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Catchment Management
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Waterways for Life.



Burnt Creek Waterway Action Plan

Oct 2005



Burnt Creek

Waterway Action Plan

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Glossary

Term	Definition
aggradation	Deposition of material which raises the level of the stream bed.
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.
confluence	The junction of two streams.
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..
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.
erosion	The group of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the earth's surface.
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.
fluvial-geomorphology	The study of the evolution and configuration of landforms as produced by the action of a river or stream.

Term	Definition
geomorphology	The study of the evolution and configuration of landforms (see also fluvial-geomorphology).
headcut	Vertical, or near vertical drop in channel elevation greater than 300mm
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
left bank	The streambank on a persons left hand side when facing downstream
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).
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.
streampower	The ability of a stream to do work. Calculated as shear stress times flow velocity.
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.

Term	Definition
valley fill	Sediment accumulated within the floor of a valley.

Abbreviations

ASL	Above Sea Level
DPI	Department of Primary Industries
DSE	Department of Sustainability & Environment
EVC	Ecological Vegetation Class
GWM Water	Grampians Wimmera Mallee Water
ISC	Index of Stream Condition
LWD	Large Woody Debris
NRM	Natural Resource Management
RHA	Rapid Habitat Assessment
USEPA	United States Environmental Protection Agency
WAP	Waterway Action Plan
Wimmera CMA	Wimmera Catchment Management Authority

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1 Introduction

In November 2004 the Wimmera Catchment Management Authority (Wimmera CMA) completed the development of a Waterway Action Plan (WAP) for the Mackenzie River. The WAP was developed as a result of the findings of the report 'A Geomorphic Categorisation and Stream Condition Assessment of the Wimmera River Catchment' (Earth Tech 2003), in which the Mackenzie River was identified as a rare stream type in south eastern Australia. Field investigations for the Mackenzie River WAP revealed a diverse vegetation community in the riparian zone. Official confirmation has since been received that a new species of Callistemon (*Callistemon wimmerencis*) was also found, although its future and the future of the Mackenzie River riparian zone in many locations, is threatened by a lack of flow in the river.

As an example of an anastomosing stream type the Mackenzie River is made up of a number of anabranches and tributaries. One of these distributaries, known as Burnt Creek was not included in the original Waterway Action Plan for the Mackenzie River. In order to develop a comprehensive works plan for the entire Mackenzie River catchment the Wimmera CMA has developed the Burnt Creek Waterway Action Plan as an addition to the Mackenzie River WAP. The aim of the Burnt Creek WAP is to determine the contemporary stream channel and riparian geomorphic, ecological and social condition. This information will be 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 Burnt Creek developed. As such, the Waterway Action Plan includes:

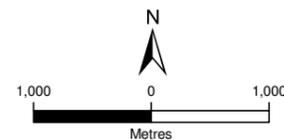
1. The development of objectives for Burnt Creek in accordance with state and regional priorities for management;
2. An assessment of the current geomorphic and ecological conditions of Burnt Creek;
3. An assessment of values and threats to the creek, as perceived by the stakeholders (GWM Water, DPI, DSE and the Horsham Rural City Council) and the Burnt Creek catchment community;
4. An assessment of threats to waterway health within the Burnt Creek catchment, and;
5. A determination of waterway health targets for Burnt Creek, incorporating a detailed action plan to achieve these targets.

Burnt Creek Catchment Location

Burnt Creek is a right bank distributary of the Mackenzie River that branches from the Mackenzie River at Distribution Heads near the town of Laharum. At a point approximately 1km south of the Northeast-Wonwondah Road a minor left bank distributary of Burnt Creek known as Bungalally Creek branches from Burnt Creek to rejoin the Mackenzie river. As the reach of Burnt Creek upstream of the confluence of Burnt and Bungalally Creeks was covered in the Mackenzie River WAP, the focus of this report is on the reach of Burnt Creek between the confluence of Bungalally Creek and the Wimmera River (Figure 1). For the purpose of this report this reach is referred to as Burnt Creek.

Located to the southeast of Horsham, Burnt Creek has a stream length of 30.4 kilometers and drains a catchment of approximately 10,400 hectares.

Location of BURNT CREEK



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Legend

- Burnt Creek Catchment
- Burnt Creek
- Wimmera Catchment - CMA Boundaries
- Waterways
- Minor Waterways

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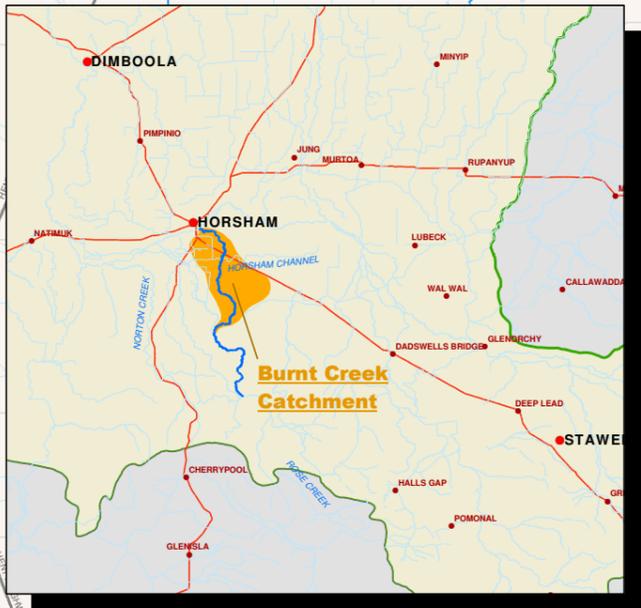
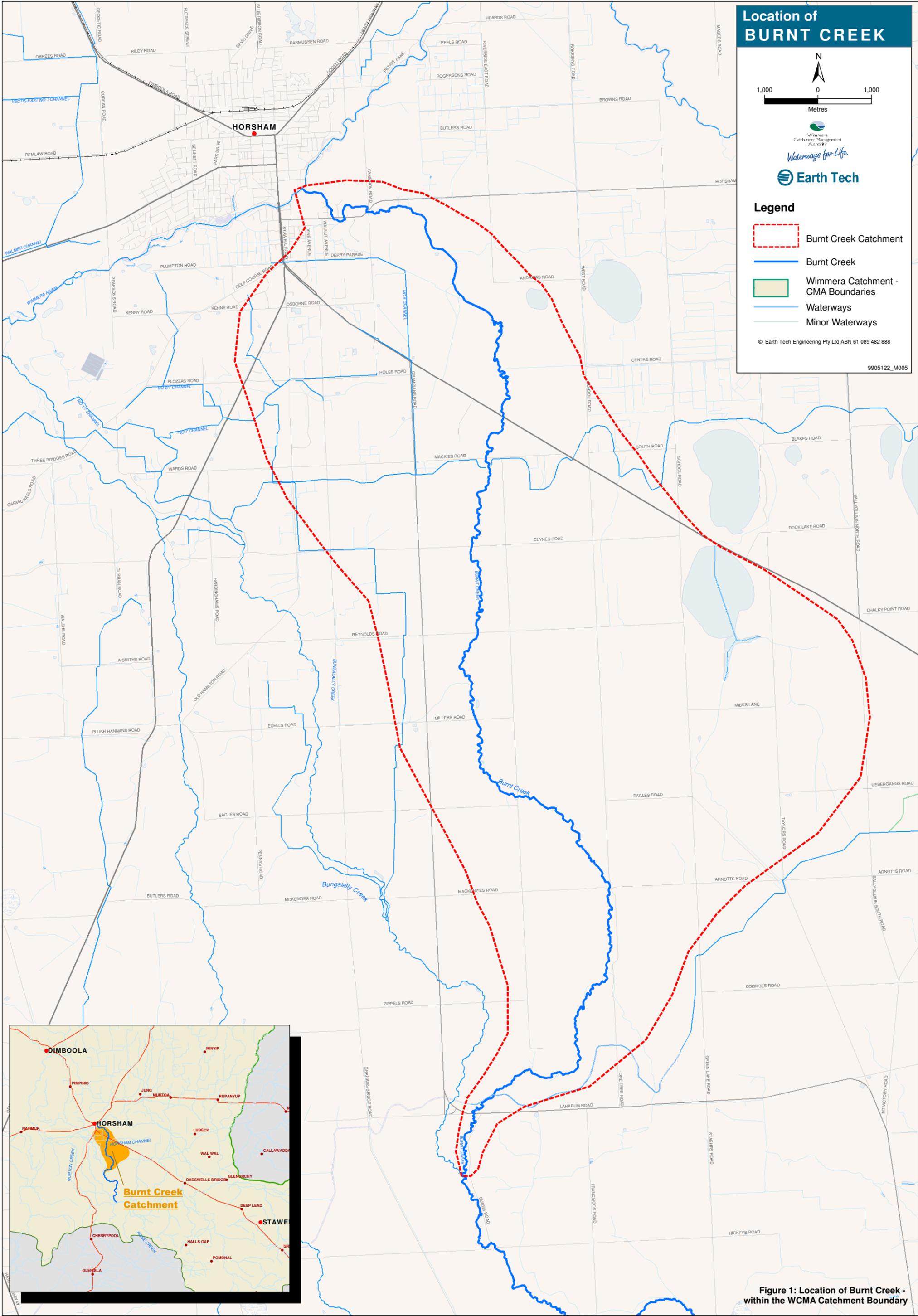


Figure 1: Location of Burnt Creek - within the WCMCA Catchment Boundary

2 Methods

Three steps were taken to determine the current geomorphic condition, habitat quality and community perceptions of Burnt Creek. These were:

1. a desktop review of State government, Wimmera CMA and other relevant literature;
2. a Stakeholder and Community consultation program to determine the economic, social and environmental values & issues associated with Burnt Creek; and
3. field assessments to investigate the geomorphic condition and habitat quality of Burnt Creek with careful consideration given to the processes which may be threatening the current condition and quality of the creek .

This information was then combined to assess the risks to the physical and social values of Burnt Creek, enabling goals to be set for future stream health and amenity.

2.1 Desktop Review

A desktop 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 Stakeholder and Community Consultation

Letters were sent to representatives of government bodies and authorities that play a role in the management of Burnt Creek and surrounding land, inviting them to a stakeholder meeting. Follow up meetings were arranged with DPI and Horsham Rural City Council representatives as they were unable to attend the 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 Burnt Creek is best conducted at a reach scale, Burnt Creek was divided into five reaches of similar physical character. The delineation of reaches was based on a combination of changes in planform, landuse, hydrology and vegetation density (Table 1). The location and extent of each reach is shown on Figure 2.

A minimum of two sites within each reach was assessed by a specialist team, including a geomorphologist, waterway engineer and vegetation specialist. The inspections were conducted in the presence of Wimmera CMA waterways staff and follow up consultation with willing landholders was undertaken. This approach permitted a continuous exchange

of information by which all parties cooperated, learned from and contributed to the Waterway Action Plan.

Table 1. Reach delineation of Burnt Creek

Reaches	Location
Reach 1	Gauging station #415223 to the confluence with the main right-bank tributary near One Tree Road
Reach 2	Confluence with the main right-bank tributary to half-way between Clynes Rd and Reynolds Rd (just downstream of Dingly Dell)
Reach 3	Halfway between Clynes Rd and Reynolds Rd to the most downstream crossing of Riverside East Rd (where Burnt Creek becomes channelised)
Reach 4	The most downstream crossing of Riverside East Rd to Cameron Rd
Reach 5	Cameron Rd to the confluence with the Wimmera River

Information collected during the field inspections included:

- past and present geomorphic condition;
- contemporary vegetation condition and extent;
- habitat quality, and;
- requirements for fencing, revegetation and engineering works.

Contemporary Vegetation Condition 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.

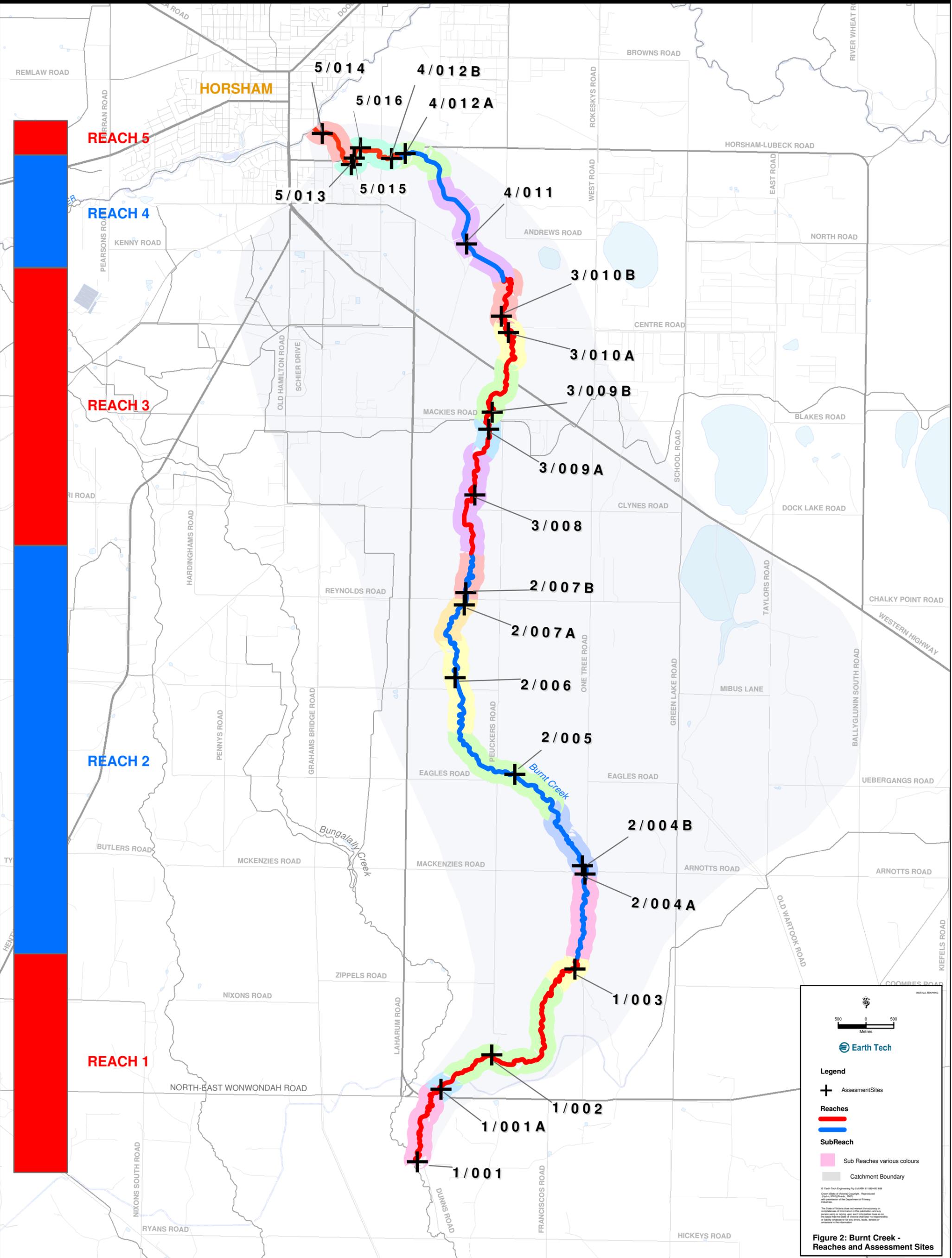
Symbol	Conservation Status	Brief Definition
X	Presumed Extinct	Probably no longer present in the bioregion (or, if present, below the resolution of available mapping)
E	Endangered	<10% of pre-European extent remains (or a combination of depletion, loss of quality, current threats and rarity that gives 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% or 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 Burnt Creek catchment. Species lists are provided in Appendix A.

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Reaches and SubReaches



Habitat quality

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 3.2).

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).

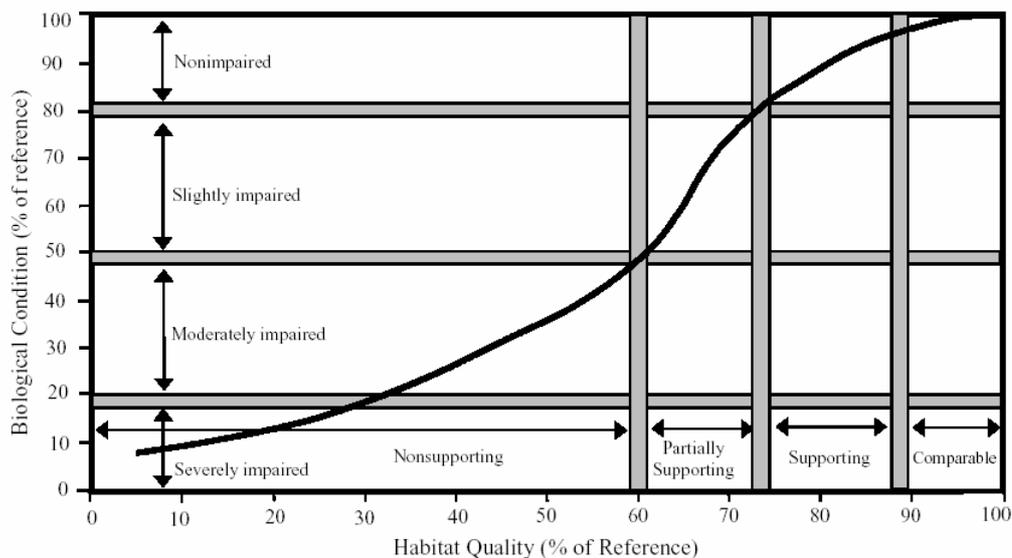


Figure 3. The relationship between habitat and biological condition. From Parsons et al (2000).

Habitat quality assessments vary throughout the Burnt Creek catchment and as such the results are provided on a reach by reach basis in the Sub-Reach section of this report. 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 five identified management reaches were assessed during the field program. Each site score was then weighted by the length of the creek 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

At each site, the quality of the habitat can be seen as worsening, stable or improving as a result of the current land management practices 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.

2.4 Risk assessment and 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 Burnt Creek. 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 Burnt Creek 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 4.3

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)

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:

$$RRS = Asset\ value \times Likelihood \times Consequence$$

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.

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. Wimmera Waterway Management Strategy (WCMA, 2002)
4. Wimmera River Geomorphic Investigation (ID&A, 2001)
5. Wimmera Geomorphic Categorisation and Stream Condition Assessment (Earth Tech, 2003)
6. Water Quality Strategy (WCMA, 2002b)
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.

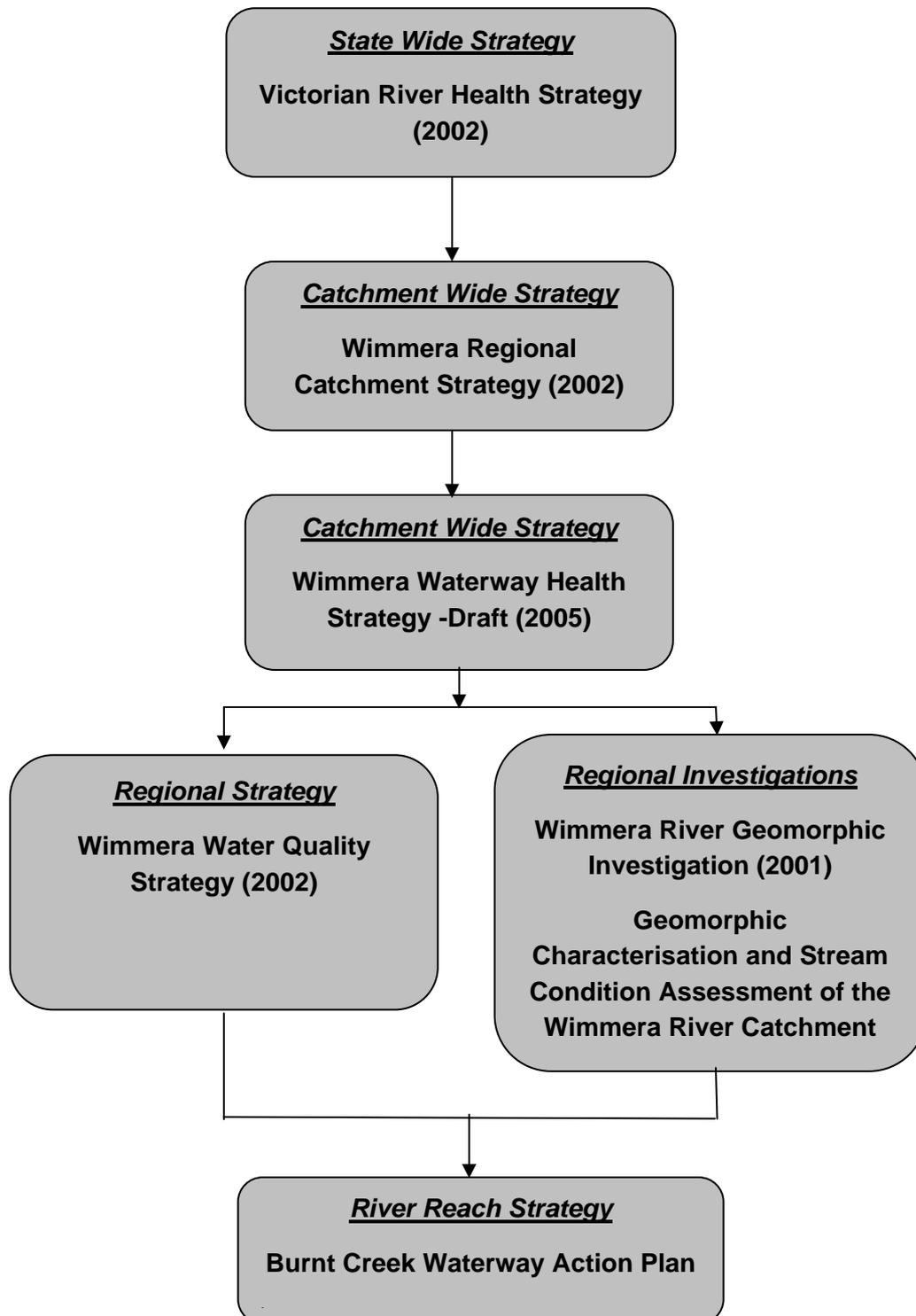


Figure 4. The framework reporting relationship for achieving waterway management goals for Burnt Creek.

3.2 State Wide Strategies

The 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 geomorphological 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

The 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
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 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.

Part 2 of the Wimmera WHS details waterway health programs derived from a series of issues papers that collate the existing body of knowledge relevant to waterway health.

Part 3 of the Wimmera WHS includes specific actions identified for each high value waterway reach. The actions and corresponding priorities for Burnt Creek are listed in Table 8.

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

Burnt Creek is identified with the MacKenzie River as Waterway Management Unit 8 within the Wimmera WHS. The flow regime for Burnt Creek is described as being significantly impacted through supplementation as a result of regulation. The Wimmera WHS notes 'Although no significant stability concerns are evident in these waterways, there is potential for improvement in their ecological values' (WCMA 2005).

Table 8: Actions and priorities identified within the WCMA Wimmera Waterway Health Strategy for Burnt Creek

Action	Priority
Implement MacKenzie River Waterway Action Plan (2004)	High
Implement recommended environmental flows	Medium
Increase community understanding of waterway health	High
Investigate and where necessary address physical constraints to delivery of environmental flows	Medium
Investigate options for restoring fish passage and where necessary address	Low
Investigate septic tank and greywater leakage	Low
Riparian fencing and revegetation	High

Unrestricted stock access is identified within the Wimmera WHS as one of the major threats to the health of Burnt Creek.

The 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, 2002b).

The Wimmera Water Quality Strategy is to be implemented through the series of programs targeted toward the catchments and subcatchments within the Wimmera CMA region. These catchments have been defined in terms of Nutrient Management Units, of which Burnt Creek is included in Nutrient Management Unit 7. Table 9 details programs that are relevant to Nutrient Management Unit 7 and therefore Burnt Creek.

Table 9. Programs from the Wimmera Water Quality Strategy that are relevant to nutrient management in Burnt Creek (WCMA, 2002b).

Program	Objective	Objective Achieved Through
1. Coordination, communication, education & awareness	To increase stakeholder and community awareness of and commitment to addressing water quality issues in the Wimmera CMA Region.	- Implementation of the Wimmera Water Quality Strategy and Communication Plan - Delivering communication, education and awareness activities.
2. Urban Waters	To minimise the impact of urban waters on surface, groundwater and wetlands.	- Training and Education - Planning - Works - Investigations
4. Minimising the impact of Agriculture & Forestry	To minimise the impact of agricultural and forestry practices on surface, groundwater and wetlands.	- Education and awareness; - Development of appropriate management practices; - Planning; and - Incentives.
6. Planning	To ensure that water quality is considered in the planning processes at all levels.	- Ensuring water quality issues are considered in statutory planning processes

Of particular importance to the management of Burnt Creek 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, 2002b).

The Wimmera Weed Action Plan

Like riparian vegetation along the majority of river reaches within the Wimmera CMA boundary, the Burnt Creek 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 10 provides a brief description of weed categories and a list of the weeds associated with them, from the existing WWAP.

Table 10. Weed categories and species list (DNRE, 2000)

Weed Categorisation	Species
<p>NEW & EMERGING WEEDS</p> <p>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</p>	<p>African Daisy African Weed Orchid Chilean Needle Grass Long-styled Feather-Grass Prairie Ground Cherry Serrated Tussock</p>
<p>PRIORITY WEEDS</p> <p>Weeds causing economic and environmental impact. Currently well established, but restricted in the Wimmera, but pose a significant threat if allowed to spread</p>	<p>Bridal Creeper (Smilax) Hardheads Paterson's Curse Siver-leaf Nightshade St John's Wort</p>
<p>CONTROLLED WEEDS</p> <p>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.</p>	<p>Blackberry Boneseed Cape Broom Cape Tulip (one and two leaf) Furze (Gorse) Horehound Spiny Burr Grass Wild Garlic</p>

Vegetation assessments conducted at numerous sites along Burnt Creek have identified a significant number of weed species.

3.4 Catchment Wide Investigations

The Wimmera River Geomorphic Investigation

The Wimmera River Geomorphic Investigation (WRGI) comprised a review and analysis of sediment processes within the Wimmera catchment. 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.

Although the WRGI does not refer directly to Burnt Creek, it does note the geomorphic condition of the Mackenzie River, of which Burnt Creek is a distributary. Of relevance to the Burnt Creek Waterway Action Plan is the note in the WRGI that, "As the Mackenzie River approaches the Wimmera River it cuts through almost perpendicular to the east-west sand dune ridges of the Lowan Formation, intercepting easily mobilized sands. These sand appear to be stored within the dense, intact riparian vegetation corridor that covers the lower Mackenzie channel belt. Within the channel belt the creek takes the form of multiple discontinuous channels" (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 Mackenzie River was identified as a rare stream type, and as such, requires responsible and effective management that considers (Earth Tech, 2003):

- restoring flows that mimic natural flow regimes;
- a detailed assessment to identify any specific risks due to sediment input and/or channel incision; and
- a monitoring system should be developed to assess changes in the waterway condition and identify risks within the system.

These points are also relevant to Burnt Creek.

The WRGCSCA report also makes the following specific comments with regard to Burnt Creek:

- Burnt Creek is an alluvial continuous stream type with 20% to 80% overstorey vegetation cover. The creek is also hydrologically affected due to a lack of flow from water diversions (Earth Tech, 2003).
- Burnt Creek from the Toolondo Channel to the Wimmera River was used to distribute water during summer dam filling operations (Earth Tech, 2003). Note that further investigations have revealed that this was the case up until 2003 when water restrictions resulted in a cessation of these transfer flows (B.Dyer, GWMWater, pers. comm., 2005).
- Burnt Creek was identified as having a low sinuosity channel with a few very minor scours. Possible flood channels exist on the floodplain, however they have a very straight alignment and may therefore be anthropogenic (Earth Tech, 2003).

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. Burnt Creek immediately below the Toolondo channel was assessed as Site 5 within this study and the following key points are identified from the report:

- Burnt Creek is naturally ephemeral, displaying long periods of cease to flow during summer months interspersed with large short duration high flows.
- Current flow management regimes have extended these cease-to-flow periods for much of the year and as such, the creek is unable to support an aquatic community.

Key flow recommendations for this section of Burnt Creek were:

- Cease to flow periods last a maximum of 4 months
- A summer fresh of > 45 ML/day be provided for 1 day at least every 2 years to distribute organic matter and move accumulated material
- A minimum flow of 1 ML/day be provided during the months of May- December to maintain aquatic habitats
- A minimum of two winter freshes of >2 ML/day for 5 days be provided to freshen pool habitat, wet in-channel features and provide biological cues for native aquatic fauna.
- Three larger channel full flows of > 45 ML/day be provided to move sediments and distribute organic matter.

Constraints to Environmental Flows

In February 2005 the Wimmera Catchment Management Authority commissioned a report to investigate the physical constraints to environmental flows (e-flows) (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 e-flow releases, however alterations to some of the structures used to regulate flow would also be required to improve their ability to pass e-flows (Earth Tech 2005).

Priority river reaches where there are existing, or planned future e-flow entitlements or allocations were also identified. Burnt Creek downstream of the Toolondo channel regulator is included in this list of streams recommended to receive regular e-flows (Earth Tech 2005). Modifications to this structure are required to provide the level of fine control for the release of flows of 1 to 2 ML/day, which is not feasible with the current vertical lift gate arrangement (Earth Tech 2005).

The Physical Constraints to Environmental Flows report (Earth Tech 2005) did not identify issues such as landholder constructed dams and flow diversions, however these are discussed as part of the field assessment for individual Burnt Creek reaches (Section 6).

Habitat & Biodiversity Restoration Plan for Burnt Creek

Leonard (2004) produced a report detailing the issues affecting the downstream reach of Burnt Creek between the Lubeck/Cameron's Road intersection, and low lying swampy ground approximately 2km upstream of the intersection. In a review of the history of this area Leonard (2004) notes that prior to European settlement the vegetation probably consisted of a savannah woodland that was lightly treed with an understorey of native grasses and shrubs. As a result of clearing and current land management practices the existing vegetation community in this reach contains no native trees or shrubs (Leonard, 2004).

In Leonard's (2004) study reach, the soils are dominated by self mulching grey cracking clays, and as such exhibit few signs of bed and bank instability. In some areas however, the impact of rabbits and stock access to the creek has resulted in localized erosion (Leonard, 2004), a fact confirmed during the field investigations undertaken for the Burnt Creek Waterway Action Plan. Dumping of rubbish in the creek bed also poses a problem for water quality although this reach of Burnt Creek has not experienced a significant flow for more than 10 years (Leonard, 2004). Leonard (2004) also notes that a lack of flow is the most significant factor affecting Burnt Creek.

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 Mackenzie River and Burnt Creek systems at the Catchment Wide Strategy and Investigations level. As such, Table 11 summarises the findings of these lower level reports, thereby providing a focus for the field investigations and content of the Burnt Creek Waterway Action Plan.

Table 11. Summary of priorities and actions from existing studies that include Burnt Creek.

Report Name	Priorities
Wimmera Water Quality Strategy	<p><u>Rural reaches of Burnt Creek</u> Minimise impacts of agriculture by:</p> <ul style="list-style-type: none"> - Education and awareness; - Development of appropriate management practices; - Planning; and - Incentives <p><u>Urban Reaches of Burnt Creek</u> 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	- Restore aspects of the natural flow regime including maximum summer cease-to-flow periods, minimum winter flows and both summer and winter freshes
Physical Constraints to Environmental Flows	- Modify the Toolondo Channel – Burnt Creek regulator to allow the passing of 1-2 ML/day Winter minimum flows
Habitat & Biodiversity Restoration Plan for Burnt Creek	<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

4 Stakeholder & Community Issues

For the purpose of the Burnt Creek Waterway Action Plan, Stakeholders are considered to be organisations and authorities that play a role in the management of Burnt Creek. 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 Burnt Creek.

4.1 Stakeholder Issues

Grampians Wimmera Mallee Water

To gain the input of Stakeholders in the management of Burnt Creek a meeting was held on the 19th of May 2005 at the Horsham Angling Club rooms. Representatives of Grampians Wimmera Mallee Water attended and provided the following input:

- Flows of less than 600ML/day are diverted from Burnt Creek through the Burnt Creek Channel (Reach 1) for distribution to the Wimmera Mallee Stock and Domestic supply system;
- Constraints to flow exist at:
 - The bridge crossing Burnt Creek on Mackenzie Road. This bridge causes a backwater and overtops at flows of greater than 10ML/day;
 - A number of other road crossings along the length of Burnt Creek.
- Landholder crossings of Burnt Creek on private property may be affected by any proposed environmental flow regime;
- Traditionally flows have been released into Burnt Creek during the Summer months. This is contrary to the natural high flow during Winter regime. When water becomes available for the provision of environmental flows it may be possible to provide a Summer base flow with an increase in Winter flow coming from the use of the Burnt Creek channel for stock and domestic water transfers;
- In Reach 1 a short length of the Burnt Creek channel is kept full during Summer to provide firefighting water. This results in water backing up into the upstream end of Reach 1, creating a wetland. Site inspections have revealed that this inundation is leading to the death of many large trees;
- The date of release of the first environmental flow is unknown as this is a function of water availability. Although Burnt Creek is a priority for receipt of an environmental flow current drought conditions mean that water for the Stock and Domestic system has a higher priority.

Horsham Rural City Council

Horsham Rural City Council (HRCC) did not send a representative to the stakeholder meeting on the 19th May. Follow up consultation with the technical services department indicated the Burnt Creek is of considerable importance to the council, councilors and community of Horsham and some input to the planning process is required from HRCC. It was agreed that the draft report would be circulated to council following an initial review

by the Wimmera Catchment Management Authority and input would be received during the review period.

A presentation outlining the findings of the study was made to the Mayor, interested councilors and members of the Technical Services Department on the 4th of August. A written submission was received and the following points were made at the meeting and reiterated in a submission to the Wimmera CMA:

- There was a need to undertake additional site assessments along the section of Burnt Creek which runs north of Williams Rd between Cameron Rd and Williams Rd.
- Additional information regarding the nature of the work recommended at the road crossings is required.
- There was a need to more effectively communicate the environmental flows that might be passed along Burnt Creek and the needs associated with these.
- Clearer recommendations were required regarding the land management practices needed to be adopted on Council owned land (such as the Burnt Creek Industrial Estate).

Following the recommendations of the council an additional field visit was arranged with Councillors Gross and Dellar to:

1. Visit the northern end of the Burnt Creek catchment;
2. Identify the nature of flooding that occurs across the north of the Burnt Creek catchment; and
3. Identify additional sites for assessment.

Department of Primary Industries

The Department of Primary Industries (DPI) did not send a representative to the stakeholder meeting on the 19th May. Follow up consultation with the department on the 31st May indicated a number of pest plant and animal issues, as detailed below:

- Foxes occur along the full length of Burnt Creek;
- Rabbits occur in scattered patches along the length of Burnt Creek. Calicivirus has caused the low population densities, however resistance to the disease could lead to increased numbers. Very little is done in terms of landholder control programs due to the nature of the creek and soils. Thick vegetation and fallen timber offer habitat;
- Kangaroos and corellas were also perceived as pest animals;
- Bathurst Burr was noted to occur near the old saleyards site;
- Pattersons Curse has the potential to threaten Burnt Creek, is a high priority weed in the Wimmera and is listed as a Weed of National Significance. It was noted as occurring adjacent to Coombes Road;
- Bridal Creeper occurs along Burnt Creek, and is also a Weed of National Significance;

It was agreed that the draft report would be circulated to DPI following an initial review by the Wimmera Catchment Management Authority and input would be received during the review period.

4.2 Community Issues

To gain the input of Stakeholders in the management of Burnt Creek a meeting was held on the 19th of May 2005 at the Horsham Fishing Club rooms. This meeting was attended by 24 interested community members who readily provided historical and contemporary information regarding issues, concerns and aspirations regarding the management of Burnt Creek. 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 12 provides a summary of community values, aspirations and comments expressed at the meeting.

Table 12. A summary of community values and comments expressed at the community meeting.

Community Values	Comments
Economy	- The general consensus is that the areas along Burnt Creek were much more economically viable when the natural flow regime occurred. The area supported a greater human population before flow was diverted away from Burnt Creek.
Environment	- Platypus were a regular feature of Burnt Creek waterholes. They are no longer found in the majority of the length of Burnt Creek. - Abundant bird and aquatic life existed prior to flow diversion. The community feels that this is a very important aspect of the Burnt Creek environment. - All effort should be made to return flows to Burnt Creek as soon as possible.
Amenity	- Prior to flow diversion swimming was a popular past time in the waterholes of Burnt Creek. - Local community members claim that Burnt Creek used to provide the 'best' Blackfish fishing in the state. - Both swimming and fishing are activities that should be returned to Burnt Creek. - The walking track along the urbanized reach of Burnt Creek is a valued community asset.
History	- Burnt Creek is an area of great historical significance to the community. - The site of the Burnt Creek State School at Dingley Dell is a significant historical area and requires preservation and acknowledgement of its significance. - South Brighton, Rosebrook and Wonwondah Stations relied solely on Burnt Creek for their water supply.

Historically the Burnt Creek State School was an important institution in the lives of the Burnt Creek community. In their book, *We Rang the Bell at Dingley Dell – The story of Burnt Creek State School 1349, 1872-1948*, Matuschka, Eagle and Miller (1999) have assembled the thoughts and views of the amenity and environment of Burnt Creek. The following extracts and photo (Figure 5) provide clues as to the condition of Burnt Creek prior to the diversion of flows for the Stock and Domestic Water Supply, and the lament of former students at its current condition (Matuschka, Eagle & Miller, 1999):

“During my school days the Burnt Creek was a lovely clear running stream with plenty of blackfish, redfin and some trout. We used to love fishing and often had fish for breakfast. It was a great water supply for drinking and for the garden, also very popular for swimming in the summertime”

“In later years when the Wimmera-Mallee water channel system was formed, the water in the creek was diverted into the water storages. Taylors and Pine Lakes mostly and Burnt Creek became a sorry sight especially in the summertime, but it would still flood during a wet winter”

“The flora and fauna of those days have just about disappeared entirely. Walking to school in the mornings in winter and spring in particular, the amount of nature that was observed. The crabholes were all full of tadpoles and other creatures with a shell back, that are not even seen now. Wild flowers, buttercups, snowdrops, billy-buttons, daisies, harbingers of spring, all seem to have vanished...”

“How often do you hear a frog chorus at night now. Even the bird population has disappeared to a large extent, swallows and bottle-neck swallows....blue martins, curlews, plovers, kingfishers....kookaburras, wrens, finches, red robins..”

“Now it makes me sad to see it dry in the summertime knowing what a lovely stream it used to be and the pleasure it gave so many people”

“A lot of Horsham people would be out there fishing and picnicking at weekends, but now that is apparently all history”. A Miller.



Figure 5. Swimming in a waterhole on Burnt Creek at Dingley Dell prior to flow diversion (Matuschka, Eagle & Miller, 1999).

In line with the views expressed in 'We Rang the Bell at Dingley Dell' (Matuschka, Eagle & Miller, 1999), community members expressed similar concerns about the effect of the lack of flow in Burnt Creek. This and other issues raised at the community meeting are summarized in Table 13. A summary of community issues and comments expressed at the community meeting.

Table 13. A summary of community issues and comments expressed at the community meeting.

Issue	Comments
Lack of Flow	<ul style="list-style-type: none"> - Burnt Creek traditionally flowed for eight to twelve months of the year - When Burnt Creek does flow following rain there is a dramatic increase in birdlife, yabbies and vegetation growth - Existing riparian vegetation is dying and thinning due to a lack of water - Many large Redgums in the creek are starting to die from lack of water - Water could be maintained and controlled for longer if a weir was to be constructed at the downstream end of Burnt Creek - Stagnant water in the period following flow is perceived to be a problem for wildlife and people
Landholder crossings on Burnt Creek	<ul style="list-style-type: none"> - Community would prefer to see flows returned to Burnt Creek and deal with the issue of crossings if it arises
Rubbish Dumping	<ul style="list-style-type: none"> - The dumping of farm and domestic rubbish into the waterway is a problem in some areas, particularly near public roads crossing the waterway - Rubbish dumping has become a problem since the closure of local landfills
Motorbike Access	<ul style="list-style-type: none"> - Not a major issue due to limited public access to the majority of the riparian zone
Pumping from Waterholes	<ul style="list-style-type: none"> - Pumping from waterholes needs to be restricted during the period following a flow
Stock Access	<ul style="list-style-type: none"> - Stock access is a major problem in some reaches of the creek and should be restricted
Sediment	<ul style="list-style-type: none"> - Sediment is an issue in some reaches of the creek. The build up of sediment and debris is perceived to affect the extent of flows when they occur
Salinity	<ul style="list-style-type: none"> - Salinity due to backflow of saline water from the Wimmera River is considered to be a problem in the lower reaches of Burnt Creek

The feeling of the community is that the diversion of flows has resulted in a dramatic decline in the condition and amenity of Burnt Creek. A return to the natural flow regime is considered to be of the highest priority. Environmental flow requirements for Burnt Creek are covered in the report 'Wimmera Bulk Entitlement Conversion – Environmental Flow Study', (SKM 2003). This Waterway Action Plan addresses the range of issues including vegetation and on-ground works. The views expressed by stakeholders and the community have also provided areas of focus for the field work stage of the project.

4.3 Waterway Action Plan Objectives for Burnt Creek/Overall Waterway Management Targets

Combining the relevant objectives of the Wimmera Waterway Management Strategy with the concerns and aspirations of stakeholders and the community has enabled the setting of key waterway health targets for Burnt Creek (Table 14).

Table 14. Key Waterway Health Targets for Burnt Creek.

<p>Target</p> <ol style="list-style-type: none">1. Preserve, maintain and /or rehabilitate the environmental, economic and social values of Burnt Creek.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 Burnt Creek.
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These targets have been used in Section 6 of the report to define the actions necessary to maintain or improve the health of each reach of Burnt Creek.

5 Burnt Creek Catchment

5.1 Catchment description

Burnt Creek is a right bank tributary of the anastomosing MacKenzie River system that originates in the northern Grampians in western Victoria. It branches from the MacKenzie River at Distribution Heads near the town of Laharum and flows north, joining the Wimmera River immediately upstream of Horsham. As outlined in the Introduction, the focus of this report is the reach of Burnt Creek from its confluence with Bungalally Creek to the Wimmera River. In forming part of the MacKenzie River system, much of the contextual catchment description provided for the MacKenzie River Waterway Action Plan (Earth Tech, 2005) remains relevant to this reach of Burnt Creek. To ensure the self-contained nature of this report, much of the following catchment description is common to both the current Waterway action Plan and the MacKenzie River Waterway Action Plan (Earth Tech, 2005) although it has been modified so that key details relevant to the reach of Burnt Creek studied in this report have been highlighted. The reader is reminded that while Burnt Creek flows from Distribution Heads to the Wimmera River, for the purposes of this report, Burnt Creek refers ONLY to the study reach, unless otherwise stated.

Burnt Creek drains a narrow catchment of approximately 10,400 hectares of low relief grazing and cropping country to the south of Horsham. Almost half of the Creek is privately owned (from Clynes Rd to the Wimmera River) and Crown Frontage exists on both sides of the southern half of the creek.

Geology

The headwaters of the MacKenzie River are found in the steep area in the north of the Grampians Range. This is an area which is underlain by rocks which are dominated by the Grampians Group of resistant quartz-rich sandstones and red siltstones (Earth Tech 2003). These rocks derive from sediment deposited on the sea floor around 420 million years ago and are highly resistant to weathering, and thus produce little sediment. As it passes from the steep slopes of the Grampians Range to lower gradient slopes, the MacKenzie River flows through an area underlain by granodiorite which has weathered to produce a region of moderate slopes and sandy soils. Approximately 2km upstream of Distribution Heads, the geology changes to the much younger sediments of the Shepparton Formation (Figure 6). These are relatively erosion resistant silts and sands which were deposited in the past 2 million years and are overlain by the flat plains of the middle Wimmera.

The MacKenzie River flows through a band of sediments less than one kilometre wide, which it has deposited over the last few thousand years. In places deposits of the Parilla Sand form low hills on either side of the channel restricts the channel to a zone less than 300m wide.

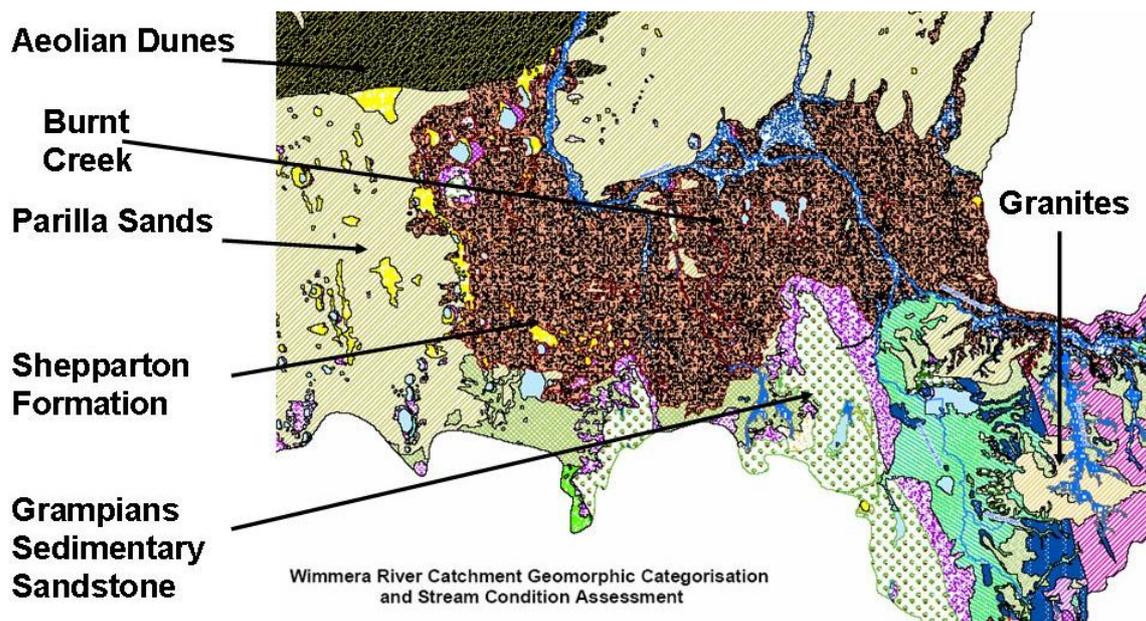


Figure 6. The extent of the Shepparton Formation with respect to Burnt Creek (Earth Tech 2003)

Burnt Creek distributes from the MacKenzie river flowing across the Shepparton Formation toward the Wimmera River. The Creek travels through a narrow band of recently deposited sediments which are dominated by clays and sands. Unlike the main stem of the MacKenzie River, Burnt Creek is not flanked by deposits of the Parilla sand, yet the channel is still restricted to a zone which is typically less than 200 m wide.

Hydrology

Under natural hydrological conditions, Burnt Creek would have received water from the MacKenzie River system as well as runoff from its own catchment on the lower western slopes of the Grampians. The majority of the flow would have occurred between June and October – coinciding with the high rainfall months. During summer, long periods of cease to flow would have been observed.

During periods of flood, water in Burnt Creek is derived from the MacKenzie system, the lower western slopes of the Grampians, overflow from Taylors, Pine, Green and Dock Lakes as well as flows which leave the Wimmera River north of Taylors Lake and Drung. The complexity of sources and the volumes of water involved in large floods are unlikely to have changed significantly from natural conditions. The key changes to flows in Burnt Creek have been to low and moderate flows with most of these flows replaced with cease-to-flow periods (SKM, 2003).

The contemporary MacKenzie River is a key component of the water supply and distribution network for Horsham and surrounding districts and Burnt Creek is used as part of this network. Water is released from Lake Wartook and flows along the Mackenzie River to 'Dad and Dave' weir where a significant portion of the flow is diverted for Horsham's urban water supply. Water in the MacKenzie River continues downstream to Distribution Heads where the majority is diverted via Burnt Creek and the Toolondo channel to Taylors Lake for GWMWater Stock and Domestic system. This diversion occurs annually between April and November, and in dry years may continue through to January. There is generally no flow in Burnt Creek downstream of the Toolondo Channel

(the study reach) except in wet conditions, although a limited flow has been released into Burnt Creek to fill dams adjacent the creek during February and March prior to 2003. As a result of the drought conditions, these limited flows have not been released over the past 3 years.

The use of the MacKenzie River system for water supply purposes has resulted Burnt Creek experiencing two vastly different flow regimes in which the reach from the Bungalally confluence to the Toolondo Channel experiences moderate to high flow conditions for extended periods of time, while the lower reaches receive little or no flow at any time.

Geomorphology

Despite significant hydrologic changes there has been little geomorphic change to Burnt Creek from the confluence with Bungalally Creek to just past the Western Highway since European settlement. A reduction in flow would normally be expected to result in channel infilling because there is insufficient flow to maintain scour pools. However, limited sediment input from the catchment headwaters has prevented substantial infilling.

The lower reaches of Burnt Creek have been extensively modified since European settlement. From approximately 1 km downstream of the Western Highway Burnt Creek would have naturally flowed out across a wide swampy area, possibly through a series of distributary channels. It is likely that the creek would not have reached the Wimmera River except under high flow conditions and there are paleochannels which indicate that the Burnt Creek / Wimmera River confluence has migrated over a 2-3 km zone. With the agricultural and urban development the swampy area has been drained and Burnt Creek channelled to a single path.

Vegetation

Flowing through a highly fertile alluvial plain, the remnant flora along Burnt Creek is the product of over 100 years of grazing and agriculture. It is generally in a more degraded and less diverse state at its confluence with the Wimmera River than it is at its divergence from the Mackenzie River. However there are several rich nodes of diversity along its course, particularly around the swampland where Burnt Ck crosses the Wonwondah East Road and the Slender Cypress-pine forest at Mackeys Road crossing.

The original native vegetation would have been riparian and open woodland over a scattered mid storey and a diverse grassy ground flora. The woodland is dominated over the majority of its length by River Red Gum *Eucalyptus camaldulensis*, with Grey Box *Eucalyptus microcarpa* becoming more dominant in the mid reaches and Black Box *Eucalyptus largiflorens* dominant where the creek approaches the Wimmera River. The mid storey is made up of a mixture of Wattles *Acacia spp* and Cross-leaf Honey-myrtle *Melaleuca decussata*, while the ground flora is dominated by a range of Wallaby-grasses *Austrodanthonia spp*, Spear-grasses *Austrostipa spp* and a good variety of herbaceous plants. Unfortunately there are a large variety of exotic weeds along the creek, several of which are beginning to seriously dominate the native ground flora. However there are also at least four listed significant native plant species still growing along the creek, with two of these common along much of the waterway.

The Ecological Vegetation Class (EVC) group for the riparian zone is defined as a riparian woodland. The Endangered Conservation Status of the EVC group present along Burnt Creek means that the conservation significance of the vegetation present will always be classed as high and very high.

Within the Wimmera community there is a desire to create links between core habitat areas such the Grampians, the Little Desert and the Big Desert National Parks.

Wherever possible these links will utilise roadsides, existing remnants and waterways. The MacKenzie River system, including Burnt Creek, currently provides an important component of this habitat corridor and other core habitat within the Wimmera region.

Aquatic Species

Local fishing stories for Burnt Creek revolve around the capture of blackfish in some of the deeper pools along the creek during wetter times. The creek typically displays a low diversity of fish species with only five species recorded in Burnt Creek (Table 15) below Toolondo Channel (DNRE Victorian Fish Database, 2002). The low diversity is considered to reflect the lack of perennial flow conditions within the majority of the creek (SKM, 2003).

Table 15. Fish Species recorded in Burnt Creek below Toolondo Channel (DNRE, 2002 as reported in SKM 2003)

Scientific Name	Common Name
<i>Galaxias olidus</i>	Mountain galaxias
<i>Nannoperca australis</i>	Southern Pygmy Perch
<i>Philypnodon grandiceps</i>	Flat headed gudgeon
<i>Retropinna semoni</i>	Australian Smelt
<i>Perca fluviatilis</i>	European Perch

Heritage

Burnt Creek and the surrounding area have been sites of cultural and historic significance since the long before European settlement in 1843 (Matuschka, Eagle & Miller, 1999). Aboriginal people from the Murra murra barap, Lil lil gundidj and Dyura balung clans lived their lives in and around Burnt Creek, sustained by the land that provided for their needs over thousands of years (Matuschka, Eagle & Miller, 1999). In 1836 Major Mitchell, on an expedition of discovery, passed through the Wimmera and was shortly followed by cattle drovers and white settlers. From 1843 permanent occupation by Europeans led to conflict with the indigenous peoples as they were driven from land claimed by the farmers for cattle and sheep grazing (Matuschka, Eagle & Miller, 1999).

Brighton Station, the first farm along Burnt Creek was established in 1843, and was shortly followed by numerous other farms of varying size. The increase in the population in the area led to a requirement for teaching facilities, and on the 1st of September 1872 classes began at the Burnt Creek School at Dingley Dell (Matuschka, Eagle & Miller, 1999).

Life at the school revolved around Burnt Creek which, with its deep holes, plentiful water and abundant wildlife provided a rich swimming and playground for the children (Matuschka, Eagle & Miller, 1999). Testimonies from past pupils (Section 4.2) detail the role that Burnt Creek played in their lives. Following World War Two student numbers dwindled as local schools consolidated and buses were provided to take students to Horsham. On the 24th of August 1948, after 76 years of service, the Burnt Creek School was closed (Matuschka, Eagle & Miller, 1999).

In 1953 a regulator was built to divert flow from Burnt Creek into the Toolondo Channel, forming an integral part of the Wimmera Mallee Stock and Domestic water supply system (B. Dyer, pers comm. 2005). Since this time the nature, diversity and ecology of the waterway has changed, and in most cases there has been a significant decline in the health of Burnt Creek (Matuschka, Eagle & Miller, 1999).

6 Burnt Creek

6.1 Waterway Assessment and Target Setting

Assessments of the contemporary health of Burnt Creek were made during two days of field inspections undertaken in June 2005. Data was collected from at least two sites in each Reach of the creek. 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.

Among the information collected were assessments of riparian and stream channel vegetation, and habitat condition. The existence and condition of riparian zone fencing was also noted. Reduction of the field data provided an assessment of the trajectory, threatening processes and risks to the condition of each reach. 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 16.

Table 16. Key waterway management target numbers and descriptions for Burnt Creek

Target No.	Target Description
1	Preserve, maintain and /or rehabilitate the environmental, economic and social values of Burnt Creek
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 Burnt Creek

6.2 Reach 1: Gauging station #415223 to confluence with right bank tributary near One Tree Road

6.2.1 Geomorphology

From the gauging station to the confluence with its main right bank tributary, Burnt Creek is a small u-shaped sinuous channel set within a 75-150 m wide symmetrical floodplain. The creek comprises sequences of pools and runs, with a very good range of pool sizes present which contributes to a highly variable long profile in some places. Some very deep pools are present on bends and upstream of tree roots. A fenced riparian zone has provided good vegetative cover and resulted in the moderate to steep Creek banks displaying high stability. Flood channels (which are often braided) and floodplain scours are present across the floodplain, with floodplain scours often located around large old river red-gums.

The bed of the Creek is stable and made up of fine sands, silts and clays. There is no evidence of sedimentation, but the lack of flow and good riparian vegetation has resulted in a thick covering of organic debris across the base of the creek. The large amount of organic matter on the creek is likely to contribute to poor water quality (very low dissolved oxygen) and minor flooding (because of debris jams) during the first substantial flows along the creek. There does not appear to be vegetation encroachment or channel narrowing as a result of reduced flows, however, it is likely that the extended dry period and complete cessation of flows will have prevented vegetation encroachment.

The upstream section of reach 1 is used to transfer water to the Toolondo channel and was the only section of Burnt Creek which contained flowing water. Water transfers have enlarged this section of the channel to 5-6 m wide and around 2 m deep in contrast to the creek downstream of the Toolondo channel which is 1-3 m wide and only 0.5-1.5 m deep. There is a small amount of bank erosion and small sandy point bars were present. The diversity of pool sizes is limited and it is likely that much of the larger woody debris has been removed from the creek to facilitate flows.

At the confluence with the Toolondo channel, Burnt Creek flows through a low lying swampy area, characterized by billabongs, flood channels and floodplain scours. Burnt Creek is still 5-6 m wide through the swamp and the channel averages 1 m deep. The banks of the Creek are low to moderate in slope and at the time of assessment, the creek was running at almost bank-full. The area was very well vegetated, producing high stream bank stability and contributing woody debris to the Creek.

6.2.2 Vegetation

This reach is dominated by a canopy gallery of River Red Gums *Eucalyptus camaldulensis* along the creekline, with a fringing woodland of River Red Gums, Yellow Box *Euc melliodora* and Grey Box *Euc microcarpa*. The shrubby mid storey is scattered. Evidence from several sections of the creek indicate that prior to clearing and grazing this component would have been more diverse and more widely occurring. Dominant species are Cross-leaf Honey-myrtle *Melaleuca decussata* and Hedge Wattle *Acacia paradoxa*.

The ground flora is dominated by native grasses and herbaceous species, with Wallaby Grasses *Austrodanthonia spp* and Common Wheat Grass *Elymus scaber* occurring most often. Several species listed rare for Victoria and rare for the region were frequently recorded in this component of the community – in particular, Leafy Wallaby-grass *Austrodanthonia bipartita* and Grassland Flax-lily *Dianella sp nov aff longifolia*.

Weed invasion is a serious threat to the native flora. Pasture weeds, notably Perennial Veldt-grass *Ehrharta calycina*, Paspalum *Paspalum sp.*, and Wild Oats *Avena fatua*, are

smothering the ground flora species and in several places totally preventing regeneration of all three strata.

The swamp section adjacent to Wonwondah East Rd (Site 1A.) is unique, supporting an extensive variety of native sedges, rushes and wetland plants. However the altered hydrological regime of this site has killed a large number of the River Red Gums and many of the remainder are under serious stress.

6.2.3 Habitat

Four habitat assessments were completed in this reach (Figure 2) and the results are presented in Table 17. There is general agreement of the two habitat assessment methods with both the HABSCORE assessment and the RHA assessment indicating that habitat quality is generally high in reach 1. The riparian corridor is fenced for the majority of this reach which promotes the retention of vegetation values and the riparian zone has subsequently provided woody debris and organic matter to the creek. The protection of the riparian corridor has resulted in high RHA values for large trees, canopy cover, understorey, recruitment litter and logs.

Geomorphically, the creeks are stable and in relatively good condition. There was no infilling of the creek with sediment and the diversity of pool sizes was typically good to excellent. This provides a diversity of habitat types and the potential for refugia in deep pools during dry periods. Most of the sites assessed display fair to good in-stream cover well suited to epifaunal colonisation and fish cover and the stream banks stability is good.

At sites 2 and 3, the key aspect contributing to the lower than optimal habitat score is the lack of water. At the time of assessment, Burnt Creek provides no aquatic habitat, however, the creek in reach 1 is in physically in very good condition which means the potential for recolonisation upon recommencement of flows is very high.

Site 1a is a low lying swampy area which is maintained because of the transfer of water along Burnt Creek for the stock and domestic supply system (refer section on Hydrology above). This area displays some excellent habitat features - good substrate comprising root matts, overhanging vegetation, and woody debris contributing to an environment that is good for colonisation and fish cover.

Table 17. Habitat quality assessments for Reach 1

Site	HABSCORE	RHA Score
1	130/200	10/20
1a	163/200	14/20
2	135/200	12.5/20
3	156/200	15/20
Weighted Average	139/200	12.3/20

Trajectory and identification of threatening processes

Table 18. Trajectory and threatening processes identified for Reach 1

Site	Trajectory	Threatening processes
1	Stable	• Removal of vegetation
		• Altered Hydrology
		• Weed invasion
1a	Worsening	<ul style="list-style-type: none"> • Altered Hydrology • Weed invasion
2	Worsening	• Earthworks
		• Lack of protection
		• Weed invasion
		• Exotic Fauna
3	Stable	• Weed invasion
		• Lack of protection

Threatening Processes and Risks

Table 19. Threatening Processes and high and very high Risks identified for Reach 1

Threatening processes	Assets Threatened	Comment	Risk Rating
Altered Hydrology	Substrate Stream Banks Riparian Zone	<p>Although the swampy area is in good condition and the channel displays good habitat character, the area is showing the effects of continual watering (die-back of red-gums) and should be targeted for a drying phase as part of its environmental flow regime. It is likely that this area provides refugia during extended dry periods as well as good examples of remnant wetland species. The management of this site under changed flow regimes (such as will be brought about by the installation of the Wimmera Mallee pipeline) should be carefully considered for its impact on the refugia and remnant populations.</p> <p>The large amount of organic matter and litter in the Creek has the potential to cause substantial water quality problems (in particular low dissolved oxygen) following the first reasonable flows in the creek. As the creek is currently completely dry downstream of the Toolondo channel this is likely to delay the recolonisation process until there is sufficient flow to improve the water quality.</p>	High-Very High
Earthworks	Geomorphic Character Stream Banks Riparian Zone	<p>At site 2, a small earthen bank has been constructed across the creek to divert water from the creek into an adjacent landholders dam. This provides an obstruction to any flow which is released into the Creek and reduces the quality of the potential habitat at the site.</p> <p>Also at site 2 the riparian zone has been affected by rabbit warren ripping which has destroyed patches of groundcover and understorey.</p>	High

Threatening processes	Assets Threatened	Comment	Risk Rating
Lack of protection	Riparian zone	The fencing and protection of riparian zone is good at the upstream end of reach 1 and is reflected in the good vegetation cover present. Downstream of the Toolondo Channel offtake the quality of fencing deteriorates and the potential for reduced protection is high. Vehicle access to the riparian zone of this reach is causing soil compaction and damage to ground flora.	High
Weed invasion	Riparian Zone	At site 3, round hay-bales are being stored within the riparian corridor which has the potential to promote the spread of non-native species and weed species into the riparian zone.	Very high
Exotic Fauna	Riparian Zone	Rabbits were noted to be a problem for regeneration.	High

Actions required to meet targets

Table 20. Actions required in Reach 1 to achieve key waterway health targets.

Target No.	Site No.	Action	Priority
1	2	Remove flow diversion banks constructed across the channel.	High
	3	Fence to protect riparian zone	High
2	1	Control/prevent vehicle access.	High
	1	Control weeds as listed in Appendix A	High
	2	Control exotic fauna (rabbits)	High
3	1	Manage flows to mimic natural conditions	Medium
	1a	Manage flows to provide a drying period	High
	2 & 3	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)	Very High

6.3 Reach 2: Confluence with the main right-bank tributary to just downstream of Dingly Dell

6.3.1 Geomorphology

Burnt Creek between the confluence of its main right bank tributary and Dingly Dell is a 3-6 m wide u-shaped sinuous channel meandering across a zone which is less than 200 m wide. There are many flood channels across the flood-plain and flood scours are common. The creek comprises pool and run sections with pools ranging from 2-5 m in depth. There is a very high diversity of pools, both size and depth vary markedly, and consequently this reach displays a highly variable long profile. Deep pools are often truncated by high, narrow bars associated with tree roots. Under a normal flow regime, the deepest pools would have provided key refugia in all but the driest of conditions.

Some channelization of the creek has occurred at road crossings and has impacted short sections of the reach. Under natural conditions, the creek has probably flowed in multiple channels, but a combination of channelization and reduced flows, has produced a main channel and many flood channels.

At site 6 a small quarry has been located adjacent the stream from which sandstone was removed for some local road building. The quarry is now inactive and regeneration is occurring along the steep banks. Some fill which had been removed from the quarry was placed in the margin of the riparian zone but is stable and unlikely to be remobilized.

Creek bed stability continues to be generally high, with little evidence of sediment movement. The stream banks are typically moderate to steep and at some sites are almost vertical. The riparian zone has not been as well protected in this reach of the creek, with poor to no fencing present. Stock access and cropping within the riparian zone have impacted on the riparian zone vegetation with consequent impacts on the creek bank stability. Undercutting and erosion scars were observed at some sites, and there is the potential for considerable stream bank erosion where overgrazing has reduced the vegetative bank protection.

Reduced riparian vegetation has also reduced the amount of organic debris present in the channel although for most of the reach, there is still a thick cover of woody debris. At site 5 woody debris has been removed from the stream, possibly for firewood. The combination of a high organic debris load causing debris jams and reduced vegetative bank protection is likely to result in bank erosion during the first substantial flows in the Creek.

As in reach 1, this section of the creek does not display any contracting of the active channel. Until about 2001/2002 water was transferred along this section of the creek for stock and domestic dam filling. This will have prevented the channel contraction that might have been expected through a reduced flow regime.

6.3.2 Vegetation

Reach 2. is dominated by an open woodland of River Red Gums *Eucalyptus camaldulensis*, with Grey Box *Euc microcarpa* becoming more frequent. Mid storey is largely destroyed by grazing. The ground flora is again dominated by native grasses and grassland herbaceous species, but is again considerably reduced at most sites by grazing. Despite this several listed rare species for Victoria and the region notably Leafy Wallaby-grass *Austrodanthonia bipartita* and Grassland Flax-lily *Dianella sp nov aff longifolia* still appear occasionally in this component of the community (2 out of 4 sites surveyed).

Large sections of this endangered grassy woodland vegetation community were observed to be recently ploughed right up to the creeks edge at a number of sites inspected.

Weed invasion is an even more serious concern to biodiversity in this reach, the ground flora being dominated by pasture weeds, in particular Perennial Veldt-grass **Ehrharta calycina*, several Brome's *Bromus spp.*, and Wild Oats *Avena fatua*.

6.3.3 Habitat

Six habitat assessments were conducted within reach 2 at 4 sites (Figure 2) with the results presented in Table 21. Habitat quality varies along reach 2 and is closely aligned with the land management practices. The high number of assessments conducted along this reach allow the impact of these differing land-use practices to be highlighted. As with part of reach 1, an important factor in the reducing the HABSCORE values is the lack of flow in the creek at the time of assessment.

The basic stream structure along reach 2 is excellent – there is no sediment infilling, the stream remains sinuous and the high diversity in pool sizes provide great variability in habitat. There is fair to good in-stream cover which means the potential for epifaunal colonization and fish cover is good. These good habitat features have been impacted by overgrazing and channelization and at site 5, woody debris has been removed from the stream for firewood, substantially reducing the amount of available habitat and in-stream cover. There is currently limited stream bank erosion present but the vegetation cover is severely reduced and the riparian zone impacted through overgrazing and cropping.

Good scores were recorded for large trees but the remaining vegetation features varied considerably. Very low scores were recorded where cropping reaches the top of the stream banks or stock have access to the creek but much higher scores were recorded where the riparian vegetation is protected.

Table 21. Habitat quality assessments for Reach 2

Site	HABSCORE	RHA Score
4a	142/200	8.5/20
4b	112/200	
5	115/200	4.5/20
6	121/200	8/20
7a	152/200	9/20
7b	88/200	4/20
Weighted Average	121/200	6.3/20

Trajectory and identification of threatening processes

Table 22. Trajectory and threatening processes identified for Reach 2

Site	Trajectory	Threatening process
4a	Stable	• Lack of Protection
		• Weed invasion
4b	Worsening	• Overgrazing
		• Lack of Protection
5	Worsening	• Weed invasion
		• Vegetation removal
		• Cropping
		• Exotic Fauna
		• Earthworks
6	Worsening	• Overgrazing
		• Lack of protection
		• Exotic Fauna
		• Earthworks
7a	Improving	• Lack of protection
		• Weed invasion
7b	Worsening	• Overgrazing
		• Lack of protection
		• Exotic Fauna

This reach has the potential for serious erosion and a degradation of habitat values if it remains impacted by cropping and grazing. If it is actively managed for the protection of stream-side values – most importantly riparian vegetation, it has good potential for recovery. This is clearly illustrated by the differing habitat scores for sites 7a and 7b. These sites are on either side of Reynolds road at Dingley Dell. The basic stream structure – pool variability, sediment regime and flow regime are the same yet the upstream site (7a) has the riparian zone protected through fencing and the downstream site (7b) has been seriously overgrazed and impacted by channelisation. The overgrazing has reduced the score for vegetative protection, riparian zone, bank stability substrate character and available cover markedly (Table 23) and the construction of levee banks has reduced both the channel alteration and channel sinuosity scores.

The management of road crossings in this reach may provide an impediment to environmental flows should they be released. At site 5, an earthen bank has been constructed in the upstream side of the road crossing which will increase the height of the river upstream, change the erosion and flooding character of the stream. At the MacKenzies Rd crossing sediment is built up on each side of the culverts making the passing of any flows difficult (Figure 7).



Figure 7. MacKenzies Rd Crossing of Burnt Creek

Table 23. Habitat quality assessments for site 7 – upstream and downstream of Reynolds Rd

Habitat parameter	Sites	
	7a	7b
Pool variability	18	18
Sediment deposition	19	19
Channel flow status	0	0
Epifaunal substrate / available cover	13	6
Pool substrate characterization	19	7
Channel alteration	18	14
Channel sinuosity	9	6
Bank stability	18	12
Vegetative protection	20	2
Riparian zone	18	4
Total	152	88

Threatening Processes and Risks

Table 24. Threatening Processes and high and very high Risks identified for Reach 2

Threatening process	Assets Threatened	Comment	Risk Rating
Lack of Protection	Substrate Stream Banks Riparian Zone	Failure of fencing and lack of fencing and stock access to the creek means there is the potential for bank erosion through sheep trampling, weed invasion through transport of seed matter and an increased potential for overgrazing.	High-Very High
Weed invasion	Riparian Zone	Reducing native species diversity within the riparian zone impacting on the Endangered Vegetation class which is the riparian zone of Burnt Ck	Very High
Overgrazing	Stream Banks Riparian Zone	Has the potential to remove much of the riparian vegetation and prevent re-establishment and recruitment of plants. This will impact on stream bank stability.	High – very High
Vegetation removal	Stream Banks Riparian Zone	Removal of LWD from the stream and stream side zone for firewood removes habitat from the creek, thus minimising the potential for re-establishment if and when flows recommence.	High – Very High
Altered Hydrology	Substrate Stream Banks Riparian Zone	Altered flow regimes are affecting the health of the native riparian and stream bank vegetation. At the MacKenzies Road crossing sediment is built up on the upstream and downstream side of the crossing. At site 5, an earthen bank has been constructed in the upstream side of the road.	High-Very High

Actions required to meet targets**Table 25. Actions required in Reach 2 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
1	5	Remove flow diversion banks constructed across the channel.	High
	4a	Remove vegetation and soil from culvert to allow flows to pass without causing scouring & outflanking.	High
	4b, 6, 7b	Fence to protect riparian zone, active revegetation of site 7b.	High
	4a, 7a	Fence to protect riparian zone	Medium
2	4a, 5, 7a	Control weeds as listed in Appendix A	High
	5	Stop cropping within the riparian zone	High
	5	Stop vegetation removal & firewood collection	High
	6, 7b	Control exotic fauna (rabbits)	High
3	All sites	Manage flows to mimic natural conditions	Medium
	All sites	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)	Very High
	4a	Plan to allow crossing to pass a minimum of 45 ML/day once the Wimmera Mallee Pipeline project is completed.	High

6.4 Reach 3: Halfway between Clynes Rd and Reynolds Rd to the most downstream crossing of Riverside East Rd

6.4.1 Geomorphology

Reach 3 of Burnt Creek is characterized by a sinuous, deeply incised channel which ranges between 4-6 m wide and up to 4 m deep. The bed profile is again highly variable but the diversity of pool sizes is not as high as in reaches 1 and 2. Most pools are large and deep, at times reaching bedrock. There are few shallow pool areas in this reach. The creek planform shows several right angle bends – these have typically been caused by the creek intersecting small sections of sandstone bedrock. The soils in this reach are dominated by sands in contrast to the silts and clays of the uppers two sites.

The creek generally has very steep to almost vertical banks with only a few sites displaying moderate bank slopes. It is unlikely that in its natural state, the creek would have showed the same depth of incision and this is most likely to have been caused by widespread clearing following European settlement. There is an obvious contraction in the active channel but the extended dry period and complete cessation of flows has prevented substantial vegetation encroachment into the channel. Some bank instability and slumping is occurring as the new active channel is undercutting the steep banks of the creek (Figure 8). The steep banks are at risk of erosion if the vegetation cover is not maintained to protect them.



Figure 8. Undercutting of banks at site 10.

There are paleochannels, floodplain scours and remnant channels across the floodplain. At site 9 the active channel was eroding an outside bend and threatening the adjacent water supply channel. Works appear to have been undertaken in the creek to promote a

cutoff meander forming and prevent the water supply channel being affected by erosion. There are only small areas of intact riparian vegetation and at several sites cropping was occurring into the near stream zone.

6.4.2 Vegetation

Reach 3 is dominated by an open woodland of Grey Box *Eucalyptus microcarpa* with a lesser component of River Red Gums *E. camaldulensis* and Buloke *Allocasuarina leuhmannii*. Mid storey is now almost non-existent due to grazing. The ground flora is again dominated by native grasses and grassland herbaceous species, but is again considerably reduced at most sites by grazing. Despite this several species listed rare for Victoria and listed rare for the region still occasionally appear in this component of the community - particularly Robust Pale Grassland Flax-lily *Dianella sp nov aff longifolia* – robust and Grassland Flax-lily *Dianella sp nov aff longifolia* (3 out of 7 sites surveyed). The endangered Buloke Mistletoe *Amyema linophylla ssp orientale* was also recorded in this reach.

The process of weed dominance is more advanced with the ground flora here dominated by Phalaris **Phalaris aquatica*, Ox-tongue Daisy **Picris echioides* and Sea Barley **Critesion marinum* as well as a variety of thistles.

Of significance in this reach is the dense stand of Slender Cypress-pine *Callitris gracilis* at Site 9. This is a relict of a vegetation community that would have been occasional along this reach of the creek prior to European settlement.

6.4.3 Habitat

Five habitat assessments were conducted at 3 sites within Reach 3 (Figure 2) and the scores recorded are provided in Table 26. The quality of the habitat observed within Reach 3 was again variable and depended upon site specific management practices. However, in general this reach displayed habitat that was in worse condition than in the upper two reaches. The basic stream structure is still solid – the creek is sinuous and there is only minor sedimentation at some sites. The diversity of pool sizes and in-channel substrate is fair to good, but grazing and stock access has reduced bank stability, vegetative protection and the quality of the riparian zone. The soils are sandy and inherently unstable which means there is the potential for considerable erosion if the vegetative protection remains poor.

The impacts of grazing and cropping have reduced the vegetation based scores of the RHA assessment, with sites typically showing low scores for the understorey. Good scores were recorded for large trees but a lack of recruitment of woody species and a high percentage of weed species was noted at most sites.

Table 26. Habitat quality assessments for Reach 3

Site	HABSCORE	RHA Score
8	105/200	4/20
9a	137/200	13/20
9b	96/200	5/20
10a	105/200	8/20
10b	84/200	3/20
Weighted Average	102/200	5.6/20

Trajectory and identification of threatening processes

Table 27. Trajectory and Threatening processes identified along Reach 3

Site	Trajectory	Threatening process
8	worsening	• Cropping
		• Lack of protection
		• Exotic fauna
		• Weed invasion
		• Overgrazing
		• Vegetation removal
		• Earthworks
		• Altered hydrology
9a	stable	• Rabbit warrens
		• Weed invasion
		• Altered hydrology
9b	worsening	• Earthworks
		• Lack of protection
		• Overgrazing
		• Weed invasion
		• Exotic fauna
10a	stable	• Altered hydrology
		• Lack of protection
		• Weed invasion
10b	worsening	• Lack of protection
		• Removal of vegetation
		• Overgrazing
		• Weed invasion
		• Altered hydrology

A number of threatening processes are acting to reduce the habitat condition along reach 3. Of particular note is the lack of fencing and overgrazing which is causing stream bank instability and a reduction in the quality of the riparian zone vegetation. There are several impediments to the passage of environmental flows within this reach which will contribute to the altered hydrology of the reach. These impediments are the construction of a dam across the creek at site 8, the presence of a vehicle crossing at site 9 and the low capacity of the culverts under Mackies Rd combined with the dumping of rubble on the downstream side of this crossing.

Threatening Processes and Risks

Table 28. Threatening processes and high risks identified for reach 3

Threatening process	Assets threatened	Comments	Risk Rating
Lack of protection	Substrate Riparian Zone Stream Banks	Lack of fencing on right bank Stock access causing bank instability of creek banks	High
Exotic fauna	Riparian Zone	Rabbits	High
Weed invasion	Riparian Zone	Reducing native species diversity within the riparian zone impacting on the Endangered Vegetation class which is the riparian zone of Burnt Ck	High
Overgrazing	Riparian Zone	Grazing through the stream-line and cropping the riparian zone has resulted in a lack of recruitment of woody species which means that the area is not regenerating or replenishing itself. The steep banks are at risk of erosion if the vegetation cover is not maintained to protect them and this was displayed quite markedly at site 9	High

Threatening process	Assets threatened	Comments	Risk Rating
Earthworks	Geomorphic Character	At site 8, a dam has been constructed across the creek which is causing some instability both upstream and downstream. This dam must be removed prior to the release of environmental flows to gain the full benefit of the environmental flow in downstream reaches. A vehicle crossing has been constructed across the creek at site 9. Rubble has been dumped on the downstream end of Mackies Rd crossing.	High
Vegetation removal	Riparian Zone	Removal wood from the stream side zone removes habitat from the creek, thus minimising the potential for re-establishment if and when flows recommence.	High
Altered hydrology	Substrate Riparian Zone	There is an obvious contraction in the active channel but the extended dry period and complete cessation of flows has prevented substantial vegetation encroachment into the channel. Some bank instability and slumping is occurring as the new active channel is undercutting the steep banks of the creek. The hydrology of the creek will also be affected by the earthworks (ie dams, vehicle crossings and road crossings) in the creek.	High

Actions required to meet targets**Table 29. Actions required in Reach 3 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
1	8	Remove dam constructed across the channel.	High
	Mackies Rd Crossing	Remove rubble dumped on downstream side of the crossing. Clear soil and vegetation from culvert.	Medium
	9	Remove/modify private vehicle crossing	High
	8, 9b, 10b	Fence to protect riparian zone	High
	10a	Fence to protect riparian zone	Medium
2	8, 9a, 9b, 10a, 10b	Control weeds as listed in Appendix A	High
	8	Stop cropping within the riparian zone	High
	8	Stop vegetation removal & firewood collection	High
	8, 9a, 9b	Control exotic fauna (rabbits)	High
3	All sites	Manage flows to mimic natural conditions	Medium
	All sites	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)	Very High
	Mackies Rd Crossing	Plan to replace existing culvert crossing with 600mm RCP culvert or 600x450 box culvert to allow flows of up to 45ML/day to pass without obstruction.	Medium

6.5 Reach 4: The most downstream crossing of Riverside East Rd to Cameron Rd

6.5.1 Geomorphology

Reach 4 of Burnt Creek retains little of its natural character as it has been extensively channelized and most of the riparian vegetation has been removed. Much of the channelisation was conducted following settlement of the Drung Irrigation area. The most significant works were conducted between 1970 and 1980 when drains were enlarged and channels cleaned out (B. Gross, pers. comm. 2005). The creek now displays a uniform, low gradient bed profile and straightened planform.

Immediately downstream of Riverside East Rd, Burnt Creek would naturally have flowed out through a series of distributary channels into a low lying swamp area. There is evidence of the swampy area in the soils and vegetation to the left hand side of the creek and there are drains on the floodplain to the right of the creek. It is possible that the creek only rarely reached the Wimmera River, instead terminating in this swampy area. There is some evidence from gamma surveys (G. Eagle, pers. comm. 2005) that at one stage in the history of Burnt Creek, it flowed west from where it intersects the sandy soils around Mackies Rd (part way along Reach 3) possibly joining the Wimmera River on the downstream side of Horsham. Evidence from the aerial photograph would indicate that the Creek has at one stage flowed to the Wimmera River approximately 1.5 km upstream from its present confluence. It is likely that no clear or consistent channel existed for this section of the creek.

The swampy areas downstream of Riverside East Rd have been drained to produce the current broad, shallow channel. Some serious bank erosion is occurring on the creek where it is subject to grazing and this is jeopardizing the few remaining trees (Figure 9).

Immediately upstream of Cameron Rd, Burnt creek remains heavily channelized but some sinuosity has been re-instated. There are no pools or remnant floodplain features and overgrazing is apparent at the sites visited. The active channel has contracted because of the reduced volumes of water and the combination of overgrazing and sheep tracks are causing some bank erosion.

There are extensive fencing and revegetation works along Reach 4 which has substantially improved the stability of the banks and provided instream habitat. Some of the fencing and revegetation is very recent, yet provides a marked difference in stream bank stability.

6.5.2 Vegetation

The vegetation in this reach is largely dominated by exotic weeds, with very few remaining native trees. Occasional Black Box *Eucalyptus largiflorens* indicate the former open Grassy Woodland community that would have occurred. No listed significant species were recorded for this reach although a number of locally rare species were observed. Areas that have been fenced out and replanted with indigenous trees and shrubs exhibit remarkable recolonisation with native grasses and herbaceous species, however here also these are being threatened with invading exotic weeds particularly *Phalaris aquatica*.



Figure 9. Bank Erosion Site 11.

6.5.3 Habitat

Poor habitat quality in reach 4 reflects the substantial modifications to the Creek which have taken place over many years. Three habitat assessments were conducted at two sites (Figure 2) and very low scores were obtained (Table 30) for most habitat features.

The basic creek structure has been substantially modified from its natural state producing a straight channel with no pool / run sequences evident. There is little in-stream cover present, a uniform substrate and the lack of vegetative cover combined with stock access has resulted in some erosion of the banks. These characteristics combine to create a creek with very little diversity of habitat and therefore lacks the potential for colonisation.

Although generally in a very poor condition, extensive fencing and revegetation works along Reach 4 have substantially improved the stability of the banks and provided instream habitat. Some of the fencing and revegetation is very recent, yet provides a marked difference in stream bank stability and habitat (refer the contrast in the HABSCOREs for the two assessments conducted at site 12). While the creek is unlikely to regain its original character, these activities are to be encouraged.

The vegetation scores (RHA) were very low with a lack of understorey, large trees, woody debris, recruitment and the prevalence of weeds combining to produce very low habitat value.

Table 30. Habitat quality assessments for Reach 4

Site	HABSCORE	RHA Score
11	54	1.5
12 revegetated	79	-
12	40	0
Average	49.7	0.75/20

Trajectory and identification of threatening processes

Table 31. Trajectory and Threatening processes identified along Reach 4

Site	Trajectory	Threatening process
11	worsening	• Lack of protection
		• Weed invasion
		• Vegetation removal
		• Altered hydrology
		• Exotic fauna
12 reveg	improving	• Weed invasion
		• Altered hydrology
12	worsening	• Lack of protection
		• Weed invasion
		• Altered hydrology
		• Overgrazing
		• Vegetation removal

Threatening Processes and Risks

Table 32. Threatening Processes and risks for Reach 4

Threatening process	Assets Threatened	Comment	Risk Rating
Lack of protection	Stream banks Riparian zone	This reach has the potential for serious stream bank erosion, undercutting and loss of large trees in areas where the channel is straightened and stock have access. Some serious bank erosion was noted at site 10 it is subject to grazing and this is jeopardizing the few remaining trees.	Medium
Weed invasion	Riparian Zone	The vegetation in this reach is largely dominated by exotic weeds, with very few remaining native trees.	High
Vegetation removal	Riparian Zone	Removal of LWD and stream side vegetation has removed habitat from the creek, thus minimising the potential for re-establishment if and when flows recommence.	High
Altered hydrology	Riparian Zone	The draining of this area and confinement of the flow into a single channel has completely changed the character of the creek along Reach 4.	Medium
Exotic fauna	Riparian Zone	Hares are preventing the recruitment of native woody species	Medium

The condition of Burnt Creek in this reach is already very poor and, aside from bank erosion, it is unlikely that it could degrade much further. The Risk Ratings reflect the low scores given to the environmental assets in this reach of the creek.

There is the potential to reintroduce habitat values in this section of the creek as illustrated in the fencing and revegetation works which are already occurring. The HABSCOREs from site 12 show that even very recent fencing and revegetation work has doubled the habitat score.

Actions required to meet targets**Table 33. Actions required in Reach 4 to achieve key waterway health targets.**

Target No.	Site No.	Action	Priority
1	11, 12 (non-revegetated)	Fence to protect riparian zone	High
2	11, 12	Control weeds as listed in Appendix A	High
	11, 12	Stop vegetation removal & firewood collection	High
	11	Control exotic fauna (rabbits)	High
3	All sites	Manage flows to mimic natural conditions	Medium
	All sites	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)	Very High

6.6 Reach 5: Cameron Rd to the confluence with the Wimmera River.

6.6.1 Geomorphology

Burnt Creek ranges from 7-8 m wide downstream of Cameron Rd, to 10-12 m wide downstream of the second Williams Rd crossing. The creek is a 2-3 m deep flat u-shaped channel set within a relatively narrow floodplain which flows through urban development to the confluence with the Wimmera River. Upstream of the second Williams Rd crossing the banks are steep to vertical and display signs of erosion on the outside of bends. This section of the channel is showing signs of contraction caused by low flows over previous years with some vegetation encroachment into the channel. There is a reasonable mix of pool sizes but there is also evidence of some sediment deposition in the base of the channel which is currently stabilised by vegetation. Children have constructed a small rock weir across the channel near the second Williams Rd crossing.

Downstream of the second Williams Rd crossing, the banks of Burnt Creek display low to moderate slopes and at the time of assessment, water (back-flow from the Wimmera River) was present in this reach of the creek. Channelization means that few pools are present and there is little diversity in either bed or long profiles, although some sinuosity has been retained in the long profile. There are constructed wetlands on the floodplain and housing on the margins of the floodplain which makes it difficult to determine the original character of the creek. However, it is likely that this is only one of the paths that the creek would have naturally used to reach the Wimmera River.

There is deposition of fine material on the bed of the creek which has smothered bed habitat and there is some erosion of the creek banks and early stages of undercutting of large trees. There is encroachment of vegetation into the channel with small eucalypts observed at the margins of the water and the overall vegetative protection of the banks is patchy.

There is little evidence in the form of the channel of the volumes of floodwaters which have been described as passing through this area. This is because the flooding occurs relatively infrequently and there are significant dry periods between floods. It is important that any restoration works within this section of the creek are designed with an understanding of the passage of floodwaters.

6.6.2 Vegetation

From Cameron Rd to the second Williams Rd crossing Burnt Creek has several large old remnant overstorey trees, although the majority of this section of reach 5 is devoid of native vegetation. There is virtually no mid storey left apart from one or two struggling melaleucas. The ground flora is almost entirely exotic weed species including serious noxious weeds such as Bathurst Burr, African Boxthorn and Amsinkia. The area has been planted with non-indigenous and exotic trees at site 15 and more recently indigenous trees at site 16. Many of the trees planted at site 15 are dead or dieing.

The recovery potential for Site 15 is reasonable as there is still a low level of native ground flora and the weeds are not completely dominant at the site. However the remaining willows at this site should be removed before they escape and invade the Wimmera River. Site 16 has serious problems with almost total weed cover of the ground flora, resulting in no regeneration of native species. The weeds have seriously impacted on the revegetation works that have been carried out at the site, and this has been further impacted by large numbers of rabbits and hares that are sheltering in the rank weed

growth. The site requires either regular weed control or re-guarding of the young trees and the seasonal reintroduction of sheep to the site.

Downstream of the second Williams Rd crossing the reach supports an excellent example of Riparian Woodland, with an open overstorey of Black Box *Eucalyptus largiflorens* and occasional River Red Gum *E camaldulensis*. There is little sign of a mid storey component, although several patches of Tangled Lignum *Meuhlenbeckia florulenta* and Gold-dust Wattle *Acacia acinacea* were recorded. The ground flora is dominated by a diversity of native grasses and herbaceous species including Common Wallaby Grass *Austrodanthonia caespitosa*, Rigid Panic *Whalleya proluta*, Mat Grass *Hemarthria uncinata* and Narrow-fruit Saltbush *Atriplex leptocarpha*. No listed significant species were recorded for this reach although a number of locally rare species were observed. Proximity to housing and the grazing history has resulted in a large variety of weed species notably Spiny Rush *Juncus acutus*, Gazania *Gazania linearis* and Paspalum *Paspalum sp.*

6.6.3 Habitat

Habitat assessments were conducted at two sites along reach 5 (Figure 3) during the initial field program and an additional 2 sites were assessed on the 13th of September with the results presented in Table 34. Habitat quality was comparable to reach 4 at the start of the reach and then improved considerably toward the river where the assessed sites display typically fair habitat scores. The creek has been extensively modified from its original form and overall habitat quality and diversity is low – particularly in the upper half of the reach. There are a few channel margin features between Cameron Rd and the second Williams Rd crossing which lend themselves to the re-creation of habitat values along this section of the reach.

Pool substrate, bank stability and vegetative protection is generally good, although the poor vegetation cover in the upper half of the reach has impacted on bank stability. There has been some infilling of pools in the upper half of the reach, but there is generally little in the way of active deposition.

Human access at all sites is impacting on both the vegetation and the bank stability. The changed flow regime is probably having a greater impact on bank stability – particularly in the lower half of reach 5. Backflow from the Wimmera River has provided some sustaining water to the in-stream cover, as well as the surrounding vegetation. This is reflected in the higher HABSCORE for site 14 than site 13.

Good vegetation scores were recorded for understorey and recruitment in the lower half of the reach with some active planting having occurred along this reach some years ago. Low scores were recorded for large trees, organic litter and large woody debris. These features reduce the amount of habitat in the creek as well as the productivity of the creek.

Table 34. Habitat quality assessments for Reach 5.

Site	HABSCORE	RHA Score
13	89	10.5/20
14	109	4/20
15	99	2/20
16	87	0/20
Average	99	4.6/20

Trajectory and identification of threatening processes

There is the potential for bank erosion to occur at all sites assessed – in the upper half of the reach, the outsides of the beds are bare and susceptible to erosion during high flows and in the lower half of the reach, erosion may occur where there are tracks through the creek. A lack of vegetative bank protection along the reach means that it is susceptible to bank erosion during high flows.

Table 35. Trajectory and threatening processes identified along reach 5.

Site	Trajectory	Threatening process
13	Stable	<ul style="list-style-type: none"> • Weed invasion • Lack of protection • Altered hydrology
14	Stable	<ul style="list-style-type: none"> • Weed invasion • Altered hydrology • Vegetation removal
15	Stable	<ul style="list-style-type: none"> • Weed invasion • Lack of protection • Altered hydrology
16	Worsening	<ul style="list-style-type: none"> • Weed invasion • Lack of protection • Altered hydrology

Table 36. Risk ratings for threatening processes in Reach 5

Threatening process	Asset threatened	Comments	Risk Rating
Lack of protection	Substrate Riparian Zone	There is the potential for bank erosion to occur at both sites where there are tracks through the creek. A lack of vegetative bank protection at sites 14-16 means that these sites are susceptible to bank erosion during high flows.	High
Weed invasion	Riparian Zone		Medium
Altered hydrology	Substrate Riparian Zone		High

The condition of Burnt Creek in this reach is generally fair and it displays little in the way of good habitat features or habitat diversity. It is obviously an area of some recreational amenity and value to its surrounding residents. The creek retains little of its natural form and presently contains little in the way of aquatic fauna but there is considerable potential to reintroduce habitat values to this section of the creek. Given that the creek is surrounded by urban development, it provides an opportunity to undertake an urban design project. Such a project could re-create the creek along reach 5, providing some key habitat features as well as retaining flow and flood passage. The native riparian and aquatic plants could be re-established within the framework of existing native plants. This project could gain considerable support from the local community and provide a key recreational amenity following its implementation.

Actions required to meet targets

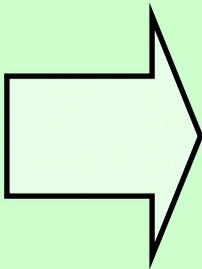
Table 37. Actions required in Reach 5 to achieve key waterway health targets.

Target No.	Site No.	Action	Priority
1	13, 14	Fence to protect riparian zone and retain cyclists & pedestrians on designated pathways	High
2	All sites	Control weeds as listed in Appendix A	High
3	All sites	Implement environmental flow recommendations as per Wimmera Bulk Entitlement Conversion – Environmental Flow Study (SKM 2003)	Medium
1 (2 & 4)	All sites	Re-create reach with key habitat and riparian features as well as good flow passage.	Low

7 Works Program and Cost Estimate

A number of the actions recommended for Burnt Creek are covered under programs independent of the Waterway Action Plan e.g. weed and exotic fauna control. Table 38 provides greater detail of works activities that are not covered by the WAP works plan.

Table 38. Waterway and land management programs relevant to the Burnt Creek 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>Burnt Creek Waterway Action Plan</i>
Exotic pest plants	<i>Wimmera Weed Action Plan</i>
Whole farm and pasture management	<i>Steep Hill Country Management Plan</i> <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>

Reduction of desktop and field inspection data has yielded the information to formulate the works program shown in Table 39. The following points highlight important aspects of the findings of the Burnt Creek Waterway Action Plan works program:

- Revegetation and fencing provide the greatest opportunity to increase the habitat quality of the creek even in severely degraded areas. This is demonstrated by the changes in habitat condition scores at a number of sites along the creek (refer for examples, site 12, site 7 and site 10).
- The altered hydrology due to flow diversion is impacting the condition of the creek substantially and environmental flows would provide a positive benefit to the habitat condition. Recommendations for environmental flows provided as part of the bulk entitlement process (SKM 2003) indicates that short duration flushing flows of around 45 ML/day should be released into the creek approximately 3 times per year. It was noted in the field assessment that there are several road

crossings that are unlikely to pass 45 ML/day, many of the road culverts would be unlikely to pass *any* flows and there are a number of impediments to flow in the creek. In particular:

- Peuckers Rd crossing – 450 mm under road pipe with an earthen bank pushed up on the upstream side to deepen a pool for pumping (Figure 10).
- Mackies Rd crossing – two culverts blocked with organic matter and rubble has been dumped on the downstream side (Figure 11).
- MacKenzies Rd crossing – two pipes under road filled with sediment, possibly pushed up (Figure 12).
- A dam across the creek at site 8 and the diversion activities at site 5 will impede the passage of flows.

Existing road culverts could be replaced with 600mm RCP pipes culverts or 600x450 box culverts laid at a grade of 1:150 to enable passage of a 45ML/day flow.



Figure 10. Peuckers Rd crossing of Burnt Creeks showing the bank constructed on the upstream side



Figure 11. Mackies Rd crossing of Burnt Creek showing rubble dumped downstream of crossing



Figure 12. MacKenzies Rd crossing of Burnt Creek, upstream view. Downstream view is similar

Table 39. Burnt Creek Waterway Action Plan works program. Note that coloured priorities are actions to occur under this Waterway Action Plan program. Note: Rate used is a guide only and is an estimate based on combined fencing and revegetation costs. The WMCA Incentive Rates schedule shown in Table 40 provides more accurate cost information.

Action Number	Reach/site Number	Management Action	Location		Provisional Quantity.	Rate (\$)	Provisional Total* (\$)	Priority	Lead Agency
			Easting	Northing					
Reach 1									
1.1	1/002	Remove flow diversion banks constructed across the channel.	E 611 142	N 5 918 515				High	GMMW
1.2	1/003	Fence right bank.	E 612 639	N 5 920 062	2,100m	\$5.50 /m	\$11,600 WCMA incentives available	High	
1.3	1/001	Control/prevent vehicle access to riparian zone.	E 609 803	N 5 916 588				High	
1.4	1/001	Control weeds.	E 609 803	N 5 916 588			Other program	High	
1.5	1/002	Control exotic fauna.	E 611 142	N 5 918 515			Other program	High	

Action Number	Reach/site Number	Management Action	Location		Provisional Quantity.	Rate (\$)	Provisional Total* (\$)	Priority	Lead Agency
			Easting	Northing					

Reach 2									
2.1	2/004a	Unblock (remove vegetation and soil) from Mackenzies Rd crossing culvert.	E 612 823	N 5 921 774			\$5000	High	HRCC
2.2	2/005	Remove flow diversion banks constructed across the channel.	E 611 557	N 5 923 571				High	GWMW
2.3	2/005	Stop cropping in the riparian zone.						High	Landholder responsibility
2.4	2/005	Stop vegetation & firewood collection in channel & riparian zone.						High	Landholder responsibility
2.5	2/004a	Replace left & right bank fences in 2-5 years.	Start: 612 978 End: 612 802	Start: 592 0402 End: 592 1802	Right bank 1,900m Left bank 1,940m	\$5.50 /m	\$21,200 WCMA incentives available	Medium	

Action Number	Reach/site Number	Management Action	Location		Provisional Quantity.	Rate (\$)	Provisional Total* (\$)	Priority	Lead Agency
			Easting	Northing					
2.6	2/005	Fence riparian zone upstream of Pueckers Road crossing.	Start: 611 886 End: 611 262	Start: 592 3466 End: 592 3669	Right bank 700m	\$5.50 /m	\$3,900	High	
2.7	2/005	Fence left bank between Pueckers Road crossing of Burnt Ck and Millers Road.	Start: 611 226 End: 610 466	Start: 592 3549 End: 592 5078	Left bank 1,900m	\$5.50 /m	\$10,500	High	
2.8	2/006	Fence right bank riparian zone immediately downstream of Millers Road crossing.	Start: 610 591 End: 610 518	Start: 592 5125 End: 592 5905	Right bank 830m	\$5.50 /m	\$4,600	High	
2.9	2/007B	Fence right bank riparian zone immediately downstream of Reynolds Road crossing.	Start: 610 711 End: 610 830	Start: 592 6758 End: 592 7538	Right bank 800m	\$5.50 /m	\$4,400	High	

Action Number	Reach/site Number	Management Action	Location		Provisional Quantity.	Rate (\$)	Provisional Total* (\$)	Priority	Lead Agency
			Easting	Northing					
2.10	2/004a, 005, 007a	Control weeds.	004a E 612 823 005 E 611 557 007a E 610 646	N 5 921 774 N 5 923 571 N 5 926 626			Other program	High	Landholder responsibility
2.11	2/006, 007b	Control exotic fauna.	006 E 610 481 007b E 610 675	N 5 925 314 N 5 926 849			Other program	High	Landholder responsibility
Reach 3									
3.1	3/008	Remove dam constructed across channel.	E 610 837	N 5 928 608			Landholder responsibility	High	GWMW
3.2	3/008	Stop cropping in the riparian zone.						High	Landholder responsibility
3.3	3/008	Stop vegetation removal & firewood collection in riparian zone.	E 610 837	N 5 928 608				High	Landholder responsibility

Action Number	Reach/site Number	Management Action	Location		Provisional Quantity.	Rate (\$)	Provisional Total* (\$)	Priority	Lead Agency
			Easting	Northing					
3.4	3/009a	Remove rubble dumped on downstream side of Mackies Rd crossing. Remove vegetation and soil from within the culvert.	E 611 650	N 5 930 158			\$5000	Medium	HRCC
3.5	3/008	Replace fence both sides of stream immediately upstream of Clynes Road crossing in 2-5 years.	Start: 610 830 End: 610 700	Start: 5 927 538 End: 5 928 360	Left bank 900m Right bank 900m	\$5.50 /m	\$9,900 WCMA incentives available	Medium	
3.6		Fence right bank riparian zone downstream of Clynes Road crossing.	Start: 610 174 End: 610 872	Start: 5 928 354 End: 5 929 155	Right bank 1,800m	\$5.50 /m	\$9,900 WCMA incentives available	High	
3.7	3/009A	Replace fence both sides of stream immediately upstream of Mackies Road crossing in 5-15 years.	Start: 611 059 End: 610 872	Start: 5 929 982 End: 5 929 166	Right bank 1,000 Left bank 1,000	\$5.50 /m	\$11,000 WCMA incentives available	Low	

Action Number	Reach/site Number	Management Action	Location		Provisional Quantity.	Rate (\$)	Provisional Total* (\$)	Priority	Lead Agency
			Easting	Northing					
3.8	3/009B	Fence riparian zone between Mackies Road and Western Highway.	Start: 611 039 End: 611 392	Start: 5 930 003 End: 5 930 674	Right bank 1,000m Left bank 760m	\$5.50 /m	\$9,700 WCMA incentives available	High	
3.9	3/010B	Fence right bank riparian zone between Western Highway and Centre Road.	Start: 611 439 End: 611 481	Start: 5 930 742 End: 5 931 584	Right bank 980m	\$5.50 /m	\$5,400 WCMA incentives available	High	
3.10	3/008, 9a, 9b, 10a, 10b	Control weeds.	008 E 610 836 9a E 611 087 9b E 611 149 10a E 611 443 10b E 611 313	N 5 928 607 N 5 929 794 N 5 930 099 N 5 931 536 N 5 931 830			Other program	High	Landholder responsibility
3.11	3/008, 9a, 9b	Control exotic fauna.	008 E 610 836 9a E 611 087 9b E 611 149	N 5 928 607 N 5 929 794 N 5 930 099			Other program	High	Landholder responsibility

Action Number	Reach/site Number	Management Action	Location		Provisional Quantity.	Rate (\$)	Provisional Total* (\$)	Priority	Lead Agency
			Easting	Northing					
Reach 4									
4.1	4/011, 012	Stop removal of vegetation & firewood collection in the riparian zone.	E 610 690 E 609 585	N 5 933 133 N 5 934 762				High	Landholder responsibility, DSE on Crown frontage
4.2	4/011 4/012	Fence riparian zone between Riverside East and revegetated area 300m upstream of Horsham-Drung Road.	Start: 611 351 End: 609 583	Start: 5 932 484 End: 5 934 862	Right bank 3,600m Left bank 3,700m	\$5.50 /m	\$40,200	High	
4.3	4/011, 012	Control weeds.	011 E 610 690 012 E 609 585	N 933 133 N 5 934 762			Other program	High	Landholder responsibility
4.4	4/011	Control exotic fauna.	E 610 690	N 933 133			Other program	High	Landholder responsibility

Action Number	Reach/site Number	Management Action	Location		Provisional Quantity.	Rate (\$)	Provisional Total* (\$)	Priority	Lead Agency
			Easting	Northing					
Reach 5									
5.1	5/ 013, 014	Fence riparian zone to keep cyclists & pedestrians on designated pathways.	Start: 608 745 End: 608 469	Start: 5 934 616 End: 5 934 621	Right bank 300m	\$5.50 /m	\$1,700 WCMA incentives available	High	
5.2	5/012, 013, 014 015, 016	Control weeds.	012 E 609 585 013 E 608 612	N 5 934 762 N 5 934 563			Other program	High	Landholder responsibility
5.3	5/ 013,014 015, 016	Implement stream rehabilitation works to provide habitat and riparian features	013 E 608 612 014 E 608 469 015 E 608 785 016 E 608 898	N 5 934 762 N 5 934 621 N 5 934 857 N 5 935 043			\$ 50,000	Low	HRCC, WRIC, WCMA
End									
Total Provisional Cost of Works Program*							\$204,000		

*Total Cost has not considered cost sharing

Wimmera CMA offers landholders incentive rates to undertake fencing and revegetation of streamside areas. Details of this scheme are outlined in the following table:



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.

Wimmera 05/06 Incentive Rates

The rates below represent the full incentives that will be paid. They have been calculated to consider the full cost of the works. For example, the price of \$1.00 for a plant, includes plant establishment costs such as weed control, deep ripping and tree guards, as well as the purchase of the plant. As these costs have been considered in the incentive rates, additional funding is not available for these activities.

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%		PMP*	\$3.45	m
		70%	Very High Conservation significance potential	No PMP	\$3.00	m
	H	70%		PMP	\$3.00	m
		60%	High Conservation significance potential	No PMP	\$2.60	m
	M	55%		PMP	\$2.35	m
		45%	Medium Conservation significance potential	No PMP	\$1.90	m
	L	35%		PMP	\$1.50	m
L	25%	Low Conservation significance potential	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		
	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
L	25%	Discharge Fencing	No PMP	\$1.10	m	

* To be eligible for higher rates, inspecting officer must sight completed Property Management Plan or Whole Farm Plan

Higher incentive rates may be available for salinity works if they have conservation outcomes. In such cases rates for revegetation may be applied.

9 References

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Appendix A

Vegetation Species Lists for Burnt Creek

AROTS = Australian Rare Or Threatened Species
VROTS = Victorian Rare Or Threatened Species

Reach 1

Site 1

Native Species

AROTS VROTS	Name	Common Name
	<i>Acacia paradoxa</i>	Hedge Wattle
	<i>Acacia pycnantha</i>	Golden Wattle
	<i>Acaena echinata</i>	Sheep's Burr
	<i>Allocasuarina luehmannii</i>	Buloke
r	<i>Austrodanthonia bipartita</i>	Leafy Wallaby Grass
	<i>Austrodanthonia racemosa</i> var. <i>racemosa</i>	Striped Wallaby-grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia</i> sp.	Wallaby-grass
	<i>Austrostipa</i> sp.	Spear-grass
	<i>Bursaria spinosa</i>	Sweet Bursaria
	<i>Carex apressa</i>	Tall Sedge
	<i>Cynodon dactylon</i>	Native Couch
	<i>Cyperus lucidus</i>	Leafy Flat-sedge
	<i>Deyeuxia quadriseta</i>	Reed Bent-grass
r	<i>Dianella sp nov aff longifolia</i>	Grassland Pale Flax-
	<i>Dichelachne crinita</i>	Long-hair Plume-grass
	<i>Eleocharis acutus</i>	Common Spike-rush
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus melliodora</i>	Yellow Box
	<i>Isolepis nodosa</i>	Knobby Club-sedge
	<i>Juncus holoschoenus</i>	Joint-leaf Rush
	<i>Juncus</i> sp.	Rush
	<i>Lachnagrostis filiformis</i>	Blown Grass
	<i>Lepidosperma congestum</i>	Clustered Sword-sedge
	<i>Leptospermum continentale</i>	Prickly Tea-tree
	<i>Lomandra micrantha</i> ssp <i>tuberculata</i>	Small-flowered Mat-rush
	<i>Lomandra</i> sp aff <i>filiformis</i>	Mat-rush
	<i>Melaleuca decussata</i>	Totem Poles
	<i>Microlaena stipoides</i>	Weeping Grass
	<i>Poa</i> sp.	Tussock-grass
	<i>Rumex brownii</i>	Slender Dock
	<i>Vittadinia cuneata</i>	Fuzzy New Holland

Weed Species

* <i>Agrostis capillaris</i> sl	Brown-top Bent
* <i>Aira cupaniana</i>	Quicksilver Grass
* <i>Asparagus asparagoides</i>	Bridal Creeper
* <i>Avena fatua</i>	Wild Oat
* <i>Briza maxima</i>	Large Quaking-grass
* <i>Bromus diandrus</i>	Great Brome
* <i>Bromus hordeaceus</i>	Soft Brome
* <i>Cirsium vulgare</i>	Spear Thistle

**Cynodon dactylon*
**Ehrharta calycina*
**Hypochaeris radicata*
**Lagurus ovatus*
**Holcus lanatus*
***Marrubium vulgare**
**Narcissus sp*
**Paspalum sp.*
**Phalaris aquatica*
**Picris echioides*
**Romulea rosea*
**Trifolium angustifolium*
***Watsonia bulbifera**

Couch
Perennial Veldt Grass
Cat's-ear
Hare's Tail
Yorkshire Fog Grass
Horehound
Daffodill
Paspalum
Canary Grass
Ox-tongue Daisy
Onion Grass
Narrow-leaf clover
Watsonia

REACH 1.

Site 1A. –Wetland North of Wonwondah East Rd

Native Species

AROTS VROTS	Name	Common Name
	<i>Acacia mearnsii</i>	Black Wattle
	<i>Allocasuarina luehmannii</i>	Buloke
r	<i>Austrodanthonia bipartita</i>	Leafy Wallaby Grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Baumea articulata</i>	Jointed Twig-sedge
	<i>Carex sp.</i>	Sedge
	<i>Chorizandra enodis</i>	Black Bristle Rush
	<i>Chrysocephalum apiculatum s.l.</i>	Common Everlasting
	<i>Deyeuxia quadriseta</i>	Reed Bent-grass
r	<i>Dianella sp nov aff longifolia</i>	Grassland Pale Flax-lily
	<i>Dichelachne crinita</i>	Long-hair Plume-grass
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Eragrostis brownii</i>	Common Love-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus microcarpa</i>	Grey Box
r	<i>Eutaxia diffusa</i>	Spreading Eutaxia
	<i>Eutaxia microphylla s.s</i>	Common Eutaxia
	<i>Goodenia humilis</i>	Swamp Goodenia
	<i>Hydrocotyle sibthorpioides</i>	Shining Pennywort
	<i>Isolepis fluitans</i>	Floating Club-sedge
	<i>Juncus sp.</i>	Rush
	<i>Juncus sp.-fine foliage</i>	Rush
	<i>Juncus flavidus</i>	Yellow Rush
	<i>Lepidosperma congestum</i>	Clustered Sword-sedge
	<i>Melaleuca decussata</i>	Totem Poles
	<i>Myriophyllum sp</i>	Water Millfoil
	<i>Templetonia stenophylla</i>	Leafy Templetonia
	<i>Thysanotus patersonii</i>	Twining Fringe-lily
	<i>Triglochin procera sl</i>	Water Ribbons
	<i>Typha domingensis</i>	Cumbungi
	<i>Vittadinia gracilis</i>	Woolly New Holland Daisy

Weed Species

* <i>Briza maxima</i>	Large Quaking-grass
* <i>Holcus lanatus</i>	Yorkshire Fog Grass
* <i>Cynodon dactylon</i>	Couch
* <i>Conzya bonariensis</i>	Flaxleaf (Hairy) Fleabane
* <i>Rubus fruticosus spp agg</i>	Blackberry
* <i>Paspalum sp.</i>	Paspalum
* <i>Watsonia bulbifera</i>	Watsonia

REACH 1.

Site 2.

Native Species

AROTS VROTS	Name	Common Name
	<i>Acacia acinacea</i>	Gold-dust Wattle
	<i>Acacia paradoxa</i>	Hedge Wattle
	<i>Acacia pycnantha</i>	Golden Wattle
	<i>Allocasuarina luehmannii</i>	Buloke
r	<i>Austrodanthonia bipartita</i>	Leafy Wallaby Grass
	<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Austrostipa densiflora</i>	Dense Spear-grass
	<i>Bursaria spinosa</i>	Sweet Bursaria
	<i>Carex apressa</i>	Tall Sedge
r	<i>Dianella sp nov aff longifolia</i>	Grassland Pale Flax-lily
	<i>Dichelachne crinita</i>	Long-hair Plume-grass
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus melliodora</i>	Yellow Box
	<i>Eucalyptus microcarpa</i>	Grey Box
	<i>Hypericum gramineum</i>	Small St John's Wort
	<i>Isolepis fluitans</i>	Floating Club-sedge
	<i>Juncus pallidus</i>	Pale Rush
	<i>Juncus sp.</i>	Rush
	<i>Lachnagrostis filiformis</i>	Blown Grass
	<i>Lomandra micrantha ssp tuberculata</i>	Small-flowered Mat-rush
	<i>Lomandra filiformis ssp coriacea</i>	Wattle Mat-rush
	<i>Melaleuca decussata</i>	Totem Poles
	<i>Microlaena stipoides</i>	Weeping Grass

Weed Species

* <i>Avena fatua</i>	Wild Oat
* <i>Bromus diandrus</i>	Great Brome
* <i>Cirsium vulgare</i>	Spear Thistle
* <i>Cotoneaster sp.</i>	Cotoneaster
* <i>Cynodon dactylon</i>	Couch
* <i>Holcus lanatus</i>	Yorkshire Fog Grass
* <i>Paspalum sp.</i>	Paspalum
* <i>Phalaris aquatica</i>	Canary Grass
* <i>Rosa rubiginosa</i>	Briar Rose
* <i>Watsonia bulbifera</i>	Watsonia

REACH 1.

Site 3.

Native Species

AROTS VROTS	Name	Common Name
	<i>Acacia acinacea</i>	Gold-dust Wattle
	<i>Acaena echinata</i>	Sheep's Burr
	<i>Arthropodium fimbriatum</i>	Nodding Chocolate-lily
	<i>Arthropodium strictum</i>	Chocolate-lily
	<i>Austrostipa</i> sp.	Spear-grass
r	<i>Austrodanthonia bipartita</i>	Leafy Wallaby Grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia</i> sp.	Wallaby-grass
	<i>Bursaria spinosa</i>	Sweet Bursaria
	<i>Calocephalus citreus</i>	Lemon Beauty-heads
	<i>Carex apressa</i>	Tall Sedge
	<i>Chorizandra enodis</i>	Black Bristle Rush
	<i>Chrysocephalum apiculatum</i> s.l.	Common Everlasting
	<i>Dianella revoluta</i> s.l	Black-anther Flax-lily
r	<i>Dianella</i> sp nov aff <i>longifolia</i>	Grassland Pale Flax-lily
	<i>Dichelachne crinita</i>	Long-hair Plume-grass
	<i>Dillwynia glaberrima</i>	Smooth Parrot-pea
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Eragrostis</i> sp	Love-grass
	<i>Eryngium ovinum</i>	Blue Devil
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus microcarpa</i>	Grey Box
r	<i>Eutaxia diffusa</i>	Spreading Eutaxia
	<i>Eutaxia microphylla</i> s.s	Common Eutaxia

Weed Species

* <i>Avena fatua</i>	Wild Oat
* <i>Briza maxima</i>	Large Quaking-grass
* <i>Bromus diandrus</i>	Great Brome
* <i>Picris echioides</i>	Ox-tongue Daisy
* <i>Phalaris aquatica</i>	Canary Grass
* <i>Romulea rosea</i>	Onion Grass

REACH 1.

Site 4. Just upstream of Reach 2.

Native Species

AROTS VROTS	Name	Common Name
	<i>Acacia acinacea</i>	Gold-dust Wattle
	<i>Allocasuarina luehmannii</i>	Buloke
	<i>Amyema miquellii</i>	Box Mistletoe
	<i>Arthropodium fimbriatum</i>	Nodding Chocolate-lily
	<i>Austrostipa mollis</i>	Supple Spear-grass
	<i>Austrostipa sp.</i>	Spear-grass
	<i>Austroanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austroanthonia sp.</i>	Wallaby-grass
	<i>Bursaria spinosa</i>	Sweet Bursaria
	<i>Carex appressa</i>	Tall Sedge
r	r <i>Chrysocephalum apiculatum</i>.-fine	Wimmera Common
r	r <i>Dianella sp nov aff longifolia</i>	Grassland Pale Flax-lily
	<i>Dichelachne crinita</i>	Long-hair Plume-grass
	<i>Einadia nutans</i>	Nodding Saltbush
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus microcarpa</i>	Grey Box
	<i>Eutaxia microphylla s.s</i>	Common Eutaxia
	<i>Isolepis nodosa</i>	Knobby Club-sedge
	<i>Juncus sp.</i>	Rush
	<i>Lachnagrostis filiformis var 1.</i>	Common Blown-grass
	<i>Vittadenia cervicalis</i>	Annual New-Holland

Weed Species

* <i>Avena fatua</i>	Wild Oat
* <i>Briza maxima</i>	Large Quaking-grass
* <i>Bromus diandrus</i>	Great Brome
* <i>Bromus hordeaceus</i>	Soft Brome
* <i>Bromus rubens</i>	Red Brome
* <i>Cynodon dactylon</i>	Couch
* <i>Paspalum sp.</i>	Paspalum
* <i>Plantago lanceolata</i>	Ribwort
* <i>Romulea rosea</i>	Onion Grass

Site 5. Peuckers Rd Crossing

A. Roadside

Native Species

AROTS VROTS	Name	Common Name
r	<i>Austrostipa sp.</i>	Spear-grass
	<i>Austrodanthonia bipartita</i>	Leafy Wallaby Grass
	<i>Austrodanthonia racemosa</i>	Stiped Wallaby-grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Bursaria spinosa</i>	Sweet Bursaria
	<i>Carex apressa</i>	Tall Sedge
	<i>Carex sp</i>	Sedge
r	<i>Dianella sp nov aff</i>	Grassland Pale Flax-lily
	<i>Deyeuxia quadriseta</i>	Reed Bent-grass
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus microcarpa</i>	Grey Box
	<i>Isolepis nodosa</i>	Knobby Club-sedge
	<i>Juncus subsecundus</i>	Finger Rush
	<i>Juncus sp.</i>	Rush
	<i>Lachnagrostis filiformis var</i>	Common Blown-grass
	<i>Melaleuca decussata</i>	Totem Poles
	<i>Poa sieberiana</i>	Grey Tussock-grass

Weed Species

<i>*Avena fatua</i>	Wild Oat
<i>*Bromus diandrus</i>	Great Brome
<i>*Dactylis glomerata</i>	Cocksfoot
<i>*Romulea rosea</i>	Onion Grass

B. Adjoining private property

Native Species

r <i>Austrodanthonia</i>	Leafy Wallaby Grass
<i>Austrodanthonia sp.</i>	Wallaby-grass
<i>Eucalyptus camaldulensis</i>	River Red-gum
<i>Eucalyptus microcarpa</i>	Grey Box

Weed Species

<i>*Avena fatua</i>	Wild Oat
<i>*Bromus diandrus</i>	Great Brome
<i>*Bromus hordeaceus</i>	Soft Brome
<i>*Bromus rubens</i>	Red Brome
<i>*Dactylis glomerata</i>	Cocksfoot
<i>*Romulea rosea</i>	Onion Grass

REACH 2.

Site 6. Millers Rd Crossing

Native Species

AROTS VROTS	Name	Common Name
	<i>Acacia paradoxa</i>	Hedge Wattle
	<i>Allocasuarina luehmannii</i>	Buloke
	<i>Arthropodium fimbriatum</i>	Nodding Chocolate-lily
	<i>Austrostipa scabra</i>	Rough Spear-grass
	<i>Austrostipa sp.</i>	Spear-grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Calocephalus citreus</i>	Lemon Beauty-heads
	<i>Carex sp</i>	Sedge
	<i>Chloris truncata</i>	Windmill Grass
	<i>Chrysocephalum</i>	Common Everlasting
r	<i>Dianella sp nov aff</i>	Grassland Pale Flax-lily
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus microcarpa</i>	Grey Box
	<i>Melaleuca decussata</i>	Totem Poles
	<i>Themeda triandra</i>	Kangaroo Grass

Weed Species

* <i>Avena fatua</i>	Wild Oat
* <i>Bromus hordeaceus</i>	Soft Brome
* <i>Chondrilla juncea</i>	Skeleton Weed
* <i>Cirsium vulgare</i>	Spear Thistle
* <i>Dactylis glomerata</i>	Cocksfoot
* <i>Hypochoeris radicata</i>	Cat's-ear
* <i>Paspalum sp.</i>	Paspalum
* <i>Romulea rosea</i>	Onion Grass
* <i>Rosa rubiginosa</i>	Briar Rose
* <i>Rumex sp.</i>	Dock

REACH 2.

Site 7. Reynolds Rd Crossing “Dingley Dell”

North side

Native Species

AROTS VROTS	Name	Common Name
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum

Weed Species

<i>*Arctotheca calendula</i>	Cape Weed
<i>*Avena sp</i>	Wild Oat
<i>*Bromus spp</i>	Bromes
<i>*Cucumis myriocarpus</i>	Paddy Melon
<i>*Lycium ferocissimum</i>	African Boxthorn
<i>*Rosa rubiginosa</i>	Briar Rose
<i>*Schinus molle</i>	Peppercorn

REACH 2.

Site 7A. Reynolds Rd Crossing “Dingley Dell”

Native Species

AROTS VROTS	Name	Common Name
	<i>Austrostipa sp.</i>	Spear-grass
	<i>Acaena echinata</i>	Sheep's Burr
	<i>Allocasuarina luehmannii</i>	Buloke
	<i>Asperula conferta</i>	Common Woodruff
r	<i>Austrodanthonia bipartita</i>	Leafy Wallaby Grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Bursaria spinosa</i>	Sweet Bursaria
	<i>Carex apressa</i>	Tall Sedge
	<i>Carex inversa</i>	Knob Sedge
	<i>Dianella revoluta s.l</i>	Black-anther Flax-lily
r	<i>Dianella sp nov aff</i>	Grassland Pale Flax-lily
	<i>Dichelachne crinita</i>	Long-hair Plume-grass
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Isolepis nodosa</i>	Knobby Club-sedge
	<i>Juncus sp.</i>	Rush
	<i>Microlaena stipoides</i>	Weeping Grass
	<i>Melaleuca decussata</i>	Totem Poles
	<i>Phragmites australis</i>	Common Reed
	<i>Rumex brownii</i>	Slender Dock
	<i>Wahlenbergia sp.</i>	Bluebell

Weed Species

* <i>Aira cupaniana</i>	Quicksilver Grass
* <i>Avena fatua</i>	Wild Oat
* <i>Bromus diandrus</i>	Great Brome
* <i>Bromus hordeaceus</i>	Soft Brome
* <i>Cirsium vulgare</i>	Spear Thistle
* <i>Cynodon dactylon</i>	Couch
* <i>Ehrharta calycina</i>	Perennial Veldt Grass
* <i>Hypochaeris radicata</i>	Cat's-ear
* <i>Lactuca serriola</i>	Prickly Lettuce
* <i>Lagurus ovatus</i>	Hare's Tail
* <i>Lepidium africanum</i>	African Peppergrass
* <i>Holcus lanatus</i>	Yorkshire Fog Grass
* <i>Paspalum sp.</i>	Paspalum
* <i>Rosa rubiginosa</i>	Briar Rose
* <i>Trifolium angustifolium</i>	Narrow-leaf clover

REACH 3.

Site8. Clynes Rd

Native Species

AROTS VROTS	Name	Common Name
	<i>Austrostipa sp.</i>	Spear-grass
	<i>Austrostipa eremophila?</i>	Desert Spear-grass
	<i>Austrostipa sp.-fine leaf</i>	Spear-grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Carex apressa</i>	Tall Sedge
	<i>Carex inversa</i>	Knob Sedge
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Enneapogon nigricans</i>	Nigger-heads
	<i>Enteropogon acicularis</i>	Spider Grass
	<i>Eragrostis diandra</i>	Close-headed Love-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Isolepis nodosa</i>	Knobby Club-sedge
	<i>Juncus sp.</i>	Rush
	<i>Juncus pallidus</i>	Pale Rush
	<i>Juncus subsecundus</i>	Finger Rush
	<i>Lomandra filiformis ssp</i>	Wattle Mat-rush
	<i>Lomandra nana</i>	Dwarf Mat-rush

Weed Species

* <i>Acetosella vulgaris</i>	Sheep Sorrell
* <i>Arctotheca calendula</i>	Cape Weed
* <i>Avena fatua</i>	Wild Oat
* <i>Bromus diandrus</i>	Great Brome
* <i>Bromus hordeaceus</i>	Soft Brome
* <i>Cirsium vulgare</i>	Spear Thistle
* <i>Cynodon dactylon</i>	Couch
* <i>Ehrharta calycina</i>	Perennial Veldt Grass
* <i>Lagurus ovatus</i>	Hare's Tail
* <i>Lepidium africanum</i>	African Peppercross
* <i>Poa bulbosa</i>	Bulbous Meadow-grass
* <i>Polygonum arenastrum</i>	Wireweed
* <i>Rosa rubiginosa</i>	Briar Rose
* <i>Rumex sp.</i>	Dock
* <i>Schinus molle</i>	Peppercorn

REACH 3.

Site9. Mackeys Rd

South Side

Native Species

AROTS VROTS	Name	Common Name
	<i>Acacia implexa</i>	Lightwood
	<i>Alternanthera denticulata</i>	Lesser Joyweed
r	<i>Austrodanthonia bipartita</i>	Leafy Wallaby Grass
	<i>Austrodanthonia racemosa</i>	Stiped Wallaby-grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Austrostipa eremophila?</i>	Desert Spear-grass
	<i>Austrostipa mollis</i>	Supple Spear-grass
	<i>Callitris gracilis</i>	Slender Cypress-pine
	<i>Chrysocephalum apiculatum</i>	Common Everlasting
	<i>Crassula helmsii</i>	Swamp Crassula
	<i>Cyperus lucidus?</i>	Leafy Flat-sedge
r	<i>Dianella sp nov aff</i>	Grassland Pale Flax-lily
	<i>Dianella revoluta s.l</i>	Black-anther Flax-lily
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Euchiton involucratus</i>	Star Cudweed
	<i>Isolepis nodosa</i>	Knobby Club-sedge
	<i>Juncus sp.</i>	Rush
	<i>Juncus subsecundus</i>	Finger Rush
	<i>Lachnagrostis filiformis var 1.</i>	Common Blown-grass
	<i>Lythrum hyssopifolia</i>	Small Loosestrife
	<i>Lomandra nana</i>	Dwarf Mat-rush
	<i>Oxalis perennans</i>	Grassland Wood-sorrel
	<i>Phragmites australis</i>	Common Reed
	<i>Pittosporum angustifolium</i>	Weeping Pittosporum
	<i>Pseudognaphalium luteoalbum</i>	Cudweed
	<i>Senecio quadridentatus</i>	Cotton Fireweed
	<i>Themeda triandra</i>	Kangaroo Grass
	<i>Tricoryne elatior</i>	Yellow Rush-lily
	<i>Vittadinia gracilis</i>	Woolly New Holland Daisy
	<i>Wahlenbergia communis</i>	Tufted Bluebell
	<i>Wahlenbergia stricta</i>	Tall Bluebell

Weed Species

* <i>Acetosella vulgaris</i>	Sheep Sorrell
* <i>Arctotheca calendula</i>	Cape Weed
* <i>Asparagus asparagoides</i>	Bridal Creeper
* <i>Avena fatua</i>	Wild Oat
* <i>Bromus diandrus</i>	Great Brome
* <i>Cirsium vulgare</i>	Spear Thistle
* <i>Conzya bonariensis</i>	Flaxleaf (Hairy) Fleabane

<i>*Cynodon dactylon</i>	Couch
<i>*Ehrharta calycina</i>	Perennial Veldt Grass
<i>*Holcus lanatus</i>	Yorkshire Fog Grass
<i>*Hypochoeris radicata</i>	Cat's-ear
<i>*Lagurus ovatus</i>	Hare's Tail
<i>*Lepidium africanum</i>	African Peppergrass
<i>*Olea europaea</i>	Olive
<i>*Paspalum sp.</i>	Paspalum
<i>*Pennisetum clandestinum</i>	Kikuyu Grass
<i>*Phalaris aquatica</i>	Canary Grass
<i>*Polygonum arenastrum</i>	Wireweed
<i>*Polypogon monspeliensis</i>	Annual Beard grass
<i>*Rosa rubiginosa</i>	Briar Rose
<i>*Solanum nigrum</i>	Black Nightshade
<i>*Sonchus oleraceus</i>	Common Sow-thistle

REACH 3.

Site9A. Mackeys Rd

North Side –Rural City of Horsham Council land

Native Species

AROTS VROTS	Name	Common Name
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Austrostipa eremophila?</i>	Desert Spear-grass
	<i>Arthropodium strictum</i>	Chocolate-lily
	<i>Cyperus lucidus?</i>	Leafy Flat-sedge
	<i>Juncus sp.</i>	Rush
	<i>Pseudognaphalium luteoalbum</i>	Cudweed

Weed Species

<i>*Acetosella vulgaris</i>	Sheep Sorrell
<i>*Arctotheca calendula</i>	Cape Weed
<i>*Avena fatua</i>	Wild Oat
<i>*Bromus spp</i>	Bromes
<i>*Cynodon dactylon</i>	Couch
<i>*Ehrharta calycina</i>	Perennial Veldt Grass
<i>*Hypochaeris radicata</i>	Cat's-ear
<i>*Lagurus ovatus</i>	Hare's Tail
<i>*Lycium ferocissimum</i>	African Boxthorn
<i>*Oxalis pes-caprae</i>	Soursob

REACH 3.

Site 9B. Western Highway Crossing

Native Species

AROTS VROTS	Name	Common Name
	<i>Acacia acinacea</i>	Gold-dust Wattle
	<i>Acacia pycnantha</i>	Golden Wattle
	<i>Allocasuarina luehmannii</i>	Buloke
	<i>Austrodanthonia racemosa</i>	Stiped Wallaby-grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Austrostipa eremophila?</i>	Desert Spear-grass
	<i>Callitris gracilis</i>	Slender Cypress-pine
	<i>Carex apressa</i>	Tall Sedge
	<i>Cyperus lucidus?</i>	Leafy Flat-sedge
r	<i>Dianella sp nova ff</i>	Robust Grassland Pale Flax-lily
	<i>Elymus scaber</i>	Common Wheat-grass
	<i>Eragrostis diandra</i>	Close-headed Love-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus microcarpa</i>	Grey Box
	<i>Isolepis nodosa</i>	Knobby Club-sedge
	<i>Juncus sp.</i>	Rush
	<i>Lachnagrostis filiformis var 1.</i>	Common Blown-grass
	<i>Persicaria prostrata</i>	Creeping Knotweed
	<i>Vittadinia cuneata</i>	Fuzzy New Holland Daisy

Weed Species

* <i>Arctotheca calendula</i>	Cape Weed
* <i>Avena fatua</i>	Wild Oat
* <i>Bromus diandrus</i>	Great Brome
* <i>Cirsium vulgare</i>	Spear Thistle
* <i>Conzya bonariensis</i>	Flaxleaf (Hairy) Fleabane
* <i>Ehrharta calycina</i>	Perennial Veldt Grass
* <i>Holcus lanatus</i>	Yorkshire Fog Grass
* <i>Hypochaeris radicata</i>	Cat's-ear
* <i>Lagurus ovatus</i>	Hare's Tail
* <i>Lycium ferocissimum</i>	African Boxthorn
* <i>Olea europaea</i>	Olive
* <i>Oxalis pes-caprae</i>	Soursob
* <i>Paspalum sp.</i>	Paspalum
* <i>Phalaris aquatica</i>	Canary Grass
* <i>Picris echioides</i>	Ox-tongue Daisy
* <i>Rumex sp.</i>	Dock

REACH 3.

Site10. Powerline Crossing Downstream from Western Highway on private property

Native Species

AROTS VROTS	Name	Common Name
	<i>Allocasuarina luehmannii</i>	Buloke
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Carex apressa</i>	Tall Sedge
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus largiflorens</i>	Black Box
	<i>Eucalyptus microcarpa</i>	Grey Box

Weed Species

<i>*Arctotheca calendula</i>	Cape Weed
<i>*Avena fatua</i>	Wild Oat
<i>*Bromus sp</i>	Brome
<i>*Critesion marinum</i>	Sea Barley
<i>*Romulea rosea</i>	Onion Grass
<i>*Vulpia sp.</i>	Fescue

REACH 4

Site11. Channelised section of creek on private property

Native Species

AROTS VROTS	Name	Common Name
	<i>Acacia spp</i> –planted	Wattles
	<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Juncus sp</i>	Rush
	<i>Melaleuca sp</i> –planted	Honey-myrtle

Weed Species

<i>*Arctotheca calendula</i>	Cape Weed
<i>*Avena fatua</i>	Wild Oat
<i>*Bromus diandrus</i>	Great Brome
<i>*Cirsium vulgare</i>	Spear Thistle
<i>*Critesion marinum</i>	Sea Barley
<i>*Cynodon dactylon</i>	Couch
<i>*Hypochaeris radicata</i>	Cat's-ear
<i>*Lactuca serriola</i>	Prickly Lettuce
<i>*Phalaris aquatica</i>	Canary Grass
<i>*Picris echioides</i>	Ox-tongue Daisy
<i>*Polygonum arenastrum</i>	Wireweed
<i>*Rumex sp.</i>	Dock
<i>*Sonchus oleraceus</i>	Common Sow-thistle

REACH 4.

Site12. Burnt Creek 3. Horsham-Drung South Rd. -channelised section of creek on private property

Native Species

AROTS VROTS	Name	Common Name
	<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass
	<i>Austrodanthonia setacea</i> var. <i>setacea</i>	Bristly Wallaby-grass
	<i>Alternanthera denticulata</i>	Lesser Joyweed
	<i>Chamaesyce drummondii</i>	Flat Spurge
	<i>Chloris truncate</i>	Windmill Grass
	<i>Convolvulus remotus</i>	Bindweed
	<i>Eragrostis infecunda</i>	Southern Cane-grass
	<i>Eucalyptus largiflorens</i>	Black Box
	<i>Hemarthria uncinata</i>	Mat Grass
	<i>Juncus</i> sp.	Rush
	<i>Oxalis perennans</i>	Grassland Wood-sorrel
	<i>Sida corrugata</i>	Variable Sida
	<i>Whalleya proluta</i>	Rigid Panic

Weed Species

* <i>Arctotheca calendula</i>	Cape Weed
* <i>Avena fatua</i>	Wild Oat
* <i>Bromus diandrus</i>	Great Brome
* <i>Chenopodium album</i>	Fat Hen
* <i>Cirsium vulgare</i>	Spear Thistle
* <i>Critesion marinum</i>	Sea Barley
* <i>Cynodon dactylon</i>	Couch
* <i>Cucumis myriocarpus</i>	Paddy Melon
* <i>Heliotropium europaeum</i>	Common Heliotrope
* <i>Lactuca serriola</i>	Prickly Lettuce
* <i>Phalaris aquatica</i>	Canary Grass
* <i>Picris echioides</i>	Ox-tongue Daisy
* <i>Polygonum arenastrum</i>	Wireweed
* <i>Romulea rosea</i>	Onion Grass
* <i>Rumex</i> sp.	Dock
* <i>Sonchus oleraceus</i>	Common Sow-thistle

REACH 5.

Site13. Burnt Ck 2 Crossing, Horsham-Drung South Rd.

Native Species

Plants recorded from the site do not include those native species that have been replanted in this section.

AROTS	Name	Common Name
VROTS	<i>Acacia acinacea</i>	Gold-dust Wattle
	<i>Alisma plantago- aquatica</i>	Water Plantain
	<i>Alternanthera denticulata</i>	Lesser Joyweed
	<i>Atriplex leptocarpha</i>	Narrow-fruit Saltbush
	<i>Austrodanthonia caespitosa</i>	Common Wallaby Grass
	<i>Austrodanthonia racemosa</i> var. <i>racemosa</i>	Stiped Wallaby-grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia</i> sp.	Wallaby-grass
	<i>Austrostipa aristiglumis</i>	Plump Spear grass
	<i>Austrostipa eremophila?</i>	Desert Spear-grass
	<i>Austrostipa scabra</i>	Rough Spear-grass
	<i>Calocephalus citreus</i>	Lemon Beauty-heads
	<i>Chamaesyce drummondii</i>	Flat Spurge
	<i>Chloris truncata</i>	Windmill Grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus largiflorens</i>	Black Box
	<i>Enchylaena tomentosa</i>	Ruby Saltbush
	<i>Enteropogon acicularis</i>	Spider Grass
	<i>Eryngium ovinum</i>	Blue Devil
	<i>Goodenia pinnatifida</i>	Cut-leaf Goodenia
	<i>Hemarthria uncinata</i>	Mat Grass
	<i>Lachnagrostis filiformis</i> var 1.	Common Blown-grass
	<i>Lythrum hyssopifolia</i>	Small Loosestrife
	<i>Maireana decalvans</i>	Black Bluebush
	<i>Oxalis perennans</i>	Grassland Wood-sorrel
	<i>Persicaria prostrata</i>	Creeping Knotweed
	<i>Pseudognaphalium luteoalbum</i>	Cudweed
	<i>Typha domingensis</i>	Cumbungi
	<i>Whalleya proluta</i>	Rigid Panic

Weed Species

* <i>Aster subulatus</i>	Aster Weed (Smooth Fleabane)
* <i>Cynodon dactylon</i>	Couch
* <i>Critesion maritimum</i>	Sea Barley
* <i>Dactylis glomerata</i>	Cocksfoot
* <i>Gazania linearis</i>	Gazania
* <i>Hypochaeris radicata</i>	Cat's-ear
* <i>Juncus acutus</i>	Spiny Rush
* <i>Lactuca serriola</i>	Prickly Lettuce
* <i>Lolium rigidum</i>	Wimmera Rye-grass
* <i>Paspalum</i> sp.	Paspalum
* <i>Phalaris aquatica</i>	Canary Grass
* <i>Polygonum arenastrum</i>	Wireweed
* <i>Romulea rosea</i>	Onion Grass
* <i>Sonchus oleraceus</i>	Common Sow-thistle

REACH 5.

Site14. Stockton Drive Estate

Native Species

Plants recorded from the site do not include those native species that have been replanted in this section.

AROTS VROTS	Name	Common Name
	<i>Acacia acinacea</i>	Gold-dust Wattle
	<i>Alternanthera denticulata</i>	Lesser Joyweed
	<i>Austrodanthonia caespitosa</i>	Common Wallaby Grass
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Cyperus lucidus</i>	Leafy Flat-sedge
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus largiflorens</i>	Black Box
	<i>Eucalyptus microcarpa</i>	Grey Box
	<i>Enchylaena tomentosa</i>	Ruby Saltbush
	<i>Eragrostis infecunda</i>	Southern Cane-grass
	<i>Eryngium ovinum</i>	Blue Devil
	<i>Goodenia pinnatifida</i>	Cut-leaf Goodenia
	<i>Muehlenbeckia florulenta</i>	Tangled Lignum
	<i>Oxalis perennans</i>	Grassland Wood-sorrel
	<i>Triglochin procera sl</i>	Water Ribbons
	<i>Typha domingensis</i>	Cumbungi

Weed Species

* <i>Cynodon dactylon</i>	Couch
* <i>Critesion marinum</i>	Sea Barley
* <i>Fraxinus angustifolia</i>	Desert Ash
* <i>Heliotropium europaeum</i>	Common Heliotrope
* <i>Juncus acutus</i>	Spiny Rush
* <i>Lactuca serriola</i>	Prickly Lettuce
* <i>Lepidium africanum</i>	African Peppercross
* <i>Lolium rigidum</i>	Wimmera Rye-grass
* <i>Malva parviflora</i>	Small-flowered Mallow
* <i>Picris echioides</i>	Ox-tongue Daisy
* <i>Polygonum arenastrum</i>	Wireweed
* <i>Sonchus oleraceus</i>	Common Sow-thistle
* <i>Vulpia sp.</i>	Fescue

REACH 5.

Site 15. Just north of Williams Rd at Crossing 2

Native Species

Plants recorded from the site do not include those native species that have been replanted in this section.

AROTS	Name	Common Name
VROTS	<i>Acacia acinacea</i>	Gold-dust Wattle
	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
	<i>Austrodanthonia sp.</i>	Wallaby-grass
	<i>Austrostipa aristiglumis</i>	Plump Spear grass
	<i>Austrostipa sp.</i>	spear grass
	<i>Carex aptessa</i>	Tall sedge
	<i>Carex inversa</i>	Knob sage
	<i>Chloris truncata</i>	Windmill Grass
	<i>Crassula decumbens</i>	Spreading Stoncrop
	<i>Eragrostis infecunda</i>	Southern Cane Grass
	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus largiflorens</i>	Black Box
	<i>Halonagis heterophylla</i>	Varied Respwort
	<i>Juncus pauciflorus</i>	Loose flower rush
	<i>Juncus sp.</i>	Rush
	<i>Marsetia drummondii</i>	Nandoo
	<i>Melaleuca decussata</i>	Cross leaf Honey myrtle
	<i>Melaleuca pannistaminae</i>	Rough barked Honey myrtle
	<i>Oxalis perennans</i>	Grassland Wood-sorrel
	<i>Schoenus apogon</i>	Common Bog-sedge
	<i>Typha domingensis</i>	Cumbungi
	<i>Whalleya proluta</i>	Rigid Panic

Weed Species

* <i>Amsinckia sp.</i>	Amsinckia
* <i>Archtotheca calendula</i>	Cape Weed
* <i>Bromus sp.</i>	Brome
* <i>Cynodon dactylon</i>	Couch
* <i>Cyperus</i>	Gutter Sedge
* <i>Erhata calycina</i>	Perennial Veldt grass
* <i>Erodium cicutarium</i>	Common Heron's bill
* <i>Erodium moschatum</i>	Musky Heron's bill
* <i>Gazania linearis</i>	Gazania
* <i>Hordium marinum</i>	Sea Barley
* <i>Hypochaeris radicata</i>	Cat's-ear
* <i>Lolium rigidum</i>	Wimmera Rye-grass
* <i>Lycium ferocissimum</i>	African Box thorn
* <i>Malva parviflora</i>	Small flowered mallow
* <i>Oxalis pes-carpe</i>	Soursob
* <i>Paspalum sp.</i>	Paspalum
* <i>Picris echioides</i>	Ox-tongue daisy
* <i>Poa bulbosa</i>	Bulbous meadow Grass
* <i>Romulea rosea</i>	Onion Grass
* <i>Rumex sp.</i>	Dock
* <i>Sonchus oleraceus</i>	Common Sow-thistle
* <i>Trifolium subterrarium</i>	sub clover
* <i>Vulpia sp.</i>	Fescue

REACH 5.

Site16. Between Williams Rd and Cameron Rd

Native Species

Plants recorded from the site do not include those native species that have been replanted in this section.

AROTS VROTS	Name	Common Name
	<i>Carex aptessa</i>	Tall sedge
	<i>Juncus sp.</i>	Rush
	<i>Lachnagrostis filiformis var 1.</i>	Common Blown-grass
	<i>Lythrum hyssopifolia</i>	Small Loosestrife
	<i>Oxalis perennans</i>	Grassland Wood-sorrel
	<i>Typha domingensis</i>	Cumbungi
	<i>Whalleya prolata</i>	Rigid Panic

Weed Species

<i>*Amsinckia sp.</i>	Amsinckia
<i>*Archtotheca calendula</i>	Cape Weed
<i>*Aster subulatus</i>	Aster Weed (Smooth Fleabane)
<i>*Bromus sp.</i>	Brome
<i>*Cynodon dactylon</i>	Couch
<i>*Cyperus</i>	Gutter Sedge
<i>*Dactylis glomerata</i>	Cocksfoot
<i>*Gazania linearis</i>	Gazania
<i>*Hordium marinum</i>	Sea Barley
<i>*Hypochaeris radicata</i>	Cat's-ear
<i>*Lolium rigidum</i>	Wimmera Rye-grass
<i>*Malva parviflora</i>	Small flowered mallow
<i>*Paspalum sp.</i>	Paspalum
<i>*Phalaris aquatica</i>	Canary Grass
<i>*Picris echioides</i>	Ox-tongue daisy
<i>*Polygonum arenastrum</i>	Wireweed
<i>*Romulea rosea</i>	Onion Grass
<i>*Rumex sp.</i>	Dock
<i>*Trifolium subterraneum</i>	sub clover
<i>*Vulpia sp.</i>	Fescue
<i>*Xanthium spinosum</i>	Bathurst Burr
<i>Cirsium vulgare</i>	spear thistle
<i>Crassula helmsii</i>	Swamp Crassula
<i>Epilobium sp.</i>	Willow Herb

Appendix B
Habitat Quality Field Assessment Summaries for
Burnt Creek

Habitat parameter	Reach 1			Reach 2				Reach 3				Reach 4				Reach 5					
	Site	1	1a	2	3	4a	4b	5	6	7a	7b	8	9a	9b	10a	10b	11	12 revege	12	15	16
Epifaunal substrate / available cover		10	14	11	14	11	7	7	14	13	6	11	11	9	11	11	5	5	1	13	6
Pool substrate characterization		11	15	16	19	14	10	12	15	19	7	11	18	11	8	6	6	8	1	15	8
Pool variability		14	19	10	20	20	20	17	16	18	18	12	16	12	15	11	5	2	2	13	13
Sediment deposition		18	20	20	20	19	19	19	18	19	19	16	16	14	17	17	18	18	18	15	14
Channel flow status		14	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Channel alteration		15	16	16	20	19	19	19	17	18	14	15	18	18	15	15	2	4	2	11	13
Channel sinuosity		10	14	11	13	11	11	9	9	9	6	14	14	14	15	12	2	6	6	7	8
Bank stability (Left)		6	6	7	8	9	6	9	8	9	6	6	6	3	6	4	3	7	5	5	6
(Right)		6	6	8	8	9	6	9	8	9	6	6	6	3	6	4	3	7	5	3	5
Vegetative protection (L)		6	9	10	9	8	3	4	4	10	1	4	8	3	2	1	4	6	0	4	4
(R)		6	9	10	9	8	3	4	4	10	1	4	8	3	2	1	4	6	0	4	4
Riparian zone score (L)		7	9	8	8	7	4	3	4	9	2	3	8	3	4	1	1	5	0	3	3
(R)		7	9	8	8	7	4	3	4	9	2	3	8	3	4	1	1	5	0	3	3

Total HABSCORE	130	163	135	156	142	112	115	121	152	88	105	137	96	105	84	54	79	40	99	87
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Large Trees	2	1	1	2	2		2	2	2	2	2	2	2	2	2	2	0		0	1	0
Canopy Cover	1	1	1	1	1		0	0.5	0.5	1	0.5	1	0.5	0.5	0	0	0		0	0	0
Understory	2	5	5	4	2		0	3	0	2	0	5	0	3	0	0	0		0	0	0
Weediness	0	2	2	3	0		0	0	0	0	0	0	1	0	0	0	0		0	0	0
Recruitment	1	2	1	2	1		0	0	0	1	0	2	0	0	0	1	0		0	1	0
Organic Litter	1	1	1	1	1		1	1	0	1	1	1	0	1	0	0	0		0	0	0
Logs	0.5	1	0.5	1	0.5		0.5	0.5	0.5	1	0.5	1	0.5	0.5	1	0.5	0		0	0	0
Size	1.5	1	1	1	1		1	1	1	1	0	1	1	1	1	0	0		0	0	0
Neighbourhood	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0	0	0
Core Area	1	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0	0	0

RHA scores	10	14	12.5	15	8.5	4.5	4.5	8	9	4	4	13	5	8	3	1.5	0	2	0
Sub-reach length (m)	1756	561	3590	956	1832	1575	2728	2138	1016	1106	2415	713	1514	1187	1397	2465	1106	750	200
%	0	0	0.52	0.14	0.18	0.15	0.26	0.21	0.10	0.11	0.33	0.10	0.21	0.16	0.19	0.69	0.31	0.31	0.08

Weighted Averages	Reach 1	Reach 2	Reach 3	Reach 4	Reach
Weighted Reach Average (HABSCORE)	138.9	121.3	102.2	49.7	99.4
Weighted Reach Average (RHA)	12.3	6.3	5.6	1.0	4.6



Appendix C

Risk Assessment for the Burnt Creek

RISK WORKBOOK

Burnt Creek Reach 1			
LEGEND			
Likelihood	3	3	Consequence
Risk Ranking Score	27	low	Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

ENVIRONMENTAL	ASSET	Characterised by....	ASSET WEIGHTING	vegetation removal		Lack of protection		weed invasion		Altered Hydrology		exotic fauna		overgrazing		cropping		Earthworks	
				1	1	1	1	1	1	1	1	1	1	1	1	1	1		
	Substrate	Epifaunal substrate	3	3	3	4	4	4	1	5	4	3	3	3	3	2	2	4	4
		Pool substrate/sediment deposition		27	medium	48	medium	12	low	60	HIGH	27	medium	27	medium	12	low	48	medium
	Geomorphic character	planform/channelisation	3	3	3	4	2	4	1	5	3	3	1	3	1	2	1	4	5
		profile		27	medium	24	low	12	low	45	medium	9	low	9	low	6	low	60	HIGH
	Stream Banks	bank stability	3	3	5	4	4	4	2	5	4	3	4	3	5	2	4	4	5
		vegetative protection		45	medium	48	medium	24	low	60	HIGH	36	medium	45	medium	24	low	60	HIGH
Riparian Zone	human access/impact	4	3	5	4	4	4	5	5	4	3	5	3	5	2	4	4	4	
	integrity of native vegetation		60	HIGH	64	HIGH	80	VERY HIGH	80	VERY HIGH	60	HIGH	60	HIGH	32	medium	64	HIGH	

Asset	
4	Excellent
3	good
2	Fair
1	Poor

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

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

Score	
Low	< 25
Medium	50
High	75
Very High	> 75

RISK WORKBOOK

Burnt Creek Reach 2

LEGEND

Likelihood	3	3	Consequence
Risk Ranking Score	27	low	Risk Rating

Threatening Processes/Processes preventing improvements or meeting targets

ENVIRONMENT	ASSET	Characterised by....	ASSET WEIGHTING	vegetation removal		Lack of protection		weed invasion		Altered Hydrology		exotic fauna		overgrazing		cropping	
				1	1	1	1	1	1	1	1	1	1				
ENVIRONMENT	Substrate	Epifaunal substrate	3	4	3	5	4	4	1	5	4	4	3	4	3	3	2
		Pool substrate/sediment deposition		36	medium	60	HIGH	12	low	60	HIGH	36	medium	36	medium	18	low
	Geomorphic character	planform/channelisation	3	4	3	5	2	4	1	5	3	4	1	4	1	3	1
		profile		36	medium	30	medium	12	low	45	medium	12	low	12	low	9	low
	Stream Banks	bank stability	3	4	5	5	4	4	2	5	4	4	4	4	5	3	4
		vegetative protection		60	HIGH	60	HIGH	24	low	60	HIGH	48	medium	60	HIGH	36	medium
Riparian Zone	human access/impact	4	4	5	5	4	4	5	5	4	4	5	4	5	3	4	
	integrity of native vegetation		80	VERY HIGH	80	VERY HIGH	80	VERY HIGH	80	VERY HIGH	80	VERY HIGH	80	VERY HIGH	48	medium	

Asset
4 Excellent
3 good
2 Fair
1 Poor

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 most none

Score	<	>
Low	<	25
Medium	<	50
High	<	75
Very High	>	75

RISK WORKBOOK

Burnt Creek Reach 3

LEGEND



Threatening Processes/Processes preventing improvements or meeting targets

ENVIRONMENT	ASSET	Characterised by...	ASSET WEIGHTING	vegetation removal		Lack of protection		weed invasion		Altered Hydrology		exotic fauna		overgrazing		cropping	
				1	1	1	1	1	1	1	1	1	1				
ENVIRONMENT	Substrate	Epifaunal substrate	3	4	3	5	4	4	1	5	4	4	3	5	3	2	2
		Pool substrate/sediment deposition		36	medium	60	HIGH	12	low	60	HIGH	36	medium	45	medium	12	low
	Geomorphic character	planform/channelisation	3	4	3	5	2	4	1	5	3	4	1	5	1	2	1
		profile		36	medium	30	medium	12	low	45	medium	12	low	15	low	6	low
	Stream Banks	bank stability	2	4	5	5	4	4	2	5	4	4	4	5	5	2	4
		vegetative protection		40	medium	40	medium	16	low	40	medium	32	medium	50	medium	16	low
Riparian Zone	human access/impact	3	4	5	5	4	4	5	5	4	4	5	5	5	2	4	
	integrity of native vegetation		60	HIGH	60	HIGH	60	HIGH	60	HIGH	60	HIGH	75	HIGH	24	low	

Asset
4 Excellent
3 good
2 Fair
1 Poor

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	<	25
Medium		50
High		75
Very High	>	75

RISK WORKBOOK

Burnt Creek Reach 4

LEGEND



Threatening Processes/Processes preventing improvements or meeting targets

ENVIRONMENT	ASSET	Characterised by...	ASSET WEIGHTING	vegetation removal		Lack of protection		weed invasion		Altered Hydrology		exotic fauna		overgrazing	
				1	1	1	1	1	1	1	1	1	1		
ENVIRONMENT	Substrate	Epifaunal substrate	2	4	3	4	4	4	1	5	4	4	3	4	3
		Pool substrate/sediment deposition		24	low	32	medium	8	low	40	medium	24	low	24	low
	Geomorphic character	planform/channelisation	1	4	3	4	2	4	1	5	3	4	1	4	1
		profile		12	low	8	low	4	low	15	low	4	low	4	low
	Stream Banks	bank stability	2	4	5	4	5	4	2	5	4	4	4	4	5
		vegetative protection		40	medium	40	medium	16	low	40	medium	32	medium	40	medium
Riparian Zone	human access/impact	3	4	5	4	4	4	5	5	4	4	5	4	5	
	integrity of native vegetation		60	HIGH	48	medium	60	HIGH	60	HIGH	60	HIGH	60	HIGH	

Asset
4 Excellent
3 good
2 Fair
1 Poor

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 most none

Score	<	>
Low	<	25
Medium		50
High		75
Very High	>	75

RISK WORKBOOK

Burnt Creek Reach 5

LEGEND			
Likelihood	3	3	Consequence
Risk Ranking Score	27	low	Risk rating

Threatening Processes/Processes preventing improvements or meeting targets

ENVIRONMENTAL

ASSET	Characterised by....	ASSET WEIGHTING	vegetation removal		Lack of protection		weed invasion		Altered Hydrology	
			1	1	1	1	1	1		
Substrate	Epifaunal substrate	3	3	3	5	4	4	4	5	4
	Pool substrate/sediment deposition		27	medium	60	HIGH	48	medium	60	HIGH
Geomorphic character	planform/channelisation	2	3	3	5	2	4	1	5	4
	profile		18	low	20	low	8	low	40	medium
Stream Banks	bank stability	2	3	5	5	4	4	2	5	4
	vegetative protection		30	medium	40	medium	16	low	40	medium
Riparian Zone	human access/impact	2	3	5	5	4	4	5	5	4
	integrity of native vegetation		30	medium	40	medium	40	medium	40	medium

Asset
4 Excellent
3 good
2 Fair
1 Poor

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 most n one

Score	<	>
Low	<	25
Medium		50
High		75
Very High	>	75