

Department for Environment and Heritage

Wetland Inventory



Fleurieu Peninsula 2005



Government
of South Australia

Department for Environment and Heritage

Wetland Inventory

Fleurieu Peninsula South Australia

2005



Natural Heritage Trust

*Helping Communities Help Australia
An Australian Government Initiative*



**Mount Lofty Ranges &
Greater Adelaide NRM GROUP**



**Government
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EXECUTIVE SUMMARY

The Fleurieu Peninsula wetland inventory builds upon wetland inventory projects of varying scales already completed within South Australia and provides updated methods, survey protocols and a specifically designed database for guiding future wetland inventories in a whole-of-State approach. This inventory provides detailed information on the location, condition, threats and conservation value of wetlands throughout the Fleurieu Peninsula. Detailed mapping of wetlands was completed for the entire study region, and data collected was analysed to identify wetlands of high ecological significance across the Fleurieu Peninsula.

A total of 858 wetland bodies were mapped from rectified aerial photography on the Fleurieu Peninsula as part of the wetland inventory. Due to the large number of wetlands identified, a sampling procedure was developed to strategically select wetlands to be physically surveyed. Through this procedure, a total of 138 wetlands were inventoried, and an additional 134 wetlands were ground-truthed.

Analysis of inventory data and mapping revealed an estimated 42% loss of wetland area on the Fleurieu Peninsula since European settlement. The loss of wetland habitat can be attributed primarily to the development of the region for agricultural purposes, where swamp habitat was cleared, burnt, and drained on a large scale. Additional stress on water resources within the region as a result of development has decreased the water supply to many wetlands systems. From the analysis performed, 49% of all mapped wetlands contain in-stream farm dams.

Over 80% of wetlands surveyed for the inventory were identified as permanently inundated freshwater waterbodies, the majority of which are spring-fed. The maintenance of groundwater resources and quality on the Fleurieu Peninsula is crucial to the continuation of many wetlands systems. Changes to water regimes and water quality within Fleurieu Peninsula swamps often results in severe weed infestations.

A total of 742 plant species have been recorded within and on the margins of wetlands within the region, of which, 80% are indigenous. Over 30% of all flora species recorded are of conservation significance, including 73 listed in State schedules and six listed as Nationally threatened. Additionally many threatened fauna species are known to utilise swamp habitat to varying degrees. Of particular note is the endemic Mount Lofty Ranges Southern Emu-wren (*Stipiturus malachurus intermedius*) which has been recorded at 29 wetland sites on the Fleurieu Peninsula.

A total of 23 distinct wetland character groups were identified through the analysis of inventory data. Characterisation of wetlands was performed using dominant vegetation characteristics and structural formation, salinity, substrate type, and landform element. The most common wetland character types were Shrub-dominated freshwater peat swamps, and Sedge-dominated freshwater swamps. Peat swamps were consistently the most diverse wetland ecosystems on the Fleurieu Peninsula, with over 450 flora species recorded within these swamp types.

Weed infestations were the most commonly recorded threatening process to wetlands on the Fleurieu Peninsula, where species such as Yorkshire Fog (*Holcus lanatus*), Blackberry (*Rubus* sp.), Gorse (*Ulex europaeus*), White Arum Lilly (*Zantedeschia aethiopica*) and Radiata Pine (*Pinus radiata*) are identified as severe threats. Additionally, over 80% of wetlands that were surveyed are threatened by inappropriate grazing regimes.

The results of the analysis revealed that only 2% of remaining wetlands on the Fleurieu Peninsula could be regarded as pristine. The large majority of wetlands (53% of the total number) were considered degraded or worse.

The majority of wetlands (92%) are located on freehold land. Although more than half of wetlands on private land were identified as degraded (52%), a significant number (21.7%) of wetlands in moderate to intact condition remain, many of which are privately managed for conservation purposes.

Wetlands of high ecological importance were quantitatively assessed through the inventory procedure. Significance analysis identified eight wetlands of very high significance, 11 wetlands of high significance and 52 wetlands that were identified as 'notable' within the region. Those identified as very highly significant are to be considered for listing in the Directory of Important Wetlands in Australia.

Management priorities were also identified, where wetlands of high significance that were also threatened by various processes were selected for targeted conservation action in the future.

TABLE OF CONTENTS

Introduction.....	1
Project scope.....	1
Wetland definition	1
Specific aims and objectives of wetland inventory.....	2
Report structure.....	2
Study area boundaries and characteristics.....	3
SECTION 1	
Overview of inventory data and wetland research in the Fleurieu Peninsula region ..	7
1.1 Wetland inventory	7
South Australia	7
National and International.....	7
1.2 Overview of Fleurieu Peninsula wetlands	8
Threatening processes	9
Relevant legislature	11
1.3 Wetland assessments in the Fleurieu Peninsula region	13
SECTION 2	
Wetland inventory process.....	16
2.1 Inventory development.....	16
Aims of the assessment methodology.....	17
Wetland rapid assessment methodology.....	17
2.2 Wetland mapping	18
Fleurieu Wetland GIS layer.....	19
Accuracy assessment of spatial mapping	22
2.3 Data management.....	22
South Australia Wetland Inventory Database.....	22
SECTION 3	
Sampling procedure.....	24
3.1 Priority sub-catchments.....	24
3.2 Priority wetlands for survey	25
Additive ranking analysis	25
3.3 Field survey.....	27
SECTION 4	
Assessment of wetlands – Fleurieu Peninsula.....	28
4.1 Wetland distribution.....	28
Distribution of wetlands in relation to landscape features	29
Land tenure and land use	32
4.2 Character.....	34
Wetland vegetation	37
Vertebrate fauna	42
Water chemistry.....	43
General hydrology	51
4.3 Threatening processes and management issues	56

Weed Infestation.....	58
Vegetation destruction / inappropriate disturbance regimes	60
Hydrological disturbances.....	61
4.4 Condition	64
Results of condition analysis	65
Tenure	66
Sub-catchment.....	68
Character	69
4.5 Wetlands of high ecological importance	70
Results of the significance analysis.....	71
4.6 Management Priorities	75
4.7 Future directions and recommendations.....	76
References	78

APPENDICES

Appendix 1.	Description of Fleurieu Peninsula Swamps	82
Appendix 2.	Threatened flora and fauna recorded in wetland habitats of the Fleurieu Peninsula	84
Appendix 3.	Survey sheets	87
Appendix 4.	Instructions for completing wetland inventory survey protocol	88
Appendix 5.	GIS dataset descriptions.....	98
Appendix 6.	Fleurieu wetlands inventory GIS database – metadata	100
Appendix 7.	Vegetation association descriptions – MU_50.....	104
Appendix 8.	SAWID – Basic User guide	105
Appendix 9.	Example SAWID Wetland Report	111
Appendix 10.	Database fields and descriptions – SAWID	113
Appendix 11.	Most commonly recorded flora species of Fleurieu Peninsula Swamps	120
Appendix 12.	Vertebrate fauna species recorded within wetlands of the Fleurieu Peninsula	122

List of figures

Figure 0.1. Wetland inventory process – Fleurieu Peninsula wetland inventory.	2
Figure 0.2. Fleurieu Peninsula wetland inventory study region boundaries.	4
Figure 0.3. Sub-catchment boundaries – Fleurieu Peninsula.	5
Figure 0.4. Breakdown of land use for the Fleurieu Peninsula wetland inventory study region.	6
Figure 1.1. Location of wetlands currently listed on the Directory of Important Wetlands within the Fleurieu Peninsula region.	8
Figure 1.2. Water usage modelling, Fleurieu Peninsula	12
Figure 2.1. Wetland mapping method.	21
Figure 3.1. Priority sub-catchments for field survey identified through existing survey effort.	25
Figure 3.2. Percentage of priority wetlands surveyed.	27
Figure 3.3. Percentage of wetlands surveyed across differing land tenures	27
Figure 4.1. Density of wetlands across the Fleurieu Peninsula region shown as total area of wetland per 20 hectare grid square	30
Figure 4.2. Position of wetlands within the stream network (example sub-catchment)	31
Figure 4.3. Number of wetlands per sub-catchment boundary.	31
Figure 4.4. Percentage of sub-catchment area occupied by wetland bodies	31
Figure 4.5. Major land uses of wetlands on the Fleurieu Peninsula (Source: DCDB).	32
Figure 4.6. Wetland land use of sites surveyed for the Fleurieu Peninsula wetland inventory, onsite and surrounding.	33
Figure 4.7. Wetland types in the Fleurieu Peninsula region (Directory of Important Wetlands in Australia classification)	34
Figure 4.8. Percentage of wetlands within each wetland character group.	36
Figure 4.9. Flora species richness within each wetland character category identified on the Fleurieu Peninsula.	38
Figure 4.10. Fauna survey methods - frequency of use.	42
Figure 4.11. Conductivity of wetlands surveyed for the Fleurieu Peninsula wetland inventory.	44
Figure 4.12. Salinity induced by the water table	46
Figure 4.13. Conductivity distribution of wetlands.	46
Figure 4.14. Conductivity of wetland character categories on the Fleurieu Peninsula.	47
Figure 4.15. Salinity tolerance of commonly recorded wetland flora species on the Fleurieu Peninsula showing minimum / maximum and mean conductivity readings.	48
Figure 4.16. pH values of wetlands surveyed for the Fleurieu Peninsula wetland inventory.	49
Figure 4.17. Turbidity results within EPA guideline ranges as percentage of individual samples.	50
Figure 4.18. Average annual rainfall isohyets – Fleurieu Peninsula.	52
Figure 4.19. Mean monthly rainfall for weather stations on the Fleurieu Peninsula.	52
Figure 4.20. Water sources of wetlands on the Fleurieu Peninsula.	53
Figure 4.21. Relationship between stream order and wetland location.	54
Figure 4.22. Water regimes of wetlands surveyed for the Fleurieu Peninsula wetland inventory.	55
Figure 4.23. Average and maximum water depth of wetlands surveyed for the Fleurieu Peninsula wetland inventory.	55
Figure 4.24. Extent of threatening processes on the Fleurieu Peninsula based on field survey and existing data.	56
Figure 4.25. Threatening processes of wetlands on the Fleurieu recorded during field survey for the Fleurieu Peninsula wetland inventory.	57
Figure 4.26. Severity of overgrazing by different stocking types.	60
Figure 4.27. Density of farm dams on the Fleurieu Peninsula.	63
Figure 4.28. Condition of wetlands expressed as a percentage of all wetlands on the Fleurieu Peninsula.	66

Figure 4.29. Condition of wetlands within major land tenures (expressed as % numbers) of the Fleurieu Peninsula	66
Figure 4.30. Sub-catchment condition as indicated by wetland health	68
Figure 4.31. Condition of wetland character groups on the Fleurieu Peninsula.	69

List of tables

Table 1.1. Summary of past assessments of Fleurieu Peninsula region wetlands.	14
Table 2.1. Existing wetland inventory methods used in the development of the Fleurieu Peninsula wetland inventory.	16
Table 2.2. Data attributes collected during the field survey for each wetland.	17
Table 3.1. Priority scores assigned to ranking parameters for identifying wetlands of high importance for field survey.	26
Table 3.2. Number of wetlands identified for each Priority range.	26
Table 4.1. Wetland character classes – Fleurieu Peninsula.	35
Table 4.2. Most commonly recorded species within each wetland character category identified on the Fleurieu Peninsula.	39
Table 4.3. Turbidity ratings.	49
Table 4.4. Visibility ratings.	49
Table 4.5. Most commonly recorded weed species in wetlands on the Fleurieu Peninsula	58
Table 4.6. Significant wetlands identified on the Fleurieu Peninsula.	71
Table 4.7. Regionally notable wetlands.	73
Table 4.8. Management priorities for significant wetland ecosystems of the Fleurieu Peninsula.	75

List of plates

Plate 1.1. Fleurieu Peninsula wetlands shown abutting forestry practices	10
Plate 1.2. Male Mount Lofty Ranges Southern Emu-wren	13
Plate 3.1. Field survey for Fleurieu Peninsula wetland inventory.	27
Plate 4.1. Typical upper catchment wetland system on the Fleurieu Peninsula, positioned between steeply dissected hills (Upper Tookayerta catchment wetland)	29
Plate 4.2. Examples of wetland character categories on the Fleurieu Peninsula.	37
Plate 4.3. Examples of common flora species within Fleurieu Peninsula wetlands.	41
Plate 4.4. Examples of wetlands with minimum and maximum turbidity readings on the Fleurieu Peninsula.	50
Plate 4.5. Examples of typical wetlands of upper catchment streams (stream orders 1 & 2)	54
Plate 4.6. Examples of weed infestations in Fleurieu Peninsula wetlands.	59
Plate 4.7. Examples of overgrazing and pugging within wetlands on the Fleurieu Peninsula.	60
Plate 4.8. Examples of vegetation destruction in Fleurieu Peninsula swamps	61
Plate 4.10. Examples of freshwater swamp ecosystems on the Fleurieu Peninsula in varying condition	67
Plate 4.11. Examples of wetlands of very high significance for the Fleurieu Peninsula.	72

List of maps

Map 1. Location of Wetlands Surveyed: Fleurieu Peninsula Wetland Inventory	back of report
Map 2. Character of Fleurieu Peninsula Wetlands	back of report
Map 3. Condition of Fleurieu Peninsula Wetlands	back of report
Map 4. Ecologically Significant Wetlands on the Fleurieu Peninsula	back of report

List of abbreviations

AG DEH	Australian Government – Department of Environment and Heritage
ANZECC	Australia and New Zealand Environment and Conservation Council
BDBSA	Biological Databases of South Australia
CAMBA	China – Australia Migratory Bird Agreement
CD	Compact Disc
CP	Conservation Park
DEH	Department for Environment and Heritage
DIW	Directory of Important Wetlands
DO	Dissolved Oxygen
DWLBC	Department of Water, Land and Biodiversity Conservation
DWR	Department for Water Resources
EPA	Environment Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act (1999) (Cth)</i>
FPS	Fleurieu Peninsula Swamps
GIS	Geographical Information Systems
JAMBA	Japan – Australia Migratory Bird Agreement
MLRSEWRP	Mount Lofty Ranges Southern Emu-wren Recovery Program
MLRSEWRT	Mount Lofty Ranges Southern Emu-wren Recovery Team
NLWRA	National Land and Water Resources Audit
NHT	Natural Heritage Trust
NPW Act	<i>National Parks and Wildlife Act (1972)</i>
NTU	Nephelometric Turbidity Units
SA	South Australia
SAWID	South Australia Wetland Inventory Database

INTRODUCTION

The Wetlands Strategy for South Australia was adopted by the South Australian Government in 2003 (DEH & DWLBC 2003). The objectives and actions listed in the Wetlands Strategy guide a whole of government approach for the management, protection and creation of wetlands. The Wetlands Strategy also establishes a framework for a more focused and integrated approach to wetlands management for government and non-government partners.

The State Water Plan 2000 (DWR 2000) clearly articulates wetlands management as an integral part of water resource management in South Australia. The Wetlands Strategy has been developed as an initiative arising from this Plan and demonstrates the South Australian commitment to addressing wetland issues State-wide.

Wetland inventory is addressed within the Wetlands Strategy for South Australia under the following objectives:

- To identify those wetlands which are important at the Regional, State, National and International levels, and ensure appropriate recognition, management and protection of these sites; and
- To develop, maintain, and make readily accessible to all, a comprehensive inventory of South Australia's wetlands and their resources.

To establish the current range, adequacy, status and accessibility to wetland-related data is essential for supporting and guiding the implementation of the Wetlands Strategy for South Australia.

The Fleurieu Peninsula wetland inventory builds upon wetland inventory projects of varying scales already completed within South Australia and provides updated methods, survey protocols and a specifically designed database for guiding future wetland inventories in a whole-of-State approach for standardised inventories. This inventory provides detailed information on the location, condition, threats and conservation value of wetlands throughout the Fleurieu Peninsula. Detailed mapping of wetlands was completed for the entire study region, and data collected was analysed to identify wetlands of ecological significance across the Fleurieu Peninsula.

The information presented within this report will assist in prioritising and targeting future wetlands conservation efforts throughout the Fleurieu Peninsula. It also aids in identifying those wetlands that meet criteria for Nationally Important Wetlands for inclusion in the Directory of Important Wetlands in Australia (Environment Australia 2001).

Project scope

The Fleurieu Peninsula wetland inventory is restricted to wetland habitats within the Fleurieu Peninsula region (see description of study area boundaries). The inventory was to be completed within a twelve-month time frame: from November 2003 to December 2004.

Due to time, funding and accessibility constraints it is not possible for the wetland inventory to encompass all wetland habitats located in the study area. A strategic sampling procedure is used to identify priorities for field survey.

Wetland definition

Wetlands are defined within the scope of this project as areas where water is the primary factor controlling the environment and the associated flora and fauna (Ramsar Convention Bureau 2001). Wetlands, as defined by the Ramsar Convention Bureau (2001) include:

“areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters.”

The very broad definition of wetlands adopted by the Ramsar Convention Bureau has been adopted for this inventory. As a result, the coverage of the inventory extends to a wide variety of habitat types, including freshwater swamps and marshes, estuaries, floodplains and artificial wetlands. Rivers, streams, creeks and marine waters are excluded from this inventory. However, floodplains originating from natural or artificial drainage lines and estuarine wetlands are included.

Specific aims and objectives of wetland inventory

The aims and objectives defined for the Fleurieu Peninsula wetland inventory include the following:

- Review data and literature relevant to Fleurieu Peninsula wetlands and identify gaps in information;
- Develop GIS coverage of wetland bodies within the Fleurieu Peninsula region;
- Design a wetland inventory protocol (based on previous inventory work in South Australia);
- Develop data management and retrieval system in the form of a database that links to the wetland GIS layers;
- Enter existing wetland data into the database, and design a sampling procedure that strategically selects wetlands for survey;
- Undertake wetland field survey of selected wetlands within the Fleurieu Peninsula;
- Analyse wetland data and produce a report which details the condition, character, threats and management issues within the Fleurieu region; and
- Identify wetlands that are of particular ecological significance in the region that could be recommended for listing on the Directory of Important Wetlands in Australia.

Report structure

This report is divided into sections relating to Phases identified for the inventory process (Figure 0.1). Four major Phases for wetland inventory are identified.

Section 1 – Documents Phase 1 of the inventory process: Overview of existing inventories (SA) and data for wetlands within the Fleurieu Peninsula region;

Section 2 – Documents Phase 2 of the inventory process: Detailed description and discussion of methods relating to wetland mapping, survey protocol and the development of South Australia Wetland Inventory Database (SAWID);

Section 3 – Documents Phase 3 of the inventory process: Explanation of sampling strategy and field survey method; and

Section 4 – Documents Phase 4 of the inventory process: Analysis of results and assessment of wetlands.

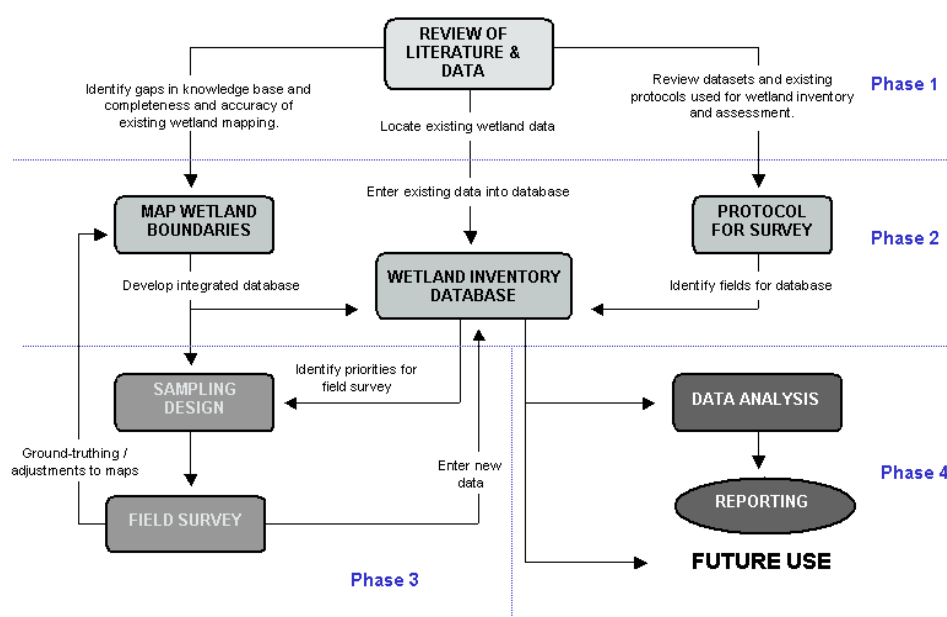


Figure 0.1. Wetland inventory process – Fleurieu Peninsula wetland inventory.

Study area boundaries and characteristics

The study area, as defined in Figure 0.2, covers the Fleurieu IBRA sub-region of the Flinders Lofty Block. The western boundary adjoins the eastern boundary of previous wetland inventory work in the Mount Lofty Ranges (Seaman 2002a). The eastern boundary follows the designated boundary for the Fleurieu IBRA sub-region of the Flinders Lofty Block to the northern point where it intersects the NHT boundary. The Fleurieu Peninsula region as defined by this project encompasses 377 100 hectares.

The Fleurieu IBRA sub-region is predominantly an undulating to low hilly upland with steeper marginal ranges and hills. A laterised surface occurs on the Fleurieu Peninsula and becomes increasingly dissected northward to where rounded crests and summits with mottled yellow duplex soils exist. The lowest lying areas are within the Inman Valley where soft glacial and fluvio-glacial deposits have been lowered more quickly than the surrounding sedimentary rocks (Blason & Carruthers, in prep).

The southern Fleurieu Peninsula area is a plateau with an average altitude of 350m above sea level, dissected by steeply descending creeks with an average rainfall of 850mm per annum (Armstrong *et al.* 2003). In the northern half of this sub-region few native remnants remain. Most common are open woodlands dominated by *Eucalyptus goniocalyx* (Long-leafed box). Regions with higher rainfall and deep, lateritic soils support Eucalypt woodlands and forests commonly dominated by *E. obliqua* (Messmate Stringybark) and *E. baxteri* (Brown Stringybark). Shallower sandy soils support *E. fasciculosa* (Pink Gum) and *E. cosmophylla* (Cup Gum). Eucalypts are replaced by *Allocasuarina verticillata* (Drooping Sheoak) along the coast (Armstrong *et al.* 2003). The southern Fleurieu Peninsula region has a wet and cool climate with predominantly winter rainfall. Average annual rainfall within the study region varies from 300mm in the north of the study region to 1000mm in the upper Deep Creek catchment in the south of the region.

A total of 70 sub-catchments have been mapped within the study region (Figure 0.3). Catchments drain to Gulf St Vincent and the Southern Ocean as well as into Lake Alexandrina and the Lower Murray River. No entirely 'land-locked' internally draining catchments exist. Wetlands rely on a combination of surface and ground-water sources (MLRSEW Recovery Team, in prep a).

Land use is predominantly dedicated to primary industry, with grazing and/or agriculture comprising 69% of the total land use (Figure 0.4). Rural living/hobby farming makes up the next highest land use at 21%. A total of 96.2% of the study region is freehold with crown land making up the remaining 3.8%. A total of 21 individual Conservation and Recreation Parks and Reserves are encompassed by the study boundaries, however these make up a very small percentage, 3% and 1% respectively, of the total area as represented in Figure 0.4.

Freshwater swamps are the dominant wetland types of the area. Four locations within the study area are designated as Nationally significant wetlands under the Australian and New Zealand Environment and Conservation Council (ANZECC) Wetlands Network criteria.

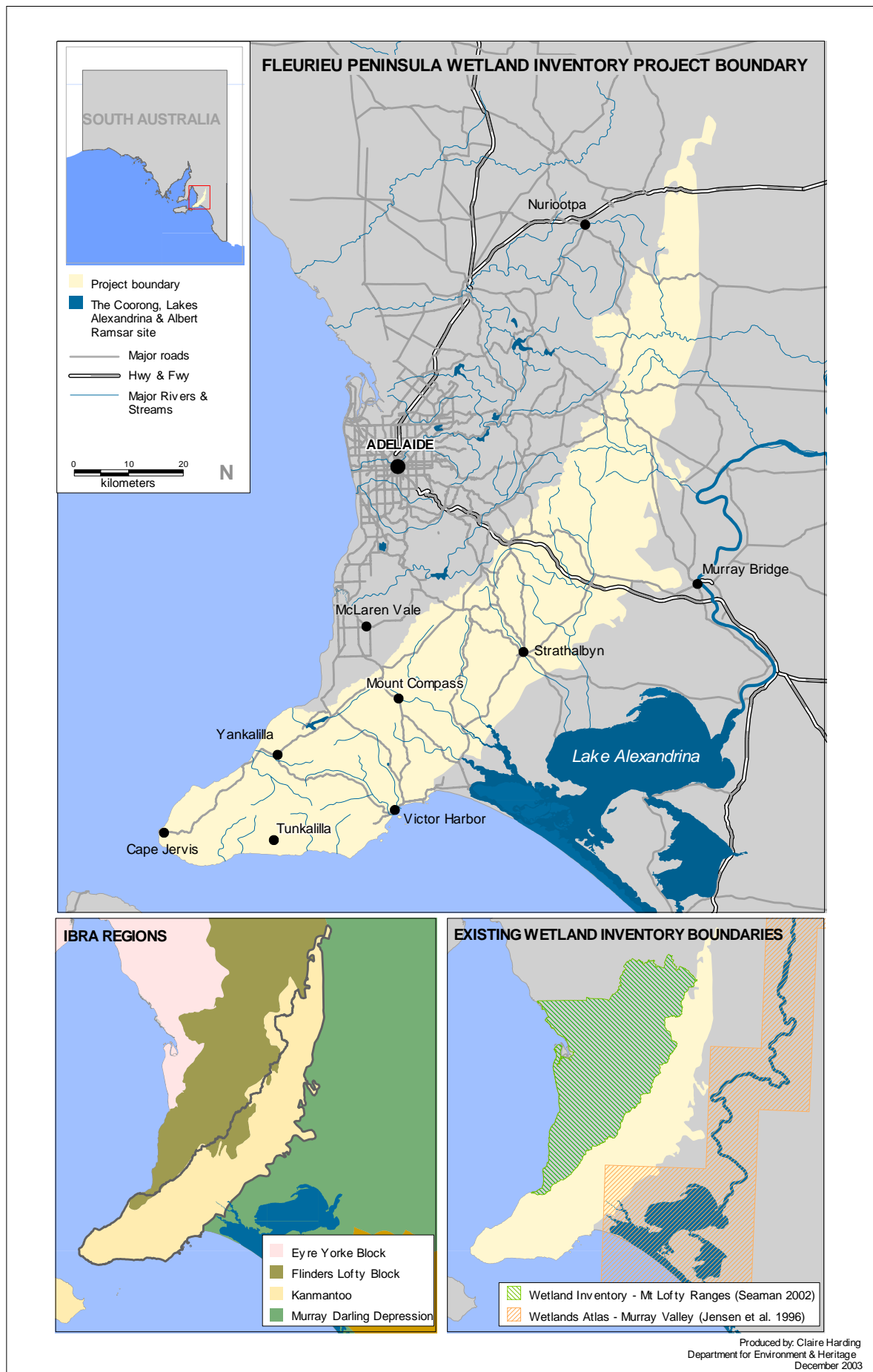


Figure 0.2. Fleurieu Peninsula wetland inventory study region boundaries.

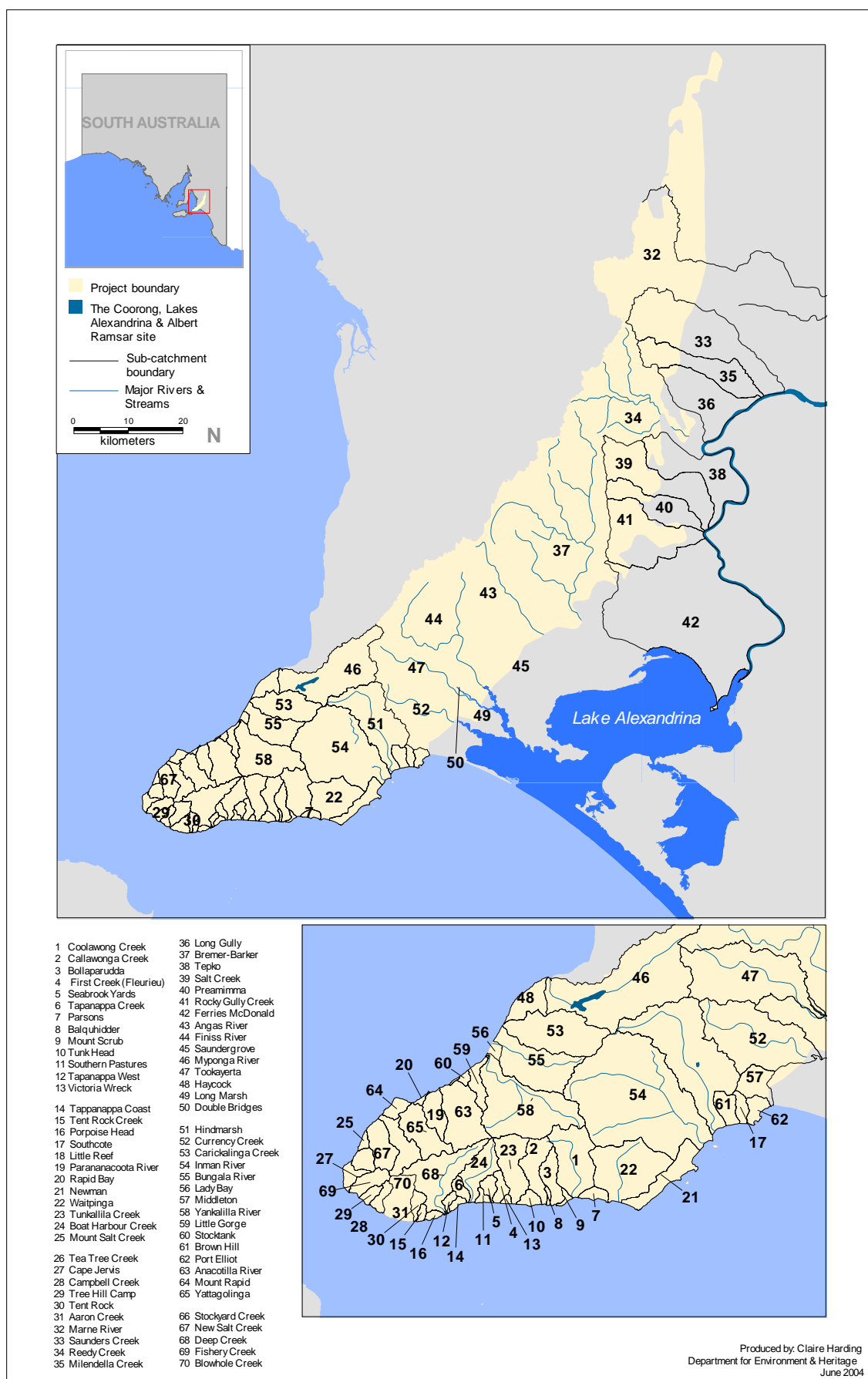


Figure 0.3. Sub-catchment boundaries – Fleurieu Peninsula.

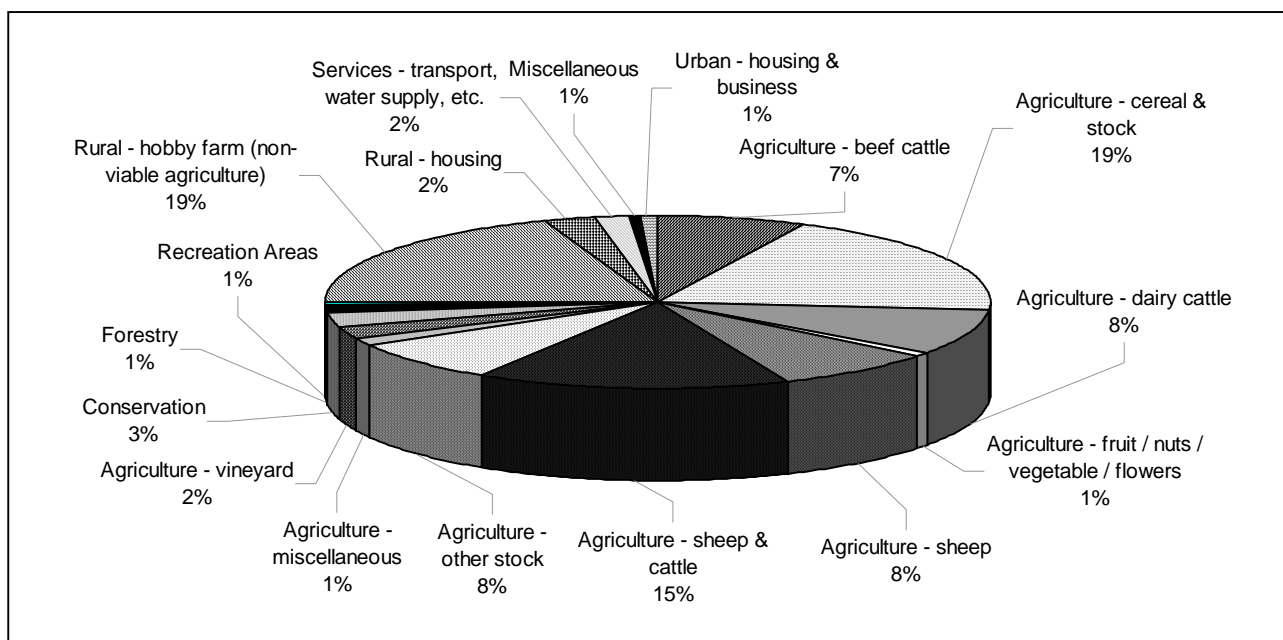


Figure 0.4. Breakdown of land use for the Fleurieu Peninsula wetland inventory study region.

SECTION 1

Overview of inventory data and wetland research in the Fleurieu Peninsula region

1.1 Wetland inventory

South Australia

A desktop study by Lloyd and Balla (1986) identified approximately 1500 wetlands and complexes Statewide which provided a basis for understanding some of the physical and ecological attributes. The listing was a desktop study that collated and recorded information within a standard format including:

- wetland type;
- location;
- size;
- water regime;
- impacts;
- aquatic fauna;
- name;
- catchment;
- wetland condition;
- land use;
- tenure; and
- aquatic and fringing vegetation.

Lloyd and Balla (1986) provide limited information for the Fleurieu Peninsula region, listing incomplete data for only 12 swamps. This document was the most comprehensive dataset for wetlands in South Australia prior to four regional wetland inventories completed by Seaman (2002a; 2002b; 2002c; 2002d).

The Department for Environment and Heritage (DEH) has made a commitment to identify and map priority wetlands for conservation across South Australia (DEH & DWLBC 2003). To date, regional wetland inventories have been undertaken in the following regions:

- River Murray Corridor (Jensen *et al.* 1996);
- Upper South-East (Wilson 1999);
- Mount Lofty Ranges (Seaman 2002a);
- Kangaroo Island (Seaman 2002b);
- Northern Agricultural Districts (Seaman 2002c);
- Eyre Peninsula (Seaman 2002d); and
- Coorong and Lower Lakes (Seaman 2003).

Additional wetland inventories are currently in the process of completion or preliminary planning:

- Lower South East (Taylor in prep, due 2006);
- Channel Country (Wainwright in prep, due 2005);
- Great Artesian Basin Springs (Gotch in prep, due 2006); and
- Upper South-East revision and update (Harding in prep, due 2006).

National and International

The Australian Wetlands Database (AG DEH 2004) and the Directory of Important Wetlands (Environment Australia 2001) identifies Nationally important wetlands across Australia and provides information on each, including their classification and dependent flora and fauna. The Directory is a cooperative project between the Commonwealth, State and Territory Governments of Australia and is available as an online searchable database. A total of four wetland complexes were identified within the Fleurieu Peninsula region currently listed

as: Lanacoona Road Swamps; Tookayerta and Finniss Catchments; Upper Hindmarsh River Catchment; and Upper Tunkalilla Creek Swamps. Figure 1.1 shows the locations of these sites within the Fleurieu Peninsula region.

Wetlands within the database are classified into 40 different wetland types in three categories: A – Marine and coastal zone; B- Inland water; and C – Human-made wetlands. The system was based on that used by the Ramsar Convention in describing Wetlands of International Importance, however it was modified slightly to suit Australian conditions.

The Ramsar Convention Bureau (2002a) listed Wetlands of International Importance. The Coorong, Lakes Alexandrina and Albert Ramsar site occurs to the south-east of the Fleurieu Peninsula region, and incorporates areas of wetlands identified on the Tookayerta and Finniss rivers.

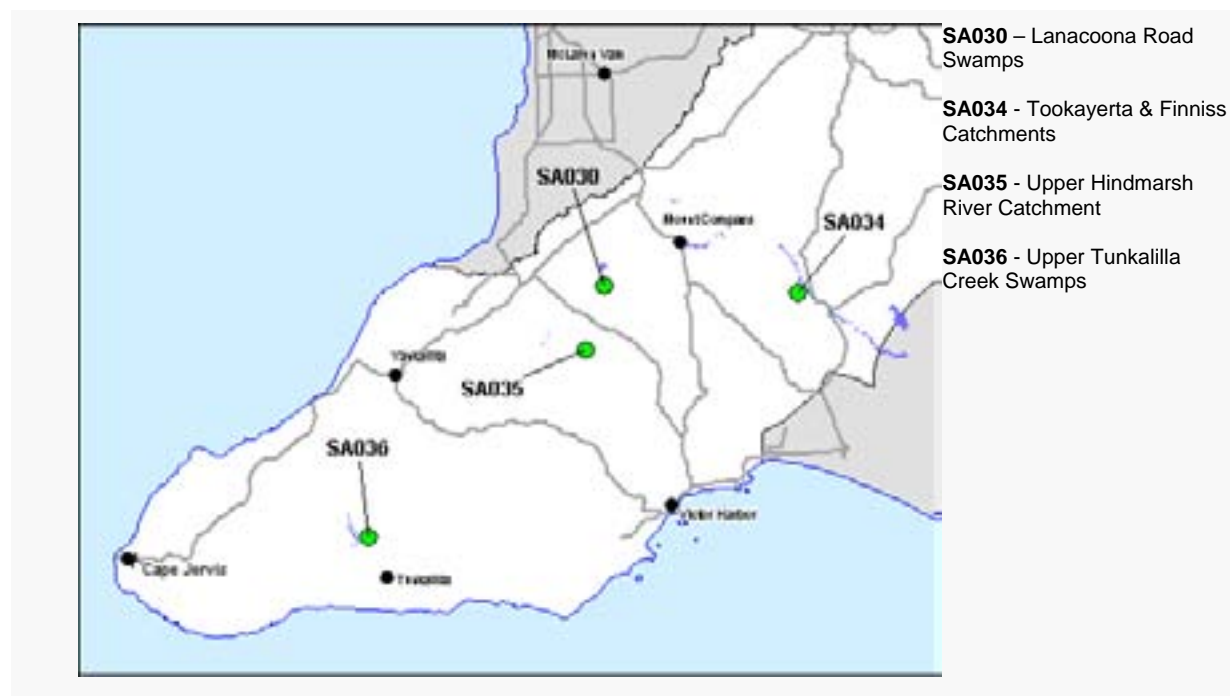


Figure 1.1. Location of wetlands currently listed on the Directory of Important Wetlands within the Fleurieu Peninsula region.

1.2 Overview of Fleurieu Peninsula wetlands

The Fleurieu Peninsula region encompasses several different wetland community types, reflecting the variable landscape of the region. The majority of wetlands within the study area occur in the higher rainfall regions and are generally located along low-lying watercourses. Wetlands located within the higher rainfall regions are often densely vegetated peat swamps, and include spring-fed and perched swamps. Creekline floodplains occur along many drainage lines within the study area and are often broad and dominated by sedges and reeds. Coastal wetlands including estuaries and freshwater lagoons also exist within the Fleurieu Peninsula region, localised on stream outlets in the south of the study region. Salt marsh wetlands are also found along the south-eastern margin of the region and are part of the Lake Alexandrina Complex.

Wetland communities within the Fleurieu Peninsula region include those known as 'Fleurieu Peninsula swamps'. These swamp communities occur only on the Fleurieu Peninsula and have been recognised as a Nationally Critically Endangered ecological community under the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act). Fleurieu Peninsula swamps are characterised by their reedy or heathy vegetation growing on peat, silt, peat silt, or black clay soils (AG DEH 2003). Whilst not all wetlands on the Fleurieu Peninsula are defined under the EPBC Act, those vegetation communities identified as Fleurieu Peninsula Swamps are the most significant from a conservation perspective. Appendix 1 provides a description of Fleurieu Peninsula swamps as defined by the EPBC Act listing.

Fleurieu Peninsula swamps provide various ecosystem services to the Southern Fleurieu Peninsula region. They act as natural water filters to trap sediments and nutrients and to break down pollutants from fertilisers and pesticides and improves the water quality for downstream use. In addition to intercepting surface flow water, many Fleurieu Peninsula swamps exist where natural springs reach the surface and discharge water, thereby providing a perennial water supply.

Land use change, clearing, drainage and filling have reduced the extent of the swamps substantially with as little as 500ha (under 25% of original swamps) remaining as reported by Duffield and Hill (2002). Knowledge of vegetation responses to regional disturbance and altered water regimes is limited. Data from a study of a peat swamp on the Fleurieu indicated that a reduction of species richness occurs when permanently submerged plants are subjected to significant decreases in water level (Roberts 2002; MLRSEW Recovery Team, in prep a). Where drying of the swamps does not affect species richness, morphological changes such as stunted growth have been observed in some species (Roberts 2002).

The Nationally endangered Mount Lofty Ranges Southern Emu-wren (*Stipiturus malachurus intermedius*) occurs only on the Fleurieu Peninsula and the swamps are a habitat type upon which the taxon is largely dependant (Duffield & Hill 2002). A total of 42 plant species and 11 animal species supported by the swamps are listed under the threatened species schedules of the *National Parks and Wildlife Act 1972*. An additional 112 plant and 18 animal species are deemed to be of regional conservation significance. Appendix 2 provides a list of all threatened flora and fauna species recorded within wetland habitats on the Fleurieu Peninsula.

Threatening processes

The economic, social and environmental future of the Fleurieu Peninsula region depends on the sustainable use of water resources. Due to the variable quality of groundwater (Liddicoat *et al.* 2004), surface water has been widely exploited. Pressure on water resources throughout the Fleurieu Peninsula including dams and bores has been investigated with water usage models (pers. comm. Doug McMurray, unpublished data, DWLBC). Figure 1.2 displays preliminary modelling of water resource issue hotspots throughout the Fleurieu region.

A total of 12 648 individual dams have been mapped for the Fleurieu Peninsula region, with an estimated total storage capacity of greater than 42 000 ML when full (source: Farm Dam mapping, DWLBC). Farm dam development, as well as direct pumping from watercourses, can impact on the water available to downstream users, including wetlands dependant on stream-flow. Dams have the potential to impact on the size and duration of low and medium flows and may increase the frequency and duration of no-flow periods (Liddicoat *et al.* 2004). DEH & DWLBC (2003) estimates that up to 80% of the natural water flows in the Adelaide and Mount Lofty Ranges area are intercepted by reservoirs and dams.

Blue-gum forestry is an emerging industry across the Fleurieu Peninsula, with some 10,000 ha of scattered farm forestry proposed. Targeted areas are often in the hinterlands of wetland systems identified in this report where rainfall is high and the local topography facilitates inundation. The hydrological impacts to wetlands are potentially significant without site-specific modelling. Such modelling should identify the water requirements of the proposed forestry and compare it with the availability of surface and ground water. The water requirements a plantation should draw sustainably on the available environmental flows and not lead to a decline in the ecological character of natural wetland systems.

Additionally, water availability to swamps in catchments dominated by forestry practices may have decreased as the plantations have matured, thereby using more water resources (Pickett 2003). Figure 1.2 (4) shows the location of pine plantations within the Fleurieu Peninsula region. Theoretical work undertaken in 2001 to investigate the potential for forestry practises to reduce runoff into creeks indicated that careful analysis of the types and locations of plantations is required to ensure groundwater, and therefore wetlands are not deprived of recharge potential (Australian Government 2001). Recent research has shown that the age, type and management of the plantations can also affect the amount of water uptake. Forested areas uptake more water than pasture or cropped land, a figure that increases with the age of the plantation and therefore the size of the trees. In addition higher rainfall areas are more susceptible to a reduction of runoff from plantations than lower rainfall areas. Other factors related to the forestry industry which may affect water runoff into creeks and aquifers include the soil type, topography and position of the forests. Suggestions to negate these effects include well managed thinning of plantations and locating the stands further away from creeks and drainage lines (Keenan *et al.* 2004).

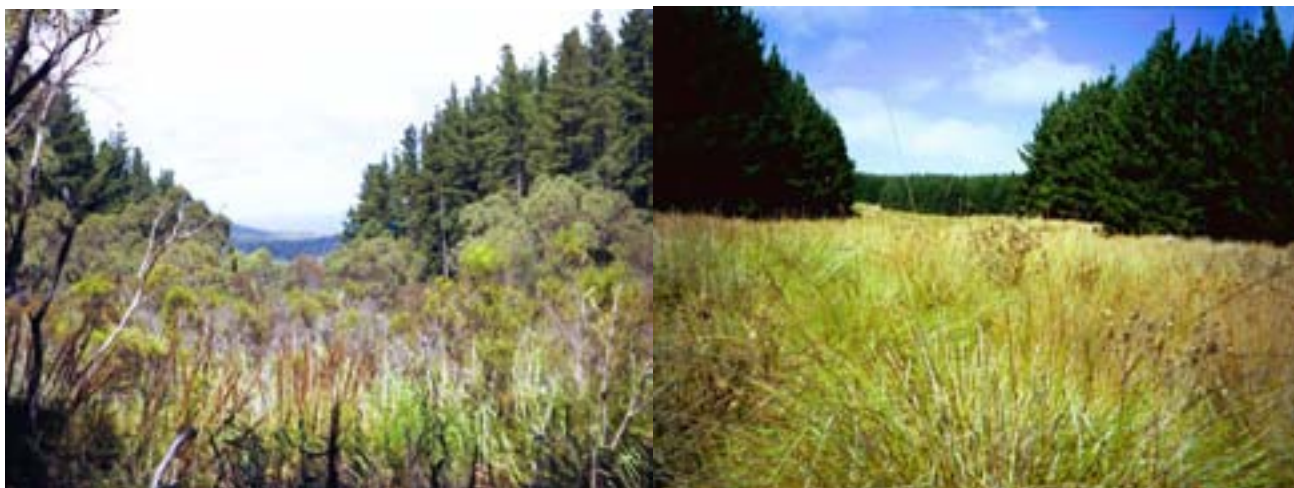


Plate 1.1. Fleurieu Peninsula wetlands shown abutting forestry practices.

The potential impact of sand mining is of some concern to neighbouring wetlands as mining operations may effect the permeation of water from spring-fed sources. Changes to water quality or quantity may negatively impact on the swamps. Mining operations involve the removal of vegetation and bring about changes to the topography and natural drainage of catchment areas. This contributes to a loss of surface water flows.

These reductions in water resources affect the ability of many wetland ecosystem dependant flora and fauna to survive over seasonal or episodic drought (DWR 2000) and influences wetland communities through changes in water regimes (ie, from permanent to seasonal). Hydrological requirements of swamps are poorly understood, as are the physical and ecological processes operating in the swamps (MLRSEW Recovery Team, in prep a).

Further investigation into the state of water resources in the Fleurieu Peninsula, as it relates to water resources, environmental water requirements and urban water demand is currently in progress (pers. comm. E. Pikusa, DWLBC). This investigation will include hydrological and hydrogeological assessment of swamps on the Fleurieu Peninsula and will greatly improve the current knowledge relating to water requirements of endangered wetland ecosystems.

Weed infestations documented as significant within wetland habitats of the Fleurieu Peninsula include Radiata Pine (**Pinus radiata*) (specific to wetlands occurring in pine plantation blocks), Blackberry (**Rubus discolor*) and Gorse (**Ulex europaeus*) (Pickett 2003). Pasture grasses and herbs have also invaded many of the drier swamp areas and are common where stock grazing occurs within the wetland, and where land clearance has removed native vegetation buffers between the wetland and agricultural practices.

Ongoing cumulative vegetation clearance is still occurring, some legal, some illegal and some accidental and is a continuing threat to these swamps (MLRSEW Recovery Team, in prep a).

Drainage, over-grazing, aerial application of herbicide, peat extraction and local dieback caused by *Phytophthora cinamomi* have also played a part in the overall reduction in wetland area in this region (DEH & DWLBC 2003; MLRSEW Recovery Team, in prep a). In addition, land management practices with an over reliance on the use of fertilisers and herbicides often result in high loadings of nutrients and other chemicals within the wetlands. All swamp biota are particularly sensitive to such influxes (MLRSEW Recovery Team, in prep a) and some swamp plants have a low tolerance to salinity (Croft 1999), which is increasing due to land clearance and irrigation practises (MLRSEW Recovery Team, in prep a).

The potential impacts of climate change on wetlands are based on studies assessing the effects on wetland plant communities of climate variability and overuse of water resources. The effects generally involve the replacement of original wetland species with other types of wetland species (e.g., succession of swamp and fen peatland communities to bog peatland communities) or forest or heathland species, and associated effects. Related to this, climate warming could promote the invasion of alien species and the range expansion of existing alien species (Ramsar Convention Bureau 2002b). The extent of effects of climate change on Fleurieu Peninsula swamps is largely unknown, although continual drying over time is expected.

Relevant legislature

The *Native Vegetation Act 1991* prohibits the clearance of native vegetation in South Australia (including native vegetation associated with swamps) without approval. However, vegetation clearance can still occur to maintain existing land uses such as cultivation, pasture or forestry (*Regulation 5(1) (zf) Native Vegetation Act 1991*). Some illegal clearance also occurs (MLRSEW Recovery Team, in prep a).

Wetlands identified as Fleurieu Peninsula Swamp ecological communities are listed as critically endangered under the EPBC Act (see <http://www.deh.gov.au/epbc/index.html>). The majority of these wetlands are located on privately owned land which results in some land use restrictions. However, under the 'continuing use' provisions of the EPBC Act, allowance is made for the continuation of certain land management activities under the following criteria:

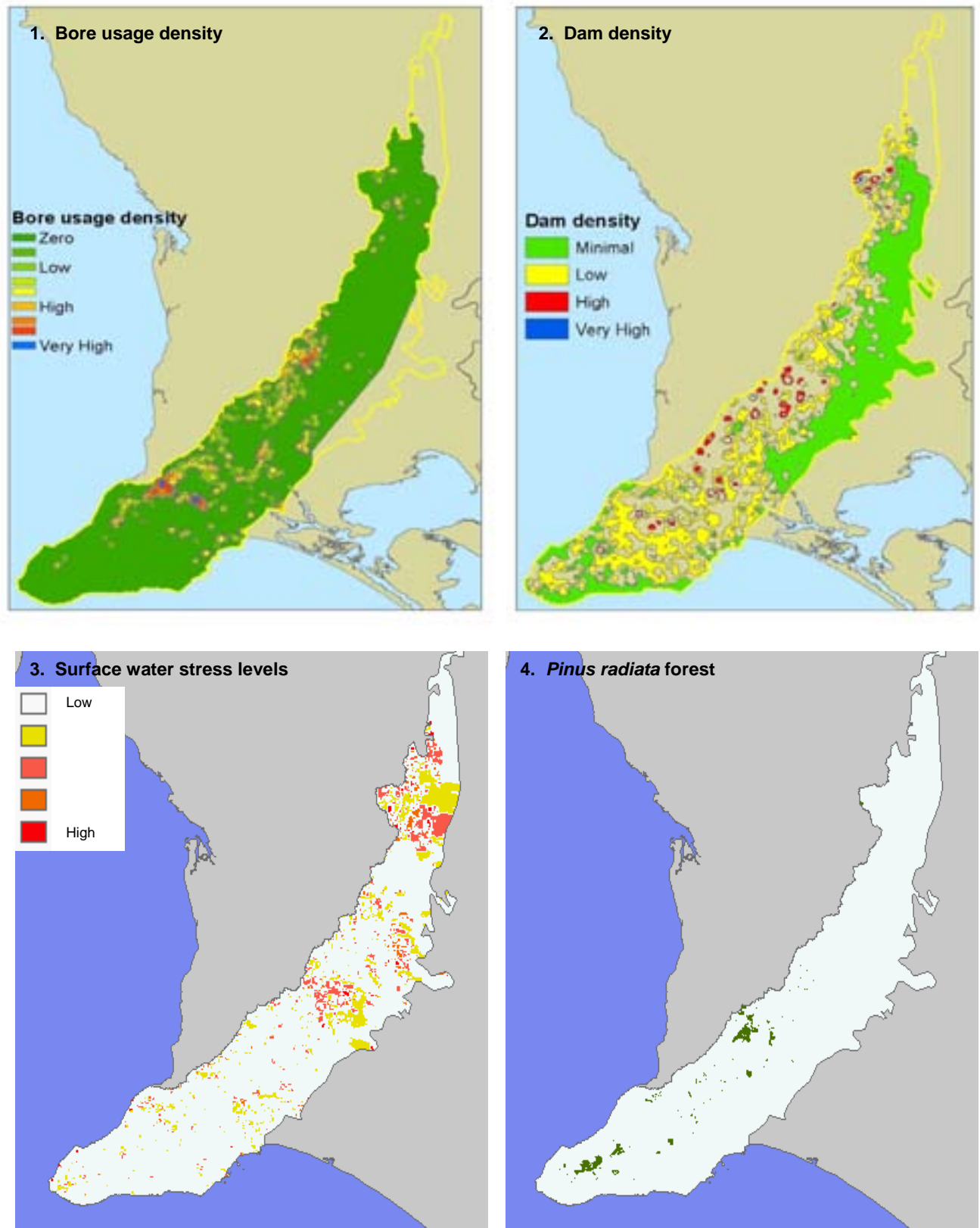
- the action was specifically authorised (e.g. by a permit or approval) under a Commonwealth, State or Territory law before 16 July 2000; and
- immediately before 16 July 2000, no further environmental authorisations were necessary; or
- the action was not specifically authorised before 16 July 2000; and
- the action is a lawful continuation of a land use, sea or seabed; and
- the use was occurring immediately before 16 July 2000; and
- the use has not been enlarged, expanded or intensified.

However new or intensified activities that are likely to impact on the ecological community will require a referral under the EPBC Act. In addition, some land use activities may also require approval at a State level.

Fleurieu Peninsula Swamps are recognised as critical habitat in the recovery of the Mount Lofty Ranges Southern Emu Wren which is listed as Endangered under the EPBC Act. This provides a second trigger for referral to the EPBC Act.

The *Water Resources Act 1997* requires that the water requirements of dependent ecosystems are determined as part of the planning process, where the environment is recognised as a legitimate user of water. The Act has provisions for a licensing regime where there are high water demands in a particular region, such as the Fleurieu Peninsula. This applies to both surface and groundwater resources. However, the Act requires that a water allocation plan be developed which investigates the sustainable water resource limits and environmental water requirements before legislation can be enforced. The procedure requires extensive research and ministerial, stakeholder and public consultation. The Southern Fleurieu Peninsula region has many users of its water resources, including Nationally significant wetlands.

A Water Allocation Plan is now in progress for the Southern Fleurieu Peninsula region (J. Vanlaarhoven pers. com. DWLBC).



1. *Bore usage density*: Based on operational bores 2002, yielding >3L/sec and run at max recorded yield for 500hrs/yr with a cap of 50ML per bore. Bores summed in 1km radius circles. Smoothing applied. Values in ML. (Source: unpublished data: Hotspot Modelling by D. McMurray, DWLBC) 2. *Dam density*: Based on 50% (25% usage, 25% evaporated) of estimated volume. Values are combined volume water in ML removed by all dams in 1km radius circles. Smoothing applied. (Source: unpublished data: Hotspot Modelling by D. McMurray, DWLBC) 3. *Modelled stream stress levels*: Values are percentage of modelled runoff that is removed by usage and evaporation from farm dams. Quantity of water used and evaporated each assumed to be 25% of estimated volume (ie. 50% of volume). Modelled runoff based on tanh equation of rainfall. (Source: unpublished data: Stream and Catchment Stress Modelling by D. McMurray, DWLBC). 4. **Pinus radiata* Forests: Mapped locations of *Pinus radiata forestry reserves. (Source: FORESTS GIS dataset, DEH)

Figure 1.2. Water usage modeling, Fleurieu Peninsula.

1.3 Wetland assessments in the Fleurieu Peninsula region

The most comprehensive data on Fleurieu Peninsula swamps has been collected by the Mount Lofty Ranges Southern Emu-wren Recovery Program (MLRSEWRP) (Table 1.1). The program was established in 1993 to identify the distribution and establish a recovery plan for the endangered Mount Lofty Ranges Southern Emu-wren (*Stipiturus malachurus intermedius*), a species restricted to swamp and dry heath habitats of the Fleurieu Peninsula. The Program sponsors on-ground vegetation works on Fleurieu Peninsula swamps, vegetation analysis, providing swamp management guidelines (Duffield & Hill 2002) and can offer technical advice to landholders on best practice / adaptive management of the swamps to maximise biodiversity outcomes (pers. comm., Michelle Drew, MLRSEWRP).

Literature and data reviews identified sources of information currently existing for wetlands in the Fleurieu Peninsula. This data provides a survey history for the Fleurieu Peninsula wetlands (Table 1.1) and aids in identifying inadequacies in the current data sets.

A number of biological surveys have involved flora assessments of wetlands within the Fleurieu Peninsula region. These were identified from Biological Survey databases (BDBSA) and are listed in Table 1.1. The surveys provide species lists for a total of 201 vegetation quadrats surveyed in 64 wetland bodies within the Fleurieu Peninsula region. Generally, the flora data is of high quality, however these surveys have lacked essential baseline wetland information as data has been collated for a variety of purposes and were often not specific to wetlands. Targeted surveys such as EPA Frogwatch census (Walker 2003), and fish inventories (Hammer, in prep; Wedderburn & Hammer 2003) provide species lists for a limited number of wetlands on the Fleurieu.

The MLRSEWRP has recently released Draft Recovery Plans for 2004 – 2008 for the Fleurieu Peninsula Swamps and the Mount Lofty Ranges Southern Emu-wren (MLRSEW Recovery Team, in prep a&b). Further information on the Mount Lofty Ranges Southern Emu-wren Recovery Program (MLRSEWRP) can be obtained from Conservation Council of South Australia (08) 8223 7473 or email: emuwren2@ccsa.asn.au (website: www.ccsa.asn.au/EmuWren/wren.html).

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Plate 1.2. Male Mount Lofty Ranges Southern Emu-wren (*Stipiturus malachurus intermedius*)

Existing wetland mapping for the Fleurieu Peninsula was produced by the MLRSEW Recovery Team (Littlely & Cutten 1994) and identified swamps as part of a study of presence and absence of Mount Lofty Ranges Southern Emu-wren populations. This layer has major spatial errors (projection and rectification errors) and errors of commission and omission, where many known wetlands are not identified (Pickett 2003), or are misidentified. A total of 529 Fleurieu Peninsula swamp units were identified in this layer. Pickett (2003) however provides accurate mapping for wetlands identified within the Second Valley Forest pine production blocks in the Southern Fleurieu region.

Considering the relative abundance of wetland information for the Fleurieu Peninsula, no study has documented hydrological processes, attempted to define wetland condition or wetland character on a regional scale. While projects such as Wetland Resources of South Australia (Lloyd & Balla 1986) and the Directory of Important Wetlands in Australia (Environment Australia 2001) attempt to provide detailed information on wetlands, the scale of study was far too broad to be capable of providing this information for any more than a few individual wetlands.

Table 1.1. Summary of past assessments of Fleurieu Peninsula region wetlands.

Survey Name	General Description / Objectives	Time-frame of surveys	Publication	Number of Wetlands surveyed
Mt Lofty Southern Emu-wren Survey (MLRSEW Recovery Program)	Database of sightings and known former locations of Mount Lofty Ranges Southern Emu-wren, including GIS layer (Emuswamp). This project also includes surveys completed to determine the status of known Emu-wren habitats and to compare swamp characteristics with species presence and absence.	1993-2004	Emuswamp (1993) (GIS layer) M. Pickett (unpublished data)	82
Mt Lofty – Private Collectors	Record base-line data for remnant vegetation and swamps within the Southern Fleurieu Peninsula region and northeast of Adelaide including wet creekline and peat bog swamps (Nangkita, Mt Compass, Parawa, Myponga).	1987 - 1991	Southern Districts Environment Group (1988)	32
Swamp Trial Project	Series of management plans prepared for providing technical advice to landholders on swamp management on private land as part of the MLRSEW Recovery Program.	2003 - 2004	M. Drew (unpublished reports)	27
EPA Frogwatch - census data	Community survey of frogs throughout SA using audio recording, coordinated by EPA. The Frog Census provides a 'snapshot' of the distribution and abundance of frogs in SA.	1994 - 2002	Walker (2003)	21
Fleurieu Peninsula – Second Valley Forest	A survey of the location, extent, type and condition of Fleurieu Peninsula Swamp within Second Valley Forest timber production area.	2003	Pickett (2003)	20
Biological Survey Database – Plant Population record	Records from BDBSA plant population database.	Early settlement - 2003	N/A	
Directory of Important Wetlands in Australia	Identifies Nationally important wetlands across Australia and provides information on each, including their classification and the dependent flora and fauna. The Directory was last updated for South Australia in 1995.	1995	Environment Australia (2001)	18
Mt Lofty Ranges	Data collected to classify and map plant communities in the southern Mount Lofty Ranges as part of a fire management system. The study included the Mount Lofty Ranges area with an emphasis on forest woodland and heath with a shrub understorey	1986 - 1987	Unknown (1986)	12
Southern Mt Lofty Ranges	Biological survey of remnant native vegetation (flora and fauna) in the Southern Mount Lofty Ranges area.	1999 - 2000		11
Eastern MLR Fish Inventory	Broad baseline survey of aquatic habitats in the Eastern Mount Lofty Ranges region. Fish sampled at sites using seine nets, bait nets and dip-netting.	2004	Hammer (in prep)	8
Biological Survey Database - Opportune records	Opportunistic sightings of fauna and flora recorded in BDBSA.	1967 - 2002		5
Phytophthora Project	Recorded the presence (suspected by physical observation and/or confirmed by soil testing) of Phytophthora in native vegetation.	1995 - 2002		5

Wetlands and Water Resources of South Australia	A desk-top study that provided base-line data on selected wetlands throughout South Australia.	1980 - 1986	Lloyd & Balla (1986)	5
Fleurieu Roadside Survey (M. Hyde)	To map remnant roadside vegetation in the areas of Yankallila, Victor Harbor, Port Elliot and Goolwa.	1996 - 1999	Hyde (1997; 1998; 1999)	3
Southern Fleurieu (SEG)	An evaluation of the biodiversity of road reserves on the Southern Fleurieu Peninsula.	1997 - 1998	Unknown (1997 – 1998)	2
Mount Lofty Ranges (DEP 1981)	Vegetation survey to determine conservation significance in the Mount Lofty Ranges area: Angaston in the north to Myponga in the south and bounded by Lake Alexandrina in the south east.	1979 - 1980	Mitchell <i>et al.</i> (1981)	1
Wetlands Inventory for the Mount Lofty Ranges	Physical. Chemical and biological attributes from a sample of wetlands. 85 wetlands were surveyed which included brackish water bodies, freshwater wetlands, bogs and constructed wetlands.	2002	Seaman (2002)	85
Birds for Biodiversity – Mt Lofty Ranges	Assess habitat restoration potential for providing habitat for declining birds on selected properties in the Mount Lofty Ranges.	2004	Croft (in prep)	1
The Lower Lakes Fish Inventory	Broad baseline survey of aquatic habitats in the Lower Lakes region. Fish sampled at sites using seine nets, bait nets and dip-netting.	2003	Wedderburn & Hammer (2003)	1