The Department of
Water, Land and
Biodiversity
Conservation

Salinity and Water Quality Management in the Inman River, Waitpinga and Coolawang Creek Catchments

Craig Liddicoat, Bill New and Tim Herrmann

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Land and Biodiversity Services Division

Land Management and Revegetation Group
Department of Water, Land and Biodiversity Conservation
Soil and Water Environs Centre, Waite Rd, Urrbrae
GPO Box 2834, Adelaide, SA, 5001

Telephone	National	(08) 8303 9500
	International	+61 8 8303 9500
Fax	National	(08) 8303 9555
	International	+61 8 8303 9555
Website	www.dwlbc.sa.gov.au	

Inman River Catchment Group

c/- City of Victor Harbor
Bay Rd, Victor Harbor
PO Box 11, Victor Harbor, SA, 5211

Telephone	National	(08) 8551 0500
	International	+61 8 8551 0500
Fax	National	(08) 8551 0501
	International	+61 8 8551 0501

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A tributary of the Inman River

EXECUTIVE SUMMARY

The combined catchments of the Inman River, Waitpinga and Coolawang Creeks (and minor catchments of Newland Cliffs and Parsons Beach) are typical of the agriculture based catchments found in the Southern Fleurieu Peninsula. With a combined area of around 32,230 ha, roughly 80% of the land is involved with agricultural production and the balance largely comprises protected/ conservation areas, residential land use and forestry. Interspersed among these land uses, native vegetation covers around 17% of the study area.

The mix of rural and urban land uses in these catchments place significant demands on land and water resources while their associated activities have the potential to degrade these resources. Those who rely for a living on the natural resources of the region, owe their future to the sustained health of the soils, waterways and natural habitats that provide the foundations for economic production and our social well being. Land managers are also increasingly recognised as custodians of that other important 'user' of our natural resources, the environment itself.

The regularly competing demands and pollution pressures acting on our natural resources (particularly water), and threats to our native biodiversity are only likely to intensify with future development and increasing populations. The information contained in this report will assist with an integrated approach to natural resource management that will hopefully enable sustainable catchment management and development.

This report compiles and summarises information and data from various sources, with a focus on salinity and water quality issues. Management options to address these issues are also presented. The following topics are discussed in more detail:

Salinity and Water Resources

Highly salinised land occupies less than 1% of the landscape, however some catchments (eg. Waitpinga) have significantly larger areas affected by moderate levels of salinity.

Surface water salinity is a significant issue in some catchments (eg. Inman River, Halls Ck, Waitpinga Ck) and generally varies in seasonal cycles. The highest salinities occur during reduced summer flows, due to the dominance of higher salinity baseflows.

Extraction of water directly from watercourses (reducing dilution flows), and on-stream dams (intercepting dilution flows and concentrating saline baseflows) are thought to contribute to elevated surface water salinities. Elsewhere, dam siting issues can significantly impact on the salinity of harvested water.

Underground water is of variable quality and yield. Low yields or elevated salinities generally limit usage, however there is potential for further use of this resource where locally suitable groundwater, and land suitable for the intended use, can be found.

Priority areas for the management of salinity have been identified and management options/ strategies are suggested for a range of different scenarios.

Estimates of water balance components (rainfall, evapotranspiration, runoff and recharge) were calculated for each of the catchments using approximate GIS based techniques (see Appendix 6). They show reasonable agreement with existing previously calculated values determined for the Inman River catchment.

The impact of farm dams and direct extraction from watercourses, on overall catchment streamflows, requires further investigation. Previous estimates of farm dam volumes (determined using aerial photography) are approximately 10-20% of calculated estimates for annual streamflows. This indicates there may be potential for further development, under the policy of dam volume limits equivalent to 50% median annual runoff and assuming dams fill once per year. However better information on actual surface water harvesting and extraction regimes is required before an accurate assessment can be made.

The need to establish environmental flow requirements is also recognised and it is likely that water use/ dam volume limits will be reviewed when better information becomes available (see section 3.1). Ideally, decisions regarding further dam development should be based on better knowledge of current diversions and environmental flow requirements.

Dam developments, and other 'new or intensified activities', occurring in sub-catchments containing protected swamps, require approval in accordance with requirements of the Federal EPBC Act (see section 2.3.4).

Acidity

Acidity is an important issue in the study catchments (see section 6). Over one third of the landscape has surface and subsoils susceptible to acidity combined with surface soils of a low capacity to resist acidification. Acidification of soils reduces productivity and economic returns. In addition, poor crop performance lowers water use, giving rise to potential salinity impacts.

Acid soils also have the potential to cause environmental harm through acidic runoff (and associated pollutants), however there is no evidence of this occurring in the study area.

Nutrients and Pathogens

Agricultural effluent from intensive industries, land and stream bank erosion, inefficient use of fertilisers, poorly managed stock access to waterways, lack of buffering for watercourses from agricultural activities and poorly maintained septic tanks are among the potentially significant sources of nutrient and pathogen pollution to watercourses. Appropriate management practices, codes of best practice and legislation (where applicable) are discussed.

Nutrient rich discharge to the lower Inman River from the Victor Harbor Waste Water Treatment Plant (WWTP) will be discontinued in the near future when the plant is replaced by a new facility capable of producing high quality recycled water for irrigation.

The role of native vegetation

Protection and enhancement of existing vegetation (including riparian zones), revegetation of cleared land, linking of vegetation corridors, and weed and feral animal threat abatement will have multiple benefits for salinity, water quality and biodiversity (see section 3.3).

Vegetation mapping has been undertaken, to provide an indication of pre-European vegetation across the study area. Species lists and guidelines are presented to assist with revegetation activities (see from section 2.3.2 and Appendix 14).

Implementation of integrated natural resource management

Successful implementation of INRM objectives requires partnerships between the community, land managers and all levels of government. The development of community understanding of, and capacity to tackle, the NRM issues is an important step. Property based planning will also play a fundamental role in ensuring that relevant NRM issues are addressed while also achieving objectives related to the continued operation of respective farming systems.

Stakeholders should be mindful of the different time scales over which NRM issues can operate and try to achieve balanced, positive outcomes. For example, recharge reduction through planting perennials (revegetation, farm forestry, etc.) in saltier sub-catchments may have short-term negative impacts on stream flows (and salinity), but is more likely to produce improved water quality in the longer term through reduced groundwater discharge (baseflow) to streams.

This study has highlighted some of the major issues that need to be considered by existing land users and those who will come in the future. Sustainable development will only be achieved when the impacts on our natural environment are minimised and economic outputs contribute to sustaining local communities and the land on which they depend.

Summary of the Report's Recommendations

ASSESSMENT OF WATER RESOURCES AND ENVIRONMENTAL FLOWS

Recommendation 1: Water resources

That study of water resources be undertaken, to develop greater understanding of:

- water use by property owners, especially rates of extraction directly from watercourses, and
- environmental flow requirements.

Findings should be incorporated into a Water Plan for the Southern Fleurieu.

Recommendation 2: Monitoring

Monitoring programs continue or be expanded to adequately monitor stream salinity. At selected locations additional parameters (including flow) should also be measured. Locations of sampling points need to be strategically placed to enable ease of sampling and to capture information relevant to the various sub-catchments. At selected sites, the adequacy of environmental flows should be monitored, once requirements have been established.

It is also suggested that a comprehensive survey/ audit be conducted to determine the salinity of farm dams. Ideally this would be undertaken in spring and autumn to obtain information on seasonal variability.

These measures require funding and capacity building for ongoing work.

IMPROVEMENT OF LAND MANAGEMENT

Recommendation 3: Building landowner understanding of NRM issues

Programs that develop and build landowner understanding of NRM issues and appropriate management options be continued and expanded.

Recommendation 4: Property-scale planning

Landholders be encouraged to develop basic property plans that enable them to clearly target the key NRM issues on their property and identify actions to manage and address them. Appropriate technical assistance needs to be available to support this process, which is an important preliminary step before undertaking on-ground works.

Recommendation 5: Rubbish disposal

Landholder awareness/ education programs be implemented to discourage (and clean up) on-property disposal of refuse.

ON-GROUND WORKS

Recommendation 6: Actions to address NRM issues

Programs be established to assist landholders to address identified NRM issues on their property. Activities should be based on appropriate planning at the property scale, and are likely to include:

- Salinity control measures in priority areas (see Tables 9,10 & Figure 15).
- Soil acidity mitigation measures in priority areas (see Figure 17 & section 6.3).
- Erosion potential reduction in priority areas (see Figure 16).
- Addressing the decline and fragmentation of native vegetation (see section 3.3).
- Revegetation for economic and environmental outcomes (see section 3.3 & Appendix 14).
- Addressing declining water quality, including potential nutrient and other pollution sources (see Table 12 & sections 5.3, 8). This includes fencing off watercourses to buffer and control stock access.
- Addressing water repellent soils in priority areas (see Figure 18).

WATER RESOURCE MANAGEMENT

Recommendation 7: Management of effluent

A program be implemented to advise and assist operators of intensive agricultural industries to meet the recommended EPA guidelines regarding effluent management and disposal (see section 5.3).

Recommendation 8: Dams

Low-flow bypass structures be installed on dams that are on-stream and collect baseflows during summer. Future dams be sited with regard to issues of salinisation associated with interception of saline groundwater flows (see section 4.3, p48).

Recommendation 9: Septic tanks

An education program be conducted to inform property owners of their responsibilities regarding the operation of septic tanks. This may include an audit on septic tanks, particularly where they are located adjacent to watercourses.

Recommendation 10: Farm forestry and water balance

Impacts of farm forestry on catchment water balance (and salinity) be investigated. Studies undertaken should include comparisons with sub-catchments under remnant native vegetation cover. Findings should be incorporated into a Water Plan for the Southern Fleurieu.

BIODIVERSITY PROTECTION

Recommendation 11: Swamps

Management of swamps follow accepted protocols in accordance with their protection under the Federal Environment Protection and Biodiversity Conservation Act (see section 2.3.4).

Investigate the opportunities for establishing or enhancing swamps for biodiversity, education and/ or ecotourism.

Recommendation 12: Farm forestry and biodiversity

The value of farm forestry in complementing biodiversity conservation be investigated.

Recommendation 13: Southern Pygmy Perch

A specific program to secure and conserve the critically endangered Southern Pygmy Perch be undertaken, in the tributary of the Inman River where it has been found (see Appendix 5). [Also see Recommendations 1 and 2.]

ADDITIONAL RESEARCH RELEVANT TO THE GREATER MOUNT LOFTY RANGES REGION (AND OTHER PARTS OF SOUTH AUSTRALIA)

Recommendation 14: Long-term riparian management

Research / adaptive management methods be undertaken to develop improved management options and practices for riparian areas once stock are excluded. Issues include weeds, haven for feral animals, fence maintenance, access, impact on farm operations and water supply regimes, impact on workloads, role of strategic grazing, etc.

Recommendation 15: Impacts of salinity management

Research be performed into the impact of implementing high water use options across the catchments for management of salinity and the impact of this on stream flow patterns and subsequent implications for stream health and quantities of water available for irrigation, etc.

1 INTRODUCTION

Overview

The natural resources of the Inman River, Waitpinga and Coolawang Creeks (and minor catchments of Newland Cliffs and Parsons Beach), underpin the social well-being and economic productivity of local communities, while typifying the valuable environmental assets common to the Southern Fleurieu Peninsula.

Significant demands have already been placed on these resources from both rural and urban populations, and continued development is likely to intensify the pressure on land, water and biodiversity resources.

The importance of protecting the region's natural assets has been recognised in particular by the members of the Inman River Catchment Group (IRCG). This report grew from this community group's desire for a better understanding of salinity and water quality issues in the area, and a call for information to assist with natural resource management (NRM) planning and allocation of funding for on-ground works.

The resulting report sets out to consolidate existing information, and identify options and priority areas for addressing a range of NRM issues. Advances in revegetation planning and salinity management have been achieved through the careful analysis of existing natural resource information (including spatial datasets) and the application of expertise, accumulated by many experienced workers in these fields. This has included key inputs from the Department of Water, Land and Biodiversity Conservation (DWLBC), Rural Solutions SA and local knowledge from members of the IRCG.

This report has been made possible, and we believe highlights the value that can be attained, through successful partnerships between community/ catchment groups, State Government agencies and the Commonwealth (National Action Plan for Salinity and Water Quality).

Background

With the release of the *Integrated Natural Resource Management Plan for the Mt Lofty Ranges and Greater Adelaide Region* (MLR Interim INRM Group, 2003), a concerted effort is now required to bring together existing data on the natural resources of the Southern Fleurieu Peninsula as well as filling many information gaps, such as quantifying our water resources and determining the health of those resources.

This study aims to fill some of these gaps, while building on the recent valuable work undertaken by:

- Burston and Good (1995) Watercourse Management Guidelines for the Inman River Catchment,
- Yeatman (1999) Plan for Wildlife Corridors in the Inman River Catchment,
- Carmichael (2000) Master's thesis - An Assessment of Water Resources and Recharge in the Hindmarsh River, Inman River and Currency Creek Catchments, which was further built on by,
- Barnett and Zulfic (2002) Mount Lofty Ranges Groundwater Assessment – Southern Fleurieu catchments.

Supplementing the *Southern Fleurieu Peninsula Salinity Management Plan* (Liddicoat and Herrmann, 2002), this study provides a detailed look at selected aspects of water quality, water balances and management options within the study catchments of the Inman River, Coolawang and Waitpinga Creeks and the minor catchments of Newland Cliffs and Parsons Beach. Also included is a compilation of relevant data gathered by community groups, and Local and State Government bodies. This study continues to build the necessary data that will enable sustainable, whole of catchment planning, seen as essential as population numbers increase, and bring accompanying pressures for more intensive land uses.

The authors of this report value the principles of ‘integration’ which are being increasingly embraced by natural resource managers, and are reflected in the current legislative and organisational reform being undertaken by the State Government. By applying the knowledge and resources of multiple groups, and with prioritised focus and coordinated action we will have the best chance of reaching the best overall outcome. This type of approach to NRM optimises the value obtained from limited funding and ensures solutions to one issue minimise flow-on impacts. And when catchment health problems can be viewed from multiple perspectives, it is often possible to address many issues at once.

This report provides information on selected catchment health issues, management options and recommendations for future work. However detailed plans for on-ground action should be developed by the local community, with consideration given to suggested management options. For only with local input and ownership will catchment health issues be successfully addressed in the long term.

Understanding the problems and processes, effectively coordinating effort and having the capacity to act are all essential in striving to maintain the health of the soils, watercourses and natural habitats that provide the foundations for economic production and the social well being of our community. Commonwealth, State and Local Government help to make this possible through the provision of financial grants and technical support, but without community involvement, such as by members of the Inman River Catchment Group, and other dedicated landholders, little preservation or restoration work would be undertaken.

Scope of the study

The main issues discussed include salinisation of land and watercourses, nutrient and pathogen pollution, and sustainable levels of water use. Also described are management options and recommendations aimed at addressing these issues.

Due to the complex interactions between terrestrial and aquatic ecosystems, land management problems will typically impact on watercourses. Hence the impacts of upstream land management practices can be deduced by studying the health of waterways. However care is required to consider the full range of activities that will influence down stream water quality.

Threats to catchment health can be discussed on the basis of cause (eg. source of a pollutant) or impact (eg. degradation of a resource). Where impacts are transient, not obvious in nature, or accompanied by a suite of other impacts, the use of key indicators (eg. pollutant, presence of sensitive organisms, etc.) can provide a useful and cost efficient means of detecting a problem. A summary of the problem impacts and potential causes to be discussed in this report are shown in Table 1.

Table 1. Summary of issues discussed

Impacts	Potential cause
Salinised land	• Natural water balance of landscape disrupted due to clearance of native deep-rooted perennial plants.
Saline streamflows	• Natural water balance of landscape disrupted due to clearance of native deep-rooted perennial plants. • Increased proportion of saline baseflow in streamflow. • Over-extraction of diluting streamflows and surface runoff in upper catchment
Nutrient pollution of streams (Nitrogen & Phosphorus)	• Poor management of intensive animal-based industries. • Soil erosion. • Over-application or poor timing of fertiliser application. • Stock access to waterways. • Insufficient buffering of watercourses from stock. • Waste Water Treatment Plant input in lower Inman.
High levels of microbial pathogens (*E. coli*) in streams	• Poor management of intensive animal-based industries. • Insufficient buffering of watercourses from stock. • Leaking septic tanks.
Low pH levels	• Acidification of agricultural soils.

Coordinating action

It is worth remembering that individuals and community groups are not alone in their desire to protect catchment health. The table in Appendix 1 provides an overview of some of the roles and responsibilities of the various community groups, Local and State government planning, regulatory and extension agencies involved in catchment management. With the absence of a Catchment Water Management Board in the study area, this means that greater responsibility is passed onto local government.

Most of the actions suggested in this report will be aimed at landholders and community catchment groups who are able to do the on-ground work. Adopted management options should form part of an integrated approach and therefore be compatible with a range of NRM issues. Some examples will illustrate this principle:

- Strategic revegetation to address salinity may also tackle potential erosion and provide benefits for biodiversity and aesthetics.
- Introducing efficient water use measures in irrigated areas will minimise wasteful deep drainage (past the root zone), reducing recharge to watertables and allow better quality (and quantity) of water for downstream users and the environment.

2 DESCRIPTION OF THE STUDY AREA

The study area, as shown in Figure 1 consists of:

- The Inman River catchment, 19526 ha, includes the sub catchments of the Boundy, Strangways, Back Valley and Halls Creek. Terrain ranges from steep hills on the northern and southern boundaries of the catchment, through rolling hills to the gently sloping floor of the Inman Valley (SCRN, 1999).
- The Waitpinga catchment, 6115 ha, includes a 'land locked' area bordered by Newland Head which is at the western extremity of Encounter Bay. In the eastern fringe of this catchment there appears to be linking of the groundwater systems to Halls Creek, within the Inman River catchment. Waitpinga contains well defined valleys grading to an undulating landscape near the coast (SCRN, 1999).
- The Coolawang Creek catchment to the west, 4077 ha, includes Willow Creek Swamp, a significant perched watertable swamp that was a habitat for the endangered Mt Lofty Ranges Southern Emu-wren. (The protected swamps of the Southern Fleurieu are further discussed in section 2.3.4).
- Newland Cliffs, 1909 ha, a small coastal catchment containing significant areas of remnant vegetation in a National Park to the south and residential areas to the north.
- Parson's Beach catchment, 600 ha, links the Coolawang Creek to the Waitpinga Creek catchment.

Further background information can be obtained from Liddicoat and Hermann (2002).

2.1 Climate

The region has a wet and cool climate with predominantly winter rainfall. Average annual rainfall in the region varies from above 900mm in the headwaters of the Boundy (between Spring Mount and Clarke Hill), and also around 900mm near Weymouth Hill in the northwest of the Coolawang Creek catchment, to around 500-550mm along the coast between Victor Harbor and Newland Head.

Rainfall isohyets and rainfall gauging stations of relevance to the study catchments are shown in Figure 2. The Mount Alma station has been excluded due to its short term monitoring record. The Spring Mount (Hindmarsh Valley) is included as it is considered representative of the high rainfall received in the top of the Inman River catchment.

Plots of the cumulative deviation from mean monthly rainfall for the rain gauging stations are shown in Figure 3. These graphs always start and end on zero cumulative deviation from the long term average, however where the plot rises and falls it indicates whether there has been a series of wet or dry years, respectively. This allows recent rainfall trends to be placed in a historical perspective.

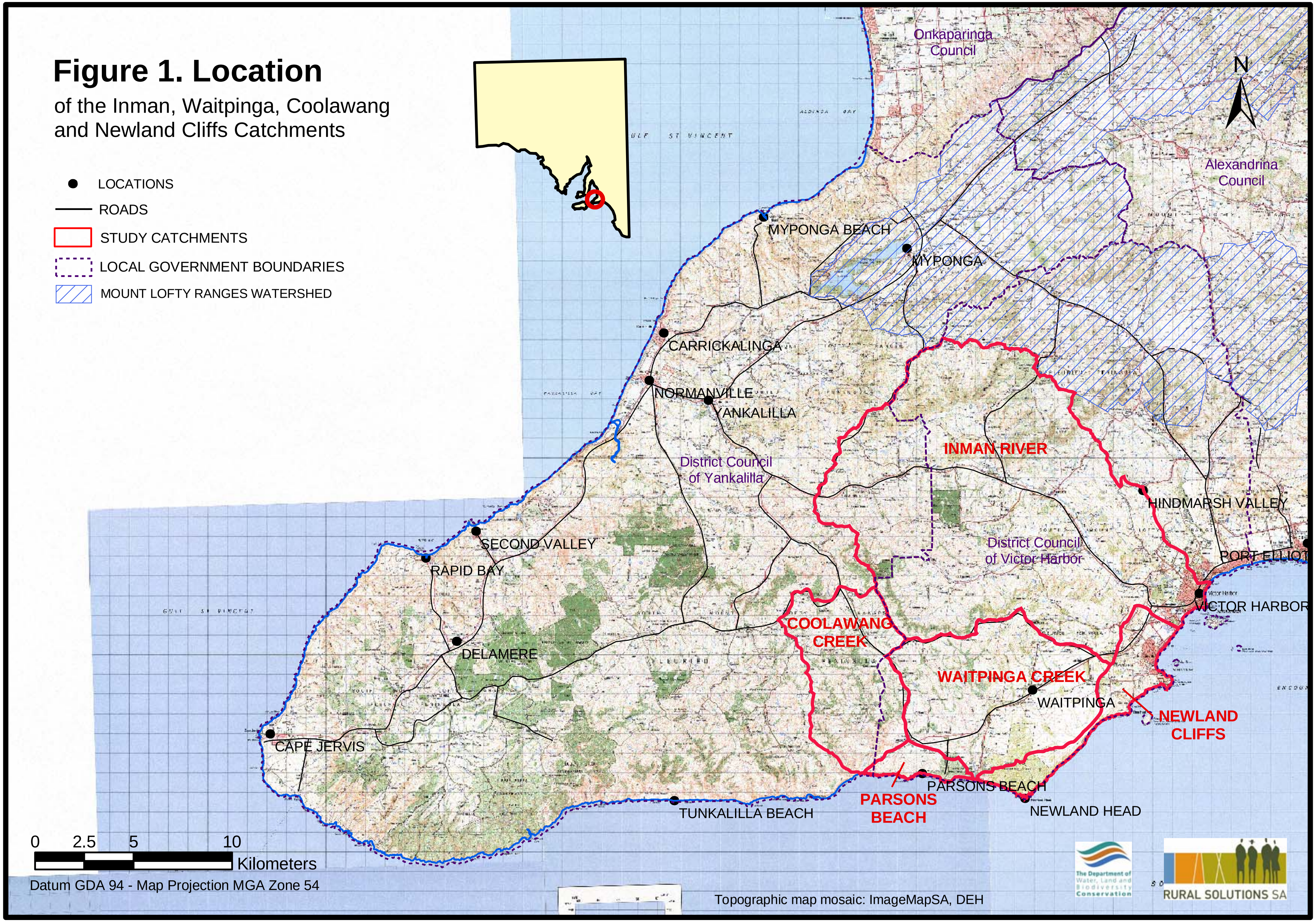
Figure 1. Location
of the Inman, Waitpinga, Coolawang and Newland Cliffs Catchments
LOCATIONS
ROADS
STUDY CATCHMENTS
LOCAL GOVERNMENT BOUNDARIES
MOUNT LOFTY RANGES WATERSHED
N
Onkaparinga Council
Alexandrina Council
District Council of Yankalilla
District Council of Victor Harbor
MYPONGA BEACH
MYPONGA
CARRICKALINGA
NORMANVILLE
YANKALILLA
SECOND VALLEY
RAPID BAY
DELAMERE
CAPE JERVIS
TUNKALILLA BEACH
PARSONS BEACH
NEWLAND HEAD
WAITPINGA
HINDMARSH VALLEY
PORT ELLIOT
VICTOR HARBOR
INMAN RIVER
COOLAWANG CREEK
WAITPINGA CREEK
NEWLAND CLIFFS
PARSONS BEACH
0 2.5 5 10 Kilometers
Datum GDA 94 - Map Projection MGA Zone 54
Topographic map mosaic: ImageMapSA, DEH
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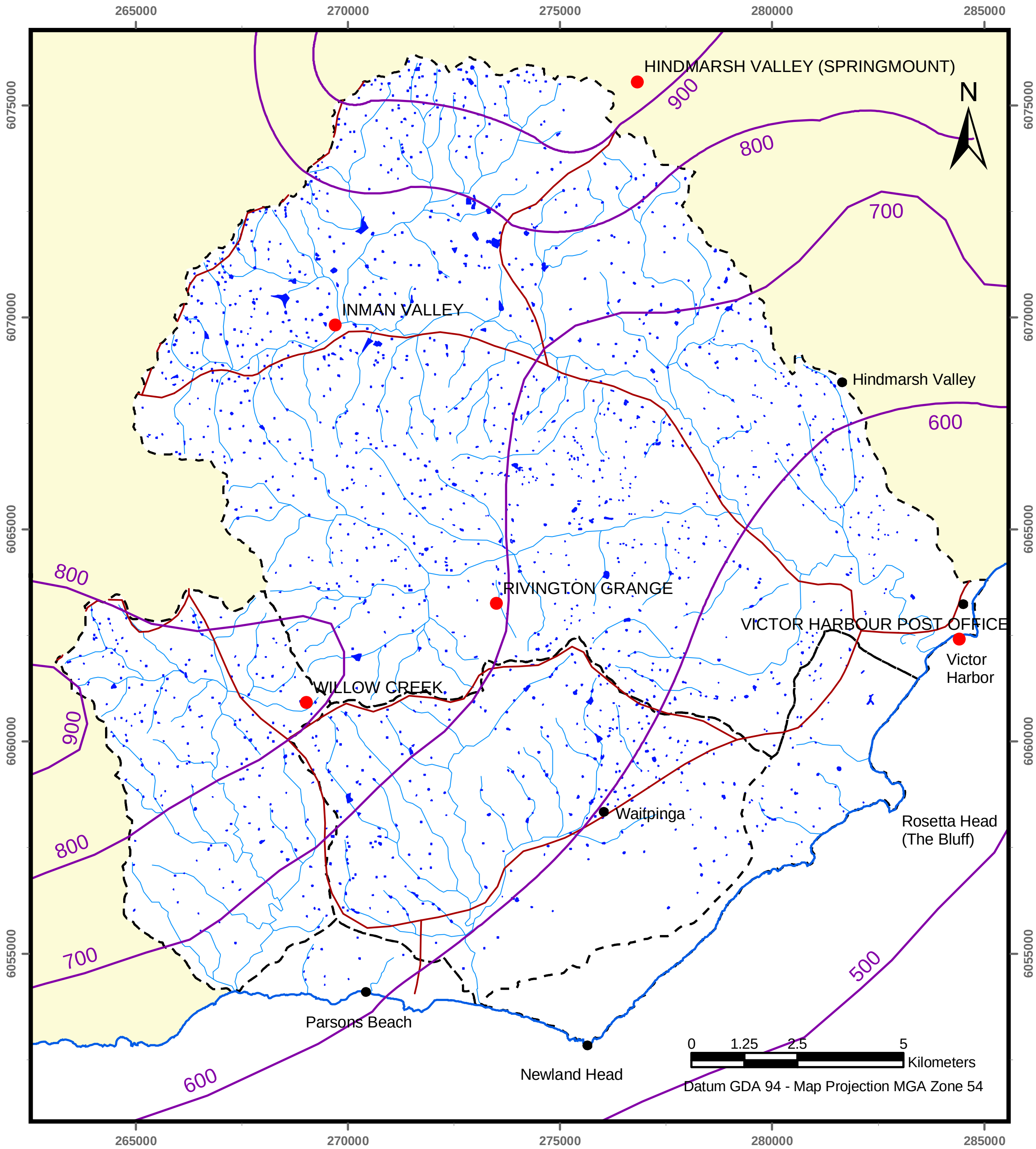
Figure 2. Rainfall

in the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



- LOCATIONS
- CATCHMENT BOUNDARY
- DAMS
- DRAINAGE LINES
- MAIN ROADS
- AVERAGE ANNUAL RAINFALL ISOHYETS (mm) (Adapted from SHSCB, 2000)
- RAIN GAUGING STATIONS

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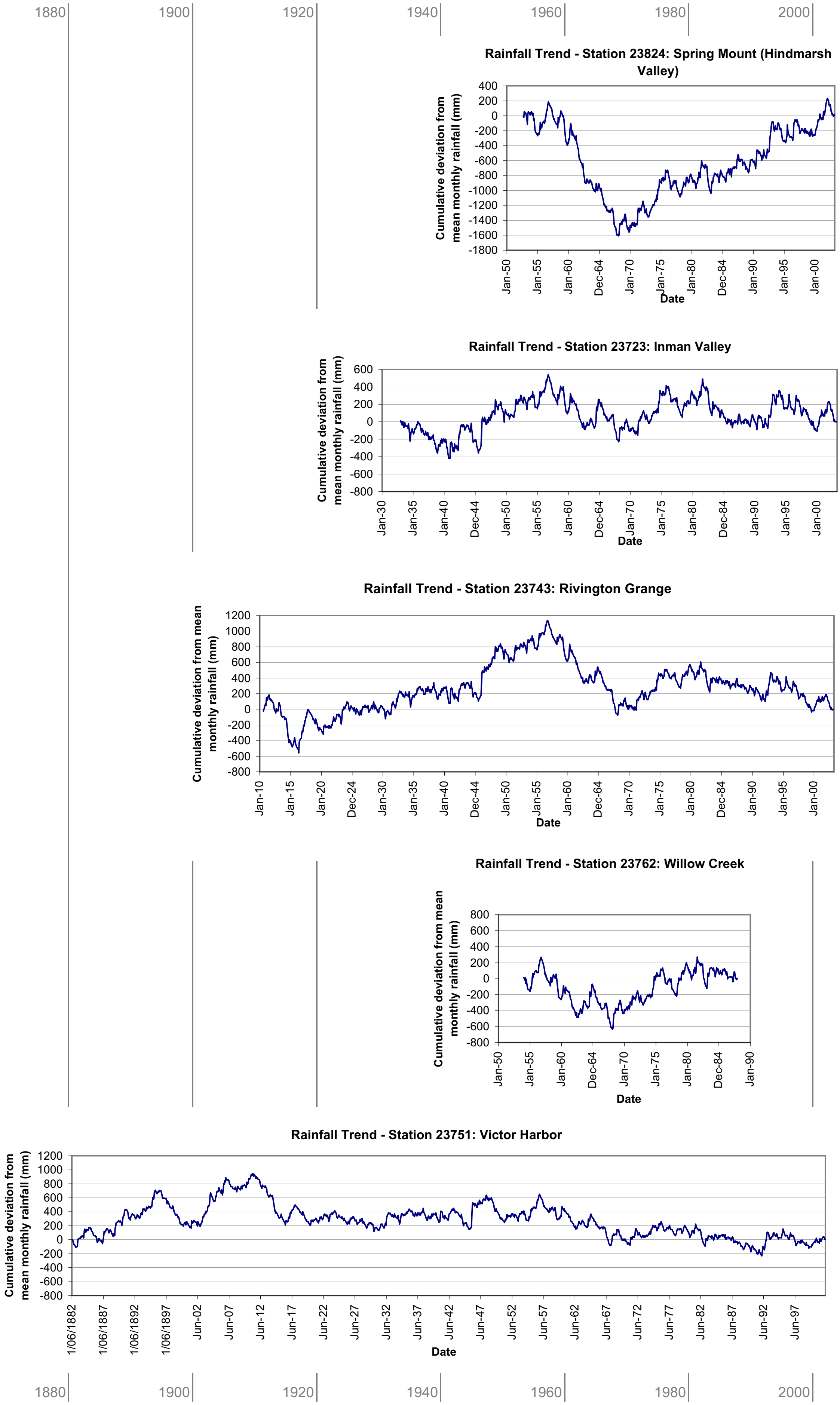
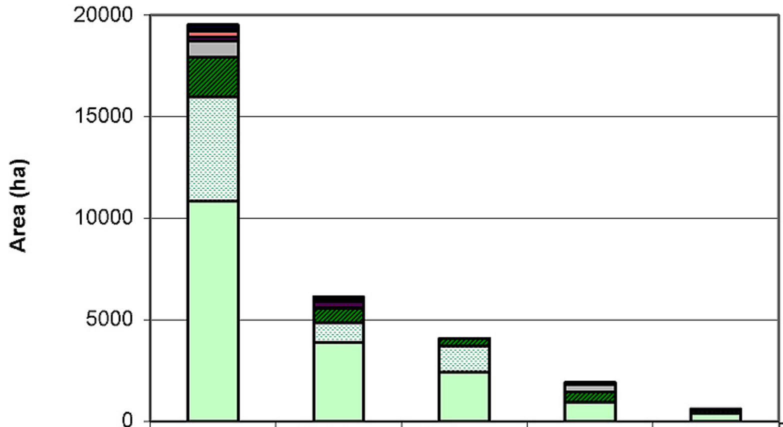
Figure 3. Cumulative deviations from mean monthly rainfall (in mm) for stations in the study area



2.2 Land use

Consistent with the broader Fleurieu Peninsula, land use (see Figure 4) is dominated by grazing of livestock, with dairy cattle (likely to be around 50% improved pasture), protected areas and residential being other major land uses. Grazing of other improved pastures occupies only a minor proportion of the area and there is much scope for increasing catchment water use by improving annual pastures or switching to perennials. Figure 5 (and the associated table) give the breakdown of land uses for the study area (based on 1999 data).

Figure 5. Detailed land use information for individual catchments and the study area (areas in ha; based on 1999 data)



	Inman River	Waitpinga Creek	Coolawang Creek	Newland Cliffs	Parsons Beach	Total area	% of Total study area
Other minor land uses	48	25	0	5	1	78	0.2
Cultural & Rec. Areas	176	0	0	80	0	256	0.8
Horses	75	111	0	2	0	189	0.6
Field Crops	0	102	0	27	58	187	0.6
Forest Plantation	306	0	0	0	0	306	1
Improved Pasture	206	302	0	0	0	508	1.6
Residential	793	9	2	367	0	1170	4
Protected Areas	1948	725	365	493	163	3690	11
Dairy Cattle	5145	967	1282	3	0	7400	23
Livestock/ Grazing	10829	3874	2428	932	386	18450	57

Catchments

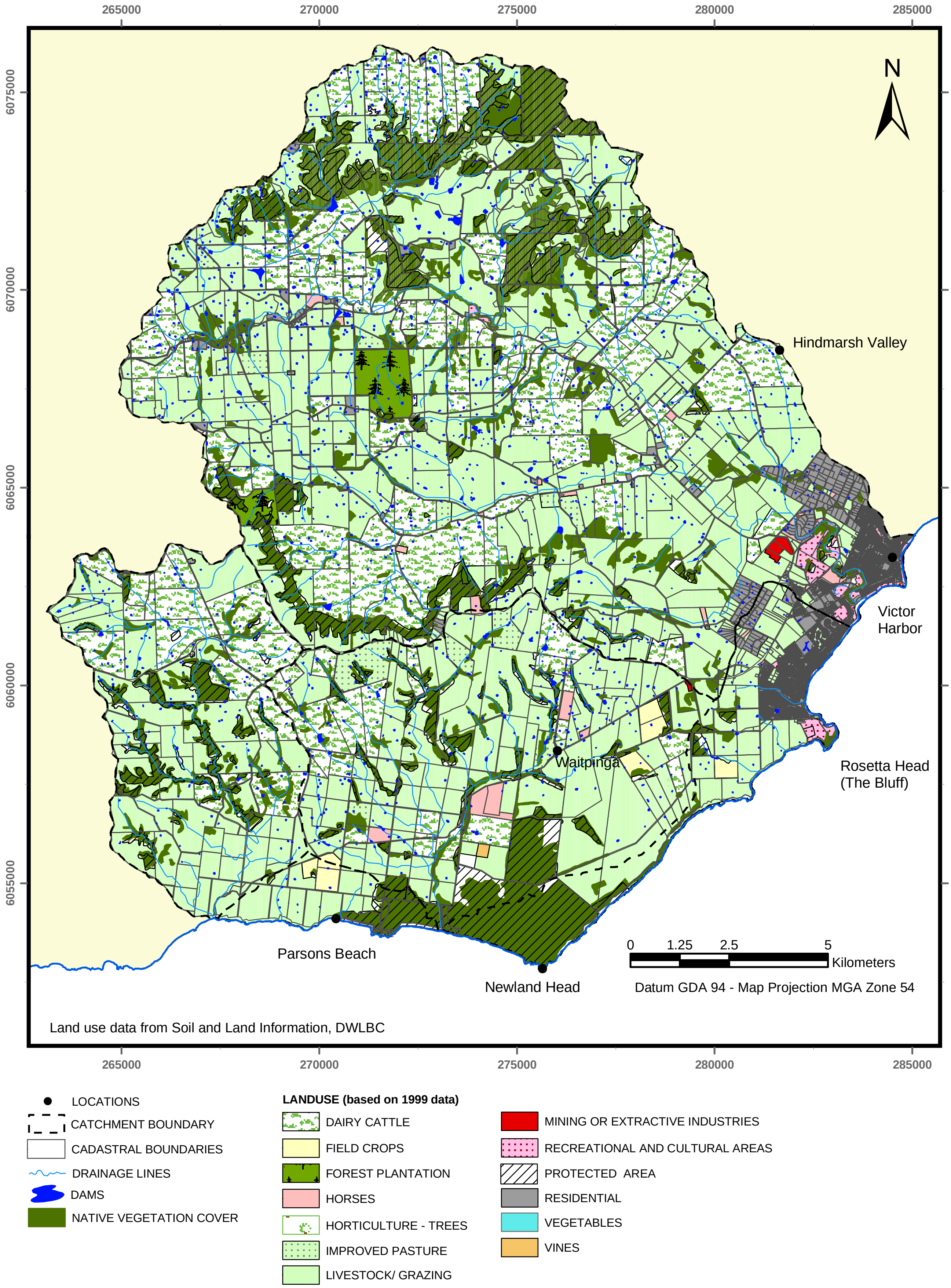
2.3 Native Vegetation

2.3.1 REMNANT VEGETATION ACROSS THE CATCHMENTS

Since European settlement of the Inman River, Coolawang and Waitpinga Creek Catchments the area has been extensively cleared of remnant vegetation for agricultural purposes. Areas cleared include the valley floors, flood plains, hill slopes and the hilltops where deeper soils have developed. This pattern of remnant vegetation is evident in Figure 4.

Figure 4. Native Vegetation and Landuse

of the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



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Approximately 5,540 ha of remnant vegetation exists on the less accessible and rocky shallow soiled slopes and hill tops where the use for agricultural pursuits were of little value, and on roadside reserves. These remnants cover 17% of the 32,200 ha land area of the study catchments.

Significant stands of native vegetation occur in Newland Head Conservation Park in lower rainfall sandy country on the south coast, and in the headwaters of the Inman River around Inman Hill and between Spring Mount Conservation Park and Moon Hill. Catchment areas and coverage of native vegetation are shown in Table 2.

Table 2. Catchment areas and native vegetation cover

Sub-catchment	Sub-catchment Area (ha)	Area of Veg. Cover (ha)	% Veg. Cover
Inman River	19526	3375	17
Waitpinga Ck	6115	928	15
Coolawang Ck	4077	576	14
Newland Cliffs	1909	520	27
Parson's Beach	608	142	23
Totals	32234 ha	5540 ha	17 %

Remnant vegetation on reserves, private property and roadsides persist in varying degrees of degradation, and scattered trees exist across the landscape. Approximately 24% of the area of remnants is held in Conservation Parks with an area of 1,351 ha. With a further 19% privately managed under 44 Heritage Agreements. The remaining areas of remnants have no registered protection covering them.

These remnants have varying degrees of degradation resulting from a number of factors such as fragmentation, weed invasion, grazing and salinity. Because of this pattern of clearing the existing remnants give a misrepresentation of what the pre-European vegetation would have been across the whole area prior to clearance.

It is therefore important to build a picture of what the pre-European vegetation across the region was prior to clearing in order to assist with revegetating areas appropriately.

2.3.2 PRE-EUROPEAN VEGETATION ACROSS THE CATCHMENTS

The pre-European vegetation of the study area is strongly influenced by changes in soil type and wetter sites such as creeklines, and the coast has significant influence along this margin.

From remnant vegetation mapping of the study region and its correlation with soil type, creeklines and coastal factors, an indication of the pre-European vegetation has been determined for this area. The following vegetation groupings are based on the vegetation mapping and GIS analysis methodology described in Appendix 2. Associated species lists for the vegetation groups were determined through this process and are also included in this Appendix.

These Vegetation Groups are displayed in Figure 6. This map is intended to provide a guide to the changes in vegetation across the study area and should be used in conjunction with the following vegetation group descriptions, on ground observations and local knowledge of remnant vegetation.

2.3.3 VEGETATION GROUP DESCRIPTIONS

Mixed stringybark forests:

Eucalyptus obliqua and *E. baxteri* form low forest to open forest formations on a range of well-drained depleted soils of the upper catchments in the region. These are high rainfall areas and soils include shallow to moderately deep acidic soils on rock, ironstone soils and shallow soils on rock.

Other associated dominants include *E. cosmophylla* and *E. fasciculosa*. Patches of *E. baxteri* and *E. cosmophylla* exist on the drier northern and westerly aspects of the Back Valley catchment on sand over clay soils with these drier aspects.

Coastal shrublands:

These occur on southern facing exposed sites on shallow and deep sands and rocky sections of coastline. *Acacia paradoxa* exists at the Bluff forming shrublands on shallow soils on rock. *Sarcornia sp.* and *Sclerostegia arbuscula* exists on the deep sands of the Newland head area with shrubland of *Olearia axillaris* and *Acacia longifolia var sophorae* blending through to coastal mallee of *E. diversifolia* and *E. cosmophylla*. This coastal mallee formation extends inland and along the coast on sand over clay soils.

The high coastal exposure of these sites form the frontline vegetation into shrubland that grades to low mallee moving inland as coastal exposure drops off and soils develop.

Perched swamps[1]:

The formation of forest by *E. ovata* (and sometimes sharing dominance with *E. leucoxylon*) occurs on high rainfall sites with poorly drained soils. These generally occur as linear features following the creek lines of the upper catchments where wet soils have developed.

Leptospermum continentale, *L. lanigerum* and *A. retinodes* form shrublands on similar sites to the forest formations and extend to highly leached soils of these upper catchments.

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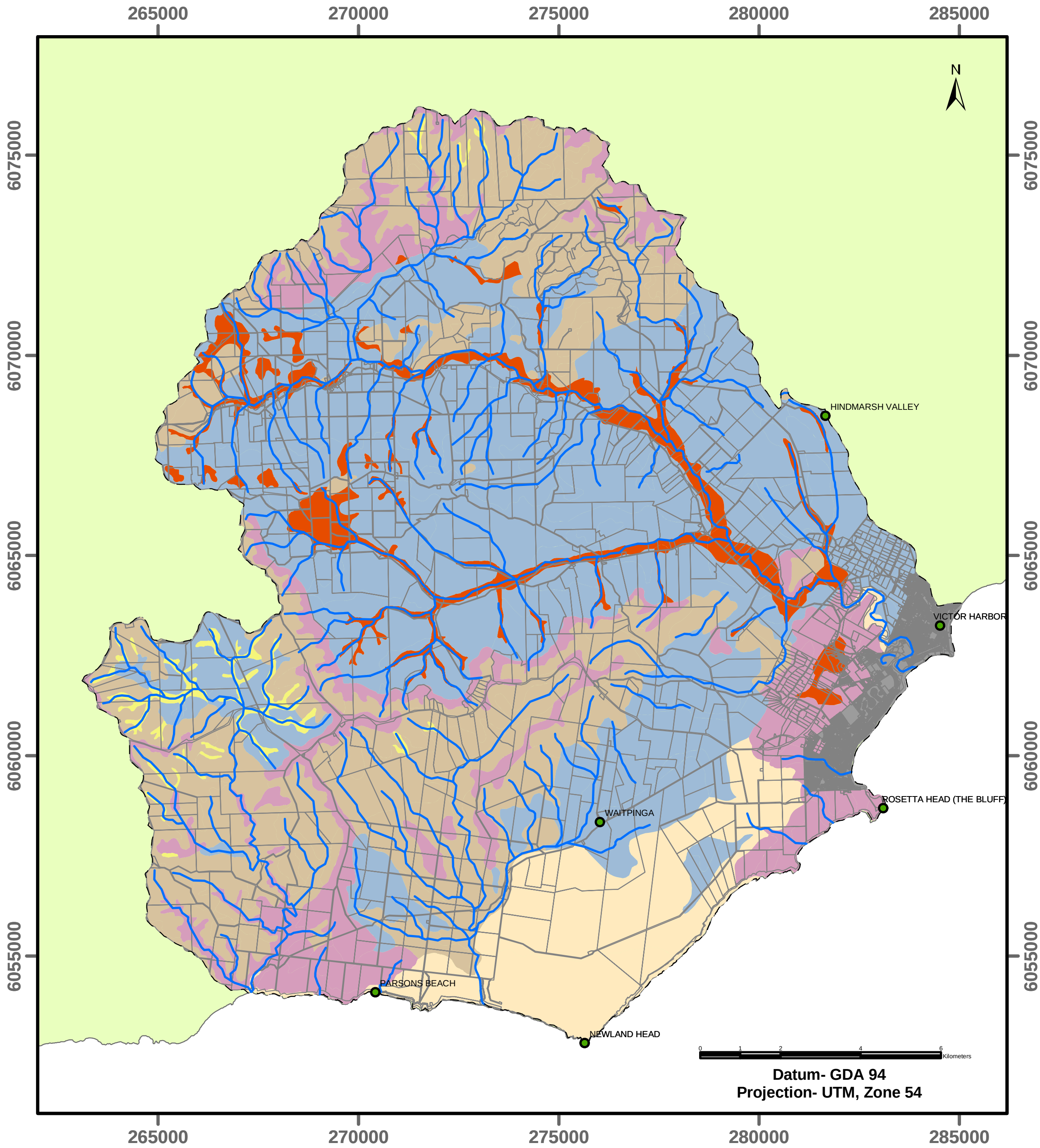
[1] More detailed description and mapping of the Southern Fleurieu swamps (which are protected under the Federal EPBC Act) has been undertaken by the The Mount Lofty Ranges Southern Emu-Wren Recovery Program and the SA Department for Environment and Heritage, as discussed in section 2.3.4. The 'Perched swamps' vegetation group (of section 2.3.3) has included a subset of these swamps while the accompanying species lists include transitional species (eg. *Eucalyptus*) that have been found at the edge of swamps.

Figure 6. Mapped Vegetation Groups

of the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



Locations

Study Area Boundary

Drainage Lines

Cadastre

VEGETATION GROUPS

- Mixed Stringybark Forest
- Blue Gum Woodland
- Pink Gum Woodland
- Perched Swamps
- Red Gum Woodlands
- Coastal Shrubland
- Urban

This map depicts vegetation mapping for pre-european vegetation and revegetation zones based on the analysis of vegetation surveys from biological survey data and its extrapolation across the study area in correlation with Dominant Soil Types.

The development of this map was carried out using data available at the time and does not claim to be complete and exhaustive.

The use of this map should be indicitave only and local knowledge of vegetation and onground observation should be taken into consideration at each site.

Pink gum woodlands:

These occur on well drained, soils and slopes of the ridgelines of the catchments. *Eucalyptus fasciculosa* is predominantly found alongside the Mixed Stringybark Forests of the upper catchments on shallow soils on rock and on shallow to moderately deep acidic soils on rock. Pink gum woodlands will often share dominance with *E. cosmophylla*, *Allocasuarina verticillata* and *Allocasuarina mulleriana* on these sites. On several of the south facing creeklines on the northern ridgeline, *E. fasciculosa* shares dominance with *E. viminalis cygnetensis*.

Blue gum woodlands:

Small isolated pockets of blue gum woodland exist on the well-drained fertile soils of the region and can be have grassy or shrubby understorey. These remnants are very fragmented across the landscape, often surviving along creeklines and less accessible sites where clearance was difficult. Blue gum woodlands would have predominantly extended across the hill slopes on the sand over clay soils of the central region and deep loamy texture contrast soils with brown or dark subsoils of the Waitpinga area, stretching into the shallow to moderately deep acidic soils on rock along the creek lines.

Red gum woodlands:

Some remnants of *E. camaldulensis* form woodlands on the deep loamy texture contrast soils with brown or dark subsoils of the valley floors and lower creeks extending from Victor Harbor to the upper Inman. Branching out from these heavier soils *E. camaldulensis* exists on sand over clay soils along the lower creek lines.

2.3.4 PROTECTED SWAMPS OF THE SOUTHERN FLEURIEU

The swamps of the Southern Fleurieu are localised wetlands occurring in high rainfall areas. They are densely vegetated and occur adjacent to waterlogged soils around low-lying creeks and flats. They are typified by their reedy or heathy vegetation growing on peat, silt, peat silt, or black clay soils (DEH, 2003). Characteristics of the swamps are further described in Appendix 3.

The swamps are a natural part of the landscape. They provide valuable ecosystem services (eg. water filtration and flood mitigation), and are home to a number of rare and endangered species. Some of these species are unique to the swamps. This includes the nationally endangered Mount Lofty Ranges Southern Emu-wren (Duffield and Hill, 2002).

Land use change, clearing, drainage and filling have reduced the extent of the swamps substantially, with estimates of as little as 500ha [under 25% of original swamps] remaining (Duffield and Hill, 2002). Due to the small patches of remaining swamps, their vulnerability to ongoing threats, and their importance as habitat for a range of rare and endangered species, the swamps of the Fleurieu Peninsula were listed as a ‘critically endangered ecological community’ in amendments to the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Listing under the EPBC Act is aimed at protecting against further decline, and assisting community efforts toward the recovery of the swamps (DEH, 2003).

Protection under the EPBC Act takes into account pre-existing land use, however any new or intensified activities likely to impact on the swamps (eg. drainage, land use change in upper sub-catchment, change in sub-catchment hydrology, etc.) need to be referred to the Federal Department of the Environment and Heritage (DEH). Such activities also require approval at State level. The Federal Environment Minister may require an assessment process to enable a decision based on more detailed information, however strict timeframes in the EPBC Act ensure the assessment and decision process is conducted in a timely manner (DEH, 2003).

Further information on the swamps is available from the Australian Government DEH website, the information sheet (DEH, 2003), or from the Mount Lofty Ranges Southern Emu-wren Recovery Program (MLRSEWRP) on 8223 7437 or email: emuwren2@ccsa.asn.au, (website: www.ccsa.asn.au/EmuWren/wren.html).

The MLRSEWRP have produced swamp management guidelines (Duffield and Hill, 2002) and can offer technical advice to landholders on best practice/ adaptive management of the swamps to maximise biodiversity outcomes (pers. comm. Rebecca Duffield, MLRSEWRP, 25 Feb 2004).

Detailed mapping of the Fleurieu swamps from aerial photography (including indicative condition scores) has been recently completed, however this information is yet to be ground-truthed (pers. comm. Claire Harding, Wetlands Project Officer, Department for Environment and Heritage (SA), 27 Feb 2004). Ground-truthing activities are likely to occur in the months up to around mid 2004.

Due to the potential for impacts to the hydrology of swamps from salinity management activities, this mapping of the Fleurieu swamps has been included in Figure 15 (Priority zones for salinity management), in section 4.3 – 'Salinity Management'.

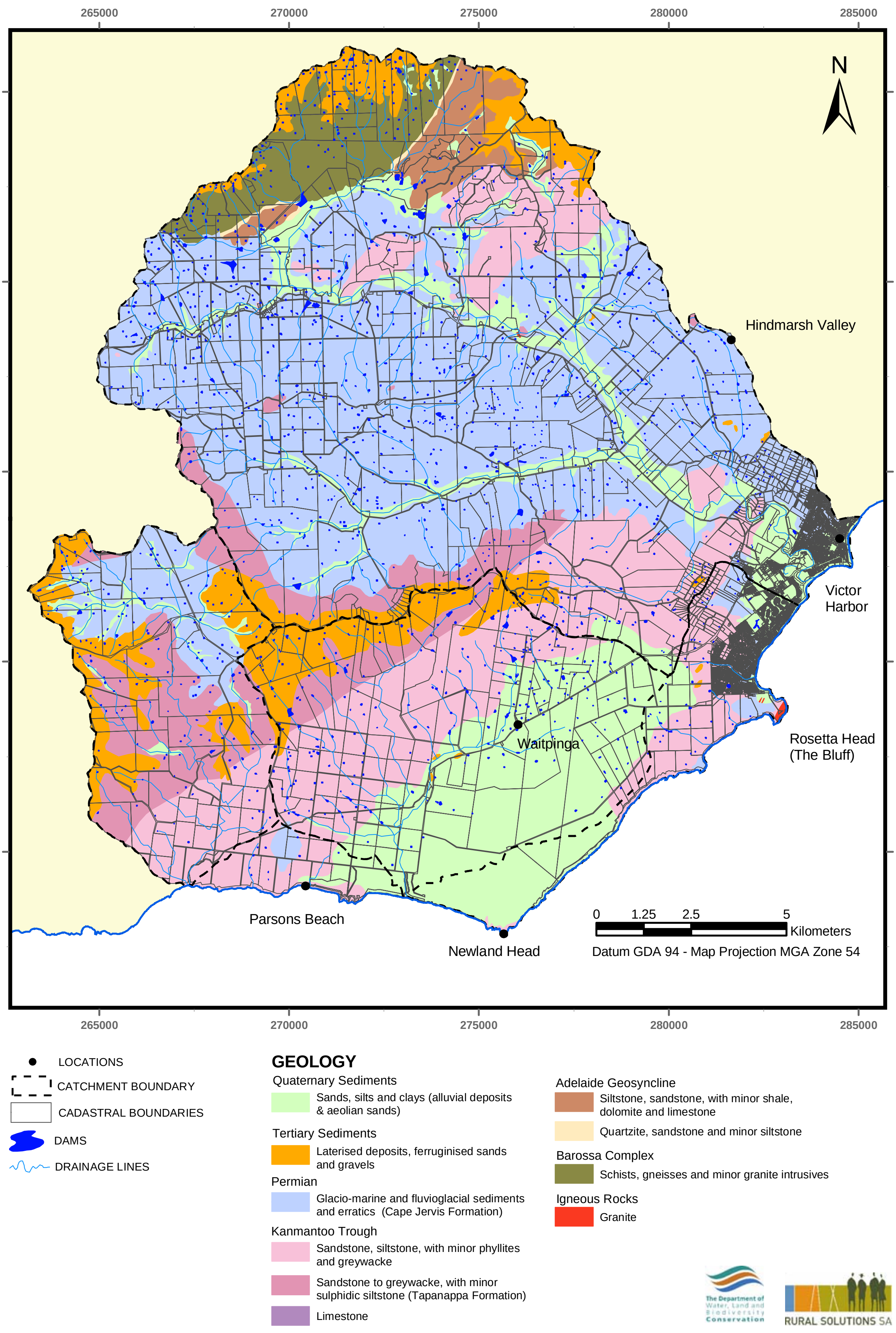
Mapping of salt affected land and salinity risk (as discussed in section 4.2) are also of interest for the protection of the swamps. These issues are explored further in Appendix 3 and section 4.3.

2.4 Geology

As shown in Figure 7, the Inman River catchment is dominated by Permian glacial sediments deposited in U-shaped valleys carved into mostly Kanmantoo Group basement rock. In the Waitpinga, Coolawang and Newland Cliffs catchments, the Kanmantoo basement rocks outcrop over much of the area but have been subjected to deep chemical weathering (producing lateritic profiles) between Wilson Hill and Mount Desert and buried beneath Quaternary alluvial and aeolian deposits around Waitpinga. Deeply weathered lateritic profiles, preserved from the erosion that impacted much of their surrounding landscapes, are remnants of a time when the land was very flat and the climate much wetter. These weathered lateritic profiles also occur at the northern bounds of the Inman catchment at Clarke Hill and Spring Mount, occurring from the weathering of Barossa Complex and Adelaide Geosyncline rocks, respectively.

Figure 7. Geology

of the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



2.5 Soils

Dominant soil types (Figure 8) largely reflect the outcropping geology. In the Inman, where Permian sediments dominate, soils are mostly sand over clays, with deep loamy texture contrast soils infilling the drainage lines and broad valley flats. Where basement rock outcrops in steep hilly country, soils are shallow over rock. Undulating rises and low hills may be formed on soft unconsolidated clay or sandy clay. These clays are sodic, highly dispersive and prone to landslip and erosion, particularly around Bald Hills (Burston and Good, 1995).

In the Coolawang and Waitpinga catchments, shallow to moderately deep acidic soils have formed on Kanmantoo Group rocks. North of Waitpinga deep loamy texture contrast soils with brown or dark subsoils have formed at the verge of Kanmantoo rocks and their overlying Quaternary sediments. South of Waitpinga Quaternary sand over clay and deep sands dominate.

Soil Land Systems (groupings of similar soil types, landforms and geology for the purpose of aiding land description) are shown in Appendix 4. This Appendix includes summary descriptions, while more detailed information is available from PIRSA Land Information (2001); now called 'Soil and Land Information', in the Department of Water, Land and Biodiversity Conservation (DWLBC).

This group has made detailed assessments of the state's agricultural soils and developed maps of various soil attributes, many of which represent real and potential limitations to production. Several soil attribute maps (covering issues including acidity, water repellence, landslip, water erosion and salinity) are discussed in later sections.

2.6 Water Resources

The poor quality of groundwater in the study catchments is a limitation to potential development and highlights the area's reliance on good quality surface water.

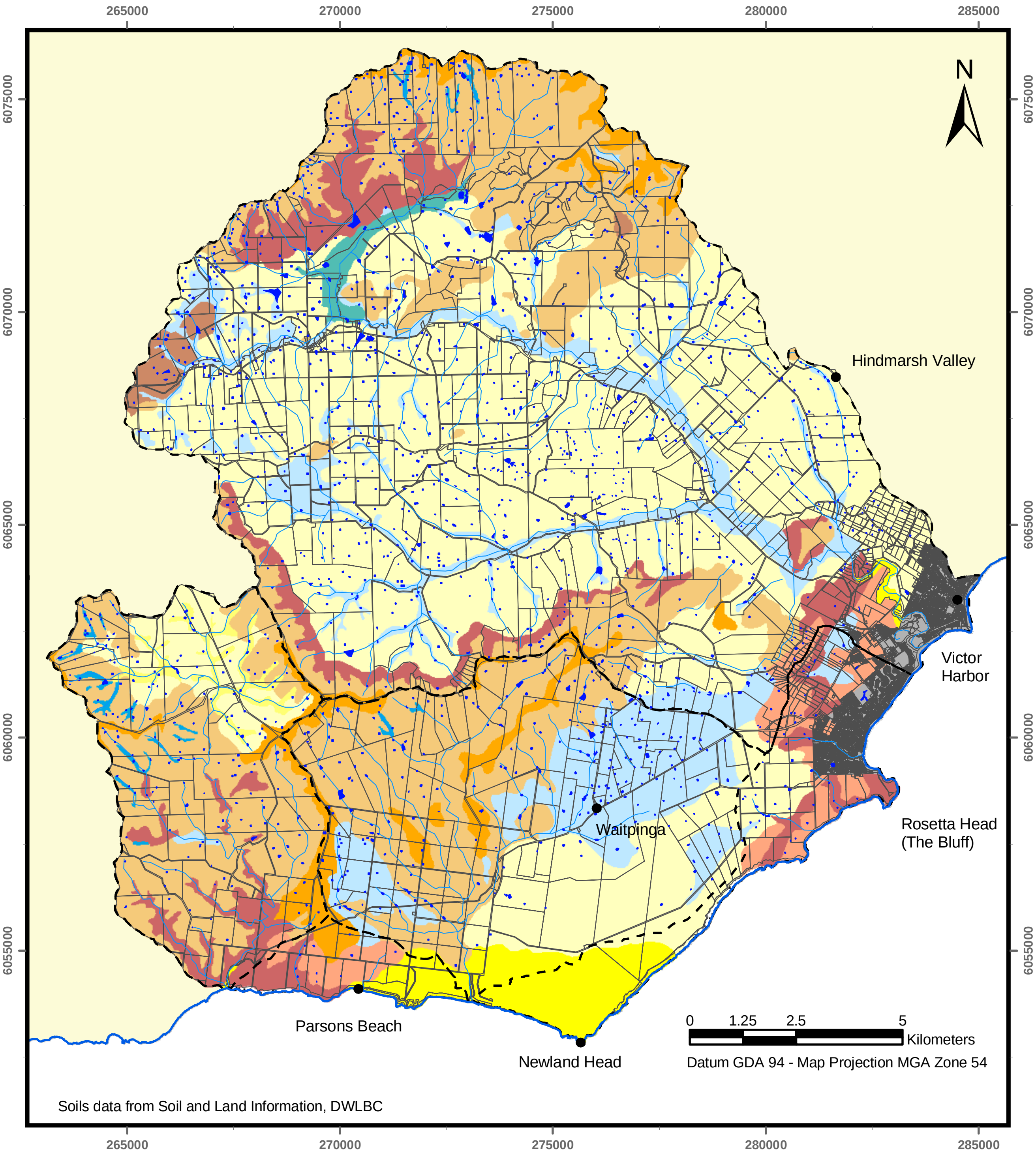
Groundwater

SA GEODATA records (updated in 2002) were analysed for salinity and yield information. As shown in Table 3, groundwater quality in the area is, on average, not suitable for irrigation except for relatively salt tolerant plants. However, average salinity levels indicate that much of this groundwater is suitable for stock watering.

Groundwater salinity and yield information is also shown graphically in section 4.2.

Figure 8. Dominant Soil Types

of the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



- LOCATIONS
- CATCHMENT BOUNDARY
- CADASTRAL BOUNDARIES
- DAMS
- DRAINAGE LINES

DOMINANT SOIL TYPES

- Calcareous soils
- Shallow soils on calcrete or limestone
- Hard red-brown texture contrast soils with highly calcareous lower subsoils
- Cracking clay soils
- Deep loamy texture contrast soils with brown or dark subsoils
- Sand over clay soils
- Deep sands
- Highly leached sands
- Ironstone soils
- Shallow to moderately deep acidic soils on rock
- Shallow soils on rock
- Deep uniform to gradational soils
- Wet soils
- Rock
- Not Applicable

This map depicts the distribution of generalised soil groups. The map is based on an interpretation of soil landscape units. Soil landscapes invariably comprise several soils. The most commonly occurring soil group in each landscape is delineated on this map.

The Department of Water, Land and Biodiversity Conservation — Soil and Land Information

The Department of Water, Land and Biodiversity Conservation

RURAL SOLUTIONS SA

Table 3. Bore salinities and yields (from SA GEODATA records)

Catchment	Salinity (mg/L)				Yield (L/s)		
	Total records	Range	Mean	No.	Range	Mean	No.
Inman River	208	680 - 15000	2738	161	0.038 - 75	3.29	105
Waitpinga Creek	85	578 - 17692	5018	48	0.1 - 3	1.11	26
Coolawang Creek	30	79 - 7657	1242	13	0.1 - 3.12	0.806	11
Newland Cliffs	43	167 - 9255	2252	36	0.03 - 18.75	2.47	19
Parsons Beach	17	2542 - 13423	5648	8	0.15 - 1.26	0.72	3

Note: Not all bore records have salinity and/or yield information. The number of bores with each type of data are shown.

Carmichael (2000) analysed bore salinities in relation to geology of bore completion for the Inman catchment and found that the majority of the bores (with completed bore logs) were completed in the river valleys of the Cape Jervis Beds (Permian). The Cape Jervis Beds (mean TDS = 3496 mg/L) had the highest salinity levels, followed by the Kanmantoo Group (mean TDS = 1737 mg/L) and Quaternary sediments (mean TDS = 1023 mg/L). Groundwater of better quality is often limited due to low yields.

Surface water

Surface water is an important resource for the region, and is harvested in dams or extracted directly from the rivers. Uses include stock watering, irrigation and domestic applications.

The capacity of dams throughout the Mt Lofty Ranges has been estimated from aerial photography (pers. comm., Doug McMurray, DWLBC) and volumes for the study catchments are shown in Table 4.

Table 4. Dam volumes

Catchment	Volume stored in dams (ML)	Number of dams
Inman River	2758	1219
Waitpinga Creek	658	276
Coolawang Creek	291	198
Newland Cliffs	85	52
Parsons Beach	12	11
Totals	3804	1756

Degradation of water quality has the potential to limit the usefulness of surface water resources. Excessive extractions can adversely impact on downstream users, including stream ecosystems (some of which are dependent on groundwater supplied permanent pools and dry season flows). These issues are expanded in following sections.

Section 4.2 contains further information on the salinity of surface waters.

3 OVERVIEW: ISSUES AND POLICY

3.1 Water Use

The economic, social and environmental future of the region depend on the sustainable use of natural resources, one of the most important of which, is water. Due to the variable quality of groundwater, surface water has been widely exploited. Collected in dams or extracted from streams, surface water is used for irrigation, stock and domestic purposes. Increasing levels of residential development in the catchments will place greater pressure on surface water resources, with each farmlet (or rural living block) within a subdivision often demanding its own dam for a water supply.

Farm dam development, as well as direct pumping from watercourses, can impact on the water available to downstream users, including water-dependant ecosystems. 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. Excessive direct pumping from permanent pools impacts on the ability of many plants and animals to survive over seasonal or episodic drought (DWR, 2000).

However in recent years, awareness among communities is growing for the need to treat the environment as an important user of water. A balance must be struck between the different users of water including irrigators, graziers, domestic users and the environment. In agricultural pursuits the increasing value of a limited water resource will be recognised as more emphasis is placed on higher water efficiencies, recycling, reuse, and higher value end products.

According to the State Water Plan (DWR, 2000), the management and allocation of water resources should occur in a manner that achieves:

- ecologically sustainable development;
- provision for environmental water needs;
- promotion of efficient and effective water use;
- account of existing use; and
- provision of flexibility to deal with new information, technology and uses.

A policy was developed within the Mt Lofty Ranges Regional Strategy Plan 1993 whereby landholders were restricted to capturing 50% of the runoff generated from their properties. While this policy has been useful, it is being reviewed in the light of environmental water requirements and the significant development of farm dams in some areas.

Current policy (DWR, 2000) states that:

"Outside of prescribed areas, and until there is additional information, 25% of median annual adjusted catchment yield should be used as an indicator of the sustainable limit of the catchment surface water and watercourse water use. 'Adjusted' is defined as the annual catchment discharge with the impact of farm dams removed."

However, in practice this means no change to pre-existing policy. A dam volume limit (of 50% median annual runoff) has been replaced by a water use limit (of 25% median annual runoff), but DWR (2000) considers that only about half of a dam's volume is actually used, the rest being lost to evaporation and seepage. This loss of water is considered acceptable. Thus, for example, if an irrigation dam had a 10 ML capacity, the area to be irrigated should not require more than 5ML of water. However any direct pumping from watercourses would need to be included within the 25% usage limit.

The "50% rule" can be varied in prescribed areas, or where water allocation plans operate (eg. in the eastern Mt Lofty Ranges where a 30% average annual runoff limit applies for the total capacity of sub-catchment dams [RMCWMB, 2003]).

On-stream dams, while the most common, create problems for downstream users and ecosystems. They have little flexibility of management, capturing all flow until full. In contrast, off-stream dams provide greater flexibility, as the extraction mechanism (eg. pump and/ or gravity fed diversions) can be varied to allow capture of water at different times or flow rates. This has the added benefit of improving control over the quality of water collected.

Direct extraction of water from permanent or near permanent pools can have severe impacts on dependant plants and animals if pool levels fall below critical levels. Such pools in this region are important refuges for aquatic organisms over summer or prolonged dry periods (McEvoy et al., 2003).

In a tributary of the Inman River, a critically endangered population of the Southern Pygmy Perch[2] is threatened by the loss of available habitat (pools) over summer, that can be attributed at least in part to surface water harvesting altering the timing and delivery of environmental flows (Hammer, 2002).

Further examples of permanent pools are found on the alluvial floodplain of the Inman Valley between Sawpit Rd and Swain's Crossing (pers. comm. Graham Webster, Inman River Catchment Group).

Impacts of Farm Forestry

Catchment clearance has resulted in many natural resource management problems including increased levels of erosion, rising watertables often bringing greater saline discharges to streams, and loss of habitat and biodiversity. Farm forestry has the potential to address some of these issues as well as providing other on farm benefits (eg. windbreaks, stock shade & shelter). As expected, afforestation will have impacts on the catchment water balance, making less water available for runoff and recharge to groundwater (ie. less yield).

In a forested area, increased levels of water use will occur due to the greater depth of soil accessed by roots (which creates a greater soil moisture deficit requiring replenishment before runoff can occur) and the interception and direct evaporation of rainfall from tree canopies. Water use (and hence yields) will vary according to factors including tree species (rooting & canopy structure), planting density, maturity, health, regrowth and, of course, the area of planting. Studies have shown that

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[2] The Southern Pygmy Perch is also threatened by other factors causing degradation of its habitat, including poor water quality, sedimentation, impacts from stock in creeks, exotic fish species and loss of riparian vegetation. Further information on this endangered species and activities required to encourage its recovery are contained in Hammer (2002), and summarised in Appendix 5.

impacts to streamflows from afforestation of up to 20% of a grassland catchment can be difficult to discern from natural variations in flow. But where catchments have afforestation levels of 30-60%, yield changes of the same order can be expected, with the full effects on catchment water balance taking 15-50 years to develop (O'Shaughnessy and Moran, 1983).

In the study area it has been estimated that, due to factors such as small land holdings, land tenure, existing land use and soil/ land constraints, farm forestry is only likely to be established on up to a maximum of 20-30% of any catchment (pers. comm. Martyn England, Adelaide Blue Gums Pty. Ltd., Mar 2004).

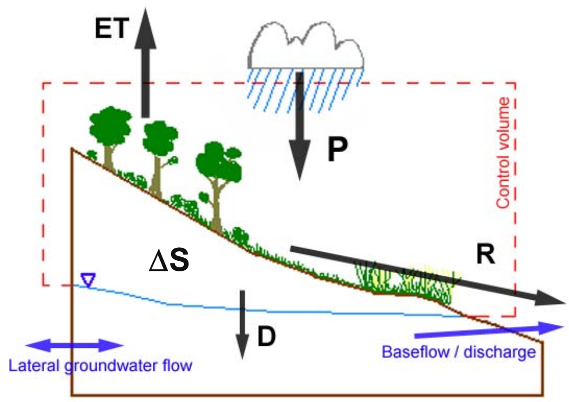
Catchment Water Balance

The concept of a catchment water balance provides a framework for studying the hydrological behaviour of a catchment and is useful for estimating components of the water balance that are potentially available for, or could be impacted by, human activities.

A simple water balance for a catchment can be written as: *Inputs = Outputs + Change in Storage*, or $P = ET + R + D + \Delta S$ (or shown diagrammatically below)

Figure 9. Components of a catchment water balance

(This simplified scenario ignores elements such as groundwater pumping and use of imported water.)



Where *P* is precipitation (rainfall), *ET* is evapotranspiration, *R* is streamflow, *D* is recharge to groundwater (analogous to deep drainage below the root zone), and ΔS is the change in soil water storage.

There are inherent difficulties in estimating these water balance components. In particular it is difficult to separate runoff and recharge, as transfer between streamflow and groundwater can occur with changing hydrological conditions along a stream. Estimating 'available water' (P – ET) is typically the most certain step, with the remainder then allocated between recharge and runoff. In hilly terrain a greater proportion of recharge will re-enter streamflows (as water courses provide good drainage for groundwater), compared to flatter landscapes.

Water balance components have been previously derived for the Inman River (Carmichael, 2000; Barnett and Zulfic, 2002) however given time constraints a simplified procedure was adopted so that water balance components could be estimated for the other catchments. This procedure is based on selected catchment characteristics and approximate formulae, and is outlined in Appendix 6. The results are summarised in the table below.

Table 5. Summary of estimated water balance components for the major catchments

	Inflows		Outflows	
	Type	Amount (ML)	Type	Amount (ML)
Inman River	Annual Rainfall	141113	Evapotranspiration	107493
			Streamflow	22437
			Dam storage	2758
			Recharge	14742
	Totals	*141113*		*147430*
Waitpinga Creek	Annual Rainfall	38494	Evapotranspiration	30428
			Streamflow	3657
			Dam storage	658
			Recharge	2034
	Totals	*38494*		*36777*
Coolawang Creek	Annual Rainfall	31591	Evapotranspiration	23202
			Streamflow	3412
			Dam storage	291
			Recharge	2888
	Totals	*31591*		*29793*

These values should serve as a guide, but are not expected to be highly accurate. Prior to making an assessment about the true status of water resources in the area more rigorous methods may need to be applied. In addition, further information is required, in particular the best available knowledge (on an annual basis) of:

- water captured in dams,
- surface water extractions (direct pumping from watercourses),
- artificial transfers into or out of the catchments, and
- use of reclaimed water.

Estimates of catchment groundwater and surface water use (once obtained) can be compared with sustainable limits, which have been estimated at:

- for surface water – 25% median annual catchment yield (with effect of dams removed);
- for groundwater – 50-75% of annual recharge.

Questions of over-allocation of a water resource are often raised in times of low rainfall. However it should be remembered that in Australia's climate, such dry periods should be expected. It does not necessarily mean that a resource is over-exploited if surface water flows drop, due to a lack of rain.

On a regional basis, surface and groundwater resources have been assessed as not being over-committed (pers. comm. Karla Billington and Steve Barnett).

Notwithstanding this statement, individual development proposals will still need to consider the availability of both suitable water and land.

3.2 Water Quality

Water quality is a very important and multi-faceted measure of catchment health. Degradation of water quality will limit the available uses for a water resource, and can adversely impact the health of humans, stock, agricultural systems and the environment.

Pollutant sources

Water quality is influenced by many factors, both natural and human-induced, including soil and vegetation types, climate, land use and management practices. Pollution sources are generally divided into two types:

- Point sources – locally significant, with a defined point of entry to a catchment, and
- Diffuse sources – generated over a large area.

While point sources of water pollution (eg. waste water treatment plants, dairy shed effluent) can be important, many catchment studies have found that diffuse sources are the main contributor of pollutants (Camp Scott Furphy et al., 1992; NLWRA, 2003).

Different land use types will represent different examples of diffuse sources, with pollutant yields within a land use type largely dependant on management practices and climatic factors. Wood (1986) presents a study of 5 catchments in the Mt Lofty Ranges, each with a dominant land use type, and compares pollutant concentrations and pollutant yields (kg/ha/yr) based on 12 years of data. While the results are based on 1970-1982 management techniques, this data (summarised in Tables 6 and 7) provides a useful guide to the influence that land use has on catchment water quality. A summary of actual values from the study are provided in Appendix 7.

Table 6. Relative water quality for dominant land uses compared to native vegetation (native veg. = 1), using median concentration values (Wood, 1986)

Land use	TDS	NOx	TN	Sol P	TP	TOC	Total coliforms	*E. coli*
Urban	1.1	25.5	3.2	8.0	4.4	2	10	10
Intensive horticulture	1.8	230	14.1	14.2	8.9	1	22	4.4
Mixed agriculture	1.9	13.5	2.1	2.2	1.9	1	8.5	6.1
Grazing	5.5	2.5	3.3	4.0	3.1	3	2.2	3.1

(For Tables 6 & 7: TDS = total dissolved solids, NOx = oxidised nitrogen, TN = total nitrogen, Sol P = soluble phosphorus, TP = total phosphorus, TOC = total organic carbon)

Table 7. Relative mean yields from dominant land uses compared to native vegetation (native veg. =1) using mean loads/ha/year (Wood, 1986)

Land use	TDS	NOx	TN	Sol P	TP	TOC	Total coliforms	*E. coli*
Urban	2	25	4	9	4	2	52	25
Intensive horticulture	4	196	17	30	27	3	56	10
Mixed agriculture	3	24	3	5	2	2	42	28
Grazing	4	12	3	6	2	1	10	14

Also Clark (1988) conducted a multiple regression analysis of 31 catchments throughout the Mt Lofty Ranges in an attempt to develop a predictive model for 5 water quality parameters based on a breakdown of catchment land use types, building density (a measure of urban development) and catchment runoff rates.

Based on the findings of Wood (1986) and Clark (1988), the lowest concentrations of nitrogen, phosphorus and turbidity were consistently associated with uncleared catchments. The highest concentrations and pollutant yields (loads per ha) were associated with intensive horticulture and animal husbandry. Urbanisation is associated with moderately high pollutant yields, but its impact will be moderated by the typically low percentage of a catchment that it occupies. Activities associated with grazing will be a significant contributor of pollutant loads to a catchment, particularly when areas under this land use are high.

Studies have generally found that most pollutants in catchment runoff are transported in association with particulate matter, particularly following high rainfall events (Chittleborough, 1983; Clark, 1988; Camp Scott Furphy et al., 1992). An important component of particulate matter is suspended sediment, with pollutants attached to fine soil fractions and colloidal suspensions. Catchment soil properties (and variability) also impact on stream water quality, with higher clay content soils able to adsorb more organic matter from throughflows, thereby reducing stream organic carbon and nutrient concentrations (Camp Scott Furphy et al., 1992).

The main pollutant generating processes are (Camp Scott Furphy et al., 1992):

- washoff of material accumulated on impervious surfaces since the previous storm;
- dislodgement of soil with associated material (eg. nutrients, pesticides); and
- dissolution of anions and cations of the soil as a result of infiltration to and interception of groundwater.

Of particular relevance to our study area, the important land use, management (diffuse sources) and point source pressures impacting on the quality of surface waters include:

- Insufficient buffering of livestock or access to watercourses, causing erosion and movement of sediment, nutrients and pathogens into waterways.
- Poor management of dairy shed and feedlot effluent, with high nutrient and pathogen loads entering streams particularly during high rainfall events.
- Input of secondary treated waste from the Victor Harbor Waste Water Treatment Plant, in the lower Inman River.

- Poorly maintained and inadequately sized septic tanks, discharging effluent which may eventually reach rivers and streams.
- Pesticides and herbicides causing diffuse pollution particularly when applied near watercourses.
- Excessive or poorly timed fertiliser applications causing nutrient rich runoff.
- Intensive agricultural practices causing acidification of soils.
- Overgrazed paddocks or inappropriate agricultural practices on steeper valley slopes causing soil erosion and delivering large amounts of sediment to waterways.
- Flow reductions caused by in-stream dams and extraction directly from waterways, increasing pollutant concentrations.
- Increased salinity levels due to increased deep drainage beneath low water use landscapes and the increased saline baseflow component of streamflows.
- Runoff from sealed and gravel roads.
- Earthworks associated with housing and other developments.

Groundwater – surface water interactions

Salinity is the obvious catchment pollutant associated with groundwater. However groundwater can also contribute significantly to the nutrient (particularly nitrogen) load of some surface water ecosystems (Lamontagne et al., 2003). Difficulties arise in predicting the contribution of nutrients from groundwater due to:

- a poor understanding of the impact of groundwater/ surface water interactions (eg. with spatial and temporal variation in redox and hydrological conditions) on the load and form in which nutrients are discharged;
- The impacts of riparian zones on nutrient biogeochemistry – which under certain situations have potential for greater plant uptake, or transformations mediated by microbial activity; and
- significant time lags – associated with establishing the new groundwater equilibrium under a change in land use, and the transport of nutrients in groundwater from source to discharge sites.

However continuing research will help to build this developing area of knowledge.

Monitoring and future trends

Physical and chemical measurements provide ‘snapshots’ of water quality. To obtain meaningful information often long-term and strategic monitoring must be undertaken, which may include a biological component. Such a monitoring campaign should reflect:

- seasonal variations in flows and water quality;
- variations between years (eg. wet versus dry years); and
- the influence of storm events (and their ability to transport the bulk of pollutants, often during events of short duration, particularly in relatively highly cleared catchments).

Biological monitoring (eg. using macroinvertebrates, native fish, etc) is increasingly seen as an essential component in the assessment of river and stream health with studies often implemented to directly assess impacts to ecological systems or detect transient disturbances that are typically missed by physico-chemical sampling programs. Further details on this field of monitoring and results from the AUSRIVAS monitoring program for the study area are contained in Appendix 8.

Biological surveys are also important when determining environmental water requirements. Fish surveys, in particular, would help to set flow targets and better understand regional aquatic biodiversity (pers. comm. Michael Hammer, Environmental Biologist, Mar 2004).

A limited amount of physical, chemical and biological monitoring data has been collated for this study, much of which is summarised in spreadsheet format on the attached data CD, with highlights shown in the Appendices.

From a biological perspective, the major threats to river health in the Mt Lofty Ranges relate to factors known to impact on water quality – flow modification, sediment characteristics and riparian condition. Each of these can produce conditions in local waterways that make the persistence of some species impossible or limits their ability to maintain large enough population sizes to persist in the long term. Given the range of land uses and increasing pressure of urban encroachment it is inevitable that continued changes to the landscape will degrade river health measurements. Hence programs such as AUSRIVAS are very important for providing baseline knowledge of river health, for use in following future catchment changes and informing management authorities of the likely outcomes of planning and development decisions (McEvoy et al., 2003).

Water quality policy and guidelines

The principle legislation concerning pollution in South Australia is the *Environment Protection Act 1993*. Section 25 of this Act imposes the general environmental duty on all people undertaking activities with potential to pollute, to take all reasonable and practicable measures to prevent or minimise any resulting environmental harm. The Act also provides for the creation of environment protection policies, which may include both recommended and mandatory requirements to enable protection of a particular aspect of the environment, such as water quality (EPA, 2003b).

The recently released Environment Protection (Water Quality) Policy (EPA, 2003a) offers a statewide approach to the protection of all inland, surface, groundwater and marine waters and covers a range of issues including:

- management principles for control of point and diffuse sources of pollution,
- obligations relating to particular industrial and agricultural activities,
- water quality values and objectives,
- water quality criteria, discharge limits and listed pollutants.

Implications of the water quality policy (EPA, 2003a) for local government are summarised in the fact sheet EPA (2003c), available from the EPA website.

Water quality guidelines (eg. ANZECC & ARMCANZ, 2000; NHRMC & ARMCANZ, 1996; EPA, 2003a) and various industry codes of best practice (eg. EPA, 1997) exist in a variety of forms. While not all water quality guidelines are particularly suited to South Australian conditions, they nonetheless serve as a guide, indicating when problems might be expected. Such general guidelines (including EPA, 2003a) are likely to be updated by more detailed local knowledge when it becomes available.

Focus of this report

The following aspects of water quality will be discussed in more detail:

- salinity,
- nutrients (nitrogen and phosphorus),
- pathogens (*E. coli*), and
- pH.

Water quality guidelines for these selected parameters are summarised in Appendices 9 - 13, for various uses of water, comprising: aquatic ecosystems, drinking water, primary industries, and recreation and aesthetics.

3.3 The role of perennial vegetation in salinity and water quality

Perennial vegetation (eg. protected remnants, regeneration, revegetation, and farm forestry[3]) plays an important role in salinity reduction and water quality of catchments. This land use can assist to:

- reduce ground water recharge, impacting on dryland salinity and waterlogging;
- reduce water run off and associated sediment loads of surface flowing water;
- provide wind protection reducing wind erosion and wind exposure;
- provide water quality and catchment management benefits;
- protect coastal waters from nutrient loading and provide fresh water flush for near coastal ecosystems; and
- provide forage and habitat for biodiversity outcomes.

Perennial native vegetation and remnant vegetation can intercept up to 100% of rainfall therefore having a significant impact on recharge, with potentially zero recharge occurring. Fencing off remnant vegetation and restoring these areas along with appropriate revegetation activities on recharge areas are high priority activities for implementation to reduce waterlogging and dryland salinity.

The Mount Lofty Ranges (MLR) Regional Revegetation Strategy outlines a range of revegetation options for the MLR region; those identified as high priority have high to medium recharge and water quality benefit. Revegetation options identified as priority in the MLR region include:

- protection of remnants,
- natural regeneration in degraded remnants and around isolated trees,
- local native species blocks,
- local native species shelterbelts,
- woodlots,

[3] Guidelines have been developed to minimise the risk of impacts from farm forestry operations on the environment, including consideration of soil erosion and water quality (Forestry SA, 1997).

- timberbelts,
- product blocks,
- fodder blocks, and
- managed native grass pastures.

These revegetation options have significance for the study area where a combination of activities can be applied strategically across the landscape to assist in ameliorating salinity and water quality issues in the region.

Priority zones for salinity management are identified in Section 4.3 - Salinity Management (see Figure 15). Particular native vegetation activities for salinity management are identified for recharge and discharge areas.

Recharge reduction activities include:

- enhance and protect remnants;
- avoid further fragmentation of remnants;
- revegetate adjacent to remnant vegetation to buffer and connect existing patches;
- protect and revegetate riparian areas and swamps; and
- establish strategic revegetation on properties such as vegetation blocks and windbreaks.

Discharge zone vegetation activities include:

- establishing salt tolerant native species on salt affected areas.

Remnant vegetation biodiversity principles

Protecting and managing remnant vegetation provides an important base to biodiversity conservation where natural flora, fauna, and ecosystems constitute the biodiversity of an area. These areas are the last hold for remnant species and the genetic remnants of the region.

Priority order principles for biodiversity conservation are:

- **Retain** existing remnant vegetation areas, including degraded remnants and scattered trees;
- **Remove** threats of weeds, livestock and vermin from these areas;
- **Restore** the natural processes in remnant vegetation; and
- **Revegetate** appropriately.

These principles are known as the **“4R’s”** and are covered in more detail in the fact sheet ***Biodiversity*** (Ecological Evaluation, 2000).

Revegetation principles

Further information on revegetation principles, species selection, planning and establishment techniques can be found in Appendix 14.

4 SALINITY

4.1 Salinity Issues

Salinity can be described as the accelerated accumulation of salts in land and water to sufficient levels to cause adverse impacts on natural and human assets. This can occur through natural processes (primary salinity) or as a result of land use changes made by human activity (secondary salinity).

Secondary salinity is generally attributed to an increase in recharge to groundwater (following clearing, or with irrigation) and mobilisation of stored salt towards the surface with rising watertables. However the particular mechanism of salinisation is likely to vary between sites. While increased lateral groundwater flows or particular soil properties can sometimes play an important role, in most cases excessive deep drainage (potential recharge), of water below the root zone, would be expected to be a critical factor.

The high rainfall and hilly landscapes typical of much of this region ensure that salinity problems are not as dramatic or widespread as seen in other parts of the state. However salinity has significant impacts on stream water quality and on limited areas of agricultural land in flats and sluggish drainage lines (often associated with waterlogging). In the Inman River it is thought that streams are impacted by a combination of incision (bed deepening due to erosion) and rising watertables, which has resulted in elevated levels of saline groundwater discharging to the river (Burston and Good, 1995).

Salinisation of watercourses is of great concern in this region due to the importance of stream water quality:

- where water is extracted directly, or collected in dams for stock drinking water, irrigation or other commercial enterprises (eg. inland aquaculture); and
- for the health of in-stream and riparian ecosystems;

Salinity levels of harvested water supplies may limit potential land use, particularly irrigation activities. Both livestock and irrigated plants vary in their tolerance to salinity. Appendices 8 and 9 provide salinity tolerance information for selected agricultural plants and livestock. It should be noted that tolerance of plants to salinity will vary with soil type, drainage, levels of flushing and soil moisture levels.

Salinity also has impacts on the biodiversity of freshwater ecosystems, with elevated salt concentrations causing physiological stress in non-tolerant plants and animals. Studies have shown that the total number of species in aquatic ecosystems declines with salinities greater than 1000 mg/L (ppm). However it is also noted that saline ecosystems are often natural (some being transient in nature) and the suite of tolerant species that flourish in such waters are important contributors to the overall biodiversity of the state (McEvoy and Goonan, 2003).

Irrigation induced salinity

Irrigation of horticultural crops or pastures can lead to salinity impacts through:

- the accumulation and concentration of salts from irrigation water in the root zone, with potential impacts on plant growth and/ or soil structure (including sodicity – see Appendix 12).
- over irrigation leading to raised watertables, bringing potential for waterlogging or salinisation.

Salts from irrigation water that have accumulated in the root zone during the dry season can be flushed by winter rains in regions with sufficient rainfall (ie. most of the study area). Where rainfall is inadequate, leaching fractions should be applied with due consideration given to soil type, plant rooting depth, impacts to the watertable, offsite impacts, and conservation of water resources.

Best practice irrigation techniques that will help minimise environmental impacts include:

- soil moisture monitoring,
- irrigation system design according to soil type and rooting depth,
- water efficient irrigation practices (eg. delivery systems, uniformity of irrigation, time of day, and period of watering to reduce wastage from evaporation or deep drainage),
- regular maintenance of irrigation systems,
- periodic salinity testing of irrigation water and soil,
- consider water balances for the annual production cycle (eg. for vineyards - cover crops between rows can prevent excessive groundwater recharge beneath winter dormant grape vines, and are often cut or sprayed off when soil moisture is needed. [Some species of native grasses are ideal for this purpose]).

4.2 Salinity Status

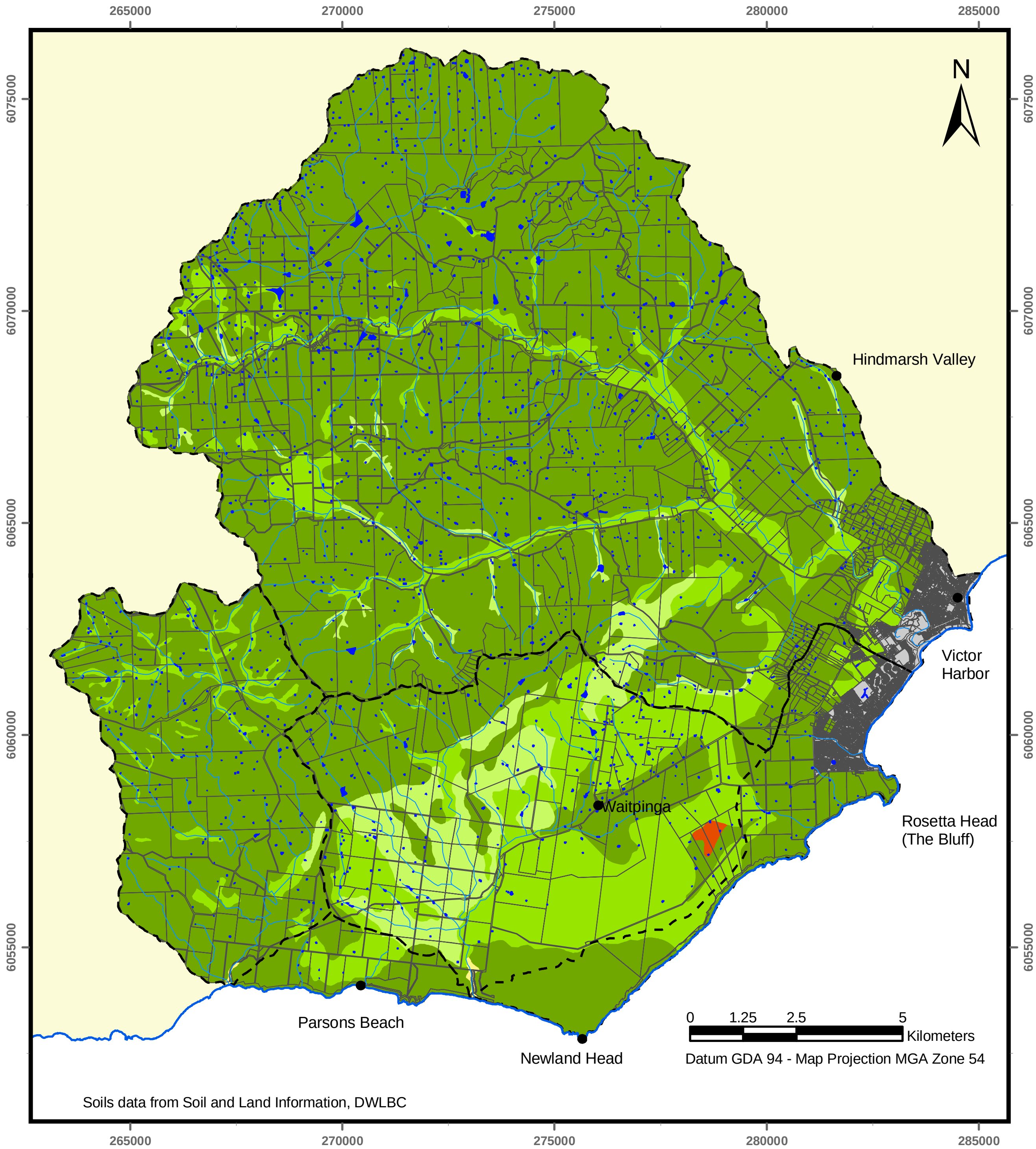
Figures 10 and 11 respectively show the varying degrees by which land is affected by salinity and at risk of salinisation. Where affected land is adjacent to waterways this indicates areas where saline baseflow, or salt wash-off, is entering streams. While there are only minor areas of highly affected land throughout the study area, large areas of Waitpinga are affected by moderate salinity. Much of the salt affected land occurs in Kanmantoo, Quaternary infill, or Permian sediments with poor drainage and high potential to accumulate, store and release salt.

Areas of land affected and at risk are shown in Table 8. While the area of land at risk of salinisation is low, in the event of rising water tables stream salinity would be expected to rise with increased groundwater discharge to streams in incised landscapes.

Further information regarding the status of salinity in the broader Fleurieu Peninsula is contained in Liddicoat and Herrmann (2002).

Figure 10. Salinity induced by watertable

in the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



- LOCATIONS
- CATCHMENT BOUNDARY
- CADASTRAL BOUNDARIES
- DAMS
- DRAINAGE LINES

SALINITY (induced by water table)

- Negligible
- Slight salinity, or less than 2% of land affected by highly saline seepage
- Moderate salinity, or 2-10% of land affected by highly saline seepage
- Moderately high salinity, or 10-30% of land affected by highly saline seepage
- Moderately high to high salinity, or 30-50% of land affected by highly saline seepage
- High salinity affects more than 50% of the land
- Not Applicable

NOTES ON THE USE OF THIS MAP:

1. This information is derived from limited field inspection, and is subject to amendment as and when more data become available.
2. Boundaries between mapping units should be treated as transition zones.
3. The map is intended to provide a regional overview and should not be used to draw conclusions about conditions at specific locations.
4. Under no circumstances must the scale of the map be enlarged beyond its scale of publication.
5. Advice from DWLBC Soil and Land Information should be sought prior to using this information for commercial decision making.
6. Under no circumstances may the data or information associated with this map or any accompanying report be altered in any way without the express permission of DWLBC Soil and Land Information.

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The classes of water table induced salinity shown in this map account for the degree of salinity of the landscape as a whole, and for the proportion of land affected by discrete saline seepages. The classes do not distinguish between primary (natural) salinity and secondary (European induced) salinity.

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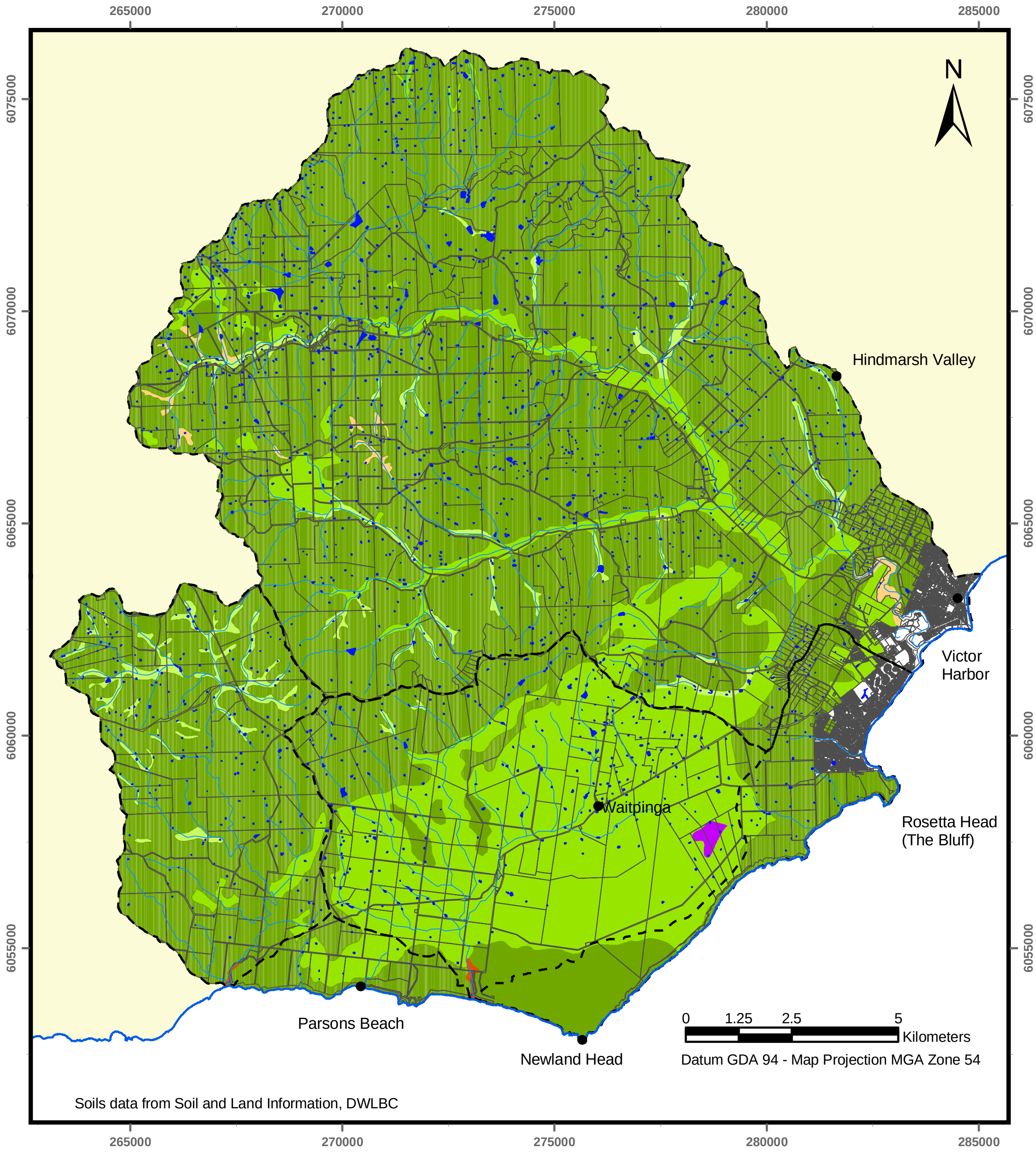
Figure 11. Salinity Risk in the event of rising watertables

in the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



LOCATIONS
CATCHMENT BOUNDARY
CADASTRAL BOUNDARIES
DRAINAGE LINES
DAMS

This map shows six classes of salinity risk related to the occurrence of rising water tables. In addition, there is one class where the land is already mostly highly to extremely saline. Classes are based on an interpretation of soil landscape units. Each map unit is classified according to the salinity risk of its component areas, on a proportional basis. Classes are determined from existing salinity attribute ratings, position in the landscape, and the salinity status of adjacent map units and the encompassing land system.

RISK OF INCREASED SALINISATION

- LOW - Land which shows little to no evidence of salinisation, and is considered to have little risk of becoming saline.
- MODERATELY LOW - Land which presently shows little to no evidence of salinisation but is at possible risk of becoming increasingly saline if watertables rise significantly.
- MODERATE - Land which already has somewhat raised subsoil salinity levels, which may be the result of relatively shallow watertables, and if so, is at risk of becoming increasingly saline if watertables rise.
- MODERATELY HIGH - Land which already has raised subsoil salinity levels resulting from relatively shallow saline watertables, and is at risk of becoming increasingly saline if watertables rise.
- HIGH - Land which is often already too saline for some field crops, and is at risk of becoming increasingly saline if watertables rise.
- VERY HIGH - Land which is already too saline for many field crops, typically including significant areas of highly saline to extremely saline land, and is at risk of becoming increasingly saline if watertables rise even a small amount.
- EXISTING MOSTLY HIGHLY SALINE LAND
- Not Applicable

NOTES ON THE USE OF THIS MAP:

1. This information is derived from limited field inspection, and is subject to amendment as and when more data become available.
2. Boundaries between mapping units should be treated as transition zones.
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Table 8. Areas of land (in ha) currently salt affected and at risk

Catchment	Catchment area	Secondary salinity	Primary salinity	Total salinity	At risk of salinisation (with rising water- tables)
Inman River	19526	38	0	38	0
Waitpinga Ck	6115	103	1	104	16
Coolawang Ck	4077	6	0	6	7
Newland Cliffs	1909	2	0	2	0
Parsons Beach	608	2	0	2	0
Totals	32234	151	1	152	23

Figures 12 to 14 show the geology overlain with indicative salinity measurements[4] of groundwater and surface water. Groundwater salinities were obtained from the SA GEODATA (Drillhole) database, with samples often taken at the time of drilling. Figure 12 also displays information on bore yields, showing that wells with better quality water are often limited by low yields. Figure 13 depicts borehole salinity with borehole standing water level (SWL). This provides an indication of the hydrostatic pressure acting on the water in the aquifer(s), at the depth over which the well is screened. It should be noted that bore SWL is not the same as the 'depth to watertable'. Surface water salinities, shown in Figure 14, include sampling conducted by Graham Webster, Victor Harbor Council, Inman River Catchment Group, Peter Goonan (EPA) as part of the AUSRIVAS program, and 'Water Point' data held in the SA GEODATA database.

Elevated salinities are found most noticeably in sediments derived from Kanmantoo Group rocks (eg. in the Halls Ck subcatchment; to the north of Waitpinga and in the southern Coolawang catchment) and in the Quaternary alluvial infill sediments (eg. in the southern half of the Waitpinga catchment). Permian sediments show varying salinities from fresh (eg. in the headwaters of Coolawang Creek and parts of the Inman Valley) to highly saline (eg. in the valley flats of the Inman River). This variability likely reflects local differences in drainage, geology (eg. Kanmantoo or Adelaide Geosyncline), rainfall and soil texture (eg. clayey sediments will store more salts washed in from the upland areas compared to more easily draining sands).

Limited time series salinity records have been collected (by groups including the Inman River Catchment Group; EWS and EPA at the Inman River gauging station; and Camp Scott Furphy et al., 1992) for several locations in the Inman River catchment. This data is presented in Appendix 15 and is also contained on the data CD attached to this report.

[4]These salinity measurements provide only an indication of surface and ground water salinities and can not be directly compared. Measurements have been taken at different times of the year and with different operators and instruments. Ground water salinities are taken at different depths and in aquifers which may not correspond to outcropping geology.

Figure 12. Borehole Salinities, Yields and Geology

of the Inman, Waitpinga, Coolawang and Newland Cliffs catchments

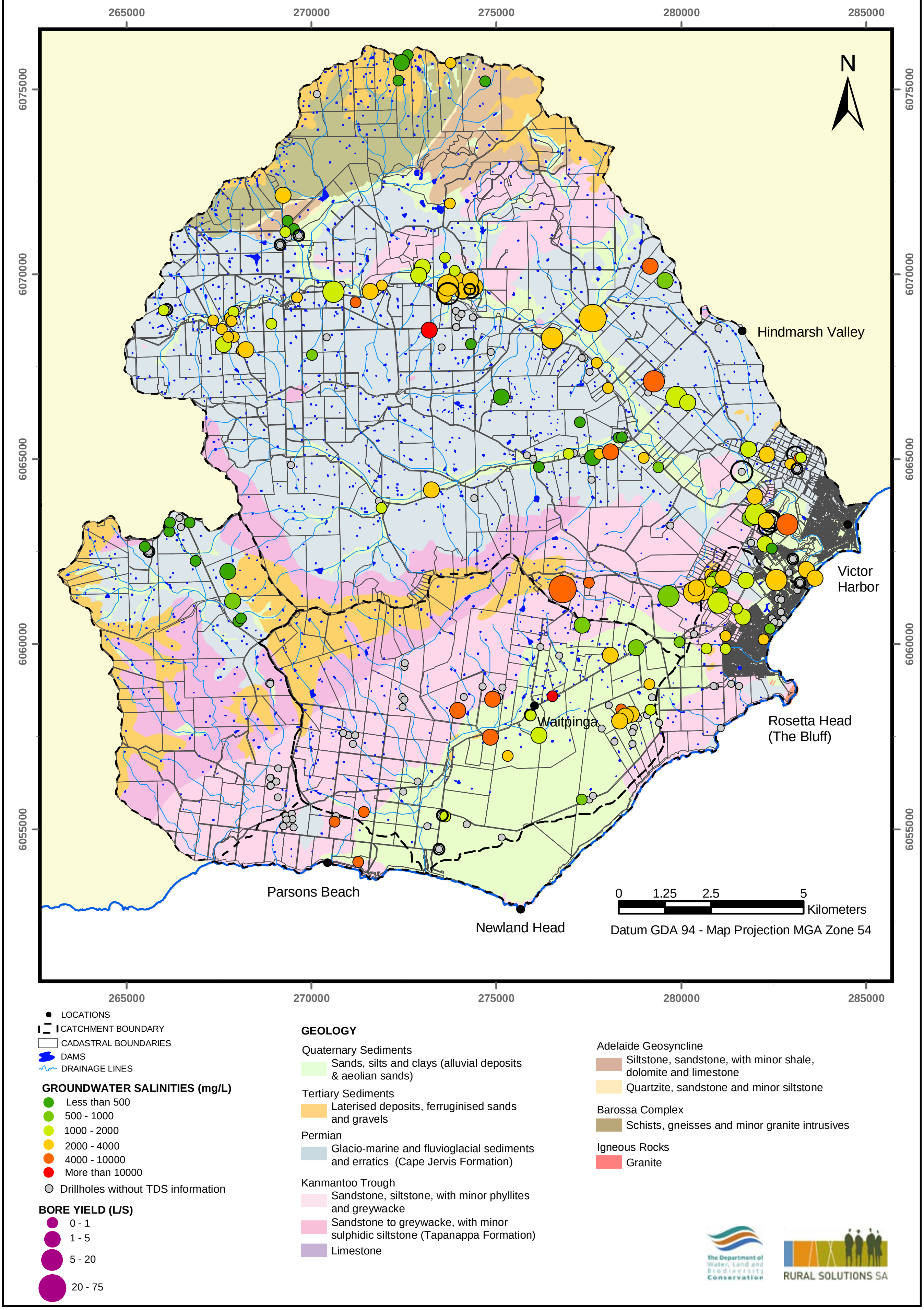
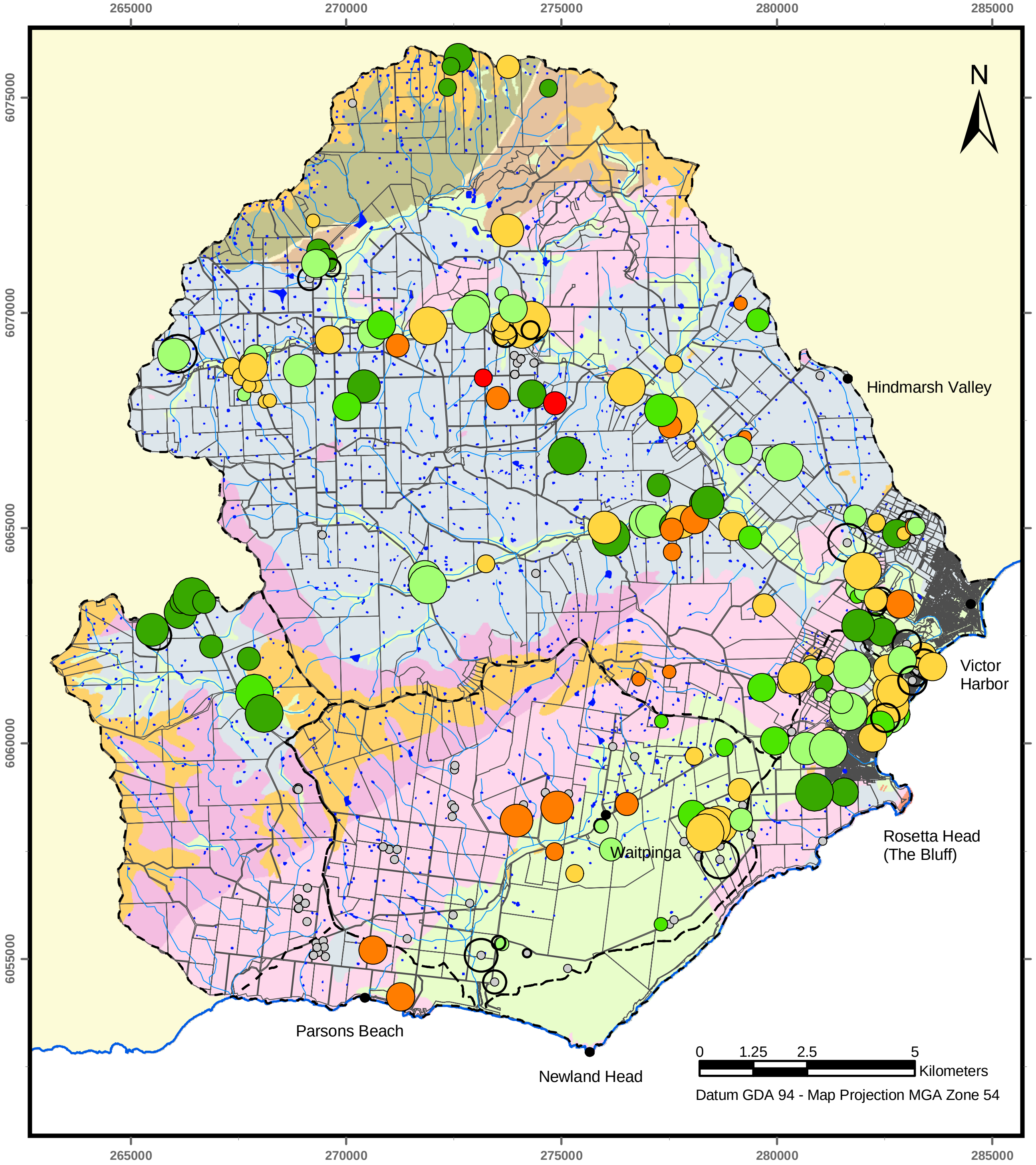


Figure 13. Borehole Salinities and Standing Water Levels

of the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



LOCATIONS
CATCHMENT BOUNDARY
CADASTRAL BOUNDARIES
DAMS
DRAINAGE LINES

GROUNDWATER SALINITIES (mg/L)

- Less than 500
- 500 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 10000
- More than 10000

Drillholes without TDS information

DEPTH TO WATER (m)

- At or above ground level
- within 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 103

GEOLOGY

Quaternary Sediments
- Sands, silts and clays (alluvial deposits & aeolian sands)

Tertiary Sediments
- Laterised deposits, ferruginised sands and gravels

Permian
- Glacio-marine and fluvioglacial sediments and erratics (Cape Jervis Formation)

Kanmantoo Trough
- Sandstone, siltstone, with minor phyllites and greywacke
- Sandstone to greywacke, with minor sulphidic siltstone (Tapanappa Formation)
- Limestone

Adelaide Geosyncline
- Siltstone, sandstone, with minor shale, dolomite and limestone
- Quartzite, sandstone and minor siltstone

Barossa Complex
- Schists, gneisses and minor granite intrusives

Igneous Rocks
- Granite

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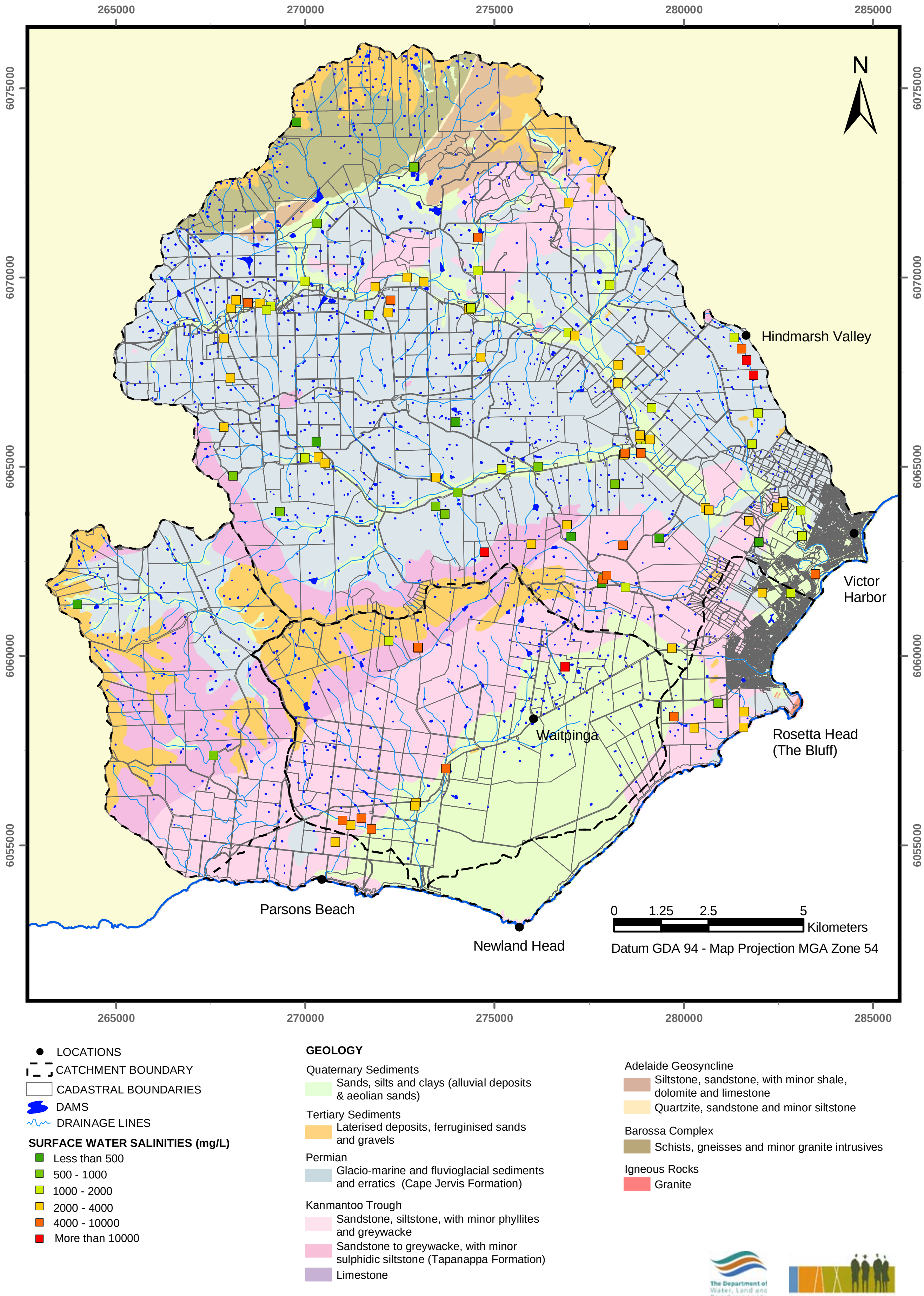
Figure 14. Surfacewater Salinity and Geology

of the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



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These records exhibit seasonal salinity cycles, peaking in summer when surface runoff is negligible and more saline baseflow dominates. Some of the highest salinities occur high in the catchment (eg. as measured at Millard Reserve) before dilution of streamflow occurs from tributaries draining higher rainfall country. The extent of this data is insufficient to detect long-term salinity trends.

Significant stream salinity issues observed in the region occur in:

- the Inman River – where every summer salinity rises quite dramatically, with the dominance of saline baseflows (see Appendix 15). At the time of European settlement, the Inman was reported to support an expanse of freshwater wetlands, hence salinity in this developing watercourse may be a recent phenomena (Burston and Good, 1995). Burston and Good (1995) also report that flow of water in the Inman River during the summer months appears to be sensitive to the extraction of large volumes of surface water.
- all water courses draining the Permian glacial sediments – these are reported to become brackish during the summer months (Burston and Good, 1995).
- water courses draining the Bald Hills Land System – This landscape comprises of very clayey Permian glacial sediments from Bald Hills through Torrens Vale (in the western headwaters of the Inman).
- Halls Creek – this tributary of the Inman River drains sediments derived from Kanmantoo Group rocks which surround the deeply weathered lateritic capping atop Wilson Hill. (Field EC measurements of 9dS/m were recorded in this creek during low flows in August 2002 after a light rain the night before.)
- in-stream dams – particularly when watercourses drain sediments with high salt storage. In-stream dams tend to capture a greater proportion of the undesirable saline baseflows, while off-stream dams are designed to captured fresher peak flows.

4.3 Salinity Management

The range of salinity management options generally fall into 3 categories:

- *Recharge reduction* – increasing water use over the catchment.
- *Living with salt* – using saline resources productively.
- *Engineering* – pumping and drainage options to increase discharge mainly for protection of valuable assets.

Prior to producing a plan for on-ground works it is vital to have a conceptual understanding of processes occurring in the catchment. The likely effectiveness of management options, and the scale at which they need to be applied, can be determined, and will depend on the type of groundwater system causing the problem. It is then necessary to evaluate actions according to various economic, social, moral and environmental criteria.

Salinity management options appropriate for the study catchments are discussed in detail in the *Southern Fleurieu Peninsula Salinity Management Plan* (Liddicoat and Herrmann, 2002). There is a copy of this report on the attached data CD.

Summary of Management Options

Effective salinity management will often require a mix of the three strategies. Table 9 lists the types of options that might be suited to a range of scenarios likely to be encountered in the study area.

Table 9. Summary of salinity management options (adapted from Liddicoat and Herrmann, 2002)

Situation	Where examples are found	Suggested Management Options
Stream salinity	Mostly in clayey Permian, Kanmantoo and infill sediments (eg. Inman River in summer)	• Regulate surface water harvesting regimes (timing and volumes of extraction) to maintain acceptable ratios of runoff : saline baseflow. • Recharge reduction across catchments contributing to groundwater baseflow – via productive pastures (see Fairbrother et al., 1999), or woody perennials (eg. native vegetation, farm forestry*, see Appendices 14 and 16). • Control stream bank erosion, where bed deepening processes are draining increasing volumes of saline groundwater into streams. • Ensure new dams are constructed off-stream. • Relocate in-stream dams that contribute to high stream salinity.
Poorly drained valley floors	(eg. Inman Valley, Waitpinga)	• Establish or enhance swamps/ wetlands [Noting that swamps are protected under the EPBC Act – see section 2.3.4, and Appendix 3]. • Improve surface drainage (with shallow drains). • Seepage interceptor drains. • Forestry, revegetation and/or well managed pastures in upper parts of landscape, or at break of slope.
Hillside seeps	Mostly in Permian sediments and Kanmantoo rocks. (eg. Inman Valley, Waitpinga)	• Local recharge reduction strategies. • 'Living with salt' – plant salt/ waterlogging tolerant trees, shrubs or forage plants and fence off to manage impacts of livestock. • 'Engineering' – siphon groundwater from behind flow barriers (with appropriate disposal method if high salinity groundwater)

High recharge zones (eg. rocky or sandy ridges and hill slopes)	Sandy Permian and infill sediments, shallow or rocky soils, mostly in Kanmantoo Group sediments.	• High water use perennial vegetation – native species, agroforestry, or highly productive well managed pastures.
Irrigation induced Salinity		• Adopt best practice irrigation techniques (eg. soil moisture monitoring, system design for soil type, maintainence, etc.)
Waterlogging on perched watertables	In sediments with a shallow, low - permeability layer (eg. sodic clay subsoils).	• Seepage interceptor drains . • Apply lime or gypsum to address sodicity problems. • Introduce tolerant pastures and livestock management to avoid pugging.
Saline sulphidic seeps	Mostly in Kanmantoo Group Sediments (Tunkalilla Formation) (eg. Coolawang Ck)	• Fence off, plant waterlogging / salt tolerant perennial vegetation. • Add lime if acidic. • Exclude stock completely in highly saline, sulphidic or waterlogged areas. • Stabilise eroded areas with tolerant trees, shrubs, or grasses (including native grasses), or construct simple control weirs to reduce gully gradients. • Establish or enhance wetland. • (refer to Fitzpatrick (1999) for more information on acid sulphate soils.)
Salinisation of Groundwater resources	(eg. Valley floor of Inman River)	• Avoid over extraction of groundwater resources (& drawing in saline water from aquifer fringes) • Avoid over- or under-irrigation, particularly with saline water.

(Note* - Areas with basic suitability for farm forestry are mapped in Appendix 16.)

Identifying priority areas

Priorities for on-ground action should be targeted:

- In areas of high recharge potential that contribute to salinity problems. This is where recharge reduction measures will be most cost effective. (As shown in Liddicoat and Herrmann (2002), higher recharge potential occurs in sands and alluvial sediments south of Waitpinga and in shallow soils over rock near the coast in Coolawang Creek catchment and in the uplands of the south and north Inman River catchment area.)
- Where the risk of spreading salinity is high (see Figure 11 – ‘Salinity Risk’).
- In sub-catchments contributing to high stream salinity levels (see Figure 14 – ‘Surface water salinity’).

- In areas of existing native vegetation as these contribute significantly to catchment water use (see Figure 4 – 'Native vegetation & land use').

Hence the following priority zones (as shown in Figure 15) have been identified:

- Sub-catchments with existing salinity.
- Sub-catchments with some existing salinity and a moderately high risk of becoming more saline.
- Areas of native vegetation located near or in high recharge potential areas.
- Other areas contributing to localised saline land and catchment stream salinity.

In other salinity studies it has been shown that to halt the spread of saltland or stabilise stream salinity levels it is necessary to achieve reductions in recharge of around 50%. Appendix 17 presents an example of how this type of recharge reduction might be achieved using combinations of the various management options that should be considered. The water use and hence reduction in recharge under various land uses can be estimated using the 'Total Water Use' factsheet, contained in Appendix 18.

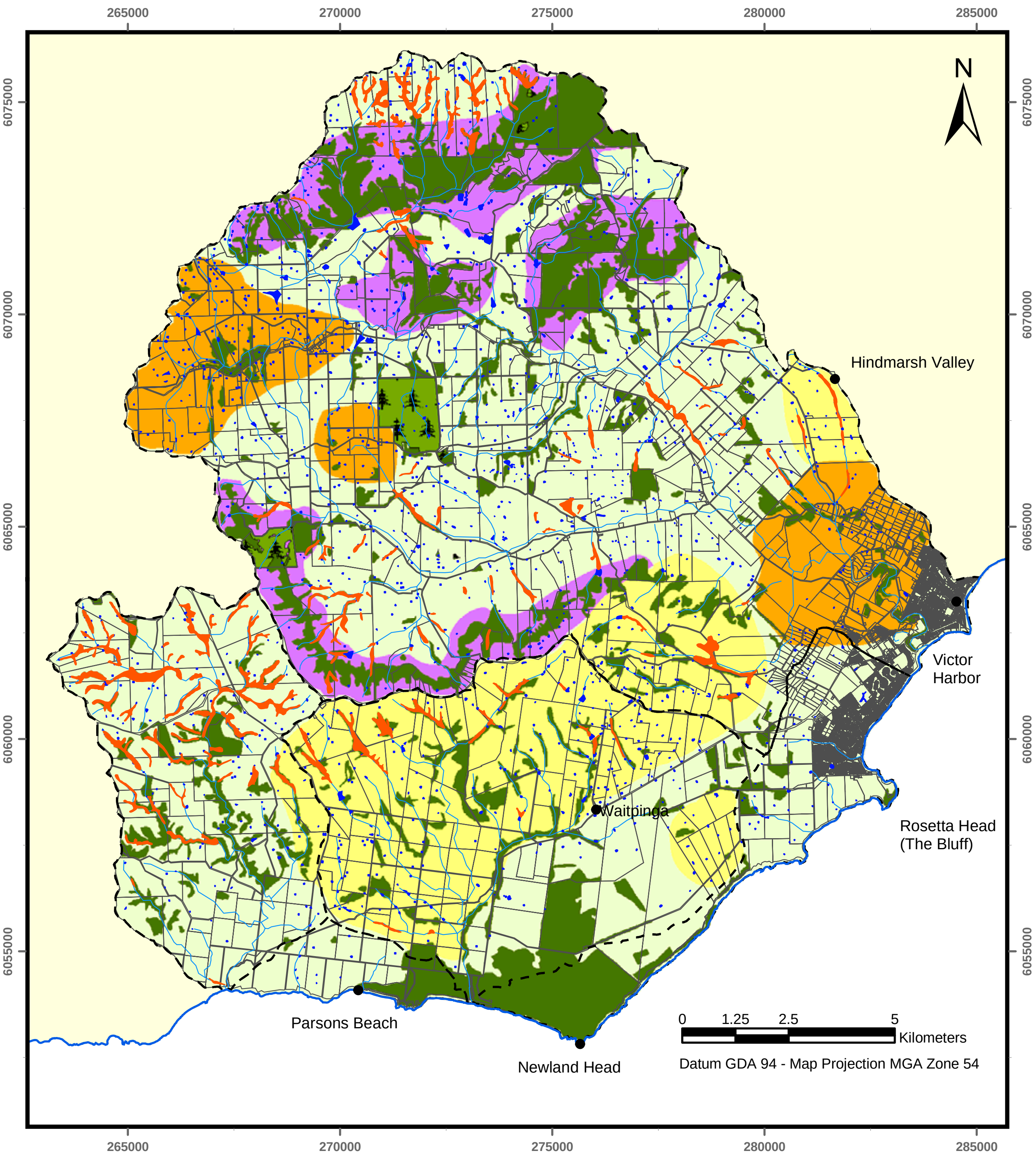
Strategies adopted in the priority areas will depend on factors such as existing salinity levels, risk of salt spread, existing land use, the presence of native vegetation (including protected swamps [also see section 2.3.4]), landholder intentions for the property, the value of the asset at risk and the role an area plays in the salinity process (eg. recharge, discharge zones). In short, adopted strategies should follow the principles outlined in the table below.

Table 10. Salinity control strategies for priority areas

Recharge Reduction (Catchment high water use)	For existing native vegetation	• Enhance / protect • Avoid fragmentation of native vegetation. • Establish adjacent additional revegetation to buffer / connect existing stands. • Enhance riparian areas (eg. protect and revegetate where appropriate; establish wetlands)
	For pasture	• Convert annual pastures to perennials. • Improve productivity of annuals and perennials (eg. through addressing fertility, acidity, erosion, etc.) and graze appropriately for high water use. • Establish strategic revegetation / windbreaks / farm forestry. • Clay spreading for moisture retention (if appropriate).
Living with salt	For salt-affected/ discharge areas	• Protect from over-grazing and erosion. • Establish salt tolerant pastures and / or native vegetation. • Protect / develop wetlands (see Section 2.3.4)
Engin-eering	To protect high value assets	• groundwater pumping, siphoning, • drainage works.

Figure 15. Priority Zones for Salinity Management

in the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



- LOCATIONS
- CATCHMENT BOUNDARY
- CADASTRAL BOUNDARIES
- DAMS
- DRAINAGE LINES
- NATIVE VEGETATION COVER
- FOREST PLANTATION

PRIORITY ZONES

- SUB-CATCHMENTS WITH EXISTING SALINITY
- SUB-CATCHMENTS WITH SOME EXISTING SALINITY AND A MODERATELY HIGH RISK OF BECOMING MORE SALINE
- EXISTING NATIVE VEGETATION AND/ OR HIGHER RECHARGE POTENTIAL
- OTHER AREAS WITH LOCALISED SALINITY & CATCHMENT STREAM SALINITY

PROTECTED SWAMPS

- SWAMPS PROTECTED UNDER THE EPBC ACT (DRAFT)
  Determined from interpretation of aerial photography, and yet to be ground-truthed (pers. comm. Claire Harding, Wetlands Project Officer, Department for Environment and Heritage, Feb 2004).

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Protected swamps

The protected swamps of the Southern Fleurieu (previously discussed in section 2.3.4) are highlighted in Figure 15 due to the potential for hydrological impacts on swamps from salinity management activities.

Where swamps are being degraded by salinity (as suggested in Appendix 3) there may be scope for some salinity management measures, however such activities should be only be undertaken in accordance with requirements of the EPBC Act and relevant State legislation, as discussed in DEH (2003).

Additional measures to prevent water salinisation

For the protection of surface and groundwater resources from salinity the following practices are recommended:

- Siting dams off-stream. Avoid poorly draining valleys, and immediately above 'break of slope' situations.
- Regulating surface water extraction regimes (seasonality and volumes of water harvesting both into dams and directly from watercourses). Extraction of water directly from watercourses over summer potentially has the greatest impact on seasonal increases in stream salinity. This is because the saline baseflow becomes more dominant in watercourse pools as water is extracted. New dam construction may also require regulation. However regulation requires a greater understanding of:
  - (i) acceptable levels of stream salinity (for the community and environment), and
  - (ii) the hydrology of surface water, unsaturated zone and groundwater flows for respective catchments.

5 NUTRIENTS

5.1 Nutrient issues

Surface water nutrients are essential for aquatic food chains however excessive inputs lead to nutrient pollution. Resulting impacts can include excessive growth of nuisance aquatic plants, algae and cyanobacteria, which can smother streambed habitats and choke waterways and estuaries. Flow on effects can occur where waterways discharge to the sea and algal growth smothering sea grasses can cause the loss of important coastal feeding and breeding habitats.

Produced in conditions of warm, still, nutrient-rich water, blooms of blue-green algae (cyanobacteria), upon decomposition, release compounds toxic to humans and stock. In addition, nutrient rich waters provide an environment more suitable to the survival of microbial pathogens, increasing the risks of infection and disease in exposed animals and humans.

Once nutrients are depleted or settle out of the water column, decomposing organic matter, resulting from excessive aquatic weed and algal growth, will deplete oxygen levels, and in some cases lead to fish kills. Nutrient rich waters have depleted levels of biodiversity, with tolerant organisms dominating what remains of aquatic communities.

Simple measurement of dissolved nutrient concentrations in the water column may not accurately reflect the status of a waterway. Polluted water bodies will have significant nitrogen and phosphorus stores in the sediments (where the larger plants are likely to obtain nutrients) and associated with suspended particulate matter (that is often overlooked during sampling). There are a multitude of physical, chemical and biological processes that cycle nutrients between different molecular and bound (or adsorbed) forms, and also between sediments and the water column. The most bio-available (ie. available for nuisance plant growth) forms of nitrogen and phosphorus are generally ammonia (NH_4^+), nitrate (NO_3^-) and phosphate (PO_4^{3-}). It is generally found that phosphorus is the nutrient limiting plant growth in fresh waters, while nitrogen limits plant growth in marine and estuarine waters (ANZECC & ARMCANZ, 2000).

Social and economic impacts of nutrient pollution include increased costs of water treatment, public health risks, loss of amenity values (fishing, swimming, boating, aesthetics), reduced fisheries productivity and impacts on tourism.

5.2 Nutrient Status

At a local scale point sources (such as sewage treatment plants) can be significant contributors to surface water nutrient loads. However other studies have generally found a more significant contribution is made from sources such as soil erosion* and domestic animal wastes* (*NLWRA, 2003), and fertiliser applications (Chittleborough, 1983), which accumulate over large areas of the catchment. The contribution of these types of diffuse sources (ie. land use and management practices) is discussed in section 3.2. In the case of the lower Inman River a highly significant point source of nutrient pollution is currently present. In the region, intensive animal based industries (eg. dairies) have also been identified as potentially significant sources of nutrient pollution.

While some studies have shown groundwater to be a significant contributor of nutrients (particularly nitrogen) to surface waters (Lamontagne et al., 2003), there is insufficient information available to determine if this is an issue in the study catchments. As mentioned in section 3.2, the time lags associated with groundwater movement mean that the full extent of this potential pollution source may not be realised until some time in the future when past catchment management practices will show their impact.

Victor Harbor Waste Water Treatment Plant (WWTP)

The main concerns arising out of the WWTP discharge to the lower Inman are high loadings and concentrations of nitrogen and phosphorus, high concentrations of ammonia, and chloramines (formed when chlorine is used in the disinfection process), which can be toxic to aquatic fauna.

For the purpose of assessing the impacts of the WWTP discharge, monitoring was conducted on the Inman River on a weekly basis for the period Feb 1990 – May 1991, at Swains Crossing (upstream of WWTP discharge), the Footbridge below the discharge, and at the River Mouth (Kent Reserve) (Camp Scott Furphy et al., 1992). Monitoring of the Hindmarsh River (deemed to have similar land use and expected water quality) was also used as a comparison.

Total nitrogen and total phosphorus levels upstream of the discharge were thought to be within the general range observed for pasture/ grazing land use. Increases in total nitrogen (TN) and total phosphorus (TP) due to the WWTP discharge are evident from the range of concentrations observed at upstream and downstream sites, on an annual basis, and during summer – the period of greatest ecological concern.

Table 11. Range of nutrient concentrations observed upstream and downstream of the Victor Harbor WWTP (Feb 1990 – May 1991; from Camp Scott Furphy et al., 1992)

		Total nitrogen (mg/L)		Total phosphorus (mg/L)	
		Range	Median	Range	Median
Annual basis	Upstream	0.31 - 8.81	0.72	0.01 - 0.62	0.027
	Downstream	1.66 - 41.35	11.41	0.24 - 12.0	2.4
Over summer	Upstream	0.71 – 1.88	N/A*	0.02 – 0.15	N/A
	Downstream	3.55 – 41.35	N/A	0.087 – 12.0	N/A

(* N/A = Not available)

On an annual basis the effluent contributes approximately 11% of the total nitrogen and 46% of the total phosphorus load to the river. The remainder is mainly derived from catchment agricultural activities. From December to January (when diluting flows from the catchment are low) the WWTP contributes 63-87% of total nitrogen load and 93-96% of total phosphorus load to the river (Camp Scott Furphy et al., 1992).

Because of the high nutrient concentrations it is not unexpected that nuisance algal blooms have occurred, including toxic cyanobacteria blooms. These blooms are most likely to occur during the summer, with combined conditions of higher temperatures, low flow conditions and abundant nutrient supply. Resulting high organic loads deplete dissolved oxygen, while discharged ammonia (in conditions of elevated pH) and chloramines (in sufficient concentration) are potentially toxic. While fish kills can occur due to natural phenomena, the water quality impairment caused by the WWTP discharge is likely to be the major contributing factor to past observed fish kills in the lower Inman River (Camp Scott Furphy et al., 1992).

The estuarine reach is regularly declared unfit for recreational use during the summer months and the unpleasant odours have been a cause of community concern for some years, affecting both locals and tourists (Burston and Good, 1995). (Disinfection enables the WWTP discharges to meet the faecal coliform standards for primary contact recreation all year round.)

SA Water is in the process of upgrading this facility to tertiary treatment via the construction of a new plant at a new site, with the storage of treated water in the disused Hindmarsh Valley Reservoir. Tenders have been called for the construction of the new $28 million plant capable of producing high quality treated water for irrigation of horticultural crops, parks and sports fields (SA Water, 2003). Treatment and diversion of the reclaimed water will result in significant reductions in nutrient loads to the lower Inman.

Septic Tanks

Septic tanks have been identified as a key contributor to nutrient problems in the Adelaide Hills (DWR, 2000), with poor maintenance, lack of regular pump-outs and under-sized systems largely at fault. These poorly maintained systems discharge effluent, containing nutrients and potentially harmful micro-organisms, into local streams. Similarly, throughout the non-sewered areas of the Fleurieu Peninsula, septic tanks are likely to be an important threat to water quality.

Monitoring data

Some data has been collected from the study area (by the Inman River Catchment Group; and Camp Scott Furphy et al., 1992). Selected parts are presented in Appendix 19, with further data contained in spreadsheet form on the data CD.

From work undertaken by Camp Scott Furphy et al. (1992), upstream of the Victor Harbor WWTP (Appendix 19, Location 9) nutrients (Total Phosphorus/ Soluble Phosphorus and Total Nitrogen/ Oxidised Nitrogen) in the Inman River show good correlation with E.coli levels. This would be expected with faecal contamination of watercourses in the upstream catchment.

At sampling locations in the upper Inman catchment, nutrients, particularly soluble phosphorus, are commonly found at levels higher than recommended guideline values (refer to data CD). There appears to be a reduction in maximum recorded phosphate concentrations towards downstream sites (prior to the WWTP), suggesting that episodically high nutrient input occurs in the upper Inman catchment which is being diluted as flows make their way downstream. However the limited extent of data makes it difficult to reach any solid conclusions. Low levels of nitrates have been detected from the tributary catchment of Back Valley Creek, sampled near the confluence with the Inman.

Downstream of the WWTP (Appendix 19, Location 10 & 11) there is no correlation between nutrients and E.coli. This is consistent with high nutrient, disinfected input from the WWTP.

5.3 Nutrient Management

Determining the sources and relative contribution of nutrient types from different land uses is the key to any management strategy. Previous sections (see 3.2) have discussed the importance of land use and management practices in determining the quality of surface water runoff, in particular:

- levels of soil disturbance leading to erosion – from cultivation, over-grazing, unsuitable land use, etc.
- intensity and timing of fertiliser applications – in inorganic and organic forms (including animal wastes).

Phosphorus is largely transported in association with fine particulate matter, particularly during high rainfall / storm events. Recognition of the link between nutrients (particularly phosphorus) and turbidity is very important for effective management of nutrient loads to waterways. Because phosphorus binds to particulate matter (eg. suspended sediments) soil erosion contributes to both turbidity and nutrient pollution.

Nitrogen is more soluble and largely mobilised by leaching processes, rather than erosion processes, and will move down the profile to groundwater or laterally in texture contrast soils into waterways.

Management practices (see Table 12) should firstly aim to minimise the problem at the source, and then try to intercept and assimilate nutrients within the catchments they originate from. This will also help to ensure that nutrient exports from a catchment remain within ecologically sustainable limits (NLWRA, 2003).

Table 12. Management approaches to reduce nutrient exports (from NLWRA, 2003)

Strategy	Example
Reduce nutrient sources	• Reduce soil erosion. • Adoption of agricultural effluent disposal best management practices (see section* on page 55). • Development and adoption of fertiliser best management practices (rates, timings, buffer zones). • Tertiary and /or land based sewerage treatment. • Septic tanks are to be correctly sized and properly installed and operated. This will include high standards of maintenance and regular pump outs. • Restrict and buffer stock access to waterways.
Intercepting and assimilating nutrients	• Maintain and rehabilitate buffering riparian vegetation • Maintain and rehabilitate wetland areas. • Maintain, design and construct catchment scale sediment and nutrient retention/ trap features including artificial wetlands and detention basins within urban and agricultural landscapes.

Soil erosion

Measures undertaken to reduce erosion will reduce nutrient and sediment loss from land, and transport to waterways, and may include:

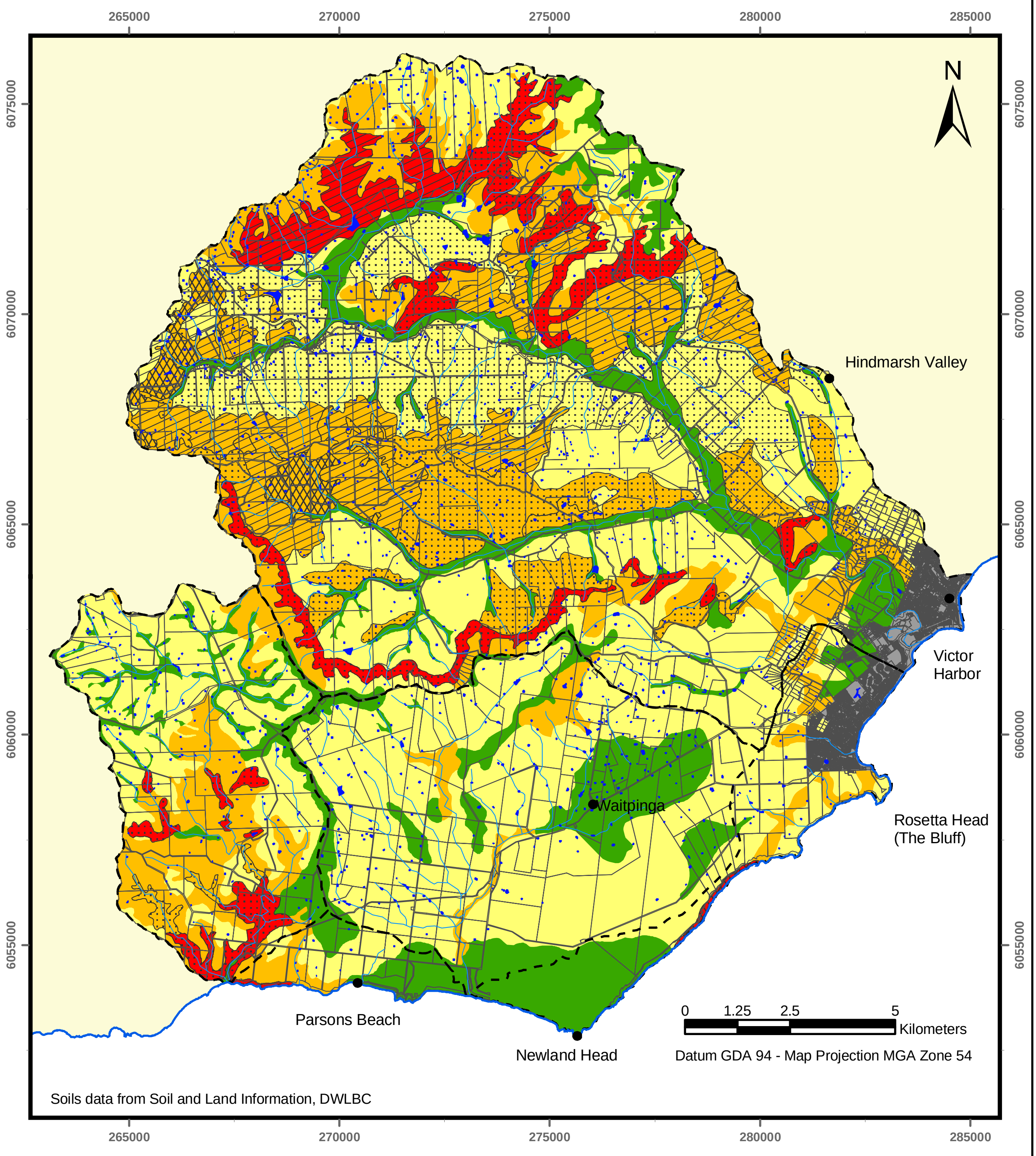
- Planning to protect unsuitable soils, steep slopes, and riparian buffers from inappropriate clearing and use.
- Rehabilitation of areas affected by severe sheet, gully and bank erosion by land use retirement, contouring and revegetation.
- Development and adoption of best management practices / codes of conduct by agricultural industries eg, timing (in relation to rainfall) and frequency of cultivations; adopting minimum tillage techniques, use of contouring and stubble / ground cover blanketing.
- Development and adoption of best management practices by pastoral industries eg. conservative grazing intensities and frontage and erodable slope exclusion fencing.
- Improved design and implementation of erosion control during road construction and maintenance, including buffer strips to collect sediment eroded from dirt roads.

Figure 16 shows the potential for water erosion and landslip in the study catchments, based on soil attribute mapping undertaken by Soil and Land Information, DWLBC.

Water erosion potential depends on slope and soil type (and rainfall), however the risk of an actual erosion event also depends on existing land use/ condition. In Figure 16, all land is assumed to be in a bare, clean cultivated state for the purpose of making a consistent interpretation. The inherent potential of a soil type to erode (for a given slope class) is influenced by its capacity to absorb falling rain, and the

Figure 16. Water Erosion Potential and Landslip

in the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



- LOCATIONS
- CATCHMENT BOUNDARY
- CADASTRAL BOUNDARIES
- DAMS
- DRAINAGE LINES

MASS MOVEMENT (landslip)

Extent of (or potential for) landslip

- Negligible land affected, more than 30% of land with potential
- Up to 5% of land affected
- More than 5% of land affected

WATER EROSION POTENTIAL

- Low (No special management needed) - Moderately low (Modified surface management needed)
- Moderate (Engineering works needed) - Moderately high (Semi arable)
- High (Non arable)
- Very high (Non arable, not traversible) - Extreme (Non productive)
- Not applicable

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Water Erosion Potential - classes are based on an interpretation of the slope and erodibility of soil landscape units. Map units are classified according to the dominant water erosion potential class occurring in the unit. No account is taken of land cover or land use - ie the assessment is made on the inherent characteristics of the land.

Landslip - classes are based on an interpretation of soil landscape map units. Each map unit is classified according to the proportion of land affected by or susceptible to landslip (mass movement).

resistance to raindrop impact and to being dragged along (entrained) by overland flow. Soil infiltration rates, permeability and the stability of the soil surface are key properties. Soil surface stability is largely determined by its texture and organic matter content (DWLBC SALI, 2002).

Mass movement (landslip) occurs on sloping ground where large slabs of soil slide or flow downhill. This is thought to be caused by the loss of binding in the soil mass following clearing of woody vegetation, and triggered by excessive wetness in the soil producing simultaneously loss of strength and increased mass. Soils particularly prone to this phenomenon include those on unconsolidated and slowly permeable substrate materials, such as the clays and sand to sandy loam over clays of the old glacial valleys of the Fleurieu Peninsula (DWLBC SALI, 2002).

***Agricultural effluent management**

Activities undertaken by a variety of industries are covered by best management practice codes[5]. These codes may include guidelines for dealing with effluent derived from production activities.

Of relevance to the study area, such a code of practice pertains to dairy operations and is outlined in the *Code of Practice for Milking Shed Effluent* (EPA, 2003b) which updates the *Environment Protection (Milking Shed Effluent Management) Policy 1997* (EPA, 1997). This policy document summarises requirements for dairies to:

- prevent their effluent from entering adjacent waterways, or land where risk of runoff to waterways is high, or contaminating groundwater resources;
- construct suitably designed containment and treatment facilities (eg. protecting against inundation and damage from storms and floods);
- observe buffer distances between such features and adjacent land, houses and waterways; and
- implement sustainable effluent disposal practices (eg. spreading on land in accordance with approved procedures).

This policy contains valuable guidelines on protecting waterways and other landholders from the potential pollution associated with dairy operations, however to date it has had little impact on existing dairies throughout most of the Southern Fleurieu (pers. comm. Graham Webster, Victor Harbor Council, Mar 2003). Notwithstanding this, both new and existing dairies are required to incorporate effluent management systems that meet the minimum design requirements as outlined in EPA (2003b). The EPA is responsible for enforcing this policy requirement and complaints are investigated on a priority basis, with the resources available (pers. comm. Phil Hazell, EPA, July 2003). Areas containing sensitive resources (ie. catchments for water supply reservoirs) are given a higher priority, however more stringent enforcement of the guidelines, in other areas, is likely with the Environment

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[5] Selected industry codes of practice (particularly relating to the protection of water resources) can be downloaded from the EPA website at:
http://www.environment.sa.gov.au/epa/water_protect.html
Also, Section 2.14 in the 'Explanatory Report' of EPA (2003a) lists industries that are required to effectively manage their wastewater.

Protection (Water Quality) Policy coming into effect from October 2003 (EPA 2003a, 2003b).

Legal requirements aside, the land application of dairy shed wastes on areas growing crop or pasture is considered the most effective and beneficial means of utilising the nutrients contained in these by-products (Clark, 2003), and an approved effluent management system will be the safest way to capture, store and treat this resource for later reuse.

Effluent disposal, for many agricultural activities (not just dairies), will often take the form of spreading over the land to make productive use of nutrients in the waste. Clark (2003), through a cross-agency project involving PIRSA, EPA and DWLBC (with NHT funding), has compiled a manual (in CD format) promoting best management practices for the spreading of nutrient rich wastes on agricultural land. The manual deals with a range of industries such as dairies, feedlots, wineries, piggeries, broiler sheds, olive processing and fruit and vegetable processing. Information is presented on the composition of various waste types, typical amounts produced, buffer distances relevant to spreading areas, health issues and legislation. It incorporates an Excel spreadsheet model for calculating sustainable loading rates of effluents and manures. Model calculations are based on site data (eg. soils, climate and land use), effluent type, and on the rates at which critical constituents within the wastes are removed from the system (eg. by plant uptake and harvest).

Also of interest to the study area, the author of the abovementioned manual (Trevor Clark, Senior Cattle Consultant with Rural Solutions SA), has also been involved in the compilation of a best practice management plan covering a wide range of environmental impacts for dairy farms in the Barossa Valley (BDDG, 2002). Adoption of best practices reduces harm to the environment while minimising costs to producers associated with wasted inputs. The issues covered in this plan would be applicable in other areas of the state and include:

- Fertiliser (N & P) applications - forms, timings, rates, and buffer zones;
- Management of intensive feeding areas – nutrient buildup & stormwater runoff;
- Management of dairy shed wastes;
- Property management by land capability – optimising productive potential and sustainability, while avoiding land degradation and nutrient losses to waterways;
- Management of watercourses; and
- Management of pasture irrigation – scheduling, optimising nutrient & waste recycling, and minimising buildup of salinity.

As discussed in BDDG (2002), irrigated pastures are capable of recycling more nutrients than dryland pastures and are an important way to maximise the utilisation of dairy shed wastes. Also the control of wastes associated with supplementary feeding is better where the conserved fodder is fed to the cows on irrigated pastures rather than dryland pastures. Aside from the more rapid recycling of nutrients on the irrigated pastures, because of the better ground cover, there is less risk of rainfall carrying wastes and nutrients into waterways than there would be with supplementary feeding in dryland paddocks.

While irrigated pastures can better utilise the nutrients in wastes to produce large amounts of quality feed throughout the year, capable of supporting high stocking rates, there is potential for negative impacts such as increased risk of salinisation (as discussed in section 4.1 – *Irrigation induced salinity*).

5.4 Watercourse Management

Appropriate management of watercourses is an important aspect of the management of stream water quality. Best practice management guidelines have recently been updated (URTLCG, 2003).

Activities such as fencing off watercourses, providing a buffer zone from agricultural activities, protecting and enhancing riparian vegetation, restricting stock access and erosion control will contribute to improving stream water quality and aquatic ecosystem health.

Such measures would also assist efforts to protect threatened biodiversity in the region, such as the critically endangered Southern Pygmy Perch (Hammer, 2002; also see Appendix 5).

Adaptive management methods may be required to address some management issues that arise following fencing of watercourses (eg. weed and feral pest control perhaps through the use of strategic grazing, alternative stock watering arrangements, etc.)

6 ACIDITY (PH)

6.1 Acidity Issues

pH is a measure of the acidity or alkalinity of water and has a scale from 0 (extremely acidic) to 14 (extremely alkaline), with a neutral pH of 7. Most fresh natural waters have a pH in the range 6.5 – 8.0, while the pH of most marine waters is close to 8.2. Most waters have some capacity to resist changes in pH, which is generally provided by the carbonate–bicarbonate buffer system. This buffering capacity is particularly strong in marine waters (ANZECC & ARMCANZ, 2000).

Adverse effects to stream organisms are noticed particularly at low pH when:

- several pollutants (eg. ammonia, cyanide & aluminium) become increasingly toxic to aquatic organisms, and
- fish and aquatic insects suffer diminished reproductive success, thereby impacting on aquatic food chains.

Recommended guidelines for the pH of waters for a variety of uses are contained in Appendix 9.

Of the factors that can cause acidification of natural waters, the most important for our study area comprise (ANZECC & ARMCANZ, 2000):

- geology – which influences the chemistry of base flow;
- soil acidification due to agricultural practices - which may lead to lower pH levels in streams.
- drainage from acid sulfate soils – which occur when soils containing iron sulfides are exposed to air, oxidation of the sediment produces acid and subsequent rainfall leaches this into waterways (also see Fitzpatrick, 1999).

Soil acidity can vary with management practices, soil type and climate. Soils with low clay/ low organic matter content are more susceptible to acidification than other soils, and are described as having low buffering capacity (ie. low capacity to resist acidification). Some soils, particularly those with low clay and/or low organic matter contents, in high rainfall areas, are naturally acidic. Induced acidification is a more widespread problem, and is caused by accelerated accumulation of hydrogen (H^+) ions under certain land management practices.

Acidification of agricultural soils is caused by (DWLBC Soil and Land Information, 2002 – CD containing report: *'Assessing agricultural land'*):

- accumulation of organic matter, producing organic acids.
- addition of nitrogen to the soil by fertilisers or fixation of atmospheric nitrogen by legumes. Nitrate nitrogen in excess of plant requirements combines with base elements such as calcium and magnesium and is readily leached. Hydrogen ions replace the bases on the cation exchange complex, increasing acidity.
- inappropriate fertiliser use - fertilisers with ammonium or elemental sulphur can react to directly acidify the soil, and all fertilisers can indirectly contribute to soil acidification because they increase productivity and hence the amount of product removed.
- Removal of alkaline farm products such as legume hay.

Hence, acidity problems should be expected in high nitrogen fertiliser input, high production systems, with high levels of product removal (eg. hay production, dairying).

Acid soils will lead to acidification of waterways only where runoff flowing from the surface soil horizons contains elevated concentrations of hydrogen (H^+) ions or aluminium (ANZECC & ARMCANZ, 2000). In the latter situation, if receiving waters are rich in organic matter (eg. humic acid), inorganic aluminium will form complexes that release H^+ ions. Where H^+ ions leach into waterways, the rate of soil acidification is slowed, at the expense of stream ecosystems.

6.2 *Acidity Status*

Figure 17 is a map of 'Susceptibility to acidity', highlighting areas where soil acidity is, or could become, a significant problem. This figure shows large areas of agricultural land in the study area with potential for acidity problems, which may in turn impact on waterways. All land that is inherently susceptible to acidity, regardless of current land use or management, is classified accordingly (DWLBC SALI, 2002). Table 13 shows areas of land in the study catchments with higher levels of susceptibility to acidity.

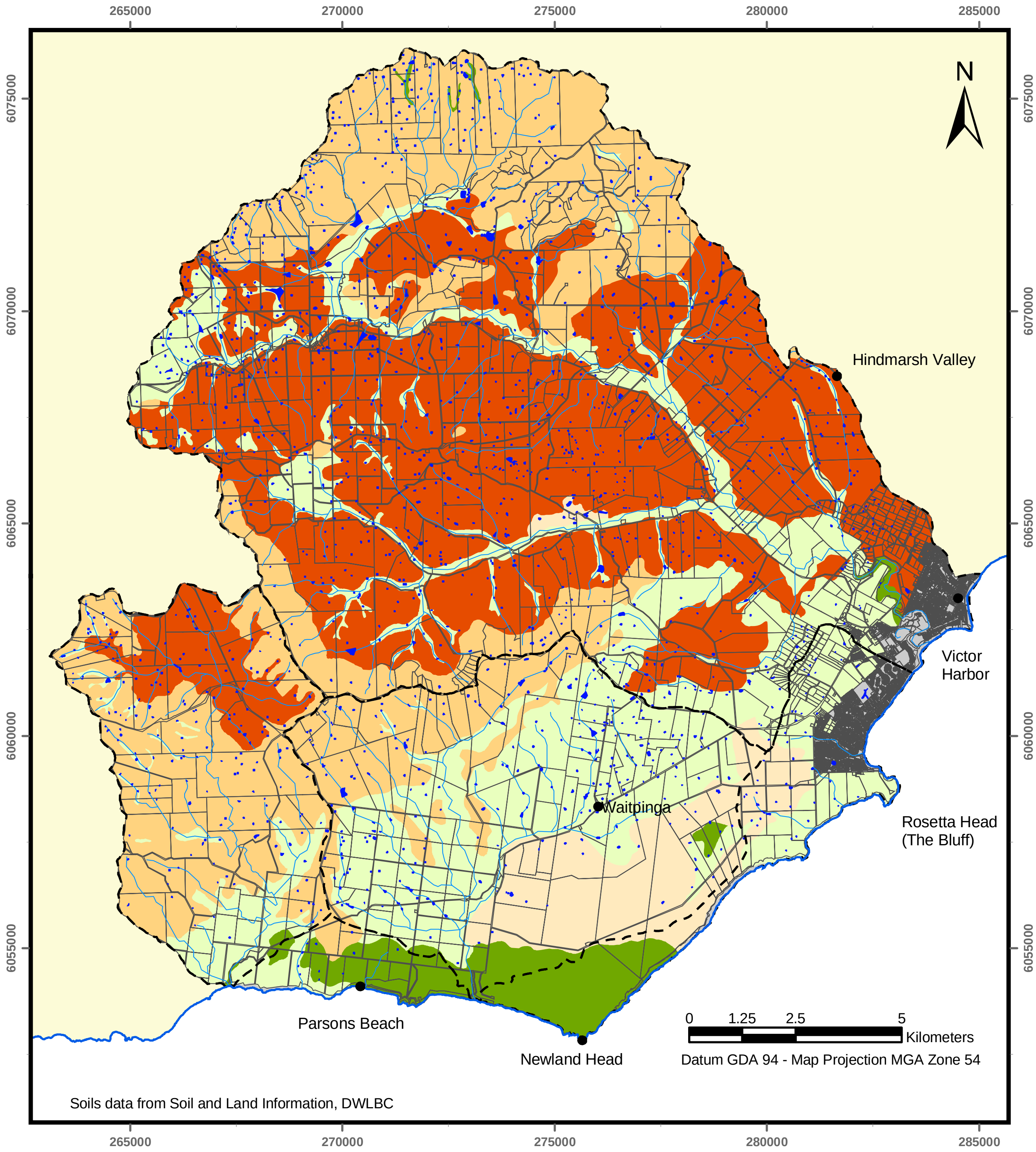
Table 13. Areas of land (in ha) susceptible to acidity

Catchment	Catchment area	Surface acidity only, Low surface buffering	Surface & subsoil acidity, Moderate to high surface buffering	Surface & subsoil acidity, Low surface buffering
Inman River	19526	99	4776	10,761
Waitpinga Ck	6115	1398	1360	0
Coolawang Ck	4077	0	2517	863
Newland Cliffs	1909	331	0	0
Parsons Beach	608	0	69	0
Totals	32234	1828	8722	11,624

Inspection of limited water quality testing results throughout the study area (see data CD), indicates stream pH values are within the acceptable range (6.5 – 9) for aquatic ecosystems (ANZECC & ARMCANZ, 2000 – see Appendix 9).

Figure 17. Susceptibility to Acidity

of the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



- LOCATIONS
- CATCHMENT BOUNDARY
- CADASTRAL BOUNDARIES
- DAMS
- DRAINAGE LINES

SOIL ACIDITY

Susceptibility to acidity	Surface buffering capacity
Negligible	Any
Surface soil only	Moderate to high
Surface soil only	Low
Surface and subsoil	Moderate to high
Surface and subsoil	Low
Not applicable	

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Classes are based on an interpretation of soil landscape map units. Acidity varies within soil classes (depending on management practice and climate), and within mapping units (which often include a complex of soils). Rankings are made according to pH measurements and extrapolation between similar environments. All land which is inherently susceptible to acidity is classified accordingly, regardless of land use or management. The susceptibility to acidity of each component of a mapping unit is assessed. The units are then classified according to the acidity of the most 'at risk' component, provided that it accounts for more than 30% of the area of the map unit. Limited occurrences of susceptible soils (ie account for 10-30% of the area of the map unit) are indicated as an additional class.

Classes take account of both surface and subsoil (ie deeper than 30 cm) acidity, and the buffering capacity of the surface soil (buffering capacity is an indication of the soil's capacity to resist acidification).

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6.3 Acidity Management

Most agricultural plants prefer soils with approximately neutral pH levels. The application of lime is the most widely adopted method of remediation. Application rates will depend on current pH, target pH, clay content and intended land use. Typical application rates range from 2 – 3 tonnes/ha. A soil test is recommended to determine the current pH and most appropriate liming material.

Land affected by acid soils are also a major contributor to salinity, with poorer performing pastures using less water and contributing greater recharge to groundwater. This provides another motivation for the issue of acidity to be addressed.

7 OTHER SOIL ISSUES

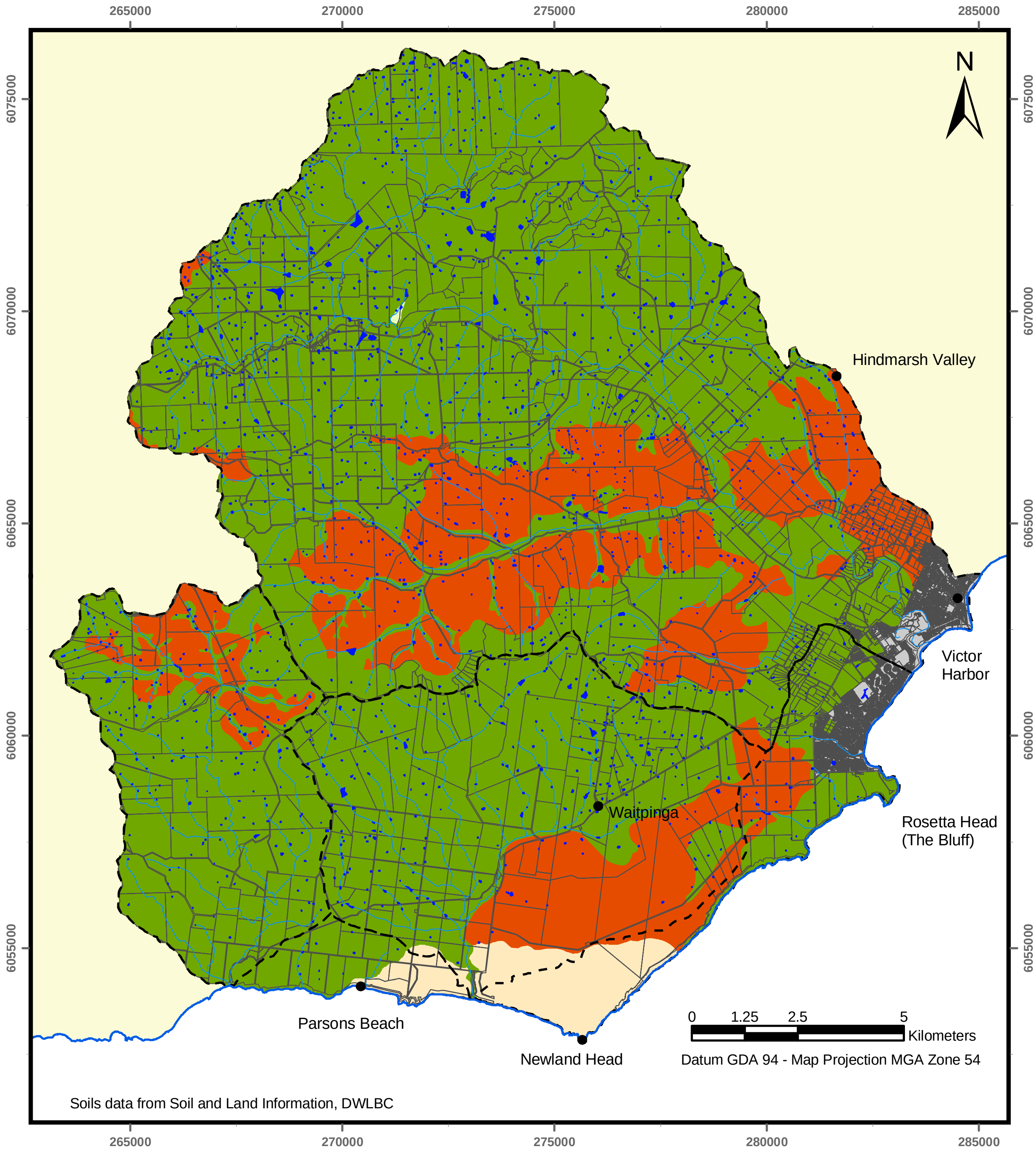
As previously discussed, limitations to productivity also limit water use, and the resulting increased recharge to groundwater can have salinity implications.

Another soil attribute, with potential to impact on production activities in the study catchments is water repellence. Water repellence is caused by hydrophobic organic materials (mainly waxes) contained in plant remains in the soil. Wax coated soil particles cause water to bead on the surface and result in uneven wetting of the upper soil profile, patchy and poor plant growth. In Figure 18, classes indicate both the severity of potential repellence and the approximate percentage of the landscape that is susceptible (DWLBC SALI, 2002).

Management techniques include clay spreading and delving (mixing in-situ sub-surface clays) into the surface soil. Land managers should test the suitability of potential clay sources for this purpose (for the presence of adverse clay properties) and seek advice prior to undertaking these types of activities.

Figure 18. Susceptibility to Water Repellence

of the Inman, Waitpinga, Coolawang and Newland Cliffs catchments



- LOCATIONS
- CATCHMENT BOUNDARY
- CADASTRAL BOUNDARIES
- DAMS
- DRAINAGE LINES

WATER REPELLENCE

Proportion of land susceptible to water repellence

- Negligible
- 10-30% Mainly Moderate
- 30-60% Mainly Moderate
- 60% or more Mainly Moderate
- Not applicable

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Classes are based on an interpretation of soil landscape map units. Each map unit is classified according to the proportion of its are susceptible to water repellence. Where more than 10% of land is affected, there is a further subdivision according to the degree of repellence.

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8 PATHOGENS AND POLLUTANTS

There are a wide range of potential water-borne microbial pathogens that may affect human and animal health. These are often associated with faecal contamination. It is often not feasible to test waters for all these organisms, however a useful indicator species is *Escherichia coli*, also represented by thermotolerant coliforms or faecal coliforms. The presence and concentration of *E. coli* gives an indication of the extent of faecal contamination and thus the possible presence of other microbial pathogens. Appendix 9 and 13 outline recommended maximum faecal coliform concentrations for various uses.

Sources of faecal contamination include:

- Poorly maintained septic tanks,
- Inneffective effluent management systems associated with dairy sheds or feed lots.
- Livestock, particularly with unrestricted access to waterways,
- Domestic animals and native fauna,
- Direct pumping or discharge of effluent to stormwater drains and waterways,
- Stormwater runoff in urban areas.

Limited data collected on *E. coli* (by the Inman River Catchment Group and Camp Scott Furphy et al., 1992) is presented in Appendix 19 and also contained on the data CD. Graphs of *E. coli* concentrations in the lower Inman show high variability (peaks and troughs). This most likely reflects the episodic nature of pollutant input (eg. associated with high rainfall events), while sampling frequency influences the patterns recorded.

From work undertaken by Camp Scott Furphy et al. (1992), upstream of the Victor Harbor WWTP (Appendix 19, Location 9) nutrients (TP/ Sol P and TN/ Oxidised N) in the Inman River show good correlation with E.coli levels. This would be expected with faecal contamination of watercourses in the upstream catchment.

Downstream of the WWTP (Location 10 & 11) there is no correlation between nutrients and E.coli. This is consistent with high nutrient, disinfected input from the WWTP.

From the limited data available, there is an alarmingly high exceedance rate of the primary and secondary contact guidelines for *E. coli*, at sites from upstream of the WWTP to the mouth.

Management of this issue will take the form of measures already discussed to eliminate faecal contamination of waterways (eg. precautions with effluent (fertiliser) spreading, restricting and buffering stock access to waterways, maintenance of septic tanks, etc.).

Other pollutants

Runoff from roads can be a significant source of pollutants such as hydrocarbons and heavy metals.

On-property disposal of refuse has the potential to result in pollution of watercourses and groundwater.

9 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The catchments of the Inman River, Waitpinga and Coolawang Creeks, Newland Cliffs and Parsons Beach are typical of the many agriculture based catchments in the Southern Fleurieu Peninsula. From a combined area of 32,230 ha, around 82% of the land is involved with agricultural production, with the balance largely comprising protected (conservation) areas, residential land use and forestry. Native vegetation covers around 17% of the study area.

This report compiles and summarises information and data from various sources. It focuses on salinity and water quality issues, and suggests management options to address them.

Future development and increasing populations in the area are likely to be accompanied by increasing recreational demands and more intensive agriculture. This will place rising demands on water resources and increase the threat of pollution sources impacting on water quality. Among the impacts to the environment will be greater threats to remnant vegetation and biodiversity. The information contained in this report will assist with an integrated approach to natural resource management that will hopefully enable the whole-of-catchment planning required for sustainable catchment management and development.

Salinity and Water Resources

Highly salinised land occupies less than 1% of the landscape, however some catchments (eg. Waitpinga) have significantly larger areas affected by moderate levels of salinity.

Surface water salinity is a significant issue in some catchments (eg. Inman River, Halls Ck, Waitpinga Ck) and generally varies in seasonal cycles. The highest salinities occur during reduced summer flows, due to the dominance of higher salinity baseflows.

Extraction of water directly from watercourses (reducing dilution flows), and on-stream dams (intercepting dilution flows and concentrating saline baseflows) are thought to contribute to elevated surface water salinities. Elsewhere, dam siting issues can significantly impact on the salinity of harvested water.

Underground water is of variable quality and yield. Low yields or elevated salinities generally limit usage, however there is potential for further use of this resource where locally suitable groundwater, and land suitable for the intended use, can be found.

Priority areas for the management of salinity have been identified and management options/ strategies are suggested for a range of different scenarios.

Estimates of water balance components (rainfall, evapotranspiration, runoff and recharge) were calculated for each of the catchments using approximate GIS based techniques (see Appendix 6). They show reasonable agreement with existing previously calculated values determined for the Inman River catchment.

The impact of farm dams and direct extraction from watercourses, on overall catchment streamflows, requires further investigation. Previous estimates of farm dam volumes (determined using aerial photography) are approximately 10-20% of calculated estimates for annual streamflows. This indicates there may be potential for further development, under the policy of dam volume limits equivalent to 50% median annual runoff and assuming dams fill once per year. However better information on actual surface water harvesting and extraction regimes is required before an accurate assessment can be made.

The need to establish environmental flow requirements is also recognised and it is likely that water use/ dam volume limits will be reviewed when better information becomes available (see section 3.1). Ideally, decisions regarding further dam development should be based on better knowledge of current diversions and environmental flow requirements.

Dam developments, and other 'new or intensified activities', occurring in sub-catchments containing protected swamps, require approval in accordance with requirements of the Federal EPBC Act (see section 2.3.4).

Acidity

Acidity is a significant issue in the study catchments. Over one third of the landscape has surface and subsoils susceptible to acidity combined with surface soils of a low capacity to resist acidification. Much of the remaining landscape is susceptible to acidity, to a lesser degree. Acidification of soils will eventually reduce productivity and economic returns. In addition, poor crop performance lowers water use, giving rise to potential salinity impacts. Acid soils also have the potential to cause environmental harm through acidic runoff (and associated pollutants) however there is no evidence of this occurring in the study area.

Areas identified with high susceptibility should adopt least acidifying agricultural practices, and ameliorate acid soils with the application of lime.

Nutrients and Pathogens

The Victor Harbor Waste Water Treatment Plant is a significant source of the plant nutrients, nitrogen and phosphorus, to the lower Inman River. It is planned to discontinue this discharge to the lower Inman, recycle the water and make it available for irrigation. There may be a requirement to monitor and manage salinity issues where recycled water is imported into an irrigation area.

Agricultural effluent from intensive industries (eg. dairies, feedlots, piggeries, wineries, etc.) has potential to cause localised pollution of streams. Appropriate effluent management practices and the relevant literature (policies and management codes) are discussed.

Poorly maintained septic tanks are often an important point source of pollution, supplying pathogens and nutrients to watercourses.

Erosion (including stream bank erosion) provides both sediment and nutrients to catchment waterways. Management measures include fencing for protection of riparian areas and stock control, and revegetation to improve bank stability. In broad-acre situations, erosion control measures include appropriate tillage practices, contour banks, and grazing management.

Adopting best management practices for fertiliser applications (timing and rates), buffering of watercourses and management of stock access will also reduce nutrient pollution of waterways.

The role of native vegetation

Threats to native vegetation include fragmentation (due to agricultural activities, urban expansion and subdivision) and the growing presence of woody weeds and feral pests.

Protection and enhancement of existing vegetation (including riparian zones), revegetation of cleared land and weed and feral animal threat abatement will have multiple benefits for salinity, water quality and biodiversity.

Vegetation mapping has been undertaken, to provide an indication of pre-European vegetation across the study area. Species lists and guidelines are presented to assist with revegetation activities.

Implementation of integrated natural resource management

Success will require partnerships between the community, land managers, Local Government, and State and Federal Governments. An important and valuable step will be the development of the capacity for the community to manage at the local level. Also important is the property based planning that identifies NRM issues at the property level, assigns priorities, chooses appropriate management options and allocates resources (funds, time and knowledge) to address the issues.

Stakeholders should be mindful of the different time scales over which NRM issues can operate and try to achieve balanced, positive outcomes. For example, recharge reduction through planting perennials (revegetation, farm forestry, etc.) in saltier sub-catchments may have short-term negative impacts on stream flows (and salinity), but is more likely to produce improved water quality in the longer term through reduced groundwater discharge (baseflow) to streams.

This study has highlighted the issues that need to be considered by existing land users and those who will come in the future. Sustainable development will only be achieved when the impacts on our natural environment are minimised and economic outputs contribute to sustaining local communities and the land on which they depend.

Recommendations

The following recommendations are made with specific reference to the catchments included in this study (not necessarily in order of priority).

ASSESSMENT OF WATER RESOURCES AND ENVIRONMENTAL FLOWS

Recommendation 1: Water resources

That study of water resources be undertaken, to develop greater understanding of:

- water use by property owners, especially rates of extraction directly from watercourses, and
- environmental flow requirements.

Findings should be incorporated into a Water Plan for the Southern Fleurieu.

Recommendation 2: Monitoring

Programs continue or be expanded to adequately monitor stream salinity. Locations of sampling points need to be strategically placed to enable ease of sampling and to capture information relevant to the various sub-catchments. At selected locations other water quality parameters (including flow) should also be measured. At selected sites the adequacy of environmental flows should be monitored, once requirements have been established.

It is also suggested that a comprehensive survey/ audit be conducted to determine the salinity of farm dams. Ideally this would be undertaken in spring and autumn to obtain information on seasonal variability.

These measures require funding and capacity building for ongoing work.

IMPROVEMENT OF LAND MANAGEMENT

Recommendation 3: Building landowner understanding of NRM issues

Programs that develop and build landowner understanding of NRM issues and appropriate management options be continued and expanded.

Recommendation 4: Property scale planning

Landholders be encouraged to develop basic property plans that enable them to clearly target the key NRM issues on their property and identify actions to manage and address them. Appropriate technical assistance needs to be available to support this process. Property scale planning is an important preliminary step before undertaking on-ground works. (This process has worked successfully in the Barossa Sustainable Farming Project, NABCWMB & Upper Torrens Land Management Program.)

Recommendation 5: Rubbish disposal
Landholder awareness/ education programs be implemented to discourage (and clean up) on property disposal of refuse.

ON-GROUND WORKS

Recommendation 6: Actions to address NRM issues
Programs be established to assist landholders to address identified NRM issues on their property. Activities should be based on appropriate planning at the property scale, and are likely to include:

- Salinity control measures in priority areas (see Tables 9,10 & Figure 15).
- Soil acidity mitigation measures in priority areas (see Figure 17 & section 6.3).
- Erosion potential reduction in priority areas (see Figure 16).
- Addressing the decline and fragmentation of native vegetation (see section 3.3).
- Revegetation for economic and environmental outcomes (see section 3.3 & Appendix 14).
- Addressing declining water quality, including potential nutrient and other pollution sources (see Table 12 & sections 5.3, 8). This includes fencing off watercourses to buffer and control stock access.
- Addressing water repellent soils in priority areas (see Figure 18).

Incentives via a devolved grants process is a suitable means to assist landholders to implement appropriate on-ground works on their property.

WATER RESOURCE MANAGEMENT

Recommendation 7: Management of effluent
A program be implemented to advise and assist operators of intensive agricultural industries to meet the recommended EPA guidelines regarding effluent management and disposal (see section 5.3). This includes dairies, feedlots, piggeries, poultry and any other enterprise where polluting wastewaters are produced or animals are held in sheds or in paddocks that become bare or have low levels of ground cover.

Recommendation 8: Dams
Low-flow bypass structures be installed on dams that are on-stream and collect baseflows during summer.

Future dams be sited with regard to issues of salinisation associated with interception of saline groundwater flows (see section 4.3, page 48).

Recommendation 9: Septic tanks
An education program be conducted to inform all property owners about their responsibilities regarding appropriate siting, establishment, maintenance and management of septic tanks. This may include an audit on septic tanks, particularly

where they are located adjacent to watercourses. Information on location, maintenance and frequency of pump-outs could be collected.

Recommendation 10: Farm forestry and water balance
Impacts of farm forestry on catchment water balance (and salinity) be investigated. Studies undertaken should include comparisons with sub-catchments under remnant native vegetation cover. Findings should be incorporated into a Water Plan for the Southern Fleurieu

BIODIVERSITY PROTECTION

Recommendation 11: Swamps
Management of swamps follow accepted protocols in accordance with their protection under the Federal Environment Protection and Biodiversity Conservation Act (see section 2.3.4).

Investigate the opportunities for establishing or enhancing swamps for biodiversity, education and/ or ecotourism.

Recommendation 12: Farm forestry and biodiversity
The value of farm forestry in complementing biodiversity conservation be investigated.

Recommendation 13. Southern Pygmy Perch
A specific program to secure and conserve the critically endangered Southern Pygmy Perch be undertaken, in the tributary of the Inman River where it has been found (see Appendix 5). [Also see Recommendations 1 and 2.]

ADDITIONAL RECOMMENDATIONS APPLICABLE TO THE GREATER MOUNT LOFTY RANGES REGION (AND OTHER PARTS OF SOUTH AUSTRALIA)

Recommendation 14: Long-term riparian management
Research / adaptive management methods be undertaken to develop improved management options and practices for riparian areas once stock are excluded. Issues include weeds, haven for feral animals, fence maintenance, access, impact on farm operations and water supply regimes, impact on workloads, role of strategic grazing, etc.

Recommendation 15: Impacts of salinity management
Research be performed into the impact of implementing high water use options across the catchments for management of salinity and the impact of this on stream flow patterns and subsequent implications for stream health and quantities of water available for irrigation, etc.

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APPENDIX 1. THE ROLES AND RESPONSIBILITIES OF GOVERNMENT AGENCIES AND OTHER STAKEHOLDERS IN WATER MANAGEMENT (ADAPTED FROM EPA, 2000)

	Monitoring and Evaluation	Environmental Control	Water Resource Planning & Control	Bulk Water Management	Development Control & Planning	Education	Restoration
Lead Agency	DEH (EPA)	DEH (EPA)	Catchment water management boards	SA Water	Planning SA	Catchment water management boards	Catchment water management boards
Contributing agency	Catchment water management boards SA Water PIRSA Human Services DWR (now DWLBC)	SAHC Local government Soil boards	DWR (now DWLBC) DEH (EPA)		Local government Catchment water management boards DEH (EPA) DWR (now DWLBC)	DEH (EPA) PIRSA Local government Soil boards Mt Lofty Ranges Catchment Program	Landowner partnership programmes SA Water PIRSA DEH (EPA) DWR (now DWLBC) Soil boards Landcare/ community groups Mt Lofty Ranges Catchment Program
Strategies	Meet water quality objectives Monitor point source pollution Monitor streams & reservoirs Catchment audits Risk evaluation Monitor licensed activities Raise community awareness Monitor water quantity and flows	Environment Protection Act licences Environment protection policies Septic tank regulation Environment protection orders	Development of catchment water management plans Water Resources Act licences	Water transfers Reservoir management Water treatment Water supply	Mt Lofty Ranges Strategy Plan Planning Amendment Reviews Development applications Subdivision control Stormwater control	Codes of Practice Demonstration schemes Newsletters Farm extension	Catchment management plans Riparian restoration Retention of wetlands Wastewater upgrades Trash racks Erosion control Revegetation

APPENDIX 2. VEGETATION MAPPING – METHODOLOGY & SPECIES LISTS

I Vegetation mapping and GIS analysis of revegetation zones

Following is a description of the methodology used to analyse floristic mapping, group vegetation types, refine vegetation groups and deduct revegetation zones for the Inman River and associated study catchments.

Thanks to Jo Spencer for assistance with working through this process and access to the DEH vegetation data required (data sourced from DEH Biological Survey Database).

Step 1- GIS Analysis of Floristic Mapping

- Southern Mount Lofty Floristic vegetation mapping data set used to extract 20 vegetation types based on dominant overstorey species.
- Identify structural form description and ecosystem characteristics, such as:
    - Forest;
    - Woodland;
    - Shrubland;
    - Coastal Shrubland;
    - and Coastal Mallee.

Step 2- Group Vegetation Types

- Systematically analyse ecosystem characteristics for vegetation type.
- Broad vegetation group decisions made based on dominant vegetation types and structural information. This simplifies vegetation types into 7 broad categories (vegetation groups).

Step 3- Refine Vegetation Groups

- Display geographical locations of vegetation types to consider a landscape approach. Observed some general patterns when correlated with:
    - Landform;
    - Geology;
    - and Soil Types.
- For example- Acacia paradoxa ± A. pycnantha was identified as sharing ecosystem characteristics with the Coastal Shrublands group and combined together. Resulting in 6 clearly defined key groups.

Descriptions of vegetation groups are included in the main text – Section 2.3.3.

Step 4- Create Vegetation Group Map

- Using GIS and visual analysis, extrapolate remnant vegetation groups across the study area based on correlation with Dominant Soil Types.
- Other factors of consideration included correlation with drainage lines and location in the landscape.

Step 5- Species Lists for Vegetation Groups

- Using GIS, display all known flora records within each vegetation group. This included information from biological survey, reserves and opportune databases.
- Information extracted includes;
    - Species;
    - Common names;
    - and Conservation Status.
- Develop revegetation species lists from all known flora lists based on:
    - ease of propagation and establishment of species;
    - availability of seed and cutting stock;
    - First or second stage revegetation.

II Vegetation Group Species Lists

The following pages list species found in each of the vegetation groups. This data has been compiled from previous vegetation surveys conducted throughout the region by the Department for Environment and Heritage. (The subset of these species that are most suitable for revegetation are listed in Appendix 14.)

Zones occupied by the different vegetation groups are shown in Figure 6 (Section 2.3.3) and comprise:

- Mixed Stringybark Forest
- Coastal Shrublands
- Perched Swamps
- Pink Gum Woodlands
- Blue Gum Woodlands
- Red Gum Woodlands

Conservation status codes used in the species lists are explained in a table that follows the species lists.

Stringybark Forest Species List (DEH survey data)

SPECIES	COMMON NAME 1	COMMON NAME 2	Conservation Significance SA	AUS	ENDANGERED SPECIES ACT	NPW ACT
Acacia myrtifolia(NC)	Myrtle Wattle	Bitter Leaf Wattle				
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle				
Acacia pycnantha	Golden Wattle					
Acacia retinodes var.	Silver Wattle					
Acacia retinodes var. retinodes (swamp form)	Swamp Wattle					
Acacia spinescens	Spiny Wattle		N			
Acacia verticillata	Prickly Moses		N			
Acaena echinata var.	Sheep's Burr					
Acaena echinata var. echinata	Sheep's Burr					
Acaena novae-zelandiae	Biddy-biddy	Bidgee-widgee	N			
Acaena sp.	Sheep's Burr					
Acianthus pusillus	Mosquito Orchid	Gnat Orchid				
Acrotriche affinis	Ridged Ground-berry	Prickly Honeypots	N			
Acrotriche serrulata	Cushion Ground-berry	Honeypots	N			
Adenanthos terminalis	Yellow Gland-flower		N			
Adiantum aethiopicum	Common Maiden-hair		N			
Agrostis aemula	Blown-grass	Annual Blown-grass				
Agrostis avenacea var. avenacea	Common Blown-grass	Fairy Grass				
Agrostis sp.	Blown-grass/Bent Grass					
Allocasuarina mackliniana ssp. mackliniana	Macklin's Oak-bush	Coarse Oak-bush	N			
Allocasuarina muelleriana ssp.	Common Oak-bush	Slaty Oak-bush				
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush	Slaty Oak-bush	N			
Allocasuarina paludosa	Swamp Oak-bush	Scrub Sheoak				
Allocasuarina pusilla	Dwarf Oak-bush	Heath Oak-bush	N			
Allocasuarina striata	Stalked Oak-bush	Tall Oak-bush				
Allocasuarina verticillata	Drooping Sheoak					
Alternanthera denticulata	Lesser Joyweed		N			
Amphipogon caricinus var. caricinus	Long Grey-beard Grass	Kutanu	N			
Amphipogon sp.	Grey-beard Grass					
Amphipogon strictus var. setifer	Spreading Grey-beard Grass		N			
Amyema miquelii	Box Mistletoe	Nyirunypa				
Amyema pendulum ssp. pendulum	Drooping Mistletoe		N			
Apium prostratum ssp. prostratum var.	Native Celery	Sea Celery	N			
Arthropodium fimbriatum	Nodding Vanilla-lily	Summer Vanilla-lily	N			
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	N			
Asplenium flabellifolium	Necklace Fern		N			
Astroloma conostephioides	Flame Heath		N			
Astroloma humifusum	Cranberry Heath	Native Cranberry	N			
Baeckea ramosissima ssp. ramosissima	Rosy Baeckea					
Banksia marginata	Silver Banksia	Honeysuckle	N			
Banksia ornata	Desert Banksia	Sand-heath Banksia	N			
Baumea juncea	Bare Twig-rush	Blue Twig-rush	N			
Billardiera bignoniacea	Orange Bell-climber		U			
Billardiera cymosa	Sweet Apple-berry					
Billardiera sericophora	Silky Apple-berry		N			
Billardiera sp.	Apple-berry					
Billardiera uniflora	One-flower Apple-berry	Single-flower Apple-berry	N			
Blechnum minus	Soft Water-fern		U			
Blechnum nudum	Fishbone Water-fern		R			R
Boronia edwardsii	Edwards' Boronia	Island Boronia	N			
Bossiaea prostrata	Creeping Bossiaea		N			
Brachyloma ericoides ssp.	Brush Heath					
Brachyloma ericoides ssp. ericoides	Brush Heath		N			
Bracteantha bracteata	Golden Everlasting	Tjulpun-tjulpunpa	N			
Brunonia australis	Blue Pincushion	Tjulpun-tjulpunpa	N			
Burchardia umbellata	Milkmaids	Milk Lily	N			
Bursaria spinosa	Sweet Bursaria	South Australian Christmas Bush				
Caesia calliantha	Blue Grass-lily		N			
Caladenia carnea var. carnea	Pink Fingers	Pink Fingers Caladenia	N			
Caladenia dilatata complex	Green-comb Spider-orchid	Fringed Spider-orchid				
Caladenia leptochila	Narrow-lip Spider-orchid	Queen Spider-orchid	N			
Caladenia tentaculata	King Spider-orchid	Large Green-comb Spider-orchid	N			
Calochilus paludosus	Red Beard-orchid	Swamp Beard-orchid	V			V
Calochilus robertsonii	Purplish Beard-orchid	Brown-beard	N			
Calytrix tetragona	Common Fringe-myrtle					
Carex appressa	Tall Sedge	Tussock Sedge	N			
Carex breviculmis	Short-stem Sedge		N			
Carex fascicularis	Tassel Sedge		U			
Cassytha glabella forma dispar	Slender Dodder-laurel	Tangled Dodder-laurel	N			
Cassytha melantha	Coarse Dodder-laurel	Large Dodder-laurel				
Cassytha pubescens	Downy Dodder-laurel		N			
Centipeda minima	Spreading Sneezeweed		N			
Centrolepis aristata	Pointed Centrolepis		N			
Centrolepis strigosa	Hairy Centrolepis					
Chamaescilla corymbosa var. corymbosa	Blue Squill	Blue Stars	N			
Cheilanthes austrotenuifolia	Annual Rock-fern	Green Rock-fern	N			
Cheiranthera alternifolia	Hand-flower	Finger-flower	N			
Choretrum glomeratum var.	Sour-bush					
Choretrum glomeratum var. glomeratum	White Sour-bush	Common Sour-bush	N			

Stringybark Forest Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	SA	AUS	ENDANGERED SPECIES ACT	NPW ACT
			Conservation Significance			
Chrysocephalum apiculatum	Common Everlasting	Small Yellow Button				
Chrysocephalum baxteri	White Everlasting	Fringed Everlasting	N			
Clematis microphylla	Old Man's Beard	Small-leaf Clematis				
Comesperma calymega	Blue-spike Milkwort	Heath Milkwort	N			
Conospermum patens	Slender Smoke-bush	Slender Conospermum	N			
Correa aemula s.str.	Hairy Correa		R			
Correa aemula(NC)	Hairy Correa					
Correa eburnea			V	V		V
Correa reflexa	Common Correa					
Correa reflexa var. reflexa	Common Correa					
Corybas dilatatus	Common Helmet-orchid					
Craspedia glauca	Billy-buttons	Bachelor Buttons	N			
Cryptandra tomentosa	Heath Cryptandra	Velvet Cryptandra	N			
Cullen australasicum	Tall Scurf-pea	Verbine Scurf-pea				
Cyanicula deformis	Bluebeard Orchid	Blue Fairies				
Cynoglossum suaveolens	Sweet Hound's-tongue	Sweet Forget-me-not	Q			
Cyperus tenellus	Tiny Flat-sedge		N			
Cyperus vaginatus	Stiff Flat-sedge	Puta-puta	N			
Cyrtostylis reniformis	Small Gnat-orchid	Spring-flowering Gnat-orchid				
Danthonia caespitosa	Common Wallaby-grass	White-top	N			
Danthonia eriantha	Hill Wallaby-grass		N			
Danthonia geniculata	Kneed Wallaby-grass		N			
Danthonia pilosa var. paleacea	Velvet Wallaby-grass		N			
Danthonia setacea var. setacea	Small-flower Wallaby-grass	Bristly Wallaby-grass				
Danthonia sp.	Wallaby-grass					
Danthonia tenuior	Short-awn Wallaby-grass	Purplish Wallaby-grass	R			R
Daucus glochidiatus	Native Carrot	Australian Carrot				
Daviesia brevifolia	Leafless Bitter-pea					
Daviesia leptophylla	Narrow-leaf Bitter-pea		N			
Daviesia ulicifolia ssp. incarnata			N			
Daviesia ulicifolia(NC)	Gorse Bitter-pea		N			
Derwentia derwentiana ssp. homalodonta	Mt Lofty Speedwell	Derwent Speedwell	E	3KC-		E
Deyeuxia densa	Heath Bent-grass		R			R
Deyeuxia quadriseta	Reed Bent-grass		N			
Dianella brevicaulis	Short-stem Flax-lily	Coast Flax-lily				
Dianella brevicaulis/revoluta var.	Black-anther Flax-lily	Spreading Flax-lily				
Dianella revoluta var.						
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily				
Dianella revoluta(NC)						
Dichelachne crinita	Long-hair Plume-grass		N			
Dichelachne sp.	Plume-grass					
Dichondra repens	Kidney Weed	Tom Thumb				
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	N			
Dillwynia sericea	Showy Parrot-pea		N			
Dipodium punctatum(NC)	Hyacinth Orchid	Spotted Orchid				
Dipodium roseum	Pink Hyacinth Orchid	Christmas Orchid	N			
Dipodium sp.	Hyacinth Orchid					
Diuris aff. corymbosa	Wallflower Donkey-orchid	Bulldogs	N			
Dodonaea viscosa ssp.	Sticky Hop-bush					
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Spoon-leaf Hop-bush				
Drosera auriculata	Tall Sundew	Errienellam	N			
Drosera glanduligera	Scarlet Sundew		N			
Drosera macrantha ssp. planchonii	Climbing Sundew					
Drosera peltata	Pale Sundew		N			
Drosera pygmaea	Tiny Sundew		N			
Drosera sp.	Sundew					
Drosera whittakeri ssp.						
Drosera whittakeri ssp. whittakeri			N			
Drosera whittakeri(NC)	Scented Sundew	Whittaker's Sundew				
Epacris impressa	Common Heath	Heath	N			
Epilobium billardierianum ssp. cinereum	Variable Willow-herb		N			
Epilobium pallidiflorum	Showy Willow-herb		U			
Eriochilus cucullatus	Parson's Bands		N			
Eucalyptus baxteri	Brown Stringybark	Baxter's Stringybark	N			
Eucalyptus camaldulensis var.	River Red Gum					
Eucalyptus camaldulensis var. camaldulensis	River Red Gum	Red Gum	N			
Eucalyptus cneorifolia	Kangaroo Island Narrow-leaf Mallee		N			
Eucalyptus cosmophylla	Cup Gum	Bog Gum				
Eucalyptus fasciculosa	Pink Gum	Hill Gum	N			
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		N			
Eucalyptus leucoxylon(NC)	South Australian Blue Gum	Yellow Gum				
Eucalyptus obliqua	Messmate Stringybark	Stringybark	N			
Eucalyptus obliqua var. obliqua(NC)	Messmate Stringybark	Stringybark				
Eucalyptus obliqua var.(NC)	Messmate Stringybark					
Eucalyptus rubida ssp. rubida	Candlebark Gum	White Gum	R			R
Eucalyptus viminalis ssp.	Manna Gum					
Eucalyptus viminalis ssp. cygnetensis	Rough-bark Manna Gum		N			
Euchiton gymnocephalus	Creeping Cudweed					
Euchiton gymnocephalus(NC)	Creeping Cudweed					

Stringybark Forest Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	Conservation Significance SA	AUS	ENDANGERED SPECIES ACT	NPW ACT
Eutaxia sp.	Eutaxia	Eggs-and-bacon				
Exocarpos cupressiformis	Native Cherry	Cherry Ballart	N			
Exocarpos sparteus	Slender Cherry	Broom Ballart	N			
Gahnia sieberiana	Red-fruit Cutting-grass	Red-fruit Saw-sedge	U			
Galium gaudichaudii	Rough Bedstraw		N			
Galium sp.	Bedstraw					
Gastrodia sesamoides	Potato Orchid	Cinnamon Bells	R			R
Genoplesium rufum	Red Midge-orchid	Dark Midge-orchid	N			
Geranium retrorsum	Grassland Geranium	Grassland Crane's-bill				
Geranium sp.	Geranium	Crane's-bill				
Glossodia major	Purple Cockatoo	Wax-lip Orchid	N			
Gompholobium ecostatum	Dwarf Wedge-pea		N			
Gonocarpus mezianus	Broad-leaf Raspwort	Hairy Raspwort	N			
Gonocarpus tetragynus	Small-leaf Raspwort	Common Raspwort				
Goodenia blackiana	Native Primrose	Black's Goodenia	N			
Goodenia geniculata	Bent Goodenia	Native Primrose	N			
Goodenia ovata	Hop Goodenia		N			
Goodenia varia	Sticky Goodenia		N			
Gramineae sp.	Grass Family					
Gratiola peruviana	Austral Brooklime		N			
Grevillea ilicifolia var. ilicifolia	Holly-leaf Grevillea	Native Holly	N			
Grevillea lavandulacea var.	Spider-flower	Heath Grevillea				
Grevillea lavandulacea var. lavandulacea	Spider-flower	Heath Grevillea				
Grevillea lavandulacea var. sericea	Spider-flower	Heath Grevillea	U			
Hakea carinata	Erect Hakea		N			
Hakea rostrata	Beaked Hakea	Turkey Gobblers	N			
Hakea rugosa	Dwarf Hakea	Wrinkled Hakea	N			
Haloragaceae sp.	Raspwort					
Haloragis heterophylla	Variable Raspwort	Perennial Raspweed	U			
Haloragis sp.	Raspwort					
Helichrysum scorpioides	Button Everlasting		N			
Hibbertia aspera(NC)						
Hibbertia exutiacies	Prickly Guinea-flower	Spiky Guinea-flower	N			
Hibbertia incana			N			
Hibbertia riparia	Guinea-flower					
Hibbertia riparia (glabriuscula)	Smooth Guinea-flower					
Hibbertia riparia (long-leaved aff. H. stricta)	Bristly Guinea-flower		N			
Hibbertia sericea var.	Silky Guinea-flower					
Hibbertia sericea var. sericea	Silky Guinea-flower					
Hibbertia sp.	Guinea-flower					
Hibbertia sp. B	Scrambling Guinea-flower		N			
Hibbertia stricta var. stricta	Stalked Guinea-flower	Erect Guinea-flower				
Hibbertia virgata	Twiggy Guinea-flower					
Hydrocotyle callicarpa	Tiny Pennywort	Small Pennywort	N			
Hydrocotyle hirta	Hairy Pennywort		U			
Hydrocotyle sp.	Pennywort					
Hypericum gramineum	Small St John's Wort		N			
Hypolaena fastigiata	Tassel Rope-rush		N			
Hypoxis glabella var. glabella	Tiny Star					
Hypoxis vaginata var. vaginata	Yellow Star	Sheath Star	N			
Indigofera australis var. australis	Austral Indigo	Hill Indigo	N			
Isolepis fluitans	Floating Club-rush		U			
Isolepis inundata	Swamp Club-rush		N			
Isolepis nodosa	Knobby Club-rush	Knobby Club-sedge	N			
Isopogon ceratophyllus	Horny Cone-bush	Cone-bush	N			
Ixodia achillaeoides ssp.	Ixodia					
Ixodia achillaeoides ssp. achillaeoides	Coast Ixodia		N			
Ixodia achillaeoides ssp. alata	Hills Daisy	Winged Ixodia	N			
Juncus bufonius	Toad Rush					
Juncus caespiticius	Grassy Rush		N			
Juncus kraussii	Sea Rush		N			
Juncus pallidus	Pale Rush					
Juncus pauciflorus	Loose-flower Rush					
Juncus planifolius	Broad-leaf Rush		N			
Juncus sarophorus			N			
Juncus sp.	Rush					
Juncus subsecundus	Finger Rush		N			
Kennedia prostrata	Scarlet Runner	Running Postman	N			
Lagenifera huegelii	Coarse Bottle-daisy	Coarse Lagenifera	N			
Lavatera plebeia	Australian Hollyhock	Native Hollyhock	N			
Laxmannia orientalis	Dwarf Wire-lily		N			
Laxmannia sessiliflora(NC)	Dwarf Wire-lily					
Lepidobolus drapetocoleus	Scale Shedder		N			
Lepidosperma carphoides	Black Rapier-sedge		N			
Lepidosperma concavum	Spreading Sword-sedge	Sandhill Sword-sedge				
Lepidosperma curtisiae	Little Sword-sedge		N			
Lepidosperma laterale s.str.	Tall Sword-sedge		U			
Lepidosperma longitudinale	Pithy Sword-sedge	Swamp Sword-sedge	N			
Lepidosperma semiteres	Wire Rapier-sedge		N			

Stringybark Forest Species List

			Conservation Significance			
SPECIES	**COMMON NAME 1**	**COMMON NAME 2**	**SA**	**AUS**	**ENDANGERED SPECIES ACT**	**NPW ACT**
Lepidosperma viscidum	Sticky Sword-sedge					
Leporella fimbriata	Fringed Hare-orchid		N			
Leptocarpus brownii	Coarse Twine-rush		N			
Leptocarpus tenax	Slender Twine-rush		N			
Leptoceras menziesii	Hare Orchid	Rabbit Orchid	N			
Leptospermum continentale	Prickly Tea-tree					
Leptospermum lanigerum	Silky Tea-tree	Woolly Tea-tree	N			
Leptospermum myrsinoides	Heath Tea-tree					
Leptospermum sp.	Tea-tree					
Lepyrodia valliculae	Kangaroo Island Scale-rush		R	2RCa		R
Leucopogon australis	Spike Beard-heath					
Leucopogon concurvus	Scrambling Beard-heath					
Leucopogon lanceolatus	Lance Beard-heath		U			
Leucopogon rufus	Ruddy Beard-heath		U			
Leucopogon virgatus	Common Beard-heath		N			
Levenhookia dubia	Hairy Stylewort		N			
Levenhookia pusilla	Tiny Stylewort	Midget Stylewort				
Lichen sp.						
Lindsaea linearis	Screw Fern	Necklace Fern	U			
Linum marginale	Native Flax	Wild Flax	N			
Lobelia alata	Angled Lobelia		N			
Lobelia gibbosa	Tall Lobelia	False Orchid				
Logania recurva	Recurved Logania		U			
Lomandra collina	Sand Mat-rush	Sharp-leaf Mat-rush	N			
Lomandra fibrata	Mount Lofty Mat-rush	Fine Mat-rush	N			
Lomandra juncea	Desert Mat-rush		N			
Lomandra micrantha ssp.	Small-flower Mat-rush					
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		N			
Lomandra micrantha ssp. tuberculata	Small-flower Mat-rush		N			
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	N			
Lomandra nana	Small Mat-rush	Soft Mat-rush	N			
Lomandra sororia	Sword Mat-rush	Small Mat-rush	U			
Lomandra sp.	Mat-rush					
Luzula densiflora	Dense Wood-rush		U			
Luzula meridionalis	Common Wood-rush		N			
Lythrum hyssopifolia	Lesser Loosestrife	Small Loosestrife				
Melaleuca brevifolia	Short-leaf Honey-myrtle	Swamp Honey-myrtle	N			
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle				
Micrantheum demissum	Dwarf Micrantheum		N			
Microlaena stipoides var. stipoides	Weeping Rice-grass	Weeping Grass	N			
Microseris lanceolata	Yam Daisy	Native Yam				
Microtis unifolia	Common Onion-orchid		N			
Microtis unifolia complex	Onion-orchid					
Microtis unifolia(NC)	Common Onion-orchid					
Mimulus repens	Creeping Monkey-flower		N			
Moss sp.						
Neurachne alopecuroidea	Fox-tail Mulga-grass		N			
Olearia grandiflora	Mount Lofty Daisy-bush		U			
Olearia ramulosa	Twiggy Daisy-bush		N			
Olearia sp.	Daisy-bush					
Opercularia sp.	Stinkweed					
Opercularia turpis	Twiggy Stinkweed		N			
Opercularia varia	Variable Stinkweed		N			
Orchidaceae sp.	Orchid Family					
Oxalis perennans	Native Sorrel	Native Oxalis				
Patersonia fragilis	Short Purple-flag	Swamp Iris	U			
Patersonia occidentalis	Long Purple-flag		U			
Pelargonium littorale	Native Pelargonium	Native Storks-bill				
Persoonia juniperina	Prickly Geebung	Geebung	N			
Phragmites australis	Common Reed	Bamboo Reed				
Phyllota pleurandroides	Heathy Phyllota		N			
Pimelea glauca	Smooth Riceflower					
Pimelea humilis	Low Riceflower	Common Riceflower	N			
Pimelea linifolia ssp. linifolia	Slender Riceflower		N			
Pimelea octophylla	Woolly Riceflower	Downy Riceflower				
Pimelea phylicoides	Heath Riceflower		N			
Pimelea sp.	Riceflower					
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	N			
Platysace heterophylla var.	Slender Platysace					
Platysace heterophylla var. heterophylla	Slender Platysace	Corn Parsley	N			
Pleurosorus rutifolius	Blanket Fern		N			
Poa clelandii	Matted Tussock-grass	Cleland's Poa	N			
Poa sp.	Meadow-grass/Tussock-grass	Poa				
Poa tenera	Slender Tussock-grass	Spreading Tussock-grass	Q			
Polygonum sp.(NC)						
Pomaderris paniculosa ssp.			N			
Poranthera ericoides	Heath Poranthera		N			
Poranthera microphylla	Small Poranthera	Small-leaf Poranthera	N			
Pseudanthus micranthus	Fringed Pseudanthus		R	2RCa		R

Stringybark Forest Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	Conservation Significance SA	AUS	ENDANGERED SPECIES ACT	NPW ACT
Pteridium esculentum	Bracken Fern	Austral Bracken	N			
Pterostylis nana	Dwarf Greenhood					
Pterostylis nutans	Nodding Greenhood	Parrot's Beak Orchid	N			
Pterostylis pedunculata	Maroon-hood		N			
Pterostylis plumosa	Bearded Greenhood		N			
Pterostylis sanguinea	Blood Greenhood	Red Banded-greenhood				
Pterostylis sp.	Greenhood					
Pterostylis sp.(NC)						
Pultenaea acerosa	Bristly Bush-pea		N			
Pultenaea canaliculata var.	Soft Bush-pea	Coast Bush-pea	U			
Pultenaea canaliculata var. canaliculata	Soft Bush-pea	Coast Bush-pea				
Pultenaea daphnoides	Large-leaf Bush Pea		N			
Pultenaea graveolens	Scented Bush-pea		U			
Pultenaea involucrata	Mount Lofty Bush-pea		U	R		
Pultenaea largiflorens	Twiggy Bush-pea		N			
Pultenaea pedunculata	Matted Bush-pea		N			
Pultenaea trinervis	Three-nerve Bush-pea		N	N		
Pyrorchis nigricans	Black Fire-orchid	Red-beak Orchid	N			
Ranunculus lappaceus	Native Buttercup	Australian Buttercup	N			
Ranunculus pumilio var. pumilio	Ferny Buttercup	Small-flower Buttercup	N			
Rubus parvifolius	Native Raspberry	Small-leaf Bramble	U			
Scaevola albida	Pale Fanflower	Small-fruit Fanflower				
Scaevola albida var. albida	Pale Fanflower	Small-fruit Fanflower				
Scaevola albida var.(NC)						
Schoenus apogon	Common Bog-rush	Common Bog-sedge	N			
Schoenus breviculmis	Matted Bog-rush	Moss Bog-rush	N			
Scutellaria humilis	Dwarf Skullcap	Skullcap	R			R
Sebaea ovata	Yellow Sebaea	Yellow Centaury	N			
Senecio glomeratus	Swamp Groundsel	Toothed Groundsel	N			
Senecio hispidulus var. hispidulus	Rough Groundsel	Hispid Fireweed	U			
Senecio odoratus var.	Scented Groundsel					
Senecio odoratus var. odoratus	Scented Groundsel		N			
Senecio quadridentatus	Cotton Groundsel	Cotton Fireweed	N			
Senecio sp.	Groundsel	Fireweed				
Senecio squarrosus	Squarrose Groundsel	Leafy Fireweed	N			
Senecio tenuiflorus	Woodland Groundsel	Narrow Groundsel	N			
Spyridium coactilifolium	Butterfly Spyridium		V	2VCa	V	V
Spyridium sp.	Spyridium					
Spyridium thymifolium	Thyme-leaf Spyridium		N			
Stackhousia aspericocca ssp.	Bushy Candles	Rough Candles				
Stackhousia aspericocca ssp. "Cylindrical inflorescence"(W.R.Barker 1418)	Bushy Candles	Rough Candles	N			
Stackhousia aspericocca ssp. "One-sided inflorescence"(W.R.Barker 697)	One-sided Candles	Rough Candles	N			
Stackhousia sp.	Candles					
Stipa mollis	Soft Spear-grass	Supple Spear-grass	N			
Stipa muelleri	Tangled Spear-grass	Wiry Spear-grass	R			
Stipa sp.	Spear-grass					
Stylidium graminifolium	Grass Trigger-plant		N			
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells	Pink-eyed Susan	N			
Thelymitra antennifera	Lemon Sun-orchid	Rabbit-ears				
Thelymitra benthamiana	Leopard Sun-orchid	Blotched Sun-orchid	U			
Thelymitra ixioides	Spotted Sun-orchid	Dotted Sun-orchid				
Thelymitra pauciflora	Slender Sun-orchid		N			
Thelymitra rubra	Salmon Sun-orchid	Pink Sun-orchid	N			
Thelymitra sp.	Sun-orchid					
Themeda triandra	Kangaroo Grass	Ilintji	N			
Thomasia petalocalyx	Paper-flower		N			
Thysanotus juncifolius	Rush Fringe-lily		N			
Thysanotus patersonii	Twining Fringe-lily					
Tricoryne elatior	Yellow Rush-lily		N			
Tricoryne elatior(NC)	Yellow Rush-lily					
Tricoryne tenella	Tufted Yellow Rush-lily	Rigid Rush-lily	N			
Triglochin procerum var. procerum(NC)	Water-ribbons					
Typha domingensis	Narrow-leaf Bulrush	Narrow-leaf Cumbungi	N			
Viola cleistogamoides	Shy Violet	Hidden Violet	U			
Viola hederacea	Ivy-leaf Violet		N			
Viola sieberiana	Tiny Violet	Sieber's Violet	N			
Wahlenbergia gracilenta	Annual Bluebell					
Wahlenbergia multicaulis	Tadgell's Bluebell		N			
Wahlenbergia sp.	Native Bluebell					
Wahlenbergia stricta ssp. stricta	Tall Bluebell					
Xanthorrhoea semiplana ssp.	Yacca	Flat-leaf Grass-tree				
Xanthorrhoea semiplana ssp. semiplana	Yacca	Flat-leaf Grass-tree	N			
Xanthorrhoea semiplana ssp. tateana	Tate's Grass-tree		N			
Xanthosia pusilla	Hairy Xanthosia	Heath Xanthosia	N			
Xanthosia tasmanica	Southern Xanthosia		R			R

'unverified species - nv`

Coastal Shrubland Species List (DEH survey data)

SPECIES	COMMON NAME 1	COMMON NAME 2	SA	AUS	ENDANGERED SPECIES ACT	NPW ACT
			Conservation Significance			
Acacia longifolia var. sophorae	Coastal Wattle	False Boobialla				
Acacia myrtifolia var. myrtifolia	Myrtle Wattle	Scrub Wattle	N			
Acacia myrtifolia(NC)	Myrtle Wattle	Bitter Leaf Wattle				
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle				
Acacia pycnantha	Golden Wattle					
Acacia retinodes var. uncifolia	Coast Silver Wattle		U			
Acacia spinescens	Spiny Wattle		N			
Acacia verticillata	Prickly Moses		N			
Acaena agnipila var.	Downy Sheep's Burr		U			
Acaena echinata var.	Sheep's Burr					
Acaena novae-zelandiae	Biddy-biddy	Bidgee-widgee	N			
Acaena x anserovina	Hybrid Burr					
Acianthus caudatus var. caudatus	Mayfly Orchid	Dead Horse	N			
Acianthus pusillus	Mosquito Orchid	Gnat Orchid				
Acianthus sp.	Mosquito Orchid					
Acrotriche cordata	Blunt-leaf Ground-berry	Coast Ground-berry	N			
Acrotriche serrulata	Cushion Ground-berry	Honeypots	N			
Adenanthos terminalis	Yellow Gland-flower		N			
Adriana klotzschii	Coast Bitter-bush		N			
Agrostis avenacea var. avenacea	Common Blown-grass	Fairy Grass				
Agrostis billardieri var. billardieri	Coast Blown-grass					
Agrostis sp.	Blown-grass/Bent Grass					
Allocasuarina muelleriana ssp.	Common Oak-bush	Slaty Oak-bush				
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush	Slaty Oak-bush	N			
Allocasuarina paludosa	Swamp Oak-bush	Scrub Sheoak				
Allocasuarina pusilla	Dwarf Oak-bush	Heath Oak-bush	N			
Allocasuarina striata	Stalked Oak-bush	Tall Oak-bush				
Allocasuarina verticillata	Drooping Sheoak					
Alyxia buxifolia	Sea Box	Dysentery Bush	N			
Amyema miquelii	Box Mistletoe	Nyir#unypa				
Angianthus preissianus	Salt Angianthus	Salt Cup-flower	N			
Apalochlamys spectabilis	Showy Firebush	False Tobacco	U			
Aphelia pumilio	Dwarf Aphelia		N			
Apium annuum	Annual Celery		N			
Apium prostratum ssp. prostratum var. filiforme	Native Celery	Sea Celery				
Argentipallium obtusifolium	Blunt Everlasting		N			
Arthropodium fimbriatum	Nodding Vanilla-lily	Summer Vanilla-lily	N			
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	N			
Asterolasia muricata	Rough Star-bush	Kangaroo Island Star-bush	R	2RCa		R
Astroloma conostephioides	Flame Heath		N			
Astroloma humifusum	Cranberry Heath	Native Cranberry	N			
Atriplex cinerea	Coast Saltbush	Grey Saltbush				
Austrofestuca littoralis	Coast Fescue		N			
Baeckea crassifolia	Desert Baeckea	Desert Heath-myrtle	N			
Banksia marginata	Silver Banksia	Honeysuckle	N			
Banksia ornata	Desert Banksia	Sand-heath Banksia	N			
Baumea juncea	Bare Twig-rush	Blue Twig-rush	N			
Beyeria lechenaultii	Pale Turpentine Bush	Felted Wallaby-bush				
Billardiera cymosa	Sweet Apple-berry					
Billardiera sp.	Apple-berry					
Billardiera uniflora	One-flower Apple-berry	Single-flower Apple-berry	N			
Billardiera versicolor	Yellow-flower Apple-berry	Pale Apple-berry	U			
Blennospora drummondii	Dwarf Button-flower	Dwarf Beauty-heads				
Boronia filifolia	Slender Boronia		N			
Bossiaea prostrata	Creeping Bossiaea		N			
Brachycome cuneifolia	Wedge-leaf Daisy		U			
Brachycome goniocarpa	Dwarf Daisy	Angle-fruit Daisy	N			
Brachycome lineariloba	Hard-head Daisy	Dwarf Daisy	N			
Brachycome perpusilla	Tiny Daisy	Rayless Daisy				
Brachyloma ericoides ssp.	Brush Heath					
Brachyloma ericoides ssp. ericoides	Brush Heath		N			
Bromus arenarius	Sand Brome		N			
Bulbine bulbosa	Bulbine-lily	Native Leek	N			
Bulbine semibarbata	Small Leek-lily	Annual Bulbine-lily	N			
Burchardia umbellata	Milkmaids	Milk Lily	N			
Bursaria spinosa	Sweet Bursaria	South Australian Christmas Bush				
Caesia calliantha	Blue Grass-lily		N			
Caladenia bicalliata	Western Daddy-long-legs		R	3RC-		R
Caladenia cardiochila	Heart-lip Spider-orchid	Thick-lip Spider-orchid	N			
Caladenia carnea complex	Pink Fingers Caladenia	Pink Fingers				
Caladenia carnea var. carnea	Pink Fingers	Pink Fingers Caladenia	N			
Caladenia filamentosa var. tentaculata	Wispy Spider-orchid	Daddy-long-legs	N			
Caladenia latifolia	Pink Caladenia	Pink Fairies	N			
Caladenia prolata	Shy Caladenia	Fertile Caladenia	N			
Caladenia sp.	Spider-orchid					
Caladenia stricta	Upright Caladenia	Stiff Green-comb Spider-orchid	U			
Caladenia tentaculata	King Spider-orchid	Large Green-comb Spider-orchid	N			
Caladenia valida	Robust Spider-orchid		R	3RC-		R
Calandrinia brevipedata	Short-stalked Purslane		U			

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Calandrinia calyptrata	Pink Purslane	Small Parakeelya	N			
Calandrinia corrigioloides	Strap Purslane		N			
Calandrinia eremaea	Dryland Purslane	Small Purslane	N			
Calandrinia granulifera	Pigmy Purslane		N			
Calandrinia sp.	Purslane/Parakeelya					
Callistemon rugulosus var. rugulosus	Scarlet Bottlebrush		N			
Calochilus robertsonii	Purplish Beard-orchid	Brown-beard	N			
Calostemma purpureum	Pink Garland-lily	Garland Lily	N			
Calytrix glaberrima	Smooth Heath-myrtle	Smooth Fringe-myrtle	N			
Calytrix sp.	Fringe-myrtle					
Calytrix tetragona	Common Fringe-myrtle					
Carex breviculmis	Short-stem Sedge		N			
Carpobrotus rossii	Native Pigface	Karkalla				
Cassinia uncata	Sticky Cassinia		N			
Cassytha glabella forma dispar	Slender Dodder-laurel	Tangled Dodder-laurel	N			
Cassytha melantha	Coarse Dodder-laurel	Large Dodder-laurel				
Cassytha pubescens	Downy Dodder-laurel		N			
Centella asiatica	Asian Centella		Q			
Centrolepis aristata	Pointed Centrolepis		N			
Centrolepis cephaloformis ssp. cephaloformis	Cushion Centrolepis	Dwarf Centrolepis	R			R
Centrolepis polygyna	Wiry Centrolepis		N			
Centrolepis strigosa	Hairy Centrolepis					
Chamaescilla corymbosa var. corymbosa	Blue Squill	Blue Stars	N			
Cheilanthes austrotenuifolia	Annual Rock-fern	Green Rock-fern	N			
Cheiranthera alternifolia	Hand-flower	Finger-flower	N			
Choretrum glomeratum var. glomeratum	White Sour-bush	Common Sour-bush	N			
Chorizandra enodis	Black Bristle-rush	Black Bristle-sedge	N			
Chrysocephalum apiculatum	Common Everlasting	Small Yellow Button				
Chrysocephalum baxteri	White Everlasting	Fringed Everlasting	N			
Clematis microphylla	Old Man's Beard	Small-leaf Clematis				
Comesperma calymega	Blue-spike Milkwort	Heath Milkwort	N			
Comesperma polygaloides	Mauve Milkwort	Small Milkwort	U			
Comesperma volubile	Love Creeper	Twining Milkwort				
Conospermum patens	Slender Smoke-bush	Slender Conospermum	N			
Convolvulus erubescens	Australian Bindweed	Pink Bindweed				
Convolvulus remotus	Grassy Bindweed		N			
Correa alba var. pannosa	White Correa		R			R
Correa eburnea			V	V		V
Correa pulchella	Salmon Correa		N			
Correa reflexa var. coriacea	Thick-leaf Correa					
Correa reflexa var. reflexa	Common Correa					
Corybas despectans	Coast Helmet-orchid		N			
Corybas dilatatus	Common Helmet-orchid					
Corybas sp.	Helmet-orchid					
Cotula australis	Common Cotula	Carrot Weed				
Cotula vulgaris var. australasica	Slender Cotula		N			
Craspedia glauca	Billy-buttons	Bachelor Buttons	N			
Crassula closiana	Stalked Crassula	Red Crassula	N			
Crassula colorata var.	Dense Crassula	Dense Stonecrop				
Crassula colorata var. acuminata	Dense Crassula	Dense Stonecrop				
Crassula decumbens var. decumbens	Spreading Crassula	Spreading Stonecrop				
Crassula sieberiana ssp. tetramera	Australian Stonecrop	Common Crassula				
Crassula sp.	Crassula/Stonecrop					
Cryptandra hispidula	Rough Cryptandra		U			
Cryptandra leucophracta	White Cryptandra	Rusty Poison	N			
Cryptandra tomentosa	Heath Cryptandra	Velvet Cryptandra	N			
Cyanicula deformis	Bluebeard Orchid	Blue Fairies				
Cymbonotus preissianus	Austral Bear's-ear	Australian Bear's-ear	U			
Cynoglossum australe	Australian Hound's-tongue		N			
Cynoglossum suaveolens	Sweet Hound's-tongue	Sweet Forget-me-not	Q			
Cyperus tenellus	Tiny Flat-sedge		N			
Cyperus vaginatus	Stiff Flat-sedge	Put#a-put#a	N			
Cyrtostylis reniformis	Small Gnat-orchid	Spring-flowering Gnat-orchid				
Cyrtostylis robusta	Robust Gnat-orchid	Winter-flowering Gnat-orchid	N			
Dampiera dysantha	Shrubby Dampiera					
Dampiera lanceolata var.	Grooved Dampiera					
Danthonia caespitosa	Common Wallaby-grass	White-top	N			
Danthonia geniculata	Kneed Wallaby-grass		N			
Danthonia racemosa var. racemosa	Slender Wallaby-grass	Stiped Wallaby-grass	N			
Danthonia setacea var. setacea	Small-flower Wallaby-grass	Bristly Wallaby-grass				
Danthonia sp.	Wallaby-grass					
Daucus glochidiatus	Native Carrot	Australian Carrot				
Daviesia brevifolia	Leafless Bitter-pea					
Daviesia pectinata	Zig-zag Bitter-pea	Barbed-wire Bitter-pea	R	3RC-		R
Daviesia ulicifolia ssp. incarnata			N			
Daviesia ulicifolia(NC)	Gorse Bitter-pea		N			
Dianella brevicaulis	Short-stem Flax-lily	Coast Flax-lily				
Dianella brevicaulis/revoluta var.	Black-anther Flax-lily	Spreading Flax-lily				
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily				

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Dianella revoluta(NC)						
Dichelachne crinita	Long-hair Plume-grass		N			
Dichondra repens	Kidney Weed	Tom Thumb				
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	N			
Dillwynia sericea	Showy Parrot-pea		N			
Diplachne parviflora	Small-flower Beetle-grass		R			R
Disphyma crassifolium ssp. clavellatum	Round-leaf Pigface	Rounded Noon-flower	N			
Distichlis distichophylla	Emu-grass	Australian Salt-grass	N			
Diuris aff. corymbosa	Wallflower Donkey-orchid	Bulldogs	N			
Diuris brevifolia	Short-leaf Donkey-orchid	Late Donkey-orchid	R	3RCa		R
Diuris pardina	Spotted Donkey-orchid	Common Donkey-orchid	N			
Dodonaea humilis	Dwarf Hop-bush	Limestone Hop-bush	N			
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Spoon-leaf Hop-bush				
Drosera auriculata	Tall Sundew	Errienellam	N			
Drosera glanduligera	Scarlet Sundew		N			
Drosera macrantha ssp. planchonii	Climbing Sundew					
Drosera peltata	Pale Sundew		N			
Drosera pygmaea	Tiny Sundew		N			
Drosera whittakeri ssp. whittakeri			N			
Drosera whittakeri(NC)	Scented Sundew	Whittaker's Sundew				
Elymus scabrus var. scabrus	Native Wheat-grass	Common Wheat-grass	N			
Enchylaena tomentosa var. tomentosa	Ruby Saltbush	Barrier Saltbush				
Epilobium billardierianum ssp. billardierianum	Robust Willow-herb	Smooth Willow-herb	N			
Epilobium billardierianum ssp. cinereum	Variable Willow-herb		N			
Eriochilus cucullatus	Parson's Bands		N			
Eriostemon pungens	Prickly Wax-flower		N			
Erodium crinitum	Blue Heron's-bill	Blue Stork's-bill	N			
Eucalyptus 'anceps'	Sessile-fruit White Mallee		N			
Eucalyptus baxteri	Brown Stringybark	Baxter's Stringybark	N			
Eucalyptus conglobata	Port Lincoln Mallee	Cong Mallee	R			R
Eucalyptus cosmophylla	Cup Gum	Bog Gum				
Eucalyptus diversifolia	Coastal White Mallee	Soap Mallee	N			
Eucalyptus fasciculosa	Pink Gum	Hill Gum	N			
Eucalyptus foecunda(NC)	Narrow-leaved Mallee	Slender-leaved Red Mallee				
Eucalyptus incrassata	Ridge-fruited Mallee	Yellow Mallee	N			
Eucalyptus leptophylla	Narrow-leaf Red Mallee		N			
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		N			
Eucalyptus leucoxylon(NC)	South Australian Blue Gum	Yellow Gum				
Eucalyptus oleosa	Red Mallee	Acorn Mallee	N			
Eucalyptus porosa	Mallee Box	Black Mallee Box	N			
Eucalyptus rugosa	Coastal White Mallee	Kingscote Mallee	N			
Eucalyptus sp.						
Euchiton sphaericus	Annual Cudweed	Japanese Cudweed				
Eutaxia microphylla var. microphylla	Common Eutaxia	Eggs-and-bacon				
Eutaxia sp.	Eutaxia	Eggs-and-bacon				
Exocarpos cupressiformis	Native Cherry	Cherry Ballart	N			
Frankenia pauciflora var.	Southern Sea-heath					
Frankenia pauciflora var. gunnii	Southern Sea-heath					
Gahnia ancistrophylla	Curled Saw-sedge	Donkey Saw-sedge	U			
Gahnia deusta	Limestone Saw-sedge	Heathy Saw-sedge	N			
Gahnia lanigera	Black Grass Saw-sedge	Desert Saw-sedge	N			
Gahnia trifida	Cutting Grass	Coast Saw-sedge	N			
Galium compactum	Compact Bedstraw					
Galium gaudichaudii	Rough Bedstraw		N			
Galium migrans	Loose Bedstraw					
Genoplesium rufum	Red Midge-orchid	Dark Midge-orchid	N			
Geranium potentilloides var. potentilloides	Downy Geranium	Cinquefoil Crane's-bill	N			
Geranium retrorsum	Grassland Geranium	Grassland Crane's-bill				
Geranium sp.	Geranium	Crane's-bill				
Glischrocaryon behrii	Golden Pennants		N			
Glossodia major	Purple Cockatoo	Wax-lip Orchid	N			
Glycine clandestina var. sericea	Twining Glycine		N			
Gnaphalium indutum	Tiny Cudweed		N			
Gonocarpus mezianus	Broad-leaf Raspwort	Hairy Raspwort	N			
Gonocarpus tetragynus	Small-leaf Raspwort	Common Raspwort				
Goodenia amplexans	Clasping Goodenia		U			
Goodenia blackiana	Native Primrose	Black's Goodenia	N			
Goodenia geniculata	Bent Goodenia	Native Primrose	N			
Goodenia ovata	Hop Goodenia		N			
Goodenia pinnatifida	Cut-leaf Goodenia	Scrambled Eggs	Q			
Goodenia varia	Sticky Goodenia		N			
Goodenia willisiana	Silver Goodenia	Mallee Goodenia	N			
Gramineae sp.	Grass Family					
Grevillea ilicifolia var.	Holly-leaf Grevillea					
Grevillea ilicifolia var. ilicifolia	Holly-leaf Grevillea	Native Holly	N			
Grevillea lavandulacea var.	Spider-flower	Heath Grevillea				
Grevillea lavandulacea var. lavandulacea	Spider-flower	Heath Grevillea				
Grevillea lavandulacea var. sericea	Spider-flower	Heath Grevillea	U			
Gyrostemon australasicus	Buckbush Wheel-fruit	False Buckbush	N			

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			Conservation Significance			
Hakea carinata	Erect Hakea		N			
Hakea muelleriana	Heath Needlebush	Desert Hakea	N			
Hakea rostrata	Beaked Hakea	Turkey Gobblers	N			
Hakea rugosa	Dwarf Hakea	Wrinkled Hakea	N			
Haloragis acutangula forma tetraptera	Smooth Raspwort					
Haloragis aspera	Rough Raspwort					
Hardenbergia violacea	Native Lilac	Purple Coral-pea	N			
Helichrysum leucopsideum	Satin Everlasting	Coast Everlasting	N			
Helichrysum scorpioides	Button Everlasting		N			
Helichrysum sp.(NC)						
Hemichroa pentandra	Trailing Hemichroa		U			
Hibbertia riparia	Guinea-flower					
Hibbertia riparia (glabriuscula)	Smooth Guinea-flower					
Hibbertia riparia (long-leaved aff. H. stricta)	Bristly Guinea-flower		N			
Hibbertia sericea var.	Silky Guinea-flower					
Hibbertia sericea var. scabrifolia	Rough-leaf Guinea-flower		N			
Hibbertia sericea var. sericea	Silky Guinea-flower					
Hibbertia virgata	Twiggy Guinea-flower					
Hyalosperma demissum	Dwarf Sunray	Moss Sunray	N			
Hybanthus floribundus ssp. floribundus	Shrub Violet					
Hydrocotyle callicarpa	Tiny Pennywort	Small Pennywort	N			
Hydrocotyle capillaris	Thread Pennywort		N			
Hydrocotyle comocarpa	Fringe-fruit Pennywort	Hairy-fruit Pennywort	R	3RCi		R
Hydrocotyle foveolata	Yellow Pennywort		N			
Hypolaena fastigiata	Tassel Rope-rush		N			
Hypoxis glabella var. glabella	Tiny Star					
Hypoxis vaginata var. vaginata	Yellow Star	Sheath Star	N			
Isoetopsis graminifolia	Grass Cushion	Grass Buttons				
Isolepis cernua	Nodding Club-rush	Low Club-rush	N			
Isolepis marginata	Little Club-rush	Coarse Club-rush	N			
Isolepis nodosa	Knobby Club-rush	Knobby Club-sedge	N			
Isolepis platycarpa	Flat-fruit Club-rush	Flat-fruit Club-sedge	N			
Isopogon ceratophyllus	Horny Cone-bush	Cone-bush	N			
Ixiolaena supina	Coast Plover-daisy	Sprawling Ixiolaena	N			
Ixodia achillaeoides ssp. alata	Hills Daisy	Winged Ixodia	N			
Juncus bufonius	Toad Rush					
Juncus kraussii	Sea Rush		N			
Juncus pallidus	Pale Rush					
Juncus pauciflorus	Loose-flower Rush					
Juncus planifolius	Broad-leaf Rush		N			
Juncus subsecundus	Finger Rush		N			
Kennedia prostrata	Scarlet Runner	Running Postman	N			
Kunzea pomifera	Muntries	Pink Buttons	N			
Lagenifera huegelii	Coarse Bottle-daisy	Coarse Lagenifera	N			
Lasiopetalum baueri	Slender Velvet-bush		N			
Lasiopetalum discolor	Coast Velvet-bush		N			
Lavatera plebeia	Australian Hollyhock	Native Hollyhock	N			
Laxmannia orientalis	Dwarf Wire-lily		N			
Laxmannia sessiliflora(NC)	Dwarf Wire-lily					
Lemna disperma	Common Duckweed					
Lepidobolus drapetocoleus	Scale Shedder		N			
Lepidosperma canescens	Hoary Rapier-sedge		N			
Lepidosperma carphoides	Black Rapier-sedge		N			
Lepidosperma concavum	Spreading Sword-sedge	Sandhill Sword-sedge				
Lepidosperma congestum	Clustered Sword-sedge	Limestone Sword-sedge				
Lepidosperma curtisiae	Little Sword-sedge		N			
Lepidosperma gladiatum	Coast Sword-sedge	Sword Rush	N			
Lepidosperma laterale(NC)	Sharp Sword-sedge	Variable Sword-sedge				
Lepidosperma semiteres	Wire Rapier-sedge		N			
Lepidosperma sp.	Sword-sedge/Rapier-sedge					
Lepidosperma viscidum	Sticky Sword-sedge					
Leporella fimbriata	Fringed Hare-orchid		N			
Leptocarpus brownii	Coarse Twine-rush		N			
Leptoceras menziesii	Hare Orchid	Rabbit Orchid	N			
Leptorhynchos squamatus	Scaly Buttons		N			
Leptospermum continentale	Prickly Tea-tree					
Leptospermum myrsinoides	Heath Tea-tree					
Leucophyta brownii	Coast Cushion Bush	Cushion Bush				
Leucopogon parviflorus	Coast Beard-heath					
Leucopogon rufus	Ruddy Beard-heath		U			
Leucopogon virgatus	Common Beard-heath		N			
Levenhookia dubia	Hairy Stylewort		N			
Levenhookia pusilla	Tiny Stylewort	Midget Stylewort				
Levenhookia sp.	Stylewort					
Lichen sp.						
Lilaeopsis polyantha	Australian Lilaeopsis		Q			
Linum marginale	Native Flax	Wild Flax	N			
Lobelia alata	Angled Lobelia		N			
Lobelia gibbosa	Tall Lobelia	False Orchid				

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Logania crassifolia	Coast Logania		N			
Logania linifolia	Flax-leaf Logania		N			
Logania minor	Spoon-leaf Logania		U			
Lomandra collina	Sand Mat-rush	Sharp-leaf Mat-rush	N			
Lomandra densiflora	Soft Tussock Mat-rush	Pointed Mat-rush	N			
Lomandra effusa	Scented Mat-rush	Scented Iron-grass	N			
Lomandra glauca(NC)	Pale Mat-rush					
Lomandra juncea	Desert Mat-rush		N			
Lomandra micrantha ssp.	Small-flower Mat-rush					
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		N			
Lomandra micrantha ssp. tuberculata	Small-flower Mat-rush		N			
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	N			
Lomandra nana	Small Mat-rush	Soft Mat-rush	N			
Lomandra sororia	Sword Mat-rush	Small Mat-rush	U			
Lotus australis	Austral Trefoil	Australian Trefoil	N			
Luzula meridionalis	Common Wood-rush		N			
Melaleuca brevifolia	Short-leaf Honey-myrtle	Swamp Honey-myrtle	N			
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle				
Melaleuca lanceolata ssp. lanceolata	Dryland Tea-tree	Black Tea-tree	N			
Micrantheum demissum	Dwarf Micrantheum		N			
Microlaena stipoides var. stipoides	Weeping Rice-grass	Weeping Grass	N			
Microseris lanceolata	Yam Daisy	Native Yam				
Microtis arenaria	Notched Onion-orchid	Common Onion-orchid				
Microtis sp.	Onion-orchid					
Millotia muelleri	Common Bow-flower		N			
Millotia myosotidifolia	Broad-leaf Millotia		N			
Millotia tenuifolia var.	Soft Millotia					
Millotia tenuifolia var. tenuifolia	Soft Millotia		N			
Mimulus repens	Creeping Monkey-flower		N			
Minuria leptophylla	Minnie Daisy		N			
Mitrasacme paradoxa(NC)	Wiry Mitrewort					
Moss sp.						
Muehlenbeckia adpressa	Climbing Lignum	Native Sarsparilla				
Muehlenbeckia florulenta	Lignum	Tangled Lignum	N			
Muehlenbeckia gunnii	Coastal Climbing Lignum	Native Sarsparilla				
Myoporum insulare	Common Boobialla	Native Juniper	N			
Myoporum viscosum	Sticky Boobialla		U			
Myosotis australis	Austral Forget-me-not		N			
Neurachne alopecuroidea	Fox-tail Mulga-grass		N			
Nicotiana maritima	Coast Tobacco		N			
Nitraria billardierei	Nitre-bush	Dillon Bush				
Olearia axillaris	Coast Daisy-bush					
Olearia pannosa ssp. pannosa	Silver Daisy-bush		V	3VCa	V	V
Olearia ramulosa	Twiggy Daisy-bush		N			
Opercularia scabrida	Stalked Stinkweed					
Opercularia turpis	Twiggy Stinkweed		N			
Opercularia varia	Variable Stinkweed		N			
Ophioglossum lusitanicum	Austral Adder's-tongue		N			
Orthoceras strictum	Horned Orchid		U			
Oxalis perennans	Native Sorrel	Native Oxalis				
Oxalis sp.	Sorrel					
Ozothamnus turbinatus	Coast Bush-everlasting	Coast Everlasting	U			
Parietaria cardiostegia	Mallee Smooth-nettle	Mallee Pellitory	N			
Parietaria debilis	Smooth-nettle	Shade Pellitory				
Patersonia fragilis	Short Purple-flag	Swamp Iris	U			
Pelargonium australe	Australian Pelargonium	Austral Storks-bill	N			
Pelargonium littorale	Native Pelargonium	Native Storks-bill				
Persicaria prostrata	Creeping Knotweed	Trailing Knotweed	U			
Persoonia juniperina	Prickly Geebung	Geebung	N			
Phragmites australis	Common Reed	Bamboo Reed				
Phyllangium divergens	Wiry Mitrewort					
Phyllanthus australis	Southern Spurge	Pointed Spurge	N			
Phyllota pleurandroides	Heathy Phyllota		N			
Picris squarrosa	Squat Picris	Hawkweed Picris	R			R
Pimelea glauca	Smooth Riceflower					
Pimelea humilis	Low Riceflower	Common Riceflower	N			
Pimelea octophylla	Woolly Riceflower	Downy Riceflower				
Pimelea phylicoides	Heath Riceflower		N			
Pimelea serpyllifolia ssp. serpyllifolia	Thyme Riceflower					
Pimelea stricta	Erect Riceflower	Gaunt Riceflower				
Plantago hispida	Hairy Plantain		N			
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	N			
Platysace heterophylla var.	Slender Platysace					
Platysace heterophylla var. heterophylla	Slender Platysace	Corn Parsley	N			
Poa halmaturina	Kangaroo Island Poa	Salt Tussock-grass	N	3RC-		
Poa poiformis	Coast Tussock-grass	Blue Tussock-grass	N			
Poa sp.	Meadow-grass/Tussock-grass	Poa				
Poa tenera	Slender Tussock-grass	Spreading Tussock-grass	Q			
Podotheca angustifolia	Sticky Long-heads	Sticky-heads				

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Pomaderris obcordata	Wedge-leaf Pomaderris	Pimelea Pomaderris	N			
Pomaderris oraria(NC)	Coast Pomaderris					
Pomaderris paniculosa ssp. paniculosa	Mallee Pomaderris	Inland Pomaderris	N			
Poranthera ericoides	Heath Poranthera		N			
Poranthera microphylla	Small Poranthera	Small-leaf Poranthera	N			
Poranthera triandra	Three-petal Poranthera	Pink Porantha				
Prasophyllum "carnosum"			U	3RCa		
Prasophyllum elatum	Tall Leek-orchid	Piano Orchid	N			
Prasophyllum sp.	Leek-orchid					
Prostanthera chlorantha	Green Mintbush		R	R		R
Pseudanthus micranthus	Fringed Pseudanthus		R	2RCa		R
Pseudognaphalium luteoalbum	Jersey Cudweed	Cudweed				
Pterostylis aff. nana "mallee"	Mallee Dwarf Greenhood		N			
Pterostylis alata	Tall Shell-orchid	Striped Greenhood	U			
Pterostylis dolichochila	Mallee Shell-orchid	Long-tongue Shell-orchid	N			
Pterostylis nana	Dwarf Greenhood					
Pterostylis nutans	Nodding Greenhood	Parrot's Beak Orchid	N			
Pterostylis pedunculata	Maroon-hood		N			
Pterostylis plumosa	Bearded Greenhood		N			
Pterostylis sanguinea	Blood Greenhood	Red Banded-greenhood				
Pterostylis sp.	Greenhood					
Pterostylis sp.(NC)						
Pterostylis vittata(NC)	Banded Greenhood					
Ptilotus erubescens	Hairy-tails	Hairy Heads	R	Q		R
Ptilotus spathulatus forma spathulatus	Pussy-tails	Cats Paws	N			
Puccinellia stricta var. stricta	Australian Saltmarsh-grass	Marshgrass	N			
Pultenaea canaliculata var.	Soft Bush-pea	Coast Bush-pea	U			
Pultenaea canaliculata var. canaliculata	Soft Bush-pea	Coast Bush-pea				
Pultenaea canaliculata var. latifolia	Soft Bush-pea	Coast Bush-pea				
Pultenaea densifolia	Dense Bush-pea		U			
Pultenaea largiflorens	Twiggy Bush-pea		N			
Pultenaea tenuifolia	Narrow-leaf Bush-pea	Slender Bush-pea	N			
Pultenaea trinervis	Three-nerve Bush-pea		N	N		
Pyrorchis nigricans	Black Fire-orchid	Red-beak Orchid	N			
Ranunculus amphitrichus	Small River Buttercup		U			
Ranunculus sessiliflorus var.	Annual Buttercup	Small-flower Buttercup				
Ranunculus sessiliflorus var. sessiliflorus	Annual Buttercup	Small-flower Buttercup	N			
Rhagodia candolleana ssp.	Sea-berry Saltbush					
Rhagodia candolleana ssp. candolleana	Sea-berry Saltbush					
Rhodanthe laevis	Smooth Daisy	Smooth Sunray	N			
Rumex brownii	Slender Dock	Hooked Dock	N			
Ruppia polycarpa	Widgeon Grass	Many-fruit Water-tassel				
Rutidosis multiflora	Small Wrinklewort					
Samolus repens	Creeping Brookweed	Creeping Samolus	N			
Santalum acuminatum	Quandong	Native Peach	N			
Santalum murrayanum	Bitter Quandong	Ming	U			
Sarcocornia blackiana	Thick-head Samphire	Thick-head Glasswort				
Sarcocornia quinqueflora	Beaded Samphire	Beaded Glasswort	N			
Sarcozona bicarinata	Ridged Noon-flower		K	3KC-		V
Scaevola albida	Pale Fanflower	Small-fruit Fanflower				
Scaevola crassifolia	Cushion Fanflower		N			
Scaevola linearis ssp. confertifolia	Bundled Fanflower		U			
Schoenoplectus validus	River Club-rush	River Club-sedge	N			
Schoenus apogon	Common Bog-rush	Common Bog-sedge	N			
Schoenus breviculmis	Matted Bog-rush	Moss Bog-rush	N			
Schoenus deformis	Small Bog-rush	Limestone Bog-rush	N			
Schoenus nitens	Shiny Bog-rush	Shiny Bog-sedge	N			
Schoenus sp.	Bog-rush	Bog-sedge				
Sclerolaena diacantha	Grey Bindyi	Horned Bindyi	N			
Sebaea ovata	Yellow Sebaea	Yellow Centaury	N			
Senecio glomeratus	Swamp Groundsel	Toothed Groundsel	N			
Senecio glossanthus	Annual Groundsel	Slender Groundsel	N			
Senecio lautus	Variable Groundsel	Elegant Yellow-top				
Senecio odoratus var.	Scented Groundsel					
Senecio odoratus var. obtusifolius	Broad-leaf Scented Groundsel		V			V
Senecio odoratus var. odoratus	Scented Groundsel		N			
Senecio picridioides	Purple-leaf Groundsel	Scabrid Groundsel	N			
Senecio quadridentatus	Cotton Groundsel	Cotton Fireweed	N			
Senecio tenuiflorus	Woodland Groundsel	Narrow Groundsel	N			
Solanum laciniatum	Cut-leaf Kangaroo-apple	Large Kangaroo-apple	N			
Solenogyne dominii	Smooth Solenogyne		U			
Sonchus hydrophilus	Native Sow-thistle		N			
Sonchus megalocarpus	Coast Sow-thistle	Dune Thistle	N			
Spinifex sericeus	Rolling Spinifex	Coast Spinifex				
Sporobolus virginicus	Salt Couch					
Spyridium coactilifolium	Butterfly Spyridium		V	2VCa	V	V
Spyridium thymifolium	Thyme-leaf Spyridium		N			
Stackhousia aspericocca ssp. "Cylindrical inflorescence"(W.R.Barker 1418)	Bushy Candles	Rough Candles	N			

Coastal Shrubland Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	Conservation Significance SA	AUS	ENDANGERED SPECIES ACT	NPW ACT
Stackhousia aspericocca ssp. "One-sided inflorescence"(W.R.Barker 697)	One-sided Candles	Rough Candles	N			
Stenopetalum lineare	Narrow Thread-petal		N			
Stipa exilis	Heath Spear-grass		N			
Stipa flavescens	Coast Spear-grass		N			
Stipa hemipogon	Half-beard Spear-grass		N			
Stipa macalpinei	Annual Spear-grass	One-year Grass	U			
Stipa mollis	Soft Spear-grass	Supple Spear-grass	N			
Stipa mundula	Neat Spear-grass		N			
Stipa scabra ssp. falcata	Slender Spear-grass	Rough Spear-grass				
Stipa sp.	Spear-grass					
Stipa stipoides	Coast Spear-grass	Prickly Spear-grass	N			
Stuartina muelleri	Spoon Cudweed					
Stylidium calcaratum	Spurred Trigger-plant	Book Trigger-plant	N			
Stylidium graminifolium	Grass Trigger-plant		N			
Stylidium perpusillum	Tiny Trigger-plant	Slender Trigger-plant	U			
Styphelia exarrhena	Desert Heath	Beard-heath Styphelia	N			
Suaeda australis	Austral Seablite					
Swainsona lessertiifolia	Coast Swainson-pea	Poison Pea	N			
Tetragonia implexicoma	Bower Spinach					
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells	Pink-eyed Susan	N			
Thelymitra antennifera	Lemon Sun-orchid	Rabbit-ears				
Thelymitra benthamiana	Leopard Sun-orchid	Blotched Sun-orchid	U			
Thelymitra canaliculata	Azure Sun-orchid		U			
Thelymitra holmesii	Blue Star Sun-orchid	Slender Swamp Sun-orchid	V			V
Thelymitra ixioides	Spotted Sun-orchid	Dotted Sun-orchid				
Thelymitra juncifolia	Spotted Sun-orchid	Dotted Sun-orchid	N			
Thelymitra luteocilium	Yellow-tuft Sun Orchid	Fringed Sun-orchid	N			
Thelymitra pauciflora	Slender Sun-orchid		N			
Thelymitra rubra	Salmon Sun-orchid	Pink Sun-orchid	N			
Thelymitra sp.	Sun-orchid					
Themeda triandra	Kangaroo Grass	Ilintji	N			
Thomasia petalocalyx	Paper-flower		N			
Threlkeldia diffusa	Coast Bonefruit					
Thysanotus baueri	Mallee Fringe-lily		N			
Thysanotus juncifolius	Rush Fringe-lily		N			
Thysanotus patersonii	Twining Fringe-lily					
Tricoryne elatior(NC)	Yellow Rush-lily					
Tricoryne tenella	Tufted Yellow Rush-lily	Rigid Rush-lily	N			
Triglochin calcitrapum	Spurred Arrowgrass		N			
Triglochin centrocarpum	Dwarf Arrowgrass					
Triglochin procerum	Water-ribbons		N			
Triglochin striatum	Streaked Arrowgrass		N			
Triglochin trichophorum			N			
Triodia compacta	Spinifex	Porcupine-grass	N			
Typha domingensis	Narrow-leaf Bulrush	Narrow-leaf Cumbungi	N			
Utricularia tenella	Pink Bladderwort	Pink Fan	U			
Veronica hillebrandii	Rigid Speedwell	Coast Speedwell	N			
Vittadinia australasica var. australasica	Sticky New Holland Daisy	New Holland Daisy	N			
Vittadinia cuneata var. cuneata forma cuneata	Fuzzy New Holland Daisy	Fuzzweed				
Wahlenbergia gracilenta	Annual Bluebell					
Wahlenbergia litticola	Coast Bluebell	Edge Bluebell	N			
Wahlenbergia luteola	Yellow-wash Bluebell	Yellowish Bluebell	N			
Wahlenbergia stricta ssp. stricta	Tall Bluebell					
Wilsonia backhousei	Narrow-leaf Wilsonia		N			
Wilsonia humilis var. humilis	Silky Wilsonia		N			
Wilsonia rotundifolia	Round-leaf Wilsonia		N			
Wurmbea dioica ssp. dioica	Early Nancy	Early Star-lily	N			
Xanthorrhoea semiplana ssp.	Yacca	Flat-leaf Grass-tree				
Xanthorrhoea semiplana ssp. semiplana	Yacca	Flat-leaf Grass-tree	N			
Xanthorrhoea semiplana ssp. tateana	Tate's Grass-tree		N			
Xanthosia pusilla	Hairy Xanthosia	Heath Xanthosia	N			
Zieria veronicea	Pink Zieria		R			R
Zygophyllum billardierei	Coast Twinleaf					

Perched Swamp Species List (DEH survey data)

			Conservation Significance			
SPECIES	**COMMON NAME 1**	**COMMON NAME 2**	**SA**	**AUS**	**ENDANGERED SPECIES ACT**	**NPW ACT**
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle				
Acacia pycnantha	Golden Wattle					
Acacia retinodes var.	Silver Wattle					
Acacia spinescens	Spiny Wattle		N			
Acacia verticillata	Prickly Moses		N			
Acaena novae-zelandiae	Biddy-biddy	Bidgee-widgee	N			
Acianthus caudatus var.	Mayfly Orchid	Dead Horse				
Acianthus pusillus	Mosquito Orchid	Gnat Orchid				
Allocasuarina pusilla	Dwarf Oak-bush	Heath Oak-bush	N			
Allocasuarina striata	Stalked Oak-bush	Tall Oak-bush				
Amyema miquelii	Box Mistletoe	Nyirunypa				
Amyema pendulum ssp. pendulum	Drooping Mistletoe		N			
Amyema preissii	Wire-leaf Mistletoe		N			
Argentipallium blandowskianum	Woolly Everlasting		N			
Argentipallium obtusifolium	Blunt Everlasting		N			
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	N			
Astroloma conostephioides	Flame Heath		N			
Astroloma humifusum	Cranberry Heath	Native Cranberry	N			
Baeckea ramosissima ssp. ramosissima	Rosy Baeckea					
Banksia ornata	Desert Banksia	Sand-heath Banksia	N			
Baumea juncea	Bare Twig-rush	Blue Twig-rush	N			
Baumea tetragona	Square Twig-rush	Square Twig-sedge	U			
Billardiera cymosa	Sweet Apple-berry					
Blechnum minus	Soft Water-fern		U			
Brunonia australis	Blue Pincushion	Tjulpun-tjulpunpa	N			
Bulbine bulbosa	Bulbine-lily	Native Leek	N			
Burchardia umbellata	Milkmaids	Milk Lily	N			
Caladenia dilatata complex	Green-comb Spider-orchid	Fringed Spider-orchid				
Caladenia leptochila	Narrow-lip Spider-orchid	Queen Spider-orchid	N			
Caladenia tentaculata	King Spider-orchid	Large Green-comb Spider-orchid	N			
Calochilus robertsonii	Purplish Beard-orchid	Brown-beard	N			
Calytrix tetragona	Common Fringe-myrtle					
Carex appressa	Tall Sedge	Tussock Sedge	N			
Carex tereticaulis	Rush Sedge		N			
Cassytha glabella forma dispar	Slender Dodder-laurel	Tangled Dodder-laurel	N			
Cassytha pubescens	Downy Dodder-laurel		N			
Centipeda minima	Spreading Sneezeweed		N			
Centrolepis fascicularis	Tufted Centrolepis		U			
Chamaescilla corymbosa var. corymbosa	Blue Squill	Blue Stars	N			
Cheiranthera alternifolia	Hand-flower	Finger-flower	N			
Chrysocephalum baxteri	White Everlasting	Fringed Everlasting	N			
Comesperma calymega	Blue-spike Milkwort	Heath Milkwort	N			
Conospermum patens	Slender Smoke-bush	Slender Conospermum	N			
Correa reflexa var. reflexa	Common Correa					
Corybas dilatatus	Common Helmet-orchid					
Corybas incurvus	Slaty Helmet-orchid	Purple Helmet-orchid	U			
Craspedia glauca	Billy-buttons	Bachelor Buttons	N			
Cryptandra tomentosa	Heath Cryptandra	Velvet Cryptandra	N			
Cyrtostylis reniformis	Small Gnat-orchid	Spring-flowering Gnat-orchid				
Danthonia setacea var. setacea	Small-flower Wallaby-grass	Bristly Wallaby-grass				
Daviesia arenaria	Sand Bitter-pea	Mallee Bitter-pea	U			
Daviesia brevifolia	Leafless Bitter-pea					
Daviesia ulicifolia ssp. incarnata			N			
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily				
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	N			
Dillwynia sericea	Showy Parrot-pea		N			
Dipodium roseum	Pink Hyacinth Orchid	Christmas Orchid	N			
Dipodium sp.	Hyacinth Orchid					
Diuris aff. corymbosa	Wallflower Donkey-orchid	Bulldogs	N			
Diuris brevifolia	Short-leaf Donkey-orchid	Late Donkey-orchid	R	3RCa		R
Dodonaea viscosa ssp.	Sticky Hop-bush					
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Spoon-leaf Hop-bush				
Drosera auriculata	Tall Sundew	Errienellam	N			
Drosera binata	Forked Sundew		R			R
Drosera glanduligera	Scarlet Sundew		N			
Drosera macrantha ssp. planchonii	Climbing Sundew					
Drosera peltata	Pale Sundew		N			
Drosera pygmaea	Tiny Sundew		N			
Drosera whittakeri ssp. whittakeri			N			
Eleocharis gracilis	Slender Spike-rush	Slender Spike-sedge	U			
Empodisma minus	Tangled Rope-rush	Spreading Rope-rush	U			
Epacris impressa	Common Heath	Heath	N			
Epilobium hirtigerum	Hairy Willow-herb	Hoary Willow-herb	N			
Epilobium pallidiflorum	Showy Willow-herb		U			
Eucalyptus baxteri	Brown Stringybark	Baxter's Stringybark	N			
Eucalyptus fasciculosa	Pink Gum	Hill Gum	N			
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		N			
Eucalyptus obliqua	Messmate Stringybark	Stringybark	N			
Eucalyptus ovata	Swamp Gum		N			

Perched Swamp Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	SA	AUS	Conservation Significance ENDANGERED SPECIES ACT	NPW ACT
Euchiton involucratus	Star Cudweed	Common Cudweed	N			
Gahnia sieberiana	Red-fruit Cutting-grass	Red-fruit Saw-sedge	U			
Gleichenia microphylla	Coral Fern	Scrambling Coral-fern	R			R
Glossodia major	Purple Cockatoo	Wax-lip Orchid	N			
Glycine clandestina var. sericea	Twining Glycine		N			
Gnaphalium indutum	Tiny Cudweed		N			
Gonocarpus mezianus	Broad-leaf Raspwort	Hairy Raspwort	N			
Gonocarpus micranthus ssp. micranthus	Creeping Raspwort		R			R
Gonocarpus tetragynus	Small-leaf Raspwort	Common Raspwort				
Goodenia geniculata	Bent Goodenia	Native Primrose	N			
Goodenia ovata	Hop Goodenia		N			
Gratiola peruviana	Austral Brooklime		N			
Grevillea lavandulacea var.	Spider-flower	Heath Grevillea				
Grevillea lavandulacea var. lavandulacea	Spider-flower	Heath Grevillea				
Hakea rostrata	Beaked Hakea	Turkey Gobblers	N			
Helichrysum scorpioides	Button Everlasting		N			
Hibbertia riparia	Guinea-flower					
Hibbertia virgata	Twiggy Guinea-flower					
Hypolaena fastigiata	Tassel Rope-rush		N			
Hypolepis rugosula	Ruddy Ground-fern		R			R
Hypoxis glabella var. glabella	Tiny Star					
Hypoxis vaginata var. vaginata	Yellow Star	Sheath Star	N			
Isolepis inundata	Swamp Club-rush		N			
Isolepis marginata	Little Club-rush	Coarse Club-rush	N			
Isopogon ceratophyllus	Horny Cone-bush	Cone-bush	N			
Juncus bufonius	Toad Rush					
Juncus caespiticius	Grassy Rush		N			
Juncus holoschoenus	Joint-leaf Rush		N			
Juncus pallidus	Pale Rush					
Juncus planifolius	Broad-leaf Rush		N			
Juncus prismatocarpus	Branching Rush		E			E
Juncus sarophorus			N			
Kennedia prostrata	Scarlet Runner	Running Postman	N			
Laxmannia orientalis	Dwarf Wire-lily		N			
Lepidobolus drapetocoleus	Scale Shedder		N			
Lepidosperma carphoides	Black Rapier-sedge		N			
Lepidosperma laterale s.str.	Tall Sword-sedge		U			
Lepidosperma longitudinale	Pithy Sword-sedge	Swamp Sword-sedge	N			
Lepidosperma semiteres	Wire Rapier-sedge		N			
Leporella fimbriata	Fringed Hare-orchid		N			
Leptoceras menziesii	Hare Orchid	Rabbit Orchid	N			
Leptospermum continentale	Prickly Tea-tree					
Leptospermum lanigerum	Silky Tea-tree	Woolly Tea-tree	N			
Leptospermum myrsinoides	Heath Tea-tree					
Leucopogon hirsutus	Hairy Beard-heath		R			R
Leucopogon virgatus	Common Beard-heath		N			
Lindsaea linearis	Screw Fern	Necklace Fern	U			
Lobelia alata	Angled Lobelia		N			
Lobelia gibbosa	Tall Lobelia	False Orchid				
Lobelia rhombifolia	Tufted Lobelia		U			
Lomandra collina	Sand Mat-rush	Sharp-leaf Mat-rush	N			
Lomandra micrantha ssp.	Small-flower Mat-rush					
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	N			
Lythrum hyssopifolia	Lesser Loosestrife	Small Loosestrife				
Lythrum salicaria	Purple Loosestrife		R			R
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle				
Micrantheum demissum	Dwarf Micrantheum		N			
Microtis parviflora	Slender Onion-orchid		U			
Microtis unifolia	Common Onion-orchid		N			
Myriophyllum amphibium	Broad Milfoil	Broad Water-milfoil	R			R
Neurachne alopecuroidea	Fox-tail Mulga-grass		N			
Olearia ramulosa	Twiggy Daisy-bush		N			
Paracaleana minor	Small Duck-orchid		V			V
Patersonia fragilis	Short Purple-flag	Swamp Iris	U			
Patersonia occidentalis	Long Purple-flag		U			
Phragmites australis	Common Reed	Bamboo Reed				
Pimelea humilis	Low Riceflower	Common Riceflower	N			
Pimelea octophylla	Woolly Riceflower	Downy Riceflower				
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	N			
Platysace heterophylla var. heterophylla	Slender Platysace	Corn Parsley	N			
Pratia pedunculata	Matted Pratia		U			
Prunella vulgaris	Self-heal	Heal-all				
Pseudanthus micranthus	Fringed Pseudanthus		R	2RCa		R
Pseudognaphalium luteoalbum	Jersey Cudweed	Cudweed				
Pteridium esculentum	Bracken Fern	Austral Bracken	N			
Pterostylis pedunculata	Maroon-hood		N			
Pterostylis sanguinea	Blood Greenhood	Red Banded-greenhood				
Pyrorchis nigricans	Black Fire-orchid	Red-beak Orchid	N			
Scaevola albida	Pale Fanflower	Small-fruit Fanflower				

Perched Swamp Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	SA	AUS	Conservation Significance ENDANGERED SPECIES ACT	NPW ACT
Schoenus apogon	Common Bog-rush	Common Bog-sedge	N			
Schoenus breviculmis	Matted Bog-rush	Moss Bog-rush	N			
Schoenus maschalinus	Leafy Bog-rush	Creeping Bog-rush	U			
Senecio glomeratus	Swamp Groundsel	Toothed Groundsel	N			
Senecio quadridentatus	Cotton Groundsel	Cotton Fireweed	N			
Spiranthes sinensis ssp. australis	Austral Lady's Tresses	Ladies Tresses	R			R
Sprengelia incarnata	Pink Swamp-heath		R			R
Spyridium thymifolium	Thyme-leaf Spyridium		N			
Stipa mollis	Soft Spear-grass	Supple Spear-grass	N			
Stylidium graminifolium	Grass Trigger-plant		N			
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells	Pink-eyed Susan	N			
Thelymitra antennifera	Lemon Sun-orchid	Rabbit-ears				
Thelymitra ixioides	Spotted Sun-orchid	Dotted Sun-orchid				
Thelymitra luteocilium	Yellow-tuft Sun Orchid	Fringed Sun-orchid	N			
Thelymitra nuda	Scented Sun-orchid	Plain Sun-orchid				
Thelymitra pauciflora	Slender Sun-orchid		N			
Thelymitra rubra	Salmon Sun-orchid	Pink Sun-orchid	N			
Thysanotus juncifolius	Rush Fringe-lily		N			
Thysanotus patersonii	Twining Fringe-lily					
Tricoryne elatior	Yellow Rush-lily		N			
Typha domingensis	Narrow-leaf Bulrush	Narrow-leaf Cumbungi	N			
Utricularia dichotoma	Purple Bladderwort	Fairies Apron	U			
Villarsia umbricola var. umbricola	Lax Marsh-flower		U			
Viminaria juncea	Native Broom	Golden Spray	R			R
Viola sieberiana	Tiny Violet	Sieber's Violet	N			
Wahlenbergia gracilenta	Annual Bluebell					
Wahlenbergia stricta ssp. stricta	Tall Bluebell					
Xanthorrhoea semiplana ssp. semiplana	Yacca	Flat-leaf Grass-tree	N			
Xanthosia pusilla	Hairy Xanthosia	Heath Xanthosia	N			

Pink Gum Woodland Species List (DEH survey data)

SPECIES	COMMON NAME 1	COMMON NAME 2	SA	AUS	Conservation Significance ENDANGERED SPECIES ACT	NPW ACT
Acacia melanoxylon	Blackwood		N			
Acacia myrtifolia var. myrtifolia	Myrtle Wattle	Scrub Wattle	N			
Acacia myrtifolia(NC)	Myrtle Wattle	Bitter Leaf Wattle				
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle				
Acacia pycnantha	Golden Wattle					
Acacia retinodes var.	Silver Wattle					
Acacia retinodes var. retinodes (swamp form)	Swamp Wattle					
Acacia spinescens	Spiny Wattle		N			
Acacia verticillata	Prickly Moses		N			
Acaena echinata var.	Sheep's Burr					
Acaena echinata var. echinata	Sheep's Burr					
Acaena novae-zelandiae	Biddy-biddy	Bidgee-widgee	N			
Acaena sp.	Sheep's Burr					
Acianthus caudatus var.	Mayfly Orchid	Dead Horse				
Acianthus pusillus	Mosquito Orchid	Gnat Orchid				
Acrotriche serrulata	Cushion Ground-berry	Honeypots	N			
Adiantum aethiopicum	Common Maiden-hair		N			
Agrostis sp.	Blown-grass/Bent Grass					
Allocasuarina muelleriana ssp.	Common Oak-bush	Slaty Oak-bush				
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush	Slaty Oak-bush	N			
Allocasuarina striata	Stalked Oak-bush	Tall Oak-bush				
Allocasuarina verticillata	Drooping Sheoak					
Amphipogon strictus var. setifer	Spreading Grey-beard Grass		N			
Amyema miquelii	Box Mistletoe	Nyirunypa				
Amyema preissii	Wire-leaf Mistletoe		N			
Apium prostratum ssp. prostratum var.	Native Celery	Sea Celery	N			
Arthropodium fimbriatum	Nodding Vanilla-lily	Summer Vanilla-lily	N			
Arthropodium sp.	Vanilla-lily	Chocolate-lily				
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	N			
Asplenium flabellifolium	Necklace Fern		N			
Astroloma conostephioides	Flame Heath		N			
Astroloma humifusum	Cranberry Heath	Native Cranberry	N			
Baeckea ramosissima ssp. ramosissima	Rosy Baeckea					
Billardiera bignoniacea	Orange Bell-climber		U			
Billardiera cymosa	Sweet Apple-berry					
Billardiera sp.	Apple-berry					
Billardiera uniflora	One-flower Apple-berry	Single-flower Apple-berry	N			
Blechnum minus	Soft Water-fern		U			
Blechnum nudum	Fishbone Water-fern		R			R
Bossiaea prostrata	Creeping Bossiaea		N			
Brachyloma ericoides ssp.	Brush Heath					
Brachyloma ericoides ssp. ericoides	Brush Heath		N			
Bracteantha bracteata	Golden Everlasting	Tjulpun-tjulpunpa	N			
Bromus sp.	Brome					
Brunonia australis	Blue Pincushion	Tjulpun-tjulpunpa	N			
Burchardia umbellata	Milkmaids	Milk Lily	N			
Bursaria spinosa	Sweet Bursaria	South Australian Christmas Bush				
Caesia calliantha	Blue Grass-lily		N			
Caladenia carnea var. carnea	Pink Fingers	Pink Fingers Caladenia	N			
Caladenia dilatata complex	Green-comb Spider-orchid	Fringed Spider-orchid				
Caladenia dilatata(NC)	Green-comb Spider-orchid	Fringed Spider-orchid				
Caladenia leptochila	Narrow-lip Spider-orchid	Queen Spider-orchid	N			
Caladenia sp.	Spider-orchid					
Caladenia tentaculata	King Spider-orchid	Large Green-comb Spider-orchid	N			
Calochilus robertsonii	Purplish Beard-orchid	Brown-beard	N			
Calytrix tetragona	Common Fringe-myrtle					
Cardamine paucijuga	Annual Bitter-cress		R			R
Carex appressa	Tall Sedge	Tussock Sedge	N			
Carex breviculmis	Short-stem Sedge		N			
Cassinia uncata	Sticky Cassinia		N			
Cassytha glabella forma dispar	Slender Dodder-laurel	Tangled Dodder-laurel	N			
Cassytha melantha	Coarse Dodder-laurel	Large Dodder-laurel				
Cassytha sp.	Dodder-laurel					
Centrolepis aristata	Pointed Centrolepis		N			
Centrolepis polygyna	Wiry Centrolepis		N			
Chamaescilla corymbosa var. corymbosa	Blue Squill	Blue Stars	N			
Cheilanthes austrotenuifolia	Annual Rock-fern	Green Rock-fern	N			
Cheiranthera alternifolia	Hand-flower	Finger-flower	N			
Choretrum glomeratum var.	Sour-bush					
Chrysocephalum apiculatum	Common Everlasting	Small Yellow Button				
Chrysocephalum baxteri	White Everlasting	Fringed Everlasting	N			
Clematis microphylla	Old Man's Beard	Small-leaf Clematis				
Comesperma calymega	Blue-spike Milkwort	Heath Milkwort	N			
Convolvulus remotus	Grassy Bindweed		N			
Correa aemula s.str.	Hairy Correa		R			
Correa calycina	Hindmarsh Correa		V	2VCi	V	
Correa pulchella	Salmon Correa		N			
Correa reflexa	Common Correa					
Craspedia glauca	Billy-buttons	Bachelor Buttons	N			
Crassula decumbens var. decumbens	Spreading Crassula	Spreading Stonecrop				
Crassula sp.	Crassula/Stonecrop					
Cryptandra tomentosa	Heath Cryptandra	Velvet Cryptandra	N			
Cryptandra tomentosa(NC)						
Cullen australasicum	Tall Scurf-pea	Verbine Scurf-pea				
Cymbonotus preissianus	Austral Bear's-ear	Australian Bear's-ear	U			
Cynoglossum suaveolens	Sweet Hound's-tongue	Sweet Forget-me-not	Q			
Cyperus vaginatus	Stiff Flat-sedge	Puta-puta	N			
Cyrtostylis reniformis	Small Gnat-orchid	Spring-flowering Gnat-orchid				
Dampiera dysantha	Shrubby Dampiera					

Pink Gum Woodland Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	SA	AUS	Conservation Significance ENDANGERED SPECIES ACT	NPW ACT
Danthonia caespitosa	Common Wallaby-grass	White-top	N			
Danthonia geniculata	Kneed Wallaby-grass		N			
Danthonia pilosa var. paleacea	Velvet Wallaby-grass		N			
Danthonia setacea var. setacea	Small-flower Wallaby-grass	Bristly Wallaby-grass				
Danthonia sp.	Wallaby-grass					
Daucus glochidiatus	Native Carrot	Australian Carrot				
Daviesia brevifolia	Leafless Bitter-pea					
Daviesia leptophylla	Narrow-leaf Bitter-pea		N			
Daviesia ulicifolia ssp. incarnata			N			
Daviesia ulicifolia(NC)	Gorse Bitter-pea		N			
Deyeuxia quadriseta	Reed Bent-grass		N			
Dianella brevicaulis	Short-stem Flax-lily	Coast Flax-lily				
Dianella brevicaulis/revoluta var.	Black-anther Flax-lily	Spreading Flax-lily				
Dianella longifolia var. grandis	Pale Flax-lily	Yellow-anther Flax-lily	R			R
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily				
Dianella revoluta(NC)						
Dichelachne crinita	Long-hair Plume-grass		N			
Dichondra repens	Kidney Weed	Tom Thumb				
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	N			
Dillwynia sp.	Parrot-pea					
Dipodium punctatum(NC)	Hyacinth Orchid	Spotted Orchid				
Dipodium sp.	Hyacinth Orchid					
Diuris aff. corymbosa	Wallflower Donkey-orchid	Bulldogs	N			
Diuris brevifolia	Short-leaf Donkey-orchid	Late Donkey-orchid	R	3RCa		R
Diuris longifolia(NC)	Bulldogs	Wall-flower Orchid				
Diuris sp.	Donkey Orchid					
Dodonaea sp.	Hop-bush					
Dodonaea viscosa ssp.	Sticky Hop-bush					
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Spoon-leaf Hop-bush				
Drosera auriculata	Tall Sundew	Errienellam	N			
Drosera macrantha ssp. planchonii	Climbing Sundew					
Drosera peltata	Pale Sundew		N			
Drosera sp.	Sundew					
Drosera whittakeri(NC)	Scented Sundew	Whittaker's Sundew				
Epacris impressa	Common Heath	Heath	N			
Epilobium billardierianum ssp. billardierianum	Robust Willow-herb	Smooth Willow-herb	N			
Epilobium billardierianum ssp. cinereum	Variable Willow-herb		N			
Eriochilus cucullatus	Parson's Bands		N			
Eucalyptus baxteri	Brown Stringybark	Baxter's Stringybark	N			
Eucalyptus camaldulensis var. camaldulensis	River Red Gum	Red Gum	N			
Eucalyptus cosmophylla	Cup Gum	Bog Gum				
Eucalyptus fasciculosa	Pink Gum	Hill Gum	N			
Eucalyptus foecunda(NC)	Narrow-leaved Mallee	Slender-leaved Red Mallee				
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		N			
Eucalyptus obliqua	Messmate Stringybark	Stringybark	N			
Eucalyptus obliqua var. obliqua(NC)	Messmate Stringybark	Stringybark				
Eucalyptus obliqua var.(NC)	Messmate Stringybark					
Eucalyptus viminalis ssp. cygnetensis	Rough-bark Manna Gum		N			
Eucalyptus viminalis ssp. viminalis	Manna Gum	Ribbon Gum	R			R
Euchiton gymnocephalus	Creeping Cudweed					
Euchiton sp.	Cudweed					
Euphrasia collina ssp. osbornii	Osborn's Eyebright		E	3EC-	E	E
Exocarpos cupressiformis	Native Cherry	Cherry Ballart	N			
Gahnia sieberiana	Red-fruit Cutting-grass	Red-fruit Saw-sedge	U			
Galium gaudichaudii	Rough Bedstraw		N			
Genoplesium rufum	Red Midge-orchid	Dark Midge-orchid	N			
Geranium retrorsum	Grassland Geranium	Grassland Crane's-bill				
Geranium solanderi var. solanderi	Austral Geranium	Australian Crane's-bill				
Geranium sp.	Geranium	Crane's-bill				
Glossodia major	Purple Cockatoo	Wax-lip Orchid	N			
Glycine clandestina var. sericea	Twining Glycine		N			
Glycine latrobeana	Clover Glycine		V	3VCa	V	V
Gnaphalium sp.	Cudweed					
Gnaphalium sp.(NC)						
Gompholobium ecostatum	Dwarf Wedge-pea		N			
Gonocarpus mezianus	Broad-leaf Raspwort	Hairy Raspwort	N			
Gonocarpus sp.	Raspwort					
Gonocarpus tetragynus	Small-leaf Raspwort	Common Raspwort				
Goodenia amplexans	Clasping Goodenia		U			
Goodenia blackiana	Native Primrose	Black's Goodenia	N			
Goodenia geniculata	Bent Goodenia	Native Primrose	N			
Goodenia ovata	Hop Goodenia		N			
Goodenia sp.	Goodenia					
Goodenia varia	Sticky Goodenia		N			
Goodia medicaginea	Western Golden-tip	Golden-tip				
Gratiola peruviana	Austral Brooklime		N			
Grevillea lavandulacea var.	Spider-flower	Heath Grevillea				
Grevillea lavandulacea var. lavandulacea	Spider-flower	Heath Grevillea				
Grevillea lavandulacea var. sericea	Spider-flower	Heath Grevillea	U			
Hakea carinata	Erect Hakea		N			
Hakea rostrata	Beaked Hakea	Turkey Gobblers	N			
Hakea rugosa	Dwarf Hakea	Wrinkled Hakea	N			
Haloragis sp.	Raspwort					
Helichrysum scorpioides	Button Everlasting		N			
Hibbertia aspera(NC)						
Hibbertia exutiacies	Prickly Guinea-flower	Spiky Guinea-flower	N			
Hibbertia riparia	Guinea-flower					
Hibbertia riparia (glabriuscula)	Smooth Guinea-flower					
Hibbertia riparia (long-leaved aff. H. stricta)	Bristly Guinea-flower		N			

Pink Gum Woodland Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	SA	AUS	Conservation Significance ENDANGERED SPECIES ACT	NPW ACT
Hibbertia sericea var. sericea	Silky Guinea-flower					
Hibbertia sp.	Guinea-flower					
Hibbertia sp. B	Scrambling Guinea-flower		N			
Hibbertia stricta var. stricta	Stalked Guinea-flower	Erect Guinea-flower				
Hyalosperma demissum	Dwarf Sunray	Moss Sunray	N			
Hydrocotyle callicarpa	Tiny Pennywort	Small Pennywort	N			
Hydrocotyle capillaris	Thread Pennywort		N			
Hydrocotyle hirta	Hairy Pennywort		U			
Hypericum gramineum	Small St John's Wort		N			
Hypoxis vaginata var. vaginata	Yellow Star	Sheath Star	N			
Indigofera australis var. australis	Austral Indigo	Hill Indigo	N			
Isolepis cernua	Nodding Club-rush	Low Club-rush	N			
Isolepis inundata(NC)	Swamp Club-rush					
Isolepis marginata	Little Club-rush	Coarse Club-rush	N			
Isopogon ceratophyllus	Horny Cone-bush	Cone-bush	N			
Ixodia achillaeoides ssp.	Ixodia					
Ixodia achillaeoides ssp. alata	Hills Daisy	Winged Ixodia	N			
Juncus caespiticius	Grassy Rush		N			
Juncus holoschoenus	Joint-leaf Rush		N			
Juncus pallidus	Pale Rush					
Juncus pauciflorus	Loose-flower Rush					
Juncus sp.	Rush					
Juncus subsecundus	Finger Rush		N			
Kennedia prostrata	Scarlet Runner	Running Postman	N			
Lagenifera huegelii	Coarse Bottle-daisy	Coarse Lagenifera	N			
Lasiopetalum baueri	Slender Velvet-bush		N			
Laxmannia sessiliflora(NC)	Dwarf Wire-lily					
Lepidosperma carphoides	Black Rapier-sedge		N			
Lepidosperma curtisiae	Little Sword-sedge		N			
Lepidosperma longitudinale	Pithy Sword-sedge	Swamp Sword-sedge	N			
Lepidosperma semiteres	Wire Rapier-sedge		N			
Lepidosperma sp.	Sword-sedge/Rapier-sedge					
Lepidosperma viscidum	Sticky Sword-sedge					
Leporella fimbriata	Fringed Hare-orchid		N			
Leptoceras menziesii	Hare Orchid	Rabbit Orchid	N			
Leptorhynchos squamatus	Scaly Buttons		N			
Leptospermum continentale	Prickly Tea-tree					
Leptospermum lanigerum	Silky Tea-tree	Woolly Tea-tree	N			
Leptospermum myrsinoides	Heath Tea-tree					
Leucopogon australis	Spike Beard-heath					
Leucopogon concurvus	Scrambling Beard-heath					
Leucopogon lanceolatus	Lance Beard-heath		U			
Leucopogon parviflorus	Coast Beard-heath					
Leucopogon virgatus	Common Beard-heath		N			
Levenhookia pusilla	Tiny Stylewort	Midget Stylewort				
Lobelia gibbosa	Tall Lobelia	False Orchid				
Lomandra densiflora	Soft Tussock Mat-rush	Pointed Mat-rush	N			
Lomandra fibrata	Mount Lofty Mat-rush	Fine Mat-rush	N			
Lomandra micrantha ssp.	Small-flower Mat-rush					
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		N			
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	N			
Lomandra nana	Small Mat-rush	Soft Mat-rush	N			
Lomandra sororia	Sword Mat-rush	Small Mat-rush	U			
Lotus australis	Austral Trefoil	Australian Trefoil	N			
Luzula meridionalis	Common Wood-rush		N			
Luzula ovata	Clustered Wood-rush	Oval Wood-rush	R			R
Lysiana exocarpi ssp. exocarpi	Harlequin Mistletoe	Ngan#tja				
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle				
Melaleuca lanceolata ssp. lanceolata	Dryland Tea-tree	Black Tea-tree	N			
Micrantheum demissum	Dwarf Micrantheum		N			
Microlaena stipoides var. stipoides	Weeping Rice-grass	Weeping Grass	N			
Microseris lanceolata	Yam Daisy	Native Yam				
Microtis parviflora	Slender Onion-orchid		U			
Microtis sp.	Onion-orchid					
Microtis unifolia	Common Onion-orchid		N			
Microtis unifolia complex	Onion-orchid					
Millotia tenuifolia var. tenuifolia	Soft Millotia		N			
Mitrasacme paradoxa(NC)	Wiry Mitrewort					
Myoporum viscosum	Sticky Boobialla		U			
Neurachne alopecuroidea	Fox-tail Mulga-grass		N			
Olearia grandiflora	Mount Lofty Daisy-bush		U			
Olearia ramulosa	Twiggy Daisy-bush		N			
Opercularia sp.	Stinkweed					
Opercularia turpis	Twiggy Stinkweed		N			
Opercularia varia	Variable Stinkweed		N			
Oxalis perennans	Native Sorrel	Native Oxalis				
Oxalis sp.	Sorrel					
Pelargonium australe	Australian Pelargonium	Austral Storks-bill	N			
Pelargonium littorale	Native Pelargonium	Native Storks-bill				
Persicaria decipiens	Slender Knotweed		N			
Persoonia juniperina	Prickly Geebung	Geebung	N			
Phragmites australis	Common Reed	Bamboo Reed				
Phyllanthus australis	Southern Spurge	Pointed Spurge	N			
Phyllota remota	Slender Phyllota		U			
Pimelea glauca	Smooth Riceflower					
Pimelea humilis	Low Riceflower	Common Riceflower	N			
Pimelea linifolia ssp. linifolia	Slender Riceflower		N			
Pimelea micrantha	Silky Riceflower	Curved Riceflower	N			
Pimelea octophylla	Woolly Riceflower	Downy Riceflower				

Pink Gum Woodland Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	SA	AUS	ENDANGERED SPECIES ACT	NPW ACT
					Conservation Significance	
Pimelea phylicoides	Heath Riceflower		N			
Pimelea sp.	Riceflower					
Plantago hispida	Hairy Plantain		N			
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	N			
Platysace heterophylla var.	Slender Platysace					
Platysace heterophylla var. heterophylla	Slender Platysace	Corn Parsley	N			
Pleurosorus rutifolius	Blanket Fern		N			
Poa clelandii	Matted Tussock-grass	Cleland's Poa	N			
Poa labillardieri var. labillardieri	Common Tussock-grass	Tussock Poa				
Poa poiformis	Coast Tussock-grass	Blue Tussock-grass	N			
Poa sp.	Meadow-grass/Tussock-grass	Poa				
Pomaderris paniculosa ssp. paniculosa	Mallee Pomaderris	Inland Pomaderris	N			
Poranthera microphylla	Small Poranthera	Small-leaf Poranthera	N			
Prostanthera chlorantha	Green Mintbush		R	R		R
Pseudanthus micranthus	Fringed Pseudanthus		R	2RCa		R
Pteridium esculentum	Bracken Fern	Austral Bracken	N			
Pterostylis curta	Blunt Greenhood		R			R
Pterostylis foliata	Slender Greenhood		R			R
Pterostylis nana	Dwarf Greenhood					
Pterostylis nutans	Nodding Greenhood	Parrot's Beak Orchid	N			
Pterostylis pedunculata	Maroon-hood		N			
Pterostylis plumosa	Bearded Greenhood		N			
Pterostylis sp.	Greenhood					
Pterostylis sp.(NC)						
Pterostylis vittata(NC)	Banded Greenhood					
Pultenaea acerosa	Bristly Bush-pea		N			
Pultenaea canaliculata var.	Soft Bush-pea	Coast Bush-pea	U			
Pultenaea canaliculata var. canaliculata	Soft Bush-pea	Coast Bush-pea				
Pultenaea daphnoides	Large-leaf Bush Pea		N			
Pultenaea involucrata	Mount Lofty Bush-pea		U	R		
Pultenaea largiflorens	Twiggy Bush-pea		N			
Pultenaea pedunculata	Matted Bush-pea		N			
Pyrorchis nigricans	Black Fire-orchid	Red-beak Orchid	N			
Ranunculus lappaceus	Native Buttercup	Australian Buttercup	N			
Ranunculus sp.	Buttercup					
Rubus parvifolius	Native Raspberry	Small-leaf Bramble	U			
Rumex sp.	Dock					
Rutidosis multiflora	Small Wrinklewort					
Samolus repens	Creeping Brookweed	Creeping Samolus	N			
Scaevola albida	Pale Fanflower	Small-fruit Fanflower				
Scaevola albida var. albida	Pale Fanflower	Small-fruit Fanflower				
Scaevola albida var.(NC)						
Schoenus apogon	Common Bog-rush	Common Bog-sedge	N			
Schoenus breviculmis	Matted Bog-rush	Moss Bog-rush	N			
Scutellaria humilis	Dwarf Skullcap	Skullcap	R			R
Senecio glomeratus	Swamp Groundsel	Toothed Groundsel	N			
Senecio hispidulus var.	Rough Groundsel	Hispid Fireweed				
Senecio lautus	Variable Groundsel	Elegant Yellow-top				
Senecio odoratus var.	Scented Groundsel					
Senecio odoratus var. obtusifolius	Broad-leaf Scented Groundsel		V			V
Senecio odoratus var. odoratus	Scented Groundsel		N			
Senecio quadridentatus	Cotton Groundsel	Cotton Fireweed	N			
Senecio sp.	Groundsel	Fireweed				
Senecio squarrosus	Squarrose Groundsel	Leafy Fireweed	N			
Senecio tenuiflorus	Woodland Groundsel	Narrow Groundsel	N			
Spyridium coactilifolium	Butterfly Spyridium		V	2VCa	V	V
Spyridium thymifolium	Thyme-leaf Spyridium		N			
Stackhousia aspericocca ssp.	Bushy Candles	Rough Candles				
Stackhousia aspericocca ssp. "Cylindrical inflorescence"(W.R.Barker 1418)	Bushy Candles	Rough Candles	N			
Stellaria palustris var.	Swamp Starwort					
Stipa mollis	Soft Spear-grass	Supple Spear-grass	N			
Stipa semibarbata	Fibrous Spear-grass		N			
Stipa sp.	Spear-grass					
Stylidium graminifolium	Grass Trigger-plant		N			
Styphelia exarrhena	Desert Heath	Beard-heath Styphelia	N			
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells	Pink-eyed Susan	N			
Thelymitra antennifera	Lemon Sun-orchid	Rabbit-ears				
Thelymitra benthamiana	Leopard Sun-orchid	Blotched Sun-orchid	U			
Thelymitra ixioides	Spotted Sun-orchid	Dotted Sun-orchid				
Thelymitra nuda	Scented Sun-orchid	Plain Sun-orchid				
Thelymitra pauciflora	Slender Sun-orchid		N			
Thelymitra rubra	Salmon Sun-orchid	Pink Sun-orchid	N			
Thelymitra sp.	Sun-orchid					
Themeda triandra	Kangaroo Grass	Ilintji	N			
Thomasia petalocalyx	Paper-flower		N			
Thysanotus juncifolius	Rush Fringe-lily		N			
Thysanotus patersonii	Twining Fringe-lily					
Tricoryne elatior	Yellow Rush-lily		N			
Triglochin procerum	Water-ribbons		N			
Triglochin striatum	Streaked Arrowgrass		N			
Villarsia umbricola var. umbricola	Lax Marsh-flower		U			
Viola hederacea	Ivy-leaf Violet		N			
Viola sieberiana	Tiny Violet	Sieber's Violet	N			
Viola sp.	Violet					
Wahlenbergia gracilenta	Annual Bluebell					
Wahlenbergia sp.	Native Bluebell					
Wahlenbergia stricta ssp. stricta	Tall Bluebell					
Wurmbea dioica ssp. dioica	Early Nancy	Early Star-lily	N			

Pink Gum Woodland Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	SA	AUS	Conservation Significance ENDANGERED SPECIES ACT	NPW ACT
Xanthorrhoea semiplana ssp.	Yacca	Flat-leaf Grass-tree				
Xanthorrhoea semiplana ssp. semiplana	Yacca	Flat-leaf Grass-tree	N			
Xanthorrhoea semiplana ssp. tateana	Tate's Grass-tree		N			
Xanthosia pusilla	Hairy Xanthosia	Heath Xanthosia	N			

SA Conservation Significance (National Parks and Wildlife Act 1972) and
Australian Conervation Significance (Environment Protection and Biodiversity Conservation Act 1999)
Endangered Species Act
National Parks and Wildlifw Act 1972

Blue Gum Woodland Species List (DEH survey data)

SPECIES	COMMON NAME 1	COMMON NAME 2	Conservation Significance SA	AUS	ENDANGERED SPECIES ACT	NPW ACT
Acacia longifolia var.	Sallow Wattle					
Acacia myrtifolia var.	Myrtle Wattle	Scrub Wattle				
Acacia myrtifolia var. myrtifolia	Myrtle Wattle	Scrub Wattle	N			
Acacia myrtifolia(NC)	Myrtle Wattle	Bitter Leaf Wattle				
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle				
Acacia pycnantha	Golden Wattle					
Acaena echinata var.	Sheep's Burr					
Acrotriche depressa	Native Currant	Wiry Ground-berry	U			
Acrotriche serrulata	Cushion Ground-berry	Honeypots	N			
Agrostis avenacea var.	Common Blown-grass	Fairy Grass				
Agrostis sp.	Blown-grass/Bent Grass					
Allocasuarina muelleriana ssp.	Common Oak-bush	Slaty Oak-bush				
Allocasuarina pusilla	Dwarf Oak-bush	Heath Oak-bush	N			
Allocasuarina striata	Stalked Oak-bush	Tall Oak-bush				
Allocasuarina verticillata	Drooping Sheoak					
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	N			
Astroloma conostephioides	Flame Heath		N			
Astroloma humifusum	Cranberry Heath	Native Cranberry	N			
Billardiera cymosa	Sweet Apple-berry					
Bursaria spinosa	Sweet Bursaria	South Australian Christmas Bush				
Bursaria spinosa var. macrophylla(NC)	Sweet Bursaria	Native Blackthorn				
Caesia calliantha	Blue Grass-lily		N			
Cassinia laevis	Curry Bush	Cough Bush	N			
Cassinia uncata	Sticky Cassinia		N			
Cassytha glabella forma dispar	Slender Dodder-laurel	Tangled Dodder-laurel	N			
Cassytha pubescens	Downy Dodder-laurel		N			
Chamaescilla corymbosa var. corymbosa	Blue Squill	Blue Stars	N			
Cheilanthes austrotenuifolia	Annual Rock-fern	Green Rock-fern	N			
Chrysocephalum apiculatum	Common Everlasting	Small Yellow Button				
Clematis microphylla	Old Man's Beard	Small-leaf Clematis				
Correa reflexa	Common Correa					
Correa schlechtendalii	Mallee Correa	Narrow-bell Correa				
Dampiera dysantha	Shrubby Dampiera					
Danthonia geniculata	Kneed Wallaby-grass		N			
Danthonia setacea var. setacea	Small-flower Wallaby-grass	Bristly Wallaby-grass				
Danthonia sp.	Wallaby-grass					
Deyeuxia quadriseta	Reed Bent-grass		N			
Dianella brevicaulis/revoluta var.	Black-anther Flax-lily	Spreading Flax-lily				
Dianella revoluta var.						
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily				
Dichondra repens	Kidney Weed	Tom Thumb				
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	N			
Diuris pardina	Spotted Donkey-orchid	Common Donkey-orchid	N			
Drosera auriculata	Tall Sundew	Errienellam	N			
Drosera macrantha ssp. planchonii	Climbing Sundew					
Drosera whittakeri ssp.						
Elymus scabrus var. scabrus	Native Wheat-grass	Common Wheat-grass	N			
Eucalyptus cosmophylla	Cup Gum	Bog Gum				
Eucalyptus fasciculosa	Pink Gum	Hill Gum	N			
Eucalyptus leptophylla	Narrow-leaf Red Mallee		N			
Eucalyptus leucoxylon ssp.	South Australian Blue Gum	Yellow Gum				
Eucalyptus leucoxylon(NC)	South Australian Blue Gum	Yellow Gum				
Eutaxia sp.	Eutaxia	Eggs-and-bacon				
Exocarpos cupressiformis	Native Cherry	Cherry Ballart	N			
Geranium sp.	Geranium	Crane's-bill				
Gonocarpus elatus	Hill Raspwort	Tall Raspwort				
Gonocarpus mezianus	Broad-leaf Raspwort	Hairy Raspwort	N			
Goodenia blackiana	Native Primrose	Black's Goodenia	N			
Goodenia ovata	Hop Goodenia		N			
Goodenia varia	Sticky Goodenia		N			
Grevillea lavandulacea var.	Spider-flower	Heath Grevillea				
Hakea rostrata	Beaked Hakea	Turkey Gobblers	N			
Hakea rugosa	Dwarf Hakea	Wrinkled Hakea	N			
Hardenbergia violacea	Native Lilac	Purple Coral-pea	N			
Hibbertia exutiacies	Prickly Guinea-flower	Spiky Guinea-flower	N			
Hibbertia riparia	Guinea-flower					
Hibbertia riparia (glabriuscula)	Smooth Guinea-flower					
Hibbertia sericea var.	Silky Guinea-flower					
Isopogon ceratophyllus	Horny Cone-bush	Cone-bush	N			
Kennedia prostrata	Scarlet Runner	Running Postman	N			
Lepidosperma carphoides	Black Rapier-sedge		N			
Lepidosperma curtisiae	Little Sword-sedge		N			
Lepidosperma semiteres	Wire Rapier-sedge		N			
Lepidosperma viscidum	Sticky Sword-sedge					
Leucopogon virgatus	Common Beard-heath		N			
Levenhookia pusilla	Tiny Stylewort	Midget Stylewort				
Lomandra densiflora	Soft Tussock Mat-rush	Pointed Mat-rush	N			
Lomandra fibrata	Mount Lofty Mat-rush	Fine Mat-rush	N			
Lomandra micrantha ssp.	Small-flower Mat-rush					

Blue Gum Woodland Species List

SPECIES	COMMON NAME 1	COMMON NAME 2	Conservation Significance SA	AUS	ENDANGERED SPECIES ACT	NPW ACT
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		N			
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	N			
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle				
Microlaena stipoides var. stipoides	Weeping Rice-grass	Weeping Grass	N			
Mitrasacme paradoxa(NC)	Wiry Mitrewort					
Moss sp.						
Muehlenbeckia adpressa	Climbing Lignum	Native Sarsparilla				
Olearia pannosa ssp. pannosa	Silver Daisy-bush		V	3VCa	V	V
Olearia ramulosa	Twiggy Daisy-bush		N			
Olearia sp.	Daisy-bush					
Opercularia turpis	Twiggy Stinkweed		N			
Oxalis perennans	Native Sorrel	Native Oxalis				
Phyllanthus australis	Southern Spurge	Pointed Spurge	N			
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	N			
Poa sp.	Meadow-grass/Tussock-grass	Poa				
Pseudanthus micranthus	Fringed Pseudanthus		R	2RCa		R
Pultenaea canaliculata var.	Soft Bush-pea	Coast Bush-pea	U			
Pultenaea scabra	Rough Bush-pea		R			R
Pultenaea trinervis	Three-nerve Bush-pea		N	N		
Scaevola linearis ssp.	Rough Fanflower					
Schoenus apogon	Common Bog-rush	Common Bog-sedge	N			
Schoenus breviculmis	Matted Bog-rush	Moss Bog-rush	N			
Stackhousia aspericocca(NC)						
Stipa mollis	Soft Spear-grass	Supple Spear-grass	N			
Stipa semibarbata	Fibrous Spear-grass		N			
Stipa sp.	Spear-grass					
Thelymitra pauciflora	Slender Sun-orchid		N			
Themeda triandra	Kangaroo Grass	Ilintji	N			
Wahlenbergia luteola	Yellow-wash Bluebell	Yellowish Bluebell	N			
Xanthorrhoea semiplana ssp.	Yacca	Flat-leaf Grass-tree				
Xanthorrhoea semiplana ssp. tateana	Tate's Grass-tree		N			

Red Gum Woodland Species List (DEH survey data)

SPECIES	COMMON NAME 1	COMMON NAME 2	Conservation Significance SA	AUS	ENDANGERED SPECIES ACT	NPW ACT
Alternanthera denticulata	Lesser Joyweed		N			
Cheilanthes austrotenuifolia	Annual Rock-fern	Green Rock-fern	N			
Clematis microphylla	Old Man's Beard	Small-leaf Clematis				
Cyperus vaginatus	Stiff Flat-sedge	Puta-puta	N			
Dichondra repens	Kidney Weed	Tom Thumb				
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Spoon-leaf Hop-bush				
Eucalyptus camaldulensis var.	River Red Gum					
Eucalyptus leucoxylon(NC)	South Australian Blue Gum	Yellow Gum				
Isolepis nodosa	Knobby Club-rush	Knobby Club-sedge	N			
Juncus kraussii	Sea Rush		N			
Leptospermum lanigerum	Silky Tea-tree	Woolly Tea-tree	N			
Melaleuca brevifolia	Short-leaf Honey-myrtle	Swamp Honey-myrtle	N			
Mimulus repens	Creeping Monkey-flower		N			
Phragmites australis	Common Reed	Bamboo Reed				
Pteridium esculentum	Bracken Fern	Austral Bracken	N			
Senecio sp.	Groundsel	Fireweed				
Triglochin procerum var. procerum(NC)	Water-ribbons					
Typha domingensis	Narrow-leaf Bulrush	Narrow-leaf Cumbungi	N			
Xanthorrhoea semiplana ssp. tateana	Tate's Grass-tree		N			

III Conservation Status Codes

General Table
Key to South Australian (SA) Conservation Status Codes

Status Code	Status Type	Description
X	Extinct/ presumed extinct	Not located despite thorough searching of all known and likely habitats;known to have been eliminated by the loss of localised population(s); or not recorded for more than 50 years from an area where substantial habitat modification has occurred.
E	Endangered	Rare and in danger of becoming extinct in the wild.
V	Vunerable	Rare and at risk from potential of long term threats which could cause the species to become endangered in the future.
T	Threatened	Likely to be either Endangered or Vunerable but insufficient data for a more precise assessment.
R	Rare	Having low overall frequency of occurrence: confined to a restricted range or scatterred sparsely over a wider area. Not currently exposed to significant threats, but warranting monitoring and protective measures to prevent reduction of population sizes.
K	Uncertain	Likely to be either Threatened or Rare but insufficient data for a more precise assessment.
U	Uncommon	Less common species of interest but not rare enough to warrant special protective measures.
Q	Not assessed	Not officially assessed but likely to be of significance.
N	Common	

Key to Australian (AUST) Conservation Status Codes
Briggs, J (1996) "Rare or threatened Australian Plants, 1995 revised edition"

Conservation Codes

X	Presumed extinct	Species that have either not been found in recent years despite thorough searching, or have not been collected for at least 50 years and were known only from intensively settled areas.
E	Endangered	In serious risk of disappearing from the wild state within one or two decades if present land use and other casual factors continue to operate.
V	Vunerable	Not presently Endangered but at risk of disappearing from the wild over a longer period (20-50 years), or which largely occur on sites likely to experience changes in land use that would threaten the survival of the species in the wild.
R	Rare	Species which are rare in Australia but whichb overall are not considered Endangered or Vunerable. Such species may be represented by a relatively large population in a very restricted area, or by smaller populations spread over a wider range or some intermediate combination of distribution pattern.
K	Poorly known	Species that are suspected, but not definitely known, to belong to any of the above categories.

Distribution Codes

1	Species known from type collection or from a single known location.
2	Species with a very restricted distribution in Australia and with a maximum geographic range of less than 100 km.
3	Species with a range of at least 100km but occurring only in small populations (often restricted to highly specific and localised habitats.

Reservation Categories

C	Known to be present within a national park or other conservation reserve.
a	Adequately reserved with a total of at least 1000 plants known to occur in reserves.
i	Inadequately reserved with a total of less than 1000 plants in reserves.
t	Total known populations are in reserves.

APPENDIX 3. PROTECTED SWAMPS OF THE SOUTHERN FLEURIEU

1. *Characteristics of the Fleurieu Peninsula Swamps*

(pers. comm. Rebecca Duffield, Mt Lofty Ranges Southern Emu-wren Recovery Program [MLRSEWRP], Feb 2004)

Fleurieu Peninsula (FP) swamps are mostly small areas in the landscape that can be found where the soil is waterlogged. A swamp does not usually have large areas of open water. There are many types of FP swamps with each having its own unique mix of soil types, water regimes, wetting and drying patterns, landforms and vegetation influenced by underlying rocks.

Because swamps vary so much in species composition, structural diversity, soil type, water source and landform element there are different “types” of FP swamps that can be defined as satisfying **some or all** of the below criteria:

Geographical

- Localised wetland areas.
- Occurring in high rainfall areas between 700-950mm and/or approximately 600mm on the lower lands.
- Within the IBRA (Interim Biogeographic Regionalisation for Australia) regions of Kanmantoo and Flinders Lofty (formerly Lofty Block) and Murray Darling Depression.
- Occurs in the local government areas of DC Onkaparinga, DC Alexandrina, DC Victor Harbor, DC Yankalilla.

Biological

- Densely vegetated at one or more layers.
- Vegetation formations usually dense shrublands, sedgelands and reedlands with fern habitats in association or independent.
- Structurally diverse with eleven vegetation formations identified from MLRSEW biological surveys – including:
  - *Leptospermum lanigerum* shrubland with sedge understorey
  - *Leptospermum lanigerum* shrubland with sedge and fern understorey
  - *Leptospermum continentale* shrubland with sedge understorey
  - *Leptospermum continentale* shrubland with sedge and fern understorey
  - *Leptospermum continentale/Sprengelia incarnata* shrubland with sedge understorey
  - Mixed *Leptospermum* shrubland with emergent *Viminaria juncea* or *Acacia retinodes* and sedge understorey
  - *Melalueca decussata* shrubland with sedge understorey
  - *Leptospermum continentale/Viminaria juncea* shrubland with sedge understorey
  - *Leptospermum continentale/Melaleuca squamea* shrubland with sedge understorey
  - Mixed sedgeland (e.g. Lignum – *Muehlenbeckia florulenta*)

- *Phragmites* and/or *Typha* grassland with emergent *Viminaria juncea, Acacia retinodes* and sedge understorey

  In addition to these, other shrublands, sedgelands, reedlands and fern habitats with single or several species (see characteristic vegetation below) dominating the strata may also constitute a FP swamp.

- Characteristic vegetation species. Dominant or co-dominant overstorey species include the sclerophyllous shrubs *Leptospermum continentale*, *Leptospermum lanigerum*, *Melaleuca squamea*, *Melaleuca decussata*, *Sprengelia incarnata* and *Acacia retinodes* var. *retinodes* and *Viminaria junce*a. *Viminaria juncea* and *A.retinodes* var *retinodes* can also be present as an emergent species rather than dominant overstorey. Dominant understorey species are typically sedge and rush genera such as *Baumea*, *Juncus, Eleocharis*, *Leptospermum*, *Empodisma* and *Gahnia* species and ferns *Gleichenia microphylla*, *Blechnum minus* and *Pteridium esculentum.*

Physical

- Freshwater and rarely saline, however becoming slighty brackish towards the end of summer.
- Typically occurring on peat bog, silt, silty-peat or black clay soils.
- Are fed by run off and/or groundwater.
- Occurring in the major catchments of Tookayerta, Hindmarsh, Myponga River, Yankalilla (that consists of a variety of smaller catchments including the Anacotilla and Congeratinga Rivers and Carrickalinga Creek), Currency Ck and Finniss River, Inman River, Parawa (that consists of a variery of smaller catchments including Boat Harbour Creek, Bollaparudda Creek, Callawonga Creek, Coolawang Creek, Deep Creek, First Creek, Tapanappa Creek, Tunkalilla Creek, Waitpinga Creek).

2. Investigating salinity impacts on the Fleurieu Peninsula Swamps

Mapping of the swamps from aerial photography [performed by Claire Harding, Wetlands Project Officer, from the (SA) Department for Environment and Heritage (DEH)] has included an indicative condition score (intact, partially degraded, or degraded). While this mapping is yet to be ground-truthed and swamps are likely to be impacted upon by multiple sources of degradation, it is possible to gain insight into possible salinity impacts on the swamps. In the following figures, swamp locations are displayed against a background of mapped land and stream salinity and also salinity risk.

As shown in Figure A3.1, the majority of mapped swamps occur in areas of negligible salinity, however some swamps occur in drainage lines impacted by slight to moderate salinity. The swamps vary in condition across the landscape, however salinity may be causing negative impacts in some cases.

Figure A3.2 indicates some swamps are at moderate risk of increased salinisation if water tables rise.

Figure A3.1. Fleurieu swamps, land and stream salinity

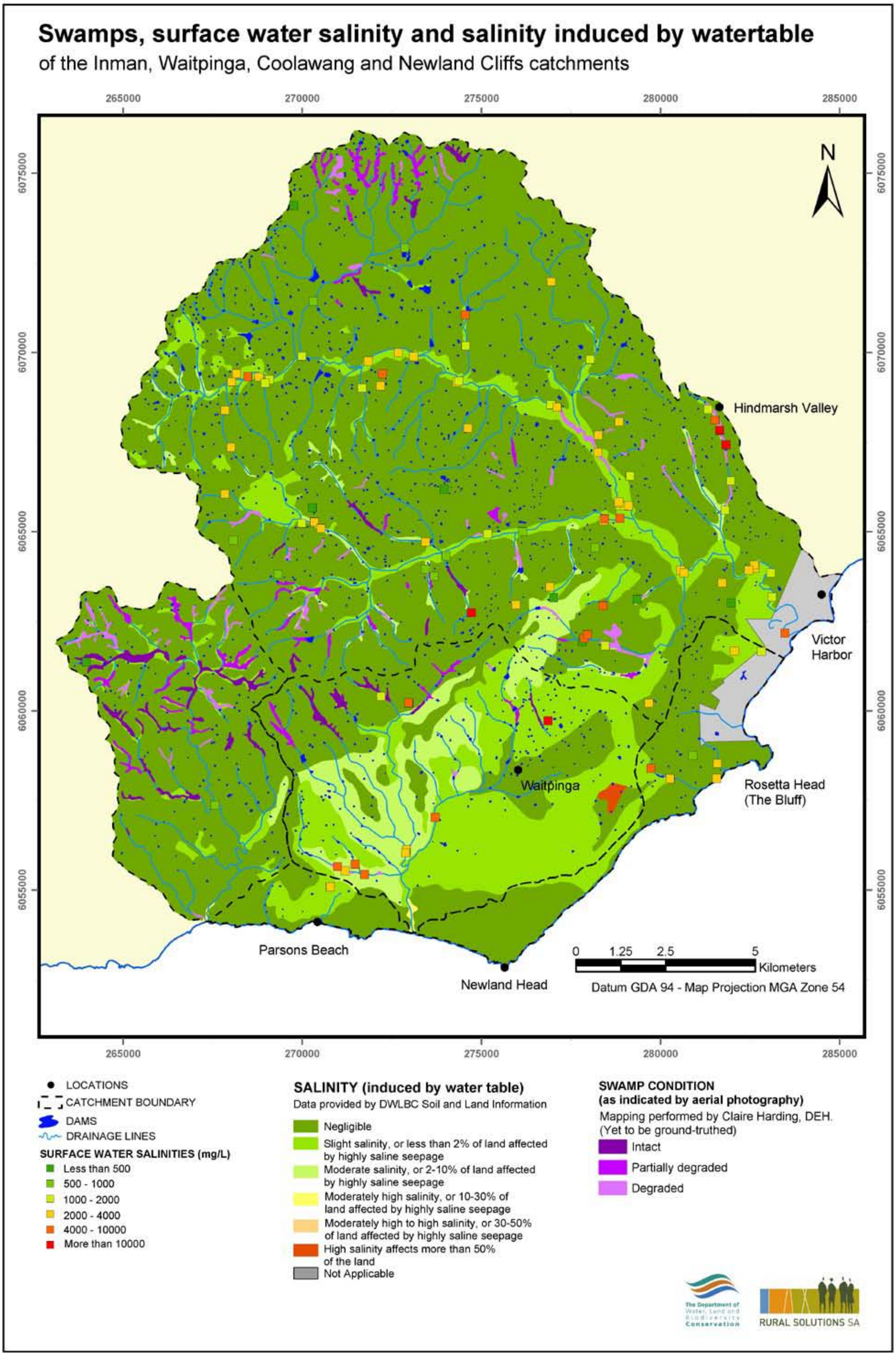
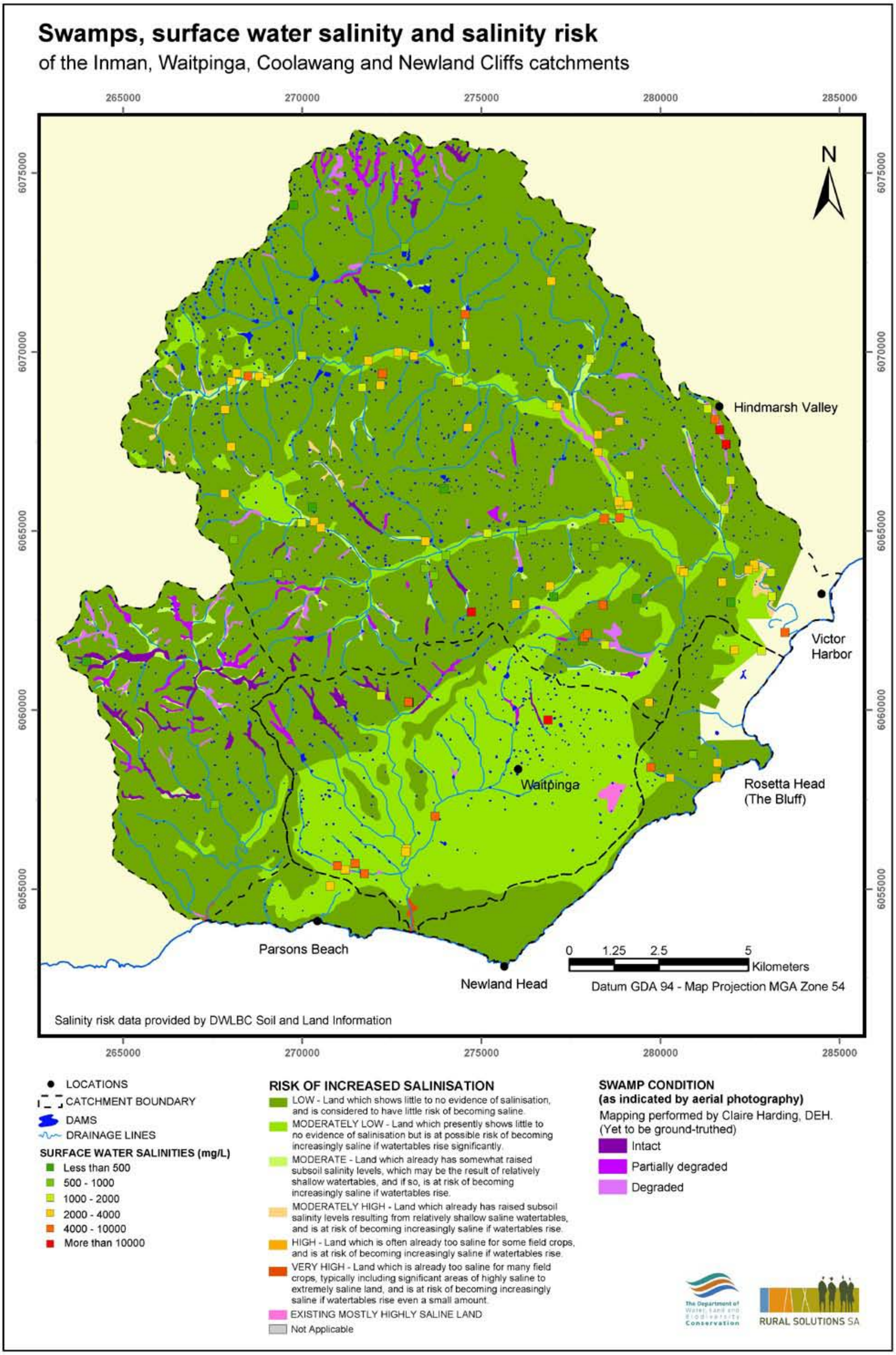
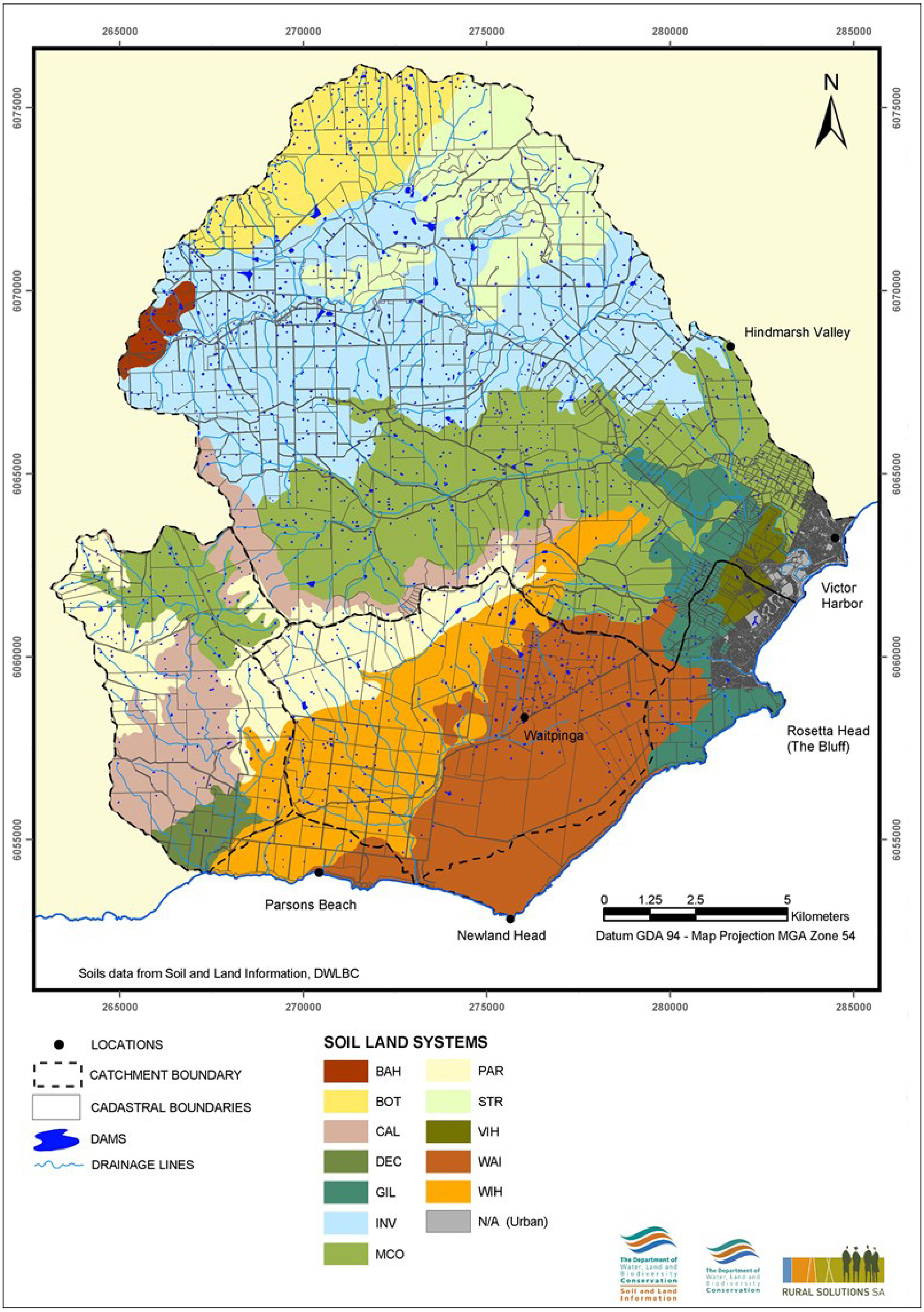


Figure A3.2. Fleurieu swamps and salinity risk



APPENDIX 4. SOIL LAND SYSTEMS



Soil Land Systems Descriptions (Adapted from PIRSA Land Information, 2001)

BAH (Bald Hills Land System)
This land system is characterised by low rolling hills with mainly clayey sediments in the Yankalilla to Torrens Vale area. Dissection by watercourses has carved the present day topography out of the thick sedimentary beds, thought to have been deposited within ancient glacial valleys of Permian age. These water courses mostly flow to the northwest into the Bungala River, with minor drainage to the northeast into the Inman. Many of the clays are morphologically similar to the Hindmarsh Clay of the Adelaide Plains. Predominant clayey soils are associated with sandy loam and some sandy texture contrast soils. Grey and black clays occur. Greyer types are poorly structured, moderately fertile and generally acidic. Black types are well structured (self-mulching surfaces), highly fertile, and alkaline. The texture contrast soils are imperfectly drained with low to moderate fertility. Moderate slopes (as low as 12%) are unstable and susceptible to landslip. Gentler slopes are commonly cropped while steeper slopes are mainly used for grazing. Limited sampling of watercourses in this land system has detected saline baseflow to streams (up to 9 dS/m) which contributes to elevated salinity levels in the Bungala River.

BOT (Bob Tiers Land System)
This land system is a moderately steep to steep range of hills, between Yankalilla and Kuitpo, characterised by sandy loam texture contrast soils with friable clayey soils forming in weathering schists and gneisses of the Barossa Complex. Remnants of an old deeply weathered lateritised and kaolinised land surface occur as flat topped ridges, across the highest parts of the landscape. Except on steeper slopes where there are significant areas of shallow stony soils, profiles are generally moderately deep and adequately drained. Inherent fertility is low and soils are prone to acidification and erosion. There are minor lower slope and valley floor deposits of locally derived alluvium (clays, silts, sands and gravels).

CAL (Callawonga Land System)
Comprising moderately steep to steep slopes flanking the Parawa Plateau, this land is underlain by Kanmantoo Group metasandstone, metasiltstone, phyllite and low grade schist basement rocks. At the upslope margins, adjacent to the Parawa Land System), the rocks become increasingly deeply weathered and grade to lateritic materials. Slopes are deeply dissected by water courses flowing away from the plateau surface. Drainage depressions are often swampy. The majority of soils are moderately deep over weathering basement rock. Surface textures vary from sandy loams to clay loams, depending on the coarseness of the parent rock (metasandstones to metasiltstones). Subsoils are firm to friable, yellowish brown to red clay. Drainage is generally good, but some slightly sodic soils have impeded drainage. 90% of the land is too steep for cultivation, but there is scope for perennial horticulture and viticulture, where water is available and exposure is not a problem. Salinity is a potential problem in the east (towards Coolwang Creek catchment), where the underlying Tapanappa rocks often carry saline groundwater.

DEC (Deep Creek Land System)
The Deep Creek land system occurs in steep sea facing slopes along the southern coast of the Fleurieu Peninsula. The degree of dissection is such that there are negligible deep weathering remnants, and no significant alluvial deposits. Regularly spaced, deeply cut, south flowing water courses result in a pattern of razor back ridges, steep side slopes and narrow valleys. Underlying rocks are coarse to medium grained, giving rise to sandy loam to loam soils, sometimes with clayey subsoils but more often shallow and stony over rock. More than two thirds of the area is too steep for vehicular access, so light grazing

is the only feasible primary production option. Productive potential is also affected by extreme coastal exposure of much of the land. Consequently much of the land has remained under native vegetation.

GIL (Giles Land System)

Extending to the north from Rosetta Head, the Giles land system is mostly moderately steep to steep hill country with variable (often extensive) rocky outcrop. It is underlain by metamorphosed sedimentary rocks of the Kanmantoo Group. Most of the land is unarable due to excessive slopes or rocky outcrop. Of the arable land, most is sloping and characterized by red texture contrast soils. These have poorly structured sandy loam to loam surfaces, with clayey subsoils varying from well structured to dispersive. Soil drainage consequently varies from good to imperfect. Lower slopes and drainage depressions are minor overall and have deep but usually poorly structured soils prone to waterlogging. Erosion potential is moderate to high throughout the system.

INV (Inman Valley Land System)

Characterised by rolling low hills separated by creek flats up to a kilometre wide, this land system is contained within the broad deep valleys of ancient glaciers. Sediments associated with glaciation have been extensively eroded by streams which are still uncovering the old valleys. These eroding streams include the Hindmarsh, Inman, Boundy, Yankalilla, and Bungala Rivers, and Carrickalinga and Wattle Flat Creeks. Rolling low hills with mainly sandy to sandy loam soils with clay subsoils account for 75% of the area. The flats are dominated by sandy loam texture contrast soils with clayey subsoils. Slopes are prone to waterlogging caused by perched water on subsoil clays, and also have low fertility and are susceptible to acidification. Poor deep drainage on slopes has led to widespread landslips in the past. Alluvial flats are commonly limited by waterlogging, however there are large patches of moderately well drained fertile loamy soils with high productivity potential. Sporadic salinization is a locally important land management issue.

MCO (Mount Compass Land System)

Occurring in undulating to rolling low hills in the southern Inman catchment and Myponga catchment, this land system has predominantly sandy soils derived from clayey sands and sandy clays deposited under glacial and fluvio-glacial conditions during the Permian period. Ancient glacial valleys were largely filled with sediment, and later extensively lateritized. Isolated crests remain dotted throughout the landscape, containing remnant deep weathering profiles with ironstone, characteristic of the lateritic profile. Subsoils are variable, consisting of sandy clay, heavy clay or ironstone. On rising ground drainage is generally moderate to good, although wet areas occur. On low-lying areas, imperfect to poor drainage typically limits productivity, unless drains are installed.

PAR (Parawa Land System)

This land system occurs on a high plateau extending from Silverton (east of Cape Jervis) to Wilson Hill (west of Victor Harbor). The plateau is a remnant of an ancient lateritic high plain which has been progressively eroded away. The landscape is underlain by metamorphosed sandstones and siltstones of the Kanmantoo Group, which are commonly deeply weathered with a thick layer of kaolinitic material, sometimes containing massive laterites, and always with ironstone gravels. Locally derived outwash sediments have accumulated in drainage depressions (about 10% of the area). Gentle to moderate slopes grading away from the central spine account for almost 75% of the area and have deep, moderately fertile, adequately drained, acidic soils. Cool humid weather, high winter rainfall and exposure of much of the land to high winds mean that the land has limited potential uses other than supporting productive pastures. Deep ironstone soils are common on the crest of the plateau, and are imperfectly drained and highly leached.

Narrow creek flats flowing away from the crests are typically swampy. Although wet, there is little evidence of salinity.

STR (Strangways Land System)
Occurring in low hills in the Victor Harbor to Inman Valley area, this land system is underlain by strongly metamorphosed basement rocks (phyllites, schists, metasandstones and metasiltstones) of the Kanmantoo Group. During Tertiary times the whole region was a peneplain of low relief, on which extensive deep weathering and lateritization occurred. Following uplift of the ranges, most of this deep weathering surface has been eroded away, but remnants persist as summit surfaces. Localised deposits of unconsolidated alluvium derived from erosion of higher ground occur as valley fill. Gaps between blocks of hills were formed by glacial valleys. Soils vary from shallow stony sandy loams over basement rock to deeper sandy loam to loam texture contrast types. Variable soil depth can cause uneven pasture growth. Sandy loam over clay soils are prone to erosion. Deep variable soils, usually with sandy to sandy loam surfaces, occur on lower slopes and flats, where impeded drainage (due as much to topographic position as to clay subsoils) is common.

VIH (Victor Harbor Land System)
Underlain predominantly by clayey sediments derived from the basement rock ranges of adjacent land systems, this land system is characterised by gentle slopes with mainly sandy loam texture contrast soils in the Victor Harbor to Port Elliot area. Soils typically have hard setting surfaces and dispersive clayey subsoils, and waterlogging can be expected in wet seasons. About 25% of the area comprises undulating to moderately inclined rises with sandy surfaced soils over dispersive heavy clay subsoils. These are prone to waterlogging due to perching of water on the clay. Most of these soils are marginal for irrigation. Potentially the most productive soils (deep gradational clay loams) occur on the flats of the Hindmarsh River.

WAI (Waitpinga Land System)
The majority of this land is underlain by unconsolidated or weakly indurated sediments of indeterminate age. The Geological Survey of SA (Barker 1:250 000 sheet, 1962) maps the area as Permian age glacial and fluvio-glacial deposits, but the sediments are similar to Tertiary age sequences found in the Willunga basin. The landscape is undulating to gently rolling. Massive clayey sands to sandy clays, red yellow and grey in colour, often weakly indurated and associated with ironstone gravel, are typical of the rising ground. Sandy soils derived from these sediments have been extensively reworked into dunes of deep sand. Water courses draining the rising ground, at the coastal and inland margins, flow to a broad central flat where drainage is sluggish. Excess water flows from the western end of the depression into Waitpinga Creek which occupies a narrow valley, eventually discharging to the sea at Waitpinga Beach. On lower lying ground, heavy grey brown and yellow brown clays are typical. At the eastern end of the system is an internally draining depression about 150ha in area. Soils are predominantly texture contrast types of two main groups: sandy surfaces with friable clayey subsoils, and hard sandy loam to sandy clay loam surfaces with dispersive clay subsoils. The low lying, poorly drained flats are known to accumulate salt. Undulating coastal rises with shallow stony soils and deep sands are unsuitable for any agricultural uses other than light grazing, and most is contained within conservation reserves.

WIH (Wilson Hill Land System)
Formed on fine grained metamorphosed rocks of the Kanmantoo Group (Tapanappa Formation), this land system occurs in undulating to moderately steep land extending from inland of Victor Harbour to the coast west of Parson's Beach. Basement rocks are within a metre or so of the surface for over 75% of the area and contain a shallow saline

groundwater table. Saline seepages are a feature of this land system. In 15% of the system, the rocks are covered by deep weathering profiles with laterite development. Unconsolidated sandy clays and clays, containing some remnant ferricrete (ironstone) cover the remaining 10% of the area. Although mapped as Permian glacial and fluvioglacial deposits (Geological Survey of SA, 1962), these sediments may be of Tertiary age. On summit surfaces and upper slopes, where the basement rock is covered by deep weathering lateritic profiles or younger unconsolidated clayey sediments, sandy or sandy loam texture contrast soils have impeded drainage and marginal fertility. The majority of the land is undulating to gently rolling and characterized by red loamy soils, moderately deep and fertile but affected by widespread although very patchy saline seepage. The bulk of the land has high production potential, but irrigation is risky given the salinity problem. Maximum water use should be a target of any land use.

APPENDIX 5. SOUTHERN PYGMY PERCH

Actions required to secure and conserve populations of the Southern Pygmy Perch will include watercourse management (eg. fencing, restricting stock access and riparian revegetation), and salinity, erosion and nutrient pollution control activities as discussed in the main report.

In addition, surface water diversions should be managed to improve habitat for the species.

The following two pages are a summary of the 'Recovery outline for the Southern Pygmy Perch in the Mount Lofty Ranges, South Australia' (Hammer, 2002). The full version of this document can be downloaded from the Native Fish Australia (SA) website at: www.nativefishsa.asn.au , through the 'Research' link.

A 'recovery update' is being prepared to assess the current status and to look at what activities have been undertaken to reverse the decline of this threatened species (pers. comm. Michael Hammer, Dept. of Environmental Biology, Adelaide University; and Native Fish Australia (SA), 9 Mar 2004).

Summary: Recovery Outline for the Southern Pygmy Perch in the Mount Lofty Ranges

Southern pygmy perch (*Nannoperca australis*) Also known as swamp perch. A colourful native species, a much smaller relative of the well-known Murray cod and callop.

Size: max 8.5 cm, common to 3-4 cm

Identification: Broad, golden to brown body with red to clear fins, long singular dorsal (top) fin. During the spring breeding season males intensify in colour with bright red and black edged fins. Not to be confused with juvenile introduced redfin, which have a much larger mouth and dark vertical bars on their body.

Adult male (top) and female MLR southern pygmy perch (MH)

Status: Considered locally endangered in the SA section of the Murray-Darling Basin. Southern pygmy perch are totally protected in South Australia (*Fisheries Act 1982*), but have no formal regional conservation status.

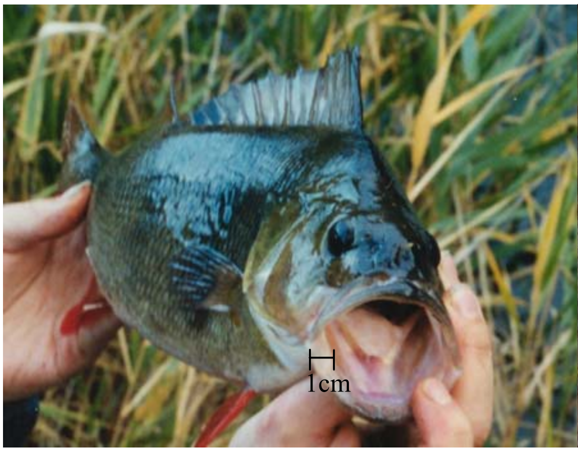
Historic distribution: Southern pygmy perch in the Murray Darling Basin (MDB) belong to a distinct genetic group (likely a sub-species) which historically covered much of the southern half of the Basin. In the SA section of the MDB the species was wide-spread in the fringing swamps and tributary streams of the Lower Murray and Lake Alexandrina, and it is also likely to have been commonly found in areas associated with the River Murray through to Victoria.

Current distribution: Overall there has been a large decrease in the range of the southern pygmy perch in the MDB. In the SA section, this species is now restricted to a handful of tributary streams. They now only exist in five isolated and genetically distinct sub-populations of the eastern Mount Lofty Ranges (MLR); the Angas River, Finniss River, Inman River, Lake Alexandrina and Tookayerta Creek drainage areas. These sub-populations consist of a low number of small and restricted sites, and there is evidence of continuing local extinctions. They are not known to occur in any conservation reserves, instead almost exclusively occurring on areas within private land. *If you find a southern pygmy perch*, carefully release it recording the location and habitat, and report it on the Native Fish Australia (SA) website (www.nativefishsa.asn.au).

Habitat and ecology: Prefers smaller pools and swamps with dense aquatic, emergent or overhanging edge vegetation, feeding on a variety of small crustaceans and invertebrates, and are natural mosquito predators. They move out into shallow areas during higher water levels to shelter from flooding and to feed. Juveniles are heavily associated with edge vegetation. Produces a relatively small number of eggs scattered over aquatic vegetation, but can still breed up under the right conditions (e.g. good seasons, swamp or bank restoration). They seem poor migrators, with only local movement onto flooded stream edges or swamps. Most common in fenced and ungrazed areas.

Swamp (top) and stream habitats (left) in the MLR

Threats: Habitat loss through stock damage to stream edge vegetation and banks, swamp drainage, as well as altered flows (e.g. abstraction and river flow regulation) appear to be the primary threat to the species. Negative interactions with introduced species such as predation by redfin and trout and interaction with the aggressive gambusia (mosquitofish) are believed to be contributing to the decline. A general lack of awareness surrounding the conservation requirements and even existence of native fish in the Mount Lofty Ranges within the wider community and government agencies is an immediate concern.



Introduced predators such as the redfin are a threat to pygmy perch and other native fish (MH)

Stock access reduces important edge cover and water quality as well as destabilising banks (MH)

Broad recovery objectives:
- Improve the status of the southern pygmy perch in the Mount Lofty Ranges by increasing the security and extent (range and density) of populations in each of the five catchment areas occupied, increasing the amount and quality of stream and swamp habitats (including minimising threatening processes).
- Establish long-term government and community support structures to promote the southern pygmy perch (subsequently native fish in general) within regional planning and management as well as aquatic protection, restoration and education programs.

Restoration and Management: Management action requires various levels of input of equal importance from the efforts of landholders and the community through to government contribution and management. In many respects people need to know of the presence of pygmy perch and the problems they face so that efforts can be focused toward their conservation. *Recovery actions*:

1. Secure core populations across the five known sub-populations with restoration works and community involvement (e.g. fencing and revegetation).
2. Seek to provide within catchment artificial refuge dams, especially for critically endangered sub-populations (Angas and Inman Catchments) using existing dams.
3. Undertake investigations of environmental flow requirements to ensure that surface and groundwater flows are maintained for pygmy perch survival through critical periods (summer and during reproduction); act towards sustainable water use to protect the environment and existing users.
4. Education about the unique southern pygmy perch and local aquatic habitats, the threats they face and options for conservation (signs, media, publications, Waterwatch and school programs, corporate involvement/sponsorship).
5. Fence and restore areas immediately surrounding existing populations or other suitable areas to provide stream corridors for natural dispersal or future restocking.
6. Targeted feral fish control; encourage community participation in removal of redfin, carp and gambusia (links to education), seek to prevent stocking of trout in sensitive areas.
7. Further research into the local range, population size, viability of populations, species ecology, response to threatening processes and management options.
8. Water quality monitoring at pygmy perch sites by the community and schools. Investigate options for hands on involvement of the community.
9. Recognition of southern pygmy perch and other native fish within regional planning and conservation initiatives.
10. Formal recognition of regional conservation status for South Australian fish.

APPENDIX 6. WATER BALANCE METHOD

The water balance for a catchment can be written as:

Inputs = Outputs + Change in Storage, or

$P = ET + R + D + \Delta S$

Where:
P = precipitation,
ET = evapotranspiration,
R = runoff (streamflow),
D = deep drainage (recharge),
ΔS = change in soil moisture storage.

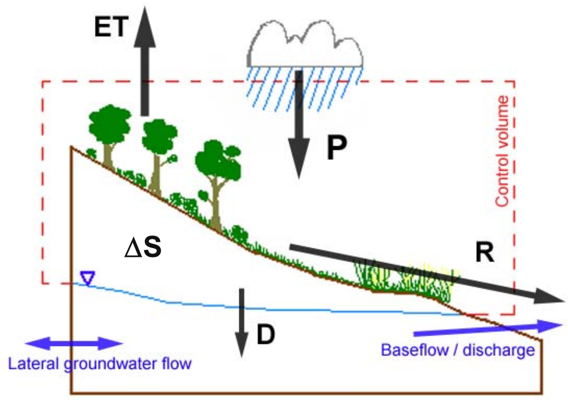


Figure A3-1. Components of a water balance.

Note: This equation considers only the control volume shown. ie. groundwater movement, pumping, and imported water are not considered. In this analysis 'runoff' is taken to mean streamflow and includes baseflow (ie. recharge that discharges back into streams).

Estimates of water balance components have been made previously for the Inman River catchment and are shown below (from Carmichael, 2000; Barnett and Zulfic, 2002).

Inputs		Outputs	
Type	Amount (ML)	Type	Amount (ML)
Effective rainfall	114,400	Evapotranspiration	75,878
		Streamflow (Runoff + baseflow)	22,045 (13,040 + 9005)
		Farm Dams	896
		Groundwater recharge	17,000
Totals	114,400		114,027

Due to time constraints the detailed method of Carmichael (2000) was not repeated for the other catchments comprising the study area (Inman R, Waitpinga Ck, Coolawang Ck, Newland Cliffs, and Parsons Beach). A GIS-based approach, incorporating various approximate formulae, was adopted, with existing knowledge serving as a guide.

Estimation of water balance components proceeded as follows:

Precipitation (P)
A rainfall isohyet map (adopted from SHSCB, 2000) was modelled using a Triangular Irregular Network (TIN). This was converted to raster grids with 100m x 100m (1ha) cell size (see Figure A3-2).

For each catchment, the mean value of rainfall was determined and multiplied by catchment area to give average annual rainfall volumes.

Barnett and Zulfic (2002) consider only the 'effective rainfall' as contributing to the water balance. This arises from the observation that most of the summer rainfall is lost by evaporation before it has a chance to percolate down to the plant root zone or watertable. Therefore only winter rainfall (April-October) is considered to be effective in contributing to the water balance. In the study area 'effective rainfall' is about 80% of annual rainfall. However the approximate formulae used in this analysis are based on average annual rainfall, so the concept of 'effective rainfall' was not used.

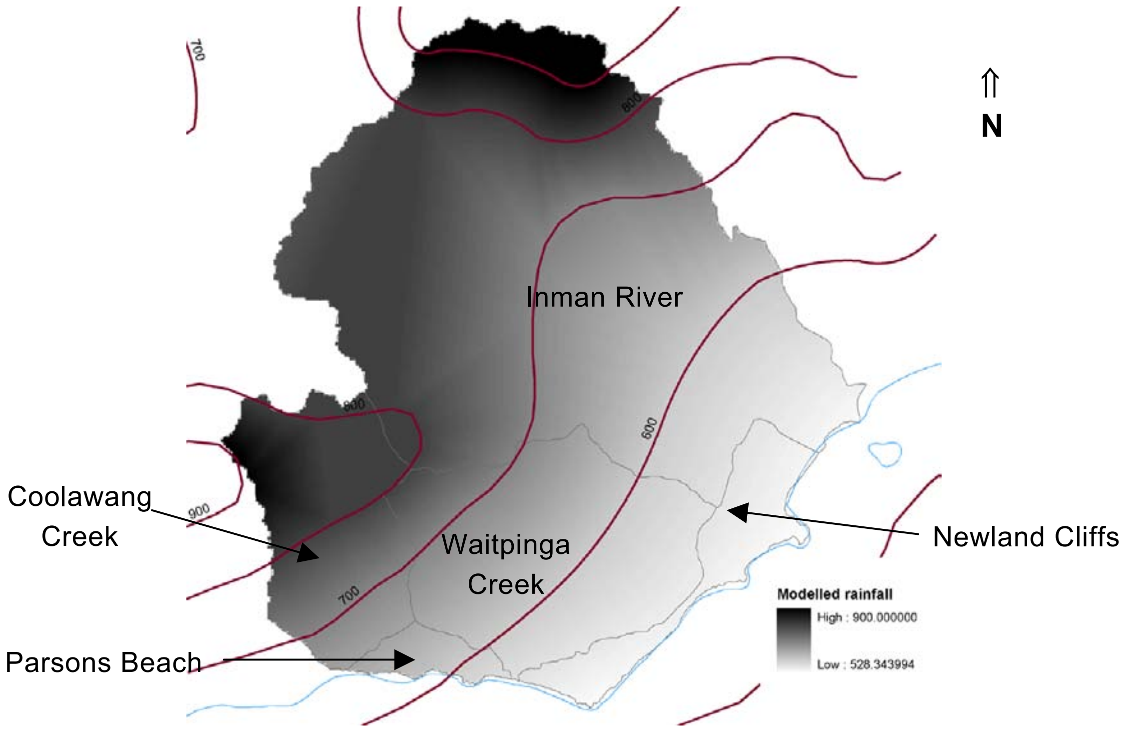


Figure A3-2. Grid of TIN modelled average annual rainfall, with rainfall isohyets.

Hence precipitation is calculated as:

		Average annual rainfall	
Catchment	**Area (ha)**	**(mm)**	**(ML)**
Inman River	19525.8	723	141113
Waitpinga Ck	6115	630	38494
Coolawang Ck	4076.8	775	31591
Newland Cliffs	1908.9	552	10531
Parsons Beach	607.7	623	3787
TOTAL	32234.2	700	225530

Evapotranspiration (ET)

Zhang et al. (2001) argue that the most important factors controlling mean annual ET appear to be annual rainfall, potential ET and vegetation type. Based on a collection of studies into mid-latitude forested and grassland catchments throughout the world (listed in Zhang et al., 1999), parameters have been established to enable an estimate of ET from average annual rainfall and the fractions of catchment that are forested (f) or under grassland (1-f).

Hence ET can be estimated from the following equation:

$$ET = \left[f \left(\frac{1 + 2\frac{1410}{P}}{1 + 2\frac{1410}{P} + \frac{P}{1410}} \right) + (1-f) \left(\frac{1 + 0.5\frac{1100}{P}}{1 + 0.5\frac{1100}{P} + \frac{P}{1100}} \right) \right] P$$ (Zhang et al., 2001)

Where ET = average annual evapotranspiration (in mm)
P = average annual rainfall (in mm), and
f = fraction of forest in the catchment(s).

This equation provides a very simplistic approach in that:

- it is based on the average potential evaporation rates for the studies looked at, and
- it bluntly divides the catchment area into either forest or grasslands.

For the purposes of this study, 'forest' (f) was also taken to include areas mapped as native vegetation as this is most likely to contain largely deep-rooted and perennial plants, which would deserve placement in the higher water use bracket. This may not be an entirely valid assumption. The area and fraction of the catchments under these land uses were determined from spatial information (see Figure A3-3).

By default, 'grassland' was that proportion of the catchment not picked out as 'forest'. These are assumed to comprise areas of herbaceous plants, pasture, crops and other shallow rooted plants (including annuals and perennials) and are classed as low water use. This assumption is not likely to be entirely valid.

ET was calculated using the equation above, with results shown below:

			Average annual ET	
Catchment	**Area (ha)**	**Fraction of forest (f)**	**(mm)**	**(ML)**
Inman River	19525.8	0.189	551	107493
Waitpinga Ck	6115	0.154	498	30428
Coolawang Ck	4076.8	0.141	569	23202
Newland Cliffs	1908.9	0.273	462	8821
Parsons Beach	607.7	0.234	502	3050
TOTAL	32234.2	0.182	538	173400

Streamflow (R)
A recent study has modelled catchment rainfall-runoff relationships throughout the south central region (SCRN, 1999), based on data collected from catchments with streamflow gauging stations. Streamflow coefficients (the fraction of rainfall that is available as surface runoff/ catchment yield) are estimated for each catchment, spanning the range from dry to wet years. Coefficients for median rainfall years were chosen to predict streamflow, with results shown below:

			Approx. average annual streamflow	
Catchment	**Area (ha)**	**Streamflow coefficient**	**(mm)**	**(ML)**
Inman River	19525.8	0.159	115	22437
Waitpinga Ck	6115	0.095	60	3657
Coolawang Ck	4076.8	0.108	84	3412
Newland Cliffs	1908.9	0.163	90	1717
Parsons Beach	607.7	0.098	61	371
TOTAL	32234.2			31593

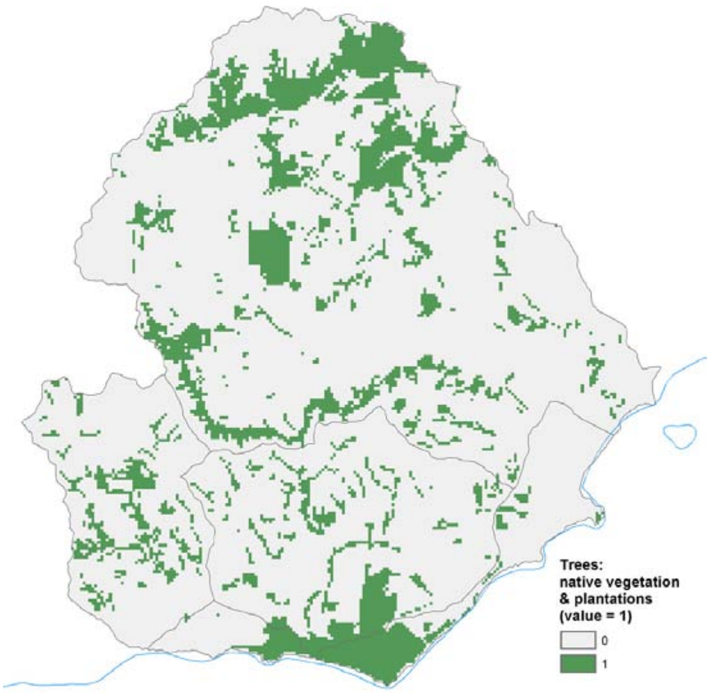


Figure A3-3. Proportion of the catchment under 'forest' (trees and native vegetation)

This modelling was based on streamflows measured in gauged catchments, and volumes held back by dams were not included due to uncertainty of their cumulative capacity at the time the modelling was conducted (SCRN, 1999).

Since then, dam volumes in the Mt Lofty Ranges have been estimated from aerial photos, using formulae based on surface area (pers. comm. Doug McMurray, DWLBC, 2002), and are shown in the table below.

Catchment	Estimated dam storage (ML)
Inman River	2758
Waitpinga Ck	658
Coolawang Ck	291
Newland Cliffs	85
Parsons Beach	12
TOTAL	3804

Additional volumes are likely to be directly harvested from streams for use for stock water or irrigation. However for this analysis, it is assumed that dams are filled to capacity once per year. (A previous investigation into dam volumes in the MLR, conducted by McMurray in 1996, estimated total dam storage in the Inman River catchment of 896 ML (Carmichael, 2000).)

Comparison with stream gauging data
The only stream gauging station covering the study catchments is GS 501503, which is located at the lower end of the Inman and monitors flow from 84% of the catchment. From a short monitoring record (Jan 1995 to Jan 1999) a mean annual flow of 6961 ML and a median annual flow of 4206 ML have been recorded (Carmichael, 2000).

This gauging station data should be treated with caution as:
- the streamflow record was obtained during a dry period of reduced flows,

- the levels of surface water extraction are not well known and likely to be under-estimated (ie. dams filled more than once per year, and/ or direct pumping from the river for stock, irrigation),
- the Inman Valley is an area with sandy soils and it is likely that significant leakage occurs from the river to groundwater through a porous stream bed. In the lower Inman Valley the river disappears at some stages (eg. between Glacier Rock and Stephen's Rock – pers. comm. Graham Webster) and reappears further downstream.

Further modelling predicts that across the total Inman catchment total streamflow will be from 19520 to 22450 ML (or 100 to 115mm) (Carmichael, 2000).

Recharge (D)
Recharge rates are difficult to predict and are influenced by factors such as land use, climate, and soils. Within these factors much variation can occur across the landscape and complications occur due to (Petheram et al., 2000):

- variation in the maturity, density, rooting depth and health of vegetation;
- non-uniform soil texture and structures;
- land management practices;
- seasonality and episodicity of rainfall – with many groundwater investigations showing that most recharge occurs following high rainfall events;
- higher recharge rates where water tables are shallower; and
- the presence of preferential recharge zones

Despite this, generalizations can be made. Stirzaker et al. (2000) claim that typically 5-15% of long term average rainfall gets past the roots of annual plants, whereas less than 1% escapes the native (typically deep-rooted) perennial vegetation.

Also, recharge increases faster as rainfall increases for sandy soils compared to non-sands (Petheram et al., 2002). For herbaceous/ annual/ shallow-rooted plants on sandy soils the following relationship provides a useful estimate of recharge (D).

$\ln(D) = -19.03 + 3.63\ln(\text{Rainfall})$ (Petheram et al., 2002; $R^2 = 0.6$)

For the purpose of providing a simple estimate of recharge, the following formulae were applied:

For:

1. 'Forest' areas (ie. plantation forest or native vegetation): **D = 1% of rainfall**.
2. Non-'forest' areas (ie. assume herbaceous/ annuals/ low water use crops & pastures*):
    - **(a)** sandy soils: $\mathbf{D = e^{(3.63\ln P - 19.03)}}$, where P = rainfall
    - **(b)** non-sandy soils: **D = 5% of rainfall**.

*Assumption for non-forest areas being low water use vegetation not likely to be always valid.

Areas of 'forest' are the same as used for ET calculations (seen in Figure A3-3).

Areas of 'sandy' soils, represent zones of higher recharge potential. These are determined from spatial information and shown in Figure A3-4. Shallow soils over rock were included with this group due to their high recharge potential (however in most areas of the study catchment, shallow soils over rock are under native vegetation, and are accounted for in part 1 – 'Forest' areas). The 'sandy soils' group also includes sand over clay soils, despite a lack of information about the depth of sand. For this part of the analysis (Non 'forest' areas), vegetation is assumed to be herbaceous/ annual/ or of low water use potential, and thus rooting depth may not extend beyond the sand.

Also, the Permian sediments of the Southern Fleurieu catchments have relatively discontinuous interbedded sands and clays (Barnett and Zulfic, 2002) so it might be assumed that, in combination with steep topographic gradients, water perching above clays will drain laterally to nearby points of discontinuity where recharge to local, poorly connected "aquifers" (which are common to the 'Cape Jervis Beds' of the region – Carmichael, 2000) can occur.

Figure A3-4. Proportion of the catchment with sandy or shallow soils
(Soils data derived from DWLBC SALI, 2002)

Hence, the following grid based calculation was performed:

[Recharge] = [Forest]*0.01*[Rainfall] + (1-[Forest])***(**[SandySoils]*(EXP(3.63*LN([Rainfall]) – 19.03)) + (1-[SandySoils])*0.05*[Rainfall]**)**

Where:
[Forest] has cell values = 1 for native vegetation or tree plantations; 0 elsewhere.
[SandySoils] has cell values = 1 for sands, sand over clays & shallow soils over rock; 0 elsewhere.
[Rainfall] has cell values modelled from rainfall isohyets.

Recharge estimates were calculated, as shown below:

		Average annual recharge	
Catchment	**Area (ha)**	**(mm)**	**(ML)**
Inman River	19525.8	76	14742
Waitpinga Ck	6115	33	2034
Coolawang Ck	4076.8	71	2888
Newland Cliffs	1908.9	29	549
Parsons Beach	607.7	40	245
TOTAL	32234.2	63	20450

Change in storage (ΔS)
When averaged over a long period of time (ie. 5 to 10 years), it is reasonable to assume that the change in soil water storage is zero (Zhang et al, 1999).

Summary of Results

Results for the Inman River are in reasonable agreement with previously determined values (when rainfall and ET are converted into annual terms). Estimated water balance components for the major catchments are summarised below:

	Inflows		**Outflows**	
	Type	Amount (ML)	Type	Amount (ML)
Inman River	Annual Rainfall	141113	Evapotranspiration Streamflow Dam storage Recharge	107493 22437 2758 14742
	Totals	*141113*		*147430*
Waitpinga Creek	Annual Rainfall	38494	Evapotranspiration Streamflow Dam storage Recharge	30428 3657 658 2034
	Totals	*38494*		*36777*
Coolawang Creek	Annual Rainfall	31591	Evapotranspiration Streamflow Dam storage Recharge	23202 3412 291 2888
	Totals	*31591*		*29793*

Errors

Errors will arise due to the many assumptions that have been made in the application of the various formulae. The non-exact nature of this analysis is made clear by the imbalance between inflows and outflows, however the percentage differences observed are reasonably low.

Significant variation was observed in rainfall isohyet patterns obtained from different sources, however the pattern chosen (or ones similar to it) was found in at least 3 reports from different groups (SHSCB,2000; Henschke, 1997; Lamprey & Mitchell, 1979; pers comm. Bureau of Meteorology, 2002), and matched best with anecdotal evidence from the region, of high rainfall centred on the Parawa plateau area (outside the study area).

Not all areas mapped as native vegetation will have perennial, deep-rooted high water use vegetation. Conversely, some areas of pasture may have improved, perennial pastures with grazing management that promotes high water use. Soils are mapped according to the dominant soil present in each of the soil mapping units. Minor but significant proportions of each soil type class will comprise other soil types (DWLBC SALI, 2002).

Runoff coefficients obtained from SCRN (1999) may undergo revision as this yet unpublished document and the data contained therein may be reviewed. Modelling that has produced the runoff coefficients will have associated inaccuracies and assumptions.

Inaccuracies are associated with the process of modelling catchments parameters in 100m square (1 ha) cell sizes. Given the levels of uncertainty associated with the various steps and formulae applied, this resolution could be viewed as satisfactory.

APPENDIX 7. LAND USE AND WATER QUALITY

Water Quality (concentrations) in catchment creeks with dominant land uses in the Mount Lofty Ranges 1970-1982 (from Wood, 1986)

Land use (Catchment)		**Total Dissolved Solids** (mg/L)	**Oxidised Nitrogen** (mg/L)	**Total Nitrogen** (mg/L)	**Soluble Phos-phorus** (mg/L)	**Total Phos-phorus** (mg/L)	**Total Organic Carbon** (mg/L)	**Total Coliforms** (orgs/ 100mL)	***E. coli*** (orgs/ 100mL)
Native vegetation (First Creek)	max	240	0.72	4.19	0.061	0.320	55.0	38,000	38,000
	min	69	0.01	0.07	0.005	0.005	2.0	15	5
	mean	150	0.03	0.51	0.010	0.025	7.5	1100	525
	med	**170**	**0.02**	**0.40**	**0.006**	**0.016**	**6.0**	**250**	**80**
	no.	146	145	141	143	143	139	138	138
Urban (Aldgate Creek)	max	350	3.10	6.50	0.280	0.761	84.0	180,000	90,000
	min	56	0.01	0.11	0.005	0.010	1.0	70	11
	mean	180	0.53	1.29	0.045	0.098	14.1	11,200	3540
	med	**180**	**0.51**	**1.26**	**0.040**	**0.071**	**12.0**	**2500**	**800**
	no.	282	282	280	272	284	128	267	267
Intensive horticulture (Cox Creek)	max	470	21.5	38.33	2.360	8.750	90.0	380,000	55,000
	min	70	0.09	0.29	0.011	0.039	1.0	90	0
	mean	300	4.85	6.12	0.120	0.377	10.8	16,000	1180
	med	**310**	**4.60**	**5.63**	**0.071**	**0.143**	**7.0**	**5500**	**350**
	no.	125	121	120	119	121	119	105	105
Mixed agriculture/ orchards (Lenswood Creek)	max	1900	4.47	5.20	0.210	0.520	30.0	180,000	25,000
	min	120	0.01	0.12	0.005	0.005	1.0	25	4
	mean	370	0.43	0.96	0.025	0.050	8.1	7800	1750
	med	**330**	**0.27**	**0.83**	**0.011**	**0.030**	**6.0**	**2130**	**490**
	no.	225	223	220	203	221	75	202	212
Grazing (Inverbrackie Creek)	max	2000	11.6	13.64	0.589	1.030	83.0	180,000	90,000
	min	170	0.01	0.36	0.005	0.005	3.0	7	5
	mean	920	0.29	1.65	0.033	0.071	24.4	6260	3310
	med	**930**	**0.05**	**1.32**	**0.020**	**0.050**	**18.0**	**550**	**250**
	no.	163	163	163	151	161	45	156	156

Mean Annual yields (loads/ha/year) from catchment creeks with dominant land uses in the Mount Lofty Ranges 1970-1982 (from Wood, 1986)

Land use (Catchment)	**Total Dissolved Solids** (kg/ha/ year)	**Oxidised Nitrogen** (kg/ha/ year)	**Total Nitrogen** (kg/ha/ year)	**Soluble Phos-phorus** (kg/ha/ year)	**Total Phos-phorus** (kg/ha/ year)	**Total Organic Carbon** (kg/ha/ year)	**Total Coliforms** (orgs/ha/ year x 10^9)	***E. coli*** (orgs/ha/ year x 10^9)
Native vegetation (First Creek)	232	0.1	1.5	0.02	0.10	21.9	8.8	4.9
Urban (Aldgate Creek)	519	2.5	5.3	0.18	0.39	45.8	459.4	122.6
Intensive horticulture (Cox Creek)	934	19.6	26.0	0.59	2.7	59.7	490.8	47.0
Mixed agriculture/ orchards (Lenswood Creek)	656	2.4	4.5	0.12	0.22	26.0	366	136
Grazing (Inverbrackie Creek)	994	1.2	4.6	0.09	0.2	33.6	83.8	67.9

APPENDIX 8. BIOLOGICAL MONITORING & AUSRIVAS RESULTS

Biological monitoring is increasingly seen as an essential component in the assessment of river and stream health, particularly for:

- directly assessing impacts to ecological systems, or
- detecting short-lived transient disturbances that are typically missed by physico-chemical sampling programs.

Macroinvertebrates are one group of organisms commonly used in biological monitoring studies (eg. AUSRIVAS) because they are common, widely distributed, easily sampled, and are relatively easy to identify to an appropriate taxonomic level. Macroinvertebrates are small aquatic organisms without backbones that are large enough to be seen with the naked eye. They include insects, crustaceans, snails, worms, mites and sponges. The structure of the macroinvertebrate community observed at a particular site will be determined by factors including physical habitat, ecological considerations (eg. predation, competition, life cycles, season, etc) and tolerance to (natural and artificial) disturbances.

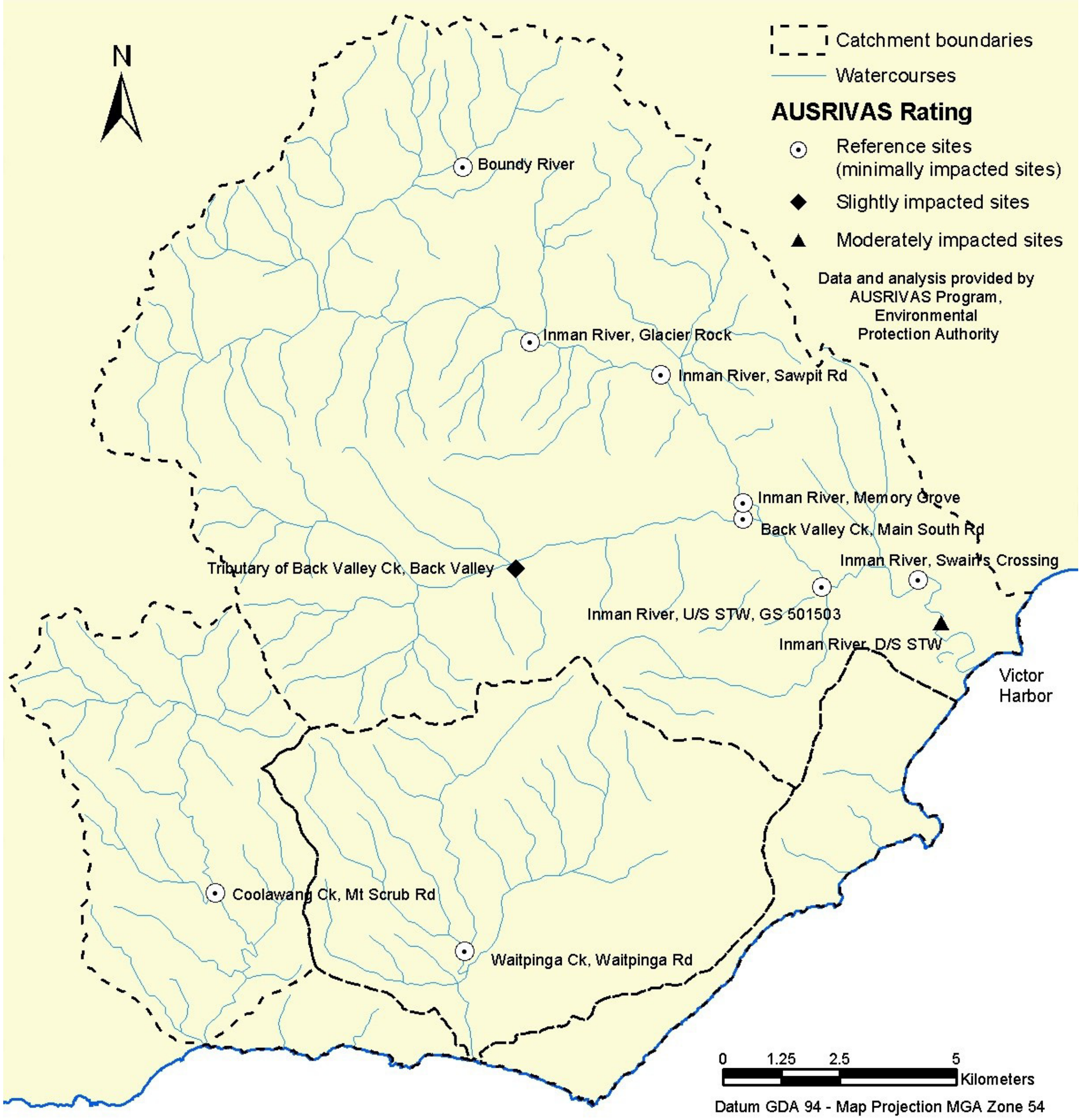
Biological measurements are combined with the physical and chemical characteristics of the site to build a better picture of the status of a waterway. Predictive models (eg. AUSRIVAS) have been developed, based on this type of information gathered at many sites. The models are capable of estimating the macroinvertebrate community composition that would be expected at a particular site, with minimal levels of disturbance. Comparison with what is observed provides a measure of the level of disturbance.

Disturbance to stream organisms can occur through a variety of natural and human-induced phenomena. Expert knowledge of individual organisms' tolerances to various types of pollution is necessary before any definitive statements can be made about the precise nature of the disturbance (pers. comm. Paul McEvoy, Australian Water Quality Centre).

The first coordinated national biological assessment of Australian river and streams was carried out under the Monitoring River Health Initiative (MRHI) from 1994-95. This initial work focussed on least disturbed or reference sites, representing the best available condition. Later work under the AUSRIVAS (AUStralian RIver Assessment Scheme) from 1997-99 tested as many sites as possible, representing locations thought to have been disturbed by some sort of impact. The combined results form a database of knowledge that is used for predictive modelling to provide assessments of river and stream health.

The following figure shows the results of AUSRIVAS studies conducted on locations within the study area.

Ratings for AUSRIVAS sites within the study area (from McEvoy et al., 2003)



In this figure, ratings for each site have been summarised across different seasonal and habitat types (eg. edge, riffle) to reflect the average score for each site.

Most sites were rated as equivalent to reference condition, implying that they were similar to other 'least-disturbed' sites in the State. Coolawang Creek was noted for its biodiversity (high numbers of species). This site has similar catchment conditions to the adjacent Deep Creek Conservation Park, which contains numerous watercourses preserved in near remnant condition (McEvoy et al., 2003).

Moderate impact was detected downstream of the WWTP reflecting nutrient enrichment from this recognised point source of pollution. A tributary of Back Valley Creek was identified as being slightly impacted.

APPENDIX 9. SUMMARY OF WATER QUALITY GUIDELINES (FOR SELECTED PARAMETERS AND USES)

When using the guidelines in the following table, the conversions below may be useful:

- Nitrate (NO_3^-): 1 mg/L = 0.226 mgN/L
- Nitrite (NO_2^-): 1 mg/L = 0.304 mgN/L
- Total Nitrogen = NO_x - N + TKN (where NO_x = NO_3^- + NO_2^-)

- Phosphate (PO_4^{3-}): 1 mg/L = 0.326 mgP/ L
- Filterable reactive phosphorus ≡ Soluble phosphorus ≡ mostly phosphate

Appendix 9. Summary of water quality guidelines (for selected parameters and uses)

Use		Salinity: TDS	Nutrients: Nitrogen: Ammonia (NH_3) / ammonium (NH_4^+)	Nutrients: Nitrogen: Oxidised nitrogen (nitrate – NO_3^-, nitrite – NO_2^-)	Nutrients: Nitrogen: Total nitrogen (TN)	Nutrients: Phosphorus: Filterable reactive phosphorus	Nutrients: Phosphorus: Total phosphorus (TP)	pH	Pathogens: E. coli (thermotolerant or faecal coliforms)
Drinking Water (NHRMC & ARMCANZ, 1996) [+ Health guideline ++ Aesthetic guideline]		**500 mg/L (++)** <500 mg/L is regarded as good quality drinking water based on taste. 500-1000 mg/L is acceptable based on taste. >1000mg/L may be associated with scaling, and unsatisfactory taste.	**NH_3: 0.5 mg/L(++)** Presence beyond this level may indicate sewage contamination &/or microbial activity. High levels may corrode copper pipes & fittings.	**NO_3^-: 50 mg/L (+)** Nitrate occurs naturally but is increasing in some waters (particularly groundwater) from intensive farming & sewage effluent. Guideline value will protect bottle-fed infants under 3 months from methaemoglobin-aemia (blue baby disease). Adults & children over 3 months can safely drink water with up to 100 mg/L nitrate. **NO_2^-: 3 mg/L (+)** Nitrite is rapidly oxidised to nitrate (see above).				**6.5 – 8.5 (++)** Extreme pH values (<4 & >11) may adversely affect health, however there is insufficient data to set a health guideline. < 6.5 may be corrosive. >8 progressively decreases efficiency of chlorination. >8.5 may cause scale and taste problems. New concrete tanks and cement mortar lined pipes increase pH and values up to 9.2 may be tolerated provided monitoring indcates no deterioration in microbiological quality.	**Zero** organisms in 100mL minimum sample **(+)** No sample should contain any E. coli/ thermotolerant/ faecal coliforms. If detected in drinking water, immediate steps to remediate should be undertaken.
Aquatic Ecosystems (ANZECC & ARMCANZ, 2000)	*-Ecosystem type-*								
	Lowland rivers	**100-5000 mg/L** (highly variable depending on flow)	**NH_4^+: 0.1 mgN/L**	**NO_x: 0.1 mgN/L** (**NO_x: 0.5 mgN/L)	**1 mgN/L** (**5 mgN/L)	**0.04 mgP/L** (**0.1 mgP/L)	**0.1 mgP/L** (**0.5 mgP/L)	**6.5 - 9**	
See notes below	Freshwater lakes & reservoirs	**300-1000 mg/L** (wetlands can have much higher salinity due to saline groundwater intrusion & evaporation) (**10% variation)	**NH_4^+: 0.025 mgN/L** (**NH_3: 0.01 mgN/L)	**NO_x: 0.1 mgN/L** (**NO_x: 0.5 mgN/L)	**1 mgN/L** (**5 mgN/L)	**0.01 mgP/L** (**0.1 mgP/L)	**0.025 mgP/L** (**0.5 mgP/L)	**6.5 - 9**	
(EPA, 2003a: ** values in brackets)	Wetlands		no data	no data	no data	no data	no data	no data	
	Estuaries		**NH_4^+: 0.05 mgN/L**	**NO_x: 0.1 mgN/L**	**1 mgN/L**	**0.01 mgP/L**	**0.1 mgP/L**	**6.5 - 9**	
	Marine		**NH_4^+: 0.05 mgN/L** (**NH_3: 0.05 mgN/L)	**NO_x: 0.05 mgN/L** (**NO_x: 0.2 mgN/L)	**1 mgN/L** (**5 mgN/L)	**0.01mgP/L** (**0.1 mgP/L)	**0.1 mgP/L** (**0.5 mgP/L)	**8 – 8.5**	

Notes: 1. These guideline values for the protection of aquatic ecosystems should be used with caution. They indicate default trigger values below which there is considered to be a low risk that adverse biological effects will occur. That does not mean that above these values an environmental problem can be inferred, or that below these values adverse problems will not occur. They provide an initial assessment of the state of the water regarding the parameter of interest. These values are based on limited data and are intended to only be indicative values for assigning different assessments of risk. A more comprehensive means of assessment is to model stream biological responses (eg. macroinvertebrate communities) and using water chemistry, habitat and community measurements, and other environmental data to assess impacts and infer causes of degradation in the landscape. ie. incorporating a biological response is a better means of assessment than using physical and chemical water quality measurements in isolation (Pers. comm. Peter Goonan, EPA, March 2003).
2. (**) Where different from earlier guidelines, indicator values presented in the Environment Protection (Water Quality) Policy 2003 (EPA, 2003) are also shown in brackets.

Appendix 9. Summary of water quality guidelines (for selected parameters and uses) - continued

Use		**Salinity**	**Nutrients**					**pH**	**Pathogens**
		TDS	Nitrogen			Phosphorus			E. coli (thermotolerant or faecal coliforms)
			Ammonia (NH_3) / ammonium (NH_4^+)	Oxidised nitrogen (nitrate – NO_3^-, nitrite – NO_2^-)	Total nitrogen (TN)	Filterable reactive phosphorus	Total phosphorus (TP)		
Primary Industries (ANZECC & ARMCANZ, 2000) (EPA, 2003a): **values in brackets, shown where different to earlier guideline values	*-Use-* Irrigated plants	**See Appendix 10.** Tolerance levels will vary according to species, soil & management.			**5mg/L (LTV)** **25-125mg/L (STV)** To maintain crop yields, prevent bioclogging of irrigation equipment, and minimise offsite impacts (eg. leaching to groundwater), concentrations of TN in irrigation water should be less than: - long-term trigger value (LTV) for up to 100 years, or - less than short-term trigger value (STV) for up to 20 years.		**0.05mg/L (LTV)** **0.8-12mg/L (STV)** To maintain crop yields, prevent bioclogging of irrigation equipment, and minimise offsite impacts (eg. prevent algal growth in irrigation water), concentrations of TP in irrigation water should be less than: - long-term trigger value (LTV) for up to 100 years, or - less than short-term trigger value (STV) for up to 20 years.	(**4.5 – 9)	**See Appendix 13.** Values depend on purpose of irrigation. (**1000 orgs/100mL)
	Livestock	**See Appendix 11.** Tolerance levels will vary according to species.		**NO_3^-: 400-1500mg/L** (**133 mg/L) Nitrate concentrations in drinking water less than 400mg/L should not be harmful. Stock should tolerate higher levels provid-ed levels in feed are not high. Water containing > 1500mg/L is likely to be toxic. **NO_2^-: 30mg/L** Concentrations of nitrite exceeding this value may be hazardous to animal health.					**100 orgs/100mL** Drinking water for livestock should contain less than 100 thermotolerant coliforms/ 100mL based on the median value from regular monitoring. (**1000 orgs/100mL)
	Soil	**See Appendix 12.** Soil structural stability will depend on sodium content & TDS.							
	Equipment							**6 – 8.5** (groundwater), **6 – 9** (surface water) To minimise risk of corrosion at low pH, and fouling at high pH, in irrigation, pumping and stock watering systems.	
	Aquaculture species	**3000mg/L** (freshwater) but species dependant, **3000 – 37,000mg/L** (saltwater)		**NO_3^-:** **50mg/L** (freshwater), **100mg/L** (saltwater) **NO_2^-:** **0.1mg/L** (freshwater), **0.1mg/L** (saltwater			**0.1mg/L** (freshwater), **0.05mg/L** (saltwater)	**5 – 9** (freshwater), **6 – 9** (saltwater)	**14 MPN/100mL** (**0 orgs/100mL) In shellfishing water – the median faecal coliform bacterial concentration should not exceed 14 MPN (most probable number) / 100mL, with no more than 10% of the samples exceeding 43 MPN/100mL.

Appendix 9. Summary of water quality guidelines (for selected parameters and uses) - continued

Use		Salinity	Nutrients					pH	Pathogens
		TDS	Nitrogen			Phosphorus			E. coli (thermotolerant or faecal coliforms)
			Ammonia (NH_3) / ammonium (NH_4^+)	Oxidised nitrogen (nitrate – NO_3^-, nitrite – NO_2^-)	Total nitrogen (TN)	Filterable reactive phosphorus	Total phosphorus (TP)		
Recreation & Aesthetics (ANZECC, 1992)	*-Use-* Primary contact (eg. swimming)		**NH_3: 0.01 mgN/L**	**NO_3^-: 10 mg/L** **NO_2^-: 1 mg/L** To protect against exposure and ingestion.				**6.5 – 8.5**	**150 orgs/ 100mL** The median bacterial content in fresh or marine waters should not exceed 150 faecal coliform organisms / 100mL (minimum of 5 samples taken at regular intervals not exceeding one month, with 4 out of 5 samples containing less than 600 organisms/ 100mL.
	Secondary contact (eg. boating)							**5 - 9**	**1000 orgs/100mL** The median bacterial content in fresh or marine waters should not exceed 1000 faecal coliform organisms / 100mL (minimum of 5 samples taken at regular intervals not exceeding one month, with 4 out of 5 samples containing less than 4000 organisms/ 100mL.
	Aesthetics/ visual use (no contact)								

APPENDIX 10. TOLERANCE OF PLANTS TO SALINITY

Tolerance of plants to salinity in irrigation water (adapted from ANZECC & ARMCANZ, 2000)

Common name	Scientific name	Average root zone salinity threshold (ECse) (dS/m) (see note 1)	ECi threshold for crops growing in (see notes 2 & 3)		
			sand	loam	clay
Field crops					
Barley, grain	*Hordeum vulgare*	8	12.6	7.2	4.2
Cotton	*Gossypium hirsutum*	7.7	12.1	6.9	4.0
Beet, sugar	*Beta vulgaris*	7	11.0	6.3	3.7
Sorghum	*Sorghum bicolor*	6.8	9.4	5.3	3.1
Wheat	*Triticum aestivum*	6	9.4	5.3	3.1
Sunflower	*Helianthus annuus*	5.5	7.5	4.3	2.5
Oats	*Avena sativa*	5	7.0	4.0	2.3
Soybean	*Glycine max*	5	7.0	4.0	2.3
Peanut	*Arachis hypogala*	3.2	4.4	2.5	1.5
Rice, paddy	*Oryza sativa*	3	4.8	2.7	1.6
Corn, grain, sweet	*Zea mays*	1.7	3.2	1.8	1.1
Sugarcane	*Saccharum officinarum*	1.7	4.3	2.5	1.4
Fruits					
Olive	*Olea europaea*	4	5.1	2.9	1.7
Macadamia seedling		3.6	4.6	2.6	1.5
Peach	*Prunus persica*	3.2	4.7	2.7	1.6
Rockmelon	*Cucumis melo*	2.2	4.6	2.6	1.5
Grapefruit	*Citrus paradisi*	1.8	3.0	1.7	1.0
Orange	*Citrus sinensis*	1.7	2.9	1.7	1.0
Grape	*Vitis spp.*	1.5	3.3	1.9	1.1
Avocado	*Persea americana*	1.3	2.3	1.3	0.8
Apple	*Malus sylvestris*	1	2.0	1.2	0.7
Pastures					
Puccinellia	*Puccinellia ciliata*	11.5			
Wheatgrass, tall	*Agropyron elongatum*	7.5	12.5	7.2	4.2
Rhodes grass, Pioneer	*Chloris gayana*	7	12.8	7.3	4.2
Couch grass	*Cynodon dactylon*	6.9	10.8	6.1	3.6
Buffel grass, Gayndah	*Cenchrus ciliaris var Gayndah*	5.5	8.2	4.7	2.7
Phalaris	*Phalaris tuberosa (aquatica)*	4.2	5.3	3.0	1.8
Fescue	*Festuca clatior*	3.9	7.3	4.2	2.4
Green Panic, Petri	*Panicum maximum*	3	5.6	3.2	1.8
Townsville stylo	*Stylosanthes humilis*	2.4	3.7	2.1	1.2
Clover, Berseem Clover	*Trifolium alexandrinum*	2	3.8	2.2	1.3
Lucerne, Hunter River	*Medicago sativa*	2	4.7	2.7	1.6
Clover, strawberry (Palestine)	*Trifolium fragiferum*	1.6	3.3	1.9	1.1
Snail medic	*Medicago scutellata*	1.5	2.9	1.7	1.0
Clover, white (New Zealand)	*Trifolium repens*	1	2.5	1.4	0.8
Vegetables					
Zucchini	*Cucurbita pepo melopepo*	4.7	7.3	4.2	2.4
Beet, garden	*Beta vulgaris*	4	6.5	3.7	2.1
Broccoli	*Brassica oleracea*	2.8	4.9	2.8	1.6
Cucumber	*Cucumis sativus*	2.5	4.2	2.4	1.4
Pea	*Pisum sativum L.*	2.5	3.2	1.8	1.1
Tomato	*Lycopersicon esculentum*	2.3	3.5	2.0	1.2
Potato	*Solanum tuberosum*	1.7	3.2	1.8	1.1
Pepper	*Capsicum annum*	1.5	2.8	1.6	0.9
Lettuce	*Lactuca sativa*	1.3	2.7	1.5	0.9
Onion	*Allium cepa*	1.2	2.3	1.3	0.8
Eggplant	*Solanum melongena*	1.1	3.2	1.8	1.1
Bean	*Phaseolus vulgaris*	1	1.9	1.1	0.6
Carrot	*Daucus carota*	1	2.2	1.2	0.7

Notes:

(1) this is the soil salinity threshold beyond which increasing salinity will result in increasing yield losses.

(2) this is the irrigation water salinity threshold beyond which increasing salinity will result in increasing yield losses

(3) Many factors determine how tolerant a particular plant will be to saline water. These include soil type, drainage characteristics, local climate and rainfall. The following points should be taken into consideration:

- Saline water progressively reduces growth and yield long before visual symptoms (eg. marginal leaf burn) are apparent.
- Higher levels of salt can be tolerated on well drained soils. (The salinity limits given below assume the worst soil drainage conditions, and it is likely that higher salinities will be tolerated with improved drainage.)
- Salty water should not be sprayed onto foliage, especially not during the heat of the day.
- When using salty water it is most important to keep the soil moist. Adequate water supplies must be available to avoid a wet and dry watering cycle where soil salinity increases dramatically as the soil dries out. Frequent watering is essential.

Heavy and frequent applications of water for the purpose of flushing excess salts beyond the root zone may lead to waterlogging or salinity problems due to raised watertables. Normal winter rains in higher rainfall areas will wash excess salts through the soil profile.

APPENDIX 11. TOLERANCE OF LIVESTOCK TO SALINITY

Stock vary considerably in their ability to tolerate salt in drinking water. The more important factors affecting tolerance are:

- Stock can tolerate higher salt levels when on green pastures than on dry feed, prepared rations or saltbush.
- Sheep and cattle can tolerate very high levels of salt but stock must be given time to adapt. Sudden changes from low to high salt levels can cause toxicity even below maximum tolerance figures.
- The physiological state of the animal is important – pregnant or lactating stock and young animals are less tolerant and should not be given water with a higher salt content than the levels shown in the 'healthy growth' column.
- Storage tanks and troughs need frequent flushing to prevent build up of salts from evaporation. The composition of salts is important and some ions (eg. sulphate, chloride, sodium and magnesium) cause most problems.
- Better quality water is required during periods of high water intake (eg. hot weather, high salt diets)

Guide to livestock salinity tolerances

Animal	Max. concentration for healthy growth (ppm)	Max. concentration to maintain condition (ppm)	Max. concentration tolerated (ppm)
Sheep	6 000	13 000	14 000
Beef Cattle	4 000	5 000	10 000
Dairy Cattle	3 000	4 000	6 000
Horses	4 000	6 000	7 000
Pigs	2 000	3 000	4 000
Poultry	2 000	3 000	4 000

SALINITY UNIT CONVERSIONS:
1 dS/m (decisiemen/ metre)
= 1000 μS/cm (microsiemens/centimetre) [Electrical Conductivity (EC)]
≈ 640 ppm (parts per million) or mg/L (milligrams/ litre) [Total Dissolved Solids (TDS)].

Exact conversion figure depends on composition of salts in water.

- If mostly sodium chloride, 1dS/m ≅ 500 ppm.
- If mostly gypsum or bicarbonates, 1dS/m ≅ 800-900 ppm.

APPENDIX 12. SOIL STRUCTURAL DEGRADATION CAUSED BY IRRIGATION WATER QUALITY

Saline irrigation water has the potential to develop sodicity in soils, resulting in potential for soil structure degradation. Sodicity is the name given to water or soil that has a high concentration of sodium in comparison to calcium and magnesium. Water is said to be sodic when the sodium adsorption ratio (SAR – see formula below) is greater than 3. Soil is said to be sodic when the exchangeable sodium percentage (ESP - the percentage of exchangeable sodium bound to clay particles that can be replaced by another ion such as calcium) is greater than 6.

Sodic soils contain sufficient exchangeable sodium to adversely affect soil stability/structure and plant growth. These clayey soils may occur on the surface or in the subsoil. They are dispersible when wet, often hard-setting when dry, and susceptible to erosion and waterlogging (Fitzpatrick et al., 1997). They can be improved with the addition of gypsum (or lime, if soils are acid). High concentrations of exchangeable sodium cations (originating from geological salt storage or saline irrigation) are retained within the molecular layers of clay particles. When soil-water salinity is high clay particles remain flocculated however with the addition of fresh water (eg. from rainfall), soil-water salinity lowers and water molecules are osmotically driven towards the sodium attached between the clay layers. The large molecular radius of sodium atoms, with attached water molecules, causes the clay layers to separate and molecular bonds to break down. The clay disperses into tiny fragments, which block the soil pores on drying.

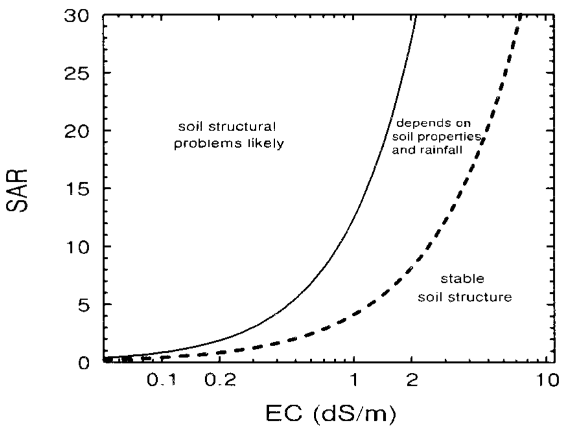
Increased risk of soil structure decline occurs when salts are washed out of a sodic soil. This can occur when irrigation with saline water over a number of years (or over the summer months) is stopped, followed by fresh water irrigation or (winter) rainfall.

Calculation of a Sodium adsorption ratio (SAR), together with ECi (EC of irrigation water) can provide a useful guide to predicting soil structure stability in relation to irrigation water (ANZECC & ARMCANZ, 2000).

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}}$$

Where Na^{+}, Ca^{2+} and Mg^{2+} are expressed in mmole/L.

The quality of the irrigation water can be evaluated by superimposing its ECi and SAR values on the figure shown.



Relationship between SAR & EC of irrigation water (ANZECC & ARMCANZ, 2000)

APPENDIX 13. TRIGGER VALUES FOR THERMOTOLERANT COLIFORMS IN IRRIGATION WATERS USED FOR FOOD AND NON FOOD CROPS (ANZECC & ARMCANZ, 2000)

Intended use	Level of thermotolerant/ faecal coliforms (E.coli) (median values)
Raw human food crops in direct contact with irrigation water (eg. via sprays, irrigation of salad vegetables)	< 10 cfu* / 100mL
Raw human food crops not in direct contact with irrigation water (edible product separated from contact with water, eg. by peel, use of trickle irrigation); or crops sold to consumers cooked or processed.	< 1000 cfu / 100mL
Pasture and fodder for dairy animals (without withholding period)	< 100 cfu / 100mL
Pasture and fodder for dairy animals (with withholding period of 5 days)	< 1000 cfu / 100mL
Pasture and fodder (for grazing animals except pigs and dairy animals, ie. cattle, sheep and goats)	< 1000 cfu / 100mL
Silviculture, turf, cotton, etc. (restricted public access)	< 10 000 cfu / 100mL

* cfu = colony forming units

Testing of irrigation waters for the presence of thermotolerant coliforms (also known as faecal coliforms), gives an indication of faecal contamination and thus the possible presence of microbial pathogens. However further testing will be required to indicate whether particular pathogenic organisms are present.

It is recommended that a median value be used based on a number of readings generated over time from a regular monitoring program.

APPENDIX 14. REVEGETATION: PRINCIPLES, PLANNING, TECHNIQUES AND SPECIES SELECTION

CONTENTS

I Revegetation Design

Planning of remnant vegetation protection and management and revegetation on your property needs to be in context with your whole property vision and how you want your property to interact with the broader region and meet the challenges of sustainable land use.

Regional and property planning is a key starting point for this process where remnant vegetation and land management issues are identified, and farming and environmental management activities are planned and implemented around this. Through this process it is possible to gain multiple land management, economic and biodiversity benefits.

Ia Revegetation and biodiversity

Through revegetation we are not trying to return the landscape to its original state, as this would be an impossible task, however through your revegetation activities it is desirable to incorporate biodiversity principles wherever possible.

Appropriate revegetation for biodiversity involves a number of design principles that need to be incorporated, they are:

- **Link** your remnant vegetation, natural regeneration and revegetation across your property, district and region.
- **Bigger** areas are better for biodiversity and the **shape** of remnants and revegetation is important. Square and round areas are better than narrow/ long areas.
- **Plant back** what was on the site before clearance. Collect local seed from as close as possible with the same soils, slope and aspect as your project site.
- **Plan** your projects and **manage** the remnant and revegetated areas by monitoring and controlling pest plants and animals.

► **Refer to: *Creative Revegetation - Enhancing biodiversity by design* (Dalton, 1998).**

Incorporating these design principles into regional and property planning will highlight the importance of protecting and managing our local remnant flora and fauna resources.

II Species selection

The appropriate selection of species for revegetation is important. You need to choose species that will thrive on the site and that will do what you want the revegetation to do.

IIa Local species

It is a common recommendation that you use species that would have originally occurred on the site, these are local species to the area and can suit the range of revegetation activities required across the region. Such activities include shelterbelts, riparian protection and recharge plantings.

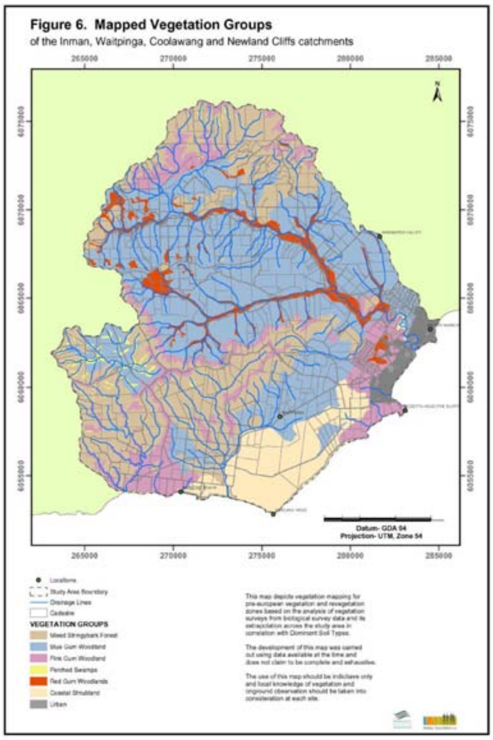
Using local species provides benefits of being suitable to the site. They can provide original forage and habitat for the fauna of the region, where appropriate vegetation structure is created, and do not pose a weed issue where local provenance propagation material are used.

Planting back what was on a site before clearance requires an understanding of the pre-European vegetation that occurred across the region. An understanding of this can be built up from studying the remnant vegetation near to your revegetation site along with studying historic documents of the vegetation changes across the region, and referring to vegetation mapping for your area.

Shown at right is the map of Vegetation Groups produced using the methodology outlined in Appendix 2 (see Figure 6 of this report).

This map is only to be used as an indication of the vegetation changes across the study area and should be used in conjunction with on ground observations and broader local knowledge.

Part VIa of this Appendix contains lists of species, particularly suited to revegetation, that have been drawn from DEH survey data. The full suite of species found in previous DEH surveys (and subsequently organised according to recognised Vegetation Groups) are listed in Appendix 2.



▶ **Refer to: Fact Sheet - Growing Local Plants (PIRSA, 1998b).**

Determining vegetation / revegetation zones for a site

Step 1 - From this publication build up your background knowledge:

- Locate your site on the Mapped Vegetation Groups map (Figure 6, or above).
- Identify the Vegetation Group changes from the map.
- Read the Vegetation Group descriptions in Section 2.3.3 of this report (Pre-European vegetation across the catchments).

Step 2 - Refine your understanding of vegetation on the site. Observe on-ground factors of:

- slope,
- aspect,
- soil,
- landscape, and
- remnant vegetation on the site and near by.

Step 3 - Draw conclusions of changes in vegetation type across your site from Step 1 and Step 2. Refer to species list for appropriate Vegetation Groups.

NOTE: The revegetation species lists (in Part VIa of this Appendix) are an indication of the species that can be revegetated that are found in association with each other. However the revegetation zones are quite broad and it is unlikely that all species listed would have occurred on the one site, hence the importance of assessing each site individually. Assistance with this can be gained from project officers, revegetation officers and contractors.

For example- where the Mixed Stringybark vegetation zone extends down to the coast, a greater proportion of coastal vegetation species will be present.

For particular coastal revegetation information refer to *A Handbook for Revegetation and Weed Control in the Southern Fleurieu Dunes* (Taylor, 2000).

Also, for more information on the protected Fleurieu Peninsula swamps see Section 2.3.4 of the main report, Appendix 3, or contact the Mt Lofty Ranges Southern Emu-wren Recovery Program.

IIb Special purpose species

Other species can be used where special purpose plantings are required. For economic purposes such as farm forestry, species are selected for site suitability, growth rate, tree form and timber properties and market requirements. Selecting species on this basis helps to maximise the economic return from products grown.

Special purpose species can also be utilised on sites that are highly altered where local species will not grow successfully, such as in highly saline areas. Where special purpose species are utilised it is necessary to consider the potential invasive nature of these species.

Questions to consider for each species include:

- How successfully does the species set seed?
- Does the seed readily germinate?
- Over what range will the species successfully grow in the region?
- What are the vectors of spread of the species?
- Will the species hybridise with local species?

Having considered the weed potential of a species, management plans should be developed and implemented to monitor and control the escape of any individuals from the planting area. Any non-local species can be gradually replaced with local species where changes in site condition allow or landholder requirements of the site change.

► **Refer to:**
- **Fact Sheet – Species Selection (Bulman, 1991), and**
- **Planning Principles for Revegetation - Planning Principles for establishing revegetation species suspected to be invasive (Section 10) (Edwards, 2001).**
- **Planning Principles for Revegetation - Planning Principles within and adjacnt to National Parks and Heritage Agreements and other areas of Significant Vegetation (Section 8) (Edwards, 2001).**

III Revegetation Planning

Allowing at least 18 months for planning and action prior to establishing revegetation will ensure that seed is collected, seedlings are ordered and grown and that the necessary weed control is carried out. The 'General Revegetation Planning Calendar' below contains details of activities and general timing.

General Revegetation Planning Calendar

	Year before planting						Year of planting												Ongoing
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Start Planning Seek advice early to ensure your time is not wasted																			**Ongoing control of woody weeds, broad leaf and grassy weeds. Infill of understorey species and native grasses. Allow natural process such as natural regeneration to occur. Maintain fences and control feral animals.**
Previous year weed control and fencing																			
Collect local seed																			
Obtain seedlings (By one of 3 methods)																			
a) Propagate own seedlings If propagating your own seedlings collect seed now and start propagation in November																			
b) Join Trees for Life Join and order by July Collect seedlings in May																			
c) Order seedlings from nursery																			
1st Weed control Summer/autumn weed control will be beneficial if good opening rains																			
Plant seedlings																			
Direct seed For higher rainfall areas June-August could be too wet for seeding																			
Insect control such as red legged earth mite (critical for direct seeding where this is an issue)																			
Follow up weed control																			
OR Contact consultant	This should be done as early as possible, it is never to early to plan.																		

The success of a revegetation project relies on many variables including season, appropriate seed/ seedlings being available, weed control and individual site conditions such as soil type, waterlogging and early drying out of sites (northern and western slopes). Good planning can minimise failure by planting/ seeding at the right time, reducing competition with weed control and allowing for changes in vegetation across the site.

Even with good planning a project may be unsuccessful in the first year due to unforseen circumstances. However appropriate planning and management of the site will see that works may not be wasted. Tubestock can be replanted and where direct seeding was carried out you can expect seed to come up over a number of seasons - the seed is in the ground and germination can be expected for two to three years. A requirement here is to manage weeds into the second and third years to reduce competition to later germinating seed.

▸ **Refer to: *Planning Principles for Revegetation,* (Edwards, 2001)**

IIIa Seed ordering/ collection and seedling ordering

Having the appropriate seed/ seedling material available at the right time for planting is a key factor for the successful establishment of revegetation. Different native plants vary in their timing of readiness for seed collection. Table (ii) below indicates the range of collection times for some genus. Even where a particular genus can have seed collected through the whole year, particular species can have a limited time available for seed collection.

Seed collection times vary from year to year, being earlier or later depending on the seasonal factors that affect flowering, pollination and setting of seed. Quantities of seed available for collection are also affected seasonally and this can impact on revegetation activities in a poor year. Revegetation establishment techniques may need to be varied where seed quantities are low.

Regional seed banks can assist with evening out good and bad seed collection years where in good collection years a bit extra could be collected and stored for use in the poorer years.

Planning ahead is important for preparing to collect seed yourself, for ordering seed from a contractor and where you require tubestock to be grown from collected seed. Six to eight months is generally required to grow seedlings to a suitable size for planting.

A permit is required to collect native seed from Public or Crown land. This can be obtained through the Department of Environment and Heritage, Native Vegetation Branch or through your local Council. When collecting from private land you need to contact the landowner for consent.

There are several publications available to assist with plant identification, seed collection and storage:

- *What Seed is That, by Neville Bonney*
- *How to collect native tree seed, easily, by Greening Australia*
- *Direct seeding native trees and shrubs, by Greg Dalton*

Table (ii) - A guide to seed collection times for native plant seed.

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Acacia (Wattles)					■	■	■					
Allocasuarina (Sheoak)	■	■	■	■	■	■	■	■	■	■	■	■
Banksia (Banksia)							■	■	■			
Bursaria (Christmas Bush)									■	■		
Callistemon (Bottle Brush)	■	■	■	■	■	■	■	■	■	■	■	■
Callitris (Native Pine)					■	■	■	■				
Dodonea (Hop bush)					■	■	■					
Eucalyptus (Gums)	■	■	■	■	■	■	■	■	■	■	■	■
Leptospermum (Tea Tree)	■	■	■	■	■	■	■	■	■	■	■	■
Melaleuca (Paperbarks)	■	■	■	■	■	■	■	■	■	■	■	■
Pultenea (Bush Pea)					■	■						
Rhagodia (Saltbush)						■	■	■	■	■		
Xanthorrhoea (Yacca)						■	■					

Learning the art of seed collection will vary depending on individual interest, the range of species being revegetated and the scale of seed collection activities carried out. Attend a Seed Collection workshop to assist with this. Trees for Life run seed collection and plant identification workshops throughout the year. For more details contact the Pasadena office on 8372 0150.

Once you have a basic understanding of seed collection techniques you can further develop your knowledge by observing the plants you want to collect seed from. Through this you can learn about the reproduction cycle of the plants and when particular seed will be ready for collection. When you see them flowering, follow the development of flowers into fruit and the fruit maturing to a stage ready for collection.

► **Refer to:** • **Fact Sheet – Collecting Native Plant Seed (Martin,1999b), and**
• **Fact Sheet - Seed Collection for Native Understorey Species (Murphy and Martin, 1999b)**

IIIb Weed control

A lot of effort goes into revegetation activities, collecting seed, growing seedlings and fencing from livestock. Appropriate weed control adds value to the time and money spent on these activities by improving the establishment and survival of seed and seedlings.

The most important factor with weed control is that once you begin weed control activities you open the site up to invasion by species that may not have been present on the site for a while, such as Salvation Jane. Planning should allow time for weed control activities for at least a couple of germinations prior to revegetating- **It is easier to control weeds on a site with out working around germinating seedlings**. And follow up weed control is required for at least a couple of years following revegetation to assist with successful establishment. Ongoing weed control in your revegetation area should also be carried out as part of your general property management so that the area does not become a weed infested treed area and to allow natural regeneration of any remnant species and the revegetated species on the site.

Photo (i) - Salvation Jane rosettes establishing on bare ground of a hand direct seeding spot. The site was prepared with a spot spray of knockdown herbicide.

Weeds reduce seedling establishment by competition for mainly moisture and also light and nutrients. Through good weed control a soil moisture reserve can be available for seedling use. This allows seed to germinate and seedlings to establish even in a low rainfall year and to better survive over the summer.

A weed free zone of 1.5- 2 meters around the establishing seedlings will allow the soil moisture reserve to develop. For tubestock and hand seeding a 1.5- 2m weed free spot is suitable and for machine seeding a 1.5- 2m wide weed free strip is required. In a good rainfall year this allows stronger and deeper-rooted seedlings to develop that are better able to survive through the summer and into the second year. It also assists to prevent shading and smothering of seedlings.

Photo (ii) - Strip weed control ready for speedling established farm forestry planting.

Photo (iii) - Spot spraying for tubestock and hand seeding of local species

Weed control requirements of revegetation activities will vary depending on remnant vegetation and weeds present, establishment techniques and site accessibility. The Table (iii) below gives an indication of site issues and weed control patterns suitable for different issues. Where remnant vegetation exists the use of minimum disturbance weed removal techniques are required. This will assist with the natural regeneration of the area.

On high rainfall sites with vigorous weed growth the control of weeds should start ideally 1-2 years before revegetating the site. Such sites may contain perennial weeds such as phalaris, sorrel, veldt grass, primrose, lucerne, couch grass, fog grass and clovers.

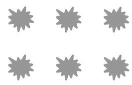
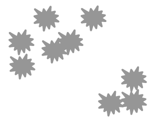
Generally knockdown herbicides (such as glyphosate) are used several times before and after planting seedlings or seeding. Soil residual herbicides can extend weed control over a longer period of time; affected soil however needs to be scraped away before seeding. Tubestock however should not be affected. Residuals have varying effects and longevity depending on soil type and humus levels present in the soil. Do not use residuals where remnant vegetation is present and natural regeneration can be expected. **SEEK ADVICE BEFORE USING RESIDUALS.**

Broadleaf specific and grass specific chemicals can be of use in revegetation weed control activities. Where remnant grasslands are present, broadleaf chemicals can be used to manage salvation jane with out effecting the grasses. Caution needs to be taken where other remnant species are present as selective herbicides can effect herbaceous grassy ecosystem species and young wattles with juvenile foliage. Once wattles are completely out of this stage then they are generally OK.

Grass specific herbicides can assist controlling annual and perennial grasses in establishing and established revegetation areas.

SEEK ADVICE BEFORE USING SELECTIVE HERBICIDES ON A SITE SPECIFIC BASIS- EFFECT ON REMNANTS BEING THE MAIN ISSUE.

Table (iii) - Site issues and weed control patterns

Site Issues	**Weed Control Patterns**				
	Blanket 	Straight Strip 	Crossover Strip 	Even Spaced Spots 	Clumped Spots 
Machine seeding	✓	✓	✓		
Hand seeding				✓	✓
Tubestock				✓	✓
Natural visual appeal			✓		✓
Improved habitat through random nature of reveg.			✓		✓
Weeds issue likely to be ongoing, such as sites with ex-improved pasture or crop	✓	✓		✓	
Sandy soil, high erosion potential		✓	✓	✓	✓
Difficult vehicle access such as steep sites and boggy sites				✓	✓
Large site	✓	✓	✓		
Remnant vegetation restoration					✓
Understorey and native grassy species present					✓

IIIc Timing

Timing of seeding and planting is just as important as plant selection and weed control. Seeding too early or too late can yield poor results. The same can be said for planting but not usually to the same degree, poor establishment could be particularly evident where planting takes place very late in the season.

The aim is to plant and or seed at a time to maximise growth for that year and minimise stress. Planting of tube stock can take place after the first rains, however, the plants will not put on much growth until the soil temperatures rise in early spring. This is not a problem unless the weed regime on the property includes competitive spring germinating weeds. If this is the case then these weeds will be directly competing with the newly planted natives and can inhibit their growth. Spot spraying at the end of winter/ beginning of spring can avoid competition, with planting taking place a few weeks after spraying in August/September. This minimises the weed competition and still provides for sufficient rain to settle in the new plants.

Direct seeding can also be carried out at this time of year, for the same reasons of weed control and soil moisture. It also allows the fine seeds in the seeding mix to be exposed to the moisture of spring and the rising soil temperatures, this increases the germination rate of some species.

Timing of establishment is generally determined by the seasons, however this can vary from year to year with seasonal fluctuations. Always consider how the season is going, if it is looking like a dry one perhaps postpone establishment for the following season.

IIId Spacing

Tighter spacing of seedlings can assist to compete with weed species more effectively along with weed control activities. Planting spacings where the canopies touch in the first 18 months will assist. Seedlings can generally be grouped into **shrubs to 2 metres**, **large shrubs** and **trees**. Shrubs to 2m can be planted approx 1m apart in single species clumps on weedy areas (size of clumps will depend on size of weedy areas but generally 5-10/ clump). This will assist plants to more quickly compete out weeds and for them to set seed and naturally regenerate themselves, also providing thickets of habitat. Large shrubs can also be planted in this style with approx 2m spacing between seedlings. Trees can be planted at approx 5m apart across the weedy area- avoiding the weed free native grassland areas.

In general broadleaf native species such as *Goodenia ovata* (hop goodenia, for wet areas) and *Dodonaea viscose ssp. spathulata* (sticky hop bush) can have greater shading effect on weed species, particularly broadleaf weeds.

On sites that would have been open woodland with scattered trees, scattered clumps of shrubs and open areas of grassland, it is important to not over plant trees and shrubs as this will change the grassy nature of the area.

IV Establishment techniques

Techniques used for the establishment of revegetation will vary from site to site and often across a site. Factors that will determine which techniques are used include what is present on the site, remnant vegetation, weed issues, seed and/or seedling availability and accessibility for vehicles. Four commonly used revegetation techniques are:

- natural regeneration
- seedling planting
- hand direct seeding
- machine direct seeding

IVa Natural Regeneration

One of the easiest ways to establish large areas back to native vegetation is to allow the natural regeneration of remnant vegetation to occur. This requires propagules of seed or bulbs to be available from existing remnant vegetation or existing in the soil seed reserves.

Many species will regenerate naturally provided the right conditions are also available and that the area being regenerated has stock removed and vermin controlled. Weed control provides an important factor where competition from weeds for light, moisture and warmth can be reduced to allow regeneration to occur. The factors of weed, vermin and livestock control are essential for success.

Areas can be monitored for species that have regenerated and an assessment made of species that could be reintroduced over time.

► **Refer to: Fact Sheet - Natural Regeneration of Native Vegetation (Martin, 1999).**

IVb Seedling Planting

Seedlings can be grown from seed and cuttings depending on the propagation material available and the best technique for the species being propagated. Tubestock can be labour intensive and costly on large-scale projects. Planting of seedlings is useful on all sites, particularly incorporating more difficult species into natural regeneration and previously established revegetation. Boggy and steep sites with difficult access can be planted with seedlings.

Seedlings are grown in a range of container sizes from speedlings (trays of 30-40 seedlings with small root balls) and traditional tube containers to more advanced pot stock. Speedlings and tubestock have advantages of cost, ease of planting and good establishment.

Generally spot spraying is suitable for seedling planting. Strip spraying is most practical where a site requires ripping. Ripping compacted sites can provide easier planting conditions. A good rip lifts and fractures the subsoil, which is best achieved using a wide boot or a winged tine. The main concern with getting a good rip is in clay soils. If the soil is too wet, the tine and boot slice through the soil leaving a slicked channel, this causes problems with plant establishment and root development. Early winter is a good time where following some initial rains the surface soil is damp and the subsoil is relatively dry from the summer. Ripping should ideally take place 12 months prior to planting to allow the rip line to settle and reduce air pockets and to provide time for weed control activities. The soil disturbance from ripping opens the site up to weeds.

IVc Hand Direct Seeding

Hand direct seeding is a technique where seed is placed by hand directly on to a prepared soil bed and pressed in, it is labour intensive and often used in combination with other techniques. The seedbed is prepared using a fire rake/ rake hoe to chip away trash and dead weeds from the surface, break soil clods and firm seed into the soil.

As with tubestock planting you have control of placement of seedlings and can vary density of seeding and placement of species. Hand seeding is suitable on all sites and is particularly useful on steep, rocky and less accessible sites for machine seeders and where moving tubestock around the site is difficult. It is also useful for incorporating missing species into degraded remnant areas where machine seeding is inappropriate.

Amounts of seed used are considerably less than those used in machine seeding: 200-300 grams/ha of fine seed and 300-500 grams/ha of large seed, 500-600 grams of seed required all up if a fine and large seed being used on a site. Ideally the germination from hand seeding will occur with in 2-3 weeks of sowing the seed. For this to occur some species require the pre-treatment of seed, such as heat treating (wattles and other hard coated seeds) or cooling of seed (such as *Bursaria sp*.). Species from the Eucalyptus, Melaleuca, Leptospermum genus's and other fine seed generally requires no treatment and germinate readily where the right conditions are provided. Fine seed can however be pre-treated and some contactors will pre-treat this seed. Advice should be sought on the appropriate treatment of seed.

► **Refer to:**
- **Fact Sheet – Hand Direct Seeding of Native Plants (PIRSA, 1998), and**
- **Fact Sheet - Seed Pre-treatments for Native Understorey Species (Murphy and Martin, 1999).**

IVd Machine Direct Seeding

Machine direct seeding is an easy and cost effective way of seeding large accessible areas. The seeding machine is towed behind a four-wheel drive vehicle or a tractor, so access is limited on steeper areas and boggy sites.

A lot of seed (1000-1500 grams/ha) is required for machine seeding in comparison to tube stock establishment and hand seeding. And the control of the placement of seed is restricted to the seeding lines and changing species mixes for different sites. The germination of seed in the seeding lines varies in density of seedlings and placement of species, germination can be dense or very patchy and a range of species can come up next to one another. As with hand seeding some species require the pre-treatment of seed for germination to occur quickly.

► **Refer to: Fact Sheet – Direct Seeding (Rural Solutions SA, 2003)**

IVe What Technique to Use Where

Using a combination of establishment techniques can assist to achieve success on a range of sites with a range of issues. Table (iv) below gives an example of site issues that may be encountered and appropriate establishment techniques.

Table (iv) - Site issues and establishment technique options

Site Issues	Establishment Technique			
	Natural Regeneration	Machine Seeding	Hand Seeding	Tubestock
Remnant vegetation restoration	✓		✓	✓
Understorey and native grassy species present	✓		✓	✓
Rocky ground	✓		✓	✓
Difficult vehicle access such as steep and boggy sites			✓	✓
Large sites with easy access		✓	✓	✓

Figure (i) below indicates a range of revegetation techniques being used across a site where site conditions change from a wet creekline area (top left hand corner), across a large open gentle slope to a steep rocky thin soiled area (bottom right hand corner)

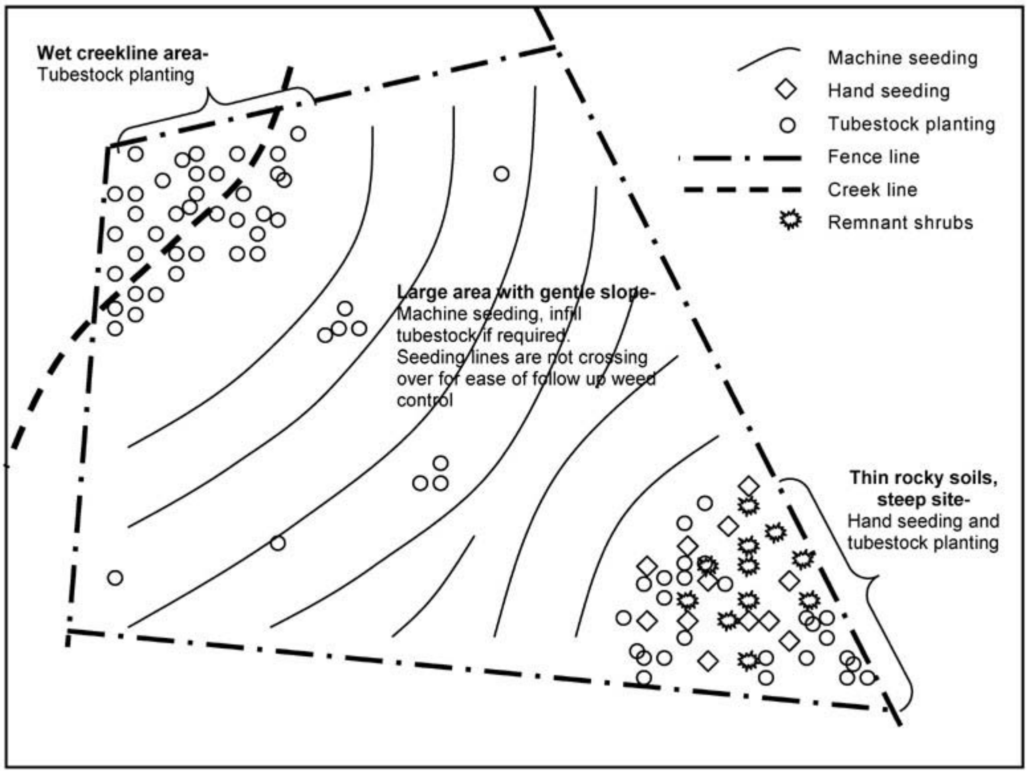
V Issues

Va Revegetation and landslips

High rainfall, cleared land of the region is prone to landslip issues where soil becomes sodden and liquefies and mass movement of soil occurs down the slope. These sites require particular planning and establishment actions to ameliorate the issue.

The area that needs to be planted up is not just the slip area, the hillside above the slip also needs to be planted. This will intercept (use) some of the ground water moving down the slope and reduce the soil moisture levels in the slip prone soils. A range of trees, shrubs and native grasses can be established above the slip, however trees should be

Figure (i) - Using different establishment techniques across a site with different features



avoided on the slip and a range of shrubs and grasses used. If possible it is good to plant the recharge areas on the hill tops to reduce the recharge of ground water.

Weed control on slump prone areas is still required and spot spraying is appropriate, blanket spraying should not be carried out and the sites are generally too steep for strip spraying.

Vb Maintenance

Maintaining your remnant vegetation and revegetation is an investment in your property and the broader community and must have long term, ongoing, action for it to thrive. Ongoing weed control is essential for the initial survival and establishment of seed and seedlings used in revegetation. Refer to the weed control section for details.

Electric fences have been used effectively to protect remnants and revegetation from livestock and vermin, they do however require checking and ongoing maintenance. Absentee landholders may consider using pre-emergent herbicides along fence lines to reduce weed growth and shorting of electrics.

In areas of remnant grassland, slashing of grasses can be utilised to reduce the seed set of weedy grasses and promote the seed set and establishment of native grass species.
This can be carried out with slashing or spraying. Spraying is of concern as it could damage the grassland species. High slashing is another option, being aware of fire issues, this could take place in late winter/ early spring to reduce annual grass seed set.

Annual grass management should take place over 5-10 years to assist with the natural regeneration of the native grassland species. If possible it is best to catch or rake and remove cut grass, as this impacts on the regenerative processes of the grassland species.

Tree guards are only useful if fitted properly and they stay in place, check them regularly for placement. Removal of tree guards is required once seedlings are established and the tree guards no longer serve a purpose. A good indicator to remove guards is when the seedlings are just over the top of the guard. Removing guards prevents them from becoming rubbish in the environment and allows them to be recycled and prevents the guard strangling the plant as it grows, depending on the type of guard.

Native vegetation is prone to attack from insects. Young wattles can get galls and Eucalypts can be prone to leaf blister and defoliation. In general these pests are natural species and are crucial for our natural systems. They provide food sources for birds and mammals and other insects and can provide lifecycle links for flora and fauna. The damage caused by insects can actually be beneficial for vegetation structure, where weaker plants may be killed by persistent attack and provide a natural thinning of vegetation. Other plants will be promoted in to lateral branching and growth with habitat, forage and perching benefits for birds. It is generally not required to control insect attack on natural regeneration and revegetation, insects can be removed by hand to a limited degree and control with chemicals can be fairly toxic with limited benefit. A major insect attack on vegetation generally indicates an imbalance in the natural processes and interactions between flora, fauna and insects. As vegetation grows and the system changes and these imbalances can even out with less severe insect attacks occurring.

It can be frustrating when tubestock and seeded areas fail, however all may not be wasted. Tubestock can be replanted and the weed control already carried out can be continued and benefit the project when re-planting occurs.

Machine and hand seeding gaps can be used to create patchiness, habitat for seed foraging birds, insect catching birds and reptiles. Seeding should be allowed to come up over a couple of years. This is possible because more seed is put in than required and can germinate when the conditions are suitable.

It is important therefore to manage weeds into the second and third years- spot spray hand seeded areas and strip spray machine seeded areas. Use a shielded spray to avoid contacting seedlings that have come up in the first year. This weed control will also assist germinated seedlings to become established.

Adding in more difficult species can be done as the initial revegetation species form canopies, microclimates develop, humus builds up, recycling of nutrients begins and other natural process occur. These are species that require protection from exposure and a degree of natural process occurring and are listed in the phase 2 revegetation species list. These species can also be difficult to collect seed from; seed can show poor viability and propagation techniques may be poorly understood. Part of this process may be thinning some of the larger canopy trees where densities are high and lateral branching is not occurring. This can take place at 3-5 years and is more likely to be required in machine direct seeded areas or natural regeneration areas where Eucalyptus species can dominate.

Vc Threats

As previously mentioned, unexpected weather patterns can affect germination in direct seeding, however selection of correct species can partly overcome this problem.

The biggest threats to revegetation work often come from inadequate weed control and grazing from vermin (rabbits and hares). Direct seeding can be effected severely from red-legged earth mite and snails, so this needs to be taken into account before the project begins. Kangaroos can also do a lot of damage through grazing especially when in large numbers.

The following list can be used as a checklist before planting:

1. Area for planting/seeding be sprayed with a translocated herbicide two months before implementation. If possible, this could also take place in the year prior to planting/ seeding.
2. Rabbit/hare control be implemented in conjunction with revegetation work (Animal and Plant Control Board can provide advice, also on weed control).
3. If direct-seeding, spray for red-legged earth mite if required.
4. Snail bait should be laid if required.
5. Guard plants or plan other control/ deterrent if kangaroos present a major threat (see Part Vd of this Appendix).
6. Plan for on-going maintenance after planting.
7. If ripping is required on hard ground, this needs to be done 12 months before planting if possible.
8. Make sure fences for stock are finished before planting.

These actions will not be required for every site, but may need to be incorporated into a revegetation plan, depending on site conditions.

It should be noted that weed control is just that, it is the control of weeds for the establishment period. Weeds will return to the area, but if adequate planting density is achieved then competition from native plants will help to suppress weeds. Some species of weeds are particularly difficult to control and professional advice should be sought to obtain the best methodology for a single species or group of species.

The planting of *Themeda triandra* (Kangaroo Grass) in areas of Phalaris can also assist in its control. This native grass does well in high rainfall and fertile soils, and can hold it's own against Phalaris once established.

Vd Kangaroo Issues

Kangaroo browsing can reduce the successful establishment of revegetation and is noted as a particular issue on the Southern Fleurieu. A number of techniques have been used to reduce kangaroo browsing.

Fencing your revegetation is required to exclude stock A hot wire top and bottom has been used to reduce kangaroo access to revegetation areas. Caution is required here as a bottom hot wire can entangle and harm echidnas. Electricity should not be applied to fences with barbs as kangaroos and livestock can be caught up in the barbs and electrified wires, with severe damage resulting from movement with each shock.

Particular species are preferred by kangaroos such as the sheoaks and will often be sought out. During the summer period when food is scarce and on sites where kangaroos are in large numbers many species will be damaged. Prickly species are generally less palatable once fresh growth has hardened off, and can be utilised as a nurse species to protect more palatable species. *Acacia paradoxa* (kangaroo thorn) and *A. verticillata* (prickly moses) are species found in the Inman region and can be used for this purpose. This technique can be used with machine and hand direct seeding where a high proportion of prickly species seed is in the seed mix for machine seeding. With hand seeding, prickly species seed is placed on the seeding site with seed of the species you are trying to protect. Where tubestock is used, clumps of prickly species can be planted with the more palatable species. Encouraging native grass re-establishment throughout your revegetation area provides an alternative food source for kangaroos. This is particularly effective during summer when feed is short.

The use of tree guards has had mixed success. Narrow cardboard carton guards with one stake have worked. Being narrow they minimise browsing from above and a stake pushed well into the ground and secured holds the guard down. Another guard that has been used is the stretchy orange bag mesh, this sits firmly around the foliage of the seedling and provides mechanical protection from browsing.

Browsing deterrents have had some interest in recent years where concoctions with deterring odours, flavour and texture have been tried. These deterrents can be placed on the ground around the seedlings (odour deterrents) or applied to the seedlings (odour, taste and palatability deterrents).

Kangaroos are fairly easily harassed and easily moved on either through deliberate noise and activity in areas where they congregate, or through heavier stocking of paddocks surrounding areas being established with revegetation. “Roo Shoo” devices may also deter kangaroos from hanging around and research into the effectiveness of different devices for particular situations is required.

Culling of kangaroos is an option to reduce the size of large mobs or to disturb a mob. This activity requires a Permit from DEH and may be required periodically as mob numbers build up. Taking out the buck disturbs the mob, however reducing buck, doe and joey numbers across the mob reduces the genetic impact on the mob. Leaving a carcass as a deterrent has reduced kangaroo activity in areas.

▸ **Refer to: Fact Sheet – Animal Repellants (QLD DNR, 1996) (this does not refer to roos but some recipes are worth a go).**

Ve Hygiene

The possibility of spreading plant diseases and environmental weeds through seed collection and revegetation activities is a real one. These threats can be spread through soil on vehicles, machinery, equipment and boots. And spread through infected tubestock and plant materials. The soil borne root rot disease, *phytophthora sp.* is known to occur in the region and has a huge potential to damage remnant vegetation areas and affect revegetated areas.

Best practice techniques should be put in place to reduce the risk of spread of these threats. Best practice activities should be implemented by LandCare Groups, seed collection contractors, spray contractors, revegetation contractors and local government workers. See Edwards (2001), *Section 9 - Planning Principles for Hygiene Management* for details on best practice activities. The Department of Environment and Heritage (DEH) also has a Phytophthora Species Project Officer who should be worked with (for more information contact your local DEH office).

VI Additional Information

VIa Revegetation Species Lists

The following pages contains lists of species suitable for revegetation based on revegetation zones identified. 'Reveg Phase' indicates the suitability of a species to be used in the initial revegetation stages (reveg phase 1) or in the latter stages of revegetation and degraded remnant vegetation enhancement (reveg phase 2), where suitable conditions exist. Species from reveg phase 1 can be used at any stage through the revegetation process. Note that species marked as Direct Seeding establishment method can be established through Seed Grown Tubestock.

Mixed Stringybark Forest Revegetation Species List
NOTES:
Reveg Phase- 1= Initial reveg (Phase 1 species can also be used for Phase 2), 2= Infill for established reveg AND for degraded remnant vegetation.

Establishment Method- C= Cutting grown tubestock, S=Seed grown tubestock, D= Direct seeding (can also be established from Seed grown tubestock), P= Divided material and Plugged directly into the site, *= Very difficult to propagate.

Plant Type- C= Canopy, M= Mid Storey, U=Understorey, CL= Climber, T= Tussock (grasses, sedges etc)

SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Acacia myrtifolia(NC)	Myrtle Wattle	Bitter Leaf Wattle	1	D	M
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle	1	D	M
Acacia pycnantha	Golden Wattle		1	D	M
Acacia retinodes var.	Silver Wattle		1	D	M
Acacia retinodes var. retinodes (swamp form)	Swamp Wattle		1	D	M
Acacia spinescens	Spiny Wattle		1	D	M
Acacia verticillata	Prickly Moses		1	D	C
Allocasuarina mackliniana ssp. mackliniana	Macklin's Oak-bush	Coarse Oak-bush	1	D	M
Allocasuarina muelleriana ssp.	Common Oak-bush	Slaty Oak-bush	1	D	M
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush	Slaty Oak-bush	1	D	M
Allocasuarina paludosa	Swamp Oak-bush	Scrub Sheoak	1	D	M
Allocasuarina pusilla	Dwarf Oak-bush	Heath Oak-bush	1	D	M
Allocasuarina striata	Stalked Oak-bush	Tall Oak-bush	1	D	M
Allocasuarina verticillata	Drooping Sheoak		1	D	C
Banksia marginata	Silver Banksia	Honeysuckle	1	S	M
Banksia ornata	Desert Banksia	Sand-heath Banksia	1	S	M
Bursaria spinosa	Sweet Bursaria	South Australian Christmas Bush	1	S	M
Carex appressa	Tall Sedge	Tussock Sedge	1	D/P	T
Carex breviculmis	Short-stem Sedge		1	D/P	T
Carex fascicularis	Tassel Sedge		1	D/P	T
Clematis microphylla	Old Man's Beard	Small-leaf Clematis	1	S	CL
Danthonia caespitosa	Common Wallaby-grass	White-top	1	S	T
Danthonia eriantha	Hill Wallaby-grass		1	S	T
Danthonia geniculata	Kneed Wallaby-grass		1	S	T
Danthonia pilosa var. paleacea	Velvet Wallaby-grass		1	S	T
Danthonia setacea var. setacea	Small-flower Wallaby-grass	Bristly Wallaby-grass	1	S	T
Danthonia sp.	Wallaby-grass		1	S	T
Danthonia tenuior	Short-awn Wallaby-grass	Purplish Wallaby-grass	1	S	T
Daviesia leptophylla	Narrow-leaf Bitter-pea		1	S	U/M
Dodonaea viscosa ssp.	Sticky Hop-bush		1	D	M
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Spoon-leaf Hop-bush	1	D	M
Eucalyptus baxteri	Brown Stringybark	Baxter's Stringybark	1	D	C
Eucalyptus camaldulensis var.	River Red Gum		1	D	C
Eucalyptus camaldulensis var. camaldulensis	River Red Gum	Red Gum	1	D	C
Eucalyptus cneorifolia	Kangaroo Island Narrow-leaf Mallee		1	D	C
Eucalyptus cosmophylla	Cup Gum	Bog Gum	1	D	C
Eucalyptus fasciculosa	Pink Gum	Hill Gum	1	D	C
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		1	D	C
Eucalyptus leucoxylon(NC)	South Australian Blue Gum	Yellow Gum	1	D	C
Eucalyptus obliqua	Messmate Stringybark	Stringybark	1	D	C
Eucalyptus obliqua var. obliqua(NC)	Messmate Stringybark	Stringybark	1	D	C
Eucalyptus obliqua var.(NC)	Messmate Stringybark		1	D	C
Eucalyptus rubida ssp. rubida	Candlebark Gum	White Gum	1	D	C
Eucalyptus viminalis ssp.	Manna Gum		1	D	C
Eucalyptus viminalis ssp. cygnetensis	Rough-bark Manna Gum		1	D	C
Goodenia ovata	Hop Goodenia		1	S/C	U
Goodenia varia	Sticky Goodenia		1	S/C	U
Hakea carinata	Erect Hakea		1	S	U
Hakea rostrata	Beaked Hakea	Turkey Gobblers	1	S	U
Hakea rugosa	Dwarf Hakea	Wrinkled Hakea	1	S	U
Helichrysum scorpioides	Button Everlasting		1	S	U
Indigofera australis var. australis	Austral Indigo	Hill Indigo	1	S	M
Isolepis fluitans	Floating Club-rush		1	D/P	T
Isolepis inundata	Swamp Club-rush		1	D/P	T
Isolepis nodosa	Knobby Club-rush	Knobby Club-sedge	1	D/P	T
Juncus bufonius	Toad Rush		1	D/P	T
Juncus caespiticius	Grassy Rush		1	D/P	T
Juncus kraussii	Sea Rush		1	D/P	T
Juncus pallidus	Pale Rush		1	D/P	T
Juncus pauciflorus	Loose-flower Rush		1	D/P	T
Juncus planifolius	Broad-leaf Rush		1	D/P	T
Juncus sarophorus			1	D/P	T
Juncus sp.	Rush		1	D/P	T
Juncus subsecundus	Finger Rush		1	D/P	T
Kennedia prostrata	Scarlet Runner	Running Postman	1	S	U
Lavatera plebeia	Australian Hollyhock	Native Hollyhock	1	S	M
Lepidosperma concavum	Spreading Sword-sedge	Sandhill Sword-sedge	1	S/P	T
Leptospermum continentale	Prickly Tea-tree		1	D	M
Leptospermum lanigerum	Silky Tea-tree	Woolly Tea-tree	1	D	M
Leptospermum myrsinoides	Heath Tea-tree		1	D	M
Leptospermum sp.	Tea-tree		1	D	M
Melaleuca brevifolia	Short-leaf Honey-myrtle	Swamp Honey-myrtle	1	S	M
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle	1	D	M
Olearia ramulosa	Twiggy Daisy-bush		1	S/C	U
Phragmites australis	Common Reed	Bamboo Reed	1	S/P	T
Poa clelandii	Matted Tussock-grass	Cleland's Poa	1	S	T
Poa sp.	Meadow-grass/Tussock-grass	Poa	1	S	T
Poa tenera	Slender Tussock-grass	Spreading Tussock-grass	1	S	T
Pultenaea daphnoides	Large-leaf Bush Pea		1	D	M
Schoenus apogon	Common Bog-rush	Common Bog-sedge	1	D/P	T
Schoenus breviculmis	Matted Bog-rush	Moss Bog-rush	1	D/P	T
Stipa mollis	Soft Spear-grass	Supple Spear-grass	1	S	T
Stipa sp.	Spear-grass		1	S	T
Themeda triandra	Kangaroo Grass	Ilintji	1	D	T

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SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Typha domingensis	Narrow-leaf Bulrush	Narrow-leaf Cumbungi	1	S	T
Daviesia brevifolia	Leafless Bitter-pea		1-2	S	U
Daviesia ulicifolia ssp. incarnata			1-2	S	U
Daviesia ulicifolia(NC)	Gorse Bitter-pea		1-2	S	U
Dianella brevicaulis	Short-stem Flax-lily	Coast Flax-lily	1-2	S/P	T
Dianella brevicaulis/revoluta var.	Black-anther Flax-lily	Spreading Flax-lily	1-2	S/P	T
Dianella revoluta var.			1-2	S/P	T
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily	1-2	S/P	T
Dianella revoluta(NC)			1-2	S/P	T
Eutaxia sp.	Eutaxia	Eggs-and-bacon	1-2	C	U
Lomandra juncea	Desert Mat-rush		1-2	S	T
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	1-2	S	T
Acrotriche serrulata	Cushion Ground-berry	Honeypots	2	C	U
Adenanthos terminalis	Yellow Gland-flower		2	C	U
Arthropodium fimbriatum	Nodding Vanilla-lily	Summer Vanilla-lily	2	S	U
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	2	S	U
Astroloma conostephioides	Flame Heath		2	C*	U
Astroloma humifusum	Cranberry Heath	Native Cranberry	2	C*	U
Baeckea ramosissima ssp. ramosissima	Rosy Baeckea		2	C*	U
Baumea juncea	Bare Twig-rush	Blue Twig-rush	2	SP	T
Billardiera bignoniacea	Orange Bell-climber		2	S/C	CL
Billardiera cymosa	Sweet Apple-berry		2	S/C	CL
Billardiera sericophora	Silky Apple-berry		2	S/C	CL
Billardiera sp.	Apple-berry		2	S/C	CL
Billardiera uniflora	One-flower Apple-berry	Single-flower Apple-berry	2	S/C	CL
Boronia edwardsii	Edwards' Boronia	Island Boronia	2	C	U
Bossiaea prostrata	Creeping Bossiaea		2	S	U
Bracteantha bracteata	Golden Everlasting	Tjulpun-tjulpunpa	2	S	U
Brunonia australis	Blue Pincushion	Tjulpun-tjulpunpa	2	S	U
Burchardia umbellata	Milkmaids	Milk Lily	2	S	U
Calytrix tetragona	Common Fringe-myrtle		2	S/C	U/M
Cheiranthera alternifolia	Hand-flower	Finger-flower	2	C	U
Chrysocephalum apiculatum	Common Everlasting	Small Yellow Button	2	S	U
Chrysocephalum baxteri	White Everlasting	Fringed Everlasting	2	S	U
Correa aemula s.str.	Hairy Correa		2	C	U
Correa aemula(NC)	Hairy Correa		2	C	U
Correa eburnea			2	C	U
Correa reflexa	Common Correa		2	C	U
Correa reflexa var. reflexa	Common Correa		2	C	U
Craspedia glauca	Billy-buttons	Bachelor Buttons	2	S	U
Cryptandra tomentosa	Heath Cryptandra	Velvet Cryptandra	2	C*	U
Cullen australasicum	Tall Scurf-pea	Verbine Scurf-pea	2	S	U
Cyperus tenellus	Tiny Flat-sedge		2	D/P	T
Cyperus vaginatus	Stiff Flat-sedge	Puta-puta	2	D/P	T
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	2	S/C	U
Dillwynia sericea	Showy Parrot-pea		2	S/C	U
Epacris impressa	Common Heath	Heath	2	C*	U
Exocarpos cupressiformis	Native Cherry	Cherry Ballart	2	S*	M
Exocarpos sparteus	Slender Cherry	Broom Ballart	2	S*	U
Gahnia sieberiana	Red-fruit Cutting-grass	Red-fruit Saw-sedge	2	S	T
Gompholobium ecostatum	Dwarf Wedge-pea		2	S/C*	U
Gonocarpus mezianus	Broad-leaf Raspwort	Hairy Raspwort	2	C	U
Gonocarpus tetragynus	Small-leaf Raspwort	Common Raspwort	2	C	U
Goodenia blackiana	Native Primrose	Black's Goodenia	2	S*	U
Goodenia geniculata	Bent Goodenia	Native Primrose	2	S*	U
Grevillea ilicifolia var. ilicifolia	Holly-leaf Grevillea	Native Holly	2	S/C	U
Grevillea lavandulacea var.	Spider-flower	Heath Grevillea	2	S/C	U
Grevillea lavandulacea var. lavandulacea	Spider-flower	Heath Grevillea	2	S/C	U
Grevillea lavandulacea var. sericea	Spider-flower	Heath Grevillea	2	S/C	U
Hibbertia aspera(NC)			2	C	U
Hibbertia exutiacies	Prickly Guinea-flower	Spiky Guinea-flower	2	C	U
Hibbertia incana			2	C	U
Hibbertia riparia	Guinea-flower		2	C	U
Hibbertia riparia (glabriuscula)	Smooth Guinea-flower		2	C	U
Hibbertia riparia (long-leaved aff. H. stricta)	Bristly Guinea-flower		2	C	U
Hibbertia sericea var.	Silky Guinea-flower		2	C	U
Hibbertia sericea var. sericea	Silky Guinea-flower		2	C	U
Hibbertia sp.	Guinea-flower		2	C	U
Hibbertia sp. B	Scrambling Guinea-flower		2	C	U
Hibbertia stricta var. stricta	Stalked Guinea-flower	Erect Guinea-flower	2	C	U
Hibbertia virgata	Twiggy Guinea-flower		2	C	U
Isopogon ceratophyllus	Horny Cone-bush	Cone-bush	2	S	U
Ixodia achillaeoides ssp.	Ixodia		2	S/C	U
Ixodia achillaeoides ssp. achillaeoides	Coast Ixodia		2	S/C	U
Ixodia achillaeoides ssp. alata	Hills Daisy	Winged Ixodia	2	S/C	U
Laxmannia orientalis	Dwarf Wire-lily		2	S	T
Laxmannia sessiliflora(NC)	Dwarf Wire-lily		2	S	T
Lepidosperma carphoides	Black Rapier-sedge		2	S/P	T
Lepidosperma curtisiae	Little Sword-sedge		2	S/P	T
Lepidosperma laterale s.str.	Tall Sword-sedge		2	S/P	T
Lepidosperma longitudinale	Pithy Sword-sedge	Swamp Sword-sedge	2	S/P	T
Lepidosperma semiteres	Wire Rapier-sedge		2	S/P	T
Lepidosperma viscidum	Sticky Sword-sedge		2	S/P	T
Leucopogon australis	Spike Beard-heath		2	C*	U

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Leucopogon concurvus	Scrambling Beard-heath		2	C*	U
Leucopogon lanceolatus	Lance Beard-heath		2	S/C*	U
Leucopogon rufus	Ruddy Beard-heath		2	C*	U
Leucopogon virgatus	Common Beard-heath		2	C*	U
Logania recurva	Recurved Logania		2	S/C	M
Lomandra collina	Sand Mat-rush	Sharp-leaf Mat-rush	2	S	T
Lomandra fibrata	Mount Lofty Mat-rush	Fine Mat-rush	2	S	T
Lomandra micrantha ssp.	Small-flower Mat-rush		2	S	T
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		2	S	T
Lomandra micrantha ssp. tuberculata	Small-flower Mat-rush		2	S	T
Lomandra nana	Small Mat-rush	Soft Mat-rush	2	S	T
Lomandra sororia	Sword Mat-rush	Small Mat-rush	2	S	T
Lomandra sp.	Mat-rush		2	S	T
Micrantheum demissum	Dwarf Micrantheum		2	C	U
Microlaena stipoides var. stipoides	Weeping Rice-grass	Weeping Grass	2	S	T
Olearia grandiflora	Mount Lofty Daisy-bush		2	S/C	U
Patersonia fragilis	Short Purple-flag	Swamp Iris	2	S/P	T
Patersonia occidentalis	Long Purple-flag		2	S/P	T
Persoonia juniperina	Prickly Geebung	Geebung	2	C*	U
Phyllota pleurandroides	Heathy Phyllota		2	C*	U
Pimelea glauca	Smooth Riceflower		2	C	U
Pimelea humilis	Low Riceflower	Common Riceflower	2	C	U
Pimelea linifolia ssp. linifolia	Slender Riceflower		2	C	U
Pimelea octophylla	Woolly Riceflower	Downy Riceflower	2	C	U
Pimelea phylicoides	Heath Riceflower		2	C	U
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	2	S	U
Pomaderris paniculosa ssp.			2	S/C	U
Poranthera ericoides	Heath Poranthera		2	C	U
Poranthera microphylla	Small Poranthera	Small-leaf Poranthera	2	C	U
Pultenaea acerosa	Bristly Bush-pea		2	S/C	U
Pultenaea canaliculata var.	Soft Bush-pea	Coast Bush-pea	2	S/C	U
Pultenaea canaliculata var. canaliculata	Soft Bush-pea	Coast Bush-pea	2	S/C	U
Pultenaea graveolens	Scented Bush-pea		2	C	U
Pultenaea involucrata	Mount Lofty Bush-pea		2	S/C	U
Pultenaea largiflorens	Twiggy Bush-pea		2	S/C	U
Pultenaea pedunculata	Matted Bush-pea		2	S/C	U
Pultenaea trinervis	Three-nerve Bush-pea		2	S/C	U
Scaevola albida	Pale Fanflower	Small-fruit Fanflower	2	S/C	U
Scaevola albida var. albida	Pale Fanflower	Small-fruit Fanflower	2	S/C	U
Scaevola albida var.(NC)			2	S/C	U
Senecio glomeratus	Swamp Groundsel	Toothed Groundsel	2	S	U
Senecio hispidulus var. hispidulus	Rough Groundsel	Hispid Fireweed	2	S	U
Senecio odoratus var.	Scented Groundsel		2	S	U
Senecio odoratus var. odoratus	Scented Groundsel		2	S	U
Senecio quadridentatus	Cotton Groundsel	Cotton Fireweed	2	S	U
Senecio squarrosus	Squarrose Groundsel	Leafy Fireweed	2	S	U
Senecio tenuiflorus	Woodland Groundsel	Narrow Groundsel	2	S	U
Spyridium coactilifolium	Butterfly Spyridium		2	C	U
Spyridium sp.	Spyridium		2	C	U
Spyridium thymifolium	Thyme-leaf Spyridium		2	C	U
Stipa muelleri	Tangled Spear-grass	Wiry Spear-grass	2	S	T
Stylidium graminifolium	Grass Trigger-plant		2	S	U
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells	Pink-eyed Susan	2	C	U
Thomasia petalocalyx	Paper-flower		2	S/C	U
Thysanotus juncifolius	Rush Fringe-lily		2	S	U
Thysanotus patersonii	Twining Fringe-lily		2	S	U
Viola cleistogamoides	Shy Violet	Hidden Violet	2	S/C	U
Viola hederacea	Ivy-leaf Violet		2	S/C	U
Viola sieberiana	Tiny Violet	Sieber's Violet	2	S/C	U
Wahlenbergia gracilenta	Annual Bluebell		2	S/P	U
Wahlenbergia multicaulis	Tadgell's Bluebell		2	S/P	U
Wahlenbergia sp.	Native Bluebell		2	S/P	U
Wahlenbergia stricta ssp. stricta	Tall Bluebell		2	S/P	U
Xanthorrhoea semiplana ssp.	Yacca	Flat-leaf Grass-tree	2	S	T
Xanthorrhoea semiplana ssp. semiplana	Yacca	Flat-leaf Grass-tree	2	S	T
Xanthorrhoea semiplana ssp. tateana	Tate's Grass-tree		2	S	T
Xanthosia pusilla	Hairy Xanthosia	Heath Xanthosia	2	C	U
Xanthosia tasmanica	Southern Xanthosia		2	C	U

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Acacia longifolia var. sophorae	Coastal Wattle	False Boobialla	1	D	C
Acacia myrtifolia var. myrtifolia	Myrtle Wattle	Scrub Wattle	1	D	M
Acacia myrtifolia(NC)	Myrtle Wattle	Bitter Leaf Wattle	1	D	M
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle	1	D	M
Acacia pycnantha	Golden Wattle		1	D	M
Acacia retinodes var. uncifolia	Coast Silver Wattle		1	D	M
Acacia spinescens	Spiny Wattle		1	D	M
Acacia verticillata	Prickly Moses		1	D	C
Allocasuarina muelleriana ssp.	Common Oak-bush	Slaty Oak-bush	1	D	M
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush	Slaty Oak-bush	1	D	M
Allocasuarina paludosa	Swamp Oak-bush	Scrub Sheoak	1	D	M
Allocasuarina pusilla	Dwarf Oak-bush	Heath Oak-bush	1	D	M
Allocasuarina striata	Stalked Oak-bush	Tall Oak-bush	1	D	M
Allocasuarina verticillata	Drooping Sheoak		1	D	C
Alyxia buxifolia	Sea Box	Dysentery Bush	1	C?	C
Atriplex cinerea	Coast Saltbush	Grey Saltbush	1	D	M
Banksia marginata	Silver Banksia	Honeysuckle	1	S	M
Banksia ornata	Desert Banksia	Sand-heath Banksia	1	S	M
Bursaria spinosa	Sweet Bursaria	South Australian Christmas Bush	1	S	M
Callistemon rugulosus var. rugulosus	Scarlet Bottlebrush		1	S	M
Carex breviculmis	Short-stem Sedge		1	D/P	T
Carpobrotus rossii	Native Pigface	Karkalla	1	S/C	U
Clematis microphylla	Old Man's Beard	Small-leaf Clematis	1	S	CL
Danthonia caespitosa	Common Wallaby-grass	White-top	1	S	T
Danthonia geniculata	Kneed Wallaby-grass		1	S	T
Danthonia racemosa var. racemosa	Slender Wallaby-grass	Stiped Wallaby-grass	1	S	T
Danthonia setacea var. setacea	Small-flower Wallaby-grass	Bristly Wallaby-grass	1	S	T
Danthonia sp.	Wallaby-grass		1	S	T
Disphyma crassifolium ssp. clavellatum	Round-leaf Pigface	Rounded Noon-flower	1	S/C	U
Distichlis distichophylla	Emu-grass	Australian Salt-grass	1	S/C	T
Dodonaea humilis	Dwarf Hop-bush	Limestone Hop-bush	1	D	U
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Spoon-leaf Hop-bush	1	D	M
Elymus scabrus var. scabrus	Native Wheat-grass	Common Wheat-grass	1	S	T
Enchylaena tomentosa var. tomentosa	Ruby Saltbush	Barrier Saltbush	1	D	M
Eucalyptus 'anceps'	Sessile-fruit White Mallee		1	D	C
Eucalyptus baxteri	Brown Stringybark	Baxter's Stringybark	1	D	C
Eucalyptus conglobata	Port Lincoln Mallee	Cong Mallee	1	D	C
Eucalyptus cosmophylla	Cup Gum	Bog Gum	1	D	C
Eucalyptus diversifolia	Coastal White Mallee	Soap Mallee	1	D	C
Eucalyptus fasciculosa	Pink Gum	Hill Gum	1	D	C
Eucalyptus foecunda(NC)	Narrow-leaved Mallee	Slender-leaved Red Mallee	1	D	C
Eucalyptus incrassata	Ridge-fruited Mallee	Yellow Mallee	1	D	C
Eucalyptus leptophylla	Narrow-leaf Red Mallee		1	D	C
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		1	D	C
Eucalyptus leucoxylon(NC)	South Australian Blue Gum	Yellow Gum	1	D	C
Eucalyptus oleosa	Red Mallee	Acorn Mallee	1	D	C
Eucalyptus porosa	Mallee Box	Black Mallee Box	1	D	C
Eucalyptus rugosa	Coastal White Mallee	Kingscote Mallee	1	D	C
Eucalyptus sp.			1	D	C
Glischrocaryon behrii	Golden Pennants		1	S/C	U
Goodenia ovata	Hop Goodenia		1	S/C	U
Goodenia varia	Sticky Goodenia		1	S/C	U
Hakea carinata	Erect Hakea		1	S	U
Hakea muelleriana	Heath Needlebush	Desert Hakea	1	S	U
Hakea rostrata	Beaked Hakea	Turkey Gobblers	1	S	U
Hakea rugosa	Dwarf Hakea	Wrinkled Hakea	1	S	U
Hardenbergia violacea	Native Lilac	Purple Coral-pea	1	D	U/CL
Helichrysum leucopsideum	Satin Everlasting	Coast Everlasting	1	S	U
Helichrysum scorpioides	Button Everlasting		1	S	U
Helichrysum sp.(NC)			1	S	U
Isolepis cernua	Nodding Club-rush	Low Club-rush	1	D/P	T
Isolepis marginata	Little Club-rush	Coarse Club-rush	1	D/P	T
Isolepis nodosa	Knobby Club-rush	Knobby Club-sedge	1	D/P	T
Isolepis platycarpa	Flat-fruit Club-rush	Flat-fruit Club-sedge	1	D/P	T
Juncus bufonius	Toad Rush		1	D/P	T
Juncus kraussii	Sea Rush		1	D/P	T
Juncus pallidus	Pale Rush		1	D/P	T
Juncus pauciflorus	Loose-flower Rush		1	D/P	T
Juncus planifolius	Broad-leaf Rush		1	D/P	T
Juncus subsecundus	Finger Rush		1	D/P	T
Kennedia prostrata	Scarlet Runner	Running Postman	1	S	U
Kunzea pomifera	Muntries	Pink Buttons	1	S/C	U
Lavatera plebeia	Australian Hollyhock	Native Hollyhock	1	S	M
Lepidosperma canescens	Hoary Rapier-sedge		1	S/P	T
Lepidosperma concavum	Spreading Sword-sedge	Sandhill Sword-sedge	1	S/P	T
Lepidosperma congestum	Clustered Sword-sedge	Limestone Sword-sedge	1	S/P	T
Lepidosperma gladiatum	Coast Sword-sedge	Sword Rush	1	S/P	T
Lepidosperma laterale(NC)	Sharp Sword-sedge	Variable Sword-sedge	1	S/P	T

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SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Lepidosperma sp.	Sword-sedge/Rapier-sedge		1	S/P	T
Leptospermum continentale	Prickly Tea-tree		1	D	M
Leptospermum myrsinoides	Heath Tea-tree		1	D	M
Leucophyta brownii	Coast Cushion Bush	Cushion Bush	1	S	U
Logania crassifolia	Coast Logania		1	S/C	M
Logania linifolia	Flax-leaf Logania		1	S/C	M
Logania minor	Spoon-leaf Logania		1	S/C	M
Melaleuca brevifolia	Short-leaf Honey-myrtle	Swamp Honey-myrtle	1	S	M
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle	1	D	M
Melaleuca lanceolata ssp. lanceolata	Dryland Tea-tree	Black Tea-tree	1	D	M/C
Muehlenbeckia adpressa	Climbing Lignum	Native Sarsparilla	1	S/C	M/CL
Muehlenbeckia florulenta	Lignum	Tangled Lignum	1	S/C	M/CL
Muehlenbeckia gunnii	Coastal Climbing Lignum	Native Sarsparilla	1	S/C	M/CL
Myoporum insulare	Common Boobialla	Native Juniper	1	C	M
Myoporum viscosum	Sticky Boobialla		1	C	M
Nitraria billardierei	Nitre-bush	Dillon Bush	1	S/C	M
Olearia axillaris	Coast Daisy-bush		1	S/C	M
Olearia ramulosa	Twiggy Daisy-bush		1	S/C	U
Ozothamnus turbinatus	Coast Bush-everlasting	Coast Everlasting	1	S	U/M
Phragmites australis	Common Reed	Bamboo Reed	1	S/P	T
Poa halmaturina	Kangaroo Island Poa	Salt Tussock-grass	1	S	T
Poa poiformis	Coast Tussock-grass	Blue Tussock-grass	1	S	T
Poa sp.	Meadow-grass/Tussock-grass	Poa	1	S	T
Poa tenera	Slender Tussock-grass	Spreading Tussock-grass	1	S	T
Pultenaea densifolia	Dense Bush-pea		1	C	U
Pultenaea tenuifolia	Narrow-leaf Bush-pea	Slender Bush-pea	1	C	U
Rhagodia candolleana ssp.	Sea-berry Saltbush		1	D/C	U/M
Rhagodia candolleana ssp. candolleana	Sea-berry Saltbush		1	D/C	U/M
Schoenoplectus validus	River Club-rush	River Club-sedge	1	D/P	T
Schoenus apogon	Common Bog-rush	Common Bog-sedge	1	D/P	T
Schoenus breviculmis	Matted Bog-rush	Moss Bog-rush	1	D/P	T
Schoenus deformis	Small Bog-rush	Limestone Bog-rush	1	D/P	T
Schoenus nitens	Shiny Bog-rush	Shiny Bog-sedge	1	D/P	T
Schoenus sp.	Bog-rush	Bog-sedge	1	D/P	T
Spinifex sericeus	Rolling Spinifex	Coast Spinifex	1	S/P	T
Stipa exilis	Heath Spear-grass		1	S	T
Stipa flavescens	Coast Spear-grass		1	S	T
Stipa hemipogon	Half-beard Spear-grass		1	S	T
Stipa macalpinei	Annual Spear-grass	One-year Grass	1	S	T
Stipa mollis	Soft Spear-grass	Supple Spear-grass	1	S	T
Stipa mundula	Neat Spear-grass		1	S	T
Stipa scabra ssp. falcata	Slender Spear-grass	Rough Spear-grass	1	S	T
Stipa sp.	Spear-grass		1	S	T
Stipa stipoides	Coast Spear-grass	Prickly Spear-grass	1	S	T
Tetragonia implexicoma	Bower Spinach		1	S/C	U
Themeda triandra	Kangaroo Grass	Ilintji	1	D	T
Triodia compacta	Spinifex	Porcupine-grass	1	S/P	T
Typha domingensis	Narrow-leaf Bulrush	Narrow-leaf Cumbungi	1	S	T
Vittadinia australasica var. australasica	Sticky New Holland Daisy	New Holland Daisy	1	S	U
Vittadinia cuneata var. cuneata forma cuneata	Fuzzy New Holland Daisy	Fuzzweed	1	S	U
Wahlenbergia litticola	Coast Bluebell	Edge Bluebell	1	S/P	U
Wahlenbergia luteola	Yellow-wash Bluebell	Yellowish Bluebell	1	S/P	U
Daviesia brevifolia	Leafless Bitter-pea		1-2	S	U
Daviesia ulicifolia ssp. incarnata			1-2	S	U
Daviesia ulicifolia(NC)	Gorse Bitter-pea		1-2	S	U
Dianella brevicaulis	Short-stem Flax-lily	Coast Flax-lily	1-2	S/P	T
Dianella brevicaulis/revoluta var.	Black-anther Flax-lily	Spreading Flax-lily	1-2	S/P	T
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily	1-2	S/P	T
Dianella revoluta(NC)			1-2	S/P	T
Eutaxia microphylla var. microphylla	Common Eutaxia	Eggs-and-bacon	1-2	C	U
Eutaxia sp.	Eutaxia	Eggs-and-bacon	1-2	C	U
Lomandra densiflora	Soft Tussock Mat-rush	Pointed Mat-rush	1-2	S	T
Lomandra effusa	Scented Mat-rush	Scented Iron-grass	1-2	S	T
Lomandra juncea	Desert Mat-rush		1-2	S	T
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	1-2	S	T
Acrotriche serrulata	Cushion Ground-berry	Honeypots	2	C	U
Adenanthos terminalis	Yellow Gland-flower		2	C	U
Adriana klotzschii	Coast Bitter-bush		2	C/D	M
Arthropodium fimbriatum	Nodding Vanilla-lily	Summer Vanilla-lily	2	S	U
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	2	S	U
Astroloma conostephioides	Flame Heath		2	C*	U
Astroloma humifusum	Cranberry Heath	Native Cranberry	2	C*	U
Baeckea crassifolia	Desert Baeckea	Desert Heath-myrtle	2	C*	M
Baumea juncea	Bare Twig-rush	Blue Twig-rush	2	SP	T
Beyeria lechenaultii	Pale Turpentine Bush	Felted Wallaby-bush	2	C	M/C
Billardiera cymosa	Sweet Apple-berry		2	S/C	CL
Billardiera sp.	Apple-berry		2	S/C	CL
Billardiera uniflora	One-flower Apple-berry	Single-flower Apple-berry	2	S/C	CL

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SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Billardiera versicolor	Yellow-flower Apple-berry	Pale Apple-berry	2	S/C	CL
Boronia filifolia	Slender Boronia		2	C	U
Bossiaea prostrata	Creeping Bossiaea		2	S	U
Brachycome cuneifolia	Wedge-leaf Daisy		2	S	U
Brachycome goniocarpa	Dwarf Daisy	Angle-fruit Daisy	2	S	U
Brachycome lineariloba	Hard-head Daisy	Dwarf Daisy	2	S	U
Brachycome perpusilla	Tiny Daisy	Rayless Daisy	2	S	U
Bulbine bulbosa	Bulbine-lily	Native Leek	2	S	U
Bulbine semibarbata	Small Leek-lily	Annual Bulbine-lily	2	S	U
Burchardia umbellata	Milkmaids	Milk Lily	2	S	U
Calostemma purpureum	Pink Garland-lily	Garland Lily	2	S	U
Calytrix glaberrima	Smooth Heath-myrtle	Smooth Fringe-myrtle	2	S/C	U/M
Calytrix sp.	Fringe-myrtle		2	S/C	U/M
Calytrix tetragona	Common Fringe-myrtle		2	S/C	U/M
Cassinia uncata	Sticky Cassinia		2	S/C	M
Cheiranthera alternifolia	Hand-flower	Finger-flower	2	C	U
Chrysocephalum apiculatum	Common Everlasting	Small Yellow Button	2	S	U
Chrysocephalum baxteri	White Everlasting	Fringed Everlasting	2	S	U
Convolvulus erubescens	Australian Bindweed	Pink Bindweed	2	S	U
Convolvulus remotus	Grassy Bindweed		2	S	U
Correa alba var. pannosa	White Correa		2	C	U
Correa eburnea			2	C	U
Correa pulchella	Salmon Correa		2	C	U
Correa reflexa var. coriacea	Thick-leaf Correa		2	C	U
Correa reflexa var. reflexa	Common Correa		2	C	U
Craspedia glauca	Billy-buttons	Bachelor Buttons	2	S	U
Cryptandra hispidula	Rough Cryptandra		2	C*	U
Cryptandra leucophracta	White Cryptandra	Rusty Poison	2	C*	U
Cryptandra tomentosa	Heath Cryptandra	Velvet Cryptandra	2	C*	U
Cyperus tenellus	Tiny Flat-sedge		2	D/P	T
Cyperus vaginatus	Stiff Flat-sedge	Puta-puta	2	D/P	T
Dampiera dysantha	Shrubby Dampiera		2	C	U
Dampiera lanceolata var.	Grooved Dampiera		2	C	U
Daviesia pectinata	Zig-zag Bitter-pea	Barbed-wire Bitter-pea	2	S	U
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	2	S/C	U
Dillwynia sericea	Showy Parrot-pea		2	S/C	U
Eriostemon pungens	Prickly Wax-flower		2	C	U
Exocarpos cupressiformis	Native Cherry	Cherry Ballart	2	S*	M
Frankenia pauciflora var.	Southern Sea-heath		2	C	U
Frankenia pauciflora var. gunnii	Southern Sea-heath		2	C	U
Gahnia ancistrophylla	Curled Saw-sedge	Donkey Saw-sedge	2	S*	T
Gahnia deusta	Limestone Saw-sedge	Heathy Saw-sedge	2	S*	T
Gahnia lanigera	Black Grass Saw-sedge	Desert Saw-sedge	2	S*	T
Gahnia trifida	Cutting Grass	Coast Saw-sedge	2	S*	T
Glycine clandestina var. sericea	Twining Glycine		2	S/C	U
Gonocarpus mezianus	Broad-leaf Raspwort	Hairy Raspwort	2	C	U
Gonocarpus tetragynus	Small-leaf Raspwort	Common Raspwort	2	C	U
Goodenia amplexans	Clasping Goodenia		2	S/C	U
Goodenia blackiana	Native Primrose	Black's Goodenia	2	S*	U
Goodenia geniculata	Bent Goodenia	Native Primrose	2	S*	U
Goodenia pinnatifida	Cut-leaf Goodenia	Scrambled Eggs	2	S/C	U
Goodenia willisiana	Silver Goodenia	Mallee Goodenia	2	S/C	U
Grevillea ilicifolia var.	Holly-leaf Grevillea		2	S/C	U
Grevillea ilicifolia var. ilicifolia	Holly-leaf Grevillea	Native Holly	2	S/C	U
Grevillea lavandulacea var.	Spider-flower	Heath Grevillea	2	S/C	U
Grevillea lavandulacea var. lavandulacea	Spider-flower	Heath Grevillea	2	S/C	U
Grevillea lavandulacea var. sericea	Spider-flower	Heath Grevillea	2	S/C	U
Hibbertia riparia	Guinea-flower		2	C	U
Hibbertia riparia (glabriuscula)	Smooth Guinea-flower		2	C	U
Hibbertia riparia (long-leaved aff. H. stricta)	Bristly Guinea-flower		2	C	U
Hibbertia sericea var.	Silky Guinea-flower		2	C	U
Hibbertia sericea var. scabrifolia	Rough-leaf Guinea-flower		2	C	U
Hibbertia sericea var. sericea	Silky Guinea-flower		2	C	U
Hibbertia virgata	Twiggy Guinea-flower		2	C	U
Hybanthus floribundus ssp. floribundus	Shrub Violet		2	C*	U
Isopogon ceratophyllus	Horny Cone-bush	Cone-bush	2	S	U
Ixodia achillaeoides ssp. alata	Hills Daisy	Winged Ixodia	2	S/C	U
Lasiopetalum baueri	Slender Velvet-bush		2	S/C	U
Lasiopetalum discolor	Coast Velvet-bush		2	S/C	U
Laxmannia orientalis	Dwarf Wire-lily		2	S	T
Laxmannia sessiliflora(NC)	Dwarf Wire-lily		2	S	T
Lepidosperma carphoides	Black Rapier-sedge		2	S/P	T
Lepidosperma curtisiae	Little Sword-sedge		2	S/P	T
Lepidosperma semiteres	Wire Rapier-sedge		2	S/P	T
Lepidosperma viscidum	Sticky Sword-sedge		2	S/P	T
Leucopogon parviflorus	Coast Beard-heath		2	S/C*	U
Leucopogon rufus	Ruddy Beard-heath		2	C*	U
Leucopogon virgatus	Common Beard-heath		2	C*	U

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Lomandra collina	Sand Mat-rush	Sharp-leaf Mat-rush	2	S	T
Lomandra glauca(NC)	Pale Mat-rush		2	S	T
Lomandra micrantha ssp.	Small-flower Mat-rush		2	S	T
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		2	S	T
Lomandra micrantha ssp. tuberculata	Small-flower Mat-rush		2	S	T
Lomandra nana	Small Mat-rush	Soft Mat-rush	2	S	T
Lomandra sororia	Sword Mat-rush	Small Mat-rush	2	S	T
Micrantheum demissum	Dwarf Micrantheum		2	C	U
Microlaena stipoides var. stipoides	Weeping Rice-grass	Weeping Grass	2	S	T
Olearia pannosa ssp. pannosa	Silver Daisy-bush		2	S/C	U
Patersonia fragilis	Short Purple-flag	Swamp Iris	2	S/P	T
Persoonia juniperina	Prickly Geebung	Geebung	2	C*	U
Phyllota pleurandroides	Heathy Phyllota		2	C*	U
Pimelea glauca	Smooth Riceflower		2	C	U
Pimelea humilis	Low Riceflower	Common Riceflower	2	C	U
Pimelea octophylla	Woolly Riceflower	Downy Riceflower	2	C	U
Pimelea phylicoides	Heath Riceflower		2	C	U
Pimelea serpyllifolia ssp. serpyllifolia	Thyme Riceflower		2	C	U
Pimelea stricta	Erect Riceflower	Gaunt Riceflower	2	C	U
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	2	S	U
Pomaderris obcordata	Wedge-leaf Pomaderris	Pimelea Pomaderris	2	S/C	U
Pomaderris oraria(NC)	Coast Pomaderris		2	S/C	U
Pomaderris paniculosa ssp. paniculosa	Mallee Pomaderris	Inland Pomaderris	2	S/C	U
Poranthera ericoides	Heath Poranthera		2	C	U
Poranthera microphylla	Small Poranthera	Small-leaf Poranthera	2	C	U
Poranthera triandra	Three-petal Poranthera	Pink Porantha	2	C	U
Prostanthera chlorantha	Green Mintbush		2	C	U
Pultenaea canaliculata var.	Soft Bush-pea	Coast Bush-pea	2	S/C	U
Pultenaea canaliculata var. canaliculata	Soft Bush-pea	Coast Bush-pea	2	S/C	U
Pultenaea canaliculata var. latifolia	Soft Bush-pea	Coast Bush-pea	2	S/C	U
Pultenaea largiflorens	Twiggy Bush-pea		2	S/C	U
Pultenaea trinervis	Three-nerve Bush-pea		2	S/C	U
Rhodanthe laevis	Smooth Daisy	Smooth Sunray	2	S	U
Santalum acuminatum	Quandong	Native Peach	2	S	M/C
Santalum murrayanum	Bitter Quandong	Ming	2	S	M/C
Scaevola albida	Pale Fanflower	Small-fruit Fanflower	2	S/C	U
Scaevola crassifolia	Cushion Fanflower		2	S/C	U
Scaevola linearis ssp. confertifolia	Bundled Fanflower		2	S/C	U
Senecio glomeratus	Swamp Groundsel	Toothed Groundsel	2	S	U
Senecio glossanthus	Annual Groundsel	Slender Groundsel	2	S	U
Senecio lautus	Variable Groundsel	Elegant Yellow-top	2	S	U
Senecio odoratus var.	Scented Groundsel		2	S	U
Senecio odoratus var. obtusifolius	Broad-leaf Scented Groundsel		2	S	U
Senecio odoratus var. odoratus	Scented Groundsel		2	S	U
Senecio picridioides	Purple-leaf Groundsel	Scabrid Groundsel	2	S	U
Senecio quadridentatus	Cotton Groundsel	Cotton Fireweed	2	S	U
Senecio tenuiflorus	Woodland Groundsel	Narrow Groundsel	2	S	U
Solanum laciniatum	Cut-leaf Kangaroo-apple	Large Kangaroo-apple	2	S/C	U
Spyridium coactilifolium	Butterfly Spyridium		2	C	U
Spyridium thymifolium	Thyme-leaf Spyridium		2	C	U
Stylidium calcaratum	Spurred Trigger-plant	Book Trigger-plant	2	S	U
Stylidium graminifolium	Grass Trigger-plant		2	S	U
Stylidium perpusillum	Tiny Trigger-plant	Slender Trigger-plant	2	S	U
Swainsona lessertiifolia	Coast Swainson-pea	Poison Pea	2	S	U
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells	Pink-eyed Susan	2	C	U
Thomasia petalocalyx	Paper-flower		2	S/C	U
Thysanotus baueri	Mallee Fringe-lily		2	S	U
Thysanotus juncifolius	Rush Fringe-lily		2	S	U
Thysanotus patersonii	Twining Fringe-lily		2	S	U
Wahlenbergia gracilenta	Annual Bluebell		2	S/P	U
Wahlenbergia stricta ssp. stricta	Tall Bluebell		2	S/P	U
Xanthorrhoea semiplana ssp.	Yacca	Flat-leaf Grass-tree	2	S	T
Xanthorrhoea semiplana ssp. semiplana	Yacca	Flat-leaf Grass-tree	2	S	T
Xanthorrhoea semiplana ssp. tateana	Tate's Grass-tree		2	S	T
Xanthosia pusilla	Hairy Xanthosia	Heath Xanthosia	2	C	U
Zieria veronicea	Pink Zieria		2	C	U/M
Zygophyllum billardierei	Coast Twinleaf		2	C	U/M

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SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle	1	D	M
Acacia pycnantha	Golden Wattle		1	D	M
Acacia retinodes var.	Silver Wattle		1	D	M
Acacia spinescens	Spiny Wattle		1	D	M
Acacia verticillata	Prickly Moses		1	D	C
Allocasuarina pusilla	Dwarf Oak-bush	Heath Oak-bush	1	D	M
Allocasuarina striata	Stalked Oak-bush	Tall Oak-bush	1	D	M
Banksia ornata	Desert Banksia	Sand-heath Banksia	1	S	M
Carex appressa	Tall Sedge	Tussock Sedge	1	D/P	T
Carex tereticaulis	Rush Sedge		1	D/P	T
Danthonia setacea var. setacea	Small-flower Wallaby-grass	Bristly Wallaby-grass	1	S	T
Dodonaea viscosa ssp.	Sticky Hop-bush		1	D	M
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Spoon-leaf Hop-bush	1	D	M
Eleocharis gracilis	Slender Spike-rush	Slender Spike-sedge	1	D/P	T
Eucalyptus baxteri	Brown Stringybark	Baxter's Stringybark	1	D	C
Eucalyptus fasciculosa	Pink Gum	Hill Gum	1	D	C
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		1	D	C
Eucalyptus obliqua	Messmate Stringybark	Stringybark	1	D	C
Eucalyptus ovata	Swamp Gum		1	D	C
Goodenia ovata	Hop Goodenia		1	S/C	U
Hakea rostrata	Beaked Hakea	Turkey Gobblers	1	S	U
Helichrysum scorpioides	Button Everlasting		1	S	U
Isolepis inundata	Swamp Club-rush		1	D/P	T
Isolepis marginata	Little Club-rush	Coarse Club-rush	1	D/P	T
Juncus bufonius	Toad Rush		1	D/P	T
Juncus caespiticius	Grassy Rush		1	D/P	T
Juncus holoschoenus	Joint-leaf Rush		1	D/P	T
Juncus pallidus	Pale Rush		1	D/P	T
Juncus planifolius	Broad-leaf Rush		1	D/P	T
Juncus prismatocarpus	Branching Rush		1	D/P	T
Juncus sarophorus			1	D/P	T
Kennedia prostrata	Scarlet Runner	Running Postman	1	S	U
Leptospermum continentale	Prickly Tea-tree		1	D	M
Leptospermum lanigerum	Silky Tea-tree	Woolly Tea-tree	1	D	M
Leptospermum myrsinoides	Heath Tea-tree		1	D	M
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle	1	D	M
Olearia ramulosa	Twiggy Daisy-bush		1	S/C	U
Phragmites australis	Common Reed	Bamboo Reed	1	S/P	T
Schoenus apogon	Common Bog-rush	Common Bog-sedge	1	D/P	T
Schoenus breviculmis	Matted Bog-rush	Moss Bog-rush	1	D/P	T
Schoenus maschalinus	Leafy Bog-rush	Creeping Bog-rush	1	D/P	T
Stipa mollis	Soft Spear-grass	Supple Spear-grass	1	S	T
Typha domingensis	Narrow-leaf Bulrush	Narrow-leaf Cumbungi	1	S	T
Viminaria juncea	Native Broom	Golden Spray	1	D	M
Daviesia brevifolia	Leafless Bitter-pea		1-2	S	U
Daviesia ulicifolia ssp. incarnata			1-2	S	U
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily	1-2	S/P	T
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	1-2	S	T
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	2	S	U
Astroloma conostephioides	Flame Heath		2	C*	U
Baeckea ramosissima ssp. ramosissima	Rosy Baeckea		2	C*	U
Baumea juncea	Bare Twig-rush	Blue Twig-rush	2	SP	T
Baumea tetragona	Square Twig-rush	Square Twig-sedge	2	SP	T
Billardiera cymosa	Sweet Apple-berry		2	S/C	CL
Brunonia australis	Blue Pincushion	Tjulpun-tjulpunpa	2	S	U
Bulbine bulbosa	Bulbine-lily	Native Leek	2	S	U
Burchardia umbellata	Milkmaids	Milk Lily	2	S	U
Calytrix tetragona	Common Fringe-myrtle		2	S/C	U/M
Cheiranthera alternifolia	Hand-flower	Finger-flower	2	C	U
Chrysocephalum baxteri	White Everlasting	Fringed Everlasting	2	S	U
Correa reflexa var. reflexa	Common Correa		2	C	U
Craspedia glauca	Billy-buttons	Bachelor Buttons	2	S	U
Cryptandra tomentosa	Heath Cryptandra	Velvet Cryptandra	2	C*	U
Daviesia arenaria	Sand Bitter-pea	Mallee Bitter-pea	2	S	U
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	2	S/C	U
Dillwynia sericea	Showy Parrot-pea		2	S/C	U
Epacris impressa	Common Heath	Heath	2	C*	U
Gahnia sieberiana	Red-fruit Cutting-grass	Red-fruit Saw-sedge	2	S	T
Glycine clandestina var. sericea	Twining Glycine		2	S/C	U
Gonocarpus mezianus	Broad-leaf Raspwort	Hairy Raspwort	2	C	U
Gonocarpus micranthus ssp. micranthus	Creeping Raspwort		2	C	U
Gonocarpus tetragynus	Small-leaf Raspwort	Common Raspwort	2	C	U
Goodenia geniculata	Bent Goodenia	Native Primrose	2	S*	U
Grevillea lavandulacea var.	Spider-flower	Heath Grevillea	2	S/C	U
Grevillea lavandulacea var. lavandulacea	Spider-flower	Heath Grevillea	2	S/C	U
Hibbertia riparia	Guinea-flower		2	C	U
Hibbertia virgata	Twiggy Guinea-flower		2	C	U
Laxmannia orientalis	Dwarf Wire-lily		2	S	T

Perched Swamps Revegetation Species List
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Plant Type- C= Canopy, M= Mid Storey, U=Understorey, CL= Climber, T= Tussock (grasses, sedges etc)

SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Lepidosperma carphoides	Black Rapier-sedge		2	S/P	T
Lepidosperma laterale s.str.	Tall Sword-sedge		2	S/P	T
Lepidosperma longitudinale	Pithy Sword-sedge	Swamp Sword-sedge	2	S/P	T
Lepidosperma semiteres	Wire Rapier-sedge		2	S/P	T
Leucopogon hirsutus	Hairy Beard-heath		2	C*	U
Leucopogon virgatus	Common Beard-heath		2	C*	U
Lomandra collina	Sand Mat-rush	Sharp-leaf Mat-rush	2	S	T
Lomandra micrantha ssp.	Small-flower Mat-rush		2	S	T
Micrantheum demissum	Dwarf Micrantheum		2	C	U
Patersonia fragilis	Short Purple-flag	Swamp Iris	2	S/P	T
Patersonia occidentalis	Long Purple-flag		2	S/P	T
Pimelea humilis	Low Riceflower	Common Riceflower	2	C	U
Pimelea octophylla	Woolly Riceflower	Downy Riceflower	2	C	U
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	2	S	U
Pratia pedunculata	Matted Pratia		2	C	U
Scaevola albida	Pale Fanflower	Small-fruit Fanflower	2	S/C	U
Senecio glomeratus	Swamp Groundsel	Toothed Groundsel	2	S	U
Senecio quadridentatus	Cotton Groundsel	Cotton Fireweed	2	S	U
Spyridium thymifolium	Thyme-leaf Spyridium		2	C	U
Stylidium graminifolium	Grass Trigger-plant		2	S	U
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells	Pink-eyed Susan	2	C	U
Thysanotus juncifolius	Rush Fringe-lily		2	S	U
Thysanotus patersonii	Twining Fringe-lily		2	S	U
Viola sieberiana	Tiny Violet	Sieber's Violet	2	S/C	U
Wahlenbergia gracilenta	Annual Bluebell		2	S/P	U
Wahlenbergia stricta ssp. stricta	Tall Bluebell		2	S/P	U
Xanthorrhoea semiplana ssp. semiplana	Yacca	Flat-leaf Grass-tree	2	S	T
Xanthosia pusilla	Hairy Xanthosia	Heath Xanthosia	2	C	U

Pink Gum Woodlands Revegetation Species List
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Plant Type- C= Canopy, M= Mid Storey, U=Understorey, CL= Climber, T= Tussock (grasses, sedges etc)

SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Acacia melanoxylon	Blackwood		1	D	C
Acacia myrtifolia var. myrtifolia	Myrtle Wattle	Scrub Wattle	1	D	M
Acacia myrtifolia(NC)	Myrtle Wattle	Bitter Leaf Wattle	1	D	M
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle	1	D	M
Acacia pycnantha	Golden Wattle		1	D	M
Acacia retinodes var.	Silver Wattle		1	D	M
Acacia retinodes var. retinodes (swamp form)	Swamp Wattle		1	D	M
Acacia spinescens	Spiny Wattle		1	D	M
Acacia verticillata	Prickly Moses		1	D	C
Allocasuarina muelleriana ssp.	Common Oak-bush	Slaty Oak-bush	1	D	M
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush	Slaty Oak-bush	1	D	M
Allocasuarina striata	Stalked Oak-bush	Tall Oak-bush	1	D	M
Allocasuarina verticillata	Drooping Sheoak		1	D	C
Bursaria spinosa	Sweet Bursaria	South Australian Christmas Bush	1	S	M
Carex appressa	Tall Sedge	Tussock Sedge	1	D/P	T
Carex breviculmis	Short-stem Sedge		1	D/P	T
Clematis microphylla	Old Man's Beard	Small-leaf Clematis	1	S	CL
Danthonia caespitosa	Common Wallaby-grass	White-top	1	S	T
Danthonia geniculata	Kneed Wallaby-grass		1	S	T
Danthonia pilosa var. paleacea	Velvet Wallaby-grass		1	S	T
Danthonia setacea var. setacea	Small-flower Wallaby-grass	Bristly Wallaby-grass	1	S	T
Danthonia sp.	Wallaby-grass		1	S	T
Daviesia leptophylla	Narrow-leaf Bitter-pea		1	S	U/M
Dodonaea sp.	Hop-bush		1	D	M
Dodonaea viscosa ssp.	Sticky Hop-bush		1	D	M
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Spoon-leaf Hop-bush	1	D	M
Eucalyptus baxteri	Brown Stringybark	Baxter's Stringybark	1	D	C
Eucalyptus camaldulensis var. camaldulensis	River Red Gum	Red Gum	1	D	C
Eucalyptus cosmophylla	Cup Gum	Bog Gum	1	D	C
Eucalyptus fasciculosa	Pink Gum	Hill Gum	1	D	C
Eucalyptus foecunda(NC)	Narrow-leaved Mallee	Slender-leaved Red Mallee	1	D	C
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		1	D	C
Eucalyptus obliqua	Messmate Stringybark	Stringybark	1	D	C
Eucalyptus obliqua var. obliqua(NC)	Messmate Stringybark	Stringybark	1	D	C
Eucalyptus obliqua var.(NC)	Messmate Stringybark		1	D	C
Eucalyptus viminalis ssp. cygnetensis	Rough-bark Manna Gum		1	D	C
Eucalyptus viminalis ssp. viminalis	Manna Gum	Ribbon Gum	1	D	C
Goodenia ovata	Hop Goodenia		1	S/C	U
Goodenia varia	Sticky Goodenia		1	S/C	U
Hakea carinata	Erect Hakea		1	S	U
Hakea rostrata	Beaked Hakea	Turkey Gobblers	1	S	U
Hakea rugosa	Dwarf Hakea	Wrinkled Hakea	1	S	U
Helichrysum scorpioides	Button Everlasting		1	S	U
Indigofera australis var. australis	Austral Indigo	Hill Indigo	1	S	M
Isolepis cernua	Nodding Club-rush	Low Club-rush	1	D/P	T
Isolepis inundata(NC)	Swamp Club-rush		1	D/P	T
Isolepis marginata	Little Club-rush	Coarse Club-rush	1	D/P	T
Juncus caespiticius	Grassy Rush		1	D/P	T
Juncus holoschoenus	Joint-leaf Rush		1	D/P	T
Juncus pallidus	Pale Rush		1	D/P	T
Juncus pauciflorus	Loose-flower Rush		1	D/P	T
Juncus sp.	Rush		1	D/P	T
Juncus subsecundus	Finger Rush		1	D/P	T
Kennedia prostrata	Scarlet Runner	Running Postman	1	S	U
Lepidosperma sp.	Sword-sedge/Rapier-sedge		1	S/P	T
Leptospermum continentale	Prickly Tea-tree		1	D	M
Leptospermum lanigerum	Silky Tea-tree	Woolly Tea-tree	1	D	M
Leptospermum myrsinoides	Heath Tea-tree		1	D	M
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle	1	D	M
Melaleuca lanceolata ssp. lanceolata	Dryland Tea-tree	Black Tea-tree	1	D	M/C
Myoporum viscosum	Sticky Boobialla		1	C	M
Olearia ramulosa	Twiggy Daisy-bush		1	S/C	U
Phragmites australis	Common Reed	Bamboo Reed	1	S/P	T
Poa clelandii	Matted Tussock-grass	Cleland's Poa	1	S	T
Poa labillardieri var. labillardieri	Common Tussock-grass	Tussock Poa	1	S	T
Poa poiformis	Coast Tussock-grass	Blue Tussock-grass	1	S	T
Poa sp.	Meadow-grass/Tussock-grass	Poa	1	S	T
Pultenaea daphnoides	Large-leaf Bush Pea		1	D	M
Schoenus apogon	Common Bog-rush	Common Bog-sedge	1	D/P	T
Schoenus breviculmis	Matted Bog-rush	Moss Bog-rush	1	D/P	T
Stipa mollis	Soft Spear-grass	Supple Spear-grass	1	S	T
Stipa semibarbata	Fibrous Spear-grass		1	S	T
Stipa sp.	Spear-grass		1	S	T
Themeda triandra	Kangaroo Grass	Ilintji	1	D	T
Daviesia brevifolia	Leafless Bitter-pea		1-2	S	U
Daviesia ulicifolia ssp. incarnata			1-2	S	U
Daviesia ulicifolia(NC)	Gorse Bitter-pea		1-2	S	U
Dianella brevicaulis	Short-stem Flax-lily	Coast Flax-lily	1-2	S/P	T

Pink Gum Woodlands Revegetation Species List
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SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Dianella brevicaulis/revoluta var.	Black-anther Flax-lily	Spreading Flax-lily	1-2	S/P	T
Dianella longifolia var. grandis	Pale Flax-lily	Yellow-anther Flax-lily	1-2	S/P	T
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily	1-2	S/P	T
Dianella revoluta(NC)			1-2	S/P	T
Lomandra densiflora	Soft Tussock Mat-rush	Pointed Mat-rush	1-2	S	T
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	1-2	S	T
Acrotriche serrulata	Cushion Ground-berry	Honeypots	2	C	U
Arthropodium fimbriatum	Nodding Vanilla-lily	Summer Vanilla-lily	2	S	U
Arthropodium sp.	Vanilla-lily	Chocolate-lily	2	S	U
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	2	S	U
Astroloma conostephioides	Flame Heath		2	C*	U
Astroloma humifusum	Cranberry Heath	Native Cranberry	2	C*	U
Baeckea ramosissima ssp. ramosissima	Rosy Baeckea		2	C*	U
Billardiera bignoniacea	Orange Bell-climber		2	S/C	CL
Billardiera cymosa	Sweet Apple-berry		2	S/C	CL
Billardiera sp.	Apple-berry		2	S/C	CL
Billardiera uniflora	One-flower Apple-berry	Single-flower Apple-berry	2	S/C	CL
Bossiaea prostrata	Creeping Bossiaea		2	S	U
Bracteantha bracteata	Golden Everlasting	Tjulpun-tjulpunpa	2	S	U
Brunonia australis	Blue Pincushion	Tjulpun-tjulpunpa	2	S	U
Burchardia umbellata	Milkmaids	Milk Lily	2	S	U
Calytrix tetragona	Common Fringe-myrtle		2	S/C	U/M
Cassinia uncata	Sticky Cassinia		2	S/C	M
Cheiranthera alternifolia	Hand-flower	Finger-flower	2	C	U
Chrysocephalum apiculatum	Common Everlasting	Small Yellow Button	2	S	U
Chrysocephalum baxteri	White Everlasting	Fringed Everlasting	2	S	U
Convolvulus remotus	Grassy Bindweed		2	S	U
Correa aemula s.str.	Hairy Correa		2	C	U
Correa calycina	Hindmarsh Correa		2	C	U
Correa pulchella	Salmon Correa		2	C	U
Correa reflexa	Common Correa		2	C	U
Craspedia glauca	Billy-buttons	Bachelor Buttons	2	S	U
Cryptandra tomentosa	Heath Cryptandra	Velvet Cryptandra	2	C*	U
Cryptandra tomentosa(NC)			2	C*	U
Cullen australasicum	Tall Scurf-pea	Verbine Scurf-pea	2	S	U
Cyperus vaginatus	Stiff Flat-sedge	Puta-puta	2	D/P	T
Dampiera dysantha	Shrubby Dampiera		2	C	U
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	2	S/C	U
Dillwynia sp.	Parrot-pea		2	S/C	U
Epacris impressa	Common Heath	Heath	2	C*	U
Exocarpos cupressiformis	Native Cherry	Cherry Ballart	2	S*	M
Gahnia sieberiana	Red-fruit Cutting-grass	Red-fruit Saw-sedge	2	S	T
Glycine clandestina var. sericea	Twining Glycine		2	S/C	U
Glycine latrobeana	Clover Glycine		2	S/C	U
Gompholobium ecostatum	Dwarf Wedge-pea		2	S/C*	U
Gonocarpus mezianus	Broad-leaf Raspwort	Hairy Raspwort	2	C	U
Gonocarpus sp.	Raspwort		2	C	U
Gonocarpus tetragynus	Small-leaf Raspwort	Common Raspwort	2	C	U
Goodenia amplexans	Clasping Goodenia		2	S/C	U
Goodenia blackiana	Native Primrose	Black's Goodenia	2	S*	U
Goodenia geniculata	Bent Goodenia	Native Primrose	2	S*	U
Goodenia sp.	Goodenia		2	S/C	U
Goodia medicaginea	Western Golden-tip	Golden-tip	2	S/C	U
Grevillea lavandulacea var.	Spider-flower	Heath Grevillea	2	S/C	U
Grevillea lavandulacea var. lavandulacea	Spider-flower	Heath Grevillea	2	S/C	U
Grevillea lavandulacea var. sericea	Spider-flower	Heath Grevillea	2	S/C	U
Hibbertia aspera(NC)			2	C	U
Hibbertia exutiacies	Prickly Guinea-flower	Spiky Guinea-flower	2	C	U
Hibbertia riparia	Guinea-flower		2	C	U
Hibbertia riparia (glabriuscula)	Smooth Guinea-flower		2	C	U
Hibbertia riparia (long-leaved aff. H. stricta)	Bristly Guinea-flower		2	C	U
Hibbertia sericea var. sericea	Silky Guinea-flower		2	C	U
Hibbertia sp.	Guinea-flower		2	C	U
Hibbertia sp. B	Scrambling Guinea-flower		2	C	U
Hibbertia stricta var. stricta	Stalked Guinea-flower	Erect Guinea-flower	2	C	U
Isopogon ceratophyllus	Horny Cone-bush	Cone-bush	2	S	U
Ixodia achillaeoides ssp.	Ixodia		2	S/C	U
Ixodia achillaeoides ssp. alata	Hills Daisy	Winged Ixodia	2	S/C	U
Lasiopetalum baueri	Slender Velvet-bush		2	S/C	U
Laxmannia sessiliflora(NC)	Dwarf Wire-lily		2	S	T
Lepidosperma carphoides	Black Rapier-sedge		2	S/P	T
Lepidosperma curtisiae	Little Sword-sedge		2	S/P	T
Lepidosperma longitudinale	Pithy Sword-sedge	Swamp Sword-sedge	2	S/P	T
Lepidosperma semiteres	Wire Rapier-sedge		2	S/P	T
Lepidosperma viscidum	Sticky Sword-sedge		2	S/P	T
Leucopogon australis	Spike Beard-heath		2	C*	U
Leucopogon concurvus	Scrambling Beard-heath		2	C*	U
Leucopogon lanceolatus	Lance Beard-heath		2	S/C*	U

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SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Leucopogon parviflorus	Coast Beard-heath		2	S/C*	U
Leucopogon virgatus	Common Beard-heath		2	C*	U
Lomandra fibrata	Mount Lofty Mat-rush	Fine Mat-rush	2	S	T
Lomandra micrantha ssp.	Small-flower Mat-rush		2	S	T
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		2	S	T
Lomandra nana	Small Mat-rush	Soft Mat-rush	2	S	T
Lomandra sororia	Sword Mat-rush	Small Mat-rush	2	S	T
Micrantheum demissum	Dwarf Micrantheum		2	C	U
Microlaena stipoides var. stipoides	Weeping Rice-grass	Weeping Grass	2	S	T
Olearia grandiflora	Mount Lofty Daisy-bush		2	S/C	U
Persoonia juniperina	Prickly Geebung	Geebung	2	C*	U
Phyllota remota	Slender Phyllota		2	C*	U
Pimelea glauca	Smooth Riceflower		2	C	U
Pimelea humilis	Low Riceflower	Common Riceflower	2	C	U
Pimelea linifolia ssp. linifolia	Slender Riceflower		2	C	U
Pimelea micrantha	Silky Riceflower	Curved Riceflower	2	C	U
Pimelea octophylla	Woolly Riceflower	Downy Riceflower	2	C	U
Pimelea phylicoides	Heath Riceflower		2	C	U
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	2	S	U
Pomaderris paniculosa ssp. paniculosa	Mallee Pomaderris	Inland Pomaderris	2	S/C	U
Poranthera microphylla	Small Poranthera	Small-leaf Poranthera	2	C	U
Prostanthera chlorantha	Green Mintbush		2	C	U
Pultenaea acerosa	Bristly Bush-pea		2	S/C	U
Pultenaea canaliculata var.	Soft Bush-pea	Coast Bush-pea	2	S/C	U
Pultenaea canaliculata var. canaliculata	Soft Bush-pea	Coast Bush-pea	2	S/C	U
Pultenaea involucrata	Mount Lofty Bush-pea		2	S/C	U
Pultenaea largiflorens	Twiggy Bush-pea		2	S/C	U
Pultenaea pedunculata	Matted Bush-pea		2	S/C	U
Scaevola albida	Pale Fanflower	Small-fruit Fanflower	2	S/C	U
Scaevola albida var. albida	Pale Fanflower	Small-fruit Fanflower	2	S/C	U
Scaevola albida var.(NC)			2	S/C	U
Senecio glomeratus	Swamp Groundsel	Toothed Groundsel	2	S	U
Senecio hispidulus var.	Rough Groundsel	Hispid Fireweed	2	S	U
Senecio lautus	Variable Groundsel	Elegant Yellow-top	2	S	U
Senecio odoratus var.	Scented Groundsel		2	S	U
Senecio odoratus var. obtusifolius	Broad-leaf Scented Groundsel		2	S	U
Senecio odoratus var. odoratus	Scented Groundsel		2	S	U
Senecio quadridentatus	Cotton Groundsel	Cotton Fireweed	2	S	U
Senecio squarrosus	Squarrose Groundsel	Leafy Fireweed	2	S	U
Senecio tenuiflorus	Woodland Groundsel	Narrow Groundsel	2	S	U
Spyridium coactilifolium	Butterfly Spyridium		2	C	U
Spyridium thymifolium	Thyme-leaf Spyridium		2	C	U
Stylidium graminifolium	Grass Trigger-plant		2	S	U
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells	Pink-eyed Susan	2	C	U
Thomasia petalocalyx	Paper-flower		2	S/C	U
Thysanotus juncifolius	Rush Fringe-lily		2	S	U
Thysanotus patersonii	Twining Fringe-lily		2	S	U
Viola hederacea	Ivy-leaf Violet		2	S/C	U
Viola sieberiana	Tiny Violet	Sieber's Violet	2	S/C	U
Wahlenbergia gracilenta	Annual Bluebell		2	S/P	U
Wahlenbergia sp.	Native Bluebell		2	S/P	U
Wahlenbergia stricta ssp. stricta	Tall Bluebell		2	S/P	U
Xanthorrhoea semiplana ssp.	Yacca	Flat-leaf Grass-tree	2	S	T
Xanthorrhoea semiplana ssp. semiplana	Yacca	Flat-leaf Grass-tree	2	S	T
Xanthorrhoea semiplana ssp. tateana	Tate's Grass-tree		2	S	T
Xanthosia pusilla	Hairy Xanthosia	Heath Xanthosia	2	C	U

Blue Gum Woodlands Revegetation Species List
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SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Acacia longifolia var.	Sallow Wattle		1	D	M
Acacia myrtifolia var.	Myrtle Wattle	Scrub Wattle	1	D	M
Acacia myrtifolia var. myrtifolia	Myrtle Wattle	Scrub Wattle	1	D	M
Acacia myrtifolia(NC)	Myrtle Wattle	Bitter Leaf Wattle	1	D	M
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle	1	D	M
Acacia pycnantha	Golden Wattle		1	D	M
Allocasuarina muelleriana ssp.	Common Oak-bush	Slaty Oak-bush	1	D	M
Allocasuarina pusilla	Dwarf Oak-bush	Heath Oak-bush	1	D	M
Allocasuarina striata	Stalked Oak-bush	Tall Oak-bush	1	D	M
Allocasuarina verticillata	Drooping Sheoak		1	D	C
Bursaria spinosa	Sweet Bursaria	South Australian Christmas Bush	1	S	M
Bursaria spinosa var. macrophylla(NC)	Sweet Bursaria	Native Blackthorn	1	S	M
Cassinia laevis	Curry Bush	Cough Bush	1	S/C	M
Clematis microphylla	Old Man's Beard	Small-leaf Clematis	1	S	CL
Danthonia geniculata	Kneed Wallaby-grass		1	S	T
Danthonia setacea var. setacea	Small-flower Wallaby-grass	Bristly Wallaby-grass	1	S	T
Danthonia sp.	Wallaby-grass		1	S	T
Elymus scabrus var. scabrus	Native Wheat-grass	Common Wheat-grass	1	S	T
Eucalyptus cosmophylla	Cup Gum	Bog Gum	1	D	C
Eucalyptus fasciculosa	Pink Gum	Hill Gum	1	D	C
Eucalyptus leptophylla	Narrow-leaf Red Mallee		1	D	C
Eucalyptus leucoxylon ssp.	South Australian Blue Gum	Yellow Gum	1	D	C
Eucalyptus leucoxylon(NC)	South Australian Blue Gum	Yellow Gum	1	D	C
Goodenia ovata	Hop Goodenia		1	S/C	U
Goodenia varia	Sticky Goodenia		1	S/C	U
Hakea rostrata	Beaked Hakea	Turkey Gobblers	1	S	U
Hakea rugosa	Dwarf Hakea	Wrinkled Hakea	1	S	U
Hardenbergia violacea	Native Lilac	Purple Coral-pea	1	D	U/CL
Kennedia prostrata	Scarlet Runner	Running Postman	1	S	U
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle	1	D	M
Muehlenbeckia adpressa	Climbing Lignum	Native Sarsparilla	1	S/C	M/CL
Olearia ramulosa	Twiggy Daisy-bush		1	S/C	U
Poa sp.	Meadow-grass/Tussock-grass	Poa	1	S	T
Schoenus apogon	Common Bog-rush	Common Bog-sedge	1	D/P	T
Schoenus breviculmis	Matted Bog-rush	Moss Bog-rush	1	D/P	T
Stipa mollis	Soft Spear-grass	Supple Spear-grass	1	S	T
Stipa semibarbata	Fibrous Spear-grass		1	S	T
Stipa sp.	Spear-grass		1	S	T
Themeda triandra	Kangaroo Grass	Ilintji	1	D	T
Wahlenbergia luteola	Yellow-wash Bluebell	Yellowish Bluebell	1	S/P	U
Dianella brevicaulis/revoluta var.	Black-anther Flax-lily	Spreading Flax-lily	1-2	S/P	T
Dianella revoluta var.			1-2	S/P	T
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily	1-2	S/P	T
Eutaxia sp.	Eutaxia	Eggs-and-bacon	1-2	C	U
Lomandra densiflora	Soft Tussock Mat-rush	Pointed Mat-rush	1-2	S	T
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	1-2	S	T
Acrotriche serrulata	Cushion Ground-berry	Honeypots	2	C	U
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	2	S	U
Astroloma conostephioides	Flame Heath		2	C*	U
Astroloma humifusum	Cranberry Heath	Native Cranberry	2	C*	U
Billardiera cymosa	Sweet Apple-berry		2	S/C	CL
Cassinia uncata	Sticky Cassinia		2	S/C	M
Chrysocephalum apiculatum	Common Everlasting	Small Yellow Button	2	S	U
Correa reflexa	Common Correa		2	C	U
Correa schlechtendalii	Mallee Correa	Narrow-bell Correa	2	C	U
Dampiera dysantha	Shrubby Dampiera		2	C	U
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	2	S/C	U
Exocarpos cupressiformis	Native Cherry	Cherry Ballart	2	S*	M
Gonocarpus elatus	Hill Raspwort	Tall Raspwort	2	C	U
Gonocarpus mezianus	Broad-leaf Raspwort	Hairy Raspwort	2	C	U
Goodenia blackiana	Native Primrose	Black's Goodenia	2	S*	U
Grevillea lavandulacea var.	Spider-flower	Heath Grevillea	2	S/C	U
Hibbertia exutiacies	Prickly Guinea-flower	Spiky Guinea-flower	2	C	U
Hibbertia riparia	Guinea-flower		2	C	U
Hibbertia riparia (glabriuscula)	Smooth Guinea-flower		2	C	U
Hibbertia sericea var.	Silky Guinea-flower		2	C	U
Isopogon ceratophyllus	Horny Cone-bush	Cone-bush	2	S	U
Leucopogon virgatus	Common Beard-heath		2	C*	U
Lomandra fibrata	Mount Lofty Mat-rush	Fine Mat-rush	2	S	T
Lomandra micrantha ssp.	Small-flower Mat-rush		2	S	T
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		2	S	T
Microlaena stipoides var. stipoides	Weeping Rice-grass	Weeping Grass	2	S	T
Olearia pannosa ssp. pannosa	Silver Daisy-bush		2	S/C	U
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	2	S	U
Pultenaea canaliculata var.	Soft Bush-pea	Coast Bush-pea	2	S/C	U
Pultenaea scabra	Rough Bush-pea		2	S/C	U
Pultenaea trinervis	Three-nerve Bush-pea		2	S/C	U
Scaevola linearis ssp.	Rough Fanflower		2	S/C	U
Xanthorrhoea semiplana ssp.	Yacca	Flat-leaf Grass-tree	2	S	T
Xanthorrhoea semiplana ssp. tateana	Tate's Grass-tree		2	S	T
Lepidosperma carphoides	Black Rapier-sedge		2	S/P	T
Lepidosperma curtisiae	Little Sword-sedge		2	S/P	T
Lepidosperma semiteres	Wire Rapier-sedge		2	S/P	T
Lepidosperma viscidum	Sticky Sword-sedge		2	S/P	T

Red Gum Woodlands Revegetation Species List
NOTES:
Reveg Phase- 1= Initial reveg (Phase 1 species can also be used for Phase 2), 2= Infill for established reveg AND for degraded remnant vegetation.

Establishment Method- C= Cutting grown tubestock, S=Seed grown tubestock, D= Direct seeding (can also be established from Seed grown tubestock), P= Divided material and Plugged directly into the site, *= Very difficult to propagate.

Plant Type- C= Canopy, M= Mid Storey, U=Understorey, CL= Climber, T= Tussock (grasses, sedges etc)

SPECIES	COMMON NAME 1	COMMON NAME 2	REVEG PHASE	EST	PLANT TYPE
Acacia paradoxa	Kangaroo Thorn	Hedge Wattle	1	D	M
Acacia pycnantha	Golden Wattle		1	D	M
Acacia retinodes var. retinodes (swamp form)	Swamp Wattle		1	D	M
Allocasuarina verticillata	Drooping Sheoak		1	D	C
Banksia marginata	Silver Banksia	Honeysuckle	1	S	M
Bursaria spinosa	Sweet Bursaria	South Australian Christmas Bush	1	S	M
Clematis microphylla	Old Man's Beard	Small-leaf Clematis	1	S	CL
Danthonia geniculata	Kneed Wallaby-grass		1	S	T
Danthonia pilosa var. paleacea	Velvet Wallaby-grass		1	S	T
Danthonia racemosa var. racemosa	Slender Wallaby-grass	Stiped Wallaby-grass	1	S	T
Distichlis distichophylla	Emu-grass	Australian Salt-grass	1	S/C	T
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Spoon-leaf Hop-bush	1	D	M
Elymus scabrus var. scabrus	Native Wheat-grass	Common Wheat-grass	1	S	T
Enchylaena tomentosa var. tomentosa	Ruby Saltbush	Barrier Saltbush	1	D	M
Eucalyptus camaldulensis var.	River Red Gum		1	D	C
Eucalyptus camaldulensis var. camaldulensis	River Red Gum	Red Gum	1	D	C
Eucalyptus fasciculosa	Pink Gum	Hill Gum	1	D	C
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		1	D	C
Eucalyptus leucoxylon(NC)	South Australian Blue Gum	Yellow Gum	1	D	C
Eucalyptus ovata	Swamp Gum		1	D	C
Goodenia ovata	Hop Goodenia		1	S/C	U
Helichrysum scorpioides	Button Everlasting		1	S	U
Isolepis nodosa	Knobby Club-rush	Knobby Club-sedge	1	D/P	T
Juncus kraussii	Sea Rush		1	D/P	T
Juncus pallidus	Pale Rush		1	D/P	T
Juncus sarophorus			1	D/P	T
Juncus subsecundus	Finger Rush		1	D/P	T
Kunzea pomifera	Muntries	Pink Buttons	1	S/C	U
Leptospermum lanigerum	Silky Tea-tree	Woolly Tea-tree	1	D	M
Leptospermum myrsinoides	Heath Tea-tree		1	D	M
Melaleuca brevifolia	Short-leaf Honey-myrtle	Swamp Honey-myrtle	1	S	M
Melaleuca decussata	Totem-poles	Cross-leaved Honey-myrtle	1	D	M
Muehlenbeckia adpressa	Climbing Lignum	Native Sarsparilla	1	S/C	M/CL
Muehlenbeckia gunnii	Coastal Climbing Lignum	Native Sarsparilla	1	S/C	M/CL
Myoporum insulare	Common Boobialla	Native Juniper	1	C	M
Olearia ramulosa	Twiggy Daisy-bush		1	S/C	U
Phragmites australis	Common Reed	Bamboo Reed	1	S/P	T
Poa labillardieri var. labillardieri	Common Tussock-grass	Tussock Poa	1	S	T
Rhagodia candolleana ssp. candolleana	Sea-berry Saltbush		1	D/C	U/M
Schoenoplectus validus	River Club-rush	River Club-sedge	1	D/P	T
Stipa mollis	Soft Spear-grass	Supple Spear-grass	1	S	T
Stipa sp.	Spear-grass		1	S	T
Tetragonia implexicoma	Bower Spinach		1	S/C	U
Themeda triandra	Kangaroo Grass	Ilintji	1	D	T
Typha domingensis	Narrow-leaf Bulrush	Narrow-leaf Cumbungi	1	S	T
Dianella brevicaulis	Short-stem Flax-lily	Coast Flax-lily	1-2	S/P	T
Dianella revoluta var. revoluta	Black-anther Flax-lily	Spreading Flax-lily	1-2	S/P	T
Lomandra multiflora ssp. dura	Hard Mat-rush	Iron-grass	1-2	S	T
Arthropodium strictum	Common Vanilla-lily	Common Chocolate-lily	2	S	U
Billardiera cymosa	Sweet Apple-berry		2	S/C	CL
Calytrix tetragona	Common Fringe-myrtle		2	S/C	U/M
Correa reflexa var. reflexa	Common Correa		2	C	U
Cyperus vaginatus	Stiff Flat-sedge	Puta-puta	2	D/P	T
Dillwynia hispida	Red Parrot-pea	Downy Parrot-pea	2	S/C	U
Exocarpos cupressiformis	Native Cherry	Cherry Ballart	2	S*	M
Grevillea lavandulacea var. sericea	Spider-flower	Heath Grevillea	2	S/C	U
Hibbertia riparia	Guinea-flower		2	C	U
Isopogon ceratophyllus	Horny Cone-bush	Cone-bush	2	S	U
Lepidosperma carphoides	Black Rapier-sedge		2	S/P	T
Lepidosperma viscidum	Sticky Sword-sedge		2	S/P	T
Leucopogon rufus	Ruddy Beard-heath		2	C*	U
Leucopogon virgatus	Common Beard-heath		2	C*	U
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		2	S	T
Lomandra nana	Small Mat-rush	Soft Mat-rush	2	S	T
Microlaena stipoides var. stipoides	Weeping Rice-grass	Weeping Grass	2	S	T
Platylobium obtusangulum	Holly Flat-pea	Common Flat-pea	2	S	U
Thysanotus patersonii	Twining Fringe-lily		2	S	U
Xanthorrhoea semiplana ssp. tateana	Tate's Grass-tree		2	S	T

VIb References / Fact Sheets

[Note: • PIRSA fact sheets are available online through links found at: http://www.pir.sa.gov.au/dhtml/ss/section.php?sectID=1269&tempID=1
• Fact sheets can also be obtained through the Mt Lofty Ranges Catchment Centre, cnr Mann and Walker Streets, Mt Barker]

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Rural Solutions SA (2003) *Fact sheet – Direct Seeding.*

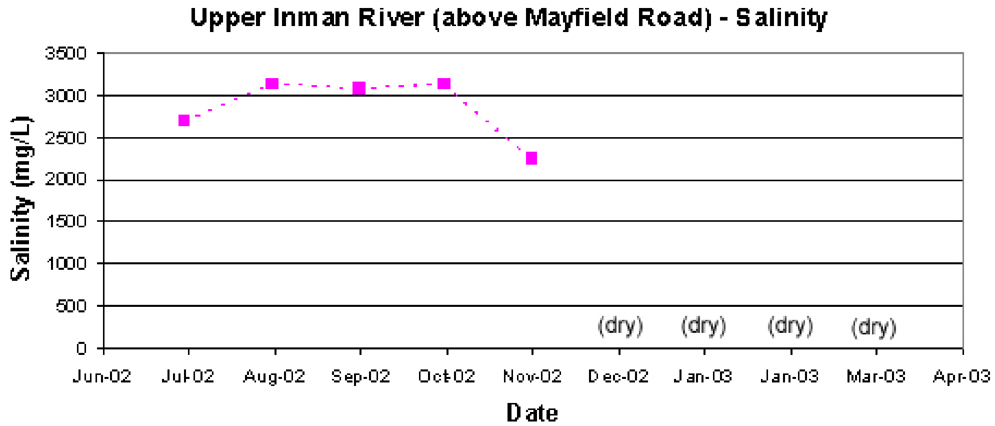
Taylor, R., (2000a) *A Handbook for Revegetation and Weed Control in the Southern Fleurieu Dunes*, Ron Taylor, Coastcare

Taylor, R., (2000b) *A Handbook for Revegetation and Weed Control in the Southern Fleurieu Dunes- Victor Harbor Appendix*, Ron Taylor, Coastcare

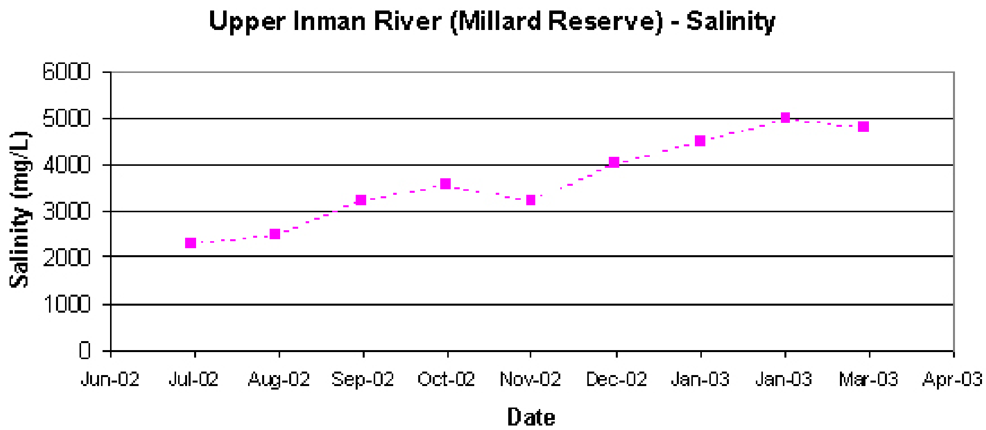
APPENDIX 15. SALINITY TIME RECORDS FOR THE INMAN RIVER CATCHMENT

The following graphs refer to locations marked on the map at the end of this Appendix. (Data sources, listed in the attached data CD, include the Inman River Catchment Group, Camp Scott Furphy et al, 1992, EWS and EPA.)

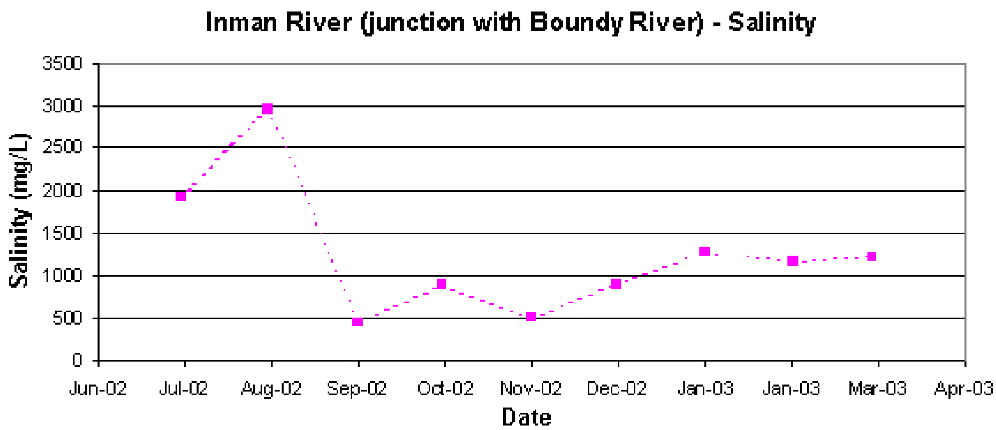
Location 1:



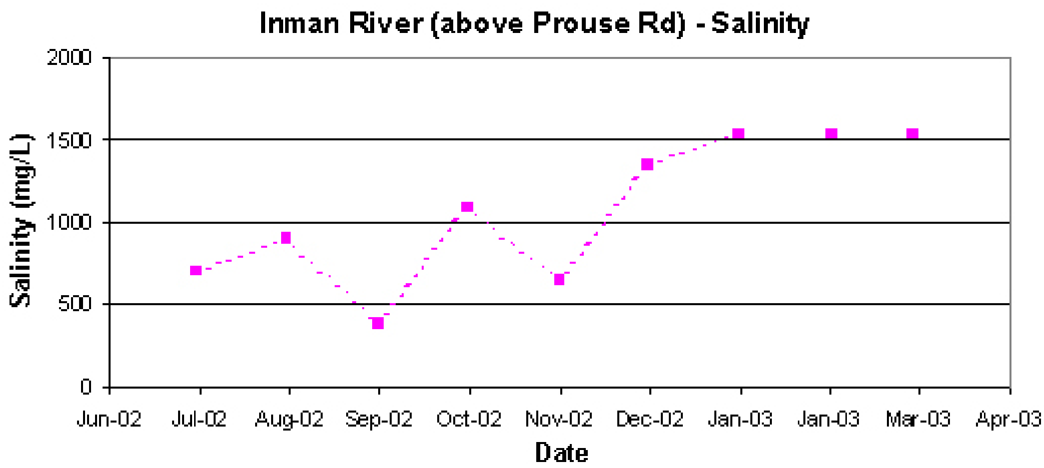
Location 2:



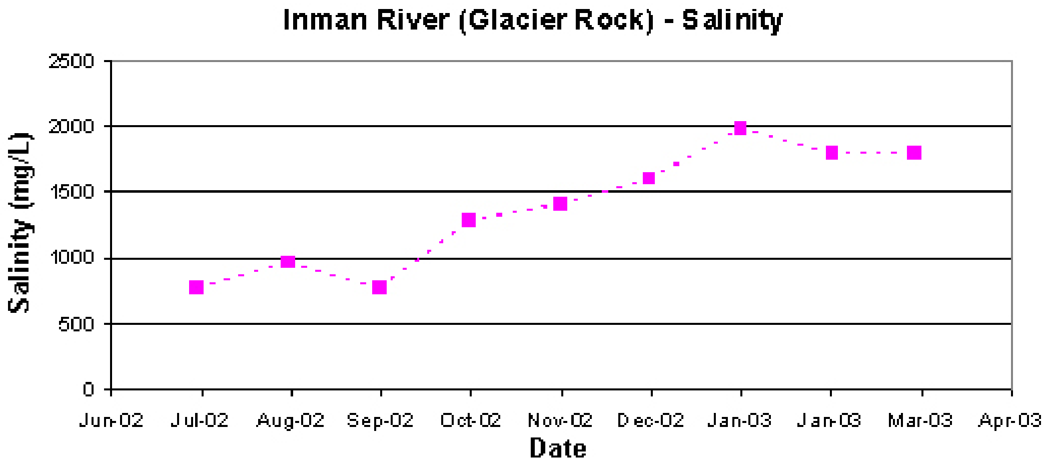
Location 3:



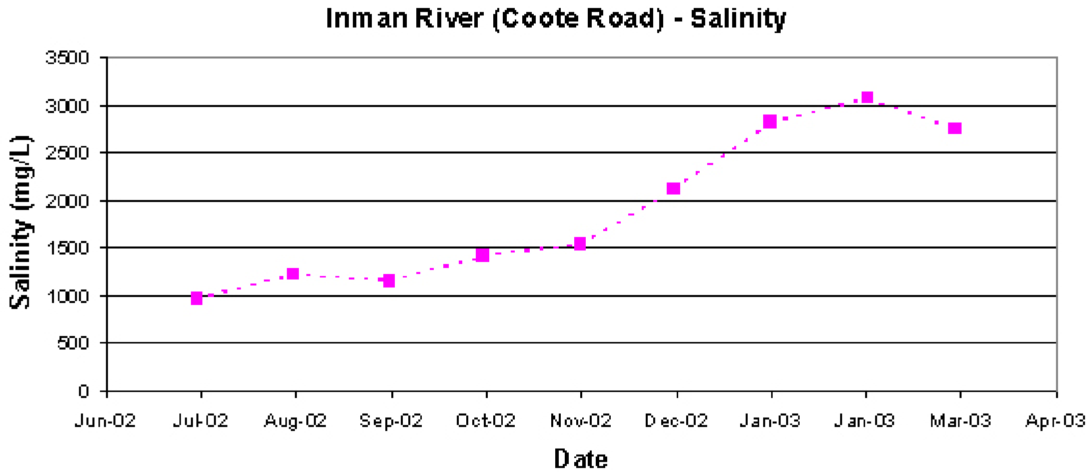
Location 4:



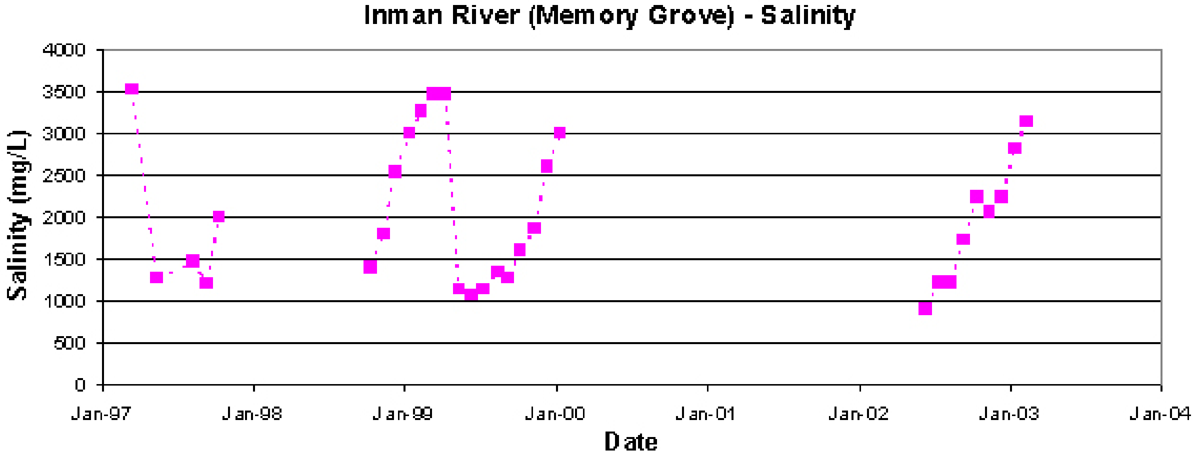
Location 5:



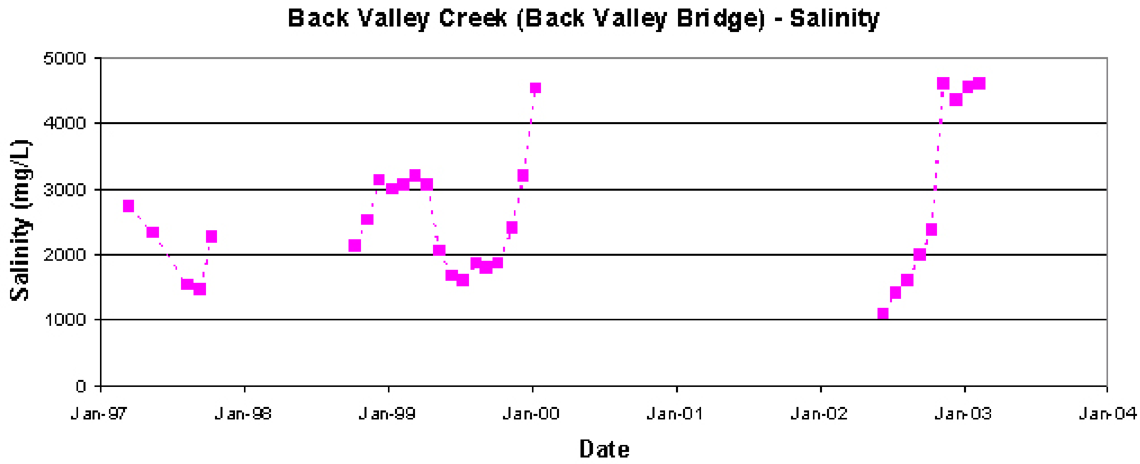
Location 6:



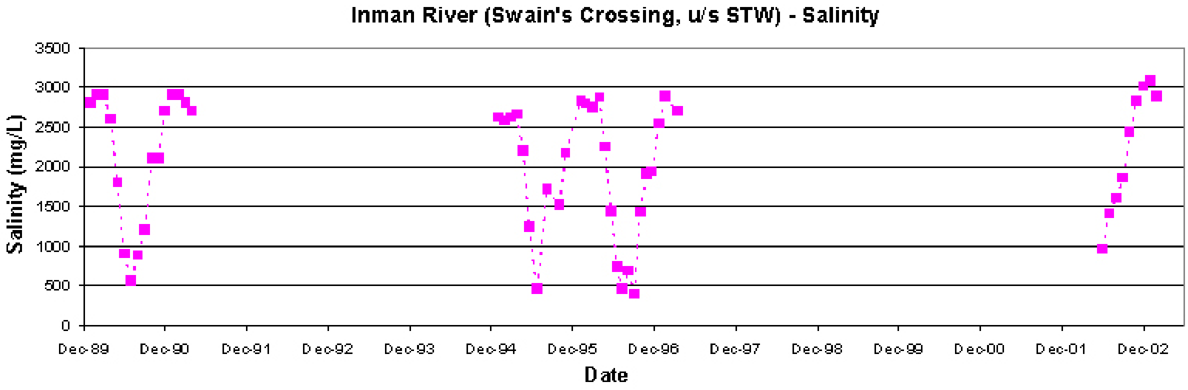
Location 7:



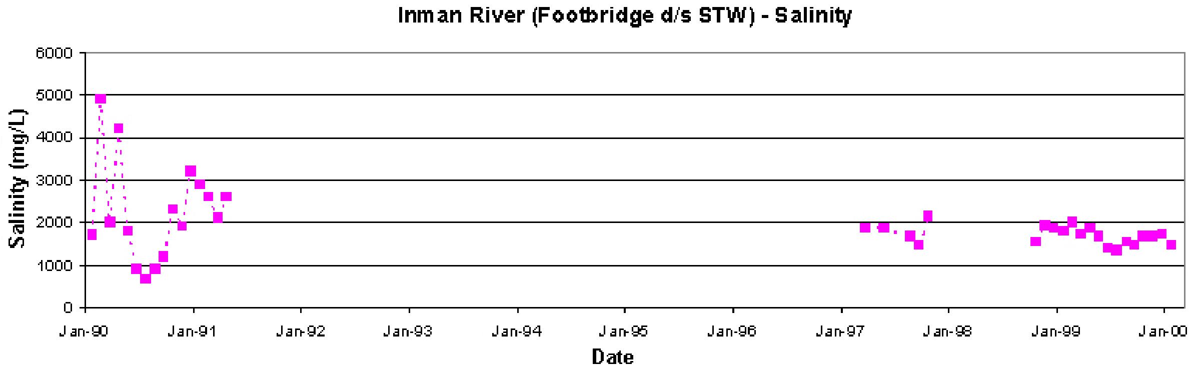
Location 8:



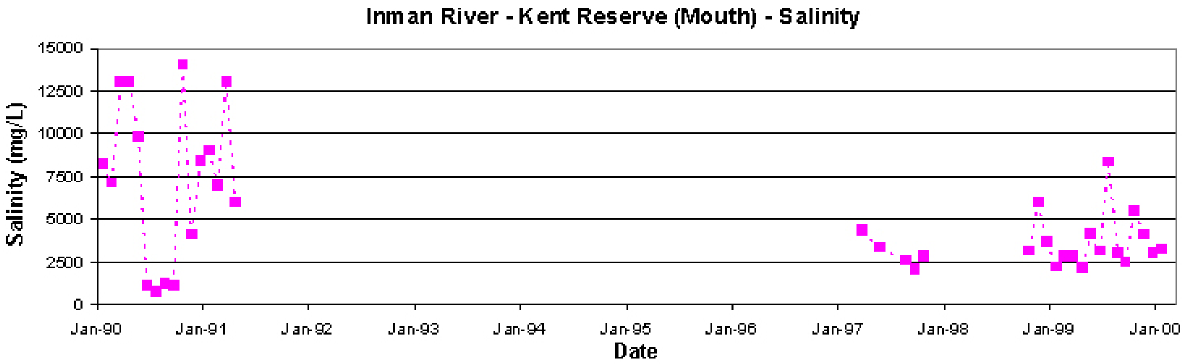
Location 9: (Swain's Crossing & GS501503 combined)

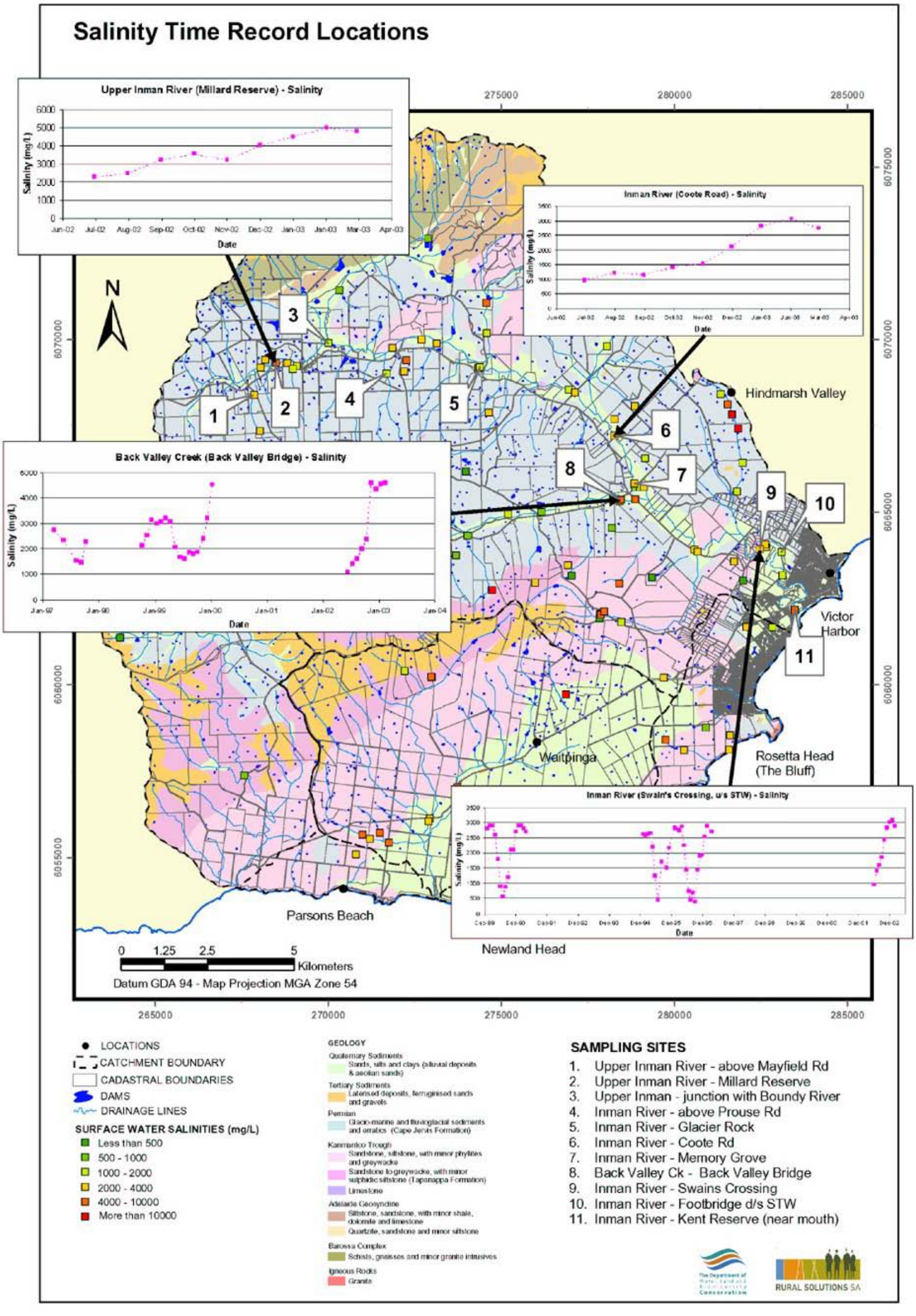


Location 10:

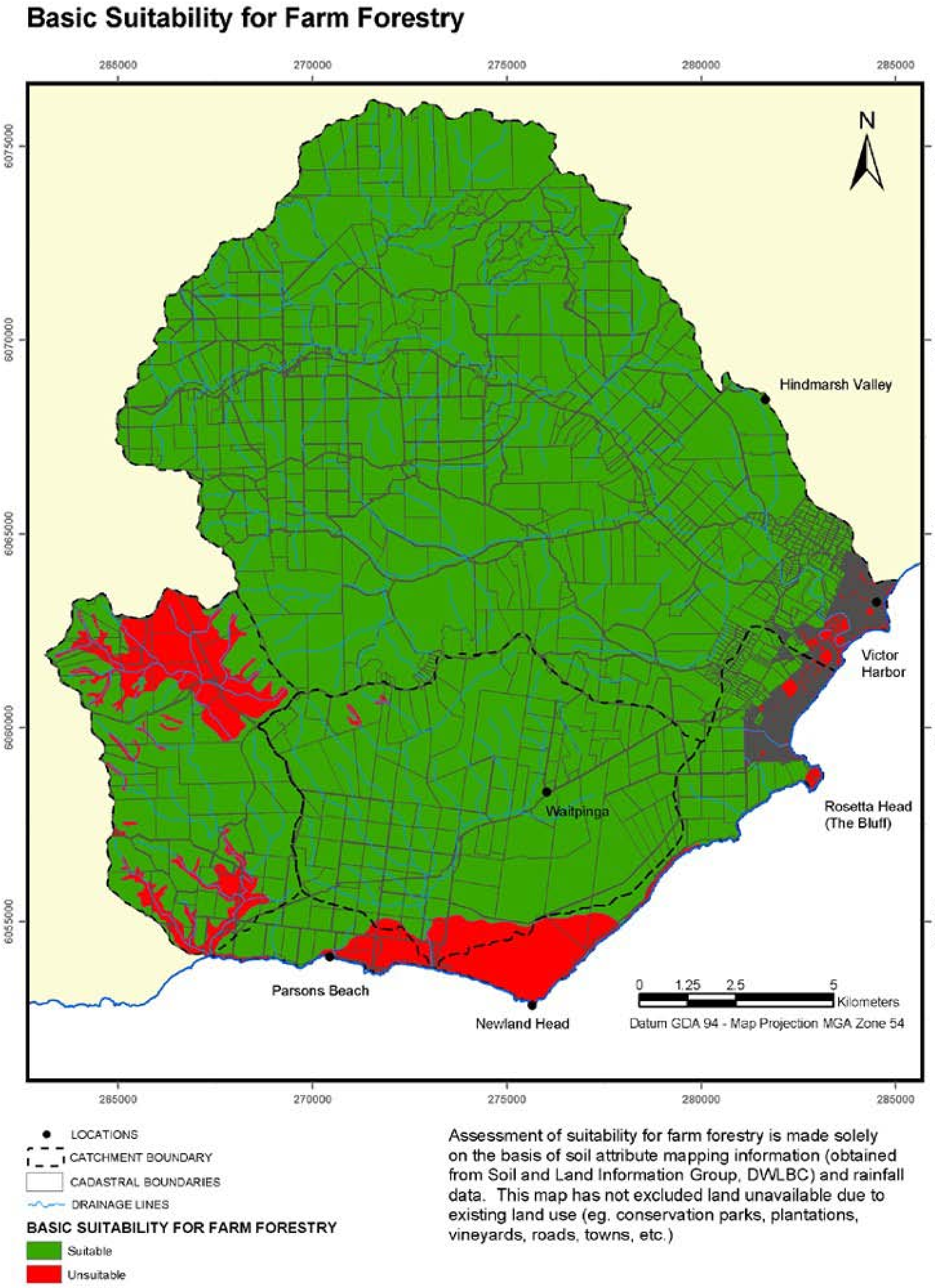


Location 11: (this site is located within the estuary)




Salinity Time Record Locations
Upper Inman River (Millard Reserve) - Salinity
Inman River (Coote Road) - Salinity
Back Valley Creek (Back Valley Bridge) - Salinity
Inman River (Swain's Crossing, u/s STW) - Salinity
Salinity (mg/L)
Date
N
Hindmarsh Valley
Victor Harbor
Rosetta Head (The Bluff)
Waitpinga
Parsons Beach
Newland Head
0 1.25 2.5 5 Kilometers
Datum GDA 94 - Map Projection MGA Zone 54
LOCATIONS
CATCHMENT BOUNDARY
CADASTRAL BOUNDARIES
DAMS
DRAINAGE LINES
SURFACE WATER SALINITIES (mg/L)
Less than 500
500 - 1000
1000 - 2000
2000 - 4000
4000 - 10000
More than 10000
GEOLOGY
Quaternary Sediments
Sands, silts and clays (alluvial deposits & aeolian sands)
Tertiary Sediments
Laterised deposits, ferruginised sands and gravels
Permian
Glacio-marine and fluvioglacial sediments and erratics (Cape Jervis Formation)
Kanmantoo Trough
Sandstone, siltstone, with minor phyllites and greywacke
Sandstone to greywacke, with minor sulphidic siltstone (Tapanappa Formation)
Limestone
Adelaide Geosyncline
Siltstone, sandstone, with minor shale, dolomite and limestone
Quartzite, sandstone and minor siltstone
Barossa Complex
Schists, gneisses and minor granite intrusives
Igneous Rocks
Granite
SAMPLING SITES
1. Upper Inman River - above Mayfield Rd
2. Upper Inman River - Millard Reserve
3. Upper Inman - junction with Boundy River
4. Inman River - above Prouse Rd
5. Inman River - Glacier Rock
6. Inman River - Coote Rd
7. Inman River - Memory Grove
8. Back Valley Ck - Back Valley Bridge
9. Inman River - Swains Crossing
10. Inman River - Footbridge d/s STW
11. Inman River - Kent Reserve (near mouth)
RURAL SOLUTIONS SA

APPENDIX 16. SUITABILITY FOR FARM FORESTRY



APPENDIX 17. EXAMPLE RECHARGE REDUCTION TARGETS

Catchment	▪ Combined Inman/ Waitpinga/ Coolawang/ Newland Cliffs ▪ 32000 ha in area, mostly 600 to 800 mm rainfall zone
Current Land use (approx.)	▪ Remnant vegetation/forestry 20% of the catchment (~ 6400 ha) ▪ Improved pastures 20% (~6400 ha) ▪ Other pasture 55% (~ 17600 ha) ▪ Other 5% (~ 1600 ha)
Water use	▪ Currently 60% of annual rainfall ▪ Runoff coefficient ~ 0.1 to 0.15
Salinity	▪ Currently 150 ha of saltland ▪ Stream salinity at ~ 2500 ppm
Recharge Reduction Actions	▪ Fence off and re-invigorate 1000 ha of remnant native vegetation ▪ Convert 6000 ha of annual pasture to perennial pasture ▪ Establish 4500 ha of woody perennials (farm forestry, woodlots, native vegetation) ▪ Establish salt/waterlogging tolerant perennial vegetation on seepage/wetland areas ▪ Increase productivity and total water use from annuals over 5000 ha (eg. liming, waterlogging control, improved grazing and agronomic practices)

The recharge reduction actions are an example of the land management and land use change that is required to:

- help stabilise and reduce stream salinity levels.
- help reduce the export of salt into wetland environments.
- stop the spread of salt.

On-ground works should be targeted initially in subcatchments where:

- The risk of salt spread is greatest (see Fig - Salinity Risk)
- Stream salinity levels are highest (see Fig - Geology and surfacewater salinity; also indicated by Fig - Salinity induced by Watertable)

On-ground works in these subcatchments are best located in any higher recharge zones (see Fig - Recharge Potential) that are contributing to the problem areas.

APPENDIX 18. TOTAL WATER USE FACTSHEET

(HIGHER RAINFALL AREAS > 550 MM)

LAND USE	WATER USE FACTOR		EXAMPLE FARM		
			% farm area	Water use (% of rainfall)	
	higher	**lower**		**higher**	**lower**
Farm forestry	1.1	1.0	5	5.5	
Native vegetation	1.0	0.9	5		4.5
Lucerne/ phase farming	0.9	0.8			
Other perennial pasture	0.8	0.7	40	32	
Continuous cropping	0.7	0.6			
Crop/pasture	0.6	0.5	5	3	
Annual pasture	0.5	0.4	40		16
irrigation	0.7	0.6	5		3.0
other					
		TOTAL	**100%**	**64 %**	

Water use for each land use = <u>water use factor x the % area of your farm.</u>

In the example farm, **higher water use factors** have been used where the land use is well managed and highly productive, and lower factors used where things are not so productive. For example, the native vegetation is degraded whereas all the perennial pasture is growing vigorously and is highly productive.

To reduce recharge and successfully control salinity on this example farm, water use needs to increase to 82% of annual rainfall (64 + half [100 – 64]). Use this formula to see what the target future water use needs to be to control salinity on your farm.

FOR YOUR FARM

LAND USE	WATER USE FACTOR		YOUR FARM			
			Current % farm area	Current water use	Future % farm area	Future water use
	Higher	Lower				
Farm forestry	1.1	1.0				
Native vegetation	1.0	0.9				
Lucerne/ phase farming	0.9	0.8				
Other perennial pasture	0.8	0.7				
Continuous cropping	0.7	0.6				
Crop/pasture	0.6	0.5				
Annual pasture	0.5	0.4				
irrigation	0.7	0.6				
other						
		TOTAL	100%		100%	

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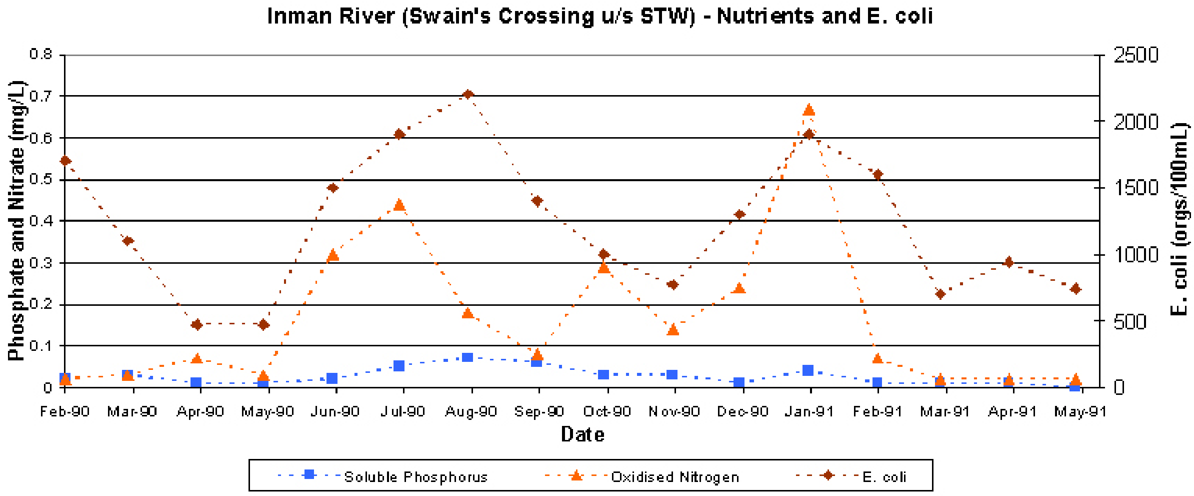
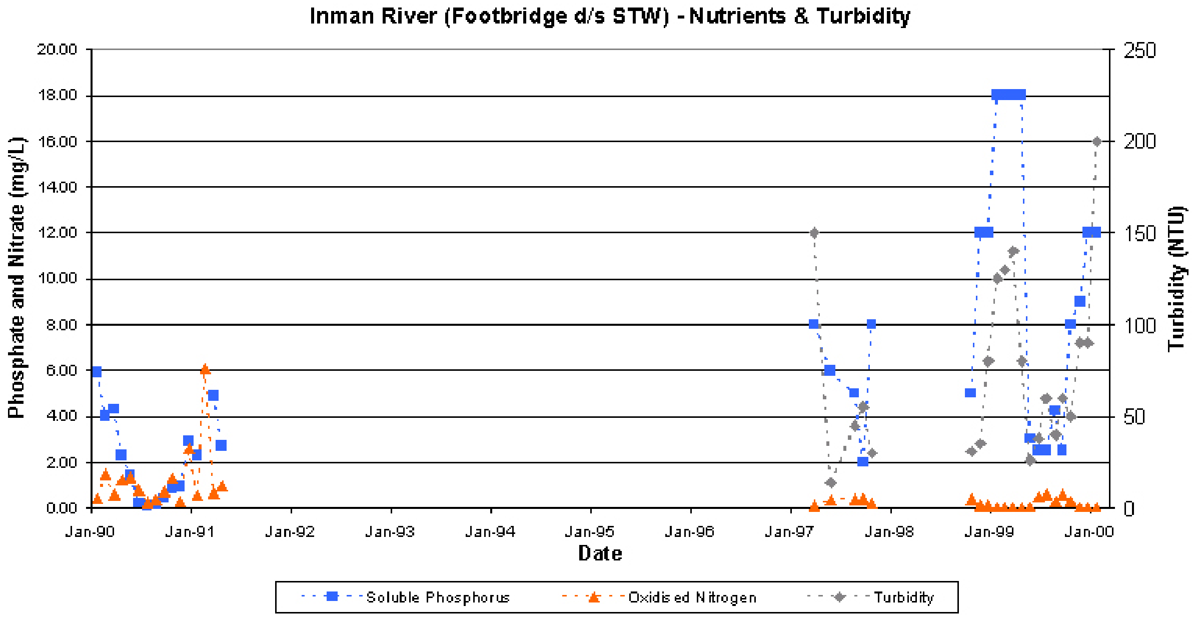
APPENDIX 19. NUTRIENT AND E.COLI TIME RECORDS FOR THE INMAN RIVER CATCHMENT

The following graphs refer to locations marked on the map in Appendix 15.
(Data sources are provided in the data CD attached to this report.)

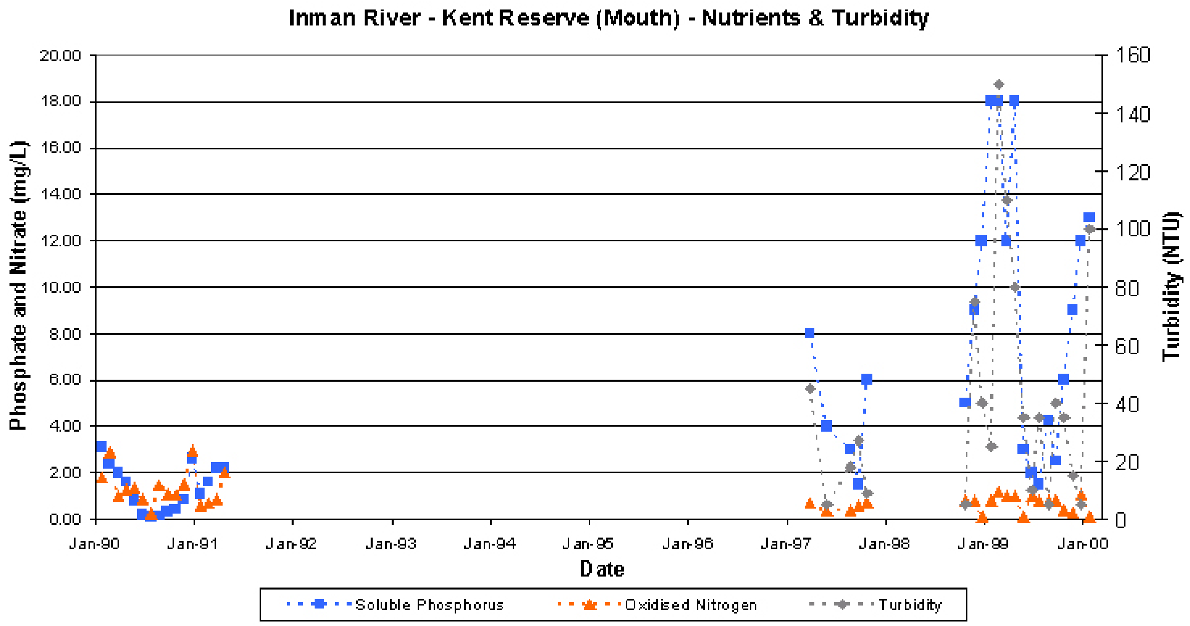
Location 9:



Location 10:



Location 11:



Location 11: