Cockburn Sound. The Policy outlines the environmental values, objectives and criteria for managing Cockburn Sound, and requires the preparation of an Environmental Management Plan by the Cockburn Sound Management Council (CSMC, 2002).

In the preparation and development of the CSMC, the WA Government was guided by the processes reflected in the NWQMS guidelines 3. In the management of water quality in Cockburn Sound, WA has adopted NWQMS guidelines 4 and 7.

4.1.2 North West Shelf Joint Environmental Management Study

Western Australia's North West Shelf is a major contributor to the national economy. It produces the majority of Australia's domestic and exported oil and gas, and hosts commercial fisheries, aquaculture, salt production and tourism, and shipping associated with the transport of oil, gas, salt and iron ore. Each of these industries has its own management authority, and these operate under more than 200 separate Federal, State and Local Government legislative requirements (CSIRO & DEP, 2002).

A collaborative approach to integrated management that identifies the resources, habitat types and conservation values of ecosystems, and involves stakeholders in decision-making, is essential to balancing these uses, and avoiding conflict. An integrated, ecologically based management framework is vital to protecting the integrity and productive capacity of this marine ecosystem for all interest groups.

The principal objective of North West Shelf Joint Environmental Management Study is to develop and demonstrate practical and science-based methods that support integrated regional planning and management of marine ecosystems to achieve ecologically sustainable development (CSIRO & DEP, 2002).

The study will provide an understanding of the marine environment, and the tools to aid and streamline management decision-making. Outcomes of the four-year Study will support initiatives by the Government of Western Australia to manage human uses of the region using an integrated, ecosystem and science-based approach. They will include:

- A model of the North West Shelf to predict the cumulative impacts of multiple use;
- Methods of testing proposed management options and scenarios, in a risk context, for regional multiple management;
- An understanding of how the physical and chemical environment and the biological environment are linked, with a focus on major primary producers, rare and endangered species, and commercial and recreational species;
- The ability to predict the effects of selected human uses on conservation and other values of the North West Shelf ecosystem;
- Predictions for use in risk assessment and risk management strategies, including strategies based on adaptive management in response to the results of monitoring programs; and
- Comprehensive knowledge of the region's natural wealth and variability in the short- and long-term to enable greater flexibility in managing new threats and activities (CSIRO & DEP, 2002).

The study is consistent with the NWQMS/SWQMS principles and strategies as it seeks to promote partnerships in water quality management among the various users of the North West Shelf resources. It also seeks to establish government coordination mechanisms and the collection and promotion of access to water quality data held by various agencies.

4.1.3 Protection of public drinking water supplies through land use planning

The Water and Rivers Commission employs a number of mechanisms to ensure public drinking water sources are protected from potential contamination. These include developing water source protection plans, incorporating water source protection into land use planning, developing policy and land use guideline documents and using legislation and by-laws to prevent pollution.

Water Source Protection Plans are developed in consultation with affected landowners, industry and community groups and government agencies to establish a level of protection for catchments used for public drinking water supply. Catchment protection of water sources is considered a fundamental part of ensuring the provision of a safe drinking water supply. The Commission has developed policies for the protection of public drinking water source areas that include three levels of priority classification. Priority classifications (1-3) are assigned to areas within a catchment according to the land use and the strategic nature of the area to ensure good safe drinking water. The plans identify sources of contamination that should be investigated and set out programs for management of the resource.

The Water and Rivers Commission, Department for Planning and Infrastructure and Local Governments work pro-actively to incorporate water protection in the land planning process. Decisions on land use zoning and subdivision applications have a significant impact on the protection of water sources. Therefore it is essential that Town Planning Schemes and Development Strategies are compatible with Water Source Protection Areas. The 2003 release of the WAPC's Public Drinking Water Source Policy will greatly assist in the protection of public drinking water source areas.

Drinking water quality protection involves a complex interaction of responsibilities, accountabilities and liabilities between various government authorities (including the Water and Rivers Commission, Department of Health, Office of Water Regulation, Department for Planning and Infrastructure, Environmental Protection Authority, Local Government Authorities, etc), government water utilities (including the Water Corporation) commercial organisations and community groups. As part of its broad responsibility for management, protection and conservation of Western Australia's water resources, the WRC has the function of making by-laws for the prevention of pollution in catchment areas or water reserves. Proclaiming Catchment Areas under the *Country Areas Water Supply Act 1947* and *the Metropolitan Water Supply, Sewerage and Drainage Act 1909* enables the Commission to control potentially polluting activities, regulate land use, inspect premises and take steps to prevent or clean up pollution.

In the protection of public drinking water supplies the Commission directly employs the NWQMS policies, principles and implementation guidelines No 5 &6 in the management of land use activities and through the promotion of protection planning with local government.

4.1.4 Water resource recovery catchment program

Many of the rivers in the southwest of WA are too brackish or saline to use as public water supplies. The Salinity Action Plan and the Salinity Strategy identified five water resource recovery catchments, namely the Mundaring Weir (Helena River), Wellington Reservoir (Collie River), and the Warren, Kent and Denmark rivers.

The program has adopted partnership approach with local communities so that the water quality objectives can be matched with objectives for agricultural profitability, community stability and landscape enhancement. The Commission has developed a Salinity Management Program with a three year initial focus on planning and information management. Recovery Teams, with strong membership, have been formed to direct the partnership approach towards effective salinity management actions.

Action has already been taken to halt and subsequently reduce salinisation and to restore water quality in these catchments. Projects underway include:

- Demonstration of Lucerne establishment for groundwater management (400 ha being planted in 1999);
- Salinity risk assessment incorporating drilling with the application of airborne geophysical information;
- Developing agroforestry skills (Master Tree Growers course and oil mallee trials);
- Creek and river surveys and rehabilitation (the Kent River is almost completely fenced);
- Protection of remnant natural vegetation by fencing;
- Monitoring stream flow and water quality;
- Assessment of drainage and development of surface water design.

Future management actions identified in the strategy for these catchments include the preparation of integrated catchment plans addressing ground and surface water management, waterway management, remnant native vegetation protection (including fringing vegetation), farm forestry and high water use farming systems, and conservation planting next to discharge areas.

The Salinity Strategy target for the Collie River inflow to the Wellington Dam was to have potable water by 2015. The targets for both the Kent and Warren rivers were for potable water at sites suitable for future dams by 2030. Results of regular water quality monitoring in the Helena and Denmark rivers would be used to determine actions required for salinity control (GWA, 2000).

4.1.5 Waterways WA Program

Waterways WA is a program aimed at the protection and enhancement of Western Australia's waterways through support for on-ground action. The program works with local catchment groups to protect, rehabilitate and restore degraded creeks.

Waterways WA is not a stand-alone program, but builds on what is already being undertaken and achieved by community groups, landholders, local government and State agencies. The program helps these and other groups to implement on-ground actions aimed at protecting and enhancing the State's creeks, rivers, wetlands and estuaries.

The program has two main objectives:

- To develop and implement a State-wide Policy and Strategy for the management of our waterways in partnership with the community; and
- To support on-ground action to conserve, rehabilitate and restore our waterways.

Current projects being delivered by the program include:

- Helping local groups to identify and resolve issues relating to waterways and their management;
- Developing a wide range of technical and management guidelines to assist community groups who are working to improve waterways across the State;
- Delivering training workshops for community groups;
- Supporting waterway-related planning exercises, especially by regional groups;
- Developing a prioritisation system to identify those rivers that are most in need of management.

Through the Waterways WA Program, numerous aspects of the SWQMS are being implemented, including establishing partnerships between government, community and landowners. The program also acts as a central coordination mechanism for waterways restoration programs throughout the state, which provides advice and technical assistance to community restoration projects. Through the program water quality data is collated and accessed by various community groups to aid in their waterways restoration projects.

Appendix A - NWQMS Guidelines

Document Number	Title	Publication Date
1	Water Quality Management – An Outline of the Policies	1994
2	Policies and Principles: A Reference Document	1994
3	Implementation Guidelines	1998
4	Australian and New Zealand Guidelines for Fresh and Marine Water Quality	2001
5	Australian Drinking Water Guidelines - Summary	1996 (2002 draft update)
6	Australian Drinking Water Guidelines	1996
7	Australian Guidelines for Water Quality Monitoring and Reporting	2001
8	Guidelines for Groundwater Protection in Australia	1995
9	Rural Land Uses and Water Quality: A Community Resource Document	2000
10	Australian Guidelines for Urban Stormwater Management	2000
11	Australian Guidelines for Sewerage Systems: Effluent Management	1997
12	Guidelines for Sewerage Systems: Acceptance of Trade Waste (Industrial Waste)	1994
13	Guidelines for Sewerage Systems: Biosolids Management (draft)	2003
14	Guidelines for Sewerage Systems: Use of Reclaimed Water	2000
15	Guidelines for Sewerage Systems: Sewerage System Overflows (draft)	2001
16a	Effluent Management Guidelines for Dairy Sheds	1999
16b	Effluent Management Guidelines for Dairy Processing Plants	1999
17	Effluent Management Guidelines for Intensive Piggeries	1999
18	Effluent Management Guidelines for Aqueous Wool Scouring and Carbonising	1999
19	Effluent Management Guidelines for Tanneries and Related Industries	1999
20	Effluent Management Guidelines for Australian Wineries and Distilleries	1998

Appendix B - Summary of NWQMS Commitments

National water quality management strategy	*2001/02 scheduled work*	*2002/03 scheduled work*	*Planned 2003/04 scheduled work*	*Comment*
Outline of policies – 1 A reference document – 2 Implementation guidelines - 3	Yes	Yes	Yes	These NWQMS guidelines were considered in the preparation of the *State Water Quality Management Strategy (SWQ1, May 2001)*, and have been incorporated within *SWQ2 (see below) 2003.* NWQMS policies, guiding principles, strategies, references and implementation guidelines are considered in the development and implementation of the SWQMS and its related 'State Water Quality' series of documents (SWQ3 will relate to Drinking Water, SWQ4 considers Groundwater Protection and SWQ5 covers Effluent Management). The 'State Implementation Plan' SWQ2 document was presented to the NCC in draft form at an interim December 2002 consultative meeting. The related March 2003 meeting advised NCC that this document is planned to be published by June 2003.
Fresh and marine water quality – 4	Yes	Yes	Yes	EPA Bulletin 1078 was presented to NCC at the December 2002 consultative meeting. In the March 2003 meeting the Water and Rivers Commission identified the need to more widely consider natural resource management initiatives before finalising this work and the subsequent development of another State Water Quality series document (SWQ6) in 2003/04.
Drinking water summary - 5 Drinking water guidelines - 6	Yes	Yes	Yes	Progress to implement the Australian Drinking Water Guidelines was presented to NCC in December consultative meeting. The Department of Health WA (DoH) assessment of the Water Corporation (the States largest water service provider) against the Australian Drinking Water Guidelines 1996 and a Memorandum Of Understanding between DOH and WC were tabled. It was noted that the Governments 2003 State Water Strategy incorporated the ADWG 'Catchment to Consumer' multiple barrier approach and that Cabinet has approved the Statement of Planning Policy for Public Drinking Water Sources. A Water and Rivers Commission Policy about appropriate Recreational uses of Priority 1 Crown Land was also tabled and NCC was advised that it was planned to be published by June 2003. A comprehensive Water and Rivers Commission 'Public Drinking Water Source Area Policy' is proposed to progress in 2003/04 subject to resources.
Monitoring and reporting - 7	Yes	Yes	Yes	See NWQMS Guideline 4.
Groundwater Protection - 8	Yes	No	No	The Water and Rivers Commission, Resource Quality Branch is in the process of drafting an implementation plan for this National guideline. This work will continue in 2003/04 subject to resources. Specific processes are in place over the Gnangara and Jandakot groundwater areas in WA to ensure they are protected from inappropriate land uses/activities. A discussion paper was released by the Commission for public comment on the protection of future water resources. The responses will aid in development of supporting policy for groundwater protection.
Rural land uses - 9	Yes	No		An implementation plan may not be required. Rural land use issues addressed by this NWQMS guidelines are covered in existing government approval processes. A review is planned in 2003–04 subject to progress of agreements on the National Action Plan for Salinity and Water Quality, the Natural Heritage Trust, and other resourcing issues.

National water quality management strategy	*2001/02 scheduled work*	*2002/03 scheduled work*	*Planned 2003/04 scheduled work*	*Comment*
Urban stormwater - 10	Yes	Yes	Yes	The existing 1998 Western Australian storm-water management guideline is currently being reviewed. This review commenced May 2002. A draft position statement was presented to the Board of the WRC February 2003. An up to date manual/guideline is expected to be complete by December 2003.
Effluent management – 11	Yes	No	-	Effluent management issues are primarily dealt with under *Environmental Protection Act 1986* license conditions. These conditions are developed after consideration of NWQMS. The plan will be reconsidered 2003-2004.
Trade/industrial waste acceptance – 12	Yes	No	No	A trade waste document is already in place in WA for acceptance of waste by the Water Corporation of WA. The need to consider other trade waste issues will be considered for the 2003/04 period.
Biosolids management - 13	No	No	No	A State guideline was prepared and released in February 2002 that considered the draft national guideline. This document will be reviewed pending finalisation of the equivalent national guideline.
Reclaimed water - 14	Yes	No	-	The Government's State Water Strategy 2003 has considered this issue and deals with grey water recycling and scheme based reclamation and its use for industry, parks, gardens and horticulture. Progress of this work is subject to implementation of the State Water Strategy in 2003/2004
Sewerage overflows - 15	No	No	No	An implementation guideline for the referral and assessment of sewage pumping stations was completed November 2001 by the Department of Environmental Protection, this was developed considering the draft national guideline. No further work is planned on this document at this time.
Dairy sheds effluent - 16a	Yes	No	-	*Guidelines for Managing Farm Dairy Effluent in WA* (1998). This guideline considered NWQMS outcomes. A review of the existing State guideline will be considered in 2003--04.
Dairy processing plant effluent - 16b	Yes	No	-	Dairy processing sheds are subject to licensing under the Environmental Protection Act. The licenses use NWQMS outcomes in setting conditions to protect water quality. An implementation plan is to be considered 2003–04.
Intensive piggeries - 17	Yes	No	No	The *Environmental Guidelines for New and Existing Piggeries* (2000) are in place. They consider the national guideline. The 2003/04 program will not consider this work further.
Wool scouring and carbonising - 18	Yes	No	No	WA has only one wool related industry, the discharges report to a dedicated treatment plant and are regulated by EPA licence. A plan is not proposed for this guideline given that WA has only one wool related industry subject to licensing under the Environmental Protection Act.
Tanning and related industry – 19	Yes	No	No	A plan is not proposed for this guideline given that WA has a limited number of industries and significant premises are managed through the EPA licensing provisions. These licenses address NWQMS outcomes as part of their approval conditions.
Wineries and distilleries - 20	No	No	No	No implementation plan is proposed. However, a water quality protection note and licensing guideline are available for wineries, these notes address water quality issues. These premises are managed through the EPA licensing provisions. These licenses address NWQMS outcomes as part of their approval conditions.

Appendix C - State Agency Roles

Department of Agriculture

Department of Agriculture (DOA) works in partnership with industries and communities to increase the value of agriculture, food and fibre exports from Western Australia. Sustainable management of natural resources affected by agriculture falls within the Department of Agriculture's Sustainable Rural Development Program. This program includes development of environmental standards, monitoring of resource condition, research and development, and catchment management planning. The role of DOA in implementing the SWQMS is to work in partnership with other agencies and the community to address regional priorities for natural resource management. Through the *Soil and Land Conservation Act 1945*, DOE has a responsibility to ensure the sustainable management of the resource base used for agriculture. This includes both on site and off site impacts of agricultural land use.

Department of Conservation and Land Management

The Department of Conservation and Land Management (DCLM) works in partnership with the community to conserve Western Australia's biodiversity (native flora, fauna and ecosystems) and manage the land and water entrusted to it, for the benefit of present and future generations. DCLM manages the State's national parks, marine parks, nature reserves, marine nature reserves, State forests and timber reserves, and the associated forest produce, fauna and flora. DCLM is also responsible for the conservation and protection of flora and fauna throughout the State. DCLM's role in implementing the SWQMS is through the development and implementation of management plans for land and water it manages and through the implementation of sustainable forest management practices, as well as through its general biodiversity conservation policies and programs and working with the community and other agencies in natural resource management.

Department of Environmental Protection

The Department of Environmental Protection (DEP) is responsible for administration of the *Environmental Protection Act 1986*. The DEP supports the Environmental Protection Authority in carrying out its responsibilities in impact assessment and formulation of Environmental Protection Policies and undertakes administration of Part V of this Act including the registration, works approval and licensing of prescribed premises that discharge/deposit waste to the environment. The DEP is also responsible for preparing the WA State of the Environment Report on behalf of the Minister for the Environment. The DEP gives effect to the SWQMS through its pollution control provisions, State of the Environment reporting and investigation processes.

Department of Land Administration

The Department of Land Administration (DOLA) has general administrative responsibility for the Crown Estate. This can include unallocated Crown land and unmanaged reserves such as foreshores. DOLA works in partnership with other key water and land management agencies to effectively manage this land.

Department of Industry and Resources *(formerly Department of Mineral and Petroleum Resources)*

The Department of Industry and Resources (DIR) has the responsibility of facilitating responsible exploration and development of the State's mineral and petroleum resources for the long-term benefit of all Western Australians. DIR does this through the grant and maintenance of titles to explore for and mine minerals or produce petroleum. It has in place a system for regulating and promoting environmental management in both the minerals and petroleum industries.

Department for Planning and Infrastructure and Western Australian Planning Commission

The Department for Planning and Infrastructure (DPI) provides advice to the Western Australian Planning Commission (WAPC), the Minister for Planning and Infrastructure, and the State Government on strategic land use planning, town planning schemes, subdivision and development control, urban design, demographic trends, regional, environmental and transport planning, the provision of infrastructure and custody of reserved land under the Metropolitan Region Scheme. The WAPC has a broad role to formulate and coordinate land use strategies for Western Australia across all aspects of the State's planning process. The DPI and WAPC are implementing the SWQMS through promotion and integration of water quality management with the land use planning process. Draft Statements of Planning Policy (SPPs) for Natural Resource Management and Public Drinking Water Sources have been developed, and are in the process of being finalised. These SPPs will support and reinforce protection of groundwater and surface water public drinking sources through land use strategies and controls. The DPI and WAPC also require consideration of water sensitive urban design through planning approval processes.

Department of Fisheries

Department of Fisheries is responsible for the conservation and management of all aquatic plants and animals (except mammals, reptiles, birds and amphibians).

Department of Health

The Department of Health (DOH) is responsible for promoting public health, healthy surroundings and healthy lifestyles and providing high quality health services. Through the *Health Act 1911*, the DOH administers statutory processes to promote adequate sewage treatment and protection and maintenance of safe recreational and drinking water. The DOH chairs the Advisory Committee for the Purity of Water, which advises the Minister for Health and Minister for the Environment on regulation and monitoring of drinking water quality.

Office of Water Regulation

The Office of Water Regulation (OWR) regulates the water industry through requirements set out in operating licences issued to all water service providers. It is responsible for planning and coordinating the provision of water services and for advising Government on all aspects of policy relating to water services. The OWR has a statutory requirement to ensure water efficiency.

Water and Rivers Commission

The Water and Rivers Commission (WRC) is responsible for sustainable management of Western Australia's water resources. The WRC identifies, assesses, manages, protects, conserves, plans and assigns uses of water resources in Western Australia. The quantity and quality of these resources are managed to protect their environmental values or beneficial uses. The WRC provides access to water resources for commercial use through an allocation and licensing process. It is also broadly responsible for addressing water quality problems arising from diffuse sources by developing management and catchment plans and protecting raw water supplies through source protection planning. The Commission has a number of community-based management bodies established that are responsible for waterways management.

Water Service Providers

Water service providers (including Water Corporation, Aqwest and Busselton Water Board) are responsible for one or more of the following commercial services:

- supplies of drinking water to standards set by the Office of Water Regulation;
- reticulated wastewater collection, treatment and disposal;
- rural and urban drainage and flood protection; and
- reticulated irrigation.

The Water Corporation is the largest water service provider in Western Australia, supplying Perth and nearly all country towns. It is a statutory corporation operating under the *Water Corporation Act 1995* and is wholly Government owned. The Corporation, as with other water service providers, is headed by a Board of Directors acting in accordance with Corporations Law and is responsible to the Minister for Government Enterprises. The Water Corporation has a Memorandum of Understanding (MoU) with the Health Department on drinking water quality issues. It also has a Memorandum of Understanding with the Water and Rivers Commission on drinking water source protection. The Water and Rivers Commission has delegated to the Corporation powers to manage specified water catchments subject to certain conditions.

Aqwest provides drinking water services to the City of Bunbury and Busselton Water Board supplies drinking water services to the Busselton area.

Glossary of Terms

Aquifer	A geological formation or group of formations capable of receiving, storing and transmitting significant quantities of water. Aquifer types include Confined, Unconfined and Artesian.
Beneficial use	The current or future uses for a water resource which have priority over other potential uses because of their regional significance to the community. Beneficial use designations provide guidance in determining the management and protection of the quality and quantity of the resource.
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Community	May include water user groups, landowners or catchment protection groups.
Degradation	Any decline in the quality of natural resources commonly caused by human activities.
Diffuse source pollution	Pollution originating from a widespread area, e.g. urban stormwater runoff, agricultural runoff.
Discharge	Volumetric outflow rate of water, typically measured in cubic metres per second.
Ecologically sustainable development	development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.
Ecosystem	A term used to describe a specific environment, e.g. lake, to include all the biological, chemical and physical resources and the interrelationships and dependencies that occur between those resources.
Effluent	The liquid, solid or gaseous wastes discharged by a process, treated or untreated.
Environmental value	Particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and that require protection from the effects of pollution, waste discharges and deposits.
Eocene Sediments	A geological time-rock unit and the name for a geological epoch of geological time
Ephemeral watercourses	A stream whose channel lies above the water table and that flows only during or immediately after periods of precipitation.
Fauna	Animal life of a particular area or period of time.
Flora	Plant life.
Fractured rock aquifer	Aquifers where groundwater is stored and flows through joints, fractures, cavities and other spaces formed by cooling volcanic lavas, by earth movements and limestone dissolved by percolating groundwater.
Gneiss	Gneiss refers to a coarse-grained metamorphic rock made up of parallel bands of light and dark minerals. The bands may be highly contorted and form under high grade regional pressure and temperature.
Habitat	A geographic area or environment that can provide for the key activities of life.

Igneous	Rock or mineral that solidified from molten or partly molten material.
Integrated catchment management	The coordinated planning, use and management of water, land, vegetation and other natural resources on a river or groundwater catchment basis. ICM is based on cooperation between community groups and government agencies at all levels to consider all aspects of catchment management.
Nutrient enrichment	Over-enrichment of water by dissolved nutrients, particularly nitrates and phosphates, which leads to excessive growth of aquatic plants.
Point source pollution	Specific localised source of pollution, e.g. sewage or effluent discharge, industrial waste discharge.
Riparian vegetation	Vegetation situated on or belonging to a river or stream bank.
Sewage	The waste matter that passes through sewers.
Sewerage	System of pipes (sewers) and related infrastructure to transport sewage.
Terrestrial water	All inland water, including estuarine water.
Treatment	Application of techniques such as settlement, filtration and chlorination, to render water suitable for specific purposes including drinking and discharge to the environment.
Wastewater	Water which has been used for some purpose and would normally be treated and discarded. Wastewater usually contains significant quantities of pollutant.
Water cycle	The continual cycle of water between the land, the ocean and the atmosphere.
Water pollution	Water pollution occurs when waste products or other substances, e.g. effluent, litter, refuse, sewage or contaminated runoff, change the physical, chemical, biological or thermal properties of the water, adversely affecting water quality, living species and beneficial uses.
Water quality	The physical, chemical and biological measures of water.
Water resources	Water in the landscape (above and below ground) with current or potential value to the community and the environment.

Abbreviations and Acronyms

ACC	Avon Catchment Council
AWRC	Australian Water Resources Council
COAG	Council of Australian Governments
CSMC	Cockburn Sound Management Council
DCLM	Department of Conservation and Land Management
DEP	Department of Environmental Protection
DIR	Department of Industry and Resources
DOA	Department of Agriculture
DOH	Department of Health
DOLA	Department of Land Administration
DPI	Department for Planning and Infrastructure
EPA	Environmental Protection Authority
EPP	Environmental Protection Policy
EWP	Environmental Water Provisions
FPC	Forest Products Commission
GWA	Government of Western Australia
MoU	Memorandum of Understanding
NACC	Northern Agricultural Catchments Council
NAP	National Action Plan for Salinity and Water Quality
NCC	National Competition Council
NHT	National Heritage Trust
NRM	Natural Resource Management
NRMMC	Natural Resource Management Ministerial Council
NWQMS	National Water Quality Management Strategy
OWR	Office of Water Regulation
PIMC	Primary Industries Ministerial Council
SCC	Swan Catchment Council
SCRIPT	South Coast Regional Initiative Planning Team
SoE	State of the Environment Report
SPP	Statement of Planning Policy
SSC	State Salinity Council
SWCC	South West Catchments Council
SWQMS	State Water Quality Management Strategy
WAPC	West Australian Planning Commission
WRC	Water and Rivers Commission

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Other documents within the State Water Quality Management Strategy Series

Government of Western Australia 2003, *State Water Quality Management Strategy Framework for Implementation*, Report SWQ 1.

Government of Western Australia 2003, *State Water Quality Management Strategy, Implementation Plan: Status Report*, SWQ 2.

Reports to come:

Review of Water Quality Management Documents and Processes , SWQ 3

Implementation of the NWQMS Australian Drinking Water Guidelines in Western Australia, SWQ 4.

Implementation of the NWQMS for Groundwater Protection in Western Australia, SWQ 5.

Implementation of the NWQMS Effluent Management Guidelines in Western Australia, SWQ 6.

Implementation of the NWQMS Fresh and Marine Water Quality and Monitoring and Reporting Guidelines in Western Australia, SWQ 7.