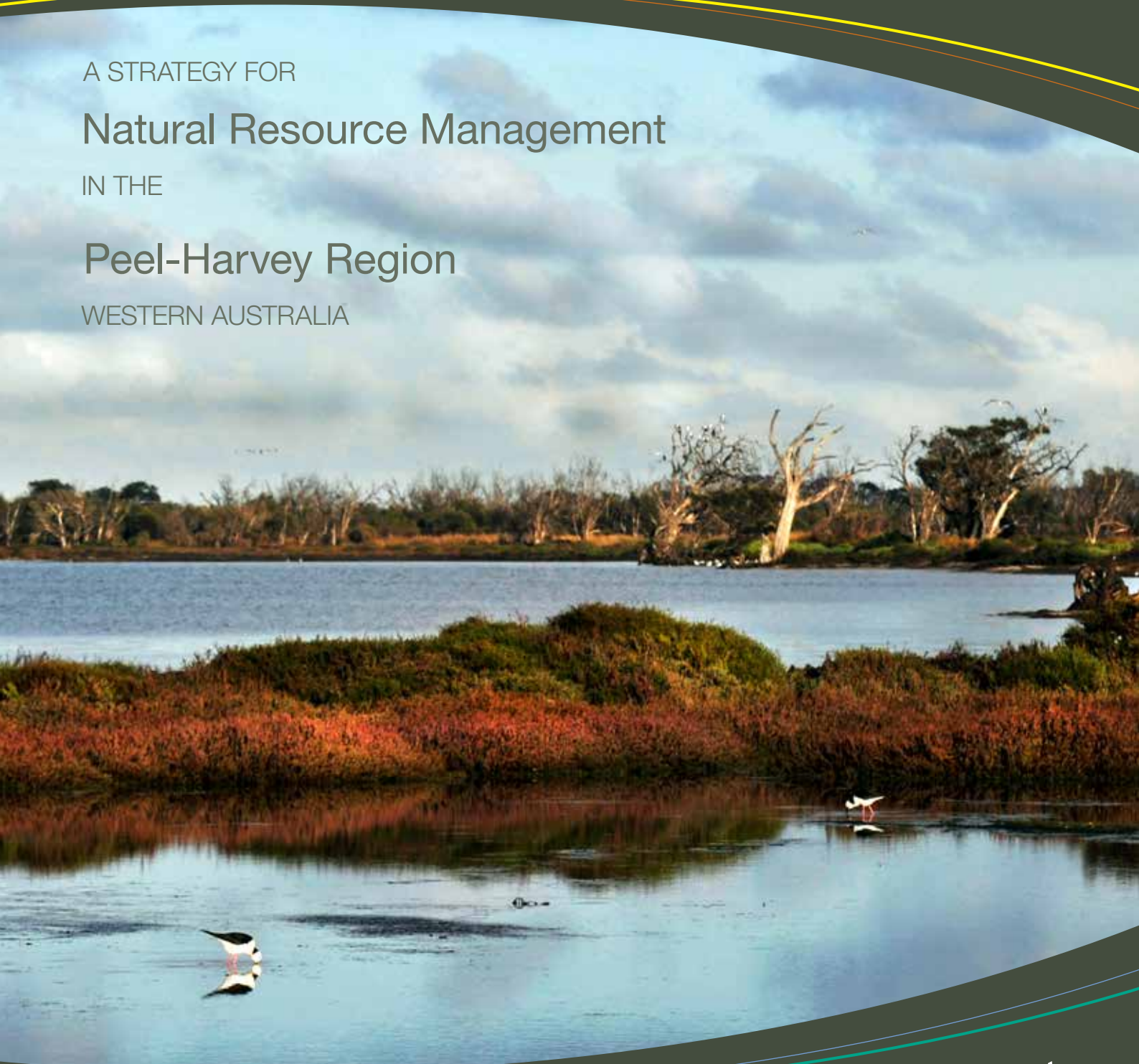




Binjareb Boodja Landscapes 2025

A STRATEGY FOR
Natural Resource Management
IN THE
Peel-Harvey Region
WESTERN AUSTRALIA



People Working Together for a Healthy Environment



Acknowledgements

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- Jan Star, AM (Chair)
- Dr Peter Hick
- Bob Pond
- Cr Caroline Knight
- Jane O'Malley
- Kim Wilson
- Andrew Del Marco

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Chairperson's Welcome

I am very pleased to present the first Regional Natural Resource Management Strategy for the Peel-Harvey Region. Its intent is to provide guidance for everyone working in our natural environment as well as in the social and economic areas that interact with, and depend on, that environment.

Significant attempts have been made over the past 25 years to improve our ecology. Many initiatives have been delivered through Landcare and catchment management. One lesson we have learnt over that time is how vital are the personal and organisational relationships which underpin this work. We also know that much more needs to be done and that there is much more to be learnt about this complex, valuable environmental system and the effects of the growing number of people upon it. We do know that our waterways are still deteriorating and the threat of another ecological collapse of the estuary looms. A far greater amount needs to be done—and soon—to reverse the effects of farming and urban development and the increasing number of people.

Sharing information and practical knowledge is the core of our operations. We like to work with people whether they be farmers, small landholders, community groups, local Aboriginal groups, researchers, industry, local governments or government agencies in a collaborative, open manner.

As we enter this new phase of regional natural resource management, we hope that we can both guide and motivate communities, land managers, governments and businesses with this Regional Strategy. Because of the knowledge and skills held by us, at times the most appropriate form of support may require us to advocate on their behalf.



Our Strategy will pave the way for farmers to be more ecologically sustainable and more profitable, both in the Hotham-Williams catchments and the Coastal Plain. It will provide a renewed focus for Aboriginal people, local governments, Landcare centres and the many community groups active in caring for our environment.

Key elements of our environment are still deteriorating and reversing that decline will require working together and a much greater investment from all parts of society. Such investment will deliver significant social, economic and ecological returns far beyond initial dollar values and help protect the amenity and lifestyle that we all enjoy. Making our environment resilient to current and future challenges is fundamental to maintaining our quality of life and that of generations to come.

Jan Star, AM
Chair



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Welcome to Country

Koorndarm yey *(In the Dreaming)*

Nyittin yey *(In the time of the ice ages)*

Koora yey *(In the long time ago)*

Koori yey *(In the recent times)*

Ngany moort Kaaleepga nidja *(My family homes have been here)*

I have grown up on the rivers, lakes, swamps, estuary and ocean so I want these waterways to be protected.

My family survived on the swamp turtles and it kept us alive, as well as ducks in one particular swamp, until other people came along and dug a dam in the corner which then destroyed the swamp and food place. They dug through the natural things that plugged the fresh water from the salt water underneath.

Birds and plants lived at the swamp, and the damage caused made less food for us. Gilgies died, turtles died and their foods died, and birds moved away.

I looked at that swamp as a survival kit because it kept us alive. I have taken family back there and

other groups and was embarrassed because there was nothing to show them.

The message is that we need to protect our waterways and land near the waterways. Turtles use the land nearby to go and lay their eggs.

The river's name is bilya and bilya also means umbilical cord, Noongar people have always seen the importance of looking after the waterways and land, and then we will be looked after. If the umbilical cord is sick then we will be sick.

We all have a responsibility to take care of our waterways and land so please work with us to take care of it.

Elder: Harry Nannup

Written by nephew: George Walley,

Welcome – this is my country – my boodja

Let's work together to protect our waterways



HARRY NANNUP (ELDER) AND GEORGE WALLEY (2014)



Executive Summary

The Peel-Harvey is a place of great natural beauty strategically located between the Perth and South West regions of Western Australia. These natural assets are of significant environmental, social and economic importance and are under increasing pressure from a multitude of threats and stresses.

The Peel-Harvey Catchment Council has compiled this, the Region's first official natural resource management (NRM) Strategy to provide a road map for how the Peel-Harvey community will repair and care for the natural resources of the Region over the next 10 years towards a 100 year vision.

The Region

The Peel-Harvey region, Binjareb Boodja, is one of seven NRM regions in Western Australia recognised by the Australian and WA governments. It is 1 173 620 ha and covers the entire surface water catchment of the Peel-Harvey estuarine system. The Region is home to 159 000 residents, and this is expected to grow to 257 700 by 2061 with the majority centred around the Peel-Harvey Estuary and lower reaches of the Murray and Serpentine rivers.

Major land-based economic activities are agriculture (\$324 million p.a.), mining (\$3.4 billion p.a.), water supply, land development, recreation, tourism and logging. The coverage and impact of these on natural resources is significant and a major challenge for natural resource managers.

Values

Much of the region is of international and national significance for its unique natural values. These include the Peel-Yalgorup Wetland System, Dryandra Woodland, Banksia woodlands, and the majestic Jarrah Forest of the Darling Plateau. Due to the uniqueness of the area's flora and fauna and the severe pressure it is under from human impacts the Region forms part of the internationally recognised South West Biodiversity Hotspot. Iconic species such as the numbat (*Myrmecobius fasciatus*), woylie (*Bettongia penicillata*), chuditch (*Dasyurus geoffroii*), Carnaby's black cockatoo (*Calyptorhynchus*

latirostris), thrombolites and blue manna crab (*Portunus pelagicus*) all have significant habitats and are valued by our community and visitors.



NUMBAT

PHOTO: BERT WELLS/PARKS AND WILDLIFE

Issues

Significant pressures and threats to the Region's natural resources include:

- excessive nutrients and sediments entering waterways, drains and wetlands
- acidification of agricultural soils and loss of soil structure
- degradation of natural habitat
- poorly located and planned development
- climate change, including reduced rainfall.



Community Priorities

Binjareb Boodja Landscapes 2025 (the Strategy) is based on an asset-threat model. Addressing the underlying causes of these threats is critical.

The Strategy was developed through a process of community consultation and analysis of technical information. Consultation involved workshops with community groups including the local Aboriginal community. The response to this process demonstrated the enthusiasm of our catchment community for improved NRM in all forms; landcare, bushcare, rivercare, coastcare and working on Country.

Common priorities include:

- the importance of ‘sense of place’
- protection of remaining natural areas
- community engagement programs
- management of productive agricultural land
- protection of Aboriginal heritage sites
- addressing the spread of weeds, feral animals and litter
- concern over the urban development footprint
- the need for consistent standards of management across public and private lands.

The Strategy (*Binjareb Boodja Landscapes 2025*)

The Strategy framework provides a comprehensive and flexible scheme to enable the Peel-Harvey community and PHCC to prioritise, organise and implement NRM programs over the next 10 years and beyond. To achieve the Vision and address key threats to the Region’s natural assets, the Strategy proposes three objectives.

- 1. An Engaged and Active Community**
- 2. A Healthy Catchment that Supports Life and Livelihood**
- 3. Science and Knowledge Underpin Natural Resource Management**

The objectives emphasise the importance of people applying the best-available knowledge to manage the Region’s natural resources.

Goals, strategies and activities have been developed to guide the planning and implementation of actions to achieve overarching objectives (Figure 1 and sections 8-10).

Subsystems

The Region has been divided into four subsystems that reflect the diverse landscapes, communities and land use of the Region:

- Ramsar Wetlands, Coastal and Nearshore
- Coastal Plain
- Forest and Scarp
- Hotham and Williams

Implementation

One of the ways in which the PHCC aims to attract investment to implement the Strategy will be through the development of investment plans. Priorities in the 2015/18 Investment Plan will be identified using a scientifically credible and transparent prioritisation process. The prioritisation methodology is included in Appendix J.

The Strategy is intended to assist all sectors of the community—industry and farmers, community groups, and government—to work more collaboratively together to repair and care for the Region’s natural assets. There is much to do, and through leadership, collaboration and adequate investment, much can be achieved.

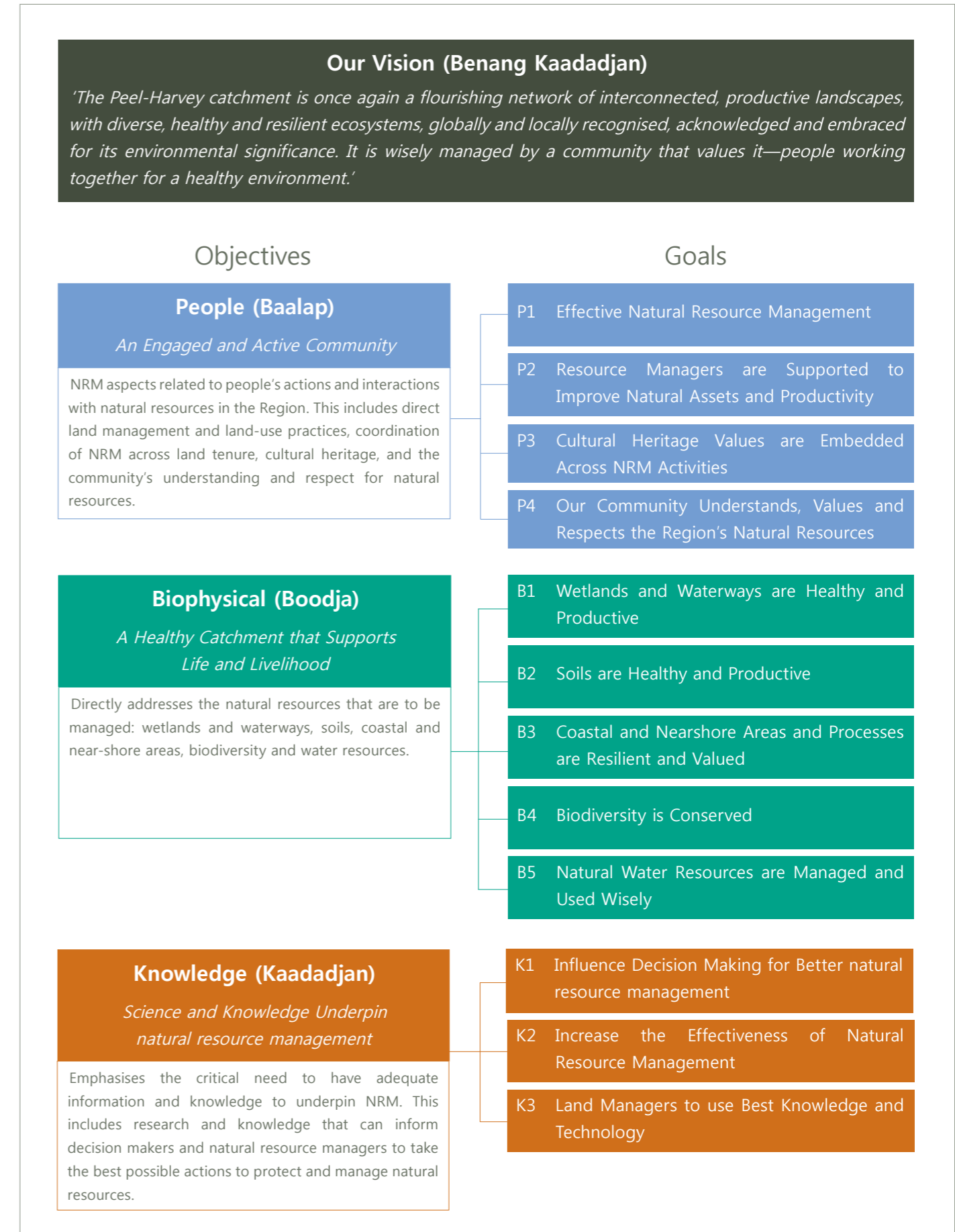


Figure 1: Vision, Objectives and Goals for Management of the Peel-Harvey Region’s Natural Resources

The Strategy is presented as a three-part document:

- Part A** **SETTING THE SCENE** provides background information on the Region and the Strategy, including how it was developed
- Part B** **THE STRATEGY TO ACHIEVE OUR VISION** presents the Strategy Framework, including the objectives, goals and activities of the Strategy
- Part C** **IMPLEMENTING THE STRATEGY** provides information related to the implementation of the Strategy, including investment planning, monitoring and reporting.



Binjareb Boodja Landscapes 2025

Setting the Scene

A

1. Introduction

The Peel-Harvey Region is one of seven natural resource management regions in WA recognised by the Australian and Western Australian governments (Figure 2). The Region is 1 173 620 ha and includes the Serpentine, Hotham, Williams, Murray and Harvey River sub-catchments, that flow into the Peel-Harvey Estuarine System.



Figure 2: NRM Regions in Western Australia

1.1 About the Strategy

The Strategy has been compiled by the Peel-Harvey Catchment Council as the Region’s first official natural resource management (NRM) Strategy. It provides a road map for how the Peel-Harvey community plans to repair and care for the natural resources of the Region over the next 10 years to reach a 100 year Vision. The Strategy is designed to be embraced and implemented by all natural resource managers over time.

The Strategy summarises key information. More detailed information, including further background on the characteristics of the Region’s natural resources is provided in appendices, available online (www.peel-harvey.org.au).

The Strategy’s central piece is a Framework of Objectives, Goals, Strategies and Activities. This hierarchical planning approach is presented in Figure 3 and detailed within.

1.2 Strategic Planning Approach

The Strategy serves three main purposes.

1. Provide strategic direction for the future of regional NRM in the Peel-Harvey Region, including identification of regional NRM priorities and the preferred manner in which regional NRM will be delivered.
2. Capture community priorities.
3. Inform the preparation of investment plans to attract investment in NRM to the Region.

The Strategy is based on three Objectives to achieve the Vision for the Catchment.

1 People (Baalap)
‘An Engaged and Active Community’

2 Biophysical (Boodja)
‘A Healthy Catchment that Supports Life and Livelihood’

3 Knowledge (Kaadadjan)
‘Science and Knowledge Underpin Natural Resource Management’

The objectives, in common with all parts of the Strategy Framework, have been developed through an analysis of Government priorities for the catchment, feedback from our community, and a review of technical literature on the Region’s natural resources and management issues.

The Goals, Strategies and Activities to deliver each Objective are detailed in sections 8, 9 and 10.

Natural assets include soil, water, biodiversity, and their direct links to people (e.g. Aboriginal and European heritage). In preparing the future Strategies, the PHCC may consider the role of ‘systems-based’ approaches to NRM. Systems-based approaches are now being considered by numerous regional NRM organisations. Refer Section 15.

The Strategy uses an ‘assets-based’ approach to NRM planning. This means that the focus is on identifying, protecting and managing specific natural assets in the Region to maintain or restore them to a desired condition.

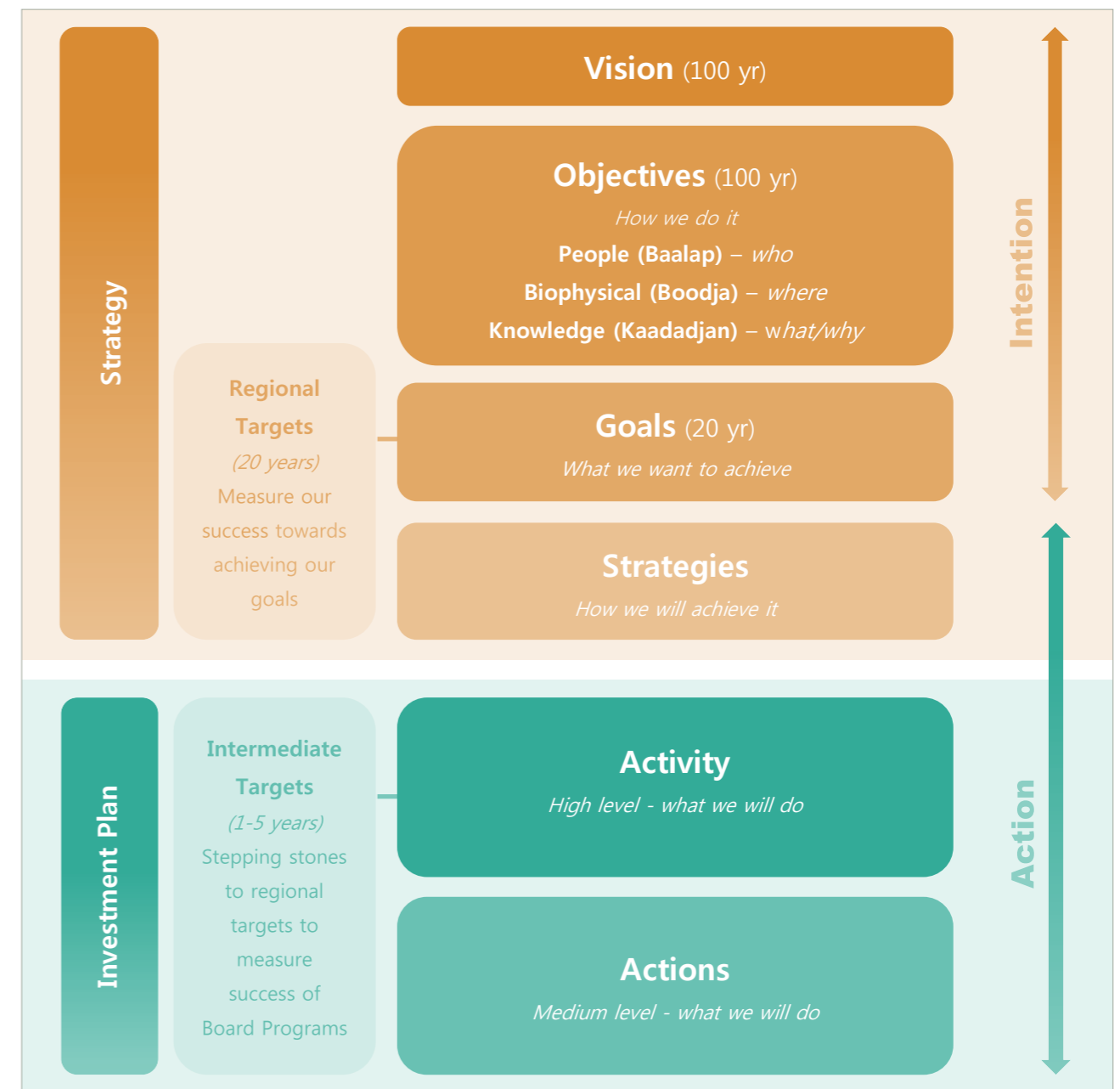


Figure 3: Peel-Harvey NRM Strategy Framework

2. NRM and the Peel-Harvey Community

The Peel-Harvey community is involved in many facets of NRM, and the PHCC has a long history of engaging with the community to deliver NRM outcomes.

The community is defined in broad terms as all individuals and groups who have a stake in the Region, including all levels of government, businesses, industries, NGOs, Aboriginal groups, land owners, farmers, residents and community groups.

Successful delivery of this Strategy depends on the whole community being even more actively involved in NRM, including continued investment and policy support of the Australian and Western Australian governments.

2.1 Peel-Harvey Catchment Council

The PHCC has provided leadership to the Peel-Harvey community, on catchment and NRM matters since 1999, and as an incorporated community body since 2001. It has delivered projects to the value of approximately \$1.5 million per annum over this period, despite fluctuating funding cycles.

The PHCC undertakes a variety of roles in NRM in the Region, guided by its Constitution, Strategic Directions, and now this Regional NRM Strategy.

As a not-for-profit community group the PHCC aims to continue to facilitate collaborative adaptive management, influence decision makers and deliver quality on-ground and community capacity-building NRM projects.

The PHCC is actively consulted by the State Government, including as part of the Strategic Assessment of the Perth-Peel Regions, and has close, collaborative relationships with most local governments in the Region. Strong working relationships with the Department of Water, local landcare centres and Aboriginal groups have also contributed to the successful delivery across the Region.

Flagship programs include the Rivercare Program, Lake Mealup Recovery Project, Water Sensitive

Urban Design and Filtering the Nutrient Storm, The Ramsar Initiative, Lake Clifton Recovery Project, Rural Drainage initiatives and the Estuary Science Strategy. Through significant investment, measurable change has been achieved as a result of delivery of these programs. Since 2000, PHCC projects have revegetated or restored 1631 ha across the Region and have assisted community groups in similar projects. Examples include restoration of river erosion, streamlining of drains, bushland management and perennial pasture trials. Like all PHCC projects, on-ground works are carried out through partnerships and collaborative efforts with local communities.

In 2012, the PHCC won the Western Australian Environment Awards 'Community Achievement Region' and 'Rivers, Estuaries and Wetlands' categories. The PHCC is guided by a skills based volunteer Board and a small professional workforce.

2.2 Our Landcare Community

Many Landcare and other community groups make an important contribution to NRM in the Peel-Harvey; the PHCC has direct and ongoing relationships with many of them. These groups, mostly volunteers, play an important role in working with other community sectors, including government and local businesses, to implement on-ground projects and other NRM activities. Some of the major community groups are shown in Figure 4.

The activities of these groups are many and varied. Most carry out both on-ground and capacity-building activities with their local communities. Some groups, such as Landcare groups and Land Conservation District Committees (LCDCs) cover large parts of the Region, while many others have a specific focus, such as a local reserve, river or issue. Projects and activities carried out by our community groups include revegetation, weed control, fauna and flora surveys, fencing, dune restoration, field days, soil testing, water monitoring and public awareness and advocacy.

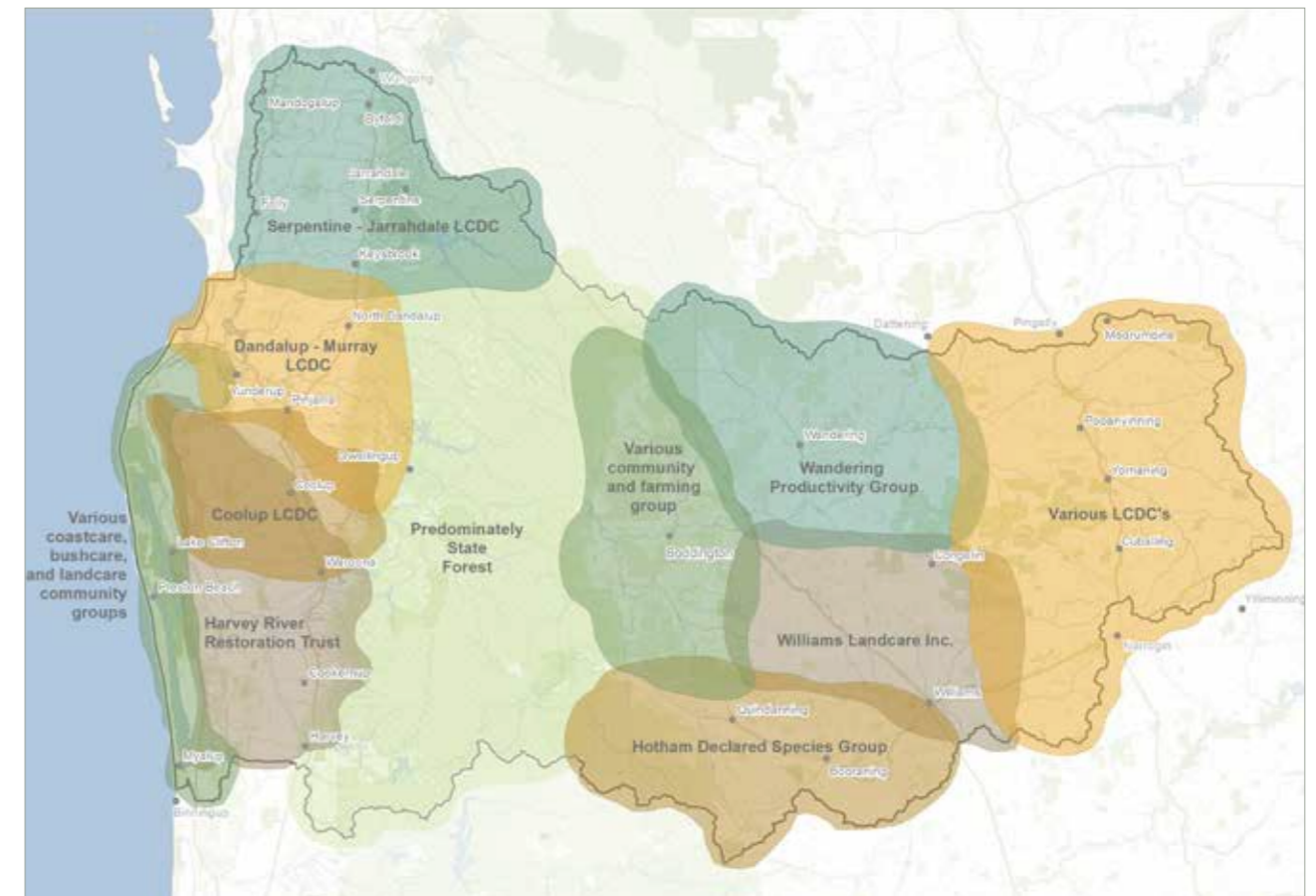


Figure 4: Major Landcare Groups in the Peel-Harvey Region

The PHCC works with community groups in numerous ways, including:

- assistance with technical aspects of NRM, including provision of data (e.g. providing research information or mapping)
- training and skills development (e.g. training volunteers how to count and identify waterbirds)
- project development (e.g. planning bushland restoration projects)
- securing funding for projects (e.g. assisting with grant applications)
- group facilitation (e.g. administrative support)
- logistical support (e.g. field days, practical on-ground support at revegetation sites)
- coordination between groups and organisations (e.g. bringing partners to the table).

Strengthening working relationships across the Region is a priority.

The COCKATUBE® Nesting Box a community partnership success story

Designed and constructed by Landcare SJ and their partners, Cockatubes have been installed across the Peel Region, providing artificial nest boxes that replicate, and substitute for, natural hollows, replacing those lost to clearing and feral bees.

Since 2005, over 500 Cockatubes have been installed for WA's three listed, vulnerable and endangered black cockatoo species.



2.3 Our Aboriginal Community

The PHCC recognise, acknowledge and respect Noongar People as the Traditional Owners of lands within the south-west of Western Australia. For tens of thousands of years Noongar People of the Bindjareb, Whadjuk and Gnaala Karla Boodja dialect groups have dwelt here, tended the land and been sustained by its natural resources. Their spiritual, cultural and intellectual connections to the land are strong and provide opportunities to enhance management of the Region's natural resources.

To help guide Noongar engagement in NRM the PHCC works with:

- The South West Aboriginal Land and Sea Council (SWALSC), the endorsed representative body under the *Native Title Act (1993)* and the Gnaala Karla Boodja (Native Title Working Party) to:
 - acknowledge, respect and integrate correct protocols for engaging Traditional Owners and the local community
- Local Traditional Custodians, Elders and their communities to:
 - work closely and in partnership with Traditional Owners in the planning, implementation and maintenance of on-ground projects to integrate and respect the significance of sites and the spiritual beliefs of the local communities

- share and integrate cultural knowledge and understanding into NRM activities
- acknowledge the traditional values and spiritual connection to sites, such as Lake Clifton, through stories and art work
- work together to develop ways to communicate and respect traditional cultural sites and values and to develop opportunities to continue to work together into the future
- provide opportunities for training for future employment.

The PHCC is working with our local communities to determine the aspirations of local Aboriginal people for NRM in the Region and how they wish to be involved in the delivery of NRM projects.

The PHCC will continue to directly involve local Noongar people to strengthen partnerships, foster a greater understanding of cultural values, and identify with the community opportunities to lead to Working on Country. This approach has been used in the successful delivery of projects, including Subcatchment Implementation Plans (2011–2012), Lake Mealup Recovery Program, Lake Clifton Recovery Project (2012–2013) and the Peel-Harvey Rivers 2 Ramsar project (2013–2017).



GLORIA KEARING, COLLEEN ARCHIBALD (WAROONA LANDCARE) AND KARRIE-ANNE KEARING - MURRAY RIVER, PINJARRA (2013)

2.4 Government

The Australian, Western Australian and Local governments play a significant role, including:

- enacting legislation on NRM matters, including the protection and wise use of natural resources (e.g. EPBC Act 1999)
- implementation of policy and initiatives which provide direction to land managers on how natural resources are to be used, managed or protected (e.g. Strategic Assessment of the Perth and Peel Regions)
- funding Regional NRM and local NRM initiatives (e.g. Landcare programs)
- land management and on-ground services (e.g. management of reserves and stormwater)
- land-use planning, water licensing and allocation.

Through these roles, governments influence NRM practices and outcomes. Proactive protection on NRM assets are more effective than reactive restoration and therefore the PHCC works closely with government on strategic land-use planning matters. On average, the Commonwealth Government provides 70–80% of investment into the Region's NRM projects.

The links between this Strategy and government legislation, policy and priorities are covered in Section 5.1 and Appendix C.

2.5 Growers and Industry

Most of the Peel-Harvey is freehold land, managed by individuals and private entities. The predominant land use in the Hotham-Williams subsystem is cereal cropping and grazing. Land use on the Coastal Plain subsystem is predominately grazing, dairies, intensive animal keeping, nurseries, horticulture and keeping of horses. Many of these land managers implement sound NRM practices as part of the overall management of their operations; however, legacy fertiliser stores and land management is still one of the largest challenges for soil health and impacts on our rivers and estuary

Grower and industry groups have a history of innovation and trialing new management practice and are central to the identification, development and adoption of new and innovative management systems essential to achieving improved NRM. This has been made clear through consultation with the community during development of this Strategy. The types of assistance sought include:

- skills development
- information sharing
- practical assistance with on-ground works
- building cooperation between neighbours to achieve common aims across the landscape (e.g. weed control, wildlife corridors)
- connection to industry and academic institutions.

Industry sectors, including mining and land development, also play a significant role in NRM. Major players in the jarrah forests are bauxite mining companies Alcoa Australia, BHP Billiton Worsley Alumina and Newmont's Boddington Gold Mine. Clearing for mining requires subsequent intensive land rehabilitation exercises and they must manage the by-products of their activities. Land development on the coastal plain and around the Peel-Yalgorup Ramsar System is a significant challenge but can also provide opportunities for improved NRM.

Mining in the Peel-Harvey

The total value of mining in the Peel-Harvey Region is \$3.4 billion p.a. (2012).

The main commodities are bauxite and gold, produced from mines in the Jarrah Forest.

Mining leases cover 340 201 hectares of the Region's Jarrah Forest



3. A Region of Diverse Landscapes

The Peel-Harvey is loved by many Western Australians for its natural environment and the opportunities these natural, rural places provide. Many West Australians have fond memories of crabbing and prawning in the Estuary, canoeing on the Murray River, hiking on the Bibbulmun Track or fun family days at the Waroona and Harvey Shows. The Region has changed significantly over the last 50 years, but this sense of place remains and is the reason over 158 000 people call the Peel-Harvey home.

'We maintain that a healthier Peel-Harvey catchment is the cornerstone of any economic or other regional development initiatives that may be under consideration by any Government or agency.'
J. Lambrecht, RDA (Peel)

The Coastal Plain Subsystem and Ramsar, Coastal and Near-shore Subsystem are connected by an extensive drainage system that conveys water, sediments and nutrients from the upstream catchment to the Peel-Harvey Estuary and other wetlands in the Ramsar Site. However, the two subsystems have been separated for the purposes of the strategy to highlight the different land-use and management issues facing these two areas. The focus on the Coastal Plain is on managing land-use change and drainage management, while the priority for the Ramsar, Coastal and Nearshore Subsystem is management and buffering of the Ramsar Site, coastal foreshores and the Peel-Harvey Estuarine System (the Catchment's receiving environment).

3.1 Four Subsystems

The Region consists four sub-systems that reflect the diverse landscapes, communities and land uses of the Region (refer Regional Profile p 24–25).

- **Ramsar Wetlands, Coastal and Near-shore**—includes the 26 530 ha Ramsar-listed Peel-Yalgorup Wetland System and over 83 km of coastal and near-shore environments. Most of this subsystem is developed for urban and rural residential land use or reserved for conservation.
- **Coastal Plain**—is the relatively flat, winter-wet and artificially drained sandplain which has been extensively cleared and is used for agriculture, townsites and rural residential areas.
- **Forest and Scarp**—covers large areas of jarrah forest across the centre of the Catchment. The area is managed for a multitude of values including public water supply, conservation, mining, recreation and forestry.
- **Hotham and Williams**—makes up more than half of the Region and includes some of the most reliable and productive cropping and farming districts of the Western Australian wheatbelt.



CHUDITCH (*DASYURUS GEOFFROII*)



WOYLIE (*BETTONGIA PENICILLATA*)
PHOTOS: BABS AND BERT WELLS/PARKS AND WILDLIFE

An Amazing Diversity of Plants and Animals

The diversity and rareness of ecosystems and species is a stand-out feature of the Region. Three (3) bioregions and thirty-seven (37) vegetation associations occur within the Region supporting 120 species of threatened flora and habitat for 109 species of threatened fauna. Such is the level of diversity, endemism and level of threat that the Region is recognised as part of one of the world's Biodiversity Hotspots. Whilst some parts of the Region are well vegetated, such as the Forest and Scarp Subsystem, others have been extensively cleared. Some vegetation types in the Hotham and Williams Catchment are less than 10% of pre-European settlement while on the eastern side of the Swan Coastal Plain some types have less than 5% retained.

Some of the Region's outstanding natural areas, and the threats which they face are detailed in Appendix F.

Agriculture and the Regional Economy

Agriculture is one of the top three economic activities in the Region with regional farm-gate agricultural production values exceeding \$324 million per annum. The most significant products are cereals (Hotham-Williams) and pigs, poultry and intensive horticulture (Coastal Plain). The equine, forestry and fisheries sectors are also of significant economic and social value. The total value of racing and recreational horse-keeping is estimated at \$167 million (2012).

Some of the key features of the Region's agricultural sector:

- The Hotham-Williams is one of the most productive cereal cropping areas in WA due to its reliable rainfall and favourable soil conditions. Annual production value is estimated at \$129 million.
- Total production by area, the Peel-Harvey Region supports 10% of Western Australia's glasshouse and nursery production. (PDC, 2011).
- By number of animals, the Region grows 33% of Western Australia's sow herd. (Russell Cox, pers. comm.)
- Intensive agriculture will continue to grow on the Region's Coastal Plain due to availability of water and land supplies in close proximity to Perth and Mandurah.

Water, Wetlands and Waterways

Water shapes much of the Region's landscape, sense of place, land use and NRM issues.

There are over 5592 km of waterways in the Region. Over 1445 km (25%) of these are in a near pristine or good condition (Hamilton, 2002). Most are within the well-forested Forest and Scarp Subsystem. In contrast, 943 km of 951 km of waterways assessed on the Coastal Plain are degraded, significantly weed-infested drains.

Over 4000 km of drains of the Coastal Plain deliver 140 tonnes of phosphorus to the Peel-Harvey Estuarine System and lower catchment rivers each year. The target to return the System to a healthy condition is to remove 75 tonnes of phosphorus per year. This is a significant challenge for the Catchment community, including government.

3.2 Regional NRM Status and Trends

The Strategy is focused on protecting the Region's significant natural resource values and preventing future problems that may be caused by a lack of knowledge, poor planning, poor land management or misuse of resources. Before all else, this approach requires an understanding of existing natural resource values, condition and threats.

In 2011, the Peel-Harvey *Catchment Condition and Priorities* report was compiled to provide a snapshot of the condition of the Region's natural resources and future trends, particularly for water and biodiversity resources. The study, commissioned by Regional Development Australia (Peel) and the Peel-Harvey Catchment Council, showed most of the catchment's natural resources are in a state of deterioration (PHCC, 2011).

The *Catchment Conditions and Priorities* report looked at the Region's water and biodiversity resources from the perspective of three inter-related systems: the Peel-Harvey Estuary, the Peel-Yalgorup Ramsar System and the Peel-Harvey Catchment. Where available, natural resource indicators were used to describe the status and trend of various components of these systems to provide a 'condition snapshot'. Tables 1, 2 and 3 provide a summary of the results.

More recently, information from the Report Card on sustainable natural resource use in agriculture has been made available on the status and trend of soil resources in the Region (DAFWA, 2013). This information is summarised in Table 4 for the Coastal Plain and Hotham-Williams subsystems.

Table 1: Estuary and lower river—condition snapshot (PHCC, 2011)

Asset/indicator	Status	Trend	Reference
Estuary nutrient levels	Good	Likely deterioration	Rogers, Hall & Valesini (2010)
Lower river nutrient levels	Of concern	Likely deterioration	
Estuary algae levels	Average	Likely deterioration	
Lower river algae	Of concern	Likely deterioration	
Fisheries—Estuary	Average	Likely deterioration	
Fisheries—lower rivers	Of concern	Likely deterioration	
Dolphins	Measures not available	Measures not available	
Foreshore vegetation	Measures not available	Measures not available	

Table 2: Ramsar site environmental assets—condition snapshot (PHCC, 2011)*

Asset	Status	Trend	Reference
Waterbirds – including migratory waterbirds	Average	Steady	Hale & Butcher (2007)
Yalgorup Lakes hydrology, and water quality (salinity and nutrients)	Of concern	Likely deteriorating	Peel-Harvey Catchment Council, 2009)
Lake Clifton Thrombolites	Of concern	Likely deteriorating	Environmental Protection Authority (2010a)
Lake Clifton—fish	Of concern	Measures not available	Hale & Butcher (2007)
Lake McLarty—hydrology	Of concern	Measures not available	Hale & Butcher (2007)
Lake Mealup—hydrology	Of concern	Likely deteriorating	Hale & Butcher (2007)
Goegrup and Black Lakes	Measures not available	Measures not available	Hale & Butcher (2007)

*For more information on the Peel-Yalgorup Ramsar System see Section 3.3

Table 3: Catchment environmental values—condition snapshot

Asset	Status	Trend	Reference
Natural watercourses condition (Coastal Plain and Wheatbelt)	Of concern	Likely deterioration	Land Assessment (2005)
Drains—water quality	Of concern	Measures not available	Environmental Protection Authority (2008)
Wetlands—coastal plain	Of concern	Likely deterioration	Land Assessment (2005)
Flora and fauna—Swan Coastal Plain	Of concern	Likely deterioration	Hick (2004)
Flora and fauna—Jarrah Forest	Average	Likely deterioration	EPA (2010b)
Flora and fauna—Avon Wheatbelt	Of concern	Likely deterioration	Government of Western Australia (2003)
Wheatbelt soil and land (dryland salinity)	Of concern	Likely deterioration (due to dryland salinity)	Land Assessment (2005)

Table 4: Status and condition of soils of the Coastal Plain and Hotham-Williams systems (DAFWA, 2013)

Soil asset characteristic	Coastal Plain		Hotham-Williams Catchments	
	Status/risk	Trend	Status/risk	Trend
Soil acidity	Very poor	Likely deterioration	Poor	Likely deterioration
Wind erosion	Not assessed		Moderate risk	Variable
Water erosion	Low risk	Stable	Moderate risk	Stable
Soil organic carbon levels	Good—very good	Measures not available	Moderate	Measures not available
Soil compaction	Low risk	Stable	Moderate risk	Stable
Water repellence	Very poor	Stable	Poor	Likely deterioration
Dryland salinity	Low risk	Stable	Moderate risk	Stable
Nutrient status (phosphorus)	Excess	Stable	Well in excess	Stable
Nutrient export	Very high	Variable (mostly moderate to very high)	Not assessed	

Tables 1 to 4 provide general information at a broad scale, and may not reflect the condition of resources at the local scale. Notably, measures are not available for a number of natural assets, or data may no longer be collected to assess the condition of some of these assets in the future. Without good measurement it is difficult to soundly manage.

This reinforces the importance of continuous monitoring of natural resources in the long term as a major tool in NRM. Monitoring is not only important to assess condition and trends, but is essential for better decision making by natural resource managers, land-use planners and government. Where the community understands the values and condition of natural resources it may be better placed to allocate resources to priority natural resource management initiatives.



REGIONAL PROFILE

Over 306 000 ha of world famous jarrah forest ecosystems. Home to the forest red-tailed black cockatoo



MAJOR NATURAL ASSETS:	PRIMARY LAND USES:	KEY NRM ISSUES:
<p>(188 3340 ha)</p> <ul style="list-style-type: none"> Peel-Yalgorup Ramsar System Peel-Harvey Estuarine System Goegrup and Black Lakes Nature Reserves Habitat for migratory waterbirds Coastal/beach environs, primary and secondary dune systems 	<ul style="list-style-type: none"> Conservation Residential and rural residential Recreation, boating and fishing Grazing and rural uses Lifestyle—coastal living 	<ul style="list-style-type: none"> Land-use development Management and buffering of the Peel-Yalgorup Ramsar System Improvement of riverine and estuarine health Recreational pressures and management

Ramsar Wetlands, Coastal & Nearshore

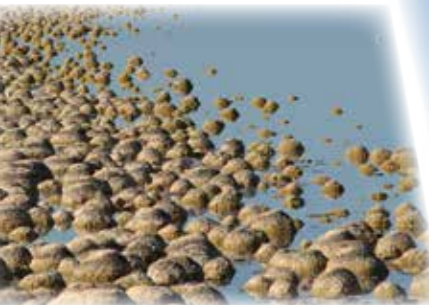
<p>(188 340 ha)</p> <ul style="list-style-type: none"> 27 700 ha (15% cover) of native vegetation, including Lowlands Conservation Estate 13 664 ha of wetlands in Conservation or Resource Enhancement management categories 142 790 ha of lands under agricultural production 	<ul style="list-style-type: none"> Cattle for beef and dairy Intensive agriculture—glasshouse & nursery production, poultries, piggeries Residential and rural residential Peri-urban lifestyle 	<ul style="list-style-type: none"> Arterial drainage system management Management of nutrient export from agricultural land use Protection of natural assets through land-use change processes
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Coastal Plain



Peel-Yalgorup Ramsar System including Peel-Harvey Estuary, the largest and most diverse estuarine system in South Western Australia

Thrombolites at Lake Clifton are living 'rocks', relics of the first life on Earth over 3.5 billion years ago



Dryandra Woodland is one of the largest and most diverse remnant bushland areas in the Western Australian wheatbelt. It is home to ten species of threatened fauna, including numbat, woylie and chuditch



<p>(349 180 ha)</p> <ul style="list-style-type: none"> Jarrah forest Significant surface water resources used for public water supply 	<ul style="list-style-type: none"> Public water supply Mining Recreation, tourism and lifestyle Forestry 	<ul style="list-style-type: none"> Impact of multiple uses on forest health, including mining Climate change impacts on biodiversity, water supply Biosecurity Recreation
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Forest & Scarp

<p>(573 350 ha)</p> <ul style="list-style-type: none"> 386 800 ha of agricultural lands under cropping, grazing and agricultural management 111 840 ha of native vegetation including Dryandra Woodland Habitat for 40 threatened fauna species no longer present over most of WA wheatbelt 	<ul style="list-style-type: none"> Agricultural cropping and grazing Conservation Rural residential 	<ul style="list-style-type: none"> Management of soil acidity Management of isolated native vegetation patches and fauna habitat Management of weeds and pest animals Management of dryland salinity Management of nutrient export
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Hotham & Williams

The woodlands, wetlands and heathlands of the Coastal Plain support many threatened and endangered species and communities.





3.3 Ramsar Wetlands, Coastal and Nearshore

‘During the last five or so years...some of the biological indicators of estuarine health point potentially to a gradual reversal of ecological conditions back towards the status of the Estuary that existed immediately prior to the construction of the (Dawesville Cut) channel.’
(Rogers, Hall & Valesini, 2010)

The Ramsar Wetlands, Coastal and Near-shore Subsystem, including the City of Mandurah, is the lifestyle and residential hub of the Region. Many people enjoy the natural wonders of the Peel-Harvey Estuary, Murray River, Yalgorup National Park and beaches of the Indian Ocean. The Peel Inlet and Harvey Estuary is the largest and most diverse estuarine system in the south-west of Western Australia and is part of the Peel-Yalgorup Ramsar System.



PHOTO: DAVID RENNIE

3.3.1 Ramsar 482

The Peel-Yalgorup Ramsar System is recognised as a Wetland of International Importance under the Ramsar Convention. The 26 530 ha System meets multiple criteria for listing under the Convention. It supports a huge number and diversity of residential and migratory waterbirds. It provides habitat for fish breeding and nursery grounds for fish, crustacea and birds and rare living ‘rocks’ known as thrombolites. The System comprises the Peel-Harvey Estuary, the lands and lakes of Yalgorup National Park, Lake McLarty, Lake Mealup and Roberts Bay Swamp.

Eighty-six species of waterbirds have been recorded in the Peel-Yalgorup System. Thirty-five of these are international migrants. Some fly up to 24 000 kilometres every year from their breeding grounds in northern Asia to Australia where they spend our summer feeding on the mudflats and foreshores of the Estuary and surrounding wetlands.

The Peel-Yalgorup Ramsar System requires careful management as residential areas continue to grow. Buffers to the wetlands and bushlands need to be protected and recreational use of waterways and foreshores must recognise the principles of Wise Use of Wetlands (Article 3.1 of the Ramsar Convention). Boating and fishing need to be carefully managed.

Increases in salinity and reductions in groundwater flows due to bores and declining rainfall are threatening natural assets such as Lake Clifton and its ancient thrombolites. The thrombolites are listed as a critically endangered threatened ecological community for which a Recovery Plan has been prepared.

Complementing the wetlands of the Ramsar System are woodlands of tuart, WA peppermint and other vegetation types that provide habitat for a variety of terrestrial fauna. These include the western ringtail possum (*Pseudocheirus occidentalis*), a threatened species which had become locally extinct and has been successfully re-introduced into Yalgorup National Park and surrounding areas.

3.3.2 Peel Inlet and Harvey Estuary

Mandurah and Murray draw much from the natural beauty of the Peel-Harvey Estuary. Residents and visitors enjoy its foreshores, fishing, boating, crabbing, waterbirds and dolphins.

‘The Estuary and its waterways have been conservatively estimated to be worth at least \$361 million per annum to the Region in terms of fishing, tourism, boating and residential land values.’
(Economic Consulting Services, 2008)

The near-collapse of the Estuary between the 1970s and 1980s due to excessive nutrient loads from the Coastal Plain catchment led the State Government to construct the Dawesville Cut (1994). Whilst the Cut flushes nutrients out of the Estuary, levels of nutrients and sediment entering the lower rivers, particularly the Serpentine River, continue to be high and algal blooms and fish kills are regular occurrences.

‘The lower reaches of the Serpentine River, as an effective ecosystem, could now be described as biologically dead and perhaps not possible to save, and there are indications that the health of the lower reaches of both the Murray and Harvey Rivers are in a parlous biological state.’
(Rogers, Hall & Valesini, 2010)

The condition and rate of decline of these environments are potentially the most significant indicator of current and future trends having an impact on the Estuary. In terms of strategic assessment and monitoring programs this environment is of critical importance.

Solutions to the Estuary’s water quality problems are known and are achievable but require significant changes in the way that land on the Coastal Plain is developed and managed. While there are no silver bullets, broadscale amendment of soils and management of fertiliser use provide the greatest opportunities to reduce nutrient pollution entering the rivers and estuarine system (Kelsey, P *et. al.*, 2011 and Environmental Protection Authority, 2008).

3.3.3 Coastal and Nearshore Environments

Framing the Ramsar Site to the east are 83 kilometres of coastal and near-shore environments. This coastal landscape is characterised by tuart woodlands, coastal heath (primary and secondary sand dunes), and sandy beaches. Most of the Region’s coastline is protected within foreshore reserves of varying widths and the Yalgorup National Park. Development of near-coastal areas has occurred to create residential areas, recreational and boating facilities, and the Dawesville Cut.

The Estuary and near-shore environments support a range of wildlife, including dolphins, crabs, fish and birds. Many of these species are iconic and valued by the community and visitors. Commercial fisheries centred at Mandurah and based on estuarine and marine species were valued at \$4.38 million per annum in 2010 (Peel Development Commission, 2014).

Statistics—Ramsar Wetlands, Coastal and Nearshore	
Area of subsystem	62 751 ha
Area of Peel-Yalgorup Ramsar System	26 530 ha
Area native vegetation cover or estuary waterbody (% subsystem)	36 724 ha (59%)
Area of subsystem in Parks and Wildlife Estate	10 569 ha (17%)
Area of subsystem in conservation reserves	10 205 ha (16%)
Number of threatened flora species	25
Number of recorded populations of threatened flora	83
Number of threatened fauna species or protected under International Agreement	75
Total length of mapped watercourses	64 km
Waterways in good/near-pristine condition	5%
Total area of wetlands (% subsystem)	29 808 ha (48%)
Total area of Conservation and Resource Enhancement Wetlands (% wetlands)	25 204 ha (85%)
Area of land under rural use (2003) (% subsystem)	13 317 ha (21%)

SOURCE: GAIA RESOURCES 2014



3.3.4 Community Priorities—Ramsar Wetlands, Coastal & Near-shore

What you told us...

'Our truly unique Ramsar site should be economically valued for its ecosystem support services/contribution to the regional economy, and in accordance with the wishes of our Aboriginal community, there should be no future development.'

'Legislative and responsibility gaps which exist in managing the Peel-Yalgorup Ramsar Site need to be addressed.'

'Whilst volunteers are keen, support is needed. We need to build resilience in natural areas through management, bushland retention and purchase, weed and pest control, and revegetation.'

'Practices that cause sedimentation and contribute to the rapid accumulation of MBOs need to cease.'

'Maintaining connections between people and their natural environment is important. However, there are areas that are so important as habitats for our protected species that there needs to be some 'no-go' zones.'

Our Community's Priorities...

- Increase recognition of the Ramsar Site amongst managers and users.
- Monitor Estuary health and model the impacts of proposed development.
- Establish a single authority with management capability, authority, funding, legislative backing and long-term staffing for Estuary/Catchment management.
- Consider all types of impacts (on and off-site) of development proposals on Ramsar sites, and modify proposals accordingly, and identify and coordinate research needs for the Catchment through a single authority.
- Refine and implement Regional Coastal Management Plans and Local Action Plans and implement catchment management to improve water quality.
- Stop the encroachment of urban and peri-urban development onto natural areas (direct and indirect impacts).
- Prevent new development between Mandurah, Eaton Ridge and the ocean in the Yalgorup Lakes region to maintain and improve the present integrity of the lakes system.
- Ensure land-use planning excludes development from sensitive and significant natural areas in the Region and insist developers meet high standards of practice to protect wetlands and watercourses.
- Provide additional resources for existing coastcare groups.
- Deliver robust community engagement, awareness and education campaigns.
- Support volunteer efforts and new groups to grow membership, build skills and understanding.



'Forward planning is vital so that we, as Aboriginal custodians, are consulted during the planning for works that will take place on our lands. The consultation, including engagement and monitoring, must continue during the time of actual work, with our people on-site. This will avoid our sites and heritage being destroyed.'

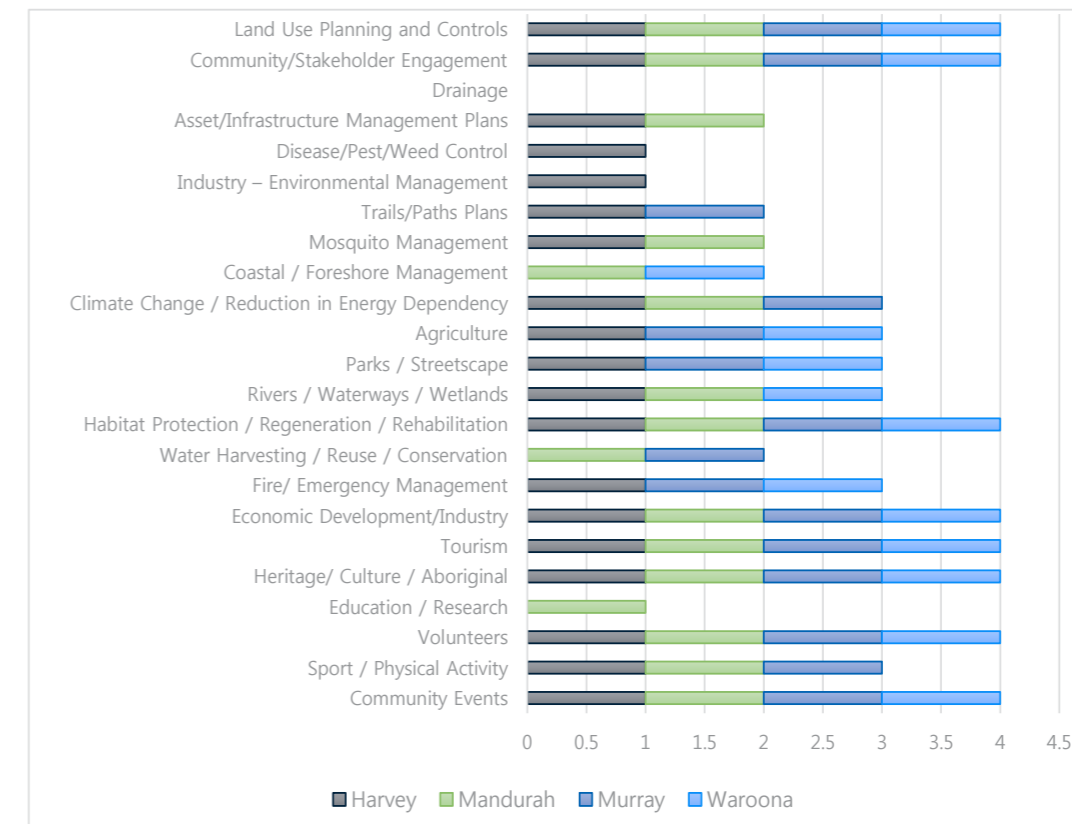
—extract of conversation with Harry Nannup (Elder) and Franklin Nannup (Community Representative), May 2014—



'The Mandurah community consider the natural environment as one of their proudest and the most important features of their city. Naturally, they place high importance on its protection and the promotion of conservation.'

—extract from City of Mandurah Strategic Community Plan—

Summary—Local Government Strategic Community Plans



3.4 Coastal Plain

The Coastal Plain is a broad, flat area of wetland with farms and mixed land use that is undergoing significant change. Much of the estimated 60% growth in the Region's population will be housed here by 2030 and many farms are morphing to new suburbs, rural residential estates and commercial areas (Government of WA, 2010). Growth of Perth will also expand into the southern parts of this area.

The Plain has been significantly cleared, drained and modified, but retains much of its natural and rural character. Waterways dissect the Plain, such as the Serpentine and Murray rivers, but most meander into broad, flat wetlands after leaving the Darling Scarp before being directed into man-made drains.

3.4.1 The Palusplain

Seventy-two percent of the subsystem is wetland, mostly continuous flat seasonal wetlands called palusplains. Under natural conditions the palusplains and damplands provided a natural water-purifying function for the Peel-Harvey Estuarine System. Due to historic agricultural and townsite development, the palusplain has been drained, causing water and nutrients to flow off the wetlands more quickly, carrying nutrients, organic matter and sediments from farms and towns into drains, rivers and the Estuary. Drains have made settlement and farming of the Coastal Plain possible, but have contributed to the eutrophication of the Peel-Harvey Estuary. There is much work to be done to replace or return the water-cleaning function of the Coastal Plain's waterways and wetlands.

3.4.2 Flora and Fauna

The predominately cleared Coastal Plain is intersected by isolated remnants of native vegetation. Only 15% of the land of the coastal plain now supports native vegetation. This consists of private remnants (14%) and conservation reserves (1%). These are important refuges for a diversity of flora, fauna and vegetation types including banksia, melaleuca, and marri woodlands and wetland heaths.

Conservation areas such as Lowlands Conservation Estate and Buller Nature Reserve support fauna that has largely disappeared from the remainder of the

Coastal Plain, both north and south of Perth. Species such as the rakali or native water rat (*Hydromys chrysogaster*) provide important benchmarks for the health and ecology of the Coastal Plain. The rakali eats a range of aquatic fauna such as insects, fish, crustaceans and mussels which it can find in the Serpentine River adjacent to lowlands. Freshwater mussels, an indicator of good water quality, are found in an ever-decreasing number of waterways on the Coastal Plain.



FRESHWATER MUSSELS ARE A SIGN OF GOOD WATER QUALITY IN SOME WATERWAYS ON THE COASTAL PLAIN

Other fauna characteristic of the Coastal Plain are the southern brown bandicoot (*Isodon obesulus*) and Carnaby's black cockatoo both of which are under threat due to habitat loss and degradation.

The Coastal Plain is largely held in freehold ownership and used for broadscale and intensive agriculture, rural residential estates, equestrian estates and residential areas. Agriculture is a significant part of the Plain's social and economic fabric and is worth at least \$195.4 million p.a. and includes beef grazing, dairy, poultry, vegetable growing and hay production. However, declining terms of trade over recent decades has made more traditional agricultural enterprises less profitable, resulting in increasing pressure for land-use change. This is exacerbated by the spread of urban and peri-urban development, presenting a range of issues arising from the associated change in land use. Small areas of the Plain are also covered in mining tenements for mineral sands.

3.4.3 Soils

Many of the soils of the Coastal Plain have poor nutrient retention properties due to their predominately sandy nature. Combined with the extensive drainage network, excess nutrients and associated organic matter are quickly transported to downstream environments, including lower river reaches, wetlands and the Peel-Harvey Estuarine System. Some areas support deep sandy soils (e.g. Bassendean Sands, and others are duplex sands and loams (e.g. Pinjarra Plain). All of these soils are able to be used for agriculture, but often with an unavoidable loss of nutrients, the extent to which depends on the type of agriculture, soil characteristics and the measures put in place to reduce nutrient loss risk.

3.4.4 Monosulfidic Black Ooze

An emerging issue which affects water quality is monosulfidic black ooze (MBO). MBO is a sludge-like material that is rapidly accumulating in the Region's rivers, lakes and Estuary. When disturbed, such as through dredging, MBOs can have a devastating ecological impact on waterways by releasing contaminants, reducing aquatic oxygen levels and potentially resulting in fish deaths. The role of sediment entering waterways via the drainage network and leading to the formation of MBO requires further research.

Changing land use on the Coastal Plain (e.g. from agriculture to residential) does not in itself improve water quality or the condition of any natural resource. All development types can put natural resources, including water quality, at risk.



The challenge is for land managers to understand the opportunities and responsibilities they have to better manage their land and natural resources, and implement best practice and innovation.

Statistics—Coastal Plain	
Area of subsystem	188 337 ha
Area native vegetation cover (% subsystem)	27 722 ha (15%)
Area of subsystem in Parks and Wildlife Estate	4345 ha (2%)
Area of subsystem in conservation reserves	1530 ha (1%)
Number of threatened flora species	102
Number of recorded populations of threatened flora	229
Number of threatened fauna species or protected under International Agreement	56
Total length of mapped natural watercourses	952 km
Waterways in good/near-pristine condition	1%
Total area of mapped wetlands (% subsystem)	134 783 ha (72%)
Total area of Conservation and Resource Enhancement Wetlands (% wetlands)	13 664 ha (10%)
Area of land under rural use (2003) (% subsystem)	142 791 ha (76%)
Area under mining tenement (% subsystem)	7081 ha (4%)

SOURCE: GAIA RESOURCES 2014

Resilient Farming Community

Despite economic, climatic and production challenges presented over the past few decades, our farming community continues to adapt and rural production remains strong. Production within the Peel Region represents 10% of WA's glasshouse and nursery production, 30% of WA's pig production, and the overall income exceeds \$324 million. Farmers markets have also delivered new marketing and income opportunities for growers.



3.4.5 Community Priorities—Coastal Plain

What you told us...

'Our rural lands need to be zoned in perpetuity for agricultural production. The effort of Landcare in our catchment is important. It is vital future generations understand and appreciate the changes in our landscape which Landcare helped achieve.'

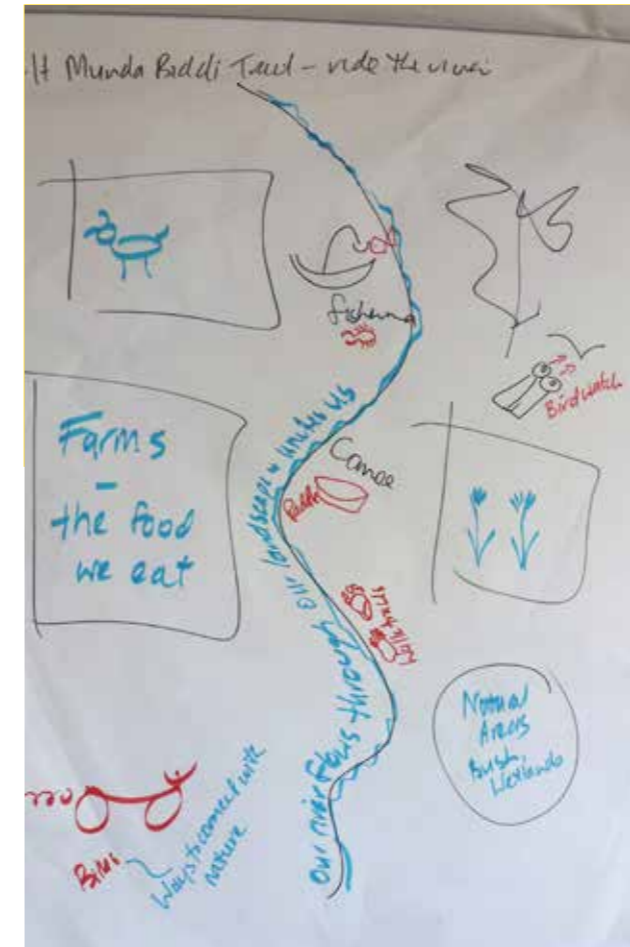
'Intergenerational equity is important to us. There needs to be landscape scale protection and restoration of our remnant bushland, wetlands and waterways and we need to retain natural areas within new housing estates.'

'We need robust buffers and to stop the encroachment of development into our natural areas. Climate change means buffers need to be increased not decreased. Our waterways are vital. There needs to be a focus on ecological function to ensure long-term quality and quantity of surface water flows and groundwater availability, for the environment and human use.'

'Increasing population puts pressure on our natural resources. We need to plan for the capacity of our landscapes. This needs to include recreational infrastructure as part of high level land-use structure planning.'

Our Community's Priorities...

- Connect people with each other and natural areas for multiple benefits including social well-being and mental health.
- Engage young people in NRM, including on-ground management.
- Support volunteer efforts. Support groups and grow membership, build skills and understanding.
- Support all land managers in integrated biosecurity management programs for agriculture and biodiversity objectives.
- Monitor Estuary health and model the impacts of proposed development.
- Establish a central agency for all government departments involved in catchment management (e.g. to consolidate volunteer effort and ensure best-practice and contemporary knowledge is applied consistently).
- Maintain local and regional sense of place through protection of natural areas and ecosystem service protection.
- To protect natural areas, ensure land use planning applies ecologically sustainable development principles at all levels from regional planning to public open space design.
- Identify and coordinate research needs for the Catchment through a central agency.
- Identify and classify the Region's Aboriginal cultural and heritage sites and knowledge.
- Protect priority agricultural lands for agriculture.
- Implement catchment management to improve water quality. Fence waterways to control stock access, protect riparian habitats and manage riparian areas.



'As 'Landcare elders', we remember our landscape from 30, 50, 70 years ago. We are still keen to help arrest the decline and to find new ways to engage new generations of carers for our unique environment.'

—Coolup and Harvey Landcarers Workshop, April 2014—

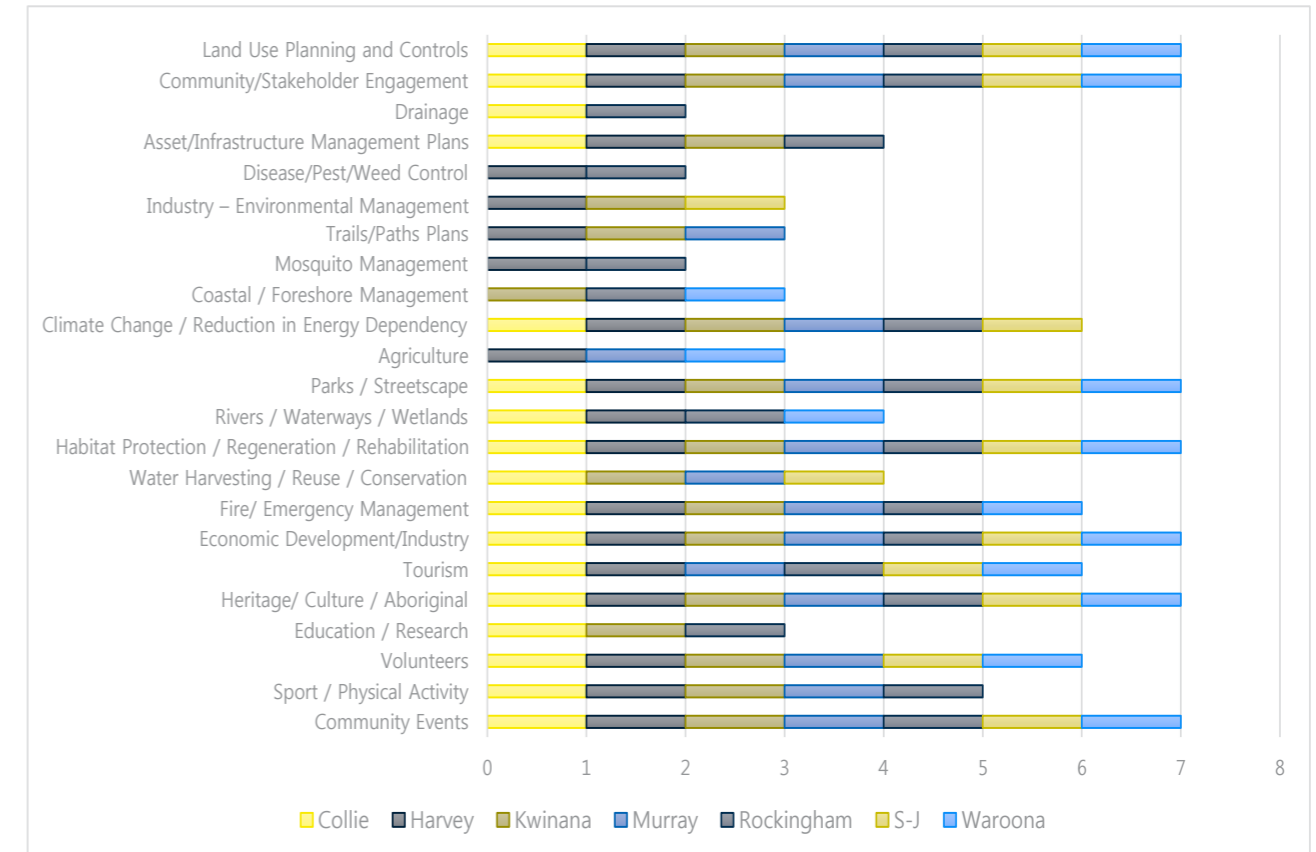
'Support community groups (both new and existing), who are preserving and enhancing the natural environment.'

—extract from Shire of Serpentine-Jarrahdale Strategic Community Plan—

'We value the unique aspects of our natural environment, coast and countryside, and want to see them conserved and appreciated by all residents and visitors.'

—extract from Shire of Waroona Strategic Community Plan—

Summary—Local Government Strategic Community Plans





3.5 Forest and Scarp

In the middle reaches of the Region are extensive areas of eucalypt forest. The Darling Scarp to the west of the forests provides an abrupt, stunning backdrop to the Coastal Plain.

This subsystem is characterised by multiple and overlapping land uses. Eighty-eight percent (88%) is vegetated, mostly in native forests, and used for a variety of purposes. Significant land uses, by area, are public water supply catchment, forestry, recreation and tourism, conservation and mining. Small areas of freehold lands in the forests are used for orchards, grazing and rural retreats.

There is a long and continuing use of the forests for timber production, including the harvesting of jarrah and marri. Logging and forest management practices are controlled under the 2014–2023 Forest Management Plan and administered by the Conservation Commission of Western Australia.

3.5.1 Biodiversity

All of this subsystem is within the Jarrah Forest Bioregion. This belies the richness and uniqueness of the area's biodiversity, including its eucalypts. In western areas of the subregion, jarrah-marri forest dominates with bullich and blackbutt in the valleys, while wandoo in the eastern areas and marri woodlands dominate with powderbark wandoo occurring on breakaways. Other areas support low banksia woodlands, heathlands and granite outcrops.

Given the extent of vegetation in this area many native mammals, reptiles, amphibians and birds remain or utilise the forest, including threatened species, such as the forest red-tailed black cockatoo (*Calyptorhynchus banksii*), numbat and chuditch. The forest provides a refuge for species that have disappeared from the plain or wheatbelt.

3.5.2 Recreation

The Perth and Peel communities have numerous connections to the area, including use of the forests for camping, hiking, mountain bike riding, canoeing and picnicking. Public access is extensive given that

eighty-one percent of the subregion is public land and managed by the Department of Parks and Wildlife. Key natural areas and features include Lane-Poole Reserve and Serpentine National Park. Main settlements are Dwellingup and Jarrahdale, each with links to the timber heritage of the area.

Given the proximity of the forests to the urban populations of the Perth and Peel regions, there are significant opportunities for recreation and ecotourism. Existing nature-based recreation assets include the Murray River, Bibbulmun Track and Munda Biddi Trail.



MUNDA BIDDI BIKE TRAIL, DWELLINGUP (2014)

3.5.3 Mining

Over 97% of the Forest and Scarp Subsystem is included within mining tenements, mostly targeting extensive bauxite reserves in the Darling Plateau (bauxite is used to produce alumina and aluminium).

These commercial-grade bauxite deposits are associated with lateritic soils that cover the Darling Plateau and extend into the western parts of the Hotham-Williams Subsystem. Bauxite is mined by Alcoa Australia and BHP Billiton from a number of operating sites in the Region, and refined at Pinjarra, Kwinana, Worsley and Wagerup.

In 2013, alumina to the value of \$4.117 billion was produced in WA, all within the Peel-Harvey Region. (Department of Mines and Petroleum, 2013)

Bauxite mining covers a relatively small portion of the Jarrah Forest, at any particular time (Alcoa Australia, 2014). The rehabilitation objective for mined areas is to re-establish a functional ecosystem that will fulfil the pre-mining forest land uses including conservation, timber production, water catchment and recreation. Post-mining rehabilitation includes reshaping mined areas, topsoil return, fauna habitat creation and revegetation with locally indigenous plant species.

Management of by-products from the process used to extract alumina from bauxite is a significant issue. Large quantities of sand and mud are produced which are currently stored in stockpiles close to refineries, such as Pinjarra and Wagerup on the Coastal Plain. These by-products have potential for a variety of uses including amendment of agricultural soils to improve productivity and nutrient retention, fill material and roadbase.

The variety and extent of uses of the forest provides opportunities for the community and natural resource managers. Management of the forests is largely undertaken by Parks and Wildlife, Water Corporation, mining leaseholders and local governments. Management of reserves is largely guided by Forest Management Plans prepared by the Conservation Commission of WA and implemented by Parks and Wildlife.

Joint management agreements between Traditional Owners and the State Government will lead to greater involvement of Aboriginal people in the management of these areas.

There are numerous challenges to management of the Forest and Scarp Subsystem, some of which are made more complex by the multiple and overlapping uses of the area. Climate change is causing extensive tree deaths in some years and significant reductions in runoff into public and private water supply dams.

Phytophthora dieback, weeds and feral animals are also key threats which require careful and strategic attention. Together, all of these NRM issues require management as various user groups wish to enjoy 'their piece of the forest'.

Statistics—Forest and Scarp	
Area of subsystem	349 178 ha
Area native vegetation cover (% subsystem)	306 359 ha (88%)
Area of subsystem in Parks and Wildlife Estate	282 780 ha (81%)
Area of subsystem in conservation reserves (Conservation Park, Nature Res. & National Park)	14 986 ha (4%)
Number of threatened flora species	17
Number of recorded populations of threatened flora	127
Number of threatened fauna species or protected under International Agreement	26
Total length of mapped watercourses	1665 km
Waterways in good or near-pristine condition	73%
Area of land under rural use (2003) (% subsystem)	29 666 (8%)
Area under mining tenement (% subsystem)	340 201 (97%)

SOURCE: GAIA RESOURCES 2014



3.5.4 Community Priorities—Forest and Scarp

What you told us...

'There is nowhere in the world like here, where you can head off into the forest and have a picnic in the Scarp. We treasure these opportunities and they connect visitors to our landscape.'

'The Northern Jarrah Forest has suffered from a number of impacts over many years such as clear felling, mining, jarrah dieback, fragmentation for infrastructure and logging. It needs a new focus on restoring resilience to the ecosystem, an approach that considers the modelled impacts of climate change.'

'Plan for, and use fire as a tool to proactively manage natural areas.'

'Access to water and markets are crucial to the fruit industry.'

'There are huge pressures on our water supplies for drinking, living and production. Declining rainfall means there is less water to 'go around'. Plus the warmer weather, with less chill hours, affects fruit quality.'

'Farmers markets have been economically beneficial, as has been growing niche crops, for niche markets.'

Our Community's Priorities...

- Prepare and implement plans to restore resilience to the Jarrah Forest in light of climate change and past management practices.
- Implement projects to stabilise and restore riparian habitats and decrease erosion (e.g. foreshore management).
- Implement catchment management to improve water quality.
- Promote ecotourism for economic and environmental benefits, and build the capacity of the Region, factoring in economic drivers and implications within future NRM plans.
- Review water allocation plans to protect environmental assets and ensure security of water quality and quantity. Ensure new water resource development (e.g. for horticulture) maintains environmental flows.
- Ensure developers meet high standards of practice to protect wetlands and watercourses.
- Plan for increased buffers to accommodate climate change impacts.
- Set development back from wetlands and watercourses.
- Maintain local and regional sense of place through protection of natural areas and ecosystem services.
- Ensure ecologically sustainable development principles are applied to land-use planning at all levels (regional and local).
- Use fire as a tool to manage natural areas.



'Being in touch with "nature" (bushland) is vital for our mental health'

'Bushland on the Darling Scarp provides fauna habitat and maintains ecosystem function, including "services" to humans'

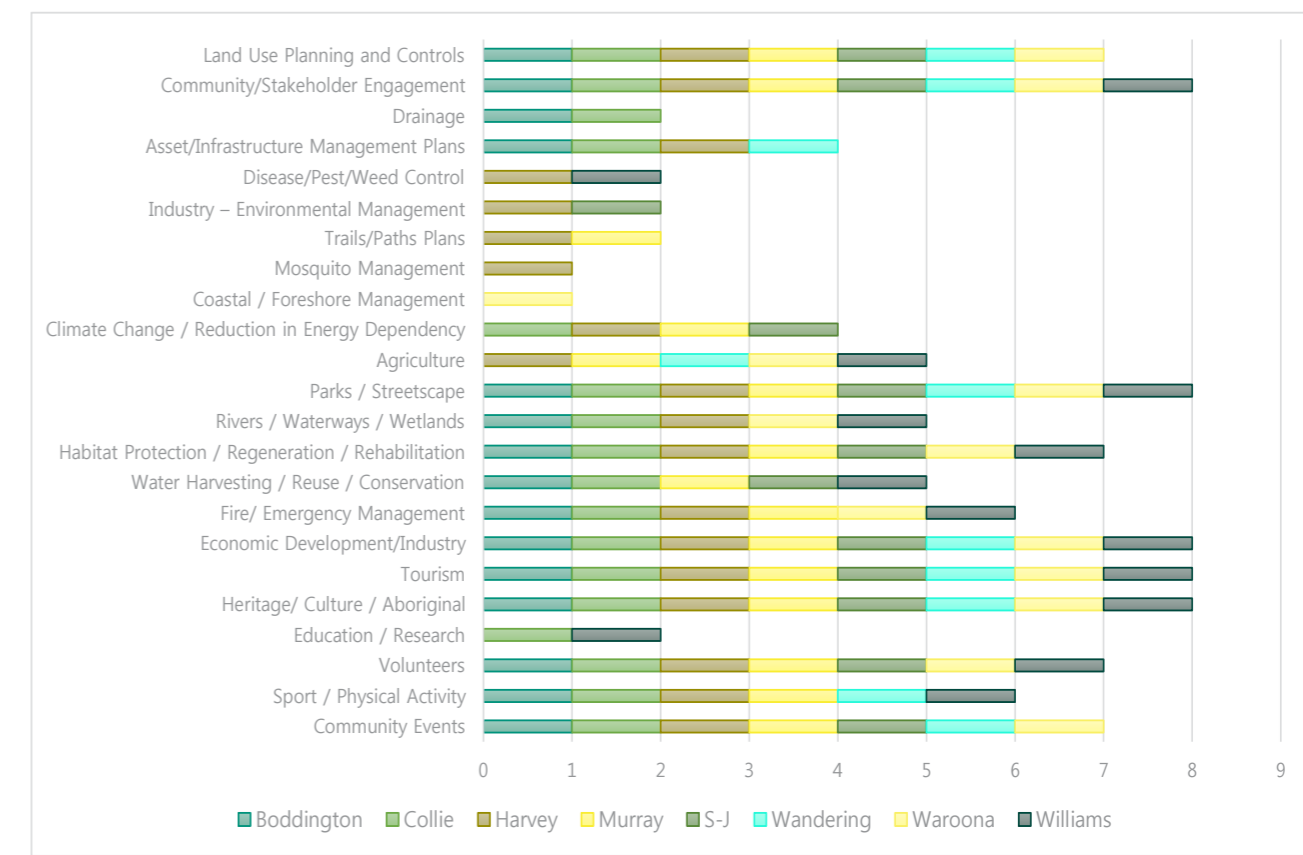
—Landcare S-J workshop, 2014—



'This Strategic Community Plan shares our visions and aspirations for the future of Boddington and outlines how we will, over the ensuing years, work towards achieving the best possible outcomes for the entire community.'

—extract from Shire of Boddington Strategic Community Plan—

Summary—Local Government Strategic Community Plans



3.6 Hotham and Williams

The catchments of the Hotham and Williams rivers are one of the two main agricultural powerhouses of the Region and include the districts of Boddington, Wandering, Williams, Cuballing.

Together, the catchments form the highest and geologically oldest part of the Region. They are characterised by rolling hills, steepest close to the jarrah forest, and becoming more gentle to flat towards the top of the catchments. Small areas of lateritic remnants with breakaways also occur.

Small areas are used for mining, including the Newmont Boddington Goldmine and BHP Billiton's Worsely Alumina operations at Marradong.

Around 33% of the subregion is vegetated, with the largest areas of native vegetation being Dryandra Woodland and areas of forest in the west.

3.6.1 Dryandra Woodland

Dryandra Woodland is one of the most significant conservation areas remaining in the Western Australian wheatbelt. It is made up of seventeen discrete blocks of vegetation in public ownership totalling 28 066 ha. Key values are:

- habitat for ten (10) threatened species of fauna, and two (2) in need of special protection
- twelve (12) vegetation associations, of over 800 native species, including one (1) rare and eight (8) priority species
- extreme diverse flora and fauna due to Dryandra's transitional location between the arid zone and the wetter environment to the west and southwest
- significant recreation and tourism opportunities.

Dryandra supports populations of several marsupials that have disappeared from most of the Australian or Western Australian mainland including numbat, woylie, tammar (*Macropus eugenii*), red-tailed phascogale (*Phascogale calura*) and brushtail possum (*Trichosurus vulpecula*).

A small timber industry, based on mallee plantations, exists within the Dryandra Woodland. Plantations were established over 50 years from the mid-1920's to develop a tannin industry. They are important historically, and provide an ongoing resource for small sawlogs.

The challenge remains to manage Dryandra as part of an extensively cleared rural landscape in cooperation with its neighbours. Key issues are the management of feral animals such as foxes and cats, and the connections of the Woodland to other areas of remnant vegetation and nature reserves such as Tutanning Nature Reserve and Lake Toolibin.



DRYANDRA WOODLAND (2005) PHOTO: JILL HARRISON

3.6.2 Agricultural Production

Agricultural production, mainly cereal cropping from this part of the Region, is valued at \$129.3 million per annum, making the districts of Wandering, Williams and Cuballing some of the most productive parts of the wheatbelt. This high level of productivity is due to adequate and reliable rainfall (between 500–600 mm) and variety of suitable soil types.

Maintenance of soil health is a significant issue for this part of the Region. Dryland salinity, soil fertility, soil acidification and compaction are all important considerations for farmers and NRM.

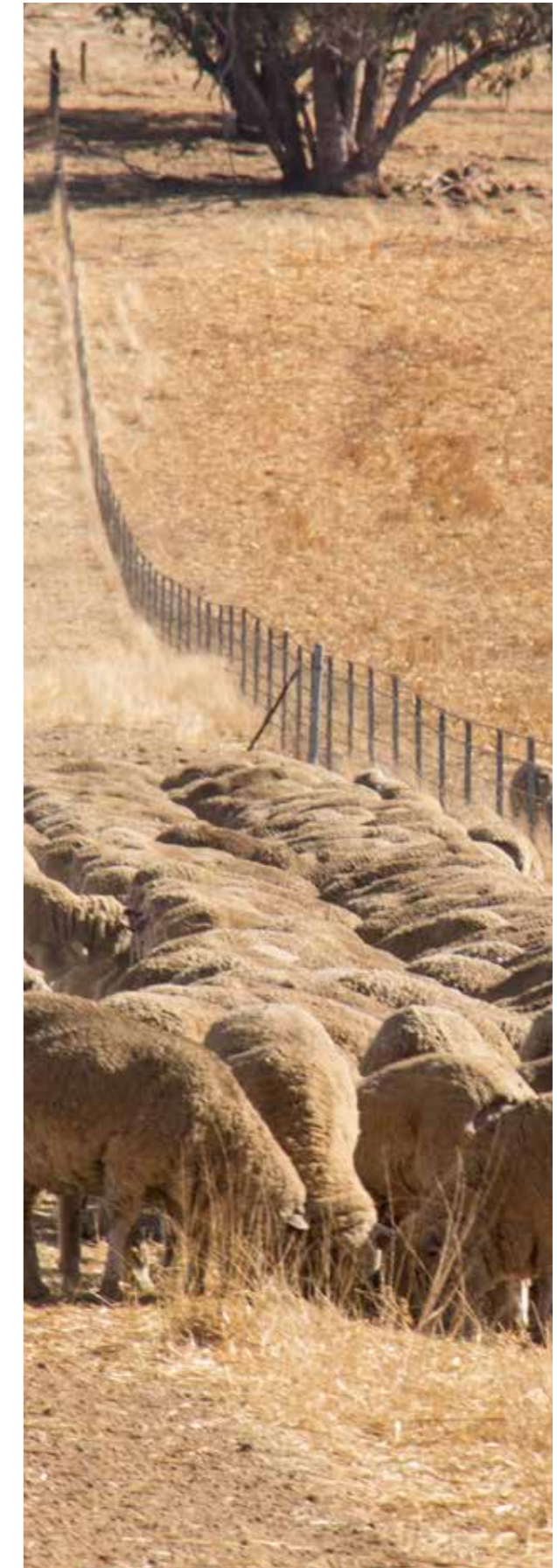
Greater issues relate to the social and economic aspects of modern farming in the wheatbelt including the costs of inputs, farm size and succession planning. These compound NRM issues such as climate variability and soil condition.

Revegetation of large areas of farmland has occurred through programs such as Western Power's Greening Challenge and oil mallee plantings. Future revegetation with woody species may be targeted to address specific land management issues such as salinization.

The local communities have a long and proud history of Landcare. Community groups such as the Hotham-Williams Catchments Environmental Alliance provide new opportunities into the future.

Statistics—Hotham and Williams	
Area of subsystem	573 349 ha
Area native vegetation cover (% subsystem)	186 550 ha (33%)
Area of subsystem in Parks and Wildlife Estate	74 709 ha (13%)
Area of subsystem in Conservation Reserves	4610 ha (1%)
Number of Threatened flora species	27
Number of recorded populations of threatened flora	100
Number of threatened fauna species or protected under International Agreement	40
Total length of mapped watercourses	2912 km
Waterways in good or near-pristine condition	7%
Area of land under rural use (2003) (% subsystem)	435 086 ha (76%)
Value of agricultural production (2006)	\$129.3M
Area under mining tenement (% subsystem)	208 013 ha (36%)

SOURCE: GAIA RESOURCES 2014



HOTHAM AND WILLIAMS (2014) PHOTO: JILL HARRISON



3.6.3 Community Priorities—Hotham and Williams

What you told us...

'We need new ways for people to engage in, and contribute to, Landcare and sustainable agriculture. With support (technical and financial) and through engagement, we have the champions to lead the way.'

'Over the last 30 years, rainfall has declined, there has been an increase in the area cropped, and a decreasing amount of sheep being run. Market and rural socio-economic changes have led to fewer, larger farming enterprises within our catchment.'

'We are concerned about the ongoing availability and quality of water and the further impacts this will have into the future. We are keen to engage in new technologies and innovation to improve our farming systems, secure our water and protect our bushland. This can be achieved through building strong partnerships across the catchment.'

'Weeds and ferals, and their impacts on agricultural production and natural areas, need to be addressed through integrated weed and pest management.'

'There must be public acknowledgement of the contribution our private bush makes to the Region.'

Our Community's Priorities...

- Embed NRM practices as part of standard agricultural production systems through understanding and applying drivers of rural practice change.
- Build the Region's capacity to factor in economic drivers and implications for future NRM plans.
- Remove financial and non-financial disincentives for private land conservation and provide incentives and public acknowledgement.
- Support volunteer groups to grow membership, build skills and understanding.
- Support all land managers in integrated biosecurity management programs for agriculture and biodiversity, whilst addressing the degradation of agricultural soils.
- Connect people with each other and natural areas for multiple benefit including social well-being and mental health.
- Encourage robust community engagement, awareness and education campaigns.
- Implement catchment management to improve water quality.
- Build resilience in natural areas through sound management, bushland retention, purchase of remnants, weed and pest control, and revegetation.
- Implement vigorous community engagement, awareness and education campaigns.



'It probably goes without saying but water is really important for us; for our farming, our living and our natural areas. We are already seeing the impact of the drying climate and issues with the sedimentation of waterways and dams. We need to act now as assets are declining, not try to bring things back after they are lost'

—Darralyn Ebsary, Wandering—
(2014)



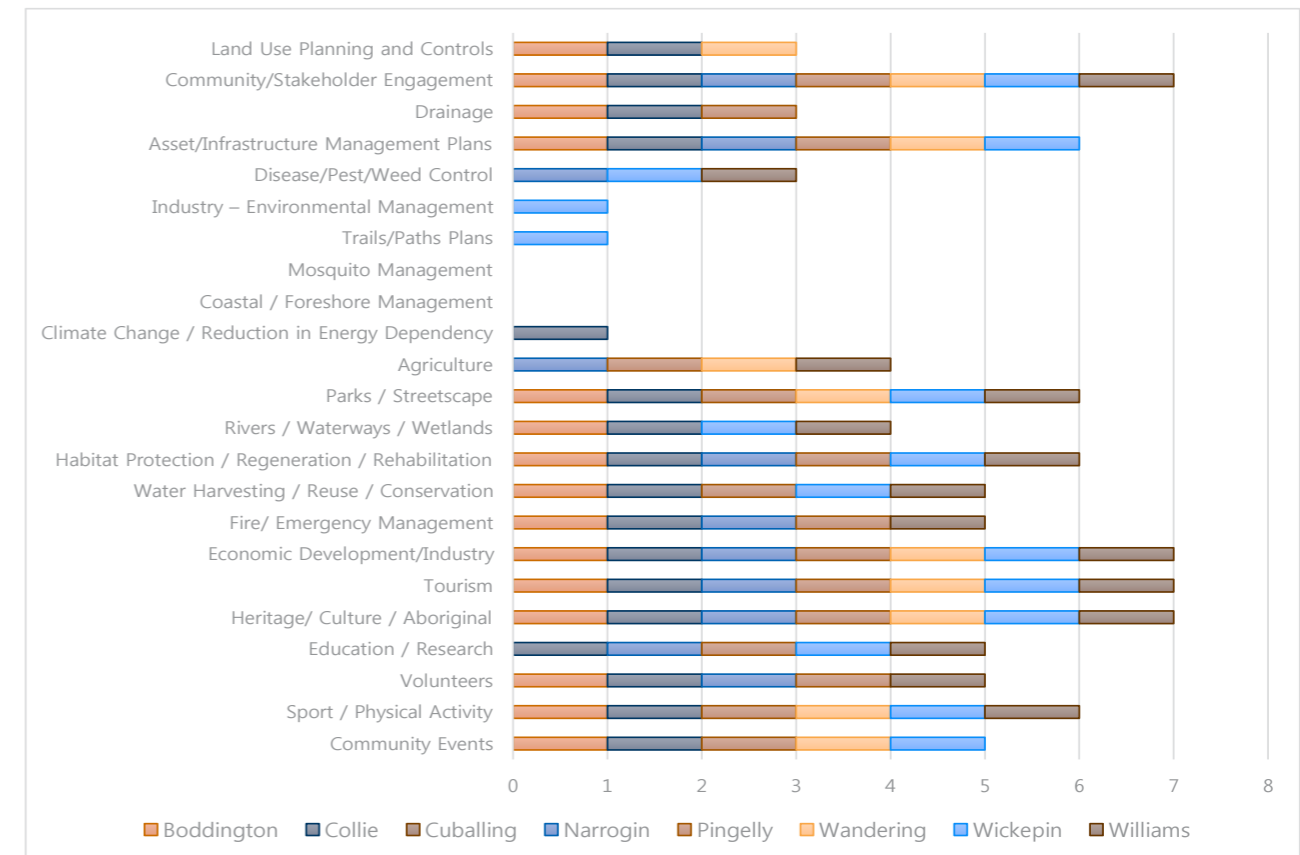
'A protected and enhanced environment that is aesthetically beautiful and provides benefits for generations to come.'

—extract from Shire of Wickepin Strategic Community Plan—

'Reintroduce a natural resource management Officer (NRMO) to the District. To be well informed with regards to the requirements behind having an NRMO and to drive this project if there is community support.'

—extract from Shire of Williams Strategic Community Plan—

Summary—Local Government Strategic Community Plans



4. Strategies for the Future

4.1 How the Strategy was Developed

The Strategy was developed over a 12-month period by a Project Team, including staff and board member representatives of the PHCC and an external NRM planning consultant. The Team liaised closely with the Australian Government's Department of Environment and Department of Agriculture. Much of the Strategy draws on information collected through

a targeted Community Consultation Process and a Technical Review Process. Together, community feedback and the results of the Technical Review were used to develop the Strategy Framework featured in sections 7 to 10.

The overall process is summarised in Figure 5.

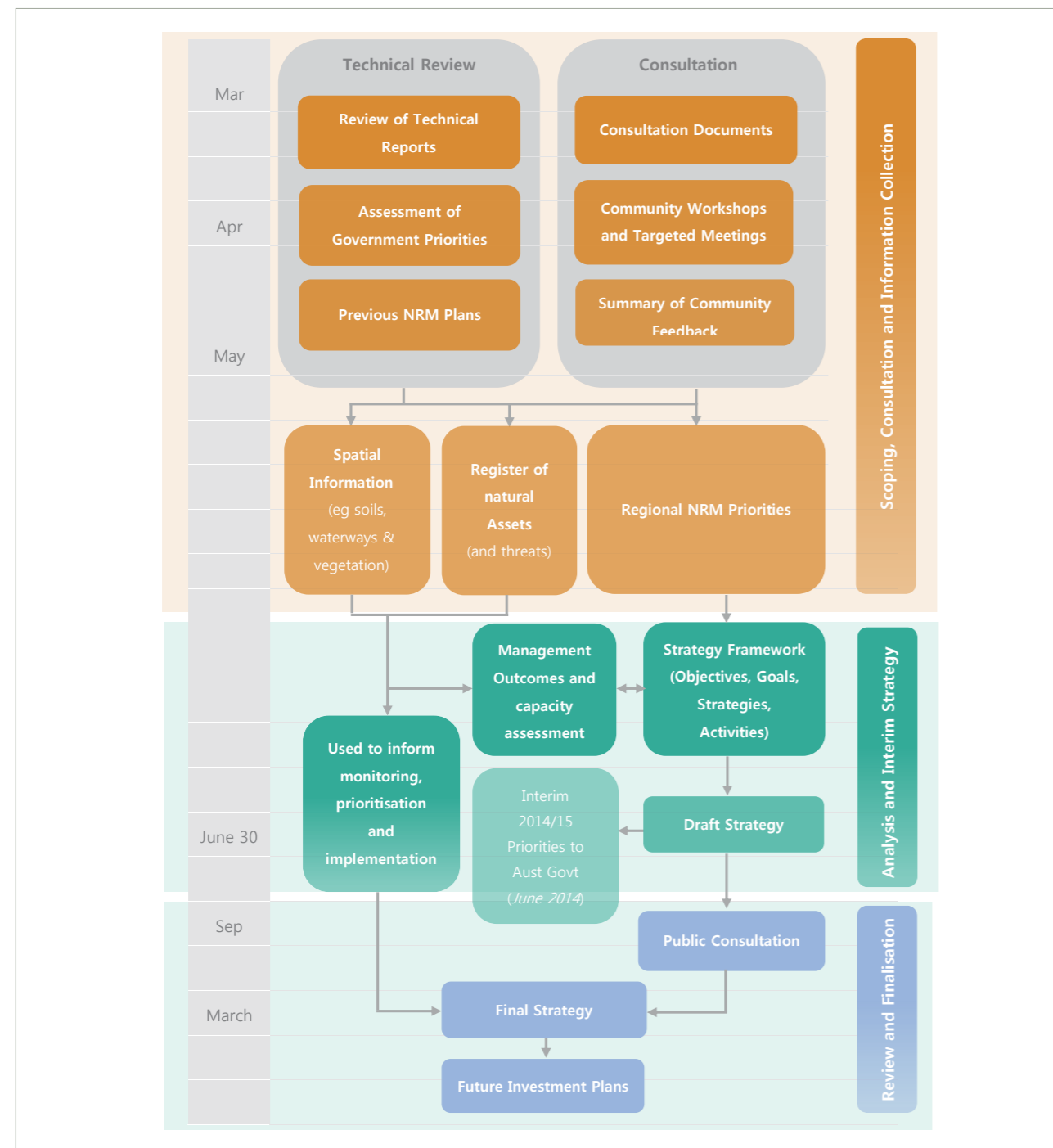


Figure 5: Strategy Development Process (2014-15)

4.2 Community Consultation

The Community Consultation process was targeted at existing NRM organisations, community, local governments, local Aboriginal people, grower groups and industry. The process is summarised in Figure 6 and included:

- a series of targeted consultation meetings with community groups and key individuals across the catchment, including farmers and growers, landcare and conservation groups, industry representatives and biosecurity groups
- a two-day field visit to the Hotham-Williams catchments to meet local governments, community groups and farmers
- a review of NRM issues included in local government Strategic Community Plans for each of the 16 Local Governments in the Region (See Section 5.3 and Appendix A)
- discussions with local government chief executive officers, senior staff and elected members
- discussions with grower/industry groups.

Local Government Strategic Community Plans were included in the process as they provided a thorough method of capturing issues of importance to each local community in the Region. For each Community Plan, actions were recorded that were directly or strongly linked to NRM. The Plans have been developed within the past 18 months and reflect current local community priorities.

The results of the Community Consultation Process are summarised in Sections 3 and 5.3 and Appendix A. Issues raised through the process have been used directly to identify Regional NRM Priorities (Table 5).

A particular focus of the Community Consultation process was engagement with the local communities of the Hotham-Williams catchments. The PHCC is aware that further efforts are required to rebuild connections with farmers and communities of this area given the absence of Landcare support in the upper Catchment over the past 5 years due to resourcing issues. Preliminary consultation to develop this Strategy has shown that the communities of the Hotham-Williams catchments are keen to see a reinvigoration of Landcare efforts.



JANE O'MALLEY (PHCC), BRAD HARDIE, MAXINE WHATELY, MELANIE DURACK (PHCC) & DARRALYN EBSARY (2014)

4.3 Technical Review

The Technical Review process included an assessment of studies, plans, legislation, policies, and Australian and State Government priorities relevant to the Region. Documents were reviewed for actions, recommendations, descriptions of significant natural assets and threats. All literature reviewed was checked for currency and relevance.

Key technical or NRM planning reports included the:

- *South-West Regional natural resource management Strategy 2012–2020* (Christensen M & MacMahon G, 2012)
- *Catchment Condition and Priorities, Peel-Harvey Catchment 2011* (PHCC, 2011)
- Peel-Harvey Water Quality Improvement Plan (EPA, 2008)
- *Peel-Harvey Catchment natural resource management Plan*, A draft report prepared for the Peel-Harvey Catchment Council, (Land Assessment Pty Ltd, 2005).

Other reports focusing on particular aspects of NRM in the Catchment were reviewed as part of the technical review and are listed in Appendix B.

Australian and Western Australian Government priorities were identified through a review of legislation and current government policy relating to NRM in the Peel-Harvey Catchment.

Key Federal Government policy statements included:

- A Plan for a Cleaner Environment (2013)
- EPBC Act and related policy statements such as recovery plans and referral guidelines
- Closing the Gap on Indigenous Disadvantage (2008)
- Australia State of the Environment 2011 (SoE Committee 2011)
- The National Soil Research, Development and Extension Strategy (2014)
- Agricultural Competitiveness Issues Paper (2014)
- Carbon Farming Initiative (2013).

Key State Government policies and initiatives reviewed included:

- Strategic Assessment of Perth and Peel Regions (under agreement with the Federal Government, EPBC Act 1999)
- Fertiliser Partnership—Swan Coastal Plain
- South West Native Title Settlement (Government of WA, 2013)
- Bushland Policy for the Perth Metropolitan Region
- SPP 2.6 State Coastal Planning Policy (PD Act 2005)
- Environmental Protection (Swan Coastal Plain Lakes (Policy) 1992 in EP Act 1986
- Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992 in EP Act 1986.
- SPP 2.1 Peel-Harvey Coastal Plain Catchment Policy (PD Act 2005)
- Threatened species and ecological communities recovery plans (various under WA Minister for Environment).

A summary of the relevant Federal and State Government legislation and policies is provided in Appendix C.

4.4 Natural Assets Register

The Review Process was also used to develop a Regional Natural Assets Register. The register is a listing of the major biophysical natural assets in the Region categorised under terrestrial biodiversity, aquatic biodiversity, water resources, land, and Aboriginal culture. This Register drew on the:

- Peel-Harvey Draft NRM Plan (Land Assessment, 2005),
- South-West Regional natural resource management Strategy 2012–2020 (Christensen M & MacMahon G, 2012)
- Biodiversity Sub-Strategy for the South West Catchments Council (Ecosystem Solutions, 2009).

A summary is included in Appendix D. The register also lists threats to each asset class and will be used as part of the process to plan priority projects for investment (Section 11).



Figure 6: Community Consultation Process—March 2014 to March 2015



5. Findings from Community Consultation and Technical Review

The following summarises the key themes that arose through the Community Consultation and the Technical Review processes.

5.1 Government Priorities

Government priorities are described in various Acts, policies and positions of the government and their agencies. The key priorities are described below:

- **Protection of a clean and resilient environment.** Articulated through 'A Plan for a Clean Environment' and supported through legislation such as the *Environment Protection and Biodiversity Conservation Act (1999)*.
- **Conservation of biodiversity and matters of national environmental significance.** An explicit requirement through the *Environment Protection and Biodiversity Conservation Act (1999)* and *Wildlife Conservation Act (1950)*.
- **Participation of Aboriginal people in NRM.** As identified in Closing the Gap and the draft South West Native Title Settlement.
- **A productive and profitable agricultural sector.** An emerging issue, in discussion through papers such as the Australian Government's Agricultural Competitiveness Issues Paper.
- **Sustainable production, including fisheries and forests.** As per the Regional Forest Agreement and the Commonwealth Fisheries Harvest Strategy Policy and Guidelines.
- **An engaged and skilled agricultural sector.** A re-emerging issue aimed to be supported through the National Landcare Program.
- **Facilitating sustainable development.** As evidenced by the current Strategic Assessment of the Perth and Peel Region (SAPPR), which aims to deliver an effective long-term and strategic response to key environmental issues in the Perth and Peel regions, including for example, Carnaby's cockatoo and water quality in the

Peel-Harvey Estuary. The SAPPR process will also provide greater certainty to industry as to which areas can be developed and what the obligations will be in terms of protection and mitigation.

- **Clean and productive soils.** National Soil Research, Development and Extension Strategy (DAFF, 2014) and Fertiliser Partnership.
- **Water quality improvement.** As described in the Water Quality Improvement Plan for the Peel-Harvey Estuary (EPA, 2008).

There are numerous other legislative and policy links to NRM in the Catchment. A summary of legislation and policies relevant to NRM in the Peel-Harvey Catchment is provided in Appendix C.

5.2 What the Science and Research is Telling Us

An extensive body of research, technical studies, previous NRM plans and catchment reviews have been prepared on the Catchment's natural resources. Many studies have focused on issues directly related to the health of the Peel-Harvey Estuarine System. Other studies relate directly to natural asset classes such as soils, biodiversity or water quality, or particular threats such as climate change. The major relevant and current themes presented in these studies, and the level of understanding under each theme, are summarised below.

5.2.1 Catchment Condition

The condition of most natural resources in the Region is of concern or likely to deteriorate (See Section 3.2). This applies to most indicators of surface water quality and biodiversity values of the Peel-Harvey Estuarine System and the Catchment (PHCC, 2011). The status and condition of soils is less well known, although extent of soil acidity is a growing concern (DAFWA, 2013).

5.2.2 Climate Change

The climate of the Peel-Harvey Catchment and South West region has changed significantly over the past 50 years, and is predicted to continue to change over coming decades (CSIRO & BOM, 2007). Climate change has significant implications for natural resource management, emergency management, and development. Studies into climate change have occurred at all scales, including global and regional, and cover possible causes, consequences and mitigation strategies.

The major climate change trends occurring in the Peel-Harvey Catchment are a decline in annual rainfall, by approximately 10% from 1969 and by a further ~20% after 2000 and a general mean temperature increase, particularly after 1975.

For the south-west of Western Australia, including the Peel-Harvey Catchment, future climate change is predicted to mean (CSIRO & BOM, 2007):

- further increased average temperatures
- further decreases in rainfall
- increased frequency and intensity of storms
- sea level rise.

These changes in climate have a significant impact on the availability and management of natural resources, particularly water resources and biodiversity. Some of the implications are discussed below.



Climate Change

Presenting ever-emerging challenges and shifts to our thinking, climate change is being observed through declining rainfall. Whilst drivers of climate change often exist globally, adaptation options are best achieved locally. Emergency Management and Biodiversity Conservation adaptation strategies have been developed to support Peel Region local governments to tackle the impacts of climate change. Strategies have been created to address and reduce risks, impacts and potential liabilities for local government created by climate change.

5.2.3 Soil and Land Resources

Significant issues related to regional soil resources are management of acidity, nutrient holding capacity, acid sulfate soils (ASS) and the formation of monosulfidic black ooze (MBO). Soil acidity has been mapped at a regional scale and there is a better understanding of its extent and severity (DAFWA, 2013). Mapping of the phosphorus retention index (PRI) has identified priority areas for soil improvement and fertiliser management (PHCC, 2012c). The impact of a changing climate on wind and water erosion risks is likely to be difficult to predict and is being monitored as part of broader assessments of erosion risk in the south-west of Australia (DAFWA, 2013). MBOs and their role in the acidification of Catchment waters, is an emerging issue requiring further research.

5.2.4 Biodiversity Resources

There are a number of studies related to the status and condition of biodiversity and native vegetation of the Region or large parts of the Region (e.g. Hick, 2004; Local Biodiversity Program, 2013a & b; Neville 2014). These provide some, albeit limited, indication of the state of the Region's biodiversity resources. Whilst there are some positive stories, the general trend in biodiversity condition is of concern.

There are 120 species of threatened flora recorded for the Region and 109 species of threatened fauna or species protected under international agreements.

(Parks and Wildlife, 2014)

Decline in the condition of biodiversity resources is due to many factors, including continued loss of natural areas, and the multitude of threats on natural areas. The impact of climate change on biodiversity is of particular concern.

Decreased rainfall and increased temperatures associated with climate change can have immediate and long-term effects on vegetation, wildlife and biodiversity:

- Drier conditions will increase the occurrence and size of intense wildfires, directly impacting vegetation, wildlife populations and habitat.
- Increases in temperatures and drought can stress animals and plants, possibly leading to death.

An example of an immediate impact on species is where, in late 2010 and early 2011, approximately 16 800 ha of the northern jarrah forest collapsed due to abnormally dry conditions. Based on these extensive tree deaths, researchers have predicted that major structural changes are likely to occur in the jarrah forest with future predicted drying and warming.
(Hardy, Matusick & Ruthrof, 2012)

Species distributions are also likely to significantly change over the long term due to climate change.

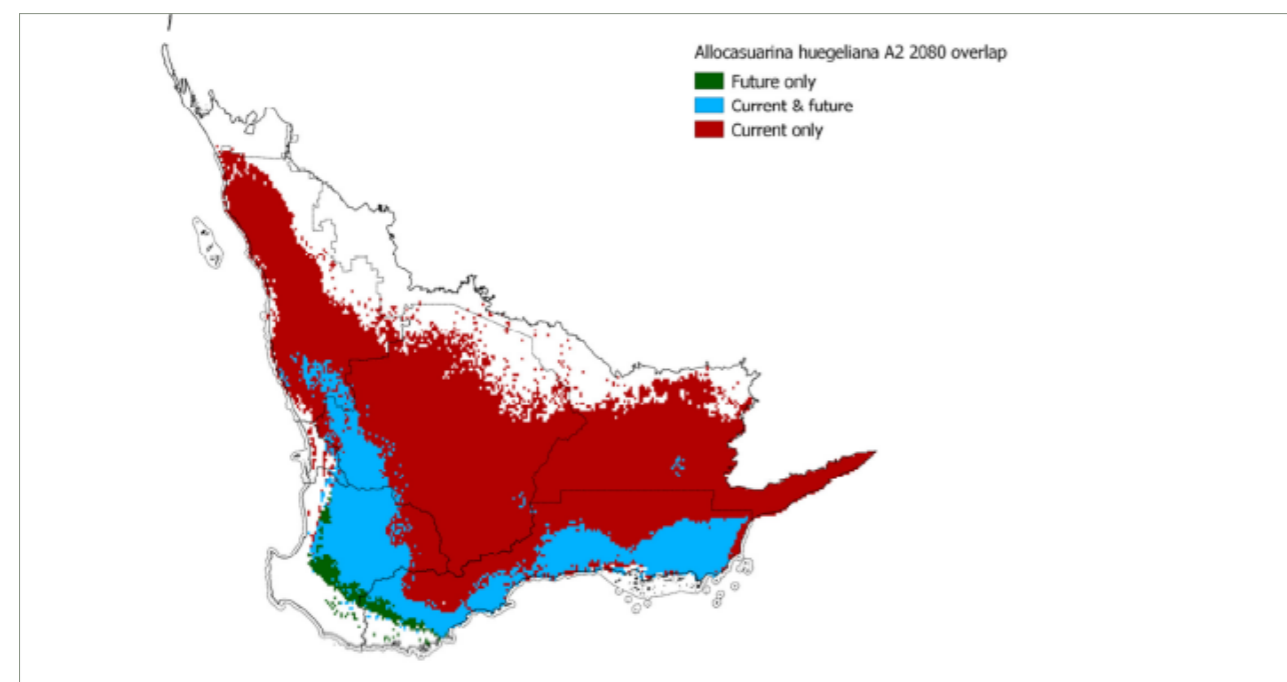


Figure 7: Predicted Range of Rock Sheoak Under Current and Future Climate Scenarios

Generally drier, hotter conditions lead to changes in food and water availability and contribute to gradual movement of species' preferred habitat. Generally, species ranges will contract towards the south-west corner of WA as the climate warms and dries.

Work has been conducted to estimate the scale of this change in species distribution. Modelling undertaken by the Centre for Excellence in NRM has used GIS analysis to predict the future distribution of selected species under climate change scenarios. Figure 7 shows rock sheoak (*Allocasuarina huegeliana*) current distribution in blue and dark red, and likely future range in blue. The blue shaded area indicates a likely refuge range for this species in the long-term (B. Ford, CENRM, pers. comm., 2015).

Prioritisation of natural areas is important to guide NRM investment in biodiversity conservation and effectively respond to challenges of climate change and other threats. A recent prioritisation exercise across the entire south-west of WA has occurred to prioritise biodiversity assets for climate change resilience and other values (Neville, 2014). Prioritisation is based on the combined influence of several environmental criteria, including biodiversity value, climate refuge potential and presence of threatened species. The resulting map (Figure 8), will be a useful basis for biodiversity project prioritisation and planning.

5.2.5 Water Resources, Water Quality, Wetlands and Waterways

Streamflows and groundwater aquifer levels are falling due to declining rainfall. Rainfall in the south-west has declined since the 1970s, and streamflows in the Jarrah Forest to public water supply dams were 64% less during 1975–1996 compared to the 1911–1974 (Gill, 2004). Refer Figure 9.

Reductions in rainfall are having an impact on groundwater resources with flow-on effects to groundwater-related ecosystems such as wetlands.

Information on water quality on the Coastal Plain is improved through subcatchment report cards produced by the Department of Water (DoW, 2014a, b & c). Monitoring shows levels of critical water quality parameters such as phosphorus are high, and not being reduced to the levels required to return the Peel-Harvey Estuarine System to health. Evidence of poor water quality in the lower Serpentine, Murray rivers and the Estuary includes regular algal blooms and fish kills.

Studies show the most cost effective solutions for water quality are extensive amendment of soils and fertiliser management on the Coastal Plain.

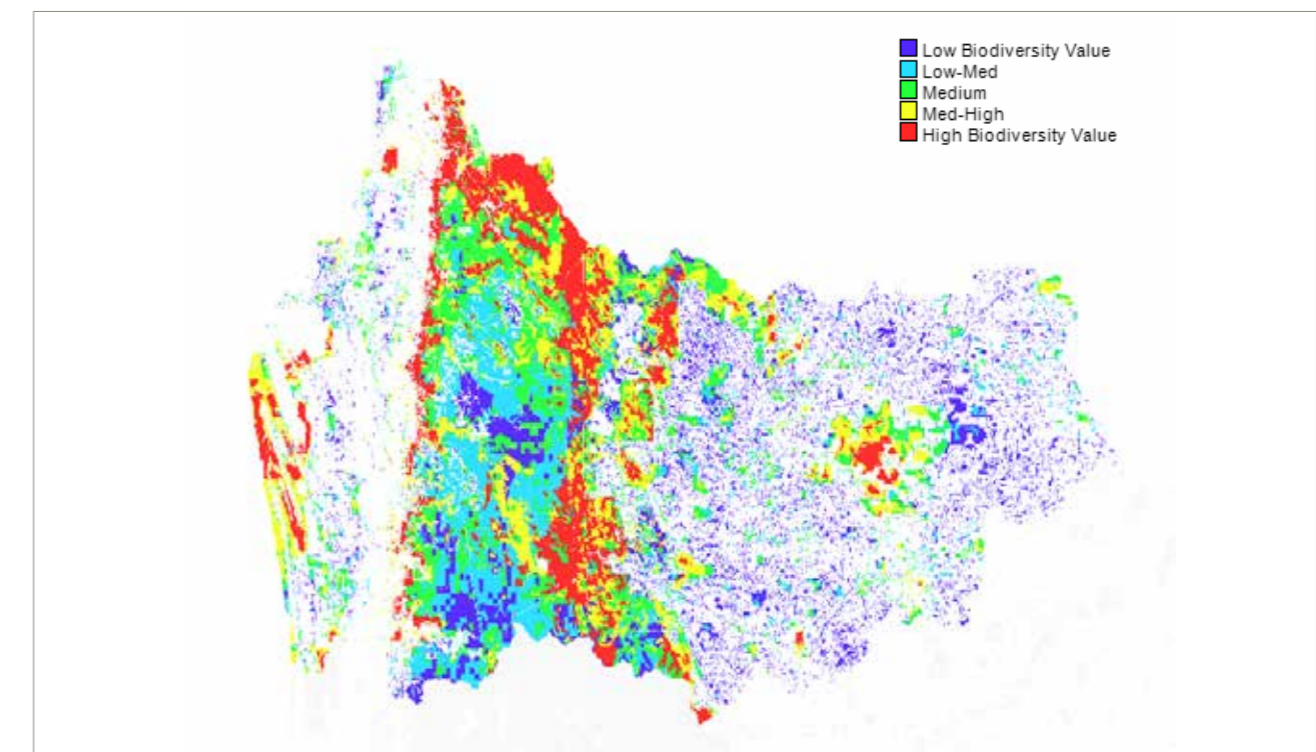


Figure 8: Relative Biodiversity Asset Values in the Catchment (Neville, 2014)

The condition of waterways throughout the Catchment have been assessed and 1445 km of the 5592 km of waterways were found to be in a good condition with little or moderate weed infestation (25.8%). All of the waterways of the Hotham-Williams catchments, once fresh, are now salty due to extensive clearing of native vegetation.

Wetlands, a key feature of the Peel-Yalgorup Ramsar System and Coastal Plain, have been mapped and assessed as either Conservation (near-natural), Resource Enhancement (modified) or Multiple Use (extensively modified). Whilst there is some level of protection of Conservation Category Wetlands through the land-use planning system, other wetlands are under threat, being degraded or lost.

5.2.6 Monitoring Catchment Condition

There is generally insufficient monitoring of the status or condition of natural resources to assess the extent, rate or causes of this decline in most resources. This applies to most natural resources, including water quality of the Catchment's waterways and Peel-Yalgorup Ramsar System (RDA Peel, 2013).

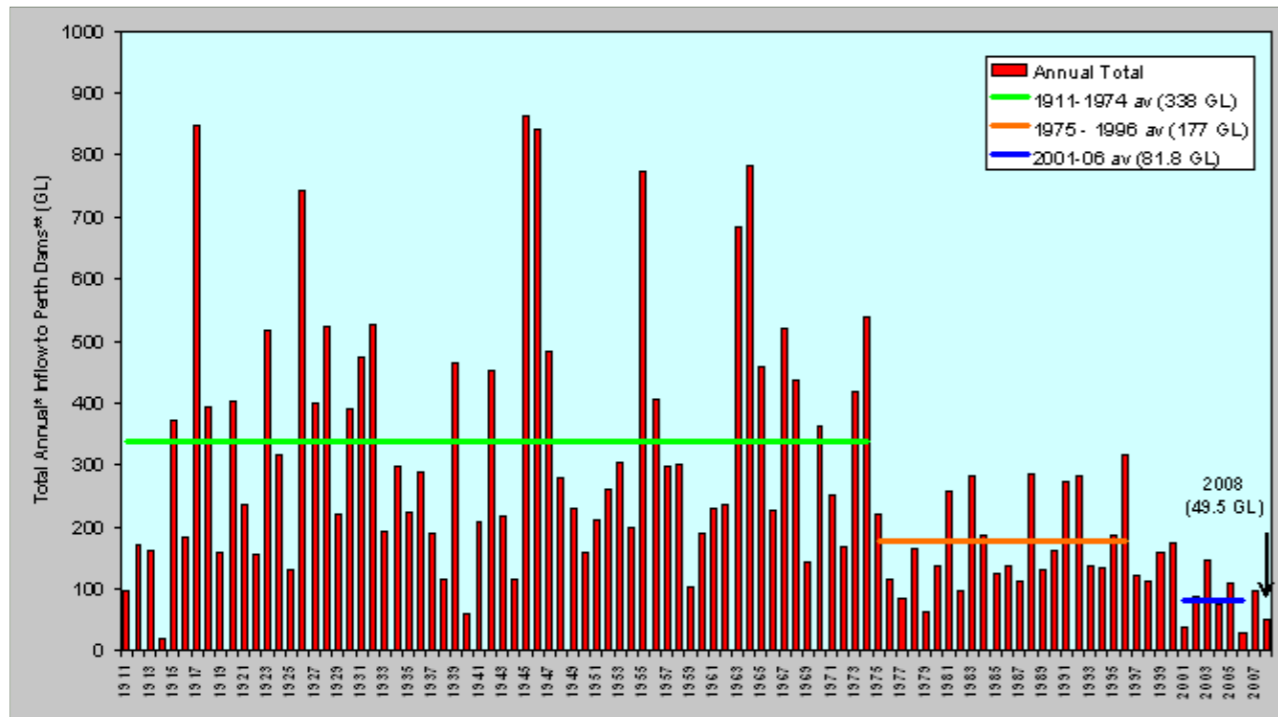


Figure 9: Inflow into Perth Dams 1911–2007

5.2.7 Spatial Information

There is a large amount of mapped information on the Region’s natural resources. Some spatial information has been gathered in the development of the Strategy. The PHCC will work with the community and the custodians of information to use in the development and delivery of projects. Some of this spatial information is presented in maps in appendices E to H. Some of the most important spatial datasets include:

- soils—e.g. soil types, phosphorus retention index, water repellence
- native vegetation—extent and condition trends
- waterways—location and condition
- wetlands—extent, type and management category.



Peel Waterways Institute

The proposed Peel Waterways Institute (PWI) would be a science, education and training experience showcasing and preserving the Peel-Harvey region, using an approach based on learning—which leads to appreciation—and encourages involvement—giving everyone the opportunity to play a role in integrated waterways, catchment and environmental management through a variety of core and non-core business activities.

The PWI remains a priority project for the Peel Regional Leaders Forum.

5.3 What Our Community is Telling Us

Over 300 comments were received through the Community Consultation Process from community group members, growers, industry and local government. These are summarised in Appendix A into themes as discussed in Section 3. The following is a synthesis of these comments to provide the key messages being made by the Catchment community:

1. Protect our natural jewels and maintain our sense of place. This sense of place and connection to nature is fundamental to our social well-being and mental health. It is shaped by our landscape, natural areas and rural areas.
2. Protect our Aboriginal heritage sites. This includes consultation with Elders during the planning and on-site phases of projects.
3. All lands need to be well managed regardless of ownership, tenure, purpose or use of the land.
 - Our resources, land (soil) and water should be used wisely.
 - Government agencies and local government need to control weeds in their reserves.
 - Rural lands not used for production should be managed to address biosecurity threats to neighbours.
4. Weeds, rubbish and feral animals are blighting our natural areas and require urgent attention. They present biosecurity risks and de-value ecotourism opportunities.
5. Restore the landscape, both natural and productive areas.
 - Prevent degradation and disturbance of our natural areas and the animals that live there.
 - We need to understand the drivers of rural practice, and the drivers that will encourage landholders to change rural practices.
 - Value the ecosystem services the landscape provides.
 - Our local patches form the fabric of the landscape.

‘Recognise the economic contribution of the ecosystem services provided by our catchment.’

6. A robust program of community engagement and capacity building is required for new, young and existing landcarers.
 - Support the invaluable volunteer effort and ensure connection between people and our natural resources.
 - Ongoing assistance to communities is needed to address emerging issues that affect both our farming systems and economic drivers.

‘We are keen to volunteer. Volunteer effort needs support—so that we can apply best practice efficiently and consistently and so that everyone is working constructively and efficiently. Build our capacity to contribute as volunteers. Our volunteer efforts need professional enhancement, especially to fill our resource and knowledge gaps.’



AN EXAMPLE OF THE IMPORTANCE OF BIOSECURITY TO FARMERS IN HOTHAM-WILLIAMS AND COASTAL PLAIN SUBSYSTEMS

Biosecurity

Weeds and feral animals including cotton bush, sharp rush, rabbits, pigs, arum lily and blackberry are just a few pests causing grief across the Peel-Harvey. They cost our community through lost production, direct costs of control and increased fire risk. We are committed to eradication through Regional Biosecurity groups across the Region.



6. Regional NRM Priorities

Regional NRM Priorities has been developed based on the Community Consultation and Technical Review Processes (Table 5). An issue or action has been included as a Regional NRM Priority if it has been identified through either process, in at least two independent published sources, and rated as significant by the Strategy Project Team. The priorities are grouped according to the three Objectives of the Strategy: People, Biophysical and Knowledge. Table 5 is not an exhaustive list and may be improved and refined as further community consultation and

technical information is incorporated into the Final Strategy. The Regional NRM priorities are not listed in order of importance.

The Regional NRM Priorities table has been used as a checklist to ensure that the Strategy Framework presented in sections 7, 8, 9 and 10 covers all significant issues raised through the Community Consultation and Technical Review Processes. The Priorities are also likely to be used as a criterion in future investment planning exercises (Section 12).

Table 5: Regional NRM Priorities for the Peel-Harvey Region

Regional NRM Priority		Strategy Link (Goal and Strategy)	Source				Relevance to Sub-System			
			Priority		Tech Review		Hotham-Williams	Forest and Scarp	Coastal Plain	Ramsar, Coastal
			Community	Government	Catchment	Other				
People (Baalap) 'An Engaged and Active Community'										
1	Provide direct assistance (support) for farmers and farming communities.	P2.1 K3.1								
2	Assist landowners in rural residential estates (peri-urban) and hobby farmers to improve knowledge and practices.	P2.1 K3.1								
3	Local governments require technical and practical assistance.	P1.1								
4	Encourage Indigenous communities to be more involved in the management of natural resources and the delivery of projects to incorporate and maintain traditional land management methods.	P3.1 P3.2								
5	Identify, manage and promote key nature-based recreational & tourism opportunities.	P4.3								
6	Integrate management of Crown land with Catchment goals.	P1.1 K3.1								
7	Prepare a Catchment Management Plan	P1.1								
Biophysical (Boodja) 'A Healthy Catchment that Supports Life and Livelihood'										
1	Promote economic, environmental and social benefits of appropriate on-farm revegetation.	B2.2 K3.1								
2	Develop new approaches to managing soil chemistry which are required in the context of total soil health.	B2.1 B2.3								
3	Develop new methods for the management of soil nutrition through soil testing to be addressed in the context of overall soil health, and sustainability objectives.	B2.3								
4	Better understand the extent and physical effects of soil compaction and water repellence on productivity.	B2.1								
5	Increase understanding of current and potential development of dryland salinity on agricultural production, infrastructure and conservation areas.	B2.1								
6	Minimise or avoid water and wind erosion across all landscapes.	B2.1/2/3 B3.1								
7	Identify and meet environmental water requirements and variability tolerance of major watercourse and wetland ecosystems.	B5.1								

Regional NRM Priority		Strategy Link (Goal and Strategy)	Source				Relevance to Sub-System			
			Priority		Tech Review		Hotham-Williams	Forest and Scarp	Coastal Plain	Ramsar, Coastal
			Community	Government	Catchment	Other				
8	Review and reform current and proposed uses of surface and groundwater resource trends in light of reduced rainfall, varying seasonal temperatures and related stresses placed on the environment.	B5.1								
9	Manage the coastal plain drainage network holistically for flood protection, water quality, agriculture, biodiversity conservation, amenity and recreation.	B1.2								
10	Meet nutrient pollution reduction targets for Coastal Plain Catchment.	B2.3								
11	Promote fencing for management of wetlands and watercourses as a best practice. Provide direct technical and financial assistance to make the practice financially and socially attractive.	B1.2								
12	Promote fencing for management of native vegetation as best practice. Direct technical and financial assistance to make the practice financially and socially attractive.	B4.2								
13	Increase investment for key reserve management plans (e.g. Dryandra State Forest Management Plan, National Parks and Nature Reserves).	B4.1								
14	Increase investment and coordination for key Recovery Plan actions for listed species/TECs.	B4.1								
15	Undertake restoration of degraded habitat within Regional Ecological Linkages.	B4.3								
16	Manage the Peel-Yalgorup Ramsar System through a coordinated and adequately resourced approach.	B1.1								
17	Build capacity of practitioners for coastal management to be implemented at a high & consistent standard across managers & tenures.	B3.1								
18	Control priority feral species through integrated and coordinated action. Priority species include pigs, foxes, cats, rabbits, exotic fish.	B4.2 B2.4								
19	Control priority weed species impacting on agriculture, biodiversity, and watercourses and wetlands through integrated and coordinated action.	B4.2 B2.4								
20	Prioritise and coordinate efforts to prevent spread and impact of pathogens, e.g. Phytophthora.	B4.2								
Knowledge (Kaadadjan) 'Science and Knowledge Underpin natural resource management'										
1	Development of the Peel Waterways Institute	K1.3								
2	Land developers should be required to consider off-site and on-site implications and implement NRM strategies.	K1.2								
3	Develop a better understanding of how climate change will affect biodiversity and the implications for natural area management.	K3.2 K2.2								
4	Develop a better understanding of the relationship between climate change, fire management, natural area management and revegetation.	K3.2 K2.2								
5	Develop a better understanding of the physio-chemical effects of Acid Sulfate Soils and Monosulfidic Black Ooze on the waterways	K1.1								
6	Develop a long-term structure to ensure scientific research priorities are identified, monitored and implemented for priority NRM needs.	K1.1								
7	Investment in regular monitoring programs is required to cover natural asset classes and monitoring & evaluation to determine status & trends.	K2.1								
8	Communicate Strategy goals and targets so they influence all levels of land-use planning, from regional scale planning to development approval.	K1.2								

Strongly Raised	Raised	Not Raised	Highly	Moderately	Somewhat
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Our Vision

'The Peel-Harvey Catchment is once again a flourishing network of interconnected, productive landscapes, with diverse, healthy and resilient ecosystems, globally and locally recognised, acknowledged and embraced for its environmental significance. It is wisely managed by a community that values it – people working together for a healthy environment.'

*The Strategy to Achieve
our Vision*



7. Vision, Objectives and Goals

The Strategy aims to deliver our Vision for the Peel-Harvey Region:

‘The Peel-Harvey Catchment is once again a flourishing network of interconnected, productive landscapes, with diverse, healthy and resilient ecosystems, globally and locally recognised, acknowledged and embraced for its environmental significance. It is wisely managed by a community that values it—people working together for a healthy environment.’

The Vision is set as a 100-year aim to emphasise the long-term nature of the NRM challenge in the Peel-Harvey Region. Many issues, such as the impact of nutrient-enriched groundwater on the Peel-Harvey Estuary, may take in the order of 50–100 years to fully manifest and be addressed.

To deliver the Vision, three Objectives have been set to encompass three key themes that are essential to better management of natural resources in the Catchment.



WESTERN RINGTAIL POSSUM (*PSEUDOCHEIRUS PEREGRINUS OCCIDENTALIS*)

Objective 1: People (Baalap) *‘An Engaged and Active Community’*

NRM aspects related to people’s actions and interactions with natural resources in the Region. This includes direct land management and land-use practices, coordination of NRM across land tenure, cultural heritage, and the community’s understanding and respect for natural resources.

Objective 2: Biophysical (Boodja) *‘A Healthy Catchment that Supports Life and Livelihood’*

Directly addresses the natural resources that are to be managed: wetlands and waterways, soils, coastal and near-shore areas, biodiversity and water resources.

Objective 3: Knowledge (Kaadadjan) *‘Science and Knowledge Underpin Natural Resource Management’*

Emphasises the critical need to have adequate information and knowledge to underpin NRM. This includes research and knowledge that can inform decision makers and natural resource managers to take the best possible actions to protect and manage natural resources.

Goals have been set under each Objective (Figure 10). The goals have been set under a 10-year timeframe to:

- protect natural resources that are valued
- repair degradation caused by past land practices
- ensure new land use and development protects and repairs natural resources as appropriate.

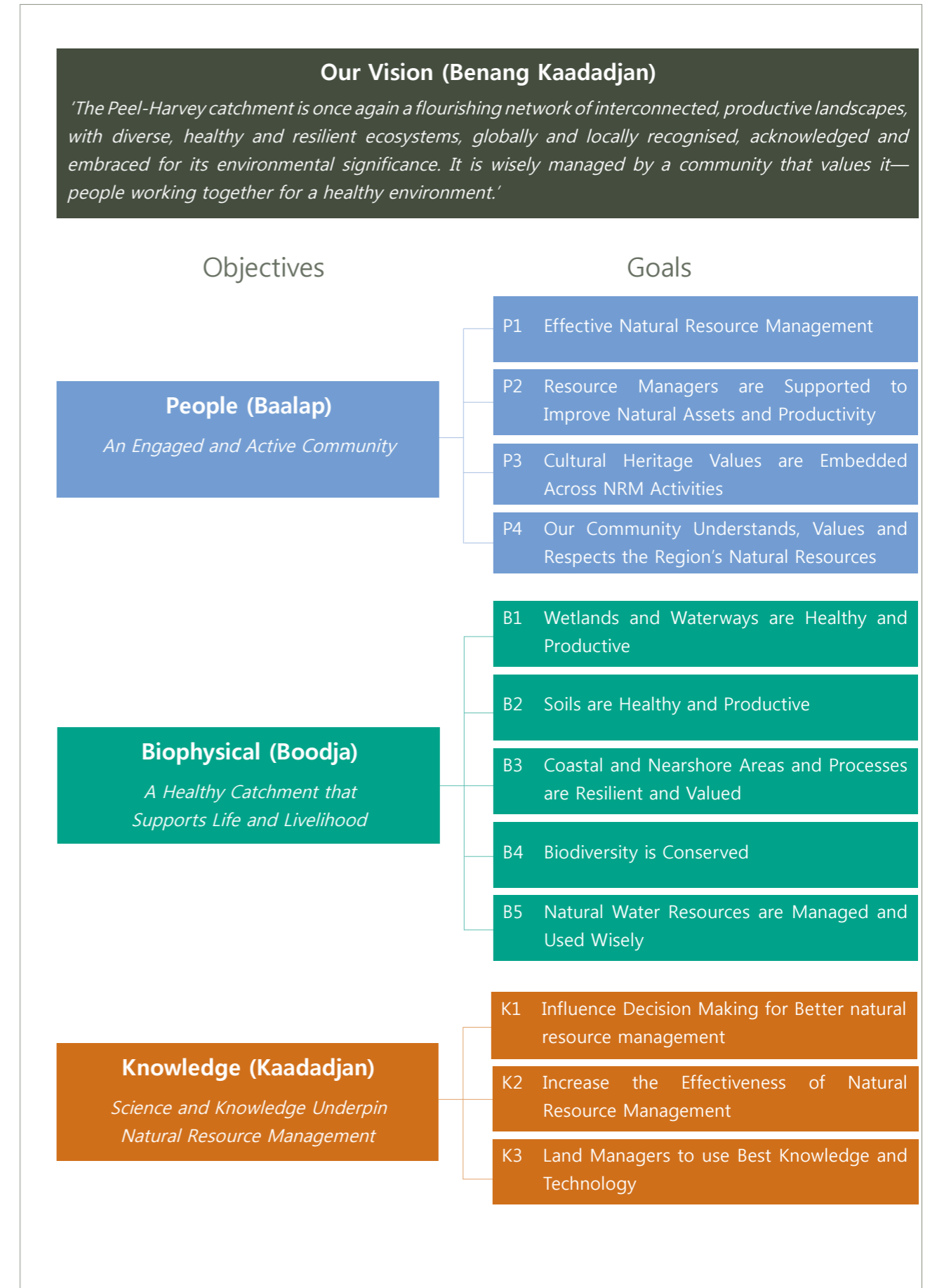


Figure 10: Framework Overview - Vision, Objectives and Goals

8. People (Baalap)

‘An Engaged and Active Community’

Successful NRM is as much about working with people as it is about natural resources. This includes providing direct and practical support to groups and individuals such as local government, community groups, Aboriginal people and farmers. Objective 1 is based on the experience that people who are engaged and involved in NRM have a benefit and impact far beyond their local patch. These benefits are not only environmental, but also social and economic.

To create an engaged and active community, the Strategy includes four goals.



P1 EFFECTIVE NATURAL RESOURCE MANAGEMENT		goal
<p><i>This goal encompasses the full spectrum of strategies to achieve effective NRM in the Region. This includes operating an effective regional NRM organisation, maintaining and implementing an NRM Strategy, coordinating activities between organisations and across the Catchment, and monitoring and evaluating the condition of natural resources.</i></p>		
P1.1 Operate an effective regional body		strategy
P1.1.1	Establish a responsive business model that builds resilience for a sustainable future	activity
P1.1.2	Develop and implement workforce plan/s to address the objectives of the NRM Strategy	
P1.1.3	Ensure on-going skills development of the Board and staff	
P1.1.4	Prepare, maintain and review an NRM Strategy for the Peel-Harvey	
P1.1.5	Facilitate prioritisation, investment and capacity to implement the NRM Strategy for the Peel-Harvey	
P1.1.6	Share knowledge with and between key stakeholders	
P1.2 Communicate, educate, raise awareness and encourage participation in NRM		strategy
P1.2.1	Develop and implement a communication plan	activity
P1.2.2	Develop and implement an engagement and participation plan	

P2 RESOURCE MANAGERS ARE SUPPORTED TO IMPROVE NATURAL ASSETS AND PRODUCTIVITY		goal
<p><i>Direct and practical support is required by land managers to effectively implement sound land management practices. Experience has shown this is most effectively delivered through landcare centres and professional NRM staff.</i></p>		
P2.1 Establish appropriate support structures across the Region, including Landcare Centres		strategy
P2.1.1	Support and extend existing Landcare Centres	activity
P2.1.2	Establish additional community support structures (e.g. new landcare centres/groups)	
P2.1.3	Support natural resource managers through targeted skills and training programs	
P2.2 Provide mechanisms for adaptive management		strategy
P2.2.1	Assist in the planning, implementation, monitoring and evaluation of NRM activities	activity

P3 CULTURAL HERITAGE VALUES ARE EMBEDDED ACROSS NRM ACTIVITIES		goal
<p><i>Protection of our Aboriginal and European Heritage sites is crucial. Aboriginal people have both a cultural and intellectual connection to places which enhance NRM and enrich our community. Most major rivers and wetlands in the Region are of cultural significance to Aboriginal people, and are often also of social and recreational significance to the wider community. Various strategies to increase communication with, and involvement of, Aboriginal people in NRM are included under this goal.</i></p>		
P3.1 Foster communication and leadership with and between Aboriginal and non-Aboriginal resource managers		strategy
P3.1.1	Develop protocols for communicating with Aboriginal groups and communities	activity
P3.1.2	Collaboratively gather information on local traditional ecological values and land management practices	
P3.1.3	Support partnerships with Aboriginal and non-Aboriginal communities and groups to plan and participate in NRM	
P3.2 Develop joint management opportunities for Aboriginal involvement in NRM		strategy
P3.2.1	Work with Aboriginal people to determine their aspirations for involvement in NRM	activity
P3.2.2	Explore collaborative opportunities for training that could lead to employment opportunities in NRM	
P3.3 Recognise and acknowledge European heritage and social links to natural resources		strategy
P3.3.1	Cultivate ties to sense of place	activity

P4	OUR COMMUNITY UNDERSTANDS, VALUES AND RESPECTS THE REGION'S NATURAL RESOURCES	goal
<p><i>One of the major themes raised by the community in the consultation process was that the natural environment maintains a sense of place for people and the connection between people and their local environment should be strengthened. Strategies under this goal aim to increase people's connection with the natural environment, support sustainable recreational use of natural areas and support a skilled landcare and volunteer base.</i></p>		
P4.1	Increase awareness, knowledge and understanding of natural assets	strategy
P4.1.1	Design and implement communication, participation and marketing plans for local, national and international communities	activity
P4.1.2	Develop and implement education and participation programs	activity
P4.2	Engage community in activities that raise the awareness of a connection with natural assets and values	strategy
P4.2.1	Promote volunteer opportunities	activity
P4.3	Sustainable recreational use of natural resources	strategy
P4.3.1	Promote awareness of nature based recreational opportunities provided by a healthy environment	activity
P4.3.2	Raise appreciation of need to protect the natural environment to enable recreational activities	activity
P4.4	Foster a philanthropic culture in support on the natural environment	strategy
P4.4.1	Establish structures to receive financial contributions towards NRM	activity

Lake Mealup

Typha invasion and declining water levels were the catalysts for the development and implementation of the Lake Mealup Interim Recovery Plan in 2007. PHCC joined forces with Parks and Wildlife, DoW and the Lake Mealup Preservation Society Inc. Australian Government and SWCC funding assisted with the eradication of Typha across 54 ha, via manipulation of water levels through two weirs. The water's pH is back to neutral and the birds and frogs have returned in their thousands.



9. Biophysical (Boodja)

'A Healthy Catchment that Supports Life and Livelihood'

A Healthy Catchment that Supports Life and Livelihood is the core aim of natural resource management in the Peel-Harvey Region. All goals directly related to the condition of the Region's natural resources are included under Objective 2.



B1	WETLANDS AND WATERWAYS ARE HEALTHY AND PRODUCTIVE	goal
<p><i>Wetlands and waterways have a special place, with all major townsites and communities living in proximity to a local waterway or wetland. Major waterway assets include the Hotham, Williams, Murray, Serpentine, North and South Dandalup and Harvey rivers. Major wetland assets include the Peel-Harvey Estuarine System and the Peel-Yalgorup Ramsar System. Key threats include poorly planned development, changing hydroperiods, reduced flow, eutrophication, ASS and MBO. Strategies to achieve this goal are designed to support coordinated management of the Estuary and Ramsar System, implement management actions to improve waterway and wetland condition, and protect groundwater quality and flows into wetlands and waterways. For a summary of the values, threats and management needs for the Region's wetlands and waterways see Appendix G</i></p>		
B1.1	Support the establishment and operations of coordinated governance frameworks for the Peel-Yalgorup Ramsar System	strategy
B1.1.1	Work with key stakeholders to establish and operate a coordinated framework for the Peel-Harvey Estuarine System	activity
B1.1.2	Work with key stakeholders to establish and operate a coordinated framework for the Peel-Yalgorup Ramsar System	activity
B1.2	Improve the condition of wetlands and watercourses	strategy
B1.2.1	Prepare and implement action plans to restore the natural function of wetlands and watercourses	activity
B1.2.2	Prepare and implement action plans to manage drains for multiple benefits	activity
B1.2.3	Manage issues such as erosion, sediment and monosulphidic black ooze to improve/protect condition of wetlands and watercourses	activity
B1.3	Protect wetlands and watercourses	strategy
B1.3.1	Influence land-use planning to afford protection to wetland and watercourse values	activity
B1.3.2	Encourage implementation of management plans and ongoing maintenance in accordance with planning conditions	activity
B1.4	Protect groundwater quality and quantity as hydrological inputs to wetlands and watercourses	strategy
B1.4.1	Ensure environmental water provisions are adequate for maintenance of ecosystem health	activity
B1.4.2	Ensure groundwater monitoring is sufficient to measure and assess environmental water provision adequacy	activity

B2 SOILS ARE HEALTHY AND PRODUCTIVE

goal

Soils and landforms are the fundamental resources which shape wetlands and waterways, biodiversity and land use, especially agriculture. Agricultural production in the Catchment is worth \$324.7 million per annum and relies directly on the health and conservation of soil resources. Soils should be managed as a living resource with consideration to soil acidity, dryland salinity, prevention of erosion and discharge of sediment.

Biosecurity is an issue of significant concern to the community and is included under this goal given its impact on soils, productivity and biodiversity. Other emerging issues such as water repellence and compaction of soils may also be having an impact on farm productivity levels, although the impact on productivity is not clearly understood. Healthy soils will reduce the loss of topsoil to waterways and the impact of sediment on rivers and the Estuary.

Strategies under this goal aim to assist farmers and land managers to better understand their local soils, make informed decisions on soil management practices, and support biosecurity programs. **Farmers own and manage over 50% of the Region, making their increased participation in NRM essential.**

For a summary of the characteristics, threats and management priorities for the Region's soil resources see Appendix E.

B2.1 Understand soil characteristics and risks

strategy

- B2.1.1 Undertake **risk/soil mapping** at a local level
 - B2.1.2 **Encourage and support research** that improves our understanding of soil characteristics and their productive potential
- activity

B2.2 Support land managers to match land uses and management practices to soil type and land capability

strategy

- B2.2.1 Support change of **land management practices** in vulnerable areas
 - B2.2.2 Maintain priority areas for **agricultural production**
- activity

B2.3 Support land managers to implement sound soil management practices and use suitable land productively

strategy

- B2.3.1 Encourage and support farming methods to enhance **soil and soil resilience**
 - B2.3.2 Encourage use of **soil amendments** for multiple benefits
 - B2.3.3 Support **'whole of farm'** planning to better meet social, economic and environmental objectives
- activity

B2.4 Support biosecurity practices

strategy

- B2.4.1 Support, preparation and implementation of **biosecurity** program/s for multiple benefits
- activity

B3 COASTAL AND NEARSHORE AREAS AND PROCESSES ARE RESILIENT AND VALUED

goal

Coastal foreshores, beaches and near-shore areas have significant social, ecological and economic values. They support commercial and recreational fisheries, protect coastal residential areas and provide a diversity of habitat for flora and fauna. A key aspect of coastal management in the Region is the network of community groups, local governments and state agencies that manage coastal foreshores and maintain public access to beaches. Strategies to achieve this goal are aimed at supporting the groups and organisations who are undertaking coastal area and near-shore management.

For a summary of the values, threats and management priorities for the Region's coastal and near-shore environments see Appendix H.

B3.1 Protect foreshores for their ecological and recreational values

strategy

- B3.1.1 Encourage/support **foreshore management** that enables natural process and resilience to a changing climate
 - B3.1.2 Support the **community** to value and **manage coastal areas**
 - B3.1.3 Support **recreational** uses consistent with **environmental protection**
- activity

B3.2 Protect near-shore habitats for productivity and biodiversity

strategy

- B3.2.1 Support actions/activities to protect **near-shore habitats** for ecological, recreational and commercial productivity
- activity



NGULLA, BRIDGING THE GAP TEAM MEMBERS PLANTING AT LAKE MCLARTY (2013)

B4 BIODIVERSITY IS CONSERVED

goal

Biodiversity is the term used to describe the natural diversity of life. This diversity exists at the ecosystem, species and genetic levels. The Region is recognised as a global biodiversity hotspot because of its mega-diverse and unique biodiversity and the level of threat this biodiversity is under. Biodiversity is most effectively and efficiently conserved by protecting natural areas, these being areas of bushland, forest, woodland, waterway, wetland, dune, rock outcrop, foreshore and any other area in a near-nature state. The Region is home to many globally significant natural areas, notable examples being Dryandra Woodland, jarrah forests, and the Peel-Yalgorup Ramsar System. The strategies to achieve this goal are focused on protecting priority natural areas, managing and reducing threats to biodiversity assets, and restoring ecological linkages between significant natural areas. Assisting local governments to implement local biodiversity strategies will be one of a number of ways of achieving this goal.

For a summary of the values, threats and management priorities of the Region's biodiversity and natural areas see Appendix F.

B4.1 Protect priority terrestrial and aquatic natural areas strategy

- B4.1.1 Influence **land-use planning** to afford protection to **priority natural areas**
- B4.1.2 Undertake assessments of **biodiversity status** activity
- B4.1.3 **Assist land managers** to protect priority natural areas—**terrestrial**
- B4.1.4 **Assist land managers** to protect priority natural areas—**aquatic**

B4.2 Manage and reduce threats strategy

- B4.2.1 Identify and **monitor threats** and threatening processes activity
- B4.2.2 Implement and support **threat reduction** activities in priority areas

B4.3 Restore ecological linkages strategy

- B4.3.1 Undertake landscape scale **restoration** for multiple benefits activity
- B4.3.2 Encourage **restoration** processes being identified and embedded into the land-use planning system

B5 NATURAL WATER RESOURCES ARE MANAGED AND USED WISELY

goal

Water resources are essential to life. They shape our wetlands, waterways and biodiversity and influence the type and location of agricultural production. Water resources include both surface waters and groundwater, and the aquifer systems that link them both. Most of the forested areas of the Forest and Scarp Subsystem are proclaimed water supply catchments (Land Assessment, 2005).

Water resources are managed under a regime which recognises both public and private use values as well as environmental water requirements. The strategies to achieve this goal support water allocation planning and other activities to ensure the wise use of resources for protection of ecosystems in the long term. These strategies complement the Department of Water's role in water allocation planning.

For a map of the location of the major water resource management areas, see Appendix G.

B5.1 Support water allocation planning and management for wise use strategy

- B5.1.1 Undertake a **water audit** across the catchment
- B5.1.2 Encourage adequate environment **water allocations** in all priority systems activity
- B5.1.3 Support measuring and assessment of **priority water systems**

B5.2 Support land managers to manage water resources—for multiple benefits strategy

- B5.2.1 Support resource managers to assess and implement **water capture** and/or **storage** facilities activity
- B5.2.2 Support resource users to implement **water efficiencies**

Science Strategy for the Peel-Harvey Estuary

Prepared for the PHCC in 2010 by Murdoch University, the Science Strategy delivers a fresh approach to managing ongoing and emerging risks to the ecosystem health of the Estuary. Facilitating science planning, delivery and priority setting for research, ultimately the Plan aims to integrate science with management objectives for the Estuary.



PHOTO: P. COULSON

MURDOCH UNIVERSITY RESEARCHERS SAMPLING FISH BY SEINE NET IN THE SHALLOWS OF THE PEEL HARVEY ESTUARY (2010)



10. Knowledge (Kaadadjan)

'Science and Knowledge Underpin Natural Resource Management'

Science, sound research and the sharing of information are key components of NRM in the Peel-Harvey Region. There is a wealth of scientific research and technical study that has occurred across the Region and it is essential that this is used by decision makers and natural resource managers to achieve a 'Healthy Catchment that Supports Life and Livelihood'. There are also considerable knowledge gaps that need to be filled over the coming decade to support effective and cost-efficient NRM activities. The three goals under Objective 3 reflect the primary purposes of science and knowledge in NRM.

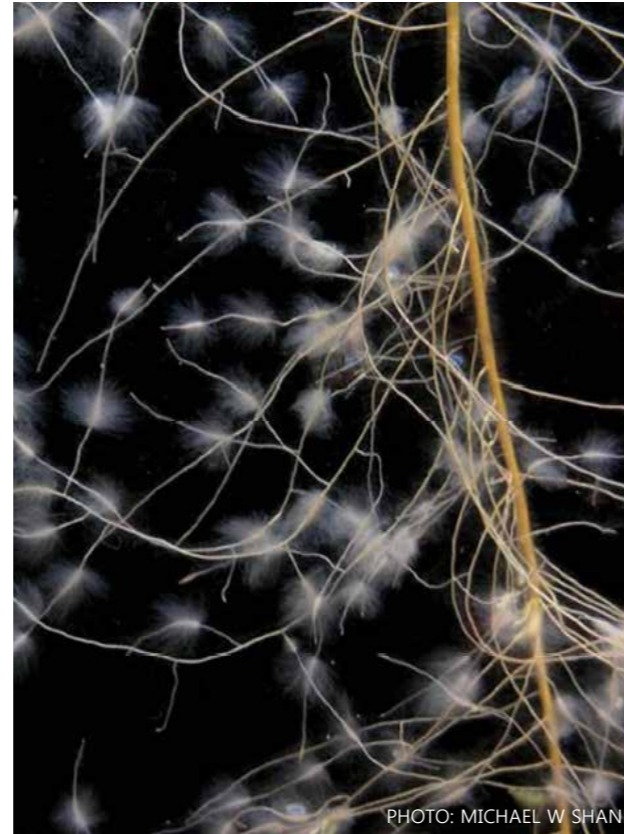


PHOTO: MICHAEL W SHANE

K1	INFLUENCE DECISION MAKING FOR BETTER NRM	goal
<p><i>Decision makers in government and the private sector need access to the best available research findings and information to ensure that land is managed wisely. New development and land uses should not create new NRM challenges for the future but provide for new opportunities for good stewards of the environment. A number of landmark strategies and activities will achieve this goal including the preparation of regular State of the Region reports, implementation of a Science Strategy for the Estuary and establishing the first stages of a Peel Waterways Institute. A summary of the major land uses in the Region is provided in Appendix I.</i></p>		
K1.1	Science is undertaken to address current and emerging issues	strategy
K1.1.1	Establish a Science Program for the Peel-Harvey	activity
K1.1.2	Prepare and implement a Science Strategy for the Peel-Harvey	
K1.1.3	Collaborate with research institutions to target research	
K1.2	Communicate State of the Catchment and relevant science to decision makers/community	strategy
K1.2.1	Prepare and communicate a State of the Catchment Report Card/s	activity
K1.2.2	Communicate science and knowledge relevant to health of the catchment	
K1.3	Establish a Peel Waterways Institute	strategy
K1.3.1	Establish first stages of a Peel Waterways Institute	activity

K2	INCREASE THE EFFECTIVENESS OF NATURAL RESOURCE MANAGEMENT	goal
<p><i>NRM practices must continue to evolve and adapt to the best available information. To enable this adaptive management and continuous improvement to occur, information must be collected for monitoring and evaluation purposes, science should be used to address knowledge gaps and innovation must be encouraged. The strategies to address this goal cover each of these aspects as well as incorporating the knowledge of Aboriginal people to improve the effectiveness of NRM activities.</i></p>		
K2.1	Maintain effective information collection, storage and analysis processes	strategy
K2.1.1	Establish and maintain an effective information collection process	activity
K2.2	Use scientific methods to develop, inform and improve natural resource management programs	
K2.2.1	Develop adaptive management systems and protocols	activity
K2.2.2	Establish and support citizen science programs	
K2.3	Incorporate Aboriginal knowledge to improve natural resource management	strategy
K2.3.1	Collaboratively document and use Aboriginal knowledge/practice in NRM programs	activity
K2.4	Encourage Innovation in natural resource management programs	strategy
K2.4.1	Identify and assess new techniques , particularly for agriculture and restoration	activity
K2.4.2	Communicate and support innovation in NRM and agricultural programs and practices	

K3	LAND MANAGERS TO USE BEST KNOWLEDGE AND TECHNOLOGY	goal
<p><i>Land managers use a wealth of knowledge and experience to inform the way they manage their paddock, patch or park. They may need support to access new information that has become available through research and field trials. Strategies to achieve this goal aim at information sharing between landholders, through field days, extension support, and field-based research trials.</i></p>		
K3.1	Relevant information/knowledge is provided to land managers	strategy
K3.1.1	Develop a targeted land management extension program	activity
K3.2	Use science to inform land manager programs	strategy
K3.2.1	Implement targeted extension programs to support NRM for productive environments	activity
K3.2.2	Influence research trials to be relevant to land managers	



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Landscapes
2025

Implementing the Strategy

11. Investment and Delivery

One of the purposes of this Strategy is to enable the preparation of a 2015/18 Investment Plan to prioritise delivery of activities.

The Investment Plan will describe the priority activities to be delivered via the Australian National Landcare Program in 2015/18. There are limited investment funds available which may mean that not all actions proposed will be achieved in 2015/18. The PHCC will continue to work collaboratively with the Australian Government to prioritise ongoing investment.

Whilst the Australian Government has traditionally been the largest investor in NRM in the Peel-Harvey, the PHCC will also seek investment from other sources, including state and local governments, who have various roles and responsibilities for, and in, NRM. Additional, alternative funding will also be sought from industry and other sources.

The relationship between governments as investors and the PHCC, on behalf of the Peel-Harvey community, will be given effect through partnership agreements or contracts.

Delivery will also be achieved through building collaborative partnerships, including supporting existing community groups and individuals. The establishment of mechanisms to further refine investment decisions and monitor, evaluate and improve processes will assist in delivery of the Peel-Harvey Strategy, towards our 100-year Vision.



12. Prioritisation of Activities for Investment

For the initial (1 July, 2014 - 30 June, 2015) investment request to the Australian Government, Activities were selected on the basis of existing prioritisation exercises recognised by the Australian and Western Australian governments, PHCC and community. These regional prioritisation exercises included the:

- Peel-Harvey Water Quality Improvement Plan (EPA, 2008)
- Peel-Harvey Catchment Council Water Quality Improvement Plan Implementation Review 2008 –2011 (PHCC, 2013)
- Subcatchment Implementation Plan for selected subcatchments (PHCC, 2012c)
- Ramsar Management Plan (PHCC, 2009)
- Regional Natural Assets Register (Appendix D)

For future Investment Plans, the PHCC will apply a stand-alone prioritisation methodology tailored to the Region. A draft methodology has been developed for this purpose and is included in Appendix J. The methodology is designed to be:

- technically and scientifically sound
- address threats to key assets
- be simple and easy to communicate to the Catchment community
- replicable with flexibility to adapt to new circumstances
- intuitive and informative for decision-makers.

The prioritisation process will also address practical delivery issues including value for money and strategic considerations such as continuity of partnerships.

Rivercare

European settlement for towns, roads, rail and farms has seen much of catchment cleared, and winter flooding required rivers and brooks to be drained and trained. Solutions of the time left a legacy of degradation. A catchment-wide Rivercare program commenced in 2003 and has seen significant repair across the Catchment. Fencing waterways, revegetating riparian areas and incorporating ecological function back into our drains are all contributing to improved farm, town and catchment health.



13. Project Delivery and the PHCC

In December 2013, the Commonwealth Minister for the Environment formalised the Australian Government's intention to recognise the Peel-Harvey Catchment Council as the 55th NRM regional body in Australia, responsible for the newly established Peel-Harvey NRM Region, from 1 July, 2014.

While the PHCC has been operating as a sub-region of the South West Catchments Council since 1999, as at 1 July 2014, the PHCC has additional roles and responsibilities, as a Regional Body. This includes the preparation of a community owned, robust and scientifically based Regional NRM Strategy to inform future investment in the newly established Peel-Harvey NRM Region, ensuring sound governance and increasing organisational capacity.

As a Regional Body, a Notional Regional Allocation is available to the PHCC to implement the Strategy, subject to the acceptance of a proposal against the government's guidelines for investment. This requires alignment with government proposals to deliver against the Strategic Objectives and

Outcomes of the National Landcare Program. If proposals are accepted, a subsequent contract and MERI plan must be prepared and approved. The approved MERI plan is then used as the reporting tool against which the PHCC must report delivery of outcomes within budget and timeframes.

All projects to be delivered under future regional allocation funding from the Australian Government will either be directly undertaken by the PHCC in partnership with other organisations, or undertaken by others via service agreements or contracts with the PHCC. The capacity of the PHCC to deliver or manage these projects will be dependent on a number of factors, including the level of available financial investment and the ability of other organisations to invest in projects, either directly or via in-kind contributions.

When scoping and developing future projects, the PHCC will directly approach other organisations which it considers have a stake, benefit or expertise related to the project.



BEN, HARRY NANNUP (ELDER), JO GARVEY (PHCC), MARK AND FRANKLIN NANNUP (2104)

14. Measuring Project Outputs and Longer Term Outcomes

The PHCC is committed to measuring and monitoring outputs at a project level and outcomes on a broader scale. Monitoring Evaluation Reporting and Improvement (MERI) protocols and standards will be developed and implemented as part of future delivery of projects.

MERI protocols and standards will be developed in consideration of a number of existing frameworks including the Commonwealth Government framework.

In developing MERI protocols and standards, the PHCC will set targets and conduct monitoring to measure outputs or outcomes at three levels:

- a) Project outputs and immediate outcomes (potentially targets set for 3–5 year timeframes) to ensure projects deliver outputs and outcomes as planned;
- b) Intermediate outcomes and targets (potentially targets set for 5–10 year timeframes and aligned to Strategies and Goals). This measurement should also drive adaptive management; and
- c) Long-term regional targets (potentially targets set for 20–50 timeframes and aligned to Goals and Objectives).

Intermediate and long-term targets will be selected to track performance against all or some of the Strategy Goals and ensure that monitoring is occurring against each of the Strategy's three Objectives. However, it will be important that sufficient intermediate and long-term targets are selected to track the condition of a broad cross-section of biophysical assets under Objective 2 (wetlands, soil, biodiversity, coastal, water quality). This will be important for reporting catchment condition to the wider community on a regular basis.

To ensure MERI is a key part of operating, a number of Strategy Activities are specifically included to cover monitoring, evaluation, reporting and improvement. Where no current baseline or benchmark exists, the PHCC will endeavour to establish these as part of building its MERI Framework. The PHCC have

installed a Geographical Reporting and Information Database (GRID). This online GIS reporting tool enables efficient and centralised collation of Peel-Harvey spatial information, by the PHCC and partners. GRID, with appropriate protocols and training, will ensure data is collected and stored in a robust and consistent manner across time and will enable reporting to funding bodies, project planning and design.

The PHCC will factor the measurement of project outputs into project budgets and plans in the Investment Plan. Additional resources or cooperative arrangements required to measure intermediate and long-term targets requires further discussion and negotiation with Government. Most data used to measure long-term Catchment health, such as water quality and native vegetation extent, have traditionally been collected and analysed by the State Government. It is hoped that these arrangements can continue.

Ecological Monitoring in the Peel-Harvey 'Rivers 2 Ramsar' Project

Measurement of the environment forms the foundation of the Peel-Harvey 'Rivers 2 Ramsar' Project. In partnership with the Australian Government, PHCC has tailored measurement standards of the National Monitoring Guide to the Coastal Plain environment. These and other measurement standards will be implemented by the PHCC and its partners for long-term use across the Region.



15. Future Strategies

This Strategy sets out how the Peel-Harvey catchment community intends to manage natural resources into the future, based on current condition, technical information and community needs.

Therefore, while the Objectives and Goals are likely to be durable across the lifetime of the Strategy, emerging issues, catastrophic events or other unforeseen issues may require a shift in Activities and Actions to enable the PHCC and its community to be responsive.

Continuous improvement for prioritisation of project planning, design and delivery will be guided by:

- new technical information, such as the results of the South West Catchments Council Climate Change Project and new spatial datasets (e.g. mapping of soil acidity)
- further development of prioritisation processes and Monitoring Evaluation Reporting and Improvement protocols and standards
- the outcomes of further discussions with local Aboriginal people to determine their aspirations for NRM in the Region and how they wish to be involved in the future planning and delivery of NRM projects

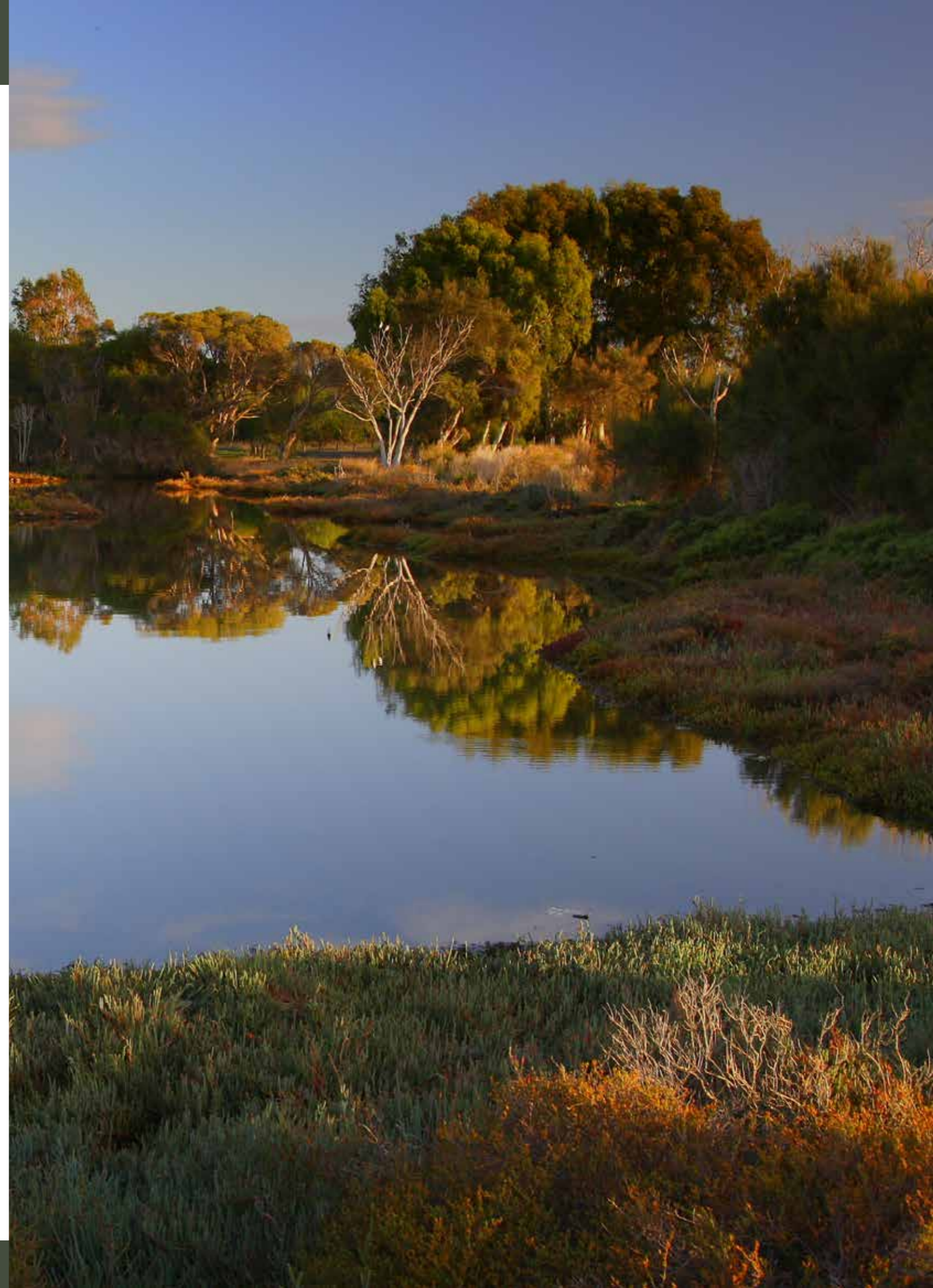
- further consideration of the benefits, risks and implications of adopting a 'systems-based' approach to NRM planning. The advantages and disadvantages of 'systems-based' approaches need to be assessed before the PHCC can make a decision on how, if at all, it is used as part of future NRM planning in the Peel-Harvey Region.

The Strategy will be in operation for a 10-year period, with a review anticipated in or around 2020. Additional reviews may be required should there be significant changes in natural resource condition, new scientific and research findings, regional community expectations or changes in government policy.

The review process will enable a reassessment of Regional NRM priorities, strategy framework and the process used to prioritise investment.



PHOTO: DAVID RENNIE





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Acronyms

ASS	Acid Sulfate Soils
BMP	Best management practice
COAG	Council of Australian Governments
DAFF	Department of Agriculture
DAFWA	Department of Agriculture and Food Western Australia
DoP	Department of Planning
DoW	Department of Water
EP Act 1986	Environmental Protection Act
EPA	Environmental Protection Authority
EPBC Act	Environmental Protection and Biodiversity Act
EPP	Environmental Protection Policy
LCDC	Land Care District Committee
MBO	Monosulfidic Black Ooze
MERI	Monitoring, Evaluation, Reporting and Improvement
NRM	natural resource management
PD Act 2005	Planning and Development Act
PHCC	Peel-Harvey Catchment Council
SCP	Strategic Community Plan
SIP	Subcatchment Implementation Plan
SWCC	South West Catchments Council
WAPC	Western Australian Planning Commission
WQIP	Water Quality Improvement Plan
WSUD	Water Sensitive Urban Design

Glossary

Biodiversity: is the variety of all life forms—the different plants, animals and microorganisms, the genes they contain, and the ecosystems of which they form a part. Biodiversity is not static, but constantly changing. It is increased by genetic change and evolutionary processes and reduced by processes such as habitat degradation, population decline and extinction (Commonwealth of Aust 1996).

Biodiversity has two key aspects:

- its intrinsic value at the genetic level, individual species level, and species assemblages levels
- its functional value at the ecosystem level.

Two species assemblages may have different intrinsic values but still have the same functional value in terms of the part they play in maintaining ecosystem processes.

Biodiversity hotspots: are areas with high numbers of endemic species (that is, found nowhere else) under a high degree of threat. Conservation planning is best done when investments centre on these ‘hotspot’ areas where there is the greatest need and where the pay-off from safeguard measures would also be greatest.

Catchment (as in river catchment—lowercase): is the area from which the river’s water is collected; usually defined on maps as a surface water catchment boundary.

Catchment (as used in this report—uppercase): the area recognised by the Australian and State governments as the Peel-Harvey Catchment Region.

Communicate: convey information, skills and knowledge in such a way as to increase the recipients understanding and capacity to respond.

Condition: the ecological state or health of a natural area.

Condition indicator: something that describes the quality of the environment and the quality and quantity of natural resources; highlights changes in environmental conditions over time. <http://www.environment.gov.au/node/21612>.

Condition scale: refers to vegetation condition as assessed using published methodologies such as those of Keighery (1994) or Kaesehagen (1994).

Connectivity: refers to the degree of connection between natural areas. Effectiveness will vary according to the type and mobility of different species.

Conservation: the protection, maintenance, management, sustainable use, restoration and enhancement of the natural environment. <http://www.environment.gov.au/node/21612>

Conservation reserves: all nature reserves, national parks, conservation parks, marine parks, and any other Crown Land vested for the purpose of conservation.

Cultural landscape: the way in which perceptions, beliefs, stories, experiences and practices give shape, form and meaning to the landscape. A cultural landscape embraces a diversity of manifestations of the interaction between humankind and its natural environment. <http://www.environment.gov.au/node/21694>.

Cultural significance: the aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects. Places may have a range of values for different individuals or groups. <http://www.environment.gov.au/node/21694>.

Dawesville Channel (Cut): the man-made channel opened in 1994 that provides a direct connection between the northern extremity of the Harvey Estuary, close to the estuary’s confluence with the Peel Inlet, and the Indian Ocean. <http://www.water.wa.gov.au/Water+regions/Kwinana+Peel/Peel-Harvey+waterways/The+Dawesville+Channel/default.aspx>.

Ecological character: ‘the combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time’ (Resolution IX.1 Annex A) <http://www.ramsar.org>.

Ecological community: a naturally occurring biological assemblage that occurs in a particular type of habitat (English & Blyth 1997; 1999).

Ecosystem services: the role played by organisms in creating a healthy environment for human beings, from production of oxygen to soil formation and maintenance of water quality (from: Williams, J. Read, C. Norton, A. Dovers, S. Burgman, M. and Anderson, H. (2001) *Biodiversity, Australian State of the Environment Report 2001* [Theme Report]. CSIRO Publishing on behalf of the Department of Environment and Heritage, Canberra). They are ‘the benefits that people receive from ecosystems, including provisioning, regulating, and cultural services’ (Millenium Ecosystem Assessment).

Effectiveness: refers to the level of positive impact of an action or program; ideally this will occur efficiently in order to obtain best value for money invested.

Environmental Protection Policies (EPPs): policies prepared by the Environmental Protection Authority under their powers as set in the Environmental Protection Act. EPPs have the force of law and can cover the protection of any portion of the environment or the prevention, control or abatement of pollution.

Eutrophication: the process where high levels of nutrients, especially phosphorus and/or nitrogen, encourage the growth of algae. It can occur in most wetland types, including rivers, lakes, swamps and estuaries.

Health (in the context of the natural environment): the complete ‘well-being’ of the biotic and abiotic components of the ecosystem. There are interconnections between natural areas and human health, including consideration of the positive values of natural areas (often wetlands) in contributing to achievement of public health objectives, and also for managing the potential negative interactions between natural areas and human health e.g. mosquito born diseases www.ramsar.org.

Heathland: species-rich vegetation communities dominated by small-leaved sclerophyllous shrubs less than 3 m tall.



Heritage values: natural and cultural heritage values are the qualities which make a specific and definable place or area important to the community. Heritage values are a cultural construct—people identify and value their existence—so different people may hold differing values, leading to dynamism and diversity in heritage issues and management. These values are often separated into natural, historic and Indigenous categories. However the three categories can overlap at a site and responsible management demands that, where they exist, these values be catered for simultaneously (SOE, 2001).

Cultural heritage refers to qualities and attributes possessed by places and objects that have aesthetic, historic, scientific or social value for past, present or future generations, and it relates to both Indigenous and non-Indigenous (historic) heritage. Values may be physical features or intangible qualities.

Natural heritage incorporates a spectrum of values, ranging from existence values through to culturally-based values at the other. The fundamental concept of natural heritage which most clearly differentiates it from cultural heritage is that of dynamic ecological processes, including ongoing evolution and the ability of ecosystems to be self-perpetuating.

Landcare (as in landcare works or practices): a general term to describe actions that aim to repair and restore natural processes and resources such as landform, soil, water, biodiversity and air as part of agricultural production systems.

Landcare (movement): a community-based movement that grew through the 1980s and 1990s in partnership with Government through programs such as the Decade of Landcare, National Landcare Program and the Natural Heritage Trust.

Landscape: a place containing cultural and natural features and values which extend over a large area (SOE, 2001).

Monosulfidic Black Ooze (MBO) organic oozes enriched with iron monosulfides. These gelatinous black organic sludges form under anoxic conditions, in the presence of sulfate-reducing bacteria and organic material often on the floors of a waterways (DoW).

Natural area: describes an area that contains native species or communities in a relatively natural state and hence contains biodiversity. They include native vegetation, vegetated or open water bodies (lakes, swamps), or waterways (waterways/channel wetlands, estuaries), springs, rock outcrops, bare ground (generally sand or mud), caves, coastal dunes or cliffs (adapted from Environmental Protection Authority 2003a).

NRM or natural resource management: the broad term used to describe actions that aim to manage soils, landforms, water, air and biodiversity for the ecosystem services they provide (e.g. sustaining food production, erosion control, climate) as well as their intrinsic values (e.g. species diversity, landscape).

Priority fauna: those 'conservation significant' animal species listed by the State's Threatened Species Consultative Committee but which are not currently listed under Section 14 (2) (ba) of the Wildlife Conservation Act 1950 as Specially Protected Fauna.

Priority flora: plant taxa that are under consideration as threatened flora but need further survey to adequately determine their status, or are adequately known but require monitoring to ensure that their security does not decline.

Productive (as in land use): refers to the capability of land to produce food, fibre, timber.

Programs: refer to a group of actions, plans or projects with the aim of achieving a specific outcome.

Ramsar: city in Iran where the Convention on Wetlands was agreed on 2 February 1971 <http://www.ramsar.org>.

Ramsar Convention: refers to the Convention on Wetlands, signed in Ramsar, Iran in 1971. This international treaty focuses on the conservation of internationally important wetlands and promotes the wise use of wetlands through international cooperation and action at a national level as a means of achieving global sustainability.

Ramsar site a wetland designated for the 'List of Wetlands of International Importance' as it meets the criteria required by the Ramsar Convention.

Ramsar listed: a wetland designated as a Wetland of International Importance.

Reserves: areas of Crown land reserved for various public purposes, for example, parks, recreation, drainage or church sites. Reserves may be vested, leased or Crown Granted in Trust. Crown reserves have varying levels of protection depending on the purpose of the reserve.

Resilience: *"the amount of change a (social-ecological) system can undergo (its capacity to absorb disturbance) and remain within the same regime"* (Walker and Salt 2006, 164) cited by M. Mitchell et al., Society and Natural Resources, 0:1–16, 2014.

Restoration: the return of a community to its pre-disturbance or natural state in terms of abiotic (non-living) conditions, community structure and species composition (English & Blyth, 1999). The aim of restoration is to reinstate a long-term self-regenerating natural ecosystem (Kaesehagen, unpub, 2001).

Revegetation: the planting or direct seeding of native species in areas that have been cleared or highly modified (Commonwealth of Australia, 2001a), after weed control and ground preparation has been undertaken. Local native species of local provenance should be used. Revegetation should only occur where there is no potential for using regeneration techniques to assist natural regeneration processes.

Riparian: refers to the zone along or surrounding a water body where the vegetation and natural ecosystems benefit from and are influenced by the passage and storage of water (Water and Rivers Commission, 1998).

Threatened ecological community (TEC): an ecological community that has been assessed through a procedure and assigned to one of the following categories related to the status of the threat to the community. The categories are 'Presumed Totally Destroyed', 'Critically Endangered', 'Endangered' or 'Vulnerable' (English & Blyth, 1997; 1999).

Waterways: all streams, creeks, rivers, estuaries, coastal lagoons, inlets and harbours (Water and Rivers Commission, 1998) and include wetland types in which the water flows in a channel landform either permanently or intermittently (streams creeks, rivers and man-made drainage features) (Environmental Protection Authority, 1997).

Wetlands: *'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres'* (Ramsar Convention 1987; ECD, PHCC 2007).

Wise use: the wise use of wetlands is defined as *'the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development'* <http://www.ramsar.org>.





Binjareb Boodja Landscapes 2025

- A: Community Consultation Report
- B: Literature Review Bibliography
- C: Federal and State Government Legislation and Policies Review
- D: Regional Natural Assets Register
- E: Regional Land and Soils Snapshot
- F: Regional Biodiversity and Natural Areas Snapshot
- G: Regional Water Resources, Watercourses and Wetlands Snapshot
- H: Coastal and Nearshore Snapshot
- I: Regional Land Use Snapshot
- J: Draft Prioritisation Process for Investment Planning
- K: Climate Change

Appendices

(for all appendices see www.peel-harvey.org.au)



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