

Burrill Lake

Estuary and Catchment Management Plan



December 2002

BURRILL LAKE

ESTUARY AND CATCHMENT

MANAGEMENT PLAN

Adopted by Shoalhaven City Council
on December 17th 2002

FOREWORD

Why An Estuary and Catchment Management Plan?

Burrill Lake and its catchment are important community assets for environmental, economic, recreational and social reasons. Competing demands for agricultural, residential and recreational opportunities need to be balanced with protection of the very values that people find attractive. We need to ensure the long-term protection of our environment, and to minimise our impacts on the natural resources of the area. To this end, Shoalhaven City Council and State Government Agencies have prepared this Estuary and Catchment Management Plan.

This plan is accessible at libraries, Council offices and on the Shoalhaven City Council website – www.shoalhaven.nsw.gov.au.

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1 INTRODUCTION

1.1 BURRILL LAKE

Burrill Lake is located in the City of Shoalhaven on the New South Wales south coast, by road approximately 230km south of Sydney, 65 km south of Nowra and 6km south of Ulladulla.

Burrill Lake's waterways and their catchments are characterised by many environmental, social, commercial and recreational values that make them popular places for a wide variety of activities. The pressure of these uses has sometimes resulted in competition for and some degradation of the area's natural resources.

1.2 AIM

This Burrill Lake Estuary and Catchment Management Plan provides a comprehensive and integrated set of strategies to **enhance, protect and conserve the natural resources of Burrill Lake and its catchments so as to ensure that its use is ecologically sustainable in the long term.**

By natural resources, we mean the soil, water, vegetation, fauna, landscape and cultural heritage of the catchment.

The plan has been prepared under the following hierarchy of NSW Government policies.

NSW Coastal Policy

The NSW Coastal Policy 1997 is the Government's policy for the co-ordinated planning and management of the NSW coastal zone. It aims to guide the management and planning of the coastal zone by co-ordinating the various policies, programs and standards that apply at both State and local government level including the Estuary Management Policy under which this Estuary Management Plan has been developed.

The goals of the Coastal Policy establish the overall long term outcomes for the policy to be implemented through specific objectives and strategic actions for which responsibility is assigned to government agencies, local councils and the wider community. Estuary management plans are one of the many tools by which the objectives of the Coastal Policy can be met.

Total Catchment Management

Total Catchment Management (TCM) is the overlying management approach that involves the coordinated use and management of land, water, vegetation, ecosystems and other resources within a drainage basin. In the Shoalhaven, the Southern Catchment Management Board manages TCM. In 2002, the Board released a draft blueprint for the management of natural resources in the region.

NSW Estuary Management Policy

The NSW Estuary Management Policy is one of several component policies under the umbrella NSW State Rivers and Estuaries Policy. The Estuary Management Policy has been developed by the State Government in recognition of the ecological, social and economic importance of the State's estuaries and in response to concern about the long-term consequences of their accelerating degradation. This policy forms part of a suite of catchment management policies and 'provides for the assessment of all estuarine uses, the resolution of conflicts and the production of a unified and sustainable management plan for each estuary, including remedial works and the redirection of activities, where appropriate' (NSW Government 1992).

The goal of the Government's Estuary Management Policy is to achieve integrated, balanced, responsible and ecologically sustainable use of the State's estuaries, which form a key component of coastal catchments.

1.3 PLANNING PROCESS

This draft plan is a result of research, discussions and negotiations commencing in 1999 and involving the Burrill Lake Task Force, State Government Agencies, Shoalhaven Council, various community organisations and individual landowners and residents. The approach has been to examine the range of issues and concerns affecting the Lake, its waterways and all of the lands in the catchment.

This approach to natural resource management is based on the following:

- The quality of estuaries is largely determined by management of their catchments;
- It is the policy of government to integrate the management of natural resources
- It is important to increase community understanding about how activities in the catchment impact the estuary
- Community input into planning will improve the ways that activities are managed in the catchment
- Estuary and catchment management should identify landcare needs in the catchment.

1.4 PLANNING FRAMEWORK

A range of policies, plans and strategies were considered during the preparation of this plan. These included:

- NSW State Rivers and Estuaries Policy
- NSW Wetlands Management Policy
- NSW Coastal Policy 1997
- Shoalhaven Local Environment Plan (as amended) 1985
- Milton Ulladulla Structure Plan
- NSW Government Water Quality and River Flow Interim Environmental Objectives
- NSW Government Flood Management Manual

- Crown Land Foreshore Tenures Policy (non commercial occupations) (1991)

While this Plan was in preparation, the Healthy Rivers Commission conducted an independent inquiry into the management of coastal lakes in NSW. Its final report, released in April 2002, allocates Burrill Lake a provisional classification of 'Healthy Modified Conditions', warranting more detailed assessment. It indicates a range of actions to ensure that key natural processes are rehabilitated and retained. This report is now subject to NSW Government consideration. If endorsed, any actions arising could be incorporated in the future review of this plan.

Also while this Plan was in preparation the NSW Government announced a 'Coastal Protection Package' that included, amongst other things, a Comprehensive Coastal Assessment (CCA) to be undertaken over three years. It is not clear at this stage whether the CCA will provide any new information that would change this Plan. If it does, there will be opportunity to incorporate it during future reviews of this plan

Shoalhaven City Council has adopted a development control plan for foreshores. Development Control Plan No 62 (Foreshore Development Guidelines) provides detailed guidelines to ensure that development within foreshore areas is undertaken in a manner that preserves the amenity of the foreshore and is sympathetic to the physical constraints encountered within such areas. The DCP provides controls on, amongst other things, the height and bulk of foreshore development.

Actions carried out as a result of this plan will have to comply with legislation and statutory instruments such as:

- *Coastal Protection Act 1979 (DLWC)*
- *Crown Lands Act 1989 (DLWC)*
- *Environmental Planning & Assessment Act 1979 (Planning NSW)*
- *Fisheries Management Act 1994 (NSW Fisheries)*
- *Local Environmental Plan 1985, (SCC) as amended*
- *Local Government Act 1993 (SCC)*
- *Marine Safety Act (1998) (Waterways Authority)*
- *National Parks & Wildlife Act 1974 (NSW NPWS)*
- *Native Vegetation Conservation Act 1998 (DLWC)*
- *Protection of the Environment Operations Act 1997 (EPA)*
- *Rivers and Foreshores Improvement Act 1948 (DLWC)*
- *Soil Conservation Act 1938 (DLWC)*
- *State Environmental Planning Policy No. 14 - Coastal Wetlands and No. 35 - Maintenance Dredging (Planning NSW)*
- *Threatened Species Conservation Act 1995 (NSW NPWS).*
- *Water Management Act 2000 (DLWC)*
- *And current acts as applicable at the time.*

Management Plans have been adopted for some areas of Council and State Government land, including the Kings Point Foreshore, and all lands classified as either Parks or for General Community Use. These plans provide detailed guidelines on the management of these particular areas, and are in the process of being implemented.

Council will use the information and actions in the plan in formulating its Corporate Management Plan required by the Local Government Act to be produced each year.

Some of the strategies in this plan may require amendments to existing Council policies, development controls or consents, permits or licences. The

strategies will be taken into account in future planning for the area.

Many outcomes of the strategies and actions in the Plan will be reported in the State of the Environment Report.

1.5 ASSISTANCE

Shoalhaven City Council and the Commonwealth Government (Natural Heritage Trust, National Landcare and Coast and Clean Seas) provided financial assistance for the preparation of this plan.

The Burrill Lake Estuary Processes Study (WBM Oceanics, 2002) provides technical background to this document. It was funded by Shoalhaven City Council and Department of Land and Water Conservation.

In addition, technical assistance has been provided by:

- Department of Land & Water Conservation (DLWC)
- Southern Catchment Management Board
- Environment Protection Authority, NSW (EPA)
- Waterways Authority
- NSW Fisheries
- NSW National Parks & Wildlife Service (NPWS)
- Environment Australia and the National Oceans Office

1.6 CONSULTATION

The Burrill Lake Task Force was established in 1996 and re-established in 2000 as an advisory committee to Shoalhaven City Council. It provides a forum for community consultation and input into the Estuary Management Planning Process.

Committee members are drawn from the local community, together with Council and State Government representatives. The Task Force was established to perform the role of an

Estuary Management Committee in accordance with the Estuary Management Policy. Task force members have contributed greatly to the preparation of this plan.

A questionnaire was distributed to gauge the Burrill Lake community's opinions on a set of draft values and issues. This survey provided significant input into the preparation of this plan, and results have been incorporated into the individual management areas.

This draft plan is the next phase of formal consultation during the preparation of the Estuary and Catchment Management Plan for Burrill Lake.

2 BURRILL LAKE, ITS TRIBUTARIES AND CATCHMENT

2.1 LOCATION AND CHARACTER

Burrill Lake has a surface area of approx four sq km, an entrance channel three km long and between one and five hundred metres wide and one major tributary, Stoney Creek.

The Burrill Lake catchment covers an area of 78 sq km. It is largely covered by dry sclerophyll forest in the south and west (both National Park and private land) and agricultural grazing lands to the north.

There are five urban areas in the catchment; Dolphin Point, Burrill Lake, Kings Point, Milton and West Ulladulla.

2.2 COAST AND ESTUARY

Burrill Lake is a barrier-type estuary, formed by the drowning of a river valley following the last ice age some 6500 years ago.

The channel is relatively shallow, less than 3m in depth, within 4 major shoals along its length. The entrance shoal is the only active shoal. The entrance is located between a rock platform and the beach sand barrier, resulting in a highly constricted mouth.

Burrill Lake is mostly open to the sea. It was last closed to the sea in 1987. However, it seems likely that it was more frequently closed in the past (see table page 45).

The entrance channel is crossed by a causeway and bridge, originally built in the 1880s and raised in the 1950s. Many community members have seen the causeway as a cause of significant environmental degradation. However, two recent studies have examined the causeway, and reached similar conclusions. The most recent Causeway Option Study concluded that the causeway 'appears to have only a very minor and localised effect

on sand transport and broader scale shoal development'. (WBM Oceanics 2001) The causeway is further discussed in section 11, page 41.

The lake comprises three, steep-sided, basins with a depth of up to 9m. These basins catch the bulk of the fluvial sediment entering the lake from Stoney Creek, and are covered with a thick layer of mud. There appears to be little movement of marine sands from the entrance channels into the basins. The central basin has been described as having an intermediate degree of tidal flushing (20 to 90 days) and the southern and northern basins as poorly flushed (90 to 120 days, WBM Oceanics 2002).

The mouth of Stoney Creek comprises a fluvial delta with SEPP 14 wetlands on either side. The tidal limit extends three km upstream along a narrow, relatively shallow and poorly flushed channel.

2.3 SURFACE WATER

The bulk of the catchment drains into the lake through the Stoney Creek system, which includes Woodstock Creek as a major tributary. There are no records of the volumes of water flows in these creeks.

There are no flow records for any stream within the catchment. However, anecdotal evidence suggests that the creek system suffers from very low flows in dry periods.

The morphology of the stream system is primarily governed by bedrock outcrops, precluding the development of a typical pool and riffle sequence, particularly in the mid-upper sections of the catchment. Despite this, some pools formed by bedrock controls do exist along parts of the system, providing storage of water in dry periods and refuge for aquatic life.

Creek systems draining the lower sections of catchment typically flow through areas that have been cleared

for agriculture, with little riparian vegetation. Channel morphology is generally not dominated by bedrock in these areas and as a result, many creeks have been subject to bed erosion and flow through incised channels.

2.4 GEOLOGY AND SOILS

The Burrill Lake Catchment consists of three geological components.

The farming lands consist of soils derived from the Milton Monzonite, a volcanic laccolith that intruded into sedimentary layers approximately 255-260 million years ago. The Monzonite is chemically related to the Gerringong Volcanics to the north and the Mount Dromedary intrusion in the south. The rock shows large crystals of plagioclase in a groundmass of ferromagnesium minerals.

The Milton Monzonite extends for an area approximately 8km in diameter, which includes the bulk of the rich soils of the Milton farming district. The soils are derived directly from the breakdown of the Monzonite. Only the higher points in the district show outcrops. A scree slope of monzonite-derived rocks covers a number of steeper sites, where remains of subtropical rainforest persist. (Taken from Thompson and Mitchell 1999)

The areas surrounding the Monzonite are marine deposits of conglomerate, siltstone and sandstone of the Conjola Formation, laid down in the Permian period. These typically have only a shallow soil cover, with a build up of alluvial soils along the watercourses. They support dry sclerophyll eucalypt forests.

The flat lands adjoining the estuary and the lower reaches of the creeks are alluvial soils, developed as a floodplain and in estuarine conditions over the past 5000 years. Only small areas of the floodplain formed coastal wetlands. Those wetlands fronting the

channel have been filled for urban development.

The wetlands near the mouth of Stoney Creek are underlain with layers of potential acid sulfate soils that may cause serious environmental problems if they are disturbed or drained. Acid sulfate soils when exposed to oxygen produce sulfuric acid that can pollute the creeks and estuary and severely degrade the aquatic ecosystem.

2.5 GROUNDWATER

The Burrill Lake catchment provides only a poor groundwater resource. The sandstone and siltstones provide a low yield of low salinity groundwater. There are 24 licensed groundwater bores in the catchment and adjoining Parish areas as shown below.

Parish	Number of groundwater licenses
Croobyar	2
Ulladulla	10
Woodburn	12

2.6 NATURAL HABITATS

There are significant natural habitats in the catchment.

- The channel flats and shoals are a highly productive aquatic resource, supporting both fishing and migratory bird populations.
- There are 6 wetlands protected under SEPP 14 on the western and northern shores of the lake.
- The foreshore vegetation around the lake has been recognised as one of the most diverse on the South Coast.
- The coastal eucalypt forests are an important habitat for arboreal mammals, owls and glossy black cockatoos.
- Approx 12 rainforest remnants have been identified within the Burrill Lake Catchment. Of particular interest are the remnants of the dry subtropical rainforest on the steeper slopes of the Milton monzonite.

2.7 ABORIGINAL HERITAGE

The Burrill Lake catchment is located within the lands of the Wandandian speaking people and Budawang/Murramarang tribes of the Dhurga language group. The Ulladulla Local Aboriginal Land Council covers the area.

The Burrill Lake coast and foreshore areas have been the site of continual and intense Aboriginal occupation since the last sea level rise. The estuary and the adjoining coastal areas were a rich food source. Over 60 sites have been identified and documented, and a significant amount of archaeological research has been undertaken around the lake.

The most significant site is the Aboriginal Rock Shelter near the southern shore of the lake. Excavation at this site has revealed a pattern of continuous occupation for more than 20,000 years. Information from this site is used to date other sites along the east coast.

2.8 EUROPEAN HERITAGE

Milton and the agricultural lands towards Woodstock retain much evidence of the original dairying industry and early European settlement. Milton has a significant number of historic buildings and structures. The pastoral landscapes around Milton identify the original patterns of land subdivision from the 19th century.

Burrill Lake retains some of the character of its origins as a coastal holiday retreat from the early and mid 20th century.

2.9 RESOURCE USE

Waterways

Burrill Lake is a popular location for a range of recreational activities including fishing, sailing, water skiing, boating and swimming. Commercial fishing occurred prior to 2002, and oyster farming still occurs.

Recreational usage is discussed in some detail in section 12, page 47.

Surface Water

There is limited extraction of water from the streams throughout the catchment. According to DLWC records there are three extraction licences that cover an active area of 33.5 hectares. It should be noted that these licences do not include riparian use rights that allow for extraction for stock and domestic use. The volume of water extracted as a result of riparian use rights has not been estimated.

Land Use

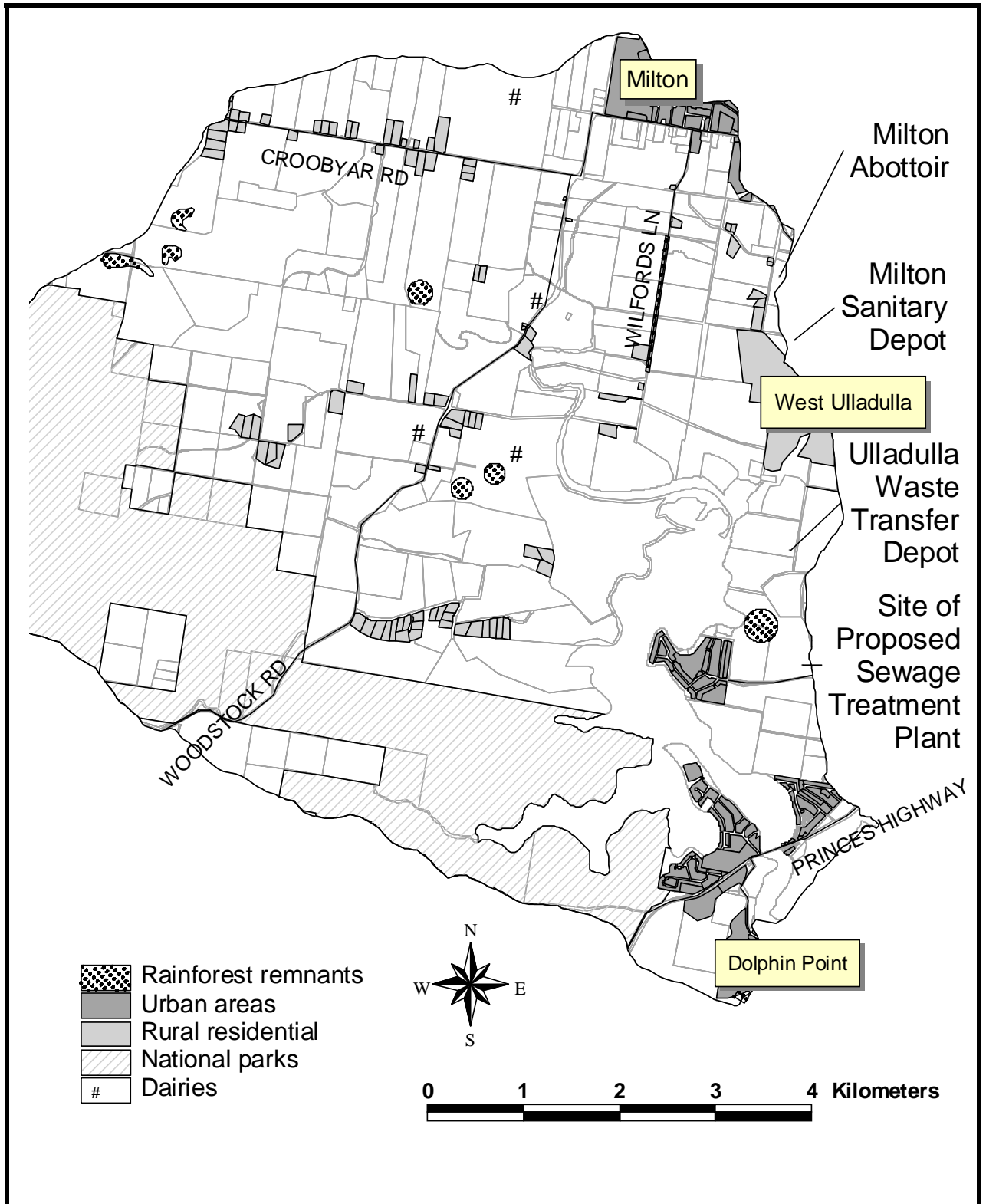
Major land uses in the catchment include:

- Four dairies currently operate in the catchment. Another two closed in the past 2 years. Most of the dairies have a dry run elsewhere in the catchment.
- Grazing, mostly of beef cattle and also horses, occupies the remainder of the agricultural lands.
- A number of large establishments operate along the eastern edge of the catchment; Milton District Meats, the Milton Sanitary depot and the Ulladulla Waste Transfer Depot. The proposed Ulladulla Sewage Treatment Plant will be sited on the ridge above Kings Point.
- A significant tourism industry operates in the catchment, incorporating a range of types of accommodation and a range of water based activities. The industry is concentrated on the lake and its foreshores.
- Privately owned forests surround the agricultural lands. There is some grazing and other rural activities. Logging and clearing have occurred on these lands in the past.
- A significant portion of the catchment is national park. This land was managed as state forests until 12 months ago and had been

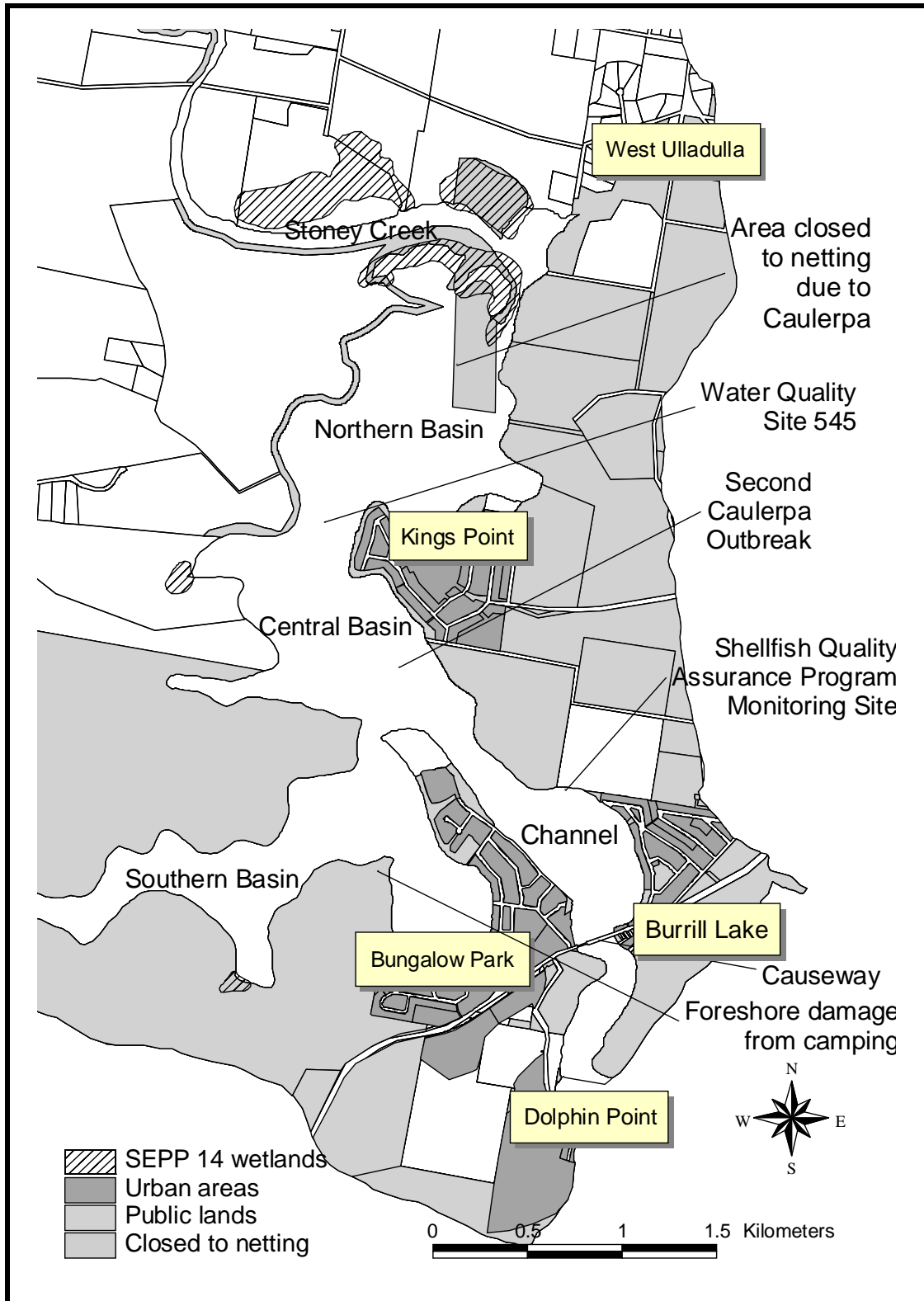
- logged (both clear felling and selective logging) over the past 150 years.
- Four distinct urban areas exist: Dolphin Point, Burrill Lake, Kings Point and Milton.
- There are four main areas of rural residential development; along West Ulladulla, along Slaughterhouse Road; Croobyar Road; Evans Lane; and Kyeema Drive/Tallow Wood Road/Westlake Drive.

Table 2.2 - Land Area in Each Land Use Zone

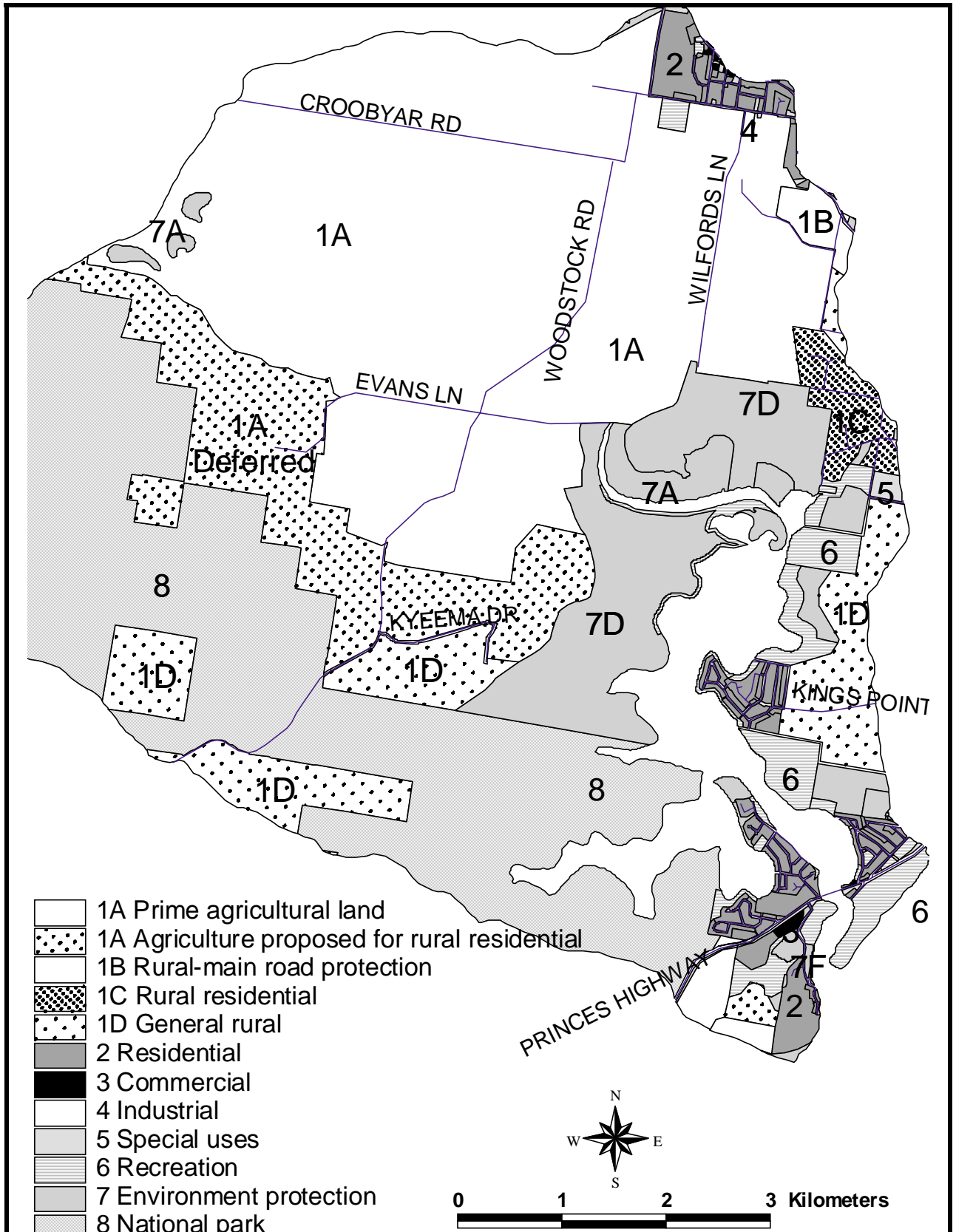
Zone	Description of Zone	Area in ha	% of catchment
1A	Prime agricultural land	2218	37%
1A Deferred	Agricultural land proposed for rural residential	515	9%
1B	Agriculture-main road protection	61	1%
1C	Rural residential	77	1%
1D	General rural	405	7%
2	Residential	187	3%
3	Commercial	5	0%
4	Industrial	2	0%
5	Special uses	17	0%
6	Recreation	196	3%
7	Environmental protection	584	10%
8	National park	1756	29%
	Total land area of catchment	6024	100%



Map 1.1 - Features of the Burrill Lake Catchment



Map 2.2 - Features of the Burrill Estuary



Map 2.3 - Zoning Summary for the Burrill Lake Catchment

(As currently gazetted. A draft LEP amending this zonings for the eastern side of Burrill Lake, based on the Milton Ulladulla Structure Plan, is currently being finalised).

3 KEY VALUES

The following is a list of the important social, economic, environmental, recreational and ecological values of the Burrill Lake Catchment, taken from records of public meetings, Task Force meetings, and other research done on the lake and catchment.

SCENIC QUALITY

1. The scenic qualities of the lake are a major asset for both residents and visitors, with views of the lake itself, the beaches and foreshores, the existing townscape, boating and recreation and the vegetated ridges.

2. The landscapes of the current and former dairy farms around Milton are of high quality and are recognised in the Shoalhaven Heritage Study.

RECREATION

3. The lake provides opportunities for a diverse range of recreational activities: in particular boating, fishing, swimming and water sports.

4. The natural areas provide opportunities for a wide range of nature-based recreation: camping, walking, horse riding, biking and nature study.

5. It is an important holiday destination for many families who have been returning here for many years.

AQUATIC ENVIRONMENT

6. The waters of creeks and lake are generally clean and of high quality for habitat, recreational and aesthetic purposes.

7. There are diverse and abundant communities of fish, shellfish, crustaceans and other species.

8. Seagrass beds and foreshore vegetation are an important habitat. They oxygenate the water and assist to stabilise sediments.

9. Internationally protected wading birds use the foreshore vegetation, sand

and mud flats, beaches and wetlands for feeding, roosting and breeding.

10. Six wetlands around the lake are protected under State Planning Policies and house regionally significant plant and animal species.

TERRESTIAL ENVIRONMENT

11. The forests to the south are an important habitat link between the coastal vegetation and the larger wilderness areas to the west.

12. The small remnants of remaining rainforests contain regionally significant plant and animal species.

13. Natural bushland and heath to the east of the lake contain several endangered plant species and habitat for several endangered animal and bird species.

CULTURAL HERITAGE

14. Various sites around the estuary are significant sites of Aboriginal occupation. Important academic research of international significance has been done around the lake (see section 13).

15. Milton and the surrounding dairying lands contain many fine historic buildings and sites from early European development.

SOCIAL

16. All four villages in catchment offer distinctive residential lifestyles in a small community.

ECONOMIC

17. The lake supports a large and diverse tourist industry and a commercial shellfish industry.

18. Rich agricultural soils of the Milton area support productive and profitable dairy and grazing industries.

4 MANAGEMENT ISSUES

Information on issues affecting the lake and catchment, and which this management plan has been designed to address, have been assembled from records of public meetings, Task Force meetings and from a range of social, scientific and environmental research conducted in and around the lake.

More recently, Council and DLWC commissioned an Estuary Processes Study, to investigate and report on the significant issues affecting the water quality and the ecology of the lake and its adjacent lands.

As a result of this work, the following have been identified as the most significant issues to be considered in the preparation of this management plan:

- The state and management of riparian vegetation, and its impact on water quality.
- The presence and spread of *Caulerpa taxifolia* in the northern and central basins of the lake.
- The poor flushing capacity of the northern and southern basins of the lake, and their possible future water quality implications.
- The management of agricultural activities in the catchment, in particular riparian management and effluent management.
- The impact of urban stormwater on water quality in the lake.
- The impact of the causeway on the water quality, sedimentation and ecology of the lake.
- The impact of past commercial and ongoing recreational fishing on fish stocks.
- The absence of native vegetation in the northern half of the catchment, and the reduction in habitat of native fauna.

- Reduction in the usage and amenity of the urban foreshores due to reed and sedge expansion.
- The absence of a formalised entrance management policy.
- The absence of a flood risk and flood management study.

Many other issues identified by residents and from research are considered in the various management areas.

5 MANAGEMENT PLAN

5.1 MANAGEMENT AREAS, OBJECTIVES, STRATEGIES AND ACTIONS

This Management Plan is grouped into nine management areas:

1. Water Quality
2. Erosion and Sedimentation
3. Water Flow
4. Flooding
5. Nature Conservation
6. Entrance Management
7. Recreation and Tourism
8. Visual Quality
9. Cultural Heritage

Each management area is discussed in further detail in the following sections. The important values, relevant objectives, issues of concern and existing data are documented.

Each management area also contains a table of

- The strategies and actions required to manage the concerns and
- The timing and priority for each strategy;
- Environmental performance measures necessary for gauging the effectiveness of the actions in achieving desired outcomes; and
- An appropriate target to indicate whether the action has been achieved.

The proposed actions consist of a combination of:

- advice on planning and development controls
- protective and remedial works
- education programs
- monitoring and research.

5.2 IMPLEMENTATION

Responsibility for implementation of the Management Plan and its individual components lies with the various organisations and individuals listed in the tables. The Burrill Lake

Task Force will provide community input and recommendations for its implementation.

Following this exhibition of the draft plan, submissions will be assessed; changes to the draft plan discussed by the task force and a final plan put to Council for adoption. Following adoption, the task force will work with government departments, community groups, the Southern Catchment Management Board and funding agencies to implement the plan.

Timing for implementation of strategies is indicated. Three timeframes for implementation were chosen: short (present to end 2004), medium (2005 to 2007) and long term (2008 and beyond).

Implementation will depend on cost of the particular actions and available funds. Consequently, some low priority strategies may be implemented in the short term because they require little or no additional funding for implementation. Indicative costs of strategies are given in the tables.

5.3 FUNDING SOURCES

Council will be responsible for the implementation of many of the actions set out in the plan. The level of resources provided by Council needs to be balanced against all of Council's other priorities. A wide range of funding sources (both State and Commonwealth) is presently available to assist Council with implementation of the plan. Table 5-1 indicates State and Commonwealth funding programs respectively and the administering Department.

Some of these programs accept grant applications at any time during the year whilst others have fixed submission periods. The organisations and individuals responsible for implementation of the plan will seek to develop and submit applications for funds in a timely manner.

Table 5.1 - Government Funding Sources

Department	Program
DLWC	Estuary Management Program Coastal Management Program Waterways Program Floodplain Management Program Rivercare Incentive Scheme Land Management Programs Native Vegetation Conservation Program Public Reserves Management Fund
Waterways Authority	Waterways Asset Development and Management Program
NSW Fisheries	Fishcare Recreational Fishing Trust State Fishways Program
EPA	Environment Trust Grants Stormwater Trust Program
Department of Primary Industries & Energy	Farm Forestry Rural Access Program Fisheries Research & Development Corporation
Environment Australia	Natural Heritage Trust
Department of Tourism	National Ecotourism Program Ecotourism Grants Program
Department of Employment Education and Training	Work for the Dole Green Corp Jobskills Program

against specific environmental performance measures and targets developed to assess actions and strategies against objectives. The plan will need to be updated as new data and feedback from the performance measures become available, as strategies are implemented and as community values or issues change.

5.4 ADAPTIVE MANAGEMENT & REVIEW

The Management Plan will be reviewed on an annual basis. The success of the plan will be judged

6 WATER QUALITY

6.1 VALUES

Water quality is one of the key factors determining the ecological character of an estuary and its tributaries. It is important for recreational or commercial purposes, for the tourist industry and for those living on its foreshores and adjacent areas.

The water quality of Burrill Lake and its tributaries is generally of moderate to high quality and suitable for recreation, aquatic systems, for aquatic seafood and for limited irrigation, stock and domestic usage from the fresh water streams.

6.2 OBJECTIVES

To ensure that water quality in the creeks and Burrill Lake meets the NSW Governments Interim Water Quality Objectives for the protection of aquatic ecosystems, visual amenity, secondary and primary contact recreation, limited household and livestock water supply and aquatic foods (cooked).

The EPA has established Water Quality Objectives for the estuaries and freshwater creeks of the Shoalhaven. These objectives are quite lengthy and complex. The Shoalhaven City Council water quality objectives applying to both the Burrill Lake and its creeks are as follows:

- Nitrogen and phosphorous should remain below .5 and .05 mg/ml respectively;
- Turbidity should remain in the very low range.
- pH should not fall below 6.5; and
- Waters should be free of floating debris and litter

Different objectives apply to bacterial counts. A lower bacterial level is required for those creeks used for household water supply (zero bacterial colony forming units, or cfus per 100 ml). The oyster industry seeks a

bacterial contamination level below 14 cfus per 100 ml at the Kendall Crescent boat ramp. Otherwise, the level required for primary contact recreation would be the general goal (150 cfus per 100 ml).

Water quality objectives of the community are generally couched differently. They speak in terms of the presence or absence of visible gross pollutants (litter), of the clarity of the water in bays and the shallow areas, of silt or organic ooze on the shoals and of odours from rotting vegetation.

The fundamental principles guiding water quality management should be the notion of continual improvement in the management of activities in the catchment, and the implementation of the National Water Quality Management Strategy (Australian and New Zealand Guidelines For Fresh and Marine Water Quality, ANZECC 2000).

Implementation of the new ANZECC guidelines is seen as a long-term objective. The first necessary stage is to implement changes to the water quality monitoring program as outlined in actions 27 and 28, page 24.

6.3 ISSUES

The latest State of the Environment Report (2001) reports the water quality of Burrill Lake as follows.

The results for this reporting period (1998-2000) indicate that water quality was generally good except for fluctuations in levels of dissolved oxygen, higher faecal coliforms in the upper catchment in Stoney Ck and peaks of high phosphorous levels in September and November 1999.

The very high levels of dissolved oxygen were likely to be associated with water aeration due to wave action and possibly above average phytoplankton (tiny water plants and algae) around the time of sampling. The very low levels in Stoney Ck were

likely to be caused by low flow, poor flushing, iron oxidation in the water column and additional organic materials washed into the waterway from many diffuse agricultural pollutant sources. The higher faecal coliform levels in Stoney Ck were likely to be linked to run-off from many diffuse rural sources after rainfall events. Peaks of high phosphorous were also likely to be linked to rural run-off after rainfall events.

In order to fully understand water quality issues and plan for continued good water quality, the Burrill Lake Processes Study was undertaken during 2001/2. It examined the actual and potential pollutant input from the catchment, and its impact on the functioning on the lake.

This study identified concerns regarding three areas of the lake.

- The tidal section of Stoney Creek has the poorest water quality, as a result of run off from the largely agricultural catchment and poor flushing characteristics (tidal flushing times in excess of 150 days).
- There is increasing pressure on the northern basin (north from Kings Point). This basin has long tidal flushing times (100 to 120 days). High pollutant loading rates, from catchment and urban runoff, could overwhelm the internal processes of the lake.
- The southern basin (fronting Bungalow Park) is also poorly flushed (tidal flushing times 90 to 100 days).

Catchment runoff was identified as having a large impact on estuary water quality. The study identifies grazing operations as the most significant contributor, with dairying and urban uses being less significant contributors.

A number of industries and possible point sources of pollution exist in the catchment. Sufficient information was

not available to quantify a number of these sources. As a result, the Processes Study was unable to specify the significance of these sources. However, research shows that metal levels in sediments, biota and water are relatively low.

The study highlighted the importance of processes occurring within the waters of the lake in determining water quality, including the deposition of fine sediment on the floors of the basins and the biological processes operating that move nutrients between these sediments and the water column.

The Processes Study recommended that the most important actions to protect the water quality of Burrill Lake would be those that preserve and protect the watercourses, including creek fencing and revegetation, stabilisation of drainage lines and foreshore protection.

Second priority actions included non-structural source controls, including development controls, public education and fertiliser and effluent management. In line storm water treatment, such as sediment traps, were seen as the lowest priority.

Many residents have expressed concerns that the causeway has reduced flushing of the lake. However, according to WBM Oceanics (2002) 'modelling studies to date have found no evidence that the Causeway has had any major, broad-scale effects on either tide or flood levels, or patterns of sedimentation'.

Water Quality is important to the oyster industry, which undertakes monitoring in the channel after rainfall events as part of the Shellfish Quality Assurance Program. This monitoring generally shows higher coliform levels than that detected by SCC.

Council stormwater and road systems have been investigated in the preparation of this plan in order to

identify those sites where improved stormwater management and improved roadside management may be required. These sites are identified in the tables 6.1 and 6.2, page 20.

In regard to road verges, a number of alternative approaches may be adopted, depending on the particular sites and road usage. These may include kerb and gutter construction, grassed road verges or sealed road shoulders without a constructed kerb.

6.4 EXISTING DATA

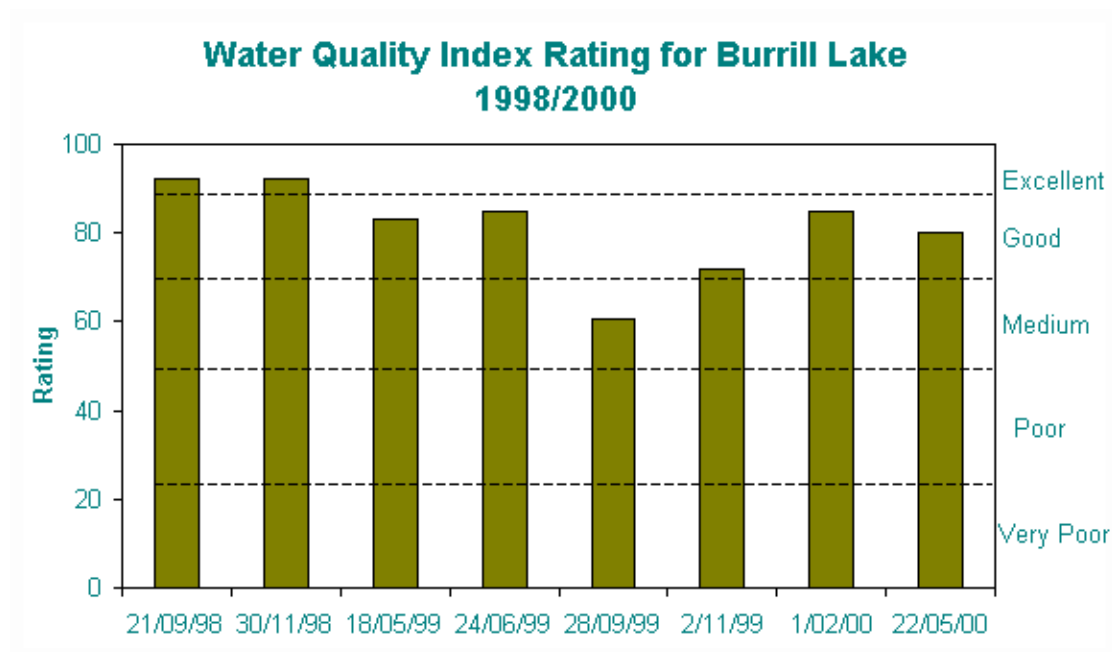
SCC currently monitors a range of parameters at various locations in the lake and channel every three months. Nutrients are sampled at only one site (Site 545, at the junction of the northern and central basins). Reports of water quality can be found in the State of the Environment (SOE) Reports in years 1991, 1992, 1994/95, 1997/98 and 1999-2000. The latest SOE report is available on Councils website. There is little monitoring of the creeks flowing into the lake.

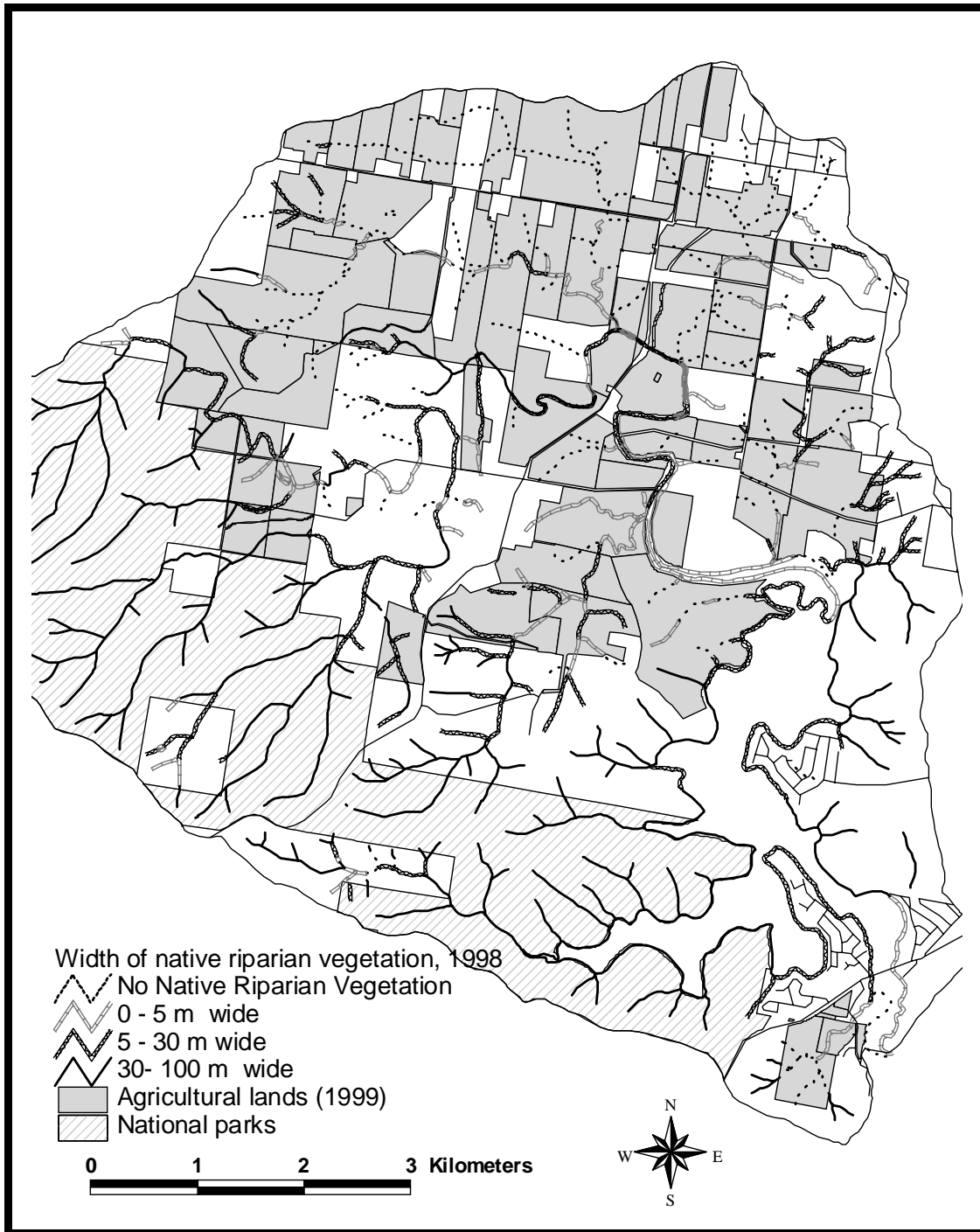
Examining water quality can be quite complex. In a bid to simplify this, Shoalhaven has adopted a weighted water quality index that incorporates individual measurements from one site, and weights them according to their importance in the environment. This is shown in the table below.

Several reports have assessed the runoff and leachate from the Ulladulla tip and its impact on the lake. (See Nolan (1987) and Douglas Partners (2000)).

Several reports have examined the erosion and sediment sources in the catchment. See Lawrence (1993) and Kerwick (1986).

The Burrill Lake Processes Study reviewed all of this existing data, and produced a comprehensive assessment of the current state of water quality in the lake and its tributaries, as well as the strategies needed to maintain good water quality into the future. This study is available for loan from the Ulladulla Library.





Map 6.1 - Agricultural Lands and Native Riparian Vegetation in the Burrill Lake Catchment, 1998/9. Data sourced from DLWC (2002) and SCC (1999)

Table 6.1 - Possible Stormwater Remediation, Burrill Lake Catchment

Site	Possible Remediation
Croobyar Road, Milton at school (BL1)	Install GPT, reshape drain and plant out in riparian species
Croobyar Road, Milton between Myrtle and Wason Sts	Manage dams as sediment traps
Croobyar Road Milton before Showground	Promote riparian planting along urban watercourse
Valley View Close, Milton	Construct energy dissipater at pipe end
Various rural residential areas (Tuckerman, Washburton, Kyeema, Evans Roads) (BL3)	Construct additional tailouts from table drain and revegetate
Harold St, Kings Point (BL8)	Construct energy dissipater at pipe end
Parkland Drive, Kings Point (BL4 and BL7)	Rehabilitate drainage lines near lake edge
Reserve at George Ave and Kings Point Drive, Kings Point	Construct wide vegetated drainage channels below pipe end;
Reserve at George Ave and Kings Point Drive, Kings Point	Replant riparian vegetation along drainage line
Previous gravel pit off Kings Point Road, Kings Point	Divert stormwater run off into vegetated areas
Commonwealth Ave and McDonald Parade, Burrill Lake (BL9)	Install GPT at pipe outlet
End of Wallaroy Drive, Burrill Lake	Upgrade vegetation in drainage line at Pump station;
Aboriginal Cave Reserve, Burrill Lake	Replant riparian vegetation along drainage line
Lions Park at Highway, Burrill Lake (BL6)	Install trash rack

Sites identified in the Shoalhaven Stormwater Management Plan are noted with their site code from the plan.

Table 6.2 - Urban Kerb and Road Shoulder Strategy, Burrill Lake Catchment

Type of road verge management	Areas appropriate
Retention of existing grassed road verge in suitable areas (ie, flat areas with good water infiltration, grassed areas with good soils and low traffic volumes)	Residential areas of Burrill Lake and Milton
Seal road shoulders on areas with eroding verges (ie, higher traffic volumes, steeper slopes and poorer soils)	Steeper and/or heavily trafficked sections of roads in Burrill Lake, Kings Point and Milton
Kerb system in new urban estates	New estates and new subdivisions
Kerb system in priority areas in existing urban areas	Priority areas identified in several streets.

6.5 WATER QUALITY STRATEGIES AND ACTIONS

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
Upgrade urban stormwater treatment in Milton and Burrill Lake	1. Install appropriate sediment and nutrient amelioration measures at priority stormwater outlets	Medium	Medium and long	Uncosted	SCC		Appropriate modifications to all outlets installed
	2. Develop and implement a cooperative strategy with land owners of the creek system below Milton to continually improve the capacity of the creek system to filter sediment and take up nutrients	Medium	Medium	Uncosted	SCC, DLWC, landowners		Program implemented
	3. Implement water sensitive urban design in new developments, incorporating rainwater tanks and in ground absorption of stormwater as appropriate.	Medium	Medium	Unknown	SCC, Planning NSW		Development control procedures in place
Reduce the generation of pollutants in the stormwater from Milton and Burrill Lake urban areas	4. Maintain grassed road verges in the Milton and Burrill Lake flats areas, with kerb and gutter construction or sealed shoulders with grassed verges on the steeper road sections.	Medium	Ongoing	Uncosted	SCC		Stable roadside verges on all urban roads throughout the catchment
	5. Maintain Council's street sweeping program.	Medium	Ongoing	No additional cost	SCC		Program maintained
	6. Require special consideration to stormwater quality management for any urban developments draining into the poorly flushed northern and southern basins	High	Ongoing	Cost borne by developer	SCC, Planning NSW		Appropriate stormwater controls in place
	7. Install rollover diversions and sediment traps on eroding bush tracks and driveways	Low	Short	Not costed	Owners, SCC, DLWC, ALC, NPWS		

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
	8. Implement necessary site and stormwater controls to protect the water quality and habitat value of the Dolphin Point wetland during urban development.	High	Medium	Incorporate in development costs	SCC		Appropriate stormwater controls in place
	9. Implement best practice erosion and sediment controls on all subdivision and building sites within the catchment	High	Short	Variable	Builders, SCC		Best Management Practices widely used
	10. Upgrade the capacity of the drainage system along Kings Point Road, to incorporate additional table drain tailouts and stormwater detention	Medium	Short	Uncosted	SCC		
	11. Ensure new or remodelled drains are designed with adequate capacity to incorporate vegetation	Medium	Medium	Variable	SCC		SCC internal design guideline adopted
	12. Continue to educate Council field staff in best practice for stormwater management	Medium	Short	Uncosted	SCC		Education program completed
Minimise contamination from overflows from waste system	13. Monitor sewerage overflows and septic management throughout the catchment through reports from Shoalwater and SCC.	Low	Ongoing	No extra cost	SCC		Regular reports to Task Force
	14. Maintain best practice waste management at the Ulladulla Waste depot	Medium	Ongoing	Uncosted	SCC		
Promote best practice in the management of riparian and foreshore areas	15. Seek natural vegetation solutions along non-urban foreshore areas of the tidal section of the estuary	High	Short	Unknown	SCC, DLWC, NSW Agriculture, landowners		All non-urban foreshores returned to native vegetation
	16. Plant only locally occurring local plant species along all riparian and foreshore areas	High	Short	No additional cost			

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
	17. Seek incentives and assistance to finance improvements in riparian management.	High	Short	Not costed	SCC, DLWC, Milton Rural Landcare		Grants and incentives gained
	18. Seek farm management of grazing areas which minimises stock access to foreshore and riparian areas incorporating shelter belts away from watercourses, off stream watering and fencing where appropriate	High	Short		SCC, DLWC, NSW Agriculture, local farmers, Milton Rural Landcare		Discussions held with all farmers with riparian lands and management arrangements in place
	19. Control vehicular access, rehabilitate and restore degraded non-urban foreshore areas	Medium	Short	Uncosted	NPWS, DLWC, SCC		
Promote best practice in the management of rural industries and activities	20. Encourage all intensive agriculture to implement the irrigation of effluent, effective sediment and nutrient traps below bare or heavily trafficked areas and riparian buffers below areas with intensive use.	High	Short and Ongoing	No public cost	SCC, local farmers		Timetables to be negotiated with industry.
	21. Encourage and promote continual water quality improvements in the management of all rural activities	Medium	Ongoing	Not costed	SCC, DLWC, EPA		
	22. Undertake programs to reduce sediment run off from rural roads,	Medium	Short	Uncosted	SCC, NPWS, private owners		Drains diverted onto vegetation or traps at regular intervals
	23. Develop water quality guidelines for rural lifestyle developments.	Medium	Medium	Uncosted	SCC		Guidelines developed, adopted and implemented.

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
	24. Adopt the objective of no net increase in sediment and nutrient export from all new developments in rural areas.	High	Short	No public cost	SCC		Objectives implemented in all new rural developments
	25. Install appropriate erosion control structures at eroding sites at Kings Point, Windward Way and Blackburn Road	Medium	Short	Uncosted	SCC, DLWC, ALC, owners		Works completed
	26. Liase with owners of lands with potential acid sulfate soils and advise on best management practices.	Low	Short	Uncosted	SCC, DLWC		Discussions completed. .
	27. Modify the water quality monitoring program in order to increase the understanding of the impact of particular land uses.	High	Short	Uncosted	SCC		Changes implemented
	28. Develop objectives for key water quality indicators for the entrance channel, central basin and northern/southern basin.	High	Short	Uncosted	SCC		Indicators established
Educate residents and visitors on stormwater issues and solutions	29. Implement Urban Stormwater Management Plan education initiatives directed at companion animals, car washing and bushland friendly parks and gardens.	Medium	Short and Ongoing	Refer Urban Stormwater Management Plan	SCC		Education programs completed

7 EROSION AND SEDIMENTATION

7.1 VALUES

Stable soils and creek banks mean that land remains productive, for agriculture, for sustaining ecological communities, for enhanced water quality and for supporting human uses. Foreshore and riparian vegetation is the most important factor in preventing erosion, maintaining water quality and reducing pollution and nutrient run off.

Coastal waterways are subject to some natural infilling by sediment transported from the catchment and eroded from banks

7.2 OBJECTIVES

To minimise the erosion of soil from the catchments and to protect the Lake from excessive sedimentation.

7.3 ISSUES

Erosion throughout the catchment occurs from a range of sources; the most significant of which are probably development, intensive agriculture and in-stream erosion. The banks of creeks and watercourses throughout the agricultural area are poorly vegetated. This, coupled with grazing pressure, would increase in stream erosion

A river health assessment carried out in the Burrill Lake catchment (DLWC, 2002) identified many potential problems in the freshwater creek system. There was generally poor riparian vegetation cover (frequently grassed and grazed with little native vegetation), an absence of vegetation regeneration, the occurrence of both bank erosion and sediment deposition and the prevalence of direct stock access to the streams. Overall, the streams within the agricultural subcatchments of Stoney and Woodstock Creeks are generally in a degraded condition.

An analysis of macroinvertebrate communities living within the streams

of these subcatchments indicates that the majority of sites sampled were mildly impacted, with smaller numbers of species present than expected. The assessment indicated that all sites sampled probably suffer from the effects of mild to moderate pollution.

Sedimentation in the lake basins has followed changes in land management. It was rapid during periods of land clearing and frequent ploughing early last century. Sedimentation rates have been much slower since the adoption of soil conservation practices (Lawrence 1993). The major source of sediment is now from the forested sandstone areas. The lake acts as a sediment trap for fine particles eroded from the catchment settling in the calmer water. Lawrence (1993) calculated a maximum deposition rate of 9mm per year for the period 1958-1993; a very high result which needs to be treated with some caution. The Processes Study calculated rates in excess of 1mm per year.

There is some concern regarding foreshore erosion or recession in some areas of the foreshore reserve. Overall, however, foreshore erosion is a relatively minor issue. Investigations are underway for foreshore stabilisation at Lions Park.

Several sediment plumes in the lake and channel have resulted from development activity at the creek at McDonald Parade, behind Casuarina Close and off the Harold St Reserve at Kings Point. The issue of whether suitable actions can and should be taken regarding these plumes remains undecided.

Note that the behaviour of the entrance and the adjacent shoals are examined in the Entrance Management Section.

7.4 EXISTING DATA

A number of studies have assessed the characteristics of the sediment in the channel and the lake, describing its sources and processes of deposition and movement. In particular, Lawrence (1993) analysed sediment accumulation and sources and the Processes Study examined sediment transport.

In 2000, Council and the Task Force prepared and circulated a brochure promoting the role and value of foreshore vegetation at Burrill Lake.

7.5 EROSION AND SEDIMENTATION STRATEGIES AND ACTIONS

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
Protect riparian and foreshore vegetation	30. Undertake site-by-site consultation with local residents to develop foreshore management strategies for urban areas.	Medium	Medium	Uncosted	SCC		Agreed SCC-resident plans
	31. Develop foreshore management policy for other publicly owned foreshore areas	Medium	Medium	Uncosted	SCC, Task Force, bushcare groups		Policy adopted
	32. Prepare and circulate promotional and educational material regarding the importance of foreshore vegetation	High	Short	Uncosted	SCC, Task Force		Educational actions in place.
	17 Seek incentives and assistance to finance improvements in riparian management. See action17 under Water Quality	High	Short	Not costed	SCC, DLWC, landowners, Milton Rural Landcare,	No of owners involved	Grants and incentives gained
Promote improved management of sediment plumes	33. Investigate the ecology of the three sediment plumes and assess the benefits and costs of retaining or removing it. (Possible University of Wollongong research project).	Low	Medium	Uncosted	SCC, DLWC, Fisheries.		Investigations completed

8 WATER FLOWS

8.1 VALUES

Water flows in Stoney Creek and its tributaries are important for the freshwater ecology and for domestic and farm water supply.

The maintenance of freshwater flows into the Burrill Lake estuary is critical to many ecological processes, such as fish migration and inundation of fringing wetlands.

The freshwater flows maintain a brackish environment required for a number of species. Additional fresh water flows into this environment provide a breeding trigger to some species in the estuary.

8.2 OBJECTIVES

To maintain the natural flow patterns of the creeks into the estuary

The EPA has established Water Flow Objectives for all of the coastal lakes and estuaries, including Burrill Lake.

These objectives are:

- To maintain wetland and floodplain inundation;
- To manage groundwater for ecosystems;
- To maintain or rehabilitate estuarine processes and structures.

Water Flow Objectives have also been established for unprotected streams (Stoney Creeks). Additional objectives relevant to these creeks include;

- To protect pools in dry times
- To protect natural low flows
- To mimic natural drying in temporary waterways and
- To maintain natural flow variability.

8.3 ISSUES

Little is known about whether the flow objectives are met, as there is currently no stream flow gauging within the catchment and little formal knowledge of the health of the creek system.

There are three extraction licences issued by DLWC that cover an active area of 33.5 hectares. In addition, landowners who own property fronting a creek can extract water for stock and domestic purposes. This is referred to as riparian use rights. The volume of water extracted as a result of riparian use rights has not been estimated.

8.4 WATER FLOW STRATEGIES AND ACTIONS

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
Maintain natural water flows as far as possible into the creeks and estuary	34. Restrict future rural residential development to areas away from creeks, so as to limit any increase in riparian water usage.	Medium	Medium	Unknown	SCC, DLWC		Development control procedures in place
Promote best practice in the management of riparian and foreshore areas	16. Plant only locally occurring local plant species along all riparian and foreshore areas. See action 16 in Water Quality	Medium	Short	No additional cost	SCC, DLWC, landowners	Types of species	No exotic species planted
	17 Seek incentives and assistance to finance improvements in riparian management. See action 17 in Water Quality	High	Short	Not costed	SCC, DLWC, Milton Rural Landcare		Grants and incentives gained

9 FLOODING

9.1 VALUES

Flooding of low-lying areas endangers urban assets and infrastructure, as well as inconveniencing residents. Most of the Burrill urban area – over 400 residences - is within the 1 in 100 year flood line. Foreshore reserves and parts of the Bungalow Park Caravan Park were most recently inundated for a brief period in October 1999 after a 150mm rainfall event. Progressively larger areas would be inundated during heavier rain events.

Flooding is a natural part of the foreshore and aquatic ecology, bringing nutrients into the lake system, allowing different species to thrive and reproduce, and providing an additional food source for aquatic species. The sediment and organic matter brought into the lake during floods can reduce the water quality of the lake, and may take weeks to clear. The fresh water wetlands at the mouth of Stoney Creek are dependent on floods to replenish their water level. Occasional inundation is believed to contribute significantly to the biodiversity of the lake and the foreshore areas.

Flooding plays an important role in scouring out the entrance to the lake and moving some of the marine sands into the beach area. This counterbalances the impact of tidal action that brings sand into the inlet from the beach system. The level of the causeway was raised in the 1960s, so that floods should not cut the highway.

9.2 OBJECTIVES

To develop and implement a flood plain management strategy to minimise risk to life and property

9.3 ISSUES

Flooding at Burrill Lake can probably be best understood by identifying three scenarios.

- Major flood events arising from significant rainfall events throughout the catchment;
- Localised flooding events; and
- Inundation of foreshore areas resulting from the closure of the entrance. This has only occurred perhaps a dozen times in the last century and is dealt with in detail in section 11-Entrance Management, page 41.

The most significant recorded flood event is the 1971 flood, which followed 630mm of rain (25 inches) over an 11 day period and reached a maximum height of 2m AHD on the flats adjoining the channel. This flood defined the flood line as adopted in the LEP (known as the 1% AEP level). The area and number of properties affected by this flood line are shown in table 9.2, page 32.

A flood at this height would cut the Highway immediately north of the causeway. Residents north of the estuary and at Dolphin Point would probably maintain vehicular access via Princess Avenue and Dolphin Point Road respectively, though many of the residential streets would be under some water. Residents south of the estuary and west of the highway would be isolated with Balmoral Avenue covered by more than half a metre of water.

Flooding at Burrill Lake should pose little direct risk to life, as the waters would be slow moving, and the heavy rainfall should give adequate warning. However, many residents would have little experience of flood events. While few houses would be inundated, emergency services would be disrupted by water over roads. In addition, there is no flood warning system for the area.

Floods with a height less than 2m AHD could still cut the highway at the causeway and bridge. Winds

associated with the storm-generated waves may be sufficient to halt traffic.

All new buildings approved in recent years have required a floor level above 2.3m AHD. This is not been required for minor extensions. Most of the residences with a floor height below 2m are older buildings with very little ground clearance.

Localised flooding is more likely to occur than a general flood, and would cut access and inundate some residences at levels below 2m AHD. Depending on the severity of rain, localised flooding could cut Kendall Crescent, Princess Avenue, Dolphin Point Road and Balmoral and Ireland Streets.

Few roads or structures in the upper catchment would be inundated during floods.

Storms at sea usually exacerbate the impact of flooding, since the heavy rainfall periods are generally accompanied by high seas. This can make the period of inundation last for a longer time, as the higher seas hold the floodwaters in. The height of the causeway (raised in the 1960s) and the height of the beach (resulting from deposition of dredging spoils and dune stabilisation works) may also act to hold floodwaters longer in the lake and lengthen the period of inundation. Overall, however, inundation would not be expected to continue for any length of time after the heavy rainfall ceases.

9.4 EXISTING DATA

Only some closures of the entrance during this century are known from historical records, although water heights are not known.

DLWC maintains a water level recorder adjacent to the Princes Highway Bridge. The water level recorder was installed in November 1991. Tidal gauging within the channel has also been carried out by DLWC (DPWS, 2001). These records

are too recent to show 'historic' flood heights.

The current understanding of flooding at Burrill Lake is incomplete. A flood study has not yet been done for. The Flood Study is planned for completion in 2004, and a Floodplain Risk Management Study/Plan scheduled for 2005/07, funding being available.

The first hydrographical survey of the channel was carried out in 1990. In 2001 DLWC carried out a complete hydrographical survey of Burrill Lake.

Historical records exist for rainfall at Milton, and for wave climate records from Port Kembla and Batemans Bay.

SCC and DLWC commissioned a survey of the low-lying assets on the Burrill floodplain in 2000. This survey identified only five buildings with a floor level below 1.6m AHD, and another nineteen with a floor level between 1.6m and 1.8m AHD. Ten caravans had an annexe with a floor level below 1.6m AHD (nine at Bungalow Park) while two pump stations have a floor level below this level (Thistleton Drive and Kendall Crescent).

The lowest road is Kendall Crescent, with the crown of the road slightly below 1m AHD. The footpath along Balmoral Drive is 1.2m AHD, and the road crown along Balmoral Drive is 1.4m AHD. The crown of the road at Rackham Crescent is 1.3m AHD. The crown of the road at McDonald Parade, Commonwealth Avenue and the Highway are all at 1.8m AHD.

Table 9.1 - Number of urban properties with the building floor level or ground level below 2m AHD

	Number of properties with floor level	Number of properties with ground level
Below 1.2 AHD	1	2
Between 1.2m and 1.4m AHD	1	7
Between 1.4m and 1.6m AHD	3	18
Between 1.6m and 1.8m AHD	19	17
Between 1.8m and 2.0m AHD	33	400 plus

Table 9.2 - Numbers of properties and area affected by the 1% AEP (or 1 in 100 year flood) level

Area affected by 1971 flood line	No of affected properties	Area affected
Burrill residential north of causeway	217 properties	13ha
Burrill residential south of causeway	225 properties	14ha
Caravan parks	3	5 ha
Foreshore reserves	7 reserves	9 ha
SEPP 14 wetlands	6 wetlands	56 ha
Low lying areas adjacent to SEPP 14 wetlands	3 farms and National Park	Approx 60 ha
Non-SEPP 14 wetlands	7 bays on western shore of lake	Approx 10 ha

9.5 FLOODING STRATEGIES AND ACTIONS

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
Develop and Implement a Flood Management Plan	35. Undertake a Flood Study and develop a Floodplain Risk Management Plan for Burrill Lake	High	Medium	\$160,000 plus	SCC, DLWC		Adoption of plan

10 NATURE CONSERVATION

10.1 VALUES

Burrill Lake, its tributaries and their catchments support a large range of ecological communities, some of which are relatively undisturbed. These are important from a conservation perspective as well as an attractive attribute of the area for many residents and visitors.

Burrill Lake was a major commercial fishery for finfish. It was the six largest south coast commercial fishery in terms of total catch over the 1990-1996 period. Burrill Lake has one commercial oyster farmer.

Burrill Lake is a major recreational fishery for finfish and crustaceans, and is considered to be a major contributor to the tourist industry.

10.2 OBJECTIVES

To maintain or, where necessary, restore the ecological integrity and biodiversity of the non-urban parts of Burrill Lake and its catchment.

There are many objectives for nature conservation that affect the catchment. The Southern Catchment Management Board's Catchment Blueprint sets objectives for habitat and vegetation Conservation across the region. A number of pieces of legislation identified on page 3 contain objectives relevant to nature conservation in the catchment. In addition, Council is in the process of developing a Conservation Strategy, in conjunction with the City's Growth Management Strategy.

10.3 ISSUES

The aquatic environment appears to be healthy and productive. The seagrass beds, particularly important in maintaining sediment stability, water quality and in providing shelter and food critical to the survival of a wide variety of aquatic biota (Fish Habitat Protection Plan #2), are present in the

entrance channel and the shallower margins of the lake.

NSW Fisheries officers believe that the greatest future threat to the fishing resources of the lake would arise from elevated turbidity levels, which would reduce light penetration into the water, and hence the depth to which seagrass will grow (Lugg, 2001). The Processes Study (WBM Oceanics, 2002) highlights the importance of water clarity in the estuarine ecosystem, and reports ' a general decline in seagrass extent' in the northern basin, most likely linked with water quality degradation.' Disturbance from boat propellers and anchors also damage seagrass beds.

The tidal flats in the channel are important elements of the aquatic food chain. They are also used as resting and feeding grounds by a number of birds that migrate to China and Japan. Australia is a signatory to, and therefore has obligations under international treaties (Japan-Australia and China-Australia Migratory Bird Agreements) to protect the feeding and breeding grounds of these migratory species.

The foreshore vegetation at Burrill Lake was recorded as the most diverse of the eight south coast estuaries studied by the CSIRO (Anderson *et al* 1981). Six wetlands bordering the estuary are protected under SEPP 14. These are free from development pressure, though some experience pressure as a result of land clearing and grazing.

The catchment has only seven remnant pockets of rainforest (moist and dry subtropical rainforest) on some of the steeper slopes on the rich agricultural soils and in gullies. These once common rainforests are under pressure from grazing and weed invasion.

10.4 FORESHORE REEDS AND SEDGES

The approach to reeds and sedges adopted in this plan is for only minor changes to the management of the reeds themselves, but rather improved access to the water via jetties, boardwalks and duckboards. Possible locations for these access works are identified in table 12.4, page 50.

Community members have raised concerns to Council and the State Government over a number of years regarding changes in foreshore and intertidal vegetation. An increase in the area and density of reeds and sedges has been seen as:

- Reducing access to the water, isolating areas where people used to walk and swim;
- Trapping litter and rubbish in areas of high use and visibility;
- Providing habitat for vermin and pests;
- Reducing the visual appeal of the lake;
- The perceived excessive growth of reeds was seen as part of the damage caused to the lake by the causeway; and
- Some people fear that the expansion of the reeds represents part of a long term process of infilling the lake.

The most recent investigations as part of the Causeway Options Study (WBM Oceanics, 2001) has revealed that

- Of the three native reed species, one (*Cyperus laevigatus*) has expanded its range around the foreshore;
- Sedges and reeds have been a conspicuous vegetation type within the entrance channel for at least the past 55 years.
- Most areas upstream of the causeway experienced a general increase in sedge and reed growth over time, with a general decline downstream of the causeway.
- The condition of the entrance to the sea determines the spread of

the reeds. A more open entrance provides conditions suitable for reeds to flourish;

- The site immediately adjoining the northern end of the causeway has increased reed growth partly as a result of the causeway; and
- The reeds and sedges trap sediment and organic matter that in turn promote reed growth.

The reeds and sedges are protected by several pieces of State Government legislation; the Crown Lands Act (1989), the Fisheries Management Act (1994) and the Rivers and Foreshores Improvement Act (1948). The foreshore and intertidal vegetation provide important ecological functions in the lake, including:

- Providing shelter and a food source for crabs, shrimps, juvenile mullet and bream and other animals;
- Carnivorous fish species such as bream and whiting move onto the foreshore vegetation to feed on high tides;
- Some fish deposit their eggs in foreshore vegetation;
- Overhanging vegetation provide shade and camouflage from predators;
- Acting as a buffer and partially filtering sediments, pesticides, fertilisers, litter and other pollutants;
- Helping stabilise the foreshore and reduce erosion, as the roots bind the soil and the above ground parts absorb wave energy from wind waves and boat wake; and
- Provide feeding and resting sites for migratory birds as discussed above.

The Causeway Options Study (WBM Oceanics 2001) analysed a number of options designed to address community concerns about siltation and reed growth. The construction of culverts under the causeway had been proposed by community members but was found to be very expensive. The

Study recommended two options for further consideration:

- Dredging circulation channels upstream and downstream of the causeway, with dredging costs of \$367,000 each 10 years; and
- Direct skimming removal of some sedge/reed areas, with dredging costs of \$90,000 each 10 years.

Both options were evaluated as having a medium to high benefit, and a medium to high negative environmental impact.

Many residents believe that the visual degradation of the lake outweighs the ecological value of the reeds. On the other hand, State Government Agencies insist that the reeds have an important ecological function. As a result, only minor changes are proposed to the way that the reeds and sedges are managed.

Access to the waterway by both residents and visitors is recognised as an important issue, and a number of actions are proposed to provide formal access over and through the reed beds for fishing, bait collection and walking across the shoals. These may include jetties, boardwalks or duckboards. Possible locations are identified in table 12.4, page 50. Council and the Stage Agencies will be seeking funding for such works in future works programs and from grant funds.

Litter and rubbish are continuing issues in all Council foreshore areas and reserves. The Lions Park site is one site requiring regular cleanout. Education and clean up programs, including Clean Up Australia, may need to address this issue.

10.5 CAULERPA TAXIFOLIA

The invasive alga, *Caulerpa taxifolia*, has been identified in Burrill Lake since 2000. This algae has been present in Lake Conjola for at least 10 years, and has spread in that lake to the stage where it has covered much

of the aquatic vegetation and substrate around the lake margins and shallow areas. *Caulerpa taxifolia* has spread rapidly and smothered aquatic vegetation in many salt water ecosystems around the world.

Caulerpa taxifolia is not endemic to coastal New South Wales, but is found in Southern Queensland and Lord Howe Island. The Minister for Fisheries declared the species as Noxious in NSW mainland coastal waters in October 2000. However, research into its genetics has not established that this species is one that would trigger the joint Commonwealth-State funding mechanism for dealing with marine pests.

The likely impact of *Caulerpa taxifolia* on the aquatic ecosystem is not clear. Many microorganisms grow on the leaves of seagrass. This is the major source of food in the seagrass beds. *Caulerpa* does not support as much of this food source. However, research has been inconclusive, showing both minor and significant declines in fish numbers at sites affected by *Caulerpa*.

NSW Fisheries imposed netting restrictions around the first outbreak site, an area near the mouth of Stoney Creek. Buoys mark this area. A second site at the end of the channel was identified before Christmas 2001 and also marked by buoys. During 2002, local fishermen have identified several additional sites.

NSW Fisheries had expected to remove the initial infestation during the winter of 2001. However, the infestation was larger than expected and hand removal was not possible. Any removal work is now dependent on trials of larger scale control techniques (salt treatment) being undertaken on the Central Coast. In 2002, the State Government announced funding of nearly \$1m for a package of community education,

monitoring, research and 'spot control' of new outbreaks on the South Coast.

The strategy adopted to address the *Caulerpa taxifolia* issue in this plan is to promote the education of the local community and visitors regarding the threat posed by this invasive algae and the control actions that individuals need to take; to increase monitoring so that small outbreaks can be controlled while they are still small, to review the value of installing boat washdown facilities at Burrill and to support efforts to introduce salt treatment on the South Coast.

10.6 PEST SPECIES

A fox and wild dog-monitoring program carried out in Meroo National Park in 2001 indicated that fox numbers are high. Only anecdotal information is available for other introduced fauna. It is likely that cats, rabbits and possibly red deer are present.

Weed assessments have been carried out on many reserves, parks and farms, although no overall assessment has been done. The Processes Study noted that 'weed invasion of forested areas was primarily sourced from the developed areas of the catchment' (WBM Oceanics, 2002). Weeds that are important to note as posing a significant risk to natural and agricultural resources in the catchment include the following.

- Blackberries remain a minor problem on agricultural lands. Monitoring for fireweed is required to ensure that any outbreaks are controlled at an early stage.
- A range of weeds including impatiens, cassia and cotoneaster pose a significant threat as escapees from urban areas into adjoining bushland.
- Riparian and foreshore areas have significant infestations of some rapidly colonising weeds. Madeira vine, bridal creeper, moth vine, morning glory and turkey rhubarb

are fast growing climbing vines that have become established and threaten the biodiversity of foreshore and riparian areas. Privet, asparagus fern and bitou bush spread rapidly from the large production of berries, spread by birds.

10.7 EXISTING DATA

Much information is available on the flora and fauna of the catchment, much of which has been reviewed in the Processes Study. Studies have been done for various development proposals near the lake. Significant data was obtained and assessed for the Milton-Ulladulla Structure Plan (which covered the area east and north of the lake).

The Woodburn and Croobyar State Forests (now Meroo National Park) were assessed as part of the RACAC investigation. To the west, flora and fauna studies were done prior to the electricity transmission line construction. One rainforest remnant (and another similar remnant in the Narrawallee catchment) has been studied in detail. Mapping of vegetation communities throughout the catchment has been completed.

Threatened species identified in or near the Burrill Catchment include

- Sooty Oystercatcher, Pied Oystercatcher and Southern Giant-Petrel on the coast and estuary; and
- Glossy Black-Cockatoo, Giant Burrowing Frog, Powerful Owl, Masked Owl, Sooty Owl, Yellow-bellied Glider and a the orchid *Cryptostylis hunteriana* in the forests surrounding the lake and to the west.

Seagrass mapping was last done in the mid 1970's (West et al, 1985 and Evans and Gibbs 1981), while foreshore vegetation was detailed by the CSIRO in 1981 (Anderson et al,

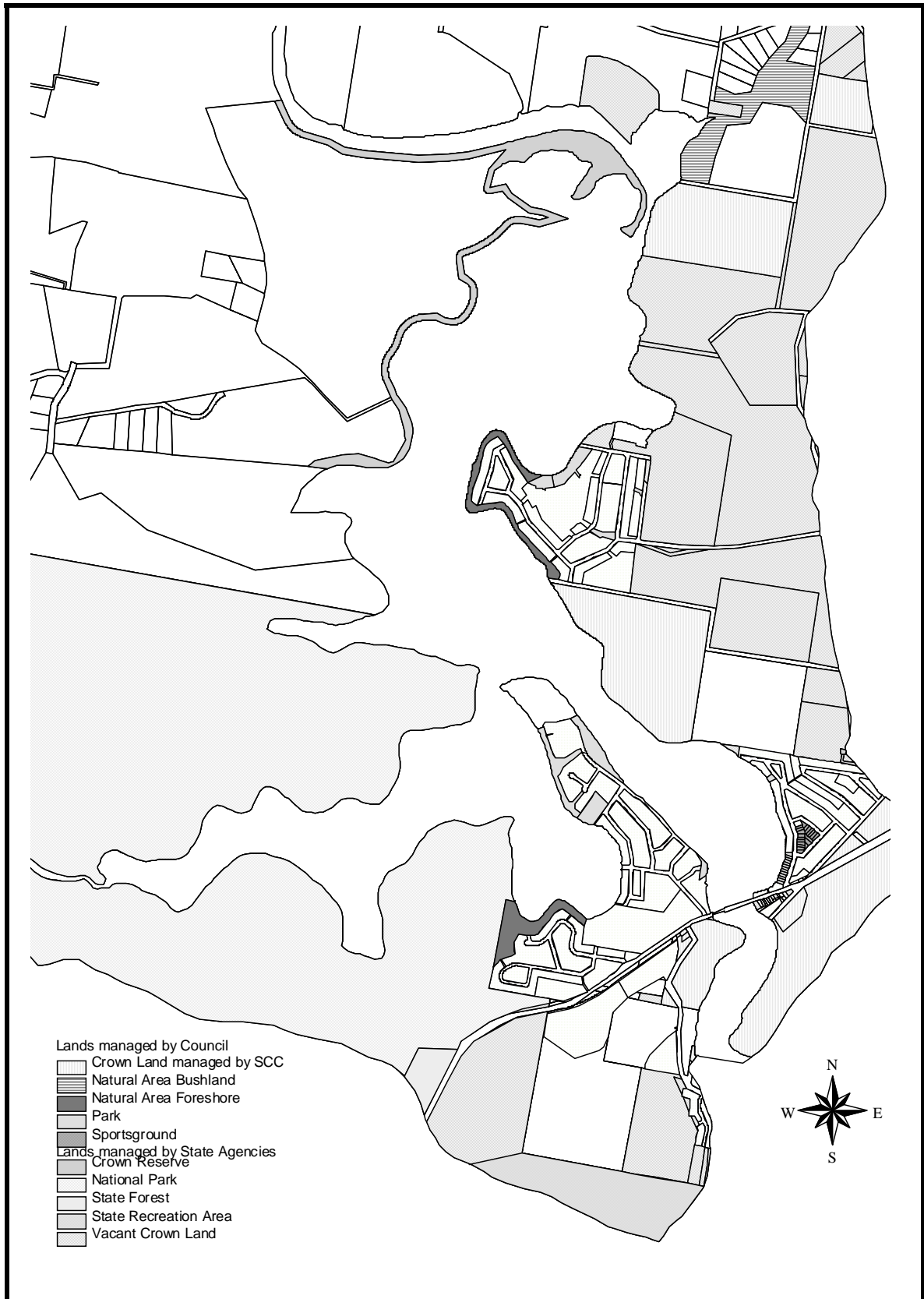
1981). Changes in the distribution of aquatic and fringing habitat types in both the channel area and the lake body were examined as part of the Causeway Study.

The Progress Association has undertaken monitoring of nutrients and reed expansion. The results of this monitoring are now published in 'Sedge Watch – Monitoring saltmarsh communities in Burrill Lake' (undated).

Recent information has been collected on the wetlands surrounding the lake, but has still to be assessed (Shoalhaven Wetlands Study 2000). The current management practices in these wetlands, and whether this management represents any threat to their continued functioning as an ecological unit, are still unclear.

Complete commercial fishing statistics exist for the period 1954 to the present. No recreational fishing statistics are available for Burrill. However, surveys from other estuaries (Lake Conjola, Jervis Bay and Narrabeen Lagoon) show significant levels of recreational catches. No data or estimates are available for fish stocks, or their relationship with commercial or recreational catches.

Research on juvenile and small fish throughout Burrill Lake is providing information on fish recruitment and relative abundance (West and Jones, 1998 and West and Jones 1999). Recent research on hauling (Otway and Macbeth 1999) has failed to find any significant link between hauling and loss of seagrasses in Burrill Lake.



Map 10.1 - Classification of Public Land around the Burrill Lake Estuary

10.8 HABITAT AND SPECIES CONSERVATION STRATEGIES AND ACTIONS

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance indicator	Target
Promote the understanding of the natural environment among residents and visitors	36. Implement educational strategy on the foreshore, promoting the role of vegetation in coastal processes and habitat conservation	Medium	Short	\$3000	SCC		Boards installed
Protect important ecological communities on private lands through a mixture of education and assistance;	37. Encourage a joint strategy among private owners of rainforest remnants involving mapping, species identification, fencing and weed control (as appropriate);	Medium	Short	\$5000	SCC, Milton Rural Landcare, NPWS (advice only)	No of owners involved	Appropriate works completed
	38. Promote the exclusion of stock from estuarine wetlands and foreshores through NHT, Green Corp and fencing assistance.	High	Short		DLWC, Fisheries, SCC, landowners	No of owners involved	Fencing completed and farm management changed
	39. Maintain the visual buffer between Burrill Lake and the highway with coastal forest and in an ecologically sustainable manner.	High	Ongoing	Non costed	SCC, NSW Planning	Area of coastal forests	
	40. Encourage the maintenance of vegetative buffers around sensitive habitats.	Medium	Short	Non costed	NPWS, SCC, landowners		
Implement control programs for noxious, feral and marine pests	41. Educate local fishers and divers about <i>Caulerpa taxifolia</i> and the importance for early identification of any outbreaks.	High	Short	Non costed	Fisheries, SCC		Educational campaign implemented
	42. Remove infestation of <i>Caulerpa taxifolia</i> from the Lake.	High	Short	Non costed	Fisheries		Outbreak removed

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance indicator</i>	<i>Target</i>
	43. In the interim, assess the benefit of installing boat washdown facilities at Burrill Lake to limit the inadvertent spread of <i>Caulerpa taxifolia</i>	High	Short	Non costed	SCC, Fisheries, Waterways		Assessment completed
	44. Monitor development of <i>Caulerpa taxifolia</i> and implement additional actions as necessary.	High	Ongoing	Not costed	Fisheries, SCC	Number and area of outbreaks	
	45. Seek joint program of land manager and owners in conjunction with Rural Lands Protection Board for feral animal control (such as foxes and rabbits) throughout the catchment.	Medium	Short	\$20000	RLPB, landowners, NPWS, Milton Rural Landcare	Number of owners involved	Programs implemented
	46. Undertake an educational campaign among residents, ratepayers and visitors to reduce the impact of companion animals on native species.	Medium	Short	\$4000	SCC		Educational campaign implemented
	47. Implement inspection, education and control programs for weed species identified in this report	High	Short	Uncosted	SCC	Area and number of infestations	
Ameliorate sites in channel area identified as impacted by causeway	48. Monitor effectiveness of Lions Park foreshore stabilisation and review any need for recirculation channels (option 8 in the Causeway Study).	High	Medium	Uncosted	SCC, Task Force	Amount of foreshore recession	Stable foreshore at Lions Park

11 ENTRANCE MANAGEMENT

11.1 VALUES

The entrance area is the most frequently used part of the Burrill Lake for most residents and visitors.

The condition of the entrance governs some key values in the inlet and estuary, including water quality, inundation of low-lying areas, the ecology of the wetlands around the inlet channel and the diversity and abundance of a range of aquatic species.

The tidal flats along the channel represent a crucial component of the recreational, visual and ecological assets of the lake. They provide habitat and food sources for both local and visiting species. At the same time, there are some fears in the community that these flats represent the infilling of the inlet that may reduce recreational use of the lake.

There is no record of how water quality has been affected by closure of the entrance.

11.2 OBJECTIVES

To maintain the Burrill Lake entrance in as natural a state as possible within the constraints of property, flooding and inundation.

11.3 ISSUES

Burrill Lake is a coastal lake that generally remains open to the sea and has sufficient tidal exchange to maintain good water quality. The lake was last closed in 1987. Available reports suggest that the lake may have closed more frequently in the past (see table 12.1, page 49). Closure periods during the past 100 years are believed to have been brief, due to regular artificial openings.

Closure of the entrance would immediately disrupt the oyster farming industry. A rise in the water level above 1m AHD would begin to disrupt

the functioning of residential areas and tourism. Initially, inundation would affect wetlands and foreshore areas, and then caravan parks, in particular Bungalow Park. The lowest lying residential areas are Kendall Crescent, Balmoral Street and McDonald Parade near Commonwealth Avenue.

The inlet channel has been found to be quite stable upstream of the causeway, with little change in the location of the shoals. The entrance shoals, however, are highly mobile with marine sands moving into the inlet under tidal conditions. Wave washovers have also brought significant amounts of sand into the inlet in the past. These are now unlikely due to replenishment and revegetation of the beach dune.

There are two key issues in regard to entrance management:

- What action if any should be undertaken when the entrance of the lake closes; and
- What action if any should be undertaken as a result of concerns of the impact of the causeway

11.4 ENTRANCE POLICY

In the recent past, Council has mechanically opened the lake when the water level (measured at the bridge) approaches 1.25m AHD and when there is rain falling or expected within the next 24 hours.

This level of 1.25m AHD was selected because there are few community assets below this level, and because it was believed that opening at any lower level would not generate sufficient scouring force to scour a permanent opening. The entrance would be expected to close again quickly.

The WBM Oceanics Causeway Study modelled proposals for dredging the entrance and concluded that all of these were ineffective because the entrance would immediately fill again with marine sands. No proposals for

rockwalling the entrance have ever been formally considered as necessary.

Many of the newer residents would not have experienced Burrill Lake when it is closed, and Council and DLWC can expect some pressure from some residents to reopen the entrance immediately.

At the present time, Council would be required to undertake an environmental assessment prior to any action to reopen the lake. Approval would be required from DLWC, Fisheries and NPWS. This procedure would need to be followed until Council prepares and adopts an entrance management plan.

Council does not have a documented entrance management policy for Burrill Lake. The development of such a policy requires a detailed assessment of the ecological, social and hydrological impacts of opening at various heights.

As an interim measure, it is proposed that Council would seek appropriate approvals and carry out negotiations with relevant state agencies when the lake water level reaches 1.25 m AHD. Opening of the lake would occur when

- Rain is falling or expected within the next 24 hours in the catchment; and
- NPWS confirms that there are no endangered species on the entrance spit.

11.5 CAUSEWAY IMPACTS

The presence and perceived effects of the causeway has been an issue raised by many residents for a number of years. The local community has expressed concerns that the causeway

- reduces tidal flushing of the lake, resulting in sediment being deposited on the tidal flats,
- increases the deposition of muddy sediments on the shoals;

- promotes increased sedge and reed growth and
- causes erosion of the foreshore of Lions Park.

Council and the State Government have commissioned consultants to investigate the impact of the causeway, including Patterson Britton (1992), the Water Research Laboratory (1992) and WBM Oceanics (2001). The WBM Oceanics analysis provides a comprehensive understanding of the functioning of the channel area. All consultants reported similar findings.

The WBM Oceanics Study found little change in the location of the shoals and the channel since 1944. The only area of constant change is the entrance shoal that is regularly reworked by tidal action. WBM Oceanics concluded that there was insufficient evidence to show whether there has been any change in the height of the shoals.

WBM Oceanics found that sedge, reed saltmarsh and seagrass growth is linked to tidal patterns, and to the opening of the entrance. The sedges and reeds were identified as plants growing in the intertidal zone, between the high and low tide marks. A more open entrance produces a larger tidal range that encourages saltmarsh, sedge and reed growth. A more constricted entrance reduces the tidal range and favours the growth of sea grasses.

The Study concluded that there has been widespread change in the location of sea grasses, sedges and reeds over the past 50 years, but no general significant increase in area. The area behind McDonald Parade is the one area with an increase in reeds over the past 60 years, from 1ha to 2 ha.

In regard to water and sediment movement, WBM Oceanics (2002) found:

- No evidence of any significant effect on either tide or flood levels;
- The size of the entrance, rather than the bridge opening, largely determines the tide and flood flows;
- Impacts on tide and flood flows are confined to the near vicinity of the causeway;
- A very minor and localised effect of the causeway on sand transport and shoal development;
- A localised increase in sedge/reed growth and silt immediately adjacent to the northern foreshore upstream of the causeway;
- An increase in the shoal immediately adjacent to the downstream side of the causeway, following wave overwash in the 1970s;
- Evidence of shoreline recession along the Lions Park foreshore.

Following this study, the Task Force remained convinced that the removal of the causeway would result in some improvement in water flows and sedimentation in the lower part of the catchment, though the extent change is unclear.

The study also examined the costs and benefits of a range of options designed to alleviate the community concerns identified above.

The one area of foreshore erosion is at Lions Park. DLWC photogrammetry indicated rates of foreshore erosion from 0.55m to 1.65m per year between 1967 and 1985. This rate has slowed in recent periods.

WBM Oceanics proposed that this erosion resulted from the channel being forced towards the southern shore by wave washover events during the 1970s. Revegetation and replenishment of the dune has removed the threat of such events in the future. Council is currently investigating some options for foreshore stabilisation.

The Causeway Options Study has effectively postponed any State Government action on the removal of or modifications to the causeway until the construction of the new bridge.

The Causeway Options Study canvassed a range of scenarios regarding the retention or removal of the causeway after the bridge is constructed. The following issues arise in this consideration:

- Retention of the causeway for local traffic would allow smoother traffic flows for through traffic;
- Removal of the causeway was costed at \$250,000, a minor component in the total \$11m estimated cost of the bridge.
- Retention of the causeway would create the unusual situation of both a bridge and causeway crossing the channel within 50m of each other.

The issues surrounding the future retention or removal of the causeway will require continuing investigation and consultation with the community and relevant State Agencies. Final responsibility for any changes or modifications to the causeway remains the responsibility of the RTA.

11.6 EXISTING DATA

Smith (1987) documented one entrance closure. This closure was attributed to a high beach berm, prevailing easterly winds and low rainfall. It is unclear whether other factors might be involved in closing the entrance. Approximately a dozen closures have been identified during the last century (Thompson 2001. See table 12.1, page 49). Earlier last century, the entrance is thought to have closed on a more frequent basis. Whether and/or how this frequency of closure is related to urban development, dredging, infilling of wetlands or climatic conditions are uncertain.

DLWC is currently researching the impact of storm events on the berm height and entrance width at Burrill and other south coast estuaries.

SCC and DLWC commissioned a survey of the low-lying assets on the Burrill floodplain in 2000. These are assets that might be threatened by inundation from extended closure of the entrance. This survey identified only one building with a floor level below 1.25m AHD, plus another two where the ground level was below this level. Ten caravans had an annexe with a floor level below 1.6m AHD (nine at Bungalow Park) while two pump stations have a floor level between 1.4m and 1.5m AHD).

The lowest road is Kendall Crescent, with the crown of the road slightly below 1m AHD. The footpath along Balmoral Drive is 1.2m AHD, and the road crown along Balmoral Drive is 1.4m AHD. The crown of the road at Rackham Crescent is 1.3m AHD. The crown of the road at McDonald Parade, Commonwealth Avenue and the Highway are all at 1.8m AHD.

Table 11.1 - Known And Reported Burrill Lake Closures During The Past 100 Years

Closure Date	Comments on closure & reopening	Source of Data	Authority of data
1902	Manual opening	McAndrew (1993)	Note in Milton and Ulladulla Times, 26/7/1902
1908	Lake apparently closed for long period	McAndrew (1993)	Historical photograph
1914	Entrance being opened by horse and scoop	McAndrew (1993)	Historical photograph
1930	Unknown. Reputedly remained opened for 40 years	Smith (1987) pp 100	N Hooper, personal communication
1942	Entrance manually opened. Prior to opening, inundation extended as far as the community hall	McAndrew (1993) pp 79	Recollection of Stan Rattey
1944-1986	No closure observed in aerial photos, though entrance heavily shoaled	SCC, Public Works, Patterson Britton and Partners (1992) (PBR (1992))	DLWC aerial photos
1957 or 58	Closed for approx 1 week. Manually opened by residents across sand dune	Peter Williams	Personal communication
1965-1970	South Coast inlets reported to be often closed in this period	Bentley (1976) quoted in Smith (1987)	
1968	Entrance being opened by manpower and shovels	McAndrew (1993)	Photograph
1970	Closed sporadically for most of 1970. Inlet naturally opened and closed 3 times before staying open	Smith (1987) identifies this as the most recent closure prior to 1987.	Unnamed local resident
1971	Spit breeched by big swells		J Downey, pers comm
1974-1977	Breeching of entrance spit by 1974 storms		DLWC aerial photos
March, 1987	Closed for 4 months before apparent natural opening.	Smith (1987). Patterson Britton (1992) claims it was manually opened.	Smith personal observation
1975-1990	Closure believed to be more frequent than in past	SCC, Public Works, Patterson Britton and Partners (1992)	N and F Hooper, pers comm

G Thompson, 31st January 2001

11.7 ENTRANCE MANAGEMENT STRATEGIES AND ACTIONS

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
Development of Entrance Management Strategy	49. Investigate the factors relevant to the artificial opening of Burrill Lake	High		\$5000	SCC, DLWC		Investigation completed
	50. Develop an Entrance Management Policy for Burrill Lake.	Medium	Medium	Uncosted	SCC, DLWC, Task Force		Awareness campaign implemented
Implementation of interim Entrance Management Strategy	51. Instigate consultation and approval process for opening of lake when water level at bridge approaches 1.25m AHD	High	Short	No additional cost	SCC, DLWC, Task Force		Adoption
Ameliorate sites in channel area identified as impacted by causeway	52 Investigate options for the preparation of a Development Control Plan for the commercial area at the northern end of the causeway, to incorporate improved public access to the foreshore and waterway.	Low	Medium	Uncosted	SCC		
	53 Monitor effectiveness of Lions Park foreshore stabilisation and review any need for recirculation channels (option 8).	High	Medium	Uncosted	SCC, Task Force	Amount of foreshore recession	Stable foreshore at Lions Park

12 RECREATION AND TOURISM

12.1 VALUES

Burrill Lake is valued for recreation by both residents and visitors.

The most popular activities undertaken are walking on the beach and foreshore, swimming and surfing, fishing, boating and water skiing and exercising pets.

The lake supports a significant commercial tourism industry involving accommodation and tour operators and using many of the recreational and natural assets of the catchment.

12.2 OBJECTIVES

To provide a range of recreational facilities for both locals and visitors.

12.3 ISSUES

Recreational demand comes from three groups:

- Christmas and Easter holiday periods
- 'Normal' lower level visitor usage throughout the remainder of the year;
- General recreational uses by the local population.

Swimming in the estuary mainly occurs in the lower part of the channel near the entrance. Few of the other public reserves have good access for swimming. The highway bridge has become a popular location for swimming and diving, as well as for fishing.

Recreational fishing in the lake is important to both locals and visitors. With the cessation of commercial fishing in Burrill Lake in 2002, any conflict between commercial and recreational fishers will cease. Burrill Lake is now recognised as one of the recreational fishing havens established by the State Government during 2002. Planning is now required to cater for

the expected increases in recreational fishing arising from this decision.

There are a number of potential issues that may arise from increased use of the waterway by recreational fishers. These include the adequacy of infrastructure (such as boat ramps, jetties, wash down facilities, fish cleaning tables and garbage disposal) and uncontrolled foreshore access.

Council dredged parts of the channel to improve navigability in 1996, and prior to that in 1975. Channel depth and width varies considerably over time, depending on flood and tidal conditions, which may affect navigability.

This Plan adopts the view that the priority for tourism infrastructure should be the provision of public facilities along the foreshore that improve the capacity of visitors to enter and use the water in the channel area. These facilities would be designed in conjunction with the development of landscape plans for the reserves, identifying potential future treatments. Possible locations for improved foreshore access are outlined in table 12.4, page 50.

12.4 EXISTING DATA

There is little existing data on recreation in the estuary, other than local knowledge. Table 12.1, page 49 estimates the number of visitors staying in the catchment during 1999, based upon the number of accommodation units and sites available. This figure of 60,000 visitor nights does not include people staying in the Ulladulla area, day visitors or people staying outside the catchment. Shoalhaven Tourism estimates that the numbers of visitors to the southern Shoalhaven (below Conjola) is 1.1 million people per year.

Some data was collected on visitor usage of the channel foreshores during January 2001. This is summarised in tables 12.2 and 12.3,

page 49/50. The key points arising from this snapshot are:

- Visitors and locals predominantly use the entrance area and adjoining flats. This area has minimal facilities, and no shade.
- Other foreshore areas are comparatively little used. Many of these areas are either not suitable or not designed for swimming.
- Boat ramps appear to be operating within their capacity, with possible exception of Kendall Crescent.
- There is significant recreational fishing, with 30 to 40 fishers observed in the channel area at any one time.

The southern part of the catchment comprises the Meroo National Park (previously the Croobyar and Woodburn State Forests). Meroo National Park extends west to join the Morton National Park.

Recreational use of these natural areas of the catchment had been limited to activities such as four wheel driving. Now that these areas have been incorporated into the Meroo National Park, additional nature-based recreational opportunities may become available.

The Barnunj State Recreation Area south of Dolphin Point comprises 146 hectares of reasonably intact Scribbly Gum/Bloodwood and Coastal vegetation complexes. Together with Meroo National Park, it protects a number of plants and ecosystems towards the southern extent of their distributions. The Area is popular with surfers and fishermen who access the Area to get to their favourite locations

Some sections of the southern foreshore have been used as an undeveloped camping area for many years, under agreement with State Forests. Management has since been transferred to NPWS. Management concerns include damage to foreshore vegetation, erosion from tracks and

unsealed roads, litter and rubbish, lack of toilets and damage to archaeological sites. New management arrangements for these areas will be developed and implemented over the next 5 years.

Burrill Lake has been the home of the Ulladulla Water Ski Club since the 1950s. The ski club ramp is the only formal boat ramp in the Kings Point area and is regularly used throughout the year.

The only authorised off leash exercise area for dogs is in the public reserve east of the Highway, opposite Kings Point Drive.

Younger residents regularly use the crown lands above Kings Point for biking and driving. One area, the future Sewerage Treatment Plant site, generates significant sediment run off during rain events and works are planned to reduce this sediment source.

Table 12.1 - Estimated Number of Visitor Nights Per Year Staying in Burrill Catchment, 1999

	Hotel/ motel	Flats/ houses	Caravan parks	Own house	TOTAL
Number of accommodation units of sites in the catchment	66	50	440	377	933
Number of visitor nights spent in the catchment	5868	2444	22008	26842	57162

This estimate does not include visitors living or staying in Milton/Ulladulla area. Numbers of accommodation units are taken from the Shoalhaven Tourism Information Booklet, (SCC undated). Occupancy rates are derived from Tourism in the Shoalhaven (SCC 1999).

Table 12.2 – Snapshot of General Tourist Usage of Burrill Lake Foreshores and Channel, taken during January 2001 Holiday Season

Location	Indication of usage during January 2001 holiday season (taken from 5 separate visits)
Surf Beach	Up to 20 people surfing, but little used during north easterly winds.
North bank, downstream of bridge	Generally 1-2 groups fishing, walking, picnicking, catching nippers, 1-2 boats pulled up on shore
Estuary below bridge	1-2 boats fishing, occasional canoe;
Holiday Haven Visitors Car Park	10-18 cars parked outside
Bridge	Up to 7 people fishing, plus people jumping and swimming from bridge
Lions Park picnic area	6 to 12 cars, with several groups at picnic tables; occasional tourist bus;
Lions Park fishing site	6 to 17 fishers; occasional picnic groups
Unsealed Access Road west beside Dolphin Point Caravan Park	30 to 40 cars, with several groups in park at picnic tables; up to 10 groups on waterfront;
Dolphin Point Caravan Park	5 to 20 cars parked outside
Entrance area and flats	Most heavily used area; 20 to 40 cars, with many parked on grass; up to 150 people within 200m of the entrance;
Dolphin Point headlands car parks	5 cars or less; few people visible;
Bungalow Park Visitors car park	20 to 50 cars; boat trailers parked inside;
Balmoral Road shops	6 to 9 cars;
Maria Ave Boat Ramp	2 to 9 cars with up to 6 boat trailers;
Moore St Boat Ramp	Up to 6 cars with up to 3 boat trailers 1-2 picnic groups with power or sailing boats in bay;
In the Channel west of bridge	2 to 5 boats moving or fishing; 1-2 groups fishing or catching nippers; 2 jet skis seen;

Thistleton Drive Reserve	Small number of cars parked along reserve but no people using reserve
Shops north on Highway	5 to 7 cars
McDonald Park Picnic area	Small number of cars with 0 to 2 groups in reserve
Picnic area at creek of Kendall St	Occasional use only
Kendall St Boat Ramp	8 to 12 cars with 4 to 10 boat trailers;

Table 12.3 - Numbers of Cars, Boats and Fishers Around Burrill Foreshore, January 2001

Location	Wed, 3/1/2001, 1.30 pm	Wed, 3/1/2001, 2.30 pm	Wed, 10/1/2001, 2.30 pm	Wed, 10/1/2001, noon	Fri, 19/1/2001, noon
No of cars parked in public places	198	212	160	152	126
No of boat trailers at boat ramps	8	8	15	12	8
No of people fishing from shore	7	27	14	22	14
No of boats seen in channel	4	5	13	9	12

Table 12.4 - Possible Sites for Improved Foreshore Access

Site	Possible treatment
Burrill Lake Lions Park downstream (east) of creek	One or two fishing jetties running parallel to the shore
Burrill Lake Lions Park between creek and bridge	Duckboard walk along edge of reeds
Thistleton Reserve	Jetty suitable for commercial use, with possible disabled access
McDonald Parade Reserve	Duckboard through reeds to provide access to tidal flats
Kendall Crescent Reserve	Small jetty suitable for fishing and swimming
Ireland Street Reserve	Fishing platform from shore to edge of reeds
North Foreshore Reserve, Kings Point	Fishing platform

12.5 RECREATION AND TOURISM STRATEGIES AND ACTIONS

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
Improve the visitor facilities in high use areas	52. Finalise and adopt management plan for Lions Park	High	Short	No additional cost	SCC, Lions Club, Task Force		Plan adopted
	53. Implement management plan for Lions Park	Medium	Short		SCC, Lions Club		Works completed
	54. Review options for foreshore stabilisation at Lions Park and implement as appropriate.	High	Short	\$50,000	SCC, DLWC, Lions Club		Works completed
	55. Develop and implement a landscape masterplan for the entrance reserve at Dolphin Point	High	Medium	Uncosted	SCC		Works completed
	56. Develop and progressively implement a strategy for interpretative signage in high usage areas to increase visitor understanding of the local ecology and heritage.	High	Short	Uncosted	SCC, DLWC, Task Force		Strategy completed
Increase opportunities for visitor usage of foreshores and reserves	57. Investigate potential sites for improved foreshore access as identified in table 12.4.	High	Short	Uncosted	SCC, DLWC, Task Force		Investigation completed
	58. Investigate opportunities for sustainable nature-based recreational activities in the development of the Plan of Management for Meroo National Park.	Medium	Medium	No additional cost	NPWS		
	59. Adopt and implement plans for Thistleton Reserve and Kendall Crescent Reserve.	Medium	Short and Medium	Uncosted	SCC		Works completed

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
	60. Develop and adopt plans for foreshore access and reserve usage at McDonald Parade Reserve, Kendall Crescent boat ramp and Barker Reserve	Low	Medium	Uncosted	SCC		Plans adopted
	52 Investigate options for the preparation of a Development Control Plan for the commercial area at the northern end of the causeway, to incorporate improved public access to the foreshore and waterway. See action 52 in Entrance Management	Low	Medium	Uncosted	SCC		
Provide necessary infrastructure for a recreational boating and fishing program	61. Monitor channel depth so as to retain navigation above the bridge from Maria Ave and Kendall Crescent boat ramps. Develop and implement dredging program as needed.	Medium	Ongoing	Uncosted	SCC, DLWC	Channel depth	Maintain navigation above bridge
	62. Incorporate appropriate facilities for fishers into the plans for foreshore reserves.	High	Medium	Uncosted	SCC, Fisheries	Numbers of facilities	Additional facilities provided
	63. Require unsafe private foreshore structures such as jetties to be repaired or removed	High	Short	No additional cost	DLWC		All foreshore structures safe

13 VISUAL QUALITY

13.1 VALUES

The visual quality of the inlet channel, the lake itself and the catchment farmlands are all crucial parts of the value of Burrill Lake. A major visual assessment of the lake and rural areas were done as part of the Rural Plan and the Milton-Ulladulla Structure Plan, and have been incorporated into the planning controls.

13.2 OBJECTIVES

To retain and enhance the visual quality of the lake and the catchment.

13.3 ISSUES

Issues that may affect the visual quality of the lake and catchment include:

- Possible major or incompatible development around the foreshore;
- Clearing of the lakeside vegetation, affecting the forested backdrop to the lake;
- Accelerated or large-scale development in the rural or forested areas;
- Proliferation of private foreshore structures, including jetties and reclamation.

13.4 VISUAL QUALITY STRATEGIES AND ACTIONS

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
Protect and enhance the visual quality of the lake	64. Recommend new jetties adjoining private land be shared facilities where applicable.	High	Ongoing		DLWC, SCC		
	15/16 Maintain existing foreshore and lakeside vegetation. See actions 15/16 in Water Quality.	High	Short	Unknown	SCC, DLWC, landowners		

14 CULTURAL HERITAGE

14.1 VALUES

The Burrill Lake catchment and estuary has been a site of intense Aboriginal occupation for over 20,000 years. Significant sites remain from this occupation. The Burrill Rock Shelter is a site of international archaeological significance. Research from this site is used to date other archaeological sites throughout Australia.

The catchment is also rich in relics from early European settlement, due to the highly productive agricultural soils of the Milton monzonite. The pastoral landscapes identify the pattern of this early settlement. The many farm buildings and public buildings in Milton highlight the importance of agricultural production from the area. There are very few remaining relics around the channel area of the timber, lime, transport, tourist and agriculture industries.

Burrill Lake and Dolphin Point still retain much of the architecture of the 'post war holiday by the coast' era when families took the four weeks break in caravans and fibro cottages.

Seventy-three items from Milton are listed on the Shoalhaven Heritage Study, as well as another twenty-three from the rural area and three from Burrill Lake.

14.2 OBJECTIVES

To protect known items of Aboriginal and European heritage and to promote the understanding and commemoration of cultural heritage items in the community' and encourage land use activities that are compatible with the cultural values of the area

14.3 ISSUES

Much of this cultural heritage is subject to the pressures of change and development affecting many coastal areas. Aboriginal foreshore sites have been subjected to damage from erosion, storms and construction activity. Most of

the sites are not widely known. Vandalism has not been an issue. Aboriginal leaders and archaeologists would prefer that the location of sites not be publicised.

Most of the middens and other sites are protected in various ways from further degradation. However, a number of sites require some action to prevent continuing degradation. These are outlined in a report by Hokchkin (1988). The rich Aboriginal heritage provides a great opportunity for education purposes.

Building and sites from early European settlement may be protected under planning and heritage legislation. The EP&A Act requires that environmental assessments be carried out for developments that may adversely impact on buildings and places having cultural significance. However the only statutory protection depends on such sites becoming heritage items under the Local Environment Plan. The majority of sites identified in the Heritage Study are not yet included in the LEP.

The pastoral landscapes are under pressure from changes in land use, particularly with the deregulation of the dairy industry. The current zoning of the prime agricultural lands prevents further subdivision and offers some protection to this landscape. However, as agriculture does not require development consent, some intensive agriculture, including horticultural activities and unsympathetic urban style residential houses may threaten this landscape.

The built character on the coast is also changing as new owners renovate or demolish and rebuild the fibro cottages. Inevitably, this will result in the loss of the original low-key holiday character that contributes to the local heritage. An example of the loss of the tourist character was the demolition of the Burrill Lake open-air theatre, a rare and

significant building to the State, which was demolished in 2000.

There is considerable potential to use the cultural heritage to show visitors the diverse and interesting history of the area, both Aboriginal and European.

14.4 EXISTING DATA

There is a significant body of academic research dealing with the Aboriginal occupation of the Burrill Rock Shelter. In addition, research by White (1987), Hotchkin (1988) and Stone (1995) have identified a total of nearly 70 Aboriginal sites around the lake. Hotchkin (1988) assessed these sites, listing their condition and any remediation actions required. There is also considerable local knowledge in the Aboriginal population regarding natural history, flora and fauna and past occupation.

McAndrew's Beautiful Burrill (1993) provides an entertaining, anecdotal history of Burrill Lake. Items of local and regional significance are listed in the Shoalhaven Heritage Study 1995-1998. The Milton-Ulladulla and District Historical Society holds considerable records. The Tabourie Museum holds a considerable collection of items of European settlement.

14.5 CULTURAL HERITAGE STRATEGIES AND ACTIONS

<i>Strategy</i>	<i>Action</i>	<i>Priority</i>	<i>Timing</i>	<i>Estimated Cost</i>	<i>Responsibility</i>	<i>Performance Indicator</i>	<i>Target</i>
Ensure the protection of all known Aboriginal sites	65. Review Council management practices in foreshore areas and modify as necessary	Medium	Short	Uncosted	NPWS, SCC, Aboriginal Land Council		No further damage to sites in SCC controlled areas
	66. Complete remedial works as recommended by Hotchkin (1988)	High	Short	Uncosted	NPWS, SCC,		Stabilise priority foreshore sites
Promote the understanding of the Aboriginal and European heritage	67. Identify capacity for preserving or developing items of Aboriginal and European heritage:	Medium	Medium	Unknown	NPWS, Aboriginal Land Council		Increased visibility of Aboriginal and European heritage
	68. Develop and install educational materials at appropriate sites	High	Short	\$5000	SCC, NPWS, ALC		Visible Aboriginal and European heritage presence
	69. Finalise the Heritage LEP as it relates to Milton and surrounding areas	High	Medium	No additional cost	SCC		Implementation of LEP

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