



Wimmera
Catchment Management
Authority

Waterways for Life.



Heritage River Waterway Action Plan

December 2005

Heritage River

Waterway Action Plan

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Glossary

Term	Definition
aeolian	Pertaining to the action or effect of the wind
aggradation	Deposition of material which raises the level of the streambed.
alluvial fan	A low spreading (often triangular in planform shape) deposit of sediment coming off a hillside. The upslope (head) of the fan is steeper than the wider base of the fan.
anastomosing	Irregular branching and rejoining of stream channels to form a net-like pattern.
armouring	A stable layer of the largest available sediment size from which finer particles have been removed by stream flow. The armoured surface acts to protect the streambed or bars from erosion.
bedrock	Exposed rock within the streambed. Cohesive rock prevents incision of the channel.
bench	Bank-attached, flat and narrow surface, deposit of fine grained sediment occurring at elevations between the stream bed and the floodplain. Generally will have more established vegetation on it than bars within the channel bed.
degradation	Erosive removal of materials from the stream bed, other geomorphic units or the floodplain, lowering their surface elevation.
CAMBA	China Australia Migratory Bird Agreement
confluence	The junction of two streams.
deltaic	Relating to or like a delta
dynamic equilibrium	The condition of a stream that is experiencing an overall balance between erosion and input of sediment. Dynamic equilibrium recognises that significant changes may occur rapidly in response to events such as flooding, resulting in short term change. Material may be passing through the stream bed for example, but the elevation of the bed remains relatively unchanged through time..

Term	Definition
Easting and northing coordinate system	A means of locating a position based on the Australian Map Grid (AMG) system. Used in conjunction with Global Positioning System (GPS) devices.
EC	Electrical Conductivity. A measure of salinity based on the ability for sodium ions to conduct an electrical charge through a fluid
EIS	Environmental Impact Statement
epifaunal	Relating to organisms that live on the surface of sediments or soils
erosion	The group of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the earth's surface.
FFG Act	Flora and Fauna Guarantee Act
fluvial-geomorphology	The study of the evolution and configuration of landforms as produced by the action of a river or stream.
geomorphology	The study of the evolution and configuration of landforms (see also fluvial-geomorphology).
halocline	A salinity gradient or change in concentration of salt dissolved in water
headcut	Vertical, or near vertical drop in channel elevation greater than 300mm
HR	Heritage River - a river with a substantial part of its system with outstanding nature conservation, recreational, scenic and/or cultural heritage values.
hydraulics	The physical science and technology of the static and dynamic behaviour of fluids. The state of forces of water in a stream at any given time.
hydrology	The scientific study of the properties, distribution and effects of water on the Earth's surface, in the soil and underlying rocks and in the atmosphere. The long term changes in stream flow, including periods of flood and drought.
incision	Lowering or downward cutting of the channel level through water erosion

Term	Definition
JAMBA	Japan Australia Migratory Bird Agreement
LCC	Land Conservation Council
left bank	The streambank on a persons left hand side when facing downstream
lunette	A broad, low-lying, typically crescent-shaped mound of sandy or loamy matter that is formed by the wind, especially along the windward side of a lake basin.
nick point	Vertical, or near vertical drop in channel elevation less than 300mm (see also head cut)
paleochannel	A remnant channel form indicating a previous channel alignment.
planform	The form or shape of a stream as viewed directly from above (such as can be seen in aerial photographs).
PLWF	Public Land Water Frontage
RAMSAR	Is the international treaty to protect wetlands that contain unique, rare and diverse ecosystems.
reach	The basic stream management unit. Defined as a length of stream with similar characteristics.
right bank	The streambank on a persons right hand side when facing downstream
riparian	From the Latin word for riverbank. Pertaining to riverbanks. Riparian vegetation refers to the vegetation along streambanks.
riverine	Relating to or resembling a river.
sinuosity	Ratio of the length of the channel between two points to the straight line distance between those two points.
SEPP	State Environment Protection Policy
standline	A shoreline, an active beach or one which marks the edge of a now-extinct body of water.
streampower	The ability of a stream to do work. Calculated as shear stress times flow velocity.

Term	Definition
sodic soils	Soils with high concentration of sodium ions such that the structure of the soil is affected. Sodic soils are highly dispersible on contact with fresh water.
TWL	Top Water Level
valley fill	Sediment accumulated within the floor of a valley.

1 Introduction

In June 1987, the Victorian Government directed the Land Conservation Council to conduct a Special Investigation of Victoria's Rivers and Streams. Following detailed investigation the Council published its final recommendations in 1991 (LCC, 1991) which the Government approved, with minor changes, in 1992. On the basis of the recommendations of the LCC, 18 Heritage Rivers were identified across Victoria as being areas of outstanding nature conservation, recreational, scenic and or cultural heritage values. The 229 km of the Wimmera River from Polkemmet Bridge to Wirrengren Plain in Wyperfeld National Park was identified as one of the 18 designated Heritage Rivers. The subsequent Heritage Rivers Act (1992) provides for the protection and management of all nominated heritage rivers.

In 2001, the Wimmera Catchment Management Authority (Wimmera CMA) undertook a geomorphic investigation and analysis of the sediment processes within the Wimmera catchment (ID&A 2001). This report provided a priority list of actions necessary to retain the significant natural features of the Heritage River. These included preserving areas with near pristine values, restoring areas of high value, rehabilitating areas that place other values at risk or provide good opportunity for restoring values, and maintaining degraded areas to prevent values declining to unacceptable levels.

In order to carry out the recommendations of the Wimmera River Geomorphic Investigation and meet the targets outlined in the Victorian River Health Strategy (DNRE 2002) and Wimmera Regional Catchment Strategy (WCMA 2003), the Wimmera Catchment Management Authority commissioned the development of the Heritage River Waterway Action Plan. This report by Earth Tech Engineering Pty Ltd (Earth Tech) documents the analyses and outcomes of an investigation into the current geomorphic, ecological and social conditions of the heritage reach of the Wimmera River known as the 'Heritage River'. The information collected from desktop analysis, community and stakeholder meetings, landholder meetings and field investigations was used to assess the threats to, and trajectory of each of these factors and from this a plan of action to maintain and improve the amenity of the Heritage River was developed. As such, the Waterway Action Plan includes:

The development of objectives for the Heritage River in accordance with state and regional priorities for management;

- An assessment of the current geomorphic and ecological conditions of the Heritage River;
- An assessment of values and threats to the river, as perceived by the stakeholders (Grampians Wimmera Mallee Water, Department of Primary Industries, Department of Sustainability and Environment and the Horsham Rural City Council) and the Heritage River catchment community;
- An assessment of threats to waterway health within the Heritage River catchment, and;
- A determination of waterway health targets for the Heritage River, incorporating a detailed action plan to achieve these targets.

Although this Waterway Action Plan acknowledges that a lack of flow within the Heritage River is a significant issue, it does not make recommendations as to required volumes of flow and the time periods over which they are to occur. Information regarding the planned environmental flow regime for the Heritage River is detailed in the Wimmera Bulk Entitlement Conversion – Environmental Flows Study (SKM 2003). This Waterway Action plan does however consider works that are required to allow the passage of future environmental flow releases and the prevention of erosion and sediment issues that may arise from increasing environmental flows.

1.1.1 Heritage River Catchment Location

Located to the north of Horsham (Figure 1), The heritage reach of the Wimmera River is located at the downstream end of the Wimmera River between Polkemmet Bridge and Outlet Creek at the northern end of Lake Albacutya. Throughout its length the Heritage River ranges between a single defined channel and an anastomosing system. The major distributary of the project reach known as Datchak Creek leaves the river immediately downstream of the Lochiel rail bridge and rejoins at Antwerp. For the purpose of this report the heritage reach of the Wimmera River including Datchak Creek is referred to as the Heritage River.

The Heritage River investigated for the Waterway Action Plan has a stream length of 165 kilometers and included the terminal lakes Hindmarsh and Albacutya.

Figure 1 -
Location of
Wimmera Heritage River

N

5,00005,000

Metres

Wimmera
Catchment Management
Authority

Waterways for Life

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Legend

Wimmera River

Highway

Arterial

Sub-Arterial

Waterways

Minor Waterways

Bridges

Wimmera Catchment
CMA Boundaries

Water Bodies

Subject to Inundation

Pondage Saltpan

Pondage Sewerage

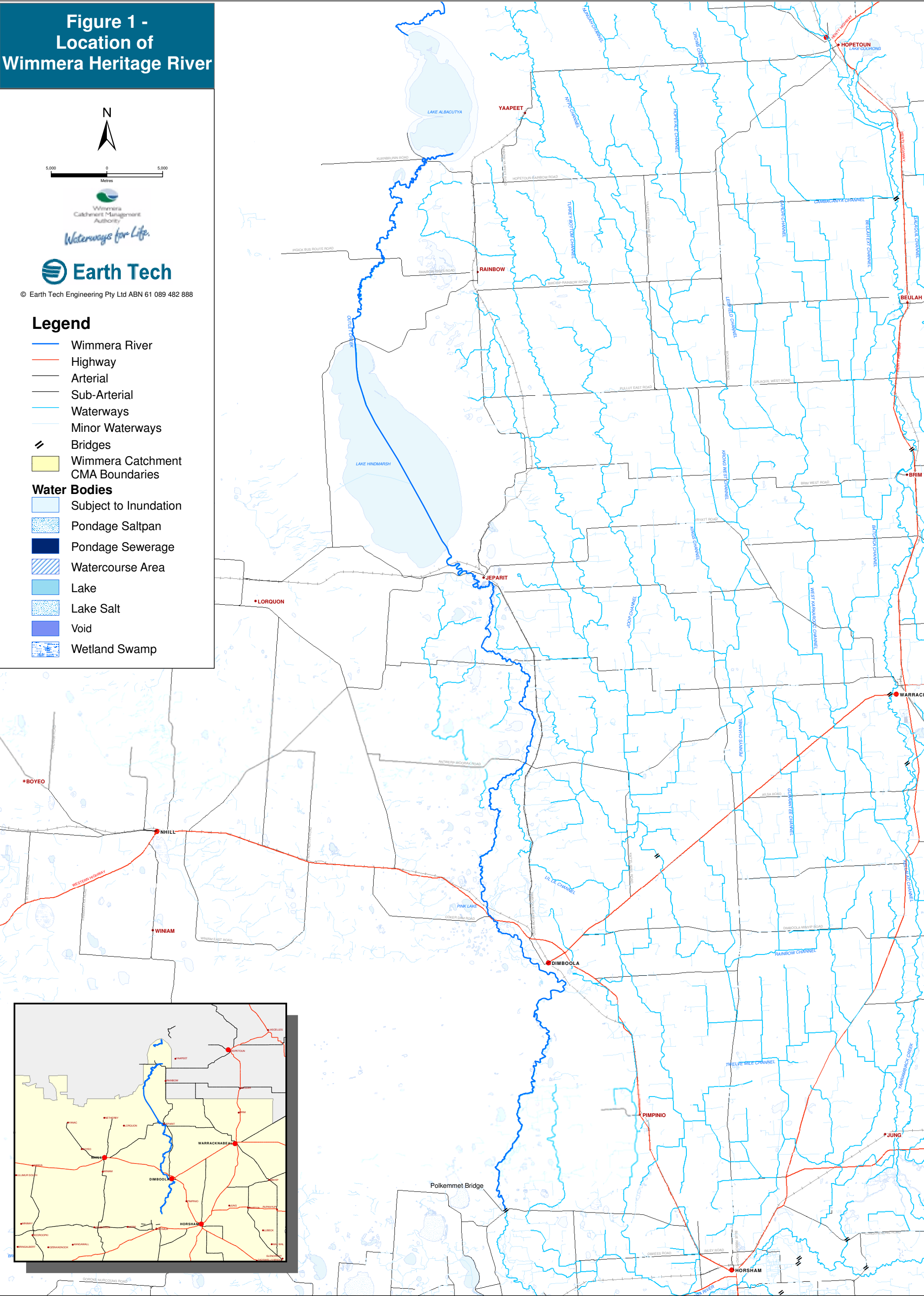
Watercourse Area

Lake

Lake Salt

Void

Wetland Swamp



INTENTIONALLY BLANK

2 Method

2.1 Background Document Review

A review of existing reports, investigations into waterway health issues and associated available data was undertaken. The aim of this process was to provide:

1. A comprehensive list of waterway health issues; This list provided the basis for data collection during fieldwork and subsequent remedial action development;
2. A list of stakeholders and community members to be consulted during the development of the plan.

2.2 Engagement of Stakeholders and the Community

Letters were sent to representatives of government bodies and authorities that play a role in the management of the Wimmera Heritage River and surrounding land, inviting them to a stakeholder meeting.

Public notices were placed in local newspapers and a letter drop was made to all roadside mailboxes within the catchment. This was undertaken at project inception to inform the community of the commencement of the project, identify opportunities for community involvement and advise people of the dates and venues for information sessions.

Consultation with interested landholders and stakeholders continued throughout the project to provide and receive feedback.

2.3 Field Assessments

In recognition that both field assessments and the management of the Wimmera Heritage River is best conducted at a reach scale, the River was divided into reaches of similar physical character. These reaches were based on those identified in ID&A (2001) and are summarised in Table 1 and is shown in Figure 2. Reach delineations within the Project Reach of the Heritage River. This provides consistency across Wimmera CMA reporting and contributes to ease of management.

Table 1. Reach delineation of the Wimmera Heritage River.

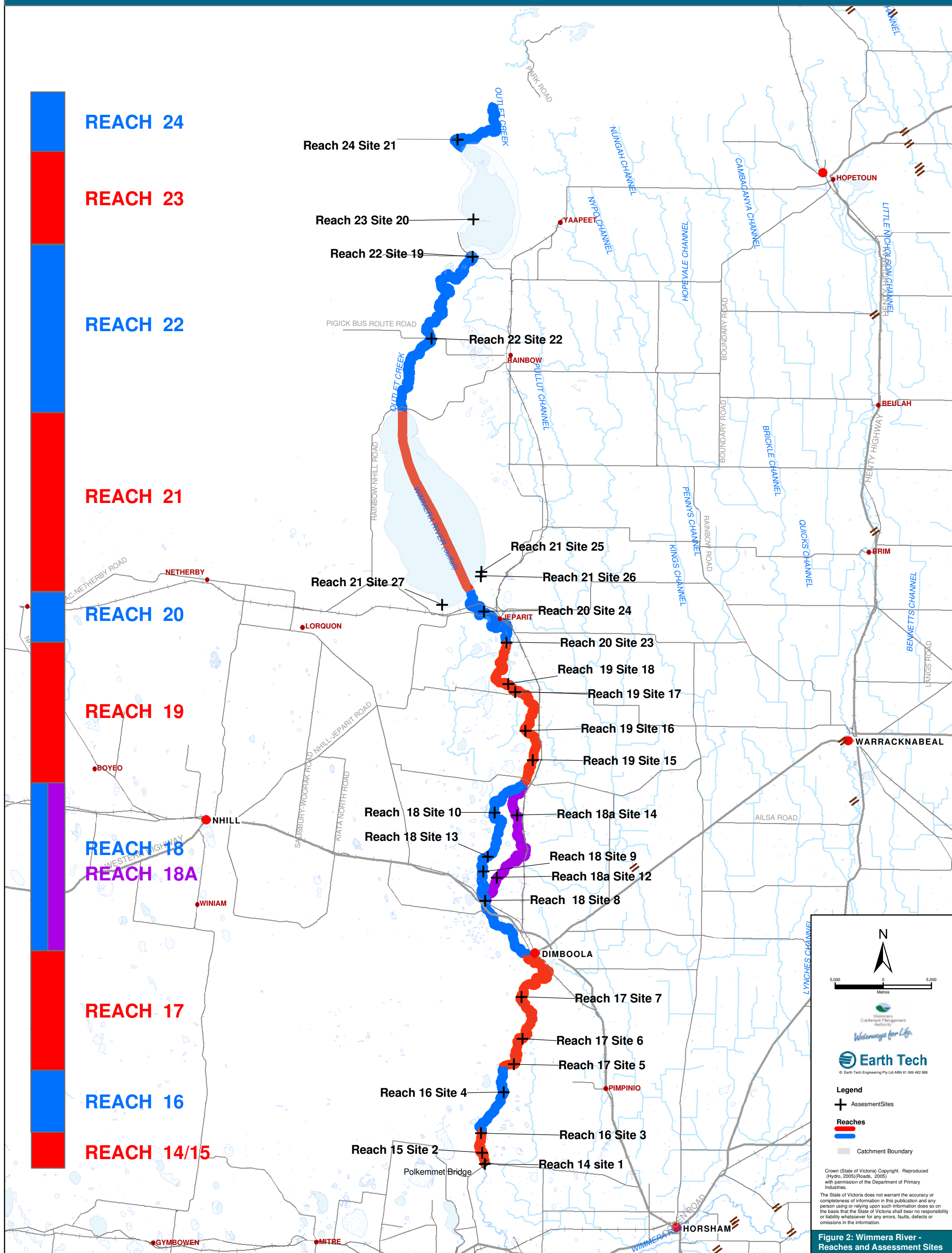
Reaches	Location
14/15*	Polkemmet Bridge to Mackleys Road
16	Mackleys Road to Ellis Crossing
17	Ellis Crossing to Dimboola (through Wail State Forest and Little Desert National Park)
18	Dimboola to downstream confluence with Datchak Creek at Antwerp
18A	Datchak Creek

Reaches	Location
19	Datchak Creek at Antwerp to just south of Jeparit
20	Just south of Jeparit to Lake Hindmarsh
21W	Lake Hindmarsh – western side
21E	Lake Hindmarsh – eastern side
22	Outlet Creek – Lake Hindmarsh to Lake Albacutya
23	Lake Albacutya
24	Outlet Creek – exiting from Lake Albacutya

* reaches 14 and 15 were combined as only a small portion of reach 14 is contained within the Heritage River.

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Reaches and SubReaches



Contemporary vegetation and extent

The field condition and extent of contemporary vegetation, including native, exotic and weed species, was assessed by a vegetation specialist. Vegetation was then described in terms of the pre-1750's Ecological Vegetation Class (EVC) for the relevant bio-region. These classes are further defined in terms of their Bio-regional Conservation Status as listed in Table 2.

Table 2. Summary of EVC Bioregional Conservation Status Definitions.

Symbol	Conservation Status	Brief Definition
X	Presumed Extinct	Probably no longer present in the bioregion (or, if present, below the resolution of available mapping)
E	Endangered	<10% of pre-European extent remains (or a combination of depletion, loss of quality, current threats and rarity that gives a comparable status)
V	Vulnerable	10 - 30% of pre-European extent remains (or a combination of depletion, decreased quality, on-going threats and rarity that gives a comparable status)
D	Depleted	>30% and up to 50% of pre-European extent remains (or a combination of depletion, loss of quality, on-going threats and rarity that gives a comparable status)
R	Rare	Rare as defined by geographic occurrence (total range generally <10 000ha, or pre-European extent in Victorian Bioregion <1000ha or patch size generally <100ha) but neither depleted, degraded nor currently threatened to an extent that would qualify as endangered, vulnerable or depleted
LC	Least Concern	>50% of pre-European extent exists and subject to little to no degradation over a majority of this area.

Source: Ecological Vegetation Class - Bioregional Conservation Status, Depletion & Tenure Area Statement on CD provided to consultants at the Native Vegetation Framework Training, September 2003.

Issues relating to the quality of vegetation, threats and opportunities are noted for each reach within the Heritage River catchment. Species lists are provided in Appendix A.

Recommendations were made on the requirement for fencing of the riparian zone to enable exclusion or controlled management of stock grazing, and comment made where possible on the condition of the existing fences. However, due to the large extent of the project, the required lengths of new or replacement fencing were not determined. A large amount of work has already been undertaken by local Wimmera CMA facilitators working in conjunction with landholders to install or renew riparian zone fencing.

Habitat quality/Stream health

Assessments of habitat quality have been provided for each of the reaches to enhance the value of the vegetation and geomorphic information collected. Two methods were used, the modified Habitat Hectares Method, also known as the Rapid Habitat Assessment (RHA) method developed by DSE to estimate vegetation quality in the riparian zone and the more comprehensive rapid in-stream habitat assessment method developed by the United States Environmental Protection Agency (USEPA) to rate in-stream habitat condition (HABSCORE). The Rapid Habitat Assessment provides an assessment of riparian vegetation condition only,

while HABSCORE gives an assessment of instream geomorphic and habitat condition. Application of both methods allows a rigorous determination of stream condition, and when repeated in the future, a means of determining if conditions at the site are changing. It also enables the assessment process to meet the Victorian River Health Strategy requirements for assessing the condition of the river for target setting (refer to section 4.3).

RHA: Modified Habitat Hectares

This method is a modified version of the Habitat Hectares Method used in more comprehensive surveys (DSE, 2005). The RHA gives an estimate of vegetation / habitat quality using the following criteria:

- Retention of large old trees
- Retention of canopy cover
- Retention of the cover of, and diversity within, understorey life forms
- Presence of appropriate recruitment
- Absence of weeds
- Litter
- Logs (in woodlands and forests)

At a particular site, native vegetation is assessed by comparing it to a benchmark which represents the average characteristics of a mature, long undisturbed stand of the same type of vegetation. The RHA therefore provides a 'snap-shot' of current vegetative habitat quality. Once current condition is established, sites may be ranked according to condition, enabling goals, minimum standards and management priorities to be formulated.

HABSCORE: USEPA habitat assessment for low gradient streams

HABSCORE is a visually based in-stream habitat assessment developed USEPA as part of their Rapid Bioassessment Protocols (RBP) (Barbour et al., 1999). HABSCORE uses a scoring system to rate in-stream and riparian habitat. It is composed of ten habitat parameters that represent aspects of the in-stream habitat that are related to aquatic life use and which are a potential source of limitation to the aquatic biota:

1. Epifaunal substrate / available cover
2. Pool substrate
3. Pool variability
4. Sediment deposition
5. Channel flow status
6. Channel alteration
7. Channel sinuosity
8. Bank stability
9. Vegetative protection

10. Riparian zone

At each site, individual parameters are assessed and rated according to a continuum of scores that represent optimal, sub-optimal, marginal or poor condition (Figure 3). A total score is obtained for each site, and provides an assessment of the ability of the habitat to support the optimal biological condition of the region. Like the RHA, HABSCORE can be used to determine an overall assessment of habitat condition at the sampling site at a point in time – current condition. Once current condition is established, sites may be ranked according to condition, enabling goals, minimum standards and management priorities to be formulated.

Although HABSCORE was developed in the United States, it is considered highly relevant for habitat assessment in Australian streams and has been adopted as part of the AUSRIVAS physical and chemical assessment protocol (Parsons et al., 2000).

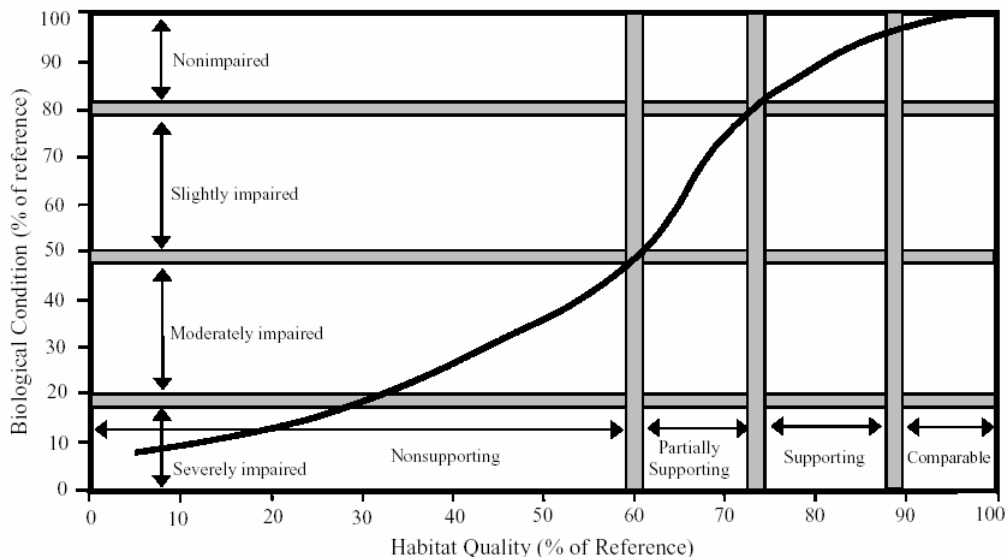


Figure 3. The relationship between habitat and biological condition. From Parsons et al (2000).

Habitat quality assessments vary along the Wimmera Heritage River and as such the results are provided on a reach by reach basis in the Sub-Reach section of this report. It should be noted that HABSCORE provides a method of assessing *in-stream* habitat quality and is not suitable for use in lake environments. Thus habitat quality scores for Lakes Hindmarsh and Albacutya are solely RHA scores. It should also be noted that the Wimmera Heritage River naturally displays relatively low sinuosity and substrate which is dominated by sands and thus it should not be expected that the optimal HABSCORE will be 200.

A summary of the field notes for the assessment undertaken in each reach are provided in Appendix B, with full copies of the field notes held by Wimmera CMA.

Reach Scores

A minimum of two sites within each of the nine identified management reaches were assessed during the field program. Each site score was then weighted by the length of the river it represents and the scores were then averaged to provide an overall score for each reach. This provides a more reliable reach score than a simple average.

Condition Trajectory

Based on observations at each site, the quality of the habitat was defined as worsening, stable or improving as a result of the rate that current land management practices are impacting on the site. The direction, or path, in which the habitat condition is moving is termed condition 'trajectory'. The condition trajectory at each site was assessed, along with the speed of movement. This was then used as part of the risk assessment process.

A worsening trajectory describes the active deterioration of habitat condition due to the effect of current management practices, while conversely an improving trajectory describes improvement in habitat condition. A stable trajectory describes the situation where current land management practices were observed to have no impact on the condition of habitat.

2.4 Risk assessment & priority setting for management actions

The information gathered during the document review, stakeholder & community consultations and field assessments was used to determine the inherent social, economic and environmental values of the Wimmera Heritage River. The processes which are threatening these values, or have the potential to threaten these values, were noted during the field assessment phases of the study. A focus has been given to the physical values of the creek in terms of habitat and vegetation quality as this is the focus for Wimmera CMA works programs.

The risk assessment conducted was a five step evaluation process which involved:

1. *Identifying the environmental assets associated with the Wimmera Heritage River and assigning them a score*

Four classes of environmental assets were identified and these were characterised by the components assessed during the field investigation (Table 3). The score assigned to the assets consisted of the class (excellent, good, fair or poor) of the reach based score as determined in the field (Appendix B, field assessment summary).

Table 3. Description of the environmental assets used in the risk assessment

Environmental ASSET	Characterised by....
Substrate	Epifaunal substrate
	Pool substrate/sediment deposition
Geomorphic character	planform/channelisation
	profile
Stream Banks	bank stability
	vegetative protection
Riparian Zone	human access/impact
	integrity of native vegetation

2. *Identifying the threats or threatening processes*

These were determined from the field investigation as being those processes which are either threatening the integrity of the environmental assets, or preventing the creek from achieving the river health targets defined in section 6.3

3. *Scoring the likelihood of the threatening process occurring*

The likelihood of a threatening process occurring was scored on a scale from practically impossible (1) to almost certain (5). The assessed likelihood of the threat occurring was based on the condition trajectory for each reach (refer section 6 and Table 4).

Table 4. Likelihood ratings

Rating	Likelihood	Trajectory
5	almost certain	worsening rapidly
4	quite possible	worsening
3	unusual but possible	stable
2	remotely possible	improving slowly
1	practically impossible	improving rapidly

4. *Scoring the consequence of the threatening process occurring*

The consequence of the threatening process occurring is based on the degree of severity of the impact on key aspects of the environmental asset. The scoring ranges from almost none (1) through moderate (3) to severe (5).

Table 5. Consequence ratings

Rating	Consequence
5	severe
4	major
3	moderate
2	minor
1	almost none

5. *Identifying the risk ranking score (RRS) and assigning a risk rating*

The risk ranking score was determined from the calculation:

$$RRS = \text{Asset value} \times \text{Likelihood} \times \text{Consequence}$$

The risk rating was assigned as being low, medium, high or very high based on the risk ranking score (Table 6).

Table 6. Risk ratings

Score	Risk Rating
<25	low
25-50	medium
50-75	high
>76	Very high

Using an asset value as part of the risk ranking score enables those areas of high priority for action to be determined. The premise is that if an area is already in poor condition, it will have a low asset value and thus its RRS will be low – regardless of the likelihood and consequence associated with the threatening process. Greater improvement to condition can be achieved by targeting those areas which have a high asset value, a concept inherent in the Victorian River Health Strategy.

Priorities for management actions were determined from the risk rating. High priority actions correspond with very high and high risk ratings. Similarly, medium and low priority actions correspond respectively with medium and low risk ratings.

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3 Management Objectives, Issues and Values

3.1 Review of Statewide and Catchment Wide Strategies

A review of reports produced by state government departments and authorities including the Department of Natural Resources (DNRE) and the Wimmera Catchment Management Authority was undertaken. The review examined the following documents:

1. Victorian River Health Strategy (DNRE, 2002)
2. Wimmera Regional Catchment Strategy (WCMA, 2003)
3. Draft Wimmera Waterway Health Strategy (WCMA, 2005)
4. Wimmera River Geomorphic Investigation (ID&A, 2001)
5. Wimmera Geomorphic Categorisation and Stream Condition Assessment (Earth Tech, 2003)
6. Water Quality Strategy (WCMA, 2002)
7. Wimmera Weed Action Plan (DNRE, 2000)

These reports may be classified as either State Wide, Catchment Wide or a River Reach Strategies. This hierarchical classification system clearly illustrates the relationships between the reviewed documents, and provides a clear pathway to the development of Waterway Action Plans. Figure 4 illustrates this relationship.

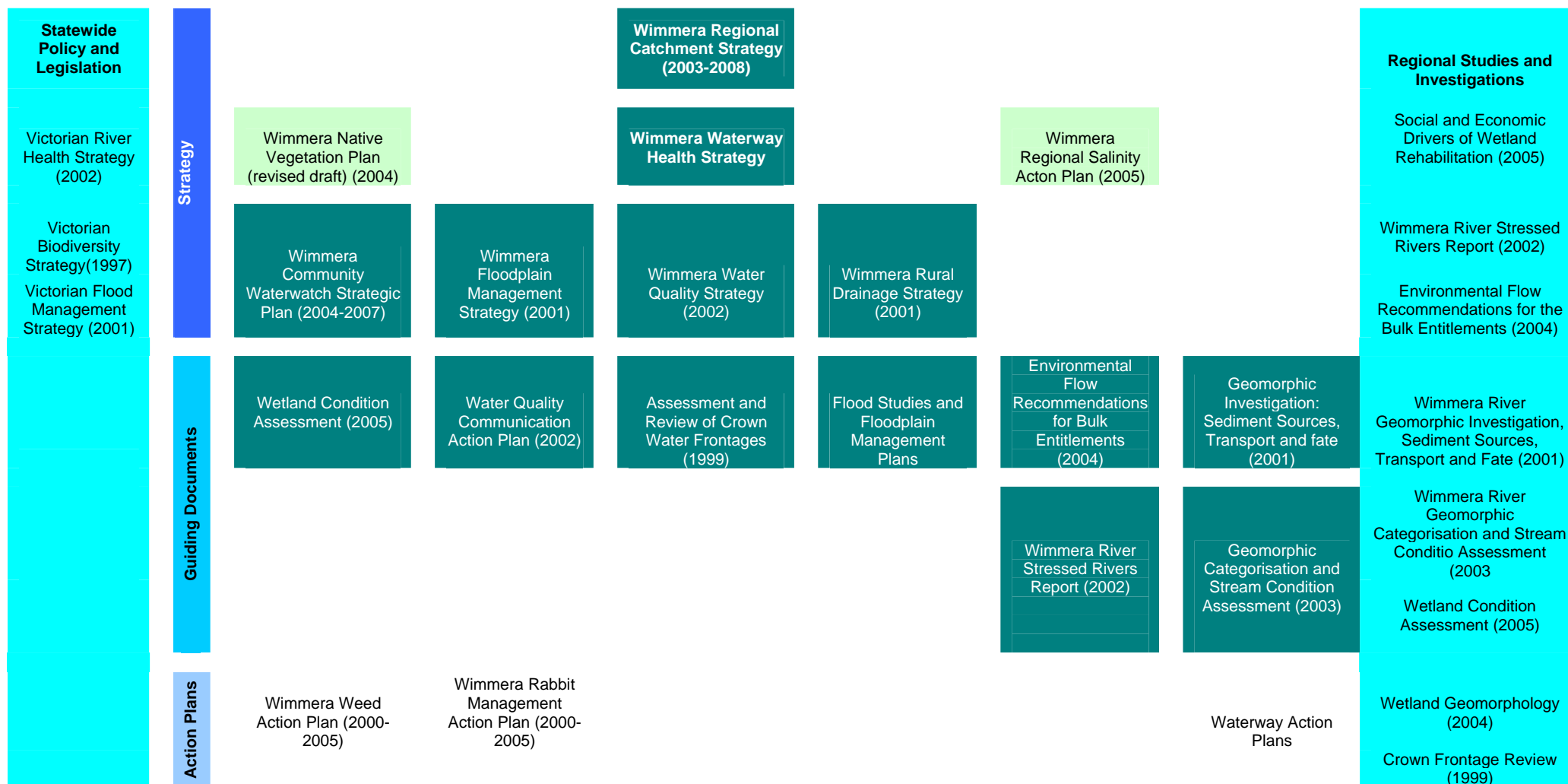


Figure 4. The framework reporting relationship for achieving waterway management goals for the Wimmera Heritage River.

3.2 State Wide Strategies

Victorian River Health Strategy

In 2002 the Department of Natural Resources and Environment produced the Victorian River Health Strategy (VRHS), a document that ‘describes the total picture for the management of rivers in Victoria’ (DNRE, 2002). This report sets out to establish a framework that will allow government to work with the community in making decisions regarding the management and restoration of Victoria’s rivers (DNRE, 2002). With its stated objective to, “*achieve healthy rivers, streams and floodplains which meet the environmental, economic, recreational and cultural needs of current and future generations*” (DNRE, 2002), the VRHS establishes a vision for river health across Victoria. It also sets out a series of targets to get there, and puts in place the mechanisms to achieve these targets. When assessing the condition of a river for target setting, the VRHS requires that the following aspects of river health are taken into account:

- environmental assets including:
 - the presence of rare species and/or communities and geomorphic features associated with the river;
 - sites of significance;
 - areas with high levels of naturalness of components of the river system including whether the river or a major river reach meets the criteria for ecologically healthy.
- economic assets including:
 - important regional industries that depend on river health;
 - town water supplies that depend on river health; and
 - public infrastructure associated with rivers; and
- social assets including:
 - important recreation sites; and
 - sites that are significant for Indigenous and European culture.

Following a determination of the condition of a river, a management approach based on the following four key elements is to be used (DNRE, 2002):

1. Protecting rivers that are of the highest community value from any decline in condition;
2. Maintaining the condition of ecologically healthy rivers;
3. Achieving an ‘overall improvement’ in the environmental condition of the remainder of the State’s rivers, and;

4. Preventing damage from future management activities.

The VRHS states that implementation of this management approach will be by:

1. Providing special protection for rivers of very high value;
2. Establishing regional five and 10 year targets for river protection and restoration through community-driven regional planning processes; and
3. Establishing policies for specific management activities aimed at preventing damage to river health from future management activities.

To determine the effectiveness of the management process regular reporting on river protection, restoration activities and resource condition monitoring is to be undertaken (DNRE, 2002). To establish a systematic approach to this reporting the Wimmera Catchment Management Authority has developed a Regional Catchment Strategy.

3.3 Catchment Wide Strategies

Regional Catchment Strategy

As a requirement of the VRHS, Catchment Management Authorities have developed a Regional Catchment Strategy (RCS) for their area. Wimmera CMA's RCS has identified river health and waterway management as a priority natural resource management issue (DNRE, 2002). Based on this the RCS has identified priority issues for rivers in the Wimmera Basin and set goals to achieve them as shown in Table 7.

Table 7. Issues affecting rivers in the Wimmera River Basin and Resource Condition Targets addressing these issues, as detailed in the WCMA Regional Catchment Strategy (WCMA, 2003).

Issue	Resource Condition Target
Altered Flow Regimes	The provision of appropriate flow regimes to sustain waterway health in the streams and wetlands of the Wimmera River Basin by 2020.
Deterioration of Water Quality	A 33% reduction in total phosphorous levels in the Wimmera River by 2030 and a 60 % reduction in algal blooms in the Wimmera River basin waterways by 2030.
Loss of Native Biodiversity	Net gain of native instream and riparian biodiversity by 2015. Reduced impact on wetlands and streams of the Wimmera River basin from invasive species by an amount to be determined by 2004.
Changed Channel Form	All stream reaches identified as being of high value and in good condition in the Draft Wimmera Waterway Management Strategy be protected by 2020. Improvement in the 'stability condition' of high value streams reaches rated as moderate by the Draft Wimmera Waterway Management Strategy protected or returned to good condition by 2020
Deficient Floodplain Management	A 20 % reduction in average annual flood damages by 2020, based on 2002 levels

Issue	Resource Condition Target
Water Use & Availability	By 2020 there will be a 20% improvement in water use efficiency within the Wimmera River basin. Sound water resource management and allocation resulting in the Wimmera River no longer classified as a stressed river by 2020.

To attain the resource condition targets detailed above, the Wimmera Catchment Management Authority has developed the Draft Wimmera Waterway Health Strategy, 2005.

Wimmera Waterway Health Strategy - Draft

The Draft Wimmera Waterway Health Strategy (2005) builds on the Wimmera RCS by identifying the environmental, social and economic values intrinsic to waterways within the Wimmera CMA region. Threats to those values are prioritised to enable clear identification and prioritisation of the required actions over the next five years. Actions are identified at program and reach levels, and include the agencies involved and cost estimates for implementing recommendations.

The Wimmera Heritage River is identified as Waterway Management Unit 12 within the Draft Wimmera WHS. The Wimmera Heritage River corridor is identified as displaying high values in the area of nature conservation, cultural heritage and recreation, however a number of processes threaten to impact upon these values (WCMA 2005). The Draft Wimmera WHS states “the majority of the Wimmera River has suffered relatively low levels of disturbance since European settlement. Riparian and instream vegetation, woody debris and geomorphic condition provide excellent habitat structure. The major issue for stream health in this part of the Wimmera River is flow.” (WCMA 2005).

The Draft Wimmera WHS also notes that “local and isolated bank erosion and anabranch development exists and needs to be monitored. The majority of the river requires protection and improved land practices” (WCMA 2005).

The Draft Wimmera WHS is comprised of four parts. Part 1 contains information about high value reaches identified within the region through assessment of data sourced from the Wimmera CMA board, Functional Committees and key stakeholders. Information from previous reports and stream assessments were also used to identify these high value reaches. The following table summarises some of the reasons behind the high value placed on these reaches (Table 8).

Table 8. Environmental and social values of the Wimmera Heritage River as identified within the Draft Wimmera WHS

Waterway	Reach	Reason
Wimmera River	1	Heritage River Status
Wimmera River	2	Heritage River status, fishing, boating, passive recreation, camping, swimming, European heritage
Wimmera River	3	Heritage River status

Waterway	Reach	Reason
Wimmera River	4	Heritage River status, fishing, boating, passive recreation, camping, swimming, European heritage
Wimmera River	5	Heritage River status
Wimmera River	53	Heritage River status
Lake Albacutya		Ramsar wetland
Lake Hindmarsh		Victoria's largest freshwater wetland

Part 2 of the Draft Wimmera WHS details waterway health programs derived from a series of issues papers that collate the existing body of knowledge relevant to waterway health. The eight key programs that have been initiated by Wimmera CMA to address waterway health issues. These programs are:

- Floodplain management
- Wetland management
- Riparian land management
- Instream and channel form management
- Environmental water-resource management
- Water quality management
- Significant Flora and Fauna
- Communications Strategy

A number of targets have been included within the Draft Wimmera WHS for all key programs except Communications Strategy to guide water resource management in the catchment, including the Wimmera Heritage River. These targets build on existing projects and management actions as well as highlighting areas for future investigation and investment.

The Draft Wimmera WHS defines three distinct target types as follows:

Aspirational Target (A): long term visions or goals to be achieved over 50-plus years.

Resource Condition Target (RC): pragmatic and achievable medium term goals (10-20 years).

Management Action Target (MA): short-term targets specific to management actions (1-5 years).

The Resource Condition and Management Action Targets identify incremental goals and actions that will direct waterway management towards the Aspirational Targets. The Aspirational Targets applicable to the Wimmera Heritage River are detailed in Table 9 below.

Table 9. Relevant Aspirational Targets for waterway health of the Wimmera Heritage River identified within the WCMA Draft Wimmera Waterway Health Strategy (WCMA, 2005)

Key Program	Target No.	Aspirational Target
Floodplain Management	A1	Floodplains of the Wimmera River Basin manage their ecosystem services while protecting social, cultural and economic assets.
	A2	Utilise flow savings from the Wimmera Mallee Pipeline to fulfill the environmental water requirements of floodplains in the Wimmera River Basin.
Wetland Management	A3	Wetlands of the Wimmera CMA region in an ecologically-healthy condition with no loss of wetland type or extent from the 1994 GIS layer.
Riparian Land Management	A4	To retain or re-establish natural riparian vegetation along all significant waterways and wetlands of the Wimmera Catchment.
Instream and Channel-form Management	A5	Preserve reaches/waterways in geomorphically pristine condition, restore high value reaches/waterways and rehabilitate degraded reaches through stability assessment, grade control, and maintenance of structures, vegetation and stock management.
Environmental Reserve Management	A6	Streams and rivers of the Wimmera system to have adequate environmental flow regimes to sustain ecosystem functions, processes and services.
	A7	Utilise the water savings from the Northern Mallee and Wimmera Mallee pipelines to meet environmental water requirements for waterways of the Wimmera catchment.
Water Quality	A8	A net increase in water quality across the Wimmera CMA region, with appropriate water quality standards met at all high-priority reaches and wetlands.
Significant Flora and Fauna	A9	Natural ecosystems, habitats and landscapes are conserved, restored, linked and managed to provide increased viability for significant flora and fauna and regional biodiversity.

Part 3 of the Draft Wimmera WHS includes specific actions identified for each high value waterway reach. The actions and corresponding priorities for Wimmera Heritage River are listed in Table 10.

Table 10: Actions and priorities identified within the WCMA Draft Wimmera Waterway Health Strategy for Wimmera Heritage River

Action	Priority
Develop and implement a Waterway Action Plan for the heritage section of the Wimmera River	High
Encourage offstream watering of stock (WWHS Reaches 4&5)	High
Encourage offstream watering of stock (WWHS Reach 2)	Low
Further research into the impacts of groundwater intrusion on waterway health	Medium
Heritage river management	High
Implement actions to alleviate the effects of groundwater intrusion	High

Action	Priority
Implement recommended environmental flows	High
Investigate and where necessary address active erosion (bed, bank and/or gully)	Low
Investigate and where necessary address physical constraints to delivery of environmental flows	High
Investigate options for restoring fish passage and where necessary address	Low
Investigate salt and water balance	Low
Riparian fencing and revegetation (WWHS Reaches 4&5)	High
Riparian fencing and revegetation (WWHS Reach 2)	Low
Understand groundwater flow system and impacts on waterway health	Low
Undertake fox management	Low
Undertake rabbit control in priority areas as per the Wimmera Rabbit management Action Plan (2004)	Medium
Undertake research into nutrient sources and waterway health sensitivities to nutrient input.	High

All the data, analysis and results that have been developed in producing the strategy are included in Part 4 of the Draft Wimmera WHS.

The Wimmera Heritage River is identified as Waterway Management Unit 12 within the Draft Wimmera WHS. The Wimmera Heritage River corridor is identified as displaying high values in the area of nature conservation, cultural heritage and recreation, however a number of processes threaten to impact upon these values (WCMA 2005). The Draft Wimmera WHS states “the majority of the Wimmera River has suffered relatively low levels of disturbance since European settlement. Riparian and instream vegetation, woody debris and geomorphic condition provide excellent habitat structure. The major issue for stream health in this part of the Wimmera River is flow.” (WCMA 2005).

The Draft Wimmera WHS also notes that “local and isolated bank erosion and anabranch development exists and needs to be monitored. The majority of the river requires protection and improved land practices” (WCMA 2005).

Wimmera Water Quality Strategy

The Wimmera Regional Catchment Strategy identified water quality as a very high priority. As a result the Wimmera CMA produced the Wimmera Water Quality Strategy (WWQS) to, “improve the quality of the Region’s water that will result in environmental, social and economic benefits to the Region” (WCMA, 2002).

The Wimmera Water Quality Strategy is to be implemented through the series of programs targeted toward the catchments and sub-catchments within the Wimmera CMA region. These catchments have been defined in terms of Nutrient Management Units, of which the Wimmera Heritage River is included in Nutrient Management Unit 8. Table 11 details the various existing programs that are relevant to Nutrient Management Unit 8 and therefore Wimmera Heritage River.

Table 11. Programs from the Wimmera Water Quality Strategy that are relevant to nutrient management in the Wimmera Heritage River (WCMA, 2002).

Program	Objective	Objective Achieved Through
Coordination, communication, education & awareness	To increase stakeholder and community awareness of and commitment to addressing water quality issues in the Wimmera CMA Region.	<ul style="list-style-type: none"> - Implementation of the Wimmera Water Quality Strategy and Communication Plan - Delivering communication, education and awareness activities.
Urban Waters	To minimise the impact of urban waters on surface, groundwater and wetlands.	<ul style="list-style-type: none"> - Training and Education - Planning - Works - Investigations
Minimising the impact of Agriculture & Forestry	To minimise the impact of agricultural and forestry practices on surface, groundwater and wetlands.	<ul style="list-style-type: none"> - Education and awareness; - Development of appropriate management practices; - Planning; and - Incentives.
Planning	To ensure that water quality is considered in the planning processes at all levels.	<ul style="list-style-type: none"> - Ensuring water quality issues are considered in statutory planning processes
Catchment and river health management	To ensure that catchment and river health management in the Region will result in improved water quality.	<ul style="list-style-type: none"> - Waterway repair and maintenance - Flow regimes - Riparian management - Catchment management

Of particular importance to the management of the Wimmera Heritage River is the recognition in the WWQS that controlling nutrients through the adoption of best management practices in primary production areas will reduce sediment entering the waterways (WCMA, 2002).

Wimmera Weed Action Plan

Like riparian vegetation along the majority of river reaches within the Wimmera CMA boundary, the Wimmera Heritage River riparian zone is subject to the threat of invasive weeds. The Wimmera Weed Action Plan (WWAP) provides direction in implementing weed control programs (DNRE, 2000). Two goals defined in the WWAP are to:

1. Prevent new and emerging weeds from establishing in the Wimmera.
2. Contain and reduce the impact of existing weed infestations in the Wimmera.

To achieve these goals the following strategies for weed management have been adopted (DNRE, 2000):

1. Develop a weed control culture in the community;
2. Prevent the establishment of new and emerging weed species;
3. Contain and reduce the impact of priority weeds;
4. Provide coordinated technical support to land managers, and
5. Develop weed prevention standards.

The WWAP allocates particular species of weeds according to one of three categories, new and emerging weeds, priority weeds and controlled weeds. The 2000 - 2005 WWAP is under review and will contain updated weed species lists. However, Table 12 provides a brief description of weed categories and a list of the weeds associated with them, from the existing WWAP.

Table 12. Weed categories and species list (DNRE, 2000)

Weed Categorisation	Species
NEW & EMERGING WEEDS Those weeds which pose a significant threat to the productive capacity and/or environmental values, and for which all know infestations can be treated within three years to achieve containment and/or eradication	African Daisy African Weed Orchid Chilean Needle Grass Long-styled Feather-Grass Prairie Ground Cherry Serrated Tussock
PRIORITY WEEDS Weeds causing economic and environmental impact. Currently well established, but restricted in the Wimmera, but pose a significant threat if allowed to spread	Bridal Creeper (Smilax) Hardheads Paterson's Curse Silver-leaf Nightshade St John's Wort
CONTROLLED WEEDS Weeds that have a significant impact on the economic, environmental and social values of the land where they grow. Often these weeds have already reached a significant proportion of their potential range. Isolated infestations of these weeds are a priority and should be eradicated where possible.	Blackberry Boneseed Cape Broom Cape Tulip (one and two leaf) Furze (Gorse) Horehound Spiny Burr Grass Wild Garlic

Vegetation assessments conducted at numerous sites along the Wimmera Heritage River reach have identified a significant number of weed species.

3.4 Catchment Wide Investigations

Wimmera River Geomorphic Investigation

The Wimmera River Geomorphic Investigation (WRGI) comprised a review and analysis of sediment processes within the Wimmera catchment. The investigation also analysed changes that have or are likely to occur in flooding, particularly in the middle reaches of the river. This report recommends that the following priorities,

based on the principles of best practice catchment management, be applied to waterway management in the Wimmera:

- Preserve areas with near pristine values;
- Restore areas of high value;
- Rehabilitate areas that place other values at risk or provide good opportunity for restoring values; and
- Maintain degraded areas to prevent values declining to unacceptable levels.

The Heritage River reach of the Wimmera River between Polkemmet and Lake Hindmarsh is covered by the study reaches 14 to 20 in the Geomorphic Investigation report, and form the basis of the reach numbering system for the Heritage River Waterway Action Plan (Table 1).

Reaches 14, 15, 16, 18, 19 and 20 were identified in the investigation as having generally good condition physical form, habitat structure and vegetation associations. The investigation recommended that management aims should be to protect high values, enhance riparian vegetation and restore flow regime. A requirement for more detailed geomorphic investigation within reach 16 was identified to determine if further works to avoid channel avulsion are required. Reaches 14, 15, 18, 19 and 20 were identified as requiring no physical form management.

Reach 17 was identified as a very high value reach of the Wimmera River, with near intact condition physical form, habitat structure and vegetation associations. Recommended management aims for this reach included protection of very high values and restore flow regime.

The investigation reported that “The majority of the Wimmera River through reaches 12 to 20 (including the Heritage River Corridor) has suffered relatively low levels of disturbance since European settlement. Riparian and in-stream vegetation, woody debris and geomorphic condition provide excellent habitat structure. The major issue for stream health in these reaches is flow.

Local and isolated geomorphic issues such as bank erosion or anabranch development do exist and should be investigated for potential works. The majority of these reaches simply require protection and improved land management practices” (ID&A, 2001).

The report also offered the following observations on flooding and sediment in the mid to lower reaches:

“Extraction of sediment, woody debris and vegetation from the river is not an effective use of WCMA resources. The analysis undertaken during this investigation shows that the occurrence of over-bank flooding is and will be similar to that which occurred prior to the regulation of the river.

The majority of sediment derived from gullying in the upper catchment is not being deposited in the river channel, in fact, the majority is not being delivered to these reaches. Mobile sediment that is seen in the channel in these reaches is in the majority from local sources, such as sand dunes.

Macrophytes such as phragmites do not have significant impacts on flooding, these plants streamline and provide very little resistance in large flow events” (ID&A, 2001).

The Wimmera River Geomorphic Categorisation and Stream Condition Assessment

The Wimmera River Geomorphic Categorisation and Stream Condition Assessment (WRGCSCA) built on the findings of the Wimmera River Geomorphic Investigation. As the name suggests, the WRGCSCA categorised stream types throughout the Wimmera River catchment. The report also provided information to assist in determining management regimes based on geomorphic characteristics and contemporary stream condition. By identifying reference sites for stream types and benchmarking stream condition at those sites a template for rehabilitation of similar stream types elsewhere throughout the catchment was produced. As a result of the investigation the Wimmera Heritage River reach was identified as a combination of anabranching fine grained and alluvial continuous stream types.

The report made the following observations on the Wimmera Heritage River:

‘Although riparian and in-stream vegetation, woody debris and geomorphic condition provide excellent structural habitat in the lower Wimmera River, its hydrology has been significantly affected by anthropogenic activities upstream’(Earth Tech, 2003).

‘Datchak Creek is a significant anabranch/flood channel of the lower Wimmera River. However, it is under significant pressure from the local agricultural industry as only a limited riparian zone buffers it from surrounding land uses. Datchak Creek retains good geomorphic condition’ (Earth Tech, 2003).

‘Lake Hindmarsh, Lake Albacutya and Outlet Creek are in reasonable geomorphic condition, though they are suffering from lack of regular flows. The flooding regimes in these systems have been changed by the significant diversion and harvesting of water in the upper Wimmera catchment. Lake Albacutya is one of Victoria’s eleven Ramsar wetlands’ (Earth Tech, 2003).

The Victorian River Health Strategy also lists the status of Lake Albacutya as “...heavily dependent on river condition” (NRE, 2002).

Important considerations for management recommended for the Heritage Wimmera River in the report are (Earth Tech, 2003);

- The retention and protection of current geomorphic form
- Improving and maintaining riparian vegetation
- Improving and maintaining in-stream features such as woody debris
- Investigation of the environmental flow requirements for Lake Hindmarsh, Lake Albacutya and Outlet Creek, with a view to returning to a flow regime similar to the natural regime for Lower Wimmera River and associated terminal systems. This work has since been completed.
- Addition of Datchak Creek to the Heritage River Corridor to increase the protection of a major geomorphic and hydrologic feature of the lower Wimmera River system.

3.5 Other Reports

Wimmera Bulk Entitlement Conversion – Environmental Flows Study

The Environmental Flow Study of the Wimmera-Mallee Bulk Entitlement Conversion Process (SKM 2003) identified the environmental flow provisions required below diversion sites in the Wimmera-Mallee Water Supply System. For each water dependent ecosystem downstream of diversion sites, this study assessed the current condition, identified the current flow management regimes, provided an estimate of the natural hydrological regime, and determined the environmental values and threats posed to those values from the current flow management practices. From this process, recommended environmental flow provisions were developed. In this study the Wimmera Heritage River was assessed as site 31 downstream of O'Brees Crossing, and the following key points were identified from the report (SKM, 2003):

- Current water management practices in the upper catchment have significantly impacted the flow regime, particularly during the summer. The primary issues impacting on environmental values at this site is the loss of small to medium flows
- The alteration of the natural flow regimes are likely to reduce the success of reproduction and recruitment events for some aquatic fauna, particularly fish
- Saline groundwater inputs are resulting in highly saline pools, particularly during periods of low flow
- Increased duration of cease to flow events exposes aquatic fauna to longer periods of stressful conditions
- A reduction of connectivity between pools and decrease in the localised water quality parameters of dissolved oxygen and salinity within the pools during protracted cease to flow events potentially having a negative impact on aquatic fauna.

The report makes the following key flow recommendations for the Wimmera Heritage River (SKM, 2003):

- A mixing flow of > 3,000ML/d should occur for at least 2 days every summer to avoid elevated salinity levels in pools during low flow conditions. The mixing flow is contrary to the natural flow regime, and should only be continued until issues of saline groundwater intrusion are resolved
- The cease to flow period should not exceed that which occurred under natural flow conditions. Cease to flow recommendations should only be implemented once saline groundwater intrusion issues are addressed
- Spring freshes of > 334ML/d and duration of at least 14 days should occur 5 times annually
- Summer freshes of > 20ML/d and duration of 7-15 days should occur 4 times annually.

Constraints to Environmental Flows

In February 2005 the Wimmera Catchment Management Authority commissioned a report to investigate the physical constraints to environmental flows (environmental water releases) (Earth Tech 2005). The report found that the Wimmera Mallee Water Supply System (WMSS) assets and operations present the most significant constraints to the provision of environmental flow delivery. Operational constraints are frequently more critical to the timing and volume of environmental water release releases, however alterations to some of the structures used to regulate flow would also be required to improve their ability to pass environmental water releases (Earth Tech 2005).

Priority river reaches where there are existing, or planned future environmental water release entitlements or allocations were also identified. The Wimmera River downstream of the McKenzie River confluence (incorporating the Heritage River reach) was included in this list of streams recommended to receive regular environmental water releases (Earth Tech 2005).

The report identified three major weirs on the Wimmera River within the Heritage River Corridor posing constraints to environmental water releases, namely:

- Dimboola Weir
- Antwerp Weir, and
- Jeparit Weir

Antwerp Weir (Figure 5) has been effectively decommissioned.



Figure 5: Antwerp weir (left) Dimboola Weir (centre) and Jeparit Weir (right).

Dimboola and Jeparit Weirs comprise pier and dropboard structures extending across the full width of the Wimmera River (Figure 5).

A number of operational issues were identified for current weir configurations that have the potential to impact on passing of environmental flows :

- Dropboards are often removed prior to floods to reduce the requirement for modification to weir operation during unpredictable flood flows. This can result in unplanned drawdown of the weir pool and modification to the flood hydrograph.
- A time lag between requests to remove boards and physical removal can severely affect the passage of environmental flow through the weirs. Temporary storage of environmental flow releases can cause significant attenuation of flow peaks.
- The discharge relationship for various dropboard removal configurations is poorly documented. Additionally, the stage-storage relationships for the weir pools are unknown.

- Locking mechanisms present on the weirs do not fully prevent adjustment by non-authorised staff, resulting in an altered weir pool height and amount of flow passing the weir.
- Vandalism of the weir structures, also resulting in an altered weir pool heights.
- It is not possible to fully 'drain' the weir pools as the concrete sill (beneath dropboard level) retains a standing body of water.

It was reported that these weirs are likely to act as physical constraints to summer and winter minimum flows. The weirs also impact on the delivery of summer and winter freshes as the operational difficulties outlined above result in significant attenuation of hydrographs passing through the system. A number of upgrade options to improve the operability of these structures under flood conditions and to improve the passage of environmental flow releases were outlined in the Constraints to Environmental Flows report (Earth Tech, 2005).

Heritage Rivers and Natural Catchment Areas – Draft Management Plans

Draft Management Plans were prepared in 1997 by NRE under the Heritage Rivers Act to set out the proposed basis for the future management of the various Heritage Rivers and Natural Catchments Areas, including the Wimmera Heritage River.

The following key values of the Wimmera Heritage River were identified in the Draft Management Plan:

Table 13. Key Values of the Wimmera Heritage River identified in the Draft Heritage River and Natural Catchment Areas Management Plan (1992)

Key Values	Description
Nature Conservation	<ul style="list-style-type: none"> -terminal lakes system is the largest landlocked drainage system in Victoria -Lake Albacutya is designated as a wetland of international significance under the RAMSAR convention -Lake Hindmarsh is the largest natural fresh-water body in Victoria and supports a number of significant bird species including JAMBA and CAMBA listed species -21 species of significant flora -significant riparian vegetation of River Red Gum-Back Box association -River Red Gums at Lake Albacutya are significant for their salt tolerance -a vital and unique wildlife corridor in an otherwise arid landscape
Cultural	<ul style="list-style-type: none"> -a long Aboriginal association with the area, with numerous middens and scar trees -Remains of Ebenezer mission
Recreation	<ul style="list-style-type: none"> -Opportunities for camping, fishing and swimming -high local significance for recreation

The key management directions contained in the plan that will maintain and enhance the values of the Wimmera Heritage River are:

- Implementation of additional measures to protect water quality and flow, including research into environmental indicators and monitoring offtake licences and fish populations
- Managing a flow regime to minimize salinity levels and dieback and which takes into account significant wetland values such as terminal lakes
- Documenting and protecting wildlife corridor values by managing public land water frontages appropriately
- Rationalizing recreation facilities and access including closing a number of tracks, discouraging ad-hoc camping and prohibiting all firewood collection other than for use in fireplaces
- Developing management plans for waterskiing zones to minimize impacts

The Management plans comprise three parts; broad Management Aims, General Management Strategies and Specific Management Strategies. A zoning scheme is also included to provide broad direction for management of different sections of Heritage Rivers and Natural Catchment Areas.

The following Management Aims apply to all Heritage Rivers:

- To protect natural, scenic, cultural heritage and recreational values
- To provide for landscape appreciation and education
- To provide for a range of recreation opportunities as permitted in accordance with land status
- To retain the river corridors free from impoundments, artificial barriers, or structures that impede the passage of in-stream fauna, except where otherwise specified
- To maintain existing water quality or improve where degraded
- To exclude timber harvesting, except as specified for particular rivers
- To manage activities which prevent re-vegetation of banks or cause bank erosion, degradation of water quality and sedimentation
- To permit exploration and mining except in accordance with land status and where heritage value may be affected.

The General Management Strategies are common to all heritage rivers where appropriate and in accordance with the underlying land status. The General Management Strategies form a basis for the Specific Management strategies. The following are issues pertaining to the lower Wimmera River addressed by the Specific Management Strategies:

Table 14. Specific Management Strategies identified within the Heritage Rivers and Natural Catchment Areas – Draft Management Plans

Management Issue		Management Strategies
Resource Conservation	-nature conservation	<ul style="list-style-type: none"> -management of FFG listed species, communities and threatening processes -ensure flooding and maintenance of an acceptable flow regime to maintain in-stream fauna, decrease salinity levels and protect against riparian vegetation dieback -Implement recommendations (Wouters, 1993) for the long-term management of dieback affected areas -monitor and consider measures to remove sand and silt build-up in the river including control reeds and Cumbungi -monitor fish populations and protect in-stream habitat including minimising barriers to fish passage and managing water quality.
	-cultural heritage	<ul style="list-style-type: none"> -assess, manage and monitor archaeological sites and liaise with Aboriginal Affairs Victoria and the Goolum-goolum Aboriginal Co-operative when undertaking works on or near the river -manage the Ebenezer mission in accordance with the approved management plan.
	-landscape	<ul style="list-style-type: none"> -protect scenic landscapes between Polkemmet and Dimboola by addressing grazing impacts and enhancing native understorey -ensure HR landscape values are considered in any planning scheme review, and that appropriate designs are applied to any structure, development or activity adjacent to the HR corridor -formalise tracks within the corridor -Encourage adjacent landholders and managers to protect landscape values near the HR corridor

Management Issue		Management Strategies
Water management	-water flows	<ul style="list-style-type: none"> -ensure that HR values are taken into account during the bulk entitlement conversion process, and then prepare a streamflow management plan for the Wimmera River -Encourage research to define environmental indicators to assist in monitoring river condition, and implement a monitoring program accordingly -ensure water savings from pipelining open channels is managed for the greatest environmental benefit -ensure future water demands are carefully planned and impacts on HR values are fully assessed -ensure construction and operation of licensed domestic and stock offtakes does not impact on HR values -ensure water trading takes into account HR values -ensure in-stream barriers do not impede passage of in-stream fauna. Investigate the potential of installing fish passage at the Dimboola Weir -ensure an EIS is submitted for any proposal for Ross Lakes. -support the Wimmera-Mallee Water buy-back of irrigation licenses
	-Outlet creek system	<ul style="list-style-type: none"> -work towards achieving a more appropriate flooding regime for the terminal lakes as a priority in accordance with Binnie and Partners (1991), RWC (1993) and the Mallee Parks Management Plan (NRE1996c) -maintain existing flooding regimes for the lower Wimmera River and investigate opportunities for more frequent flooding
	-removal of woody debris	<ul style="list-style-type: none"> -maintain instream habitat as far as possible. Assess de-snagging proposals in accordance with the FFG Act and LCC Recommendations (1991). Assess the effectiveness of de-snagging and consider the importance of woody debris and reeds as faunal habitat. -license any clearing of river obstructions.
	-water quality	<ul style="list-style-type: none"> -finalise and implement the nutrient management strategy -complete and implement the Wimmera Salinity Management Plan -Review the SEPP to reflect characteristics of an internal drainage system -continue water quality monitoring programs -manage water quality in accordance with the Integrated Catchment Strategy (WCCG, 1992) and the Regional Catchment Strategy (Wimmera Regional CaLP Board, 1997)

Management Issue		Management Strategies
Stream frontages		<p>do not issue new licenses for the PLWF areas for grazing or for any uses not compatible with the HR corridor status, ensure that naturally vegetated PLWFs are retained as uncleared.</p> <ul style="list-style-type: none"> -manage PLWFs above Lake Hindmarsh as a habitat corridor, in accordance with Thomson Hay and Associates report (1996a, 1996b) -manage PLWFs between Lake Hindmarsh and Lake Albacutya by enhancing habitat corridor values, maintaining fencing, rationalising the track system and controlling introduced plants and animals
Resource protection	-fire management	<ul style="list-style-type: none"> -develop a fire protection plan for the river. Do not burn unless for ecological purposes. Use strategic burning of areas near Lake Hindmarsh to protect recreation areas -wherever possible undertake fire protection measures other than burning to protect Red Gum/Black Box communities -conduct fire management practices in accordance with the relevant fire protection plans.
	-Introduced plants and animals	<ul style="list-style-type: none"> -manage introduced plants and animals in accordance with the relevant plans, with priority action against Radiata Pine, Early Black Wattle, Smilax, Horehound, Cactus and Olives. Continue to control rabbits and foxes. -Develop an integrated and co-operative approach with adjacent landholders, local government and land managers to introduced plant and animals management. -monitor effects of Carp and other non-native fish on water quality, and control measures as necessary.
Visitor Use	-tourism	<ul style="list-style-type: none"> -manage for tourism in accordance with the Mallee Tourism and Recreation Strategy (CNR, 1993f) -manage the Park sections of the HR corridor in accordance with the Tourism sections in the Mallee parks Management Plan (NRE, 1996c), and the Little Desert NP Management Plan (NRE, 1996f). Extend these strategies to the entire HR corridor. -encourage appropriate promotion and protection of HR values by commercial operators, and include the Wimmera River in promotional material for the area.
	-access	<ul style="list-style-type: none"> -rationalise the existing track network in consultation with the community and formalise retained tracks -implement seasonal closures as necessary to prevent damage to roads and HR values -consider closing tracks around the eastern side of Lake Hindmarsh to protect intact vegetation

Management Issue		Management Strategies
	-visitor activities and facilities	<ul style="list-style-type: none"> -manage visitor facilities within National and Regional Parks in accordance to relevant park plans -monitor recreation along the HR corridor for impact on river values and conflicts with other users -develop current and future recreation sites and facilities in appropriate locations away from the river banks, discourage camping in remaining areas -develop a recreation management plan for Lake Hindmarsh in accordance with its land, Ramsar wetland and HR status. -develop a management plan for the water skiing zones on the River, and continue to liaise with Hindmarsh Shire, water skiing clubs and the local community in relation to management of the water ski zones. -seek to make NRE the Motor Boating Authority for the HR reach -provide for fishing opportunities consistent with protection of the HR status -minimise impacts of firewood collection by providing alternative facilities, encouraging alternate sources of fuel and educating about the impacts of excessive firewood collection.
	-visitor information and interpretation	<ul style="list-style-type: none"> -provide education, information and interpretation in accordance with the relevant Park management plans, and extend these strategies to incorporate the entire HR corridor -provide interpretive material at Lake Hindmarsh to raise awareness of its natural values and promote minimal impact camping
Utilisation	-utilities and energy	<ul style="list-style-type: none"> -encourage consultation with NRE prior to works approval for maintenance or construction of any structures adjacent to or within the HR corridor, giving particular consideration to land capability and visual effects -manage any existing and potential utilities and survey in accordance with LCC Recommendations (LCC 1991)
	-grazing	<ul style="list-style-type: none"> -do not issue any new grazing licences within the HR corridor -remove grazing from known sites of bank degradation and revegetate -consider prohibiting grazing in PLWF areas with identified flora, fauna, recreational or archaeological value; with intact understorey vegetation; with salinity or dieback issues; or with frontage assessed as 'good' condition -phase out grazing on Lake Albacutya in accordance with the Mallee Parks Management Plan (NRE 1996e)
	-firewood harvesting	<ul style="list-style-type: none"> -review NRE firewood harvesting permits between Weddings Falls and Lake Albacutya -prohibit firewood harvesting in the remaining HR corridor -prior to assessment, continue firewood harvesting permits in accordance with LCC 1991. -encourage local landholders to establish woodlots for firewood use.

Management Issue		Management Strategies
	-commercial fishing	-monitor commercial yabbing in Lake Albacutya and commercial fishing in Lake Hindmarsh and manage in accordance with HR values.
	-mineral and stone production	-manage mineral, sand and stone production in accordance with LCC 1991. -investigate alternative road material sites outside the parks.
Community awareness and involvement		-encourage and support community groups within the region to undertake works and be involved in co-operative programs within the HR corridor -continue to promote HR values within the local community
Threatening processes outside the Heritage River corridor		-manage land degradation problems in accordance with the Wimmera Landcare Plan (CNR 1993b), Integrate Catchment Strategy (WCCG 1992) and the Regional Catchment Strategy d

3.6 Summary of Recommended Priorities & Actions from Existing Reports & Investigations

The hierarchical system of reviewed reports only starts to focus on issues relating specifically to the Wimmera Heritage River at the Catchment Wide Strategy and Investigations level. As such, Table 15 summarises the findings of these lower level reports, thereby providing a focus for the field investigations and content of the Heritage River Waterway Action Plan.

Table 15. Summary of priorities and actions from existing studies that include the Wimmera Heritage River

Report Name	Priorities
Draft Wimmera Waterway Health Strategy	<ul style="list-style-type: none"> - Investigate and where necessary address the impact on waterway health due to erosion and salinity - Investigate physical constraints to delivery of environmental flow - Investigate options for restoring fish passage - Improve bank stability and riparian vegetation through fencing and revegetation - Control pest weed and animal species - Undertake research into nutrient sources and waterway health sensitivities to nutrient input
Wimmera Water Quality Strategy	<p>Rural reaches of Wimmera Heritage River</p> <p>Minimise impacts of agriculture by:</p> <ul style="list-style-type: none"> - Education and awareness; - Development of appropriate management practices; - Planning; and - Incentives <p>Urban Reaches of Wimmera Heritage River</p> <p>Minimise urban impacts by:</p> <ul style="list-style-type: none"> - Training and Education - Planning - Works
Wimmera Weed Action Plan	Address weeds based on categorization as either New & Emerging, Priority or Controlled.
Wimmera River Geomorphic Investigation	<ul style="list-style-type: none"> - Preserve areas with near pristine values - Restore areas of high value - Rehabilitate areas that place other values at risk or provide good opportunity for restoring values
Wimmera River Geomorphic Categorisation & Stream Condition Assessment	<ul style="list-style-type: none"> - Restore flows that mimic natural flow regimes - Identify risks of sediment input and stream incision\ - Monitor to assess changes in waterway condition
Wimmera Bulk Entitlement Conversion – Environmental Flows Report	<ul style="list-style-type: none"> - Restore aspects of the natural flow regime including maximum summer cease-to-flow periods, minimum winter flows and both summer and winter freshes

Report Name	Priorities
Physical Constraints to Environmental Flows	-Undertake works to remove or reduce constraints to delivery of environmental water releases to protect / restore high value assets, with the Wimmera River downstream of Glenorchy as a priority.
Habitat & Biodiversity Restoration Plan for Wimmera Heritage River	<ul style="list-style-type: none"> - Restore flows - Protect creek and wetland from stock access - Remove rubbish from the stream zone - Install Large Woody Debris to provide geomorphic and habitat diversity - Remove impediments to flow & fish passage - Control weeds - Revegetate the streamside zone where required

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4 Stakeholder & Community Issues

For the purpose of the Heritage River Waterway Action Plan, Stakeholders are considered to be organisations and authorities that play a role in the management of the Wimmera Heritage River. The Community is considered to be those members of the public who derive their occupation, reside alongside or otherwise utilize or maintain an interest in the amenity of Wimmera Heritage River.

4.1 Stakeholder Issues

To gain the input of Stakeholders in the management of the Wimmera Heritage River a meeting was held on the 25th of July 2005 at the Dimboola Rowing Club rooms. Representatives of the following organisations attended and provided the input detailed below:

GWMWater

- Increased environmental water release will effect landholder crossings. Crossings should be identified during the community meetings and decisions made on those requiring upgrading.
- The river needs to be managed to handle the increased environmental water releases, in particular a plan is required for the transition from current flow regime to full environmental water release allocation.
- Antwerp weir is now decommissioned. The structure has been retained for its heritage value but most of the drop boards and a central board support have been removed.

Department of Sustainability & Environment

- Lake Albacutya used to fill approximately every 25 years, and Lake Hindmarsh used to dry out approximately once every 2 years.
- Motorbikes and 4WDs are degrading the riverbanks, particularly on the eastern bank from Ellis' crossing to Big Bend near Dimboola.
- Transport of weeds via vehicles is a problem. Bridal Creeper, olives, apples, pears and cactus are some of the weeds that occur along the river.
- Rabbits and carp are pest animals along the river reach.
- Rubbish dumping occurs within the riparian zone.
- Dirt roads on the western side of the river are too close to the top of bank and are a possible source of sediment to the river.
- Grazing of the riparian zone occurs along the whole river length, and overgrazing is typical.
- A D7 dozer was used to clear phragmites from 4.5 kilometers of the river channel downstream of Dimboola in the early 1980's, and subsequent floods washed the sediment and phragmites rhizomes from the floodplain back into the river

Hindmarsh Shire Council

- Need to manage the river for social aspect.
- Farmers have voiced concern that Datchak Creek may become a new river under the higher environmental water release regime.
- Loss of crop revenue due to flooding has potential for greater impact in the current economic climate than it has in the past.
- Farmers have mentioned litigation if their crops are lost due to flooding resulting from river blockages. Farmers are quite happy to accept flooding that occurs from high rainfall events – events of a magnitude that have historically caused floods. They will not accept flooding stemming from rainfall events that the river would normally be able to convey with a clear flow channel. Farmers would probably accept a flooding period of 1 in 3-5 years.
- Blockages need to be removed to encourage flow to remain within the existing banks for all but the largest floods.
- High nutrient levels in the river stem from poor land management practices. Buffer zones along the river may help to minimise nutrient loads into the river.
- With whom does the responsibility rest to undertake works on the river?
- Environmental water releases are to commence within 2 years, with volumes then increasing. A recent environmental water release of 56ML/d raised the water level to within 5 feet of top of bank just downstream of Dimboola.
- Many blockages are due to sand slugs colonised by phragmites. Flood events bend the vegetation over, but cannot scour the slug due to the densely matted root zone.
- Specific locations of sediment bar colonisation such as downstream of the Dimboola Weir are of concern.

4.2 Community Issues

To gain the input of community in the management of the Wimmera Heritage River meetings were held on the 25th of July 2005 at the Dimboola Rowing Club rooms, and on the 26th July at Jeparit Hall. Follow up meetings were held at the same locations on the 17th and 18th of November 2005 to hear comments on the draft report. All meetings were attended by interested community members who readily provided historical and contemporary information regarding issues, concerns and aspirations regarding the management of the heritage river reach of the Wimmera River. Following the meeting a number of people provided further information in the form of historical documents and hand written notes expressing their thoughts on the direction and focus of the Waterway Action Plan. Table 16 provides a summary of community values, aspirations and comments expressed at the meeting.

Table 16. A summary of community values and comments expressed at the community meetings.

Community Values	Comments
Environment	<ul style="list-style-type: none"> -Deep river holes at Antwerp have infilled. -Outstanding natural scenic landscapes. -River provides a focus for passive recreation in a dry area. -Very little fall in channel between Dimboola and Spears Crossing. -Tree plantations in the Glenelg River catchment are reducing flow in the river. Water will be diverted from the stock and domestic system into the Glenelg River to maintain environmental water releases.
Amenity	<ul style="list-style-type: none"> -Used for birdwatching, rowing and canoeing, swimming, camping, remnant native vegetation, stock and domestic water supply -Urban development along river due to nice environment.
History	<ul style="list-style-type: none"> -Rowing Regatta at Dimboola has a 121 year history, particularly important now as other regattas impossible due to dry/low waterbodies.
Environmental Flow	<ul style="list-style-type: none"> -Not natural to have high flow during summer, should be in spring. Under an environmental water release regime the river should be dry during summer. -Increased flooding due to environmental flows a concern for farmers with cropping on the floodplain.
Lack of Flow	<ul style="list-style-type: none"> -Jeparit fishing competition cancelled due to lack of flow. -River used to flood every 7-8 years, hasn't flooded for 15 years.
"Blockages"/Flow Obstructions	<ul style="list-style-type: none"> -Reed growth within the river channel increased greatly due to nutrient supply from raw sewerage discharges into river at - Horsham until late 1970s -Community-based channel cleaning used to work quite well. -Need to start any channel clearing from the Lake Hindmarsh end, preferably before environmental water releases are implemented while flows are low. Channel-wide obstructions in particular should be targeted.
Landholder crossings	<ul style="list-style-type: none"> -Wundersitz and Spears crossings are usually used by agricultural machinery that is too wide and slow to use the highway bridge.
Commercial	<ul style="list-style-type: none"> -Lake Hindmarsh used to support 17-18 professional redfin fishermen -Lake Albacutya supports a eucalypt nursery that breeds the highest salt tolerant River Redgums in Australia -A healthy river is an enormous asset to the community and draws in the tourist dollar. Towns without a waterbody are bypassed by tourists.
Motorbike and 4WD Access	<ul style="list-style-type: none"> -Motorbikes and 4WDs access and degrade the bed and banks. -Vehicle access gained through cutting fences, pushing gates over.
Sporting Use	<ul style="list-style-type: none"> -Canoeing becoming harder due to blockages by reeds -Speedboats prohibited at Horsham, many people travel to Dimboola to ski as only permanent water in area. -Too many speedboats on the river. -Speedboats and Heritage River don't go together -Authorities exercise very little control over speedboats
Erosion	<ul style="list-style-type: none"> -Speedboats are causing erosion of the banks -Erosion also occurring downstream of the weirs, so can't all be attributed to speedboats

Community Values	Comments
	<ul style="list-style-type: none"> -Erosion being caused by diversion of flow around blockages -Incidence of well worn tracks and camping spots increasing -Trails bikes are causing erosion at Big Bend at the southern end of the Wail Forest camping area.
Sediment	<ul style="list-style-type: none"> -Sediment due to speedboats could be washed down river during floods. -Flood events cannot move deposited sediment colonized by phragmites due to the matted root systems.
Vegetation/Weeds	<ul style="list-style-type: none"> -Water cress in the Dimboola weir pool -Phragmites viewed as an invasive weed. Intensive plantings in the upper catchment in the 50's, 60's and 70's has led to spread downstream. -In 1940's phragmites did not exist in river upstream of Dimboola. -Oversupply of nutrients from sewerage discharges encourages weed growth. Discharges created nutrient rich sediments. Horsham still discharges to the river in wet years. -Water ribbons and pond weed are both present. Pond weed probably from channels. -Most beaches are now lost to vegetation encroachment. -Weeds encroach into the channel and pools when weir boards are dropped for environmental water releases or to allow for evaporation. -Emergent vegetation growth on the dry eastern bed of Lake Hindmarsh.
Water Quality	<ul style="list-style-type: none"> -Algal blooms are not a regular occurrence, and usually linked to sewer discharges. -High nutrient levels in the sediments are due to historic sewerage discharges from Horsham, sediments have an offensive smell. -Speedboat traffic increases turbidity. -Saline groundwater seepage to the river occurs in a couple of locations. -A number of people have had health complaints attributed to swimming in the river.

Feedback was also gained from some community members during a day of fieldwork spent with Earth Tech inspecting particular issues of concern, and during post fieldwork telephone discussions. This feedback can be summarised as follows:

Table 17. Further issues raised during and after fieldwork.

Further Issues	Comments
Waterskiing	<ul style="list-style-type: none"> -Concerns that Dimboola Waterski Club cast as scapegoat for bank erosion issues. -The section of the river used for waterskiing has been gazetted for many years as open speed -the river is open to all users, both active and passive. -Ski club abides by its own incorporated rules, as well as the rules of the shire and government rules and legislation. Ski

Further Issues	Comments
	<p>club has banned wake enhancing devices and use of unmuffled boats.</p> <p>-A compromise on the regulated top water level for the Dimboola weir pool was reached between irrigators, the Dimboola Rowing Club (both requesting as high as possible) and the ski club (preferred lower to avoid impact of wash on sensitive areas near top of bank). This level was set at 1.9m, and ski club subsequently spent time sourcing reeds from Pump Corner and planting in trenches along the banks at this level. These reed beds are high and dry due to drought and have died off.</p> <p>-Concerns about skiers who are not members of the club, or who are not local, not being aware of or abiding by rules and regulations. Comparison made with Jeparit Ski Club where membership is required to be able to use skiing zone of river. Skiers camp at Horseshoe Bend and then ski towards Dimboola.</p> <p>-Ski club does not see its role as policing the shire and government rules and regulations.</p> <p>-litter, pollution by fuel and oil ingress to the river</p> <p>-danger of boat wakes to canoeists</p> <p>-clearing of bankside vegetation for better access</p> <p>-powered watercraft breaking speed restrictions, operating at dusk or after dark, operating too close to children, and not keeping boating regulations separation distance.</p> <p>-Concerned that abiding by regulations not policed.</p> <p>-Native animals disappear over the summer months due to noise.</p> <p>-Dimboola Ski Club unable to control saturation of ski traffic due to drying of recreational lakes in region.</p> <p>-Constant boat wash increases evaporation from the river, has caused undercutting of the bank during previous high water levels and the flat sandy bed during the more recent low flow periods. Boat wash has also caused the banks to recede at least 2 metres in the last 30 years</p> <p>-Dimboola Ski Club has only shown interest in revegetation as a reluctant result of addressing community concerns</p> <p>-Dimboola Ski Club rule that boats need to be “appropriately” muffled cannot be enforced as there is no stated threshold noise level or instrumentation to check for compliance.</p> <p>-Upstream end of the ski zone requires close monitoring, as use has increased due to its greater depth.</p> <p>-Amazing that ski club can argue that waterskiing has no detrimental effect on the stability of the riverbanks, yet proudly advertise attempts at erosion control</p>
Management Authorities	<p>-turnover of staff and subsequent loss of knowledge and history of the issues pertaining to the Wimmera River</p>
Trailbikes and 4WDs	<p>-Trail bikes in organised groups ride along the river into the state forest, and chop up the riparian zone.</p> <p>-4WDs and motorbike access along river damaging riparian zone.</p>

Further Issues	Comments
Public Access	-Hoon activity in carparks and camping areas scare off campers.
Phragmites	<ul style="list-style-type: none"> -An unnatural nutrient cycle has commenced where the vigorous growth and subsequent dieback of phragmites releases vast amounts of nutrients into the river that fuels the next growth cycle -Phragmites uses large amounts of water during the growth phase which wastes valuable environmental flow allocation -Value of phragmites as faunal habitat is questionable, as the reeds colonise areas of shallow open water formerly used by wading birds -serious blockages caused by the phragmites downstream of Polkemmet Bridge -Phragmites blockages at Adam's waterhole and between Lochiel Bridge and Wundersitz Crossing. -Would like to see the phragmites clearing works of the early 1980's repeated -cutting a drain through the bottom of the river channel will not fix the problem by itself - renowned white sandy beaches that existed years ago now fully colonised by phragmites - Concerns about the navigability of the river by canoeists due to phragmites encroachment -Must balance river natural state with requirements of users i.e. maintain a channel -Concerns about phragmites colonising/choking the sandy reaches, think harvesting is required to remove reed growth and nutrients from sediments -Harvesting of reeds has been used elsewhere to lower high nutrient levels in aquatic environments -Reed harvesting would reduce the amount of decaying vegetative material releasing nutrients into the river, and would gradually strip the nutrients out of the sediments to the point where further recruitment of phragmites would slow or cease.
Pond weed	<ul style="list-style-type: none"> -Dimboola Rowing Club has hired weed cutting boats for 0.5 day in 2001, 1.5 days in 2002, 3.5 days in 2003 and 2.0 days in 2004. -closes down the rowing course from 3 lanes wide to one lane wide, and grabs the oars making rowing difficult. -may not have been apparent at time of fieldwork inspections as was during the winter dieback period. Re-inspection during Nov-Dec warranted.

4.3 Waterway Action Plan Objectives for the Wimmera Heritage River/Overall Waterway Management Targets

The Aspirational Targets contained within the Draft Wimmera Waterway Health Strategy were deemed to encompass the concerns and aspirations of stakeholders and the community. These targets have been used in Section 6.1 of the report to define the actions necessary to maintain or improve the health of each reach of the Wimmera Heritage River. These key waterway health targets for the Wimmera Heritage River are detailed below (Table 18).

Table 18. Key Waterway Health Targets for the Wimmera Heritage River.

Target
A1. Floodplains of the Wimmera River Basin manage their ecosystem services while protecting social, cultural and economic assets.
A2. Utilise flow savings from the Wimmera Mallee Pipeline to fulfill the environmental water requirements of floodplains in the Wimmera River Basin.
A3. Wetlands of the Wimmera CMA region in an ecologically-healthy condition with no loss of wetland type or extent from the 1994 GIS layer.
A4. To retain or re-establish natural riparian vegetation along all significant waterways and wetlands of the Wimmera Catchment.
A5. Preserve reaches/waterways in geomorphically pristine condition, restore high value reaches/waterways and rehabilitate degraded reaches through stability assessment, grade control, and maintenance of structures, vegetation and stock management.
A6. Streams and rivers of the Wimmera system to have adequate environmental flow regimes to sustain ecosystem functions, processes and services.
A7. Utilise the water savings from the Northern Mallee and Wimmera Mallee pipelines to meet environmental water requirements for waterways of the Wimmera catchment.
A8. A net increase in water quality across the Wimmera CMA region, with appropriate water quality standards met at all high-priority reaches and wetlands.
A9. Natural ecosystems, habitats and landscapes are conserved, restored, linked and managed to provide increased viability for significant flora and fauna and regional biodiversity.

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5 Heritage River Catchment

5.1 Catchment description

The Wimmera River is a terminal river system located in central western Victoria. The headwaters of the Wimmera River rise in the Grampians and Pyrenees Ranges of western and central Victoria. The river flows in a north-westerly direction towards Horsham receiving several major tributaries that drain the northern slopes of the Grampians. No significant tributaries join after Norton Creek west of Horsham where the river turns north, flowing past Dimboola and terminating, for the majority of the time, in Lake Hindmarsh. When Lake Hindmarsh fills, it spills through Outlet Creek to Lake Albacutya and in exceptionally wet periods, Lake Albacutya overflows to a series of smaller lakes further north in the Wirrengren Plain. The last time Lake Albacutya overflowed and reached the Wirrengren Plain was 1918 (Bren & Sandell, 2004).

From Polkemmet Bridge, approximately 40 river km downstream of Horsham, through Lakes Hindmarsh and Albacutya to the lakes of the Wirrengren Plain, the river has been listed as a Heritage River by the Land Conservation Council (1991).

Geological and Geomorphic History

The lower Wimmera catchment, through which the Heritage section of the Wimmera River flows, is underlain by sediments laid down during the Tertiary (5-65 Ma) and Quaternary (0.01 – 5 Ma) geological periods. The landforms we see today are the result of the way in which these sediments were deposited (during the marine incursions of the Tertiary period) and their subsequent reworking by wind and water once sea levels receded (during the Quaternary period).

During part of the Tertiary period, most of the lower Wimmera catchment was covered by sea water which deposited a broad sandy plain, known as the Parilla sands, across this area. Advancing and retreating shorelines during the late Tertiary created a series of strandline ridges in the Parilla sands and the Heritage section of the Wimmera River flows through a NS trough between these strandline ridges.

The Parilla sands have formed a weak sandstone in most areas and outcrops are seen along the western banks of the Wimmera River from Duchembegarra through the Little Desert National Park. The deep red-brown colour of these outcrops is the result of iron oxides binding the sandstone together.

From Polkemmet Bridge to Duchembegarra on the western side, the extent of the active floodplain is controlled by the presence of erosion resistant terraces of the Shepparton formation. These fluvial silts and sands overlay or abut higher relief area of the Parilla sands.

During the late glacial events of the Quaternary, the Parilla sands became the supply for a series of aeolian (wind created) landforms. In particular the Lowan formation, which makes up the erosion prone dune fields of the Little Desert National Park, comprises pale white siliceous sands derived from the Parilla sands.

The Wimmera Heritage River intersects the Lowan formation as it travels along the edge of the Little Desert National Park.

The relatively stable reddish brown linear (west-east) dunes of the middle Wimmera catchment are known as the Woorinen Formation. These are most pronounced in the landscape where they are superimposed on the underlying Parilla sands ridges. The Woorinen formation dunes occur along the east side of the Wimmera Heritage River alluvial corridor from Vectis East until interrupted by the Lowan formation and then along both sides north of Dimboola to Lake Hindmarsh.

The Wimmera Heritage River intersects several lunette lake basins between Dimboola and Antwerp before terminating in the large lunette lakes of Hindmarsh and Albacutya. The formation of these lunette lake basins is associated with oscillations in hydrologic regimes during the Quaternary period. The lake basins are usually kidney shaped and are typically formed in the troughs created between the strandline ridges in the Parilla sands. Lunette ridges (crescent transverse dunes) are usually formed on the eastern side of the lake basins and the western (windward) margins of the lakes often display a sharp break of slope representing an ancient or modern shoreline cliff. The most obvious of these is the 4m high sandstone cliff on the western margin of Lake Hindmarsh.

The majority of the present Wimmera Heritage River is a continuous alluvial river. It often has multiple channels (anabranching), generally has low sinuosity and is low to very low in gradient. The active channel is moving through and reworking sediments known as the Coonambigdal formation and, for the most part, channel adjustment is occurring at relatively slow rates. From Polkemmet Bridge to Duchembegarra, lateral migration is confined by the Shepparton formation but in the lower reaches, the river is flowing through sands sourced from the local dune formations and the river is considered to be laterally active.

Hydrology

The Wimmera Heritage River flows through an area which can be described as semi-arid. Under natural hydrological conditions, the River would have derived the majority of its water from the upper catchment and flows would have been highly variable. The Heritage section of the River would have been intermittent, experiencing extended periods of cease to flow with the river contracting to a series of pools. The river would also have experienced a broad range of floods.

The Wimmera River has been regulated for irrigation, stock and domestic supply since the 1840's and as a result the flow regime of the river has been substantially altered. The greatest impact has been on low to moderate discharges (SKM, 2003) which are those flows which would have connected the pools and maintained the channel.

From SKM 2004: Assessment of environmental flow requirements

- The frequency of cease to flow events has increased
- Minimum flows are greatly reduced
- The frequency of summer and winter freshes is reduced

Vegetation

The section of the Wimmera River from Polkemmet Bridge through to the eastern edge of the Little Desert National Park is rich, diverse and generally in excellent condition. The riparian River Red Gums are largely healthy although signs of dieback were noted at a number of the assessment sites. Behind the Red Gums is a mixture of Riverine Chenopod Woodland and Heathy Woodland with numerous areas a mixture of all different communities together, with occasional areas of Mallee woodland. The overall condition is excellent, with a good variety of mid storey shrubs and a rich and diverse ground flora. Unfortunately the invasion of exotic weeds - particularly Bridal Creeper and Perennial Veldt-grass - is swamping the native vegetation on many areas. Considerable damage is also being done by trail bikes, four wheel drives and fishermen/campers through breaking down of the shrub layer, destroying ground flora and encouraging weed invasion and erosion.

After leaving the fringe of the Little Desert the river flows through the open Wimmera Plains with Riverine Chenopod Woodland as the major vegetation type. River Red Gum dieback becomes progressively worse with increasing distance downstream. Eventually around Jeparit the River Red Gums are nearly all dead and even the Black Box trees are beginning to die from the extremely high salt levels. The high salinity levels are also breaking down the clay structure and the resultant erosion is causing further damage. Destruction of the flora by recreational users and vehicles continues to degrade the riverbanks with weed invasion is also a serious concern.

On reaching Lake Hindmarsh the river disperses onto the dry lakebed. The fringes of the lakebed on both sides show severe salinity damage, particularly near the mouth of the river. There is also a severe infestation of Perennial Veldt-grass on all the sand dunes around the lake. In many areas this infestation is so dense there is no natural regeneration of the native vegetation. Away from the lakes edge the flora is still in good health although invasion of African Boxthorn, South African Bone-seed and Bridal Creeper are causing concern.

At the northern edge of Lake Hindmarsh the river becomes Outlet Creek and here, due to the lack of saline flows of river water, the River Red Gums are still thriving. There is a mid storey of diverse shrubs and small trees in most areas and the ground flora is again very rich. Unfortunately there is still severe damage from trail bikes and this is encouraging serious weed invasion of the ground flora.

The survey results reflect the fact that it was not undertaken during the optimal time of the year for the identification of many vegetation species. Had the survey it been done in spring there would have been far higher numbers of grasses and annual plants, lilies and orchids recorded. Despite this at least nine listed significant plant species were recorded including three new populations of the Nationally Vulnerable Floodplain Rustyhood orchid. One new species of New Holland Daisy only previously recorded north-west of Wail was recorded at one site on the river. Furthermore, of the 28 sites surveyed, at least 19 supported at least one or more of these listed species. This shows quite clearly that this section of the Wimmera River is indeed significant, with even degraded sites protecting rare or endangered species. However it also shows that unless urgent action is taken to address the threats to these plants they will not survive for many more years.

Aquatic Species

Table 19. Native and exotic fish species known to be present in the Wimmera CMA region from the report (DNRE 2001).

Scientific Name	Common Name	Conservation Status	Migratory
Indigenous native species			
<i>Edelia obscura</i>	Yarra pigmy perch	LR, FFG	No
<i>Gadopsis marmoratus</i>	River blackfish	C	No
<i>Galaxias olidus</i>	Mountain galaxias	C	No
<i>Nannoperca australis</i>	Southern pigmy perch	C	No
<i>Philypnodon grandiceps</i>	Flat-headed gudgeon	C	No
<i>Retropinna semoni</i>	Australian smelt	C	No
Non indigenous native species			
<i>Bidyanus bidyanus</i>	Silver perch	CE, FFG	Yes
<i>Galaxias rostratus</i>	Flat-headed galaxias	DD	No
<i>Galaxias maculatus</i>	Common galaxias	C	Yes
<i>Hypseleotris klunzingeri</i>	Western carp gudgeon	C	No
<i>Maccullochella peelii peelii</i>	Murray cod	V, FFG	Yes
<i>Macquaria ambigua</i>	Golden perch	V	Yes
<i>Tandanus tandanus</i>	Freshwater catfish	V, FFG	No
Exotic species			
<i>Carassius auratus</i>	Goldfish	-	No
<i>Cyprinus carpio</i>	Carp	-	Yes
<i>Gambusia holbrooki</i>	Eastern gambusia	-	No
<i>Oncorhynchus mykiss</i>	Rainbow trout	-	Yes
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	-	Yes
<i>Perca fluviatilis</i>	Redfin	-	No
<i>Salmo trutta</i>	Brown trout	-	Yes

Scientific Name	Common Name	Conservation Status	Migratory
<i>Tinca tinca</i>	Tench	-	No

Abbreviations denote conservation status as CE, critically endangered; DD, data deficient;
V, vulnerable; LR, lower risk – near threatened; C, common (DNRE 2000); *FFG*, listed on *Flora and Fauna Guarantee Act 1988*.

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6 Heritage River

6.1 Waterway Assessment and Target Setting

In an effort to maintain consistency, the management reaches identified in the Wimmera River Geomorphic Investigation- Sediment Sources, Transport and Fate (ID&A, 2001) were adopted for the purpose of this Waterway Action Plan.

Assessments of the contemporary health of the Wimmera Heritage River were made during 6 days of field inspections undertaken in August and September 2005. Data was collected from at least two sites in each Reach of the river except Reach 23 - Lake Albacutya and Reach 24 - Outlet Creek north of Lake Albacutya, where one data collection site was included for each Reach. This was because of the more consistent condition of these sites and the requirements of the WAP to direct a greater proportion of effort to the Wimmera River. While formal numerical assessments were conducted at only one site on each of reaches 23 and 24, more than one site along these reaches was visited and issues of concern noted. Where a marked contrast in stream condition was obvious within the same Reach, extra data was gathered to provide direct comparisons of channel and vegetation condition.

It must be noted that the vegetation condition at the time of the inspections was to some extent a function of the preceding extended dry period. The vegetation descriptions are also constrained by non-optimal timing of the field work – many of the understorey and ground cover plants were difficult to identify or deemed absent because identifying features are not present in winter or the plants are dormant.

Among the information collected were assessments of riparian and stream channel vegetation, and habitat condition. Reduction of the field data provided an assessment of the trajectory, threatening processes and risks to the condition of each reach.

The existence and condition of riparian zone fencing was also noted, however due to the large scale of the project, the length of fencing requiring replacement was not identified. Excellent work has been undertaken by the local Wimmera CMA Community Waterway Facilitator in encouraging landholders to replace fencing bounding the river corridor, and that program is better placed to continue working with landholders to identify lengths of required fencing.

Details of these are found in tables in the following Sections. Actions required to address the trajectory, threats and risks to each reach are based on the waterway management targets (Section 4.3) detailed again in Table 20.

Table 20. Key Waterway management target numbers and descriptions for Wimmera Heritage River.

Target No.	Target Description
1	Preserve, maintain and /or rehabilitate the nature conservation, recreational, scenic, social and/or cultural heritage values of the Wimmera Heritage River
2	Improve waterway health through the sustainable management of the riparian zone
3	Improve the health of the aquatic and riparian ecosystem through the provision of appropriate flow regimes
4	Improve the quality of water within the Wimmera River

6.2 Condition Assessment

6.2.1 Reach 14/15: Polkemmet Bridge to Mackleys Road

Geomorphology

Reach 14/15 of the Wimmera Heritage River is approximately 5.4 km long, with an estimated stream gradient of 0.0001m/m (IDA 2001). From Polkemmet Bridge to Mackleys Road the Wimmera River displays two quite different forms and therefore they are described separately in the section below.

At Polkemmet Bridge, the river adopts an anastomosing form, that is, it comprises multiple channels separated by stable alluvium. Two u-shaped, low gradient channels dominate the river which is set within a wide symmetrical floodplain. The individual channels contain short deep pools separated by sandy vegetated riffles. These pools are flanked by dense stands of phragmites and the riffles are often completely covered by phragmites and native understorey species, providing what is locally termed a '*blockage*'. The low flows experienced over the past 8-10 years have encouraged the growth of phragmites on the riffles and have promoted the encroachment of larger vegetation onto areas that would normally have been inundated regularly.



Figure 6: Reach 14/15 looking downstream from Polkemmet Bridge (left), and phragmites encroachment downstream of bridge (right).

There is the potential for reworking of the main channel during high flow events because of the vegetated riffles. The anastomosed section of the river has the potential to use one of its many channels as a new main channel if the blockages become too stable. Extended low flow periods are a natural part of the Wimmera Heritage River, however, this is likely to have been enhanced because of the extended dry period and the diversion of water in the upstream catchment.

The relatively dense vegetation cover has resulted in the steep sandy banks of the channels currently displaying good stability with only small patches of erosion present. The exposed roots of some of the riparian trees indicate that the banks have been undercut in some places. Flood channels are present across the floodplain and scattered oxbow billabongs are present at the margins of the floodplain.

The bed of this anastomosing section of the river is dominated by sands and there is little active sedimentation present in the form of depositing bars. No submerged vegetation was observed, although this may be a function of the timing of the field work. There is some in-channel large woody debris present and exposed tree roots extend into the channel.

From approximately 800 m downstream of Polkemmet Bridge, the river is characterised by a broad, single, low gradient dominant channel set within a locally contracted floodplain. At Duchembegarra (at the end of the Old Duchembegarra School Rd) the river is a wide u-shaped channel which is considerably larger than the upstream section at Polkemmet Bridge. The river comprises broad deep pools separated by deep run sections. The bed of the river appears to be dominated by clays and fine sands and there is little evidence of sediment deposition.

There is little phragmites present – except at the most upstream extent of the pool and the lack of riparian fencing and grazing access particularly on the right bank, has resulted in poor vegetative cover of the steep to almost vertical clay banks. The banks display active erosion scars, riparian tree roots have been exposed and there is the potential for more, serious, erosion during periods of high flow.



Figure 7: Wimmera River at Old Duchembegarra Road (Site 2) looking downstream (left), and saline left bank drainage line (right).

There are few flood channels and billabongs across the floodplain but there is evidence of remnant channels at its eastern margins. A small tributary/drainage line joins the river at this site and although dry at the time of sampling the salt scalds in the base of the drainage line would indicate that the salinity levels in this creek may be high. Community representatives identified that the region around Olivers Lake (directly to the west of this drainage line) had become considerably higher in salinity levels since clearing.

Vegetation

Site 1 at Polkemmet Bridge has considerable biodiversity values, however these values have been progressively reduced, particularly on the left bank by soil compaction processes and damage to native vegetation. This appears to have occurred during works on the bridge as the damage to the ground flora declines with distance from the bridge. The degradation is clearly observed on comparison of the right and left banks- the right bank is practically weed-free and with greater amounts of ground flora. This left bank disturbance has changed the balance of the ground flora with a large increase in exotic weeds. One listed significant species was recorded for this site. Vehicle access to this section of the river front needs to be restricted and invasive weeds such as Horehound and Bridal Creeper need careful removal. With attention this section of the creek will soon recover.

Site 2 on the left bank at the end of Old Duchembegarra Road supports a large remnant of the endangered Plains Grassy Woodland EVC. It is generally in very good condition, although there are problems with the lack of mid storey, vehicle/camper damage and weed invasion. There is a large variety of uncommon native grassland plants and the site supports at least one listed significant species. Again vehicle access to the river front needs to be restricted and invasive weeds such as One-leaf Cape tulip, Perennial Veldt-grass, Watsonia and African Boxthorn need careful removal. With careful management this section of the creek will recover and become a most valuable remnant.

Habitat

Two habitat assessments were conducted in this reach and the results are provided in Table 21. The riparian corridor is partially fenced for this reach which promotes the retention of vegetation values. The riparian zone has subsequently provided woody debris and organic matter to the river which provide essential in-stream habitat values. Site 2, where the riparian zone has not been fenced, displays reduced riparian values, low vegetation protection and subsequently low bank stability.

Both sites showed reduced amounts of logs within the riparian zone away from the river channel which may indicate past firewood harvesting activity. Invasion of weeds was also of a concern at Site 1, possibly because of stock accessing the riparian zone through the poorly maintained fence along the left bank. Recruitment of woody species at Site 1 was excellent, however Site 2 displayed reduced levels of recruitment because of grazing by stock and rabbits. These threatening processes reduced the RHA scores for the Reach 14/15 sites.

Neither section of this reach displays much in the way of sediment deposition and active bar formation, although there was some sediment capture on the vegetated riffles observed at site 1. Both sites displayed a low diversity of pool sizes, but the pools are typically deep and at times quite large. The multiple channels present at

site 1 provides a high diversity of habitat types and the deep pools provide refugia during dry periods. Site 1 also displayed good vegetation protection and consequently quite good stream bank stability.

Both sites assessed displayed fair to good in-stream cover, suitable for epifaunal colonisation and fish cover, but the lack of vegetation protection at site 2 means that the potential for organic matter to be provided to the river is limited. Site 2 also displays poor vegetation protection and consequently bank stability – particularly for the right hand bank.

Table 21. Habitat quality assessments for Reach 14/15

Site	HABSCORE	RHA Score
R14/15-1	129/200	16.5/20
R14/15-2	113/200	16.5/20
Weighted Average	118/200	16.5/20

6.2.2 Reach 16: Mackleys Road to Ellis Crossing

Geomorphology

Reach 16 of the Wimmera Heritage River is approximately 9.0 km long, with an estimated stream gradient of 0.0005m/m (IDA 2001). From Mackleys Rd to Ellis Crossing the Wimmera River returns to its low gradient anastomosing form but tends to retain a single dominant channel with anabranches and high flow channels. Some short sections of this reach display multiple channels operating at equal flow levels. The u-shaped channel is much narrower than that observed at the downstream end of reach 14/15 but becomes flatter and wider toward Ellis Crossing. At some sites, the channel appears to adopt a two stage form, possibly the result of reduced flow volumes causing the channel to contract.

In this reach, the river comprises a series of pools separated by sandy riffles and bars initiated by large woody debris. Both the riffles and the bars have become colonised by phragmites, and dense stands are found along the banks at the narrowest sections of the river. There is some minor sedimentation and bar formation around large woody debris and stands of phragmites, but the bed of the river is typically stable. The lack of flows in the river has prevented the realignment of the large woody debris and consequently it acts to trap sediment. As with the section of reach 14/15 around Polkemmet, the low flows experienced over the past 8-10 years have encouraged the growth of phragmites on the riffles and bars surrounding the large woody debris. This may enhance the levels of flooding during the first high flows which may pass down this section of the river.



Figure 8: Wimmera River at Mackleys Road looking upstream (left), looking downstream (centre) and LWD blockage across the channel (right).

The anastomosed section of the river has the potential to use one of its many channels as a new main channel if the '*blockages*' become too stable. Extended low flow periods are a natural part of the Wimmera Heritage River, as is the blockage of the river by large woody debris. However, this is likely to have been enhanced because of the combined effects of the extended dry period and the diversion of water from the upstream catchment.

Reach 16 is set within a broad symmetrical floodplain on which oxbows, billabongs, floodplain scours, remnant channels and flood channels are found. The river has in the past migrated across this floodplain, and the extent of the lateral migration is controlled by the soft sandstone (derived from the Parilla sands) found along this reach.

Vegetation

Site 3 at Mackleys Road is situated within a beautiful section of the river, with an extensive area of riparian forest that becomes an island when the river is in flood. This "island" has a larger variety of native ground flora species than on the adjoining river banks, possibly due to a history of reduced grazing by stock. Unfortunately the site has had serious disturbance in recent years, with piles of imported soils thick with weeds in several locations. The invasion by exotic weeds is rapidly degrading this site, with extensive annual grasses, Bridal Creeper, One-leaf Cape-tulip, Bathurst Burr and *Watsonia* evident. Regular "pulse" grazing of the site combined with careful spot spraying of the serious weeds will restore this most valuable site. Left untouched it will continue to degrade to the point where weeds will be the predominant ground cover.

Site 4 at the derelict bridge upstream of Ellis Crossing is generally in very good condition. The site displays a mixture of River Red Gum and Chenopod Black Box woodland with a diverse ground flora and occasional mid storey species. Unfortunately the site is being invaded by exotic weeds, and there is evidence of serious damage to the ground flora from overgrazing and recreational users at several locations. At least one listed significant plant species was recorded for the site. This site requires urgent attention to prevent further degradation by grazing and trail bikes in particular. The invasion of the site by weeds such as Bridal Creeper, *Watsonia* and *Asparagus* are damaging the site and they need careful spot spraying to ensure degradation does not continue.

Habitat

Two habitat assessments were conducted in this reach and the results are presented in Table 22. The basic stream structure of these sites is good, there is little sediment infilling, the stream retains a normal pattern and there is a high diversity in pool sizes which provides good variability in habitat. At site 3, the high volume of large woody debris provides excellent in-stream cover which means the potential for epifaunal colonisation and fish cover is high. This site also displays riparian vegetation which is in excellent condition, providing good vegetative protection for the stream banks, resulting in high bank stability and little stream bank erosion. Some firewood harvesting has reduced the volume of large woody debris within the riparian zone away from the river channel, which combined with weed invasion and reduced recruitment of woody species to reduced the RHA score for this site.



Figure 9: Wimmera River near abandoned bridge upstream of Ellis Crossing (left, centre), impact of recreational vehicle activity (right).

These good habitat features are reduced downstream towards Ellis Crossing with a lack of riparian zone protection and fewer large trees present. The diversity of woody species is reduced compared to Site 3, however percentage recruitment is far better. On the right hand side of the river upstream of Ellis Crossing, some firewood collection has taken place, as well as cropping and grazing of the riparian zone. This has depleted the ground cover, reduced the vegetative protection and consequently reduced bank stability.

Table 22. Habitat quality assessments for Reach 16

Site	HABSCORE	RHA Score
R16-3	166/200	17.5/20
R16-4	129/200	17.5/20
Weighted Average	153/200	17.5/20

Over the past 60-70 years, the river has carved out a new path along the western margin of the channel belt downstream of site 3 (near Mackleys Road). This is likely to be along the path of an existing anabranch or paleochannel, but anecdotal evidence is that 60 years ago it was simply a depression on the floodplain. The widening and deepening of the anabranch has occurred over the lifetime of the present landholder and will have delivered very large amounts of sediment to the river. Presently, there is a large active channel on the floodplain the bare banks of which have the potential to continue to deliver sediment to the river until they stabilise (Figure 10).



Figure 10: Erosion of an developing anabranch at the end of Mackleys Road.

Works had previously been undertaken by the Wimmera CMA at the Mackleys Road site to prevent the river from adopting a new channel along the western margin of the channel belt as the main flow path. These works involved removing a ford across the main river channel at the end of Mackleys Rd and raising of the sill level at the upstream end of the anabranch through the placement of rock, earth and large woody debris.



Figure 11: Works undertaken previously at Site 3 by the WCMA include removal of a ford (left) and raising of the sill level at the entry into an actively eroding anabranch (centre). Large volumes of material have eroded from this anabranch, the main channel of which is shown left to right in the background of the photograph (right).

There is also a concern that the culverts at Ellis Crossing will be undersized to cope with some of the environmental flows proposed to commence in 3-4 years time. The crossing currently consists of five 1100 x 800mm box culverts overlaid with a concrete slab to form a trafficable surface (Figure 12).



Figure 12: Ellis Crossing

During the 2004-05 environmental water release, a fresh of 120ML/day released from Taylors Lake, the water level rose to within approximately 100mm of the top of the crossing. This flow rate is similar to those proposed as environmental releases for the next few years with increases in the environmental water releases expected thereafter as water savings from the Wimmera Mallee pipeline are achieved.

The crossing is used by local landholders to move farm machinery and for access to agricultural land held either side of the river. It is also used to access the Wail State Forest, and as such is an important crossing point for fire brigade services. An inability for landholders to use the crossing would necessitate a significant detour. Anecdotaly most floods overtop the crossing by 300-450mm for up to 5 days at a time, however large floods can send up to a metre of water over the top of the crossing.

6.2.3 Reach 17: Ellis Crossing to Dimboola (through Wail State Forest and Little Desert National Park)

Geomorphology

Reach 17 of the Wimmera Heritage River is approximately 22.2 km long, with an estimated stream gradient of 0.0006m/m (IDA 2001). From Ellis crossing to Dimboola the Wimmera Heritage River cuts through the east-west Lowan Formation sand dunes of the Little Desert National Park. The River is characterised by a single wide and deep channel within a relatively narrow asymmetrical floodplain bordered by the sand dunes. The outside bends of the river are typically high (8-10m) cliffs with a wide lower bench. Some of the cliffs, particularly within the Wail State Forest display substantial erosion. Areas subject to the most intense recreational use display an almost complete lack of ground cover and serious erosion. Continued recreational access along these sections means that the banks of the river are generally unprotected. These sites have the potential to continue to erode and local runoff during severe rain storms will result in quite rapid erosion. This effect may be reduced on the inside of bends as the banks tend to be lower and more moderate in slope.



Figure 13: Absence of vegetative ground cover at the West Wail picnic sites.

In this reach, the river typically comprises a series of large open pools separated by sand bars or riffles, mostly on short high angle beds. At West Wail Gauging station, the bed of the river intersects the partially lithified Parilla sands which has created a small section of soft bedrock riffle (Figure 14). The bed material of the river is predominantly fine grained with occasional soft gravel sized material. This reach would appear to be a deposition zone with a number of small sandy point bars extending into the river on the inside of the bends, typically associated with large woody debris.



Figure 14: West Wail Gauging Station. Rubbish on right bank upstream of gauge (left) and view downstream (right).

It is likely that the lack of flows is enhancing the development of the sandy point bars and riffles. Some of the sand bars are being colonised and stabilised by phragmites and tea tree yet others retain the native reed species, which, anecdotally, was more prevalent along the Wimmera River prior to the 1950's.

There is, however, considerably less phragmites within this reach than within the anabranching reaches upstream. These bars will may move during the next significant flood down the river, but there will be a number of debris jams, potential bank cutting and localised flooding associated with the first floods that return to the river.

There are some oxbow billabongs present on the floodplain and at times there is evidence of remnant channels and small infilled flood channels. There are also small (presently dry) lunette lakes further back from the river within the Wail State Forest.

There is obvious saline groundwater intrusion at the West Wail Gauging station with salinity readings in the pool of 17,400 EC (18/8/2005). Salinity readings upstream and downstream of this are around 3000 EC indicating that it is an individual point of groundwater intersection.

Vegetation

Site 5 at the West Wail Gauging Station is an extremely significant site, with great diversity ranging from Salt Paperbark Woodland and Riverine Chenopod Woodland through to Ridged Plains Mallee. Unfortunately the site has been degraded by the dumping of rubbish and garden weeds. The site supports a great range of shrubs and ground flora including numerous regionally significant species and at least two listed significant species, one of which is an unnamed species only found in the Wail area.

This site is generally in very good condition apart from the rubbish dumping. The resulting invasion of Soursob and Freesia at the foot of the cliff on the right bank require urgent eradication or they will spread right along the river front.

Site 6 at the West Wail Picnic Area is an excellent mixture of Riverine Chenopod Woodland and Heathy Woodland on sandy rises. As a result the site is very rich and diverse with excellent shrub and ground flora diversity as well as numerous sedges and water plants. Unfortunately damage and bank erosion from vandalism, trail bike and four wheel drive access is having a deleterious impact on the site.

Surprisingly, despite the quality and diversity of this site, no listed significant species were recorded at the location. Measures to minimise the damaging impact of trail-bikes and four wheel drives are needed at this site and entire section of the river. Weeds such as Bridal Creeper and Watsonia will need prompt attention to prevent their further invasion. Once these problems are addressed this site has the capacity to recover quite rapidly.

Site 7 at Horseshoe Bend is a beautiful area of Red Gum and Black Box woodland that has become seriously degraded by decades of camping and recreation. Little ground flora has survived apart from along the river banks where access by vehicles and campers is reduced. The site has been invaded by numerous exotic weeds and supports no listed significant species. Due to intense recreational use the majority of this site is beyond recovery however the river banks should be carefully protected to ensure the remaining native vegetation survives. The site is becoming invaded by Perennial Veldt-grass and this needs eradication.

Habitat

Three habitat assessments were conducted within Reach 17 and the results are presented in Table 23. Not surprisingly, habitat quality as measured by the more comprehensive HABSCORE system is highest at site 5 where there is limited access and no recreational use.

In this reach the river typically displays good pool sizes and variability as well as good substrate character producing good habitat features. There is fair to good in-stream cover which means there is the potential for epifaunal colonisation and fish cover at some sites was very good. The natural openness of the pools along this section of the river mean that the in-stream cover is predominantly found along the margins of the pools but the number of deep pools would provide excellent fish habitat.

There is some active deposition of sands in the channel particularly within the West Wail State Forest area and the lack of flows means that sand bars are being vegetated and stabilised. There is also some active bank erosion and the potential for some very serious bank erosion to occur within the West Wail State Forest area. Recreation along this section of the river (sites 6 and 7) combined with the extended dry period is reducing the vegetation protection of the banks and the steep banks are subsequently moderately-to-quite unstable.

Table 23. Habitat quality assessments for Reach 17

Site	HABSCORE	RHA Score
R17-5	129/200	17/20
R17-6	114/200	18/20
R17-7	119/200	13/20
Weighted Average	120/200	15.5/20

Rubbish in the form of old fencing wire has been dumped over the right bank immediately upstream of the West Wail Gauging Station, and should be removed (Figure 14).

Degradation to vegetative cover is occurring in this reach because of the actions of recreational users and rabbit activity. A number of rabbits were observed within the Wail State Forest and a control program should be implemented to encourage vegetation recruitment and minimise soil instability derived from burrowing activity.



Figure 15: Erosion points at the West Wail picnic areas.

Headcutting and tunnel erosion is occurring at the West Wail picnic areas and has the potential to become quite severe with rainfall events and continued recreational pressure. Restriction of access and revegetation along the top of banks as detailed in the Earth Tech report 'Streambank Stabilisation at Big Bend' (2003) should be implemented to enable stabilisation of these areas.

Eroded material from the picnic areas has deposited as sediment bars within the river and have subsequently been colonised by macrophytes.



Figure 16: Sediment bars formed by material eroded from the West Wail picnic areas that have been colonised by macrophytes.

Intense recreational pressure is also having an effect on ground cover and woody habitat at the Horseshoe Bend picnic area, however at this site the tops of the banks tend to be better protected from access by vehicles. Remaining ground cover is predominately weeds. The site is also drains internally to a low lying lagoon which acts as a sediment trap before discharging to the river. This lagoon area was dry at the time of inspection and has vehicle skid marks across it.



Figure 17: Horseshoe bend picnic area bank protections (left) and low-lying internal drainage path (right).

Revegetation works have been undertaken at the picnic area to establish more ground cover and understorey species. Further works should be encouraged.

This reach also contains the gazetted open speed zone for use by the powered watercraft. The issues relating to waterskiing and jetskiing are discussed further in Section 6.3.1 Local Scale Threatening Processes.

6.2.4 Reach 18: Dimboola to downstream confluence with Datchak Creek at Antwerp

Geomorphology

Reach 18 of the Wimmera Heritage River is approximately 28.7 km long, with an estimated stream gradient of 0.0005m/m (IDA 2001). From Dimboola to Antwerp, the river returns to its branched form adopting a more classic manifestation of an anastomosing river. Datchak Creek separates from the main channel of the Wimmera River at Lochiel and rejoins at Antwerp. Datchak Creek does not flow within the main channel belt, but is separated by a large stable island several kilometres wide. The presence of aeolian features on this island would indicate that this is quite an old landscape feature. Although still part of the Wimmera River, Datchak Creek is likely to be a separate management unit and its character and issues are presented in the following section.

While there is presently a single main channel to the Wimmera River in reach 18, the presence of a large number of anabranches or flood runners (some active and some remnant) across the floodplain and surrounding land indicate that the river has in the past adopted many channels/flow paths. This is likely to be the reason that at settlement, Dimboola was originally given the name of 'Seven Creeks'.

This reach is characterised by a u-shaped channel grading to a flattened u-shaped channel at times set within a broad symmetrical floodplain. The bed forms a series of pools separated by run sections and sandy riffles. During dry times, the river disconnects to a series of discrete deep pools. This section of the river has very low stream bed gradients, with local variations ranging from less than 0.0001m/m to 0.0006m/m (IDA 2001). There is considerable sand deposition on the riverbed in the form of sand bars which have been promoted by the lack of flow. This deposition does not appear to be infilling pools.

Examples of sand deposition can be seen below the Dimboola Weir, downstream of Lochiel Bridge and near the entrance into Datchak Creek (Figure 18).



Figure 18: Sand deposition and colonisation by vegetative growth downstream of the Dimboola Weir (left), near Lochiel Bridge (centre) and at the entrance to Datchak Creek (right).

The blockage below the Dimboola Weir is being colonised by phragmites, redgums, melaleucas and also Desert Ash. The Desert Ash are likely to have established from seed washed down through the stormwater system from Dimboola street trees.

There is some large woody debris in the river but considerable amounts were removed in 1982 during works to clear the channel. Where the large woody debris has fallen into a shallow section of the river (run or riffle) and not been realigned by flows, there is a build up of sand around the wood, creating lateral sandy bars. Low flows have resulted in these bars being colonised by phragmites and tea tree and

the river will cut around these during high flows events causing some bank erosion. The rates of bank erosion are likely to be minimised by intact riparian vegetation and problems are only likely to occur where there is interruption to the riparian vegetation for access. These stabilised bars may also result in additional flood waters being passed along anabranches and flood channels during times of high flow with anecdotal evidence provided that farmland is being inundated for longer periods than in the past because of the changes in flow pathways.

A site on the right bank of the Wimmera River approximately 600 metres upstream of Spears Crossing was noted as being subject to piping erosion, which is delivering eroded material from the adjacent agricultural land into the river (Figure 19).



Figure 19. Piping erosion upstream of Spears Crossing. Head of the piping (left) with the river in the background, the receiving pool (centre) and a possible route to redirect drainage water from the agricultural land to the river (right).

The piping is a result of water draining from the adjacent agricultural land, which with some survey and earthworks could be re-directed through a stable vegetated depression to the river (Figure 19).

Vegetation

Site 8 located 150 meters downstream of Lochiel Bridge is an extremely rich and diverse site with few weeds and little disturbance. There are a number of vegetation communities all blending together with a mix of River Red Gum, Yellow Gum and Black Box woodland. There is a good variety of mid storey shrubs and a diverse ground flora. Many ephemeral species that would normally be expected at this site where not observed, possibly as the survey was undertaken before they were all up and flowering. At least one listed significant plant species was recorded for the site.

This site is in excellent condition and only needs protection from vehicular access for it to continue in its present condition.

Site 9 located 200 meters upstream of Wundersitz Crossing supports a fringing River Red Gum woodland with Riverine Chenopod Woodland further from the river channel. Many of the Red Gums are showing signs of stress from high salinity levels in the river. There is a good mid storey of shrubs including several typical “Mallee” species. The ground flora is very rich but is being swamped by extensive weed infestations –of particular concern are Bridal Creeper, Asparagus and extensive annual weed outbreaks. There is at least one listed significant plant species recorded for the site. Increased river flows are needed to reduce the salinity-induced stress on the Red Gums, and urgent control of the Bridal Creeper and other weeds is needed to save this site. If left unattended the rich ground flora will rapidly become overwhelmed.

Site 10 at Spears Crossing is located within a beautiful and diverse area of the river and is generally in excellent condition. A healthy fringe of River Red Gums occurs along the waters edge and Riverine Chenopod Woodland back from the river. There is a good variety of mid storey shrubs and a rich ground flora particularly beneath the Black Box Woodland. The site supports at least two listed significant plants including a good population of a nationally vulnerable orchid. Bank management works including revegetation were evident and little further vegetation works are required. There are no significant weed species recorded for the site.

Site 13 at Collards Road is a narrow but rich section of the Riparian Red Gum Woodland community supporting a diverse range of mid storey shrubs and ground flora. Erosion of the river bank is affecting the plants along the waters edge and damage by recreational users and campers at several sites was evident. Severe weed infestations were observed around the camping sites. The narrowness of the river front at this site has also encouraged the invasion of exotic weeds from adjoining farmland. The site supports at least three listed vulnerable species. This site will recover well with the control of the invasive Perennial Veldt-grass and Bridal Creeper, and the reduction of soil compaction and soil surface disturbance resulting from camping activity.

Habitat

Four habitat assessments were conducted within Reach 18 and the results are presented in Table 24. There is general consistency in the overall habitat quality at the sites visiting in Reach 18 but the habitat features contributing to the overall score vary along the reach.

In this reach, the river displays good pool variability and substrate character providing good pool habitat for local aquatic fauna. The low gradients of this section of the river mean it is a deposition zone, but the 2 upstream sites assessed in the this reach display much higher amounts of sediment deposition than the 2 downstream sites. The in-stream cover ranges from fair to good providing reasonable potential for epifaunal colonisation and fish cover, although there has been a substantial amount of large wood removed from sections of the river to promote flow paths. The riparian vegetation is in good condition and provides a high level of protection for the banks, particularly at sites 8 and 9. There is some evidence of bank instability around lateral bars which have formed around large wood in the river. All sites show a reduction in the volume of logs within the riparian zone that could be due to harvesting for firewood. Invasion of weeds is also a concern at Sites 9 and 13.

Table 24. Habitat quality assessments for Reach 18

Site	HABSCORE	RHA Score
R18-8	121/200	17.5/20
R18-9	133/200	14.5/20
R18-10	125/200	15.5/20
R18-13	124/200	15.5/20
Weighted Average	124/200	16.4/20

The area around the railway bridge crossing over the Wimmera River shows evidence of degradation by trail-bike and rubbish dumping activity.

WCMA have previously conducted works in a number of locations along this reach. Erosion control works consisting of installation of rock beaching and pile fields were conducted on the left bank downstream of Lochiel Bridge, with battering and revegetation of the left bank performed downstream of Spears Crossing (Figure 20).



Figure 20: Pile fields downstream of Lochiel Bridge (left) and bank battering and revegetation works below Spears Crossing (right)

Works were undertaken by local landowners in 2003 to remove deposited sediment and phragmites in the vicinity of Wundersitz crossing. (Figure 21).



Figure 21: Upstream (top) and downstream (bottom) of Wundersitz Crossing before stream clearing works in 2003 (left), after completion in 2004 (centre) and at time of inspection in 2005 (right)

Erosion of the right bank has occurred due to colonisation of points bars at Collards Road and at a location between Klinge Road and Spears Crossing (Figure 22).



Figure 22: Erosion of right bank at Collards Road (left) and upstream of Spears Crossing (right)

6.2.5 Reach 18A: Datchak Creek

Geomorphology

Reach 18A of the Wimmera Heritage River study reach corresponds to Datchak Creek, and is approximately 19.6 km long. Datchak Creek is a flattened u-shaped anabranch of the anastomosing Wimmera River which leaves the main channel at Lochiel and rejoins at Antwerp. It is set within a relatively narrow symmetrical floodplain which displays a number of flood channels, scours and billabongs. In 1982, works were undertaken by locals to raise the sill level of Datchak Creek and remove blockages in the main Wimmera River to prevent high volumes of water flowing along Datchak Creek (Figure 23). At the time of the field assessments the Creek was almost completely dry with only one groundwater fed pool still retaining water.



Figure 23: Datchak Creek. Works to raise the sill level of the entrance (left) and looking downstream (right) from the creek entrance.

The bed of Datchak Creek comprises a series of pools of varying size separated by runs and sand riffles. There are rare outcrops of the very soft sandstone developed from the Parilla Sands and this will exert some controls on the lateral migration of the creek. Some parts of the creek are almost completely infilled with sand and for the most part the channel is quite small in comparison with the Wimmera River and poorly formed anabranches appear to exist across the adjacent cropped landscape (Figure 24). Five Chain Road and Collards Road are two road crossings over Datchak Creek that do not currently have culverts, hence any flow down the creek must overtop the road surface.

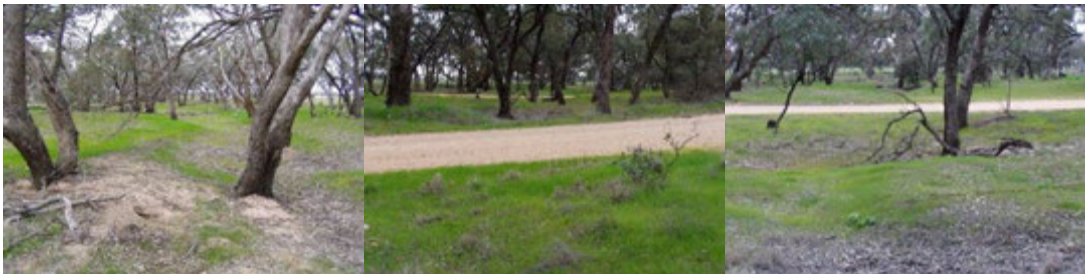


Figure 24: Datchak Creek at Five Chain Road (left, centre) and Collards Road (right). Note ill defined sand filled channel and lack of culverts under roads.

In contrast, Site 14 is a wide, well formed u-shaped channel with some large deep pools and backwaters which would have probably provided permanent water in all but the driest of times (Figure 25). There are some sand bars formed on the bed of the creek, but there is no obvious infilling of pools. This site has had most of the large woody debris removed and the base of the creek cleared of vegetation. There are some stands of phragmites present as well as a plethora of weed species. Also noted were stands of Spiny flat-sedge *Cyperus gymnocaulus* that would have been widespread throughout the area during the 1940's and 1950's, and that should be protected (Figure 25).



Figure 25: Site 14 on Datchak Creek. Note the large channel size in comparison with upstream section of the reach (left, centre) and remnant stands of indigenous reeds (right).

Vegetation

Site 11 at the Bothe Road crossing of Datchak Creek is a degraded site showing signs of salt or moisture stress to the overstorey species—all River Red Gums have died and Black Box are stressed. The site has also been heavily upstream of the crossing, with little native ground flora remaining. There are signs of good regeneration on the private property on the downstream side of the road. This site requires fencing and replanting with understorey species on the upstream side of the crossing if it is to recover. Flow along the creek is also urgently needed to improve the health of the riparian trees.

The Riverine Chenopod Woodland at Site 12 on the upstream side of Five Chain Road shows good diversity despite being currently overgrazed. The groundflora still supports a good variety of native species but the shrub layer has been severely degraded. The site supports at least one listed significant species. This site will recover well with fencing and cessation of continual grazing.

Site 14 on Datchak Creek upstream of Spears Crossing Road is another Riverine Chenopod Woodland site showing good diversity but is showing signs of rapid decline from high salinity levels. This has resulted in the death and decline of many of the trees and the severe invasion by weeds including Bridal Creeper, Soursob, Spear Thistle and Desert Ash. The site supports at least one listed significant species. Without a flow of fresh water along the creek many more of the larger trees will be lost. The immediate eradication of the seriously invasive weeds is required or the area will eventually become totally infested with weeds. Bridal Creeper is of particular concern and has already swamped large areas of native vegetation. Care will have to be taken when spraying Bridal Creeper to ensure the native vegetation is not also poisoned.

Habitat

Three habitat assessments were conducted along reach 18A and the results presented in Table 25. The key feature reducing the HABSCOREs for this reach is the lack of water in the channel at the time of assessment. Processes that can be linked to the agricultural use of land adjoining this reach reduce the RHA scores for this reach, and include weed infestation, and the reduction in recruitment of woody species, volume of logs and understorey diversity.

This reach displays fair to good in-stream cover providing the opportunity for epifaunal colonisation and fish cover when the creek contains water. Some of the woody debris has been removed from the creek, thus reducing its habitat value. There is a range of pool sizes from very small to large and deep and the pool substrate is fair. There is some deposition of sand along the creek and possibly some infilling of smaller pools particularly where the creek is not well formed but there is no obvious infilling of large pools.

The riparian vegetation has been impacted quite substantially by local landuse, reducing its integrity and allowing weeds to invade. Firewood harvesting means very few logs remain within the riparian zone.

Table 25. Habitat quality assessments for Reach 18A

Site	HABSCORE	RHA Score
R18A-11	112/200	8.5/20
R18A-12	98/200	9/20
R18A-14	111/200	11/20
Weighted Average	106/200	9.4/20

One site of note within this reach is an dam across Datchak Creek formed by pushing two embankments across the main creek channel to form a domestic water supply (Figure 26). This structure would be a major impediment to any future flow down Datchak Creek.



Figure 26: Banks pushed across Datchak Creek to form dam

6.2.6 Reach 19: Downstream confluence with Datchak Creek at Antwerp to just south of Jeparit

Geomorphology

Reach 19 of the Wimmera Heritage River is approximately 22.1 km long, with an estimated stream gradient of 0.0001m/m (IDA 2001). From the confluence with Datchak Creek at Antwerp to just south of Jeparit the Wimmera Heritage River returns to being dominated by a single well developed often deepened u-shaped channel typically set within a broad asymmetrical floodplain. Flood channels and remnant channels are present across the floodplain and a number of billabongs and backwaters are also present.

The bedform is characterized by long open pool sections separated by runs. At several points, the channel splits into two channels around well vegetated stable islands for short sections of the reach. The bed of the river comprises sands and clays with sediment deposition highly variable. There are generally small amounts of deposition evident as longitudinal bars and small sandy point bars. Upstream of the now decommissioned Antwerp Weir large volumes of sand have deposited in the channel which is currently exposed because of low water levels (Figure 27). This is a classic feature of the delta area of weir pools and will slowly mobilise into the lower sections of the weir pool and downstream during flood events.



Figure 27: Depositional zone upstream of Antwerp Weir (left) and pool on downstream side of Tarranyurk Bridge (right).

The banks of the river along Reach 19 are often steep, display signs of instability and are high on one side with a wide bench at the base. Quite often the opposing bank is of more moderate slope and is consequently more stable. Reduced flows are causing the channel to contract in places with vegetation below the historic bankfull height. At Antwerp Weir, the lack of soil protection of the riparian zone and subsequent cattle and recreational access has resulted in reduced bank stability and there is the potential for some serious erosion during high flows (Figure 28).



Figure 28: Erosion downstream of Antwerp Weir caused by stock access and flow diversion around a vegetation stabilised sediment bar

Salinity levels increase markedly along this reach indicating the presence of highly saline groundwater intrusion into the river. Salinity levels at Antwerp Weir are around 6,000 EC but reach 31,000 EC at Tarranyurk Gauging Station. At site 16, salinity levels are around 7,000 EC, and a small stream from the left bank at this site has salinity levels of more than 1,000 EC above that of the main channel.



Figure 29: Sites of high salinity include Site 16 on River Road between Antwerp and Tarranyurk (left), and the Tarranyurk Gauging Station (centre, right).

There is an obvious halocline in many of the pools from upstream of the Tarranyurk Road crossing to Tarranyurk Gauging Station. There does not appear to be a single point at which the salinity increases, rather it appears to be broad scale groundwater intrusion. A small right bank tributary upstream of the Tarranyurk Road crossing may be delivering highly saline water to the river and this should be investigated.



Figure 30: The effect of salinity and lack of flow on riparian vegetation and bank salinity is demonstrated upstream of Antwerp Weir (left), downstream of Tarranyurk bridge (centre) and at Tarranyurk Gauging Station (right).

The high salinity levels and lack of flow along this reach are impacting seriously on the riparian vegetation and consequently on bank stability. Most of the redgums within the riparian zone are dying and a number of the groundcover species that would normally stabilise the banks have also been lost. Without protection and with high groundwater salt levels affecting clay structure, the banks are bare and actively eroding (Figure 30). There is the potential for some very serious erosion to occur along the downstream portion of this reach during high flows.

Also noted was a right bank gully forming approximately 400 metres upstream of the Antwerp Weir (Figure 31). This gully is relatively stable at the present time but has very poor ground cover due to grazing. Future intense rainfall events or floods may reinitiate headcutting further into the stream reserve.



Figure 31. Right bank gully upstream of Antwerp Weir.

Vegetation

Site 15 at Antwerp Weir is a large area of Riparian River Red Gum Woodland and Riverine Chenopod Woodland with a history of overgrazing resulting in the removal of almost the entire mid storey and most of the ground flora. The only good remnants of these strata found were along the banks of the river and in the steep rockbank constructed to protect the right bank end of the weir. The ground flora is now dominated by a number of exotic pasture weeds. Many of the River Red Gums are showing signs of severe stress caused by high salinity levels. This site requires fencing and a grazing regime aimed at controlling the existing weed cover. Increased river flows are also required to improve the health of the River Redgums.

Site 16 on River Road north of the Antwerp-Woorak Road is a most diverse site with the occurrence of plant species typically found in the northern Wimmera and the Mallee. The River Red Gums in the riparian zone continue to exhibit stress from high salinity levels with many dead and dying trees. The adjoining woodland is high enough up the banks to avoid the intruding saline ground water, and is dominated by a mixture of Slender Cypress-pine and Mallees amongst the more typical Black Box trees. There is an excellent mid storey of different shrub species, and the ground flora is generally rich although exotic weeds were evident in a number of areas. There are at least two listed significant species at the site. Increased flows in the river and control of weeds at this site are imperative to ensure recovery and ongoing health of this site.

Site 17 is an unusual site located on an elongated sandy point bar 600 metres downstream of the Tarranyurk Bridge. It is dominated by a forest of Slender Cypress-pine with scattered emergent River Red Gums. The mid storey is good, but there is little diversity of the ground flora due to the density of the native pines. Most of the River Red Gums have show severe salinity stress and the ground flora is becoming dominated by Perennial Veldt-grass. Bridal Creeper is invading the site and together with the Perennial Veldt-grass requires urgent eradication. Increased river flows are also required to alleviate the salinity stress to the River Redgums.

Extremely high salinity levels at Site 18 at the Tarranyurk Gauging Station have killed the majority of trees along the river banks. Further away from the river the site is still in good condition, with a healthy mid storey and a most diverse ground flora. Interestingly several salt tolerant species such as Beaded Glasswort are now colonising the highly saline rivers edge. The site supports at least four listed significant species including one nationally vulnerable orchid. Several weeds are starting to invade including Bridal Creeper and Soursob, these need to be controlled before they impact on the rich ground flora. An increase in river flows will enable the fringing gums to gradually recover, while the eradication of the weed species will ensure that the rich ground flora survives and prospers.

Habitat

Habitat assessments were conducted at three sites along this reach and the results are summarised in Table 26. While a large proportion of this reach is still in reasonable geomorphic condition, the poor water quality caused by a lack of flow and saline groundwater intrusions have reduced the habitat quality substantially. These features are not picked up in the use of either HABSCORE or RHA.

The physical character of the river along Reach 19 provides a wide range of habitats. There is a relatively low diversity of pool sizes with most being large and open, but the presence of a range of backwater features and flood channels provides a variety of potential habitats. The removal of large woody debris from Antwerp Weir pool has resulted in fair in-stream cover at site 15, but generally the amounts of in-stream cover are good.

Bank stability ranges from very poor to excellent along this reach – a reflection of the vegetation cover on the banks and the protection of the riparian zone. At site 16, there is good protection of the riparian zone, the streamside vegetation was in good condition and the bank stability was high. In contrast at site 15, the riparian zone was not protected, stock and recreational access had reduced the riparian and stream bank vegetation to a poor state and thus the banks showed signs of being quite unstable. At site 18, while there is limited access and reasonable bank protection poor water quality and salinity levels have results in poor bank stability particularly where the banks are steep.

Sites 15, 16 and 17 all display serious weed invasion. This combined with the degraded understorey and low recruitment at sites 15 and 17 is reflected in the corresponding low RHA scores.

Table 26. Habitat quality assessments for Reach 19

Site	HABSCORE	RHA Score
R19-15	94/200	6.5/20
R19-16	146/200	11.5/20
R19-17	n/a	7.5/20
R19-18	124/200	10/20
Weighted Average	114/200	10.7/20

6.2.7 Reach 20: Just south of Jeparit to Lake Hindmarsh

Geomorphology

Reach 20 of the Wimmera Heritage River is approximately 12.5 km long, with an estimated stream gradient of 0.0001m/m. From just south of Jeparit to Lake Hindmarsh the Wimmera Heritage River is heavily influenced by the Jeparit Weir Pool and Lake Hindmarsh. The River displays very low bed slope and increased sinuosity over these final 13 kilometres and is dominated by a wide u-shaped complex channel set within a symmetrical floodplain. The complexity of the channel is a function of its deltaic influences and there are many cut-off meanders, billabongs, islands and bench features. The bed of the river in this section comprises clays and fine sand and there are small areas of deposition evident.

The banks of the river along reach 20 are steep to moderately sloping, grading to low slopes at the wider parts of the river. The banks are typically bare of vegetation and display rill erosion. Below Jeparit Weir, the left bank is steep and some bank slumping is obvious, possibly caused by wave action from the use of motor boats along this stretch. The right bank displays some sections of very serious rill erosion with some of the 'rills' almost 1 m deep (Figure 32). The lack of vegetation protection of these banks will make them highly susceptible to erosion during high flows.



Figure 32: Serious rill erosion of the right bank downstream of Jeparit Weir.

As with Reach 19, this reach is characterised by poor water quality resulting from a lack of flows and high salinity. Salinity levels recorded at Jeparit Weir were 41,000 EC. The high salinities which have existed over an extended period of time have killed many of the red-gums within the riparian zone and have changed the vegetation communities on the banks to more salt tolerant species.



Figure 33: Channel form and riparian vegetation just south of Jeparit (left), at Site 24 upstream of the Jeparit Weir (centre), and downstream of Jeparit at the Hindmarsh Ski clubrooms (right).

Some salt affected red-gums are falling into the river destabilising the banks. The high salinity levels are also reducing the cohesiveness of the clays which is contributing to the erosion occurring along the banks. There is the potential for serious erosion and lateral migration during high flows because of the reduced stability.

Vegetation

Site 23 on the Wimmera River just south of Jeparit has degraded from a once magnificent site due to the excessively high salinity levels in the river. Virtually all the River Red Gums and most of the Black Box along the river have died. The elevated salt levels are also breaking down the structure of the river banks and these are collapsing and eroding, resulting in the further loss of native vegetation. There has been extensive loss of the shrubby mid storey vegetation layer, however the ground flora is amazingly still in an excellent condition and is quite diverse, with at least two listed significant species including an extensive population of a nationally vulnerable orchid. This site will continue to degrade while salinity levels remain high. Increased river flows are needed to flush out the high salt loads, even then it will take years for this formerly superb site to recover. There are several invasive ground flora species particularly Soursob that will need to be removed to protect the nationally vulnerable orchids, and African Boxthorn and Prickly Pear plants need to be removed before they spread along the river.

Site 24 just upstream of the abandoned bridge near the Jeparit Golf Club also shows the effect of elevated salinity levels. Despite most of the River Red Gums and Black Box trees along the edge of the river being dead, there are still specimens of these trees surviving higher up the banks and away from the saline water. Beneath these Salt Paperbark thrives in excellent isolated dense stands along the rivers edge. There is a sparse but interesting ground flora dominated by numerous chenopods. Areas of severe salt scald have killed the ground flora and erosion of the riverbank at these locations is now occurring. The site supports at least two listed significant species. This site urgently requires the closure of the vehicle tracks that are damaging the ground flora and creating sites for salt scalds to begin. As with the previous site, the river requires increased flows to restore the native vegetation to something like it used to be. Bridal Creeper needs spot spraying, but there are no other serious weeds at the site.

Habitat

Habitat assessments were conducted at two sites along this reach and the results are summarised in Table 27.

As expected the diversity of habitat features is reduced in the weir pool compared with the river upstream. Good in-stream cover, substrate and pool variability was noted upstream of the weir pool but from the weir pool downstream these features recorded lower scores. The lack of LWD in the river within and downstream of the weir pool reduces its habitat quality and the consistency of river level provided by the weir has also reduced habitat diversity.

Stream bank stability, vegetation protection and the riparian zone integrity decreases markedly along the weir pool. This is primarily a function of lack of soil protection of the stream side zone and has resulted in some areas that have the potential for serious erosion. The high salinity levels in this area are hindering the establishment of vegetative protection.

Sites 23a and 23b are on the right and left bank respectively of the Wimmera River upstream of Jeparit. The right bank is of a moderately salt tolerant Black Box Chenopod Woodland EVC, with the absence of logs the main factor in reducing the RHA score. The left bank is of a Lignum Swampy Woodland EVC which is affected by the lack of flow and high salinity levels. The redgums are in very poor condition and are not recruiting, while weeds are proliferating. Hence the RHA score is lower for the left bank.

Site 24 has a low RHA score due to the lack of canopy cover, understorey density and logs that is a result of the intense recreational pressure, access and high salinity levels at this location.

Table 27. Habitat quality assessments for Reach 20

Site	HABSCORE	RHA Score
R10-23a	139/200	16/20
R20-23b	n/a	13/20
R20-24	98/200	10/20
Weighted Average	119/200	12.9/20

6.2.8 Reach 21: Lake Hindmarsh

Geomorphology

Lake Hindmarsh is the largest of the lunette lakes along the Wimmera Heritage River covering an area of 15,600 hectares and having a full capacity volume of approximately 380,000ML. It is flanked by a series of well vegetated crescent shaped transverse dunes on the eastern side and by relicts of ancient marine shorelines on the western side. A notable feature of Lake Hindmarsh is the 4m high sandstone cliffs located on the western side of the lake. The lake bed comprises fine and very fine wind deposited sands mixed with clays most likely of fluvial origin. The presence of the clays on the surface of the lake bed is not consistent with the expected surface and locals suggest that Carp are disturbing and reworking the bed of the lake and rivers thus providing the fine grey clays which subsequently blow across the region in summer. The lakebed surface on the western side also contains fine soft gravel sized material as well as some well rounded gravel sized quartz grains.



Figure 34: Lake Hindmarsh from top of mobile dune on western side (left), native annual colonising the dry lake bed (centre), interdunal vegetation on western side (right).

At the time of assessment the lake was completely dry and the lake bed was colonised by a native salt tolerant annual plant *Atriplex australasica* or Native Orache that has replaced the lake-bed herb fields (Figure 34). The sands from the bed of the lake are easily mobilised and winds across the lake have blown the sand into small hummocks around the base of most of the vegetation on the eastern side of the lake. There is also a small dune formed on the eastern margin of the lake as the wind has blown sand into what would have been the fringing vegetation when the lake was full.

Vegetation

Site 25 is located on the dry lakebed on the eastern side of Lake Hindmarsh. The few plants occurring at this site are doing an excellent job in holding the loose shifting sands. Native Orache in particular is thriving and colonising the bare salty ground. Few weeds occur in this demanding habitat. This site is in good condition and require no further management.

Site 26 within the eastern shoreline dunes of Lake Hindmarsh shows loss of many of the large River Red Gums, while the numerous younger trees survive but display signs of stress. There is a healthy mid storey of mixed tall shrubs including numerous Slender Cypress-pine, and the ground flora is reasonably diverse. Unfortunately the entire site is swamped with Perennial Veldt-grass and this is impacting on recruitment. There are several other serious weeds including Bridal Creeper and South African Bone-seed throughout the area. The site supports at least one listed significant species. The site requires filling of Lake Hindmarsh to

begin to restore the natural regeneration to the area. Eradication of Perennial Veldt-grass, Bridal Creeper and Bone-seed is also required to encourage recruitment.

Site 27 on the south-west shoreline of Lake Hindmarsh is quite variable, with mostly large River Red Gums over an open sandy area away from the lakes edge, and an open treeless shrubby area closer to the lake. There are scattered mid storey tall shrubs away from the lake with a sparse ground flora of mats of Creeping Boobialla and Inland Pigface. Close to the lakes edge there is an often dense stand of mixed low shrubs and groundcovers. There are scattered old dead gums throughout. There is a serious infestation of South African Boxthorn as well as numerous plants of Bridal Creeper, Spear Thistle and Perennial Veldt-grass. The site supports at least one listed significant species. This site is still in very good condition despite the problems with elevated salinity. Flow into the lake and the eradication of the serious weeds will return this site to excellent condition.

Habitat

RHA and HABSCORE assessments were conducted on the eastern and western sides of Lake Hindmarsh, HABSCORE assessments were not conducted as noted in the methods. Weed ingress invasion was the biggest influence to the RHA score for each site, with the dunal system on the eastern side of the lake displaying a higher percentage cover of weed species.

Table 28. Habitat quality assessments for Reach 21

Site	HABSCORE	RHA Score
R21E-26	n/a	11/20
R21W-27	n/a	15/20
Weighted Average	n/a	13/20

Four Mile Camping Ground on the southern end of Lake Hindmarsh is another site that has suffered wide scale degradation due to recreational use. Very little of the interdunal vegetation remains, with ground cover disturbed by concentrated vehicular and pedestrian traffic. Vehicle tracks from the camping area lead out along the dunes around the south-western foreshore (Figure 35). At the time of inspection many vehicles had accessed the dry lakebed with skid marks and tracks present over a wide area.



Figure 35: Four Mile Beach camping ground (left), vehicle tracks on the bed of Lake Hindmarsh (centre) and through the dunes on the south-western side of the lake (right).

6.2.9 Reach 22: Outlet Creek, Lake Hindmarsh to Lake Albacutya

Geomorphology

From Lake Hindmarsh to Lake Albacutya, Outlet Creek is a relatively small u-shaped channel of varying sinuosity set within a broad valley. The bedform is characterised by long run sections of relatively uniform depth with small pools only occurring on bends. The bed material comprises sands and there is little evidence of natural sedimentation and bar formation occurring. The banks of the creek are typically well vegetated with grasses and small herbs and are subsequently quite stable.



Figure 36: Impacts of recreational use on Outlet Creek north of Lake Hindmarsh. Creekbed used by trailbikes as a sandy track (left), derelict camping structures in the informal camping ground on Outlet Creek on the northern end of Lake Hindmarsh (centre) and evidence of trail-bike racing in the camping ground (right).

Given the long periods without flow, recreational use dominates the character of the creek. Vehicle access into the creek bed at the northern end of Lake Hindmarsh has turned it into a sandy road and it appears to be a favourite trail bike route (Figure 36). This is creating problems for bed stability and there will be erosion and deposition of bed material when the creek commences to flow. There are also points along the banks where trail bike and vehicle use has destroyed most of the stabilising vegetation and there is potential for these areas to erode once flows return to the creek.

Further along the creek toward Lake Albacutya, the waterway appears to be widely used as a walking track/bike trail and the level of damage is lessened (Figure 37). There is still some bed and bank disturbance, but the good vegetation cover is likely to keep movement to a minimum.



Figure 37: Trailbike tracks in the bed of Outlet Creek at Site 22 on Rainbow Rises Road (left) and Site 19 at Western Beach Road (right).

Vegetation

Site 19 at the Western Beach Road bridge is a most attractive site with a fringe of mostly healthy River Red Gums, a very diverse range of mid storey shrubs and a rich ground flora. The understorey is more comprised of typical “Mallee” shrubs than Wimmera shrubs and the ground flora also has many inland species. The extended dry conditions is having an impact on the shrub layer with numerous dead plants. Numerous invasive weed species were evident including Horehound, Perennial Veldt-grass, Annual Veldt-grass, Bridal Creeper and several wild Mustard species. Control of these invasive weed species will allow this site to recover rapidly. Due to the sporadic occurrence of Wimmera River flows reaching this far downstream there are few signs of the salinity stress so evident upstream of Lake Hindmarsh.

Site 22 at the Rainbow Rises Road bridge crossing of Outlet Creek supports an interesting area of Black Box Lignum Woodland, with Black Box and the occasional River Red Gum over an often dense shrub layer of Tangled Lignum. There is a sparse ground flora, degraded by years of overgrazing and rabbit infestation. Today the whole area is being severely impacted on by trail bike riding which is causing much damage to the ground flora. There are numerous chenopods and a variety of agricultural weeds including the Stemless Thistle. The removal of continual grazing, eradication of rabbits and closure of this site to trail-bikes should enable it to recover well.

Habitat

Habitat assessments were conducted at two sites along this reach and the results are summarised in Table 29. High weed cover is the main factor that reduces the RHA scores at these sites. Site 19 exhibits good understorey diversity and excellent log density. Site 22 was found to have excellent understorey, but also an increased level of weed infestation and removal of lying timber.

Table 29. Habitat quality assessments for Reach 22

Site	HABSCORE	RHA Score
R22-19	107/200	15/20
R22-22	100/200	13.5/20
Weighted Average	104/200	13.3/20

6.2.10 Reach 23: Lake Albacutya

Geomorphology

Lake Albacutya is another large lunette lake along the Wimmera Heritage River and is about one third the size of Lake Hindmarsh. As the lake is significantly deeper than Lake Hindmarsh, the full capacity is approximately 290,000ML. Lake Albacutya is also flanked by a series of well vegetated crescent shaped transverse dunes on the eastern side and by relicts of ancient marine shorelines on the western side.

At the time of assessment there was no water in the lake (the last major filling was 1974-1976) and the lake bed was covered in vegetation. The bed material comprises sands with lenses of clay in lower lying parts of the lake. There is a lot of vegetation on the bed of the lake which will provide a key source of food for macroinvertebrates as well as sites for good epifaunal colonisation and fish cover when the lake fills. These plants will also provide essential nesting sites for birds.



Figure 38: Instability due to effect of human access on vegetative ground cover at Dorrington Point (left), Jordon Valley camping ground (centre) and dunes on the north-eastern side of Lake Albacutya (right).

The lake itself is in good physical condition. The populations of wattle and red gums that populate the fringes are healthy and there is no evidence of serious erosion. Some of the dunes are mobile and human access is threatening the stability of areas both on the eastern (near the Jordon Valley) and western side (Dorrington Point).

Vegetation

Site 20 at the tip of Dorrington Point is characterised by a dense understorey of various wattles and other shrubs under tall River Red Gums growing on deep white sand. There is little ground flora, but this is a natural feature of deep sand sites. Large areas of the acacia community along the foreshore have been subject to a Parks Victoria managed ecological burn to promote regeneration. Some germination has occurred, however areas of sandy soil devoid of native vegetative cover have been sown down to non-indigenous Perennial Veldt-grass. The vegetation assessment site is in excellent condition, whereas the adjoining burnt areas at present remain in a poorly vegetated state. The sowing of Perennial Veldt-grass on the sandy soils has to be questioned given its ability to displace native vegetation –it would have been better to simply avoid disturbing the areas of light sandy soils. With Veldt-grass on the site there will be a quick recovery of the erosion problems, but a very slow recovery of the native vegetation.

Habitat

One habitat assessment was conducted within this reach at Dorrington Point and the results are summarised in Table 30. The lack of logs because of firewood harvesting reduces the RHA score for this site.

Table 30. Habitat quality assessments for Reach 23

Site	HABSCORE	RHA Score
R23-20	n/a	16/20
Weighted Average		16/20

It was noted during the field inspections of Lake Albacutya that large tracts of the lake frontage along the western shore stretching north and south from Dorrington Point have been cleared of the native vegetation. Bulldozer marks, windrowed dead vegetation, ash and charcoal beds were all evident over a wide area. The clearing of the native vegetation was undertaken by Parks Victoria as part of an ecological burn project to attempt to promote regeneration of acacias on the bed of the lake. Apparently large areas of dead timber were hampering recruitment and acting as harbour for vermin, and Parks Victoria were aiming to increase the diversity of vegetation (pers comm K Schramm, Parks Victoria). Some of the cleared sections have been sown down to Perennial Veldt-grass to stabilise the sandy surface (Figure 39).



Figure 39: Large scale clearing of native vegetation at Lake Albacutya. Unburnt cleared vegetation with uncleared area in background (left), drill lines of Perennial Veldt-grass (centre) and the area of uncleared vegetation at the tip of Dorrington Point (right).

Regeneration has been patchy with some areas of bare, sandy soil still evident. Monitoring of the ecological burn area should be undertaken, with a management plan incorporating revegetation undertaken if natural regeneration continues to be poor and soils are exposed to the threat of wind erosion.

6.2.11 Reach 24: Outlet Creek North of Lake Albacutya

Geomorphology

Outlet Creek north of Lake Albacutya is a small, well formed channel set within a symmetrical floodplain. At the time of assessment the creek was dry and the last time Lake Albacutya overflowed through Outlet Creek was in 1976 (Bren and Sandell, 2004). In spite of the lack of flows, Outlet creek remains clearly defined u-shaped (possibly 2 stage) sinuous channel.



Figure 40: Outlet Creek north of Lake Albacutya. Well vegetated creek bed (left) and recoppiced trees showing evidence of previous timber harvesting (right).

The bedform of Outlet Creek in reach 24 is characterised by a series of pools separated by sand riffles or runs and the bed is predominantly sands. There is some sand bar formation which has been stabilised by vegetation and is likely to become small islands within the creek. The banks and bed of the creek are well vegetated and appear to be very stable.

There are a series of flood channels, remnant channels and billabongs across the floodplain, reflecting widely varied flow paths over the history of the creek.

Vegetation

Site 21 on Outlet Creek north of Lake Albacutya displays a beautiful mixture of River Red Gums, Black Box and Slender Cypress-pines. All are in a good healthy condition and despite the lack of almost all mid storey, there is a rich ground flora with numerous native annual species mostly unrecorded further south due to the timing of the survey. Despite the dry conditions this site only requires the careful addition of mid storey species to be in an excellent condition. The lack of mid storey is probably explained by a history of grazing by kangaroos and rabbits. With control of rabbits the site will show steady recovery.

Habitat

A single habitat assessment was conducted along this reach and the results are summarised in Table 31.

The creek is in excellent physical condition - there is a wide variety of pool sizes, good potential in-stream cover and excellent pool substrate. This provides a variety of habitat which is well suited to colonisation once flows appear. There is some sediment deposition in the sections of the creek closest to Lake Albacutya which has become well stabilised and appears to be a natural part of the creek. The bars

formed contributes to the complexity of the channel and the diversity of habitat available.

The creek banks are well vegetated and stable displaying little in the way of erosion. There is evidence of rabbits in the creek bed causing some damage to the banks, however at this stage the effects are quite minor. No single dominant threatening process determined the outcome of the assessment scores.

Table 31. Habitat quality assessments for Reach 24

Site	HABSCORE	RHA Score
R24-21	139/200	15/20
Weighted Average	139/200	15/20

6.3 Trajectory and Identification of Threatening Processes

At each inspection site, the health of the river and the ability of the river to achieve its targets (as set out in Table 18) were noted. It became evident during the field program that these processes operate at two different scales – regional and local. The actions required to address these issues will therefore need to be undertaken at either a regional or a local (site) scale, and some issues do not fit within the terms of reference of the Waterway Action Plan. The threatening processes and their mitigative actions have been separated into two sections: Regional Scale Threatening Processes, and Local Scale Threatening Processes.

6.3.1 Regional Scale Threatening Processes

A number of processes having a negative impact on the health and value of the Wimmera River were identified as occurring across reaches, or across the full survey length of the river. These processes are having a significant or widespread impact and require considerable investment and an imaginative approach to mitigate. Wimmera CMA recognises that these issues exist, however the purpose of Waterway Action Plans is to achieve the objectives of the Wimmera Regional Catchment Strategy (RCS). The RCS aims to achieve integrated management of natural resources across the whole Wimmera Region, focussing attention in a number of areas, one of which is the wetlands and streams of the Wimmera River Basin. The RCS regional objectives detailed in the following table define the direction of works programs resulting from the WAP process.

Objective	Description
Objective 1	Preserve areas with near pristine values
Objective 2	Restore areas of high value
Objective 3	Rehabilitate areas that place other values at risk or provide good opportunity for restoring values
Objective 4	Maintain degraded areas to prevent values declining to unacceptable levels

As such regional scale processes fall under the jurisdiction of a number of additional Wimmera CMA programs and actions focusing on implementing sound management. These include:

- The Draft Wimmera Waterway Health Strategy (2005);
- The Wimmera Salinity Action Plan (2005);
- The Wimmera Weed Action Plan (2000-2005);
- The Wimmera Rabbit Action Plan (2000-2005);
- Environmental Water Reserve Management; and,
- Riparian Management.

The following provides a discussion of the key regional threatening processes identified during the field work component of this project as having an impact on the health of the Wimmera River.

Altered Hydrology

The natural flow regime of the Wimmera Heritage River has been substantially altered by the extraction for stock and domestic purposes. The main change to the flow regime has been a reduction in the frequency and occurrence of small to medium flows. These flows would have been those which maintain the instream water quality and the cross sectional form of the channel.

The change in flow regime which is the result of water extraction is currently being exacerbated by 8-9 years of low flows and drought conditions. Consequently, the river channel is observed to be contracting at a number of sites as evidenced by the series of impediments to flow – fallen timber (Large Woody Debris LWD) is not being realigned by flows, sediment is not being passed along the channel and there is a build up of material and vegetation in the channel. The extended period without flow in the river is exacerbating saline groundwater intrusion into the channel markedly raising salinity levels in some of the deeper pools.

While the Wimmera Heritage River is in the midst of an extended period of drought, there is an expectation that water savings as a result of pipelining the stock and domestic system will be returned to the river. Consequently, there is an expectation that the river will return to some of its former flow patterns.

Channel contraction

The reduction in flows in the river due to upstream diversions combined with 8-9 years of naturally reduced rainfall derived flow has resulted in the contraction of the river channel. A series of flow impediments along the river have resulted where flows have been insufficient to realign the timber which has fallen into the river. The subsequent build up of wood and debris creates debris jams which have acted to trap sediment, forming mid channel bars. These bars become colonised by vegetation, particularly phragmites, which acts to stabilise the sediment and encourages further deposition through lowering flow velocity. Combined with the inability of reduced flows to transport some of the sediment load of the river, the stabilising influence of colonising vegetation leads to the development of an elevated constriction across the river.

Phragmites encroachment

There is considerable debate regarding the historical presence of Phragmites, *Phragmites australis* or Common Reed in the Wimmera River. There is evidence of phragmites in the Wimmera River as early as the 1920's (Earth Tech 2003). Long standing landholders dispute its natural presence in the river and well reasoned arguments exist on both sides of the debate. Phragmites predominately spreads through transport of fragmented rhizome segments, and it is argued by some that following widespread planting in the upper Wimmera River catchment since the 1950's to stabilise banks and control erosion has appeared to move into the mid-to-lower reaches of the Wimmera River.

Phragmites is a pioneer species, and also acts as a successional species replacing other aquatic plants that have previously colonised deep water (Hocking, Finlayson and Chick, 1983). The thick tangled stems and dense rhizome root systems that are so good at stabilising eroding stream banks are also adept at colonising sandy in-stream bars, leading to further sediment deposition and subsequent reduction of the channel hydraulic capacity. Flood events divert around the colonised sediment bar, causing scour to the riverbanks. Flood flows are at times unable to strip away the sediment bar or vegetative matter due to the dense root system. Landholders adjacent to the river have voiced concerns that the frequency and severity of overbank flooding has increased because of this closing down of the river channel. Comments from the community meeting indicate that while farmers expect flooding to occur, they do not accept incidences of overbank flooding caused by in-channel flow rates that the river has historically been able to convey.

Salinity

Salinity is an issue that has been exacerbated by the altered hydrology and recent drought conditions along the Wimmera Heritage River. As the volume and occurrence of flushing flows decreases (derived from rainfall events or environmental flow releases) the ability of the river to dilute and transport dissolved salt also decreases. This is combined with the effects of large scale clearing causing rising groundwater tables across the region.

As the concentration of salts in the river increases the in-stream flora and fauna communities become stressed and are displaced by species with higher salt tolerance. Some loss of soil structure and slumping of banks was also noted at sites with high salinity readings.

Table 32 summarises the salinity readings for sites along the survey reach.

High salinity levels were recorded at the West Wail Gauging station (also known as the Dimboola gauging station or the Gauging station upstream of Big Bend). This appears to be a localised intrusion of ground. A rapid increase in salinity levels was also noted along the reach between Antwerp and the Tarranyurk Gauging Station, although there does not appear to be a single site at which the salinity increases rapidly. It appears that there is a general intrusion of saline groundwater along this reach.

Table 32. Electrical Conductivity (salinity) readings at survey sites along the Wimmera Heritage River, August 2005.

Site Name	Site No.	E.C. (µS/cm)
Old Duchembegarra Road	2	2,290
Mackleys Road	3	1,906
Derelict bridge near Wail State Forest	4	3,357
West Wail Gauging Station	5	17,400
Dimboola Weir		2,654 (u/s)
Downstream from Wundersitz crossing		3,747
Spears Crossing	10	4,201 (u/s) 4,381 (d/s)
River Road between Antwerp and Tarranyurk	16	6690
Upstream of Tarranyurk Bridge		16,000-27,000
Tarranyurk Bridge		12,100
Tarranyurk Gauging Station		36,000
Upstream of Jeparit	23	34,000
Jeparit weir	24	41,250 (u/s) 40,040 (d/s)

Weed Invasion

Weed invasion into the riparian zone is a process that is threatening the entire surveyed Heritage River section of the Wimmera River. The two most common invasive species noted were Bridal Creeper *Asparagus asparagoides* and Perennial Veldt-grass *Ehrharta calycina*.

Bridal Creeper is a weed of national significance, and has been classified as a Wimmera Priority Weed due to the negative economic and environmental impacts it causes (Wimmera Weed Action Plan 2000-2005). The Wimmera Priority Weeds are regarded to be currently well established, but restricted in the Wimmera, and potentially pose a significant threat if allowed to escape. The major impact of Bridal Creeper infestation on native vegetation is through the smothering and shading effect of the thick foliage and root mass. Small shrubs and woody plants are deprived of moisture and nutrients and are eventually displaced (Wimmera Weed Action Plan 2000-2005).

Bridal Creeper was identified at most survey sites. The majority of plants noted were emergent seedlings forming clumps up to 100mm in diameter. Urgent control measures are required to avoid infestation of large areas of the riparian zone throughout the Heritage River reach. Thick infestations of Bridal Creeper were noted on Datchak Creek at Site 14. Evidence of spraying to control Bridal Creeper was noted near the West Wail picnic areas at Site 6.

Perennial Veldt-grass is a hardy South African species widely planted in the region from early last century to stabilise remnant sand dune formations. It has naturalised due to its ability to cope with dry conditions and sandy soil types, and was the dominant ground cover at many sites. Unlike Bridal Creeper, it is not recognised as

a priority weed in the Wimmera region. The combination of the difficulty in differentiating between Perennial Veldt-grass and indigenous grasses, its value to land managers in ground stabilisation, and widespread existence mean that this status is unlikely to change.

Other weeds tended to be site specific, and in general were more prevalent in areas subject to increased grazing pressure. Boneseed was noted in the northern lakebed of Lake Hindmarsh. Horehound was prevalent near Spears Crossing, around Antwerp and along Outlet Creek at the southern end of Albacutya. Weeds were noted as part of the vegetation assessment for each site (Appendix A).

Vehicular and pedestrian access

Degradation of ground cover through the effects of pedestrian and vehicular access was noticeable throughout the Wimmera Heritage River. The combination of sandy erodible soils and the magnetism of a permanent water-body in an otherwise dry environment has led to intense pressure on the riparian zone. Sites such as the West Wail picnic areas (site R17-6), the informal camping ground on Outlet Creek immediately downstream of Lake Hindmarsh, the reach between Jeparit and the Jeparit Weir (R20-24), and the Jordan Valley campground and foreshore on Lake Albacutya were typified by large areas of bare sandy soil, erosion, vehicle tracks and litter. Past organised trail-bike racing at the Outlet Creek site was evident, with race track features such as cambered berms, trails and formed jumps in the creek bed, and abandoned camping structures all identified.

Many sites displayed evidence of damage caused by trail-bikes and four-wheel-drive vehicles directly accessing the riverbed and banks, including at Tarranyurk (R19-17), the lakebed and foreshore near the Four Mile Beach campground on Lake Hindmarsh (R21W-27), Outlet Creek upstream of Lake Albacutya (R22-19) and Outlet Creek at Rainbow Rises Road (R22-22). Uprooting of ground cover vegetation and destabilisation of the soil surface and riverbanks visibly scar the riparian zone, and increases the potential for erosion and localised sediment transport into the river during rainfall or flood events.

Numerous tracks and informal camping sites occur along the full length of the Wimmera Heritage River. Increased access reduces ground cover, and increases the potential for erosion, the spread of weeds and firewood harvesting.

Firewood harvesting

Firewood harvesting within the riparian zone was noted at the majority of sites surveyed along the Wimmera Heritage River. Removal of large woody debris (LWD) for firewood decreases the available habitat for terrestrial invertebrates, reptiles and small mammals, in turn impacting on the available food for birds and larger mammals. Firewood harvesting also reduces the amount of organic matter that returns into the soil profile, and reduces shade and wind protection.

However, it must be noted that clearing and burning of fallen timber may also have been undertaken at some locations to reduce the habitat available for rabbit infestation.

Waterskiing and jetskiing

Two sections within the Wimmera River heritage reach are currently gazetted as open speed, and hence are open to jetskiing and waterskiing. The Dimboola open speed zone stretches from just downstream of Horseshoe Bend to the Picnic Bend boat ramp, and is used by members of the Dimboola Ski Club and other members of the public.

A second open speed zone is located between the Jeparit Weir and Lake Hindmarsh. This zone is only open to members of the Hindmarsh Ski Club.

A site inspection along the open speed zone between the Dimboola Ski Clubrooms and Murray's corner was undertaken with members of the Dimboola Ski Club. Wash related erosion was observed in the vicinity of the Picnic Bend boatramp, however very little erosion that could be attributed to waterskiing was noted throughout the rest of the reach.

Works have been conducted by the ski club to minimise the effects of boat wash around the boat ramp including the placement of rubble and cement stabilised sandbags, and through the use of tyres along the clubroom foreshore area. The ski club have also undertaken revegetation works along the weir pool top water level, using reeds sourced from a local billabong. Some of the plantings have failed due to the low weir pool levels. The ski club have indicated a desire to identify and source the best vegetation species to use in revegetation works.

To lessen the wash related erosion of the riverbanks the Dimboola Ski Club have banned the use of wake enhancing devices as used by wakeboard enthusiasts. The ski club also recognise the community held concerns regarding noise, and in recent years instituted a club rule that all ski boats must be appropriately muffled.

6.3.2 Local Scale Threatening Processes

At each site, the processes having a negative impact on the health and value of the Wimmera River were identified. The following sections identifies these processes for each reach and also highlights which of the regional scale processes are threatening the values of the reach, although as the regional scale processes have been addressed in the previous section there is no detail provided.

Reach 14/15: Polkemmet Bridge to Mackleys Road**Table 33. Trajectory and threatening processes identified for Reach 14/15**

Site	Trajectory	Threatening processes
1	Worsening (slow)	• Altered hydrology
		• Lack of soil protection
		• Weed invasion
		• Vegetation removal
2	Worsening (moderate)	• Altered hydrology <ul style="list-style-type: none">◦ channel encroachment
		• Lack of soil protection
		• Vegetation removal
		• Weed invasion
		• Salinity

Threatening Processes and Risks

Table 34. Threatening Processes and high and very high Risks identified for Reach 14/15

Threatening processes	Assets Threatened	Comment	Risk Rating
Altered Hydrology	Substrate Geomorphic character	Reduced flows in the river have resulted in vegetation encroachment (particularly phragmites) and the stabilisation of bars across the river. A small left bank tributary at Old Duchembegarra School Rd (Site 2) appears to be delivering saline water to the river.	Very high High
Lack of soil protection	Riparian zone Stream banks	The ready access to vehicles and recreational use at Polkemmet Bridge (R14/15 – S1) is damaging the riparian vegetation and contributing to the spread of weeds. Stock access at Old Duchembegarra School Rd (R14/15 – S2) has reduced the riparian cover and resulted in a lack of stream bank protection.	High High
Weed invasion	Stream banks Riparian Zone	The ready access to vehicles, stock and recreational use at Polkemmet Bridge is contributing to the spread of weeds. Weeds borne by water, birds and wind need to be addressed in the surrounding area.	Very high High
Vegetation Removal	Riparian Zone	Timber removal from the riparian zone for camp fires	High

Actions required to meet targets**Table 35. Actions required in Reach 14/15 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
A8	2	Undertake salinity control works such as revegetation around left bank tributary	High
A4	2	Fence to protect the riparian zone and implement regulated stock grazing periods.	High
A4	All sites	Control weeds	High
A4,A5	All sites	Stop vegetation removal and firewood collection	High
A6,A7	All sites	As water becomes available, implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003) and Stressed Rivers project - Environmental Flow Study (SKM 2003)	High

Reach 16: Mackleys Road to Ellis Crossing**Table 36. Trajectory and threatening processes identified for Reach 16**

Site	Trajectory	Threatening processes
3	Worsening (slow)	• Weed invasion
		• Altered Hydrology <ul style="list-style-type: none"> ○ Channel encroachment ○ Salinity
		• Exotic Fauna
4	Worsening	• Lack of soil protection
		• Weed invasion
		• Altered Hydrology
		• Exotic Fauna

Threatening Processes and Risks**Table 37. Threatening Processes and high and very high Risks identified for Reach 16**

Threatening processes	Assets Threatened	Comment	Risk Rating
Altered Hydrology	Substrate	Continued low flows prevent the realignment of large woody debris, and promote the encroachment of vegetation across the channel. Phragmites is blocking the channel in many places New anabranch has formed over the past 60-70 years which has delivered large amounts of sediment to the river, anabranch banks may be actively eroding	Very High
	Geomorphic character		Very High
	Stream Banks		Very High
Lack of soil protection	Stream Banks	Some cropping of the riparian zone has taken place in the past Damage caused by motorbike access	High
	Riparian zone		High
Removal of vegetation	Riparian zone	Removal of vegetation – particularly from the right bank - for firewood	Very High
Weed invasion	Riparian Zone	Access by vehicles and stock is contributing to the spread of weeds. Weeds borne by water, birds and wind need to be addressed in the surrounding area.	Very High

Actions required to meet targets**Table . Actions required in Reach 16 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
A5	3	Realign LWD in channel to prevent continued blockages	High
A4, A5	All sites	Stop vegetation removal and firewood collection adjacent stream	High
A4	3	Continue to re-vegetate riparian zone on LHB across to new anabranch which has formed.	High
A5	3	Monitor erosion and extension of anabranch (install erosion pins/scour chains)	High
A8	All sites	Monitor groundwater water and salinity levels	High
A4	All sites	Control weeds	High
A4	4	Control exotic fauna (hares)	High
A9	All sites	Control exotic fauna (carp)	High
A4	4, Ellis Crossing	Stop trail bike access of riparian zone between site 4 and Ellis Crossing. Limit access to formed roads downstream of Ellis Crossing.	High
A6,A7	All sites	As water becomes available, implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003) and Stressed Rivers project - Environmental Flow Study (SKM 2003)	High

Reach 17: Ellis Crossing to Dimboola**Table 38. Trajectory and threatening processes identified for Reach 17**

Site	Trajectory	Threatening processes
5	Stable	<ul style="list-style-type: none"> • Altered Hydrology <ul style="list-style-type: none"> ○ Saline intrusion ○ Channel contraction • Weed invasion
6	Worsening (fast)	<ul style="list-style-type: none"> • Lack of soil protection <ul style="list-style-type: none"> ○ Intense human access • Altered Hydrology • Weed Invasion
7	Stable	<ul style="list-style-type: none"> • Lack of soil protection • Weed invasion • Altered Hydrology
Picnic Bend boatramp	Worsening (slow)	<ul style="list-style-type: none"> • Lack of soil protection <ul style="list-style-type: none"> ○ Bank erosion

Threatening Processes and Risks

Table 39. Threatening Processes and high and very high Risks identified for Reach 17

Threatening processes	Assets Threatened	Comment	Risk Rating
Altered Hydrology	Substrate	Saline groundwater intrusion is causing riparian vegetation to degrade. Saline groundwater may also be destabilising banks of the river Vegetation encroachment and 'shutting down of the channel'	Very High
	Geomorphic Character		High
	Riparian Zone		Very High
	Water Quality		Very High
	Aquatic Biota		Very High
Lack of soil protection	Stream banks	Uncontrolled human access is damaging the riparian vegetation and also causing bank damage. A network of trails has developed through the forest to access the river. Severe bank erosion evident	Very High
	Riparian zone		Very High
Weed invasion	Riparian Zone	The ready access by vehicles and recreational users is contributing to the spread of weeds. Weeds borne by water, birds and wind need to be addressed in the surrounding area.	Very High
	Aquatic Biota		High

Actions required to meet targets**Table 40. Actions required in Reach 17 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
A8	5	Continue to monitor groundwater bores for salinity	High
A5	6	Realignment of LWD and debris jam to reduce bank erosion.	High
A5	6	Develop (seasonal) good quality access tracks, car parking and access facilities	High
A5	6	Undertake works identified in the report Streambank Stabilisation at Big Bend (Earth Tech, 2000).	High
A5	7	Continue to carefully manage access	High
A4	All sites	Control weeds	High
A6,A7	All sites	As water becomes available, implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003) and Stressed Rivers project - Environmental Flow Study (SKM 2003)	High
A5	Picnic Bend	Replace rubble bank stabilization structures with suitable bank stabilization measures	High

Reach 18: Dimboola to downstream confluence with Datchak Creek at Antwerp**Table 41. Trajectory and threatening processes identified for Reach 18**

Site	Trajectory	Threatening processes
8	Worsening	<ul style="list-style-type: none"> Altered Hydrology <ul style="list-style-type: none"> Channel encroachment
		<ul style="list-style-type: none"> Weed Invasion
9	Worsening	<ul style="list-style-type: none"> Altered Hydrology <ul style="list-style-type: none"> Channel encroachment
		<ul style="list-style-type: none"> Weed Invasion
10	Stable	<ul style="list-style-type: none"> Altered Hydrology <ul style="list-style-type: none"> Channel encroachment
		<ul style="list-style-type: none"> Weed Invasion
13	Worsening	<ul style="list-style-type: none"> Altered Hydrology <ul style="list-style-type: none"> Channel encroachment
		<ul style="list-style-type: none"> Earthworks

Site	Trajectory	Threatening processes
		<ul style="list-style-type: none"> Vegetation Removal
Upstream of Spears Crossing	Worsening	<ul style="list-style-type: none"> Lack of soil protection

Threatening Processes and Risks

Table 42. Threatening Processes and high and very high Risks identified for Reach 18

Threatening processes	Assets Threatened	Comment	Risk Rating
Altered Hydrology	Substrate Geomorphic Character Stream Banks Water Quality Aquatic Biota	This reach shows substantial channel encroachment and stabilisation of bars by extensive strands of phragmites. There is the potential for serious flooding and erosion once flooding flows return to the river.	Very High Very High Very High High Very High
Weed invasion	Riparian Zone Aquatic Biota	Access by agricultural machinery and vehicles, stock and recreational users is contributing to the spread of weeds. Weeds borne by water, birds and wind need to be addressed in the surrounding area.	Very High High
Lack of soil protection	Stream banks Water Quality	Piping erosion upstream of Spears Crossing has the potential to quickly result in a new right bank gully	High High
Vegetation Removal	Riparian Zone	Some firewood collection is occurring within the riparian zone	High

Actions required to meet targets**Table 43. Actions required in Reach 18 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
A5	8,9,10	Realignment of LWD and debris jams blocking channel	High
A4	9, 10	Encourage farmers to washdown machinery before using Spears and Wundersitz Crossings	Medium
A4	All sites	Control weeds	High
A5	Upstream of Spears Crossing	Undertake survey and earthworks to redirect runoff from agricultural land through adjacent stable vegetated area to river	Low
A6,A7	All sites	As water becomes available, implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003) and Stressed Rivers project - Environmental Flow Study (SKM 2003)	High

Reach 18A: Datchak Creek**Table 44. Trajectory and threatening processes identified for Reach 18A**

Site	Trajectory	Threatening processes
11	Improving (slowly)	<ul style="list-style-type: none"> • Weed invasion
12	Worsening (fast)	<ul style="list-style-type: none"> • Lack of soil protection • Weed invasion
14	Worsening (slowly)	<ul style="list-style-type: none"> • Altered Hydrology • Exotic fauna (rabbits) • Weed invasion

Threatening Processes and Risks**Table 45. Threatening Processes and high and very high Risks identified for Reach 18A**

Threatening processes	Assets Threatened	Comment	Risk Rating
Vegetation Removal	Riparian Zone	Very few logs remain as habitat within the riparian zone throughout this reach.	Very High
Weed invasion	Riparian Zone	Bridal Creeper is present at all sites, with severe infestations at Site 14	Very High

Actions required to meet targets**Table 46. Actions required in Reach 18A to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
A4	All sites	Fence riparian zone to enable controlled grazing by stock, encourage recruitment and reduce weed invasion. Initiate re-vegetation program	High
A9	14	Control exotic fauna	High
A4,A5	All sites	Stop removal of vegetation and firewood from Riparian Zone	High
A4	All sites	Control weeds	High

Reach 19: Downstream confluence with Datchak Creek at Antwerp to just south of Jeparit**Table 47. Trajectory and threatening processes identified for Reach 19**

Site	Trajectory	Threatening processes
15	Worsening (fast)	• Altered Hydrology ○ Salinity
		• Weed invasion
		• Lack of soil protection
16	Worsening (fast)	• Altered Hydrology ○ Salinity
		• Weed invasion
18	Worsening (fast)	• Altered Hydrology ○ Salinity
		• Weed invasion

Threatening Processes and Risks**Table 48. Threatening Processes and high and very high Risks identified for Reach 19**

Threatening processes	Assets Threatened	Comment	Risk Rating
Altered Hydrology	Substrate Geomorphic character Stream Banks Riparian Zone Water Quality Aquatic Biota	High salinity levels are causing widespread loss of riparian vegetation and as the vegetation is lost from the riparian zone and stream banks, the banks are becoming unstable. Stratification is resulting in very low DO levels in the lower layer and there is algae forming around the margins of the pools The Antwerp Weir pool has also acted as a deposition zone and large amounts of sand is deposited at the top end.	Very High High Very high Very High Very high Very High
Weed invasion	Riparian Zone	Access by vehicles and stock is contributing to the spread of weeds. Weeds borne by water, birds and wind need to be addressed in the surrounding area.	Very High
Lack of soil protection	Stream Banks Riparian Zone	Lack of fencing and stock access at site 15 is resulting in reduced stream bank protection and the potential for some serious erosion when flooding flows return to the river. Human access along the RHB is also reducing the integrity of the riparian zone vegetation and consequently bank stability is reduced for the entire reach.	High High

Actions required to meet targets**Table 49. Actions required in Reach 19 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
A4	15	Fence riparian zone to enable controlled grazing by stock, encourage recruitment and manage weed invasion.	High
A6,A7	All sites	As water becomes available, implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003) and Stressed Rivers project - Environmental Flow Study (SKM 2003)	High
A4	All sites	Control weeds	High

Reach 20: Just south of Jeparit to Lake Hindmarsh**Table 50. Trajectory and threatening processes identified for Reach 20**

Site	Trajectory	Threatening processes
23	Worsening	<ul style="list-style-type: none"> Altered Hydrology <ul style="list-style-type: none"> Salinity
		<ul style="list-style-type: none"> Weed invasion
		<ul style="list-style-type: none"> Lack of soil protection
24	Worsening	<ul style="list-style-type: none"> Altered Hydrology <ul style="list-style-type: none"> Salinity
		<ul style="list-style-type: none"> Lack of soil protection

Threatening Processes and Risks**Table 51. Threatening Processes and high and very high Risks identified for Reach 20**

Threatening processes	Assets Threatened	Comment	Risk Rating
Altered Hydrology	Substrate	High salinity levels coupled with vehicular access are causing widespread loss of riparian vegetation. As the vegetation is lost from the riparian zone and stream banks, the banks are becoming unstable.	Very High
	Geomorphic character		High
	Stream Banks		Very high
	Riparian Zone	Stratification is resulting in very low DO levels in the lower layer and there is algae forming around the margins of the pools	Very High
	Water Quality		Very high
	Aquatic Biota		Very High
Lack of soil protection	Stream Banks	There is some use of the riparian zone at site 23 by recreational 4WD and trail bikes which currently is only minimally impacting on the riparian vegetation but has the potential to cause some serious damage. At Site 24 vehicle access is the primary threatening process.	High
	Riparian zone		High
Weed invasion	Riparian Zone	Access by vehicles and recreational users is contributing to the spread of weeds. Weeds borne by water, birds and wind need to be addressed in the surrounding area.	Very High

Actions required to meet targets**Table 52. Actions required in Reach 20 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
A4	Entire reach	Judicious planting of salt tolerant native species for bank stabilization measures	High
A5	At/Downstream of Jeparit Weir	Bank stabilization and planting of severely eroding banks with salt tolerant native species.	High
A4,A5	24	Limit vehicle access to some distance from the river, stabilize existing scoured tracks and encourage re-colonisation from existing stands of native grasses and herbs.	High
A6,A7	All sites	As water becomes available, implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003) and Stressed Rivers project - Environmental Flow Study (SKM 2003)	High
A4	All sites	Control weeds	High

Reach 21: Lake Hindmarsh

There is some vehicle access onto the lake from the eastern side, but it appears to receive minimal use and they are currently not observed to be causing serious damage. Vehicles tend to be concentrated around the Four Mile Beach area on the south-western side of the lake and while the lake bed at this site is suffering from vehicle access it is not a lake wide issue. There is the potential for vehicles (in particular 4WD's) to cause serious damage to the bed of the lake, producing an area that can be adversely affected by winds and high water levels. At present this type of activity appears to be confined to a relatively small stretch of the shoreline and should remain so.

At the time of assessment, people were observed removing fire wood from the lake reserve on the east of the Lake. Such activities are illegal within the lake reserve and do appear to be relatively limited around the areas assessed.

The designated camping area at the Parks and Wildlife managed Four Mile Beach location is currently being prepared for the introduction of powered sites. This area supports a range of high value vegetation and needs to be carefully managed to retain vegetation values.

Table 53. Trajectory and threatening processes identified for Reach 21

Site	Trajectory	Threatening processes
25	Worsening (slowly)	• Removal of vegetation
		• Weed invasion
		• Exotic Fauna (carp)
4 Mile Beach	Worsening (slowly)	• Vehicular access to lakebed when dry
		• Intense recreational use in/around camp ground
27	Worsening (slowly)	<ul style="list-style-type: none"> • Weed Invasion • Vehicular access • Removal of vegetation
Top end		• Intense recreational use in/around camp ground
		• Motorbike access and use
		• Firewood harvesting

Threatening Processes and Risks

Table 54. Threatening Processes and high and very high Risks identified for Reach 21

Threatening processes	Assets Threatened	Comment	Risk Rating
Altered Hydrology	Substrate Riparian Zone Water Quality Aquatic Biota	Salinity is currently affecting the composition of the vegetation on the bed of the lake at Picnic Point (Site 25)	Very High High High High
Lack of soil protection	Substrate Streambanks Riparian zone	Damage due to 4WD tracks on the bed of the lake is limited to a small area, should remain so.	High High High
Weed invasion	Riparian Zone	African Feathergrass and Boneseed infestation next to Flora Reserve on Amy Johnson Highway , north-eastern side of Lake Hindmarsh. Boneseed in northern foreshore area. Perennial Veldt-grass colonising sand dunes.	Very High
Exotic Fauna	Substrate Aquatic Biota	Carp are reworking the base of the lake and causing a fine clay to settle on the base which causes grey dust when dry	High High

Actions required to meet targets

Table 55. Actions required in Reach 21 to achieve key waterway health targets.

Target No.	Site No.	Action	Priority
A4,A5	All sites	Stop firewood removal from riparian zone	High
A5	4 Mile Beach	Provide good access with clear tracks and parking areas to minimize damage to lake bed and riparian area. Limit access to the lakebed when dry	High
A3	All sites	Limit vehicular access to lake bed	Medium
A4	All sites	Control weeds	High

Reach 22: Outlet Creek – Lake Hindmarsh to Lake Albacutya**Table 56. Trajectory and threatening processes identified for Reach 22**

Site	Trajectory	Threatening processes
19	Worsening (slowly)	• Weed Invasion
		• Vehicular Access
		• LWD removal
22	Worsening (moderate)	• Vehicular access
		• Weed Invasion
		• Moisture stress
		• Grazing
		• Firewood harvesting

Threatening Processes and Risks**Table 57. Threatening Processes and high and very high Risks identified for Reach 22**

Threatening processes	Assets Threatened	Comment	Risk Rating
Lack of soil protection	Substrate	Access to creekbed by motorbikes and 4WDs is removing vegetative cover and destabilising banks.	High
	Stream banks		High
	Riparian zone		High
Weed invasion	Riparian Zone	The ready access by vehicles, stock and recreational users is contributing to the spread of weeds. Weeds borne by water, birds and wind need to be addressed in the surrounding area.	Very High

Actions required to meet targets**Table 58. Actions required in Reach 22 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
A4,A5	All	Stop firewood and LWD removal from riparian zone	High
A5	All	Limit 4WD and motorbike access to creek bed	High
A4	All	Control weeds	High

Reach 23: Lake Albacutya

The sowing of Perennial Veldt-grass as a bank stabilisation technique within the ecological burn area needs to be reviewed. Its invasive and persistent nature means that it is very suitable for revegetation of bare, dry sandy soils however this also tends to discourage re-establishment of the indigenous ground cover species.

There is potential for poor regeneration and wind erosion of the bare sandy areas within the ecological burn area. The area should be monitored, and revegetation and management program initiated if required.

Some of the dunes are mobile and human access is threatening the stability of areas both on the eastern (near the Jordon Valley) and western side (Dorrington Point). Sites on the dunes on the eastern side are being actively managed to promote re- growth and stabilisation.

There are large amounts of the weed horehound at the Western Beach boat ramp which should be removed.

Table 59. Trajectory and threatening processes identified for Reach 23

Site	Trajectory	Threatening processes
Jordon Valley campground	Stable	• Vehicular and recreational access
		• Firewood harvesting
		• Weed invasion
20	Stable	• Vehicular and recreational access
		• Weed invasion
		• Firewood harvesting

Reach 23:Threatening Processes and Risks**Table 60. Threatening Processes and high and very high Risks identified for Reach 23**

Threatening processes	Assets Threatened	Comment	Risk Rating
Lack of soil protection	Riparian zone	Vehicular and recreational access due to camping and access onto lakebed and dunes has removed vegetative cover from sandy soils.	High
Weed invasion	Riparian Zone	Sowing of Perennial Veldt-grass as a bank stabilisation technique should be reviewed. Access by vehicles and stock is contributing to the spread of weeds. Weeds borne by water, birds and wind need to be addressed in the surrounding area.	Very High

Actions required to meet targets**Table 61. Actions required in Reach 23 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
A4,A3	20	Monitor and initiate re-vegetation and management project for foreshore ecological burn area if required. Review use of Perennial Veldt-grass for dune stabilisation in Heritage River Corridor.	High
A4,A5	20	Restrict vehicular access to Dorrington Point	High
A4,A5	Jordon Valley camp ground	Restrict access to selected tracks, rehabilitate and re-vegetate surplus tracks.	High
A4,A5	All sites	Discourage firewood harvesting	High
A5	All sites	Restrict vehicular access onto dunes	Medium
A4	All sites	Control weeds	High

Reach 24: Outlet Creek – exiting from Lake Albacutya**Table 62. Trajectory and threatening processes identified for Reach 24**

Site	Trajectory	Threatening processes
21	Stable	<ul style="list-style-type: none"> Exotic Fauna <ul style="list-style-type: none"> rabbits Weed invasion

Threatening Processes and Risks**Table 63. Threatening Processes and high and very high Risks identified for Reach 24**

Threatening processes	Assets Threatened	Comment	Risk Rating
Weed invasion	Riparian Zone	Access by vehicles recreational users has the potential to contribute to the spread of weeds. Weeds borne by birds and wind need to be addressed in the surrounding area.	Very High

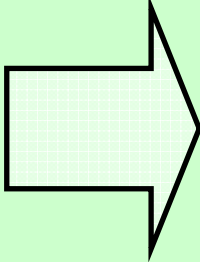
Actions required to meet targets**Table 64. Actions required in Reach 24 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
A4	21	Monitor rabbit populations and undertake eradication program as required.	Medium
A4	21	Control weeds	High

7 Works Program and Cost Estimate

A number of the actions recommended for the Wimmera Heritage River are covered under programs independent of the Waterway Action Plan e.g. weed and exotic fauna control. Table 65 provides greater detail of works activities that are not covered by the WAP works plan.

Table 65. Waterway and land management programs relevant to the Wimmera Heritage River catchment.

Issues identified in Waterway Action Plan	Responding Strategy / Plan / Activity
Bank erosion Stream bed instability In stream Water Quality In stream habitat Riparian zone revegetation	 <i>Heritage River Waterway Action Plan</i>
Exotic pest plants	<i>Wimmera Weed Action Plan</i>
Whole farm and pasture management	<i>Whole Farm planning</i>
Rabbits	<i>Wimmera Rabbit Management Action Plan</i>
Other exotic pest animals	<i>Victorian pest management framework</i>
Native pest animals	<i>Dept. Sustainability & Environment</i>
Native Vegetation Management	<i>Victorian Biodiversity Strategy</i>
	<i>Shire Planning schemes</i>

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Table 66. Heritage River Waterway Action Plan works program. Note that coloured priorities are actions to occur under this Waterway Action Plan program. Note: Further investigation is required to ascertain required fencing and revegetation provisional costs. 33The WCMA Incentive Rates schedule shown in Table 40 provides more accurate cost information.

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
			Easting	Northing			
Reach 14/15 - Polkemmet Bridge to Mackleys Road							
14/15-1	2	Investigate salinity control works for left bank tributary	587089	5944221	Other program	High	WCMA
14/15-2	2	Fence left and right bank riparian zone and implement regulated stock grazing periods to encourage recruitment and manage weeds	587089	5944221	Further investigation required	High	WCMA
14/15-3	All sites	Undertake weed control program				High	Parks Victoria
14/15-4	All sites	Stop vegetation removal and firewood collection. Promote alternative firewood sources.				High	Parks Victoria
14/15-5	All sites	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)			Other program	High	WCMA

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
Reach 16 – Mackleys Road to Ellis Crossing							
16-6	3	Undertake LWD realignment works in river channel to prevent continued blockages	586954	5946232	\$5,000	High	WCMA
16-7	3	Remove impediments to flow	586954	5946232	\$5,000	High	WCMA
16-8	3	Monitor erosion and extension of anabranh using erosion pins or scour chains	586954	5946232	\$10,000	High	WCMA
16-9	3	Continue revegetation works on left bank between river channel and scouring anabranh	586954	5946232	\$4,000	High	WCMA
16-10	4	Control hares to promote understory recruitment	589324	5950518		High	Parks Victoria
16-11	4, Ellis Crossing	Reduce trail bike access to riparian zone between Site 4 and Ellis Crossing. Limit access only to formed roads downstream of Ellis Crossing	589324, 589116	5950518, 5952270		High	Parks Victoria
16-12	All sites	Stop vegetation removal and firewood collection. Promote alternative firewood sources.				High	Parks Victoria

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
16-13	All sites	Undertake weed control program				High	Parks Victoria
16-14	All sites	Control carp				High	Parks Victoria
16-15	All sites	Implement groundwater and salinity monitoring program			Other program	High	WCMA
16-16	All sites	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)			Other program	High	WCMA
Reach 17 – Ellis Crossing to Dimboola							
17-17	5	Remove rubbish from right bank immediately upstream of gauging station.	590403	5953406		Low	Parks Victoria
17-18	5	Eradicate freesia and soursob at foot of right bank immediately downstream of West Wail gauging station	590403	5953406		High	Parks Victoria
17-19	5	Continue salinity monitoring of groundwater bores	590403	5953406	Other program	High	WCMA

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
17-20	6	Undertake LWD and debris jam realignment works in river channel to prevent bank erosion	591264	5956073	\$8,000	High	WCMA
17-21	6, Big Bend & West Wail picnic areas	Develop (seasonal) good quality access tracks, car parking and access facilities	591264 590628 590664	5956073 5954296 5954408		High	Parks Victoria
17-22	Big Bend	Implement erosion control measures as per Earth Tech report 'Streambank Stabilisation at Big Bend' (2003)	590628	5954296	\$6,500	High	WCMA
17-23	7	Develop (seasonal) good quality access tracks, car parking and access facilities	591163	5960429	\$10,000	High	Parks Victoria
17-24	All sites	Undertake weed control program				High	Parks Victoria
17-25	All sites	Control rabbits				Medium	Parks Victoria

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
17-26	All sites	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)			Other program	High	WCMA
17-27	Picnic Bend	Replace rubble bank stabilization structures with suitable bank stabilization measures	592491	5963951	\$15,000	Medium	WCMA
Reach 18 – Dimboola to downstream confluence with Datchak Creek at Antwerp							
18-28	8,9,10	Undertake LWD and debris jam realignment works in river channel to prevent bank erosion	587398, 56957, 588363	5970449, 5973192, 5979573	\$12,000	High	WCMA
18-29	8,9	Remove impediments to flow	587398, 586957	5970449, 5973192	\$20,000	High	WCMA
18-30	Dimboola Weir, Collards Road	Remove impediments to flow	590955 587696	5965138 5975011	\$20,000	Medium	WCMA

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
18-31	9,10	Work with farmers to encourage machinery washdown before using Spears and Wundersitz Crossings	586957, 588363	5973192, 5979573	\$2,000	Medium	DPI
18-32	Collards Road, Upstream of Spears Crossing	Undertake bank stabilisation works on right bank	587696 588173	5975011 5975353	\$24,000	Medium	WCMA
18-33	Upstream of Spears Crossing	Undertake survey and earthworks to redirect runoff from agricultural land through adjacent stable vegetated area to river. Revegetate piping prone area.	588389	5971096	\$30,000	Low	WCMA
18-34	All sites	Undertake weed control program				High	Parks Victoria
18-35	All sites	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)			Other program	High	WCMA

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
Reach 18A – Datchak Creek							
18A-36	14	Control rabbits	590732	5979228		High	Landowner responsibility
18A-37	All sites	Fence riparian zone and implement regulated stock grazing periods to encourage recruitment and manage weeds			More investigation required	High	WCMA
18A-38	14	Protect indigenous reed species	590732	5979228	\$5,000	Medium	WCMA
18A-39	All sites	Stop vegetation removal and firewood collection. Promote alternative firewood sources.				High	Landowner responsibility, Shire, DSE
18A-40	All sites	Undertake weed control program				High	Landowner responsibility
Reach 19 – Downstream confluence with Datchak Creek at Antwerp to just south of Jeparit							
19-41	15	Remove impediments to flow	592334	5985016	\$8,000	Medium	WCMA
19-42	15	Fence riparian zone and implement regulated stock grazing periods to encourage recruitment and manage weeds	592334	5985016		High	WCMA

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
19-43	Upstream of Antwerp Weir	Undertake stabilization works on right bank gully.	592258	5984735	\$1,100	Medium	WCMA
19-44	All sites	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)			Other program	High	WCMA
19-45	All sites	Undertake weed control program				High	Parks Victoria
Reach 20 – Just south of Jeparit to Lake Hindmarsh							
20-46	24	Limit vehicle access to riparian zone, stabilise existing scoured tracks and encourage re-colonisation from existing stands of native grasses and herbs	587239	6000479	\$15,000	High	Parks Victoria
20-47	Jeparit Weir	Undertake more appropriate bank stabilization and revegetation works at/downstream of weir	586503	6001135	\$25,000	High	WCMA

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
20-48	Between Jeparit Weir and Lake Hindmarsh	Undertake bank stabilization and revegetation works on eroding banks between weir and Lake Hindmarsh, including around Hindmarsh Ski Clubrooms	586174, 585735, 586192	6001039, 6001429, 6001872	\$10,000	High	WCMA
20-49	Whole reach	Extensive plantings of salt tolerant species for bank stabilization purposes.			\$80,000	High	WCMA
20-50	All sites	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)			Other program	High	WCMA
20-51	All sites	Undertake weed control program				High	Parks Victoria
Reach 21- Lake Hindmarsh							
21-52	4 Mile Beach	Provide good access with clear tracks and parking areas to minimize damage to lake bed and riparian area. Limit access to the lakebed when dry.	583499	6000934	\$60,000	High	HSC

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
21-53	All sites	Stop vegetation removal and firewood collection. Promote alternative firewood sources.				High	Parks Victoria
21-54	All sites	Limit vehicular access to lakebed				Medium	Parks Victoria
21-55	All sites	Undertake weed control program				High	Parks Victoria
Reach 22 – Outlet Creek between Lake Hindmarsh and Lake Albacutya							
22-56	Informal camping area on Outlet Creek	Remove derelict structures and smooth out trailbike racing track features	578854	6022056	\$1,500	Low	WCMA
22-57	All sites	Stop vegetation removal and firewood collection. Promote alternative firewood sources.				High	Parks Victoria
22-58	All sites	Limit 4WD and motorbike access to creek bed				High	Parks Victoria
22-59	All sites	Undertake weed control program				High	Parks Victoria

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
Reach 23 – Lake Albacutya							
23-60	Western foreshore	Monitor and initiate re-vegetation and management project for ecological burn area north and south of Dorrington Point if required. Review use of Perennial Veldt-grass for dune stabilisation in Heritage River Corridor.	586021, 584830, 585222	6041338, 6041932, 6038020		High	Parks Victoria
23-61	20	Restrict vehicular access to Dorrington Point	586195	6041301		High	Parks Victoria
23-62	Jordan Valley camp ground	Restrict access to selected tracks, rehabilitate and re-vegetate surplus tracks.	589680	6045795		High	Parks Victoria
23-63	All sites	Stop vegetation removal and firewood collection. Promote alternative firewood sources.				High	Parks Victoria
23-64	All sites	Restrict vehicular access onto dunes.				Medium	Parks Victoria
23-65	All sites	Undertake weed control program				High	Parks Victoria

Action Number	Site Number	Management Action	Location		Provisional Total* (\$)	Priority	Lead Agency
Reach 24 – Outlet Creek downstream of Lake Albacutya							
24-66	21	Monitor rabbit populations and undertake eradication program as required.	584510	6049596		Medium	Parks Victoria
24-67	21	Undertake weed control program				High	Parks Victoria
End							
Total Provisional Cost of Works Program*							\$300,100

8 Wimmera CMA 05/06 Incentive Rates

The Wimmera Catchment Management Authority offers landholders incentive rates to undertake fencing and revegetation of streamside areas. The rates presented in Table represent the full incentive that will be paid and have been calculated to consider the full cost of the works. For example, the price of \$1.00 for a plant includes the purchase of the plant, plant establishment costs such as weed control, deep ripping and tree guards. As these costs have been considered in the incentive rates, additional funding is not available for these activities.

Table 40. WCMA fencing and revegetation incentive rates.

Activity	Priority	WCMA cost share	Criteria	Incentive	Unit
Waterways Fencing	VH	90%	Frontage >20m & Very High, High or medium conservation significance	\$3.90	m
	H	80%	Frontage >20m, low conservation significance	\$ 3.45	m
	M	60%	Frontage 10 - 20m	\$ 2.60	m
	L	40%	Frontage <10m	\$1.70	m
Off stream watering	VH	50%	Solar pump. 50% of total project cost. Maximum grant \$3000		
	H	50%	Dam. 50% of construction cost. Maximum grant \$1000		
Remnant Vegetation Fencing	VH	100%	Very high, high or medium conservation significance, with Trust for Nature Conservation covenant in place	\$4.30	m
	H	75%	High to Very High Conservation significance	\$3.20	m
	M	65%	Medium to Low conservation significance	\$2.80	m
Land class fencing	M	60%	Fencing land class 4 & 5	\$2.60	m
Revegetation fencing	VH	80%	Very High Conservation significance potential	PMP*	\$3.45 m
		70%		No PMP	\$3.00 m
	H	70%	High Conservation significance potential	PMP	\$3.00 m
		60%		No PMP	\$2.60 m
	M	55%	Medium Conservation significance potential	PMP	\$2.35 m
		45%		No PMP	\$1.90 m
	L	35%	Low Conservation significance potential	PMP	\$1.50 m
		25%		No PMP	\$1.10 m
Revegetation	H	80%	Plants: 80% of cost of plants, guards and follow up weed control for 12 months.	\$ 1.00	each
	H	80%	Direct Seeding: 80% of cost of seed and follow up weed control for 12 months.	\$ 160	km
Erosion control works	VH	80%	Works are part of an existing Property Management Plan / whole farm plan	Up to 80% of cost of Priority works	

Activity	Priority	WCMA cost share	Criteria	Incentive	Unit
	H	60%	No Property Management Plan / Whole Farm Plan completed	Up to 60% of cost of Priority works	
Saline Pasture	M	20%		\$48	Ha
Saltbush	M	65%	Costing includes cost of plants and mounding.	\$0.25	each
Fencing to protect salinity management works#	VH	80%		PMP	\$ 3.45 m
		70%	Works in "Implementation" priority GFS	No PMP	\$3.00 m
	H	70%		PMP	\$3.00 m
		60%	Works in "Research and development" priority GFS	No PMP	\$2.60 m
	M	55%		PMP	\$2.35 m
		45%	Works in "Co-investment" priority GFS	No PMP	\$1.90 m
	L	35%		PMP	\$1.50 m
		25%	Discharge Fencing	No PMP	\$1.10 m

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Appendix A

Vegetation Species Lists for the Wimmera Heritage River

Species Name	Common Name	Reach 14/15 Site 1	Reach 15 Site 2	Reach 16 Site 3	Reach 16 Site 4	Reach 16 Site 4a	Reach 17 Site 5
Acacia acinacea s.l.	Gold-dust Wattle						X
Acacia acinacea s.s.	Gold-dust Wattle						
Acacia brachybotrya	Grey Mulga						X
Acacia farinosa	Mealy Wattle						
Acacia ligulata	Small Cooba						
Acacia melanoxylon	Blackwood	X					
Acacia montana	Mallee Wattle						
Acacia pycnantha	Golden Wattle						X
Acacia stenophylla	Eumong						
Acaena echinata	Sheep's Burr	X	X				
Actinobole uliginosum	Flannel Cudweed		X				
Adriana urticoides var. hookeri	Mallee Bitter-bush						
Aira cupaniana	Quicksilver Grass						
Ajuga australis	Austral bugle						
Allocasuarina luehmannii	Buloke	X	X	X			
Amsinckia lycopsoides	Bugloss Fiddle-neck						
Amyema miquelii	Box Mistletoe						
Amyema miraculosa ssp boormannii	Fleshy Mistletoe						
Amyema pendula	Drooping Mistletoe						X
Anagallis arvensis	Pimpernel			X			
Aphanes australasica	Australian Piert						
Aphanes australiana	Australian Piert		X				
Arctotheca calendula	Cape weed		X		X	X	X
Arctotheca calendula	Cape weed						
Arthropodium fimbriatum	Nodding Chocolate-lily	X	X		X	X	X
Arthropodium strictum	Common Chocolate-lily	X		X			X
Asparagus asparagoides	Bridal Creeper	X		X	X	X	
Asparagus officinalis	Asparagus		X	X	X	X	
Asphodelus fistulosus	Onion weed						
Aster subulatus	Aster-weed						
Aster subulatus	Aster Weed						
Aster subulatus	Aster-weed						
Astroloma humifusum	Cranberry Heath						
Atriplex australasica	Native Orache						
Atriplex leptocarpa	Slender-fruit Saltbush						
Atriplex semibaccata	Berry Saltbush		X	X	X	X	
Atriplex spp.	Saltbush						
Atriplex suberecta	Sprawling saltbush						
Austrodanthonia bipartita s.s.	Leafy Wallaby-grass			X			
Austrodanthonia caespitosa	Common Wallaby-grass	X	X	X	X	X	
Austrodanthonia duttoniana	Brown-back Wallaby-grass	X					
Austrodanthonia fulva	Copper-awned Wallaby-grass	X	X				
Austrodanthonia geniculata	Kneed Wallaby-grass						
Austrodanthonia setacea	Bristly Wallaby-grass	X	X		X	X	X
Austrodanthonia setacea var. setacea	Bristly Wallaby-grass				X	X	
Austrodanthonia spp.	Wallaby Grass						X
Austrostipa aristiglumis	Plump Spear-grass	X					
Austrostipa elegantissima	Feather Spear-grass						X
Austrostipa eremophila	Desert Spear-grass		X				
Austrostipa scabra	Rough Spear-grass	X	X	X	X	X	X
Austrostipa spp.	Spear Grass						X
Avena barbata	Bearded Oat	X					
Avena fatua	Wild Oat		X	X			
Avena spp.	Oat						
Banksia marginata	Silver Banksia						
Beyeria lechenaultii	Pale Turpentine Bush						X
Brachyscome lineariloba	Hard-headed Daisy						
Bromus diandrus	Great Brome		X	X			X
Bromus hordeaceus subsp. hordeaceus	Soft Brome						
Bromus spp.	Brome						
Bursaria spinosa	Sweet Bursaria	X	X				
Calandrinia eremaea	Small Purslane						
Callitris gracilis subsp. murrayensis	Slender Cypress-pine					X	
Calocephalus citreus	Lemon Beauty-heads		X				
Calocephalus lacteus	Milky Beauty-heads				X	X	
Calocephalus sonderi	Pale-beauty-heads						X
Calocephalus sonderi	Pale Beauty-heads						X
Calotis erinacea	Tangled Burr-daisy						
Calytrix alpestris	Snow-myrtle						
Calytrix tetragona	Common fringe-myrtle						
Carex apressa	Tall Sedge			X			
Carex sp	Sedge						
Carpobrotus modestus	Inland Pigface					X	X
Cassytha melantha	Coarse Dodder-laurel						
Cassytha melantha	Coarse Dodder-laurel						

Species Name	Common Name	Reach 14/15 Site 1	Reach 15 Site 2	Reach 16 Site 3	Reach 16 Site 4	Reach 16 Site 4a	Reach 17 Site 5
Centella cordifolia	Centella						
Chara sp	Stonewort						
Chenopodium desertorum subsp. microphyllum	Small-leaf Goosefoot		X				
Chenopodium sp	Goosefoot						
Chieranthera austrotenuifolia	Rock Fern		X				
Chloris truncata	Windmill Grass	X					
Chrysanthemoides monilifera	Boneseed						
Chrysocephalum apiculatum s.l.	Common Everlasting				X	X	
Cirsium vulgare	Spear Thistle	X		X			
Clematis microphylla	Small-leaved Clematis	X					
Clematis microphylla	Small-leaf Clematis	X					
Clematis microphylla	Small-leaved Clematis	X					
Convolvulus erubescens spp. agg.	Pink Bindweed						
Conzys bonariensis	Flaxleaf Fleabane						
Cotula bipinnata	Ferny Cotula			X	X	X	
Cotula coronopifolia	Water Buttons			X			
Crassula colorata	Dense Crassula						
Crassula decumbens	Spreading Crassula	X					
Crassula decumbens	Spreading Stonecrop	X					
Crassula decumbens	Spreading Crassula	X					
Crassula sieberiana s.l.	Sieber Crassula		X				
Cymbonotus preissianus	Austral Bear's-ear						
Cynoglossum australe	Australian Hound's-tongue					X	
Cynoglossum australe	Austral Hound's-tongue					X	
Cynoglossum australe	Australian Hound's-tongue					X	
Cyperus gymnocaulos	Spiny Flat-sedge				X	X	
Cyperus sp	Sedge						
Dactylis glomerata	Cocksfoot	X					
Daucus glochidiatus	Australian Carrot						
Davesia arenaria	Mallee Bitter-pea						
Davesia benthamii	Spiny Bitter-pea						
Daviesia arenaria	Mallee Bitter-pea						
Dianella brevicaulis	Small-flower Flax-lily						
Dianella sp aff longifolia - robust	Robust Pale Flax-lily						
Dianella sp. aff. revoluta (North-west Victoria)	Stiff Flax-lily	X					X
Dichondra repens	Kidney-weed						
Diplotaxis muralis	Wall-rocket						
Disphyma crassifolium subsp. clavellatum	Rounded Noon-flower						
Distichlis distichophylla	Australian Salt-grass	X	X				X
Dittrichia graveolens	Stinkwort			X			
Dodonaea viscosa ssp angustissima	Slender Hop-bush						
Dodonaea viscosa ssp angustissima	Slender Hop-bush						
Dodonaea viscosa ssp cuneata	Wedge-leaf Hop-bush						X
Dodonaea viscosa var angustissima	Slender Hop-bush						
Drosora whittackeri	Scented Sundew		X				
Dysphania glomulifera ssp. glomulifera	Globular Pigweed						
Eclipta platyglossa	Yellow Twin-heads						
Ehpaltes autralasica	Spreading Nut heads					X	
Ehrharta calycina	Perennial Veldt-grass		X			X	X
Ehrharta longiflora	Annual Veldt-grass						
Einadia nutans subsp. nutans	Nodding Saltbush	X	X		X	X	X
Einadia nutans subsp. nutans	Nodding Saltbush	X	X		X	X	X
Elymus scaber	Common Wheat-grass						
Elymus scaber var. scaber	Common Wheat-grass	X	X	X	X	X	
Enchylaena tomentosa var. tomentosa	Ruby Saltbush (prostate race)	X	X		X	X	X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush	X	X		X	X	X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush						
Enteropogon acicularis	Spider Grass			X			
Epaltes australasica	Spreading Nut heads				X		
Epaltes australis	Spreading Nut heads			X			
Eragrostis diandra	Close-headed Love-grass					X	
Eragrostis dielsii	Mallee Love-grass						
Eragrostis infecunda	Southern Cane-grass		X	X	X	X	
Eragrostis lacunaria	Purple Love-grass				X		
Erodium botrys	Big Heron's-bill		X				
Eryngium ovium	Blue Devil		X				
Euc camaldulensis	River Red Gum						
Eucalyptus calycogona	Red Mallee						
Eucalyptus camaldulensis	River Red-gum	X	X	X	X	X	X
Eucalyptus largiflorens	Black Box	X	X	X	X	X	X
Eucalyptus leucoxylon	Yellow Gum						
Eucalyptus leucoxylon ssp leucoxylon	Yellow gum						
Eucalyptus microcarpa	Grey Box		X				
Eutaxia microphylla var microphylla	Common Eutaxia						

Species Name	Common Name	Reach 14/15 Site 1	Reach 15 Site 2	Reach 16 Site 3	Reach 16 Site 4	Reach 16 Site 4a	Reach 17 Site 5
Eutaxia microphylla var. diffusa	Spreading Eutaxia		X				X
Eutaxia microphylla var. microphylla	Common Eutaxia		X				
Exocarpos aphyllus	Leafless Ballart						
Exocarpos strictus	Pale-fruit Ballart						
Ficinia nodosa	Knobby Club-sedge	X	X	X	X	X	
Fraxinus sp	Desert ash						
Freesia sp	Freesia						X
Fumaria sp	Fumitory						
Fumeria sp	Fumitory						
Galium gaudiodaudii	Rough Bedstraw						
Geranium retrorsum	Grassland Cranesbill			X			
Goodenia pinnatifida	Cut-leaf Goodenia	X	X				X
Goodenia pusilliflora	Small-flower Goodenia						
Hakea mitchellii	Desert Hakea						
Halgania heterophylla	Varied Raspwort						
Halgania heterophylla	variable Raspwort						
Haloragis heterophylla	Varied Raspwort		X				
Heliotropium europaeum	Common Heliotrope						
Helminthotheca echioides	Ox tongue	X					
Hibbertia stricta sl	Erect Guinea-flower						
Hibbertia virgata	Twiggy Guinea-flower						
Hordium sp	Barley	X					
Hyalosperma demissum	Moss Sunray						
Hypochoeris glabra	Smooth Cat's-ear						
Hypochoeris radicata	Flatweed	X	X	X	X	X	
Hypolaena fastigiata	Tassel Rope-rush						
Hypoxis glabella	Yellow stars						
Isolepis fluitans	Floating Club-sedge						
Juncus flavidus	Gold Rush						
Juncus spp.	Rush	X		X			
k Maireana aphylla	Leafless Bluebush				X		
Kennedia prostrata	Running Postman						
Lachnagrostis filiformis var 2	Wetland Blowngrass			X			
Lachnagrostis filiformis var 2	Wetland Blown-grass			X			
Lachnagrostis filiformis var. 1	Common Blown-grass						
Lachnagrostis sp	Blown-grass						
Lactuca serriola	Prickly Lettuce	X					X
Lawrencia glomerata	Clustered Lawrencia						
Lepidium africanum	Common Peppercross	X					
Lepidosperma congestum	Clustered Sword-sedge						
Lepidosperma laterale	Variable Sword-sedge						X
Leptomeria aphylla	Leafless Currant-bush						X
Leptorhynchus squamatus subsp. squamatus	Scaly Buttons						
Leptospermum obovatum	River Tea-tree	X		X	X	X	
Lolium rigidum	Wimmera Rye-grass						
Lomandra effusa	Scented Mat-rush		X				X
Lomandra multiflora	Many-flowered Mat-rush		X				
Lomandra multiflora	Many-flowered Mat-rush		X				
Lomandra nana	Dwarf Mat-rush		X	X			
Lycium ferocissimum	African Box-thorn		X				
Lysiana exocarpi	Harlequin Mistletoe						X
Lythrum hyssopifolia	Small Loosestrife						
Maireana brevifolia	Short-leaf Bluebush						
Maireana decalvans	Black Bluebush				X	X	
Maireana decalvans	Grey Copperburr				X	X	
Maireana decalvans	Black Bluebush				X	X	
Maireana enchylaenoides	Wingless Bluebush		X				X
Maireana sp	Bluebush						
Malva parviflora	Small-flower Mallow						
Marrubium vulgare	Horehound	X	X				
Marsilea drummondii	Common Nardoo						
Melaleuca decussata	Totem-poles	X	X	X		X	X
Melaleuca halmaturorum subsp. halmaturorum	Salt Paperbark						X
Mesembryanthemum crystallinum	Common Ice-plant						
Microlaena stipoides	Weeping Grass	X					
Mimulus repens	Creeping Monkey Flower						
Minuria leptophylla	Minnie Daisy						
Moraea flaccida	One-leaf Cape-tulip		X	X			
Muehlenbeckia florulenta	Tangled Lignum				X	X	X
Myoporum parvifolium	Creeping boobialla						
Nicotiana glauca	Tree Tobacco						
Olea europea	Olive						
Onopordum acaulon	Stemless Thistle						
Ophioglossum lusitanicum	Austral Adder's Tongue		X				

Species Name	Common Name	Reach 14/15 Site 1	Reach 15 Site 2	Reach 16 Site 3	Reach 16 Site 4	Reach 16 Site 4a	Reach 17 Site 5
Oxalis perennans	Grassland Wood-sorrel		X	X	X	X	
Oxalis pes-caprae	Soursob	X		X			X
Panicum effusum	Hairy Panic			X			
Pellargonium australe	Austral Storks-bill		X				
Phalaris aquatica	Toowoomba Canary-grass	X				X	
Phragmites australis	Common Reed	X	X	X	X	X	
Phyla canescens	Fog-fruit		X	X	X	X	
Pimelea glauca	Smooth Rice-flower						
Pimelea humilis	Common Rice-flower		X				
Pittosporum angustifolium	Weeping Pittosporum					X	X
Plantago gaudichaudi	Narrow Plantain						
Plantago hispida	Hairy Plantain						
Plantago myosurus	Mouse Plantain						
Plantago sp	Native plantain						
Plantago varia	Variable Plantain		X				
Plantago varia	Vaiable Plantain		X				
Plantago varia	Variable Plantain		X				
Poa bubosa	Bulbous Meadow-grass	X	X		X	X	X
Poa labillardierei	Common Tussock-grass	X		X	X	X	
Poa sp	Tussock-grass	X					
Podolepis cappilaris	Wiry Podolepis						
Polypogon monspeliensis	Annual Beard-grass						
Potamogeton pectinatus	Fennel Pondweed						
Pseudognaphalium luteoalbum	Jersey Cudweed						
Pterostylis curta	Blunt Greenhood						
Ptilotus exaltatus	Mulla Mulla						X
r Asperula wimmerana	Wimmera Woodruff						
Rannunculus sessiliflorus	Annual Buttercup						
Ranunc sessiliflorus	Annual Buttercup				X		
Ranunculus sessiliflorus	Annual Buttercup					X	
Ranunculus sp	Native Buttercup			X			
Rhagodia spinescens	Hedge Saltbush						X
Romulea rosea	Onion Grass	X			X	X	
Romulea rosea var reflexa	Large-flower onion grass						
Romulea rosea var. australis s.s.	Common Onion-grass						
Rosa rubiginosa	Sweet briar						
Rumex brownii	Slender Dock	X	X	X			
Salsola tragus	Prickly Saltwort						X
Salvia verbenaca	Wild Sage						
Santalum acuminatum	Sweet Quandong						X
Sarcocornia quinqueflora	Beaded Glasswort						
Sarcocornia quinqueflora subsp. quinqueflora	Beaded Glasswort						X
Schinus molle	Peppercorn						
Sclerolaena diacantha	Grey Copperburr						X
Sclerolaena muricata var villosa	Grey Roly-poly	X					
Sclerolaena muricata var. villosa	Grey Roly-poly						
Scorzonera laciniata	Scorzonera						
Selliera radicans	Shiny Swamp-mat						
Senecio hispidulus sl	Rough Fireweed						
Senecio pinnatifolius	Variable Groundsel						
Senecio pinnatifolius	Variable Groundsel						X
Senecio quadridentatus	Cotton Fireweed				X	X	
Senecio spp.	Groundsel						X
Sida corrugata	Variable Sida						
Sissymbrium orientale	Indian Hedge-mustard						
Sisymbrium orientale	Indian Hedge-mustard						
Sisymbrium orientale	Indain Hedge-mustard						
Sisymbrium orientale	Indian Hedge-mustard						
Solanum simile	Oonderoo						
Solenogyne dominii	Common solenogyne						
Sonchus asper s.l.	Rough Sow-thistle			X			
Sonchus oleraceus	Common Sow-thistle				X	X	X
Spergularia rubra s.l.	Red Sand-spurrey						
Spergularia sp. 3	Salt Sea-spurrey						
Stackhousia sp aff monogyna	Creamy candles						
Stellaria sp	Chickweed						
Stemodia florulenta	Bluerod						
Stenopetalum lineare	Narrow Thread-petal						
Stuartina muelleriana	Spoon cudweed						
Swainsona procumbens	Broughton Pea		X				
Taraxacum sp	Dandelion						
Teucrium racemosum s.l.	Grey Germander						
Teucrium racemosum s.s.	Grey Germander						
Themeda triandra	Kangaroo Grass	X					
Thysanotus baueri	Mallee Fringe-lily						

Species Name	Common Name	Reach 14/15 Site 1	Reach 15 Site 2	Reach 16 Site 3	Reach 16 Site 4	Reach 16 Site 4a	Reach 17 Site 5
Thysanotus patersonii	Twining Fringe-lily						
Toxanthes muelleriana	Common bow-flower						
Tricoryne elatior	Tall Grass-lily		X				
Trifolium angustifolium var. angustifolium	Narrow-leaf Clover			X			
Trifolium arvense var. arvense	Hare's-foot Clover	X	X	X	X	X	
Trifolium sp	Clover						
Trifolium subteranneum	Subterranean clover						
Trifolium subterrarium	Sub Clover		X				
Trifolium subterrarium	Subterrannian clover		X				
Trifolium subterrarium	Sub clover		X				
Triglochin procera s.l.	Water Ribbons			X			
Triglochin procera s.s.	Common Water-ribbons						
Typha domingensis	Narrow-leaf Cumbungi				X	X	
Typha domingensis	Narrow-leaf Cumbungi				X	X	
Urtica urens	Small Nettle						
v Acacia oswaldii	Umbrella Wattle						
v Acacia trineura	Three-nerve Wattle						
v Amyema linophyllum ssp orientalis	Buloke Mistletoe						X
v Dianella sp aff longifolia	Pale Flax-lily	X		X		X	
v Dianella sp aff longifolia	Fale Flax-lily	X		X		X	
v Dianella sp aff longifolia	Pale Flax-lily	X		X		X	
v Dianella sp aff longifolia (Riverina)	Pale Flax-lily		X				
v Dianella sp aff longifolia (riverina)	Pale Grass-lily		X				
v Dianella sp aff longifolia (Riverina)	Pale Flax-lily		X				
v Eragrostis lacunaria	Purple Love-grass						
v Melaleuca halmaturorum subsp. halmaturorum	Salt Paperbark						
v Vittadenia sp aff blackii	Wimmera Western New-Holland Daisy						X
Veronica plebeia	Trailing Speedwell						
Veronica plebia	Trailing Speedwell						
Vicia sp	Vetch			X			
Viminaria juncea	Golden Spray						
Vittadenia cervicalis	Annual New-Holland Daisy				X		
Vittadinia australasica var. australasica	Sticky New Holland Daisy		X				
Vittadinia cuneata	Fuzzy New Holland Daisy		X		X	X	X
Vittadinia gracilis	Woolly New Holland Daisy						
Vittadinia spp.	New Holland Daisy		X				X
Vulpia bromoides	Squirrel-tail Fescue						
Vulpia spp.	Fescue		X		X	X	
Vv Pterostylis cheraphila	Floodplain Rustyhood						
Wahlenbergia communis s.l.	Tufted Bluebell		X				
Wahlenbergia sp	Bluebell						
Wahlenbergia stricta	Tall Bluebell		X				
Watsonia sp	Watsonia		X	X	X	X	X
Watsonia sp	Watsonia		X	X	X	X	X
Whalleya proluta	Rigid Panic	X					
Wilsonia rotundifolia	Round-leaf Wilsonia						
Wurmbea dioica	Common Early Nancy		X				
Xanthium spinosum	Bathurst Burr			X			

Species Name	Common Name	Reach 17 Site 5	Reach 17 Site 6	Reach 17 Site 7	Reach 18 Site 8	Reach 18 Site 9	Reach 18 Site 10
Acacia acinacea s.l.	Gold-dust Wattle	X	X				
Acacia acinacea s.s.	Gold-dust Wattle				X	X	
Acacia brachybotrya	Grey Mulga	X					
Acacia farinosa	Mealy Wattle						
Acacia ligulata	Small Cooba						
Acacia melanoxylon	Blackwood						
Acacia montana	Mallee Wattle				X	X	
Acacia pycnantha	Golden Wattle	X	X	X	X		
Acacia stenophylla	Eumong						
Acaena echinata	Sheep's Burr		X	X		X	
Actinobole uliginosum	Flannel Cudweed						
Adriana urticoides var. hookeri	Mallee Bitter-bush						
Aira cupaniana	Quicksilver Grass						
Ajuga australis	Austral bugle						
Allocasuarina luehmannii	Buloke				X		
Amsinckia lycopsoides	Bugloss Fiddle-neck						
Amyema miquelii	Box Mistletoe						
Amyema miraculosa ssp boormannii	Fleshy Mistletoe						
Amyema pendula	Drooping Mistletoe	X					
Anagallis arvensis	Pimpernel			X			
Aphanes australasica	Australian Piert				X		
Aphanes australiana	Australian Piert						
Arctotheca calendula	Cape weed	X	X				
Arctotheca calendula	Cape weed			X	X		
Arthropodium fimbriatum	Nodding Chocolate-lily	X	X	X	X	X	X
Arthropodium strictum	Common Chocolate-lily	X					
Asparagus asparagoides	Bridal Creeper		X	X	X	X	
Asparagus officinalis	Asparagus					X	
Asphodelus fistulosus	Onion weed						
Aster subulatus	Aster-weed					X	
Aster subulatus	Aster Weed					X	
Aster subulatus	Aster-weed					X	
Astroloma humifusum	Cranberry Heath						
Atriplex australasica	Native Orache						
Atriplex leptocarpa	Slender-fruit Saltbush						
Atriplex semibaccata	Berry Saltbush				X	X	
Atriplex spp.	Saltbush						
Atriplex suberecta	Sprawling saltbush						
Austrodanthonia bipartita s.s.	Leafy Wallaby-grass						
Austrodanthonia caespitosa	Common Wallaby-grass						
Austrodanthonia duttoniana	Brown-back Wallaby-grass						
Austrodanthonia fulva	Copper-awned Wallaby-grass						
Austrodanthonia geniculata	Kneed Wallaby-grass					X	
Austrodanthonia setacea	Bristly Wallaby-grass	X	X	X	X		
Austrodanthonia setacea var. setacea	Bristly Wallaby-grass						
Austrodanthonia spp.	Wallaby Grass	X			X	X	
Austrostipa aristiglumis	Plump Spear-grass						
Austrostipa elegantissima	Feather Spear-grass	X			X	X	
Austrostipa eremophila	Desert Spear-grass				X	X	
Austrostipa scabra	Rough Spear-grass	X			X	X	
Austrostipa spp.	Spear Grass	X			X	X	X
Avena barbata	Bearded Oat						
Avena fatua	Wild Oat					X	
Avena spp.	Oat						
Banksia marginata	Silver Banksia		X	X	X		
Beyeria lechenaultii	Pale Turpentine Bush	X					
Brachyscome lineariloba	Hard-headed Daisy						
Bromus diandrus	Great Brome	X	X	X		X	
Bromus hordeaceus subsp. hordeaceus	Soft Brome						
Bromus spp.	Brome						
Bursaria spinosa	Sweet Bursaria						
Calandrinia eremaea	Small Purslane						
Callitris gracilis subsp. murrayensis	Slender Cypress-pine		X	X	X		
Calocephalus citreus	Lemon Beauty-heads						
Calocephalus lacteus	Milky Beauty-heads						X
Calocephalus sonderi	Pale-beauty-heads	X	X				
Calocephalus sonderi	Pale Beauty-heads	X	X				
Calotis erinacea	Tangled Burr-daisy						
Calytrix alpestris	Snow-myrtle		X				
Calytrix tetragona	Common fringe-myrtle						
Carex apressa	Tall Sedge						
Carex sp	Sedge						
Carpobrotus modestus	Inland Pigface	X	X	X	X		X
Cassytha melantha	Coarse Dodder-laurel						

Species Name	Common Name	Reach 17 Site 5	Reach 17 Site 6	Reach 17 Site 7	Reach 18 Site 8	Reach 18 Site 9	Reach 18 Site 10
Cassytha melantha	Coarse Dodder-laurel						
Centella cordifolia	Centella						
Chara sp	Stonewort						
Chenopodium desertorum subsp. microphyllum	Small-leaf Goosefoot						
Chenopodium sp	Goosefoot						
Chieranthera austrotenuifolia	Rock Fern						
Chloris truncata	Windmill Grass						
Chrysanthemoides monilifera	Boneseed						
Chrysocephalum apiculatum s.l.	Common Everlasting						
Cirsium vulgare	Spear Thistle		X				
Clematis microphylla	Small-leaved Clematis		X	X		X	
Clematis microphylla	Small-leaf Clematis		X	X		X	
Clematis microphylla	Small-leaved Clematis		X	X		X	
Convolvulus erubescens spp. agg.	Pink Bindweed						X
Conzya bonariensis	Flaxleaf Fleabane						
Cotula bipinnata	Ferny Cotula		X		X		
Cotula coronopifolia	Water Buttons		X				
Crassula colorata	Dense Crassula						
Crassula decumbens	Spreading Crassula				X		
Crassula decumbens	Spreading Stonecrop				X		
Crassula decumbens	Spreading Crassula				X		
Crassula sieberiana s.l.	Sieber Crassula		X		X		X
Cymbonotus preissianus	Austral Bear's-ear		X		X		
Cynoglossum australe	Australian Hound's-tongue			X			
Cynoglossum australe	Austral Hound's-tongue			X			
Cynoglossum australe	Australian Hound's-tongue			X			
Cyperus gymnocaulos	Spiny Flat-sedge		X				
Cyperus sp	Sedge						
Dactylis glomerata	Cocksfoot					X	
Daucus glochidiatus	Australian Carrot				X		X
Davesia arenaria	Mallee Bitter-pea						
Davesia benthamii	Spiny Bitter-pea						
Daviesia arenaria	Mallee Bitter-pea						
Dianella brevicaulis	Small-flower Flax-lily						
Dianella sp aff longifolia - robust	Robust Pale Flax-lily						
Dianella sp. aff. revoluta (North-west Victoria)	Stiff Flax-lily	X		X	X		X
Dichondra repens	Kidney-weed		X				
Diplotaxis muralis	Wall-rocket						
Disphyma crassifolium subsp. clavellatum	Rounded Noon-flower						
Distichlis distichophylla	Australian Salt-grass	X			X	X	
Dittrichia graveolens	Stinkwort						
Dodonaea viscosa ssp angustissima	Slender Hop-bush			X			
Dodonaea viscosa ssp angustissima	Slender Hop-bush						
Dodonaea viscosa ssp cuneata	Wedge-leaf Hop-bush	X			X		
Dodonaea viscosa var angustissima	Slender Hop-bush						
Drosora whittackeri	Scented Sundew				X		
Dysphania glomulifera ssp. glomulifera	Globular Pigweed						
Eclipta platyglossa	Yellow Twin-heads						
Ehpaltes autralasica	Spreading Nut heads						
Ehrharta calycina	Perennial Veldt-grass	X		X	X		
Ehrharta longiflora	Annual Veldt-grass				X		
Einadia nutans subsp. nutans	Nodding Saltbush	X	X	X	X	X	X
Einadia nutans subsp. nutans	Nodding Saltbush	X	X	X	X	X	X
Elymus scaber	Common Wheat-grass						
Elymus scaber var. scaber	Common Wheat-grass		X				X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush (prostate race)	X	X		X	X	X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush	X	X		X	X	X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush						
Enteropogon acicularis	Spider Grass						
Epaltes australasica	Spreading Nut heads						
Epaltes australis	Spreading Nut heads		X				
Eragrostis diandra	Close-headed Love-grass						
Eragrostis dielsii	Mallee Love-grass						
Eragrostis infecunda	Southern Cane-grass		X				
Eragrostis lacunaria	Purple Love-grass						
Erodium botrys	Big Heron's-bill						
Eryngium ovinum	Blue Devil						
Euc camaldulensis	River Red Gum						
Eucalyptus calycogona	Red Mallee						
Eucalyptus camaldulensis	River Red-gum	X	X	X	X	X	X
Eucalyptus largiflorens	Black Box	X	X	X	X	X	X
Eucalyptus leucoxylon	Yellow Gum				X		
Eucalyptus leucoxylon ssp leucoxylon	Yellow gum						
Eucalyptus microcarpa	Grey Box						

Species Name	Common Name	Reach 17 Site 5	Reach 17 Site 6	Reach 17 Site 7	Reach 18 Site 8	Reach 18 Site 9	Reach 18 Site 10
Eutaxia microphylla var microphylla	Common Eutaxia						
Eutaxia microphylla var. diffusa	Spreading Eutaxia	X				X	
Eutaxia microphylla var. microphylla	Common Eutaxia		X			X	
Exocarpos aphyllus	Leafless Ballart						X
Exocarpos strictus	Pale-fruit Ballart				X	X	
Ficinia nodosa	Knobby Club-sedge		X	X	X	X	
Fraxinus sp	Desert ash						
Freesia sp	Freesia	X					
Fumaria sp	Fumitory						
Fumeria sp	Fumitory						
Galium gaudiohaudii	Rough Bedstraw					X	
Geranium retrorsum	Grassland Cranesbill						
Goodenia pinnatifida	Cut-leaf Goodenia	X			X	X	
Goodenia pusilliflora	Small-flower Goodenia						
Hakea mitchellii	Desert Hakea						
Halgania heterophylla	Varied Raspwort				X		
Halgania heterophylla	variable Raspwort				X		
Haloragis heterophylla	Varied Raspwort						X
Heliotropium europaeum	Common Heliotrope						
Helminthotheca echioides	Ox tongue						
Hibbertia stricta sl	Erect Guinea-flower		X	X	X		
Hibbertia virgata	Twiggy Guinea-flower		X				
Hordium sp	Barley						
Hyalosperma demissum	Moss Sunray						
Hypochoeris glabra	Smooth Cat's-ear			X	X		
Hypochoeris radicata	Flatweed		X	X	X		
Hypolaena fastigiata	Tassel Rope-rush			X			
Hypoxis glabella	Yellow stars						
Isolepis fluitans	Floating Club-sedge		X				
Juncus flavidus	Gold Rush		X				
Juncus spp.	Rush		X				
k Maireana aphylla	Leafless Bluebush						
Kennedia prostrata	Running Postman						
Lachnagrostis filiformis var 2	Wetland Blowngrass						X
Lachnagrostis filiformis var 2	Wetland Blown-grass						X
Lachnagrostis filiformis var. 1	Common Blown-grass						
Lachnagrostis sp	Blown-grass						
Lactuca serriola	Prickly Lettuce	X					
Lawrencia glomerata	Clustered Lawrencia						
Lepidium africanum	Common Peppercross			X		X	
Lepidosperma congestum	Clustered Sword-sedge			X			
Lepidosperma laterale	Variable Sword-sedge	X				X	
Leptomeria aphylla	Leafless Currant-bush	X				X	
Leptorhynchus squamatus subsp. squamatus	Scaly Buttons					X	
Leptospermum obovatum	River Tea-tree		X				
Lolium rigidum	Wimmera Rye-grass					X	
Lomandra effusa	Scented Mat-rush	X			X	X	X
Lomandra multiflora	Many-flowered Mat-rush				X	X	
Lomandra multiflora	Many-flowered Mat-rush				X	X	
Lomandra nana	Dwarf Mat-rush				X		
Lycium ferocissimum	African Box-thorn						
Lysiana exocarpi	Harlequin Mistletoe	X					
Lythrum hyssopifolia	Small Loosestrife						
Maireana brevifolia	Short-leaf Bluebush						
Maireana decalvans	Black Bluebush						
Maireana decalvans	Grey Copperburr						
Maireana decalvans	Black Bluebush						
Maireana enchylaenoides	Wingless Bluebush	X			X	X	
Maireana sp	Bluebush						
Malva parviflora	Small-flower Mallow						
Marrubium vulgare	Horehound						
Marsilea drummondii	Common Nardoo						
Melaleuca decussata	Totem-poles	X	X	X	X	X	X
Melaleuca halmaturorum subsp. halmaturorum	Salt Paperbark	X					
Mesembryanthemum crystallinum	Common Ice-plant						
Microlaena stipoides	Weeping Grass						
Mimulus repens	Creeping Monkey Flower		X				
Minuria leptophylla	Minnie Daisy					X	
Moraea flaccida	One-leaf Cape-tulip						
Muehlenbeckia florulenta	Tangled Lignum	X					
Myoporum parvifolium	Creeping boobialla						
Nicotiana glauca	Tree Tobacco						
Olea europea	Olive				X		
Onopordum acaulon	Stemless Thistle						

Species Name	Common Name	Reach 17 Site 5	Reach 17 Site 6	Reach 17 Site 7	Reach 18 Site 8	Reach 18 Site 9	Reach 18 Site 10
Ophioglossum lusitanicum	Austral Adder's Tongue						
Oxalis perennans	Grassland Wood-sorrel				X	X	X
Oxalis pes-caprae	Soursob	X					X
Panicum effusum	Hairy Panic						
Pellargonium australe	Austral Storks-bill						
Phalaris aquatica	Toowoomba Canary-grass						
Phragmites australis	Common Reed		X	X	X	X	X
Phyla canescens	Fog-fruit						
Pimelea glauca	Smooth Rice-flower					X	
Pimelea humilis	Common Rice-flower						
Pittosporum angustifolium	Weeping Pittosporum	X	X				
Plantago gaudichaudi	Narrow Plantain		X				
Plantago hispida	Hairy Plantain						
Plantago myosurus	Mouse Plantain		X				
Plantago sp	Native plantain						
Plantago varia	Variable Plantain				X		X
Plantago varia	Vaiable Plantain				X		X
Plantago varia	Variable Plantain				X		X
Poa bubosa	Bulbous Meadow-grass	X				X	
Poa labillardierei	Common Tussock-grass				X		
Poa sp	Tussock-grass						
Podolepis cappilaris	Wiry Podolepis						
Polypogon monspeliensis	Annual Beard-grass						
Potamogeton pectinatus	Fennel Pondweed			X			
Pseudognaphalium luteoalbum	Jersey Cudweed		X				
Pterostylis curta	Blunt Greenhood		X				
Ptilotus exaltatus	Mulla Mulla	X					
r Asperula wimmerana	Wimmera Woodruff					X	
Rannunculus sessiliflorus	Annual Buttercup		X				
Ranunc sessiliflorus	Annual Buttercup						
Ranunculus sessiliflorus	Annual Buttercup						
Ranunculus sp	Native Buttercup						
Rhagodia spinescens	Hedge Saltbush	X					
Romulea rosea	Onion Grass			X			
Romulea rosea var reflexa	Large-flower onion grass			X	X		
Romulea rosea var. australis s.s.	Common Onion-grass				X	X	X
Rosa rubiginosa	Sweet briar						
Rumex brownii	Slender Dock			X			
Salsola tragus	Prickly Saltwort	X				X	
Salvia verbenaca	Wild Sage			X		X	
Santalum acuminatum	Sweet Quandong	X					
Sarcocornia quinqueflora	Beaded Glasswort						
Sarcocornia quinqueflora subsp. quinqueflora	Beaded Glasswort	X					
Schinus molle	Peppercorn						
Sclerolaena diacantha	Grey Copperburr	X				X	
Sclerolaena muricata var villosa	Grey Roly-poly						
Sclerolaena muricata var. villosa	Grey Roly-poly						
Scorzonera laciniata	Scorzonera					X	
Selliera radicans	Shiny Swamp-mat						
Senecio hispidulus sl	Rough Fireweed		X				
Senecio pinnatifolius	Variable Groundsel			X			
Senecio pinnatifolius	Variable Groundsel	X					
Senecio quadridentatus	Cotton Fireweed		X	X			
Senecio spp.	Groundsel	X					
Sida corrugata	Variable Sida					X	
Sissymbrium orientale	Indian Hedge-mustard						
Sisymbrium orientale	Indian Hedge-mustard						
Sisymbrium orientale	Indain Hedge-mustard						
Sisymbrium orientale	Indian Hedge-mustard						
Solanum simile	Oonderoo			X			
Solenogyne dominii	Common solenogyne				X		X
Sonchus asper s.l.	Rough Sow-thistle						
Sonchus oleraceus	Common Sow-thistle	X		X	X	X	
Spergularia rubra s.l.	Red Sand-spurrey		X				
Spergularia sp. 3	Salt Sea-spurrey						
Stackhousia sp aff monogyna	Creamy candles				X	X	
Stellaria sp	Chickweed						
Stemodia florulenta	Bluerod						
Stenopetalum lineare	Narrow Thread-petal						X
Stuartina muelleriana	Spoon cudweed						
Swainsona procumbens	Broughton Pea					X	
Taraxacum sp	Dandelion			X			
Teucrium racemosum s.l.	Grey Germander					X	
Teucrium racemosum s.s.	Grey Germander						
Themeda triandra	Kangaroo Grass						

Species Name	Common Name	Reach 17 Site 5	Reach 17 Site 6	Reach 17 Site 7	Reach 18 Site 8	Reach 18 Site 9	Reach 18 Site 10
Thysanotus baueri	Mallee Fringe-lily		X				
Thysanotus patersonii	Twining Fringe-lily				X		
Toxanthes muelleriana	Common bow-flower						
Tricoryne elatior	Tall Grass-lily						
Trifolium angustifolium var. angustifolium	Narrow-leaf Clover					X	
Trifolium arvense var. arvense	Hare's-foot Clover					X	
Trifolium sp	Clover						
Trifolium subteranneum	Subterranean clover						
Trifolium subterrarium	Sub Clover			X	X	X	
Trifolium subterrarium	Subterrannian clover			X	X	X	
Trifolium subterrarium	Sub clover			X	X	X	
Triglochin procera s.l.	Water Ribbons						
Triglochin procera s.s.	Common Water-ribbons		X				
Typha domingensis	Narrow-leaf Cumbungi		X				
Typha domingensis	Narrow-leaf Cumbungi		X				
Urtica urens	Small Nettle			X			
v Acacia oswaldii	Umbrella Wattle						
v Acacia trineura	Three-nerve Wattle						
v Amyema linophyllum ssp orientalis	Buloke Mistletoe	X					
v Dianella sp aff longifolia	Pale Flax-lily						X
v Dianella sp aff longifolia	Fale Flax-lily						X
v Dianella sp aff longifolia	Pale Flax-lily						X
v Dianella sp aff longifolia (Riverina)	Pale Flax-lily				X		
v Dianella sp aff longifolia (riverina)	Pale Grass-lily				X		
v Dianella sp aff longifolia (Riverina)	Pale Flax-lily				X		
v Eragrostis lacunaria	Purple Love-grass						
v Melaleuca halmaturorum subsp. halmaturorum	Salt Paperbark						
v Vittadenia sp aff blackii	Wimmera Western New-Holland Daisy	X					
Veronica plebeia	Trailing Speedwell				X		
Veronica plebia	Trailing Speedwell		X				
Vicia sp	Vetch						
Viminaria juncea	Golden Spray			X			
Vittadenia cervicalis	Annual New-Holland Daisy						
Vittadinia australasica var. australasica	Sticky New Holland Daisy		X				
Vittadinia cuneata	Fuzzy New Holland Daisy	X			X	X	X
Vittadinia gracilis	Woolly New Holland Daisy			X			
Vittadinia spp.	New Holland Daisy	X		X	X		X
Vulpia bromoides	Squirrel-tail Fescue				X		
Vulpia spp.	Fescue			X			X
Vv Pterostylis cheraphila	Floodplain Rustyhood						X
Wahlenbergia communis s.l.	Tufted Bluebell						
Wahlenbergia sp	Bluebell						
Wahlenbergia stricta	Tall Bluebell						
Watsonia sp	Watsonia	X	X				
Watsonia sp	Watsonia	X	X				
Whalleya proluta	Rigid Panic					X	X
Wilsonia rotundifolia	Round-leaf Wilsonia						
Wurmbea dioica	Common Early Nancy				X	X	
Xanthium spinosum	Bathurst Burr						

Species Name	Common Name	Reach 18a Site 11	Reach 18a Site 12	Reach 18 Site 13	Reach 18a Site 14	Reach 19 Site 15	Reach 19 Site 16
Acacia acinacea s.l.	Gold-dust Wattle						
Acacia acinacea s.s.	Gold-dust Wattle						X
Acacia brachybotrya	Grey Mulga				X		X
Acacia farinosa	Mealy Wattle						X
Acacia ligulata	Small Cooba						
Acacia melanoxylon	Blackwood						
Acacia montana	Mallee Wattle			X	X		
Acacia pycnantha	Golden Wattle				X		
Acacia stenophylla	Eumong						
Acaena echinata	Sheep's Burr		X			X	
Actinobole uliginosum	Flannel Cudweed						
Adriana urticoides var. hookeri	Mallee Bitter-bush						
Aira cupaniana	Quicksilver Grass						
Ajuga australis	Austral bugle						
Allocasuarina luehmannii	Buloke			X	X		
Amsinckia lycopsoides	Bugloss Fiddle-neck					X	
Amyema miquelii	Box Mistletoe						
Amyema miraculosa ssp boormannii	Fleshy Mistletoe						
Amyema pendula	Drooping Mistletoe			X		X	
Anagallis arvensis	Pimpernel						
Aphanes australasica	Australian Piert						
Aphanes australiana	Australian Piert						
Arctotheca calendula	Cape weed			X			
Arctotheca calendula	Cape weed		X		X	X	X
Arthropodium fimbriatum	Nodding Chocolate-lily		X	X	X	X	X
Arthropodium strictum	Common Chocolate-lily						
Asparagus asparagoides	Bridal Creeper	X	X	X	X	X	X
Asparagus officinalis	Asparagus						
Asphodelus fistulosus	Onion weed		X		X		
Aster subulatus	Aster-weed				X		
Aster subulatus	Aster Weed				X		
Aster subulatus	Aster-weed				X		
Astroloma humifusum	Cranberry Heath						
Atriplex australasica	Native Orache						
Atriplex leptocarpa	Slender-fruit Saltbush						
Atriplex semibaccata	Berry Saltbush	X		X	X		X
Atriplex spp.	Saltbush				X		
Atriplex suberecta	Sprawling saltbush				X		
Austrodanthonia bipartita s.s.	Leafy Wallaby-grass					X	
Austrodanthonia caespitosa	Common Wallaby-grass						
Austrodanthonia duttoniana	Brown-back Wallaby-grass						
Austrodanthonia fulva	Copper-awned Wallaby-grass						
Austrodanthonia geniculata	Kneed Wallaby-grass						
Austrodanthonia setacea	Bristly Wallaby-grass		X	X	X	X	
Austrodanthonia setacea var. setacea	Bristly Wallaby-grass						
Austrodanthonia spp.	Wallaby Grass	X	X	X	X		X
Austrostipa aristiglumis	Plump Spear-grass						
Austrostipa elegantissima	Feather Spear-grass	X		X			X
Austrostipa eremophila	Desert Spear-grass	X		X			
Austrostipa scabra	Rough Spear-grass			X		X	X
Austrostipa spp.	Spear Grass	X				X	X
Avena barbata	Bearded Oat						
Avena fatua	Wild Oat						
Avena spp.	Oat		X	X			X
Banksia marginata	Silver Banksia			X			
Beyeria lechenaultii	Pale Turpentine Bush						
Brachyscome lineariloba	Hard-headed Daisy						
Bromus diandrus	Great Brome			X			
Bromus hordeaceus subsp. hordeaceus	Soft Brome						
Bromus spp.	Brome	X	X	X	X	X	
Bursaria spinosa	Sweet Bursaria				X		
Calandrinia eremaea	Small Purslane						
Callitris gracilis subsp. murrayensis	Slender Cypress-pine				X		X
Calocephalus citreus	Lemon Beauty-heads						
Calocephalus lacteus	Milky Beauty-heads						
Calocephalus sonderi	Pale-beauty-heads						
Calocephalus sonderi	Pale Beauty-heads						
Calotis erinacea	Tangled Burr-daisy						
Calytrix alpestris	Snow-myrtle						
Calytrix tetragona	Common fringe-myrtle			X			
Carex apressa	Tall Sedge						
Carex sp	Sedge			X			
Carpobrotus modestus	Inland Pigface			X			
Cassytha melantha	Coarse Dodder-laurel						

Species Name	Common Name	Reach 18a Site 11	Reach 18a Site 12	Reach 18 Site 13	Reach 18a Site 14	Reach 19 Site 15	Reach 19 Site 16
Cassytha melantha	Coarse Dodder-laurel						
Centella cordifolia	Centella					X	
Chara sp	Stonewort						
Chenopodium desertorum subsp. microphyllum	Small-leaf Goosefoot						X
Chenopodium sp	Goosefoot						
Chieranthera austrotenuifolia	Rock Fern						
Chloris truncata	Windmill Grass						
Chrysanthemoides monilifera	Boneseed						
Chrysocephalum apiculatum s.l.	Common Everlasting						
Cirsium vulgare	Spear Thistle			X	X		
Clematis microphylla	Small-leaved Clematis			X			
Clematis microphylla	Small-leaf Clematis			X			
Clematis microphylla	Small-leaved Clematis			X			
Convolvulus erubescens spp. agg.	Pink Bindweed					X	
Conzya bonariensis	Flaxleaf Fleabane			X			
Cotula bipinnata	Ferny Cotula		X	X		X	X
Cotula coronopifolia	Water Buttons						
Crassula colorata	Dense Crassula		X	X	X	X	
Crassula decumbens	Spreading Crassula		X	X	X	X	X
Crassula decumbens	Spreading Stonecrop		X	X	X	X	X
Crassula decumbens	Spreading Crassula		X	X	X	X	X
Crassula sieberiana s.l.	Sieber Crassula		X		X	X	X
Cymbonotus preissianus	Austral Bear's-ear						
Cynoglossum australe	Australian Hound's-tongue						
Cynoglossum australe	Austral Hound's-tongue						
Cynoglossum australe	Australian Hound's-tongue						
Cyperus gymnocaulos	Spiny Flat-sedge			X	X		
Cyperus sp	Sedge		X		X		
Dactylis glomerata	Cocksfoot						
Daucus glochidiatus	Australian Carrot						
Davesia arenaria	Mallee Bitter-pea						
Davesia benthamii	Spiny Bitter-pea						X
Daviesia arenaria	Mallee Bitter-pea						
Dianella brevicaulis	Small-flower Flax-lily						
Dianella sp aff longifolia - robust	Robust Pale Flax-lily						X
Dianella sp. aff. revoluta (North-west Victoria)	Stiff Flax-lily			X	X		X
Dichondra repens	Kidney-weed						
Diplotaxis muralis	Wall-rocket						
Disphyma crassifolium subsp. clavellatum	Rounded Noon-flower						
Distichlis distichophylla	Australian Salt-grass						
Dittrichia graveolens	Stinkwort						
Dodonaea viscosa ssp angustissima	Slender Hop-bush						
Dodonaea viscosa ssp angustissima	Slender Hop-bush			X			
Dodonaea viscosa ssp cuneata	Wedge-leaf Hop-bush				X		
Dodonaea viscosa var angustissima	Slender Hop-bush						
Drosora whittackeri	Scented Sundew				X		
Dysphania glomulifera ssp. glomulifera	Globular Pigweed				X		
Eclipta platyglossa	Yellow Twin-heads				X		
Ehpaltes autralasica	Spreading Nut heads						
Ehrharta calycina	Perennial Veldt-grass			X	X		X
Ehrharta longiflora	Annual Veldt-grass			X		X	
Einadia nutans subsp. nutans	Nodding Saltbush	X	X	X	X	X	X
Einadia nutans subsp. nutans	Nodding Saltbush	X	X	X	X	X	X
Elymus scaber	Common Wheat-grass	X					
Elymus scaber var. scaber	Common Wheat-grass		X			X	X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush (prostate race)	X	X	X	X	X	X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush	X	X	X	X	X	X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush						
Enteropogon acicularis	Spider Grass	X					
Epaltes australasica	Spreading Nut heads						
Epaltes australis	Spreading Nut heads						
Eragrostis diandra	Close-headed Love-grass			X			
Eragrostis dielsii	Mallee Love-grass						
Eragrostis infecunda	Southern Cane-grass	X					
Eragrostis lacunaria	Purple Love-grass						
Erodium botrys	Big Heron's-bill						
Eryngium ovinum	Blue Devil		X				
Euc camaldulensis	River Red Gum						
Eucalyptus calycogona	Red Mallee						X
Eucalyptus camaldulensis	River Red-gum		X	X	X	X	X
Eucalyptus largiflorens	Black Box	X	X	X	X	X	X
Eucalyptus leucoxylon	Yellow Gum						
Eucalyptus leucoxylon ssp leucoxylon	Yellow gum		X				
Eucalyptus microcarpa	Grey Box	X					

Species Name	Common Name	Reach 18a Site 11	Reach 18a Site 12	Reach 18 Site 13	Reach 18a Site 14	Reach 19 Site 15	Reach 19 Site 16
Eutaxia microphylla var microphylla	Common Eutaxia						
Eutaxia microphylla var. diffusa	Spreading Eutaxia						X
Eutaxia microphylla var. microphylla	Common Eutaxia						
Exocarpos aphyllus	Leafless Ballart						
Exocarpos strictus	Pale-fruit Ballart			X	X		
Ficinia nodosa	Knobby Club-sedge		X	X	X	X	
Fraxinus sp	Desert ash				X		
Freesia sp	Freesia						
Fumaria sp	Fumitory		X				
Fumeria sp	Fumitory						
Galium gaudiohaudii	Rough Bedstraw						
Geranium retrorsum	Grassland Cranesbill						
Goodenia pinnatifida	Cut-leaf Goodenia						X
Goodenia pusilliflora	Small-flower Goodenia						
Hakea mitchellii	Desert Hakea						
Halgania heterophylla	Varied Raspwort					X	
Halgania heterophylla	variable Raspwort					X	
Haloragis heterophylla	Varied Raspwort			X			
Heliotropium europaeum	Common Heliotrope						
Helminthotheca echioides	Ox tongue						
Hibbertia stricta sl	Erect Guinea-flower						
Hibbertia virgata	Twiggy Guinea-flower						
Hordium sp	Barley	X					
Hyalosperma demissum	Moss Sunray						
Hypochoeris glabra	Smooth Cat's-ear			X	X	X	
Hypochoeris radicata	Flatweed			X	X	X	
Hypolaena fastigiata	Tassel Rope-rush						
Hypoxis glabella	Yellow stars						
Isolepis fluitans	Floating Club-sedge						
Juncus flavidus	Gold Rush						
Juncus spp.	Rush				X		
k Maireana aphylla	Leafless Bluebush						
Kennedia prostrata	Running Postman						
Lachnagrostis filiformis var 2	Wetland Blowngrass						
Lachnagrostis filiformis var 2	Wetland Blown-grass						
Lachnagrostis filiformis var. 1	Common Blown-grass				X		
Lachnagrostis sp	Blown-grass			X			
Lactuca serriola	Prickly Lettuce						
Lawrencia glomerata	Clustered Lawrencia						
Lepidium africanum	Common Peppercross			X			
Lepidosperma congestum	Clustered Sword-sedge						
Lepidosperma laterale	Variable Sword-sedge						
Leptomeria aphylla	Leafless Currant-bush			X			
Leptorhynchus squamatus subsp. squamatus	Scaly Buttons						
Leptospermum obovatum	River Tea-tree						
Lolium rigidum	Wimmera Rye-grass		X		X	X	X
Lomandra effusa	Scented Mat-rush				X	X	
Lomandra multiflora	Many-flowered Mat-rush				X		
Lomandra multiflora	Many-flowered Mat-rush				X		
Lomandra nana	Dwarf Mat-rush			X			
Lycium ferocissimum	African Box-thorn						
Lysiana exocarpi	Harlequin Mistletoe						
Lythrum hyssopifolia	Small Loosestrife				X		
Maireana brevifolia	Short-leaf Bluebush						
Maireana decalvans	Black Bluebush						
Maireana decalvans	Grey Copperburr						
Maireana decalvans	Black Bluebush						
Maireana enchylaenoides	Wingless Bluebush					X	X
Maireana sp	Bluebush						
Malva parviflora	Small-flower Mallow						
Marrubium vulgare	Horehound	X					
Marsilea drummondii	Common Nardoo		X				
Melaleuca decussata	Totem-poles			X	X	X	
Melaleuca halmaturorum subsp. halmaturorum	Salt Paperbark						
Mesembryanthemum crystallinum	Common Ice-plant						
Microlaena stipoides	Weeping Grass						
Mimulus repens	Creeping Monkey Flower						
Minuria leptophylla	Minnie Daisy						X
Moraea flaccida	One-leaf Cape-tulip						
Muehlenbeckia florulenta	Tangled Lignum	X			X		X
Myoporum parvifolium	Creeping boobialla						
Nicotiana glauca	Tree Tobacco						
Olea europea	Olive						
Onopordum acaulon	Stemless Thistle						

Species Name	Common Name	Reach 18a Site 11	Reach 18a Site 12	Reach 18 Site 13	Reach 18a Site 14	Reach 19 Site 15	Reach 19 Site 16
Ophioglossum lusitanicum	Austral Adder's Tongue						
Oxalis perennans	Grassland Wood-sorrel		X	X	X	X	X
Oxalis pes-caprae	Soursob	X	X	X	X	X	X
Panicum effusum	Hairy Panic						
Pellargonium australe	Austral Storks-bill						
Phalaris aquatica	Toowoomba Canary-grass						
Phragmites australis	Common Reed			X	X	X	
Phyla canescens	Fog-fruit						
Pimelea glauca	Smooth Rice-flower						
Pimelea humilis	Common Rice-flower						
Pittosporum angustifolium	Weeping Pittosporum	X		X			
Plantago gaudichaudi	Narrow Plantain						
Plantago hispida	Hairy Plantain		X				
Plantago myosurus	Mouse Plantain						
Plantago sp	Native plantain					X	
Plantago varia	Variable Plantain		X				X
Plantago varia	Vaiable Plantain		X				X
Plantago varia	Variable Plantain		X				X
Poa bubosa	Bulbous Meadow-grass		X			X	
Poa labillardierei	Common Tussock-grass			X			
Poa sp	Tussock-grass						
Podolepis cappilaris	Wiry Podolepis						
Polypogon monspeliensis	Annual Beard-grass		X		X		
Potamogeton pectinatus	Fennel Pondweed						
Pseudognaphalium luteoalbum	Jersey Cudweed				X		
Pterostylis curta	Blunt Greenhood						
Ptilotus exaltatus	Mulla Mulla						
r Asperula wimmerana	Wimmera Woodruff		X				X
Rannunculus sessiliflorus	Annual Buttercup		X				
Ranunc sessiliflorus	Annual Buttercup						
Ranunculus sessiliflorus	Annual Buttercup				X		
Ranunculus sp	Native Buttercup						
Rhagodia spinescens	Hedge Saltbush	X	X				
Romulea rosea	Onion Grass						
Romulea rosea var reflexa	Large-flower onion grass		X				
Romulea rosea var. australis s.s.	Common Onion-grass					X	
Rosa rubiginosa	Sweet briar			X			
Rumex brownii	Slender Dock		X	X		X	
Salsola tragus	Prickly Saltwort						
Salvia verbenaca	Wild Sage					X	
Santalum acuminatum	Sweet Quandong						X
Sarcocornia quinqueflora	Beaded Glasswort						
Sarcocornia quinqueflora subsp. quinqueflora	Beaded Glasswort						
Schinus molle	Peppercorn				X		
Sclerolaena diacantha	Grey Copperburr						
Sclerolaena muricata var villosa	Grey Roly-poly						
Sclerolaena muricata var. villosa	Grey Roly-poly						
Scorzonera laciniata	Scorzonera						
Selliera radicans	Shiny Swamp-mat						
Senecio hispidulus sl	Rough Fireweed						
Senecio pinnatifolius	Variable Groundsel						
Senecio pinnatifolius	Variable Groundsel						
Senecio quadridentatus	Cotton Fireweed				X		
Senecio spp.	Groundsel						
Sida corrugata	Variable Sida						X
Sissymbrium orientale	Indian Hedge-mustard						
Sisymbrium orientale	Indian Hedge-mustard						X
Sisymbrium orientale	Indain Hedge-mustard						X
Sisymbrium orientale	Indian Hedge-mustard						X
Solanum simile	Oonderoo						
Solenogyne dominii	Common solenogyne						
Sonchus asper s.l.	Rough Sow-thistle				X		
Sonchus oleraceus	Common Sow-thistle	X			X		
Spergularia rubra s.l.	Red Sand-spurrey						X
Spergularia sp. 3	Salt Sea-spurrey						X
Stackhousia sp aff monogyna	Creamy candles						
Stellaria sp	Chickweed						
Stemodia florulenta	Bluerod						
Stenopetalum lineare	Narrow Thread-petal						
Stuartina muelleriana	Spoon cudweed						
Swainsona procumbens	Broughton Pea						
Taraxacum sp	Dandelion						
Teucrium racemosum s.l.	Grey Germander						
Teucrium racemosum s.s.	Grey Germander						
Themeda triandra	Kangaroo Grass			X			

Species Name	Common Name	Reach 18a Site 11	Reach 18a Site 12	Reach 18 Site 13	Reach 18a Site 14	Reach 19 Site 15	Reach 19 Site 16
Thysanotus baueri	Mallee Fringe-lily						
Thysanotus patersonii	Twining Fringe-lily						
Toxanthes muelleriana	Common bow-flower						
Tricoryne elatior	Tall Grass-lily						
Trifolium angustifolium var. angustifolium	Narrow-leaf Clover						
Trifolium arvense var. arvense	Hare's-foot Clover					X	
Trifolium sp	Clover					X	X
Trifolium subteranneum	Subterranean clover						
Trifolium subterrarium	Sub Clover						
Trifolium subterrarium	Subterrannian clover						
Trifolium subterrarium	Sub clover						
Triglochin procera s.l.	Water Ribbons						
Triglochin procera s.s.	Common Water-ribbons						
Typha domingensis	Narrow-leaf Cumbungi					X	
Typha domingensis	Narrow-leaf Cumbungi					X	
Urtica urens	Small Nettle						
v Acacia oswaldii	Umbrella Wattle						
v Acacia trineura	Three-nerve Wattle						
v Amyema linophyllum ssp orientalis	Buloke Mistletoe			X	X		
v Dianella sp aff longifolia	Pale Flax-lily					X	
v Dianella sp aff longifolia	Fale Flax-lily					X	
v Dianella sp aff longifolia	Pale Flax-lily					X	
v Dianella sp aff longifolia (Riverina)	Pale Flax-lily			X			X
v Dianella sp aff longifolia (riverina)	Pale Grass-lily			X			X
v Dianella sp aff longifolia (Riverina)	Pale Flax-lily			X			X
v Eragrostis lacunaria	Purple Love-grass			X			
v Melaleuca halmaturorum subsp. halmaturorum	Salt Paperbark						
v Vittadenia sp aff blackii	Wimmera Western New-Holland Daisy						
Veronica plebeia	Trailing Speedwell						
Veronica plebia	Trailing Speedwell						
Vicia sp	Vetch						
Viminaria juncea	Golden Spray						
Vittadenia cervicalaris	Annual New-Holland Daisy						
Vittadinia australasica var. australasica	Sticky New Holland Daisy						
Vittadinia cuneata	Fuzzy New Holland Daisy					X	
Vittadinia gracilis	Woolly New Holland Daisy						
Vittadinia spp.	New Holland Daisy			X		X	
Vulpia bromoides	Squirrel-tail Fescue						
Vulpia spp.	Fescue		X	X	X		X
Vv Pterostylis cheraphila	Floodplain Rustyhood						
Wahlenbergia communis s.l.	Tufted Bluebell		X	X		X	
Wahlenbergia sp	Bluebell				X		X
Wahlenbergia stricta	Tall Bluebell						
Watsonia sp	Watsonia						
Watsonia sp	Watsonia						
Whalleya proluta	Rigid Panic				X		X
Wilsonia rotundifolia	Round-leaf Wilsonia						
Wurmbea dioica	Common Early Nancy						
Xanthium spinosum	Bathurst Burr						

Species Name	Common Name	Reach 19 Site 17	Reach 19 Site 18	Reach 20 Site 24	Reach 21east Site 25	Reach 21east Site 26
Acacia acinacea s.l.	Gold-dust Wattle					
Acacia acinacea s.s.	Gold-dust Wattle		X			
Acacia brachybotrya	Grey Mulga	X				
Acacia farinosa	Mealy Wattle			X		
Acacia ligulata	Small Cooba					X
Acacia melanoxylon	Blackwood					
Acacia montana	Mallee Wattle					
Acacia pycnantha	Golden Wattle					
Acacia stenophylla	Eumong			X		
Acaena echinata	Sheep's Burr					
Actinobole uliginosum	Flannel Cudweed					
Adriana urticoides var. hookeri	Mallee Bitter-bush					X
Aira cupaniana	Quicksilver Grass	X				
Ajuga australis	Austral bugle		X			
Allocasuarina luehmannii	Buloke		X			
Amsinckia lycopsoides	Bugloss Fiddle-neck					
Amyema miquelii	Box Mistletoe					
Amyema miraculosa ssp boormannii	Fleshy Mistletoe					
Amyema pendula	Drooping Mistletoe		X			
Anagallis arvensis	Pimpernel					
Aphanes australasica	Australian Piert					
Aphanes australiana	Australian Piert					
Arctotheca calendula	Cape weed					
Arctotheca calendula	Cape weed	X	X		X	X
Arthropodium fimbriatum	Nodding Chocolate-lily		X			
Arthropodium strictum	Common Chocolate-lily					
Asparagus asparagoides	Bridal Creeper	X	X	X		X
Asparagus officinalis	Asparagus					
Asphodelus fistulosus	Onion weed					
Aster subulatus	Aster-weed					
Aster subulatus	Aster Weed					
Aster subulatus	Aster-weed					
Astroloma humifusum	Cranberry Heath		X			
Atriplex australasica	Native Orache				X	
Atriplex leptocarpa	Slender-fruit Saltbush			X		
Atriplex semibaccata	Berry Saltbush			X		
Atriplex spp.	Saltbush					
Atriplex suberecta	Sprawling saltbush					
Austrodanthonia bipartita s.s.	Leafy Wallaby-grass					
Austrodanthonia caespitosa	Common Wallaby-grass					
Austrodanthonia duttoniana	Brown-back Wallaby-grass					
Austrodanthonia fulva	Copper-awned Wallaby-grass					
Austrodanthonia geniculata	Kneed Wallaby-grass					
Austrodanthonia setacea	Bristly Wallaby-grass	X		X		
Austrodanthonia setacea var. setacea	Bristly Wallaby-grass					
Austrodanthonia spp.	Wallaby Grass		X	X		
Austrostipa aristiglumis	Plump Spear-grass					
Austrostipa elegantissima	Feather Spear-grass			X		
Austrostipa eremophila	Desert Spear-grass					
Austrostipa scabra	Rough Spear-grass		X	X		
Austrostipa spp.	Spear Grass		X	X		
Avena barbata	Bearded Oat					
Avena fatua	Wild Oat					
Avena spp.	Oat					
Banksia marginata	Silver Banksia					
Beyeria lechenaultii	Pale Turpentine Bush					
Brachyscome lineariloba	Hard-headed Daisy					
Bromus diandrus	Great Brome	X				
Bromus hordeaceus subsp. hordeaceus	Soft Brome					
Bromus spp.	Brome	X	X	X		
Bursaria spinosa	Sweet Bursaria					
Calandrinia eremaea	Small Purslane					
Callitris gracilis subsp. murrayensis	Slender Cypress-pine	X	X			X
Calocephalus citreus	Lemon Beauty-heads					
Calocephalus lacteus	Milky Beauty-heads					
Calocephalus sonderi	Pale-beauty-heads					
Calocephalus sonderi	Pale Beauty-heads					
Calotis erinacea	Tangled Burr-daisy					
Calytrix alpestris	Snow-myrtle					
Calytrix tetragona	Common fringe-myrtle					
Carex apressa	Tall Sedge					
Carex sp	Sedge			X		
Carpobrotus modestus	Inland Pigface			X	X	X
Cassytha melantha	Coarse Dodder-laurel					

Species Name	Common Name	Reach 19 Site 17	Reach 19 Site 18	Reach 20 Site 24	Reach 21east Site 25	Reach 21east Site 26
Cassytha melantha	Coarse Dodder-laurel					
Centella cordifolia	Centella					
Chara sp	Stonewort			X		
Chenopodium desertorum subsp. microphyllum	Small-leaf Goosefoot					
Chenopodium sp	Goosefoot					X
Chieranthera austrotenuifolia	Rock Fern					
Chloris truncata	Windmill Grass					
Chrysanthemoides monilifera	Boneseed					X
Chrysocephalum apiculatum s.l.	Common Everlasting					
Cirsium vulgare	Spear Thistle					
Clematis microphylla	Small-leaved Clematis		X			
Clematis microphylla	Small-leaf Clematis		X			
Clematis microphylla	Small-leaved Clematis		X			
Convolvulus erubescens spp. agg.	Pink Bindweed					
Conzya bonariensis	Flaxleaf Fleabane					
Cotula bipinnata	Ferny Cotula			X		
Cotula coronopifolia	Water Buttons		X			
Crassula colorata	Dense Crassula					X
Crassula decumbens	Spreading Crassula	X				
Crassula decumbens	Spreading Stonecrop	X				
Crassula decumbens	Spreading Crassula	X				
Crassula sieberiana s.l.	Sieber Crassula	X				X
Cymbonotus preissianus	Austral Bear's-ear					
Cynoglossum australe	Australian Hound's-tongue					
Cynoglossum australe	Austral Hound's-tongue					
Cynoglossum australe	Australian Hound's-tongue					
Cyperus gymnocaulos	Spiny Flat-sedge	X	X	X		X
Cyperus sp	Sedge		X			
Dactylis glomerata	Cocksfoot					
Daucus glochidiatus	Australian Carrot	X				
Davesia arenaria	Mallee Bitter-pea					
Davesia benthamii	Spiny Bitter-pea					
Daviesia arenaria	Mallee Bitter-pea					X
Dianella brevicaulis	Small-flower Flax-lily					X
Dianella sp aff longifolia - robust	Robust Pale Flax-lily					
Dianella sp. aff. revoluta (North-west Victoria)	Stiff Flax-lily	X				X
Dichondra repens	Kidney-weed					
Diplotaxis muralis	Wall-rocket					
Disphyma crassifolium subsp. clavellatum	Rounded Noon-flower					
Distichlis distichophylla	Australian Salt-grass					
Dittrichia graveolens	Stinkwort					
Dodonaea viscosa ssp angustissima	Slender Hop-bush					
Dodonaea viscosa ssp angustissima	Slender Hop-bush					X
Dodonaea viscosa ssp cuneata	Wedge-leaf Hop-bush		X			
Dodonaea viscosa var angustissima	Slender Hop-bush	X				
Drosora whittackeri	Scented Sundew					
Dysphania glomulifera ssp. glomulifera	Globular Pigweed					
Eclipta platyglossa	Yellow Twin-heads					
Ehpaltes australasica	Spreading Nut heads					
Ehrharta calycina	Perennial Veldt-grass	X				X
Ehrharta longiflora	Annual Veldt-grass	X	X			
Einadia nutans subsp. nutans	Nodding Saltbush		X	X		X
Einadia nutans subsp. nutans	Nodding Saltbush		X	X		X
Elymus scaber	Common Wheat-grass					
Elymus scaber var. scaber	Common Wheat-grass		X			
Enchylaena tomentosa var. tomentosa	Ruby Saltbush (prostate race)		X			X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush		X			X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush					
Enteropogon acicularis	Spider Grass					
Epaltes australasica	Spreading Nut heads					
Epaltes australis	Spreading Nut heads					
Eragrostis diandra	Close-headed Love-grass		X			
Eragrostis dielsii	Mallee Love-grass					
Eragrostis infecunda	Southern Cane-grass					
Eragrostis lacunaria	Purple Love-grass					
Erodium botrys	Big Heron's-bill					
Eryngium ovinum	Blue Devil					
Euc camaldulensis	River Red Gum					
Eucalyptus calycogona	Red Mallee					
Eucalyptus camaldulensis	River Red-gum	X		X	X	X
Eucalyptus largiflorens	Black Box	X		X		
Eucalyptus leucoxylon	Yellow Gum					
Eucalyptus leucoxylon ssp leucoxylon	Yellow gum					
Eucalyptus microcarpa	Grey Box					

Species Name	Common Name	Reach 19 Site 17	Reach 19 Site 18	Reach 20 Site 24	Reach 21east Site 25	Reach 21east Site 26
Eutaxia microphylla var microphylla	Common Eutaxia					
Eutaxia microphylla var. diffusa	Spreading Eutaxia					
Eutaxia microphylla var. microphylla	Common Eutaxia					
Exocarpos aphyllus	Leafless Ballart					
Exocarpos strictus	Pale-fruit Ballart					X
Ficinia nodosa	Knobby Club-sedge	X	X		X	X
Fraxinus sp	Desert ash					
Freesia sp	Freesia					
Fumaria sp	Fumitory					
Fumeria sp	Fumitory					
Galium gaudiodaudii	Rough Bedstraw					
Geranium retrorsum	Grassland Cranesbill					
Goodenia pinnatifida	Cut-leaf Goodenia					
Goodenia pusilliflora	Small-flower Goodenia			X		
Hakea mitchellii	Desert Hakea					X
Halgania heterophylla	Varied Raspwort					
Halgania heterophylla	variable Raspwort					
Haloragis heterophylla	Varied Raspwort					
Heliotropium europaeum	Common Heliotrope					
Helminthotheca echioides	Ox tongue					
Hibbertia stricta sl	Erect Guinea-flower					
Hibbertia virgata	Twiggy Guinea-flower					
Hordium sp	Barley		X	X		
Hyalosperma demissum	Moss Sunray					
Hypochoeris glabra	Smooth Cat's-ear		X			X
Hypochoeris radicata	Flatweed		X			
Hypolaena fastigiata	Tassel Rope-rush					
Hypoxis glabella	Yellow stars					
Isolepis fluitans	Floating Club-sedge					
Juncus flavidus	Gold Rush					
Juncus spp.	Rush					
k Maireana aphylla	Leafless Bluebush					
Kennedia prostrata	Running Postman					
Lachnagrostis filiformis var 2	Wetland Blowngrass					
Lachnagrostis filiformis var 2	Wetland Blown-grass					
Lachnagrostis filiformis var. 1	Common Blown-grass					
Lachnagrostis sp	Blown-grass	X				
Lactuca serriola	Prickly Lettuce					
Lawrencia glomerata	Clustered Lawrencia				X	X
Lepidium africanum	Common Peppercross			X		
Lepidosperma congestum	Clustered Sword-sedge					
Lepidosperma laterale	Variable Sword-sedge					
Leptomeria aphylla	Leafless Currant-bush					
Leptorhynchus squamatus subsp. squamatus	Scaly Buttons					
Leptospermum obovatum	River Tea-tree					
Lolium rigidum	Wimmera Rye-grass		X	X		X
Lomandra effusa	Scented Mat-rush					
Lomandra multiflora	Many-flowered Mat-rush					
Lomandra multiflora	Many-flowered Mat-rush					
Lomandra nana	Dwarf Mat-rush		X			
Lycium ferocissimum	African Box-thorn					
Lysiana exocarpi	Harlequin Mistletoe					
Lythrum hyssopifolia	Small Loosestrife					
Maireana brevifolia	Short-leaf Bluebush			X		X
Maireana decalvans	Black Bluebush			X		X
Maireana decalvans	Grey Copperburr			X		X
Maireana decalvans	Black Bluebush			X		X
Maireana enchylaenoides	Wingless Bluebush					
Maireana sp	Bluebush					
Malva parviflora	Small-flower Mallow				X	
Marrubium vulgare	Horehound					
Marsilea drummondii	Common Nardoo					
Melaleuca decussata	Totem-poles	X	X			
Melaleuca halmaturorum subsp. halmaturorum	Salt Paperbark					
Mesembryanthemum crystallinum	Common Ice-plant					X
Microlaena stipoides	Weeping Grass					
Mimulus repens	Creeping Monkey Flower					
Minuria leptophylla	Minnie Daisy					
Moraea flaccida	One-leaf Cape-tulip					
Muehlenbeckia florulenta	Tangled Lignum		X	X		
Myoporum parvifolium	Creeping boobialla			X		X
Nicotiana glauca	Tree Tobacco					
Olea europea	Olive					
Onopordum acaulon	Stemless Thistle					

Species Name	Common Name	Reach 19 Site 17	Reach 19 Site 18	Reach 20 Site 24	Reach 21east Site 25	Reach 21east Site 26
Ophioglossum lusitanicum	Austral Adder's Tongue					
Oxalis perennans	Grassland Wood-sorrel		X			
Oxalis pes-caprae	Soursob		X			X
Panicum effusum	Hairy Panic					
Pellargonium australe	Austral Storks-bill					
Phalaris aquatica	Toowoomba Canary-grass					
Phragmites australis	Common Reed	X		X	X	
Phyla canescens	Fog-fruit					
Pimelea glauca	Smooth Rice-flower		X			
Pimelea humilis	Common Rice-flower					
Pittosporum angustifolium	Weeping Pittosporum	X				
Plantago gaudichaudi	Narrow Plantain					
Plantago hispida	Hairy Plantain					
Plantago myosurus	Mouse Plantain					
Plantago sp	Native plantain		X			
Plantago varia	Variable Plantain		X			
Plantago varia	Vaiable Plantain		X			
Plantago varia	Variable Plantain		X			
Poa bubosa	Bulbous Meadow-grass	X				
Poa labillardierei	Common Tussock-grass					
Poa sp	Tussock-grass					
Podolepis cappilaris	Wiry Podolepis					
Polypogon monspeliensis	Annual Beard-grass					
Potamogeton pectinatus	Fennel Pondweed					
Pseudognaphalium luteoalbum	Jersey Cudweed					
Pterostylis curta	Blunt Greenhood					
Ptilotus exaltatus	Mulla Mulla					
r Asperula wimmerana	Wimmera Woodruff					
Rannunculus sessiliflorus	Annual Buttercup					
Ranunc sessiliflorus	Annual Buttercup					
Ranunculus sessiliflorus	Annual Buttercup			X		
Ranunculus sp	Native Buttercup					
Rhagodia spinescens	Hedge Saltbush			X		
Romulea rosea	Onion Grass					
Romulea rosea var reflexa	Large-flower onion grass					
Romulea rosea var. australis s.s.	Common Onion-grass		X	X		
Rosa rubiginosa	Sweet briar					
Rumex brownii	Slender Dock					
Salsola tragus	Prickly Saltwort					X
Salvia verbenaca	Wild Sage					
Santalum acuminatum	Sweet Quandong					
Sarcocornia quinqueflora	Beaded Glasswort				X	
Sarcocornia quinqueflora subsp. quinqueflora	Beaded Glasswort		X	X		
Schinus molle	Peppercorn					
Sclerolaena diacantha	Grey Copperburr			X		
Sclerolaena muricata var villosa	Grey Roly-poly					
Sclerolaena muricata var. villosa	Grey Roly-poly					
Scorzonera laciniata	Scorzonera					
Selliera radicans	Shiny Swamp-mat			X		
Senecio hispidulus sl	Rough Fireweed					
Senecio pinnatifolius	Variable Groundsel	X	X	X		X
Senecio pinnatifolius	Variable Groundsel					
Senecio quadridentatus	Cotton Fireweed					
Senecio spp.	Groundsel					
Sida corrugata	Variable Sida					
Sissymbrium orientale	Indian Hedge-mustard					X
Sisymbrium orientale	Indian Hedge-mustard		X			
Sisymbrium orientale	Indain Hedge-mustard		X			
Sisymbrium orientale	Indian Hedge-mustard		X			
Solanum simile	Oonderoo					
Solenogyne dominii	Common solenogyne					
Sonchus asper s.l.	Rough Sow-thistle					
Sonchus oleraceus	Common Sow-thistle			X	X	X
Spergularia rubra s.l.	Red Sand-spurrey					
Spergularia sp. 3	Salt Sea-spurrey		X			
Stackhousia sp aff monogyna	Creamy candles					
Stellaria sp	Chickweed					
Stemodia florulenta	Bluerod					
Stenopetalum lineare	Narrow Thread-petal					
Stuartina muelleriana	Spoon cudweed					
Swainsona procumbens	Broughton Pea					
Taraxacum sp	Dandelion					
Teucrium racemosum s.l.	Grey Germander					
Teucrium racemosum s.s.	Grey Germander					
Themeda triandra	Kangaroo Grass					

Species Name	Common Name	Reach 19 Site 17	Reach 19 Site 18	Reach 20 Site 24	Reach 21east Site 25	Reach 21east Site 26
Thysanotus baueri	Mallee Fringe-lily					
Thysanotus patersonii	Twining Fringe-lily		X			
Toxanthes muelleriana	Common bow-flower					
Tricoryne elatior	Tall Grass-lily					
Trifolium angustifolium var. angustifolium	Narrow-leaf Clover					
Trifolium arvense var. arvense	Hare's-foot Clover		X	X		
Trifolium sp	Clover					
Trifolium subteranneum	Subterranean clover			X		
Trifolium subterrarium	Sub Clover					
Trifolium subterrarium	Subterrannian clover					
Trifolium subterrarium	Sub clover					
Triglochin procera s.l.	Water Ribbons					
Triglochin procera s.s.	Common Water-ribbons					
Typha domingensis	Narrow-leaf Cumbungi					
Typha domingensis	Narrow-leaf Cumbungi					
Urtica urens	Small Nettle					
v Acacia oswaldii	Umbrella Wattle		X			
v Acacia trineura	Three-nerve Wattle			X		X
v Amyema linophyllum ssp orientalis	Buloke Mistletoe		X			
v Dianella sp aff longifolia	Pale Flax-lily					
v Dianella sp aff longifolia	Fale Flax-lily					
v Dianella sp aff longifolia	Pale Flax-lily					
v Dianella sp aff longifolia (Riverina)	Pale Flax-lily					
v Dianella sp aff longifolia (riverina)	Pale Grass-lily					
v Dianella sp aff longifolia (Riverina)	Pale Flax-lily					
v Eragrostis lacunaria	Purple Love-grass		X			
v Melaleuca halmaturorum subsp. halmaturorum	Salt Paperbark			X		
v Vittadenia sp aff blackii	Wimmera Western New-Holland Daisy					
Veronica plebeia	Trailing Speedwell					
Veronica plebia	Trailing Speedwell					
Vicia sp	Vetch					
Viminaria juncea	Golden Spray					
Vittadenia cervicalaris	Annual New-Holland Daisy		X			
Vittadinia australasica var. australasica	Sticky New Holland Daisy					
Vittadinia cuneata	Fuzzy New Holland Daisy		X			
Vittadinia gracilis	Woolly New Holland Daisy			X		
Vittadinia spp.	New Holland Daisy		X			
Vulpia bromoides	Squirrel-tail Fescue					
Vulpia spp.	Fescue	X		X		X
Vv Pterostylis cheraphila	Floodplain Rustyhood		X			
Wahlenbergia communis s.l.	Tufted Bluebell		X			
Wahlenbergia sp	Bluebell		X			
Wahlenbergia stricta	Tall Bluebell					
Watsonia sp	Watsonia					
Watsonia sp	Watsonia					
Whalleya proluta	Rigid Panic			X		
Wilsonia rotundifolia	Round-leaf Wilsonia			X		
Wurmbea dioica	Common Early Nancy		X			
Xanthium spinosum	Bathurst Burr					

Species Name	Common Name	Reach 21west Site 27	Reach 22 Site 19	Reach 22 Site 22	Reach 23 Site 20	Reach 24 Site 21
Acacia acinacea s.l.	Gold-dust Wattle					
Acacia acinacea s.s.	Gold-dust Wattle				X	
Acacia brachybotrya	Grey Mulga	X	X		X	
Acacia farinosa	Mealy Wattle					
Acacia ligulata	Small Cooba	X	X			
Acacia melanoxylon	Blackwood					
Acacia montana	Mallee Wattle				X	
Acacia pycnantha	Golden Wattle	X	X		X	
Acacia stenophylla	Eumong					
Acaena echinata	Sheep's Burr					
Actinobole uliginosum	Flannel Cudweed					X
Adriana urticoides var. hookeri	Mallee Bitter-bush					
Aira cupaniana	Quicksilver Grass					
Ajuga australis	Austral bugle					
Allocasuarina luehmannii	Buloke					
Amsinckia lycopsoides	Bugloss Fiddle-neck					
Amyema miquelii	Box Mistletoe			X		
Amyema miraculosa ssp boormannii	Fleshy Mistletoe			X		
Amyema pendula	Drooping Mistletoe			X		
Anagallis arvensis	Pimpernel					
Aphanes australasica	Australian Piert					
Aphanes australiana	Australian Piert					
Arctotheca calendula	Cape weed				X	
Arctotheca calendula	Cape weed					
Arthropodium fimbriatum	Nodding Chocolate-lily					
Arthropodium strictum	Common Chocolate-lily					
Asparagus asparagoides	Bridal Creeper	X	X			
Asparagus officinalis	Asparagus					
Asphodelus fistulosus	Onion weed		X			
Aster subulatus	Aster-weed					
Aster subulatus	Aster Weed					
Aster subulatus	Aster-weed					
Astroloma humifusum	Cranberry Heath					
Atriplex australasica	Native Orache					
Atriplex leptocarpa	Slender-fruit Saltbush					
Atriplex semibaccata	Berry Saltbush	X		X		
Atriplex spp.	Saltbush					
Atriplex suberecta	Sprawling saltbush					
Austrodanthonia bipartita s.s.	Leafy Wallaby-grass					
Austrodanthonia caespitosa	Common Wallaby-grass					
Austrodanthonia duttoniana	Brown-back Wallaby-grass					
Austrodanthonia fulva	Copper-awned Wallaby-grass					
Austrodanthonia geniculata	Kneed Wallaby-grass					
Austrodanthonia setacea	Bristly Wallaby-grass			X		X
Austrodanthonia setacea var. setacea	Bristly Wallaby-grass					
Austrodanthonia spp.	Wallaby Grass		X	X		
Austrostipa aristiglumis	Plump Spear-grass					
Austrostipa elegantissima	Feather Spear-grass					
Austrostipa eremophila	Desert Spear-grass					
Austrostipa scabra	Rough Spear-grass					
Austrostipa spp.	Spear Grass		X	X		
Avena barbata	Bearded Oat					
Avena fatua	Wild Oat					
Avena spp.	Oat		X			
Banksia marginata	Silver Banksia					
Beyeria lechenaultii	Pale Turpentine Bush					
Brachyscome lineariloba	Hard-headed Daisy					X
Bromus diandrus	Great Brome			X		
Bromus hordeaceus subsp. hordeaceus	Soft Brome	X				
Bromus spp.	Brome	X		X		X
Bursaria spinosa	Sweet Bursaria					
Calandrinia eremaea	Small Purslane					X
Callitris gracilis subsp. murrayensis	Slender Cypress-pine		X			X
Calocephalus citreus	Lemon Beauty-heads					
Calocephalus lacteus	Milky Beauty-heads					
Calocephalus sonderi	Pale-beauty-heads					
Calocephalus sonderi	Pale Beauty-heads					
Calotis erinacea	Tangled Burr-daisy					X
Calytrix alpestris	Snow-myrtle					
Calytrix tetragona	Common fringe-myrtle					
Carex apressa	Tall Sedge					
Carex sp	Sedge		X			
Carpobrotus modestus	Inland Pigface	X				
Cassytha melantha	Coarse Dodder-laurel	X	X			

Species Name	Common Name	Reach 21west Site 27	Reach 22 Site 19	Reach 22 Site 22	Reach 23 Site 20	Reach 24 Site 21
Cassytha melantha	Coarse Dodder-laurel	X	X			
Centella cordifolia	Centella					
Chara sp	Stonewort					
Chenopodium desertorum subsp. microphyllum	Small-leaf Goosefoot					
Chenopodium sp	Goosefoot	X				
Chieranthera austrotenuifolia	Rock Fern					
Chloris truncata	Windmill Grass					
Chrysanthemoides monilifera	Boneseed					
Chrysocephalum apiculatum s.l.	Common Everlasting					
Cirsium vulgare	Spear Thistle	X				
Clematis microphylla	Small-leaved Clematis	X	X	X		X
Clematis microphylla	Small-leaf Clematis	X	X	X		X
Clematis microphylla	Small-leaved Clematis	X	X	X		X
Convolvulus erubescens spp. agg.	Pink Bindweed	X				
Conzya bonariensis	Flaxleaf Fleabane					
Cotula bipinnata	Ferny Cotula			X		
Cotula coronopifolia	Water Buttons					
Crassula colorata	Dense Crassula			X		X
Crassula decumbens	Spreading Crassula			X		X
Crassula decumbens	Spreading Stonecrop			X		X
Crassula decumbens	Spreading Crassula			X		X
Crassula sieberiana s.l.	Sieber Crassula					X
Cymbonotus preissianus	Austral Bear's-ear					
Cynoglossum australe	Australian Hound's-tongue					
Cynoglossum australe	Austral Hound's-tongue					
Cynoglossum australe	Australian Hound's-tongue					
Cyperus gymnocaulos	Spiny Flat-sedge	X				
Cyperus sp	Sedge					
Dactylis glomerata	Cocksfoot					
Daucus glochidiatus	Australian Carrot					X
Davesia arenaria	Mallee Bitter-pea		X		X	
Davesia benthamii	Spiny Bitter-pea					
Daviesia arenaria	Mallee Bitter-pea					
Dianella brevicaulis	Small-flower Flax-lily	X				
Dianella sp aff longifolia - robust	Robust Pale Flax-lily					
Dianella sp. aff. revoluta (North-west Victoria)	Stiff Flax-lily					
Dichondra repens	Kidney-weed					
Diplotaxis muralis	Wall-rocket		X			
Disphyma crassifolium subsp. clavellatum	Rounded Noon-flower	X				
Distichlis distichophylla	Australian Salt-grass					
Dittrichia graveolens	Stinkwort	X				
Dodonaea viscosa ssp angustissima	Slender Hop-bush					
Dodonaea viscosa ssp angustissima	Slender Hop-bush		X			
Dodonaea viscosa ssp cuneata	Wedge-leaf Hop-bush					
Dodonaea viscosa var angustissima	Slender Hop-bush					
Drosora whittackeri	Scented Sundew					
Dysphania glomulifera ssp. glomulifera	Globular Pigweed					
Eclipta platyglossa	Yellow Twin-heads			X		
Ehpaltes autralasica	Spreading Nut heads					
Ehrharta calycina	Perennial Veldt-grass	X	X		X	
Ehrharta longiflora	Annual Veldt-grass		X			
Einadia nutans subsp. nutans	Nodding Saltbush			X		X
Einadia nutans subsp. nutans	Nodding Saltbush			X		X
Elymus scaber	Common Wheat-grass					
Elymus scaber var. scaber	Common Wheat-grass					
Enchylaena tomentosa var. tomentosa	Ruby Saltbush (prostate race)	X				X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush	X				X
Enchylaena tomentosa var. tomentosa	Ruby Saltbush			X		
Enteropogon acicularis	Spider Grass					
Epaltes australasica	Spreading Nut heads					
Epaltes australis	Spreading Nut heads					
Eragrostis diandra	Close-headed Love-grass					
Eragrostis dielsii	Mallee Love-grass	X				
Eragrostis infecunda	Southern Cane-grass					
Eragrostis lacunaria	Purple Love-grass					
Erodium botrys	Big Heron's-bill					
Eryngium ovinum	Blue Devil					
Euc camaldulensis	River Red Gum				X	
Eucalyptus calycogona	Red Mallee					
Eucalyptus camaldulensis	River Red-gum	X	X	X		X
Eucalyptus largiflorens	Black Box		X	X		X
Eucalyptus leucoxylon	Yellow Gum					
Eucalyptus leucoxylon ssp leucoxylon	Yellow gum					
Eucalyptus microcarpa	Grey Box					

Species Name	Common Name	Reach 21west Site 27	Reach 22 Site 19	Reach 22 Site 22	Reach 23 Site 20	Reach 24 Site 21
Eutaxia microphylla var microphylla	Common Eutaxia				X	
Eutaxia microphylla var. diffusa	Spreading Eutaxia	X		X	X	
Eutaxia microphylla var. microphylla	Common Eutaxia					
Exocarpos aphyllus	Leafless Ballart					
Exocarpos strictus	Pale-fruit Ballart					
Ficinia nodosa	Knobby Club-sedge	X				
Fraxinus sp	Desert ash					
Freesia sp	Freesia					
Fumaria sp	Fumitory					
Fumeria sp	Fumitory	X	X	X		
Galium gaudiohaudii	Rough Bedstraw					
Geranium retrorsum	Grassland Cranesbill					
Goodenia pinnatifida	Cut-leaf Goodenia					
Goodenia pusilliflora	Small-flower Goodenia					
Hakea mitchellii	Desert Hakea					
Halgania heterophylla	Varied Raspwort					
Halgania heterophylla	variable Raspwort					
Haloragis heterophylla	Varied Raspwort		X			
Heliotropium europaeum	Common Heliotrope		X			
Helminthotheca echioides	Ox tongue					
Hibbertia stricta sl	Erect Guinea-flower					
Hibbertia virgata	Twiggy Guinea-flower					
Hordium sp	Barley					
Hyalosperma demissum	Moss Sunray					X
Hypochoeris glabra	Smooth Cat's-ear	X	X	X		X
Hypochoeris radicata	Flatweed		X	X		X
Hypolaena fastigiata	Tassel Rope-rush					
Hypoxis glabella	Yellow stars			X		
Isolepis fluitans	Floating Club-sedge					
Juncus flavidus	Gold Rush					
Juncus spp.	Rush					
k Maireana aphylla	Leafless Bluebush					
Kennedia prostrata	Running Postman	X				
Lachnagrostis filiformis var 2	Wetland Blowngrass					
Lachnagrostis filiformis var 2	Wetland Blown-grass					
Lachnagrostis filiformis var. 1	Common Blown-grass					
Lachnagrostis sp	Blown-grass					
Lactuca serriola	Prickly Lettuce					
Lawrencia glomerata	Clustered Lawrencia	X				
Lepidium africanum	Common Peppercross					
Lepidosperma congestum	Clustered Sword-sedge					
Lepidosperma laterale	Variable Sword-sedge					
Leptomeria aphylla	Leafless Currant-bush					
Leptorhynchus squamatus subsp. squamatus	Scaly Buttons					
Leptospermum obovatum	River Tea-tree					
Lolium rigidum	Wimmera Rye-grass	X		X		
Lomandra effusa	Scented Mat-rush					
Lomandra multiflora	Many-flowered Mat-rush					
Lomandra multiflora	Many-flowered Mat-rush					
Lomandra nana	Dwarf Mat-rush					
Lycium ferocissimum	African Box-thorn	X				
Lysiana exocarpi	Harlequin Mistletoe		X	X		
Lythrum hyssopifolia	Small Loosestrife					
Maireana brevifolia	Short-leaf Bluebush	X	X	X		
Maireana decalvans	Black Bluebush		X			
Maireana decalvans	Grey Copperburr		X			
Maireana decalvans	Black Bluebush		X			
Maireana enchylaenoides	Wingless Bluebush					
Maireana sp	Bluebush			X		
Malva parviflora	Small-flower Mallow					
Marrubium vulgare	Horehound	X	X			X
Marsilea drummondii	Common Nardoo					
Melaleuca decussata	Totem-poles					
Melaleuca halmaturorum subsp. halmaturorum	Salt Paperbark					
Mesembryanthemum crystallinum	Common Ice-plant					
Microlaena stipoides	Weeping Grass					
Mimulus repens	Creeping Monkey Flower					
Minuria leptophylla	Minnie Daisy					
Moraea flaccida	One-leaf Cape-tulip					
Muehlenbeckia florulenta	Tangled Lignum	X		X		
Myoporum parvifolium	Creeping boobialla	X	X	X		
Nicotiana glauca	Tree Tobacco	X	X			
Olea europea	Olive					
Onopordum acaulon	Stemless Thistle			X		

Species Name	Common Name	Reach 21west Site 27	Reach 22 Site 19	Reach 22 Site 22	Reach 23 Site 20	Reach 24 Site 21
Ophioglossum lusitanicum	Austral Adder's Tongue					
Oxalis perennans	Grassland Wood-sorrel					X
Oxalis pes-caprae	Soursob					
Panicum effusum	Hairy Panic					
Pellargonium australe	Austral Storks-bill	X				
Phalaris aquatica	Toowoomba Canary-grass					
Phragmites australis	Common Reed	X				
Phyla canescens	Fog-fruit					
Pimelea glauca	Smooth Rice-flower					
Pimelea humilis	Common Rice-flower					
Pittosporum angustifolium	Weeping Pittosporum		X			X
Plantago gaudichaudi	Narrow Plantain					
Plantago hispida	Hairy Plantain					
Plantago myosurus	Mouse Plantain					
Plantago sp	Native plantain					
Plantago varia	Variable Plantain					
Plantago varia	Vaiable Plantain					
Plantago varia	Variable Plantain					
Poa bubosa	Bulbous Meadow-grass					
Poa labillardierei	Common Tussock-grass					
Poa sp	Tussock-grass					
Podolepis cappilaris	Wiry Podolepis					X
Polypogon monspeliensis	Annual Beard-grass					
Potamogeton pectinatus	Fennel Pondweed					
Pseudognaphalium luteoalbum	Jersey Cudweed					
Pterostylis curta	Blunt Greenhood					
Ptilotus exaltatus	Mulla Mulla					
r Asperula wimmerana	Wimmera Woodruff		X			
Rannunculus sessiliflorus	Annual Buttercup					
Ranunc sessiliflorus	Annual Buttercup					
Ranunculus sessiliflorus	Annual Buttercup					
Ranunculus sp	Native Buttercup					
Rhagodia spinescens	Hedge Saltbush	X				
Romulea rosea	Onion Grass					
Romulea rosea var reflexa	Large-flower onion grass					
Romulea rosea var. australis s.s.	Common Onion-grass					
Rosa rubiginosa	Sweet briar					
Rumex brownii	Slender Dock					
Salsola tragus	Prickly Saltwort					
Salvia verbenaca	Wild Sage					
Santalum acuminatum	Sweet Quandong					
Sarcocornia quinqueflora	Beaded Glasswort					
Sarcocornia quinqueflora subsp. quinqueflora	Beaded Glasswort	X				
Schinus molle	Peppercorn					
Sclerolaena diacantha	Grey Copperburr					
Sclerolaena muricata var villosa	Grey Roly-poly					
Sclerolaena muricata var. villosa	Grey Roly-poly				X	
Scorzonera laciniata	Scorzonera					
Selliera radicans	Shiny Swamp-mat					
Senecio hispidulus sl	Rough Fireweed					
Senecio pinnatifolius	Variable Groundsel	X			X	X
Senecio pinnatifolius	Variable Groundsel					
Senecio quadridentatus	Cotton Fireweed					
Senecio spp.	Groundsel					
Sida corrugata	Variable Sida					
Sissymbrium orientale	Indian Hedge-mustard					
Sisymbrium orientale	Indian Hedge-mustard		X	X		X
Sisymbrium orientale	Indain Hedge-mustard		X	X		X
Sisymbrium orientale	Indian Hedge-mustard		X	X		X
Solanum simile	Oonderoo		X			
Solenogyne dominii	Common solenogyne					
Sonchus asper s.l.	Rough Sow-thistle					
Sonchus oleraceus	Common Sow-thistle	X		X		X
Spergularia rubra s.l.	Red Sand-spurrey					
Spergularia sp. 3	Salt Sea-spurrey					
Stackhousia sp aff monogyna	Creamy candles					
Stellaria sp	Chickweed					X
Stemodia florulenta	Bluerod		X			
Stenopetalum lineare	Narrow Thread-petal					
Stuartina muelleriana	Spoon cudweed					X
Swainsona procumbens	Broughton Pea					
Taraxacum sp	Dandelion					
Teucrium racemosum s.l.	Grey Germander					
Teucrium racemosum s.s.	Grey Germander			X		
Themeda triandra	Kangaroo Grass					

Species Name	Common Name	Reach 21west Site 27	Reach 22 Site 19	Reach 22 Site 22	Reach 23 Site 20	Reach 24 Site 21
Thysanotus baueri	Mallee Fringe-lily					
Thysanotus patersonii	Twining Fringe-lily					
Toxanthes muelleriana	Common bow-flower					X
Tricoryne elatior	Tall Grass-lily					
Trifolium angustifolium var. angustifolium	Narrow-leaf Clover					
Trifolium arvense var. arvense	Hare's-foot Clover		X			
Trifolium sp	Clover	X	X			
Trifolium subteranneum	Subterranean clover					
Trifolium subterrarium	Sub Clover			X		
Trifolium subterrarium	Subterrannian clover			X		
Trifolium subterrarium	Sub clover			X		
Triglochin procera s.l.	Water Ribbons					
Triglochin procera s.s.	Common Water-ribbons					
Typha domingensis	Narrow-leaf Cumbungi					
Typha domingensis	Narrow-leaf Cumbungi					
Urtica urens	Small Nettle					X
v Acacia oswaldii	Umbrella Wattle					
v Acacia trineura	Three-nerve Wattle	X	X			
v Amyema linophyllum ssp orientalis	Buloke Mistletoe					
v Dianella sp aff longifolia	Pale Flax-lily					
v Dianella sp aff longifolia	Fale Flax-lily					
v Dianella sp aff longifolia	Pale Flax-lily					
v Dianella sp aff longifolia (Riverina)	Pale Flax-lily					
v Dianella sp aff longifolia (riverina)	Pale Grass-lily					
v Dianella sp aff longifolia (Riverina)	Pale Flax-lily					
v Eragrostis lacunaria	Purple Love-grass					
v Melaleuca halmaturorum subsp. halmaturorum	Salt Paperbark					
v Vittadenia sp aff blackii	Wimmera Western New-Holland Daisy					
Veronica plebeia	Trailing Speedwell					
Veronica plebia	Trailing Speedwell					
Vicia sp	Vetch					
Viminaria juncea	Golden Spray					
Vittadenia cervicalis	Annual New-Holland Daisy					
Vittadinia australasica var. australasica	Sticky New Holland Daisy					
Vittadinia cuneata	Fuzzy New Holland Daisy					
Vittadinia gracilis	Woolly New Holland Daisy					
Vittadinia spp.	New Holland Daisy					
Vulpia bromoides	Squirrel-tail Fescue					
Vulpia spp.	Fescue	X	X			X
Vv Pterostylis cheraphila	Floodplain Rustyhood					
Wahlenbergia communis s.l.	Tufted Bluebell					
Wahlenbergia sp	Bluebell					
Wahlenbergia stricta	Tall Bluebell					
Watsonia sp	Watsonia					
Watsonia sp	Watsonia					
Whalleya proluta	Rigid Panic					
Wilsonia rotundifolia	Round-leaf Wilsonia					
Wurmbea dioica	Common Early Nancy					
Xanthium spinosum	Bathurst Burr					

Appendix B

Habitat Quality Field Assessments for the Wimmera Heritage River

	HABSCORE	Reach 19				Reach 20			Reach 21			Reach 22		Reach 23	Reach 24
	Site	15	16	17	18	23a	23b	24	25	26	27	19	22	20	21
1	Epifaunal substrate / available cover	8	11		13	12		5				9	8		13
2	Pool substrate characterization	11	16		11	12		11				15	10		17
3	Pool variability	11	14		13	18		14				2	10		17
4	Sediment deposition	14	18		11	16		18				18	16		12
5	Channel flow status	14	15		13	9		14				0	0		0
6	Channel alteration	15	19		19	20		13				13	13		20
7	Channel sinuosity	6	8		9	16		16				8	8		8
8	Bank stability (L)	3	7		4	7		1				8	9		9
	(R)	4	10		1	4		1				8	6		9
9	Vegetative protection (L)	2	6		8	7		1				8	6		9
	(R)	1	9		6	5		1				8	5		9
10	Riparian zone score (L)	2	8		9	8		2				4	6		9
	(R)	3	5		7	5		1				6	3		7
	Total HABSCORE	94	146		124	139		98				107	100		139
	RHA	Reach 19				Reach 20			Reach 21			Reach 22		Reach 23	Reach 24
Habitat parameter	Site	15	16	17	18	23a	23b	24	25	26	27	19	22	20	21
	Large Trees	2	2	1	2	2	1	1		2	2	2	2		2
	Canopy Cover	0	0.5	1	1	0	0	0		0.5	0.5	1	1		1
	Understory	0	2	0	4	4	3	4		4	4	4	5		4
	Weediness	0	0	0	1	3	1	2		0	2	0	0		2
	Recruitment	0	1	0	2	2	2	1		1	2	2	1		1
	Organic Litter	0	1	1	1	1	1	0		0	1	1	1		0
	Logs	0.5	1	0.5	0	0	1	0		0.5	0.5	1	0.5		1
	Size	2	2	2	2	2	2	2		2	2	2	2		2
	Neighbourhood	1	1	1	1	1	1	0		1	0	1	1		1
	Core Area	1	1	1	1	1	1	0		0	1	1	0		1
	RHA scores	6.5	11.5	7.5	15	16	13	10	0	11	15	15	13.5		15
	Sub-reach length (m)	6994	6996	1361	6781										
	Reach lengths (m)	22132													
	%	0.32	0.32	0.06	0.31	0.33	0.33	0.33		0.5	0.5	0.5	0.5		1
		Reach 19				Reach 20			Reach 21			Reach 22		Reach 23	Reach 24
	Weighted Reach Average (HABSCORE)	123				119			0			104			139
	Weighted Reach Average (RHA)	10.7				12.9			13.0			14.3			15.0

Appendix C

Risk Assessment for the Wimmera Heritage River

Heritage River Reach 14/15

LEGEND		
Likelihood	→	3 3 ← Consequence
Risk Ranking Score	→	27 low ← Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

			Altered Hydrology		Lack of Protection		Vegetation Removal		Weed Invasion	
ASSET			Characterised by....							
ENVIRONMENTAL	Substrate	Epifaunal substrate	5	4	4	2	3	1	5	1
		Pool substrate/sediment deposition	20	VERY HIGH	8	medium	3	low	5	low
	Geomorphic character	planform/channelisation	5	3	4	2	3	1	5	1
		profile	15	HIGH	8	medium	3	low	5	low
	Stream Banks	bank stability	5	2	4	4	3	3	5	3
		vegetative protection	10	medium	16	HIGH	9	medium	15	HIGH
	Riparian Zone	human access/impact	5	2	4	4	3	5	5	4
		integrity of native vegetation	10	medium	16	HIGH	15	HIGH	20	VERY HIGH
	Water Quality	DO/nutrient levels	5	2	4	1	3	1	5	1
		salinity levels	10	medium	4	low	3	low	5	low
	Aquatic Biota	aquatic flora	5	2	4	1	3	2	5	2
		aquatic fauna	10	medium	4	low	6	low	10	medium

Likelihood	Trajectory
5 almost certain	worsening rapidly
4 quite possible	worsening
3 unusual but possible	stable
2 remotely possible	improving slowly
1 practically impossible	improving rapidly

Consequence
5 severe
4 major
3 moderate
2 minor
1 almost none

Score		
Low	<	6
Medium		12
High		18
Very High	>	19

Heritage River Reach 16

LEGEND		
Likelihood	→	3
Risk Ranking Score	→	27
		3 ←
		low ←
		Consequence
		Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

			Altered Hydrology		Lack of Protection		Vegetation Removal		Weed Invasion		Exotic Fauna	
ASSET	Characterised by....											
E N V I R O N M E N T A L	Substrate	Epifaunal substrate	5	5	4	2	4	1	5	1	4	1
		Pool substrate/sediment deposition	25	VERY HIGH	8	medium	4	low	5	low	4	low
	Geomorphic character	planform/channelisation	5	5	4	2	4	1	5	1	4	1
		profile	25	VERY HIGH	8	medium	4	low	5	low	4	low
	Stream Banks	bank stability	5	4	4	4	4	3	5	2	4	3
		vegetative protection	20	VERY HIGH	16	HIGH	12	medium	10	medium	12	medium
	Riparian Zone	human access/impact	5	2	4	4	4	5	5	4	4	3
		integrity of native vegetation	10	medium	16	HIGH	20	VERY HIGH	20	VERY HIGH	12	medium
	Water Quality	DO/nutrient levels	5	2	4	1	4	1	5	1	4	1
		salinity levels	10	medium	4	low	4	low	5	low	4	low
	Aquatic Biota	aquatic flora	5	2	4	1	4	2	5	2	4	3
		aquatic fauna	10	medium	4	low	8	medium	10	medium	12	medium

Likelihood

5 almost certain
4 quite possible
3 unusual but possible
2 remotely possible
1 practically impossible

Trajectory

worsening rapidly
worsening
stable
improving slowly
improving rapidly

Consequence

5 severe
4 major
3 moderate
2 minor
1 almost none

Score

Low	<	6
Medium		12
High		18
Very High	>	19

Heritage River Reach 17

LEGEND		
Likelihood	→	3
Risk Ranking Score	→	27
		3 ←
		low ←
		Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

				Altered Hydrology		Lack of Protection		Weed Invasion	
ASSET		Characterised by....							
ENVIRONMENTAL	Substrate	Epifaunal substrate		5	4	5	2	5	1
		Pool substrate/sediment deposition		20	VERY HIGH	10	medium	5	low
	Geomorphic character	planform/channelisation		5	3	5	2	5	1
		profile		15	HIGH	10	medium	5	low
	Stream Banks	bank stability		5	2	5	4	5	2
		vegetative protection		10	medium	20	VERY HIGH	10	medium
	Riparian Zone	human access/impact		5	4	5	4	5	4
		integrity of native vegetation		20	VERY HIGH	20	VERY HIGH	20	VERY HIGH
	Water Quality	DO/nutrient levels		5	5	5	1	5	1
		salinity levels		25	VERY HIGH	5	low	5	low
Aquatic Biota	aquatic flora		5	5	5	1	5	3	
	aquatic fauna		25	VERY HIGH	5	low	15	HIGH	

Likelihood	Trajectory
5 almost certain	worsening rapidly
4 quite possible	worsening
3 unusual but possible	stable
2 remotely possible	improving slowly
1 practically impossible	improving rapidly

Consequence
5 severe
4 major
3 moderate
2 minor
1 almost none

Score		
Low	<	6
Medium		12
High		18
Very High	>	19

Heritage River Reach 18

LEGEND			
Likelihood	→	3	3 ← Consequence
Risk Ranking Score	→	27	low ← Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

				Altered Hydrology		Lack of Protection		Vegetation Removal		Weed Invasion		Exotic Fauna		Earthworks	
ASSET		Characterised by....													
ENVIRONMENTAL	Substrate	Epifaunal substrate		5	5	3	2	3	1	5	1	4	1	3	1
		Pool substrate/sediment deposition		25	VERY HIGH	6	low	3	low	5	low	4	low	3	low
	Geomorphic character	planform/channelisation		5	5	3	2	3	1	5	1	4	1	3	3
		profile		25	VERY HIGH	6	low	3	low	5	low	4	low	9	medium
	Stream Banks	bank stability		5	4	3	2	3	3	5	2	4	3	3	1
		vegetative protection		20	VERY HIGH	6	low	9	medium	10	medium	12	medium	3	low
	Riparian Zone	human access/impact		5	2	3	3	3	5	5	4	4	3	3	3
		integrity of native vegetation		10	medium	9	medium	15	HIGH	20	VERY HIGH	12	medium	9	medium
	Water Quality	DO/nutrient levels		5	3	3	1	3	1	5	2	4	1	3	1
		salinity levels		15	HIGH	3	low	3	low	10	medium	4	low	3	low
	Aquatic Biota	aquatic flora		5	4	3	1	3	2	5	3	4	3	3	1
		aquatic fauna		20	VERY HIGH	3	low	6	low	15	HIGH	12	medium	3	low

Likelihood		Trajectory	
5	almost certain	worsening rapidly	
4	quite possible	worsening	
3	unusual but possible	stable	
2	remotely possible	improving slowly	
1	practically impossible	improving rapidly	

Consequence	
5	severe
4	major
3	moderate
2	minor
1	almost none

Score		
Low	<	6
Medium		12
High		18
Very High	>	19

Heritage River Reach 18A

LEGEND		
Likelihood	→ 3	3 ← Consequence
Risk Ranking Score	→ 27	low ← Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

				Altered Hydrology		Lack of Protection		Vegetation Removal		Weed Invasion		Exotic Fauna	
ASSET		Characterised by....											
ENVIRONMENTAL	Substrate	Epifaunal substrate		3	4	3	2	4	1	5	1	4	1
		Pool substrate/sediment deposition		12	medium	6	low	4	low	5	low	4	low
	Geomorphic character	planform/channelisation		3	3	3	2	4	1	5	1	4	1
		profile		9	medium	6	low	4	low	5	low	4	low
	Stream Banks	bank stability		3	2	3	4	4	3	5	2	4	3
		vegetative protection		6	low	12	medium	12	medium	10	medium	12	medium
	Riparian Zone	human access/impact		3	2	3	4	4	5	5	4	4	3
		integrity of native vegetation		6	low	12	medium	20	VERY HIGH	20	VERY HIGH	12	medium
	Water Quality	DO/nutrient levels		3	4	3	1	4	1	5	1	4	1
		salinity levels		12	medium	3	low	4	low	5	low	4	low
	Aquatic Biota	aquatic flora		3	3	3	1	4	2	5	1	4	1
		aquatic fauna		9	medium	3	low	8	medium	5	low	4	low

Likelihood	Trajectory
5 almost certain	worsening rapidly
4 quite possible	worsening
3 unusual but possible	stable
2 remotely possible	improving slowly
1 practically impossible	improving rapidly

Consequence
5 severe
4 major
3 moderate
2 minor
1 almost none

Score		
Low	<	6
Medium		12
High		18
Very High	>	19

Heritage River Reach 19

LEGEND			
Likelihood	→	3	← Consequence
Risk Ranking Score	→	27	low ← Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

				Altered Hydrology		Lack of Protection		Weed Invasion	
ASSET		Characterised by....							
ENVIRONMENTAL	Substrate	Epifaunal substrate		5	4	4	2	5	1
		Pool substrate/sediment deposition		20	VERY HIGH	8	medium	5	low
	Geomorphic character	planform/channelisation		5	3	4	2	5	1
		profile		15	HIGH	8	medium	5	low
	Stream Banks	bank stability		5	4	4	4	5	2
		vegetative protection		20	VERY HIGH	16	HIGH	10	medium
	Riparian Zone	human access/impact		5	5	4	4	5	4
		integrity of native vegetation		25	VERY HIGH	16	HIGH	20	VERY HIGH
	Water Quality	DO/nutrient levels		5	5	4	1	5	1
		salinity levels		25	VERY HIGH	4	low	5	low
	Aquatic Biota	aquatic flora		5	5	4	2	5	1
		aquatic fauna		25	VERY HIGH	8	medium	5	low

Likelihood		Trajectory
5	almost certain	worsening rapidly
4	quite possible	worsening
3	unusual but possible	stable
2	remotely possible	improving slowly
1	practically impossible	improving rapidly

Consequence	
5	severe
4	major
3	moderate
2	minor
1	almost none

Score		
Low	<	6
Medium		12
High		18
Very High	>	19

Heritage River Reach 20

LEGEND			
Likelihood	→	3	3 ← Consequence
Risk Ranking Score	→	27	low ← Risk Rating

		Threatening Processes/Processes preventing improvements or meeting targets							
		Altered Hydrology		Lack of Protection		Weed Invasion			
ASSET		Characterised by....							
ENVIRONMENTAL	Substrate	Epifaunal substrate		5	4	4	3	5	1
		Pool substrate/sediment deposition		20	VERY HIGH	12	medium	5	low
	Geomorphic character	planform/channelisation		5	3	4	2	5	1
		profile		15	HIGH	8	medium	5	low
	Stream Banks	bank stability		5	4	4	4	5	2
		vegetative protection		20	VERY HIGH	16	HIGH	10	medium
	Riparian Zone	human access/impact		5	5	4	4	5	4
		integrity of native vegetation		25	VERY HIGH	16	HIGH	20	VERY HIGH
	Water Quality	DO/nutrient levels		5	5	4	1	5	1
		salinity levels		25	VERY HIGH	4	low	5	low
	Aquatic Biota	aquatic flora		5	5	4	1	5	2
		aquatic fauna		25	VERY HIGH	4	low	10	medium

Likelihood	Trajectory
5 almost certain	worsening rapidly
4 quite possible	worsening
3 unusual but possible	stable
2 remotely possible	improving slowly
1 practically impossible	improving rapidly

Consequence
5 severe
4 major
3 moderate
2 minor
1 almost none

Score		
Low	<	6
Medium		12
High		18
Very High	>	19

Heritage River Reach 21

LEGEND

Likelihood	→	3	3 ←	Consequence
Risk Ranking Score	→	27	low ←	Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

	ASSET	Characterised by....		Altered Hydrology		Lack of Protection		Vegetation Removal		Weed Invasion		Exotic Fauna	
E N V I R O N M E N T A L	Substrate	Epifaunal substrate		5	4	4	4	3	1	5	1	4	4
		Pool substrate/sediment deposition		20	VERY HIGH	16	HIGH	3	low	5	low	16	HIGH
	Geomorphic character	planform/channelisation		5	1	4	2	3	1	5	1	4	1
		profile		5	low	8	medium	3	low	5	low	4	low
	Stream Banks	bank stability		5	2	4	4	3	3	5	2	4	3
		vegetative protection		10	medium	16	HIGH	9	medium	10	medium	12	medium
	Riparian Zone	human access/impact		5	3	4	4	3	4	5	4	4	3
		integrity of native vegetation		15	HIGH	16	HIGH	12	medium	20	VERY HIGH	12	medium
	Water Quality	DO/nutrient levels		5	3	4	1	3	1	5	1	4	1
		salinity levels		15	HIGH	4	low	3	low	5	low	4	low
	Aquatic Biota	aquatic flora		5	3	4	3	3	1	5	1	4	4
		aquatic fauna		15	HIGH	12	medium	3	low	5	low	16	HIGH

Likelihood	Trajectory
5 almost certain	worsening rapidly
4 quite possible	worsening
3 unusual but possible	stable
2 remotely possible	improving slowly
1 practically impossible	improving rapidly

Consequence
5 severe
4 major
3 moderate
2 minor
1 almost none

Score		
Low	<	6
Medium		12
High		18
Very High	>	19

Heritage River Reach 22

LEGEND		
Likelihood	→	3
Risk Ranking Score	→	27
		3 ←
		low ←
		Consequence
		Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

				Altered Hydrology		Lack of Protection		Vegetation Removal		Weed Invasion	
ASSET		Characterised by....									
ENVIRONMENTAL	Substrate	Epifaunal substrate		4	2	4	4	3	1	5	1
		Pool substrate/sediment deposition		8	medium	16	HIGH	3	low	5	low
	Geomorphic character	planform/channelisation		4	2	4	2	3	1	5	1
		profile		8	medium	8	medium	3	low	5	low
	Stream Banks	bank stability		4	2	4	4	3	3	5	2
		vegetative protection		8	medium	16	HIGH	9	medium	10	medium
	Riparian Zone	human access/impact		4	2	4	4	3	5	5	4
		integrity of native vegetation		8	medium	16	HIGH	15	HIGH	20	VERY HIGH
	Water Quality	DO/nutrient levels		4	2	4	1	3	1	5	1
		salinity levels		8	medium	4	low	3	low	5	low
Aquatic Biota	aquatic flora		4	3	4	3	3	2	5	2	
	aquatic fauna		12	medium	12	medium	6	low	10	medium	

Likelihood	Trajectory
5 almost certain	worsening rapidly
4 quite possible	worsening
3 unusual but possible	stable
2 remotely possible	improving slowly
1 practically impossible	improving rapidly

Consequence
5 severe
4 major
3 moderate
2 minor
1 almost none

Score		
Low	<	6
Medium		12
High		18
Very High	>	19

Heritage River Reach 23

LEGEND		
Likelihood	→	3
Risk Ranking Score	→	27
		3 ←
		low ←
		Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

				Altered Hydrology		Lack of Protection		Vegetation Removal		Weed Invasion	
ASSET		Characterised by....									
ENVIRONMENTAL	Substrate	Epifaunal substrate		4	2	4	4	4	1	5	1
		Pool substrate/sediment deposition		8	medium	16	HIGH	4	low	5	low
	Geomorphic character	planform/channelisation		4	2	4	2	4	1	5	1
		profile		8	medium	8	medium	4	low	5	low
	Stream Banks	bank stability		4	3	4	4	4	3	5	2
		vegetative protection		12	medium	16	HIGH	12	medium	10	medium
	Riparian Zone	human access/impact		4	3	4	4	4	5	5	4
		integrity of native vegetation		12	medium	16	HIGH	20	VERY HIGH	20	VERY HIGH
	Water Quality	DO/nutrient levels		4	2	4	1	4	1	5	1
		salinity levels		8	medium	4	low	4	low	5	low
	Aquatic Biota	aquatic flora		4	3	4	3	4	2	5	2
		aquatic fauna		12	medium	12	medium	8	medium	10	medium

Likelihood	Trajectory
5 almost certain	worsening rapidly
4 quite possible	worsening
3 unusual but possible	stable
2 remotely possible	improving slowly
1 practically impossible	improving rapidly

Consequence
5 severe
4 major
3 moderate
2 minor
1 almost none

Score		
Low	<	6
Medium		12
High		18
Very High	>	19

Heritage River Reach 24

LEGEND		
Likelihood	→	3
Risk Ranking Score	→	27
		3 ←
		low ←
		Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

				Altered Hydrology		Weed Invasion		Exotic Fauna	
ASSET		Characterised by....							
ENVIRONMENTAL	Substrate	Epifaunal substrate		4	3	5	1	3	1
		Pool substrate/sediment deposition		12	medium	5	low	3	low
	Geomorphic character	planform/channelisation		4	3	5	1	3	1
		profile		12	medium	5	low	3	low
	Stream Banks	bank stability		4	2	5	2	3	3
		vegetative protection		8	medium	10	medium	9	medium
	Riparian Zone	human access/impact		4	2	5	4	3	3
		integrity of native vegetation		8	medium	20	VERY HIGH	9	medium
	Water Quality	DO/nutrient levels		4	3	5	1	3	1
		salinity levels		12	medium	5	low	3	low
	Aquatic Biota	aquatic flora		4	3	5	2	3	3
		aquatic fauna		12	medium	10	medium	9	medium

Likelihood	Trajectory
5 almost certain	worsening rapidly
4 quite possible	worsening
3 unusual but possible	stable
2 remotely possible	improving slowly
1 practically impossible	improving rapidly

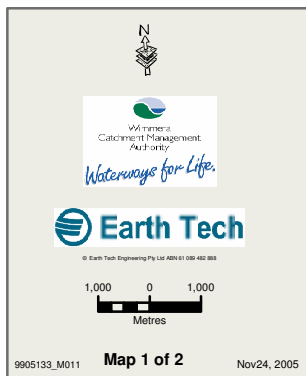
Consequence
5 severe
4 major
3 moderate
2 minor
1 almost none

Score		
Low	<	6
Medium		12
High		18
Very High	>	19

Appendix D

Works Program Maps

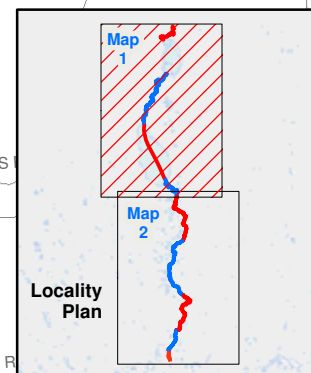
WCMA HERITAGE RIVER WATERWAY ACTION PLAN 2005



LEGEND

- Assesment Sites
- Bridges
- High Priority works
- Medium Priority works
- Low Priority works
- Reaches

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NOTE: This map is to be read in conjunction with Map 2

23/020
Action 23-61 Restrict vehicular access to Dorrington Point

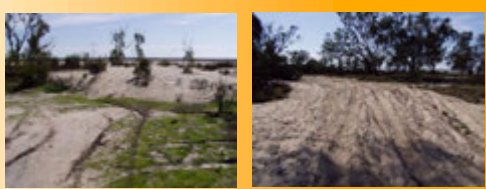
23/Western foreshore
Action 23-60 Monitor and initiate re-vegetation and management project for ecological burn area north and south of Dorrington Point if required. Review use of Perennial Veldt-grass for dune stabilisation in Heritage River Corridor.



22/All Sites
Action 22-57 Stop vegetation removal and firewood collection. Promote alternative firewood sources.



21/All Sites
Action 21-54 Limit vehicular access to lakebed



21/All Sites
Action 21-53 Stop vegetation removal and firewood collection. Promote alternative firewood sources.

21/4 Mile Beach
Action 21-44 Provide good access with clear tracks and parking areas to minimize damage to lake bed and riparian area. Limit access to the lakebed when dry



20/Jeparit Wier
Action 20-47 Undertake more appropriate bank stabilization and revegetation works at/downstream of weir



23/Jordan Valley camp ground
Action 23-62 Restrict access to selected tracks, rehabilitate and re-vegetate surplus tracks.



23/All Sites
Action 23-63 Stop vegetation removal and firewood collection. Promote alternative firewood sources.



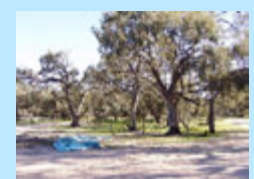
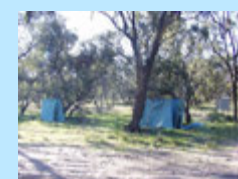
23/All Sites
Action 23-64 Restrict vehicular access onto dunes.



22/All Sites
Action 22-58 Limit 4WD and motorbike access to creek bed



22/Informal Campground
Action 22-56 Remove derelict structures and smooth out trailbike racing track features



20/Between Jeparit Wier and Lake Hindmarsh
Action 20-48 Undertake bank stabilization and revegetation works on eroding banks between weir and Lake Hindmarsh, including around Hindmarsh Ski Clubrooms



20/024
Action 20-46 Limit vehicle access to riparian zone, stabilise existing scoured tracks and encourage re-colonisation from existing stands of native grasses and herbs



20/Whole Reach
Action 20-49 Extensive plantings of salt tolerant species for bank stabilization purposes.

20/023

WCMA HERITAGE RIVER WATERWAY ACTION PLAN 2005

