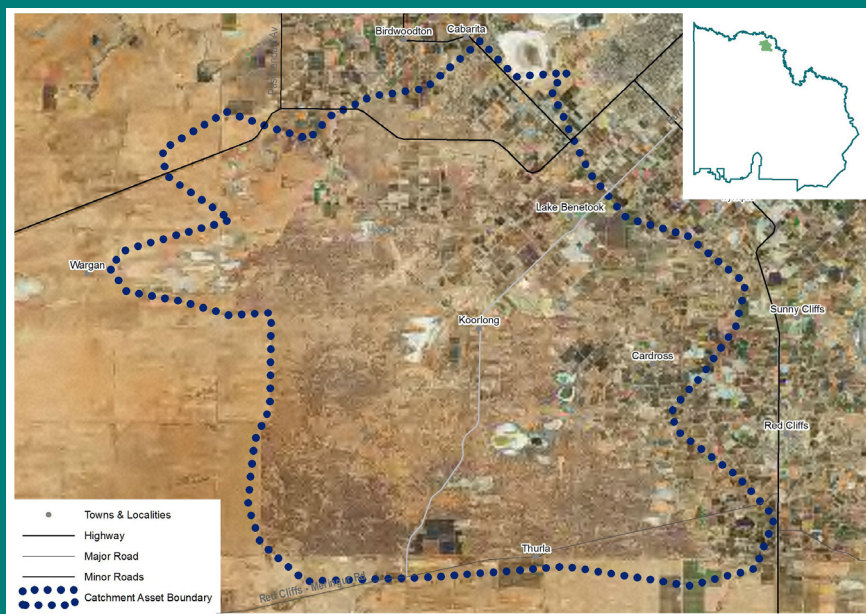


# 3 – Cardross Lakes and Koorlong State Forest

## Regional Catchment Strategy Implementation Plan



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Version Control			
Version Number	Prepared by	Reviewed by	Date
1 (Presented on internal blog)	Sean Dwyer	Jo Latta	06/11/2013
2	Amy Leamon	Jo Latta	17/03/2017

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# Contents

Section 1 - Overview .....	5
Catchment Asset Significance .....	6
Catchment Asset Value.....	6
Threatening Processes .....	6
Management Plans .....	7
Management Actions .....	7
Priorities .....	8
Regional Delivery Partners .....	10
Community NRM Groups .....	11
Section 2 – Regional Assets in this Catchment Asset .....	13
Rivers .....	14
Wetlands .....	14
Threatened Species and Communities.....	15
Terrestrial Habitat.....	20
Soils.....	22
Agricultural Land .....	23
Groundwater .....	24
Cultural Heritage .....	24
Community Capacity .....	25
Section 3 – Threatening Processes in this Catchment Asset.....	28
Land & water salinisation .....	29
Invasive Plants .....	31
Invasive Animals .....	34
Altered Hydrological Regimes.....	36
Soil Erosion .....	37
Inappropriate Water Use Practices .....	39
Recreational Pressures.....	40
Land Use Change .....	41
Direct Off-site Interactions.....	41
Misaligned Community Perceptions.....	42
Inappropriate Fire Regimes.....	43
Constrained Regenerative Capacity .....	44
Section 4 – References & Appendices .....	46
References.....	47
1. The Value of Regional Assets within a Catchment Asset.....	48

2. Categorising Threatening Processes .....	48
3. Management Plans Relevant to this Catchment Asset.....	49
4. Management Action Definitions .....	50
5. Management Actions from Existing Management Plans .....	51
6. Prioritising Potential Management Actions .....	57
7. Management Action Priorities .....	58

## Section 1 - Overview

## Catchment Asset Significance

The Cardross Lakes are a series of natural and artificial depressions that have been used as drainage basins and to control salinity by the local irrigation schemes.

Located west of Red Cliffs, these nationally important wetlands cover an area of approximately 360 hectares. The lakes are the only known occurrence of the Southern Purple-Spotted Gudgeon (*Mogurnda adspersa*) in Victoria and are particularly important habitats for Murray Hardyhead (*Craterocephalus fluviatilis*), freshwater catfish (*Tandanus tandanus*) and an abundant population of bony bream (*Nematalosa erebi*).

The area provides a number of important ecosystem services including drainage, salinity control, recreational activities such as fishing and walking, and tourism.

## Catchment Asset Value

This section examines the relative values of the Regional Assets that lie within this Catchment Asset. It provides an overview of the asset analysis in order to inform prioritisation of management actions that are intended to minimise the impact of the threatening processes upon Regional Assets and improve the status or quality of the Regional Assets within the Catchment Asset Area.

The asset value indicates the relative importance of the Regional Asset within the Catchment Asset Area. The valuation is determined from a range of indicators, many specific to each of the Regional Assets that describe the importance of the Asset relative to social, economic and environmental values.

Table 1 below provides a summary of the value of each of the Regional Assets in this Catchment Asset. Greater detail about each of the Regional Assets in this Catchment Asset can be found in Section 2 – Regional Assets in this Catchment Asset

**Table 1: Value of Regional Assets in this Catchment Asset**

Regional Asset	Value
Rivers	NONE
Wetlands	VERY HIGH
Threatened Species and Communities	VERY HIGH
Terrestrial Habitat	MEDIUM
Soils	HIGH
Agricultural Land	HIGH
Groundwater	NONE
Cultural Heritage	HIGH
Community Capacity	HIGH

A detailed explanation of how these values were defined and applied can be found in Appendix 1. The Value of Regional Assets within a Catchment Asset.

## Threatening Processes

This section examines the threatening processes that may be impacting upon Regional Assets that lie within this Catchment Asset. It provides an overview of each of the threatening processes in order to

inform prioritisation of management actions that are intended to minimise their impact upon Regional Assets and improve the status or quality of the Regional Assets within the Catchment Asset Area.

Table 2 below provides a summary of the threat level posed by each of the threatening processes that are active in this Catchment Asset. Greater detail about each of the threatening processes and their scope, scale and relative impact within this Catchment Asset can be found in Section 3 – Threatening Processes in this Catchment Asset

**Table 2: Threat Priority across this Catchment Asset**

Threatening Process	Priority of Action
Rivers	HIGH
Wetlands	HIGH
Threatened Species and Communities	HIGH
Terrestrial Habitat	HIGH
Soils	MEDIUM
Agricultural Land	HIGH
Groundwater	HIGH
Cultural Heritage	HIGH
Community Capacity	LOW
Rivers	MEDIUM
Wetlands	MEDIUM
Threatened Species and Communities	HIGH

A detailed explanation of how these threat levels were defined and applied can be found in Appendix 2. Categorising Threatening Processes.

## Management Plans

This Catchment Asset Area is subject to a diverse range of natural resource management instruments that are intended to protect, preserve and enhance the area's natural resources for the benefit of the Mallee region. These instruments can be either broad in their focus (covering many regional assets), focused on a particular area of interest (such as an individual Regional Asset) or tightly focused on a specific location or species. These management plans are prepared and owned by range of entities such as local government, statutory authorities, community groups and government departments at both State and Federal levels. Responsibility for their implementation can rest with a single entity or it may be divested across a broad range of organisations and groups. Some management plans are prepared to satisfy a legislative requirement while others are prepared to provide direction towards an organisational goal. Regardless of the reason and purpose of the management plan, they all have a common feature – they typically contain specific management direction or actions that are to be delivered through the implementation of the plan.

The identified existing management plans have been listed in Appendix 3. *Management Plans Relevant to this Catchment Asset*

## Management Actions

Actions within the management plans in the table above are typically diverse in their wording, structure and complexity. However, they are broadly similar in terms of their intent. As a result, they can usually

be easily classified into broad categories. Within each of these categories are a range of common management actions. Each of these common management actions can also be said to target specific threatening processes. These management categories, the management actions within each of them, their definitions and the targeted threatening processes are shown in Appendix 4. *Management Action Definitions*

The result of the classification process of the actions within Appendix 3. Management Plans Relevant to this Catchment Asset is contained in Appendix 5. Management Actions from Existing Management Plans. The classification table includes some detail about each action to support the classification. It is advised that if more information about a specific management action within a management plan is required then the original management plan should be consulted rather than relying specifically on the data in that classification table.

## Priorities

This section examines the potential management action groups from the management plans relevant to this Catchment Asset Area that are listed in the Management Plans section above and summarised Appendix 5. Management Actions from Existing Management Plans. The intent is to prioritise these potential management actions in terms of:

- The priorities of the regional asset within the catchment asset area (outlines in the Catchment Asset Value section above);
- section above);
- the priority to address a threatening process (outlined in the Threatening Processes section above);
- the capacity of the management action to address the threatening process; and
- the level of investment (in both of time and money) required to exercise that capacity.

The individual management actions from the plans listed in the Management Plans section were grouped and scored by consensus against agreed criteria and then each potential management action group within the Catchment Asset was assigned to a category that defines the prospective priority to the implementation. Further information regarding the definition and application of each of these categories can be found in Appendix 6. *Prioritising Potential Management Actions*.

The findings of the analysis are summarised in Table 3 below. The detailed priority matrices from which the summary table is taken can be found in Appendix 7. Management Action Priorities.

**Table 3: Summary of the Priority of Potential Management Actions**

Management Action	Priority	Threatening Processes Addressed
<b>Pest Plant Control</b>	<b>High</b>	Invasive Plants; Constrained Regenerative Capacity
<b>Pest Animal Control</b>	<b>Medium</b>	Invasive Animals; Soil Erosion; Constrained Regenerative Capacity
<b>Habitat Protection</b>	<b>Medium</b>	Invasive Animals; Soil Erosion; Recreational Pressure; Land Use Change; Direct Off-Site Interactions; Constrained Regenerative Capacity
<b>Habitat Restoration</b>	<b>Medium</b>	Land & Water Salinisation; Soil Erosion; Recreational Pressure; Direct Off-Site Interactions; Constrained Regenerative Capacity
<b>Revegetation</b>	<b>Low</b>	Land & Water Salinisation; Soil Erosion; Recreational Pressure; Direct Off-Site Interactions; Constrained Regenerative Capacity



<b>Environmental Watering</b>	<b>High</b>	Altered Hydrological Regimes; Constrained Regenerative Capacity
<b>Soil Erosion Control</b>	<b>Low</b>	Soil Erosion
<b>Threatened Species Interventions</b>	<b>High</b>	Constrained Regenerative Capacity
<b>Enhancing Land Management Regimes</b>	<b>High</b>	Land & Water Salinisation; Soil Erosion; Inappropriate Water Use Practises; Land Use Change; Direct Off-Site Interactions
<b>Supporting Human Capacity for NRM</b>	<b>Medium</b>	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
<b>Supporting Institutional Capacity for NRM</b>	<b>Medium</b>	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
<b>Supporting Social Capacity for NRM</b>	<b>Medium</b>	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
<b>Institutional Planning for NRM</b>	<b>Medium</b>	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
<b>Community Driven Planning for NRM</b>	<b>Medium</b>	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
<b>Landholder Driven Planning for NRM</b>	<b>Medium</b>	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire

		Regimes; Constrained Regenerative Capacity
<b>Research to improve knowledge</b>	<b>Medium</b>	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity
<b>Asset condition monitoring and assessment</b>	<b>Medium</b>	Land & Water Salinisation; Invasive Plants; Invasive Animals; Altered Hydrological Regimes; Soil Erosion; Inappropriate Water Use Practices; Recreational Pressures; Land Use Change; Direct Off-site Interactions; Misaligned Community Perceptions; Inappropriate Fire Regimes; Constrained Regenerative Capacity

## Regional Delivery Partners

The individuals and organisations listed below have various roles to play within the Catchment Asset area in delivering and implementing the management actions described in previous sections that will in turn contribute to the aims and expected outcomes of the Mallee RCS. This list is not considered exhaustive and can be expected to change over time. More detail about the specific role and responsibilities of these entities with respect to the RCS can be found below.

- Aboriginal Affairs Victoria
- Aboriginal Communities (Traditional Owners & Organisations)
- Birdlife Mildura
- Catchment Management Authorities – Mallee (VIC)
- Department of Environment & Primary Industries (VIC)
- Far West Anglers Association
- Landcare Groups (Cabarita; Kulkyne Way; Millewa-Carwarp; Yelta)
- Lower Murray Water
- Mildura RSL Angling Club
- Mildura Rural City Council
- Murray Darling Basin Authority
- Private Land Managers
- Research Bodies – Arthur Rylah Institute, Invasive Animals CRC, Murray Darling Freshwater Research Centre
- VicRoads
- VR Fish
- Waterwatch

## Community NRM Groups

This section provides a summary of these stakeholder groups that are active within this Catchment Asset. This is not an exhaustive list and will be updated on a regular basis. Further detail on the community NRM groups can be found in Attachment 1 – Mallee NRM Interest Groups.

### Landcare Groups

The Landcare movement has been active in the Mallee since the late 1980s, with 23 active Landcare groups operating today. From our first group, Millewa-Carwarp (established 1989), to the newest, Cabarita (established 2012), Landcare has been instrumental in harnessing and promoting the interests of local communities in natural resource management.

Many groups initially formed due to the issues of rabbits and weeds. Salinity, soil conservation and biodiversity issues have evolved and continued to propel the Landcare movement into the 21st century. Our Landcare groups are keen to ensure that the legacy of Landcare continues and actively support a range of Junior Landcare Groups activities across the region.

#### *Northern Mallee Landcare Consortium*

The Northern Mallee Landcare Consortium represents the Millewa-Carwarp, Yelta, Cabarita, Red Cliffs and Kulkynne Way Landcare Groups

- Kulkynne Way
- Millewa-Carwarp
- Yelta

#### *Non-aligned Landcare Groups*

- Cabarita

### Other Groups

There are a broad range of community, industry, indigenous and specialist groups that have a role to play in NRM within this catchment asset. The tables in this section provide a listing of the groups currently known to be active within the asset area.

Traditional owner groups provide opportunities for our local indigenous communities to have input into how the regions landscapes are managed; and to enhance regional awareness of the cultural values inherent within these landscapes.

A wide range of special interest groups provide the means for individuals to become engaged in activities and programs which reflect their particular concerns. They also provide the region with a vital source of knowledge and understanding on specific issues.

The region's industry based groups have an important role in developing and promoting best practice for competitive and sustainable agricultural sectors.

Advisory groups to statutory bodies like CMA's and water authorities are important forums for both the community and the authorities involved. These groups provide management advice and community feedback to the convening authority while at the same time communicating with the wider community about the activities of the advisory group and the organisation in general.

#### *Registered Aboriginal Parties*

There is currently no registered aboriginal party determined for this catchment asset area

#### *Special Interest and Recreational Groups*

- BirdLife Mildura
- Murray Darling Association

- Murray Lower Darling Rivers Indigenous Nations
- Waterwatch

### *Industry Groups*

- Victorian Farmers Federation (VFF)
- Victoria No-Till Farmers Association (VNTFA)
- Australian Table Grape Association Inc (ATGA)
- Dried Fruits Australia (DFA)
- Mallee Sustainable Farming Inc (MSF)
- Murray Valley Citrus Board (MVCB)
- Murray Valley Winegrowers' Inc (MVW)
- Pistachio Growers Association Incorporated (PGAI)
- Sunraysia Branch of the Victorian Apiarists Association
- Sunraysia Citrus Growers Inc (SCG)

### *Advisory Groups*

- Aboriginal Reference Group (ARG)
- Mallee CMA Land and Water Advisory Committee (LWAC)
- Mallee CMA Technical Advisory Committees (TACs)
- Lower Murray Water Customer Service Advisory Committees (Rural)
- Goulburn-Murray Water Services Committees (WSCs)
- The Living Murray (TLM) Icon Site Community Reference Groups

## Section 2 – Regional Assets in this Catchment Asset

Regional Assets in the Mallee NRM region were defined and applied in accordance with guidelines provided by DSE to support the Victorian Catchment Management Council RCS Guidelines. Each of the following sub-sections provides a background to these Regional Assets and the available information about their significance within this Catchment Asset. This follows on to an assessment of the relative value of the Regional Asset based on the criteria contained in Appendix 1. *The Value of Regional Assets within a Catchment Asset*

## Rivers

There are no natural waterways to be found within this Catchment Asset.

## Wetlands

The most significant feature of this Catchment Asset is the Cardross Lakes. The lakes are a series of eight inter-connected primary and secondary drainage basins; a further four other basins to the south-west of the Lakes are connected to these wetlands. This formerly ephemeral swale system has been transformed into an artificial, permanent wetland through their use for the storage and disposal of collected irrigation drainage. The artificially high water levels in the basins have provided a refuge for fish and waterbirds in otherwise dry seasonal conditions. Past surveys at the Cardross Lakes have shown that they have had the highest known diversities of native fish (ten species) in Victoria. In particular, Basins One, Two, Three, Four, C, D, E are considered highly significant for their aquatic fauna. As a result, the lakes system has been listed on the national Directory of Important Wetlands.

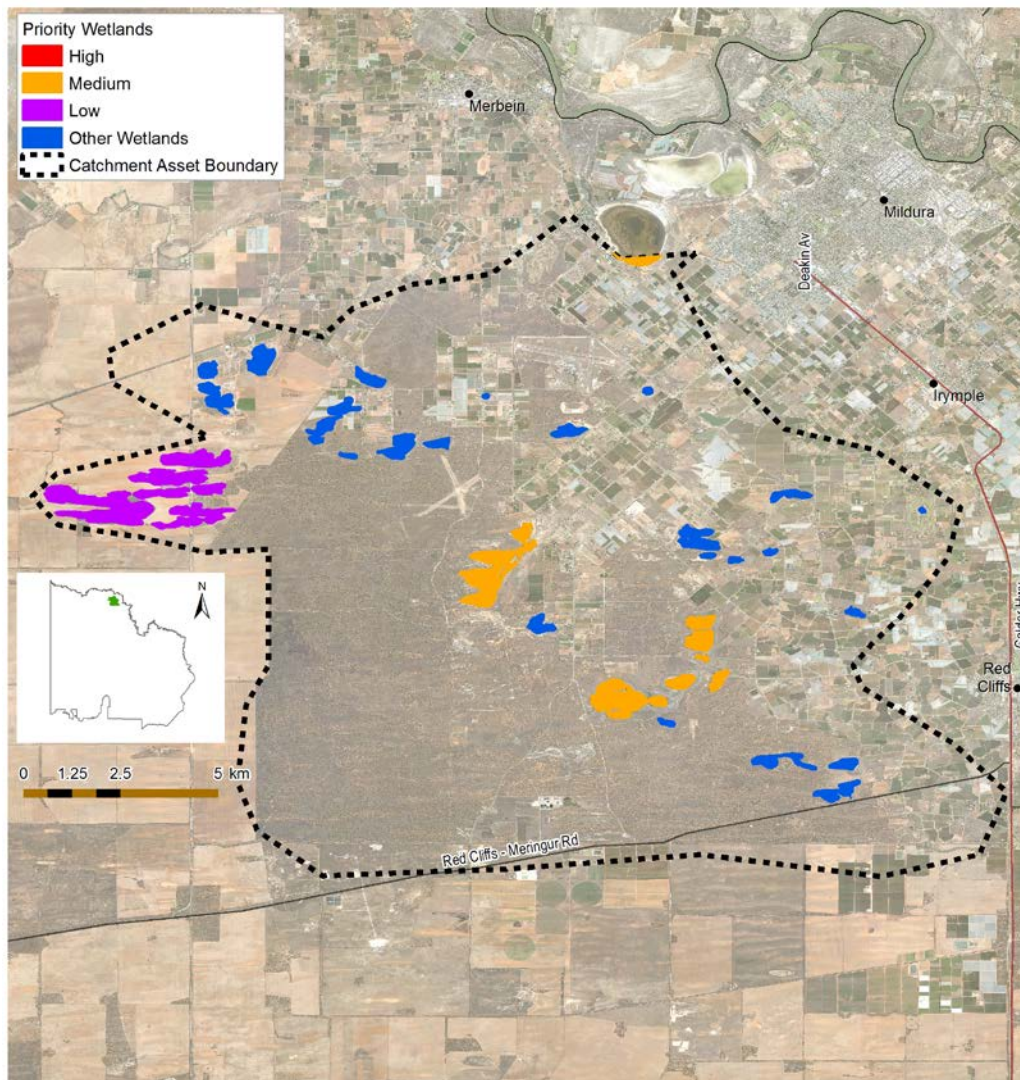
However, the hydrology of this wetland system has changed as water use practises in irrigation have become more efficient over the last two decades which has led to increasing salinity in the lakes, a reduction in the inundated surface area and a change from permanent to intermittent inundation for much of the system. Low water level is currently considered to be a more serious threat to the aquatic environment than increasing salinity and some of the lakes have received environmental water in recent times to maintain habitat.

The other significant wetland feature is the Wargan Basins. These are a system of eight saline drainage disposal basins covering about 690 hectares in previously dry swales between dunes near Merbein South. They contain extensive mudflats and reed beds. The basins vary widely from brackish to hypersaline with typical conductivity of the waters ranging from 5500 EC to 75 000 EC. Intercepted groundwater from the Mildura-Merbein Salt Interception Scheme and some collected irrigation drainage are pumped to the basins. The Wargan Basins are listed on the national Directory of Important Wetlands due to the habitat they provide for a range of waterfowl including species listed under international migratory bird agreements (JAMBA & CAMBA) and the Victorian Flora and Fauna Guarantee Act.

The Mallee Waterway Strategy (2014-22) identifies priority wetlands for future management using an Asset Based Approach; facilitating targeted planning and implementation processes to deliver greatest social, cultural and economic returns on our efforts. Each Wetland asset occurring within this Catchment Asset is ascribed a priority of 'high', 'medium', 'low', or 'additional' under this framework.

Based on the available data concerning their extent, quality and policy significance within this landscape, the Wetlands within this Catchment Asset are considered to be of **very high** value.





**Figure 1: Wetlands**

## Threatened Species and Communities

A significant range of flora and fauna species that are listed in Federal and State instruments have been observed and recorded within the area of this catchment asset over time. These species are listed in the tables that follow along with their current status as described in the listing instrument. The listing instruments are: Environmental Protection and Biodiversity Conservation (EPBC) Act 1999; Flora and Fauna Guarantee (FFG) Act 1998 and the Victorian Threatened Species Advisory Lists issued by the Department of Environment and Primary Industries (DEPI) (Flora: 2005, Fauna: 2013). The species names included in the following tables (Table 4 & Table 5) may not reflect the full range of threatened flora and fauna species that may inhabit the catchment area. Rather they reflect only species whose presence has been observed and recorded by suitably qualified observers since 1980.

The Cardross Lakes/Koorlong State Forest Catchment Asset area supports a number of threatened species including the Australasian Bittern (*Botaurus poiciloptilus*), Regent Parrot (*Polytelis anthopeplus monarchoides*), Swift Parrot (*Manorina melanotis*) and the Murray Hardyhead (*Craterocephalus fluviatilis*). Other significant fauna species for Victoria that have been observed here include numerous water birds such as the Intermediate Egret (*Ardea intermedia*), Blue Billed Duck (*Oxyura australis*), White-bellied Sea Eagle (*Haliaeetus leucogaster*) and Caspian Tern (*Hydroprogne caspia*); and woodland species including the Hooded Robin (*Melanodryas cucullata cucullata*), Bush Stone-curlew (*Burhinus grallarius*), Diamond Dove (*Geopelia cuneata*), Major Mitchell's Cockatoo (*Lophocroa*

leadbeateri), White-browed Tree Creeper (*Climacteris affinis*), and the Dwarf Burrowing Skink (*Lerista timida*). The area is also home to a number of significant plant species including the Limestone Sida (*Sida spodochroma*).

Based on the available data concerning their extent, quality and policy significance within this landscape, the Threatened Species and Communities within this Catchment Asset are considered to be of **very high** value.

**Table 4: Threatened Flora Species observed since 1980**

Scientific Name	Common Name	EPBC	FFG	DSE Advisory List
<i>Abutilon otocarpum</i>	Desert Lantern			Vulnerable
<i>Acacia colletioides</i>	Wait-a-while			Rare
<i>Acacia loderi</i>	Nealie			Vulnerable
<i>Acacia melvillei</i>	Yarran			Vulnerable
<i>Acacia victoriae subsp. victoriae</i>	Bramble Wattle			Rare
<i>Amyema linophylla subsp. orientale</i>	Buloke Mistletoe			Vulnerable
<i>Atriplex papillata</i>	Coral Saltbush			Rare
<i>Gnephosis tenuissima</i>	Dwarf Cup-flower			Rare
<i>Eremophila oppositifolia subsp. oppositifolia</i>	Twin-leaf Emu-bush			Rare
<i>Jasminum didymum subsp. lineare</i>	Desert Jasmine			Vulnerable
<i>Marsdenia australis</i>	Doubah			Vulnerable
<i>Maireana sedifolia</i>	Pearl Bluebush			Rare
<i>Myoporum montanum</i>	Waterbush			Rare
<i>Nicotiana goodspeedii</i>	Small-flower Tobacco			Rare
<i>Ptilotus sessilifolius</i>	Crimson Tails			Poorly Known
<i>Ptilotus nobilis var. nobilis</i>	Yellow Tails			Endangered
<i>Ptilotus polystachyus</i>	Long Tails			Endangered
<i>Rhagodia ulicina</i>	Spiny Goosefoot			Rare
<i>Sarcozona praecox</i>	Sarcozona			Rare
<i>Sida fibulifera</i>	Pin Sida			Vulnerable
<i>Sida intricata</i>	Twiggy Sida			Vulnerable
<i>Sida spodochroma</i>	Limestone Sida		Listed	Vulnerable
<i>Templetonia egena</i>	Round Templetonia			Vulnerable
<i>Velleia arguta</i>	Grassland Velleia			Rare
<i>Maireana georgei</i>	Slit-wing Bluebush			Vulnerable
<i>Zygophyllum angustifolium</i>	Scrambling Twin-leaf			Rare
<i>Atriplex acutibractea subsp. karoniensis</i>	Pointed Saltbush			Rare
<i>Atriplex vesicaria subsp. macrocystidia</i>	Bladder Saltbush			Poorly Known



<i>Eucalyptus phenax</i>	Green-leaf Mallee			Rare
<i>Chenopodium desertorum subsp. rectum</i>	Frosted Goosefoot			Vulnerable
<i>Tetragonia moorei</i>	Annual Spinach			Poorly Known

**Table 5: Threatened Fauna Species observed since 1980**

Scientific Name	Common Name	EPBC	FFG	DSE Advisory List
<i>Actitis hypoleucos</i>	Common Sandpiper			Vulnerable
<i>Anas rhynchos</i>	Australasian Shoveler			Vulnerable
<i>Ardea intermedia</i>	Intermediate Egret		Listed	Endangered
<i>Ardea modesta</i>	Eastern Great Egret		Listed	Vulnerable
<i>Aythya australis</i>	Hardhead			Vulnerable
<i>Biziura lobata</i>	Musk Duck			Vulnerable
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Endangered	Listed	Endangered
<i>Burhinus grallarius</i>	Bush Stone-curlew		Listed	Endangered
<i>Calidris ferruginea</i>	Curlew Sandpiper			Endangered
<i>Calidris subminuta</i>	Long-toed Stint			Near Threatened
<i>Chelodina expansa</i>	Broad-shelled Turtle		Listed	Endangered
<i>Chlidonias hybridus javanicus</i>	Whiskered Tern			Near Threatened
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo			Near Threatened
<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush			Near Threatened
<i>Circus assimilis</i>	Spotted Harrier			Near Threatened
<i>Climacteris affinis</i>	White-browed Treecreeper		Listed	Vulnerable
<i>Climacteris picumnus victorae</i>	Brown Treecreeper (south-eastern ssp.)			Near Threatened
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Listed	Critically Endangered
<i>Dromaius novaehollandiae</i>	Emu			Near Threatened
<i>Egretta garzetta nigripes</i>	Little Egret		Listed	Endangered
<i>Falco subniger</i>	Black Falcon			Vulnerable
<i>Geopelia cuneata</i>	Diamond Dove		Listed	Near Threatened
<i>Grantiella picta</i>	Painted Honeyeater		Listed	Vulnerable
<i>Grus rubicunda</i>	Brolga		Listed	Vulnerable
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle		Listed	Vulnerable
<i>Hydroprogne caspia</i>	Caspian Tern		Listed	Near Threatened
<i>Lathamus discolor</i>	Swift Parrot	Endangered	Listed	Endangered

<i>Lerista timida</i>	Dwarf Burrowing Skink		Listed	Endangered
<i>Limosa limosa</i>	Black-tailed Godwit			Vulnerable
<i>Lophocroa leadbeateri</i>	Major Mitchell's Cockatoo		Listed	Vulnerable
<i>Lophoictinia isura</i>	Square-tailed Kite		Listed	Vulnerable
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	Listed	Vulnerable
<i>Macquaria ambigua</i>	Golden Perch			Near Threatened
<i>Melanodryas cucullata cucullata</i>	Hooded Robin		Listed	Near Threatened
<i>Mogurnda adspersa</i>	Southern Purple-spotted Gudgeon		Listed	Regionally Extinct
<i>Oreoica gutturalis gutturalis</i>	Crested Bellbird		Listed	Near Threatened
<i>Oxyura australis</i>	Blue-billed Duck		Listed	Endangered
<i>Phalacrocorax varius</i>	Pied Cormorant			Near Threatened
<i>Platalea regia</i>	Royal Spoonbill			Near Threatened
<i>Plegadis falcinellus</i>	Glossy Ibis			Near Threatened
<i>Polytelis anthopeplus monarchoides</i>	Regent Parrot	Vulnerable	Listed	Vulnerable
<i>Porzana pusilla palustris</i>	Baillon's Crake		Listed	Vulnerable
<i>Stagonopleura guttata</i>	Diamond Firetail		Listed	Near Threatened
<i>Stictonetta naevosa</i>	Freckled Duck		Listed	Endangered
<i>Stiltia isabella</i>	Australian Pratincole			Near Threatened
<i>Struthidea cinerea</i>	Apostlebird		Listed	
<i>Tandanus tandanus</i>	Freshwater Catfish		Listed	Endangered
<i>Todiramphus pyrropygia pyrropygia</i>	Red-backed Kingfisher			Near Threatened
<i>Tringa nebularia</i>	Common Greenshank			Vulnerable
<i>Tringa stagnatilis</i>	Marsh Sandpiper			Vulnerable
<i>Turnix velox</i>	Little Button-quail			Near Threatened

**Table 6: Mallee Bird Community as listed under FFG Act  
(including individual species listing and number of records since 1980 from Victorian Biodiversity Atlas)**

Species Name	Common Name	Records since 1980	EPBC	FFG	DSE Advisory List
<i>Amytornis striatus striatus</i>	Striated Grasswren	No Records			Near Threatened
<i>Cinclosoma castanotus castanotus</i>	Chestnut Quail-thrush	2			Near Threatened

<i>Drymodes brunneopygia</i>	Southern Scrub-robin	No Records			
<i>Hylacola cautus cautus</i>	Shy Heathwren	No Records			
<i>Leipoa ocellata</i>	Malleefowl	No Records	Vulnerable	Listed	Endangered
<i>Manorina melanotis</i>	Black-eared Miner	No Records	Endangered	Listed	Critically Endangered
<i>Pachycephala inornata</i>	Gilbert's Whistler	1			
<i>Pachycephala rufogularis</i>	Red-lored Whistler	No Records	Vulnerable	Listed	Endangered
<i>Stipiturus mallee</i>	Mallee Emu-wren	No Records	Endangered	Listed	Endangered

**Table 7: Lowland Riverine Fish Community of the Southern Murray–Darling Basin as listed under FFG Act (including individual species listing and number of records since 1980 from Victorian Biodiversity Atlas)**

Species Name	Common Name	Records since 1980	EPBC	FFG	DSE Advisory List
<i>Ambassis agassizii</i>	Agassiz's Chanda Perch	No Records		Listed	Regionally Extinct
<i>Bidyanus bidyanus</i>	Silver Perch	No Records		Listed	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	34	Endangered	Listed	Critically Endangered
<i>Craterocephalus stercusmuscarum fulvus</i>	Non-specked Hardyhead	No Records			
<i>Galaxias rostratus</i>	Flat-headed Galaxias	No Records			Vulnerable
<i>Hypseleotris klunzingeri</i>	Western Carp Gudgeon	48			
<i>Maccullochella macquariensis</i>	Trout Cod	No Records	Endangered	Listed	Critically Endangered
<i>Maccullochella peelii peelii</i>	Murray Cod	7	Vulnerable	Listed	Vulnerable
<i>Macquaria ambigua</i>	Golden Perch	20			Near Threatened
<i>Macquaria australasica</i>	Macquarie Perch	No Records	Endangered	Listed	Endangered
<i>Melanotaenia fluviatilis</i>	Murray-Darling Rainbowfish	No Records		Listed	Vulnerable
<i>Mogurnda adspersa</i>	Southern Purple-spotted Gudgeon	12			Regionally Extinct

<i>Nematoalosa erebi</i>	Bony Bream	41			
<i>Philypnodon grandiceps</i>	Flat-headed Gudgeon	41			
<i>Tandanus tandanus</i>	Freshwater Catfish	36		Listed	Endangered

## Terrestrial Habitat

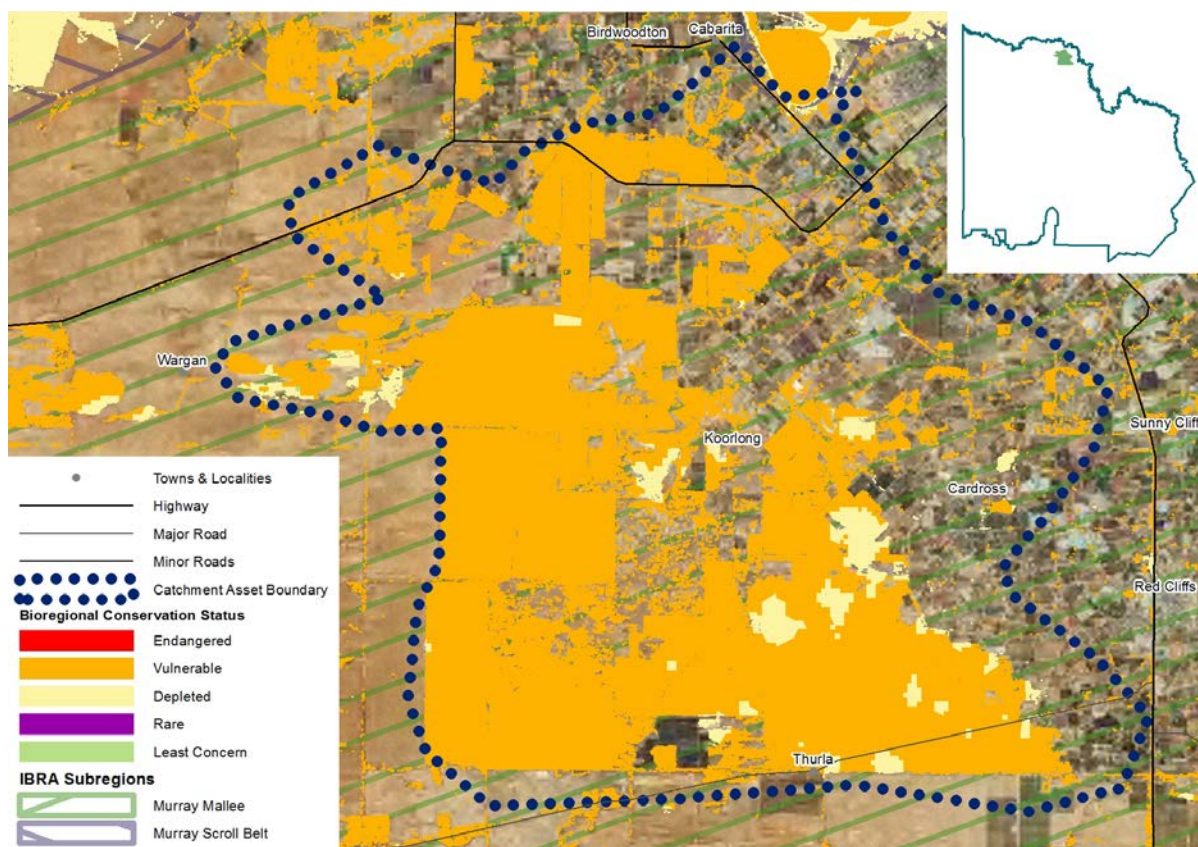
The remnant terrestrial habitat within this catchment asset area is predominantly Chenopod Mallee and Semi-arid Woodland, much of the latter occurring within the Koorlong State Forest.

Just over half of the catchment asset area retains its native habitat in some form or another. Most of this remnant habitat has been given a bioregional conservation status of 'vulnerable'.

The table below lists each of the Catchment Asset's EVCs along with the IBRA subregion within which they are contained, their Bioregional Conservation Status (BCS) and their area in hectares.

**Table 8: Area of Ecological Vegetation Classes and their Bioregional Conservation Status**

Ecological Vegetation Class	IBRA Subregion	Conservation Status	Area (hectares)
Chenopod Mallee	Murray Mallee	Vulnerable	5,470.73
	Murray Scroll Belt	Vulnerable	5.51
Dunefield Heathland	Murray Mallee	Least Concern	1.00
Lake Bed Herbland	Murray Scroll Belt	Vulnerable	11.91
Lignum Swampy Woodland	Murray Scroll Belt	Depleted	0.59
	Murray Mallee	Vulnerable	0.87
Low Chenopod Shrubland	Murray Mallee	Depleted	193.99
Riverine Chenopod Woodland	Murray Mallee	Depleted	4.56
	Murray Scroll Belt	Depleted	2.43
Semi-arid Chenopod Woodland	Murray Scroll Belt	Depleted	0.01
	Murray Mallee	Vulnerable	702.35
Semi-arid Woodland	Murray Mallee	Vulnerable	3,979.62
	Murray Scroll Belt	Vulnerable	0.29
Woorinen Mallee	Murray Mallee	Vulnerable	72.53
Woorinen Sands Mallee	Murray Mallee	Depleted	396.01



**Figure 2: Bioregional conservation status of EVCs and IBRA sub-regions**

DEPI's NaturePrint model is a landscape scale spatial planning mechanism that provides an analysis of biodiversity values across Victoria and combines the available information about biodiversity values, threatening processes and ecosystem function. It provides an analysis of the ecological value of a portion of landscape compared across the entire Victorian landscape. It is based on the following measures:

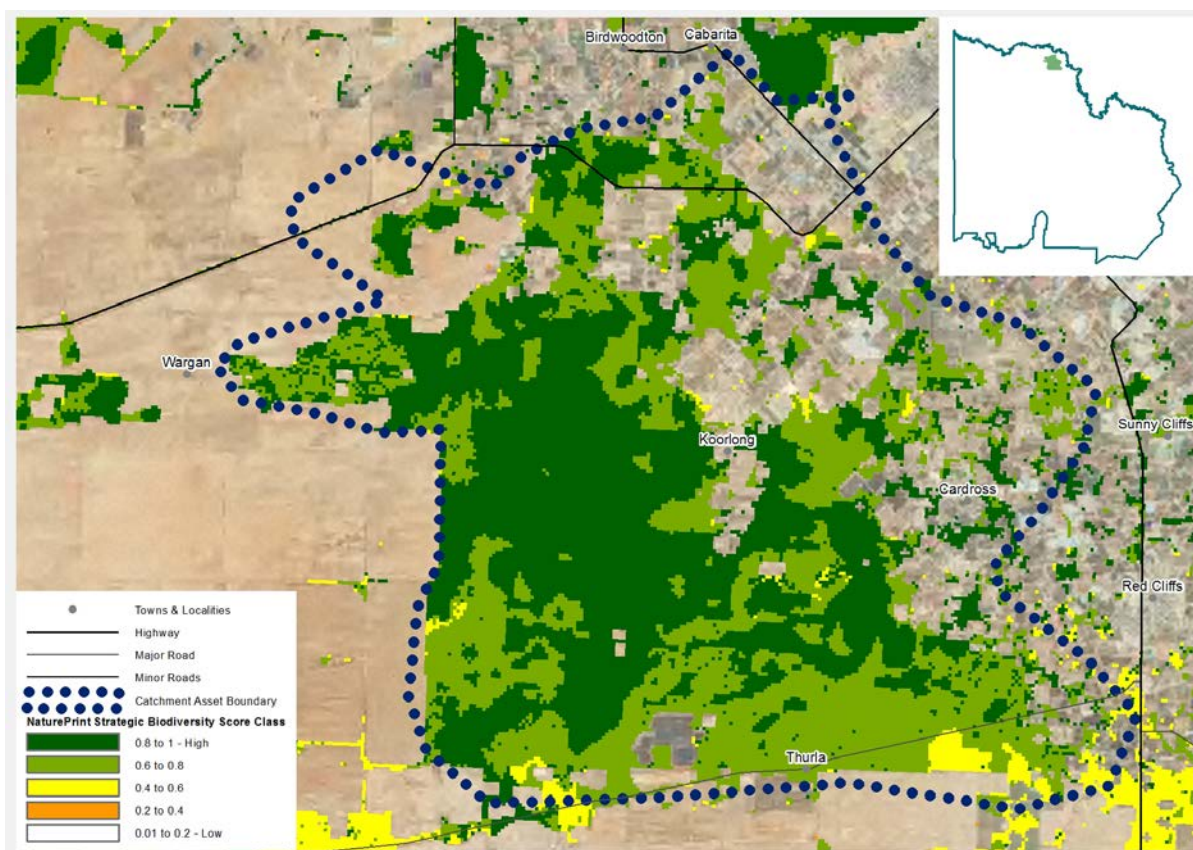
- Mathematical models of species distributions and habitats;
- The condition of these habitats;
- Pathways for connectivity across landscapes;
- Connectivity potential and recoverability;
- Threats to species persistence.

For background information about the model, its output and its significance, refer to: <http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/natureprint>.

The NaturePrint model considers that close to 41% of this Catchment Asset contains terrestrial habitat that is of the highest ecological value to Victoria and therefore high priority for protection and conservation.

Based on the available data concerning their extent, quality and policy significance within this landscape, the Terrestrial Habitat within this Catchment Asset is considered to be of **medium** value.





**Figure 3: Terrestrial Habitat given high ecological value by NaturePrint Version 3**

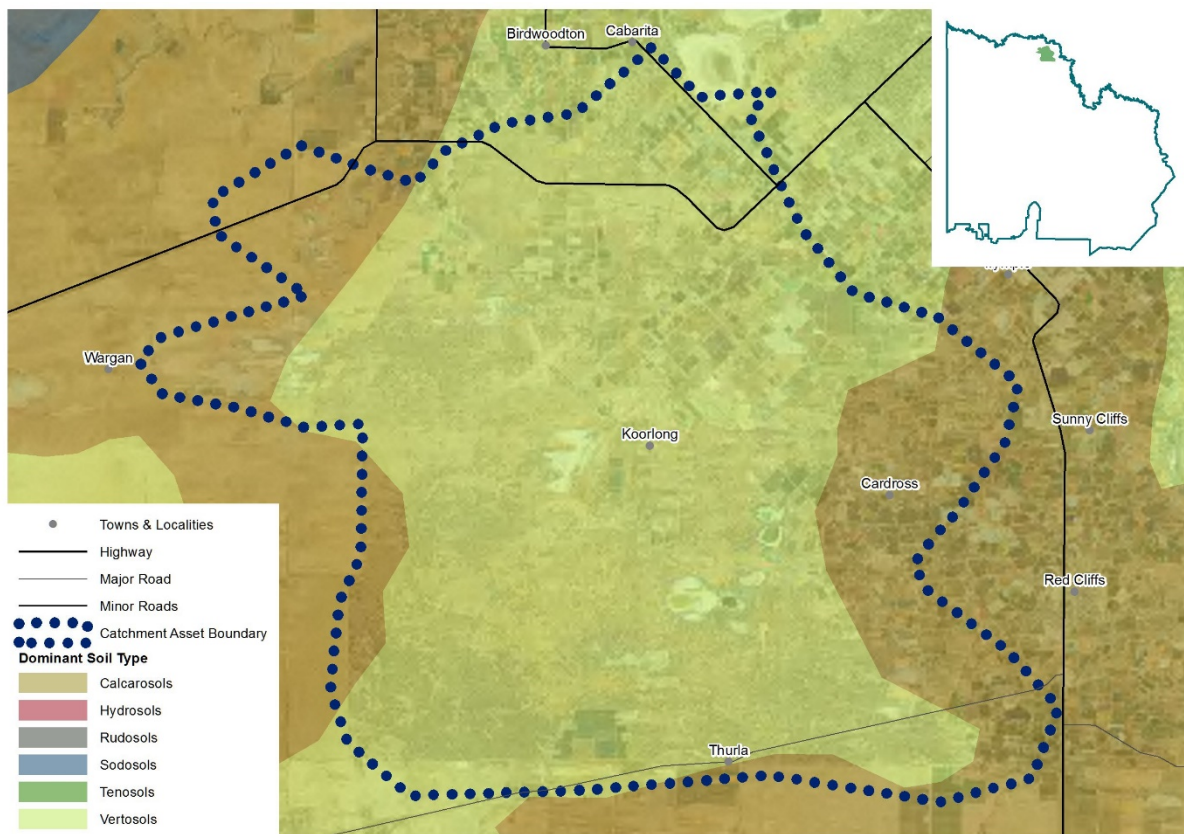
## Soils

The soils of this catchment asset area are predominantly the heavy grey cracking clays known as Vertosols that are remnants of the ancient lake system that once dominated this region. These are coarsely structured soils that are typically sodic, gypseous and somewhat saline. These Vertosols are fringed on the higher ground around the edge of the asset area by thin areas of Calcarosols.

The soils of this Catchment Asset area are predominantly valued for their capacity to provide for terrestrial habitat and the support the production of food and fibre. However, there is also an understanding that the structure of the soil and its natural capacity to resist threatening processes such as wind erosion is also of substantial value.

There is currently no accepted framework to categorise our soil asset in terms of value from lower to higher based purely upon the social, economic and environmental values and services they provide. Such a framework has only been considered to date in terms of the threatening processes that may impinge on the capacity of our soils asset to provide the services we have come to expect. This will be discussed later in this document. Despite this limitation, the most appropriate course of action is to consider the relative value of the soil asset according to its intrinsic capacity to support the other regional assets within this catchment asset as the basis for applying a value category.

Therefore, the Soils within this Catchment Asset are considered to be of **high** value.



**Figure 4: Dominant Soil Types**

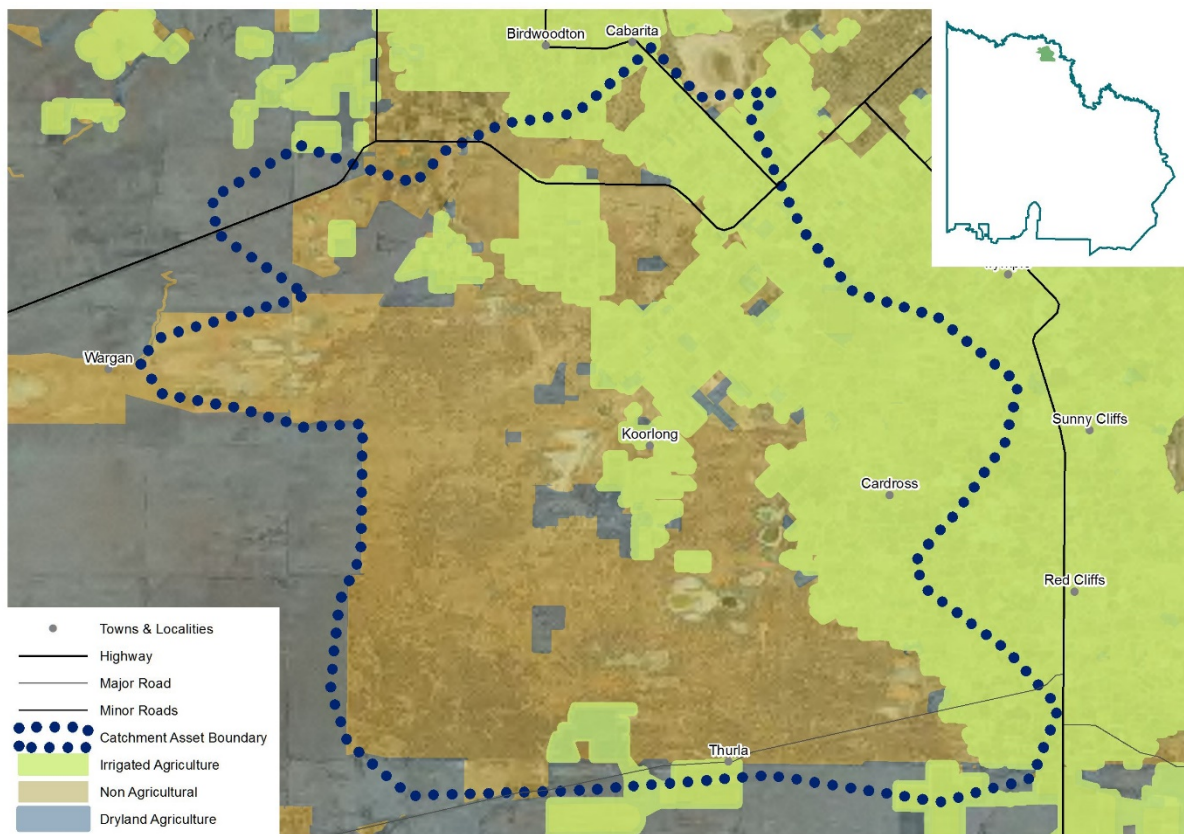
## Agricultural Land

Just over half of the catchment asset area is given over to agricultural activities, mostly irrigated agriculture. Most of this activity occurs in the east and north of the asset area taking in a sweep of irrigation districts from Red Cliffs, Cardross and Koorlong right through to Merbein South. Dryland agricultural activities are also pursued in some sectors predominantly in the form of grazing and similar opportunistic uses.

The agricultural land of this Catchment Asset area is mainly valued for its capacity to support the production of food and fibre. This in turn provides for a range of other social and economic services that are important to the Mallee region. In addition, when these services are available, they support the local community in its efforts to maintain and enhance not only their agricultural land but other regional assets. There is currently no accepted framework to categorise our agricultural land asset in terms of value from lower to higher based purely upon the social and economic values and services they provide. Such a framework has only been considered to date in terms of the threatening processes that may impinge on the capacity of our agricultural land asset to provide the services we have come to expect. This will be discussed later in this document. As a result, the most appropriate course of action is to consider the relative value of the agricultural land asset at a regional scale rather than at a catchment asset scale and in accordance to its capacity to provide and support social and economic values.

Therefore, the Agricultural Land within this Catchment Asset and across the region is considered to be of **high** value.





**Figure 5: Agricultural land use**

## Groundwater

Groundwater aquifers that lie underneath this Catchment Asset area are not known to be utilised to provide a water resource for human uses. Therefore, the Mallee's groundwater asset is not of significance to this Catchment Asset.

## Cultural Heritage

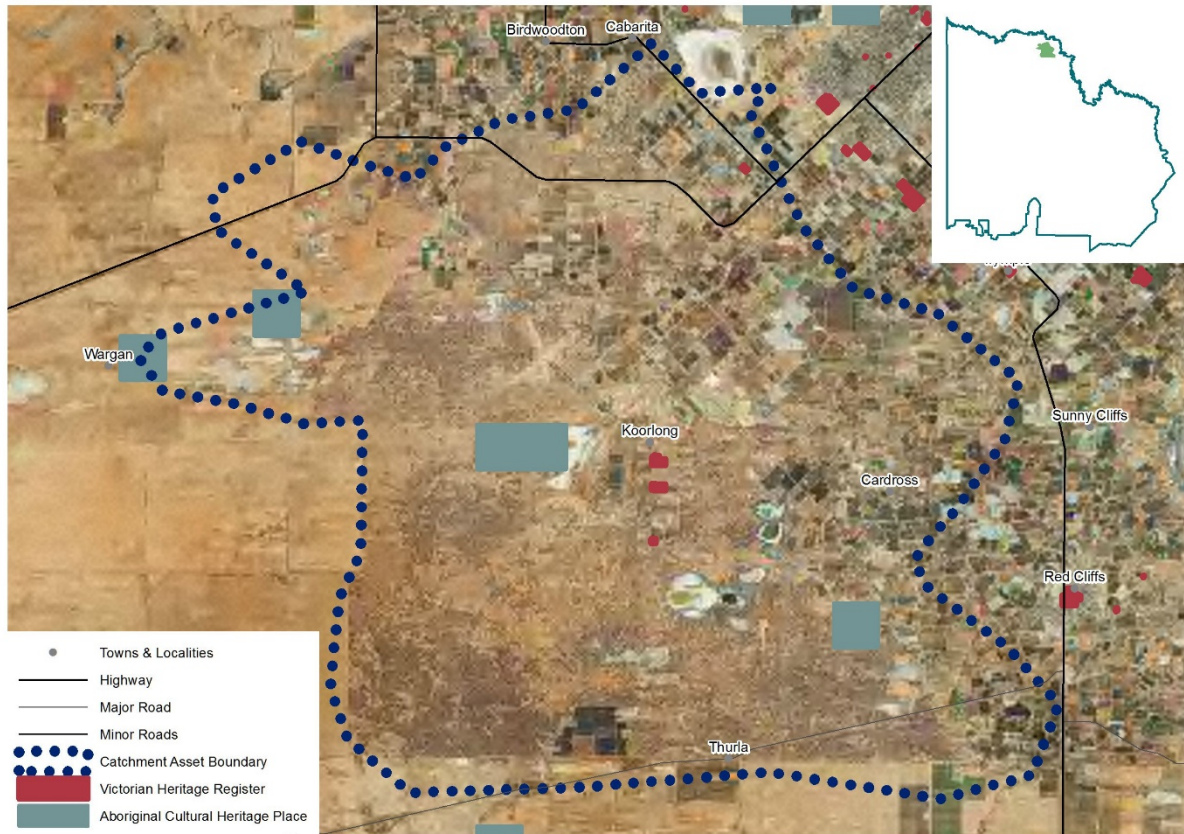
The catchment asset area has important Indigenous and non-Indigenous cultural value. Aboriginal people have had a connection to this area for tens of thousands of years. A significant number of cultural heritage sites occur in this area, ranging from small sites and earth features to larger sites containing artifacts, ovens and midden sites. From a European perspective, the area contains a number of heritage overlays that encompass sites of historical significance.

Cultural heritage sites in this Catchment Asset area are predominantly valued for the connection they provide to the community between the social and cultural landscape that we currently enjoy and the stories, ideas and history of how that came to be. These sites provide individuals and families with a physical representation of their connection to the Mallee landscape and their place in it. These connections are extremely important to these people and, in turn, can reflect upon how they value and relate to the Mallee landscape that they are familiar with today. Therefore it is important to all that these sites are managed and protected in a manner that is sympathetic to those connections and values. Heritage significance is typically assessed under a three-tier legislative system that determines the local, state, national or commonwealth significance of an item. Heritage items can also be included on non-statutory listings (such as the National Trust classifications). However, there is no single and simple approach to categorise our cultural heritage asset in terms of value to the region. Tradition distinctions between different types of value (such as economic, social and environmental values) can be determined but this data is only patchily available given the number and range of cultural heritage sites



across the Mallee. The most appropriate course of action at this point is to give equal value to all recognised cultural heritage sites in the Mallee regardless of their age, form and historical background.

Therefore, Cultural Heritage within this Catchment Asset and across the region is considered to be of **high** value. Any further processes undertaken to prioritise and target management actions will rely on assessments of risk likelihood and impact to those sites.



**Figure 6: Areas of Cultural Value**

## Community Capacity

Community capacity is an important asset as positive and long-lasting NRM outcomes are dependent on an active, willing and capable community. In order to achieve regional scale NRM outcomes, people have to play a major role, often in partnership with government and industry, in the ongoing conservation and sustainable use of our Regional Assets. This requires Mallee communities to have the capacity to work cooperatively, apply economic resources, use networks and acquire and use relevant knowledge and information to achieve NRM outcomes. Maintaining and improving this capacity is dependent not only on the financial, physical and natural resources contained within or available to a community but also its social resources.

Community capacity therefore requires ongoing development, conservation and management as its relative condition can influence the achievement of all other biophysical goals and actions outlined within the RCS.

Our communities' capacity is defined by their characteristics and resources which, when combined, determine their ability to identify, evaluate and address key issues.

Characteristics of strong regional community capacity include:

Individuals within the community being aware of regional NRM issues, and understanding the link between these issues and the long-term viability of the community

Natural resource managers and users being able and willing to access the necessary information, data and science – biophysical, social and economic – to make sound NRM decisions

Natural resource managers and users being equipped with or having access to, the necessary technical, people management, project management and planning skills to Social, participate in the development and implementation of sustainable NRM at the property, local and regional scales

Community being engaged and motivated, and exercising ownership over NRM decision making processes and effectively implementing actions arising from these processes (DAFF 2006).

This catchment asset area is one of the more heavily populated asset areas in the region. Communities within the area include Cabarita, Cardross and Koorlong plus parts of Merbein South, Mildura, Irymple and Red Cliffs. However, most of this occupation is confined to the northern and eastern halves of the asset area. The remainder is mostly agricultural land or State Forest. Even so, this area is used as a recreation resource and destination by (predominantly) the local population. Therefore, the resident community is of critical importance to the ongoing management of the catchment asset.

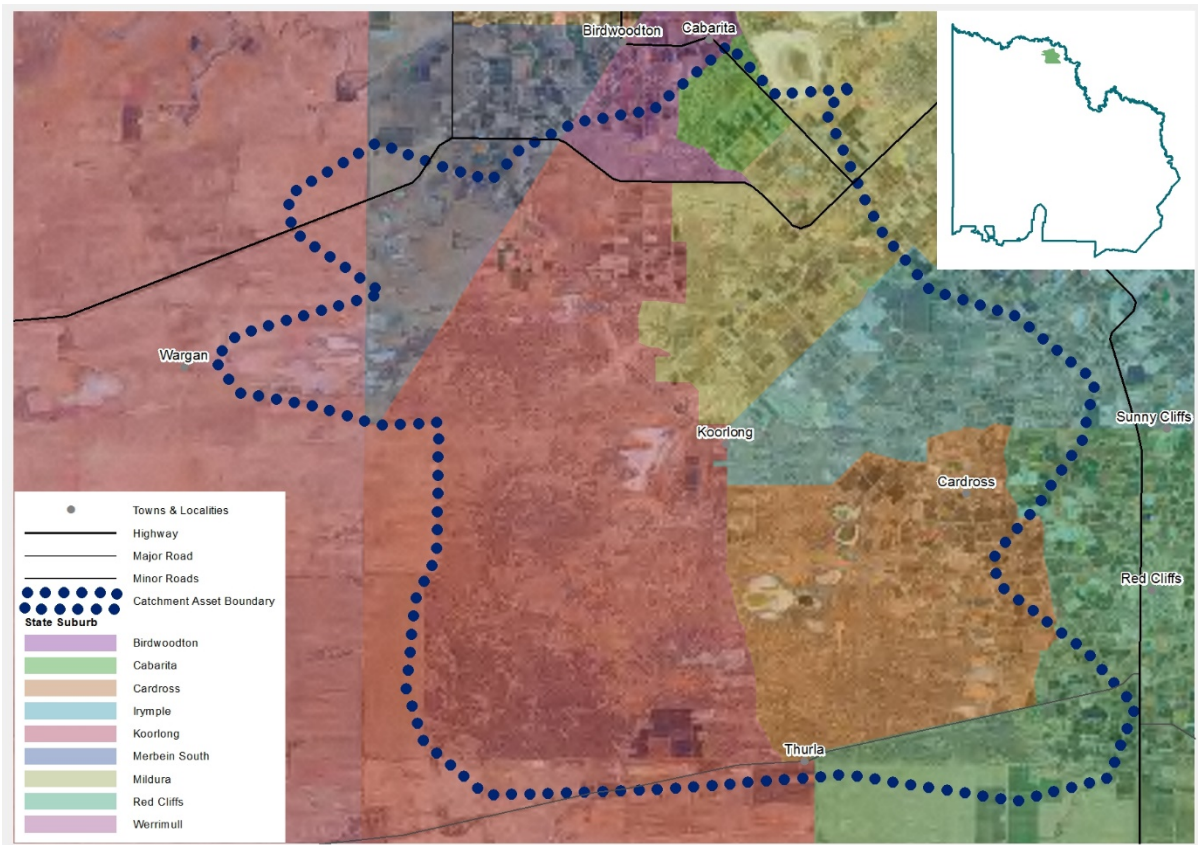
This catchment asset area is particularly well serviced by community driven NRM organisations which reflects well on the capacity of the local community to contribute to effective NRM outcomes. There are four active Landcare groups (Cabarita; Millewa-Carwarp; Yelta; and Kulkyne Way) whose areas of influence lie partially or wholly within the asset area.

A range of agricultural support and industry groups are also active within the asset area and have the potential to influence community appreciation, interest and capacity for effective NRM in conjunction with effective agricultural management practices.

A complete listing of all the known community NRM organisations within the catchment asset can be found in the Community NRM Groups section.

Whilst there are a number of methods available to evaluate the relative 'condition' of our community's capacity for NRM there is currently no accepted framework to categorise the community capacity asset in terms of value from low to high based upon the values and services it may provide. As a result, the most appropriate course of action is to consider the relative value of community capacity for NRM in terms of its potential contribution to NRM outcomes at a regional scale and what those NRM outcomes might be (and how sizeable the resources required to achieve them) if that contribution was not forthcoming. Under those circumstances, it is relatively easy to come to the conclusion that, without the communities' investment into NRM through exercising that community capacity asset, the scale and success of our NRM outcomes will be curtailed while their cost in resources increases. Such a situation would not benefit the Mallee region or its Regional Assets.

Therefore, Community Capacity within this Catchment Asset and across the region is considered to be of **high** value.



**Figure 7: State Suburbs**

## Section 3 – Threatening Processes in this Catchment Asset

Threatening processes in the Mallee NRM region were defined and applied as part of the development of Mallee Regional Catchment Strategy by the Regional Catchment Strategy Steering Committee. Each of the following sub-sections provides a background to these threatening processes, available information about their form within this Catchment Asset and some discussion regarding the impact of these processes on our regional assets. This follows on to an assessment of the relative threat level posed by each the threatening processes based on the criteria contained in Appendix 2. *Categorising Threatening Processes*.

## Land & water salinisation

Land and water salinisation is defined as: "Salinisation of the soil and water resources through the displacement of salt as a result of natural and human induced drivers."

Salinisation of soils is caused by discharge of groundwater to the atmosphere by direct transpiration of groundwater by vegetation or by capillary rise from the water table through the soil profile to either the soil surface (evaporation) or the bottom of the plant root zone. Salt contained in the water that is evaporated and/or transpired is left behind and accumulates in the soil. High rates of groundwater discharge, and hence salt accumulation, only occur in areas where water tables are shallow (typically less than 10 m, with the most severe effects when the water table is less than 5 m).

There are many naturally saline wetlands and wetland complexes in the Mallee that are situated in areas where the underlying water tables are naturally shallow. Better known examples of these natural systems include the Tyrrell Basin, Raak Plain and the Pink Lakes. These are natural saline systems that have historically developed and been maintained in a balance that provided for stable ecological communities. However, agricultural development in the last century has altered the long term balance of these systems. The removal of much of the Mallee vegetation and the use of land management techniques that were comparatively inefficient users of rainfall (compared to Mallee woodlands) allowed deep drainage past the root zone. Depending on the location, this deep drainage either manifest itself as localised discharge zones in dune swales or contributed to further shallowing of the regional water table. As water tables came closer to the surface, more wetlands and wetland ecosystems were threatened by increasing salinity and increasing areas of salinised landscape.

The incremental improvement in agricultural land management techniques to maximise water use efficiency and minimise through drainage over the last two decades coupled with the broad scale effect of the so-called Millennium Drought have begun to swing the balance back towards a more neutral status. Water table depths have fallen and correspondingly so have salinity impacts in the landscape.

Despite these recent advances, the risks remain. Many of the triggers in the landscape that created the salinisation problem still remain. Most notable of these are the altered flow regimes in our watercourses and wetlands and the large, open areas cleared of perennial Mallee vegetation. These are historical landscape modifications that are not expected to be rectified since they have provided for the bulk of the Mallee's resultant economic and social activity. Lapses in our current regimes of effective land and water management coupled with a changing climate can easily contribute to the return of a significant period of land and water salinisation.

This catchment asset does not contain any natural saline discharge areas. This is reflected in the typical depth to groundwater under the asset area which is predominantly greater than 10 metres below ground level. However, irrigation development and operation over the preceding century produced localised perched watertables and required the disposal of saline irrigation drainage water. Both factors contributed to a number of sites within the asset area where saline conditions have been induced. The Cardross Lakes and Wargan Basins are the most notable of these sites. These areas of induced salinity amount to 780 hectares or a little over 3.5% of the asset area (Mock & Grinter, 2009).

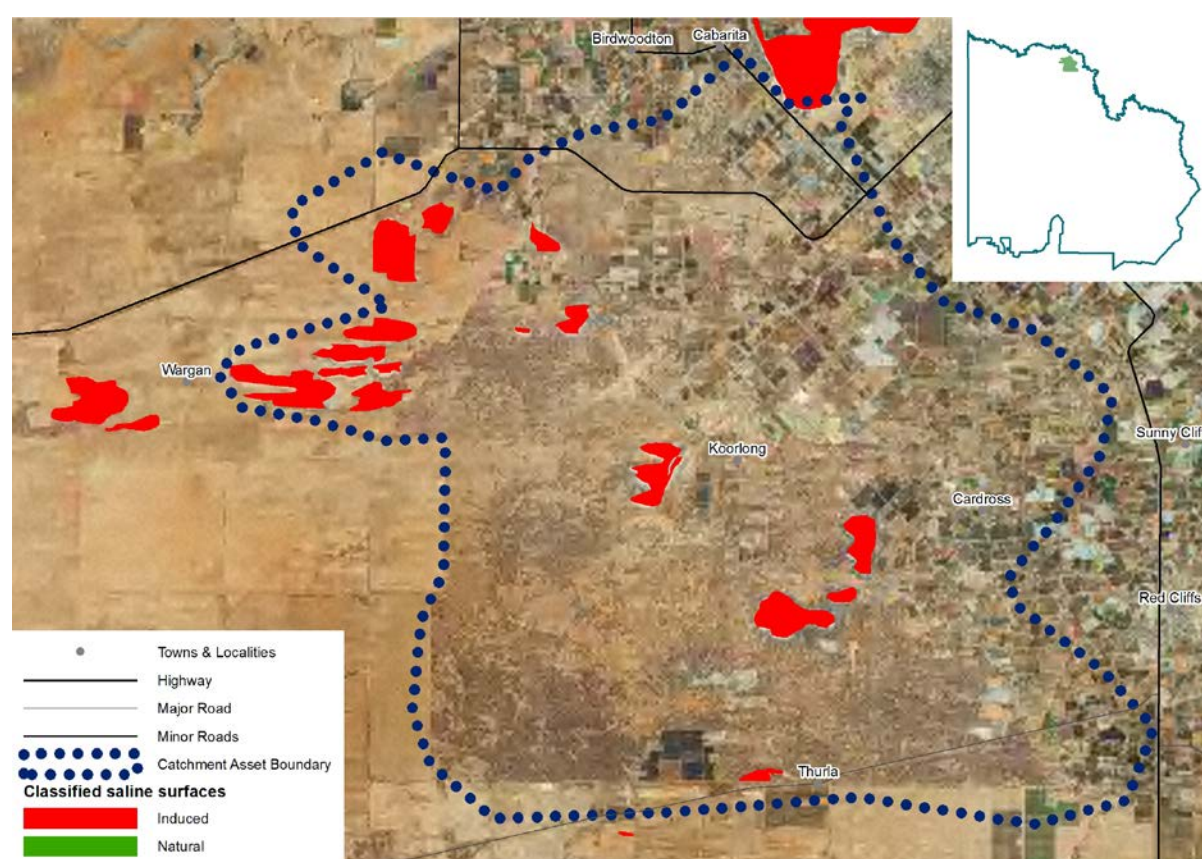
Given the current status of land and water salinisation in the Catchment asset area and consideration of the future potential of this threatening process to produce negative impacts within the area, the priority



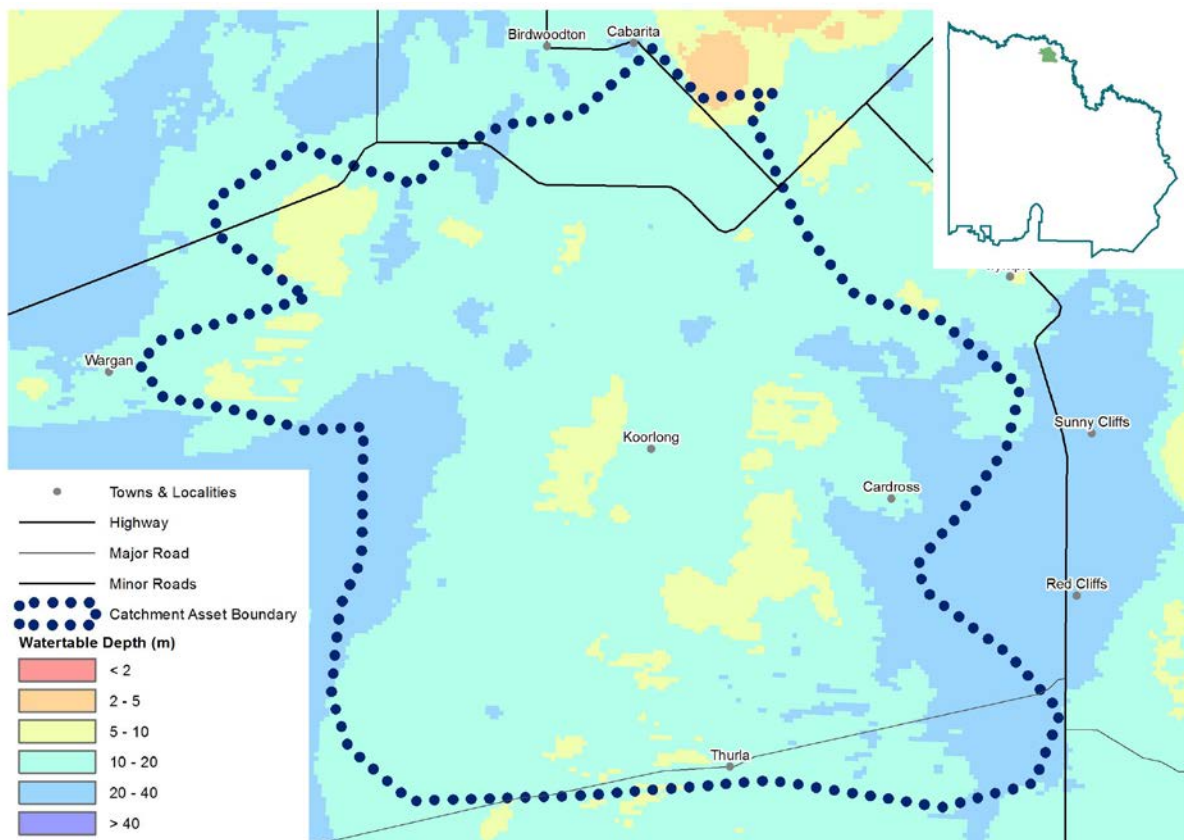
of action with respect to each Regional Asset has been determined. They are listed in the table below along with the summary of the logic behind the priority determination.

**Table 9: Prospective Priority of Action to address Land and Water Salinisation upon Regional Assets**

Regional Asset	Priority of Action	Summary Logic
Rivers	NONE	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	HIGH	To be documented
Terrestrial Habitat	HIGH	To be documented
Soils	HIGH	To be documented
Agricultural Land	HIGH	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	NONE	To be documented
Community Capacity	NONE	To be documented



**Figure 8: Natural and Induce Saline Surfaces**



**Figure 9: Estimated Depth to the Water table**

## Invasive Plants

Currently there are 25 State Prohibited Weeds, 4 Regionally Prohibited Weeds and 14 Regionally Controlled Weeds listed under the Catchment and Land Protection (CaLP) Act for the Mallee region. In addition to the conventional ways that weeds spread (e.g. wind and water) in the Mallee, disturbance from pest animals such as rabbits, goats and pigs also create good conditions for weed growth and contribute to weed spread.

Invasive plants in the Mallee threaten both biodiversity and the productive capacity of land. In many cases, weed infestation has changed the composition and character of the ecological landscape. Weed infestations also impact on the use of popular recreational spots in riparian areas, affecting aesthetic values and limiting access. Environmental weeds compete with established and regenerating indigenous species, threatening the quality and extent of native vegetation and reducing the diversity and availability of habitat. Environmental weeds present a significant risk to remnant roadside vegetation, as the 'edge effect' is particularly difficult to manage in these long, thin areas.

Agricultural weeds cause significant losses for horticulture and dryland farming through competition with crops and by reducing the quality of produce. Their control increases the cost of production and, in extreme cases, can diminish the productive capability of the land.

While the presence of recognised weed species in the asset area is almost certain, there is insufficient data available to adequately describe the current scope and scale of pest plant populations for the purposes of effective regional control. The available spatial data on invasive plant infestations dates back to 2007 and was generated as part of the Priority Weed Mapping project in 2008. This information is obviously now far out of date. The current information and response capacity relies heavily on local

activity at a local scale in response to local weed infestations. This approach, while often very successful, tends to preclude centralised management and control at a regional scale. Therefore, the priority of action to address invasive plants is strongly influenced by local scale data derived from local planning instruments and informal community consultation at the local level. On the other hand, limited knowledge and understanding of the vulnerability of the Mallee landscape to future weed incursions is available given the current listing of known invasive plants, the current understanding of their biological requirements and the planning and response framework provided by regional scale plans such as the Mallee Invasive Plants and Animals Management Strategy (IPAWS).

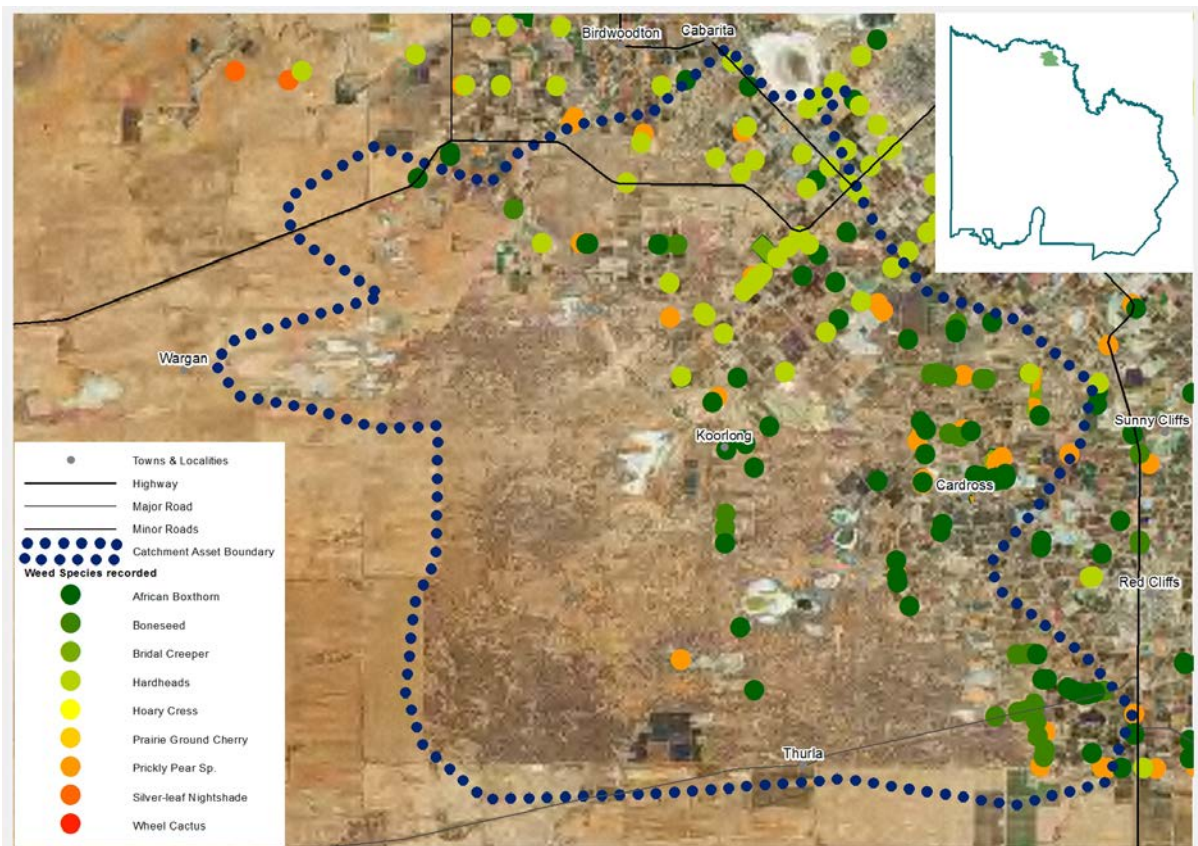
The IPAWS identifies 21 regional assets (based on geographic areas) across the Mallee region. This Catchment Asset area contains two of these geographic assets: Agricultural Land; and Cardross Lakes/Koorlong State Forest. Agricultural land was identified as an area where monitoring for future action and maintaining previous management gains was considered sufficient while the Cardross Lakes/Koorlong State Forest was considered to be a medium priority for on-ground action to manage invasive plants and animals.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with invasive plants with respect to each Regional Asset has been determined. They are listed in the table below along with the summary of the logic behind the priority determination.

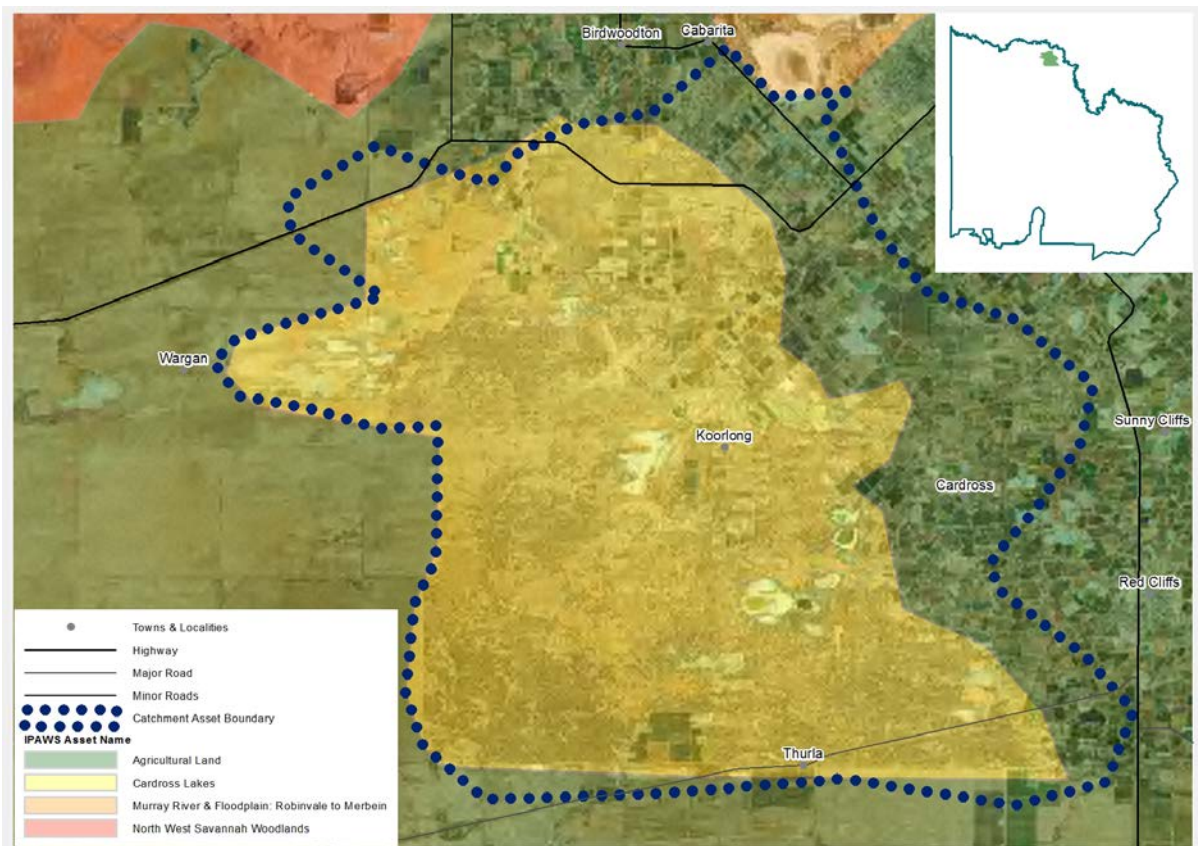
**Table 10: Prospective Priority of Action to address Invasive Plants upon Regional Assets**

Regional Asset	Priority of Action	Summary Logic
Rivers	<b>NONE</b>	This regional asset is not present within this catchment asset
Wetlands	<b>HIGH</b>	<b>To be documented</b>
Threatened Species and Communities	<b>HIGH</b>	<b>To be documented</b>
Terrestrial Habitat	<b>HIGH</b>	<b>To be documented</b>
Soils	<b>HIGH</b>	<b>To be documented</b>
Agricultural Land	<b>HIGH</b>	<b>To be documented</b>
Groundwater	<b>NONE</b>	This regional asset is not present within this catchment asset
Cultural Heritage	<b>HIGH</b>	<b>To be documented</b>
Community Capacity	<b>NONE</b>	Invasive plants do not pose a significant threat to community capacity at this time





*Figure 10: Priority Weed Infestations Recorded Between 2005 and 2007*



**Figure 11: Regional Assets from the Mallee Invasive Plants and Animal Strategy**

## Invasive Animals

Invasive animals in terms of the Mallee RCS are regarded as those established invasive pest animals as defined in Part 8 of the CaLP Act 1994

Australia is host to 56 invasive vertebrate animal species. Of these, the ones with the most impact (in order of damage estimates) are: European Red Fox, feral cats, rabbits, feral pigs, wild dogs, the house mouse, carp and goats. The Mallee region hosts populations of all of these species. However, of most significance to the Mallee is the European Red Fox and Rabbits – both are declared under the Catchment and Land Protection (CaLP) Act 1994.

Invasive species are considered to be pests when they have, or have the potential to have, an undesirable economic, environmental or social/cultural impact. Such impacts may include damage to agricultural crops, livestock predation, indigenous fauna predation, soil erosion and land degradation, spread of weeds, pasture/food and habitat competition, and the potential spread of disease. Gong et al. (2009) estimated the overall direct economic impact of several pest animal species (foxes, rabbits, wild dogs, feral pigs, birds and mice) in Australia to be \$740 million annually. This included \$620.8 million of production losses in agriculture (including horticulture) and \$122.7 million on expenditure on pest animal management, administration and research in Australia. Some of the social impacts of pest animals include damage to infrastructure or cultural/historical sites, being 'a nuisance', causing traffic accidents, as well as significant social/psychological impacts on primary producers; for example, through distress of wild dog predation on livestock.

Other non-declared pest animals present in the Mallee include feral Bees, European Wasps, Hares, Starlings, Snails, Rats, Mice and Locusts.

Virtually all of the remnant vegetation that occupies the western half of the asset area and fringes the Cardross Lakes is susceptible to rabbit activity. Nearly 4,900 hectares (22.7%) of the

catchment asset area is considered 'highly susceptible' to rabbit activity. A further 5,495 hectares (25.5%) is considered 'susceptible' to rabbit activity. However, there is little available data to describe the impact rabbits are currently having on the asset area.

The asset area is also known to be home to populations of foxes, goats and cats. As with rabbits, there is little concrete data available to scale of threat these populations pose this asset. As with invasive plants, the presence of invasive animals like rabbits and foxes in the asset area is recognised. However, there is only limited data available to adequately describe the current scope and scale of pest animal populations for the purposes of effective regional control. The current information and response capacity relies heavily on local activity at a local scale. This approach, while often very successful, tends to preclude centralised management and control at a regional scale. Therefore, the priority of action to address invasive animals is strongly influenced by local scale data derived from local planning instruments and informal community consultation at the local level. On the other hand, knowledge and understanding of the vulnerability of the Mallee landscape to future incursions or outbreaks is available for some species given the current understanding of their biological requirements and the planning and response framework provided by regional scale plans such as the Mallee Invasive Plants and Animals Management Strategy (IPAWS).

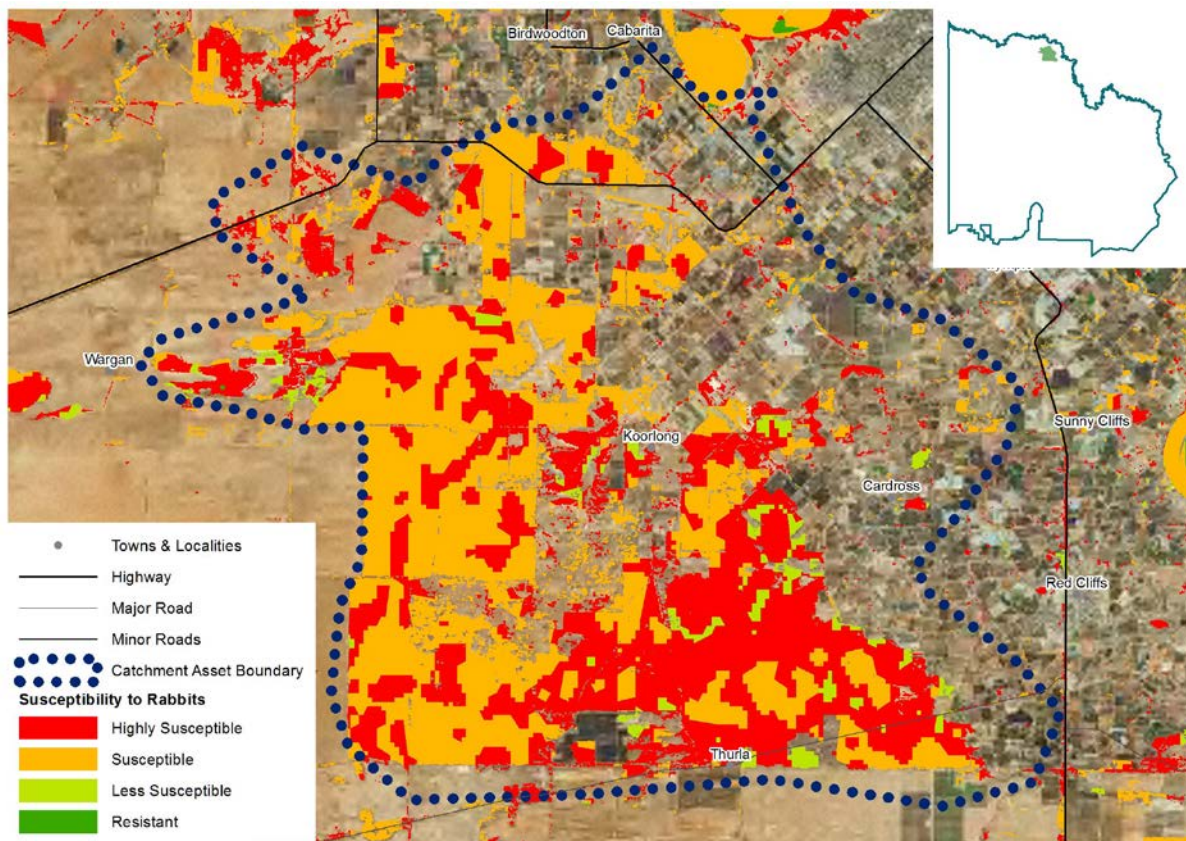
The IPAWS identifies 21 regional assets (based on geographic areas) across the Mallee region. This Catchment Asset area contains two of these geographic assets: Agricultural Land; and Cardross Lakes/Koorlong State Forest. Agricultural land was identified as an area where monitoring for future action and maintaining previous management gains was considered sufficient while the Cardross Lakes/Koorlong State Forest was considered to be a medium priority for on-ground action to manage invasive plants and animals.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with invasive plants with respect to each Regional Asset has been determined. They are listed in Table 11 below.

**Table 11: Prospective Priority of Action to address Invasive Animals upon Regional Assets**

Regional Asset	Priority of Action	Summary Logic
Rivers	<b>NONE</b>	<b>To be documented</b>
Wetlands	<b>HIGH</b>	<b>To be documented</b>
Threatened Species and Communities	<b>HIGH</b>	<b>To be documented</b>
Terrestrial Habitat	<b>HIGH</b>	<b>To be documented</b>
Soils	<b>MEDIUM</b>	<b>To be documented</b>
Agricultural Land	<b>MEDIUM</b>	<b>To be documented</b>
Groundwater	<b>NONE</b>	<b>To be documented</b>
Cultural Heritage	<b>HIGH</b>	<b>To be documented</b>
Community Capacity	<b>NONE</b>	<b>To be documented</b>





**Figure 12: Susceptibility of Remnant Native Vegetation to Rabbits**

## Altered Hydrological Regimes

Modification of the natural flow regimes in our river systems has occurred over time to meet the various needs of navigation, agriculture and urban water use. Flow regulation has resulted in changes in the frequency, magnitude and duration of flows, and the restriction of small to medium flood events. River regulation, including the effect of locks, weirs and dams, has altered wetting and drying phases of many wetlands and ephemeral anabranches, by either permanently inundating the area, or restricting flows. Engineering works, such as the building of levees, have alienated large areas of floodplain which alters flood conveyance and flood storage. These changes have great significance for: fringing and floodplain forest communities: populations of fish, macroinvertebrates, algae, macrophytes; nutrient cycling; water quality; and channel shape and form.

Wetlands across the Mallee region have also been subject to modification of natural flow regimes which poses a threat to all priority wetland units. The flow regime, or hydrology, of a wetland is typically determined by climatic conditions and the inflows and outflows of surface and groundwater. Changes in hydrology affect most aspects of wetland ecology, including nutrient cycling; water quality; wetland shape and form; biodiversity; vegetation health, type and extent; and the composition and size of faunal communities. A wetland's flow regime has three main components: frequency, duration and seasonality of inundation. Any activity that changes one or more of these components will alter the natural hydrological regime of a wetland. Examples of these activities include: changes the flow regime of the wetland's water source; interference with flows in and out of, or even within, the wetland; water disposal to or extraction from the wetland; and modification of wetland depth (which alters evaporation rates and affects inundation duration).

The hydrological regimes of both the Cardross Lakes and the Wargan Basins have been extensively altered from their natural state. Prior to agricultural development, these systems were ephemeral swamps and meadows perched in dune swales. They probably only held water infrequently following

periods of heavy or extended rainfall within their local catchments. They may have remained dry for years between intervening rainfall. Agricultural development saw these wetlands used for their capacity to retain water to benefit agriculture and the community that benefited from the industry. Cardross Lakes was permanently filled as both an off-river storage and a recreational resource before later also becoming a repository for collected irrigation drainage water. The Wargan Basins on the other hand were impacted by rising groundwater levels due to irrigated agriculture and increased run off from agricultural land in its catchment. They are perhaps now wetter more frequently and for longer than they would have otherwise been.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with altered hydrological regimes with respect to each Regional Asset has been determined. They are listed in Table 12 below.

**Table 12: Prospective Priority of Action to address Altered Hydrological Processes**

Regional Asset	Priority of Action	Summary Logic
Rivers	<b>NONE</b>	<b>To be documented</b>
Wetlands	<b>HIGH</b>	<b>To be documented</b>
Threatened Species and Communities	<b>HIGH</b>	<b>To be documented</b>
Terrestrial Habitat	<b>HIGH</b>	<b>To be documented</b>
Soils	<b>HIGH</b>	<b>To be documented</b>
Agricultural Land	<b>HIGH</b>	<b>To be documented</b>
Groundwater	<b>NONE</b>	<b>To be documented</b>
Cultural Heritage	<b>HIGH</b>	<b>To be documented</b>
Community Capacity	<b>NONE</b>	<b>To be documented</b>

## Soil Erosion

Soil erosion in the Mallee is primarily confined to two processes: wind erosion and water erosion. Wind erosion is typically a regional scale process whereas water erosion primarily occurs in discrete locations on the sides and banks of some watercourses.

Wind erosion is the process by which soil particles are detached from the land surface and transported by the wind. Wind erosion occurs when the forces exerted by the wind overcome the gravitational and cohesive forces of soil particles on the surface of the ground. Wind erosion degrades the soil, reducing its capacity to sustain biodiversity and to support agricultural production. It can also have significant off-site impacts on infrastructure, air quality and respiratory health.

The movement of soil particles by the wind occurs in three ways, each of which is dependent on the size of the particles in question. The first method is known as creep. Larger particles (like sand) are generally too heavy to be lifted by the wind, so they are rolled along the surface by wind drag or moved by bombardment by other moving particles. The next method is known as saltation and this is when middling sized soil particles (typically 0.1 to 0.5 mm) are lifted by the wind, and then fall back to the ground, so they move in a hopping or bouncing fashion. This abrades the soil surface and as they hit other particles they break into smaller particles. It is these smaller particles (typically less than 0.1 mm) that form the suspended dust that is carried away from the erosion site by the wind and is typical of a Mallee dust event.

The susceptibility of a soil to erosion is dependent on its erodibility; its exposure to erosive winds; and on its moisture content. Soil erodibility refers to the inherent properties of the soil that make it susceptible to movement should the soil be exposed to strong winds (for example when they have been completely cleared or cultivated). These properties include: surface texture, organic matter content and stability of soil aggregates. The most erodible soil types are those with single grained structure and poor aggregate stability, such soils commonly comprising a large proportion of fine sand particles.

Soil erosion susceptibility in the Mallee can be spatially described due to a recognised relationship between soil type and the terrain. Landform component mapping took advantage of the relationship and served as a basis for predicting soil properties that determine erodibility based on prevailing terrain and soil types. It is an extension of the description and mapping of Mallee land systems in 1963 by Rowan and Downes which provides information about the land, its capabilities and its susceptibilities. The mapping used soil texture as the measure of erodibility and considered the frequency and direction of erodible winds (from south-west to westerly) to be consistent across the study area. The erosion susceptibility map for this Catchment Asset area is presented in Figure 13 below.

Wind erosion susceptibility mapping does not reflect the actual threat (or likelihood) of erosion occurring. Whilst a soil's inherent susceptibility to wind erosion is important, the actual likelihood of erosion occurring also depends on how the land is managed. Land management (such as vegetation cover) and climatic conditions (such as wind strength) play an important role in the occurrence of erosion. Where inappropriate management occurs severe wind erosion can be initiated on soils with low susceptibility and conversely erosion can be minimised on soils with high susceptibility with good management practises (Lorimer, 1985). When predicting the threat of erosion, both the landform component's inherent susceptibility to erode and its current state of management must be considered.

Over 80% of the catchment asset area has soils that are considered to be moderately susceptible to wind erosion in the event that the correct precursors (such as reduced groundcover) for such erosion exist. There is a smaller area of very high susceptibility soil in landscapes dominated by sandy ridges with lighter soils such as the area to the south of the Cardross Lakes. These very highly susceptible soils account for about 12% (2,614 hectares) of the catchment asset area.

It should be pointed out that more than half of this catchment asset area is public land and therefore not intensively managed for agricultural purposes. It is considered that the soils of these lands are less likely to be exposed to wind erosion through the removal of ground cover as is seasonally the case with much agricultural land, especially those lands given over to cropping. Furthermore, most agricultural land in this catchment asset area is given over to perennial irrigation predominantly based on grapes so these soils are typically protected from wind erosion by the grape vines and their supporting trellis structures. Therefore, the actual area of soil within this catchment asset area that might be exposed and conducive to wind erosion at any particular time is likely to be comparatively small and not a particularly significant threat to regional assets within this catchment asset area.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with soil erosion with respect to each Regional Asset has been determined. They are listed in the table below along with the summary of the logic behind the priority determination. They are listed in Table 13 below.

**Table 13: Prospective Priority of Action to address Soil Erosion**

Regional Asset	Priority of Action	Summary Logic
Rivers	<b>NONE</b>	<b>To be documented</b>
Wetlands	<b>LOW</b>	<b>To be documented</b>
Threatened Species and Communities	<b>LOW</b>	<b>To be documented</b>
Terrestrial Habitat	<b>LOW</b>	<b>To be documented</b>

Soils	LOW	To be documented
Agricultural Land	MEDIUM	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	MEDIUM	To be documented
Community Capacity	NONE	To be documented

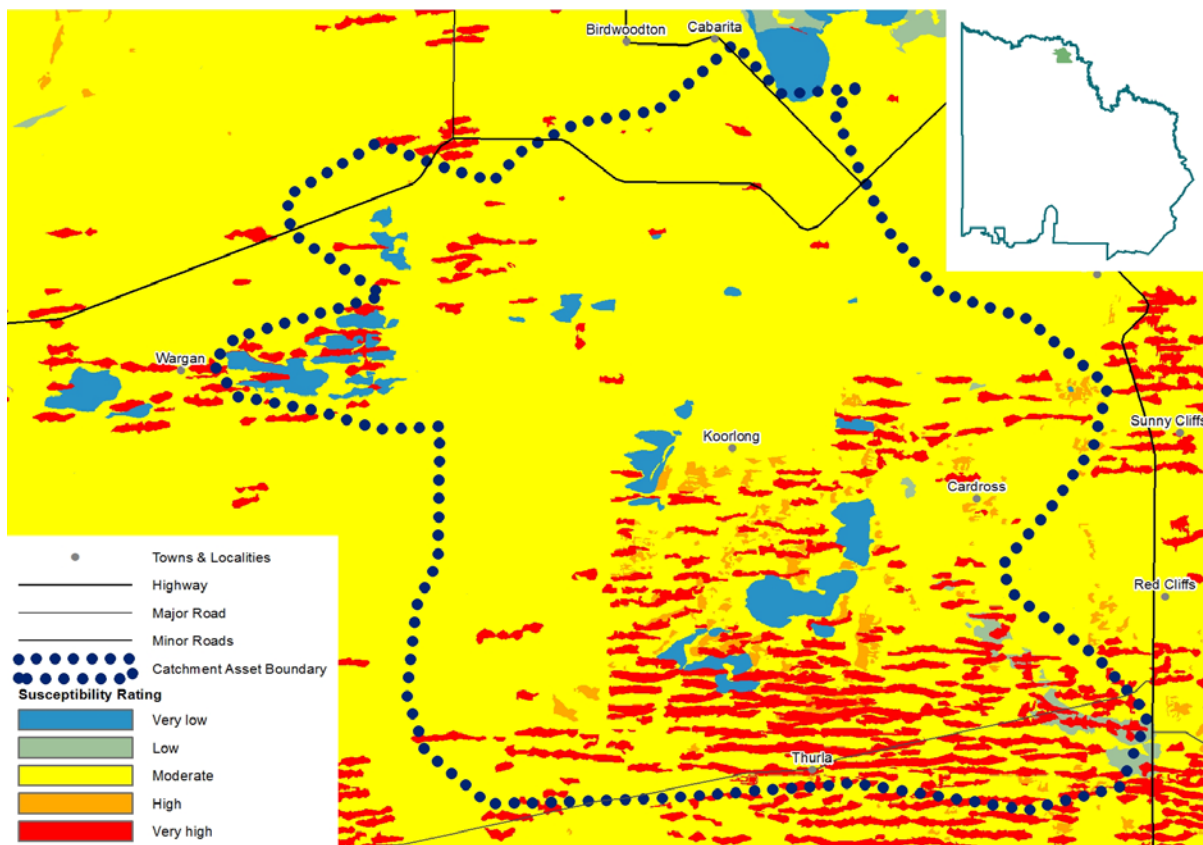


Figure 13: Wind Erosion Susceptibility

## Inappropriate Water Use Practices

Inappropriate water use practices in agricultural activities in both the irrigation and dryland zones have been demonstrated to result in excessive volumes of deep drainage past the root zone of crops and pasture and therefore contribute to the raising of local and regional water tables.

Approximately 55% (about 11,800 hectares) of the asset area is given over to agricultural activities, primarily irrigated agriculture. Considerable effort has been expended by land managers and support agencies in recent years to substantially improve water management practices in irrigated agriculture throughout the region. This catchment asset area has been one of the major beneficiaries of the improvement process. However, the capacity to adequately describe the extent to which inappropriate water use practises remain in place currently remains elusive. The complexity of irrigated crop types, irrigation systems, water use and practises and the application of best practise benchmarks has, to date, constrained the capacity to reliably and meaningfully determine irrigation efficiency at a district scale and therefore determine the scale of inappropriate water use practises. However, measures are underway to rectify this inadequacy in the life of this RCS.



Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with inappropriate water use practices with respect to each Regional Asset has been determined. They are listed in the table below along with the summary of the logic behind the priority determination. They are listed in Table 14 below.

**Table 14: Prospective Priority of Action to address Inappropriate Water Use Practices**

Regional Asset	Priority of Action	Summary Logic
Rivers	NONE	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	HIGH	To be documented
Terrestrial Habitat	HIGH	To be documented
Soils	HIGH	To be documented
Agricultural Land	HIGH	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	HIGH	To be documented
Community Capacity	NONE	To be documented

## Recreational Pressures

Recreational pressure can contribute to impacts including littering, track proliferation, fishing pressures, firewood collection, soil compaction and site erosion. The nature of the impacts is typically localised around the particular site and is highly dependent on the accessibility, popularity and sensitivity of the site along with the level of management that the location receives.

This catchment asset is a popular area for day use recreation. Koorlong State Forest in particular is used by a range of recreational vehicles. However, the scope, scale and extent of the impacts that results from this recreational pressure has not been quantified

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with recreational pressures with respect to each Regional Asset has been determined. They are listed in the table below along with the summary of the logic behind the priority determination. They are listed in Table 15 below.

**Table 15: Prospective Priority of Action to address Recreational Pressures**

Regional Asset	Priority of Action	Summary Logic
Rivers	NONE	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	HIGH	To be documented
Terrestrial Habitat	HIGH	To be documented
Soils	NONE	To be documented
Agricultural Land	NONE	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	HIGH	To be documented



Community Capacity	NONE	To be documented
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## Land Use Change

Land use change as a threatening process in this context is considered to be the change of land management or use practices from either a steady state or from accepted best practice management system. Examples include the removal of native vegetation, conversion of dryland property to irrigation development (or the reverse), change from no-till cropping to traditional fallow techniques, conversion from perennial pasture to cropping (or the reverse)

There is insufficient quality and quantity of data available to adequately describe the nature and level of impact resulting from this threatening process on this catchment asset at this time.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with land use change with respect to each Regional Asset has been determined. They are listed in Table 16 below.

**Table 16: Prospective Priority of Action to address Land Use Change**

Regional Asset	Priority of Action	Summary Logic
Rivers	NONE	To be documented
Wetlands	HIGH	To be documented
Threatened Species and Communities	HIGH	To be documented
Terrestrial Habitat	HIGH	To be documented
Soils	HIGH	To be documented
Agricultural Land	HIGH	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	HIGH	To be documented
Community Capacity	NONE	To be documented

## Direct Off-site Interactions

Direct off-site interactions are the direct physical impacts from land management activities on neighbouring off-site assets such as areas of remnant native vegetation or wetlands. Such interactions may include chemical spray drift; parking or storage of machinery and equipment; or incremental drift of cultivation into the asset.

There is insufficient quality and quantity of data available to adequately describe the nature and level of impact resulting from this threatening process on this catchment asset at this time.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with direct off-site interactions with respect to each Regional Asset has been determined. They are listed Table 17 below.

**Table 17: Prospective Priority of Action to address Direct Off-site Interactions**

Regional Asset	Priority of Action	Summary Logic
Rivers	NONE	To be documented

Wetlands	LOW	To be documented
Threatened Species and Communities	LOW	To be documented
Terrestrial Habitat	LOW	To be documented
Soils	LOW	To be documented
Agricultural Land	LOW	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	LOW	To be documented
Community Capacity	NONE	To be documented

## Misaligned Community Perceptions

Misaligned community perceptions are community opinions, approaches & values that run counter to the messages & knowledge available about natural resource management AND threaten the success of the wider communities' efforts to enhance their environment. Such perceptions include 'right of unfettered access' that results in removal of traffic management infrastructure installed near river banks; and 'we are doing no harm' where individuals are not aware of the cumulative and incremental harm of some of their actions (along with those of the rest of the community) when they are making use of our assets

There is insufficient quality and quantity of data available to adequately describe the nature and level of impact resulting from this threatening process on this catchment asset at this time. However, there is a range of anecdotal information from a range of sources that suggest the threat is present and ongoing.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with misaligned community perceptions with respect to each Regional Asset has been determined. They are listed in Table 18 below.

**Table 18: Prospective Priority of Action to address Misaligned Community Perceptions**

Regional Asset	Priority of Action	Summary Logic
Rivers	NONE	To be documented
Wetlands	MEDIUM	To be documented
Threatened Species and Communities	MEDIUM	To be documented
Terrestrial Habitat	MEDIUM	To be documented
Soils	MEDIUM	To be documented
Agricultural Land	MEDIUM	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	MEDIUM	To be documented
Community Capacity	MEDIUM	To be documented

## Inappropriate Fire Regimes

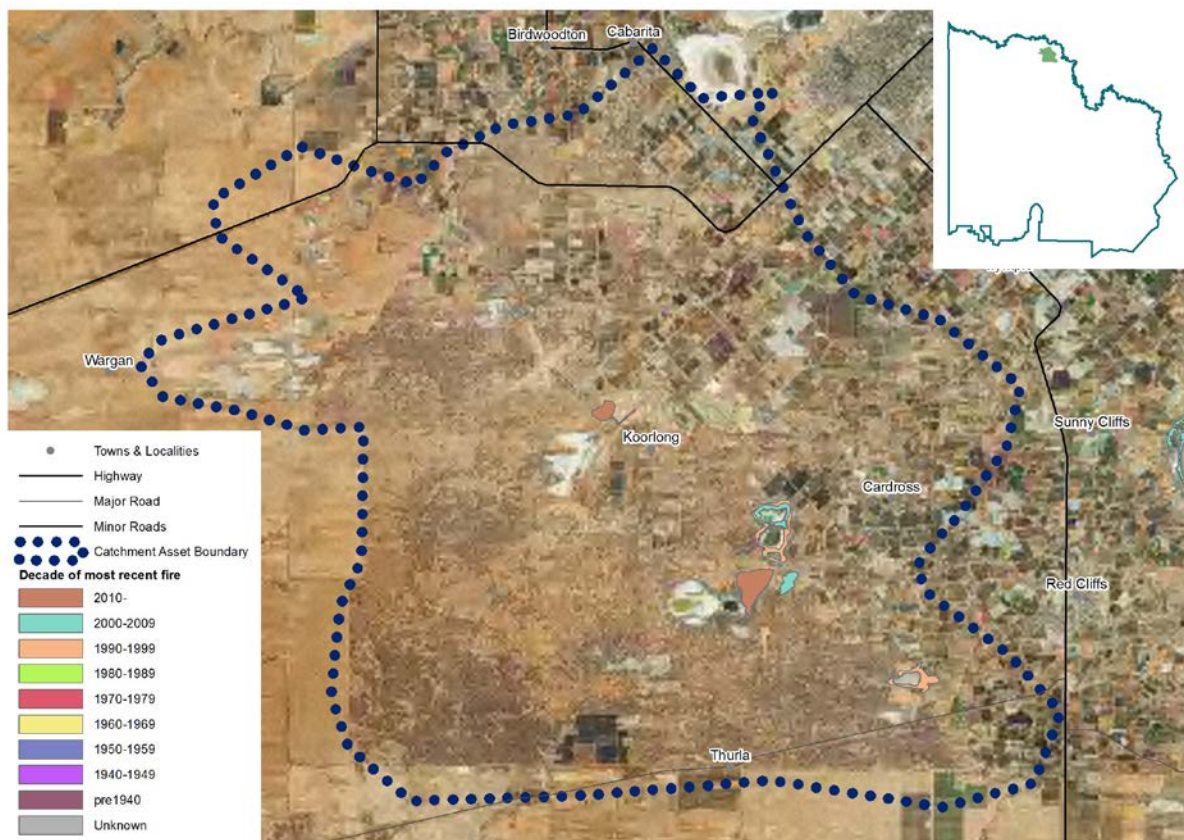
Fire is an ongoing challenge for land managers and communities alike. Fire is also a major force determining the structure, function and sustainability of Australia's ecosystems. A substantial proportion of Australia's unique biota is dependent, to varying degrees, on fire and the variety of fire regimes for its continued existence and development. In this context, inappropriate fire regimes can mean either too little or too much fire

There is insufficient quality and quantity of data available to adequately describe the nature and level of impact resulting from this threatening process on this catchment asset at this time.

Using this combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with inappropriate fire regimes with respect to each Regional Asset has been determined. They are listed in Table 19 below.

**Table 19: Prospective Priority of Action to address Inappropriate Fire Regimes**

Regional Asset	Priority of Action	Summary Logic
Rivers	NONE	To be documented
Wetlands	NONE	To be documented
Threatened Species and Communities	LOW	To be documented
Terrestrial Habitat	LOW	To be documented
Soils	NONE	To be documented
Agricultural Land	NONE	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	NONE	To be documented
Community Capacity	NONE	To be documented



**Figure 14: Fire History**

## Constrained Regenerative Capacity

The decline in vegetation cover and habitat complexity within remnant native vegetation can constrain or prevent regeneration which can lead to loss of habitat in the longer term. There are many contributors to this threatening process including weed invasion, excess grazing pressure, and habitat fragmentation. Loss of understorey flora and associated fauna are a possible outcome, also leading to a reduction in the capacity of the remnant to support flora and fauna species or maintain current population numbers, thus impacting on the biodiversity value of the asset.

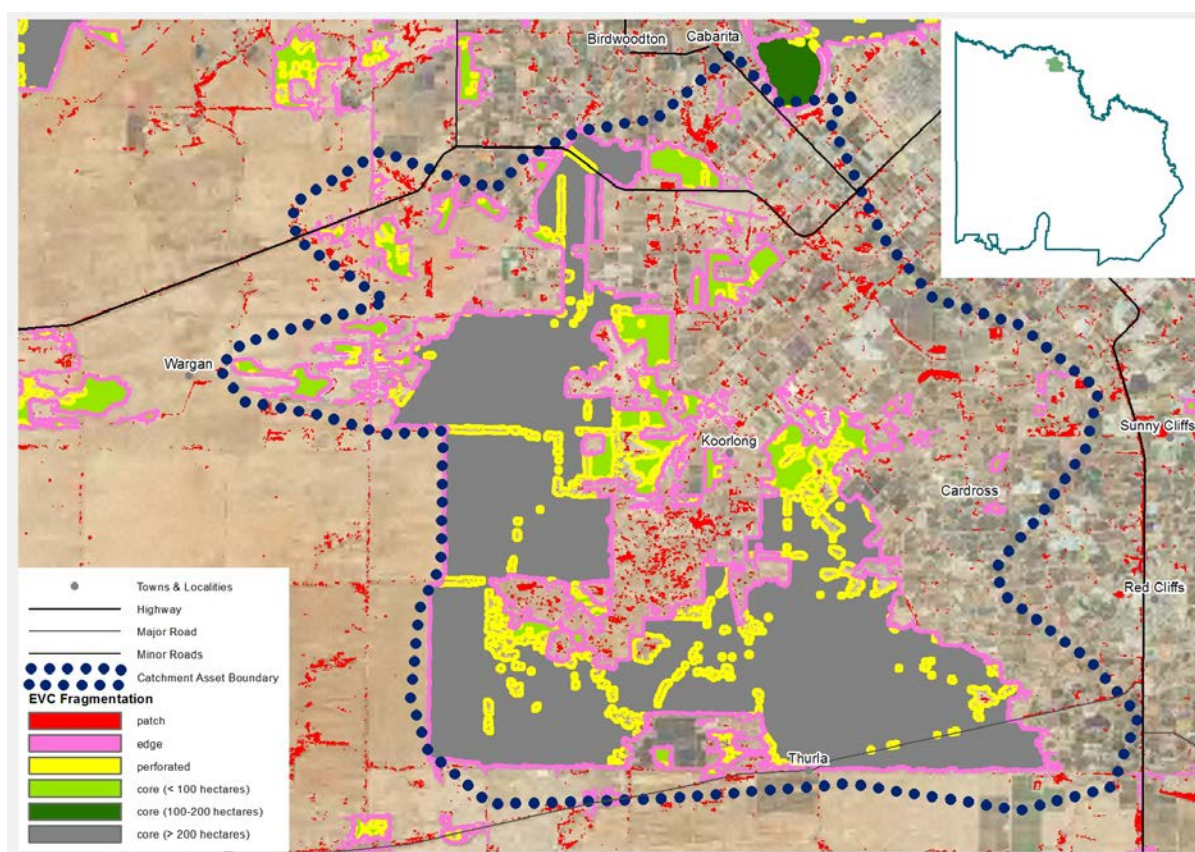
Habitat fragmentation is one useful indicator of constrained regenerative capacity. A high level of fragmentation will severely limit the capacity of a vegetation community and the ecology it supports to maintain its health and reproductive capacity. It will also hamper our efforts to improve the health and condition of remnant landscapes at a broad scale due to the level of additional resources that each remnant patch would require (such as restoration or revegetation) rather than being able to simply protect the remnant (through fencing and invasive species control) and then rely upon its own internal regenerative resources to bring about an improvement in health and condition.

Modelling of habitat fragmentation using a spatial tool (Vogt, et al. 2007) can demonstrate the level of habitat fragmentation of a landscape. Using a combination of information gathering approaches and the application of a complimentary consultative process, the priority of action for dealing with constrained regenerative capacity with respect to each Regional Asset has been determined. They are listed in Table 20 below.



**Table 20: Prospective Priority of Action to address Constrained Regenerative Capacity**

Regional Asset	Priority of Action	Summary Logic
Rivers	NONE	To be documented
Wetlands	MEDIUM	To be documented
Threatened Species and Communities	MEDIUM	To be documented
Terrestrial Habitat	MEDIUM	To be documented
Soils	NONE	To be documented
Agricultural Land	NONE	To be documented
Groundwater	NONE	To be documented
Cultural Heritage	NONE	To be documented
Community Capacity	NONE	To be documented



**Figure 15: Habitat Fragmentation**



## Section 4 – References & Appendices

## References

- Department of Agriculture, Fisheries and Forestry. *National Natural Resource Management Capacity Building Framework*. Canberra: Department of Agriculture, Fisheries and Forestry, 2005.
- Gong, W., J. Sinden, M. Braysher, and R. Jones. *The economic impacts of vertebrate pests in Australia*. Canberra: Invasive Animals Cooperative Research Centre, 2009, 59.
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- Mock, I., and V. Grinter. *Mapping the Mallee's Saline Land. Stage 3: Classifying Mapped Salinity. Final Report*, Irymple: Mallee Catchment Management Authority, 2009.
- Vogt, P., K. Riitters, C. Estreguil, J. Kozak, T. Wade, and J. Wickham. "Mapping spatial patterns with morphological image processing." *Landscape Ecology* 22, 2007: 171-177.

## 1. The Value of Regional Assets within a Catchment Asset

The Regional Asset value indicates the relative importance of the Regional Asset within the Catchment Asset Area. The valuation is determined from a range of indicators, many specific to each of the Regional Assets, that describe the importance of the Asset relative to social, economic and environmental values. One common example of an indicator of asset value is legislative significance which provides an indication of whether part or all of a Regional Asset is of significance at a local, regional, State, National or international level. These indicators were grouped and scored by consensus against agreed criteria and then each Regional Asset within the Catchment Asset was assigned a category that defines the prospective asset value and relative importance of and priority for maintaining or improving the value of the Asset.

Five category levels were identified:

**None** – indicates that the Regional Asset is unknown or not present within the Catchment Asset area.

**Low** – indicates that the Regional Asset is of relatively low status or importance within the Catchment Asset area. It may also indicate that there is insufficient knowledge or data available to define or quantify the asset value and therefore prioritise it with confidence. Further research may be required to rectify this situation.

**Medium** – indicates that the Regional Asset is locally or regionally important but relatively well known or secure at the Catchment Asset scale. This may be due in part to previously successful management interventions. Ongoing monitoring may be required as will some level of intervention (particularly at a local scale) to ensure previous management gains are not lost.

**High** – indicates that the Regional Asset within the Catchment Asset Area is of significance at a regional, State or National scale and that action is likely required over the life of the RCS in order to maintain or improve the value of the Regional Asset within the Catchment Asset Area.

**Very High** - indicates that the Regional Asset within the Catchment Asset Area is of significance at a National or international scale and that action is likely required over the life of the RCS in order to maintain or improve the value of the Regional Asset within the Catchment Asset Area.

## 2. Categorising Threatening Processes

The categorisation of the threatening processes in order to prioritise management actions was based on the current scope and scale of the impacts arising from the threatening process along with consideration of potential future impact of the threatening process. The categorisation was based on consensus against agreed criteria. Each threatening process acting upon each Regional Asset was assigned a category that defines the prospective priority of action to address that threatening process.

Four category levels were identified:

**None** – indicates that either the threatening process, or the regional asset itself, is unknown or not present within the catchment Asset area.

**Low** – indicates that, while the threatening process is known to be present, it is at a low level or the Regional Asset itself is not overly susceptible to or impacted by the threat. It may also indicate that there is insufficient knowledge or data available to define or quantify the interaction between the asset and the threatening process and therefore prioritise it with confidence. Further research may be required to rectify this situation.

**Medium** – indicates that the threatening process is real but that the Regional Asset is not under immediate threat at the Catchment Asset scale. This may be due to previously successful interventions.

Ongoing monitoring will be required as will some level of intervention (particularly at a local scale) to ensure previous management gains are not lost.

**High** – indicates that: there is a high level of potential harm to the Asset as a result of the threatening process; there are a variety of management actions available that are known to be successful at reducing harm and which are generally supported by land managers; and that action is required over the life of the RCS in order to prevent further impact as a result of the threatening process.

### 3. Management Plans Relevant to this Catchment Asset

**Table 21: Management Plans Relevant to this Catchment Asset**

Name	Type	Author/Owner	Year
North West Region Mildura Fire District Fire Protection Plan	Management Plan	Department of Sustainability & Environment	2008
Victorian Mallee Irrigation Area Land and Water Management Plan (Draft)	Management Plan	Mallee Catchment Management Authority	2011
Northern Region Sustainable Water Strategy	Strategy	Department of Sustainability & Environment	2009
Mallee Wetland Strategy 2006-2011	Strategy	Mallee Catchment Management Authority	2006
Mildura Rural City Council Significant Linkages Strategy 2007	Strategy	Mildura Rural City Council	2007
Mildura Rural City Council Sunraysia Remnant Linkage Strategy	Strategy	Mildura Rural City Council	2003
Sunraysia Drainage Strategy	Strategy	Mildura Rural City Council	2002
Native Fish Strategy for the Murray-Darling Basin 2003-2013	Strategy	Murray Darling Basin Authority	2003
Mallee Invasive Plants and Animals Management Strategy	Strategy	Mallee Catchment Management Authority	2011
Millewa Carwarp Landcare Group Action Plan 2012-2017	Action Plan	Millewa Carwarp Landcare Group	2012
National Recovery Plan for the Murray Hardyhead <i>Cratogeomys fluvialis</i>	National Recovery Plan	Department of Sustainability & Environment (Victoria)	2008
Flora & Fauna Guarantee Action Statement White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement White-browed Treecreeper <i>Climacteris affinis</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement Bush Stone-Curlew <i>Burhinus grallarius</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2004
Flora & Fauna Guarantee Action Statement Major Mitchell's Cockatoo <i>Cacatua leadbeateri</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2004
Flora & Fauna Guarantee Action Statement Freckled Duck <i>Stictonetta naevosa</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2004
Flora & Fauna Guarantee Action Statement Great Egret <i>Ardea alba</i> Intermediate Egret <i>Ardea intermedia</i> Little Egret <i>Egretta garzetta</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2001
Flora & Fauna Guarantee Action Statement Twelve threatened Swainson-peas and Darling-peas ( <i>Swainsona</i> species)	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement Blue-billed Duck <i>Oxyura australis</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2003
Flora & Fauna Guarantee Action Statement Freshwater Catfish <i>Tandanus tandanus</i>	Action Statement	Department of Sustainability & Environment (Victoria)	2005

## 4. Management Action Definitions

Management Action Category	Management Action	Definition	Threatening Processes Addressed
On-ground Works	Pest Plant Control	Control and eradication of pest plant species	Invasive Plants; Constrained Regenerative Capacity
	Pest Animal Control	Control and eradication of pest animal species	Invasive Animals; Soil Erosion; Constrained Regenerative Capacity
	Habitat Protection	Habitat protection through exclusion fencing or other physical means	Invasive Animals; Soil Erosion; Recreational Pressure; Land Use Change; Direct Off-Site Interactions; Constrained Regenerative Capacity
	Habitat Restoration	Restoration of degraded terrestrial habitat by planting vegetation	Land & Water Salinisation; Soil Erosion; Recreational Pressure; Direct Off-Site Interactions; Constrained Regenerative Capacity
	Revegetation	Re-creation of terrestrial habitat by planting vegetation (e.g. new wildlife corridor plantings)	Land & Water Salinisation; Soil Erosion; Recreational Pressure; Direct Off-Site Interactions; Constrained Regenerative Capacity
	Environmental Watering	Delivering environmental water to wetlands and floodplains; maintaining appropriate watering regimes	Altered Hydrological Regimes; Constrained Regenerative Capacity
	Soil Erosion Control	Control of soil erosion through engineering works and other structures	Soil Erosion
	Threatened Species Interventions	Interventions to improve outcomes for threatened species and ecological communities	Constrained Regenerative Capacity
	Enhancing Land Management Regimes	Interventions to enhance land management regimes on both public and private land (e.g. water use efficiency on irrigated land; maintaining appropriate soil cover in dryland agriculture; improved management or protection regimes)	Land & Water Salinisation; Soil Erosion; Inappropriate Water Use Practises; Land Use Change; Direct Off-Site Interactions
Capacity Building	Supporting Human Capacity for NRM	Provision of new skills and training in NRM; Delivery of publicity and awareness raising paraphernalia	All
	Supporting Institutional Capacity for NRM	Development and support of regional partnerships between institutions with a stake in NRM	All
	Supporting Social Capacity for NRM	Supporting community organisations that have a stake in NRM by aiding	All



		governance and provision of material	
NRM Planning	Institutional Planning for NRM	Development and implementation of NRM planning by regional institutions. Examples include institutional NRM plans, regional asset plans and sub-strategies	All
	Community Driven Planning for NRM	Development and implementation of NRM planning by community based organisations. Examples include Landcare Group Action Plans.	All
	Landholder Driven Planning for NRM	Development and implementation of NRM planning by landholders. Examples include property management plans and conservation agreements	All
Knowledge Building	Research to improve knowledge	Any research or other work delivered to improve or expand current knowledge or fill knowledge gaps in any NRM topic relevant to regional assets	All
Asset Assessment	Asset condition monitoring and assessment	Monitoring and collection of data concerning indicators of regional asset condition and/or threatening processes impacting on regional assets; Efforts to determine and/or evaluate trends in the condition of assets or the scope and scale of threatening processes impacting on regional assets.	All

## 5. Management Actions from Existing Management Plans

**Table 22: Management Actions from Existing Management Plans**

Instrument	Management Action	Details
North West Region Mildura Fire District Fire Protection Plan	Supporting Institutional Capacity for NRM	Investing in integrated fire management to balance community needs with ecological requirements
	Research to improve knowledge	Determining appropriate ecological fire regimes
Victorian Mallee Irrigation Area Land and Water Management Plan (Draft)	Enhancing Land Management Regimes	improving water use efficiency; modernising infrastructure

	Supporting Human Capacity for NRM	Education and community awareness development on a range of land, water and biodiversity management issues
	Supporting Institutional Capacity for NRM	Maintaining partnerships and communication channels amongst regional and State partners
	Institutional Planning for NRM	Considerable (and diverse) planning and policy development to enhance water trading rules, improve efficiency of water use and incorporate environmental watering into the water management process
	Landholder Driven Planning for NRM	Whole farm planning for irrigation properties
	Research to improve knowledge	Various research topics on water use efficiency improvements and the potential impacts of irrigation on biodiversity and land use management
	Asset condition monitoring and assessment	waterway salinity, groundwater and irrigation drainage monitoring
Northern Region Sustainable Water Strategy	Environmental Watering	A range of policies and actions at a regional scale that are intended to support environmental water actions
	Supporting Institutional Capacity for NRM	A range of policies and actions that support institutional partnership arrangements to improve bulk water management for irrigators, consumers and the environment
	Asset condition monitoring and assessment	Water quality and quantity monitoring in surface and groundwater resources; ecological monitoring of rivers and wetlands
Mallee Wetland Strategy 2006-2011	Pest Plant Control	Focus on willows and aquatic weeds
	Pest Animal Control	Focus on rabbits & carp
	Habitat Protection	Identification of priority sites; protection from stock grazing
	Habitat Restoration	Identification of priority sites with works to occur at five of them across the region
	Environmental Watering	Determine appropriate water regimes
	Threatened Species Interventions	Identify three priority species and implement key recommendations from their Action Statements or Recovery Plans as relevant to wetlands
	Supporting Human Capacity for NRM	Raising awareness and improving knowledge of wetland values and threats in the community; improving knowledge of indigenous wetland values
	Institutional Planning for NRM	preparation and implementation of local planning overlays and wetland management plans

	Research to improve knowledge	improve knowledge of wetland values and threats to those values
	Asset condition monitoring and assessment	Determine wetland condition; monitor responses arising from interventions
Mildura Rural City Council Significant Linkages Strategy 2007	Pest Plant Control	There is one identified corridor within this catchment asset: Meridian Road (N6). Another (Pirlta Rd - N3) touches on the boundary. Both connect this CA to CA's 5 & 6
	Pest Animal Control	
	Habitat Restoration	
	Revegetation	
	Supporting Human Capacity for NRM	
	Supporting Institutional Capacity for NRM	
	Supporting Social Capacity for NRM	
	Landholder Driven Planning for NRM	
	Asset condition monitoring and assessment	
Mildura Rural City Council Sunraysia Remnant Linkage Strategy	Pest Plant Control	Focused on two areas within the asset. First is around the Mildura Airport - roadsides; Murray Pines Cemetery and H4 Block while the second is the area around SunnyCliffs and the Red Cliffs Golf Club
	Pest Animal Control	
	Habitat Restoration	
	Supporting Human Capacity for NRM	
	Supporting Institutional Capacity for NRM	
	Supporting Social Capacity for NRM	
	Asset condition monitoring and assessment	

Sunraysia Drainage Strategy	Habitat Protection	outlining how urban development and the existing irrigation development will be serviced with surface and sub-surface drainage to the year 2050
	Enhancing Land Management Regimes	
	Supporting Institutional Capacity for NRM	
	Institutional Planning for NRM	
Native Fish Strategy for the Murray-Darling Basin 2003-2013	Pest Animal Control	Control of carp and other alien fish
	Habitat Protection	protect key aquatic and riparian habitat; protect key linkages between floodplains and aquatic habitats
	Habitat Restoration	improve fish passage/water quality/key aquatic & riparian habitats
	Institutional Planning for NRM	preparation and implementation of species and fish community recovery plans
	Supporting Institutional Capacity for NRM	enhance knowledge of and partnership support for the Strategy
	Supporting Human Capacity for NRM	enhance knowledge of and support for the Strategy and native fish in general
Mallee Invasive Plants and Animals Management Strategy 2011	Pest Plant Control	prevent new introductions; contain high risk weed species
	Pest Animal Control	prevent new introductions; contain high risk pest animal species
	Supporting Human Capacity for NRM	improve community knowledge and awareness of invasive plants and animals and methods of control
	Supporting Institutional Capacity for NRM	support partnership arrangements between organisations with responsibilities for control and management of invasive plants and animals
	Supporting Social Capacity for NRM	Support community organisations carrying out targeted invasive plant and animal management with information, education, extension, enforcement and the identification of funding opportunities; Actively seek community participation and create partnerships with community groups in all IPA management project and programs
	Asset condition monitoring and assessment	monitor invasive plants and animals against both past interventions and for future actions;
National Recovery Plan for the Murray Hardyhead <i>Craterocephalus fluviatilis</i>	Threatened Species Interventions	Establish and maintain the Murray Hardyhead in captivity; Establish new populations of Murray Hardyhead in the wild

	Supporting Human Capacity for NRM	
	Research to improve knowledge	
	Asset condition monitoring and assessment	
Flora & Fauna Guarantee Action Statement White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	Habitat Protection	buffers/barriers to protect nest sites from disturbance
	Supporting Human Capacity for NRM	community education
	Institutional Planning for NRM	incorporate suitable habitat into appropriate management plans in order to protect such habitat
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	Species population monitoring; threat status monitoring
Flora & Fauna Guarantee Action Statement White-browed Treecreeper <i>Climacteris affinis</i>	Pest Animal Control	rabbit control in pine-buloke woodlands
	Habitat Restoration	restoration of degraded pine-buloke woodland core species habitat
	Supporting Human Capacity for NRM	training and extension to improve staff and community identification of species
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
Flora & Fauna Guarantee Action Statement Bush Stone-Curlew <i>Burhinus grallarius</i>	Pest Animal Control	Fox control in and near key habitat
	Supporting Human Capacity for NRM	Raise community awareness of species; target golf courses with remnant habitat with specific education and land management material
	Institutional Planning for NRM	Develop or amend planning scheme regulations to protect key habitat areas
	Landholder Driven Planning for NRM	Encourage and support a) fencing of remnant habitat; and/or b) the creation of covenants; to protect species on private land
Flora & Fauna Guarantee Action Statement Major Mitchell's Cockatoo <i>Cacatua leadbeateri</i>	Habitat Restoration	conserve and enhance species preferred habitat
	Supporting Human Capacity for NRM	Raise community awareness of species; training and extension to improve staff and community knowledge of species requirements



	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
Flora & Fauna Guarantee Action Statement Freckled Duck <i>Stictonetta naevosa</i>	Threatened Species Interventions	wetland closures to hunting
	Supporting Human Capacity for NRM	hunter education
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	targeted searches
Flora & Fauna Guarantee Action Statement Great Egret <i>Ardea alba</i> Intermediate Egret <i>Ardea intermedia</i> Little Egret <i>Egretta garzetta</i>	Environmental Watering	Maintain appropriate water regimes in wetlands and creeks systems
	Asset condition monitoring and assessment	Species population monitoring; threat status monitoring
Flora & Fauna Guarantee Action Statement Twelve threatened Swainson-peas and Darling-peas ( <i>Swainsona</i> species)	Pest Plant Control	Control competing weeds in known populations
	Habitat Protection	Exclusion of stock and vehicular access to known habitat/populations
	Supporting Human Capacity for NRM	Raise community awareness of species
	Institutional Planning for NRM	prepare and implement management plans for public reserves containing species
	Landholder Driven Planning for NRM	Encourage and support a) fencing of remnant habitat; and/or b) the creation of covenants; to protect species on private land
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	Species population monitoring; threat status monitoring
Flora & Fauna Guarantee Action Statement Blue-billed Duck <i>Oxyura australis</i>	Pest Animal Control	Fox control in and near key habitat
	Habitat Protection	Exclusion of stock and vehicular access to known habitat/populations; minimise disturbance through wetland closure etc.
	Supporting Human Capacity for NRM	Raise community awareness of species; target golf courses with remnant habitat with specific education and land management material
	Landholder Driven Planning for NRM	Encourage and support a) fencing of remnant habitat; and/or b) the creation of covenants; to protect species on private land

	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	Species population monitoring; threat status monitoring
Flora & Fauna Guarantee Action Statement Freshwater Catfish <i>Tandanus tandanus</i>	Environmental Watering	provide for appropriate water regimes to suit species requirements
	Threatened Species Interventions	reintroductions
	Supporting Human Capacity for NRM	awareness raising of species status and means to minimise harm to species
	Institutional Planning for NRM	planning and prioritisation tools developed or modified
	Research to improve knowledge	improve knowledge of ecological requirements/potential habitat/recovery techniques
	Asset condition monitoring and assessment	routine species population survey
Millewa Carwarp Landcare Group Action Plan 2012-2017	Pest Animal Control	rabbit control
	Supporting Institutional Capacity for NRM	improve group governance; develop group capacity; partnership with TfN
	Supporting Social Capacity for NRM	support for Junior Landcare
	Community Driven Planning for NRM	identify and plan for biodiversity assets within group area

## 6. Prioritising Potential Management Actions

Potential management action categories are prioritised in terms of:

- the value of a regional asset within the catchment asset area;
- the priority to address a threatening process to those values;
- the capacity of the management action to address the threatening process; and
- the level of investment (in both of time and money) required to exercise that capacity.

Individual management actions are grouped and scored by consensus against agreed criteria and then each potential management action group within the Catchment Asset is assigned to a category that defines the prospective priority to the implementation.

Four category levels were identified:

**None** – indicates that either the management action group not contained in management plans relevant to the Catchment Asset area or the targeted threatening processes that it addresses is unknown or not present within the Catchment Asset area.

**Low** – typically indicates either that the targeted threatening processes are of low priority within this Catchment Asset area or the management action category is known to be generally not effective at mitigating the threatening process. It may also indicate that there is insufficient knowledge or data available to define or quantify the effectiveness of the management action to mitigate the threatening process and therefore prioritise it with confidence. Further research may be required to rectify this situation.

**Medium** – typically indicates that the targeted threatening processes are of medium priority within this Catchment Asset area and the management action category is known to be generally effective at mitigating the threatening process and is within the region's capacity to implement over the life of the RCS. It may also indicate that there is some uncertainty with the effectiveness of the potential management action upon a high priority threatening process in terms of either the scale of the threat, the known capacity of the action or the investment required to exercise that capacity.

**High** – indicates that the targeted threatening processes are of high priority within this Catchment Asset area and the management action category is known to be effective at mitigating the threatening process and is within the region's capacity to implement over the life of the RCS and that action is required urgently in order to prevent further impact as a result of the threatening process.

## 7. Management Action Priorities

### Threatening Processes Priority of Action

Table 23 below represents the findings of a group based analysis in June 2013 of the threat level posed by threatening processes upon Regional Assets within this Catchment Asset based on the criteria contained in Appendix 2. *Categorising Threatening Processes*. The bottom row of the table contains a median 'score' for the threat level posed by each of the threatening processes across the Catchment Asset. These 'scores' are the same as those shown in Table 2.

**Table 23: Threatening Process Priority of Action Summary**

	Land & water salinisation	Invasive Plants	Invasive Animals	Altered Hydrological Regimes	Soil Erosion	Inappropriate Water Use Practices	Recreational Pressures	Land Use Change	Direct off-site interactions	Misaligned community perceptions	Inappropriate fire regimes	Constrained regenerative capacity
Rivers	None	None	None	None	None	None	None	None	None	None	None	None
Wetlands	High	High	High	High	Medium	High	High	High	Low	Medium	None	High
Threatened Species	High	High	High	High	Medium	High	High	High	Low	Medium	Medium	High
Terrestrial Habitat	High	High	High	High	Medium	High	High	High	Low	Medium	Medium	High
Soils	High	High	Medium	High	Medium	High	None	High	Low	Medium	None	None
Agricultural Land	High	High	Medium	High	Medium	High	None	High	Low	Medium	None	None
Groundwater	None	None	None	None	None	None	None	None	None	None	None	None

Cultural Heritage	None	High	High	High	High	High	High	High	Low	Medium	None	None
Community Capacity	None	None	None	None	None	None	None	None	None	Medium	None	None
ALL REGIONAL ASSETS	High	High	High	High	Medium	High	High	High	Low	Medium	Medium	High

## Management Action Priority Matrix

The table below represents the findings of an integration and analysis of the following components:

- the threatening processes priority of action table shown above;
- the management actions from existing management plans shown in Table 22;
- knowledge and evidence supporting past successes (or otherwise) of various management actions in the Mallee or in this Catchment Asset area; and
- the likelihood of implemented management actions addressing or mitigating threatening processes over the life of the RCS.

The criteria used to apply a value to each management action against each Regional Asset is contained in Appendix 6. *Prioritising Potential Management Actions*. The far right column of the table contains a median 'score' for each the management action priority across the Catchment Asset. These 'scores' are the same as those shown in Table 3.

**Table 24: Management Action Priority Summary**

	Rivers	Wetlands	Threatened Species	Terrestrial Habitat	Soils	Agricultural Land	Groundwater	Cultural Heritage	Community Capacity	Across All Assets
Pest Plant Control	None	High	High	High	High	High	None	High	None	High
Pest Animal Control	None	High	High	High	Medium	Medium	None	High	None	High
Habitat Protection	None	High	High	High	Medium	Low	None	High	None	High
Habitat Restoration	None	Medium	Medium	Medium	Low	Low	None	High	None	Medium
Revegetation	None	Medium	Medium	Medium	Low	Medium	None	Medium	None	Medium
Environmental Watering	None	High	High	High	High	Medium	None	Medium	None	High
Soil Erosion Control	None	Medium	Medium	Medium	Medium	Medium	None	High	None	Medium
Threatened Species Interventions	None	High	High	High	None	None	None	None	None	High

Enhancing Land Management Regimes	None	High	High	High	High	High	None	High	None	High
Supporting Human Capacity for NRM	None	High	Medium	Medium	Medium	Medium	None	Medium	Medium	Medium
Supporting Institutional Capacity for NRM	None	High	High	High	High	High	None	High	Low	High
Supporting Social Capacity for NRM	None	Medium	Medium	Low	Low	Low	None	Medium	Medium	Medium
Institutional Planning for NRM	None	High	High	High	High	High	None	High	Medium	High
Community Driven Planning for NRM	None	Medium	Medium	Medium	Medium	Medium	None	Medium	Low	Medium
Landholder Driven Planning for NRM	None	High	Medium	High	High	High	None	High	Medium	High
Research to improve knowledge	None	High	High	High	High	Medium	None	High	Medium	High
Asset condition monitoring and assessment	None	High	High	High	Medium	High	None	High	Low	High

Therefore, the highest priority management actions within this Catchment Asset over the life of the Regional Catchment Strategy should be:

- Pest Plant Control;
- Pest Animal Control;
- Habitat Protection;
- Environmental Watering;
- Threatened Species Interventions;
- Enhancing Land Management Regimes;
- Supporting institutional capacity for NRM;
- Institutional Planning for NRM;
- Landholder Driver Planning for NRM;
- Research to improve knowledge; and
- Asset condition monitoring and assessment.

Implementation of these actions should provide the greatest impact on the mitigation of the most concerning threatening processes within this Catchment Asset and make a significant contribution to the achievement of the expected outcomes of the Mallee Regional Catchment Strategy.



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