Summary Report

Scoping Study

Waterway Management Plan

Hume to Yarrawonga Reach of the Murray River

May 2001
Murray Darling Basin Commission

Summary Report
Scoping Study –
Waterway Management Plan

Hume to Yarrawonga Reach of the Murray River

Project No. 2700050

May 2001
As a result of recommendations in 1999 by the Hume - Dartmouth Operations Review Reference Panel, the Commission agreed to establish an Advisory Group on Hume to Yarrawonga Waterway Management. This reflected the Commission’s intention to find and implement a sound and sustainable strategy to deal with the impact of flow regulation on riparian lands as well as on the ecology of the river and its environs in this reach.

The Advisory Group is a Committee established under the Murray Darling Basin Agreement. Its role is to advise the Commission how integrated waterway and floodplain management of the Hume to Yarrawonga reach of the Murray might best be undertaken, and to develop a program for implementation. Its members include local councillors, representatives of riparian landholders, and officers of relevant water and land management agencies including the Commission’s operating arm – River Murray Water.

The Group has been monitoring the continuing program of erosion control and revegetation works along this river reach, funded by the Commission through River Murray Water. However it has been conscious that this program is, by its nature, a reactive one. It set out to develop a broader and more strategic view of its task. This scoping study, produced in consultation with the Advisory Group by Consultants ID&A, is the result.

The summary report is supported by a series of discussion papers produced during the study. These are available in print or on a CD. The discussion papers contain a wide range of ideas and concepts, some of which were modified in the analysis leading up to the production of this summary report.

The summary report concentrates on a sustainable vision for the river, and on developing goals, a knowledge base and broad strategies for reaching that vision. The vision is to achieve a sustainable and equitable balance between the competing demands on the river and its environs in this region. The strategy provides an overall framework; its success will depend on joint and co-operative inputs from the local communities, from the wider benefiting communities and from Governments. It suggests a comprehensive series of key management programs from which detailed programs will be developed.

The Advisory Group is now poised to develop the management strategies in more detail and particularly with the local communities. As a first step, however, the results of work to date needs to be exposed to a larger audience including riparian landholders and the wider interested public.

The Advisory Group intends to hold a series of meetings to explain the conclusions reached and to seek direct response to the broad strategies developed so far. The outcome we seek is a range of short and long term actions, in co-operation with landowners, to achieve our joint vision for the River Murray.

David Dole
General Manager
River Murray Water
Hume to Yarrawonga Reach of the Murray River

Summary Report

Scoping Study – Waterway Management Plan

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1. Summary Report

Together with the Discussion Papers and the accompanying CD-ROM, this report provides the results of a scoping study outlining the options and priorities for waterway management on the section of the Murray River from Lake Hume to Lake Mulwala.

The report is the result of a combined effort by consultants ID&A Pty Ltd, River Murray Water and the Advisory Group, Hume to Yarrawonga Waterway Management (AGHYWM). Members of the AGHYWM are:

- Mr David Dole, General Manager, River Murray Water
- Mr Clarke Ballard, Project Manager, River Murray Water
- Mr Kelvin Baxter, Murray Lower Darling Community Reference Committee
- Mr Bruce Campbell, River Management Engineer, River Murray Water
- Mr Brenton Erdmann, Senior Engineer, Bulk Water Division, SA Water
- Cr Bill Gorman, Corowa Shire Council, NSW Local Government
- Dr Terry Hillman, Murray Darling Freshwater Research Centre
- Mr Mel Jackson, Manager Resource Access Works and Services, Murray Region, Department of Land and Water Conservation
- Mr Ian Lobban, Chairman, Murray River Action Group
- Mr Mac Paton, Member of Board, North East Catchment Management Authority
- Mr Kevin Ritchie, Acting Regional Manager, North East Region, Department of Natural Resources and Environment
- Mr Richard Sargood, Murray River Action Group
- Cr John Watson, Rural City of Wodonga, Victorian Local Government

2. Intent of the scoping study

The intent of this scoping study is to provide a knowledge base and broad strategies to guide management of the river over the next decade. These strategies are not intended to provide the detail of prescriptions for future actions. Instead they promote a set of key management and institutional programs that are designed to:

- stimulate an increasingly holistic approach to managing this section of river
- generate a level of acceptance, interest and commitment from stakeholders and the wider community and
- sustain continuing improvements in river condition into the future.

3. Scales

The scoping study has proceeded at two scales.

1. Across the whole section of river between Hume and Yarrawonga:

   - establishing and articulating an agreed set of goals for the medium to long term, and
recommending the broad strategies that will achieve these goals.

2. By example, the report then demonstrates how the goals and strategies for the whole Hume to Yarrawonga section can be further discriminated at the scale of “management zones” to:
   - describe more specific goals for a management zone; and
   - derive strategies to apply at a management zone scale.

4. Underpinning philosophy

The importance of goals

Progress in natural resources management is facilitated by identification and promotion of goals, broadly agreed amongst individuals, agencies, groups and enterprises. This recognises that successful natural resource management outcomes require contributions of effort, resources and goodwill from a range of sources and programs with a range of interests and imperatives.

Management options have been developed on the basis that the starting point for improving river condition is to distinguish and describe those aspirations for the river that are common currency. How do we want the river to be? Agreement to this “vision” allows progress from different directions toward common goals to be coordinated without those contributing losing autonomy or independence.

It also means that strategies must be flexible to respond to the sometimes rapid evolution of common goals.

For the Hume to Yarrawonga section of the River Murray, agreeing to broad goals for the whole section of river has proven to be comparatively easy. However as the focus sharpens to shorter management zones, and more specific actions are implied, then agreement to goals increasingly forces trade-offs and compromises between values that are more difficult to resolve.

The need for compromise

The AGHYWM has concluded that the many things that we value along the River and its floodplain can be broadly categorised as:

- water conveyance
- economic production (Hume to Yarrawonga)
- environmental values

The AGHYWM seeks to manage the river for all of these values.

The AGHYWM recognises that this will involve compromises. For example managing the river only for water conveyance would involve compromises to economic production and to environmental values. Correspondingly, management solely toward environmental outcomes implies concessions to economic values or the river’s water conveyance abilities. The AGHYWM seeks to manage toward a balance that represents the appropriate set of compromises for the present.
The following diagram shows these three values at the corners of a triangle. The location of the star suggests how trade-offs between these values are balanced under current conditions. Generally, environmental values in this section of river are compromised in favour of water conveyance values and economic production values; and economic production values are to some degree compromised in favour of water conveyance values.

5. Vision for the River

The AGHYWM has expressed a vision for the River. This vision highlights aspects of the above values that need to be retained or improved. It also suggests the balance that needs to be struck in making trade-offs and compromises.

The Hume to Yarrawonga Reach of the River Murray shall be managed as a component of a self-sustaining ecosystem that maximises compatible economic and water supply opportunities.

The Advisory Group also expressed more detailed goals:

To provide for the balanced use of the river to meet hydrological, ecological, geomorphological, landscape, and utilitarian values.

To provide for the passage of high quality water for consumers in the Hume to Yarrawonga reach and downstream.

To manage the physical form of the Murray River in a manner that is consistent with its laterally migrating, anabranching morphology.
To realise the value of vegetation in managing rates of channel change, improving aesthetics and landscape values and improving ecological values on the river and floodplain.

To operate storages to mitigate flooding where it conflicts with human activity and is consistent with water conservation and environmental goals.

To realise the value of passive recreation along the River to market the environment and educate the community.

The direction of change suggested by the vision is indicated in the following diagram.

This is not meant to imply that there are no “win-wins”. A change in the balance between values should always look to achieve improvement with minimum impact on other values in a two-stage process:

1. identify and exploit opportunities to improve the value where there is minimum conflict with other values; and then

2. facilitate trade-offs and compromises in other values where their current management will prevent the achievement of goals.

The following diagram summarises how the vision for the river and the compromises and tradeoffs lead to key management programs.
River Murray Hume Dam to Lake Mulwala

Vision to Management Programs

manage as a component of a self-sustaining ecosystem that maximises compatible economic and water supply opportunities

- balanced use to meet a range of values
- manage the anabranching morphology
- provide high quality water for consumers
- realise the value of vegetation
- mitigate flooding where compatible with other values
- realise the value of passive recreation

key management programs

- water conveyance
- economic production (Hume to Yarrawonga)
- environment

compromise

trade-offs
River Murray Hume Dam to Lake Mulwala

Key Management Programs

- **Identify ‘management zones’**
  - progressively build reach-by-reach knowledge base of condition, threats, opportunities, objectives

- **System Operation**
  - continually seek to create opportunities that reduce the impacts of system operations and system infrastructure

- **Community Support**
  - devise and implement a program of activities to generate increased understanding, recognition and acceptance of River Murray issues

- **Land Management Land Tenure**
  - agree principles & policies for a transparent process for both crown & private land
  - establish a major program of land use review in conjunction with land holders
  - engage individual land holders in discussions about their properties and needs
  - progressively reach agreements with land holders in the form of property by property plans

- **Physical Intervention**
  - establish a proactive program of intervention to manage physical form and vegetation
  - complement proactive program with landholder assistance, maintenance & emergency programs
  - set priorities for intervention using condition assessments and environmental and utilitarian objectives
  - implement detailed programs in up to 3 management zones at a time

- **Vegetation**
  - protect good remnants in low lying areas
  - protect remnants on the face and fringe of banks
  - facilitate regeneration
  - manage exotics
  - reintroduce species balance
  - replanting

- **Physical Form**
  - **anabranches**
    - vegetation
    - re-snagging
    - flow construction
    - flow control
    - erosion control
  - **morphologic diversity**
  - **bank erosion**
    - vegetation
    - rocks, gravel, etc.

- **Land Use Review**
  - establish a major program of land use review in conjunction with land holders
  - engage individual land holders in discussions about their properties and needs
  - progressively reach agreements with land holders in the form of property by property plans

- **Negotiate Partnerships, Easements or Purchases to realise Property Plans**

- **Establish a Proactive Program of Intervention to Manage Physical Form and Vegetation**

- **Complement Proactive Program with Landholder Assistance, Maintenance & Emergency Programs**

- **Set Priorities for Intervention Using Condition Assessments and Environmental and Utilitarian Objectives**

- **Implement Detailed Programs in up to 3 Management Zones at a Time**
6. **Key Management Programs**

A series of Key Management Programs are illustrated in the preceding diagram. These programs have been developed to direct the waterway management effort to those areas that will initiate persistent change toward the stated goals. The underlying black lines illustrate the interdependence of the programs and the strategies that they will generate.

The Key Management Programs are described below with more detail provided in the Discussion Papers.

**General Principles for River and Floodplain Management**

The Key Management Programs proposed herein have been derived from and should be implemented in accordance with the following principles:

- **Proactive management.** With increasing knowledge about the system, management should become increasingly proactive – implementing strategies that generate progress toward clear long-term goals, rather than reacting to short-term priorities.

- **Adaptive management** recognises that implementation of programs may need to proceed in the absence of all necessary information. Adaptive management also recognises that system response is subject to climatic and other variables that cannot always be predicted.

Adaptive management accepts that cautiously intervening in the system rather than confronting the system with a major one-off fix best and most economically treats problems with rivers and floodplains. This is contrary to the traditional capital works - maintenance paradigm of most management organisations.

Adaptive management requires progressive implementation associated with systematic monitoring and interpretation of outcomes. Management strategies are updated and improved in response to the changes that are observed through time.

- **Flexibility.** Some objectives will not be achieved in the short term. Management strategies should recognise that values and support for values will change through time, and strategies must be flexible enough to capitalise on any future opportunities that arise. In the same vein, the management options put forward here are deliberately not prescriptive. They are intended to be enabling strategies – providing the direction and the primary knowledge base for the on-going development of future activity programs in response to evolving understanding and changing demands.

- **Landscape scale change.** This reach of the river and its floodplain is to be managed as a component of a broader geographic, biological, social and physical system. Management is to broaden from a focus on the river channel to an appreciation of the river’s place in the overall ecological functioning of the floodplain, catchment and bioregion. Management goals recognise that the river and floodplain is no longer a pristine system but a system to be managed toward a complex compromise of ecological, social and economic outcomes.

- **Promoting stewardship.** Through awareness and understanding, strategies will promote a sense of obligation and a duty of care, widening from direct stakeholders to include the broader community and urban dwellers. Strategies will encourage an increasing and expanding willingness to contribute to the solution rather than seeking to lay blame for the problem. Strategies that generate enduring knowledge and cultural change are favoured.
Identify “management zones”

Some key management programs apply to the whole Hume to Yarrawonga section of the River while others are more specific to individual “management zones”. Regardless of the scale of application, all management will contribute to zone-by-zone management objectives as well as to the overall vision for the river.

Proposed “management zones” are set out on the following map (Figure 1). This map also shows the five river reaches that have conventionally been used to describe the Hume to Yarrawonga section of the river.

The accompanying CD-ROM and Discussion Papers provide a series of condition assessments for these management zones. The assessments form the basis of a zone-by-zone knowledge base that will be progressively updated and expanded as waterway management progresses with the required investigations and analysis.

Implementation

Priority Management Zone Program

Key Management Programs should be implemented in large-scale proactive intervention programs on an initial three “management zones” (number of zones depends on levels of resourcing). These three priority management zones should be selected on the basis of where best value can be gained in protecting and enhancing water conveyance, economic production and environmental values. In order of priority, best value for economic and environmental works will generally be achieved by management intervention that:

1. protects the best
2. restores areas with high values
3. rehabilitates areas that place other values at risk or provide good opportunities for restoring values
4. maintains degraded areas to prevent values declining to unacceptable levels

Landholder Assistance Program

The Key Management Programs should also be applied in a Landholder Assistance Program. This program would provide significant resources throughout the Hume to Yarrawonga section of the river to assist landholders that are outside the priority management zones. This program would respond to community support for the implementation of the Key Management Programs.

Maintenance and Emergency Programs

An emergency response program will be required to respond to major flood events and issues requiring immediate attention. The repair and maintenance of previous works will need to be carried out under a maintenance program.
Risk Based Prioritisation

Activities in all of the above programs should be prioritised to take account of risks, costs and opportunities. This concept is compatible with the management intervention priorities suggested above for the Priority Management Zone Program. It highlights the low value in investing resources in degraded areas that are more costly to rehabilitate or for which there is less benefit from rehabilitation. Less benefit may take the form of poor opportunities to improve values or low risk to existing values.

Based on the above considerations the procedure for selecting management zones for intervention should consider:

1. the variation in economic production values and environmental values along the Hume to Yarrawonga reach
2. where existing economic production values and environmental values are at risk
3. where there are opportunities to improve economic production values and environmental values
4. where you find the combination of highest existing values and highest risks/opportunities for improvement
5. the relative effort or cost of risk reduction or taking opportunities to improve values
6. weighing up the outcomes of points 4 and 5 (balancing benefit and cost) will indicate the management zones that should be selected. These then need a reality check against the AGHYWM’s vision and more specific goals for the Hume to Yarrawonga reach of the Murray River
Figure 1. River Reaches and Management Zones for the Implementation of Key Management Programs
7. **Establish a major program of land management / land tenure review in conjunction with landholders**

Develop the necessary principles and policies in consultation with landholders to initiate a major program of land management / land tenure review for both crown and private holdings.

Engage individual landholders in discussions about their properties and their needs through an agreed, transparent process. Progressively reach agreements with landowners in the form of farm by farm plans.

Negotiate partnerships, easements or purchases to allow:
- vegetation and physical form strategies to be implemented, and
- wetlands to be rejuvenated, while still allowing
- releases by River Murray Water to continue, and
- agricultural and other enterprises to remain viable.

8. **Establish a proactive program of intervention to manage physical form and vegetation**

Set priorities for intervention across management zones on the basis of condition assessments, goals and opportunities. Address both environmental and utilitarian outcomes but focus on programs that move toward goals rather than programs that react to problems.

Select up to three management zones at a time, and implement a decision making framework to develop detailed intervention programs for physical form and vegetation management.

Implement detailed programs of physical form and vegetation management thoroughly in up to three management zones at a time.

Monitor results, review and update goals and programs.

9. **Continually seek to create opportunities that reduce the impacts of system operations and system infrastructure**

Make on-going input to broader considerations of changes in flow management rules and develop opportunities to:
- progressively reduce the period of time that the channel flows at bankfull stage; and
- progressively provide flow variation to act as cues for improved ecosystem functioning.

Keep developments under continual review to identify opportunities to advocate for changes to Hume Dam infrastructure to allow
- warm water release; and
- fish passage.
10. **Promote community & stake holder understanding, recognition & acceptance**

Devise and progressively implement a program of interrelated activities designed to generate increased understanding, recognition and acceptance of River Murray issues amongst agencies, groups, local government, politicians, land holders and the broader community.

11. **Institutional Arrangements for Management**

In the short term to medium term, oversight of key management programs could be achieved by a coordinating committee sponsored by the MDBC. We recommend that the committee be serviced by an independent program coordinator with on-ground activities organised by arrangement with the Department of Land and Water Conservation and the North East Catchment Management Authority.

In the longer term, the establishment of a no-borders, autonomous waterway management agency should be pursued.

12. **Examples of strategy development for an individual management zone**

This scoping study does not provide detailed management prescriptions for individual management zones. Instead it describes a set of key management programs designed to move river condition toward its goals.

Three of the key management programs: system operation, community support and land use apply generally throughout this section of river. The remaining strategy, physical intervention in vegetation or physical form, is very management zone specific. Table 1 provides an overview of river condition for the five reaches from Hume to Yarrawonga, more detailed information on each management zone can be found in the Discussion Papers.
### Table 1. Overview of river condition and characteristics in the Hume to Yarrawonga Reach

<table>
<thead>
<tr>
<th>River Reach</th>
<th>River Chainages (km)</th>
<th>Main Anabranches</th>
<th>Main Tributaries</th>
<th>Condition of Vegetation</th>
<th>Condition of Physical Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hume Dam to Albury</td>
<td>2224 to 2188</td>
<td>Rapsey’s Creek</td>
<td>Kiewa River</td>
<td>Generally in poor condition with narrow stands of discontinuous vegetation that has poor structure, patchy regeneration and many weeds (mostly willow).</td>
<td>Accelerated deepening; reduced by bed armouring. Subsequent widening and straightening; sandy floodplain and lack of vegetation contributes to high erosion rates. Poor in-stream habitat; low morphologic diversity (de-snagging and erosion).</td>
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<td>Ryan’s Creek</td>
<td>Jack-In-Box Creek House Creek</td>
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<td>Wodonga Creek</td>
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<td>Carroll’s Creek</td>
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<td>Albury to Howlong</td>
<td>2188 to 2128</td>
<td>McFarlands Creek</td>
<td>Felltimer Creek</td>
<td>Highly variable from very poor to good. Very poor vegetation upstream of Travellers (Dights) Creek confluence with low recovery potential. Vegetation continuity good downstream of Travellers Creek on the Murray River, though lacks structure in many areas. Parlour Creek vegetation very poor.</td>
<td>Major anabranches conveying substantial proportions of mid-bank to bank full flows. Anabranches more efficient due to de-snagging and low sinuosity. Will widen (possibly deepen) and migrate laterally (more sinuosity). Anabranch development accelerated by flow regime, altered floodplain and poor riparian vegetation. Main channel will continue to lose bed diversity through riffle degradation and pool infilling. Poor in-stream habitat; low morphologic diversity (de-snagging and erosion).</td>
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<td>Reids Creek</td>
<td>Sprints Creek (NSW) Indigo Creek</td>
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<td>Cooks Lagoon</td>
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<td>Yellowbelly Creek</td>
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<td>Travellers (Dights) Creek</td>
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<td>Margery’s Creek</td>
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<td>Parlour Creek</td>
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<td>Sawyers Creek</td>
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<td>Common Creek</td>
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<td>Dunns Creek</td>
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<td>Punt Creek</td>
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<tr>
<td>Howlong to Corowa</td>
<td>2128 to 2083</td>
<td>Smart’s Creek</td>
<td>Murdering Hut Creek</td>
<td>Variable, mostly good to excellent vegetation condition. Very good continuity with some breaks at the Howlong end. Moderate vegetation structure with some scattered regeneration. Good connectivity to wetlands and billabongs.</td>
<td>Greater frequency of eroding banks than upstream due to actively widening and laterally migrating channels. Anabranch development accelerated by altered floodplain and poor riparian vegetation. Main channel will continue to lose bed diversity through riffle degradation and pool infilling. Shallowing and widening. Bank erosion helping to recruit snags. Generally poor in-stream habitat with some high value bed diversity and snag densities in anabranches.</td>
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<td>Fig Tree Creek</td>
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<td>Armstrong/Morris Creek</td>
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<td>Wild Duck Creek</td>
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<td>Little River</td>
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<td>Murphy’s Creek</td>
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<td>Gravel Creek</td>
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<td>Schmidt’s Creek</td>
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<td>Corowa Throat</td>
<td>2083 to 2075</td>
<td>Sandy Creek</td>
<td>None</td>
<td>Poor vegetation condition. Good continuity but only 1 to 2 trees wide. Very poor structure, low regeneration and weeds are common.</td>
<td>The main channel is relatively straight and the floodplain is narrow. The anabranch is not active and conveys overbank flows only. In-stream habitat and morphologic diversity are generally poor.</td>
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<td>Corowa to Lake Mulwala</td>
<td>2075 to 2044</td>
<td>Seppelt’s Creek</td>
<td>Black Dog Creek</td>
<td>Mostly excellent vegetation condition. Continuous broad vegetation with excellent connectivity to wetlands and billabongs. Structure and regeneration are good. Willows still present although scarce.</td>
<td>Sedimentation and widening probably from the Lake Mulwala backwater effect and sediment supply from deepening, bank erosion and anabranch development. Highly developed anabranches with decay of main channel delayed by de-snagging and flow regime induced widening. Poor in-stream habitat; low morphologic diversity (de-snagging and sedimentation).</td>
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<td></td>
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<td>Boiling Downs Creek</td>
<td>(Ovens River)</td>
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<td>Logie’s Creek</td>
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</table>
In the following sections of the report, we use two examples to describe how to use the knowledge of river condition to develop goals and strategies for two individual “management zones”. The examples focus on the specific physical intervention strategies for the management zone but also cross reference more general strategies where appropriate. The intervention strategies described herein have been put forward by ID&A and not endorsed by the AGHYWM.

The examples chosen are the Boiling Downs / Logies Creek management zone and the Wodonga Creek management zone. These examples were chosen for their contrasting values; the dominant natural values through the Boiling Downs management zone and the significant utilitarian values along the Wodonga Creek management zone. These zones are recommended for early management intervention, subject to prioritisation against the other “management zones”.
Figure 2 – Wodonga Creek Management Zone
13. **Wodonga Creek Management Zone**

**Condition assessment**

The Wodonga Creek management zone is generally in poor environmental condition as the result of clearing, erosion associated with anabranch enlargement, encroaching urban development other infrastructure and previous waterway works. The indigenous vegetation association, *Red Gum Woodland*, has been cleared over much of the floodplain and riparian zones within this zone. There are however, isolated sections of riparian zone and floodplain that have reasonable indigenous vegetation associations, particularly toward the upstream and downstream ends of the zone. Regeneration is notable in several areas within the zone. Woody weeds, predominantly willows, are scattered throughout this zone with several sections dominated by exotic vegetation. Condition trajectory and recovery potential is highly variable throughout this zone, depending on development and land use.

The aquatic ecosystem in this zone is heavily impacted by thermal pollution from Hume Dam. Colder than natural water temperatures particularly through summer and autumn have contributed to either the disappearance or severe depletion of native aquatic fauna species within this zone. Introduced species such as trout and carp dominate. Habitat for native animals both aquatic and terrestrial is generally poor due to clearing of the floodplain, de-snagging of the river channels, loss of macrophytes along stream banks, an unstable channel substrate and loss of hydraulic and geomorphic diversity. Condition trajectory for this zone is continued decline. Recovery potential is limited by water temperature and land use.

The Wodonga-Carrolls Creek anabranch has developed rapidly since European settlement of the area. In recent times, monitoring suggests Carrolls Creek to be one of the most rapidly developing anabranches in the Hume to Yarrawonga section of the River. These anabranches have undergone accelerated widening and deepening due to Hume Dam and flow regulation. Concurrent main channel decay has not occurred in this zone due to deepening associated with sediment starvation from the dam and de-snagging works having some influence on channel efficiency. The rate of deepening in the main channel has now declined with gravel armouring of the bed (also in the anabranches). Anabranch banks will erode rapidly due to lack of riparian vegetation and flow regulation. This is likely to increase anabranch sinuosity (which is already not much less than main channel sinuosity): hence this zone is likely to remain a multiple channel system for a long period.

Most channels within this zone exhibit very little geomorphic diversity. Willows are forming benches where planted, however more mature willows are causing bank erosion behind them as they encroach into the channel.

Water conveyance values are high through this zone as geomorphic processes maintain a multiple channel system with ample capacity. It is expected that regulation in its current form will enable the Wodonga Creek management zone to retain high water conveyance values into the foreseeable future.

Economic values are high in the Wodonga Creek zone with considerable transport infrastructure across the anabranches and the main channel. Valuable potable water supply, sewage treatment, power supply and infrastructure for other services are prevalent along this management zone. Grazing is the most common agricultural
use. Commercial and residential development is progressively encroaching on the floodplain.

High recreation values are present and continue to be developed along Wodonga Creek and this reach of the Murray River. The waterways themselves are used for recreational boating, jet skiing, canoeing, fishing, swimming and the Paddle Steamer Cumberoona. The riparian zone and floodplain have also been developed with walkways, parklands and associated facilities.

The proposed Gateway Island development and possible future infrastructure development (for example, railway and freeway developments) will see a marked increase in utilitarian values along this zone.

The detailed condition assessment for this zone is provided in the Discussion Papers.

**How does the current condition relate to our goals for the river?**

*The Hume to Yarrawonga Reach of the River Murray shall be managed as a component of a self-sustaining ecosystem that maximises compatible economic and water supply opportunities.*

Ecological values in the zone have been severely compromised by cold water release from Hume Dam, altered flow regime, de-snagging works, past clearing, willows and urban development. Some indigenous vegetation regeneration is occurring in areas no longer used heavily for cattle grazing. Encroaching urban development may reduce demand for grazing and allow increasing opportunities for sympathetic land use.

Flow regulation patterns, Hume Dam sediment trap efficiency, de-snagging and clearing of riparian vegetation have compromised geomorphic values. Enlargement of anabranch channels and to some extent the main channel through widening and deepening allows for in-channel passing of irrigation flows. Reduced sediment supply to infill any channels will mean this system remains a multiple channel reach for a long period to come, though the main channel may shift into Wodonga-Carrolls Creek.

The landscape is highly altered from a natural state, utilitarian values dominate the floodplain and river channels. This zone is used extensively for water supply, recreation, urban development, industry and agriculture.

The proximity of this zone to large populations could provide for excellent rehabilitation works demonstrations. Some isolated sections of riparian vegetation and instream habitat could be used as benchmark sites to demonstrate how environmental values can be achieved in an urban setting (adjacent Lincoln Causeway upstream of road bridge).

The potential of this zone in terms of water supply opportunities has been largely exploited. The economic and environmental values of this zone are; however, considerably lower than their potential.
Vision for the Wodonga Creek Management Zone

This zone provides a challenge for management to attain a sustainable indigenous ecosystem in a reach dominated by utilitarian values and substantially impacted by Hume Dam.

Our vision for the Wodonga Creek management zone is:

To achieve an ecologically sustainable river channel system within a floodplain dominated by utilitarian values. The management zone should have near continuous indigenous riparian vegetation corridors along all channels to buffer the river from the impacts of the urban, agricultural and commercial values. This zone should be utilised to promote ecotourism and generate an understanding in the community of the values and processes that are the River Murray.

Management Strategies

For the Wodonga Creek management zone, the overall management focus involves facilitating commercial, recreational and infrastructure development, whilst preserving and taking opportunities to improve environmental condition is.

In line with the vision, the overall strategy for managing this management zone is one of medium to high level intervention, aiming to establish a flow split between main channel and anabranches that that is reasonably easy to maintain and one that supports improved environmental conditions.

The following are a suggested set of management strategies for the Wodonga Creek management zone:

- On the basis of detailed geomorphic and hydraulic investigations:
- Manage this system as a multiple channel system with controlled anabranch development.

- Revegetation and structural measures will be the two primary means of reducing the rate of anabranch development. Carrolls Creek has developed rapidly, it requires grade control and/or lateral constrictions. Alignment training on Wodonga Creek appears to have been successfully implemented and may be required on other bends in the anabranch system.

- Erosion and meander cut-offs on the Murray River (eg. Gray’s Island) can contribute to the maintenance of a multiple channel system and hence may be favourable processes if they don’t conflict with significant economic values.

- Manage to accommodate the extensive utilitarian values, particularly Albury and Wodonga water supplies.

- Protection of infrastructure such as water supply, road, rail, electricity, telecommunications, urban, commercial and recreation assets from riverine processes. Seek 30 to 50 metre setbacks for riparian vegetation to maintain channel stability and environmental values. Otherwise use structural measures. Seek contributions from developers and infrastructure owners, particularly for structural measures.

- The presence of significant development on the floodplain in conjunction with tourism on Gateway Island may generate opportunities for sponsorship of ecotourism and river rehabilitation sites.

- Establish a near continuous indigenous riparian vegetation corridor.

- Indigenous riparian vegetation associations in reasonable condition are achievable in this zone in developed areas. Riparian vegetation should be made continuous and of minimum 30 to 50 metre width depending on site conditions. Such a corridor will improve bank stability and the chances of developing a sustainable indigenous ecosystem. It is also critical to ecotourism development and for capitalising on an improved appreciation of the environment in this population centre.

- Moderate to good condition isolated areas of remnant indigenous vegetation exist near the upstream end (Wodonga Ck offtake to km 2202) and downstream end (~km2194 to km2188) of this zone. These areas present opportunities for restoration to closer to an intact state with low management and financial inputs and less conflict with utilitarian values. These sites would also be of value for marketing the environment and are recognised to a degree in the Gateway Island plans.

- Isolated stands of exotic vegetation such as *Salix babylonica* may be appropriate through urban areas in recognition of European heritage values.
• Utilise proximity to large population to demonstrate what constitutes a healthy River Murray with a sustainable indigenous ecosystem. (Refer also to the “community support” key direction.)
  o Rehabilitation areas and demonstration sites need to be established.
  o Education programs, onsite signage, etc.
• Seek opportunities to alter dam infrastructure to allow for a sustainable indigenous aquatic ecosystem. (Refer also to the “system operation” Key Management Direction.)
  o Existing Hume Dam outlet arrangement severely constrain ecological values in this zone. Alterations are needed to provide a warm water outlet and to allow fish passage.
• Improve habitat in all channels.
  o The main channel has been extensively de-snagged, it now has a much lower LWD loading than expected for this type of river. Re-snagging should be undertaken, for stabilisation and habitat improvement. Revegetation with red gums is essential to provide future natural recruitment of viable LWD.
• Stormwater management plans and implementation are a high priority for these urban areas. Continued improvement in wastewater treatment is also important. The current augmentation of Wodonga wastewater treatment plant is an important step forward.
• Manage and market recreation in this zone such that recreational activity capitalises on and reflects well on the features of the zone.
  o Position recreation opportunities in the Wodonga Creek management zone to provide the more “urban” recreation experience with facilities developed to a high standard to cater for significant visitor numbers and mitigate the impacts.
  o The continued increase in recreation along this zone will demand greater management intervention to ensure the compatibility of uses.
  o More “urban” camping and boating activities should be attracted to this zone from adjacent reaches where it may conflict more with environmental values and private landholdings.
  o High speed motorised craft will increasingly conflict with other recreation uses and will be increasingly dangerous as natural LWD loadings are restored. Demand for such activities should be directed to nearby open water facilities such as Lake Hume or Mulwala.
  o The return of natural LWD loadings will make passage for the P.S. Cumberoona increasingly difficult. In the medium term a trade-off will need to be made between the value of aquatic habitat and river morphology and the value of passage for the P.S. Cumberoona. The heritage value of paddle steamers on the Murray River needs to be recognised.
Land Use Issues

To be able to implement the management strategies, **Floodplain Management Plans** will be developed in consultation with Landholders in accordance with the “land use” key direction. These plans will develop the trade-offs required to achieve the vision and goals for the management zone with landholders on the basis of the priority areas that have been mapped. These plans will facilitate the ongoing implementation of works via agreements including options of:

- partnership agreements with landholders
- purchase of areas of land (options for leasing back the land)
- exit option for landholders

The detailed process for the development of Floodplain Management Plans is described in the Discussion Papers.
Figure 3 - Boiling Downs Management Zone
14. Boiling Downs Management Zone

**Condition assessment**

The Boiling Downs management zone is closer to an intact state than most of the other management zones. Vegetation is mostly in good condition with continuous *Red Gum Forest* and *Red Gum Woodland* throughout. Notably this area is linked to other vegetation associations on the terrace on the NSW side of the river in the Collendina State Forest. Woody weeds are generally not prevalent, however tree willows and seeding shrub willows are present. Areas that are not used frequently for grazing have the highest potential for recovering to a near intact state.

The vegetation in this area provides excellent habitat for birds, mammals, reptiles and other indigenous terrestrial fauna. This vegetation also assists in providing valuable food sources and habitat (LWD and shade) for aquatic fauna. The abundance and diversity of indigenous fauna is likely to be higher in this management zone compared to others due to its condition and proximity to the lower Ovens River and Lake Mulwala. The ecological condition of this zone has been degraded by the altered flow regime, desnagging, introduced species such as carp and willows and reduced water temperatures (though the influence of Hume Dam on water temperature will be least in this reach).

The physical form of this zone is subject to similar processes to those occurring along the rest of the river downstream of Howlong. Due to the amount of indigenous vegetation on the waterways, however, erosion rates would be closer to natural rates than elsewhere. The processes affecting physical form are channel widening through bank erosion, bed aggradation, accelerated anabranch development and main channel decay. These processes lead to diminished hydraulic and geomorphic diversity and hence diminished habitat. They are largely responses to modifications post European settlement such as regulation, de-snagging, clearing of vegetation and grazing.

Anabranch capture will occur in this zone due to the present level of development and favourable differences in physical parameters, however it is likely this reach will remain a multiple channel system at moderate flows for a long time to come. Widening through bank erosion will contribute more mobile sediment to the stream, however it will also contribute LWD, which should increase diversity and hence in-stream habitat values.

The detailed condition assessment for this management zone is provided in the Discussion Papers.

**How does the current condition relate to our goals for the river?**

*The Hume to Yarrawonga Reach of the River Murray shall be managed as a component of a self-sustaining ecosystem that maximises compatible economic and water supply opportunities.*

This management zone is currently meeting water conveyance requirements through anabranch enlargement. The general widening trend and de-snagging has delayed main channel decay. The effect of widening on increasing main channel conveyance may have been reduced by aggradation of the stream bed in this reach. Widening at accelerated rates in all channels is damaging high value riparian vegetation.
Wetland wetting and drying cycles have been altered by flow regulation. The landscape is restoring itself following past clearing. Good riparian and floodplain vegetation are assisting in reducing the rates of erosion caused by flow regulation. Erosion is aiding recruitment of LWD to the channels. Anabranch capture of the main channel is highly favoured by comparative sinuosities.

This management zone, due to its proximity to the Ovens River and Lake Mulwala, combined with the extensive good indigenous vegetation provides an excellent opportunity for marketing the environment. Agriculture is limited in this reach by access difficulties, the frequency of inundation and crown land. Much of the land on the left floodplain is managed by Parks Victoria or covered by an agricultural licence. A short reach on the right hand side, mostly above floodplain level, is the Collendina State Forest.

Vision for Boiling Downs Management Zone

The Boiling Downs management zone has some of the most intact vegetation and habitats between Hume and Yarrawonga. This reach is furthest from the impacts of Hume Dam and closest to the high environmental values in the lower Ovens River. There are also links to terrace vegetation in the adjacent Collendina State Forest. These factors provide the opportunity for Boiling Downs to achieve the greatest environmental value of any management zone in the whole Hume to Yarrawonga section of the River. Our vision for this zone reflects this.

Our vision for the Boiling Downs management zone is:

To have near intact indigenous vegetation associations and habitats in channels and wetlands, along all riparian zones and the majority of floodplain areas that will provide for ecosystem function and process, will sustain a rich diversity of indigenous aquatic and terrestrial fauna and provide for more natural rates of geomorphic processes.
Waterway Management Strategies

For the Boiling Downs management zone, preserving and taking opportunities to improve environmental condition is the focus of the strategies to be implemented.

In line with the vision, the overall strategy for managing this zone is one of low level intervention, accepting that the anabranch will eventually capture the main channel, but intervening to the extent that the current (unnatural) rate of capture is managed to prevent unnecessary environmental impact.

The following are a suggested set of management strategies for the Boiling Downs Creek management zone.

- On the basis of detailed geomorphic and hydraulic investigations:
  - Manage the proportion of high flows carried by the anabranches by exerting hydraulic influence at the anabranch outtakes and along the anabranches. For example, construct lateral constrictions or weirs at the Logies Creek outtake.
  - Based on survey information and geomorphic investigation consider grade control structures to manage bed degradation.
  - Manage the rate of meander development through grade control using appropriate structures and lateral control using vegetation and timber pile fields.
  - Alignment training or bank erosion control at sites of least development of anabranch channel(s) to slow anabranch
development, eg. shortly upstream of West Corurgan Pumping Station.

- Generally allow bank erosion and meander cut-offs on the main channel if they occur as these help to postpone the main channel being abandoned.
- Ensure colonisation with willow species, particularly *Salix fragilis*, does not accelerate main channel abandonment.

- Manage all riparian and floodplain areas within a buffer distance of up to 50 metres such that vegetation can slow erosion rates (zone width may be reduced at Shepparton Formation).
  - The majority of the upstream end of Boiling Downs Creek requires revegetation along the riparian zone, as do isolated sections of the Murray River and Logies Creek channels.
  - Focus on shrub and macrophyte species on banks.

- Manage all channels for maximum habitat values.
  - The Murray River channel has been extensively de-snagged in the past, LWD loadings in this reach are lower than expected for this type of river, no further snag removal should be carried out. Ensure riparian vegetation associations are adequate for future natural recruitment of large river red gums.
  - LWD placement in the anabranch should be considered. Avoid sourcing debris from the adjacent floodplain.
  - Sediment influxes to this management zone from upstream (predominantly bedload sand) have aggraded the bed and diminished hydraulic diversity. Upstream works to reduce sediment supply and some structural works (re-snagging and/or timber piles) should be considered to stabilise bedload and restore diversity.

- Restore vegetation species balance, with particular focus on macrophyte and shrub species on banks.
  - Manage grazed areas to allow the regeneration/revegetation of indigenous groundcover, macrophytes and shrubs in the buffer zone. Strategic revegetation should be in non grazed areas as required to restore structure and species mix.
  - Establish monitoring sites to accurately record impacts of the regulated flow regime on indigenous vegetation associations and identify measures to overcome the impacts.

- Rehabilitate, reconnect and protect rare remnant vegetation on the upper floodplain.
  - Protect upper terrace vegetation, such as in the Collendina State Forest and the link to lower floodplain and riparian vegetation and habitats.
o Restore links along the right bank of Boiling Downs Creek with fencing and revegetation/regeneration.

o Restore links along the left bank of the Murray River, particularly where the channel impinges on the terrace.

- Restore floodplain wetlands, in particular their flow seasonality.
  
o Control selected wetlands connected by surface flows, where feasible, by inlet and outlet structures.

  o Consider intervention using subsurface impermeable barriers for selected high value wetlands connected by subsurface flows. Otherwise rely on changes to system operation. (Refer also to the “system operation” Key Management Direction.)

  o Restore vegetation associations within the wetlands.

  o Manage European Carp

- Resolve conflicts between land use and high regulated flow with outcomes that also benefit environmental values. (Refer also to the “land use” Key Management Direction.)

  o The island within Boiling Downs Creek, Logies Creek and the Murray River should be managed as above. Flood easements or land purchase may be considered to provide for complete rehabilitation of this area.

  o The right floodplain downstream of Boiling Downs Creek re-entry (~km 2045.2 to km 2041.7) should be considered for altered management and rehabilitation.

  o The left floodplain (starting at ~km2053) is only really impacted by large flow events and hence has higher agricultural value and lower priority for floodplain rehabilitation.

- Provide for access to water for the West Corurgan Private Irrigation District Pumping Station and for local landholders with existing access rights.

- Remove all exotic vegetation.

  o Woody weeds such as willows and other highly invasive exotic vegetation should be priorities for removal. Willows are growing in this reach as a result of local plantings and from seed or transported branches from upstream plantings.

- Manage and market recreation in this management zone such that recreational activity capitalises on and reflects well on the natural features of the reach.

  o Position recreation opportunities in the Boiling Downs management zone to provide the more remote wild land experience (of, for example, national park and alpine areas). The riparian vegetation and proximity of the lower Ovens offer a fairly unique opportunity to offer this niche of recreation on a low land river.
More “urban” camping, power boating activities should be concentrated in the adjacent and highly developed Corowa Throat management zone.

- Realise opportunities in this management zone for marketing the environment to the wider community.

- The good condition, high value vegetation and habitats within this reach provide one of the best opportunities to develop and demonstrate an example of a “managed” healthy River Murray, in the Hume to Yarrawonga reach. Demonstration/monitoring sites and signage in this management zone will assist in generating understanding within the local and broader community. (Refer also to the “community support” key direction.)

**Land Use Issues**

To be able to implement the management strategies, Floodplain Management Plans will be developed in consultation with Landholders in accordance with the “land use” Key Management Direction. These plans will develop the trade-offs required to achieve the vision and goals for the management zone with landholders on the basis of the priority areas that have been mapped. These plans will facilitate the ongoing implementation of works via agreements including options of:

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