Wimmera Wetlands Asset Strategy

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16 March 2011

Wimmera
Catchment Management
Authority

Document History

Version	Date	Summary of Changes	Author
V.1 draft	August 2010	Draft approved by Wimmera CMA Board for consultation	Jacqui Norris
V.2	16/03/2011	Draft revised following stakeholder consultation. Changes include: An Executive Summary has been added to summarise the main points of the strategy. The justifying detail sits in the main body of the report and associated appendices; Additional threats information has been added to improve the level of detail and justification regarding threat ratings; Some threat ratings have been revised, based on additional technical information, and expert opinion; Objectives and targets have been revised to ensure that they are realistic and measurable; The graph showing the trend in wetland loss and protection over time has been removed as it was based on large assumptions and unlikely to reflect reality.	Jacqui Norris
V.3	21/04/2011	Final version approved by the Board with photographs added.	Jacqui Norris

Publication details

Wimmera Wetlands Asset Strategy

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Photos: David Fletcher and Wimmera CMA

Acknowledgements

The following individuals or groups were consulted during the preparation of this report.

However, it is acknowledged that the contents and views expressed within this report are those of Wimmera Catchment Management Authority and do not necessarily reflect the views of the parties acknowledged below.

Department of Sustainability and Environment, Victoria, and Arthur Rylah Institute

Department of Primary Industries, Victoria

Parks Victoria

Australian Government Caring for Our Country

West Wimmera Shire Council

Mallee Catchment Management Authority

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Executive summary

Purpose

The purpose of the Asset Strategy for Wimmera wetlands is to provide a basis for:

- Guiding investment decisions by Wimmera CMA for wetland management;
- Revising and updating the Regional Catchment Strategy for the Wimmera region; and
- Communicating, discussing, reviewing and updating Wimmera CMA's approach to wetland asset management to investors and stakeholders.

Overview of contents

This strategy summarises and describes with regard to wetlands in the Wimmera:

- Their characteristics, values and importance;
- Current condition and the trend in condition;
- Threats impacting on wetland condition;
- Desired condition of the wetland asset, including a long-term vision, objectives and targets;
- Monitoring activities required for assessing achievement of targets and progress towards the objectives and vision; and
- Knowledge gaps.

This strategy fits within the framework of broader Australian and Victorian Government policies and strategies.

Asset description – Wimmera Wetlands

The Wimmera CMA region is a hotspot for wetlands and associated aquatic biodiversity. A 2004 survey identified 2,676 existing wetlands greater than one hectare in size, equating to roughly 25% of Victoria's individual non-flowing wetlands (Sinclair Knight Merz, 2006). These wetlands cover about 70,000 hectares, equating to 3% of the region's total area.

Rainfall is the primary water source of most of the region's wetlands. Others are stream-fed, including the high conservation value lakes, Lake Albacutya and Lake Hindmarsh that fill from large Wimmera River floods. Approximately 17% of wetlands are groundwater dependent ecosystems fed by saline groundwater (Sinclair Knight Merz, 2006).

Large numbers of each of the six wetland categories used in Victoria (Corrick and Norman, 1980) are represented in the Wimmera (Table 1). This demonstrates the diverse nature of Wimmera wetlands in terms of their hydrology and salinity. This contributes to high biodiversity in terms of flora and fauna, with the different categories of wetlands supporting a wide range of plant, bird, macroinvertebrate and other wetland species.

When wet, most wetlands swarm with aquatic life and provide an important food source and breeding ground for waterbirds, frogs, fish, insects and plants. When dry, they provide habitat for dryland plants and animals like native grasses, reptiles, birds and mammals like kangaroos and emus.

Table 1: Number of wetlands greater than one hectare in size in each Corrick and Norman (1980) wetland category in the Wimmera region in 2004.

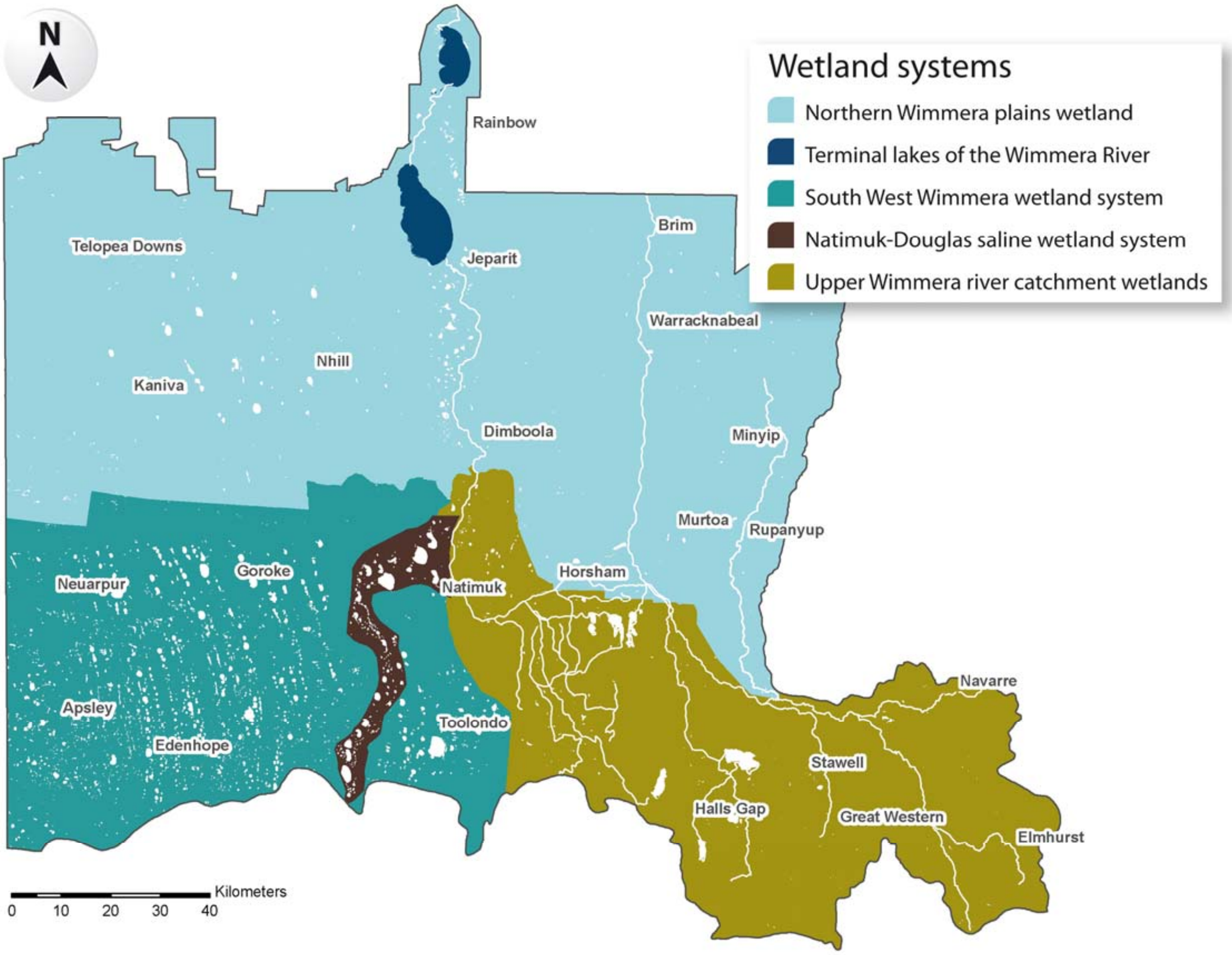
Wetland Category	Number of existing wetlands	% of total wetland number
Freshwater Meadow	988	37%
Shallow Freshwater Marsh	1,098	40%
Deep Freshwater Marsh	133	5%
Permanent Open Freshwater	231	9%
Semi-Permanent Saline	209	8%
Permanent Saline	17	1%
Total	2,676	100%

The Wimmera also provides important habitat for threatened and endangered flora and fauna listed under the *Environment Protection and Biodiversity Conservation Act 1999* and *Flora and Fauna Guarantee Act 1988* like the Growling Grass Frog, Brolga, Freckled Duck, Intermediate Egret, Blue-Billed Duck, Ridged Water-Milfoil, Swamp Sheoak and Swamp Diuris. Migratory birds also visit the region, including some that are listed on international conservation agreements between Australia and Japan, China and Republic of Korea. These include Great Egret, Latham's Snipe and Satin Fly-Catcher.

Wimmera wetlands can be grouped into sub-regions based on similar geographic characteristics and management issues (Figure 1). These regions include:

1. South West Wimmera Wetland System
2. Natimuk-Douglas Saline Wetland System
3. Northern Wimmera Plains Wetlands
4. Terminal Lakes of the Wimmera River
5. Upper Wimmera River Catchment Wetlands

Figure 1: Major wetland systems and existing wetlands in the Wimmera region.



Most (75%) of the region's wetlands, comprising more than 2,000 individual wetlands, are concentrated in the south-west Wimmera west of Horsham and south of the Little Desert. This includes the South West Wimmera System and Natimuk-Douglas Saline Wetland Systems.

Current condition and trend of wetland condition

The condition of individual wetlands varies considerably with many in good to excellent condition, but also large numbers that have been moderately to heavily degraded. In summary:

- Over half of Wimmera wetlands are modified by dams, drains, banks and/or crops.
- 474 wetlands or 18% of mapped wetlands are lost because they have been modified to the extent that they are no longer functioning as wetlands. Around 20 wetlands per year on average were lost between the late 1970s and 2004. Most of the wetlands lost (81%) were freshwater meadows.
- Freshwater meadows face the highest threat of being lost and degraded by human activities. At least 67% have been modified by dams, drains, banks and/or crops. Condition assessments of a small sample of wetlands found a higher proportion of freshwater meadows in poor to very poor condition than any other wetland type.
- All wetland types have been modified to some extent. Shallow freshwater wetlands are most impacted while saline wetlands are the least impacted.
- Condition assessments in 2005 and 2009 found soils, hydrology and physical form to generally be in good condition for the majority of wetlands. The condition of biota, or vegetation, varied with a large proportion of wetlands in moderate condition. The wetland catchment of 61% of assessed wetlands was found to be in poor to very poor condition, indicating poor “buffer areas” immediately surrounding the wetlands and potential impacts from neighbouring land.

Threats impacting on wetland condition

The majority of processes threatening the condition of Wimmera wetlands arise because most wetlands are located within an agricultural landscape. Less than 10 percent of Wimmera wetlands are protected in public reserves and individual landowners often have numerous wetlands on their properties. This presents challenges in striking a balance between agricultural production and wetland conservation.

Table 2 summarises the main threats impacting on Wimmera wetlands and whether they pose a high, moderate or low threat to wetland condition. The threat ratings are based on research, GIS data analysis, expert opinion and field observations.

Table 2: Threats impacting on the condition of different wetland types.

	Freshwater Meadows	Shallow Freshwater Marshes	Deep Freshwater Marshes	Permanent Open Freshwater	Semi-Permanent Saline	Permanent Saline
Cropping	High	High	Low	Low	Low	Low
Neighbouring land use	High	High	High	High	High	High
Changed hydrology (dam, drain, bank)	High	High	Moderate	Moderate	Low	Low
Grazing by stock	Moderate	Moderate	Moderate	Moderate	Low	Low
Declining groundwater levels	Low	Low	Low	Low	Moderate	Moderate
Climate change	High	High	High	High	High	High

Desired condition of wetlands in the Wimmera:

The Long Term Vision (50+ years)

The vision for Wimmera wetland assets is that:

Wetland ecosystems are diverse and resilient and sustained in good condition to the extent that:

- **There is adequate and connected habitat available for the flora and fauna that rely on Wimmera wetlands for survival during their life cycle; and**
- **Wetlands continue to provide ecosystem services valued by the community.**

“Diverse” means having a large variety of wetland types with a range of different characteristics supporting a range of wetland flora and fauna characteristic of the Wimmera.

“Resilient” means the ability of wetland assets to withstand or recover from shocks or disturbances like drought, fire and flooding while retaining their primary ecosystem functions.

Objectives (20 year)

Long-term objectives for achieving progress towards this vision include, by 2030:

1. **Sustain all high conservation value wetlands in good or excellent condition.**
   - High conservation value wetlands include those with recognised conservation values, including Ramsar sites, wetlands listed on the Directory of Important Wetlands in Australia, High Conservation Value Aquatic Ecosystems and wetlands that support migratory birds listed under the China-Australia, Japan-Australia and Republic of Korea-Australia Migratory Bird Agreements.
2. **Stabilise loss of wetland ecosystems by human activities.**
3. **Stabilise and improve the condition of wetland ecosystems.**
4. **Retain wetland diversity by preserving the range of existing wetland ecosystems.**
5. **Improve connectivity between wetlands to enable movement of wetland flora and fauna.**

Targets

The following outlines measurable 6-year targets aimed at achieving the objectives and vision for wetlands assets.

1. **Protect high conservation value wetlands from threatening processes and sustain them in good or excellent condition.**
2. **Achieve protection and good management of twenty percent of each wetland type so that the wetlands are improving towards a condition of good or excellent.**
3. **Enhance connectivity by protecting a hydrologically connected chain of wetlands and improving their condition towards good or excellent.**
4. **Increase the number of private land managers implementing wetland conservation practices.**
5. **Prevent impacts to wetlands from new developments by working with local councils and the community to implement planning scheme overlays.**

Actions for implementing the targets

There are a range of options available for achieving targets and progress towards objectives and the overall vision for Wimmera wetlands. They include offering financial incentives and implementing effective education activities to encourage increased adoption of recommended practices by land managers. The mechanisms and activities for achieving objectives and targets are beyond the scope of this strategy and are to be outlined in a 6-year Action Plan and annual Implementation Plans. The mix of actions will also be guided by government priorities for investment.

Monitoring and evaluation

Achievement of targets and progress towards objectives and vision will be measured, monitored and evaluated through activities like:

- Reviewing loss and degradation of wetlands by activities like dams, drains, banks and crops every 6 years;
- Assessing the condition of high conservation value wetlands and a sample of other wetlands using the Victorian Index of Wetland Condition method every 6 years;
- Assessing the ecological response of wetlands protected and enhanced under CMA activities to determine whether there has been an ecological gain on investment;
- Monitoring adoption of mechanisms for protecting wetlands in local planning schemes.

Summary of knowledge gaps

Some of the key knowledge gaps include:

- The current rate of wetland loss and degradation by cropping, dams, drains and banks. This analysis has not been repeated since 2004. This information would indicate the level of ongoing threat to wetlands from these degrading activities and help to target management effort.
- The impacts of estimated changes to climate on Wimmera wetland function, flora and fauna.
- The condition and ecological value of many individual wetlands.

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1. Overview of Contents

This Asset Strategy summarises and describes with regard to wetlands in the Wimmera:

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- Knowledge gaps.

This strategy fits within the framework of broader Australian and Victorian Government policies and strategies.

2. Asset description – Wimmera wetlands

This section describes the characteristics of Wimmera wetlands and their values and importance.

The Wimmera is a hotspot for wetlands and associated aquatic biodiversity. A survey conducted in 2004 identified 2,676 existing wetlands greater than one hectare in size in the Wimmera CMA region, equating to roughly 25% of Victoria's individual non-flowing wetlands (Sinclair Knight Merz, 2006).[1] In total, these wetlands cover about 70,000 hectares or 700 square kilometres, equating to 3% of the total area of the Wimmera CMA region. An additional 474 wetlands were found to be lost between the late 1970s/early 1980s and 2004 because they had been modified to the extent that they no longer function as wetlands. For example, many have been drained to make land more productive for farming.

Individual wetlands range from one hectare to more than 1,000 hectares in size. Most wetlands are relatively small in area, with more than 2,600 wetlands less than twenty hectares in size. Lake Albacutya and Lake Hindmarsh are the region's largest lakes, covering 5,800 and 13,900 hectares respectively.

Most of the region's wetlands are filled from overland flow and small drainage channels following winter and spring rainfall. In some parts of the region, particularly the south west, high rainfall causes water to sheet across the landscape once the ground has saturated. Water pools in the numerous depressions, forming wetlands (Butcher, 2003).

A small number of wetlands, including Lake Albacutya and Lake Hindmarsh are stream-fed, filling from overbank and river inflows when the Wimmera River floods. Approximately 17% of wetlands are groundwater dependent ecosystems fed by saline groundwater (Sinclair Knight Merz, 2006). The region's salt lakes are found in the Natimuk-Douglas Depression, extending to the west of the Wimmera River north of Natimuk and also around Edenhope and south of Wombelano.

The Corrick and Norman (1980) system of wetland classification currently used in Victoria describes six naturally occurring wetland types based on water depth, frequency of inundation and salinity. Large numbers of each of the six categories are represented in the Wimmera (Table 3), demonstrating the diverse nature of Wimmera wetlands. The Corrick and Norman wetland categories are described in Appendix 1.

Table 3: Number of existing wetlands greater than one hectare in size in each Corrick and Norman (1980) wetland type in the Wimmera region in 2004.

Wetland Category	Number of existing wetlands	% of total wetland number
Freshwater Meadow	988	37%
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Total	2,676	100%

Almost 80% of Wimmera wetlands are shallow, seasonally wet freshwater meadows and shallow freshwater marshes. When fully inundated, they are typically a maximum depth of thirty to fifty centimetres and hold water for four to eight months.

There are also large numbers of deep freshwater marshes and permanent open freshwater wetlands. These deep lakes typically hold water most of the time, except in very dry periods.

1 This refers to the number of mapped wetlands. There are likely to be additional wetlands less than one hectare in size.

The more than 200 saline wetlands in the region are predominantly fed by saline groundwater, although they may also receive some rainfall runoff during wet months.

Wimmera wetlands include features of both wet and dry environments and most will be dry at some time, which may occur seasonally, intermittently or only during drought. This is a natural part of a wetland's 'boom and bust' cycle and, for many wetlands, drying is as essential as flooding is to keep it healthy. When undisturbed, dry wetlands provide safe refuge for the many plants and animals that are adapted to the region's natural wetting and drying cycles. For example, wetlands store the seeds and tuber roots of wetland plants and the eggs of frogs or brine shrimp during dry periods. Some frogs and yabbies burrow into the mud until water returns. These plants and animals re-emerge on the return of water.

"Dry periods and wet periods are a natural part of a wetland's 'boom and bust' cycle and, for many wetlands, drying is as essential as flooding to keep it healthy."

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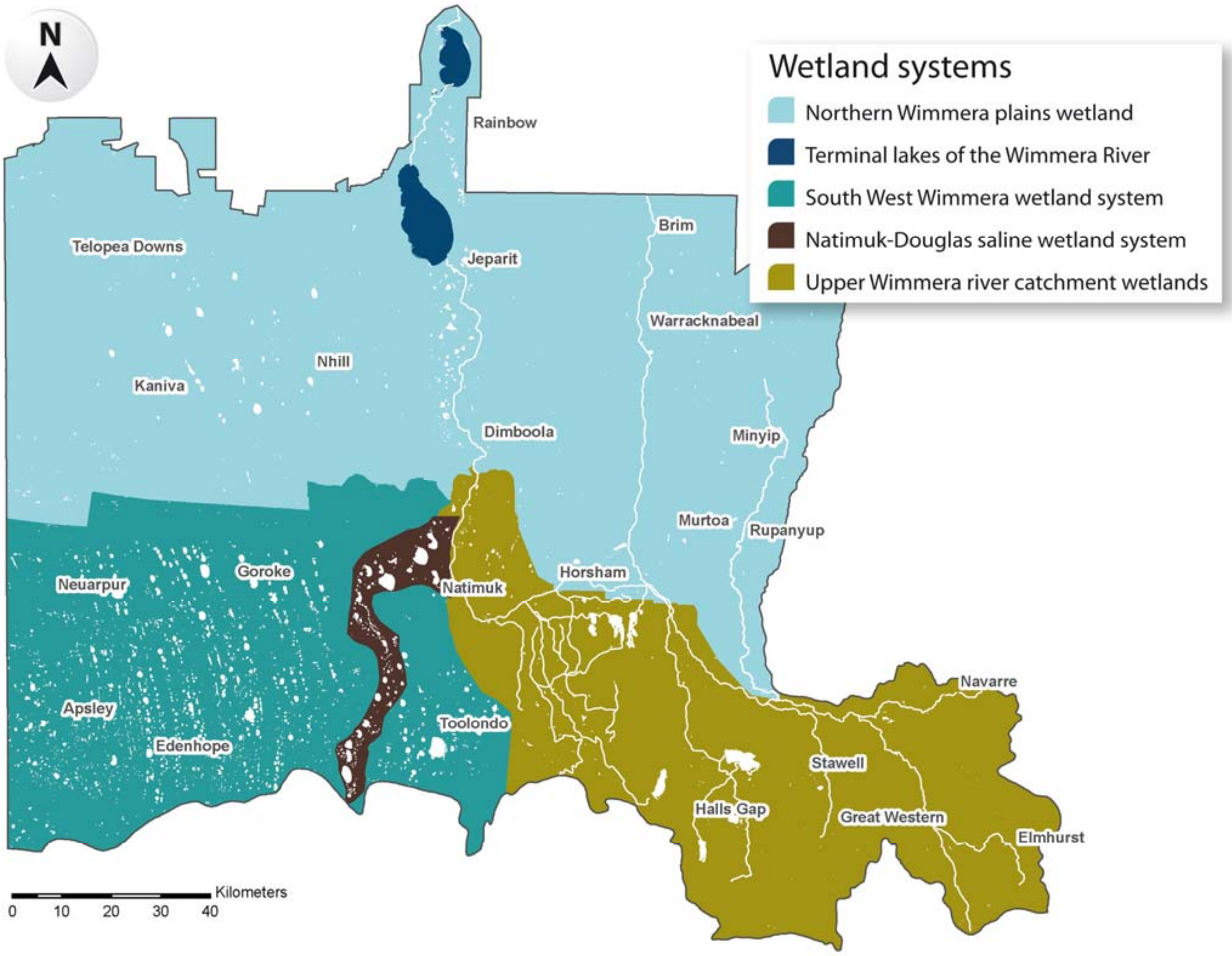
2.1. Wimmera Wetland Systems

Wimmera wetlands can be grouped into sub-regions based on similar geographic characteristics and management issues. These regions include:

1. South West Wimmera Wetland System
2. Natimuk-Douglas Saline Wetland System
3. Northern Wimmera Plains Wetlands
4. Terminal Lakes of the Wimmera River
5. Upper Wimmera River Catchment Wetlands

Figure 2 shows the location of these major wetland systems and individual wetlands across the Wimmera region.

Figure 2: Major wetland systems in the Wimmera region.



2.1.1. South West Wimmera Wetland System

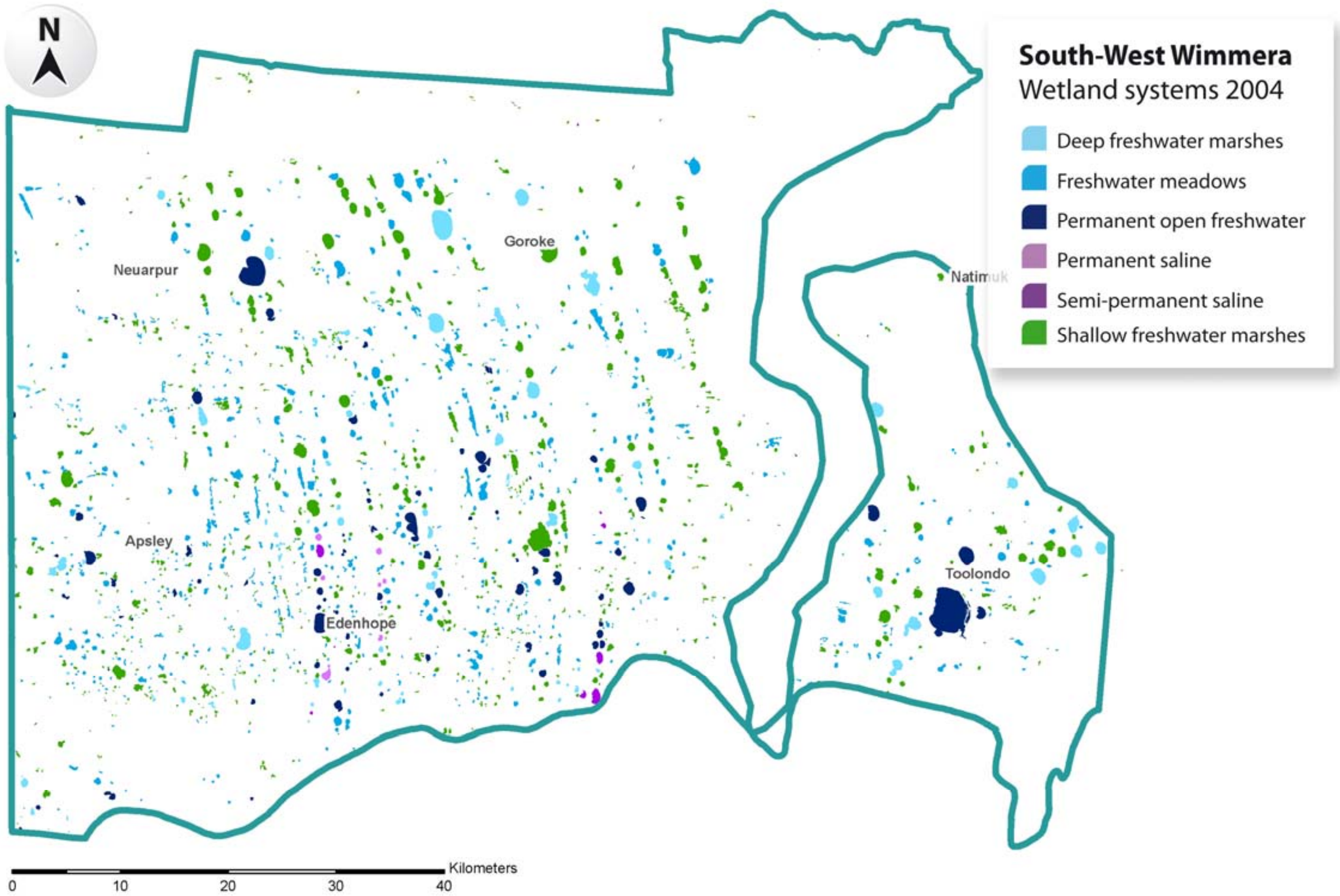
Seventy-five percent of the region's wetlands comprising more than 2,000 individual wetlands are concentrated in the south-west Wimmera west of Horsham and south of the Little Desert (figure 3). This includes the South West Wimmera System and Natimuk-Douglas Saline Wetland Systems.

About 200 of these wetlands lie in the Natimuk-Douglas depression, forming a distinct wetland sub-system or complex. Wetlands within this system are predominantly groundwater-fed saline wetlands with distinct characteristics and management issues. Consequently, they are discussed in the following section about the Natimuk-Douglas Saline Wetland System.

Wetlands cover almost 29,000 hectares and more than 7% of the land area (Sinclair Knight Merz, 2006). Less than ten percent of the wetlands are on public land, many of these only partially, and most are surrounded by agricultural land used for cropping or grazing. Many wetlands on private land are grazed and growing numbers of wetlands are being cropped.

Within the South West Wimmera Wetland System, there are two main geographic landscape features, comprising the Central Parilla Ridge and Swale System in the centre and eastern sections, and the Western Limestone System in the west extending to the South Australian border.

Figure 3: Map of the South West Wimmera Wetland System, showing the location and categories of wetlands.



The Central Parilla Ridge and Swale System is comprised of a series of sandy dunes that run across the landscape in a north-westerly direction. Swales with heavier soils lie between the dunes. Wetlands, ranging from shallow ephemeral meadows and marshes to deeper, well-developed lake basins have developed in the swales between the Parilla ridge lines. The very low gradient of slope along the swales prevents the development of more channelised drainage. Instead, surface run-off accumulates on the clay surface to form "chains" of connected wetlands aligned along the swales (Earth Tech and Bowler, 2004).

In the western part of the south-west Wimmera, the ridge-swale sequence dies out leaving a subtly undulating shallow clay plain of very low gradient that slopes gently to the southwest. Freshwater meadows with weakly developed morphological features, lacking dunes and defined banks, are most common. These wetlands have a short inundation period and can therefore be easily developed for agriculture. This area is dissected by several streams that flow west into South Australia, including Mosquito, Marambro and Naracoorte Creeks. A small number of wetlands are located along streams in the upper catchment of these systems. The area also contains a freshwater groundwater resource that provides a valuable agricultural and domestic water supply for the area and across the border in South Australia. The majority of wetlands do not connect with the aquifer, however there are some "sink hole" wetlands such as Newlands Lake and soaks that are known to recharge the aquifer.

The majority of wetlands in the South West Wimmera Wetland System are shallow seasonal freshwater wetlands, with over 800 freshwater meadows, 750 shallow freshwater marshes and around 100 each of deep freshwater meadows and permanent open freshwater wetlands. These wetlands generally sit some 10-30 metres above the watertable, relying solely on surface water inflows.

There are also about 20 groundwater-dependent semi-permanent and permanent saline and brackish wetlands in areas where the saline regional Parilla aquifer intersects with the ground surface. These groundwater-fed wetlands are mainly located close to Edenhope.

Wetlands range in size from one hectare to almost 500 hectares. The largest wetland, Toolondo Reservoir, is almost 1,200 hectares in size. However, most wetlands are much smaller with almost 66% of wetlands less than 10 hectares in size and 82% less than 20 hectares.

Together, the Central Parilla Ridge and Swale System and the Western Limestone System form a major wetland complex that supports significant biodiversity and provides a rich source of habitat for a broad range of plants and animals. When wet, most wetlands swarm with aquatic life and provide an important food source and breeding ground for waterbirds, frogs, fish, insects and plants. When dry, they provide habitat for dryland plants and animals like native grasses, reptiles, birds and mammals like kangaroos and emus.

The South West Wimmera also provides important habitat for threatened and endangered flora and fauna listed under the *Flora and Fauna Guarantee Act 1988* like the Growling Grass Frog, Brolga, Freckled Duck, Intermediate Egret, Blue-Billed Duck, Ridged Water-Milfoil, Swamp Sheoak and Swamp Diuris.

Migratory birds also visit the region to find habitat, food and breeding grounds. Some of these birds such as the Great Egret, Latham's Snipe and Satin Fly-Catcher, are listed on international agreements between Australia and the countries they migrate between, such as Japan, China and Republic of Korea. These agreements are aimed at the conservation of these birds.

South West Wimmera wetlands also have significant social, economic and cultural value. They provide important recreational areas for the local and regional community and attract tourists for activities like water-skiing, fishing, yabbying, music events and festivals, camping, duck shooting, bird watching and swimming. Social studies have found that people highly value the natural aspects of wetlands, including the birds, wildlife and vegetation. Other valued services included recreational opportunities including fishing, water sports and duck shooting; water supply; visual amenity and stock feed through grazing (Petheram, J. et al., 1999).

In addition to its wetlands, the South West Wimmera supports considerable terrestrial biodiversity, particularly large tracts of eucalypt and heath forest and endangered species and vegetation communities like the Red-Tailed Black Cockatoo and Buloke woodlands. In a whole of landscape context, wetlands contribute to landscape function and connectivity to allow species to move to suitable habitat within the landscape. Collectively, the wetlands and terrestrial biodiversity values are such that the region has been recognised by the Victorian State Government as a flagship area.

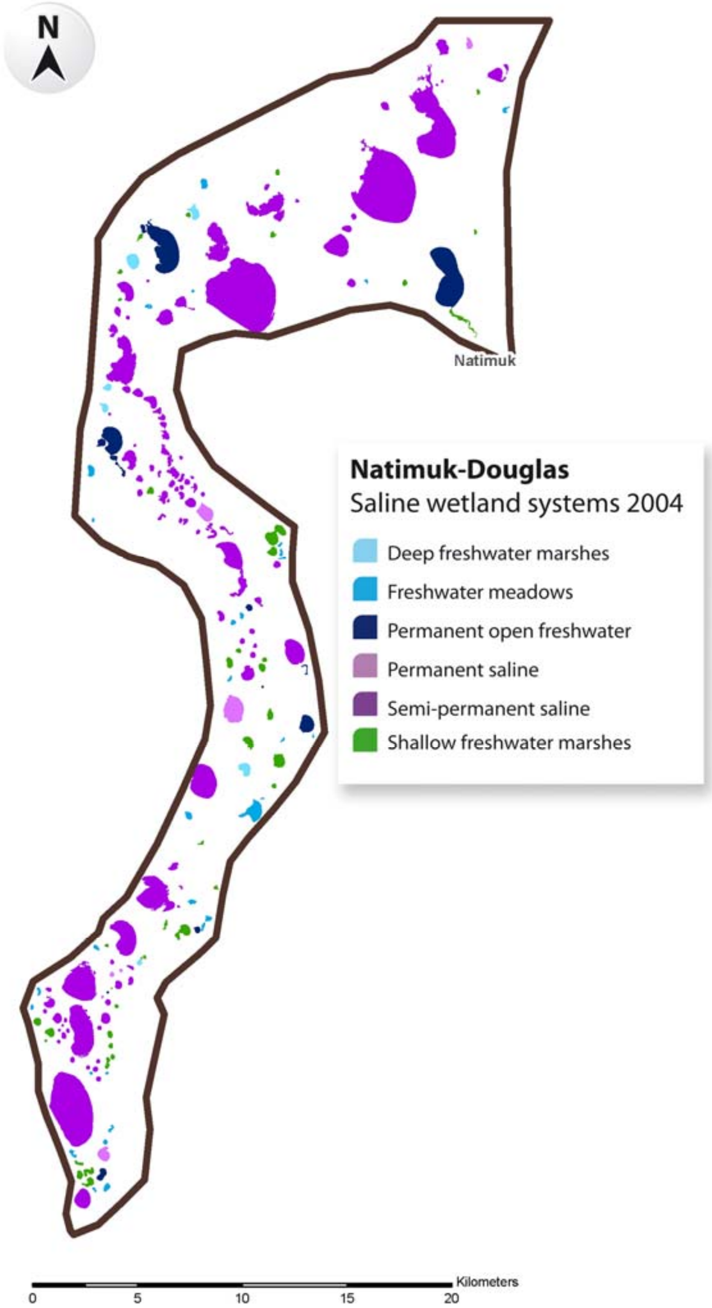

Freshwater meadow near Ullswater

2.1.2. Natimuk-Douglas Saline Wetland System

The Natimuk-Douglas Saline Wetland System (NDSWS), locally known as the Natimuk-Douglas “Chain of Lakes,” lies in the eastern section of the south-west Wimmera (figure 4). The system comprises a well-defined “chain” of more than 110 saline and brackish lakes ranging in size from one hectare to over 800 hectares. The system has formed within the Douglas depression, an area of lower elevation than the surrounding landscape. There are also approximately 90 freshwater wetlands, predominantly shallow freshwater marshes and freshwater meadows, located within or close to the Douglas depression.

The NDSWS has formed within the Douglas Depression and spans over 70 kilometres. Less than 20% of the wetlands are on public land, some of these only partially, and most are surrounded by agricultural land uses.

Figure 4: Map of the Natimuk-Douglas Saline Wetland System, showing the location and categories of wetlands.



The NDSWS has unique hydrogeology. The saline wetlands are fed from the regional Parilla saline aquifer and are areas of natural salt discharge. There are also large numbers of freshwater wetlands on higher ground immediately surrounding the depression. Freshwater springs regularly arise during the saline lakes' dry phase, appearing as puddles in otherwise dry lake beds. These springs provide an important water source for bird life during periods when surrounding freshwater lakes are dry.

The NDSWS includes 11 wetlands that are listed on the National Directory of Important Wetlands. They have received listed status because they meet one or more of the following criteria:

- Provide a good example of a wetland type occurring within a biogeographic region in Australia;
- Play an important ecological or hydrological role in the natural functioning of a major wetland system; and
- Provide important habitat for significant flora and fauna.

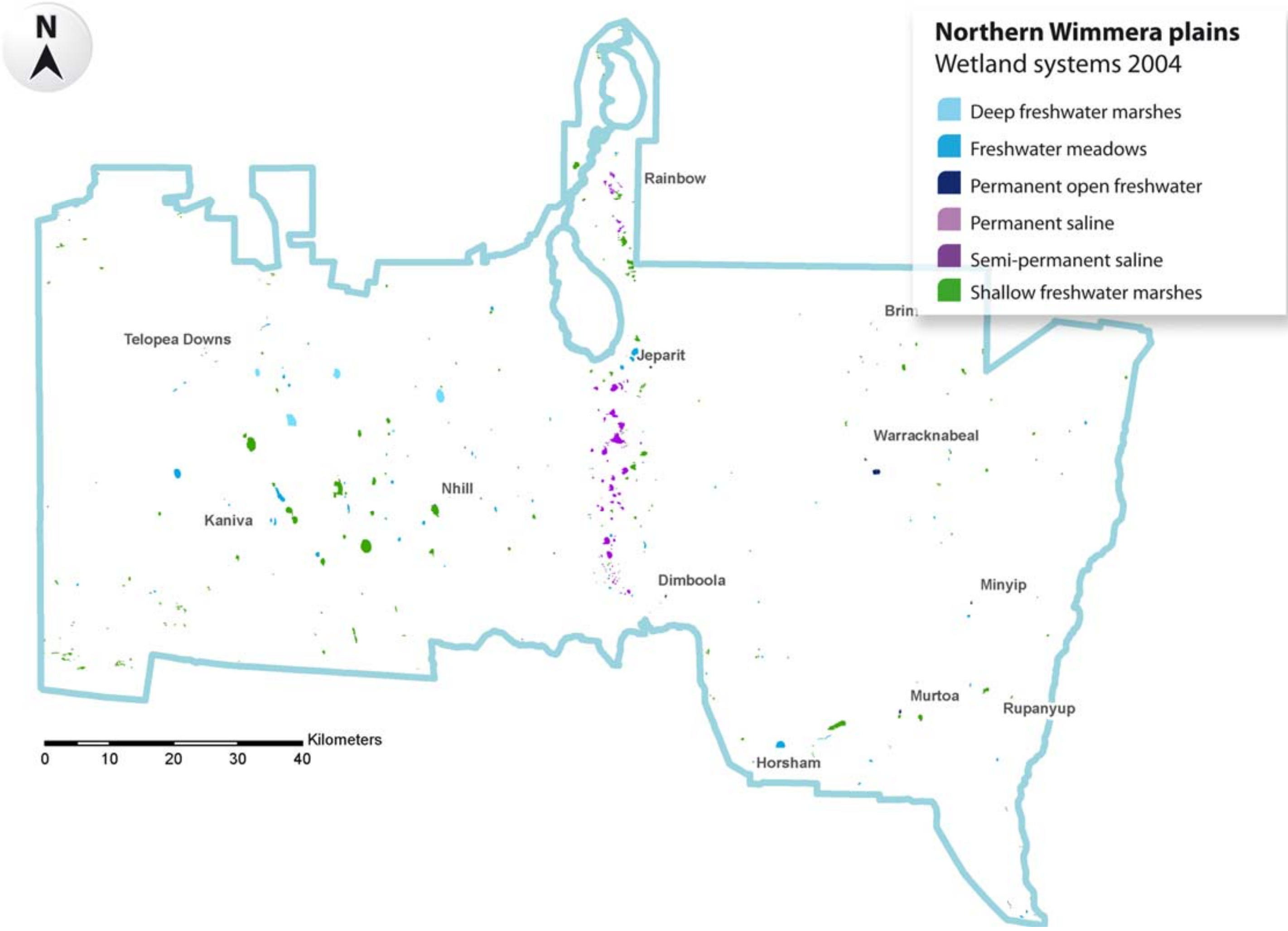
Over 180 native animal species and 222 native plant species have been recorded in the NDSWS. Of these, three plants and one bird are listed as threatened under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and five plants and ten birds are listed under the Victorian *Flora and Fauna Guarantee Act 1988*. Fourteen migratory bird species listed under the China-Australia and Japan-Australia Migratory Bird Agreements and the Bonn Convention on Migratory Species have been recorded in the NDSWS, and 20 in the immediately surrounding area. The saline lakes are particularly important habitat for Red-necked Avocets, Banded Stilts, Red-kneed Dotterels, Red-Capped Plovers and Black Swans. The NDSWS supports seasonally large numbers of Mountain Duck, Grey Teal and Banded Stilts, with maximum recorded numbers topping five, ten and sixty thousand birds respectively (Birds Australia, 2002).

NDSWS wetlands also have considerable social and economic value. Freshwater wetlands such as Saint Mary's Lake and Natimuk Lake provide important recreational areas and attract tourists for activities like water-skiing and swimming. Many of the saline wetlands are important bird-watching areas due to the large numbers of birds they are known to support.

2.1.3. Northern Wimmera Plains Wetlands

There are 424 wetlands in the Northern Wimmera Plains sub-region covering an area of approximately 8,200 hectares. Over two-thirds of these are shallow seasonal freshwater wetlands, with just over half classified as shallow freshwater marshes and almost 20% as freshwater meadows. An additional 20% are semi-permanent saline wetlands. There are also small numbers of deep freshwater marshes (2.5%) and permanent open freshwater wetlands (7.5%). Figure 5 shows the location and type of wetlands in the Northern Wimmera Plains.

Figure 5: Map of Northern Wimmera Plains wetlands, showing the location and categories of wetlands.



The 81 semi-permanent saline wetlands are found west of the Wimmera River in the low-lying river trench where saline groundwater intersects with the ground surface. There are also some saline wetlands further north to the east of the Wimmera River between Lake Hindmarsh and Lake Albacutya. There is very little recorded evidence about the conservation values of these wetlands.

However, they include Pink Lake which has recognised high conservation value through its listing on the National Directory of Important Wetlands. Pink Lake has been recognised as it is a good example of a wetland type occurring within a biogeographic region in Australia. It also supports two waterbirds that are listed under migratory waterbird conservation agreements that Australia has with Japan and China, the Sharp-tailed Sandpiper and Red-necked Stint. *Flora and Fauna Guarantee Act* listed species have also been recorded, including the Bottle Bluebush, Six-point Arrow-grass and Fused Glasswort.

Some of these saline wetlands contain gypsum and some minor mining operations have occurred at some wetlands however this is not widespread.

The north west of the region that lies between the Big and Little Desert National Parks west of the Wimmera River trench contains roughly 160 wetlands, predominantly shallow freshwater marshes as well as some freshwater meadows and a small number of deeper lakes. Some of these form "chains of wetlands" that lie within the swales of the Parilla dune-swale system that continues north of the Little Desert.

Approximately 80 wetlands lie east of the Wimmera River within Yarriambiack shire and surrounding area. Again, these are predominantly shallow seasonal freshwater wetlands with a small number of deeper lakes.

Numerous threatened and endangered species have been recorded in the region, including the Brown Toadlet, Southern Toadlet, Growling Grass Frog, Brolga, Musk Duck, Hardhead Duck, Blue-Billed Duck, Freckled Duck, Royal Spoonbill and Australasian Shoveler.

This region is heavily cropped and we would expect ongoing loss of wetlands to be low as the landscape has already been heavily cleared of native vegetation and we expect that very little active land use change that would impact on wetlands is occurring.

Terminal Lakes of the Wimmera River

The Terminal Lakes System of the Wimmera River comprises a series of large ephemeral lakes in the lower reaches of the Wimmera River in the central north of the Wimmera region downstream of Jeparit.

Flows of the Wimmera River terminate in the lake system, commencing with Lake Hindmarsh. During exceptionally wet periods, Lake Hindmarsh fills and overflows via Outlet Creek to Lake Albacutya (Figure 6). Downstream of Lake Albacutya, Outlet Creek enters the Wyperfeld National Park and passes through a mosaic of interconnected wetlands, including Lake Brambruk and Lake Agnes.

Ross Lakes is also part of the system. It is a large wetland area on the floodplain of Outlet Creek located between Lake Hindmarsh and Lake Albacutya. It is flooded by overbank flows from Outlet Creek.

Flow only reaches the Wirrengren Plain at the terminus of the system during rare, extremely wet instances. Lake Wirrengren has not flooded since 1874 and Lake Agnes has not been flooded since 1918 (Ecological Associates, 2004). Lake Albacutya was last full in 1982 and received minor inflows in 1996. Lake Hindmarsh was last full in 1996, received minor inflows in 2009 and is currently receiving inflow from flooding flows in the Wimmera River in 2010.

Lake Brambruk, Lake Agnes and the Wirrengren Plain are outside the Wimmera CMA region and consequently are not dealt with here.

Lakes Hindmarsh and Albacutya and Outlet Creek have very high conservation significance and, when filled, support exceptional diversity. Collectively, Lakes Hindmarsh and Albacutya cover an area of almost 20,000 hectares. When flooded, the lakes and their connecting channels become major aquatic ecosystems, retaining water for several years and supporting significant breeding bird and fish populations with extensive aquatic plant communities. The lakes also supported a substantial commercial and recreational fishing and yabbying industry.

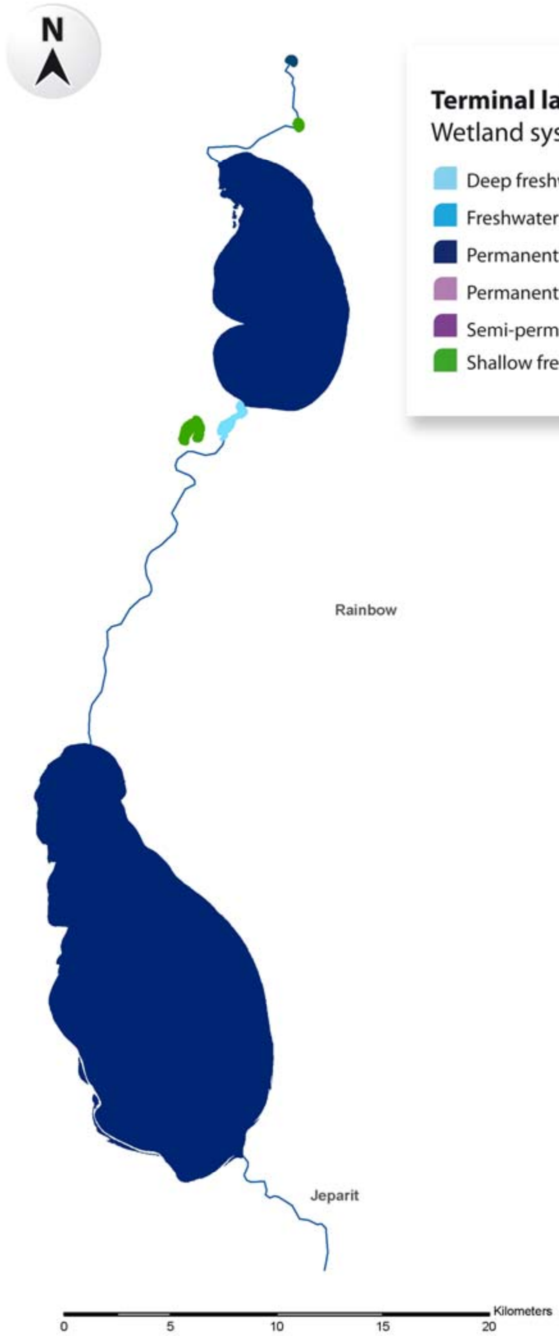
The centre of the flooded lakes provides deep, open water habitat for large fish including Murray Cod, Freshwater Catfish and Golden Perch and birds such as Australian Pelican, Pied Cormorants and Black Swans. The shallow muddy environment created by rising and receding lake levels provides important habitat for wading birds such as Spoonbills, Terns, Avocets, Masked Lapwing, Whiskered Tern and many migratory species. The shallower outer lake also provides habitat for small fish such as Flathead Gudgeon and Australian Smelt and waterbirds such as Australian Shelduck, Darter, Coot, Crake and Pacific Black Duck.

When dry, the lake beds assume many of the characteristics of terrestrial ecosystems, supporting grasslands and terrestrial vertebrate fauna such as the Western Grey Kangaroo, Emu, Bustard, Gilbert’s Whistler and Bush Thick-Knee.

The lake fringes support red gum and black box woodlands and the eastern-lying dunes support Slender Cypress-Pine woodlands. Fringing trees and other shrubby plants like Lignum provide nesting and roosting sites for waterbirds such as the Nankeen Night-heron, Egrets, Ibis, Cormorants, Black Duck and Wood Duck. Particularly at Lake Albacutya which is well-connected to surrounding vegetation in the landscape, the fringing vegetation also provides habitat for terrestrial Mallee fauna such as the Regent Parrot, Mallee Ringneck, Barking Owl, Magpie-Lark, White-Winged Chough, Major Mitchell’s Cockatoo, Chocolate Wattled Bat, Marbled Gecko and Carnaby’s Skink. Lake Hindmarsh has weaker linkages to terrestrial habitat because most of the surrounding Mallee landscape has been cleared.

Lake Albacutya is recognised internationally under the Ramsar Convention as a wetland of international significance. Under the Ramsar Convention, Australia has an obligation to maintain the ecological character of Lake Albacutya at its time of listing in 1982. Lake Albacutya is a large ephemeral freshwater lake which, when full, covers an area of 5,800 hectares, has a depth of 8 metres and stores 230 gigalitres.

Figure 6: Map of the Terminal Lakes of the Wimmera River, showing the location and categories of wetlands.



Lake Albacutya and Lake Hindmarsh have high conservation significance and share the following environmental values:

- Are Wetlands of National Importance because they:
    - Are good examples of wetland types occurring within a biogeographic region in Australia;
    - Play an important ecological or hydrological role in the natural functioning of a major wetland system/complex; and
    - Are important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail.
    - Lake Albacutya also supports 1% or more of the national populations of native plant or animal taxa.
    - Lake Hindmarsh also has outstanding historical or cultural significance.

- Are part of the Wimmera Heritage River;
- Contribute to the habitat corridor along the Wimmera River between Wyperfeld National Park and the Little Desert National Park to the south;
- Provide habitat for migratory waterbirds protected under international treaties, including the Japan Australian Migratory Bird Agreement (JAMBA), Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) and China Australia Migratory Bird Agreement (CAMBA);
- Support high waterbird diversity, with over 40 and 50 waterbirds reported at Lakes Albacutya and Hindmarsh respectively;
- Are important waterbird breeding sites, with nine waterbird species reported to breed in significant numbers;

Lake Albacutya has the following additional values:

- Is a wetland of international significance under the Ramsar Convention because:
    - It contains a rare, representative or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region;
    - It supports populations of plant and / or animal species important for maintaining the biological diversity of a particular biogeographic region;
    - It regularly supports 20,000 or more waterbirds;
    - It regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.
- Is listed on the Register of the National Estate;
- Has a high carrying capacity for waterbirds with 10 species reported to visit in significant numbers, including up to 10% of the Victorian population of the rare Freckled Duck;
- Supports other rare fauna including Regent Parrot, Common Dunnart, Tree Goanna, Freshwater Catfish and Mitchell's Hopping Mouse.

Lake Hindmarsh has the following additional values:

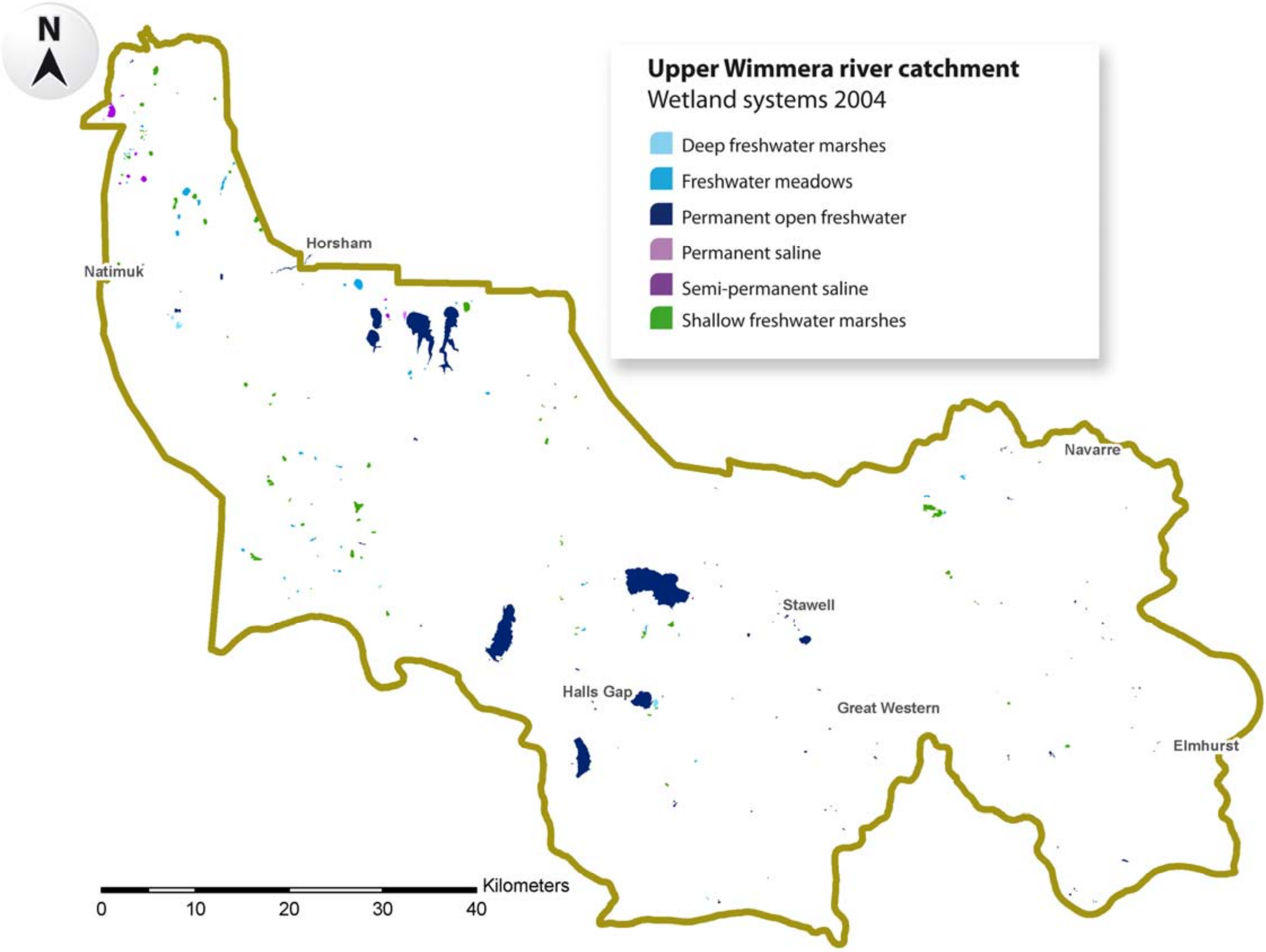
- Is Victoria's largest natural freshwater body, covering over 13,500ha. It reaches a depth of 3.4 metres and stores 378 gigalitres;
- Provides habitat for bush birds of conservation significance including the Bush Thicknee, Mallee Ringneck, Bush Stonecurlew and Gilbert's whistler which use the northern end of the lake;
- Is one of the few breeding habitats in Victoria for the Australian Pelican and Pied Cormorant;
- Provides habitat for plants and animals of conservation significance, including Salt Paperbark communities and the Golden-Rayed Blue Butterfly.

2.1.4. Upper Wimmera River Catchment Wetlands

There are 245 wetlands in the Upper Wimmera River Catchment covering an area of just over 7,000 hectares (figure 7). The most strongly represented wetland types are permanent open freshwater (37%), shallow freshwater marshes (33%) and freshwater meadows (20%). There are also a very small number of deep freshwater marshes (3%) and semi-permanent saline wetlands (4%).

Wetlands range in size from less than one hectare to the larger water storages that are generally more than 200 hectares in area. Lake Lonsdale is the largest, covering an area of 1,700 hectares.

Figure 7: Map of Upper Wimmera River Catchment wetlands, showing the location and categories of wetlands.



This sub-region includes the upper catchment of the Wimmera River. Consequently, the region's major water storages are found here, including Lake Bellfield, Lake Wartook and Taylor's Lake. A high proportion of wetlands are associated with rivers, either located in a floodplain or connected to a stream channel where they would fill from stream flow and then overflow to a downstream channel. There are also numerous non-riverine shallow freshwater wetlands, particularly on the fringes of the Grampians National Park.

Threatened and Endangered birds have been recorded in the area, including the Australasian Shoveler, Hardhead duck, Musk Duck, Glossy Ibis, Brolga, Great Egret, Freckled Duck and Royal Spoonbill.

Many wetlands have high economic value to the region because of the role they play in storing water for urban and rural water supplies. Many wetlands also have very high social value by providing a source of recreational water for popular activities for the regional community like fishing, skiing, swimming, camping, sailing and yabbying. These lakes also attract tourists to the region when full of water.

2.2. Social and Cultural Values of Wimmera wetlands

The previous sections have provided an overview of the various environmental values of the different wetland systems and sub-regions.

Wimmera wetlands also have significant social, economic and cultural value. They provide important recreational areas for the local and regional community and attract tourists for activities like water-skiing, fishing, yabbying, music events and festivals, camping, duck shooting, bird watching and swimming.

Studies over the past ten years have gathered information relating to how the West Wimmera community values wetlands. One study found that the natural aspects of wetlands, including the birds, wildlife and vegetation, were the most highly valued attributes. Other valued services provided by wetlands included recreational opportunities including fishing, water sports and duck shooting; water supply; visual amenity and stock feed through grazing (Petheram, J. et al., 1999).

A second study (Sinclair Knight Merz, 2005) found that every landholder interviewed expressed a sense of pride and ownership in the natural beauty of wetlands, particularly the native birds they attract and the gum trees. Some landholders held these values so strongly that they had located their houses near their favourite wetlands, and many respondents highlighted the sense of well being and family enjoyment that wetlands provide.

Agricultural production services provided by wetlands were also emphasised by graziers, including the high value of ‘green pick’ in and surrounding wetland areas, which has particular herd nutrition and digestion benefits that are not readily available from other areas during dry periods. Wooded wetlands also provide protection for sheep at critical times including immediately after shearing and lambing.

Wimmera wetlands are places of cultural value, especially to Aboriginal communities. Of all the Wimmera landscapes, Aboriginal people consider wetlands the most important. This is because wetlands provided most of the natural and cultural resources required to sustain a vibrant and healthy traditional lifestyle. For example, wetlands provided a water resource and large trees like red gums which Aboriginal communities used to build canoes, shelters, shields, containers and campfires.

Work by Beth Gott (2006) has found that: “In the southern parts of Australia, roots (applying that word to all underground plant parts) were the most important foods. Like the Maoris of New Zealand, the Australians used the long roots (rhizomes) of Bracken Fern, (Pteridium esculentum) from which they chewed or beat out a sticky starch. There are many native lilies with small tuberous roots which were collected for food Early Nancy (Wurmbea dioica), Chocolate Lily (Dichopogon strictus) and Milkmaids (Burchardia umbellata) for example. Murnong or Yam-daisy (Microseris lanceolata) was a plentiful and favourite food. Along the Murray-Darling river system, cumbungi or Bulrush (Typha spp.) provided much nourishment, as did Water Ribbons (Triglochin procera), and Marsh Club-rush (Bolboschoenus medianus), which has hard walnut-sized tubers.

Plants were used for many other things besides food. The long leaves of sedges, rushes and lilies were collected to make baskets and mats, and soaked and beaten to free the fibres to make string. The bark of trees made buckets, dishes and shields; River Red-gum bark was particularly good for making canoes, and old scarred 'canoe trees' can still be seen.”

3. Current condition and trend of wetland condition

This section summarises the research and data that tells us about the current condition of wetlands in the Wimmera and the trend in condition.

3.1. Condition Summary

In summary, assessments of the condition or health of small samples of wetlands in 2005 and 2009 found the majority of wetlands assessed were in moderate, good or excellent condition. Breaking this down, wetland soils, hydrology and physical form were found to be in good condition for the majority of wetlands assessed. The condition of biota, or vegetation, varied with a large proportion of wetlands in moderate condition. The wetland catchment of 61% of assessed wetlands was found to be in poor to very poor condition, indicating poor "buffer areas" immediately surrounding the wetlands and potential impacts from neighbouring land.

An analysis of change in wetland extent and modifications to wetlands between the late 1970s and 2004 (SKM, 2006) found that:

- More than half (57%) of Wimmera wetlands are modified by dams, drains, banks and/or crops.
- Four hundred and seventy-four wetlands or 18% of wetlands were lost between the late 1970s and 2004 because they have been modified to the extent that they are no longer functioning as wetlands. For example, they may have been drained so that they no longer retain water and/or may be heavily cropped.
- All wetland types have been modified to some extent. Freshwater meadows are the most impacted and saline wetlands least impacted.
- Freshwater meadows face the highest threat of being heavily modified and degraded by human activities. Most (81%) of the wetlands lost are freshwater meadows. In addition, at least 67% of wetlands in this category have been modified by dams, drains, banks and/or crops. Condition assessments of small samples of wetlands in 2005 and 2009 found a higher proportion of freshwater meadows in poor to very poor condition than any other wetland type.

3.2. Current Condition

Wetland condition assessments were completed for approximately 70 wetlands in 2005 and again in 2009 using two different non-comparable assessment methods. Both sets of results found the majority of wetlands to be in moderate, good or excellent condition. Results are summarised below and in Figures 8 and 9.

Most of the assessments were in the south west Wimmera, however there were also a small number in the north west Wimmera. Figure 9 shows the locations and results.

Due to the small number of wetlands assessed, the results may not be indicative of the overall condition of wetlands in the Wimmera. Assessors were refused access to some sites on private land and this is likely to have had an impact on the overall quality score of the wetlands assessed as wetlands on public land are generally subject to less threat. Consequently, there is a chance that scores are biased towards wetlands in better condition.

Overall Condition Results:

- Most wetlands were in moderate, good or excellent condition. Wetlands on Crown land were in slightly better condition than private land.

Sub-Indice Results:

- In 2009, the physical form, soils, hydrology and water properties of most wetlands were in excellent condition.
- The biota (vegetation) of just over half of assessed wetlands was in good or excellent condition, with wetlands on Crown land scoring slightly higher than private land.
- A higher proportion of soils on private land (17%) rated as poor to very poor compared to 3% on Crown land.
- The wetland catchment of 61% of assessed wetlands was found to be in poor to very poor condition. This was consistent across Crown and private land and indicates poor "buffer areas" immediately surrounding the wetlands and potential impacts from neighbouring land.

- In 2005, the hydrology, geomorphology (or physical form), riparian vegetation and wetland vegetation for most wetlands was found to be in moderate, good or excellent condition.
- Most wetlands (77%) were found to have a surrounding landscape that scored as being in good or excellent condition. This contrasts with the poorer wetland catchment rating in 2009, probably because of scoring differences in the assessment methods.

Figure 8: Wetland condition assessment overall results, 2009 and 2005

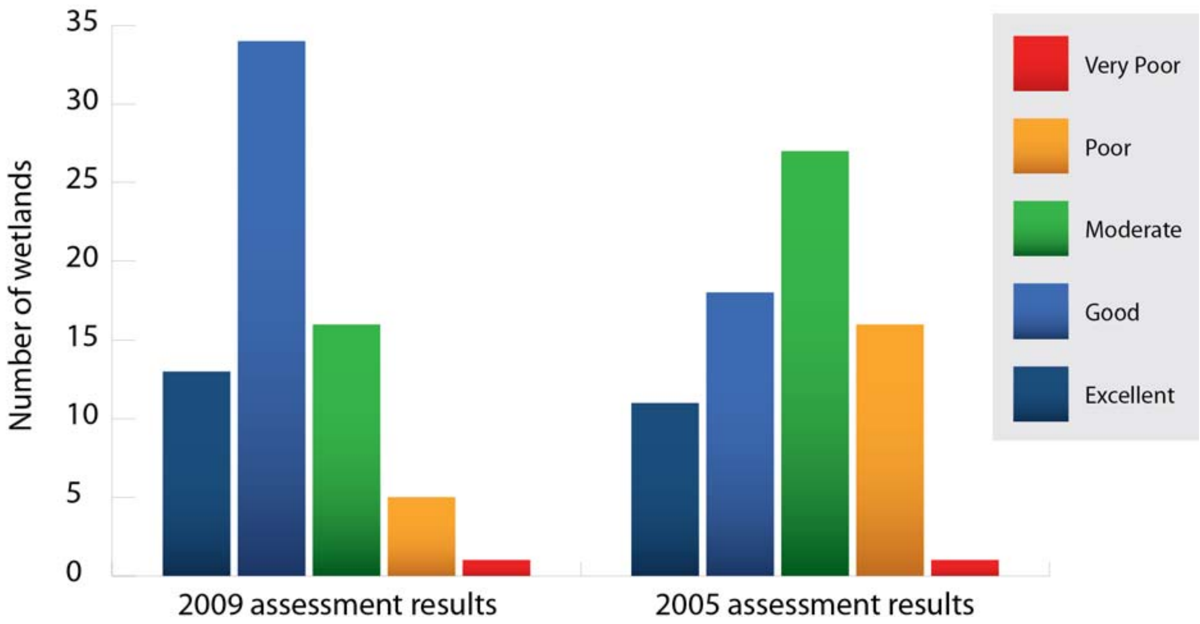
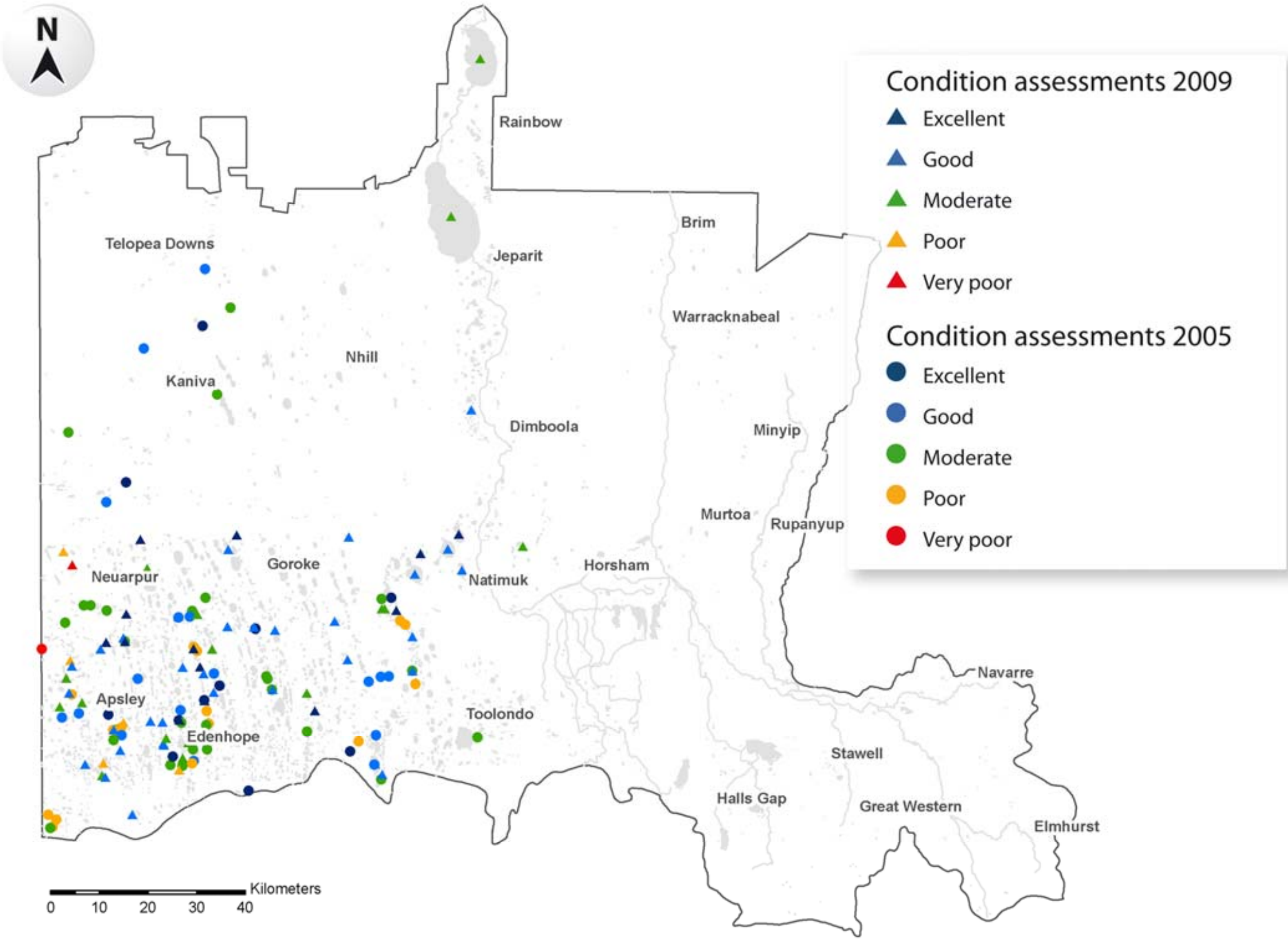


Figure 9: Results of the Wimmera Wetland Condition Assessment 2005 and Index of Wetland Condition Assessment 2009



Results for the Different Wetland Types:

- In 2009, all shallow freshwater marshes, permanent open freshwater, semi-permanent saline and permanent saline wetlands were assessed as in moderate, good or excellent condition.
- Deep freshwater marshes were good or moderate with only one wetland assessed as poor.
- 84% of the freshwater meadows assessed were in moderate to excellent condition. Freshwater meadows were the only wetland type to score as in poor to very poor condition, (with the exception of one deep freshwater marsh). However, a much higher number of freshwater meadows (31) was assessed compared to other wetland types.

Condition of wetlands with recognised conservation value:

- 12 wetlands were assessed that are listed on the Directory of Important Wetlands in Australia. One of these, Lake Albacutya, is also a Ramsar wetland.
- Most wetlands rated as good (7), with 2 excellent and 3 moderate.
- All wetlands had physical form and soils that are in excellent condition.
- The biota at most wetlands was good or excellent, with 3 rating as poor to very poor.
- The wetland catchment again had the worst ratings, with 3 wetlands rating as moderate and 6 poor to very poor.
- Lake Hindmarsh and Lake Albacutya have very poor hydrology as a result of over-extraction from their major water source, the Wimmera River, combined with prolonged drought.

Geographic trends in condition:

- There are no notable geographic trends in condition scores.

Appendix 2 includes further detail, including graphs and data relating to the condition assessment results.

3.3. Wetland loss and modification over time

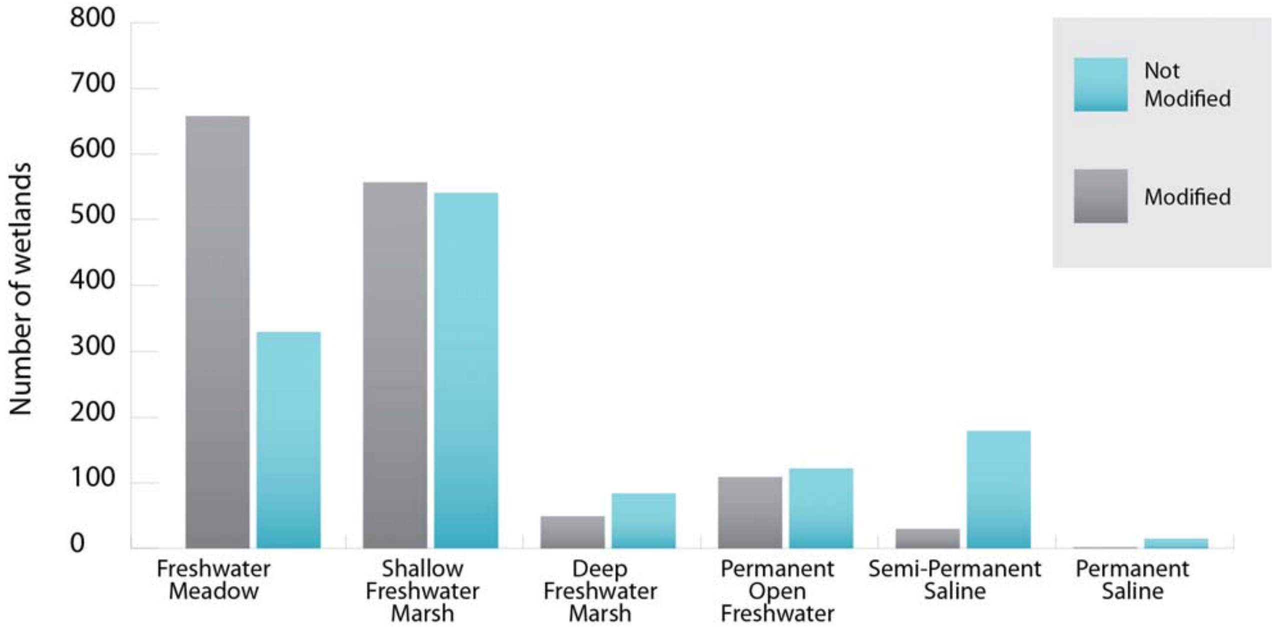
Mapping of the type and extent of wetlands greater than one hectare in size has been undertaken twice in the Wimmera. The first dataset was mapped using late 1970s / early 1980s (Department of Natural Resources and Environment, 1994) black and white aerial photography. The second dataset used 2004 aerial photography and digital elevation modelling (Sinclair Knight Merz, 2006).

A comparison of wetlands from the two datasets has revealed that human intervention has had a significant effect on the health of wetlands.

Key findings include:

- In 2004, around 18% of wetlands had been lost, meaning they have been modified to the extent that they are no longer functioning as wetlands. This indicates a potential loss of 474 wetlands over the 22-26 years since the late 1970s-early 1980s as a result of modification by agricultural activity, including dam construction within the wetland, cropping and draining. This equates to an average loss rate of about 20 wetlands per year.
- Freshwater Meadows are the most commonly lost wetland type, with 81% of the wetlands lost falling into this category. An additional 11% were shallow freshwater marshes. This indicates that shallow seasonal wetlands are most vulnerable to modification by activities like dam, drain, bank and road construction and cropping.
- Overall, 56% of wetlands region-wide were found to be modified in some way. The most common modification was the creation of a farm dam in part of the natural extent of the wetland.
- Freshwater wetlands are the most modified, with 67% impacted by a dam, drain, bank or crop. About 50% of shallow freshwater marshes and permanent open freshwater wetlands and 37% of deep freshwater marshes are modified. Figure 10 shows the number of wetlands in each type that were recorded as modified.
- Saline wetlands are the least affected wetland type, with only 14% of semi-permanent saline wetlands affected and 12% of permanent saline wetlands.

Figure 10: Number of wetlands in each wetland type modified by dams, drains, banks and/or crops in 2004.



Wetland modified by a dam/drain.

Threats impacting on wetland condition

This section describes the threats impacting on wetlands and constraining the ability to achieve desired condition.

The majority of processes threatening the condition of Wimmera wetlands arise because most wetlands are located within an agricultural landscape. More than 90 percent of Wimmera wetlands are on private land and individual landowners often have numerous wetlands on their properties. This presents challenges in striking a balance between agricultural production and wetland conservation.

Table 4 summarises the main threats impacting on Wimmera wetlands and whether they pose a high, moderate or low threat to wetland condition. The threat ratings are based on research, GIS data analysis, expert and local opinion and field observations. Appendix 3 includes more details of the rationale and evidence for the threat ratings assigned in table 4. The text below describes the listed threats in greater detail.

Table 4: Threats impacting on the condition of different wetland types.

	Freshwater Meadows	Shallow Freshwater Marshes	Deep Freshwater Marshes	Permanent Open Freshwater	Semi-Permanent Saline	Permanent Saline
Cropping	High	High	Low	Low	Low	Low
Neighbouring land use	High	High	High	High	High	High
Changed hydrology (dam, drain, bank)	High	High	Moderate	Moderate	Low	Low
Grazing by stock	Moderate	Moderate	Moderate	Moderate	Low	Low
Declining groundwater levels	Low	Low	Low	Low	Moderate	Moderate
Climate change	High	High	High	High	High	High

Anecdotally speaking, wetlands are highly resilient ecosystems that recover well over relatively short periods once threats like grazing or weeds are removed and natural hydrology is restored. However, this depends on the length of time and intensity with which a wetland has been modified or degraded. In some instances, wetland biota may be simplified, and unable to recover in the short term because some plant or animal species have been lost. Wetlands have also been observed to recover from cropping, although again this depends on the intensity of cropping.

3.4. Cropping

3.4.1. Summary

Cropping poses a high threat to shallow seasonal wetlands in the Wimmera. The proportion of shallow seasonal wetlands cropped is of concern, particularly with anecdotal evidence of a growing trend to more land being cropped in the south west Wimmera through the recent dry years. A return to wet years may slow this trend.

Table 5: Extent and trend of impact of cropping for each category of wetland

	Freshwater Meadows	Shallow Freshwater Marshes	Deep Freshwater Marshes	Permanent Open Freshwater	Semi-Permanent Saline	Permanent Saline
Current Impact	High	High	Low	Low	Low	Low
Trend	Getting Worse	Getting Worse	Getting Worse	Getting Worse	Getting Worse	Stable
Data confidence	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

3.4.2. Potential impact on wetlands

Cropping can have a significant impact on the condition of wetland ecosystems by disturbing the soil and seedbank, altering soil composition and contributing fertiliser nutrients and pesticide chemicals. This can impact on wetland health by degrading the seeds and tuber roots of wetland plants and the eggs of frogs and small insects stored in the soil, impacting on their ability to flourish on the return of water to the wetland. The magnitude of the impact on wetland health and the wetland's ability to recover are likely to vary according to the nature, intensity and duration of cropping.

3.4.3. Extent of the threat

A study of 2004 aerial photography found that 13% of wetlands comprising 399 individual wetlands were cropped across the Wimmera. Most of these were shallow seasonal freshwater wetlands, including 246 freshwater meadows and 123 shallow freshwater marshes (SKM, 2006). There was very little cropping of saline and deep freshwater wetlands recorded. Table 6 shows the number and percentage of each wetland category cropped in 2004.

Table 6: Number and percentage of wetlands cropped in 2004

Wetland Category	Number of wetlands cropped, 2004	% of wetland category cropped
Freshwater Meadow	246	18%
Shallow Freshwater Marsh	123	11%
Deep Freshwater Marsh	7	5%
Permanent Open Freshwater	6	3%
Semi-Permanent Saline	17	8%
Permanent Saline	0	0%
Total	399	13%

3.4.4. Trend in the magnitude of the threat

Observation and anecdotal evidence strongly suggests that cropping has substantially increased in the south west Wimmera since 2004 and that there has been a corresponding increase in the number of wetlands cropped. However, the exact number and area of wetlands cropped in the Wimmera has not been quantified since 2004.

Cropping has long been wide spread in the northern Wimmera and cropping of wetlands in this area is reasonably stable. In contrast, the predominant farming practice in the south west Wimmera has traditionally been sheep grazing due to the higher average rainfall and clay soils causing paddocks to generally be too wet to crop in most years. The prolonged drought over the last decade has seen dryland cropping move into higher rainfall areas previously used as pasture.

Late 2010 and the beginning of 2011 have seen a return to higher rainfall and the majority of wetlands in the south west Wimmera are full or holding some water. It is currently unknown what impact this will have on cropping of shallow wetlands. If wet years continue, it may certainly slow this trend as wetland areas will be too wet to viably crop. Alternatively, there is a risk of degradation to wetlands through alterations to drainage that make paddocks viable for cropping.

3.5. Neighbouring Land Use

3.5.1. Summary

Most Wimmera wetlands lie within agricultural land uses, primarily grazing and dryland cropping. There is also localised irrigated cropping and a handful of intensive cattle feedlots and piggeries. Urban and some industrial land uses are present around the region's towns. Sixty-one percent of wetlands assessed in 2009 as part of the Index of Wetland Condition Assessments were found to have a wetland catchment in poor to very poor condition.

Table 7: Extent and trend of impact of neighbouring land use for each category of wetland

	Freshwater Meadows	Shallow Freshwater Marshes	Deep Freshwater Marshes	Permanent Open Freshwater	Semi-Permanent Saline	Permanent Saline
Current Impact	High	High	High	High	High	High
Trend	Stable	Stable	Stable	Stable	Stable	Stable
Data confidence	Good	Good	Good	Good	Good	Good

3.5.2. Potential impact on wetlands

Land neighbouring wetlands can sometimes impact negatively on wetland health, particularly where agricultural, industrial or urban land uses have the potential to contaminate rainfall runoff entering wetlands. Neighbouring land can have a very small or very large impact on a wetland. The severity of impact depends on many factors such as the type of land use, ground slope, soil type, vegetation present and distance from the wetland. Impacts typically arise where there is an inadequate "buffering" area of land between the neighbouring land use and the wetland. Impacts can include contamination from nutrients, sediment, chemicals and other contaminants carried in rainfall runoff or spray drift and encroachment of weeds including non-native pasture grasses. This can in turn lead to poor water quality, excessive algal blooms and degraded habitat for wetland plants and animals. We expect that impacts are higher for cropped areas compared to grazed land due to the greater nutrient and chemical input requirements generally applied to crops.

3.5.3. Extent of the threat

The vast majority of Wimmera wetlands are surrounded by or lie within agricultural land uses such as grazing and dryland cropping. Irrigated cropping also occurs mainly in the far west of the Wimmera. There are a handful of intensive feedlots, including cattle feedlots and piggeries in the west Wimmera on or neighbouring properties containing wetlands. Urban and some industrial land uses are present around the region's towns with the potential to impact on the water quality of a small number of co-located wetlands through rainfall runoff.

Many wetlands do not have an adequate riparian zone to "buffer" them from neighbouring land use, both in terms of width and native vegetation cover. More than half (61%) of wetlands assessed in 2009 as part of the Index of Wetland Condition Assessments were found to have a wetland catchment in poor to very poor condition.

As a general rule of thumb, research shows that a 20 to 50 metre buffer is essential for maintaining ecological processes and major wetland food-webs, while also effectively filtering runoff from neighbouring land. A wider (100 to 200 metre) buffer area may be needed if the neighbouring land use has the potential to have a big impact on water quality, such as intensive farming like piggeries and feedlots (State of Victoria Department of Sustainability and Environment, 2005).

3.5.4. Trend in the magnitude of the threat

We expect that the extent of this threat has not changed significantly in terms of the numbers and area of wetlands affected. However, with increased cropping in the south west Wimmera, there is the potential that impacts on wetlands neighbouring cropped areas to be greater than when they were grazed.

3.6. Changed wetland hydrology – human activities

3.6.1. Summary

In 2004, the hydrology of almost 2000 (61%) Wimmera wetlands was altered by a dam, drain or bank. All freshwater wetland types were considerably affected, while saline wetlands had little modification. Anecdotally, it is unlikely that there has been a significant increase in new dams, drains and banks being installed since the 2004 assessment. Although, it is possible that there has been additional drainage works constructed to reclaim wet areas for cropping. However, this has not been assessed since 2004.

Table 8: Extent and trend of impact of changed wetland hydrology by human activities for each category of wetland

	Freshwater Meadows	Shallow Freshwater Marshes	Deep Freshwater Marshes	Permanent Open Freshwater	Semi-Permanent Saline	Permanent Saline
Current Impact	High	High	Moderate	Moderate	Low	Low
Trend	Stable	Stable	Stable	Stable	Stable	Stable
Data confidence	Good	Good	Good	Good	Good	Good

3.6.2. Potential impact on wetlands

Human modifications to wetland hydrology such as dams, drains and banks impact on wetland watering regimes by changing the natural timing, duration and extent of flooding. For example, they may divert drainage away from wetlands to reclaim land for agriculture, or deepen wetlands so that they hold more water for longer periods.

Changing the hydrology of a wetland affects the wetland’s normal ecological functioning and can impact on the ability of plants and animals to survive there under the changed conditions. Modifications to hydrology can sometimes be so great that the wetland can cease to function as a wetland, for example where water is permanently removed from a wetland by drains or banks.

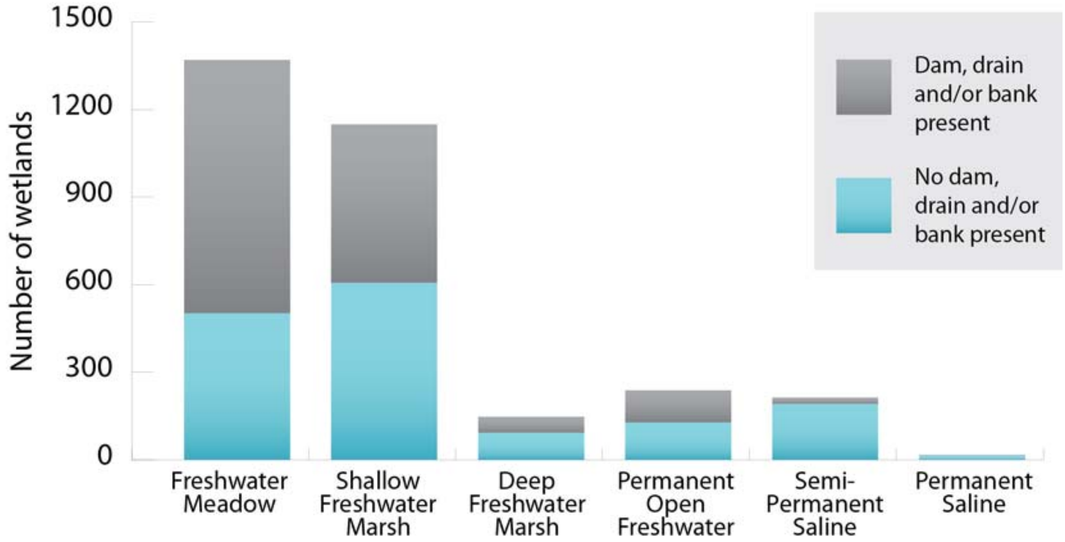
It is likely that many species will recover if hydrology is restored, however some are also likely to be lost and unable to recover.

3.6.3. Extent of the threat

In 2004, 61% or 1,914 Wimmera wetlands were recorded as having a dam, drain, bank or combination of these present (SKM, 2006). Figure 11 shows that all freshwater wetland types were considerably affected, with 63% of freshwater meadows modified, almost half of shallow freshwater marshes and permanent open freshwater wetlands affected and just less than 40% of deep freshwater marshes modified. Saline wetlands were less affected, with about 11% semi-permanent saline and permanent saline wetlands modified.

Laser levelling or land planeing of Gilgai or “crab hole” country also has impacts on the wetland values in these areas, impacting on their ability to hold and filter water and destroying vegetation.

Figure 11: Number of each wetland type with a dam, drain and/or bank in 2004



3.6.4. Trend in the magnitude of the threat

Anecdotally, it is unlikely that there has been a significant increase in new dams, drains and banks being installed since the 2004 assessment. However, this has not been analysed and quantified. Cropping has increased since 2004 with paddocks containing wetlands dry enough to crop as a result of a series of drought years. It is possible that there has been additional small-scale drainage works constructed to reclaim wet areas for cropping. It is possible that a return to wetter conditions in 2010-11 could lead to further changes to drainage in areas that have recently been converted to cropping.

It is unlikely that the number of dams has substantially increased since 2004 as many farmers now use the more reliable groundwater resources of the west Wimmera or the Wimmera-Mallee Pipeline for stock and domestic purposes.

Grazing by Stock

3.6.5. Summary

Wetlands on private land are commonly grazed. Wetland grazing practices vary from property to property and also from wetland to wetland within individual properties. It is difficult to get a precise picture of the extent, intensity and impact of wetland grazing. Based on field observation and anecdotal evidence, we assume that grazing is a moderate threat to freshwater wetlands and low threat to saline wetlands that typically have less palatable vegetation.

Table 9: Extent and trend of impact of grazing by stock for each category of wetland

	Freshwater Meadows	Shallow Freshwater Marshes	Deep Freshwater Marshes	Permanent Open Freshwater	Semi-Permanent Saline	Permanent Saline
Current Impact	Moderate	Moderate	Moderate	Moderate	Low	Low
Trend	Stable	Stable	Stable	Stable	Stable	Stable
Data confidence	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

3.6.6. Potential impact on wetlands

The impact of grazing on wetland health depends on the timing, intensity and frequency of grazing and also the grazing animal. Arguably, well-managed grazing can be beneficial for the vegetation at some types of wetlands, particularly grassy vegetation at seasonal shallow freshwater wetlands. This is because well-timed and light grazing can cause a disturbance that promotes diversity of those plant types. Grazing can also prevent introduced pasture grasses like phalaris from becoming dominant and outcompeting native species.

Conversely, wetland health can be degraded by over-grazing and poorly-timed grazing. Stock can have a range of impacts, including destroying wetland and riparian vegetation, contributing nutrients from manure, disturbing breeding birds and frogs, introducing weeds and damaging soil by pugging, compaction and erosion. Grazing during wet periods can result in significant pugging. Impacts on vegetation range from complete removal of vegetation to reduced cover and decreased species composition.

Arguably, sheep tend to cause less impact than larger animals like cattle and horses. Unlike cattle, sheep tend to avoid damp areas and are much less likely to cause soil damage through pugging and compaction or to graze on aquatic plants growing in the water. However, sheep will preferentially graze some wetland species such as swamp billy-buttons.

3.6.7. Extent of the threat

Wetlands on private land are commonly grazed. The number of wetlands grazed and the intensity of grazing regime for those that are grazed is difficult to ascertain.

A 2005 survey of west Wimmera landholders found that “many interviewees value the option of being able to graze their wetlands” (SKM, 2005). A 2008 survey of Wimmera rural landholders found that 67% of respondents run sheep. This figure is higher in the south west Wimmera, with 84% of respondents indicating that they have sheep. Beef cattle are farmed by 16% of respondents across the Wimmera and 8% indicated that they have other livestock including goats, deer and horses (Curtis et al, 2008). It is unclear how this relates to grazing of wetlands, however more than 90% of Wimmera wetlands are on private land where agriculture is the predominant land use.

Based on observations of CMA staff and discussions with landholders, many wetlands on agricultural land are grazed, however the grazing regime varies considerably from paddock to paddock. Consequently, we assume that grazing is a moderate threat to freshwater wetlands and low threat to saline wetlands that typically have less palatable vegetation.

3.6.8. Trend in the magnitude of the threat

We also assume that the threat of wetland grazing is relatively stable.

3.7. Declining groundwater levels

3.7.1. Summary

Groundwater levels in the saline Parilla Sands Aquifer have declined by one to five metres in some parts of the region since the early 1990s. This has the potential to impact on the hydrology and water quality of saline groundwater-fed wetlands in the Natimuk-Douglas saline wetland system, around Edenhope and south of Wombelano. Freshwater wetlands are typically not groundwater-fed and thus are unaffected by this threat.

Table 10: Extent and trend of impact of declining groundwater levels for each category of wetland

	Freshwater Meadows	Shallow Freshwater Marshes	Deep Freshwater Marshes	Permanent Open Freshwater	Semi-Permanent Saline	Permanent Saline
Current Impact	Low	Low	Low	Low	Moderate	Moderate
Trend	Stable	Stable	Stable	Stable	Getting Worse	Getting Worse
Data confidence	Good	Good	Good	Good	Good	Good

3.7.2. Potential impact on wetlands

Declining groundwater levels can impact on groundwater-fed wetlands by changing the wetland's hydrology, or decreasing the natural timing, duration and extent of flooding. This will affect the wetland's normal ecological functioning and can impact on the ability of plants and animals to survive there under the changed conditions.

This threat has the potential to impact on saline groundwater dependent wetlands, predominantly the region's permanent and semi-permanent saline wetlands located in the Natimuk-Douglas saline wetland system, Wimmera River trench north of Dimboola and around Edenhope and south of Wombelano. These systems rely on inflows from saline groundwater, principally the region's Parilla Sands aquifer (SKM, 2006b). Groundwater interactions are believed to be particularly important to water quality and hydrology (Ecological Associates, 2009).

In contrast, the majority of the region's freshwater wetlands lie above the water table and are fed by rainfall runoff or river inflows (SKM, 2006b). There is no known threat to these wetlands from declining groundwater levels.

3.7.3. Extent of the threat

Levels in the Parilla Sands Aquifer fell by one to five metres in the south-west, south and east of the region since the early 1990s, most likely due to reduced rainfall recharge. Groundwater levels fell two to three metres near Neuarpur and Apsley where extraction from the overlying freshwater aquifer is concentrated (Ecological Associates, 2009). There is no information regarding the impacts of this on the health of the saline wetlands affected.

The use of groundwater from the freshwater Murray Limestone Group aquifer for centre-pivot irrigation has seen groundwater levels substantially decrease over the past ten years in the western Wimmera. This is particularly the case in the far west of the region around Neuarpur and Apsley. In the decade ending in 2004, over 8,500 Ha of the southwest Wimmera was put under centre-pivot irrigation, equating to 170 centre-pivots averaging 50 hectares each (Maron et al 2008).

Current data suggests that extraction from the freshwater Murray Limestone aquifer is unlikely to be having an impact on the groundwater-dependent wetlands located around Edenhope and in the Douglas Depression. This aquifer is not known to provide a water source for many wetlands, although it may supply a small number of permanent freshwater springs in the far west of the region. The groundwater dependent wetlands are fed from the saline Parilla Sands Aquifer. The nature of interaction between the two aquifers is uncertain and further research would be required to determine the extent, nature and likelihood of future impacts of water extraction on wetlands.

3.7.4. Trend in the magnitude of the threat

Groundwater levels in the Parilla Saline Aquifer were continuing to decline during the drought of the past decade. However, recent rains in 2010-11 may have slowed this trend.

3.8. Climate Change

3.8.1. Summary

Climate change has the potential to have big impacts on wetland ecosystems as a result of potentially significant changes to wetland hydrology. However, the scale and nature of impacts is uncertain.

Table 11: Extent and trend of impact of neighbouring land use for each category of wetland

	Freshwater Meadows	Shallow Freshwater Marshes	Deep Freshwater Marshes	Permanent Open Freshwater	Semi-Permanent Saline	Permanent Saline
Current Impact	High	High	High	High	High	High
Trend	Getting Worse	Getting Worse	Getting Worse	Getting Worse	Getting Worse	Getting Worse
Data Confidence	Low	Low	Low	Low	Low	Low

3.8.2. Potential impact on wetlands

Wetlands are among the ecosystems most vulnerable to climate change. If these changes occur as projected, wetlands are likely to receive reduced surface water inflows and the most pronounced effects on wetlands will be altered hydrological regimes with some wetlands having less water for shorter periods. Shallow wetlands that rely on direct precipitation are the most likely systems to be affected by climate change. A future hotter and drier climate may reduce many wetlands in size, convert some wetlands to dryland, or shift one wetland type to another (Jin and Cant 2010).

3.8.3. Extent of the threat

There is uncertainty about the full extent of impact climate change impact on Wimmera wetland systems and on individual wetlands. CSIRO projections for the Wimmera foresee a hotter and drier environment (CSIRO, 2008). By 2030, average annual temperatures are expected to be around 0.8 degrees warmer and average annual rainfall is anticipated to decrease by around 4%. By 2070, further increases in temperature are expected (1.3 to 2.6 degrees) and average annual rainfall is presumed to decline between 6 and 12%. Increases in potential evaporation and reductions in relative humidity are predicted to contribute to drier conditions. The intensity of heavy daily rainfall is likely to rise in most seasons. However, the total number of rainy days is expected to decrease.

The consequent impacts of these predicted changes on wetland ecosystems is uncertain. Wimmera climate is highly variable, experiencing periods of drought typically followed by long wet periods. During the current extended dry period, wetlands have dried out or held less water for shorter periods. There is a tendency to think that wetlands are no longer wetlands when they are dry. However, wetlands in the Wimmera naturally fluctuate through wet and dry cycles and have persisted and survived through many extended dry periods. Wetland flora and fauna have adapted to living in this changing environment and have developed mechanisms that enable them to survive under these conditions. When water returns to low-lying wetland areas, the seeds that have lain dormant in the wetland germinate, the characteristic wetland plants and animals return and terrestrial plant species that have invaded the previously dry wetland bed drown. It is uncertain what impact more prolonged extended dry periods or a change in the seasonality of rainfall may have on wetland ecosystems and their ability to survive a change in the nature of wet and dry periods.

The Department of Sustainability and Environment is currently undertaking a project aimed at estimating the impact of climate change on wetlands in Victoria. This may provide further guidance on this issue.

The current extended dry period has exacerbated the extent and impact of threat to wetland ecosystems by making them more susceptible to cropping and grazing. This impact could potentially continue if dry conditions continue into the future.

3.8.4. Trend in the magnitude of the threat

The trend is for climate change impacts to get significantly worse, with a hotter drier climate predicted for the Wimmera.

4. Desired condition of wetlands in the Wimmera

4.1. The long term vision (50+ years)

The vision for Wimmera wetland assets is that:

Wetland ecosystems are diverse and resilient and sustained in good condition to the extent that:

- **There is adequate and connected habitat available for the flora and fauna that rely on Wimmera wetlands for survival during their life cycle; and**
- **Wetlands continue to provide ecosystem services valued by the community.**

“Diverse” means having a large variety of wetland types with a range of different characteristics supporting a range of wetland flora and fauna characteristic of the Wimmera.

“Resilient” means the ability of wetland assets to withstand or recover from shocks or disturbances like drought, fire and flooding while retaining their primary ecosystem functions.

4.2. Objectives (20 Year)

Long-term objectives for achieving progress towards this vision include, by 2030:

1. **Sustain all high conservation value wetlands in good or excellent condition.**
   - High conservation value wetlands include those with recognised conservation values, including Ramsar sites, wetlands listed on the Directory of Important Wetlands in Australia, High Conservation Value Aquatic Ecosystems and wetlands that support migratory birds listed under the China-Australia, Japan-Australia and Republic of Korea-Australia Migratory Bird Agreements.
2. **Stabilise loss of wetland ecosystems by human activities.**
3. **Stabilise and improve the condition of wetland ecosystems.**
4. **Retain wetland diversity by preserving the range of existing wetland ecosystems.**
5. **Improve connectivity between wetlands to enable movement of wetland flora and fauna.**

Targets

The following outlines measurable 6-year targets aimed at achieving the objectives and vision for wetlands assets.

1. **Protect high conservation value wetlands from threatening processes and sustain them in good or excellent condition.**
    - This includes Lake Albacutya Ramsar site and 13 wetlands listed on the Directory of Important Wetlands in Australia, including Bitter Swamp, Friedman's Salt Lake, Grass Flat (Telfer's) Swamp, Hately's Lake (Swamp), Heards Lake, Lake Hindmarsh, Lake Wyn Wyn, Mitre Lake, Natimuk Lake, Oliver's Swamp (Lake), Pink Lake (Lochiel), Saint Marys Lake and White Lake
2. **Achieve protection and good management of twenty percent of each wetland type so that the wetlands are improving towards a condition of good or excellent.**
3. **Enhance connectivity by protecting a hydrologically connected chain of wetlands and improving their condition towards good or excellent.**
4. **Increase the number of private land managers implementing wetland conservation practices.**
5. **Prevent impacts to wetlands from new developments by working with local councils and the community to implement planning scheme overlays.**

4.3. Actions for implementing the targets

There are a range of options available for achieving targets and progress towards objectives and the overall vision for Wimmera wetlands. They include offering financial incentives and implementing effective education activities to encourage increased adoption of recommended practices by land managers. The mechanisms and activities for achieving objectives and targets are beyond the scope of this strategy and are to be outlined in a 6-year Action Plan and annual Implementation Plans. The mix of actions will also be guided by government priorities for investment.

At the on-ground level, wetland health should be protected and improved if the following practices are carried out:

- Maintaining or restoring natural hydrology (wetting and drying regimes).
- Excluding or carefully managing stock grazing in the wetland and its buffer area.
- Avoiding cropping and disturbing soils by activities such as driving machinery through wetland areas.
- Preventing fertilisers, chemicals, manures, weeds and sediments from entering or draining into the wetland from neighbouring land use.
- Controlling predatory feral animals like foxes and cats.
- Controlling other grazing animals like rabbits and hares.
- Controlling and preventing invasion and growth of weeds.
- Establishing and/or retaining vegetated buffer areas around the wetland edge.
- Leaving trees, including dead trees, shrubs and fallen branches intact.
- Adopting permanent conservation covenants over wetlands and their buffer areas.

4.4. Principles to guide implementation of wetland protection actions

The following principles will guide the amount of resources and the order in which wetland protection and enhancement actions will be carried out:

- Protect wetlands in good condition and under highest threat before those in poor condition or under low threat;
- Protect rare and endangered wetland types and wetlands that provide habitat for rare and endangered species;
- Protect and enhance wetlands that contribute to landscape connectivity;
- Protect and enhance wetlands that are resilient in that they have the ability to recover well following disturbance and the removal of threats.
- Protect and enhance types of wetlands that are declining at the fastest rate.

5. Monitoring and evaluation

This section outlines how we will we measure achievements against objectives, targets and the overall vision for wetland assets.

Table 12: Monitoring Activities

Monitoring Activity	Timing	What the monitoring will tell us	Long Term Objective addressed	Six-Year Target addressed
Assessing the rate of loss of wetlands by reviewing aerial photography to determine the number and type of wetlands: • Degraded by activities like dams, drains, banks and crops; and • Degraded to the extent that they are lost or no longer functioning as a wetland.	Every 6 years	• The level of threat to wetlands from dams, drains, banks and crops (ie. the number and rate of wetland loss and degradation) • Whether CMA activities are slowing the rate of degradation and loss.	Stabilise loss of wetland ecosystems by human activities.	Increase the number of private land managers implementing wetland conservation practices. Prevent impacts to wetlands from new developments by working with local councils and the community to implement planning scheme overlays.
Assess the condition of high conservation value wetlands using the Victorian Index of Wetland Condition method	Six-yearly (Baseline assessments were completed in 2009)	The condition and level of threat to high conservation value wetlands and any change since 2009 baseline assessments.	Sustain all high conservation value wetlands in good or excellent condition.	Protect high conservation value wetlands from threatening processes and sustain them in good or excellent condition.
Assessing the condition of a sample of wetlands using the Victorian Index of Wetland Condition Assessment method	Every 3-6 years	An indication of: • The overall condition of wetlands; • Trends since previous condition assessments; and • The condition of sub-indices like hydrology, biota, soils etc.	Stabilise loss of wetland ecosystems by human activities. Stabilise and improve the condition of wetland ecosystems.	Achieve protection and good management of twenty percent of each wetland type so that the wetlands are improving towards a condition of good or excellent.

Monitoring Activity	Timing	What the monitoring will tell us	Long Term Objective addressed	Six-Year Target addressed
Assessing the ecological response of wetlands protected and enhanced under CMA activities to determine whether there has been an ecological gain on investment.	3 to 6 yearly	Whether values have been improved and assumed ecological gains have been made	Stabilise and improve the condition of wetland ecosystems.	Achieve protection and good management of twenty percent of each wetland type so that the wetlands are improving towards a condition of good or excellent Increase the number of private land managers implementing wetland conservation practices.
Number of local councils protecting wetlands through their local planning schemes	Annually	Whether planning scheme protections for wetlands have been adopted and which Wimmera areas wetlands are protected from the impacts of new developments.	Stabilise loss of wetland ecosystems by human activities.	Prevent impacts to wetlands from new developments by working with local councils and the community to implement planning scheme overlays.

6. Summary of knowledge gaps

This section summarises some of the key gaps in knowledge and research needs.

- The current rate of wetland loss and degradation by cropping, dams, drains and banks. This analysis has not been repeated since 2004. This information would indicate the level of ongoing threat to wetlands from these degrading activities and help to target management effort.
- The impacts of estimated changes to climate on Wimmera wetland function, flora and fauna.
- The condition and ecological value of many individual wetlands.
- The extent of threat to wetlands from stock grazing - Wetlands on private land are commonly grazed. Wetland grazing practices vary from property to property and also from wetland to wetland within individual properties. It is difficult to get a precise picture of the extent, intensity and impact of wetland grazing. Based on field observation and anecdotal evidence, we assume that grazing is a moderate threat to freshwater wetlands and low threat to saline wetlands that typically have less palatable vegetation.
- The impacts of falling groundwater levels in the regional Parilla Sands Aquifer on the health of ground-water dependent saline wetlands
- The nature of interaction between the freshwater Murray Limestone aquifer and saline Parilla Sands aquifer and, consequently, potential impacts on groundwater dependent wetlands that interact with the Parilla Sands aquifer.

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8. Appendices

8.1. Appendix 1: Wetland types in the Wimmera

In Victoria, wetlands are classified into broad categories defined by Corrick and Norman (!980) according to their hydrology, or depth and frequency of inundation, and salinity. The six categories of natural wetlands are:

1. Freshwater meadows.
2. Shallow freshwater marshes.
3. Deep freshwater marshes.
4. Permanent open freshwater wetlands.
5. Semi-permanent saline wetlands.
6. Permanent saline wetlands.

Each of these wetland types are found in the Wimmera in large numbers, however most Wimmera wetlands are shallow seasonal freshwater meadows and marshes. These typically fill from winter rainfall and are dry or dry out during summer. These natural wet and dry cycles contribute to rich biodiversity; with shallow wetlands generally supporting an immense and highly-diverse array of flora and fauna.

1. Freshwater meadows

These are shallow depressions that typically hold water for less than four months of the year and are less than 30 centimetres deep. They are mainly found in grasslands, forests and open woodlands. The most common types of vegetation are native herbs and grasses, sedges, red gum and lignum. Examples include Green Swamp, Dooen Swamp and Waurn Swamp.

2. Shallow freshwater marshes

These usually have water for six to eight months of the year and can have a depth of up to 50 centimetres. Floating leafy plants, herbs, sedges, reeds, cane grass, red gum trees and lignum tend to dominate marsh vegetation. Examples include Lignum Swamp, Minimay Swamp, Winter Lake and Nhill Swamp.

3. Deep freshwater marshes

These wetlands can be up to two metres deep. They are semi-permanent wetlands that dry out every four to five years on average and more frequently during extended periods of drought. Floating leafy plants and soft-stemmed plants tend to dominate marsh vegetation. Red gums, lignum, cane grass, rushes, sedges, reeds and shrubs are common. Examples include Lake Karnack, Brig Brig Swamp, Yanac Swamp and Red Gum Swamp.

4. Permanent open freshwater wetlands

A permanent open freshwater wetland is as it sounds, and in the Wimmera it mostly includes the larger and deeper lakes. There is generally little or no vegetation in the deep open water that is typical of these lakes. Fringe vegetation can include mixed herbs and sedges with woody areas further away from the water. Examples include Lake Albacutya, Lake Bringalbert, Lake Charlegrark, Lake Hindmarsh, Lake Ratzcastle and Natimuk Lake.

5. Semi-permanent saline wetlands

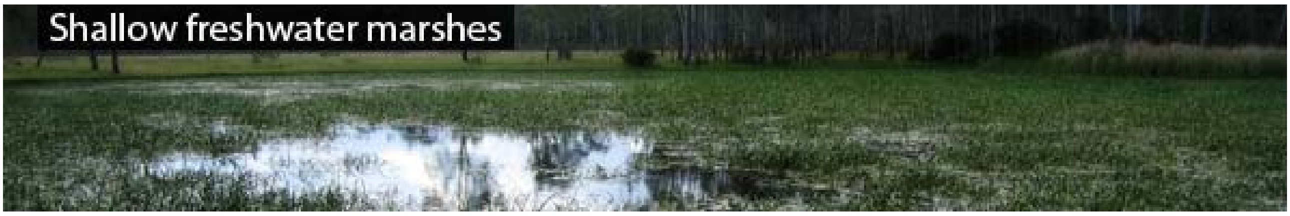
In these wetlands, water quality ranges from brackish through to extremely salty. In the Wimmera they are fed by saline groundwater and may also receive some fresh surface water runoff following rainfall. They often have large mud or salt flats that attract wading waterbirds during wetter months to forage for food.

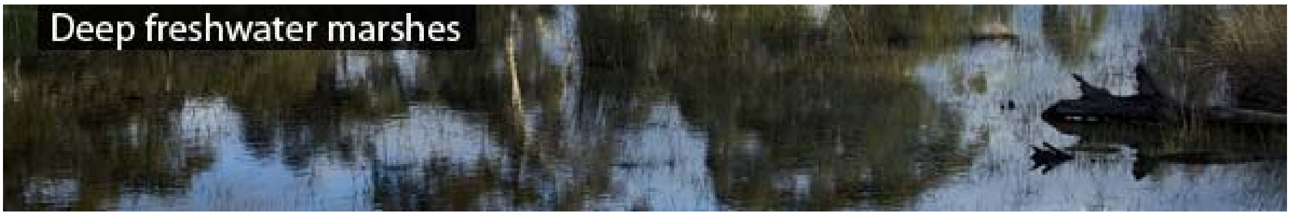
Semi-permanent saline wetlands are typically less than two metres deep and contain water for less than eight months of the year. They usually have open salt pans and fringe vegetation can include forbs, grasses and herbs with woody areas such as salt-paperbark trees and red gum woodlands further from the water. Examples include Lake Yampitcha, White Lake, Pink Lake and Mitre Lake.

6. Permanent saline wetlands

Permanent saline wetlands can reach depths of two metres or more. They typically hold water all year round except in extremely dry periods. Vegetation can range from herbs and sedges to forbs, grassy and tree areas. Examples include Reedy Swamp, Lake Kemi Kemi, Jacka Lake and Lake Carchap.

Saline wetlands in the Wimmera are most likely to be found in lower areas of the Douglas Depression, near Mount Arapiles and the chain of lakes extending south to Douglas. They also extend further north and parallel to the Wimmera River from Dimboola towards Lake Hindmarsh. There are also some saline wetlands south and east of Edenhope in the region's west.





Appendix 2: Wetland Condition Assessments from 2005 and 2009

The following provides additional detail regarding the current condition of wetlands.

Current Condition

Index of Wetland Condition Assessments 2009

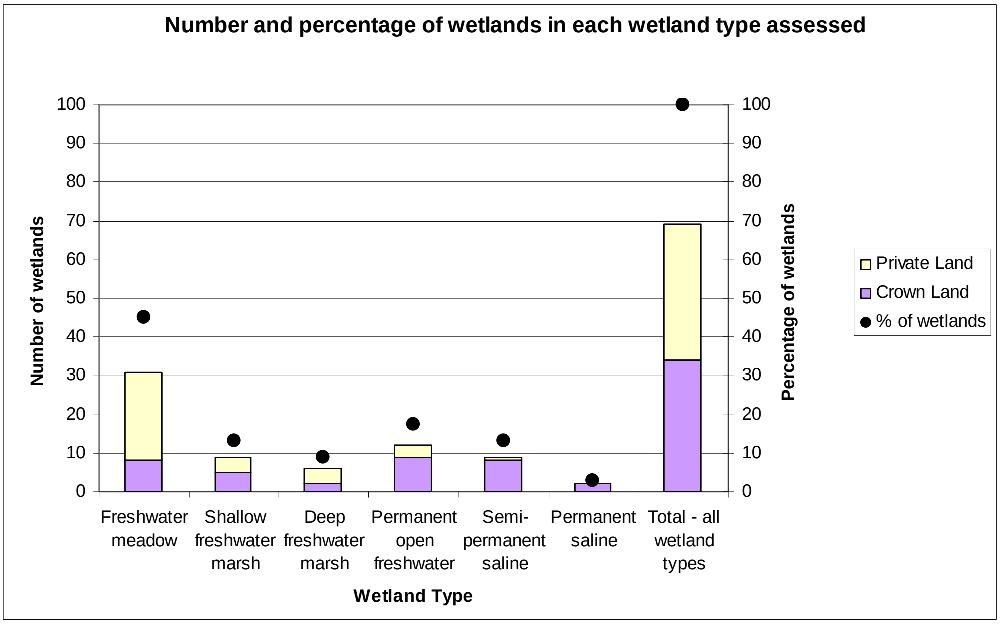
Sixty-nine wetlands were assessed in the Wimmera using the new Victorian method, the Index of Wetland Condition, during October and November 2009. Table 13 and figure 12 shows the number and type of wetlands assessed.

Wetlands assessed included the Lake Albacutya Ramsar-listed wetland, twelve wetlands listed on the Directory of Important Wetlands in Australia (DIWA) including Lake Hindmarsh, White Lake, Bitter Swamp, Saint Marys Lake, Heards Lake, Mitre Lake, Parker Swamp (Grass Flat or Telfers Swamp), Lake Wyn Wyn, Oliver's Swamp (Lake), Natimuk Lake and Pink Lake (Lochiel). Two other DIWA listed wetlands, Friedman's Salt Lake and Hately's Lake (Swamp), were not assessed due to access issues. About half of the wetlands were on Crown land and half on private land.

Table 13: Number and type of wetlands assessed in 2009 using the IWC method.

Wetland type	Total wetlands	Crown Land	Private Land	DIWA Wetlands (all Crown land)	Ramsar Wetlands
Freshwater meadow	31	8	23	0	0
Shallow freshwater marsh	9	5	4	0	0
Deep freshwater marsh	6	2	4	0	0
Permanent open freshwater	12	9	3	4	1
Semi-permanent saline	9	8	1	7	0
Permanent saline	2	2	0	1	0
Total - all wetland types	**69**	**34**	**35**	**12**	**1**

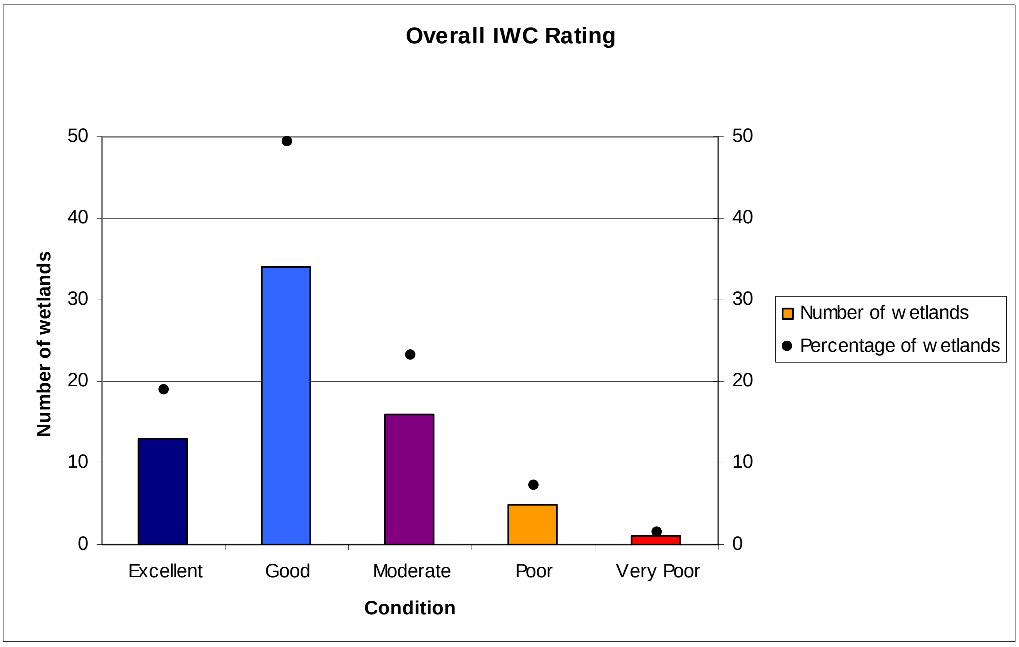
Figure 12: Number and type of wetlands assessed in 2009 using the IWC method.



Key results:

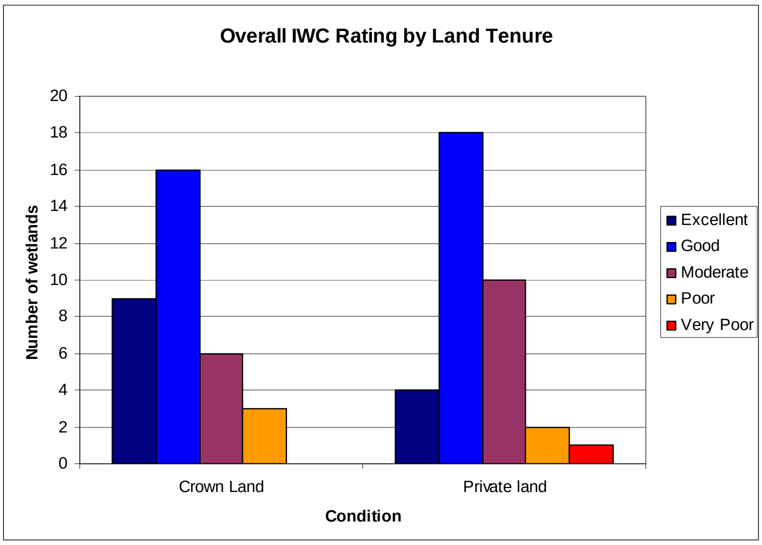
- Figure 13 shows the Overall IWC Ratings for all assessed wetlands. In summary:
    - 68% are in good (49%) or excellent (19%) condition
    - 23% are in moderate condition
    - Only 8% are in poor or very poor condition

Figure 13: Overall IWC Ratings for all assessed wetlands



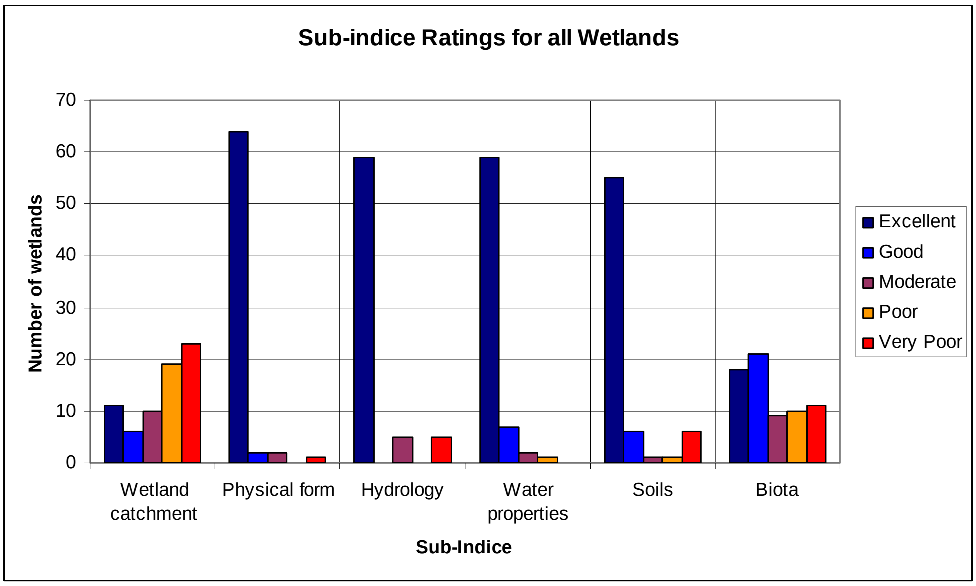
- Figure 14 compares the overall IWC results for Crown land and private land:
    - o 91% of both Crown land and public land wetlands were assessed as in moderate to excellent condition. A higher proportion were in excellent condition on Crown land (26%) than on private land (11%)
    - o Both rated poor to very poor for the wetland catchment sub-indice (56% private; 64% Crown)
    - o A higher proportion of soils on private land rated as poor to very poor (17% private; 3% Crown)
    - o Biota generally scored slightly better on Crown than private

Figure 14: Overall IWC rating by land tenure



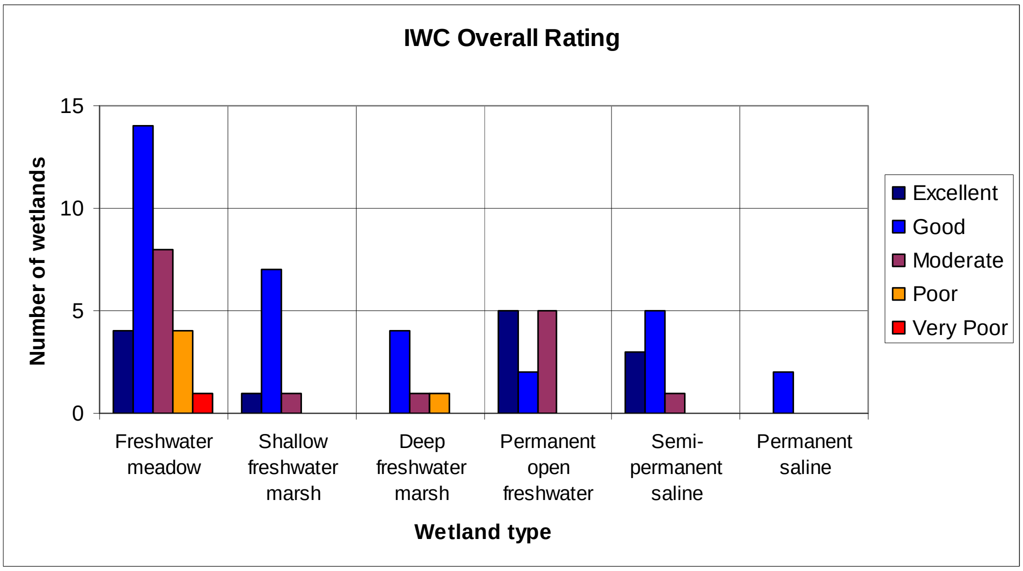
- Figure 15 shows the results for sub-indices:
    - o Wetland catchment had the worst scores, with 61% of assessed wetlands scoring poor to very poor
    - o At least 80% of wetlands assessed were rated as excellent for the physical form, soils, hydrology and water properties sub-indices
    - o Biota – 56% of assessed wetlands were rated as good to excellent

Figure 15:



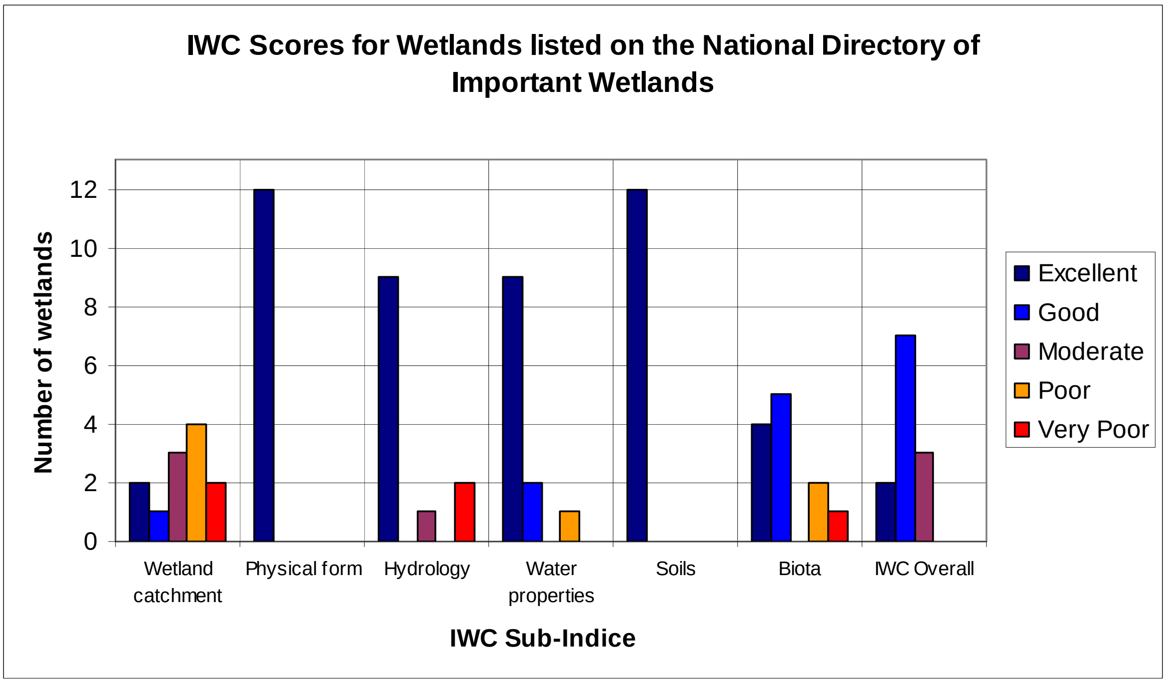
- Figure 16 shows the IWC results by wetland type:
    - All shallow freshwater marshes, permanent open freshwater, semi-permanent saline and permanent saline wetlands were assessed as in moderate to excellent condition, however very low numbers of each type were assessed
    - Deep freshwater marshes were mostly good to moderate with one wetland assessed as poor. Again, these were assessed in low numbers.
    - 84% of the 31 freshwater meadows assessed were moderate to excellent
    - 74% of the freshwater meadows assessed had poor to very poor wetland catchment. Other wetland types also scored poorly for this sub-indice

Figure 16:



- Figure 17 shows the IWC results for wetlands listed on the Directory of Important Wetlands in Australia:
    - 2 wetlands rated as in excellent condition, 7 were good and 3 moderate
    - Hindmarsh and Albacutya – have very poor hydrology. These are the only two river-fed wetlands, with the major water source comprising inflows from the Wimmera River. Over-extraction in the upper and mid catchment is severely affecting the hydrology of these two terminal lakes, as well as prolonged drought.
    - All wetlands rated as excellent for physical form and soils
    - Biota – most wetlands were rated as good to excellent. Only 3 wetlands rated as poor to very poor
    - Wetland catchment had the worst ratings – 3 moderate and 6 poor to very poor

Figure 17:



There are no notable geographic trends in condition scores.

In summary, the wetland catchment sub-indice scored most poorly, indicating that a number of the wetlands assessed had poor buffer areas. Biota also scored lower than other sub-indices, indicating that some wetlands had poor native vegetation quality.

Wetland Condition Assessment - 2005

In 2005, Wimmera CMA conducted an assessment of wetland condition in the Natimuk-Douglas Chain of Lakes and the Millicent Coast Basin (Water's Edge Consulting, 2005). This used a different methodology to the IWC assessments. Most of the sub-indices address similar concepts and themes, however measure different parameters and apply different scoring methods. As a result, the two methods are not directly comparable. However, both methods apply a 5-tier scoring system. The 2005 method rates wetlands as good, good-moderate, moderate, moderate-poor or poor. For consistency, the following summary uses the same terminology as the IWC method for the five score rankings (ie. excellent, good, moderate, poor and very poor).

A small sample of 77 wetlands were assessed in 2005 for their physical, chemical and biological condition.

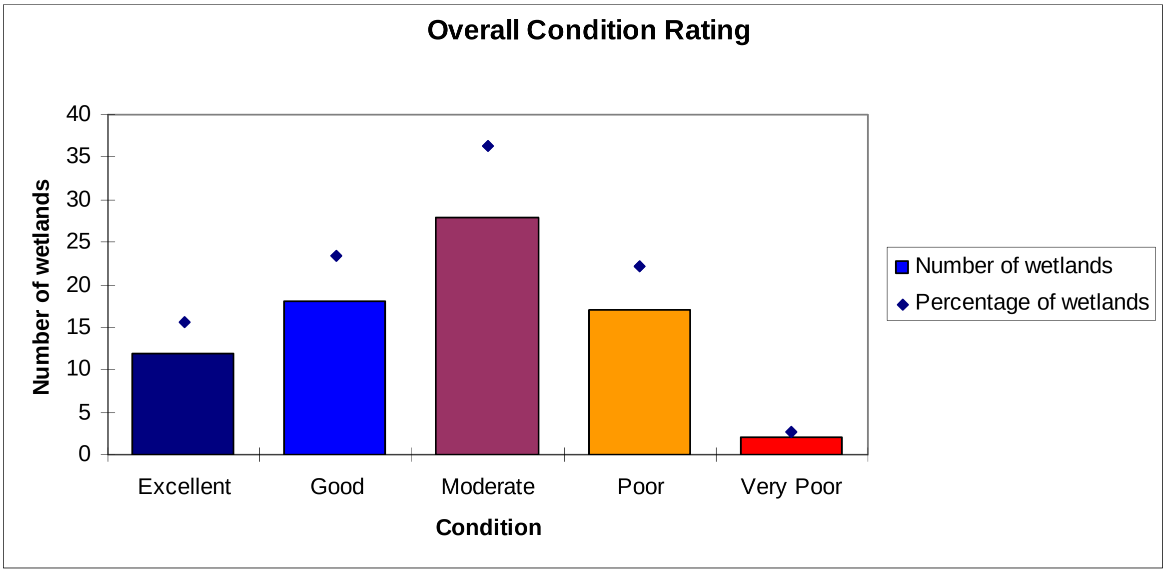
- Wetlands assessed included (Table 14):
    - 1 wetland listed on the Directory of Important Wetlands in Australia (17%) - White Lake
    - 31 wetlands on Crown land (40%)
    - 46 wetlands on private land (60%)

Table 14: Number of wetlands assessed

Wetland type	Total wetlands	Crown Land	Private Land	DIWA Wetlands (all Crown land)	Ramsar Wetlands
Freshwater meadow	18	2	16	0	0
Shallow freshwater marsh	11	3	8	0	0
Deep freshwater marsh	14	6	8	0	0
Permanent open freshwater	20	10	10	0	0
Semi-permanent saline	6	6	0	1	0
Permanent saline	8	4	4	0	0
Total - all wetland types	**77**	**31**	**46**	**1**	**0**

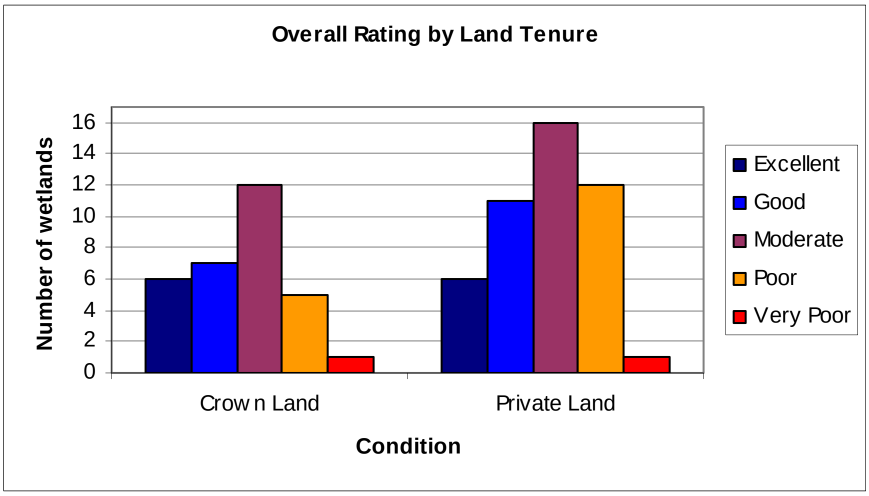
- Figure 18 depicts the overall results. In summary:
    - 40% of wetlands surveyed were rated as being in good to excellent condition while 37% were rated as moderate.
    - 22% were rated as poor to and only one permanent open freshwater wetland was rated as very poor.

Figure 18:



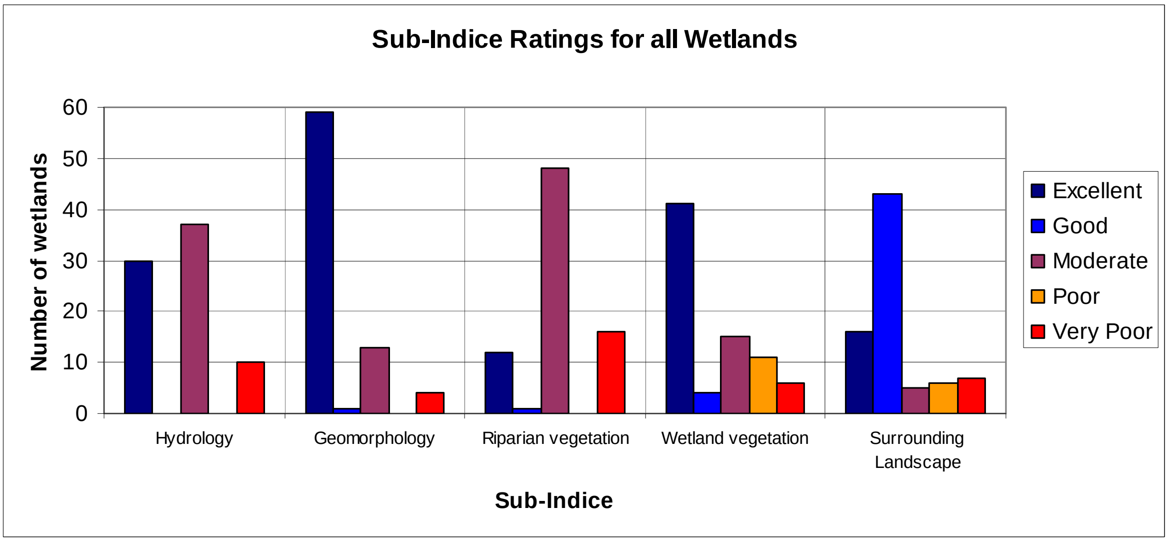
- Figure 19 shows the results for Crown and private land:
    - Same trends for each land tenure as for the Overall rating.
    - Most wetlands rated as moderate to excellent

Figure 19:



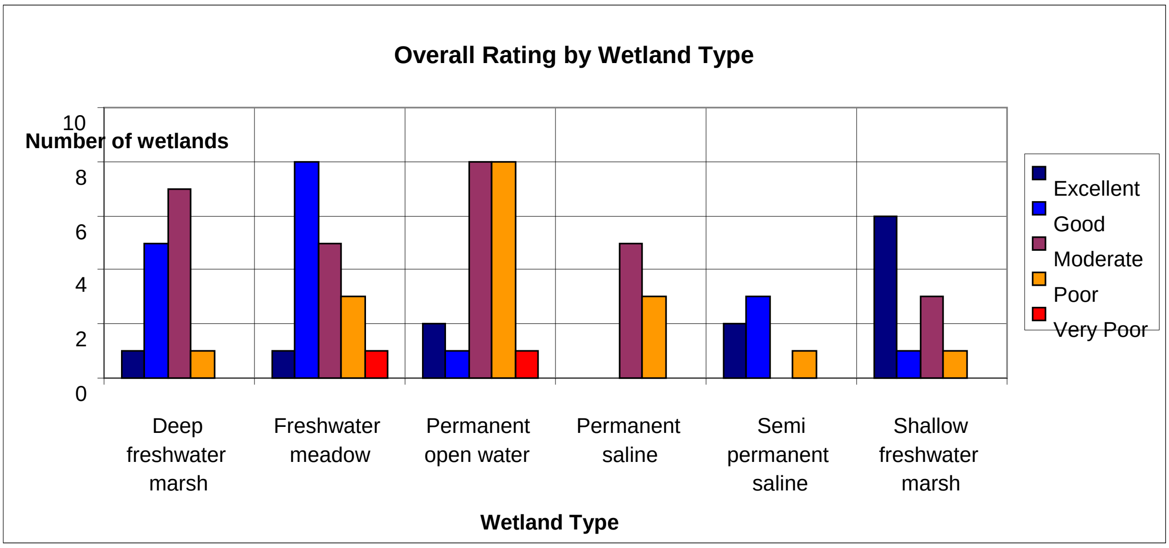
- Figure 120shows the results by sub-indice:
    - Surrounding landscape, wetland vegetation and geomorphology mostly scored good to excellent
    - Hydrology and riparian vegetation mostly scored moderate to excellent

Figure 20:



- Figure 21 shows the results by wetland type:
    - Permanent saline were all moderate to poor
    - Semi-permanent saline were all good to excellent except for one poor site
    - Shallow and deep freshwater marshes were rated as moderate to excellent, with the exception of one poor deep freshwater marsh
    - Freshwater meadows and permanent open freshwater were mostly moderate to excellent (71% and 63% respectively), but had some poor wetlands

Figure 21:



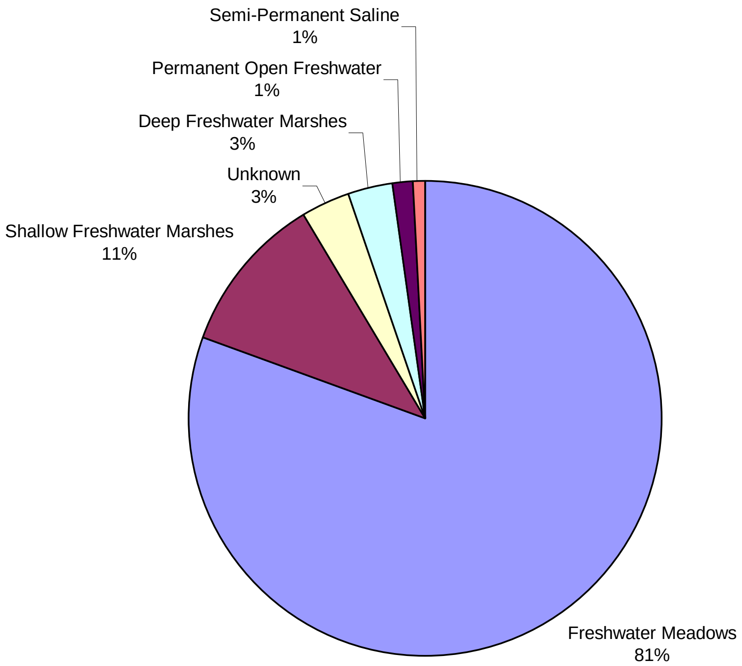
Wetland Loss and Modification Over Time:

Mapping of the type and extent of Victorian wetlands greater than one hectare in size was completed in 1994 based on black and white aerial photography taken in the late 1970s and early 1980s (Department of Natural Resources and Environment, 1994). The type and extent of wetlands greater than one hectare in size in the Wimmera CMA region was reviewed and updated in 2006 using 2004 aerial photography and digital elevation modelling information (Sinclair Knight Merz, 2006).

A comparison of wetlands from the 1994 and 2006 analyses revealed that human intervention has had a significant effect on the health of wetlands. Key findings include:

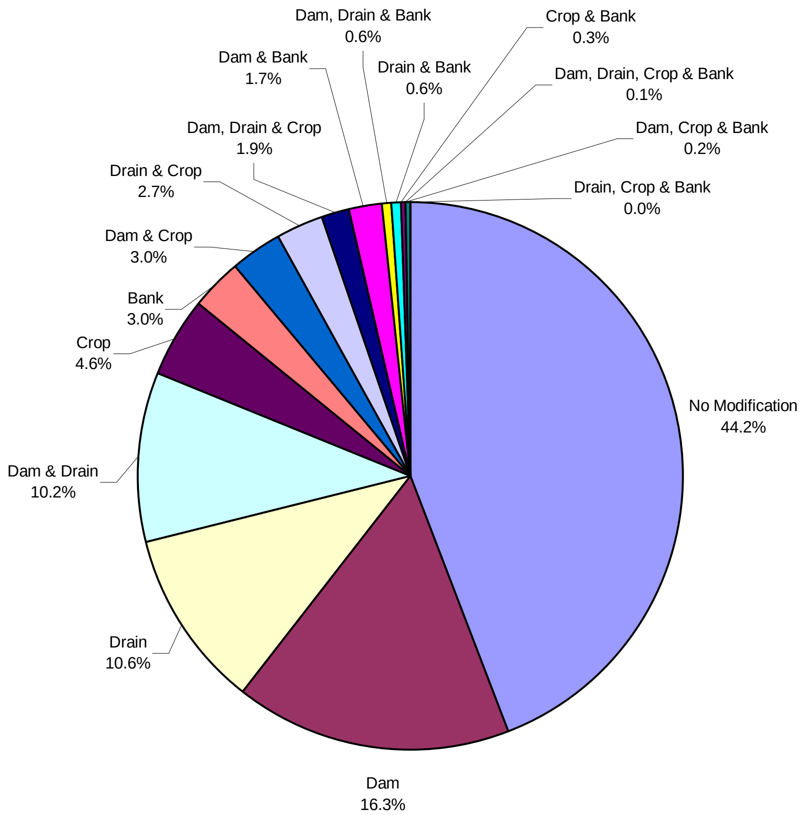
- In 2004, around 18% of wetlands had been modified since the 1994 mapping to the extent that they are no longer functioning as wetlands. This indicates a potential loss of 474 wetlands since the previous mapping was completed (an approximately 25 year period).
- Freshwater Meadows were also the most commonly affected wetland type, comprising 81% of the wetlands lost. They were found to be consistently reduced across the region as a result of modification by agricultural activity, including dam construction within the wetland, cropping and draining. Figure 22 shows the wetland types that comprise the 474 lost wetlands.

Figure 22: Percentage of each wetland type lost between the 1994 and 2004 mapping analyses.



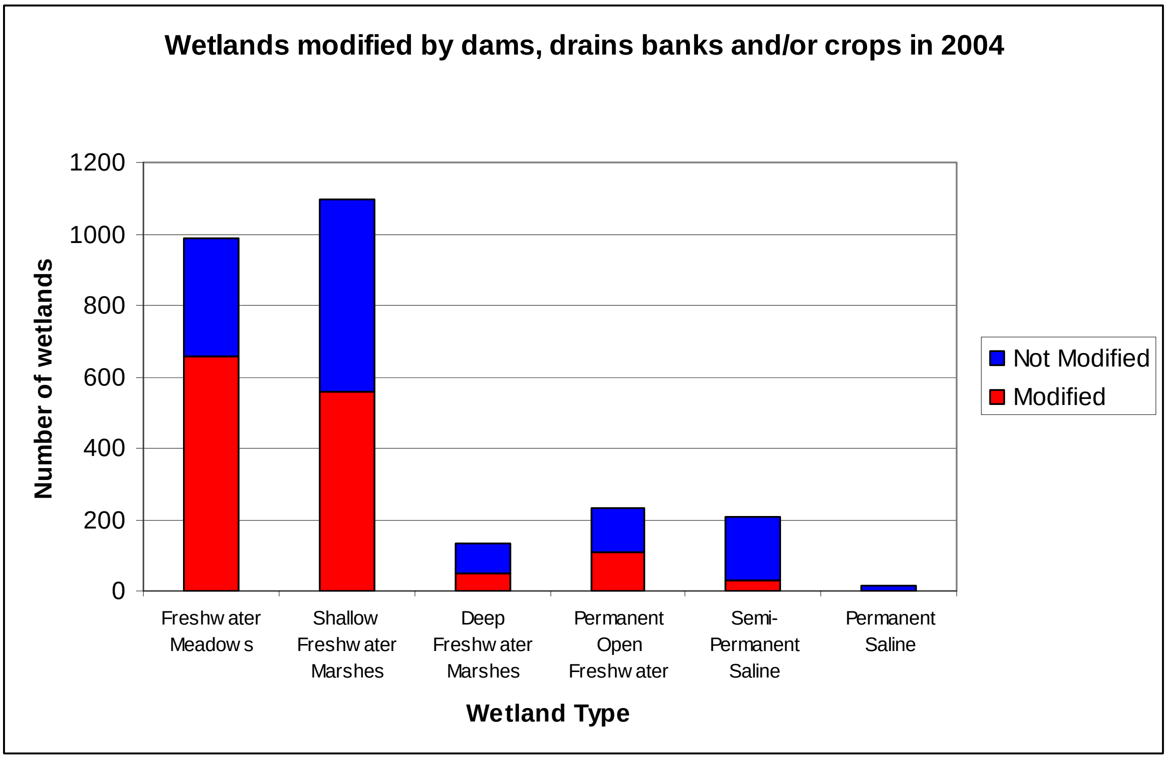
- Overall, 56% of wetlands were found to be modified in some way, most commonly through creation of a farm dam in part of the natural extent of the wetland. Figure 23 shows the proportions of wetlands affected by different modifications, including dams, drains, banks and crops.

Figure 23: proportions of wetlands affected by different modifications, including dams, drains, banks and crops



- Figure 24 shows the number of wetlands in each wetland type modified by dams, drains, banks and/or crops in 2004. Freshwater wetlands are the most modified, with 67% modified. Approximately half of shallow freshwater marshes and permanent open freshwater wetlands are modified and 47% of deep freshwater marshes are modified. Saline wetlands are the least affected wetland type, with only 14% and 12% modified respectively for semi-permanent and permanent saline wetlands.

Figure 24: Number of wetlands in each wetland type modified by dams, drains, banks and/or crops in 2004.



It is reasonable to expect that further modification is continuing, particularly through cropping of the shallower wetland types: freshwater meadows and shallow freshwater marshes. The Social and Economic Drivers of Wetland Rehabilitation study (Sinclair Knight Merz, 2005) found that the dry period over the six years prior to 2005, together with rising grain and decreasing wool prices, had contributed to an increase in the conversion of traditional grazing country to cropping within the South West Wimmera. Paddocks that had previously been too wet to crop had become arable and some wetlands, particularly shallow freshwater marshes have been substantially modified to enable them to be cropped. This trend has continued since then.

8.2. Appendix 3: Threats to wetlands

Threat	Wetland Type	Current Impact	Localised or Region-wide	Trend	Severity of Impact	Ability to be restored	Evidence	Impact
Cropping	Freshwater meadows, Shallow freshwater marshes	High	Region-wide	Increasing in the South West Wimmera; probably stable elsewhere	Med (depends on cropping intensity and length of time cropped)	Med (depends on cropping intensity and length of time cropped)	In 2004, 18% of freshwater meadows were cropped; 11% of shallow freshwater marshes were cropped; 5% of deep freshwater marshes; 2.5% of permanent open freshwater; 8% semi-permanent saline and 0% permanent saline. Expecting this to grow if dry seasons continue.	Disturbs wetland soils and may alter soil composition; degrades seeds, eggs or tuber roots stored in the soil, impacting on the ability of wetland vegetation to recover when water returns; contributes nutrients and chemicals impacting on water quality; may also degrade the quality of buffering vegetation in the riparian zone
	Deep freshwater marshes	Med	Region-wide	Increasing in the South West Wimmera; probably stable elsewhere	Med (depends on cropping intensity and length of time cropped)	Med (depends on cropping intensity and length of time cropped)		
	Permanent Open Freshwater	Low	Region-wide	Increasing in the South West Wimmera; probably stable elsewhere	Med (depends on cropping intensity and length of time cropped)	Med (depends on cropping intensity and length of time cropped)		
	Semi-Permanent Saline	Low	Region-wide	Stable	Med (depends on cropping intensity and length of time cropped)	Med (depends on cropping intensity and length of time cropped)		
	Permanent Saline	Low	Region-wide	Stable	Med (depends on cropping intensity and length of time cropped)	Med (depends on cropping intensity and length of time cropped)		

Threat	Wetland Type	Current Impact	Localised or Region-wide	Trend	Severity of Impact	Ability to be restored	Evidence	Impact
Neighbouring land use	All wetlands	High	Region-wide	Slight increase (with the increase in cropping)	Variable depending on land use intensity, buffer widths etc	Med-High	Wetland catchment condition scored poorly in the Index of Wetland Condition Assessments completed in 2009	Can contribute contaminated runoff (pesticides, nutrients etc), spray drift, encroaching weeds etc
Alteration to hydrology (ie. by dams, drains, banks etc)	Freshwater meadows, Shallow freshwater marshes	High	Region-wide	Unsure, slow increase is likely	High	Med	In 2004, 63.5% of freshwater meadows; 47% of shallow freshwater marshes; 37% of deep freshwater marshes; 46% of permanent open freshwater; 10% semi-permanent saline and 12% permanent saline had a dam, drain and/or bank. Not expecting this to grow substantially, but this is unknown	Changes the natural flooding and wetting regime of the wetland, impacting on the ability of plants and animals to continue to survive
	Deep freshwater marshes, Permanent open freshwater	Med	Region-wide	Unsure, slow increase is likely	High	Med		
	Semi-Permanent Saline, Permanent Saline	Low	Region-wide	Unsure, probably stable	High	Med		

Threat	Wetland Type	Current Impact	Localised or Region-wide	Trend	Severity of Impact	Ability to be restored	Evidence	Impact
Grazing	Freshwater meadows, Shallow freshwater marshes, Deep freshwater marshes, Permanent open freshwater	Med	Region-wide	Stable (ie. there is no indication that grazing is intensifying or that additional land is being grazed)	Variable, depending on wetland condition and the intensity and timing of grazing	High, although this depends on wetland condition, history of management, the intensity and timing of grazing and presence of weeds	GIS data shows that just over 90% of these wetlands are on private land. Most are in the south west Wimmera where the primary land-use is grazing. Field observation and expert opinion provide information on severity of impact and ability to be restored.	Destroys vegetation through grazing and damage to soil and stored tubers, contributes nutrients through manure, compacts or erodes or pugs soil
	Semi-permanent saline, Permanent Saline	Low	Region-wide	Stable				
Declining groundwater levels	Freshwater meadows, Shallow freshwater marshes, Deep freshwater marshes, Permanent open freshwater	Low	Localised - mainly saline groundwater –dependent wetlands	Levels are declining	High-mod	High	Trends in bore levels	Wetland hydrology modified.
Climate change	All wetlands	High?	Region-wide	Climate is drier	High	Low	CSIRO predictions for drier climate in the Wimmera. Some uncertainty around impacts on wetlands.	Altered hydrology, impacting on the survival of wetland plants and animals and normal ecological functioning of wetlands.