

Agency Statement of Important Natural Resource Management Assets in Western Australia

Prepared by
Department of Water
for
NRM Senior Officers Group

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Acknowledgments

This report was prepared by
Verity Klemm and Chrystal King, Department of Water

With contributions by
Department of Fisheries: Fred Welles and Andrew Hill
Department of Environment and Conservation: Keith Claymore and Ian Eliot
Department of Agriculture and Food: Jim Dixon and Ian Watson
Department of Planning and Infrastructure: Barbara Pedersen
Department of Water: Verity Klemm, Huia Colliver, Sian Bennett and Nigel Mantle

For more information contact the respective contributors:

Verity Klemm
Department of Water
Telephone (08) 6364 7600

Fred Welles
Department of Fisheries
Telephone (08) 9203 0111

Keith Claymore
Department of Environment and Conservation
Telephone (08) 6364 6500

Jim Dixon
Department of Agriculture and Food
Telephone (08) 9368 3368

Barbara Pedersen
Department of Planning and Infrastructure
Telephone (08) 9264 7777

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We welcome your feedback
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Foreword

This report was prepared under the auspices of the Natural Resource Management Senior Officers Group to identify the important NRM Assets in Western Australia. This is a compilation of the work by each of the State Agencies to identify NRM assets and threatening processes. The report complements the Salinity Investment Framework (SIF) and is consistent with the Hicks' review of the delivery of Natural Resources Management in Western Australia (Dec 2006). It will be a key resource for implementation of policy and strategy for NRM in Western Australia.

As such, it is also a step forward in improving the information available to those responsible for NRM investment planning at state level and within each region. It is a vital element in the information flow between the Western Australian Government, a joint funder with the Commonwealth of the National Action Plan for Salinity and Water Quality, and regional NRM groups.

The report presents the views of each Department on the respective NRM assets for which it has primary responsibility. By using evaluation methods that are specific to each NRM asset class this report presents differing levels of detail on information and therefore comparisons between asset classes are not recommended without further information from each sections respective authors.

This report focuses primarily on biophysical or tangible assets. The report has not addressed the social and socio-economic asset class, as it is not directly at threat from natural resource issues. However, it remains important to invest in the capacity of governments, regional groups and communities to make, transparent and evidence-based decisions and to plan and carry out effective and efficient programmes that meet expectations for public expenditure.

There is a particular need to build the capacity of NRM investment planners for quantifying and trading off among the different asset classes.

As this report is a work in progress and to be referenced as an unpublished document, it presents an opportunity for all those who have yet to be involved in its preparation to provide feedback to authors and to the NRM Senior Officers Group.

This report takes Western Australia another step towards a comprehensive and coordinated assessment of priorities for investment by the State government in natural resource management.

Comments to be provided to Natalie Moore, State NRM Office by 31st March 2007.

David Hartley
Chairman
NRM Senior Officers Group
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1 Introduction

1.1 *The situation in Natural Resource Management*

One of Australia's greatest challenges is the way we manage our natural resources, which include our soil, water and biodiversity (native plants and animals, ecological communities, ecological processes and ecosystem services). Ensuring the ecologically sustainable management of Australia's natural resources is a critical issue if we are to maintain the health of our environment, conservation of our biodiversity, and the long-term prosperity of our agricultural production and export and urban environments.

To protect the environment and the future of this State's natural resources the full range of stakeholders (Government, Industry and the Community to which they belong) must work together. By collectively tackling major issues such as salinity, declining water quality and biodiversity loss Australia will reap not only environmental but major social and economic rewards.

There are many threats to our natural resources, which include eutrophication, acidification, over clearing, introduced plants and animals, habitat fragmentation, inappropriate fire regimes, competing land uses, salinity, weed invasion and wind and water erosion. In Western Australia current estimates on the extent of salinity alone are that approximately 1.8 million ha of land in the Southwest Agricultural Zone are currently affected. It has been calculated that this saline affected area will increase to over 6 million ha (some 30% of the landscape) without intervention by the time a new hydrological equilibrium is reached. Even with the most optimistic intervention options using perennial vegetation and engineering about 4 million ha of land will be affected, and for most catchments changes in land use will not have any significant impact for at least 20 years (Government of WA, 2000).

For Western Australia's biodiversity the impacts from salinity will be great, with most or all of the existing wetland, dampland and woodland communities in the lower parts of catchments, within the south west of Australia, being lost or affected without massive intervention. As well, there will be a much increased flood risk with flood peaks and flows two to four times higher than at present for the same amount of rainfall. Just as importantly, profitable farming systems that control salinity are generally not available on the scale needed. Without proven systems that are both effective for managing salinity, and profitable, farmers will not willingly change their current ways of farming.

The clear conclusion is that both public and private investment into natural resource management will need to be increased above current levels for a significant period of time, and be much better targeted into actions that generate maximum returns to investment. It then follows that a rigorous and transparent process is needed to determine priorities for the allocation of the limited funds that will become available over time.

Over the past 5 years the Salinity Investment Framework project (SIF) has been working towards developing a process to allocate public funds to protect assets of high public value. Although this project is not fully completed it has produced a methodology for identifying assets of high importance. High importance assets are those assets that have both a High Value and High Threat. Important assets do not represent a final priority listing for investment of resources, but represent a starting point for further investigations and discussions on a final investment decision.

In parallel with the SIF the Natural Resource Management (NRM) groups across Western Australia have developed their Regional Plans which identify NRM priorities and are now implementing their Investment Plans.

Strategic planning and priority setting for investments is the fundamental basis from which the State, Commonwealth, Regional NRM groups, local communities, industry, commercial organisations and individuals will choose to address natural resource management into the future. Under the Bilateral Agreements between the State and the Commonwealth for delivery of the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality publicly funded investments must be targeted to those areas of greatest need and where they will deliver the best outcomes for public assets.

Together, State agencies invest over \$200 million of public funds annually in natural resource management programs. As the State Government is a major investor in Natural Resource Management and a major contributor to public programs through its various agencies, it has a long history of establishing NRM investment priorities. These priorities are traditionally based on the need to protect key public assets and are well understood within the agencies. In relation to salinity, priorities have been well documented in the Salinity Action Plan and Salinity Strategy and in the various agencies reports and documentation.

With the broadening of NRM in recent years to cover all natural resource issues from the marine environment, across the coasts and into the inland areas and the requirements for accredited regional NRM strategies to guide investments, there is a clear need for the State to integrate and explain its NRM priorities.

1.2 *The Update*

The State's NRM agencies have been through an internal process of reviewing the information provided for the 2003 report. This involved identifying and categorising the State's natural resource assets in terms of their ongoing programs and priorities. The processes used to complete this have evolved from the methodology developed by the SIF. Using the 'value versus threat matrix' each agency has compiled a list of assets within their NRM areas of expertise. These assets have then been ranked on the basis of threats and values.

The Senior Officers Group assigned the responsibilities for developing rules for identifying important assets for each asset class to the responsible Natural Resource Agency:

Agricultural production and infrastructure: Department of Agriculture and Food.

Biodiversity: Department of Environment and Conservation.

Coastal and Marine: Department of Planning and Infrastructure.

Fisheries Resources: Department of Fisheries.

Water Resources: Department of Water.

Identifying an asset's value and threat should involve stakeholder participation at all scales of application (State, region or local). The initial value and threat assessments described in following sections have been completed by each of the NRM agencies using available data sets and expert opinion. These assessments represent a 'State Agency' view on what assets are important in the face of a threat at a State scale. It should be acknowledged that although there will be some similarities the final lists of high importance assets at the Regional scales will be different.

1.3 Social and economic assets

This report focuses primarily on biophysical or tangible assets. The report has not addressed the social and socio-economic asset class, as it is not directly at threat from natural resource issues.

Generally the impact of environmental threats (such as wind erosion and salinity) against the social and socio-economic asset class are not significant. Forces that impact significantly on this asset stem from, for example:

- Declining terms of trade impacting on the economic health of country areas resulting in rural decline and loss of disposable income for use in NRM.
- Improved communications and the replacement of labour by technology, resulting in population decline.

The human or socio-economic asset is an important consideration in any NRM investment as in many circumstances these assets will contribute to the success of any action implemented to contend with a threat.

2 Setting priorities for investment in NRM – the Salinity Investment Approach

As discussed above the NRM Senior Officers Group decided to adopt the value versus threat approach to help identify priorities in NRM. Below is a summary of the logic behind this process as described by the SIF.

The approach developed for the Salinity Investment Framework (SIF) is described in this section to provide an overview of the basis of the approach used in the development of this report. The SIF has been adapted for use at a Statewide scale and considers all NRM threats which include eutrophication, acidification, over clearing, introduced plants and animals, habitat fragmentation, inappropriate fire regimes competing land uses, salinity, weed invasion and wind and water erosion.

2.1 *Value, threat and feasibility*

The Salinity Investment Framework is centred on an appreciation of the biophysical and socio-economic assets that are present in an area and which may be impacted to various degrees by a threat. The term ‘asset’ indicates an item of value. ‘Threat’ indicates the predicted severity and urgency of the impact of salinity (in this report’s case threat is considered across a greater spectrum of issues, e.g. eutrophication, wind erosion, weed invasion, habitat fragmentation etc) on the asset, resulting in a loss of asset value. Discussion about an asset item’s value also leads to a better understanding of what is most important at a local community, regional or State scale. When an understanding of value is combined with an understanding of future threats to an asset, it becomes easier to identify specific goals with realistic aspirations for the future. This leads logically to addressing questions including:

- What are we prepared to spend to recover, maintain, and adapt that value?
- What is required to attain a goal for an asset?
- Is that option technically and socially feasible?

For any given asset, the process of setting priorities based on the asset’s value, combined with an understanding of the threat or threats to that value, and the known ability to influence that scenario through intervention – the feasibility (or likelihood of success), will assist in deciding whether action should be aimed at recovery, containment or adaptation. The feasibility simply means the ability to meet the desired goal for an asset, which requires consideration of management options, costs, social capacity and political will.

Figure 1 illustrates how consideration of these three criteria (value, threat and feasibility) can lead to identification of asset priorities. Individual assets (for example - a discrete wetland) can be ranked on one axis for their value in achieving set goals, and on the second axis for the degree of threat measured by the extent and timing of the impact. On the third axis, the feasibility – the ability to address the threat, can be ranked.

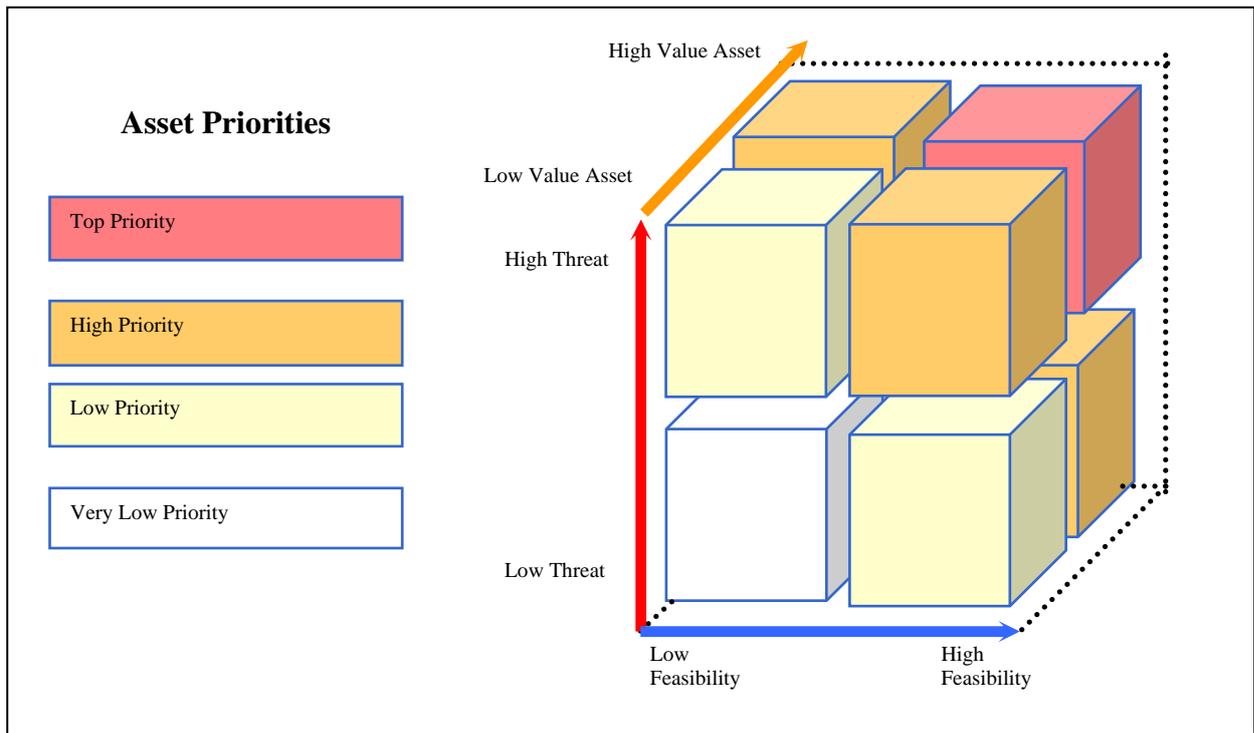


Figure 1 Graphic representation of asset priorities according to their value, threat and feasibility.

Generally those assets with the highest value that are the most threatened, but where the threat can be successfully managed (cost effective, technically feasible and socially acceptable) will be the highest priority for action – in particular public investment. In some circumstances, however, an asset under high threat may not be the highest option once feasibility is considered, and hence a High Value asset with a lower threat may be a better option for public investment in the longer term. Those assets of Low Value, that are facing Low Threat and where the ability to do something about the threat is low, will be the lowest priority for public investment.

2.2 Collecting the information

2.2.1 Measuring Asset Value

Assets are valued because they assist people to achieve goals. For example, rare flora has High Value because they contribute to the goal of conserving biodiversity. In a different example, rural town infrastructure has value for the public and private services it supports. The value of an asset is what makes the asset important. Determining the relative value of an asset needs to acknowledge that there are firm quantitative measures for economic use values, but less so for social and environmental values.

Choosing a method of expressing values depends on the goal for the asset class. If the asset can be valued in economic terms, as for example in the case of road infrastructure and agricultural productivity, then values should be assessed in financial terms. If the asset value can be expressed in other quantity and quality terms, as for example in the conservation of biodiversity, values should be expressed in the most suitable quantity terms (e.g. environment- number of species, area of vegetation type, or combination of both). Developing a consistent description for asset value across the various

classes (social, environment, and economic) is not possible beyond categorisation into 'High', 'Medium' and 'Low' value as shown in Table 1 and demonstrated by the SIF. In this report unique values have been defined for each of the asset classes (refer to sections 3-7).

2.2.2 Measuring Threat

Threat identifies the timing and/or extent of potential impact from, for example, salinity, eutrophication and erosion (or any other threat) and the urgency required for any action to recover, contain or adapt to the threat. The key question is 'How much of the asset's value will be impacted on and when will this impact occur if it has not already?' To illustrate the difference between the spatial and temporal impacts of a threat the salinity example is used. There is evidence that some wheatbelt valley floors will be totally impacted by salinity, but the impact may not occur for over 50 years. Conversely, a relatively small section of the township of Morawa is currently being affected by saline water from hillside seepage, but the extent of impact will not increase over time. The threat to this town might be considered to be low.

The left-hand column of Table 1 below separates assets into three groups depending on their threat (High, Medium or Low). The SIF project has determined that it is important for threat assessments to be somewhat similar across the asset classes to ensure that a suitable comparison can be made between asset classes. Section 9.1 describes the methods for measuring the various threats to assets within each core classes described for this report.

2.2.3 Feasibility

Feasibility information is an important ingredient in determining investment priorities. Assigning an NRM management option to an asset item requires a number of important aspects to be considered.

1. How much will the management option cost?
2. How will this cost change over time if action is not taken now?
3. Is it technically feasible?
4. Will the option achieve the goal?
5. How long will it take for the goal to be achieved?
6. Will the option be implemented or be supported by surrounding land managers?
7. What is the magnitude of the combined threats to the assets (weed invasion, eutrophication, erosion etc)?

The SIF determined that collecting this information for all assets would require an inhibitive amount of resources in terms of money, time and investigations. The proposed method developed by the SIF employs a filter that focuses assessment of feasibility on those assets that have a higher level of importance. This importance is determined from their value and threat information. Relative to threat and value data, information on feasibility is far more challenging to obtain (SIF II, 2006¹).

2.2.4 Value – Threat Matrix

Using the value and threat information, asset items can be arranged into the 'value - threat matrix'. The value – threat matrix helps to identify high importance groups or tiers of assets for further feasibility investigations. Three tiers of assets are defined within the value-threat matrix (Table 1) below. Each tier will require varying levels of investigations.

¹ Sparks, T, George, R, Wallace, K, Pannell, D, Burnside, D & Stelfox, L 2006, *Salinity Investment Framework Phase II*, Western Australia, Department of Water, Salinity and Land Use Impacts Series Report No. SLUI 34, 86p.

Table 1 Value versus Threat Matrix and the three Asset Tiers

Assets		Value		
		High	Medium	Low
Threat	High	1st Tier		
	Medium		2nd Tier	
	Low			3rd Tier

The value – threat matrix defines three tiers of assets that can be applied generally in most, but not all, situations. The tiers are described as follows:

1st Tier: Includes assets or groups of assets of High Value and at High Threat.

2nd Tier: Includes assets or groups of assets of: High Value at Medium Threat; Medium Value at High Threat; and Medium Value and Medium Threat.

3rd Tier: Those remaining assets or groups of assets that include: High Value Low Threat; Medium Value Low Threat; Low Value Low Threat; Low Value Medium Threat, and Low Value High Threat.

In summary, the value-threat matrix as defined by the SIF project helps complete the first step towards identifying investment priorities in NRM. It is most useful where a single identifiable threat category is being considered but can also be used as the basis for considering priorities in the case of multiple assets and multiple threats:

- Provides a simple and transparent approach to identify a group of high importance assets for further assessment on feasibility.
- Reduces the workload by ensuring that detailed studies for feasibility are completed on assets with high public value or of highest priority.
- Allows identification of assets and then priority groups of assets can be considered.
- Can be applied at State, Region and local scales (employing the relevant goals).
- Can incorporate multi-agency information in identifying priority groups of assets.

2.3 Salinity Investment Framework Phase 2

The SIF Phase II (Sparks et al., 2006)² report is based on ‘desk top’ analysis using a range of assumptions about possible treatments, the treatments that could be used in different situations, and about their costs and benefits, using varying methodologies for the agricultural land, rural infrastructure, biodiversity and water resource assets.

The report has two broad dimensions: the methodology for assessing the feasibility of managing a range of assets for particular goals, and the results of its application to assets at the state scale. The

² Sparks, T, George, R, Wallace, K, Pannell, D, Burnside, D & Stelfox, L 2006, Salinity Investment Framework Phase II, Western Australia, Department of Water, Salinity and Land Use Impacts Series Report No. SLUI 34, 86p.

report demonstrates the value of the overall framework approach, and the need for a systematic and outcome-focused procedure for selecting salinity investments. It highlights that the feasibility of achieving salinity management goals varies widely between individual assets in each of the classes, and between the classes themselves

3 Fish Habitats and Species Results

The Department of Fisheries (DoF) has a statewide responsibility for managing and allocating fish resources and the protection of its aquatic environment. Fisheries management responsibilities extend out to 200 nautical mile Exclusive Economic Zone (EEZ). The two broad responsibilities are:

- Protect fish and their habitats; and
- Ensure that commercial and recreational fishing activities are undertaken in an ecologically sustainable manner.

Fish resources were grouped into two subclasses that reflect the different fisheries aspects that support both protection and commercial use of fisheries within the State:

Fish Species

Fish Habitat

Most fisheries assets have numerous values associated with them. It is important to acknowledge and score these multiple values. Values were grouped into three broad categories economic, social and environmental:

- Economic: The commercial fisheries
- Social Values: Recreational fishing
- Environmental Values: Biodiversity, uniqueness

Threats considered included fishing by Australian and foreign fleets, eutrophication, introduced marine pests, pollution from point sources, ecosystem fragmentation, coastal development including the development of petroleum products, land development: intensive agriculture, water development, aquaculture and boating facilities, recreation, and commercial fishing (Table 2).

Table 2 Fish habitats and species

Fisheries Assets		Value		
		High	Medium	Low
Threat	High	Freshwater Fish (All regions)	Cockburn Sound (Swan)	North Coast Shark (Combined JANSF and WANCSF) (R) Ports (small) (R, NA, Swan, SW, SC) Ports (Large) (Swan, NA)
		Estuaries South West (SW; Swan; SC) Inshore Reefs Urban (Swan) Margaret River Marron Stocks (SW)		

	Medium	Abalone (R, Swan, NA, SW, SC) Coastal waters (offshore 3 nm) (NA, R, SC, SW, Swan) Estuaries Remote (SW, SC) Inshore Kimberley Waters (R) Marine Fish Stocks (NA, R, SC, SW, Swan) Marron stocks (SW) Pink Snapper (R) Recreational Marron (NA, SW, SC, Swan) Tailor (R, Swan, NA, SW, SC)	Broome Prawn (R) Demersal Gillnet and Demersal Longline (DGDLF) (SC) Kimberley Prawn (R) Marron Farming (NA, Swan, SW, SC) Minor Scallops Abrolhos Island and Mid West Trawl (NA) Minor Scallops South Cost Trawl (SC) Onslow Prawn (R) Pilbara Demersal Finfish (R) Shark Bay Snapper (R) Spanish Mackerel (R) West Coast Demersal Scale fish (NA, Swan, SW) Yabby Farming (NA, Swan, SW, SC)	Barramundi Farming (R) Lower West Coast beach and embayment Cockburn Sound Finfish (NA, Swan, SW, SC) Minor Scallops South West Trawl (SW) Ornamental Fish Farming (Swan, NA, SW, SC)
	Low	Abrolhos (NA) Corals and low benthic (NA, R) Exmouth Gulf Prawn (R) Greenlip and Brownlip Abalone (SC) Inshore reefs Remote (R) Pearl Oyster (R) Recreational Kimberley and Pilbara Regions (R) Recreational South Coast (SC) Rock Lobster (R, Swan, NA, SW) Roe's Abalone (SC) Shark Bay Prawn (R) Shark Bay Scallop (R) West coast Rock Lobster (SW, Swan, NA, R)	Black Snapper (R) Coastal waters (offshore 12 nm) (NA, R, SC, SW, Swan) Freshwater Angling (All regions) Mussel Farming (SC, Swan) Nickol Bay Prawn (R) Northern Demersal Scalefish (R) Recreational Northern Inland (R) South Coast Rock Lobster (SC) West Coast Blue Swimmer Crab (SW, Swan, NA, R) West Coast Deep-sea Crab (SW, Swan, NA, R) West coast Estuarine (SW, Swan) West Coast Purse Seine (Swan)	Australian Herring (SC) Coastal Aquaculture: pearl and pearl oysters and others (NA, SC) Kimberley Gillnet and Barramundi (R) Lake Argyle Freshwater Catfish (R) Lower West Coast Beach and Embayment West Coast Beach Bait (Fish Net) (NA, Swan, SW, SC) Shark Bay Beach Seine and Mesh Net (R) South Coast Estuarine (SC) South Coast Purse Seine (SC) Trout Farming (SC, SW) Western Australian Salmon (SC)

4 Coastal and Marine Results

Coastal and Marine assets were not included in the 2003 version of this report, and inclusion of these assets was identified as a priority for any update of the report. The Department of Planning and Infrastructure is the key coastal and marine planning department for Western Australia. The DPI provided a list of marine and coastal assets, with their threats and values (Table 3).

There is limited information on coastal and marine assets in WA and therefore, only High Value assets were obtained. Asset identification and classification still needs to be completed by DPI and it is hoped that this information can be included in the future.

Table 3 Marine and Coastal assets

Marine and Coastal Assets		High Value	
Threat	High	Augusta-Margaret River Bunbury Busselton Carnamah-Coorow Dandaragan Derby West Kimberley – Salt Water Country Esperance Kalbarri	Perth North Central Perth NW sector Perth South Central Roebuck Bay Rowley Shoals Shark Bay Waterbank Wyndham East Kimberley – Salt Water Country
	Medium	Albany Baron, Lowen and Montebello Islands Burrup Peninsula Cable Beach Dampier Peninsula – Salt Water Country Dongara-Port Denison Dundas East Pilbara and Roebourne Eighty Mile Beach Exmouth Gulf	Geraldton-Greenough Harvey Mandurah Manjimup Nannup Ningaloo Coast Northampton Shire Perth SW Sector Port Headland Waroona
	Low	Ashburton Broome Capel Carnarvon Dampier Archipelago Denmark Gingin Jerramunup Ravensthorpe	

5 Threats to Agricultural land Results

The Department of Agriculture and Food has statewide responsibility for supporting agricultural production.

This section only deals with the processes that directly threaten the agricultural land asset and influence the ability of the land to sustain agricultural land uses into the future. The Department of Agriculture and Food's process is based on a combination of expert knowledge and the inherent physical qualities of the land resource to determine threat. Value is based on the average value of agricultural land (\$/ha) determined from year 2000 Bank West data.

The spatial framework for the assessments of value and threat is the soil-landscape zone as defined by the Natural Resources Assessment Group of the Department of Agriculture and Food. These zones delineate broad terrain types based on geomorphological criteria and are useful for gaining a regional perspective of landscape related issues. There are 31 zones described for southwestern Australia (see Figure 19 in Appendix). Grouping of more detailed underpinning soil-landscape mapping creates the boundaries of the zones.

Five key NRM issues relevant to agriculture and related to soil and land were identified by a Department of Agriculture and Food expert panel;

- Wind erosion (Table 5)
- Water erosion (Table 6)
- Land salinisation (Table 7)
- Soil structure decline/compaction (Table 8)
- Soil acidification (Table 9)

Biodiversity, plant or animal specific issues were not considered, and NRM issues of minor extent in WA (for example mass movement) are not included.

Table 4 Threat to agricultural land resource asset based on an average of all threats (wind erosion, water erosion, land salinisation, soil structure decline/compaction and soil acidification)

Ag land (all threats)		Value		
		High	Medium	Low
Threat	High	Northern Zone of Rejuvenated Drainage	Dandaragan Plateau Zone Northern Zone of Ancient Drainage Pallinup Zone	Jerramungup Zone South-eastern Zone of Ancient Drainage

	Medium	Bassendean Zone Eastern Darling Range Zone Perth Coastal Zone Pinjarra Zone Scott Coastal Zone Warren-Denmark Southland Zone Western Darling Range Zone		Lockier Zone Ravensthorpe Zone South-western Zone of Ancient Drainage Victoria Plateau Zone
	Low	Donnybrook Sunkland Zone Leeuwin Zone	Arrowsmith Zone	Geraldton Coastal Zone Irwin River Zone Salmon Gums-Mallee Zone Southern Cross Zone

Table 5 Threat to agricultural land resource asset based on wind erosion threat

Ag land (wind erosion)		Value		
		High	Medium	Low
Threat	High	Bassendean Zone Perth Coastal Zone Scott Coastal Zone	Pallinup Zone Arrowsmith Zone Dandaragan Plateau Zone Kalbarri Sandplain Zone Albany Sandplain Zone Northern Zone of Ancient Drainage Port Gregory Coastal Zone Esperance Sandplain Zone	Geraldton Coastal Zone Jerramungup Zone Ravensthorpe Zone South-eastern Zone of Ancient Drainage
	Medium	Warren-Denmark Southland Zone Eastern Darling Range Zone Northern Zone of Rejuvenated Drainage Western Darling Range Zone	Chapman Zone Stirling Range Zone Southern Zone of Rejuvenated Drainage	South-western Zone of Ancient Drainage Victoria Plateau Zone Irwin River Zone Lockier Zone Salmon Gums-Mallee Zone Southern Cross Zone
	Low	Pinjarra Zone Leeuwin Zone Donnybrook Sunkland Zone		

Table 6 Threat to agricultural land resource asset based on water erosion threat

Ag land (water erosion)		Value		
		High	Medium	Low
Threat	High	Warren-Denmark Southland Zone Eastern Darling Range Zone Western Darling Range Zone Northern Zone of Rejuvenated Drainage Southern Zone of Rejuvenated Drainage	Chapman Zone Port Gregory Coastal Zone	Lockier Zone Ravensthorpe Zone Victoria Plateau Zone
	Medium	Perth Coastal Zone Leeuwin Zone Donnybrook Sunland Zone	Kalbarri Sandplain Zone Stirling Range Zone Dandaragan Plateau Zone Pallinup Zone	
	Low	Scott Coastal Zone Pinjarra Zone Bassendean Zone Geraldton Coastal Zone	Arrowsmith Zone Albany Sandplain Zone Northern Zone of Ancient Drainage Esperance Sandplain Zone	Jerramungup Zone Irwin River Zone Salmon Gums-Mallee Zone South-eastern Zone of Ancient Drainage South-western Zone of Ancient Drainage Southern Cross Zone

Table 7 Threat to agricultural land resource asset based on land salinisation threat

Ag land (land salinisation)		Value		
		High	Medium	Low
Threat	High	Eastern Darling Range Zone Northern Zone of Rejuvenated Drainage Pinjarra Zone Warren-Denmark Southland Zone Western Darling Range Zone	Chapman Zone Dandaragan Plateau Zone Northern Zone of Ancient Drainage Pallinup Zone Southern Zone of Rejuvenated Drainage Stirling Range Zone Esperance Sandplain Zone	Jerramungup Zone South-eastern Zone of Ancient Drainage South-western Zone of Ancient Drainage

	Medium	Bassendean Zone Perth Coastal Zone	Albany Sandplain Zone	Lockier Zone Ravensthorpe Zone Victoria Plateau Zone
	Low	Donnybrook Sunkland Zone Leeuwin Zone Scott Coastal Zone	Arrowsmith Zone Kalbarri Sandplain Zone Port Gregory Coastal Zone	Geraldton Coastal Zone Irwin River Zone Salmon Gums-Mallee Zone Southern Cross Zone

Table 8 Threat to agricultural land resources asset based on threat of soil structure decline and/or compaction

Ag land (soil structure decline/ compaction)		Value		
		High	Medium	Low
Threat	High	Pinjarra Zone	Pallinup Zone	
	Medium	Eastern Darling Range Zone Northern Zone of Rejuvenated Drainage Southern Zone of Rejuvenated Drainage Warren-Denmark Southland Zone	Albany Sandplain Zone Chapman Zone Dandaragan Plateau Zone Kalbarri Sandplain Zone	Jerramungup Zone Lockier Zone Northern Zone of Ancient Drainage Ravensthorpe Zone Salmon Gums-Mallee Zone South-western Zone of Ancient Drainage Victoria Plateau Zone
	Low	Bassendean Zone Donnybrook Sunkland Zone Leeuwin Zone Perth Coastal Zone Scott Coastal Zone Western Darling Range Zone	Arrowsmith Zone Port Gregory Coastal Zone Stirling Zone Esperance Sandplain Zone	Geraldton Coastal Zone Irwin River Zone South-eastern Zone of Ancient Drainage Southern Cross Zone

Table 9 Threat to agricultural land resources asset based on soil acidification threat

Agricultural land (soil acidification)		Value		
		High	Medium	Low
Threat	High	Bassendean Zone Northern Zone of Rejuvenated Drainage Scott Coastal Zone	Albany Sandplain Zone Dandaragan Plateau Zone Kalbarri Sandplain Zone Northern Zone of Ancient Drainage Southern Zone of Rejuvenated Drainage	Esperance Sandplain Zone Jerramungup Zone Lockier Zone South-eastern Zone of Ancient Drainage South-western Zone of Ancient Drainage Victoria Plateau Zone
	Medium	Eastern Darling Range Zone Perth Coastal Zone Warren-Denmark Southland Zone	Chapman Zone Pallinup Zone Port Gregory Coastal Zone Stirling Zone	Ravensthorpe Zone Southern Cross Zone
	Low	Donnybrook Sunkland Zone Leeuwin Zone Pinjarra Zone Western Darling Range Zone		Irwin River Zone Salmon Gums-Mallee Zone

6 Water Resources Results

The DoW has a statewide responsibility for advising on water resource management issues. Water resource issues may relate to wetlands, waterways and water supply protection and management including the restoration of degraded environments. The broad nature of these responsibilities required that two broad goals be developed for the water resource asset class:

- Protect, manage and restore present and future water supplies from the impacts of land use activities.
- Protect, conserve and restore significant Waterscapes (wetland and waterway ecosystems) from the impacts of land and water use activities.

Water resources were grouped into two subclasses that reflect the difference between the two goals describe above. The two sub-classes are:

1. Water supply – surface and groundwater supply assets
2. Waterscapes (wetland, waterway).

Most water resource assets have numerous values associated with them. It was important to acknowledge and score these multiple values. These multiple values were grouped into three broad categories:

- Economic - Industry, drinking water, aquaculture.
- Social - Recreation: fishing, swimming, bird watching, boating and other pursuits; Spirituality and culture:
- Environmental - biodiversity, uniqueness, aesthetics, ecological functions (flood mitigation, natural land drainage).

Threats considered included; erosion, sedimentation, eutrophication, salinity, feral animals, weed infestations, pollution from point sources, ecosystem fragmentation, land development: residential and rural residential, land development: intensive agriculture, land development - broad acre farming, land development – pastoral, water development - aquaculture and boating facilities, recreation, commercial fishing, industrial discharge, water abstraction agricultural drainage (e.g. coastal plain and saline land drainage).

Section 6 - Water Resources Results

Table 10 Water supply assets in Western Australia and their importance (State scales) as defined by the value-threat matrix.

State Water Supply Assets	Value			
	High		Medium	Low
Threat High Existing and/or near and substantial <2020	Arrowsmith WR (Perenjori)	Dookanooka WR	Margaret River/ Ten Mile Brook CA (PDWSA)	Aboriginal communities water supplies (Health Act)
	Albany RIWIA	Eneabba WR	Meekatharra WR	Private drinking water sources (Health Act)
	Allanooka – Dongara – Denison WR	Esperance RIWIA	Menzies WR	Bolgart WR (PDWSA)
	Angove Creek CA	Esperance WR	Millstream CA (PDWSA)	Finucane Island WR (PDWSA)
	Badgarning (6km W of Wagin) PDWSA)	Exmouth WR	Millstream WR	Gascoyne GW Area (Casuarinas)
	Balingup (see Padbury and Greenbushes) CA (PDWSA)	Fitzroy Crossing WR (PDWSA)	Mirrabooka (RIWIA)	Gooralong Brook WR
	Bancell Brook CA (PDWSA)	Fitzroy River (RIWIA)	Mirrabooka UWPCA (PDWSA)	Greenough River Pools
	Bickley Brook CA (PDWSA)	Fitzroy Alluvials	Moora Eastern WR	Guilderton WR
	Bindoon/Chittering WR PDWSA	Gascoyne River WR (PDWSA)	Mount Magnet WR	Gwelup UWPCA (PDWSA)
	Blackwood (RIWIA)	Gibson WR	Mount Peron WR	Halls Creek WR (PDWSA)
	Boyup Brook CA	Gingin GWA RIWIA	Mullalyup WR & Mullalyup Dam CA (20km SE of Donnybrook) (PDWSA)	Hutt Lagoon System
	Bremer Bay WR	Gingin WR	Mundaring Weir CA (PDWSA)	Jane Brook (PDWSA)
	Bridgetown CA (Hester Dam) PDWSA)	Gnangara (RIWIA)	Mungilup CA	Jurien WR
	Brookton - Happy Valley WR (PDWSA)	Gascoyne GW Area (Northampton Block)	Nabawa WR	Karakin Lakes
	Brookton Dam CA (PDWSA)	Grass Patch	New Norcia WR	Kent River
	Broome (RIWIA)	Greenbushes Dams (see Padbury Reservoir) CA	Newman WR (PDWSA) includes Ophthalmia Dam	Lancelin WR
	Broome WR (PDWSA)	Harding Dam CA (PDWSA)	North Dandalup Pipehead Dam CA	Ledge Point WR
	Bunbury (RIWIA)	Hopetoun WR	Northcliffe WR	Leinster (Goldfields) WR (PDWSA)
	Bunbury WR (PDWSA)	Jandakot (RIWIA)	Ord River (RIWIA) PDWSA)	Leonora WR (PDWSA)
	Busselton-Capel (RIWIA)	Jandakot UWPCA (PDWSA)	Pemberton - Lefroy Brook, (Big Brook Dam) CA(PDWSA)	Lower Helena Pipehead Dam CA (PDWSA)
	Calingiri WR	Jurien - Turquoise Coast WR	Perth (including Gwelup) (RIWIA)Port Gregory WR	Marble Bar WR (PDWSA)
	Camballin WR (PDWSA)	Jurien GW Area (RIWIA)	Preston Beach WR (PDWSA)	Miling WR
	Cane River (Onslow PDWSA)	Kalbarri WR	Quinninup Dam CA PDWSA)	Mingenew WR
	Carnarvon (RIWIA)	Kirup CA	Ravensthorpe CA Draft PDWSA	Northampton WR
	Carnarvon WR	Kojonup dam (PDWSA)	Rottnest (RIWIA)	Nullagine WR (PDWSA)
	Churchman Brook CA (PDWSA)	Kununurra WR (PDWSA)	Salmon Gums CA	Perenjori WR
	Collie (RIWIA Donnybrook WR (PDWSA) Dunsborough/ Yallingup WR PDWSA)	Lake King CA (70km NW of Ravensthorpe) (PDWSA) Lake Argyle (Irrigation schemes)	Sandstone WR	Perth Coastal UWPCA (PDWSA)
	Conjurunup Creek Pipehead Dam CA	Laverton WR (PDWSA)	Seaview Park WR	Three Springs WR
	Cue WR	Leeman WR (Midway bore)	South Dandalup Pipehead Dam CA (PDWSA)	Warmun (Turkey Creek) WR (PDWSA)
	Dathagnoorara WR	Leeuwin Spring Dam PDWSA)	Sovereign Hill WR	Watheroo WR
	De Grey River WR (Port Headland PDWSA)	Lefroy Brook CA (see Pemberton) (PDWSA)	Gnangara UWPCA (PDWSA)	Yerina Spring WR
	Denmark River CA	Manjimup Dam CA – Phillips Creek & Scabby Gully PDWSA)		Yuna WR
Derby (RIWIA)	Marbelup WR			

	<p>SW Coastal (RIWIA) Warren River WR (PDWSA) Swan (RIWIA) Tanjanerup Creek CA (PDWSA) Victoria CA (PDWSA) Walpole Weir CA-Butlers Creek CA Wanneroo (RIWIA) Wanneroo UWPCA (PDWSA)</p>	<p>Wellington Dam CA (PDWSA) West Canning Artesian Basin Wicherina CA Wiluna WR Woodridge WR Wungong Brook CA (PDWSA) Yalgoo WR</p>	<p>Yanchep (RIWIA) Cockburn (RIWIA) Rockingham (RIWIA) Jandakot UWPCA (PDWSA) Yerecoin WR Yule River WR</p>			
Medium	<p>Arrowsmith GW Area RIWIA Boddington Dam CA (PDWSA) Buntine/ Marchagee Braided Saline Drainage Line Brunswick CA Canning River CA Capel River (RIWIA) Condingup WR Dumbleyung CA Dwellingup CA (PDWSA) Gnowangerup CA Goldfields (RIWIA)</p>	<p>Harris River Dam CA (PDWSA) Harvey Dam CA (PDWSA) Lower Bickley Re CA (PDWSA) Moochalabra Dam CA (PDWSA)Murray (RIWIA) Pannawonica WR (PDWSA) Paraburdoo WR (PDWSA) Pilbara (RIWIA) Pipehead Dam CA (PDWSA) Preston Valley Irrigation RIWIA) Rocky Gully on Frankland PDWSA) Stirling Dam CA (PDWSA)</p>	<p>Samson Bk CA (Dam and pipehead) PDWSA) Serpentine Dam CA (PDWSA) South Dandalup Dam CA SW Yarragadee WR PDWSA) Tambellup Dams on Frankland River Tom Price WR (PDWSA) Turner River WR (PDWSA) Warren R DS55 (Future Dam site PDWSA) Wokalup (Wellesley River) CA</p>	<p>Arrino Bores WR Badgingarra WR Cervantes WR Bremer Bay RIWIA Canning-Kimberley (RIWIA) Coomberdale WR Dandaragan WR East Murchinson (RIWIA) Gascoyne (RIWIA) Gascoyne GW Area (Yilgarn Block) Green Head WR Guragara Lakes Hopetoun RIWIA Horrocks Beach WR</p>	<p>Jerramungup Dams Limeburners Creek CA Moora WR Munglinup Port Gregory WR Private sources for industry & commerce (RIWIA) Private stock & irrig'n sources (RIWIA) Serpentine (RIWIA) South Coast WR Utcha Swamp</p>	
Low	<p>Denham D7-2 WR Denham D7-7 WR Quickup River Dam Seabird WR Scotsdale Brook WR</p>			<p>Bolganup New Norcia GW Area Red Swamp Brook (Future Dam site PDWSA)</p>	<p>Bolgart East (RIWIA) Condingup (RIWIA) Dwellingup (RIWIA) Deep River WR Gibson RIWIA Happy Valley (RIWIA) Kondinin- Ravensthorpe (RIWIA) Westonia (RIWIA) Yenart (RIWIA) Yerecoin GW Area</p>	

Table 11 Waterscape assets in Western Australia and their importance (State scales) as defined by the value-threat matrix.

State Waterscape Assets	Value					
	High			Medium		Low
Threat High	Adelaide Brook Swamp	Eighty Mile Beach	Lefroy Brook	Abba River	Kojaneerup Rd W	Bandy Creek
	Authur River Wetland System	(RAMSAR) Ellen Brook	Lennard Brook	Avon River Lower	Kojaneerup W	Bannister Creek
	Ashburton River	Ellen Brook swamps	Leeuwin Ridge Streams	Avon River Middle	Lake Chidnup W	Bickley Bk (lower)
	Avon River (Dale to Mortlock Rivers)	system Ewans Lake W	Loch McNess System (DoIW)	Barlee Brook	Lake Matilda W	Bolghinup Lake Swamp
	Avon River Valley (DoIW)	Fitzgerald Inlet W	Lower Blackwood tributaries (DoIW)	Beaufort Inlet E	Lake Seppings W	Buchanan River
	Bandy Creek Estuary	Fitzroy River System	Lower Harding River upstream/downstream of Dam	Benje Benjenup Lake W	Lake Torrup W	Carralup River
	Barraghup Swamp (DoIW)	Forestdale Lake (DoIW, RAMSAR)	Lower Moore River & Estuary	Big Swamp	Landing Ground W	Coobidge Creek
	Blackadder-Woodbridge Ck	Fortescue River System including Fortescue Marsh	Lower Murchison River & Estuary	Biljedup Brook	Lockhart Catch/River	Coomalbidgup Creek
	Booragoon Swamp (DoIW)	Gingilup Swamp	Ludlow Wetlands	Bingham River Wetland System	Ludlow River	Corakerup Creek
	Broadwater Wetland	Gingilup-Jasper Wetland System	Margaret River and Estuary	Bloxidge W	Madjenapurdap W	Coramup Creek
	Brockman River	Gingin Brook	Margaret River Swamps	Boggy Springs Wetlands	Marbellup Brook	Coyrecup Wetland System
	Brunswick River	Hammersley Range Wetland	Millstream Wetland System	Boodijup River	Marralong W	Cuppup Creek
	Byenup Lagoon System (DOIW, RAMSAR)	Hardy Inlet Estuary	Milyannup Brook	Boyatup Swamp Wetlands	Martagallup Swamp W	Dalyup River
	Cane River	Herdsman Lake (DoIW)	Milyeannup Brook	Buayanup River	Mary River	Dalyup River West
	Canning River	Hill River Estuary	Floodplain	Bunker Bay Lake	Meelup Brook	Dongolocking Floodplain
	Carey Brook	Hilliup Lake W	Muir/ Unicup System.	Calgardup River	Miamup Brook	Five Mile Creek
	Chittering/Needonga Lakes (DoIW)	Hutt River	Mullet Lake W	Capel Wetlands	Mill Brook	Gordon River
	Churchman Brook upper	Irwin River Estuary	Munni Munni Creek to Yule River	Carbanup River	Milyunup Lake W	Helena R (lower)
	Cobomup Creek W	Joondalup Lake (DoIW)	North Sister Lake W	Chapman River	Mindinyup Rd W	Irwin River
	Collie River	Kalgan River	Ord Estuary/Parry Floodplain	Chapman River Estuary	Minvalara N W	Jackitup Creek
	Cowaramup River	Kilcarnup Rd Swamps	Ord River	Chillimup Rd W	Minvalara SS W	Jane Bk (lower)
	Crumpet creek	Lake Clifton	upstream/Downstream of Dam	Chittering Lakes (ANCA)	Minvalara SW W	Johnston Creek
	Dale River	Lake Corimup W	Oyster Harbour E	Churchman Brook (lower)	Moore Catchment/ River	Lake Moore
	Dampier Peninsula	Lake Davis Wetlands	Peel Harvey Estuaries	Collets Rd W	Murrundie W	Lake Pinjarrega
	De Grey River (including Oakover, Nullagine, Shaw, Coongan, Carawine Gorge and Running waters)	Lake Kunnunura (RAMSAR)	Perth Airport Woodland Swamp (DoIW)	Collie River East	Naturaliste Lake Wetlands	Lake Saide Drain
	Devil's Pool	Lake Logue/ Indoon System	Pfeiffer Lake W	Coomalbidgup Swamp W	No. 1 Swamp W	Little River (2)
		Lake McLarty (DoIW)	Princess Royal Harbour E	Doggerup River	Ongerup Lagoon W	Melijinup Creek
		Lake Pleasant View W		Drawbin Rd W	Pallinup River	Mongers Lakes
		Lake Preston		Dunn Bay Creek	Pfeiffer Rd W	Munster Hill Drain
		Lake Toolibin		Ellen River	Quinnup Rd Lake Wetlands	Myalup Drain
		Lake Warden W		Galli Swamps W	Quininup Brook	Neridup Creek
		Leschenault Estuary		Gledhow W	Round Swamp w	Robinson Drain
				Gordon River W	Sabina River	Salt Creek
				Greenough River Pools Avon River (Beverley upstream)	Scotsdale Brook	Seven Mile Creek
			Gunyulgup Brook Estuary	Stirling Swamp	Six Mile Creek	
			Hassell Rd W	Susannah Bk upper	Sleeman River	
			Jingarmup Creek	Swamp 67 W	Southern River	
			King River	Toby Inlet Estuary	Taylor Inlet Tribs	

	<p>Pt Pedder Swamps Red Gully Floodplains Reedia Complexes Roebuck Bay (RAMSAR) Roebuck Plains system Rosa Brook Rudall River (Wild River) Savory Creek (Wild River) Scott Coastal Plain Wetlands Scott River Serpentine River</p>	<p>Sherlock River including tributary - Tamberry Creek (Wild River) South Sister Lake W Spearwood Creek Swamp St John's Brook Station Lake W Susannah Bk lower Swan River Swan-Canning Estuary (DoIW) Tanberry Creek Tarnup Lake W Vasse Wonnerup Estuaries/Wetlands Walpole Inlet E Wannamal Lake System (DoIW)</p>	<p>Weelli Wolli Spring Wellstead Estuary Wheatfield Lake W White Lake W Wilga Rd Swamp Wilson Inlet E Wilyabrup River and Estuary Windabout Lake W Woody Lake W Worrangerup/Nuniup and Warnerup Swamps W Yalgorup Lakes (DoIW) Yealering Lakes System (ANCA) Yendinnup Swamp W Yelliup Lake W</p>	<p>Torbay Inlet E Turner River Tutunup Rd Swamps Vasse River Veryuica Brook Warburton Rd W Warriup Rd W Wellesley River</p>	<p>Wooroloo Brook Wyadup Brook Yallingup Brook Yenyening Lakes System Yilgarn Catch/River Yule River</p>	<p>Torbay Main Drain Upper Blackwood (Above Boyup Brook) Warperup Creek Warren Beachside Wetlands Wilyung Creek Wungong River Yakamia Creek Yarra Yarra Lakes Yerritup Creek</p>	
Medium	<p>Anderson Lake W Angove Creek W Aralinga W Balicup Lake W Bannitup Lake W Beaufort River Wetlands Becher point Wetlands (DoIW) Bellanger Barrier W Benger Swamp (DoIW) Bevan Rd Flats W Big Poorarecup lagoon W Blue Lagoon and wetlands Blue Lake W Boat Harbour Lakes W Break Rd Flats W Breberle Lake (DoIW) Brixton Street Swamps (DoIW) Bunda Bunda Mound Springs Camballin Floodplain – Le Livre Swamp System</p>	<p>Camel Lake W Cape Leewin System (DoIW) Cape Range Subterranean Waterways (DoIW) Chamberlain River Chandala Swamp (DoIW) Chemanup Lake W Cheyne Rd Creek W Cleerilup Rd Flats W Corecup Lake (DoIW) Culham Inlet E Culham Inlet W Donnelly River and Estuary Doombup Lake W Dragon Tree Soak Durack River Exmouth Gulf East (DoIW) Fitzgerald River Flats W Forrest River Gardner Lake W Geikie Gorge</p>	<p>Geriberiwelup Swamp W Gibbs Road Swamp System Gibson Desert Gnamma holes Gills Rd group W Gingin Catchment Lakes Goode Beach Wetland Granite Rd Flats W Greenough River Estuary Gull Rock Lake W Guraga Lake (DoIW) Helena River (upper) Hiker Rd Flats W Hunter River Lake W Hutt Lagoon System. Jebarjup Swan Lake W Jerdacuttup Lakes W Karakin Lakes Karijini (Hamersley Range) Gorges (DoIW) Kelly's Creek Lake W King Edward River (Wild River) King River Kojedda Swamp (EPP SW ag Wetlands)</p>	<p>Arrowsmith River Augustus River Aurthur River Floodplain Balgapur River Balingup Brook Bellanger Beach W Bennett Brook Bitter Water Swamp W Bolganup Creek Lake W Bonhall Creek W Bow River Bowes Estuary Bremer River Capel River and Estuary Cardiminup Swamp W Caren Caren Brook Carson River Cascade East Swamp W Cascade West Swamp W Chelgup Creek Cheyne Downs W Cheyne W</p>	<p>Cleerillup Creek W Collier Creek W Condingup Lake W Copper Mine Creek W Cordinup W Denmark River Dinninup Brook Dombakup Brook Dunns Swamp W East Mortlock River Ewarts Swamp W Ferguson River Five Mile Brook Foster Beach W Frankland River Gairdner River Gairdner Road Wetland Gnowergerup Brook Gordon Inlet E Greenough River Gum Link Rd W Hay River W</p>	<p>Harvey River Hamden System Harris River Wetlands Hay River Hazeldene Swamp W Henley Brook Howick Lake W Hutt Estuary Irwin Inlet E Johnston Creek W Kalmerndyip Lake W Kemerton Wetlands Kent River King River Flats W Kojaneerup Swamp W Kojonup Brook Kordabup River Kuliallin W Lake Barnes W Lake Bryde Catchment Lake Saide W Lake Shaster W Lake Surprise W Lake William W</p>	<p>Alexander River Barker Inlet E Blackboy Creek Bowes River Buller River Cascade Creek Cheyne Inlet E Cordinup River Dailey River Dailey Estuary Devil Creek Eneabba Creek Eyre River Jerdacuttup River Kateup Creek Kuliba Creek King Creek Kitchanning Brook Floodplain Mid Blackwood (Boyup Brook to Nannup) Moolyall Creek Muglignup Creek E Munglignup Creek Munglignup River</p>

Kookhabinna Gorge (DoIW)	Pools of the Durba hills (DoIW)	Romance Rd Flats and Sumplands	Lennard River	Oldfield Estuary and W	Scotsdale W	Needilup River
Kwornicup Lake W	Pooryonggup W	Rottnest Island Lakes (DoIW)	Leschenault Inlet Lights	Oldfield River	Seven Mile Creek W	Normans Creek
Lake Annean (Lake Nannine) (DoIW)	McCarleys Swamp (Ludlow Swamp) (DoIW)	Rowles lagoon System (DoIW)	Beach Wetlands incl Lake	Road W	St Leonards ck	North Mortlock River
Lake Argyle	Mettler W	Salmond River (Wild River) (DoIW)	Eyrie W	Sunday Swamp W	Stirling and Stirling	Oakagee River
Lake Ballard (DoIW)	Middle Rd Flats W	Shark Bay East (DoIW)	Lake Marendiup	Susetta River	Taylor Inlet E	Peenebup Creek Phillips River
Lake Barlee (DoIW)	Miller's Basin Rd Flats W	Sheepwash Creek W	Lake Williams	Swamp 68	Tone River	Princess Royal Drain
Lake Carbul W	Minvalara W	Spectacales Swamp (DoIW)	Lort River Manarup	Swan Lagoon W	Toocalup Lake W	Steere River
Lake Carnegie System (DoIW)	Mirambeen Lake W	Stevens Lake W	Lagoon W	Palusmont W	Torregullup Swamp W	Sunny Glenn Creek
Lake Dissappointment	Mitchell Creek W	Stockyard Rd Wetlands	Marbellup Flats W	Parry's Inlet E	Towadup Estuary	Thomas River
Lake Dora (DoIW)	Mitchell River	Stokes Inlet Estuary and Wetland	Mardetta Group W	Peringillup Reserve W	Towerrining Lake	Torradup River
Lake DumbleyungLake	Moates Lake W	Suez Rd Flats W	May River	Perup River	Trib to Bow River W	West River
Gidong W	Mc Neill Claypan System (DoIW)	Swan Lake W	Meda River	Perup Swamps	Tweed River	Willyun Creek
Lake Gore W	Mt Soho Flats W	Thomsons Lake (DoIW, RAMSAR)	Meerup River Wetlands	Picup Swamp W	Two Mile Lake W	Woodenup Creek Young River (2)
Lake Grace System (ANCA)	Namming Lakes	Thundelarr lignum Swamp (DoIW)	Menamup Inlet W	Preston River	Venns Rd W	Yule Bk
Lake Gregory System	Nornalup Rd Flats W	Tootanellup Lagoon W	Mill Brook W	Pullitup Swamp W	Walpole/Nornalup NP W	
Lake Gruszka (DoIW)	Owingup Swamp W	Torradup River W	Minyulo Brook	Qualinup Swamp W	Wandoo	
Lake Kubitch W	Pabelup Lake 1, 2, and 3 W	Tucker's Rd W	Mojingup Lake W	Quarderwardup Lake W	Wannamal Lake System	
Lake MacLeod (DoIW)	Pardelup Lagoon W	Tunnel Creek	Morgan RiverMurchison River	Quickup River to Hay River W	Warneford Wetland	
Lake Marmion (DoIW)	Peaceful Bay W	Turpin Rd Flats W	Murray River	Reef Beach W	Warramurrup Swamp and Surrounds W	
Lake Monjingup	Pentecost River (Wild	Wagga Wagga Salt Lake (DoIW)	Napier Creek	Richmond Rd W	Warriup W	
Lake Mortijinup W	Qualliup Lake W	Wamballup Swamp W	Native Dog Swamp W	Roberts swamp W	Warrup Group W	
Lake Nambarup W	Quaranup Rd W	Wangerup Creek Sump W	NE Walpole W		Waychinicup River	
Lake Powell W	Quindinillup Flats and Swamplands	Warren Estuary	Normans Inlet E		Wilga Wetlands	
Lake Thetis	Randell Rd W	Watershed Rd Flats and Sumplands	North Gordon Inlet W		William Bay Road Lake W	
Lake Williamup W	Ratcliffe Barrier W	Watershed Rd Flats W			Wilson Inlet W	
Ledge Point Wetland	Robe River including Upper Robe River (Wild River)	Windich Springs (DoIW)			Young River (1)	
Leslie – Port Headland salt fields (DoIW)	Rock Pools of the Breaden Hills	Windjana Gorge				
Mainbenup Swamp W	Rock Pools of the Water James Ranges (DoIW)	Wooleen Lake (DoIW)				
Maitland (Munni Munni)	Roe Rd/Suez Rd Flats W	Yadijyugga Claypan (DoIW)				
Mandora Salt Marsh (DoIW)		Yeagarup Wetlands				
River)		Yeo Lake/Lake Throssell (DoIW)				
Perillup Rd Reserve W		Willie Creek Wetlands				
Pillenorup Swamp W						
Pink Lake W						

Low	Angove River	Glenelg River (Wild River)	Nile Creek	Barker Inlet W	Alexander Estuary
	Berkeley River (wild River)	Hammersley River	Paluslopes on Granite W	Bevan Rd/Roe Rd Sumplands W	Blackboy Creek Estuary
	Bickley Bk (upper)	Hammersley Inlet E	Placid, Dominic and Noseda Creeks	Bitter Water Creek	Boothendarra Creek
	Blackwater Creek	Helby River	Poison Creek	Bluff River	Cobline Wetland System
	Boolenup Lake W	Herbert Walsh	Poison Creek Estuary	Cantebury River	Cordinup E
	Boondadup River	Hunter River	Pontoon Creek	Coyanarup Bogs W	Eneminga Swamp
	Broke Inlet E	Hunter River (Wild River)	Prince Regent River (Wild River)	Floodplains on granite W	Frederick Smith Creek
	Bulla Nulla etc Creeks	Inlet River	Quickup River Roe River	Gardner E	Leeman Lakes
	Calder River (Wild River)	Isdell River	Saint Mary Inlet E	Gardner River Cambridge Gulf	Mullering Brook
	Cape Whiskey etc Creeks	Jane Bk (upper)	Saint Mary River	Goodga River	Nambeing Swamp
	Charnley River (wild River)	Jenamullup	Sale River (wild river)	Little River (1)	Nambung River
	Chesapeake Brook	Jinunga River	Scott River	Southern Stirling Ranges W	Thomas River Estuary
	Copper Mine Creek	Jorndee Creek	Shannon River	Walpole River	Wagin Lakes
	Deep River	Jorndee Creek Estuary	Stewart River	Wongerup Creek	Yarra Monger Tributary
	Dempster Inlet E	Kellys Creek	Sturt Creek		
	Dempster River	King George (wild River)	Styx River		
	Doggerup Creek	Lake Cronin	Thompson River		
	Doubtful River	(DoIW)Lawley River	Thurburn Etc Creeks		
	Drysdale River	Limeburners Creek	Twertup Creek		
	Ellis Bk	Londonderry Creek	Upper Yule River		
	Fern Creek	Lyne River	Wade, Rocky Cove etc Creeks		
	Fitzgerald Inlet E	Maringup Lake (DoIW)	Walmar and Canal Creeks		
	Forth River	Meerup River	Waychinicup Inlet E		
	Gardner Lake Dunes W	Mitchell River	Weanerjungup		
	Gibson Creek	Moran River	Weld River		
		Mt Bland lake W	Yorkrakine Rock Pools (ANCA)		
	Mt Grey Etc Creeks				
	Mt Page creek				
	Mullocullop Creek				
	Munday Bk				

6.1 Mapping Water Resources

More than 700 water resource assets have been assessed for their values and threats. However, this is not yet the full list of water assets in the state and further work is required to map and assess many assets across the state.

The value-threat matrices catalogue the assessment of the assets but do not provide an overall indication of the areas of the state where these assets occur. To gain a visual representation of the location of multiple significant assets across state, assets from the three Tiers of importance (Tier 1, Tier 2 and Tier 3) were allocated to surface water drainage basins (Table 12 and Figure 2). A basic statistical assessment was then undertaken to determine the frequency of asset occurrences. The results were then depicted on a series of maps (Figures 3-9). This mapping provides a basic spatial analysis of the locations of Waterscapes and Water supply data. The results also combined Waterscapes and Water supply data to show the locations all water resource assets (Figures 10, 11, 12).

Table 12 Drainage basin names and numbers.

Drainage Basin	Basin Name	Drainage Basin	Basin Name	Drainage Basin	Basin Name
601	Esperance Coast	616	Swan Coastal	801	Cape Leveque Coast
602	Albany Coast	617	Moore-Hill Rivers	802	Fitzroy River
603	Denmark Coast	618	Yarra Yarra	803	Lennard River
604	Kent River	619	Ninghan	804	Isdell River
605	FranklandRiver	701	Greenough River	805	Prince Regent River
606	Shannon River	702	Murchinson River	806	King Edward River
607	Warren River	703	Wooramel River	807	Drysdale River
608	Donnelly River	704	Gascoyne River	808	Pentecost River
609	Blackwood River	705	Lyndon-Minilya Rivers	809	Ord River
610	Busselton Coast	706	Ashburton River	810	Keep River
611	Preston River	707	Onslow Coast	1202	Nullarbor Basin
612	Collie River	708	Fortescue River	1203	Warburton Basin
613	Harvey River	709	Port Headland Coast	1204	Salt Lake Basin
614	Murray River	710	De Grey River	1205	Sandy Desert Basin
615	Avon River			1206	Mackay Basin

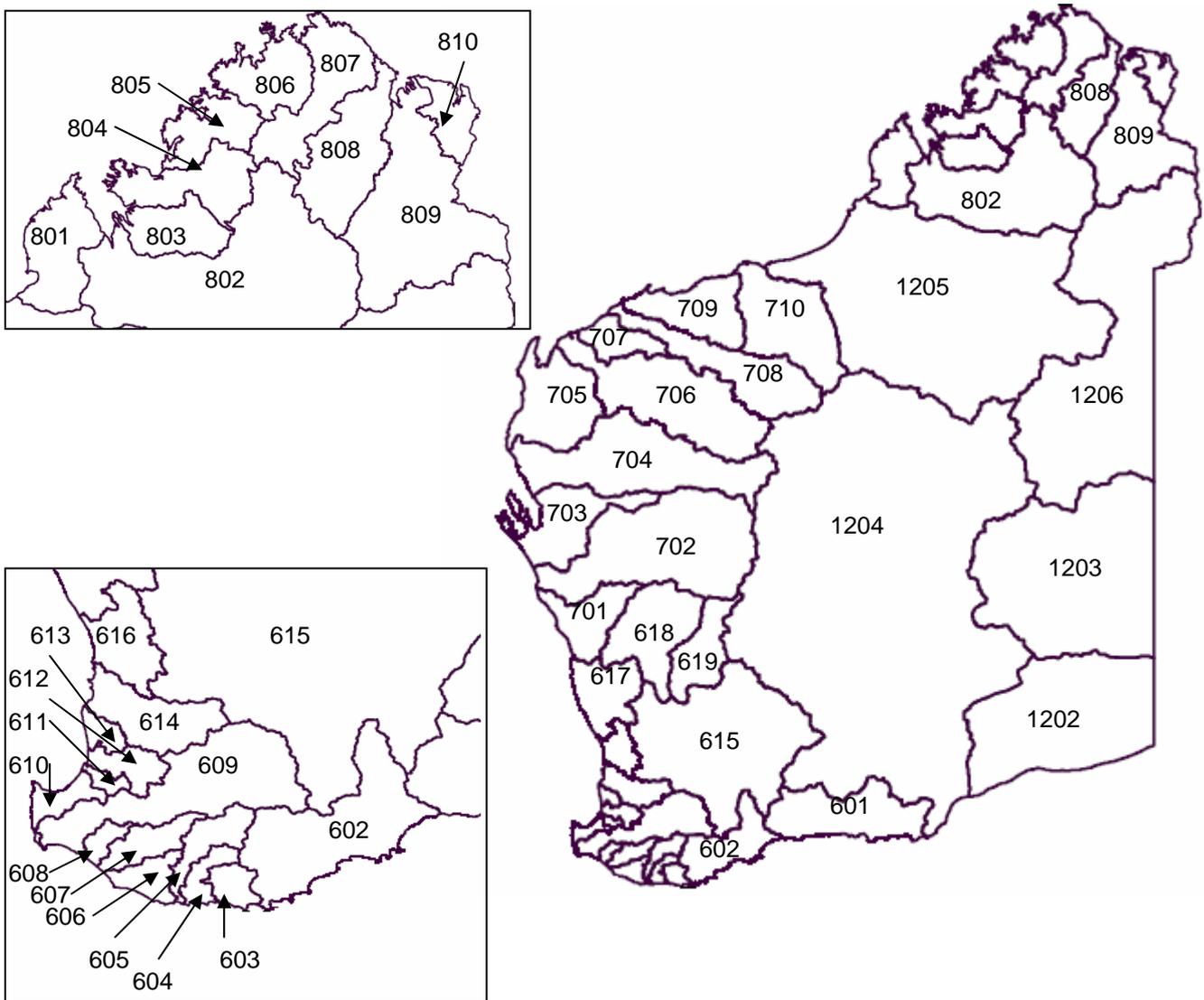


Figure 2 Drainage basins of Western Australia. Inset areas show drainage basin numbers for the Kimberley and south west areas.

6.1.1 Waterscapes

Figure 3 illustrates the distribution of Tier 1 Waterscape assets. The highest frequency of Tier 1 Waterscapes occurs in the South West Land Division (from Geraldton to Esperance). This is the most highly populated area of the state and as a result the assets are under pressure. This concentration of assets in the South West Land Division is a characteristic of all three Tiers of Importance for Waterscapes.

However, there is another area of the state where multiple Tier 1 assets occur – two drainage basins within the Pilbara. The Hamersley Range Wetland system, Weelli Wollli Spring, Millstream pools and the Fortescue Marshes in Drainage basin 708 (Ashburton). Drainage basins 709 (Port Headland Coast) contains Harding River, Munni Munni Creek, Yule River, Sherlock River and Tanberry Creek (a Wild River). These areas are under increasing pressures due to increased mining, pastoral and recreational pressures.

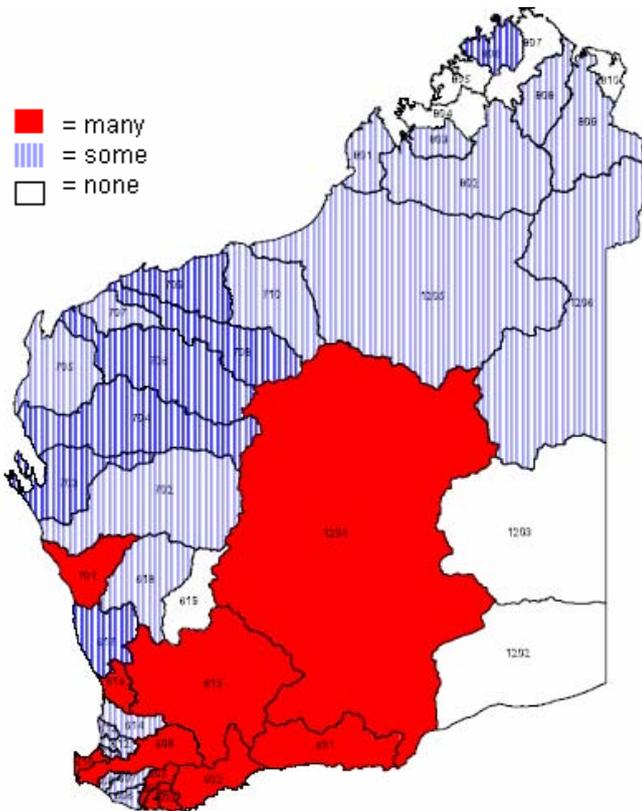


Figure 4 Location of Tier 2 Waterscapes

Note:

- Drainage basins are used as an arbitrary boundary and do not suggest assets should be delineated by drainage basins.
- Mapping provides an overview of asset locations only.
- Separation of drainage basins into many, some and none groupings has not been determined by a detailed statistical analysis.
- The data recorded for this map does not represent all Waterscape and Water supply data for the state of Western Australia.
- The information used to create this map was supplied by the Department of Water and is current as of January 2006.
- A fault in the mapping caused certain drainage basins to appear darker than others.

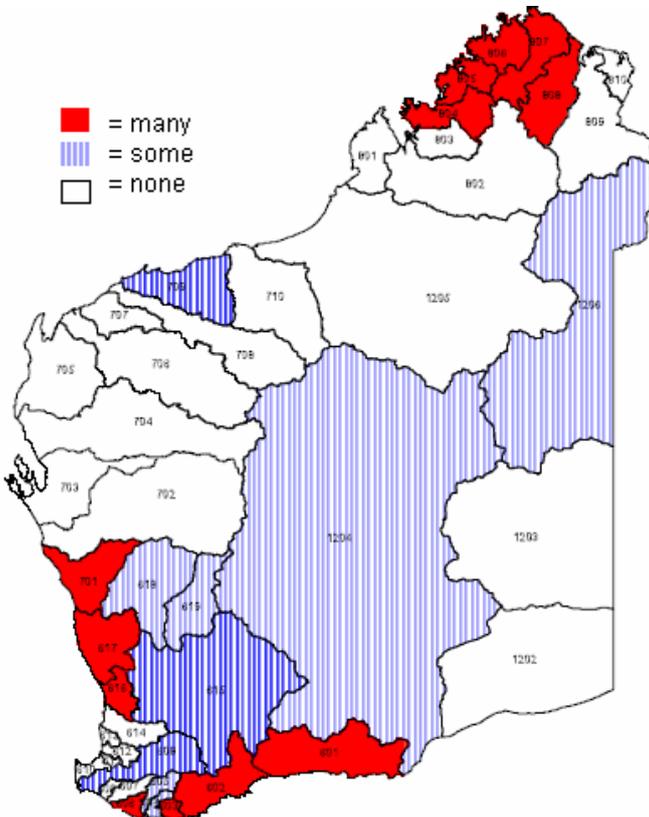


Figure 5 Location of Tier 3 Waterscapes

Note:

- Drainage basins are used as an arbitrary boundary and do not suggest assets should be delineated by drainage basins.
- Mapping provides an overview of asset locations only.
- Separation of drainage basins into many, some and none groupings has not been determined by a detailed statistical analysis.
- The data recorded for this map does not represent all Waterscape and Water supply data for the state of Western Australia.
- The information used to create this map was supplied by the Department of Water and is current as of January 2006.
- A fault in the mapping caused certain drainage basins to appear darker than others.

In Tier 3 the Kimberley drainage basins are highlighted (Figure 5). This distribution is not unexpected due to a low population base, relatively low disturbance levels and the unique characteristics of Waterscapes in this region. One component of Tier 3 group is the High Value, Low Threat systems, highlighted in Figure 6. This distribution of High Value, Low Threat assets in the Kimberley includes many of the “Wild River” catchments as well as other relatively undisturbed environments. These High Value Tier 3 assets may also be considered priorities for investment, particularly to protect waterway and biodiversity assets, which may be in remote areas but relatively undisturbed and therefore requiring comparatively lower investment than more degraded systems.

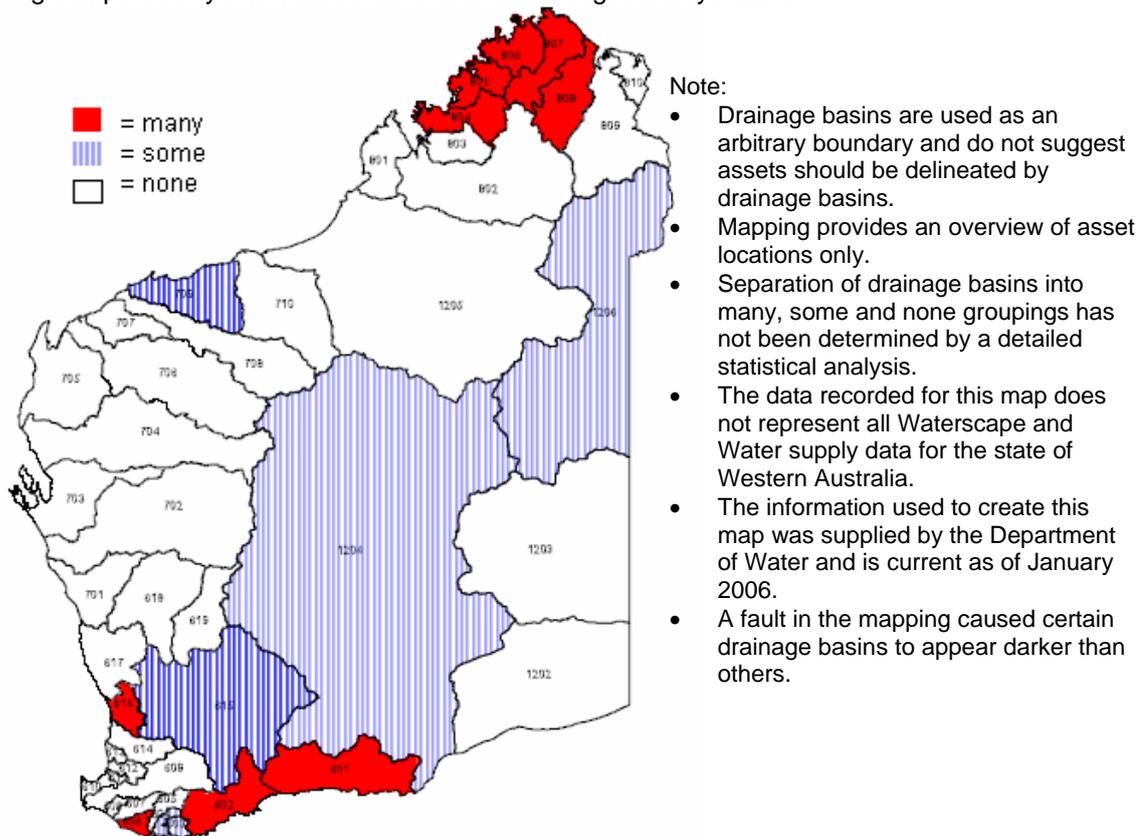


Figure 6 Location of High Value, Low Threat Waterscapes

Overall, the maps for Waterscapes show a large number of assets in the South West Land Division. However there are also a large number of Waterscapes in Drainage basins 708 and 709, which are under increasing pressure from mining, pastoralism and recreation. Tiers 2 and 3 show a large number of assets in Drainage basin 1204 (Salt Lake Basin) and the Kimberleys. These areas may represent future priorities as the population and pressures in Western Australia increase. Drainage basins 601 and 602 had large numbers of assets for all three tiers. This can be partly explained by the large amount of Waterscape assessment undertaken by SCRIPT and the Department of Water in these drainage basins.

Drainage basins 1202 and 1203 had no Waterscape assets present for any of the tiers. This does not mean that there are no waterways or wetlands in these drainage basins, just that there has not been an assessment of these assets. Mapping and assessment of these assets may also become a priority for the future.

6.1.2 Water Supply

Similarly to Waterscapes, mapping Water supply assets showed a concentration in the South West Land Division for all three Tiers of Importance. This area contains the largest number of Water supply assets, as it is the most highly populated area of the state with the greatest demand for water supply. There are a large number of Tier 1 assets in the South West Land Division (Figure 7) particularly surrounding the areas of Perth and the major regional centres of Mandurah, Bunbury and Busselton. Multiple Water supply assets exist in these drainage basins, including public drinking water supply areas, catchments areas for dams, underground water pollution control areas, water reserves and irrigation areas.

In Tier 1 drainage basins 617 (Moore-Hill) and 701 (Greenough) surrounding the areas of Geraldton, Jurien and Cervantes are categorised as having “many” assets. These areas are under increasing development pressure, which increases the threat to Water supply. Moreover, as the population increases, the Water supply assets become increasingly valuable, to provide drinking and irrigation water for these areas. A similar situation is occurring in Drainage basin 601 (Esperance Coast), with increasing population in areas such as Hopetoun, Ravensthorpe and Esperance.

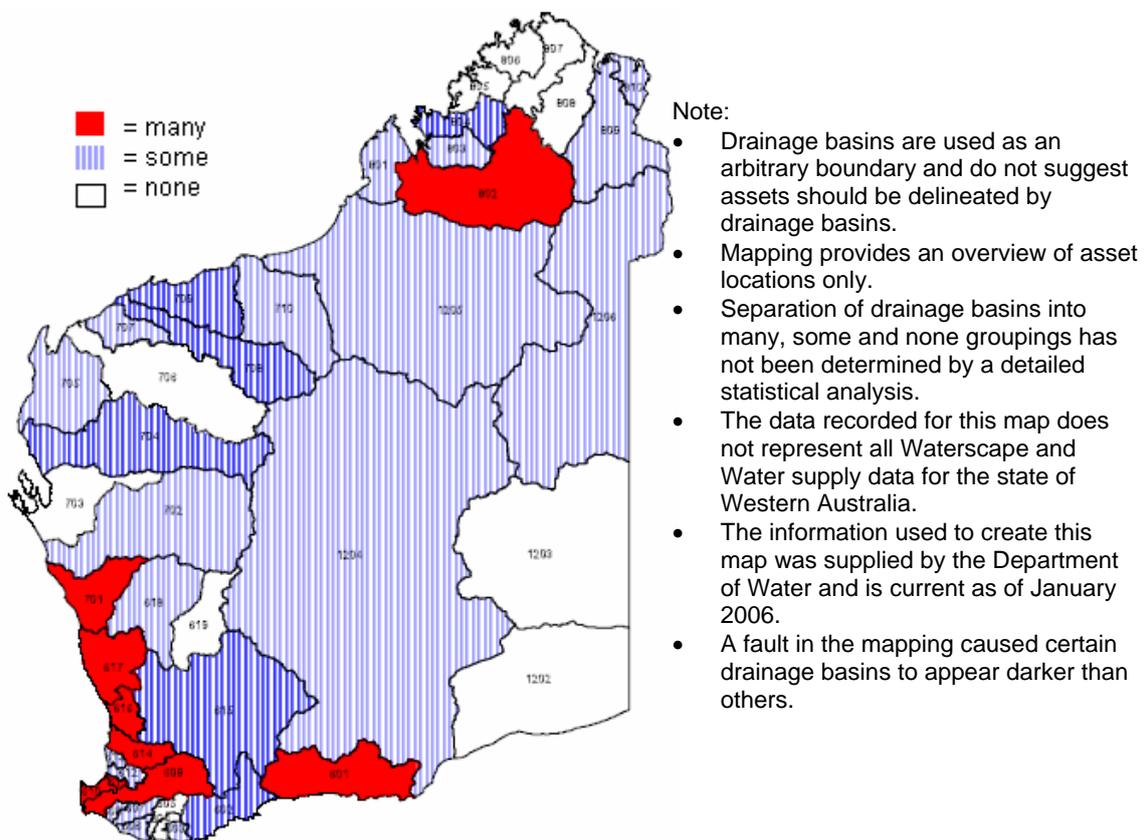


Figure 7 Location of Tier 1 Water supply assets.

In addition to the South West Land Division an area of the Kimberley - Drainage basin 802 (Fitzroy) also has a large number of Tier 1 Water supply assets. This includes Derby (RIWIA), Fitzroy crossing Water Reserve, Camballin Water Reserve, West Canning Artesian Basin, Fitzroy River (RIWIA) and the Fitzroy Alluvials (Figure 8). There is increasing pressure in this drainage basin as an irrigation area for tropical agriculture and as a potential water supply for Perth.

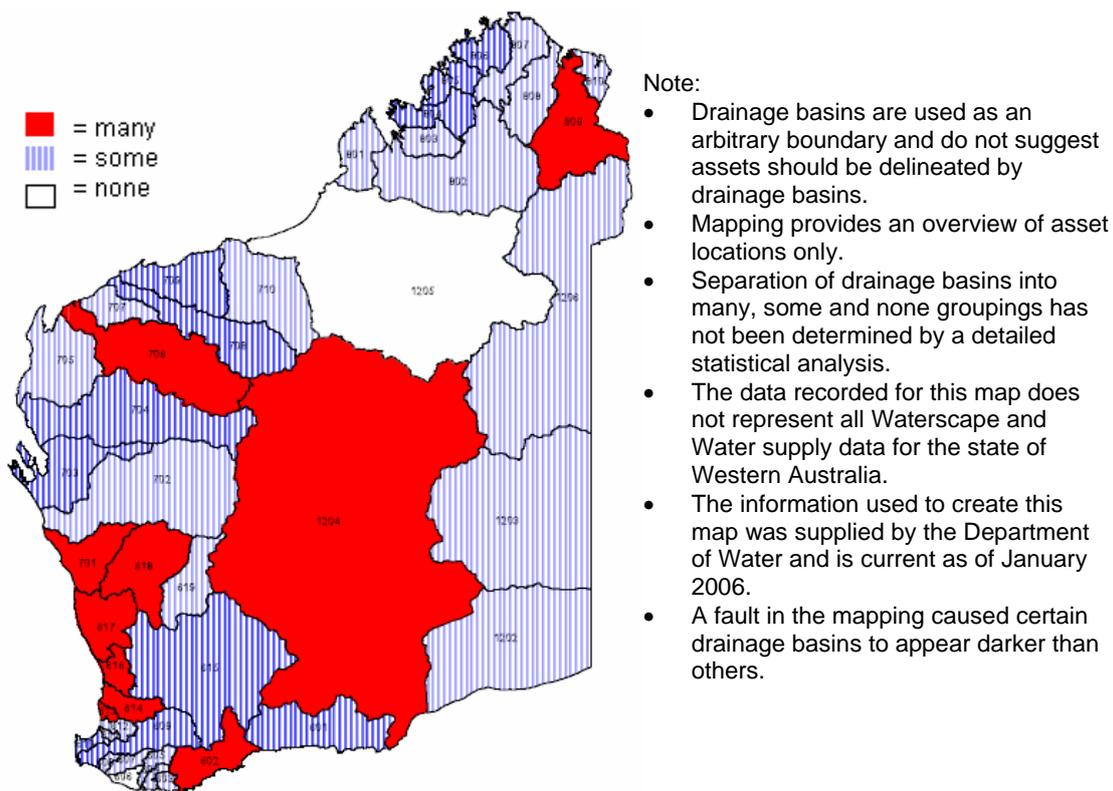


Figure 8 Location of Tier 2 Water supply

In Tier 2 Water supply several of the same drainage basins have a large number of assets located in the South West Land Division (Figure 8). Different to Tier 1 and outside the South West Land Division are drainage basins 706 (Ashburton), 809 (Ord) and 1204 (Salt Lake Basin). There are exists a number of large groundwater areas in these areas of the state, which have been identified in Tier 2, including Canning-Kimberley (RIWIA), East Murchison (RIWIA), Goldfields (RIWIA), Gascoyne Groundwater Area and Pilbara (RIWIA). These drainage basins also contain valuable water supplies for remote towns, including Parabadoo, Tom Price, Halls Creek, Turkey Creek and Leonora.

There are few Water supplies present in Tier 3, as evidenced by mapping (Figure 9). Most Tier 3 water supplies are in the South West Land Division, with the exception of Drainage basin 703 (Wooramel), which contains 2 water supplies for Denham. Water supply assets are created based upon demand for water resources, for irrigation and public supply. Therefore a large amount of Water supply assets have a High Value. Additionally the proximity of these assets to large, populated areas increases their threat. It is expected that there would be few Tier 3 Water supply assets, as represent the Low Value and Low Threat systems.

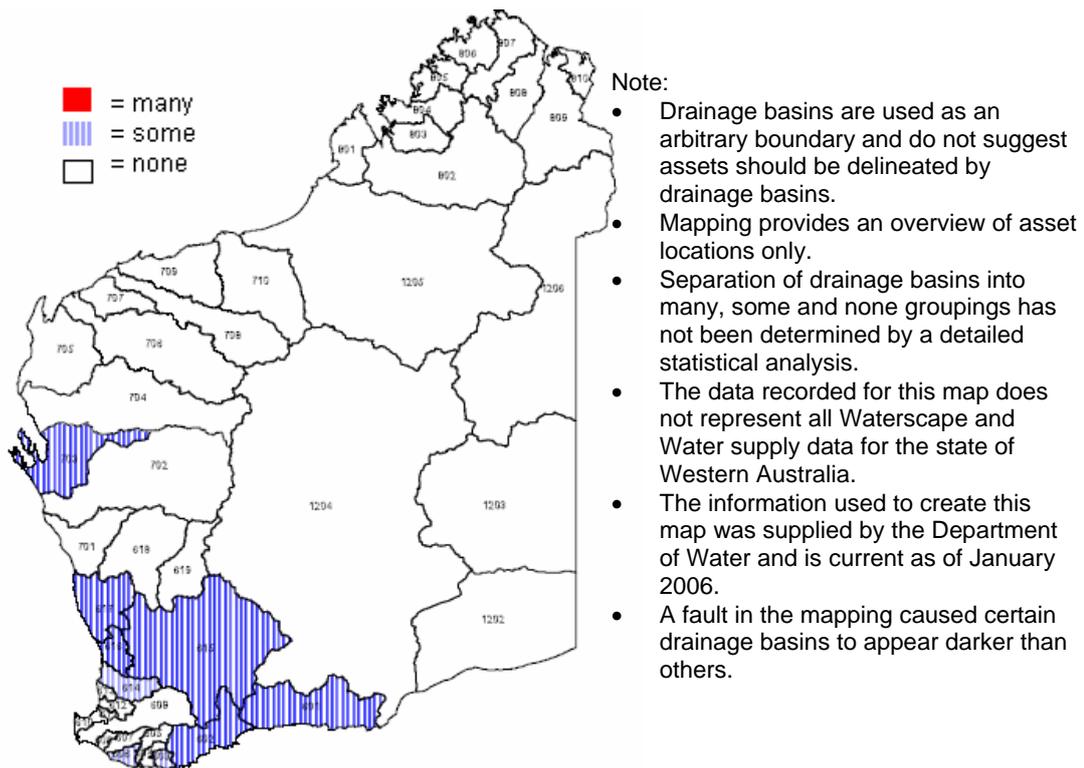


Figure 9 Location of Tier 3 Water supply.

Overall, the maps of Water supply show the majority of assets exist in the South West Land Division. However an area of the Kimberley, Drainage basin 802 also contains “many” Tier 1 assets. This area has recently been investigated as a future water supply for Perth, which increases its’ value and threat status. Tier 2 shows a large number of assets in the Ashburton, Ord and Salt Lake basins. These areas are under increasing development and mining pressure and contain a number of large groundwater areas. Water supply presents natural resource management with a challenge, as the influence of population can increase an asset’s value and threat at the same time.

6.1.3 Combining Waterscapes and Water supply

In order to demonstrate the locations of multiple Water Resource assets, a simple statistical analysis was conducted to combine Waterscapes and Water supply. Combining the two asset classes, presented a snapshot of the distribution of Water resources around the state.

As expected the majority of assets were located in the South West Land Division, for Tier 1, Tier 2 and all Water Resource assets.

However there were also large numbers of Tier 1 assets in 708 (Fortescue) and 709 (Port Headland Coast) (Figure 10). These drainage basins have many significant wetlands and waterways as well as Newman Water Reserve, West Pilbara Water Reserve, Harding Dam and Yule River Water Reserve.

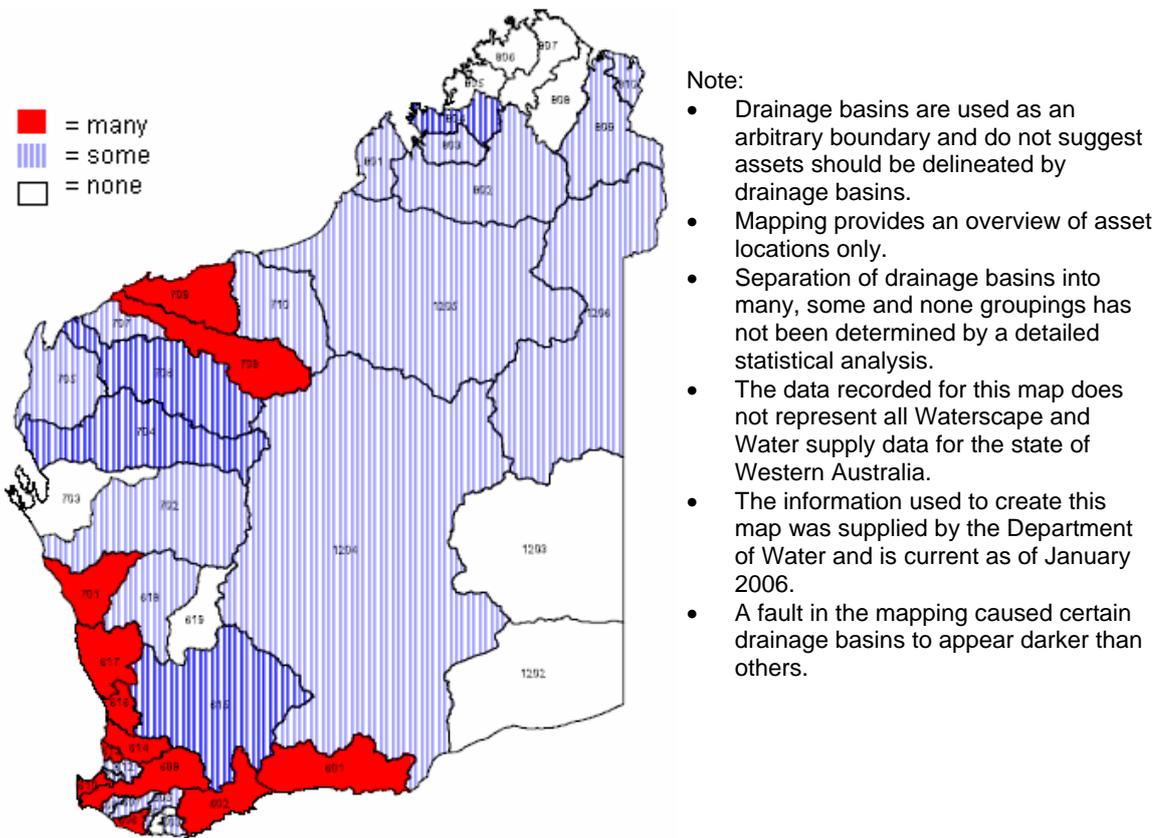
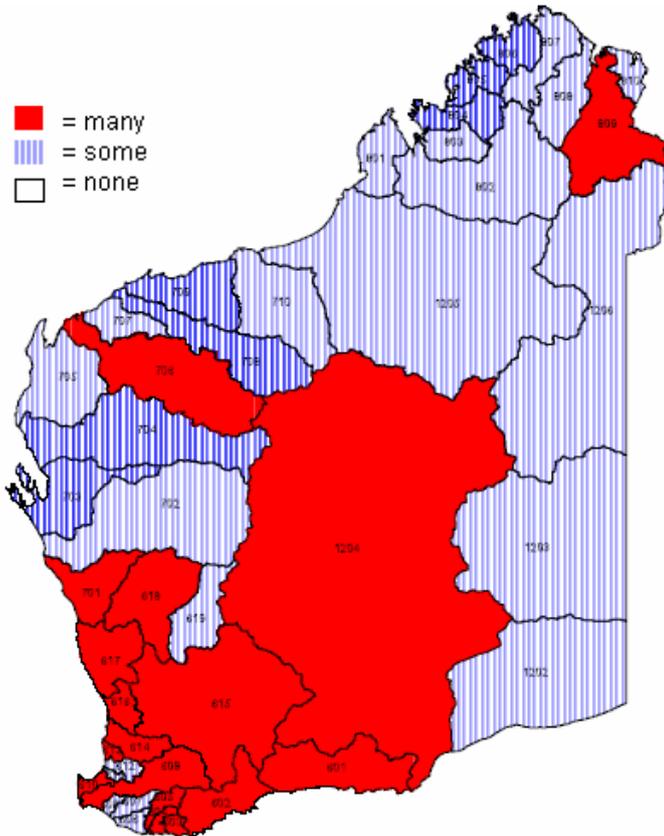


Figure 10 Location of Tier 1 Waterscapes and Water supply

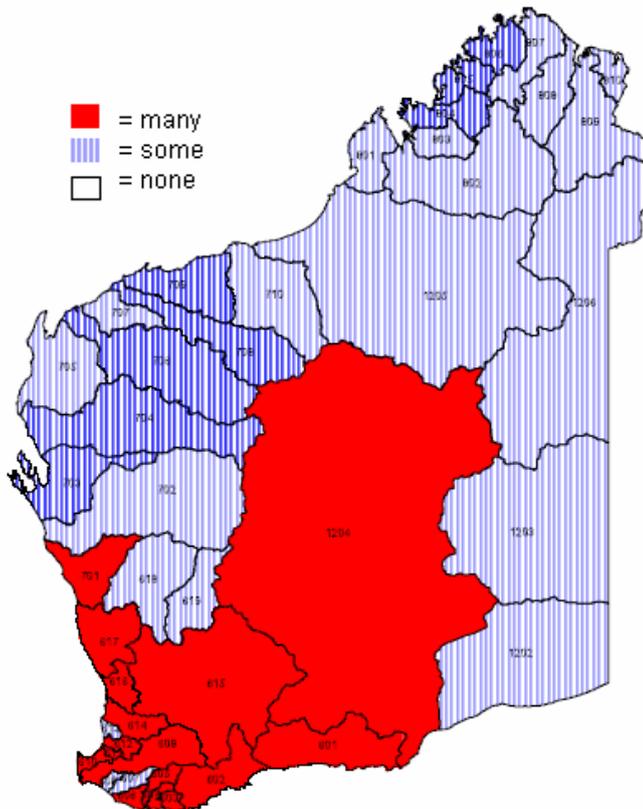
Combining Water Resources for Tier 2 shows additional drainage basins in the South West Land Division with many assets, including 615 (Avon) and 618 (Yarra Yarra) (Figure 11). Drainage basins 1204 (Salt Lake Basin), 706 (Ashburton) and 809 (Ord) have “many” Tier 2 assets. These drainage basins have several DoIW Waterscape assets and in the case of the Ashburton and Ord have several water supplies for remote towns. Drainage basin 1204 also contains many DoIW assets, and several RIWIA groundwater areas. The large area covered by this drainage basin can also explain the high number of assets.



Note:

- Drainage basins are used as an arbitrary boundary and do not suggest assets should be delineated by drainage basins.
- Mapping provides an overview of asset locations only.
- Separation of drainage basins into many, some and none groupings has not been determined by a detailed statistical analysis.
- The data recorded for this map does not represent all Waterscape and Water supply data for the state of Western Australia.
- The information used to create this map was supplied by the Department of Water and is current as of January 2006.
- A fault in the mapping caused certain drainage basins to appear darker than others.

Figure 11 Location of Tier 2 Waterscapes and Water supply



Note:

- Drainage basins are used as an arbitrary boundary and do not suggest assets should be delineated by drainage basins.
- Mapping provides an overview of asset locations only.
- Separation of drainage basins into many, some and none groupings has not been determined by a detailed statistical analysis.
- The data recorded for this map does not represent all Waterscape and Water supply data for the state of Western Australia.
- The information used to create this map was supplied by the Department of Water and is current as of January 2006.
- A fault in the mapping caused certain drainage basins to appear darker than others.

Figure 12 Location of all Waterscapes and Water supply

By combining all three Tiers of Importance for Waterscapes and Water supply assets, an overview of all assessed Water Resource assets is obtained (Figure 12). This map shows the large number of assets in the South West Land Division from Geraldton to Esperance. In addition to the South West

Land Division, Drainage basin 1204 (Salt Lake Basin) has “many” assets. The large area covered by this drainage basin helps explain the large number of assets located there. In addition there are many important Waterscapes (such as DoIW wetlands), several water supplies for remote towns and several large groundwater areas in this basin.

6.2 *Overall water resources*

The mapping of Water Resource assets allows stakeholders to determine the relative distribution of assets and to compare areas of the state. The analysis also shows the distribution of assets around the state for each Tier of Importance. The results show a concentration of both Waterscapes and Water supply assets in the South West Land Division. This is the most highly populated area of the state, under the highest pressure. The South West Land Division holds high environmental, social and economic values. Assets in this area are also the most extensively researched and recognised. In addition to the South West Land Division, the analysis also showed a number of key drainage basins, which contain multiple important assets. This includes Drainage basins 708 (Fortescue) and 709 (Port Headland Coast) in the Pilbara, with large numbers of High Value wetlands and rivers. There are several High Value, Low Threat Waterscapes in the Kimberley, including Wild Rivers in relatively undisturbed areas. These Waterscapes may present as priorities for investment in the future as expenditure to preserve these areas is likely to be less than systems under high threat.

Drainage basin 1204 (Salt Lake Basin) had multiple assets for both Waterscapes and Water supply, including several DoIW wetlands and groundwater areas. Although these assets were not often in Tier 1, the drainage basin still contains a large number of assets which may become priorities for the future, particularly under increased mining, development and pastoral pressures.

Water supply assets in the South West Land Division hold high value, due to their proximity to the public, yet at the same time, it is population pressures which put these assets under threat. Drainage basins 802 (Fitzroy) and 809 (Ord) in the Kimberley also had a large number of Water supply assets. These areas represent important water supplies for the entire state, including the Ord River Irrigation Area, an important agricultural area and the Fitzroy catchment which has been investigated as a future water supply for Perth.

In addition to highlighting where priorities may occur, the analysis can also indicate areas where future asset identification and assessment is required. Drainage basins 1202 (Nullarbor) and 1203 (Warburton) had no Waterscape assets identified in this assessment, even though minor waterways and salt lakes exist in these drainage basins. Through the analysis these areas may also become priorities for assessment. In addition, NRM regional groups may choose to undertake a detailed analysis and assessment of Waterscapes in their region, similar to that completed in the South Coast by SCRIPT and the Department of Water. The analysis of the distribution of water resources has provided the state with potential areas of priority, as well as areas where more assessment is required.

7 Biodiversity Results

Biodiversity (biological diversity) is a simple concept, with an underlying extraordinary complexity and dynamism that necessitates a multi-faceted and multi-scaled approach to its conservation.

Approaches, or mechanisms, to conserve biodiversity include direct management intervention or manipulation of a particular biodiversity asset, such as a listed Threatened species or significant landscape, to indirect approaches such as through education and awareness to bring about a better understanding of biodiversity-related issues and support, and use of regulatory mechanisms to control threatening processes like land clearing or minimizing impact of development. The complexity and dynamic nature of biodiversity makes its conservation a very significant challenge to implement through natural resource management (NRM) processes. This is because conservation approaches generally need to cover a range of scales, both in a geographic and spatial sense, and across a number of natural resource sectors making the potential for conflict sometimes high due to competing interests. Biodiversity conservation applies across all land/wildlife uses and involves a very wide range of stakeholders unlike most natural resource management issues. Further, conservation activities need to occur for over long time horizons, in some instances measured in centuries rather than decades, and accommodated into management structures that will provide long term security, public accountability and allow for adaptation of approaches when new knowledge comes to hand to decision makers and managers.

The aspirational goal for maintaining biodiversity in Western Australia over the next 25 years is to halt further loss and recover, where possible, the full range of biodiversity: ecosystems, ecological communities, species and the variability within species and ecosystems. In some instances, this will require recovery of key elements of biodiversity such as Threatened species or Threatened Ecological Communities that are on the edge of extinction, and the conservation of significant land/seascapes. It will also mean that major threatening processes that affect or diminish biodiversity will need to be controlled or eradicated. Coupled with this goal is to encourage Western Australian's to better understand and value biodiversity, and enjoy its benefits.

With limited resources available for conservation a targeted approach is vital. In such an approach, specific strategies must be pursued to maximize maintenance of existing biodiversity components, patterns and ecological processes at various spatial and temporal scales, and also to recover those elements of biodiversity that are threatened. This will necessitate an integration of the below priorities to achieve a balanced approach, which should reflect both research, planning, and a range of conservation management priorities.

Eight high order priorities, or key strategic directions, provide an overarching framework for lower order priority conservation strategies and actions. These are:

1. Establishment of terrestrial conservation reserve system that meets the criteria of comprehensiveness, adequacy and representativeness (CAR) and the establishment of a marine conservation reserve that meets the CAR criteria as part of the National Representative System of Marine Protected Areas;
2. Effective management of marine and terrestrial conservation reserves and other recognized special conservation value areas;
3. Improving biodiversity knowledge and information management;
4. Increasing education and awareness and involving more people in conservation;

5. Minimising biodiversity decline through ecologically sustainable industries and management of extractive industries;
6. Integrating biodiversity conservation into land management processes and biodiversity-related institutional reforms;
7. Recovery of Threatened species and Threatened Ecological Communities and other significant species and ecosystems; and
8. Conservation of landscape/seascape scale ecological systems (integrating reserve and off-reserve conservation).

The above eight priority areas are based on applying conservation biology principles to conserve the various biological organizational levels (genes, species, populations, communities and ecosystems), and ecosystem function. Collectively, these priorities aim to achieve a balance between landscape/seascape conservation management and management of rare or geographically restricted High Value biodiversity assets often under threat. It is important to recognize that each area is inter-related and should not be considered in isolation from one another when considering priorities at a lower or higher spatial order. In other words, the full spectrum of conservation initiatives, whether on-ground or institutionally focused, need to be reflected for a balanced biodiversity conservation approach.

Collectively the eight priority categories encompass the breadth of actions identified in “The National Strategy for the Conservation of Australia’s Biological Diversity” (1996), as signed by the Premier and Prime Minister.

Where relevant, the Interim Biogeographic Regionalisation of Australia (IBRA) and Interim Marine and Coastal Regionalisation of Australia (IMCRA) boundaries have been used as the basis for identifying and presenting spatial priorities, along with information from the 2002 Australian Terrestrial Biodiversity Assessment under the National Land and Water Resources Audit.

The following identification of Western Australia’s biodiversity conservation priorities has been prepared using a combination of analytical tools, including threat-value matrix analysis, gap analysis, existing datasets and expert opinion from within the Department of Environment and Conservation, which has the responsibility under the direction of the Minister for Environment; Science for the Wildlife Conservation Act 1950 and Conservation and Land Management Act 1984 to ensure the conservation of Western Australia’s biodiversity.

7.1 Establishment of the terrestrial conservation reserve system and marine conservation reserve system.

Establishment of the terrestrial and marine conservation reserve system represents one of the primary strategies of biodiversity conservation, where the overall goal is the formal protection of a viable sample of each major biome (to maintain biodiversity), and provision of appropriate long term security and management in accordance with the objectives outlined under IUCN protected area categories I - IV.

Establishment of a terrestrial and marine conservation reserve system, that meets the criteria of comprehensiveness, adequacy and representativeness, follows the principles as agreed between the State and Commonwealth under the Interim Bioregionalisation of Australia (IBRA) and Interim Marine and Coastal Regionalisation for Australia (IMCRA) and the Directions for the National Reserve System

– A Partnership Approach. Comprehensive refers to the inclusion of the full range of ecosystems recognised within and across each bioregion. Adequate means ensuring that sufficient proportions of each ecosystem should be included within a conservation reserve network in order to maintain ecological viability and integrity of populations, species and communities. Representative means that the reserves need to cover the breadth of the biotic diversity of the ecosystems they are seeking to conserve.

Under existing international and national protocols and agreements the basic requirements of a terrestrial conservation reserve system have been defined to include at least 15% of the ecosystem of an ecoregion being legislatively protected and managed specifically as conservation reserves with a primary goal to conserve biodiversity. Fifteen percent is a minimum figure, and must be considered in relation to the ecological processes and functions of the ecosystem in question. In some instances, there may be a requirement for a higher proportion of the ecoregion to be conserved in order to maintain essential processes, particularly sensitive or restricted ecosystems, and meet the criteria of adequacy.

The goal is therefore to grow the terrestrial conservation reserve system to at least 15% of each IBRA region.

Figure 13 shows the proportion of the area of IBRA subregions currently in the formal terrestrial conservation reserve system.

The Leeuwin-Naturaliste/Geographe Bay, Dampier Archipelago/Cape Preston and Walpole-Nornalup areas are currently in the planning phase for reservation as marine conservation reserves. The next priorities for the establishment of new marine conservation reserves have been identified by the Marine Parks and Reserves Authority as (1) the Recherche Archipelago; Fitzgerald River coast; (2) Shoalwater Islands Marine Park and Carnac and Garden Islands extensions; (3) Shark Bay Marine Park Dirk Hartog, Bernier and Dorre Islands extensions; and (4) Roebuck Bay/Lagrange Bay/Eighty Mile Beach.

Figure 14 shows the priorities (High, Medium or Low) at an IMCRA sub-region level for the establishment of a marine conservation reserve system.

Table 19 and 20 in the Appendix outline the relative value (reservation status) of existing conservation reserves versus continental landscape threat class.

Priorities are:

1. Continue the establishment of the conservation reserve system to meet criteria of conservation, adequate and representative, with priority being given to priority sub-bioregions under IBRA, particularly in the rangelands, Wheatbelt, forest areas and Swan Coastal Plain, and marine areas within priority IMCRA bioregions, in particular the Kimberley and WA South Coast marine bioregions.
 2. Undertake a gap analysis and develop a State protected area plan and bioregional plans with targets to accelerate the establishment of a conservation system covering all types of ecosystems.
 3. Develop design methodology for the identification of a terrestrial conservation reserve system, and a network of marine sanctuary zones for the temperate and tropical waters of WA, including refinement of adequacy principles and surrogate datasets for identification of representative areas.
 4. Establish marine conservation reserves in the Dampier Archipelago/Cape Preston, Leeuwin-Naturaliste/Geographe Bay and Walpole-Nornalup Inlets.
 5. Pursue reservation of high priority marine areas including the Recherche Archipelago, Fitzgerald River coast and Roebuck Bay/Eighty Mile Beach.
 6. Implement all reservation proposals in the Forest Management Plan 2004-2013.
 7. Continue to progress the creation of conservation reserves purchased under the Gascoyne-Murchison Strategy (GMS), and pursue further acquisitions to reach a comprehensive and adequate and representative reserve system for the GMS bioregions.
 8. Continue to negotiate with pastoral lessees over areas identified under the 2015 pastoral lease renewal program for exclusion in the conservation reserve system or excision under a conservation agreement.
 9. Continue maintenance of database and information requirements to support the establishment of a protected area network.
 10. Undertake ecosystem classification and new Statewide mapping of ecosystems and ecological communities at appropriate scale for biodiversity planning, and undertake mapping to refine biodiversity hotspots.
 11. Expand Bush Forever across the Swan Coastal Plain, including the Bunbury-Busselton area.
 12. Acquire appropriate lands under Bush Forever across the Perth Metropolitan area.
 13. Encourage nature conservation covenants and revolving funds to give priority to areas that meet National Reserve System standards and contribute to the National Reserve System.
- Development and implementation of a communication plan to increase awareness and understanding of the roles and functions of the conservation reserve system.

7.2 Effective management of conservation reserves and other recognised special conservation value areas.

This priority includes formal conservation reserves (nature reserves, national parks, conservation parks, Section 16 and 16A under the *Conservation and Land Management Act* and nature conservation covenants that meet National Reserve System accreditation standards) and other special areas comprising land and water and recognised under statutory mechanisms for long term security of biodiversity conservation values. Areas listed under the Convention on Wetlands (Ramsar sites) (internationally significant wetlands) and the Directory of Important Wetlands in Australia (nationally significant wetlands), biosphere reserves and World Heritage Properties can all be included under the

special conservation value category. Those areas that are protected under legislation in this category, and meet National Reserve System accreditation, can form part of the protected area network. Across the State there are around 1600 conservation reserves managed by the Department of Environment and Conservation, 12 Ramsar sites, two UNESCO biosphere reserves and two World Heritage Areas (Shark Bay World Heritage Property - part of which is protected in formal reserves or in areas purchased for conservation management, and Purnululu National Park). Note that the categories are not mutually exclusive. Rather there are areas that have been recognised and specially protected for a range of values within the formal reserve system.

The above biodiversity assets are designated for their high biodiversity conservation value, and are all considered a priority for investment.

Figure 15 shows the extent of WA's formal conservation reserve system.

Figure 16 shows the extent of the formal conservation reserve system in the South West of WA.

Figure 17 shows other special areas comprising land and water and recognised under statutory mechanisms for long term security of biodiversity conservation values.

The levels and types of threat faced by reserves will vary between each reserve/area (see Figure 20 in Appendix for the continental landscape stress class for the IBRA sub-bioregions as indication of threat at an IBRA sub-region scale).

Priorities include:

1. Continue to develop and implement management plans for the conservation reserve system in accordance with the CALM Act on a priority basis.

(Management plans should emphasize protection of unique or unusual habitats or communities and the overall maintenance of species populations, natural ecological and evolutionary processes, and provide for recovery of threatened species and ecological communities, and should include adaptive responses to climate change based on best available knowledge.)

2. Develop and implement management plans for protected areas, outside the formal conservation reserve system.

(Management plans should emphasise protection of unique or unusual habitats or communities and the overall maintenance of species populations, natural ecological and evolutionary processes, and provide for recovery of threatened species and ecological communities, and should include adaptive responses to climate change based on best available knowledge.)

3. Continue to participate in the development of a national code of management to ensure protected area management is of an appropriately high standard.

4. Develop a process and mechanisms for allocating management resources to the highest priority programs (assets and generic threat management) with a suitable level of feasibility; this work should include a detailed analysis of biophysical threats and their management, and opportunities.

5. Develop and implement a conservation reserves database for conservation managers, which also includes monitoring and evaluation, and maintaining public reporting requirements.

6. Continue to develop collaborative partnerships, including joint management arrangements, with industry, Aboriginal people and private organizations.

7. Develop and implement plans for Ramsar sites, and investigations to nominate Ramsar sites.

8. Build on the Directory of Important Wetlands in Australia, including undertaking survey and assessment, and classification of wetlands.

9. Continue to manage World Heritage Properties at Shark Bay and Purnululu National Park, and progress nomination of Ningaloo-Cape Range for World Heritage listing.

Undertake identification of potential areas for World Heritage listing.

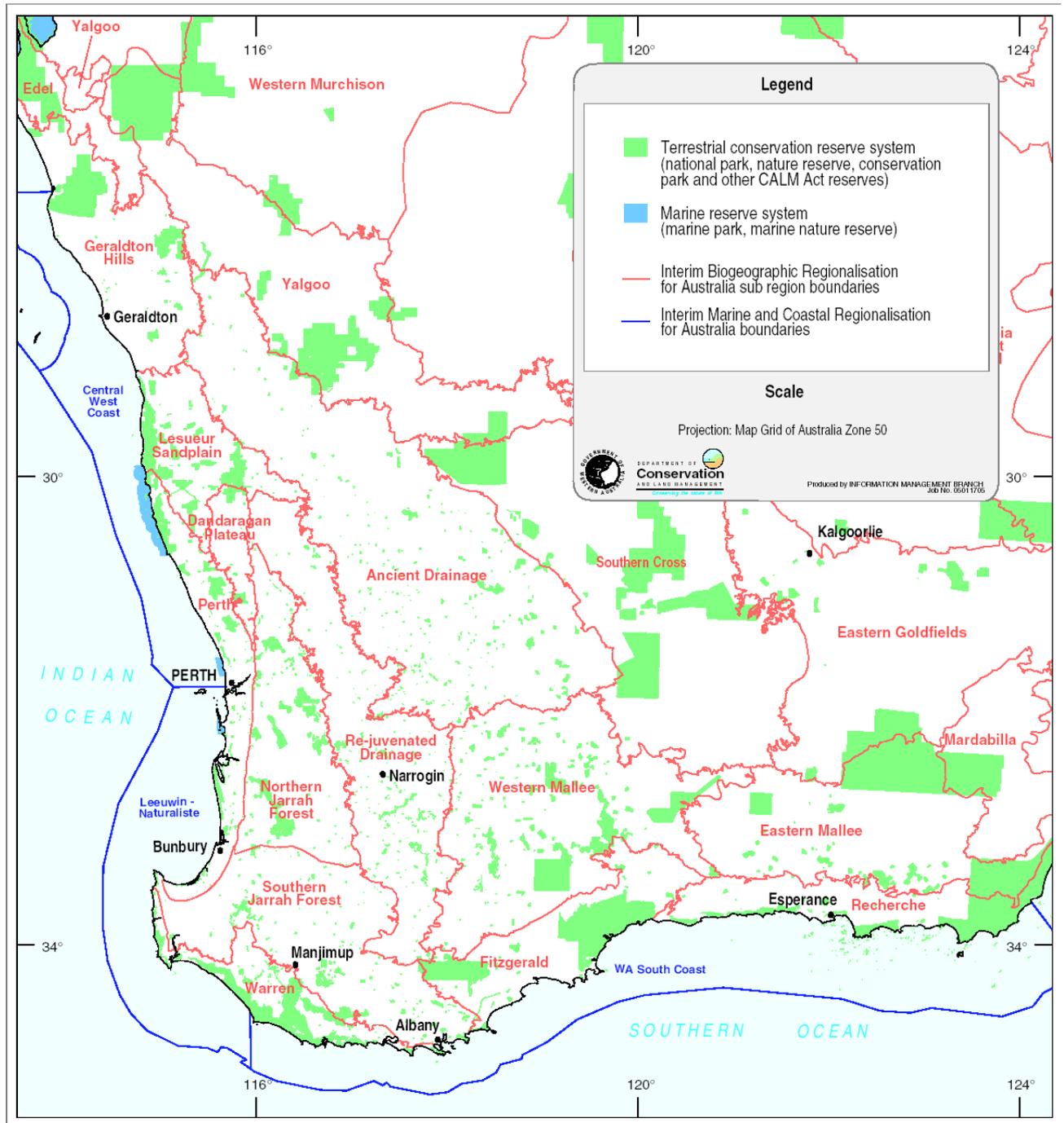


Figure 16 The extent of the formal conservation reserve system in the South West of Western Australia

7.3 *Improving biodiversity knowledge and information management*

Improving biodiversity knowledge is essential to bring about effective management. Due to its complex and dynamic nature, there remain significant gaps in both biodiversity inventory (refer Figure 18) and understanding of ecological processes associated with biodiversity and how these are affected by natural disturbances and impacts from humans and a range of competing threatening processes, such as introduced species and climate change.

There is an urgent requirement for the State to have a good understanding of its biodiversity assets and their status, particularly the patterns and components (genes, taxa, ecological communities, ecosystems) through systematic biological inventory and assessment. This provides the basis for conservation planning and action. Coupled with this priority are the taxonomic requirements, particular to expand knowledge of lower order plants, fungi, invertebrates and marine organisms.

Marine biological inventory and assessment priorities include assessment of the: Kimberley and Eucla bioregions; Beagle and Abrolhos Islands; and proposed extensions to the Shoalwater Islands and Shark Bay marine parks. In addition, a further priority is the development of rapid marine biodiversity mapping with particular focus on deeper (>20 M) and turbid waters, which is currently being addressed by the Cooperative Research Centre for Coastal Zone, Estuaries and Waterways Management.

Priorities are:

1. Develop and implement a State biodiversity research plan that identifies and addresses critical knowledge gaps for ecological and social requirements.
2. Strengthen biodiversity research opportunities and partnerships through the establishment of a WA Terrestrial Biodiversity Science Centre of excellence, and participation in relevant cooperative research centres.
3. Establish a Statewide marine, terrestrial and aquatic monitoring capability to determine and report on the state and trends of biodiversity, and to identify the causes of change; this should include development of an effective monitoring and reporting framework, identification of indicators and development of standard approaches and protocols for monitoring biodiversity.
4. Accelerate a systematic biological survey to improve understanding of biodiversity components, and their status, and patterns, in particular undertake bioregional scale inventories where there is a knowledge gap and/or major threatening processes occurring, with priority being given in the immediate for the Pilbara Bioregion, Kimberley near shore islands and Kimberley Region; Beagle and Abrolhos Islands; and proposed extensions to the Shoalwater Islands and Shark Bay marine parks.
5. Continue and expand taxonomic research, including a focus on invertebrates, non vascular plants, marine organisms and fungi, and enhance genetic diversity research, and support the training and recruitment of taxonomists, geneticists and conservation biologists.
6. Develop systems that consolidate and promote the sharing of biodiversity information and modelling through the use of databases and geographic information systems, including the development of meta databases, such as EcoBase and other spatial datasets aimed at consolidating biodiversity information
7. Investigate and develop methods for estimating the environmental, social and economic values of biodiversity and ecosystem services.
8. Continue and expand research on threatening processes (e.g. introduced predators and herbivores, weeds, disease, altered fire regimes) and develop technologies for control and restoration.

9. Establish cooperative arrangements for WA marine biodiversity conservation research, in collaboration with CSIRO, AIMS, WA Museum, DEC, Department of Fisheries and local universities, to undertake marine ecological resource assessment and social research in support of the Government's marine conservation program.
10. Maintain and expand collections of biota in the WA Museum and WA Herbarium and regional herbaria, including participation in national and international projects such as the Millennium SeedBank, and the facilitation of the databasing of marine and terrestrial floral and faunal collections.
11. Develop an ethnobiological program to facilitate the capture of and application of Indigenous knowledge in conservation programs.
12. Continue the development and ongoing maintenance of the terrestrial WA Biodiversity Audit for biodiversity planning and monitoring purposes, and undertake a marine biodiversity audit to determine status, condition, trends, and management requirements.

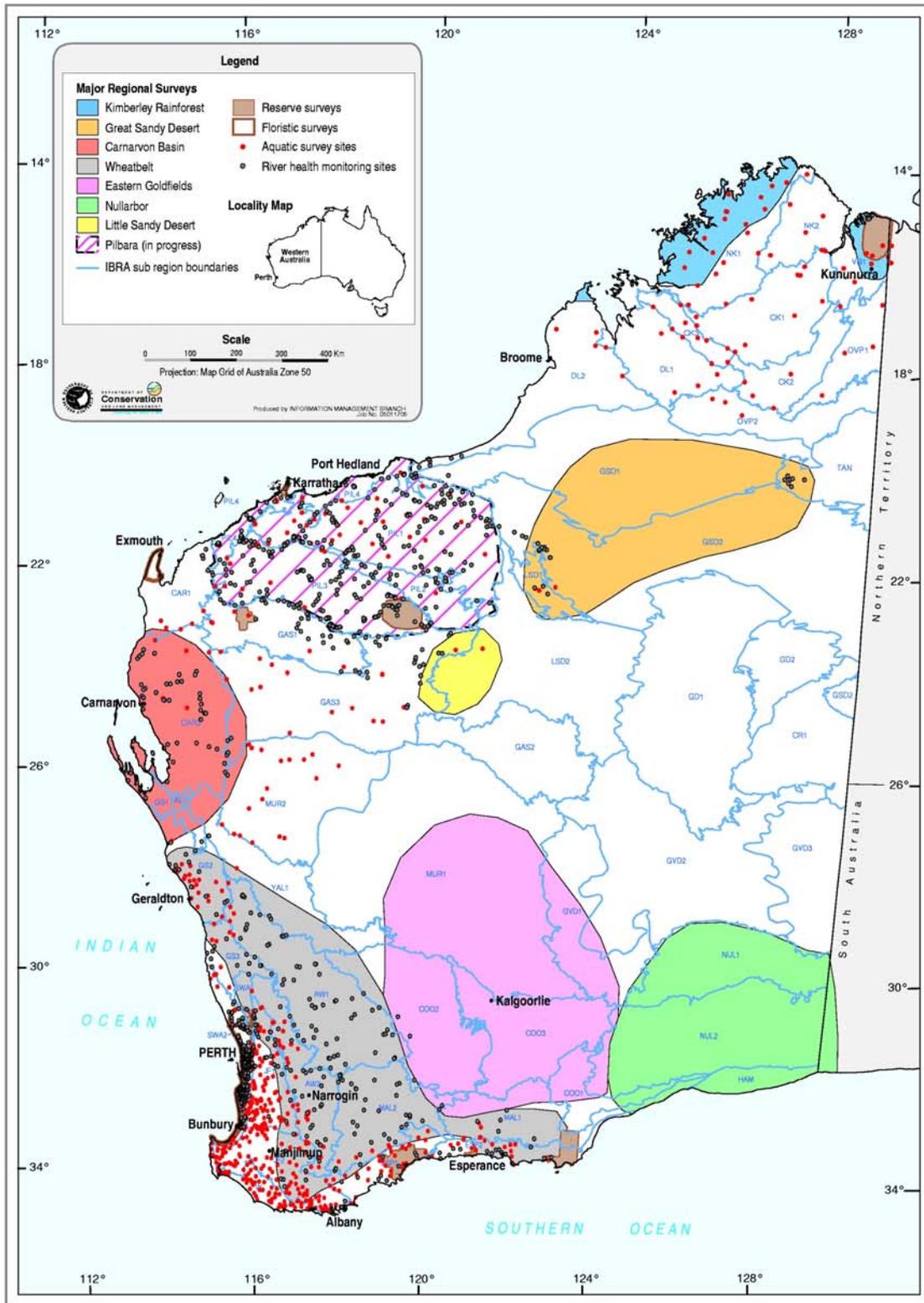


Figure 18 Current coverage of the State's biological survey program

The terrestrial biological survey program commenced in the 1970s and comprises intensive sampling across a wide range of regions to determine biodiversity patterns at local, regional (bioregional) and Statewide scales, and components (taxa and ecological communities) and their conservation status. Areas to date covered by broad scale and systematic survey include the Eastern Goldfields, Nullarbor, Kimberley rainforests, Swan Coastal Plain, southern Carnarvon Basin, south-west agricultural zone (Wheatbelt) and Pilbara bioregion (currently under way), with many smaller projects concentrating on specific areas of interest. This represents around 25-30 per cent coverage of the State's terrestrial area.

It should be noted, however, that even though the areas shown on the map below have been surveyed, the coverage of taxa is selective, and the comprehensiveness of surveys has evolved over time. For example, the Great and Little Sandy Desert, Eastern Goldfields and Nullarbor surveys included plants and vertebrate animals only, while more recent surveys have included, along with vertebrates and vascular plants, invertebrates (earthworms and Camaenid land snails) in the Kimberley, spiders in the Carnarvon Basin and spiders, scorpions and other invertebrates in the Wheatbelt. Surveys of reserves have examined varied groups over time and location. River health surveys only included macro invertebrates sorted to family level, but aquatic surveys are much more comprehensive, examining all invertebrate groups (to species level if possible) and riparian vegetation, with some also including diatoms and algae. Hence, there remain significant biodiversity knowledge gaps in areas that have already been broadly surveyed.

7.4 Increasing education and awareness and involving more people in conservation.

Increasing public awareness and understanding of biodiversity as a concept that underpins sustainability and all life support systems, including quality of human life, and providing many values and benefits, is needed to bring about empathy and build long term support for conservation programs. Encouraging people to become involved in biodiversity conservation and enjoy its benefits is a major means to achieve this goal.

Priorities are:

1. Develop and implement a communication and education plan aimed at the general public, industry and key user groups, decision-makers such as politicians, government agencies and statutory authorities, and Indigenous and key community-based groups to promote a public constituency for biodiversity conservation, and support for related conservation requirements and initiatives. Plan to include:
 - types of information and guidance needed;
 - mechanisms to foster public conservation ethic; and
 - development of a public awareness campaign and program.
2. Together with other agencies develop the biodiversity component of management and education for sustainability for all levels of pre-primary, primary and secondary schools, to support teaching, learning about and involvement in biodiversity, ecological processes and biodiversity conservation.

3. Develop and enhance courses and material for all faculties and schools at tertiary institutions that will promote and increase awareness and appreciation of biodiversity and its conservation requirements.
4. Support the professional development of educators to facilitate appropriate biodiversity related education and interpretation programs.
5. Develop and implement DEC's Healthy Parks, Healthy People program aimed out engaging people in nature-based activities.
6. Empower community-based organisations to pursue biodiversity conservation initiatives through targeted formation and technical support, including training opportunities to community-based organisations for accessing information, use of databases and GIS.
7. Establish a Statewide Biodiversity Stewardship Network for those organisations actively engaged in biodiversity conservation, such as 'friends of' groups, 'adopt a local reserve' or, landcare/coastcare groups, and groups involved in recovery programs, to share information and knowledge, and further stimulate local engagement.
8. Create opportunities for local communities to contribute to biodiversity conservation, and continue to enhance and implement existing community-based programs, and build opportunities to provide support and incentives to conserve biodiversity.
9. Build and encourage public participation into the core programs of Government agencies, such as the Marine Community Monitoring Program, to provide input into planning, monitoring and research programs.
10. Pursue opportunities for cooperative/joint conservation management agreements between public lands managed for biodiversity and Aboriginal and local communities where appropriate.
11. Develop and implement programs that link local communities, youth and schools, to embrace biodiversity conservation actions in local and other environments, such as a program of identified areas (i.e. Living Libraries) of native vegetation that can be used for teaching and learning experiences for schools, Bush Rangers and conservation volunteers and organisations.
12. Develop incentive schemes that recognise and reward the actions of those industries, agencies and community-based groups who are actively working to conserve biodiversity.
13. Embed biodiversity-related information into public participation/community involvement events (for example Arbor Day, World Environment Day, Clean Up Australia).
14. Promote and encourage more involvement in nature-based tourism and recreation opportunities, and its links to healthy living.

7.5 Minimising biodiversity decline through ecologically sustainable industries and management of non-renewable resource industries.

Biodiversity underpins sustainability and industries that use, or are dependant on, renewable natural resources. There is increasing opportunity to incorporate biodiversity conservation within natural resource management sectors to meet sustainability principles. While, there has been much effort to provide for biodiversity under various State and national statues, there still needs to be better recognition of biodiversity requirements, equal with those of economic and social considerations, and better decision making frameworks developed to provide for better biodiversity conservation outcomes.

Measures in place to promote sustainability need to be strengthened and expanded to make sure that they specifically address and take into account biodiversity conservation needs.

Priorities are:

1. Review, strengthen and implement existing industry related ecologically sustainable development policies and plans to optimise considerations for biodiversity conservation.
2. Develop indicators for sustainable use of biodiversity for each industry sector, and monitoring and reporting protocols.
3. Continue to implement and improve environmental impact assessment processes to ensure that impact on biodiversity for resource extractive and development projects is minimised through impact assessment and management, and that the full cost is borne by the developer.
4. Develop and implement ecologically sustainable pastoral land management practices in accordance with the Land Administration Act 1997, including the development and implementation of accredited property management plans for pastoral leases to adequately provide for the protection and management of biodiversity.
5. Encourage the incorporation of biodiversity conservation actions and appropriate targets for protection and management into regional NRM regional and investment plans.
6. Incorporate adequate biodiversity conservation considerations into the proposed State natural resource management strategy.
7. Develop and implement appropriate protocols and practices to ensure that industries operating on Crown land and waters (for example apiculture, wildflower and seed harvesting and aquaculture) are consistent with principles of ecologically sustainable development.
8. Implement ecologically sustainable forest management for native hardwood forests through the Forest Management Plan 2004-2013.
9. Develop and implement a State bioprospecting plan for biodiversity where the management agreement ensures conservation of biodiversity and appropriate returns to the State in terms of improved knowledge of the biota and increased capacity for the conservation of the biota.
10. In addition to the non-regulatory approaches, investigate the extension of the beneficiary-pays, user-pays and polluter-pays principles for the use of biodiversity.
11. Ensure all recreational and commercial fisheries meet ecologically sustainable development requirements under relevant State and Commonwealth legislation.
12. Investigate and trial new flora and fauna suitable for sustainable use industries, where conservation benefits will be derived, and continue the sustainable use of accredited wildlife-based industries.

7.6 Integrating biodiversity conservation into land management processes and institutional reforms.

While there has been significant effort towards addressing biodiversity-related problems and biodiversity conservation across all sectors, much of it is fragmented. This is partly due to an absence of an overarching biodiversity conservation strategy and legislation, and complementary policies. This has resulted in limited attention being given to biodiversity conservation in land use planning and development decision making, and inadequate integration of biodiversity conservation in other policies and legislation. Government-driven processes and reforms provide a fundamental basis to ensure

better integration and coordination of existing and new biodiversity conservation initiatives and need to be integrated with processes involving all land managers.

Priorities are:

1. Replace the *Wildlife Conservation Act 1950* with a *Biodiversity Conservation Act* for WA and implement the Act to provide a legislative framework for the conservation and sustainable utilisation of biodiversity.
2. Development and implementation of State biodiversity conservation strategy to provide an overarching framework and priorities
3. Investigate and reduce social and institutional barriers, including review of legislation and policies, to identify and remove policies that may have an unintended adverse effect on the conservation of biodiversity, and develop appropriate strategies for overcoming these.
4. Develop and implement plans for biodiversity management and public reporting, for State and local government agencies that seek to minimise the impacts of their activities on biodiversity, and detail efforts to protect or restore components of biodiversity under their control in their rolling corporate plans.
5. Develop and implement local government biodiversity action plans.
6. Develop and implement a conservation offsets policy and management guidelines for resource development and land use projects.
7. Develop an appropriate framework for the development, accreditation and implementation, of bioregional plans that provide for and prioritise biodiversity conservation actions and initiatives.
8. Develop and implement a State biodiversity strategy for climate change.
9. Clarify property rights and duty of care in relation to biodiversity.
10. Continue to support and improve environmental planning, protection and monitoring processes for resource and land use development.
11. Continue to support interagency fora, such as the Wetlands Coordinating Group, to coordinate natural resource management across agencies.
12. Finalise and implement the Swan Coastal Plain Wetlands Environmental Protection Policy.
13. Develop and implement appropriate biosecurity protocols and guidelines to control the introduction and spread of new species and pathogens to terrestrial, aquatic and marine ecosystems.
14. Investigate appropriate measures to reduce impacts of deliberately introduced garden species, such as labelling of nursery stock and using statutory mechanisms to prevent on-going trade in invasive plants for use in gardens, ponds and aquaria.

Provide regulatory mechanisms to ensure that there will be no gaps in State quarantine, protection, control and eradication programs across environmental, agricultural and other weed and pest threats

7.7 Recovery of threatened species and ecological communities that are listed under relevant national and state legislation, and other significant species.

Threatened species or ecological communities are those living organisms or ecological communities that are at risk from extinction in the wild. Threatening processes operate to both cause and accelerate species extinctions. At global, national and State scales extinctions are irreversible and have evolutionary consequences and help to reduce ecosystem resilience. Avoiding extinction then

becomes an important strategy to avoiding biodiversity loss. Hence, the focus and priority on the recovery of species and ecological communities threatened by extinction.

Under accepted International (IUCN) criteria species and ecological communities are assigned a threat category, which denotes its conservation status in relation to its risk of becoming extinct. The conservation status categories, including critically endangered, endangered, vulnerable, as well as the presumed extinct (or for communities, presumed destroyed) categories. In Western Australia, there is also the additional categories of near threatened/possibly threatened species denoted as conservation dependant (P5) or 'priority' species (P1-P4), which do not satisfy the criteria (including in some cases the detailed survey requirement), but which are worthy of special investigation on the basis they may be, or become in the near future, threatened.

It is possible to rank priorities across species and ecological communities that are threatened, near threatened or possibly threatened using the rankings outlined above. This has been undertaken in the threat/value matrix (Table 21 in Appendix). As indicated by the levels of risk from extinction, 'critically endangered' and 'endangered' are given the highest level of threat. Hence, species and ecological communities within these categories are priorities for investment to prevent further decline towards extinction. Notwithstanding this assessment, species or ecological communities that are rare, or geographically restricted, but are not considered as being threatened, are also a priority in order to prevent them from becoming threatened.

Recovery refers to a range of urgent and priority actions (often listed in interim recovery plans or recovery plans), including scientific research, monitoring and evaluation, management, abatement of threatening processes and maintenance of key natural processes at various scales that will lead to enhancing the quality or contribute to the return of ecosystem function, or improvement in species/ecological community conservation status. The development and implementation of recovery plans or interim recovery plans is a priority for public investment.

Table 22 in the Appendix shows the number of threatened species and ecological communities within risk categories for each IBRA sub-bioregion. Figure 21 in the Appendix shows the cumulative value of the number of species/threatened ecological communities and priority species/ecological communities for each IBRA sub-region. The value of each threat category has been weighted according to its level of risk from extinction. The SW sub-bioregions, principally due to the high level of threatening processes and high level of endemism, are identified as threatened species and ecological community hotspots.

A threat analysis framework has provided the basis to prioritize marine fauna for conservation management. Table 23 in Appendix shows the relative value of fauna and priority for management. At a State level, green turtle, loggerhead turtle, dugong, and flatback turtle have been rated the highest priority fauna for management, with the Australian sealion, blue whale, humpback whale, southern right whale, tern spp., hawksbill turtle and whaleshark having similar value but are under less threat. Within this priority key direction are species listed for their conservation value under national or international agreements or treaties, such as the Japan-Australia Migratory Bird Agreement, China-Australia Migratory Bird Agreement, Convention on the Conservation of Migratory Species of Wild Animals, Convention on International Trade in Endangered Species of Wild Flora and Fauna and the Convention for the Regulation of Whaling.

Priorities are:

1. Continue to support the work of the scientific committees in reviewing and listing threatened species and ecological communities.

2. Continue to develop and implement recovery plans and wildlife management programs for all listed threatened species and ecological communities in priority order as determined by IUCN conservation status categories CR >, EN, > VU > priority .
3. Encourage management of critical habitat on private and leasehold lands (N) through financial incentives, and provide information for management of significant species and/or ecological communities, such as a wetland restoration and management manual.
4. Continue the Western Shield program (3.5 m ha) and expand into rangeland areas (fox and feral cat control (and investigations into technologies for control) and expand to include other introduced animals such as feral pigs in the south west.
5. Undertake biological surveys of threatened and priority taxa and ecological communities to determine conservation status and threats.
6. Ensure habitat management and monitoring of abundance and distribution of shorebird/migratory species.
7. Improve the coordination and management of the Threatened Species Network.
8. Continue to involve landholders and local communities in recovery programs for threatened species and ecological communities, and integration of recovery programs in regional natural resource management programs.

7.8 Conservation of landscape/seascapes scale ecological systems (integrating reserve and off-reserve conservation).

Landscape/seascape scale ecological systems comprise a set of protected areas and sites and off reserve conservation areas on private and leasehold lands, some of which are required to be actively managed for conservation in order to ensure ongoing biodiversity conservation. A functional ecological area maintains its species and ecosystems through maintenance of ecological processes and the natural resources they depend on, including air, water, soils, minerals etc. Central to achieving a functional landscape/seascape are addressing all priorities above, and addressing land/seascape threatening processes. Each priority is interrelated, and reliant upon being dealt with in an integrated fashion within the context of landscape/seascape priorities, although primary management responsibility may change between priorities. Hence, priorities for the establishment of a conservation reserve system, management of a protected area network and recovery of threatened species and ecological communities (and other significant species/ecological communities) are nested priorities within achieving overall functional landscapes/seascapes. The major addition in this category is to ensure that ecological processes and components are conserved across both reserves and other lands and waters.

Location and scale of priority management actions will vary between landscapes/seascapes, and be related to the impact of threatening processes upon natural resources, degree of landscape fragmentation/intactness, extent of protected area network and number of threatened species and ecological communities. Hence, functional landscapes may comprise a matrix of public and private lands and waters and the management thereof to abate threatening processes and bring about recovery and return of ecosystem function. In the marine area, the concept is similar, but the execution different, as there is no private seascape areas. Marine areas that are not targeted for extractive use or for intensive shipping or port developments etc. may be considered to be similar to off-reserve conservation areas, provided threats such as pollution, introduced species etc, are managed.

Spatial priorities for establishing functional landscapes in the Wheatbelt include identification and recovery of natural diversity recovery catchments, as defined under the State's Salinity Strategy (see Figure 22 in Appendix). In addition, Statewide 'species hotspots' (areas recognised for high number of endemic species under threat) also serve to identify landscapes of high biodiversity value and threat that require special priority attention (Figure 23 in Appendix).

Priorities are:

1. Identify and ameliorate significant threats to biodiversity, such as inappropriate fire regimes, introduced species, altered hydrology, industrial and coastal development, and inappropriate resource use and management.
2. Continue to develop and implement threat abatement plans for key threatening processes, with an emphasis on foxes, feral goats, feral pigs, feral camels, secondary salinisation of land and water, cane toads, and pathogens.
3. Undertake research into ecological processes that maintain ecological processes that threaten ecosystem function.
4. Undertake a survey of feral camels and feral goats to determine distribution and abundance and undertake assessment on biodiversity values.
5. Establish a major integrated management and research program for dieback management, including:
 - a research program to improve an understanding of the development, survival, dispersal and control of *Phytophthora* dieback;
 - assessment of the spatial extent of dieback affected areas and impact on biodiversity values;and
 - continue and expand dieback management control in targeted, high priority areas (both on and off-reserve).
6. Continue to develop and expand the natural diversity recovery catchments program from six to 25 catchments in the South West of the State.
7. Continue the development of commercially viable native species for broad scale planting to abate secondary salinisation and waterlogging, and undertake trials and develop techniques for rehabilitation of native ecosystems.
8. Identify and prioritise target landscapes of high biodiversity conservation values, and establish a financial incentive program to target conservation in such areas and State level biodiversity hotspots.
9. Identify and establish continental and bioregional scale ecological linkages, to maximize maintenance of biodiversity and provide for adaptation for climate change, that comprise key areas of the formal conservation reserve system and other complementary areas under secure management containing high biodiversity values, and complementary sustainable land uses.
10. Continue to support the development and application of new market-based instruments to facilitate adoption of biodiversity conservation on private and leasehold lands, including financial incentives, and develop appropriate programs such as Bushland Benefits, to bring about targeted conservation.
11. Continue to support and expand biodiversity management advisory programs such as Land for Wildlife and Urban Nature.
12. Undertake biodiversity response modelling to investigate effects of climate change on biodiversity, and incorporate findings into planning for and management of biodiversity.
13. Implement the State's Environmental Weed Strategy focusing initially on the 34 invasive weeds rated 'high' and 'sleeper' weeds; and undertake risk analysis of environmental weeds to determine

potential impacts and identify priority species for control, and develop and implement an Environmental Weeds Action Plan.

14. Develop and implement fire management plans for each bioregion that adequately provide for maintenance and recovery of biodiversity, with initial focus on savannah woodlands and hummock grasslands.

15. Develop effective management protocols for unallocated Crown land and unvested Crown reserves to ensure that biodiversity values are not diminished.

16. Continue the work of the Roadside Conservation Committee to promote and provide guidance for the management of roadside native vegetation.

17. Develop and implement a new advisory service and incentives program for the rangelands to bring about integration of biodiversity and sustainable production through accredited property management plans for pastoral leases and Indigenous lands.

18. Develop and implement appropriate strategies to minimise the effects of introduced marine pests on the conservation of marine biodiversity and ecosystem integrity.

19. Continue to implement the State Salinity Strategy, and develop the Salinity Investment Framework to identify priorities.

8 Discussion and conclusions

8.1 Comparing the results

There are many important natural resource assets across Western Australia. However, not all are in need of investment in management to protect them against threats. This report helps separate important assets that are under a high level of threat, and potentially in need of additional investment, from those assets that are under a lower level of threat.

8.2 Where are the assets and threats

Table 13 provides a summary of the number of assets recorded in each of the three Tiers. Comparison with the 2003 report is difficult for the following reasons;

- There has been a change in the number of IBRA regions
- South coast has mapped all its waterscapes whereas other regions have not
- Coast and marine High Value assets have been included but not all value and threat levels have been assessed across the state
- TEC, DRF and priority flora information was not updated from the previous report

Table 13 Summary of asset classes and their level of importance (based on value and threat) in Western Australia

Asset class	Sub-class	Tier 1 (High importance)	Tier 2 (Medium importance)	Tier 3 (Low importance)
Fish habitats and species		4	22	41
Coast and marine		17	20	9
Agricultural land	Productive land	1 soil-landscape zone	17 soil-landscape zones	13 soil-landscape zones
Water Resources	Water supplies (includes PDWSA and RIWIA areas)	121	83	19
	Waterscapes (includes wetlands and waterways)	126	257	199

Biodiversity	Current reservation status terrestrial	6 IBRA sub bioregions	11 IBRA sub bioregions	37 IBRA sub bioregions
	Current reservation status marine	4 recommended marine conservation reserve regions	23 recommended marine conservation reserve regions	20 recommended marine conservation reserve regions
	Significant marine fauna	5	15	5

8.3 Management feasibility studies

Implementation of the Salinity Action Plan has resulted in the development of the Salinity Investment Framework. In SIF, the three tiers identified above, are generally prioritized as the first tier with the highest priority for collecting information on management feasibility, followed by assets in the second tier and then those in the third.

The term feasibility is used to describe the potential of a management option for an asset to achieve a specific goal or be protected from a specific threat. The success of a management option is dependent on a number of factors, which include:

- Specific goal for the asset (recover, maintain, or adapt)
- Assessment of biophysical threats to the asset
- Assessment of technical feasibility capacity to manage the threats
- Social and political capacity to apply adequate resources (Sparks et al., 2006)⁴.

The SIF Phase II report (Sparks et al., 2006) is based on 'desk top' analysis using a range of assumptions about possible treatments, the treatments that could be used in different situations, and about their costs and benefits, using varying methodologies for the agricultural land, rural infrastructure, biodiversity and water resource assets. The findings are preliminary, but will be useful in helping to set priorities for further investigations. The information on the suggested interventions will be used to provide a preliminary assessment of what might be needed to address the salinity threat to the assets.

Table 14 describes a set of criteria that may guide compilation of feasibility information that were developed for salinity management. Assessment of feasibility may lead to some significant changes to the ranking determined by the threat-value matrix. For example High Value, Low Threat assets (third tier in Table 1) may have a high level of feasibility and could attract a higher priority for investment. Some first tier asset items (High Value High Threat) may become low priority for investment, on the

⁴ Sparks, T, George, R, Wallace, K, Pannell, D, Burnside, D & Stelfox, L 2006, Salinity Investment Framework Phase II, Western Australia, Department of Water, Salinity and Land Use Impacts Series Report No. SLUI 34, 86p.

basis that the threat cannot be addressed within operational constraints (low feasibility). Completing the feasibility investigations on each asset item, and placing these items on the third axis in Figure 1, will help determine the priority to be given to the individual asset items.

Table 14 Information requirements to assist determination of success of actions

Criteria	Points to consider
Acceptability	<ul style="list-style-type: none"> • Has the process identified the asset or assets as having a high level of importance? • Does the goal (recover, contain or adapt) for the asset have widespread community support? • Will the management option to achieve this goal have broader community and landholder's support? • Highlight local government and regional organisation involvement if any
Dependability	<ul style="list-style-type: none"> • Considering both technical feasibility and social capacity what is the probability that the management option will achieve the goal for the asset?
Investment return	<ul style="list-style-type: none"> • What is the expected cost of implementing the management option? • Contributing partners and funding contributions (time, works undertaken by the land-holders etc) • Where investment will result in extensive private benefit, is there an appropriate balance between Government and Community resourcing? • For projects greater than \$1 million dollars, does a cost effectiveness analysis indicate this program will be the most efficient approach to deliver the positive returns to investment? • Does the program address multiple issues and have complementary effects for other programs?
Precaution	<ul style="list-style-type: none"> • Is the program important to avoid serious or irreversible outcomes? • Are there likely to be thresholds where impacts rapidly increase? • How quickly do we need to act to avoid greater impacts? • Is there chance of unintended consequences causing negative impacts?
Timeliness	<ul style="list-style-type: none"> • Is the program necessary to addressing prerequisite issues? • Does this program require other actions to be taken before it can be successful? • Will this program prevent impacts from occurring or from increasing? • Will rates of change of impact severity increase over time? • How long will it take to successfully address the issue and deliver the outcomes?
Monitoring and Evaluation	<ul style="list-style-type: none"> • An appropriate evaluation and monitoring method should be developed that demonstrates achievement or non-achievement of goals for assets.

8.4 Future planning

The assessment of asset classes within this report has been quite detailed. However, there are a number of gaps or 'under-done classes' that need to be addressed. Investigations into identifying important assets within these underdone classes may well form a priority for future investigations by the State.

The following list identifies the classes of assets not covered by this assessment:

- European and Indigenous cultural assets: This includes all biophysical assets such as indigenous significant sites (e.g. Caroline's Gap, Gnammas (watering hole), granite outcrops) and European heritage sites (e.g., Toapin Weir- Quairading).
- Unique land management issues on Indigenous land holdings: Section 3.16 of WA Bilateral,
- Infrastructure: this includes roads, rail, and towns.

- Agricultural land: The assessment in this document is very broad. Further, more detailed, assessments should examine individual soil and land types within regions as assets. This information is available within the Department of Agriculture and Food, but was considered too detailed for this overview assessment. An assessment of the off-site effects on public and private assets from agricultural land uses is not covered in this document. To discuss the asset at threat without examining the cause is a limitation of the document.
- Wetlands: Although the Water resource process has assessed some significant wetlands within DoIW and Ramsar classifications, not all have been individually assessed. In some cases there are 1000's of individual wetlands within wetland groups (e.g. conservation category wetlands on the Swan Coastal Plain and other important wetlands identified in DoW and other publications). To expedite the assessment of waterscape assets some groups of wetlands have been assessed as one asset. These assets should be considered individually.
- Rangeland and coastal and marine natural resource asset information (condition, value, and threat) is generally limited.
- Consideration of the findings of SIF II and how the assessment of the feasibility of management of broader NRM threats outside salinity affected areas can be addressed.
- Synthesis of different asset classes – this would enable comparison between different assets and different agency priorities. A method of combining different asset classes would enable stakeholders to view the locations of multiple assets, across asset classes. However, such a methodology would be complicated and would require extensive collaboration between agencies. The Water Resources maps could provide a basis for future synthesis of assets.

9 Appendices

9.1 *Methodology for each asset class*

9.1.1 Fish Habitat and Species

At the outset of this process, the DoF had already completed extensive work on prioritising the management of fish resources and preparation of:

Commercial Fisheries Management Plans

Recreational Fisheries Management Plans

Aquaculture Plans

Fisheries Environmental Management Plans (at a bioregional scale)

Annual State of the Fisheries Report

All of these publications and resources were combined with expert opinion to complete the following value-threat assessment of aquatic assets and fish resources.

9.1.1.1 Measuring Value

Most fisheries assets have numerous values associated with them. It is important to acknowledge and score these multiple values. Values were grouped into three broad categories economic, social and environmental:

Economic: The commercial fisheries of WA generate returns of approximately \$600 million/year.

Recreational fishing is one of the State's most popular leisure activities and the fishing industry is a major employer in some rural areas.

Social Values: Recreational fishing is one of the State's most popular leisure activities.

Environmental Values:

Biodiversity: Biodiversity refers to the variety of genes, species and ecosystems, and is essential to human wellbeing in many ways. It underpins ecological processes that are vital to human health and survival and the continued evolution of life on Earth.

Uniqueness: Some habitats and ecosystems are representative of environmental systems that do not occur outside of WA.

Using the following scale, fish resource assets were scored for their economic, social and environmental values described above:

1 = None, the attribute does not contribute to the value of the asset

2 = Minor, the attribute contributes to the asset at a local level

3 = Moderate, the attribute contributes to the value of the asset at a local and regional scale

4 = Important, the attribute contributes to the value of the asset at local, regional and state scale

5 = Significant, attribute contributes to the value of the asset at a local, regional, state and national level

Unknown, unable to answer

An overall score for value was obtained by adding the environment, social and economic scores. A total score of 15 could be obtained.

The High, Medium and Low value scores were as follows:

High = 10 – 15

Medium = 5 - 9

Low = 1 - 4

9.1.1.2 Measuring Threats

Threats considered included:

Fishing by Australian and foreign fleets

Eutrophication

Introduced Marine Pests

Pollution from point sources

Ecosystem fragmentation

Coastal development including the development of petroleum products

Land development: intensive agriculture

Water development: aquaculture and boating facilities

Direct loss of fish habitat (reclamation and dredging)

Commercial fishing

Using the following scale the threats to assets were scored:

1 = No other threats of significance

2 = Minor, impacts will occur in 75 years or more or significant impacts have already occurred and not expected to get any worse.

3 = Moderate, impacts will occur in 20 to 75 years

4 = Severe, impacts will occur over next 20 years

5 = Extreme, impacts will occur in a few years and impacts will be significant.

Unknown = unable to answer question

The High, Medium and Low Threat bands were defined as follows:

High = 4 – 5

Medium = 3

Low = 1

9.1.2 Marine and Coastal Assets

A list of marine and coastal assets was obtained from the DPI. This table listed marine and coastal assets in WA, and several threats and values for each asset. All listed marine and coastal assets were defined as High Value. Each threat for an asset was given a ranking based upon whether it represented a (i) High Threat, (ii) Medium Threat or (iii) Low Threat. In order to classify each asset by a single threat ranking (i.e either High, Medium or Low) the assets were subjected to a basic data analysis

9.1.2.1 . Data analysis

Each single threat for an asset was scored based upon whether it was a (i) High Threat, (ii) Medium Threat or (iii) Low Threat. High threats were give a score of 15, medium threats 10 and low threats 5. The total scores for each asset were calculated.

These final scores were used to determine a single threat ranking for each asset, based upon the total scores where:

Assets with a score between 67 –100 were ranked as High Threat

Assets with a score between 33 – 66 were ranked as Medium Threat

Assets with a score between 0 - 32 were ranked as Low Threat

This method is comparable with methods used by the Department of Water and the Department of Fisheries to assign threat levels.

The results of this method was then subjected to a review by coastal and marine expert Dr Ian Eliot, with the final result producing 17 High Threat assets, 20 Medium Threat assets and 9 Low Threat assets (Table 18).

Section 9.1.2 Marine and Coastal Assets Methodology

Table 15 Marine and Coastal assets, listing values and threats

Region	Area	Threat	Value
Kimberley	Rowley Shoals and other off shore islands	Illegal fishing and imported marine pests, health risks (H)	Biodiversity richness and refugia; high scenic value (H) charter boats, tourism and yachting (H), petrochemical resources (H)
	Wyndham, East Kimberley	Illegal fishing and imported marine pests health risks (H); increasing tourism; fire (H); changing flood regime of the Ord River (M);	Biodiversity (H); Cultural sites and traditional uses (H) wilderness areas of high scenic value (H) potential for mariculture (M) charter boats, tourism and yachting (M) port facilities at Wyndham (L) petrochemical resources (H)
	Derby, West Kimberley	Illegal fishing and imported marine pests health risks (H) emerging tourism, pressure points including pearling, aqua, charter boats (H), oil & gas industry establishment (M); fire (H)	Cultural sites and traditional uses (H) wilderness areas of high scenic value (H) Potential for mariculture (M) charter boats, tourism and yachting (M) potential for marine tourism (M); petrochemical resources (H); port facilities at Derby (M)
	Salt Water Country (Salt water country is represented by Wyndham, East Kimberley, Derby, West Kimberley, Dampier Peninsula)	Illegal fishing and imported marine pests health risks (H) emerging tourism, pressure points including pearling, aqua, charter boats (H), oil & gas industry establishment (M); fire (H) & governance (H)	Traditional Aboriginal cultural and heritage (H) wilderness areas of high scenic value (H) potential for mariculture (M) charter boats, tourism and yachting (H)
	Dampier Peninsular	Illegal fishing and imported marine pests health risks (H) Increased ease of access (M) aquaculture (M)	Biodiversity (H); Traditional Aboriginal cultural and heritage (H) wilderness areas of high scenic value (H); petrochemical resources (H); port facilities at Dampier (H)
	Waterbank	Increasing coastal tourism (M), fire (H) governance (H); storm surge & flooding (H), health risks (H)	Traditional Aboriginal cultural and heritage (H) wilderness areas of high scenic value (H)
	Cable Beach	Increasing tourism (H), proximity of development to shore (M); governance (H); traffic on the beach (H)	Wilderness areas of high scenic value (H); cultural heritage sites and traditional uses (M);
	Broome	Proposed boat harbour site (H) & increasing urban development in close proximity to the shore (M)	TEC & indigenous values, recreational uses (H) charter boats, tourism and yachting (H); port facilities at Broome (H); geoheritage – dinosaur tracks(H)
	Roebuck Bay	Increasing tourism (H), traffic on the beach (H); poorly managed pastoral land use adjacent (H)	Ramsar wetland, JAMBA/CAMBA (H); wilderness areas of high scenic value (H)
Pilbara	80 Mile Beach	Increasing tourism (H), traffic on the beach (H); poorly managed pastoral land use adjacent (H) uncontrolled camping (M)	Major recreational fishing resource (H) cultural sites and traditional uses (M)
	Port Hedland	Storm surge in industrial area (M), dredging and spoil management (H) imported marine pests (H)	Regional community & industrial centre (H); port and harbour facilities at Port Hedland (H)
	East Pilbara & Roebourne	Storm surge and flooding (M), Point Samson small boat harbour; recreational fishing (M) lack of management planning (M)	Mangroves (H), Aboriginal and cultural heritage sites (H); fish stocks (M) ecotourism (M)
	Burrup Peninsula	Heavy industry and port development (H); governance (H); dredging and spoil management (H) imported marine pests (H)	Wilderness areas of high scenic value (H); cultural heritage sites (H); geoheritage (M) regional community & industrial centre (H); port and harbour facilities (H), petrochemical resources (H)
	Dampier Archipelago	Commercial fishing & recreational boating (M)	Marine biodiversity and habitat values (H); recreational fishing (H)
	Barrow, Lowen & Montebello Archipelagos	Proposed gas processing and other industrial sites (H); charter boat operations (M)	Charter boat operations (M) marine biodiversity and habitat values (H) recreational fishing (M), petrochemical resources (H)
	Ashburton	High visitation (M), boat harbour, storm surge (H)	Coastal and marine biodiversity and habitat values (H); regional centre (M) harbour facilities (M)
Gascoyne	Exmouth Gulf	Storm surge and flooding (H), mariculture (M), commercial fishing & recreational boating (M), governance (H)	Coastal and marine biodiversity and habitat values (H); regional centre (M) harbour facilities (M); Exmouth Boat Harbour (M)
	Ningaloo coast (Vlamingh Head to Point Quobba)	Increased tourism (H); poorly managed pastoral land use adjacent (H); uncontrolled camping (M)	Coastal & marine biodiversity & habitat values (H); coastal and marine recreation (H); geoheritage (H); Aboriginal and cultural heritage sites (H)
	Carnarvon	Poorly managed pastoral land use adjacent (H); commercial & recreational fishing (H)	Gascoyne River and mouth (M); regional centre (M); Carnarvon Boat Harbour (M)

	Shark Bay	Increased uncontrolled tourism (H); commercial & recreational fishing (H); governance (H); feral animals (H); poorly managed pastoral land use adjacent (H)	Geoheritage – World Heritage Area (H); coastal and marine biodiversity and habitats (H); boundary of major biogeographical regions (H); Denham Boat Harbour (M)
Mid-West	Kalbarri	Increased tourism (H); commercial & recreational fishing (L); estuary sedimentation (M); safety of marine access (H); urban expansion (M); feral animals (H)	Scenic value of Murchison River and mouth (H); geoheritage – coastal gorges & Zytorp Cliffs (M); coastal & marine biodiversity (M); coastal and marine recreation (H); Kalbarri Boat Harbour (M)
	Northampton Shire	Increased tourism (H); commercial & recreational fishing (L); coastal erosion & susceptible to sea level rise (H) governance (H)	Coastal and marine biodiversity and habitats (H); coastal and marine recreation (H); protected waters for small boat mooring at Port Gregory and Horrocks (M)
	Abrolhos Archipelago	Increased tourism (L); commercial & recreational fishing (H); governance (H)	Coastal & marine biodiversity & habitat values (H); coastal and marine recreation (H); geoheritage - coral reefs and atolls (H); cultural heritage sites – Batavia Sites (H)
	Geraldton - Greenough	Increasing urban population (M); dredging and spoil management (H) imported marine pests (H)	Major regional centre (M); port facilities at Geraldton (H) coastal and marine recreation (H); commercial & recreational fishing (H)
	Dongara/Port Denison	Increased tourism (L); governance (M); pollution in small boat harbour (M) & harbour cleanliness (M); onshore oil and gas facilities (L)	Commercial & recreational fishing (H); offshore oil and gas field (M); small boat harbour – Port Denison (H)
	Carnamah – Coorow	Increased tourism and commercial fishing (L)	Coastal and marine recreation (M); commercial & recreational fishing (M) geoheritage - Beagle Islands and inner shelf platforms (H)
Wheatbelt	Dandaragan	Rapidly increasing urban population (H), tourism and commercial fishing (L)	Coastal & marine biodiversity & habitat values (H); coastal & marine recreation (M); commercial & recreational fishing (H); major regional centre (H); Jurien Boat Harbour (H)
	Gingin	Rapidly increasing urban population (H), increased tourism and commercial fishing (L)	Lancelin, Seabird and Ledge Point & Guilderton = regional centres (L); Moore river and estuary (L); coastal & marine biodiversity & habitat values (H); coastal & marine recreation (M); commercial & recreational fishing (H)
Perth	NW sector:	Rapidly increasing urban population (H); expansion of NW corridor and unmanaged urban sprawl (H); impacts of establishing supporting infrastructure (roads etc.) (H); marine tourism (M); impact of marine users (M); governance (H)	Biodiversity (H); pristine coastal and marine environment (M); cultural heritage sites & areas of spiritual significance (H); geoheritage (M); potential for marine infrastructure (M); tourism & recreational values (M); high quality, clean beaches (H); opportunities for sustainable development innovative design (H); ship wreck site (M);
	North central	Pressure on environment from marine users (H); proximity of housing to beach and potential erosion risk (coastal vulnerability) (H); parking problems; anti-social behaviour at some coastal nodes (M); marine and coastal pollution (M); population pressures (M); provision of sufficient recreational boating facilities (L); overcrowding of beaches (L); Department of Defence Campbell Barracks (L); governance (H)	biodiversity diversity of benthic habitats (H); existing marine and land-based coastal facilities (M); regional beach nodes (H); cultural heritage & areas of spiritual significance (M); Department of Defence Campbell Barracks (M); variety of beach experiences on high quality beaches (H); beaches in close proximity to large population(H);
	South central	Pressure on environment from marine users (M); uncontrolled public access to beach (H); beach erosion (eg. Port Beach); provision of sufficient marine facilities (L); overcrowding of beaches (L); dredging and cement works (M); outer harbour construction (M); chemical spills (M); desalination bitterns (M); potential impacts of proposed marina (M); governance (H)	Cultural heritage (M); diversity of benthic habitats including seagrasses (M); regional beach nodes (M); port and industry facilities (M); variety of beach experiences on high quality beaches (H); protected waters – marine habitats and spawning areas (H); diving (M); ports and industry (H); recreational boating facilities (M)
	SW sector	Rapidly increasing urban population and associated coastal development (H); pressures from marine users (M); provision of sufficient marine facilities; managing the public foreshore and access to beach (H); governance (H); increasing provision of infrastructure (M);	;biodiversity of benthic environments (H); cultural heritage & spiritual values (M); quality of beaches (H); geoheritage - Point Peron & Penguin Island (H)

Peel	Mandurah	Rapidly increasing urban population (H) increased tourism (M); proliferation of canal estates & their impact on water quality (H); governance & health issues (M); acid sulphate soils (M)	Major regional centre (H); small boat harbour and sheltered mooring facilities (H) coastal & marine recreation (M); commercial & recreational fishing (H); Ramsar wetlands (H), Thrombolites in coastal wetlands (M),
	Waroona	Rapidly increasing urban population (H); proliferation of canal estates & their impact on water quality (H); governance & health issues (M); salinisation of coastal freshwater wetlands (H)	Ramsar wetlands with Thrombolites (H); coastal & marine recreation (M)
South-West	Harvey	Increasing peri urban population (M); governance (M); recreational fishing (L); Uncontrolled public access (H); eutrophication of irrigation channels (H); acid sulphate soils (M)	Coastal & marine recreation (M), coastal wetlands (M),
	Bunbury	Sea change population issues (L); shore stabilisation problems (M); governance (H); reduction of riverflow (M); pollution of sheltered beaches (H); eutrophication of irrigation channels (H) acid sulphate soils (M)	Major regional centre (H); port & harbour facilities at Bunbury (H), Coastal & marine recreation (M), coastal wetlands (M),
	Capel	Increasing peri urban population (M); sand mining (L);	Coastal & marine recreation (M);
	Busselton	Sea change population issues (H); storm surge and shore stabilisation (H); acid sulphate soils (M); seaweed accumulation (M); governance (H)	Coastal wetlands (including a Ramsar wetland)(H), Coastal & marine recreation (H), geoheritage (M), barrier estuaries (M); extensive sea grass meadows (M); small boat harbour – Port Geographe (M)
	Augusta-Margaret River	Increased population density (H); tourism (H); conflict between recreational & commercial uses of nearshore waters (M);	Diversity of temperate habitats in inshore waters (H), Coastal & marine recreation (H), surfing conditions (H); High landscape values (H);
	Nannup	Salt water intrusion of coastal wetlands (L), water quality (M); reduced water flow into estuaries (M); introduced fish species (M)	Coastal & marine biodiversity & habitat values (H); geoheritage (M);
	Manjimup	Salt water intrusion of coastal wetlands (L), water quality (M); reduced water flow into estuaries (M); introduced fish species (M): Tourism (M), governance (H)	Coastal & marine biodiversity & habitat values (H); major fish nursery at Windy Harbour (H), High landscape values (H); coastal and marine recreation (H); commercial & recreational fishing (H)
Great Southern	Denmark	Uncontrolled public access (H), expansion of rural lots (H);	Coastal & marine biodiversity & habitat values (H); High landscape values (H), Lagoonal estuaries (H), Surfing conditions (M); coastal and marine recreation (H); commercial & recreational fishing (H)
	Albany	Erosion at Emu Point (H), increased population pressure (L); dieback of coastal vegetation (L), uncontrolled public access (M), recreational boating (M)	Coastal & marine biodiversity & habitat values (H); Major regional centre (H); port & harbour facilities at Albany (H), High landscape values (H),
	Jerramungup	Dieback of coastal vegetation (M), tourism (L), recreational boating (L), uncontrolled public access (M)	Coastal & marine biodiversity & habitat values (H); Small boat harbour at Bremer Bay (M), high scenic value (H),
Goldfields-Esperance	Ravensthorpe	Erosion (M), significant population increase (mine related) (L)	Coastal & marine biodiversity & habitat values (H); Small boat harbour at Hopetoun (M), high scenic value (H),
	Esperance	Erosion (H), boat harbour dredging (H): uncontrolled public access (M)	Biodiversity richness and refugia (H); high landscape value (H) charter boats, tourism and diving (H); Major regional centre (H); port & harbour facilities at Esperance and Bandy Creek (H); geoheritage – Cape Le Grand, Recherche Archipelago and Cape Arid (H);
	Dundas	Uncontrolled public access (H)	Coastal & marine biodiversity & habitat values (H); geoheritage - speleology (H), High landscape values (H); Cultural heritage (H);

9.1.3 Threats to Agricultural Land

The Department of Agriculture and Food's process is based on a combination of expert knowledge and the inherent physical qualities of the land resource to determine threat. Value is based on the average value of agricultural land (\$/ha) determined from year 2000 Bank West data.

Information on threat and asset value were obtained and put into an 'NRM issues database'. The NRM issues database provides information on the significance of NRM issues related to geographic areas of southwestern Australia.

The spatial framework for the assessments of value and threat is the soil-landscape zone as defined by the Natural Resources Assessment Group of the Department of Agriculture and Food. These zones delineate broad terrain types based on geomorphological criteria and are useful for gaining a regional perspective of landscape related issues. There are 31 zones described for southwestern Australia (Figure 19). Grouping of more detailed underpinning soil-landscape mapping creates the boundaries of the zones.

Five key NRM issues relevant to agriculture and related to soil and land were identified by a Department of Agriculture and Food expert panel. Biodiversity, plant or animal specific issues were not considered, and NRM issues of minor extent in WA (for example mass movement) are not included. The issues and their definitions are provided in Table 16.

Table 16 Key NRM issues facing agricultural land

Key NRM issues facing agricultural land	
Land salinisation	Risk of land salinisation considering the inherent susceptibility of the land to salinisation and land management practices.
Soil acidification	Risk of subsurface or subsoil acidification considering the inherent susceptibility of the land to acidification and land management practices.
Wind erosion	Risk of wind erosion considering the inherent susceptibility of the land to wind erosion and land management practices.
Water erosion	Risk of water erosion considering the inherent susceptibility of the land to water erosion and land management practices.
Soil structure decline/compaction	Risk of soil compaction/structure decline considering the susceptibility of the soil to compaction (texture/structure/organic matter/sodicity) and land management practices.

The NRM database at the Department of Agriculture and Food provides more information on the definition, processes and impacts of the issues. It also includes several other issues that influence the long-term sustainability of agricultural industries in Western Australia but have not been included in this assessment, as they do not directly threaten the agricultural land resource.

For each combination of NRM issue and soil-landscape zone, an estimate of the threat to the asset caused by the issue/process and the value of the asset being threatened was made. The threat - value matrix was then used to determine the priority of the asset/issue within a zone.

Tier 1 issues are of highest importance, Tier 2 of moderate importance and Tier 3 of low importance.

SOIL-LANDSCAPE ZONES OF SOUTH WESTERN AUSTRALIA

Based on Soil-landscape systems map version 3 - October 2001

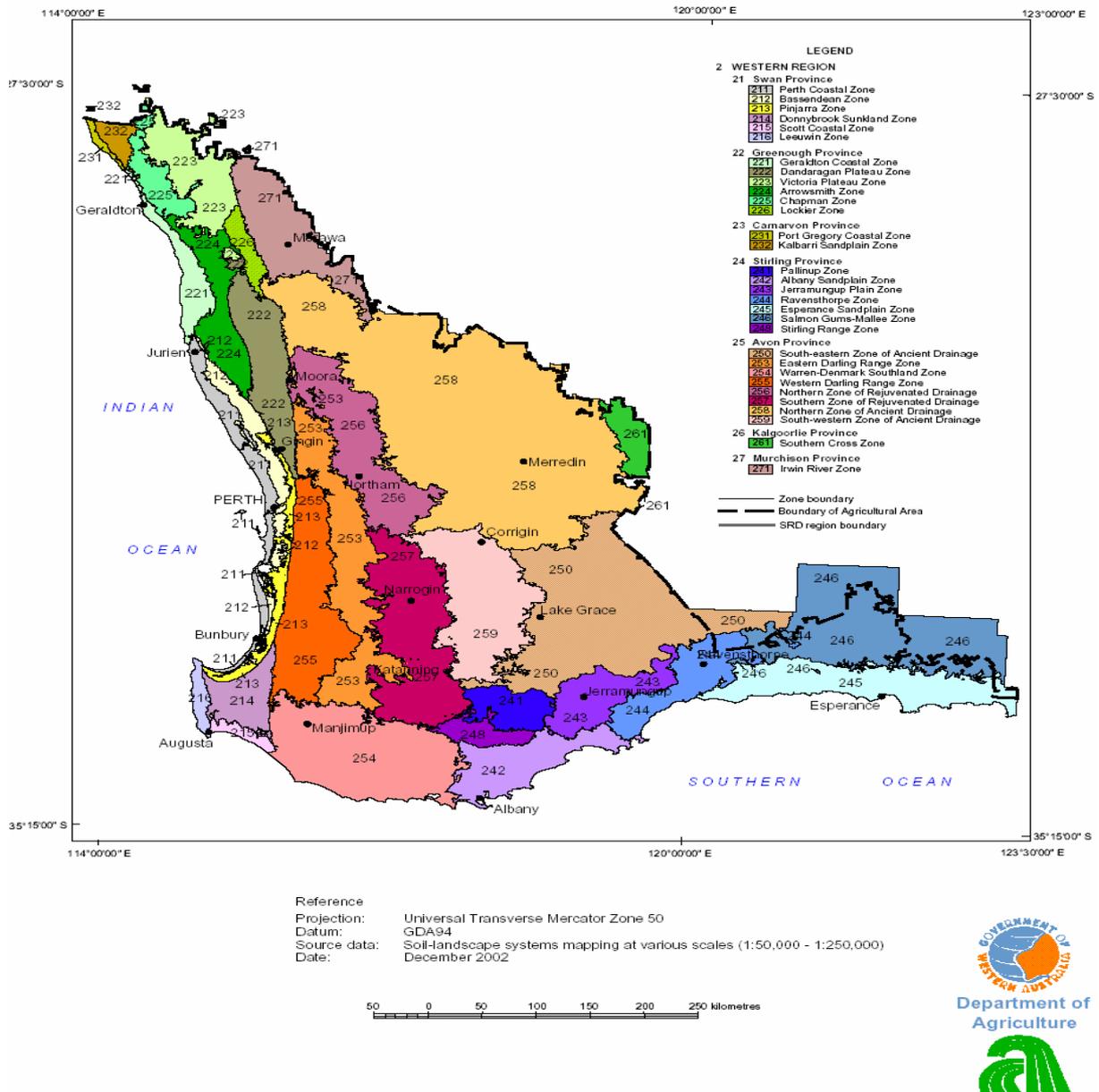


Figure 19 Soil-landscape zones of Western Australia

In addition, for each zone a summary table was prepared looking at the average threat to the land resource based on the five threatening processes. For example, if a particular zone had two issues of High Threat, one issue of Moderate Threat and two issues of Low Threat, the average threat was determined as Moderate. This process, although subjective, gives an indication of which zones are most at risk.

9.1.3.1 Measuring value

Value is the average value of agricultural land (\$/ha) per shire of land in year 2000 based on data from Bank West. The shire value data was then proportionally allocated to the soil-landscape zones based on the area of each shire in each zone. For the purposes of this exercise the agricultural land values have been allocated to three categories – High (H), Moderate (M) and Low (L). High Value land average value of >\$3000/ha, Moderate \$750 – 3000/ha and Low <\$750/ha. Average agricultural land value is strongly correlated with rainfall (higher rainfall areas tend to have higher land values) and proximity to urban centres.

9.1.3.2 Measuring threat

The level of threat is based on an assessment of the timing of a significant impact from the process/issue – ie when will the issue occur, and how big will the impact be. The threat categories were described as follows:

High: Current/imminent risk of high impact

Moderate: Current/imminent risk of moderate impact, or Medium-term risk of high impact

Low: Current/imminent risk of low impact or Medium-term risk of low-moderate impact, or Long-term risk of low-high impact

The terms used to describe these threat categories are defined as:

Current/imminent: significant impact realised within 0-20 years

Medium-term: significant impact within 20-75 years

Long-term: significant impact greater than 75 years

High impact: majority of asset at risk

Moderate impact: some of the asset at risk

Low impact: minority of asset at risk

For salinity-related issues, information already collected as part of the SIF and results from project work on the rural towns project were used to determine threat levels. For the soil-related issues, information held in the soil-landscape database of the Department of Agriculture and Food was used to determine the size and nature of the threat based on the current extent of the land degradation issue and the inherent susceptibility of the land.

9.1.3.3 Assigning priorities to regions

The spatial unit of assessment is the Soil-landscape Zone. Each zone falls within one or more NRM regions. Table 17 gives the percentage of each soil-landscape zone within each NRM region enabling an assessment of priority issues by region to be determined.

Table 17 Distribution of soil-landscape zones by % within NRM regions

Soil-Landscape Zone	NRM region					
	Avon	Northern Agricultural	South Coast	South West	Swan	Other areas (Rangelands)
Perth Coastal		26		20	54	
Bassendean		28		22	50	
Pinjarra				73		
Donnybrook Sunkland				100		

Scott Coastal				100		
Leeuwin				100		
Geraldton Coastal		100				
Dandaragan		80				
Victoria Plateau		100				
Arrowsmith		100				
Chapman		100				
Lockier		100				
Port Gregory Coastal		100				
Kalbarri Sandplain		100				
Pallinup			98	2		
Albany Sandplain			100			
Jerramungup			100			
Ravensthorpe			100			
Esperance Sandplain			95			5
Salmon Gums – Mallee			52			48
Stirling Range			100			
South Eastern Zone of Ancient Drainage	81		8	5		6
Eastern Darling Range Zone	18			52	30	
Warren-Denmark Southland			44	45		
Western Darling Range				81	19	
Northern Zone of Rejuvenated Drainage	73	17				
Southern Zone of Rejuvenated Drainage	12		17		70	
Northern Zone of Ancient Drainage	77	23				
South-Western Zone of Ancient drainage	54				46	
Southern Cross	100					
Irwin River		100				

9.1.4 Water Resources

At the outset of this process the DoW had already completed extensive work on prioritising water resource assets through the:

- State Waterways Needs Assessment (WRC, 2002)

- Process for prioritising water resource assets for the Salinity Investment Framework (DoE, 2003)

The State Waterway's Needs Assessment (WRC, 2002) value, condition, pressure and response results were re-arranged to generate threat value results as a priority for this investigation. These data covered all waterways at a broad level (all tributaries assessed as part of the larger waterway system) within Western Australia. Unfortunately the value and threat data did not extend to:

- public drinking water supplies
- proclaimed groundwater areas
- wetlands not associated with waterways

Further information for these water resource categories was required. The method employed to measure value and threat for water resources assets in the SIF was modified to measure all threats including salinity.

A guided expert panel approach was used to assess each asset for a number of criteria. The expert panel was given access to published and spatial data when scoring criteria. The expert panel comprised of DoW head office staff. Regional staff were given the opportunity to review all results and their comments were incorporated.

Given the short time frame required for completion of this process it required a centralised approach. The intention was to compile a draft list of assets and to assess them in head office prior to referring the assets to DoW regions for confirmation of value and threat assessments.

9.1.4.1 Measuring Value

Most water resource assets have numerous values associated with them. It is important to acknowledge and score these multiple values. Values were grouped into three broad categories economic, social and environmental:

Economic: Industries throughout Western Australia (eg. agricultural, aquaculture, mining, fisheries, tourism etc.) derive a multitude of economic benefits from water resources. For example, direct benefits would include the provision of water to enable agricultural production and mineral processing. Similarly provision of fresh water for drinking is another direct benefit. Indirect benefits derived from water resources (specifically waterways) would include:

Improved water quality due to a healthy riparian ecosystem.

Decreased algal blooms and eutrophication due to the flushing effect of flooding.

Increases in biological/fauna health through a reduction in heat or cold stress due to windbreaks and shelter provided by riparian vegetation.

An increase in the capital value of land due to the potential for diversification into areas such as eco-tourism.

Social Values:

Recreation: Water resources such as water supplies and Waterscapes can provide pleasant surroundings that are popular for various recreational pursuits. Rivers and the riparian zone are an important recreational resource for fishing, swimming, bird watching, boating and other pursuits.

Spirituality and culture: Wetlands, rivers and foreshores are often places of spiritual and cultural significance. Traditional landowners may have strong spiritual attachments to watercourses. Wetlands, rivers and foreshores are also places of spiritual significance for non-indigenous communities.

Environmental Values:

Biodiversity: Biodiversity refers to the variety of genes, species and ecosystems, and is essential to human wellbeing in many ways. It underpins ecological processes that are vital to human health and survival and the continued evolution of life on Earth.

Uniqueness: Some habitats and ecosystems are representative of environmental systems that are no longer widespread and are therefore considered unique.

Aesthetics: The river and riparian zone or a vegetated public drinking water catchment or groundwater area tend to dominate the local landscape and may also contribute significantly to the regional landscape and so are important to the aesthetic value of an area.

Ecological function: ability of a watercourse to mitigate floods, increase water quality, cool the land, provide habitat for organisms.

Using the following scale, water resource assets were scored for their economic, social and environmental values described above:

1 = None, the attribute does not contribute to the value of the asset

2 = Minor, the attribute contributes to the asset at a local level

3 = Moderate, the attribute contributes to the value of the asset at a local and regional scale

4 = Important, the attribute contributes to the value of the asset at local, regional and state scale

5 = Significant, attribute contributes to the value of the asset at a local, regional, state and national level

Unknown, unable to answer

An overall score for value was obtained by adding the environment, social and economic scores. A total score of 15 could be obtained. A fourth value score was taken for assets assessed by the Salinity Investment Framework process for water resource assets. The value score from the SIF assessment was modified to disregard the extra value score and only consider environmental, social and economic scores.

The High, Medium and Low value score bands were as follows:

High = 10 – 15

Medium = 5 - 9

Low = 1 - 4

9.1.4.2 Measuring Threats

Threats considered included; erosion, sedimentation, eutrophication, salinity, feral animals, weed infestations, pollution from point sources, ecosystem fragmentation, land development: residential and rural residential, land development: intensive agriculture, land development - broad acre farming, land development – pastoral, water development - aquaculture and boating facilities, recreation, commercial fishing, industrial discharge, water abstraction agricultural drainage (eg coastal plain and saline land drainage). Using the following scale the threats to assets were scored:

1 = No other threats of significance

2 = Minor, impacts will occur in 75 years or more or significant impacts have already occurred and not expected to get any worse and or the threat affects less than 20% of the asset.

3 = Moderate, impacts will occur in 20 to 75 years and or the threat affects 20-50% of the asset.

4 = Severe, impacts will occur over next 20 years and or the threat affects 50-80% of the asset.

5 = Extreme, impacts will occur in a few years and impacts will be significant and or the threat affects more than 80% of the asset.

Unknown = unable to answer question.

The High, Medium and Low threat bands were defined as follows:

High =	4 – 5
Medium =	3
Low =	1 – 2

9.1.4.3 The mapping process for Water Resources

In order to determine the distribution of assets around the state, all Tier 1, Tier 2 and Tier 3 water resource assets were depicted on a map of the state (Figures 3-9). These maps give a visual representation of the location of multiple significant assets across state drainage basins of Western Australia. This builds on the 2003 version of the report and intends to highlight possible focus areas for the state, where there may exist multiple significant water resources. The methodology used for this mapping process is outlined below:

The state drainage basins were used to group assets into spatial areas as these can efficiently group water resources data. Most water resources assets are generally confined to a single drainage basin. However, if an asset occurred over several drainage basins (e.g. a groundwater area), it was placed into all of the drainage basins it occurred in. The use of drainage basins is a guide only and does not suggest that drainage basins should be used to define or delineate areas of high priority. They simply provide an overview of the distribution of significant assets around the state, which, if necessary, should be examined in more detail on an asset-by-asset basis. The number of Tier 1, Tier 2 and Tier 3 assets in each basin was assessed and mapped. This mapping provided a spatial grouping of assets around the state.

Assigning the drainage basins to groups

The data for all drainage basins in the asset class was used to separate the drainage basins into 'many', 'some' and 'none' groupings. The 75th percentiles or 4th quartile determined the 'many' group. A percentile grouping was used as it takes into account the distribution of the data, which is important in assessing natural systems where distributions are rarely normal. This gave a similar number of "many" drainage basins for each map. As the data was not normally distributed using a percentile measure ensured that each figure produced a similar number of 'many' groupings or red drainage basins. Assets below the 75th percentile were assigned the 'some' group and drainage basins with no assets became the 'none' group.

The fourth quartile (75th percentile) gives the top quarter of the data, which gives the 'many' grouping. It is also important to acknowledge those drainage basins that do not have any assets present and this is represented by the 'none' grouping. The remainder of the data from below the fourth quartile to 1 gives the 'some' grouping of data.

Each of the groupings (many, some and none) was then assigned a colour (red, blue striped and white respectively) and the drainage basins coloured to reflect their score. This gave a visual representation for each asset class about the numbers of assets of that type and their location in the state. Red drainage basins represented the top quarter of the assets, white drainage basins indicated there was no asset present (for that tier) and blue striped represented all other assets. This was depicted in map form to provide a visual representation of numbers of assets per drainage basin and their location throughout the state. Using the same colours for both Waterscapes and Water supply allowed comparison across the two asset classes. For example, even though one asset class might have a large number of data and another have a small number of data, both asset classes can be assessed relative to one another using this weighting system.

Combining Waterscapes and Water supply

The colours are used to separate the assets were given a score (white = 0, blue = 1 red = 2) and the scores for each of the different assets classes (Waterscapes and Water supply) were summed to determine the overall relative score for each drainage basin. Adding the colour scores for each drainage basin gave the overall relative number of assets for that basin and made asset classes comparable.

This was depicted in map form to give provide a visual representation of numbers of assets per drainage basin (Figures 10, 11 and 12). These maps showed the relative number of significant assets and their locations throughout the state. Drainage basins with a combined score (from Waterscapes and Water supply data) of 3-4 were “many”; a combined score of 2-1 “some” and a score of 0 for “none”.

Bias in the Data

A data bias is evident in this methodology because of the inconsistencies in data collection and presentation. For instance, asset identification has not been conducted in some regions while detailed asset identification has occurred in other regions. Consequently, a bias is created toward those areas where the most wide-ranging data has been amassed and a greater number of scores can be summed.

All South Coast waterscape assets have been mapped and this has produced an extensive number of assets in drainage basins in the South Coast NRM area. To reduce this bias the outlier drainage basin is automatically given a red colour (i.e. many). These outliers are removed before the percentile groups are calculated and therefore do not skew the results. Drainage basin 602 was an outlier with respect to Waterscapes and therefore was defaulted to a pink colour.

Table 18 Drainage basin scores used to determine grouping of basins, where “many” equals 75th percentile and above, “none” equals zero assets and “some” equals below 75th percentile to 1 asset.

Map	Drainage basin score		
	Many	Some	None
Tier 1 Waterscapes	20 - 4	3 - 1	0
Tier 2 Waterscapes*	39 - 9	8 - 1	0
Tier 3 Waterscapes [#]	16 - 3	2 - 1	0
High Value, Low Threat Waterscapes [§]	12 - 3	2 - 1	0
Tier 1 Water supply	20 - 6	5 - 1	0
Tier 2 Water supply	10 - 4	3 - 1	0
Tier 3 Water supply		5 - 1	0

*Drainage basin 602 has a score of 100 and is defaulted to the "many" category

[#]Drainage basin 601 has a score of 43, Drainage basin 602 has a score of 48 and are defaulted to the “many” category

[§]Drainage basin 602 has a score of 19 and is defaulted to the “many” category

Tier 1 Waterscapes and Water supply [@]	4 - 3	2 - 1	0
Tier 2 Waterscapes and Water supply [@]	4 - 3	2 - 1	0
All Tiers Waterscapes and Water supply	4 - 3	2 - 1	0

[@]These Drainage Basin scores are based upon the colours obtained from the original data, where red = 2, blue striped = 1 and white = 0

Using the mapping for other assets

A similar mapping process could be used for other agencies asset data, in order to combine across agencies and determine the distribution of multiple significant assets in the state. Combining across agencies using this method would help identify cross agency priorities where partnerships and linkages could be established.

If drainage basins were used to group other assets, such as biodiversity (IBRA regions, Reservation status) a bias towards these assets would occur, as they would be more likely to be counted multiple times. IMCRA (Interim Marine and Coastal Regionalisation for Australia) regions could be used to delineate assets in the coastal and marine regions of WA and allow comparison of marine and terrestrial assets.

9.1.5 Biodiversity Assets

For more information on the methodology process and outputs in relation to State Biodiversity Assets please refer to Appendix 9.2 – State Priorities for Biodiversity Management.

9.2 State Priorities for Biodiversity Management

Table 19 Current reservation status of the terrestrial conservation reserve system versus continental landscape threat class

State Level		Biodiversity Value		
Biodiversity Assets		High	Medium	Low
Landscape context and Threat	High	Ancient Drainage Rejuvenated Drainage Pindanland Hart South Kimberley Interzone Fitzroy Trough	Western Mallee Dandaragan Plateau Pentecost Mount Eliza 3	Perth Mitchell Berkeley Geraldton Hills Southern Jarrah Forest
	Medium	Fortescue Western Murchison	Roebourne Chichester Wooramel Eastern Murchison Victoria Bonaparte	Ashburton Cape Range Ord Lesueur Sandplain Fitzgerald Southern Cross Northern Jarrah Forest Edel Tallering Warren Augustus Eastern Mallee Tallering
	Low	Tanami Kintore Mackay McLarty Dune Field Central band, Nullarbor Plain Trainor Mann-Musgrave Block Eastern Goldfields	Carnegie Eastern Maralinga Central Shield	Lateritic Plain Hampton Mardabilla Recherche Rudall Northern band, Carlisle Hamersley

Table 20 Relative conservation value of recommended marine conservation reserves within IMCRA bioregions against threat⁵

Relative Conservation Value				
High		Medium		Low
Threat	High	Dampier Archipelago Exmouth Gulf Roebuck Bay Houtman Abrolhos	Peel Harvey Inlet Geographe – Cape Leeuwin King George Sound/Princess Royal Harbour Nth SIMP Leschenault Inlet Hardy Inlet	
	Medium	Walpole-Nornalup Inlets Recherche Archipelago Eighty Mile	Cape Preston Serrurier Islands Robe Bernier, Dorre & Dirk Hartog Islds Oceanic coral banks and Cambridge Gulf islands Broke Inlet	Buccaneer Archipelago Lagrange Bay Donnelly & Gardner Inlets West Cape Howe Stokes Inlet William Bay Port Gregory Kalbarri
	Low	Prince Fredrick Harbour Fitzgerald	Pender Bay-Cape Borda Depuch and Cowrie Creek Cape Vancouver-Bald Islands Red Bluff to Pt. Quobba Sth. Ningaloo MP Admiralty Gulf Vansittart Bay	Warren Beach St. Georges Basin Montgomery Islands Walcott Inlet/Secure Bay Londonderry Keraudren Lacepede Islands Black Point ⁶ Twilight

⁵ Priorities were established via a Marine Parks and Reserves Authority workshop (MPRA) in 1998 involving all key stakeholders using a framework developed by the Department of Environment and Conservation. (Simpson, C.J. and Bancroft, K.P. (1998). A framework for prioritising the establishment of marine conservation reserves in Western Australia. A Position paper prepared for the Marine Parks and Reserves Authority. August 1998. Marine Conservation Branch, Department of Environment and Conservation). The MPRA convened a workshop in March 2004, again involving all key stakeholders, to discuss a bioregional approach to the marine reserve program, the marine reserve planning process and the next marine reserve priorities.

⁶ Only 1 MPA candidate area has been identified for the Eucla Bioregion due to insufficient data available at publication of the Marine Parks and Reserves Selection Working Group report (CALM, 1994). Further biodiversity assessment will be required for this region to identify further candidate areas.

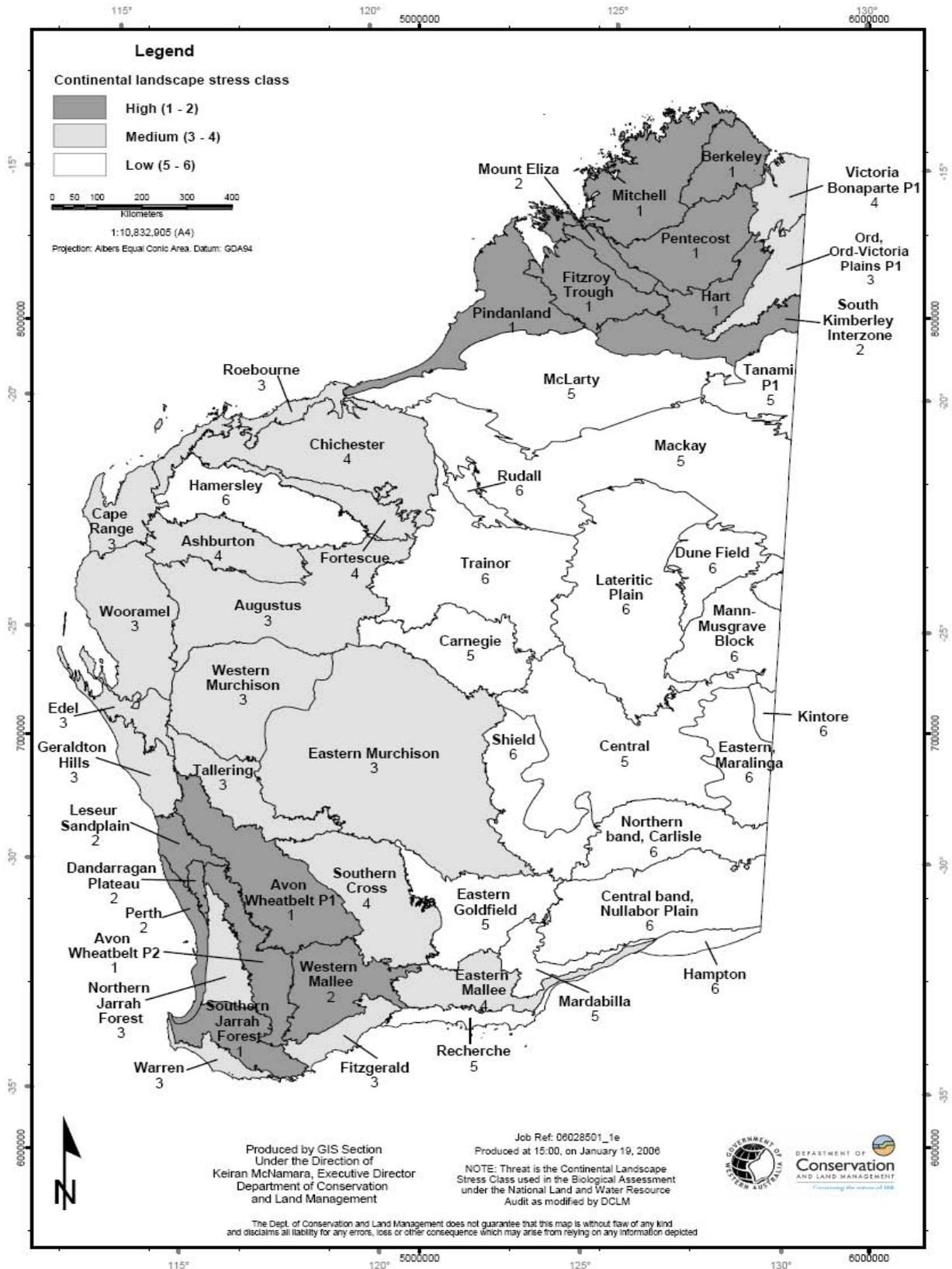


Figure 20 Continental landscape stress class for each IBRA sub-bioregion

Table 21 The relative value and threat across threatened species and ecological communities risk categories

State Level		Biodiversity Value		
Biodiversity Assets		High	Medium	Low
Threat	High	Critically endangered and endangered	Vulnerable	Priority 1-3
	Medium	Vulnerable	Vulnerable	Priority 1-3
	Low	Priority 4 and Conservation Dependant	Priority 1-3	Priority 1-3

Section 9.2 State Priorities for Biodiversity Management

Table 22 Threat versus value matrix for threatened species/ecological communities, and priority species/ecological communities

Province	FLORA								TEC					FAUNA									
	CR	EN	VUL	1	2	3	4	Total	CR	EN	VUL	Priority	Total	CR	EN	VUL	Conservation dependant	Lower risk	1	2	3	4	Total
AW1	170	180	131	106	93	73	80	833	1	13	10	71	95	8	50	274	17	3	1	116	2	15	486
AW2	106	177	161	26	96	67	187	820	4	16	12		32		175	158	1	2	5	107	22	32	502
CAR1				1		2		3	2				2	25	25	161	4	9	4	26		1	255
CAR2					1			1					0			21	5			15		3	44
CK1			6					6				2	2		1	2	4	1	4	8			20
CK2								0					0			1			1			1	3
CK3								0					0			1	4	5					10
COO1						2	8	10					0		1	6				1			8
COO2	16	5	62	35	25	10	49	202				4	4		3	17	2			17		10	49
COO3	4		5	28	1	15	4	57			3	3	6			4	16			16		3	39
CR1				3				3					0		3	14						1	18
DL1								0				24	24			22	4	16	1	24			67
DL2	1	2					1	4		100	11	3	114		2	53	1	2	5	19		6	88
ESP1	117	197	158	56	146	75	190	939	6	21	13	7	47	26	67	104	7	7	5	138	30	8	392
ESP2	15	12	10	12	4	23	29	105		4	4		8	6	19	45	1			33	5	6	115
GAS1								0					0	1		2				10			13
GAS2				9		1		10					0	2		21		1		3			27
GAS3			14	14			1	29		1			1			163				17		3	183
GD1								0					0		2	7				7		1	17
GD2								0					0										0
GS1	62	118	38	25	49	40	32	364			9		9			21	1	3	4	13	5	10	57
GS2	75	148	186	43	134	218	310	1114	1	62	7		70		22	3	1	2	5	11		2	46
GSD1		3	27					30		4			4		1	8				10		3	22
GSD2			1					1					0	1	5	12				40		2	60
GVD1								0					0		14	2		1		1		1	19
GVD2								0					0		2	4		1		2		1	10
GVD3								0					0		1					1			2
GVD4								0					0										0
HAM						1		1					0		3	18				4	1	10	36
JF1	23	63	215	33	76	156	389	955	3	4		10	17		92	761	14	5	60	143	214	22	1311
JF2	81	174	179	67	114	173	371	1159	12	2	1	8	23	54	95	605	11	7	91	193	200	13	1269
LSD1								0					0	2	1	2				7		2	14
LSD2			1					1					0		1	1		2	1	2			7
MAL1	29	2	43	17	37	16	68	212				5	5			7	1			2		2	12
MAL2	32	81	127	98	182	87	130	737	4			1	5		43	136	5		2	167	21	6	380
MUR1	5		1	17		3	88	114				3	3			43	4	1		12		6	66
MUR2				17	4	6	10	37					0			13	4			4		2	23
NK1								0		2		19	21		10	39	10	32	24	51		11	177
NK2			2					2					0					12	1	3		1	17
NUL1								0					0							12		7	19

NUL2								0					0			17	1			59	1	5	83
OVP1								0					0	4	3	1		1	2	41		11	63
OVP2								0					0		3	5			2	1			11
PIL1								0					0	1	17	10		3	136	72		3	242
PIL2								0		1			1		3			1		7			11
PIL3			19	2				21		42	10		52	1	2	3				105		1	112
PIL4				7				7					0		12	5		1	1	13			32
SWA1	9	9	46	4	9	42	50	169		3			3	5	3	4	1			5	1		19
SWA2	183	182	216	47	50	250	357	1285	224	260	2	201	687	84	103	114	8	5	44	133	161	23	675
TAN1								0					0		2	4		1		4		4	15
VB1				1				1		2			2	9	8	16	2		6	17		3	61
WAR	27	66	76	14	124	226	206	739	5	75	1		81	42	38	227	47	3	85	136	63	8	649
YAL1		9		2	4	1	12	28					0		4	53	3		5	4			69
YAL2	18	13	7	38	2	14	10	102					0	2		23			1	1		2	29

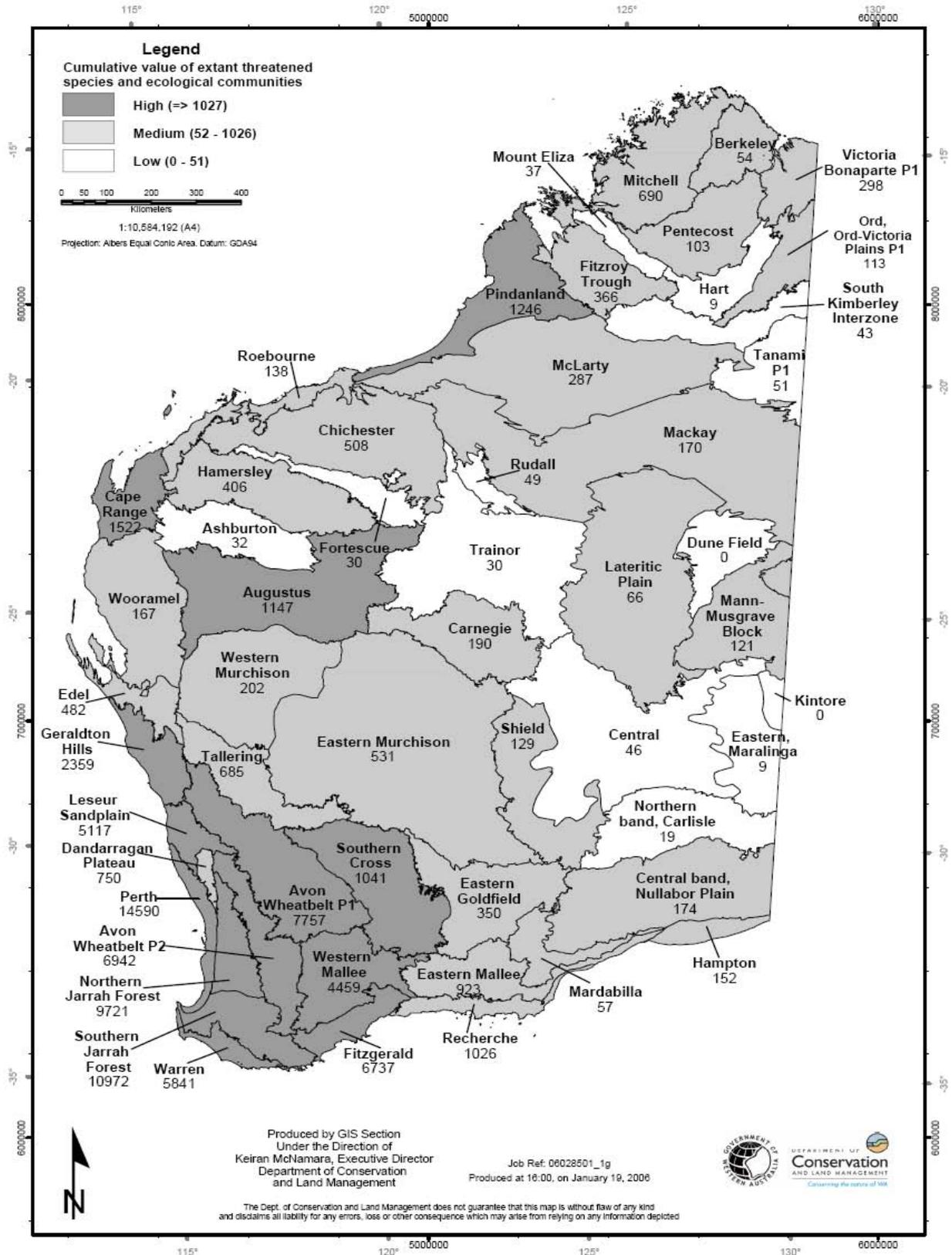


Figure 21 Cumulative value of threatened species/ecological communities and priority species/ecological communities for each IBRA sub-bioregion

Table 23 Relative value and threat of significant marine fauna

		Biodiversity Value		
		High	Medium	Low
Threat	High	Green turtles Loggerhead turtles Dugong Little Penguin Flatback turtles	Bunbury/ Busselton Dolphins Monkey Mia Dolphins Migratory birds	
	Medium	Australian sea lion Blue whale Humpback whale Southern right whale Tern spp. Hawksbill turtles Whalesharks	Marine Raptors NZ fur seals Cormorants/ Pelicans Dolphin spp.	
	Low	Sea snakes	Crocodiles Manta Rays Leatherback turtles	Sting Rays

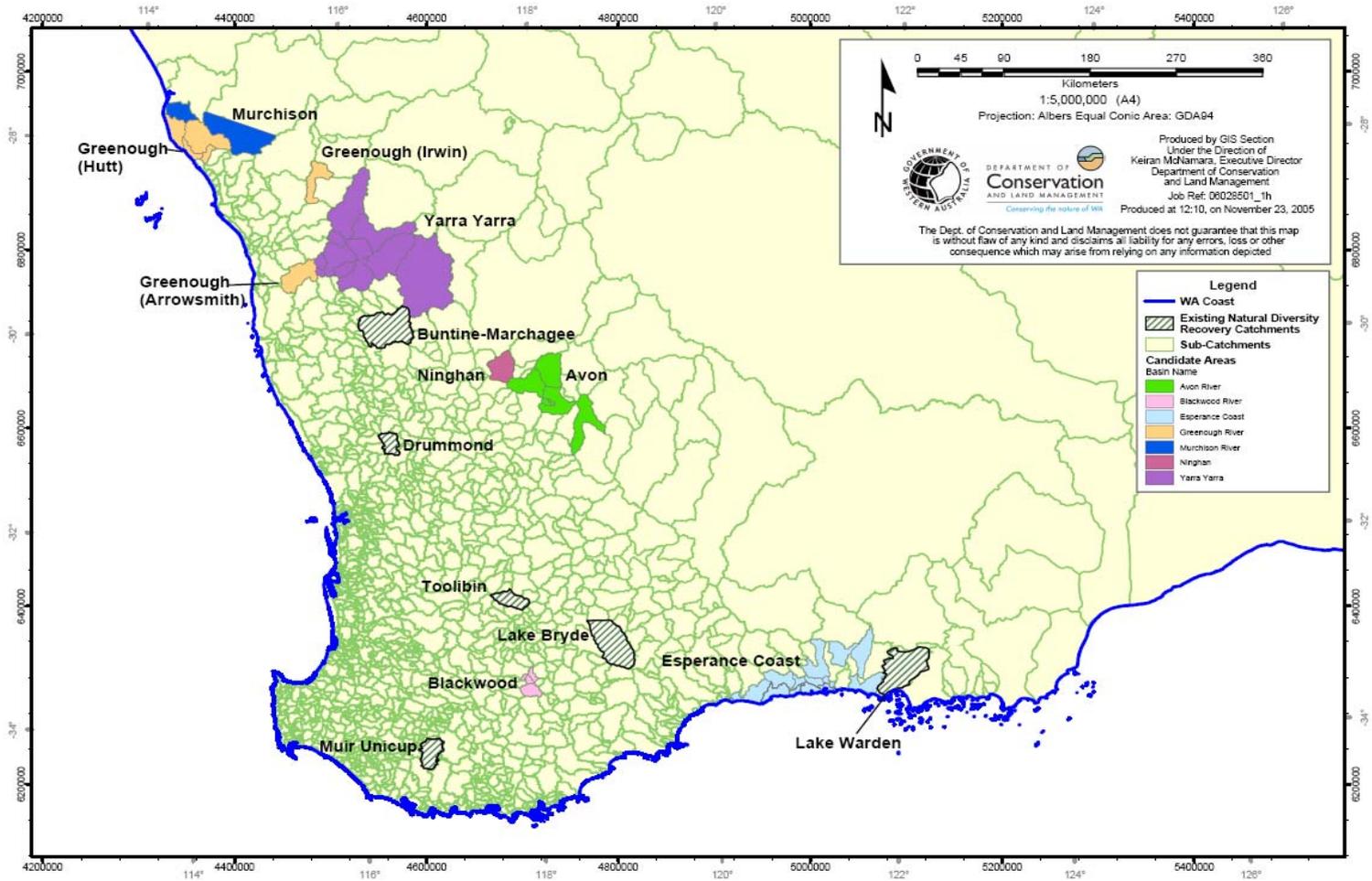


Figure 22 Map showing existing natural diversity recovery catchments, and candidate areas for the next batch of natural recovery catchments.



Figure 23 Centres of species endemism and richness in Western Australia – biodiversity hotspots

9.3 Regional Information

9.3.1 Rangelands

Table 24 Aquatic Assets and Fish Resources (Rangelands)

Fisheries Assets		Value		
		High	Medium	Low
Threat	High	Freshwater Fish (All regions)		North Coast Shark (Combined JANSF and WANCSF) (R) Ports (small) (R, NA, Swan, SW, SC)
	Medium	Abalone (R, Swan, NA, SW, SC) Coastal waters (offshore 3 nm) (NA, R, SC, SW, Swan) Inshore Kimberley Waters (R) Marine Fish Stocks (NA, R, SC, SW, Swan) Pink Snapper (R) Tailor (R, Swan, NA, SW, SC)	Broome Prawn (R) Kimberley Prawn (R) Onslow Prawn (R) Pilbara Demersal Finfish (R) Shark Bay Snapper (R) Spanish Mackerel (R)	Barramundi Farming (R)
	Low	Corals and low benthic (NA, R) Exmouth Gulf Prawn (R) Inshore reefs Remote (R) Pearl Oyster (R) Recreational Kimberley and Pilbara Regions (R) Rock Lobster (R, Swan, NA, SW) Shark Bay Prawn (R) Shark Bay Scallop (R) West coast Rock Lobster (SW, Swan, NA, R)	Black Snapper (R) Coastal waters (offshore 12 nm) (NA, R, SC, SW, Swan) Freshwater Angling (All regions) Nickol Bay Prawn (R) Northern Demersal Scalefish (R) Recreational Northern Inland (R) West Coast Blue Swimmer Crab (SW, Swan, NA, R) West Coast Deep-sea Crab (SW, Swan, NA, R)	Kimberley Gillnet and Barramundi (R) Lake Argyle Freshwater Catfish (R) Shark Bay Beach Seine and Mesh Net (R)

Table 25 Waterscape assets (Rangelands)

Waterscapes		Value		
		High	Medium	Low
Threat	High	Cane River Dampier Peninsula De Grey River (including Oakover, Nullagine, Shaw, Coongan, Carawine Gorge and Running waters) Eighty Mile Beach (RAMSAR) Fitzroy River Fortescue River System including Fortescue Marsh Hamersley Range Wetland System Harding River upstream/downstream of Dam Lake Kunnunura (RAMSAR) Lower Ashburton River Lower Murchison River & Estuary (DoIW)	Millstream Wetland System Munni Munni Creek to Yule River Ord Estuary/Parry Floodplain Ord River upstream/ Downstream of Dam Roebuck Bay (RAMSAR) Roebuck Plains system Rudall River (Wild River) Savory Creek (Wild River) Sherlock River including tributary - Tamberry Creek (Wild River) Tanberry Creek Weelli Wolli Spring	Yule River

	Medium	<p>Breberle Lake (DoIW) Camballin Floodplain – Le Livre Swamp System Cape Range Subterranean Waterways (DoIW) Chamberlain River Dragon Tree Soak Durack River Exmouth Gulf East (DoIW) Forrest River Geikie Gorge Gibson Desert Gnamma holes (DoIW) Karijini (Hamersley Range) Gorges (DoIW) King Edward River (wild River) King River Kookhabinna Gorge (DoIW) Lake Annean (Lake Nannine) (DoIW) Lake Argyle Lake Ballard (DoIW) Lake Barlee (DoIW) Lake Carnegie System (DoIW) Lake Dissapointment Lake Dora (DoIW) Lake Gregory System Willie Creek Wetlands Bunda Bunda Mound Springs Lake Gruszka (DoIW)</p>	<p>Lake MacLeod (DoIW) Lake Marmion (DoIW) Leslie – Port Headland salt fields (DoIW) Maitland (Munni Munni) Mandora Salt Marsh (DoIW) Mc Neill Claypan System (DoIW) Mitchell River Pentecost River (Wild River) Pools of the Durba hills (DoIW) Robe River including Upper Robe River (Wild River) Rock Pools of the Breaden Hills Rock Pools of the Water James Ranges (DoIW) Rowles lagoon System (DoIW) Salmond River (Wild River) Shark Bay East (DoIW) Thundelarr lignum Swamp (DoIW) Tunnel Creek Wagga Wagga Salt Lake (DoIW) Windich Springs (DoIW) Windjana Gorge Wooleen Lake (DoIW) Yadijyugga Claypan (DoIW) Yeo Lake/Lake Throssell (DoIW)</p>	<p>Carson River Lennard River May River Meda River Morgan River</p>	
	Low	<p>Berkeley River (wild River) Bulla Nulla etc Creeks Calder River (Wild River) Cape Whiskey etc Creeks Charnley River (Wild River) Doubtful River Drysdale River Gibson Creek Glenelg River (Wild River) Helby River Herbert Walsh Hunter River (Wild River) Isdell River Jinunga River King George (wild River) Lawley River Londonderry Creek</p>	<p>Lyne River Moran River Mt Grey Etc Creeks Mt Page creek Placid, Dominic and Nosedra Creeks Ponton Creek Prince Regent River (Wild River) Roe River Sale River (wild river) Scott River Stewart River Sturt Creek Thompson River Thurburn Etc Creeks Upper Yule River Wade, Rocky Cove etc Creeks Walmar and Canal Creeks</p>	<p>Cambridge Gulf</p>	

Table 26 Water supply assets (Rangelands)

Water supply		Value				
Threat		High	Medium	Low		
		High	Broome (RIWIA) Broome WR (PDWSA) Camballin WR (PDWSA) Cane River (Onslow PDWSA) Carnarvon (RIWIA) Carnarvon WR Cue WR De Grey River WR (Port Headland PDWSA) Derby (RIWIA) Exmouth WR Fitzroy Crossing WR (PDWSA) Fitzroy River (RIWIA)	Gascoyne River WR (PDWSA) Harding Dam CA (PDWSA) Kununurra WR (PDWSA) Meekatharra WR Menzies WR Millstream WR Mount Magnet WR Newman WR (PDWSA) includes Ophthalmia Dam Ord River (RIWIA) Sandstone WR West Canning Artesian Basin Wiluna WR Yule River WR	Finucane Island WR (PDWSA) Halls Creek WR (PDWSA) Marble Bar WR (PDWSA) Nullagine WR (PDWSA) Warmun (Turkey Creek) WR (PDWSA)	
		Medium	Goldfields (RIWIA) Moochalabra Dam CA (PDWSA) Pannawonica WR (PDWSA) Paraburdoo WR (PDWSA) Pilbara (RIWIA) Tom Price WR (PDWSA) Turner River WR (PDWSA)	Canning-Kimberley (RIWIA) East Murchinson (RIWIA)		
		Low	Denham D7-2 WR Denham D7-7 WR			

9.3.2 Northern Agriculture

Table 27 Aquatic assets and Fish Resources (Northern Agriculture)

Fisheries Assets		Value		
		High	Medium	Low
Threat	High	Freshwater Fish (All regions)		Ports (small) (R, NA, Swan, SW, SC) Ports (Large) (Swan, NA)
	Medium	Abalone (R, Swan, NA, SW, SC) Coastal waters (offshore 3 nm) (NA, R, SC, SW, Swan) Marine Fish Stocks (NA, R, SC, SW, Swan) Recreational Marron (NA, SW, SC, Swan) Tailor (R, Swan, NA, SW, SC)	Marron Farming (NA, Swan, SW, SC) Minor Scallops Abrolhos Island and Mid West Trawl (NA) West Coast Demersal Scale fish (NA, Swan, SW) Yabby Farming (NA, Swan, SW, SC)	Cockburn Sound Finfish (NA, Swan, SW, SC) Ornamental Fish Farming (Swan, NA, SW, SC)
	Low	Abrolhos (NA) Corals and low benthic (NA, R) Rock Lobster (R, Swan, NA, SW) West coast Rock Lobster (SW, Swan, NA, R)	Coastal waters (offshore 12 nm) (NA, R, SC, SW, Swan) Freshwater Angling (All regions) West Coast Blue Swimmer Crab (SW, Swan, NA, R) West Coast Deep-sea Crab (SW, Swan, NA, R)	Beach Bait (Fish Net) (NA, Swan, SW, SC) Lower West Coast Beach and Embayment West Coast Coastal Aquaculture: pearl and pearl oysters and others (NA, SC)

Table 28 Waterscape assets (Northern Agriculture)

Waterscapes		Value		
		High	Medium	Low
Threat	High	Gingin Brook Hill River Estuary Hutt River Irwin River Estuary Lake Logue/ Indoon System Lennard Brook Lower Moore River & Estuary Wannamal Lake System	Chapman River Chapman River Estuary Greenough River Pools Moore Catchment/ River	Irwin River Lake Moore Lake Pinjarrega Mongers Lakes Yarra Yarra Lakes
	Medium	Gingin Catchment Lakes Greenough River Estuary Guraga Lake (DoIW) Hutt Lagoon System Karakin Lakes Lake Logue/ Indoon System Lake Thetis Namming Lakes	Arrowsmith River Bowes Estuary Caren Caren Brook Greenough River Hutt Estuary Minyulo Brook Murchison River	Bowes River Buller River Eneabba Creek Oakagee River

	Low			Boothendarra Creek Eneminga Swamp Frederick Smith Creek Leeman Lakes Mullering Brook Nambeing Swamp Nambung River Yarra Monger Tributary
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Table 29 Water supply assets (Northern Agriculture)

Water supply		Value				
		High	Medium		Low	
Threat	High	Allanooka – Dongara-Denison WR Arrowsmith WR (Perenjori) Calingiri WR Dathagnoorara WR Dookanooka WR Eneabba WR Gascoyne GW Area (Northampton Block) Gingin GWA RIWIA Gingin WR Jurien - Turquoise Coast WR Jurien GW Area (RIWIA)	Kalbarri WR Leeman WR (Midway bore) Moora Eastern WR Mount Peron WR Nabawa WR New Norcia WR Port Gregory WR Wicherina CA Woodridge WR Yalgoo WR Yerecoin WR	Gascoyne GW Area (Casuarinas) Greenough River Pools Guilderton WR Hutt Lagoon System Jurien WR Karakin Lakes Lancelin WR Ledge Point WR	Miling WR Mingenew WR Northampton WR Perenjori WR Three Springs WR Watheroo WR Yerina Spring WR Yuna WR	
	Medium	Arrowsmith GW RIWIA Buntine/ Marchagee Braided Saline Drainage Line		Arrino Bores WR Badgingarra WR Cervantes WR Coomberdale WR Dandaragan WR Gascoyne (RIWIA) Gascoyne GW Area (Yilgarn Block) Green Head WR Guragara Lakes	Horrocks Beach WR Moora WR Port Gregory WR Private sources for industry & commerce (RIWIA) Private stock & irrig'n sources (RIWIA) MW Utcha Swamp	
	Low	Seabird WR				Yenart (RIWIA) Yerecoin GW Area

9.3.3 Avon Basin

Table 30 Aquatic assets and Fish Resources (Avon)

Fisheries Assets		Value		
		High	Medium	Low
Threat	High	Freshwater Fish (All regions)		
	Medium			
	Low		Freshwater Angling (All regions)	

Table 31 Waterscape assets (Avon)

Waterscapes		Value		
		High	Medium	Low
Threat	High	Avon River (Dale to Mortlock Rivers) Avon River Valley (DoIW) Brockman River Dale River Yealering Lakes System (ANCA)	Avon River (Beverley upstream) Avon River Lower Avon River Middle Lockhart Catch/River Wooroloo Brook Yenyening Lakes System Yilgarn Catch/River	
	Medium	Lake Grace System (ANCA)	East Mortlock River Lake Bryde Catchment Wannamal Lake System (ANCA)	North Mortlock River
	Low	Lake Cronin (DoIW) Yorkrakine Rock Pools (ANCA)		

Table 32 Water supply assets (Avon)

Water supply		Value		
		High	Medium	Low
Threat	High	Brookton Dam CA (PDWSA) Brookton - Happy Valley WR (PDWSA) Lake King CA (70km NW of Ravensthorpe) (PDWSA) Laverton WR (PDWSA)	Bolgart WR (PDWSA) Leinster (Goldfields) WR (PDWSA) Leonora WR (PDWSA)	

	Medium	Goldfields (RIWIA)		
	Low			Bolgart East (RIWIA) Happy Valley (RIWIA) Kondinin – Ravensthorpe (RIWIA) Westonia (RIWIA)

9.3.4 Swan

Table 33 Aquatic assets and Fish Resources (Swan)

Fisheries Assets		Value		
		High	Medium	Low
Threat	High	Estuaries South West (SW; Swan; SC) Freshwater Fish (All regions) Inshore Reefs Urban (Swan)	Cockburn Sound (Swan)	Ports (small) (R, NA, Swan, SW, SC) Ports (Large) (Swan, NA)
	Medium	Coastal waters (offshore 3 nm) (NA, R, SC, SW, Swan) Marine Fish Stocks (NA, R, SC, SW, Swan) Recreational Marron (NA, SW, SC, Swan)	Marron Farming (NA, Swan, SW, SC) West Coast Demersal Scale fish (NA, Swan, SW) Yabby Farming (NA, Swan, SW, SC)	Cockburn Sound Finfish (NA, Swan, SW, SC) Ornamental Fish Farming (Swan, NA, SW, SC)
	Low	West coast Rock Lobster (SW, Swan, NA, R) Rock Lobster (R, Swan, NA, SW)	Coastal waters (offshore 12 nm) (NA, R, SC, SW, Swan) Freshwater Angling (All regions) Mussel Farming (SC, Swan) West Coast Blue Swimmer Crab (SW, Swan, NA, R) West Coast Deep-sea Crab (SW, Swan, NA, R) West coast Estuarine (SW, Swan) West Coast Purse Seine (Swan)	Beach Bait (Fish Net) (NA, Swan, SW, SC) Lower West Coast Beach and Embayment West Coast

Table 34 Waterscape assets (Swan)

Waterscapes		Value			
		High	Medium	Low	
Threat	High	Blackadder- Woodbridge Ck Booragoon Swamp (DoIW) Brockman River Canning River Chittering/Needonga Lakes (DoIW) Churchman Brook upper Crumpet creek Ellen Brook Ellen Brook swamps system (DoIW) Forestdale Lake (DoIW, RAMSAR) Wannamal Lake System (DoIW)	Herdsman Lake (DoIW) Joondalup Lake (DoIW) Lennard Brook Loch McNess System (DoIW) Perth Airport Woodland Swamp (DoIW) Poison Gully Susannah Bk lower Swan River Swan-Canning Estuary (DoIW)	Chittering Lakes (ANCA) Churchman Brook (lower) Susannah Bk upper Wooroloo Brook	Bannister Creek Bickley Bk (lower) Helena R (lower) Jane Bk (lower) Southern River Wungong River

	Medium	Becher point Wetlands (DoIW) Brixton Street Swamps (DoIW) Chandala Swamp (DoIW) Gibbs Road Swamp System (DoIW) Helena River (upper)	Kojedda Swamp (EPP SW ag Wetlands) Rottnest Island Lakes (DoIW) Spectacales Swamp (DoIW) Thomsons Lake (DoIW, RAMSAR)	Bennett Brook Henley Brook St Leonards ck Wandoo	Yule Bk
	Low	Bickley Bk (upper) Ellis Bk Jane Bk (upper) Munday Bk			

Table 35 Water supply assets (Swan)

Water supply		High	Medium	Low	
Threat	High	Bickley Brook CA (PDWSA) Bindoon/Chittering WR (PDWSA) Churchman Brook CA (PDWSA) Gnangara (RIWIA) Gnangara UWPCA (PDWSA) Jandakot (RIWIA) Mirrabooka (RIWIA) Mirrabooka UWPCA (PDWSA) Mundaring Weir CA (PDWSA) Perth (including Gwelup) (RIWIA) Rottnest (RIWIA)	Seaview Park WR Sovereign Hill WR Swan (RIWIA) Victoria CA (PDWSA) Wanneroo (RIWIA) Wanneroo UWPCA (PDWSA) Wungong Brook CA (PDWSA) Yanchep (RIWIA) Cockburn (RIWIA) Rockingham (RIWIA) Jandakot UWPCA (PDWSA)	Gwelup UWPCA (PDWSA) Jane Brook (PDWSA) Lower Helena Pipehead Dam CA (PDWSA) Perth Coastal UWPCA (PDWSA)	
	Medium	Canning River CA Lower Bickley Re CA (PDWSA)	Serpentine (RIWIA)		
	Low		New Norcia GW Area Red Swamp Brook (Future Dam site PDWSA)	Bolgart east (RIWIA) Condingup (RIWIA)	

9.3.5 Southwest

Table 36 Aquatic assets and Fish Resources (Southwest)

Fisheries Assets		Value		
		High	Medium	Low
Threat	High	Estuaries South West (SW; Swan; SC) Freshwater Fish (All regions) Margaret River Marron Stocks (SW)		Ports (small) (R, NA, Swan, SW, SC)
	Medium	Abalone (R, Swan, NA, SW, SC) Coastal waters (offshore 3 nm) (NA, R, SC, SW, Swan) Estuaries Remote (SW, SC) Marine Fish Stocks (NA, R, SC, SW, Swan) Marron stocks (SW) Recreational Marron (NA, SW, SC, Swan) Tailor (R, Swan, NA, SW, SC)	Marron Farming (NA, Swan, SW, SC) West Coast Demersal Scale fish (NA, Swan, SW) Yabby Farming (NA, Swan, SW, SC)	Finfish (NA, Swan, SW, SC) Lower West Coast beach and embayment Cockburn Sound Minor Scallops South West Trawl (SW) Ornamental Fish Farming (Swan, NA, SW, SC)
	Low	Rock Lobster (R, Swan, NA, SW) West coast Rock Lobster (SW, Swan, NA, R)	Coastal waters (offshore 12 nm) (NA, R, SC, SW, Swan) Freshwater Angling (All regions) West Coast Blue Swimmer Crab (SW, Swan, NA, R) West Coast Deep-sea Crab (SW, Swan, NA, R) West coast Estuarine (SW, Swan)	Beach Bait (Fish Net) (NA, Swan, SW, SC) Lower West Coast Beach and Embayment West Coast Trout Farming (SC, SW)

Table 37 Waterscape assets (Southwest)

Waterscapes		Value			
		High	Medium	Low	
Threat	High	Barragup Swamp (DoIW) Broadwater Wetland Brunswick River Carey Brook Collie River Cowaramup River Gingilup-Jasper Wetland System Hardy Inlet Estuary Lake McLarty (DoIW) Lake Toolibin Leeuwin Ridge Streams Leschenault Estuary Lower Blackwood tributaries (DoIW)	Margaret River and Estuary Milyannup Brook Muir/ Unicup System. Peel Harvey Estuaries Poison Gully Reedia Complexes Scott Coastal Plain Wetlands Scott River Serpentine River Vasse Wonnerup Estuaries/Wetlands Wilyabrup River and Estuary Yalgorup Lakes (DoIW)	Abba River Barlee Brook Gunyulgup Brook Estuary Ludlow River Margaret River Wetlands Sabina River Toby Inlet Estuary Vasse River Wellesley River	Upper Blackwood (Above Boyup Brook)

	Medium	Benger Swamp (DoIW) Cape Leewin System (DoIW) Corecup Lake (DoIW) Donnelly River and Estuary Lake Dumbleyung McCarleys Swamp (Ludlow Swamp) (DoIW) Warren Estuary	Capel River Capel River Estuary Ferguson River Harvey River Kemerton Wetlands Leschenault Inlet Murray River	Perup River Preston River Stirling Wetlands Tone River Towerrining Lake Wilga Wetlands	Mid Blackwood (Boyup Brook to Nannup)
	Low	Shannon River			Wagin Lakes

Table 38 Water supply assets (Southwest)

Water supply		Value		
		High	Medium	Low
Threat	High	Badgarning (6km W of Wagin) PDWSA	Mullalyup Dam CA (20km SE of Donnybrook) (PDWSA)	Gooralong Brook WR
		Balingup (see Padbury and Greenbushes) CA (PDWSA) Bridgetown CA (Hester Dam) PDWSA)	Mungalup CA	
		Bancell Brook CA (PDWSA)	North Dandalup Pipehead Dam CA (PDWSA)	
		Blackwood (RIWIA)	Kojonup dam (PDWSA) Leeuwin Spring Dam PDWSA) Lefroy Brook CA (see Pemberton) (PDWSA)	
		Boyup Brook CA	Manjimup Dam CA – Phillips Creek & Scabby Gully PDWSA)	
		Busselton-Capel (RIWIA)	Pemberton - Lefroy Brook, (Big Brook Dam) CA(PDWSA)	
		Bunbury (RIWIA)	Preston Beach WR (PDWSA)	
		Bunbury WR (PDWSA)	Quinninup Dam CA PDWSA)	
		Collie (RIWIA)	South Dandalup Pipehead Dam CA	
		Donnybrook WR (PDWSA) Dunsborough/ Yallingup WR PDWSA)	South Dandalup Pipehead Dam CA (PDWSA)	
		Conjurunup Creek Pipehead Dam CA	SW Coastal (RIWIA) Warren River WR (PDWSA)	
		Dumbleyung CA	Tanjanerup creek CA (PDWSA)	
		Greenbushes Dams (see Padbury Reservoir) CA	Wellington Dam CA PDWSA)	
		Jandakot UWPCA (PDWSA)	Wungong Brook CA (PDWSA)	
		Kirup CA		
		Margaret River/ Ten Mile Brook CA (PDWSA)		
		Millstream CA (PDWSA)		
Mullalyup WR				

	Medium	Boddington Dam CA (PDWSA) Brunswick Water Supply (Beela Dam) CA (PDWSA) Capel River (RIWIA) Harris River Dam (PDWSA) Murray (RIWIA) Nannup - Preston Valley Irrigation RIWIA) Pipehead Dam CA (PDWSA) Dwellingup WR (PDWSA) Rocky Gully on Frankland PDWSA)	Stirling Dam CA (PDWSA) Samson Bk CA (Dam and pipehead) PDWSA) Serpentine Dam CA (PDWSA) SW Yarragadee WR PDWSA) Warren R DS55 (Future Dam site PDWSA) Wokalup (Wellesley River) CA Harvey Dam CA (PDWSA)	Serpentine (RIWIA)	
	Low				Dwellingup (RIWIA)

9.3.6 South Coast

Table 39 Aquatic assets and Fish Resources (South Coast)

Fisheries Assets		Value		
		High	Medium	Low
Threat	High	Freshwater Fish (All regions) Estuaries South West (SW; Swan; SC)		Ports (small) (R, NA, Swan, SW, SC)
	Medium	Abalone (R, Swan, NA, SW, SC) Coastal waters (offshore 3 nm) (NA, R, SC, SW, Swan) Estuaries Remote (SW, SC) Marine Fish Stocks (NA, R, SC, SW, Swan) Recreational Marron (NA, SW, SC, Swan) Tailor (R, Swan, NA, SW, SC)	Demersal Gillnet and Demersal Longline (DGDLF) (SC) Marron Farming (NA, Swan, SW, SC) Minor Scallops South Cost Trawl (SC) Yabby Farming (NA, Swan, SW, SC)	Finfish (NA, Swan, SW, SC) Lower West Coast beach and embayment Cockburn Sound Ornamental Fish Farming (Swan, NA, SW, SC)
	Low	Greenlip and Brownlip Abalone (SC) Recreational South Coast (SC) Roe's Abalone (SC)	Coastal waters (offshore 12 nm) (NA, R, SC, SW, Swan) Freshwater Angling (All regions) Mussel Farming (SC, Swan) South Coast Rock Lobster (SC)	Australian Herring (SC) Beach Bait (Fish Net) (NA, Swan, SW, SC) Lower West Coast Beach and Embayment West Coast South Coast Estuarine (SC) Western Australian Salmon (SC) South Coast Purse Seine (SC) Coastal Aquaculture: pearl and pearl oysters and others (NA, SC) Trout Farming (SC, SW)

Table 40 Waterscape assets (South Coast)

Waterscapes		Value					
		High		Medium		Low	
Threat	High	Bandy Creek Estuary	Princess Royal Harbour E	Beaufort Inlet E	Madjenapurdap W	Bandy Creek	Munster Hill
		Byenup Lagoon System (DOIW, RAMSAR)	South Sister Lake W	Benje Benjenup Lake W	Marbellup Brook	Coobidge Creek	Drain
		Cobomup Creek W	Station Lake W	Bloxidge W	Marralong W	Coomalbidgup	Neridup Creek
		Ewans Lake W	Tarnup Lake W	Boggy Springs Wetlands	Martagallup Swamp W	Creek	Robinson Drain
		Fitzgerald Inlet W	Walpole Inlet E	Boyatup Swamp Wetlands	Mill Brook	Corakerup Creek	Salt Creek
		Hilliup Lake W	Wellstead Estuary	Chillimup Rd W	Milyunup Lake W	Coramup Creek	Seven Mile
		Kalgan River	Wheatfield Lake W	Collets Rd W	Mindinyup Rd W	Cuppup Creek	Creek
		Lake Corimup W	White Lake W	Coomalbidgup Swamp W	Minvalara N W	Dalyup River	Six Mile Creek
		Lake Pleasant View W	Wilson Inlet E	Drawbin Rd W	Minvalara SS W	Dalyup River	Sleeman River
		Lake Warden W	Windabout Lake W	Galli Swamps W	Minvalara SW W	West	Taylor Inlet Tribs
		Mullet Lake W	Woody Lake W	Gledhow W	Murrundie W	Five Mile Creek	Torbay Main
		Nornalup Inlet E	Worrangerup/Nuniup and	Gordon River W	No. 1 Swamp W	Gordon River	Drain
		North Sister Lake W	Warnerup Swamps W	Hassell Rd W	Ongerup Lagoon W	Jackitup Creek	Warperup Creek
		Oyster Harbour E	Yelliup Lake W	King River	Pallinup River	Johnston Creek	Wilyung Creek
		Pfeiffer Lake W	Yendinnup Swamp W	Kojaneerup Rd W	Pfeiffer Rd W	Lake Saide	Yakamia Creek
				Kojaneerup W	Round Swamp w	Drain	Yerritup Creek
				Lake Chidnup W	Scotsdale Brook	Little River (2)	
				Lake Matilda W Warburton Rd W	Swamp 67 W	Melijinup Creek	
				Lake Seppings W	Torbay Inlet E		
				Lake Torrup W	Warriup Rd W		
		Landing Ground W					

Medium	Anderson Lake	Mettler W	Bellanger Beach W	Marbellup Flats W	Alexander River
	Angove Creek W	Middle Rd Flats W	Bitter Water Swamp	Mardetta Group W	Barker Inlet E
	Aralinga W	Minvalara W	Bolganup Creek Lake	Menamup Inlet W	Blackboy Creek
	Balicup Lake W	Mitchell Creek W	Bonhall Creek W	Mill Brook W	Cascade Creek
	Bannitup Lake	Mt Soho Flats W	Bow River	Mojingup Lake W	Cheyne Inlet E
	Bellanger Barrier W	Nornalup Rd Flats W	Bremer River	Napier Creek	Cordinup River
	Big Poorarecup lagoon W	Nornalup Rd W	Cardiminup Swamp W	Native Dog Swamp	Dailey River
	Blue Lagoon and associated wetlands	Owingup Swamp W	Cascade East Swamp	NE Walpole W	Dailey Estuary
	Blue Lake W	Pabelup Lake 1, 2, 3 W	Cascade West Swamp W	Normans Inlet E	Devil Creek
	Boat Harbour Lakes W	Peaceful Bay W	Chelgup Creek	North Gordon Inlet W	Eyre River
	Break Rd Flats W	Pillenorup Swamp W	Cheyne Downs W	Oldfield Estuary and Wetland	Jerdacuttup River
	Camel Lake W	Pink Lake W	Cheyne W	Oldfield River	Kateup Creek
	Chemanup Lake W	Pooryonggup W	Cleerillup Creek W	Palusmont W	Kuliba Creek
	Cheyne Rd Creek W	Qualliup Lake W	Collier Creek W	Parry's Inlet E	King Creek
	Culham Inlet E	Quaranup Rd W	Condingup Lake W	Peringillup Reserve W	Moolyall Creek
	Culham Inlet W	Quindinillup Flats and Swamplands W	Copper Mine Creek W	Picup Swamp W	Muglignup Creek E
	Doombup Lake	Ratcliffe Barrier W	Cordinup W	Pullitup Swamp W	Munglignup Creek
	Fitzgerald River	Romance Rd Flats and Sumplands W	Denmark River	Qualinup Swamp W	Munglinup River
	Flats W	Sheepwash Creek W	Dunns Swamp W	Quarderwardup Lake W	Needilup River
	Gardner Lake W	Stevens Lake W	Ewarts Swamp W	Quickup River W	Normans Creek
	Geriberiwelup Swamp W	Stokes Inlet E	Foster Beach W	Reef Beach W	Peenebup Creek
	Gills Rd group W	Suez Rd Flats W	Frankland River	Richmond Rd W	Phillips River
	Goode Beach Wetland	Turpin Rd Flats W	Gairdner River and Wetland	Roberts swamp W	Princess Royal Drain
	Granite Rd Flats W	Cleerilup Rd Flats W	Gordon Inlet E	Scotsdale W	Steere River
	Gull Rock Lake	Watershed Rd Flats and Sumplands W	Gum Link Rd W	Seven Mile Creek W	Sunny Glenn Creek
	Hiker Rd Flats W	Stokes Inlet W	Hay River and Hay River W	Stirling Road W	Thomas River
	Hunter River Lake W	Nornalup Rd Flats W	Hazeldene Swamp W	Sunday Swamp W	Torrakup River
	Jebarjup Lake	Roe Rd/Suez Rd Flats W	Howick Lake W	Susetta River	West River
	Jebarjup Swan Kelly's Creek Lake W	Bevan Rd Flats W	Irwin Inlet E	Swamp 68	Willyun Creek
	Jerdacuttup Lakes W	Quindinillup Area W	Johnston Creek W	Swan Lagoon W	Woodenup Creek
	Kwornicup Lake W	Watershed Rd Flats W	Kalmerndyip Lake W	Taylor Inlet E	Young River (2)
	Lake Carbul W	Swan Lake W	Kent River	Toocalup Lake W	
	Lake Gidong W	Mirambeen Lake W	King River Flats W	Torregullup Swamp	
	Lake Gore W	Wangerup Creek Sump W	Kojaneerup Swamp W	Towadup Estuary	
	Lake Namburup W	Lake Powell W	Kordabup River	Trib to Bow River W	
	Lake Williamup W	Moates Lake W	Kuliallin W	Two Mile Lake W	
	Ledge Point	Pardelup Lagoon W	Lake Barnes W	Venns Rd W	
	Lake Kubitch W	Perillup Rd Reserve W	Lake Eyrie W	Walpole/Nornalup NP W	
	Lake Monjingup (EPP SW ag Wetlands)	Randell Rd W	Lake Marendiup and Surrounds W	Warneford Wetland	
	Lake Mortijinup W	Stockyard Rd Wetlands	Lake Saide W	Warramurrup Swamp and Surrounds W	
Mainbenup Swamp W	Tootanelup Lagoon W	Lake Shaster W	Warriup W		
Miller's Basin Rd Flats W	Torrakup River W	Lake Surprise W	Warrup Group W		
	Tucker's Rd W	Lake William W	Waychinicup River		
	Wamballup Swamp W	Lights Beach Wetlands incl Lake Williams	William Bay Road Lake W		
		Lort River	Young River (1)		
		Manarup Lagoon W	Wilson Inlet W		

Low	Angove River	Kellys Creek	Barker Inlet W	Alexander Estuary
	Blackwater Creek	Limeburners Creek	Bevan Rd/Roe Rd Sumplands W	Blackboy Creek Estuary
	Boolenup Lake W	Maringup Lake (DoW)	Bitter Water Creek	Cordinup E
	Boondadup River	Meerup River	Bluff River	Thomas River Estuary
	Broke Inlet E	Mitchell River	Cantebury River	
	Chesapeake Brook	Mt Bland lake W	Coyanarup Bogs W	
	Copper Mine Creek	Mullocullop Creek	Floodplains on granite W	
	Deep River	Nile Creek	Gardner E	
	Dempster Inlet E	Paluslopes on Granite W	Gardner River	
	Dempster River	Poison Creek	Goodga River	
	Doggerup Creek	Poison Creek Estuary	Little River (1)	
	Fern Creek	Quickup River	Southern Stirling Ranges W	
	Fitzgerald Inlet E	Saint Mary Inlet E	Walpole River	
	Forth River	Saint Mary River	Wongerup Creek	
	Gardner Lake Dunes W	Shannon River		
	Hammersley River	Styx River		
	Hammersley Inlet E	Twertup Creek		
	Hunter River	Waychinicup Inlet E		
	Jenamullup	Weanerjungup		
	Jorndee Creek	Weld River		
Jorndee Creek Estuary				

Table 41 Water supply assets (South Coast)

South Coast Water supply assets		Value			
		High	Medium	Low	
Threat	High	Alany RIWIA Angove Creek CA Bremer Bay WR Denmark River CA Esperance RIWIA Esperance WR Gibson WR Grass Patch	Hopetoun WR Marbelup WR Northcliffe WR Ravensthorpe CA Draft PDWSA Salmon Gums CA Walpole Weir CA -Butlers Creek CA	Kent River	
	Medium	Condingup WR Gnowangerup CA Tambellup Dams on Frankland River	Bremer Bay RIWIA Hopetoun RIWIA Jerramungup Dams Limeburners Creek CA Munglinup South Coast WR	Deep River WR Gibson RIWIA Kondinin- Ravensthorpe (RIWIA)	
	Low	Quickup River Dam Scotsdale Brook WR	Bolganup	Gibson RIWIA Kondinin - Ravensthorpe (RIWIA)	

