July 2002

Goulburn Broken Regional Floodplain Management Strategy

GOULBURN
BROKEN
CATCHMENT
MANAGEMENT
AUTHORITY



Acknowledgements

The Goulburn Broken Catchment Management Authority would like to thank those who contributed to the development of this Strategy, in particular the Floodplain Management Steering Committee, which comprised:

Tom Perry	GBCMA	Board Member
Robert Dare	GBCMA	Upper Goulburn Implementation Committee
Bill O'Kane	GBCMA	CEO
Phil Stevenson	GBCMA	Executive Officer - Mid Goulburn Broken Implementation Committee
Russell Wealands	GBCMA	Executive Officer - Upper Goulburn Implementation Committee
Ken Sampson	GBCMA	Executive Officer - Shepparton Irrigation Region Implementation Committee
Russell Pell	GBCMA	Shepparton Irrigation Region Implementation Committee
Hubert Miller	GBCMA	Upper Goulburn Implementation Committee
Alan Robison	GBCMA	Mid Goulburn Broken Implementation Committee
Peter Robinson	GBCMA	Mid Goulburn Broken Implementation Committee
Alan Sutherland	GBCMA	Mid Goulburn Broken Implementation Committee
John Onas	NRE	Floodplain Management Unit
Simon Glass	Dept. of Infrastructure	Senior Project Officer
David Blore	Dept. of Infrastructure	Regional Manager
Gavin Kelly	Victorian SES	Regional Officer
Alan Baker	Bureau of Meteorology	Manager Hydrology and Flood Warning Services, Victorian Regional Office
Mariyapilla Seker	G-M W (Tatura)	Principle Production Analyst
David Merrit	Campaspe Shire	Manager Strategic Planning
Peter Brown	Delatite Shire	Group Manager Shire Services
Kurt Bruhn	City of Greater Shepparton	Director Infrastructure Strategy and Contracts
Greg McKenzie	City of Greater Shepparton	Manager Development Approvals
John Main	Mitchell Shire	Asset Manager
Michael Byrne	Moira Shire	Manager Assets and Infrastructure
David Beard	Murrindindi Shire	Director Engineering Services
Ian Pridgeon	Murrindindi Shire	Senior Planner
Frank Dawson	Strathbogie Shire	Manager Development Services
Phil Squires	Strathbogie Shire	Manager Engineering Services

We would also like to thank staff from local government, the NRE, BoM, VICSES, members of Landcare groups and those who attended forums, made submissions and provided support and advice.

Disclaimer

ISBN: 1-920742-00-X

Foreword

Floodplains are the commercial, social and environmental arteries of the Goulburn Broken region. Associated with waterways, they are generally highly fertile areas, and support major agricultural, food processing, forestry and tourism industries of vital significance to the region and to the State.

Over the past decade there has been increasing recognition given to the ecological significance of floodplains, the interdependence of the health of the river and its floodplain, and the role periodic flooding plays in maintaining this connection.

Regular flooding enhances agricultural productivity by increasing soil moisture, recharging groundwater and depositing fertile silt across the floodplain. However, flooding can also interfere with agricultural practices, destroying high value crops and livestock. It can also impose significant social and economic costs, disrupting communities, causing personal hardship, property damage, and in extreme cases, loss of life.

The Goulburn Broken Catchment has the highest average annual damages of the 9 Catchment Management Authorities outside Melbourne - in excess of $30 million per annum out of a combined total of approximately $100 million per annum.

This Strategy focuses on floodplain management, which is associated with planning and prevention activities to minimise flood impacts, together with related environmental activities. It is a part of a broader "flood management" framework, which includes emergency management and flood recovery. In general terms the Goulburn Broken Catchment Authority has a key role in floodplain management activities while other agencies like the Victoria State Emergency Management Service and the Department of Human Services have key roles in response and recovery activities.

Floodplain management is an integrated component of water resource management within the Goulburn Broken catchment. It is essentially about balancing the risks of living on floodplains with their inherent advantages. The challenge to those responsible for floodplain management is to balance the natural functions of floodplains to convey and store floodwater, with the economic and social benefits that those living on floodplains expect.

This Strategy provides direction for floodplain management within the Goulburn Broken catchment. A program for identifying and managing flood protection assets is detailed. Other programs include a variety of non-structural measures such as flood studies, floodplain management plans, flood warning systems, emergency response activities, statutory planning and community education and awareness.

The total cost of implementing all activities identified in the Strategy is $30 million, excluding the cost of rehabilitating the Lower Goulburn Floodplain and floodplain management works arising out of the current Shepparton-Mooroopna Floodplain Management Study. Implementation is heavily dependent on State and Federal government funding.

Implementation of the Strategy will take time and will rely on the cooperation and development of partnerships with the community, Local Government Authorities, State government agencies and other stakeholders. Even when programs are complete, the threat of flooding will remain. The Floodplain Management Strategy should therefore be regarded as a tool to manage our floodplains and not as an end in itself.

This strategy does not address the institutional arrangement associated with the ownership, operation, maintenance and replacement of the publicly owned levees on the Murray and Goulburn Rivers.

Stephen Mills
Chair
Goulburn Broken Catchment
Management Authority

Table of Contents

Seymour 1975.
Hume High Way,
Tallarook St and High St.
Photograph: The Age.

Goulburn River.

E Executive Summary

Introduction

The Goulburn Broken catchment comprises the catchments of the Goulburn and Broken Rivers and a small part of the Murray Valley, downstream of Bundalong. The catchment covers a total of 2,391,544 ha, or 10.5% of Victoria's total land area.

Approximately 185,000 people live in the catchment. The total employment pool for the catchment is 65,000, of whom 17,000 are employed in agriculture and associated industries.

The region is widely regarded as the "foodbowl" of Australia with a healthy food processing industry that contributes 25% of Victoria's export earnings. Total catchment production value is approximately $7.8 billion per annum.

The main primary industries are horticulture, dairy, cropping, wine grapes, wool, forestry and grazing (sheep and beef). The region supports a large fruit and vegetable food processing industry centred around Shepparton with value adding in other commodities such as milk products, wineries and meats.

Tourism is increasingly important to the catchment, particularly in the southern areas where easy access from Melbourne provides numerous options for tourism and recreational activities.

Goulburn Broken Catchment Assets

Natural Assets

Significant problems affecting the catchment include:

- Clearing of native vegetation and replacement with shallow rooted annual pasture and crops in the dryland, which has led to rising water tables and increased salt in the surface soils. The major impacts of salinity are expected to be destabilisation of river banks and increased salt in water, which in turn affects costs and productivity of a range of agricultural enterprises.
- The development of agriculture, mining and forestry activities, which has affected biodiversity. Only around 7% of the native vegetation cover of the region at European settlement remains in the middle and lower catchment and ninety-five species of plants and 85 animal species are considered threatened. In addition the wide array of pests and weeds in waterways and floodplains has created further threats to riverine health.
- Pollution of waterways by nutrients flowing from irrigation drainage, sewerage, sediment mobilisation, and intensive animal industries.
- The effects of climate change, which are just beginning to be explored. The Goulburn Broken catchment has a lot at stake in relation to climate change and stability.

1916 Flood, Cnr Station, Wallace and Tallarook Streets, Seymour.

Economic Assets

These include:

- Primary industry assets (eg irrigation and drainage infrastructure).
- Secondary industry assets (eg food processing).
- Tertiary industry assets (eg transport and storage).
- Quaternary industry assets (eg retail and services).
- Quintenary industry assets (eg tourism, recreation).

All capital assists in the catchment contribute to the gross regional production of about $7.8 billion each year. The existing assets are being added to at an investment rate of about $100 million each year (or $ 1 billion over 10 years).

Social Assets

These include:

- Strong regional centres of Benalla, Seymour and Shepparton.
- A close network of social organisations and strong community representation through a wide range of government and community organisations.
- Good cross section of educational facilities and resource centres such as libraries and internet access.
- Some public transport services.

Legislation

State Legislation that is relevant to the Regional Floodplain Management Strategy (RFPMS) includes:

- Water Act 1989;
- Catchment and Land Protection Act 1994; and
- Planning and Environment Act, 1987.

Corporate and Strategic Planning Framework

Under NRE's Corporate Plan, a key objective is to produce healthy rivers and catchments that underpin sustainable environments, industries and communities. This is further developed in NRE's Catchment and Water Division's Strategic Plan (2001/02-2003/04), which includes the following goals:

- All Catchment and Water products and investment should be tailored to maximise the well being of communities and minimise environmental footprint.
- A unifying framework to achieve healthy land, water and communities that provides clarity and direction for staff, collaborators and providers to bring together their rich mix of skill, competence and experience.
- A system which secures and targets investment by government and citizens to ensure sustainable future.

Two other Strategies influence the implementation of the RFPMS:

- Victoria Flood Management Strategy (1998), which provides its overall framework.
- River Health Strategy and Victorian Biodiversity Strategy (1998), which provides the mechanism for implementing Ecologically Sustainable Development.

Shepparton, 1974.

Regional Development

The State Government is committed to a policy of providing economic infrastructure so that the private sector can create jobs, particularly in rural and regional Victoria. Opportunities for boosting regional development include a State Industry Plan built on a framework of "balanced development" and a "whole of Victoria" approach to infrastructure spending across Victoria.

Implementation of the regional floodplain management strategies will provide a foundation for ensuring regional economic development in floodplains is consistent with the protection and enhancement of each region's natural resources. The increased prosperity of each region relies on the expansion and consolidation of agricultural, commercial and industrial activities in a manner that recognises and has regard for the flood risk. A balanced and sustainable approach to development on the floodplains contributes to the well being of communities.

Implementation Framework

The Goulburn Broken CMA is a statutory Authority under the Water Act 1989 and the Catchment and Land Protection Act 1994, and is required to operate according to specified protocols.

The GBCMA Board has set up three geographically and community based Implementation Committees, which have the responsibility of developing and putting in place on ground works, as well as acting as a valuable link between the GBCMA Board and the community. Two Coordinating Committees also exist to ensure a consistent region-wide approach to issues such as biodiversity and river health and water quality.

Implementation of the RFMS is priority based and will be delivered across the Goulburn-Broken catchment as funding opportunities become available.

Development of the Strategy and Consultation

The Strategy was prepared with the assistance of a steering committee comprising representatives from key agencies with interests in the region, in particular:

- the GBCMA;
- the Department of Natural Resources and Environment, the Department of Infrastructure; the Bureau of Meteorology, Goulburn-Murray Water and the Victoria State Emergency Service; and
- representatives of the seven key municipalities within the region.

Underpinning the development of the Strategy was a comprehensive consultation process though workshops and public meetings.

Spring 1993, Shepparton flood.

Photograph: Shepparton News.

The Issues

Flooding is a natural event and flood-related problems such as property damage, crop loss, and isolation, generally result from the community's choice to live on the floodplain, intentional or otherwise. Accordingly the issues associated with flooding relate to the identification and management of risk treatment measures, flood response activities, and understanding and communicating the flood risk.

Flooding of Urban and Rural Land

The primary purpose and natural function of the floodplain is to convey and store floodwaters. For this reason encroachments on the floodplain by developments and interference with major river flows need to be controlled and non-structural measures to mitigate flooding need to be implemented in preference to structural works wherever possible.

For many areas there is a need for flood studies and floodplain management plans, to better understand flood behaviour and impacts, and for risk treatment measures such as statutory land use planning improvements and levees, where justified from an economic, social and environmental point of view. There is also a need for flood monitoring and flood mapping so that potential impacts can be minimised.

Flooding and Environmental Values

Flooding is a natural phenomenon upon which a number of environmental benefits depend. Floodplains, waterways and their associated wetlands, have a fundamental role in supporting flora and fauna habitats of special significance. Floods replenish wetlands, transport food supplies and trigger stages in the life cycles of many plants and animals.

Floodplains provide natural overland flow paths and storage areas where floodwaters remain for slow release as stream heights recede, thereby reducing the potential for channel erosion from high energy flows. Nutrients, debris and sediment settle out during his process, protecting waterways from high sediment and nutrient loads and contributing to floodplain productivity.

Substantial areas of natural wetlands have been lost since European settlement. Notwithstanding this, the conservation value and status has been recognised for many watercourses.

Cultural Heritage

Watercourses provide a focal point for human activity, and consequently they are associated with cultural values that are important to the community. The Murray Valley supported a relatively large aboriginal population for many thousands of years prior to the arrival of European settlers and when considering works and measures in the floodplain, consideration needs to be given to recognising and respecting cultural sites.

Flooding and Agriculture

The opening up of the area to agriculture, which commenced in the 1840s, heralded the development of a significant number of agricultural, commercial and public assets. Large areas have been cleared to

May 1974, flood after peak, showing Sunday Creek Confluence.

agriculture. Water storage reservoirs have been constructed and waterways have been substantially modified in many areas to permit access for stock and people to waterway frontages, to convey water for irrigation purposes during the summer months, to drain excess water and to protect properties from flooding.

This has effected species biodiversity, and impacted on the health of waterways and the catchment in general.

Flood Protection

Raised structures such as levees, channels, raised roads and railways, spoil banks and bridges have had a significant impact on flood behaviour, affecting flow distributions, flow velocities and depths. While they can have significant benefits in reducing flood damages, they can however, have a number of dis-benefits including:

- a reduction in riverine and floodplain habitats, leading to an isolation of wetlands and a reduction in seeding for biological diversity;
- an increase in flow concentration and stream power, leading to increased flow rates, flood levels and stream and bank erosion;
- a reduction in the frequency of deposition of fertile material across the floodplains;
- intensification of land use in the protected areas of the floodplain, with a resultant increase in social disruption and flood damages when the levee fails;
- a reduction in soil moisture; and
- creating a false expectation of being immune from floods greater than the levees are designed to protect.

For levees and structures that act as levees to be effective, they must be adequately maintained. This requirement has often been overlooked in the past.

Achievements 1996-2001

Major achievements over the five years to 2002 are listed below:

- the production of flood maps from available flood information, an airborne laser scanning project that collected topographic, vegetation and other information, and a photogrammetric survey of the Shepparton-Mooroopna, Tatura Districts;
- substantial improvements in the quality and quantity of statutory planning matters affecting floodplain management;
- at least 13 flood studies;
- levee audits for the PWD (Murray River) and Lower Goulburn Levees and for Nathalia;
- completion of a flood protection scheme for Cobram and commencement of schemes for Euroa and Benalla;
- comencement of the first stage of a scheme for rehabilitating the northern floodplain of the Lower Goulburn River;
- a number of improvements in flood monitoring and emergency response planning;
- flood warning improvements for many areas, including flood warning system upgrades at Benalla, Euroa and Seymour.

1950 flood, Mosquito Depression.

The Strategy – Vision, Objectives and Targets

The Vision for floodplain management that has been endorsed by the Steering Committee is:

To work with the community to achieve best practice floodplain management for the benefit of current and future generations, through the implementation of the Regional Floodplain Management Strategy.

Objectives for each of the projects are:

Program 1. Asset management

- Facilitate sustainable management of existing strategic floodplain assets, having regard for level of service, ownership, roles and responsibilities of maintenance and cost sharing arrangements.

Program 2. Flood Studies and Floodplain Management Plans

- Develop and implement flood studies and floodplain management plans having regard for social, environmental, cultural and economic costs and benefits.

Program 3. Statutory Land Use Planning

- Provide decision tools to allow development and land use practices to be compatible with the flood risk.
- Streamline the referral process to screen out unnecessary referrals, and provide consistent performance-based criteria to all stakeholders.

Program 4. Development Assessment Guidelines

- Ensure development proposals in floodplains are dealt with in a consistent, efficient and effective manner, in accordance with sound floodplain management principles.

Program 5. Control of Works and Activities

- Develop an integrated program for controlling works on floodplains.

Program 6. Emergency Response Planning

- Articulate GBCMA's role in emergency response activities, flood awareness for the community and flood warning.

Program 7. Flood Monitoring Action

- Facilitate effective flood monitoring and timely flood data collection to improve flood knowledge within the catchment.

Program 8. Information Management Systems

- Develop and implement an integrated floodplain information system that provides high quality data for use in floodplain management decisions.

Program 9. Education and Communication

- Improve the community and other stakeholders' knowledge of flood management issues.
- Ensure that flood management decisions are made in accordance with best practice principles.

Wier St Nathalia, 1916.

Building Capacity and Catchment Standards

The GBCMA has adopted a series of "catchment standards" with standard practices for managing all issues within the catchment. Linkages between these standards and the RFMS are described in Appendix B.

Implementation

Implementation of the Regional Floodplain Management Strategy will be achieved over a significant period of time. Targets, key result areas and performance indicators have been developed to help measure progress.

The RFMS will be implemented in accordance with the Regional Catchment Strategy Best Practice Standards.

The RFMS has been developed to provide strategic direction for floodplain management in the Goulburn Broken catchment and forms the Floodplain Management Sub Program in the GBCMA's Regional Catchment Strategy.

The Regional Floodplain Management Strategy will be implemented through nine programs. They are summarised as follows:

Asset Management (Program 1)

This program seeks to facilitate the sustainable management of existing strategic floodplain assets by:

- upgrading and maintaining an asset register;
- investigating legal liability issues for some levees;
- facilitating management/maintenance plans;
- ensuring strategic levees are maintained; and
- reviewing asset management plans.

It is GBCMA's policy that no new levees are to be constructed other than to protect an existing dwelling and its immediate curtilage, unless they are part of an Approved Scheme.

Generally individuals will manage private levees and related assets unless alternate arrangements are identified in a floodplain management plan. The relevant local government or government agency will manage those assets constructed from public funds or by a public authority. The GBCMA has overall responsibility for managing the program through the Regional Floodplain Manager.

Flood Studies and Floodplain Management Plans (Program 2)

This program outlines an extensive program of urban and rural flood studies and floodplain management (FPM) plans to be undertaken in accordance with established priorities, and for the implementation of any associated works, using a risk management approach.

Generally municipalities are responsible for managing urban flood studies and FPM plans, while GBCMA is more strategically placed to manage rural studies and FPM plans. However, all studies and FPM plans will be steered by a committee with wide stakeholder representation. The GBCMA has overall responsibility for managing the program.

Goulburn River south of Alexandra, 1975.
Photograph: The Age.

Statutory Land Use Planning (Program 3)

The Statutory Land Use Planning program essentially concentrates on improving existing policies and the statutory planning framework, with the aim of improving the efficiency and effectiveness of planning permit processing.

To help achieve this, draft VPP amendments have been written for the key municipalities in the catchment, thereby providing a performance-based approach for decision-making. In addition, areas requiring additional mapping have been identified, for incorporation into municipal planning schemes.

Municipalities are responsible for ensuring their planning schemes incorporate the best information on flooding available, with technical assistance from DOI, NRE and GBCMA. The GBCMA has overall responsibility for managing the program through the Regional Floodplain Manager.

The update of the VPPs and incorporation of flood maps into municipal planning schemes will be implemented by the relevant municipalities. Under the new VPP format planning schemes, monitoring and review must be undertaken at least once every three years.

Development Assessment Guidelines (Program 4)

Best Practice guidelines for assessing buildings, subdivisions, whole farm plans/ raised earthworks and fences have been included as an appendix in a separate report, as a supplement best practice guidelines prepared by other Authorities. They are intended to help municipalities and the GBCMA assess planning permit applications from a flood perspective.

Control of Works and Activities on Floodplains (Program 5)

A common concern of the community, municipalities, CMAs and a number of government agencies, is how to take action against a person who has constructed works that have, or would have, a potential to change the passage of water and cause damage.

Statutory planning instruments, such as municipal planning schemes and Section 173 Agreements under the Planning and Environment Act 1987, remain the most effective means of controlling new works on floodplains.

Declaration of flood prone land under the Water Act, 1989, may however be a useful measure for modifying or removing inappropriate works.

Tasks under this program are as follows:

- introduce declarations, bylaws and other measures for controlling existing and new development on floodplains, where appropriate; and
- develop arrangements with municipal councils and other relevant groups over statutory enforcement of illegal works.

Photograph: The Herald & Weekly Times.

Emergency Response Planning (Program 6)

Flood emergency management planning and flood warning are fundamental components of the floodplain management process. Their purpose is to manage floods to maximise public safety and to reduce preventable flood damages.

At the regional level Victoria Police has established committees for police districts to plan for a coordinated response to all emergencies. The GBCMA can assist the community and other agencies in reducing community flood risk and damage costs and for integrating its actions and commitments with emergency response, through the adoption of a "Flood Response Action Plan." At the local level Councils have prepared municipal emergency management plans, which include flood sub plans and local flood response plans where appropriate.

Flood warning in Australia (in the context of a "whole of catchment" approach) relies on a cooperative and partnership approach between the three tiers of government as well as the local community. Resources are stretched and any improvements to existing arrangements must be carefully weighed against the capacity of stakeholders to pay.

This program focuses on introducing measures for assisting the community's awareness to respond to flooding in a pro-active way. It also focuses on measures that will assist, in the long term, the development of a regional monitoring partnership, responsible for operating and maintaining the flood data collection network, to be funded by respective beneficiaries, and integrated with any flood warning system upgrades. These will be developed in accordance with the Victorian Flood Warning Consultative Committee's (VFWCC's) statewide flood warning system development plan.

The main tasks under this program are as follows:

- identification of flood warning system needs;
- data network management; and
- community awareness activities.

Flood Monitoring Actions (Program 7)

Flood monitoring can be divided into three components:

- Assessing the impacts of floods by gathering, analysing and documenting all available flood information. A "Flood Assessment Manual" has been developed to assist this process, as part of its "Flood Response Action Plan.
- Communicating this information to other stakeholders. This relies on two-way communication between all relevant agencies, with the GBCMA providing technical advise on flood impacts and relying on flood information from BoM, G-MW, municipalities and other stakeholders.
- Collecting flood data, preferably during and immediately after a flood. All stakeholders, especially the GBCMA, municipalities and BoM, have a role in this process.

Near Alexandra, 1975.
Photograph: The Age.

The main tasks under this program are as follows:

- test and update the GBCMA's "Flood Response Action Plan regularly;
- review asset performance when tested by floods; and
- collect flood data.

Information Management Systems (Program 8)

This program focuses on maintaining, enhancing and improving flood information available to the Authority in order for it to carry out its floodplain management functions effectively. A key requirement is to have capability for accessing and utilising digital flood data.

The main tasks under this program are as follows:

- Review and improve the quality of flood data.
- Continue to develop GIS capability. Training, equipment upgrades and the purchase of relevant software and data will continue.

Education, Promotion and Communication (Program 9).

In order for the GBCMA (and other stakeholders) to perform their role in flood management to a high standard, it needs to keep up to date on floodplain management issues and practices locally, statewide, nationally and internationally. This requires an understanding of current best practice principles, a commitment to training programs and seminars for those involved in flood and floodplain management activities, and supporting and contributing to community flood education and awareness.

The GBCMA has a role in this process by:

- facilitating and support community education and training programs;
- promoting the use of and maintaining a library of best practice manuals and guidelines;
- being aware of and supporting relevant research projects; and
- encouraging networking and workshops of those involved in flood management.

The main tasks under this program are to:

- organise and implement training programs, conferences and workshops; and
- prepare public awareness material.

Implementation – Investment Plan

The total cost of implementing all program tasks in the regional floodplain management strategy, excluding works associated with implementing the Lower Goulburn Floodplain Rehabilitation Scheme or the Shepparton-Mooroopna Floodplain Management Study is:

- $22.9 million capital cost; and
- $0.7 million per annum recurrent costs.

Further details are provided in Appendix D.

Average capital and recurrent costs to the GBCMA are approximately $5 million and $0.5 million per annum respectively. This assumes all tasks will be implemented within a 10-year timeframe. These costs exclude GST.

Benefits

The adoption and implementation of the Strategy will bring a significant number of benefits to the Goulburn Broken Region, including:

- improved community awareness of floodplain management issues;
- acceptance of roles and responsibilities for floodplain management and identification of opportunities for partnership arrangements, particularly between the Authority and Local Government;
- clarification of cost sharing arrangements;
- adoption of best practice principles in floodplain management, particularly in relation to land use planning;
- a reduction in flood damages, when the studies, works, flood warning systems, asset management systems and statutory planning measures are implemented;
- identification of information needs and information systems required for sound decision making; and
- adoption of floodplain management measures that will reduce the flood risk.

Cost Benefit Analysis

A cost benefit analysis will be required where flood studies and floodplain management plans consider structural flood mitigation measures or flood warning upgrades.

Some indication of the relative benefits of non structural measures can be obtained by considering the reduction in the growth of annual average damages. This was calculated as $30.6 million by Read Sturgess and Associates (Ref. 6).

Assuming an average rate of growth of 1.03% and a discounted rate of 8%, the net benefit achieved through an average reduction of 0.15% in AAD, is $6.079 million. The total cost of statutory planning and other supportive measures to introduce non structural controls (Programs 3, 4 and 5) is less than $1.5 million, indicating, at this discount rate, a benefit cost ratio of at least 4.

Priority Setting

Priority setting for the various tasks within each program was based on an assessment of the economic, social and environmental benefits of each task, using a "Rapid Appraisal Method," developed by Read Sturgess and Associates for NRE where appropriate, and by subjective analysis where this method was not appropriate.

Funding and Cost Sharing Arrangements

Cost sharing arrangements have been considered in the context of:

- a user pays philosophy wherever possible;
- an understanding of funding sources; and
- identification of opportunities for cost sharing.

High cost activities, such as flood studies and floodplain management plans, structural works and flood warning system improvements may qualify for Federal and State funding assistance, subject to compliance with funding guidelines. Local Government and the GBCMA will bear local costs, with apportionment subject to negotiation on a case by case basis.

1 Introduction

About the Catchment

The Goulburn Broken catchment comprises the catchments of the Goulburn and Broken Rivers and a small part of the Murray Valley, downstream of Bundalong. as shown in Map 1. The catchment covers a total of 2,391,544 ha, or 10.5% of Victoria's total land area. Land use is shown in Table 1 and Map 2.

The catchment is part of the Murray Darling Basin. Although it covers only 2% of the basin it provides 11% of its stream flow. Usage is as follows:

- Within the catchment 803,000 ML
- Exported to adjoining catchment 565,000 ML.
  (for irrigation, stock and domestic)
- Average flows to Murray River 1,760,000 ML.

Approximately 185,000 people live in the catchment. The total employment pool for the catchment is 65,000, of whom 17,000 are employed in agriculture and associated industries.

Catchment Description

Goulburn Catchment

The Goulburn River catchment is the largest in Victoria and covers 1,619,158 ha. A number of the Goulburn's major tributaries rise on the northern slopes of the Great Dividing Range. These include the Big, Delatite, Howqua and Jamieson. The catchment covers 7.1 % of the State's total area and has a mean annual water discharge of 3,040,000 ML, which is 13.7% of the total state discharge. It produces on average, 1.8 ML/ha.

Terrain varies from the high ranges to the Murray Plain. The northern half of the catchment is relatively flat.

Rainfall varies substantially. The high country in the south east experiences cool winters with persistent snow and an average annual rainfall greater than 1,600 mm. Rainfall decreases northward and in the far north of the catchment is less than 450 mm per year, only one third of the annual evaporation in that area.

The entire catchment was once forested. While native vegetation has been retained in far south mountainous areas where slopes are steepest, clearing for agriculture has been extensive in its valleys and plains.

Streamflow along the Goulburn River has been modified by two major features, Lake Eildon and Goulburn Weir. Operation of Eildon Reservoir has reduced the July to September flows passing Eildon to 33% of the total annual flow, allowing an increase of the January to March flows to 23% of the annual flow. The Goulburn Weir near Nagambie and associated diversion channels to the east and west, have reduced the average annual down river flow to 1,340,000 ML, less than half the pre-regulated flow. Lake Eildon has a capacity of 3 390 000 ML and supplies more than half of the water used in the Shepparton Irrigation Region.

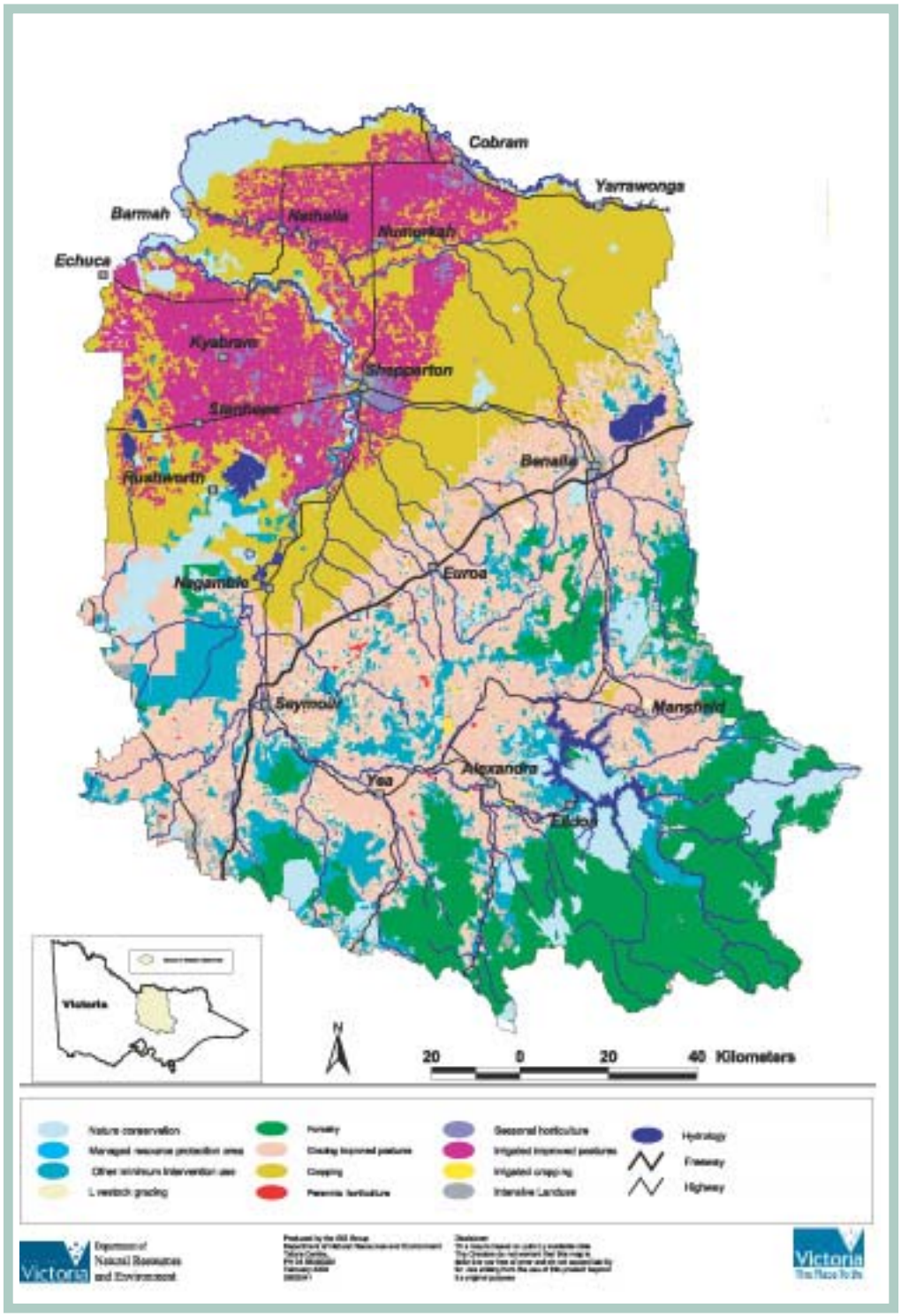
There are several large rural cities - Shepparton, Mooroopna, Seymour and Kyabram, and another eight with populations over 1,500.

Nathalia, 1916.

Map 1 Catchment Map

Map 2 Land Use

Euroa, 1993.



Railway Hotel, Nathalia, 1916.

Broken Catchment

The Broken River is a tributary of the Goulburn River. It joins the Goulburn River just south of Shepparton. The basin also includes the catchment of the Broken Creek which diverges from the Broken River just west of Lake Mokoan and flows in a north westerly direction to the River Murray. It also includes small areas of the Murray catchment, south of the River Murray.

The catchment covers 772,386 ha or 3.4% of Victoria's total area and has a mean annual flow of 325,000 ML (0.42 ML/ha).

As with the Goulburn catchment, climate varies considerably. In the south average annual rainfall about 1270 mm. Rainfall decreases to about 700 mm near Benalla, 550 mm at Dookie and 470 mm at Cobram. Across the northern section rainfall generally decreases to the west.

Streamflow is extremely variable between seasons and between years. The three months July to September account for over half the annual stream flow. Annual flow has varied from a minimum of 5,000 ML in the drought year of 1943 to maxima of more than 1,000,000 ML in the flood years of 1917 and 1956.

Most of the catchment has been cleared for agriculture which supports grazing in the south, and mixed cereal and dryland grazing in the central region. A large part of the northern section is within the Murray Valley irrigation district, with production for fruit growing, dairying and livestock production.

There are two major water storages and two smaller storages. Lake Nillahcootie was constructed in 1967 and has a capacity of 40 000 ML. Lake Mokoan, constructed in 1971, has a capacity of 365,000 ML. These reservoirs provide reliable water supply for stock domestic and irrigation supplies. On Ryans Creek two small reservoirs, operated by Ovens Water provide water to the town of Benalla.

Benalla is the largest urban area. There are numerous smaller towns including Cobram, Nathalia, Yarrawonga and Numurkah. Part of Shepparton is within the catchment.

Table 1: Land Use in the Goulburn Broken Catchment (after OCE 1991).

Land use type (ha)	Goulburn	Broken	Total
Native Vegetation (forested)	544,000	111,650	655,650
General agriculture (dryland)	916,800	532,070	1,448,870
Intensive agriculture (irrigation)	110,400	99,330	209,730
Plantation (pines)	6,400	16,940	23,340
Urban	1,600	770	2,370
Total (ha)	1,579,200	760,760	2,339,960

Benalla, 1993.

National Importance of the Catchment

The Goulburn Broken catchment is widely regarded as the "foodbowl" of Australia with production from the irrigation region (covering 270,000 irrigated hectares) supporting a very large food processing industry that contributes 25% of Victoria's export earnings. The Dryland area covers 1.4 million ha and generates $1.9 billion each year. Total catchment production value is approximately $7.8 billion per annum (Michael Young and Associates 2001). Over the last 5 years capital investment in food processing has been $630 Million.

The main primary industries are horticulture, dairy, cropping, wine grapes, wool, forestry and grazing (sheep and beef). The region supports a large fruit and vegetable food processing industry centred around Shepparton with value adding in other commodities such as milk products, wineries and meats.

Irrigation areas to the west also rely on water supplied from the Goulburn Broken catchment. Infrastructure investment by Goulburn Murray Water alone totals $2.6 billion. This relies heavily on the water resources in the Goulburn Broken catchment.

Tourism is increasingly important to the catchment, particularly in the southern areas where easy access from Melbourne provides numerous options for tourism and recreational activities. Such activities need to be managed with care as to ensure waterways and water quality for downstream users are not degraded. Main tourism activities include wineries, snow and water skiing, camping, 4 wheel driving and fishing.

Goulburn Broken Catchment Assets

Natural Assets

In 2001 the CSIRO produced an inventory of ecosystems goods and services in the Goulburn Broken catchment. This inventory also identified the natural assets and trends in their condition. The following is taken from this inventory, and the risks to the assets will be discussed in terms of social, environmental and economic threats in the Risk Management Section.

Soil

Clearing of native vegetation and replacement with shallow rooted annual pasture and crops in the dryland has led to rising water tables and increased salt in the surface soils. The Catchment contains about 4,500 ha of land that are affected by dryland salinity, which is growing at 5% per year. The major impacts of salinity are expected to be destabilisation of river banks and increased salt in water, which in turn affects costs and productivity of a range of agricultural enterprises. Significant salt loads move from the dryland region of the catchment into the irrigation region and the River Murray causing concerns about water quality. Water tables also are rising in the irrigation area and severe salinisation is predicted by 2020 if nothing is done. There are significant areas of sodic (high sodium) soils in the catchment, which can be unstable and erode easily. Sodic soils interact with salinity, irrigation and rainfall in various ways that can either enhance or mask the effects of sodicity.

Blake St Nathalia, 1916.

Understanding sodicity in the context of changing irrigation regimes and rising water tables is an emerging challenge for the Catchment. The acidity of soils has increased in many parts of the catchment since the practice of European-style agriculture began over 150 years ago. Overuse of fertilisers and sub-clovers contributes to soil acidity. Acidity affects the structure of the soil and its ability to support native vegetation, crops and pastures.

Biota

The ecosystem services provided by biota depend on there being a diversity of life forms performing a range of functions. This diversity is part of what we call biodiversity. Diverse species underpin processes that help prevent erosion and control salinity, filter and purify water and assimilate wastes, provide protection from floods and control of pests and diseases, maintain fertile soils that are the basis for agriculture, attract tourists, and provide cultural, spiritual and intellectual fulfilment in different ways to all people. Science is not able at this time to predict the impact of losing species on delivery of ecosystem services, so we have to conclude that there are risks in species loss that should be minimised. In the Goulburn Broken, the suites of species that make up ecosystems have undergone considerable change since European settlement through development of primary industries, including agriculture, mining and forestry.

The Goulburn Broken Native Vegetation Strategy reports that several vegetation types have been reduced to a small proportion (2-9%) of their former abundance and range in the mid and lower catchment, and pressures are ongoing. Ninety-five species of plants and 85 animal species are considered threatened. Overall, only around 7% of the native vegetation cover of the region at European settlement remains. Although much of this clearing occurred in the 19th Century, it has continued throughout the 20th Century. There is still gradual degradation of roadside and stream vegetation in the mid-lower Catchment and fragmentation of habitat, which affects the viability of species. Another threat to the natural asset of biota is the wide array of pests and weeds expanding in the catchment and threatening the viability of farms. There are 70 species of noxious weeds. Exotic animals considered pests in the catchment include rabbits, wild dogs, horses, pigs, foxes, feral cats, and goats. In waterways, carp are a major problem, stirring up sediment and causing decline of native species. Some native animals are also considered pests when their numbers increase to levels that threaten agricultural enterprises. Problem species include kangaroos, wallabies, cockatoos, galahs and wombats.

Waterways

Pollution of waterways by nutrients flowing from irrigation drainage, sewerage, sediment mobilisation, and intensive animal industries has become a major issue in the catchment. One major consequence is the blooms of blue-green algae that occur frequently in the catchment and downstream, threatening health of people and stock and threatening industries such as tourism. The increased use of streams and rivers in the Catchment by people since settlement has led to problems like stream instability, bank

Mooroopna, 1974.

erosion, flooding, and associated threats to public and private assets and habitat. River flows vary greatly due to irrigation needs. Operation of Eildon and the Goulburn Weir has allowed regulation of flows for industrial purposes. These flows differ in pattern across the year from the pre-regulation pattern, which will have implications for river ecosystems.

Atmosphere

Like the rest of the world, the Goulburn Broken catchment is only beginning to grapple with the question of how its industries and other land-uses affect the composition and function of the atmosphere. The Goulburn Broken catchment has a lot at stake in relation to climate change and stability. The region's primary industries – agriculture, fruit growing and dairy – would suffer negative impacts from climate change. The region is both a positive and negative contributor to climate stability. Contributions to greenhouse gas emissions are made through intensive dairy, cattle and sheep farming, while carbon sinks are provided in the catchment through existing vegetation and revegetation efforts.

Economic Assets

- Primary industry assets (eg irrigation and drainage infrastructure);
- Secondary industry assets (eg food processing);
- Tertiary industry assets (eg transport and storage);
- Quaternary industry assets (eg retail and services);
- Quintenary industry assets (eg tourism, recreation).

The existing assets are being added to at an investment rate of about $100 million each year (or $1 billion over 10 years).

All capital assists in the catchment contribute to the gross regional production of about $7.8 billion each year which is the most significant contribution of any non-metro catchment in Victoria.

Social Assets

The social assets of the Goulburn Broken catchment are harder to quantify but include:

- Strong regional centres of Benalla, Seymour and Shepparton.
- A close network of social organisations (eg sporting clubs, community arts groups, environmental groups, welfare groups and family support groups).
- Strong community representation through a wide range of organisations (eg councils, businesses, government agencies, social clubs).
- Good cross section of educational facilities (primary schools, secondary schools and colleges, universities such as University of Melbourne through their Rural Health and Dookie College and TAFES).
- Some public transport services.
- Resource centres such as libraries and internet access.

Legislative and Policy Background for Water Quality

Relevant Legislation

State Legislation that is relevant to the FPMS includes:

- Water Act 1989;
- Catchment and Land Protection Act 1994;
- Planning and Environment Act, 1987.

Policy Documents

The FPMS is part of statewide, integrated approach to floodplain management. Linkages between this and other strategies are shown in Figure 1.

Figure 1: Floodplain Management Planning Framework

Victoria Flood Management Strategy (1998)

Provides a consistent statewide framework for effective flood management by responsible authorities, agencies and groups
Sets out objectives and provide a statewide policy framework for best practice principles and guidelines
Provides a statewide context for developing regional floodplain management strategies, floodplain management plans and specific guidelines
Identifies roles and responsibilities of key stakeholders
Provides a process of continual assessment and flood management improvements
Establishes priorities across the state

Goulburn Broken CMA Regional Catchment Strategy

Addresses resource management issues for the Goulburn Broken Catchment
Incorporates the regional floodplain strategy as a means of resolving long standing problems relating to:
- Lack of agreement on implementation of previous floodplain management strategies
- Inadequate levee management
- Ineffective planning controls
- Lack of community awareness

Regional Floodplain Strategy

Provides a regional vision and objectives for floodplain management
Builds on current flood information and identifies needs for further works and measures
Identifies the key stakeholders and assigns roles and responsibilities for floodplain management
Provides a forward look program with target dates and indicative costs, for use in developing the GBCMA business plan
Provides an integrated approach to floodplain management

Benalla, 1993.

Alignment with Government and NRE Policy

Corporate and Strategic Planning Framework

Under NRE's Corporate Plan, a key objective is to produce healthy rivers and catchments that underpin sustainable environments, industries and communities. This is further developed in NRE's Catchment and Water Division's Strategic Plan (2001/02-2003/04), which includes the following goals:

- All Catchment and Water products and investment should be tailored to maximise the well being of communities and minimise environmental footprint.
- A unifying framework to achieve healthy land, water and communities that provides clarity and direction for staff, collaborators and providers to bring together their rich mix of skill, competence and experience.
- A system which secures and targets investment by government and citizens to ensure sustainable future.

Victoria Flood Management Strategy and Regional Floodplain Management Strategies

Implementation of the proposed works and measures is in accordance with the Victoria Flood Management Strategy, prepared by the State Flood Policy Committee and endorsed by Government. The preparation of regional floodplain management strategies is a major feature of the State Strategy. These strategies help achieve sustainable development of Victoria's floodplains by:

- encouraging (through the statutory planning process) development that is appropriate to floodplains and their biota; and
- allowing (through the implementation of flood studies, floodplain management plans and levee management plans), community debate about the balance between protecting existing development and maintaining environmental values.

River Health Strategy and Victorian Biodiversity Strategy (1998)

The Victorian River Health Strategy provides the mechanism for implementing Ecologically Sustainable Development as it relates to the use and protection of Victoria's waterways and meeting COAG[1] requirements.

Victoria's biodiversity management strategy specifically highlights the need for the protection and replenishment of the total area of natural vegetation, with particular emphasis on threatened or depleted types such as grasslands and riparian flora and fauna. This includes riparian and other forms of vegetation within floodplains.

Regional Development

The State Government is committed to a policy of providing economic infrastructure so that the private sector can create jobs, particularly in rural and regional Victoria. Opportunities for boosting regional development include a State Industry Plan built on a framework of "balanced development" and a "whole of Victoria" approach to infrastructure spending across Victoria.

[1] *Council of Australian Governments*

Aerial veiw of Shepparton and Mooroopna, 1974.

Implementation of the regional floodplain management strategies will provide a foundation for ensuring regional economic development in floodplains is consistent with the protection and enhancement of each region's natural resources. The increased prosperity of each region relies on the expansion and consolidation of agricultural, commercial and industrial activities in a manner that recognises and has regard for the flood risk. A balanced and sustainable approach to development on the floodplains contributes to the well being of communities.

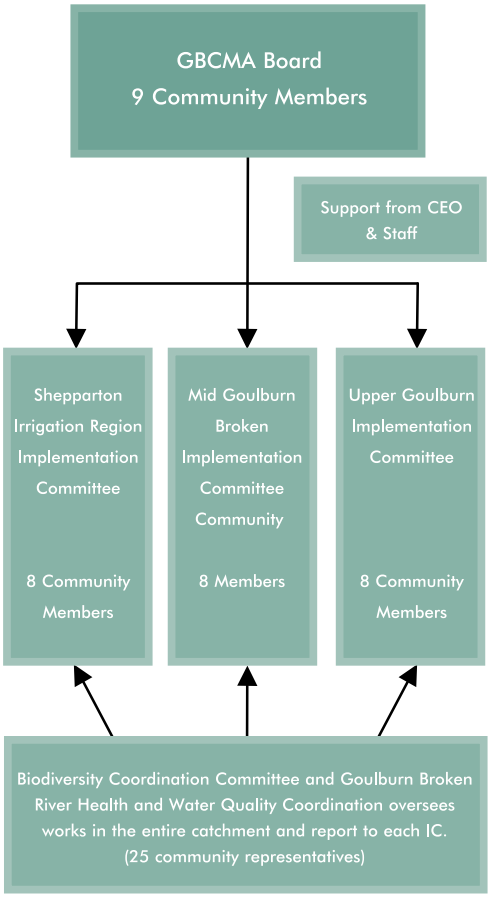
Implementation Framework

The Goulburn Broken Catchment Management Authority was established by the State Government in 1997 under the Catchment and Land Protection Act 1994 to manage land and water resources in the Goulburn Broken catchment. The GBCMA is working to ensure land and water resources are protected and enhanced as well as improving the region's social wellbeing, environmental quality and productive capacity in a sustainable manner.

The Goulburn Broken CMA is a statutory Authority under the Water Act 1989 and the Catchment and Land Protection Act 1994, and is required to operate according to specified protocols. The GBCMA publishes an Annual Report each year which is audited by the Auditor General and tabled in parliament.

To ensure activities of the GBCMA reflect community views the GBCMA Board has set up three geographically and community based Implementation Committees (see Figure 2 below). These committees have the responsibility of developing and putting in place on ground works under the regional Catchment Strategy and associated Action Plans and Strategies as well as acting as a valuable link between the GBCMA Board and the community. Two Coordinating Committees also exist to ensure a consistent region-wide approach to issues such as biodiversity and river health and water quality.

Figure 2: GBCMA Structure.



1 in 7 year flood, below McCoys Bridge, 1981.

Each of the IC's have responsibility for implementing the RCS (and relevant sub-strategies). Implementation is carried out according to a 3 year business plan (also called the Regional Management Plan and associated IC Implementation Schedules). This effectively forms the works plan for the ICs, ie overall objectives, activities, funding and outputs. Works that are catchment wide are funded through the RMP alone.

Implementation of the RFMS is priority based and will delivered across the Gouburn-Broken catchment as funding opportunities become available. Flood studies will be carried out under the guidance of specific steering committees.

The responsible construction authority will be responsible for implementation any adopted schemes, i.e. urban schemes would generally be implemented by the respective municipal councils, whereas, rural schemes will generally by implemented by the GBCMA.

Development of the Strategy and Consultation

The Strategy was prepared with the assistance of a steering committee comprising representatives from key agencies with interests in the region, in particular:

- the GBCMA;
- the Department of Natural Resources and Environment, the Department of Infrastructure; the Bureau of Meteorology, Goulburn - Murray Water and the Victoria State Emergency Service; and
- representatives of the seven key municipalities within the region.

The Strategy was prepared in a number of key phases:

- An inception and investigation phase culminating in the Investigation Report.
- Development of vision, objectives and targets for the Strategy, through a workshop with the Steering Committee.
- Development of the draft Final Strategy.
- Finalisation of the Strategy.

Underpinning it's development was a comprehensive consultation process. Initially, letters were written to key stakeholders and pamphlets providing background to the strategy were distributed. A number of meetings were held with the GBCMA's steering committee and staff at key stages of the project and a series of meetings and workshops were arranged with other stakeholders.

2 The Issues

Seymour, 1974, Cnr Tallarook and Midland Highway.
Photograph: The Age.

High Street Seymour, 1973. Whiteheads Creek.

Flooding is a natural event and flood-related problems such as property damage, crop loss, and isolation, generally result from the community's choice to live on the floodplain, intentional or otherwise. Accordingly the issues associated with flooding relate to the identification and management of risk treatment measures, flood response activities, and understanding and communicating the flood risk. They are summarised in Table 2.

Flooding of Urban and Rural Land

Since the 1840s, land within the Goulburn Broken catchment has been progressively cleared. Large parts of the floodplains of the Murray, Lower Goulburn and Broken Rivers, and Broken and Boosey Creeks, have been developed for both dryland and irrigated agriculture, and urban communities have been established.

A summary of major floods in the Goulburn Broken catchment is given in Table 3.

Flood frequency has been described in terms of the Average Recurrence Interval (ARI) which is the likelihood of occurrence of flooding expressed in terms of the long-term average number of years between the occurrence of a flood as large or larger than that event. For example, a flood with a discharge as large as or larger than the 30-year ARI flood is one which will occur on average once every 30 years.

For many areas there is a need for flood studies to better understand flood behaviour and impacts. There is also a need for flood monitoring and flood mapping so that potential impacts can be minimised.

Where risk treatment measures are warranted, floodplain management plans need to be established. These can include non structural measures such as statutory land use planning, and structural works such as levees, where justified from an economic, social and environmental point of view.

Where structural works are justified, they need to be maintained.

The primary purpose and natural function of the floodplain is to convey and store floodwaters. For this reason encroachments on the floodplain by developments and interference with major river flows need to be controlled and non-structural measures to mitigate flooding need to be implemented in preference to structural works wherever possible.

Table 2: Flood Risk Identification and Treatment

Flood Risk Identification	• Flood studies • Flood mapping • Flood monitoring • Information management
Flood Risk Treatment	• Floodplain management plans • Statutory planning controls, legislative controls and development assistance guidelines • Structural controls (eg levees, raised earthworks, diversions of floodwaters, retarding basins) • Asset Management
Flood Warning and Emergency Response	• Flood warning system improvements • Emergency response planning
Communication	• Education • Communication strategies

Table 3 Historic Floods

Month/Year	River/Stream	Comments
1867	Murray	About a 70 year ARI flood along the Murray. 4th highest on record at Albury and 2nd highest at Echuca.
1870	Murray River & Goulburn River	Very large flood along the Goulburn. 2 drowned at Seymour (ARI unknown). Largest flood on record along the Murray (>100 year ARI) affecting towns from at least Albury to Wodonga.
Sep. 1916	Murray River, Broken River & Goulburn River	About a 20 year ARI flood along the Murray at Echuca. Largest Goulburn River flood this century at Seymour, Murchison and Shepparton (100year ARI) – 5 drowned. Major flood at Benalla.
Jun. 1917	Goulburn River	About a 45 year ARI flood at Murchison.
Oct. 1917	Murray River & Goulburn River	About a 100 year ARI flood along the Murray River, affecting towns from Albury to Barmah.
Sep. 1921	Broken River	Major flood at Benalla.
Dec. 1934	Goulburn River	About a 40 year ARI flood at Murchison.
Aug. 1939		About a 30 year ARI flood at Shepparton and Mooroopna.
Sep. 1959	Yea River	About a 35 year ARI flood at Yea.
Jul. 1956	Goulburn River, Murray River	About a 13 year ARI flood at Shepparton/Mooroopna. About a 13 year ARI flood at Echuca and a 20 year ARI flood at Tocumwal.
Dec 1966	Delatite River	About a 20 year ARI flood.
Nov. 1971	King Parrot Creek	About a 43 year ARI flood.
Feb. 1973	Whiteheads Creek, Seymour	About a 100 year ARI flood. One person drowned & a house was destroyed.
May 1974	Broken River, Broken Creek	Major regional flooding occurred this year. About a 13 year ARI event along Broken River at Benalla. About a 30 year event along Broken Creek, with flooding at Nathalia, Numurkah and Katamatite. Major flood along the Goulburn River (50 year ARI and 70 year event at Murchison and Shepparton/Mooroopna respectively). Lesser flood at Seymour, but large enough to cause one drowning. Large floods also occurred along Acheron River, Hughes Creek, Sunday Creek, Yea River and the Murray River, affecting a large number of towns.
Sep. 1975	Delatite River	Flood of record along the Delatite – about a 100 year ARI event.
Oct. 1975	Murray River	About a 30-35 year ARI flood, affecting rural areas downstream of Cobram and Echuca.
Jun. 1989	Yea River	About a 50 year ARI event at Yea.
Jun. 1989	King Parrot Creek	About a 60 year ARI event.
Oct. 1992	Castle Creek	Major flood at Euroa – about a 50 year ARI.
Oct. 1993	Broken River, Broken Creek, Seven Creeks, Castle Creek, Honeysuckle Creek, Goulburn River, Murray River, Delatite River	Flood of record at Benalla (about a 100 year ARI event). Large numbers of properties affected at and downstream of Benalla, including Shepparton. Along the Broken Creek at Nathalia flooding was less severe but still significant event (35-50 year ARI). Major flooding also occurred at Euroa (Seven & Castle Creeks – about a 35 year ARI flood), Violet Town (Honeysuckle Creek - about a 50 year ARI flood), the lower Goulburn at and downstream of Shepparton (about a 30 year ARI event) and Echuca (Murray River – about a 20 year event). Major flooding along the Delatite River (about a 30 year ARI event).
Jun. 1994	Acheron River	About a 50 year ARI event.
Oct 1996	Acheron River	About a 90 year ARI event.
Sept 1998	Upper Goulburn and Jamieson Rivers	About a 30 year event along the Upper Goulburn River at Jamieson

Shepparton, 1975.

Flooding and Environmental Values

Flooding is a natural phenomenon upon which a number of environmental benefits depend. Floodplains, waterways and their associated wetlands, have a fundamental role in supporting flora and fauna habitats of special significance. Floods replenish wetlands, transport food supplies and trigger stages in the life cycles of many plants and animals.

Floodplains provide natural overland flow paths and storage areas where floodwaters remain for slow release as stream heights recede, thereby reducing the potential for channel erosion from high energy flows. Nutrients, debris and sediment settle out during his process, protecting waterways from high sediment and nutrient loads and contributing to floodplain productivity.

Substantial areas of natural wetlands have been lost since European settlement. Notwithstanding this, the conservation value and status has been recognised for many watercourses. Big River, the Goulburn River (downstream of Eildon Dam) and Howqua River are all heritage rivers, recognising the significant native flora and fauna, cultural, recreational and scenic values associated with their riverine corridors. Other streams support a number of recognised wetlands.

Cultural Heritage

Watercourses provide a focal point for human activity, and consequently they are associated with cultural values that are important to the community. The Murray Valley supported a relatively large aboriginal population for many thousands of years prior to the arrival of European settlers. Background reports and surveys have identified over 1,700 sites of aboriginal archaeological significance. Given the nomadic lifestyle of many inhabitants, evidence in the form of campsites, burial sites, scarred trees and shell middens, are evident along the lakes and waterways throughout the region. This has implications for works and measures in the floodplain.

Under the *Archaeological and Aboriginal Relics Preservation Act 1972* and the *Commonwealth Aboriginal and Torres Strait Islander Heritage Protection Act*, all sites and relics are protected. This may have implications when major earthworks are contemplated. If works are contemplated in the vicinity of river courses, lakes and wetlands, project proponents are responsible for contacting the relevant local aboriginal community organisations and Aboriginal Affairs Victoria at the planning stage.

Flooding and Agriculture

The opening up of the area to agriculture (which commenced in the 1840s) heralded the development of a significant number of agricultural, commercial and public assets, including:

- significant irrigation areas in the lower floodplains of the lower Goulburn and Broken Rivers;
- arterial irrigation and drainage infrastructure such as East Goulburn Main Channel and a number of diversion weirs in Broken River and Broken Creek); and
- water storage reservoirs along many of the major water courses.

Goulburn River.

Today over 60% of the Goulburn, Broken and Murray River catchments have been cleared to agriculture. Waterways have been substantially modified in many areas to permit access for stock and people to waterway frontages, to convey water for irrigation purposes during the summer months, to drain excess water and to protect properties from flooding.

The construction of water storage reservoirs along major water systems and the regulation of flows for irrigation has adversely affected environmental values for many areas. Small and moderate floods are mostly captured and stored for summer use. Stream reaches that once flowed intermittently now store water permanently, affecting those species requiring intermittent flooding, and raising local water tables.

River regulation has changed the magnitude, frequency, duration and seasonal distribution of flows downstream. Contrary to natural conditions, high summer flows are experienced in the lower half of the catchment, and low flows in the winter months. This reversal in natural flow conditions has had a significant effect on those species of flora and fauna that rely on a natural cycle for proliferation, in some cases changing the mix of species, and in other cases reducing the proliferation of species.

Flood Protection

Most of the floodplains in the lower reaches of the Goulburn Broken region are relatively flat. A number of raised structures such as levees, channels, raised roads and railways, spoil banks and bridges have had a significant impact on flood behaviour, affecting flow distributions, flow velocities and depths.

The construction of these structures to protect areas from flooding can have significant benefits in reducing flood damages for existing infrastructure. Not only do they reduce flood damages for existing developments but in some instances they can reduce scouring on protected areas of the floodplain and some instances they can reduce the recharging of saline aquifers.

They can however, have a number of disbenefits including:

- a reduction in riverine and floodplain habitats, leading to an isolation of wetlands and a reduction in seeding for biological diversity;
- an increase in flow concentration and stream power, leading to increased flow rates, flood levels and stream and bank erosion;
- a reduction in the frequency of deposition of fertile material across the floodplains;
- intensification of land use in the protected areas of the floodplain, with a resultant increase in social disruption and flood damages when the levee fails;
- a reduction in soil moisture; and
- creating a false expectation of being immune from floods greater than the levees are designed to protect.

For levees and structures that act as levees to be effective, they must be adequately maintained. This requirement has often been overlooked in the past.

3 Achievements 1996-2001

Major achievements over the five years to 2001 are listed below.

Court House Hotel Nathalia, 1916.

Information Management

- Flood Data Transfer Project (NRE 1998-2000). Flood maps were prepared for all municipalities within the Goulburn Broken catchment, and a large amount of flood data was transferred to GBCMA.
- An airborne laser scanning project (MDBC and Southern Murray Darling Project Consortium 2001). A range of information was collected, including ortho-rectified aerial photography, detailed topographic information and vegetation data.
- Photogrammetric Survey of the Shepparton Mooroopna district over some 220 km, including ortho-rectified aerial photography, detailed topography information and extensive feature survey, including structures and some 10,000 floor levels.

Statutory Planning and Development Guidelines

- Flood advice and input into a large number of planning permit applications (currently 1,000 – 1,500 per year).
- Incorporation of flood maps from the Flood Data Transfer Project into municipal planning schemes (2000 & 2001).
- Preparation of VPP amendments for all the 7 municipalities in the Goulburn Broken catchment, to streamline planning referrals and to provide consistent performance-based criteria to all stakeholders (2001).
- Preparation of best practice guidelines for assessing buildings, subdivisions, whole farm plans/raised earthworks and fences (2001).

Flood Studies and Floodplain Management Plans

(See also Lower Goulburn)

The following studies were undertaken:

- Euroa Floodplain Management Study (1997).
- Kyabram Drainage System – Design Basis Report on of Drainage Improvement Works (1995).
- Seymour Floodplain Study (2001).
- Shepparton Mooroopna Floodplain Management Scoping Study (1998).
- Broken Creek Management Study Parts 1 and 2 (1996 & 1998).
- Shepparton Mooroopna Floodplain Management Study (ongoing).
- Nathalia Floodplain Management Study (ongoing).
- Tatura Flood Study (ongoing).
- Violet Town Scoping Study (ongoing).
- Jamieson Floodplain Management Scoping Study (ongoing).
- Yea Flood Study (ongoing).
- Merrigum Flood Study (ongoing).
- Seymour Floodplain Management Plan (ongoing).

PWD Levees

- Levee Audit (1997). The purpose of the audit was to establish the level of service and to identify management options.
- The worst parts of the levees have been reinstated to a level of protection corresponding to approximately the 1975 flood level (ongoing).

Lower Goulburn Levees

- Levee audits (1998 and 1999). These identified a number of deficiencies, including (in comparison with best practice) inadequate compaction, steep

Flooding in the commercial centre of Benalla, 1993.
Photograph: Shepparton News.

sides, inadequate crest width, trees growing along almost the entire length, inadequate foundations and poor fill material being used. Priorities for reinstatement of sections of the levees were established and options for managing the levees were identified, including the Lower Goulburn Floodplain Rehabilitation Scheme.

- Other, related studies included:
  - Preparation of a floodplain management plan (1998).
  - Investigation into Rating for Levee Maintenance for the Lower Goulburn and PWD levees (1999).
  - Preparation of a detailed business plan for the Lower Goulburn area (2000).

Lower Goulburn Floodplain Rehabilitation Scheme

The first stage of the rehabilitation scheme commenced in 2001, focusing on an assessment of ecological, cultural and environmental values, detailed modelling, and land acquisition.

Urban Levees

- The Nathalia Town Levee Audit (1996) established the condition and recommended a number of improvements.
- Cobram Water Management Scheme (completed 2001). This flood protection scheme involved upgrading existing levees for an approximate cost of $3.4 million).
- Water management (flood protection) schemes are being prepared for Euroa and Benalla (ongoing).

Flood Monitoring and Emergency Response Planning

- Municipal emergency management plans have been prepared incorporating flood sub plans.
- CMA Flood Response Action Plan (2000). This generic plan focuses on what the Goulburn Broken Catchment Management Authority should do before, during and after a flood.
- Flood Data Assessment Manual (2001). This manual has been prepared for incorporation into the CMA Flood Response Action Plan. It contains information on flood impacts, data needs and triggers for significant areas in the Goulburn Broken catchment.
- Flood Response Guidelines (in booklet form) have been prepared for communities at Benalla (1997), Euroa (1998) and Seymour (2000).

Flood Warning

- Quantitative forecasts (predicted level and time, except for Broken Creek) for the:
  - Goulburn River at Seymour, Murchison, Shepparton and McCoys Bridge;
  - Seven Creeks at Euroa;
  - Broken River at Benalla, Casey Weir and Orrvale;
  - Murray River at Yarrawonga, Cobram, Tocumwal, Barmah and Echuca; and
  - Broken Creek at Numurkah and Nathalia (based on forecasts provided by G-M Water).
- Outflows from Lake Eildon (expected stage and flow) based on advice from G-M Water.
- A flood category warning service (minor, moderate, major) for most other Goulburn River tributaries.
- Flood warning system upgrades at Benalla (1997), Euroa (1998) and Seymour (2000).

4 The Strategy – Vision, Objectives and Targets

Hastie St, Tatura, 1993.

This strategy was produced in consultation with the community and stakeholders. In the Investigation phase, 6 public forums were held and detailed discussions and meetings were conducted with key stakeholders.

The vision, principles and objectives for this Strategy have been developed in consultation with a Steering Committee, comprising representatives from key Stakeholders, including the Goulburn Broken Catchment Management Authority, municipalities, Goulburn-Murray Water and a number of government agencies. The Committee recognises that good partnership arrangements and joint ownership of the vision and objectives are essential for effective implementation of the Strategy.

Vision

The Vision for floodplain management that has been endorsed by the Steering Committee is:

To work with the community to achieve best practice floodplain management for the benefit of current and future generations, through the implementation of the Regional Floodplain Management Strategy.

Aim

In working towards this vision, the Catchment Management Authority will strive to ensure that:

- floodplain management has regard for preserving and enhancing the environmental values of floodplains;
- local communities are working in partnership with the Catchment Management Authority and other stakeholders in flood risk decisions;
- linkages are in place to coordinate drainage and waterway management practices with floodplain management;
- land use planning measures have full regard for the flood risk and minimise future flood damages;
- flood warning and emergency planning measures are in place to minimise the risk to life, health and safety and to minimise flood damages;
- mechanisms are in place for managing levees and associated assets, and these identify and have regard for the level of service, ownership, maintenance responsibilities and cost sharing arrangements;
- mechanisms are in place for monitoring floods, capturing flood data and maintaining a GIS flood database;
- land use planning controls are implemented effectively and efficiently and have regard for best practice principles for floodplain management;
- studies are carried out to assess the impacts of flooding and identify opportunities for implementing flood management measures having regard for the flood risk;
- structural flood mitigation measures, both existing and new, are effective in reducing existing flood risk and potential flood damage costs, are cost effective and have community acceptance; and
- indicators of performance are in place.

The guiding principles of the floodplain management strategy are to:

1. Recognise that the primary purpose and natural function of the floodplain is to convey and store floodwaters.
2. Involve the community in decision making for program elements that impact on the community.
3. Identify opportunities to minimise the impacts of flooding where possible.
4. Identify opportunities to restore the natural characteristics of floodplains.
5. Promote land use practices that are compatible with the flood risk.
6. Apply best practice management principles to flood management decisions.
7. Promote community awareness of flooding.
8. Promote the provision of adequate flood warning.
9. Manage and improve flood data.
10. Implement flood management measures in a responsible manner, having regard for their full social, environmental and economic costs and benefits, including impacts on others.
11. Manage floodplain assets in a responsible manner having regard for level of service, ownership, roles and responsibilities of maintenance and cost sharing arrangements.

Programs and Objectives

Successful implementation of the Strategy relies on responsible agencies developing a strong sense of ownership, managing with a sense of urgency in the short term but continuing to pursue the long-term vision. Individual objectives have been set for all programs to help achieve this purpose. If necessary these objectives can be revised to ensure their relevance to the long-term vision continues. They are:

Program 1. Asset management

- Facilitate sustainable management of existing strategic floodplain assets, having regard for level of service, ownership, roles and responsibilities of maintenance and cost sharing arrangements.

Program 2. Flood Studies and Floodplain Management Plans

- Develop and implement flood studies and floodplain management plans having regard for social, environmental, cultural and economic costs and benefits.

Program 3. Statutory Land Use Planning

- Provide decision tools to allow development and land use practices to be compatible with the flood risk.
- Streamline the referral process to screen out unnecessary referrals, and provide consistent performance-based criteria to all stakeholders.

Alternative transport in rising floodwater.

Photograph: Herald and Weekly Times.

Hogan St, Tatura, 1955.

Program 4. Development Assessment Guidelines

- Ensure development proposals in floodplains are dealt with in a consistent, efficient and effective manner, in accordance with sound floodplain management.

Program 5. Control of Works and Activities

- Develop an integrated program for controlling works on floodplains.

Program 6. Emergency Response Planning

- Articulate GBCMA's role in emergency response activities, flood awareness for the community and flood warning.

Program 7. Flood Monitoring Action

- Facilitate effective flood monitoring and timely flood data collection to improve flood knowledge within the catchment.

Program 8. Information Management Systems

- Develop and implement an integrated floodplain information system that provides high quality data for use in floodplain management decisions.

Program 9. Education and Communication

- Improve the community and other stakeholders' knowledge of flood management issues.
- Ensure that flood management decisions are made in accordance with best practice principles.

Performance Monitoring

Implementation of the Regional Floodplain Management Strategy will be achieved over a significant period of time. To ensure this strategy is continuing to achieve desired outcomes, the programs will be reviewed and evaluated periodically, and used to prepare an annual works program.

In order to develop performance standards for monitoring the effectiveness of the Strategy:

- Key result areas have been identified, together with appropriate bench marks and indicative performance indicators that recognise the integrated nature of the programs and are applicable to the strategy as a whole. They are listed in Table 4.
- A second level of performance measurement, in the form of task completion against timelines, has been recommended for tasks within each program. They are listed in Table 5. Tasks are linked by a common reference ID number to the consolidated Implementation Program, listed in Appendix D.

Reviews of benchmarks and performance measures will be undertaken every 3 to 5 years to ensure they remain relevant and useful in respect of measuring the overall impacts of implementing the regional floodplain management strategy.

The program tasks will need to be incorporated into a rolling three-year detailed implementation program, with progress reviewed at the start of each financial year and also each January.

1993, Bridge Street Benalla.

Photograph: Shepparton News.

Annual reporting arrangements against the Strategy objectives, budgets and targets should be undertaken quarterly to the GBCMA Board, Implementation Committees and senior management where appropriate.

Table 4: Bench Marks

Linkage to Programs	Bench Mark	Suggested Performance Measures
Key Result Area 1: *Actively participate in the statutory planning process to seek appropriate controls and change in land and water use activities, including the preservation of environmental values.*		
• Statutory land use planning • Development assessment guidelines • Control of works & activities on floodplains the referral process.	a) Annual savings in flood damages through implementation of planning scheme measures. b) Reduction in administrative costs by streamlining	• Number of planning permit applications in LSI or floodway areas dealt with by municipalities without the need for referral. • Number of planning permit applications in LSI or floodway areas referred to GBCMA. • Reduction in CMA staff hours devoted to statutory planning matters. • Number of CMA responses within statutory time lines (suggest 90% as target). • Number of administrative tribunal appeals in favour of GBCMA. • Areas restored to natural wetlands or protected against degradation through planning controls (subjective assessment).
Key Result Area 2: *Reduce flood damage costs and minimise risks to health, life and safety through effective flood warning services and flood monitoring programs.*		
• Emergency response planning • Flood monitoring actions	a) Savings in flood damages through flood warning services.	• Number of properties receiving improved flood warning services. • Qualitative assessment of effectiveness of CMA Flood Response Action Plan. • Performance of flood sub plans.
Key Result Area 3: *Reduce flood damage costs and minimise risks to health, life and safety by improving flood knowledge and implementing flood mitigation measures where appropriate.*		
• Asset management • Flood studies and floodplain management plans • Structural measures arising from floodplain management plans	a) Savings in flood damages by structural works. b) Overall percentage of flood studies and floodplain management plans implemented.	• Number of properties and businesses protected and associated costs and benefits. • Number of flood studies and floodplain management plans implemented and benefits. • Details of flood data captured and benefits.
Key Result Area 4: *Improve effectiveness and efficiency of floodplain management delivery by improving information and advisory services, marketing key skills to clients, maintaining community awareness and staff training.*		
• Education, promotion and communication • Information management systems	a) % of "customers" satisfied following assessment of feedback on quality of information sent out b) Efficiency gains in information storage and dissemination.	• Number of organisations forwarded brochures and public awareness material each financial year • Number of training programs undertaken each financial year, organisations attending and level of satisfaction (from post course evaluations) • Results of customer surveys

Flooding of Benalla Art Gallery, riverside parks and sporting facilities, 1993.

Photograph: Shepparton News.

Table 5: Targets

	Task	Primary Responsibility	Priority/ (Timeline)
Asset Management – Program 1			
	General		
AR1	Upgrade and Maintain Asset Register	GBCMA	High (ongoing)
	PWD Levees		
PWD1	Resolve legal liability issues	GBCMA	High (Year 1)
PWD2	Resolve arrangements for funding for O&M	GBCMA	High (Year 1)
PWD3	Prepare a management plan	GBCMA	High (Year 2)
PWD4	Maintain levees	GBCMA	High (ongoing)
	Lower Goulburn Levees		
LG1	Resolve legal liability issues	GBCMA	High (Year 2)
LG2	Resolve arrangements for funding for O&M	GBCMA	High (Year 3)
LG3	Formalise agreement with G-MW over future arrangements for managing assets they currently maintain	GBCMA	High (Year 3)
LG4	Prepare a management plan	GBCMA	High (Year 4)
LG5	Maintain levees	GBCMA	High (ongoing)
	Beattie Depression Levees		
BD1	Maintain as required	G-MW	High (ongoing)
	Cobram Town Levees		
CTL1	Prepare a management plan	S/Moira	High (Year 1)
CTL2	Maintain the levees	S/Moira	High (ongoing)
	Nathalia Town Levees		
NTL1	Prepare a management plan	S/Moira	High (Year 1)
NTL2	Maintain the levees	S/Moira	High (ongoing)
NTL3	Acquire easement rights for levees	S/Moira	High (Year 2)
	Private Strategic Rural Assets		
PSR1	Allow self management either individually or through community or advisory committees via a floodplain management plan	Levee owners	High (ongoing)
	Review Asset Management		
AMR1	Review/audit asset management plans every 5 years	GBCMA/ Municipalities	High (every 5 years)
Flood Studies and Floodplain Management Plans – Program 2			
FSU	Prepare urban studies and floodplain management plans.	Municipalities/ GBCMA	Various – See Table 7 in Section 6
FSR	Prepare regional studies and floodplain management plans	Municipalities/ GBCMA	Various – See Table 7 in Section 6
FPW1	Implement Benalla Water Management Scheme	S/Delatite	High (Years 2-6)
FPW2	Implement Euroa Water Management Scheme	S/Strathbogie	High (years1-4)
FPW3	Implement Shepparton Water Management Scheme	City of Greater Shepparton	High (Years 1-4)
FPW4	Upgrade PWD levees to approx. 30 year ARI standard (subject to resolution of liability issues)	GBCMA	High (Years 1-5)
FPWU	Implement works recommended in future urban studies and FPM plans according to set priorities:	Municipalities/ GBCMA	Set each year
FPWR	Implement works recommended in future rural studies and FPM plans according to set priorities:	Municipalities/ GBCMA	Set each year
	Note, annual administration and maintenance costs have been averaged out over 10 years.		

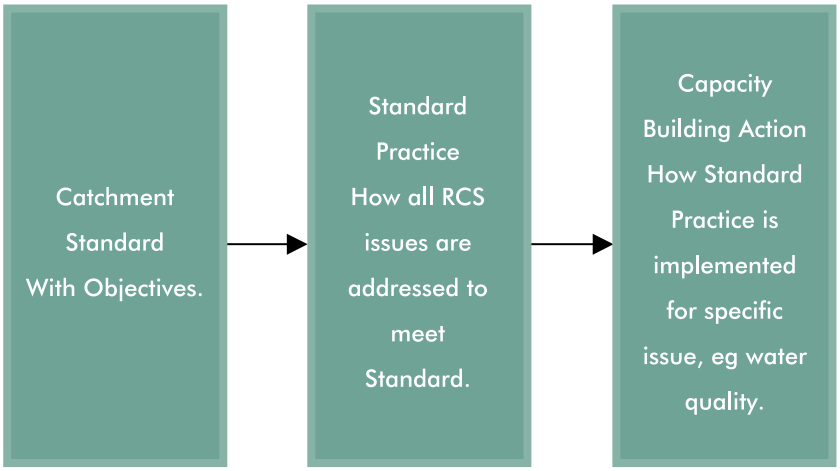
Table 5: Targets Cont'd

Statutory Land Use Planning – Program 3			
SP1	Draft VPP amendments	GBCMA	Very High (Year 1)
SP2	Incorporate FDT maps into planning schemes	Municipalities	Very High (Years 1-5)
SP3	Prepare improved flood maps	GBCMA	Very High (Years 1-3)
SP4	Incorporate improved flood maps into planning schemes	Municipalities	Very High (Years 4-6)
SP5	Review performance of planning measures	Municipalities/ GBCMA	Very High (every 5 years)
SP6	Inform VicRoads, V-Line, Goulburn-Murray Water & Power Authorities of recommended referral and consultation arrangements when appropriate	GBCMA	Very High (where appropriate)
Development Assistance Guidelines – Program 4			
AG1	Refine, amend and review the guidelines	GBCMA	Very High (ongoing)
Control of Works and Activities on Floodplains – Program 5			
CWA1	Introduce declarations, bylaws and other measures for controlling existing and new development on floodplains, in support of VPPs, where required.	GBCMA	Very High (ongoing)
CWA2	Develop arrangements with Councils and other relevant groups over statutory enforcement of illegal works.	GBCMA	Very High (ongoing)
Emergency Response Planning – Program 6			
ERP1	Identify flood warning system needs	GBCMA	High (Year 1 and ongoing)
ERP2	Data Network Management	GBCMA	High (Year 2)
ERP3	Empower community	GBCMA	High (Year 3 and ongoing)
ERP4	Resolve anomalies in roles and responsibilities	GBCMA	High (Year 1)
Flood Monitoring Actions – Program 7			
FMA1	Test the Flood Response Action Plan annually and upgrade it and the Flood Data Assessment Manual at timely intervals, after major floods	GBCMA	High (annually)
FMA2	Review the effectiveness of levees and associated structures when tested by floods	GBCMA	High (when appropriate)
FMA3	Collect flood data	GBCMA Municipalities	High (when appropriate)
Information Management Systems – Program 8			
IM1	Improve and collate existing flood data	GBCMA	High (ongoing)
IM2	Upgrade GIS capability (software & hardware)	GBCMA	High (ongoing)
IM3	Review flood data	GBCMA	High (ongoing)
Education, Promotion and Communication – Program 9			
EPC1	Organise and implement best practice training programs	GBCMA	Very High (ongoing)
EPC2	Maintain library	GBCMA	Very High (ongoing)
EPC3	Networking and attending conferences	GBCMA	Very High (ongoing)
EPC4	Prepare and print public awareness fliers	GBCMA	Very High (ongoing)
EPC5	Community workshops on flood awareness	GBCMA	Very High (ongoing)
EPC6	Undertake Community Education	GBCMA	Very High (ongoing)

5 Building Capacity and Catchment Standards

Cnr Fraser and Hogan St, Tatura, 1956.

The Regional Floodplain Management Strategy goals will only be achieved if the community has the capacity to do so. The GBCMA has adopted a set of "Catchment Standards" with "Standard Practices" for managing all issues. These Standards direct the actions to build and maintain capacity. The Standards group the essential components for ease of management. The Standards and objectives are not mutually exclusive, which is typical with attempts to isolate components when holistically managing very complex systems.



These Standards and objectives include all "Best Practice Standards" listed in the National Action Plan Agreement (2001).

Building and maintaining capacity comes at a cost. The actions are costed for each program and are detailed in Appendix A. The GBCMA Board is responsible for implementing all Capacity Building Actions.

Catchment Standards are summarised as follows:

1 Partnerships fostered

(strongly linked to Standard 7 Accountabilities)

- Communication will be optimised.
- Roles will be defined.
- Our diverse communities and agencies will be actively engaged.

2 Priorities Rigorous

- Priorities will be based on the best available scientific, economic and sociological information.
- Causes of problems will be targeted in geographic areas that maximise community return on investment.
- Priorities for works will consider risks and multiple benefits.

3 Costs Shared Fairly

- Costs and benefits will be shared transparently and equitably.
- Triple bottom line accountability.
- Link with supporting legislation will be clear.

4 Multiple Benefits

- Integrate planning and implementation at all levels

5 Large Scale Focused on

- Land use will change so that it better matches land capability across broad areas.

6 Cultural Heritage Included

- Aboriginal and non-Aboriginal cultural values will be factored into all decisions.

Rising floodwater, Shepparton / Mooroopna, 1974.

7 Accountabilities Clear

(strongly linked to 1 Partnerships)

- Project proposals will align with the priorities of the RCS.
- Progress reports will clearly link to regional, state and national targets and needs.

8 Adaptive Management Systems at all Scales

- Management systems will be in place for individuals, sub-catchments, whole of catchment and industries.
- Databases will be optimised.
- Monitoring & evaluation programs will regularly review assumptions underpinning RCS

Further details of the standard practice and how the GBCMA will achieve these can be found in Appendix B.

6 Implementation – The Programs

Hogan St, Tatura, 1956.

The Regional Floodplain Management Strategy has been developed to provide strategic direction for floodplain management in the Goulburn Broken catchment and forms the Floodplain Management Sub Program in the GBCMA's Regional Catchment Strategy.

The Regional Floodplain Management Strategy will be implemented through nine programs, listed in detail in Appendix A. They are:

- Asset Management (Program 1);
- Flood Studies and Floodplain Management Plans (Program 2);
- Statutory Land Use Planning (Program 3);
- Development Assessment Guidelines (Program 4);
- Control of Works and Activities on Floodplains (Program 5);
- Emergency Response Planning (Program 6);
- Flood Monitoring Actions (Program 7);
- Information Management Systems (Program 8); and
- Education, Promotion and Communication (Program 9).

A further two programs: "Resources – Responsibilities, Priorities, Cost Sharing" and "Performance Monitoring" have been incorporated into this document.

Program 1: Asset Management

(Refer Appendix A.1)

Objective

The primary objective of asset management is to facilitate sustainable management of existing strategic floodplain assets, having regard for level of service, ownership, roles and responsibilities of maintenance and cost sharing arrangements.

Description

Assets are those structures that can have an impact upon flooding characteristics. They are usually associated with levees but can also include channels, raised roads, spoil banks, railway embankments and other works that protect or obstruct flows. In this report, "assets" and "levees" are used synonymously. A reference to a levee or levees also implies a reference to their associated structures.

Levees are regarded as strategic if they protect important areas or assets from flooding. They will generally protect significant urban areas, or large, highly productive areas, but also can include levees which protect single properties, yet have significant adverse flooding effects on a large number of other properties. Levees that control potentially undesirable river avulsions are also considered strategic.

For effective asset management at the regional level, strategic levees have to be identified, future needs established, management responsibilities defined and assigned, and best practice measures and mechanisms put into place.

Euroa under flood.

Photograph: Herald and Weekly Times.

It is GBCMA's policy that no new levees are to be constructed other than to protect an existing dwelling and its immediate curtilage of, unless they are part of an Approved Scheme.

Management arrangements have been identified for a range of public and private levees (refer Appendix A.1).

Roles and Responsibilities

Specific roles and responsibilities have been identified in Appendices A.1 and C. Generally individuals will manage private levees and related assets unless alternate arrangements are identified in a floodplain management plan. The relevant local government or government agency will manage those assets constructed from public funds or by a public authority. The GBCMA has overall responsibility for managing the program through the Regional Floodplain Manager.

Tasks

Main tasks under this program are as follows:

- upgrade and maintain an asset register;
- resolve legal liability issues for some levees;
- management/maintenance plans;
- maintenance of strategic levees;
- review asset management plans.

Works Program

This program will be coordinated by the GBCMA through the Floodplain Manager. A rolling three-year works plan will be developed each year, prioritised from the consolidated Implementation Program outlined in Appendix D.

The works plan will outline:

- tasks to be completed by the GBCMA, together with budget, targets and priorities;
- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

Links to Other Plans or Strategies

In as much as levees impact on riverine and environmental values, this program is linked to the SIRLWMP, the Riverine Strategy and the Waterways Strategy. It is also linked to the municipal planning scheme process.

Implementation

Proposed actions are outlined in Table A.1 in Appendix A.

Flooding in the commercial centre of Benalla, 1993.
Photograph: Shepparton News.

Program 2: Flood Studies and FPM Plans

(Refer Appendix A.2)

Program Objective

The objective of this program is to develop and implement flood studies and floodplain management plans having regard for social, environmental, cultural and economic costs and benefits.

In accordance with current best practice, flood studies and floodplain management plans are formulated in accordance with a risk management approach advocated in AS/NZ Standard 4360:1995. The risk management steps are illustrated in Appendix A.2 (Figure A1).

Description

In this program flood studies, floodplain management plans, and any associated works, are identified, costed and prioritised. Roles and responsibilities for implementation are also determined.

Flood studies generally involve a detailed technical investigation of flood data (usually for several floods) to provide a better understanding of flood risk. They may involve detailed hydrologic and hydraulic investigations, review of previous studies and in some cases, levee audits or scoping studies. Findings are documented in a report, often with flood inundation maps. A floodplain management (FPM) plan integrates the results of a flood study (or flood studies) with recommended structural and non-structural flood management measures, thereby providing a basis for guiding management activities on floodplains.

When undertaking a flood study or floodplain management plan, or when implementing any associated works or measures, a steering committee will need to be formed, with representation from community groups, Implementation Committees, municipalities and State and Federal agencies where appropriate. The steering committee will provide information and direction to the relevant Implementation Committee, with technical support from the Floodplain Manager.

Roles and Responsibilities

Roles and responsibilities have been listed in Appendices A.2 and C. Generally municipalities are responsible for managing urban flood studies and FPM plans, while GBCMA is more strategically placed to manage rural studies and FPM plans. However, all studies and FPM plans will be steered by a committee with wide stakeholder representation. The GBCMA has overall responsibility for managing the program through the Floodplain Manager.

Tasks

The main task under this program is to undertake urban and rural flood studies and floodplain management plans, and to implement associated works, in accordance with established priorities.

Works Program

This program will be coordinated by the GBCMA through the Floodplain Manager. A rolling three-year works plan will be

Sandbagging in residential areas of Benalla, 1993.
Photograph: Shepparton News.

developed each year, prioritised from the consolidated Implementation Program outlined in Appendix D. The works plan will outline:

- tasks to be completed by the GBCMA, together with budget, targets and priorities;
- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

Links to Other Plans or Strategies

This program has strong linkages with amendments to municipal planning schemes, in particular local planning policies on flooding and floods overlays. Some floodplain management plans may also be linked to water quality plans and the Waterways Strategy, where they are required to consider stormwater management and rural drainage.

Implementation

Table A2 in Appendix A.2 provides details of the type, indicative cost and scope, implementation agency and priority for a number of studies and floodplain management plans in the Goulburn Broken region.

Structural measures recommended from recent flood studies are included in Table A3 along with provision for works arising from implementation of future flood studies and floodplain management plans.

Program 3: Statutory Land Use Planning

(Refer Appendix A.3)

Objectives

The objectives of this program are to:

- provide decision tools to allow development and land use practices to be compatible with the flood risk;
- streamline the referral process to screen out unnecessary referrals; and to
- provide consistent performance-base criteria to all stakeholders, which reflects best practice in floodplain management

Description

Planning Controls

Adequate planning scheme controls are the most effective means of controlling developments in floodplains so as not to increase future flood damages or place unnecessary risk to life, health and safety on occupants of floodplains. Prevention is more cost effective than cure.

The Planning and Environment Act provides for the control of land use and associated development and works through planning schemes which operate within each municipal area. The planning controls can be made specific to each area, type of use or development and can vary widely within any municipality to reflect differences in location, or differences in social, environmental or economic factors. In Victoria, all planning schemes have been reformed to use a model structure (the Victoria Planning Provisions or

Midland Highway Stanhope Depression, 1958.

VPPs) which includes the following four elements:

- the State Planning Policy Framework (SPPF);
- the Municipal Strategic Statement (MSS) - a statement of the overall land use objectives and supporting strategy that will be followed;
- the Local Planning Policy Framework (LPPF), which provides the local policies by which the MSS will be implemented); and
- specific land use planning controls which are selected from the suite of zones, overlays and additional provisions of the VPPs.

These elements are described in greater detail in Appendix A.3.

The Statutory Land Use Planning Program essentially concentrates on those actions which are aimed at improving the existing policies and statutory planning framework and those which aim to improve the efficiency and effectiveness of planning permit processing.

One of the key aims of the Authority in statutory land use planning is to reduce the number of unnecessary planning referrals it sees and the time taken to process them without compromising its functions as a floodplain management authority. To help achieve this aim, draft VPP amendments have been written for the municipalities of Campaspe, Delatite, Greater Shepparton, Moira and Strathbogie. This program provides a performance-base approach for decision making, which reflects local issues and best practice in floodplain management. They were developed in consultation with the respective municipalities and the Authority, and were modelled on Planning Practice Notes developed for this purpose by DOI, in conjunction with NRE and Melbourne Water.

Improved Flood Maps

Good flood mapping across the entire Goulburn-Broken Region is considered to have a high priority compared to other programs because it will lead to improved statutory planning decisions, thereby reducing potential flood damages. Municipalities will need to incorporate flood maps from NRE's "Flood Data Transfer Project" into the relevant flood zone and overlays in the VPPs at the earliest opportunity, if they have not already done so.

There are flood prone areas where there is inadequate or non-existent flood information, which require further "infill" mapping" and incorporation into municipal planning schemes. The areas have been identified in Table A4 of Appendix A.3.

Roles and Responsibilities

Specific roles and responsibilities have been identified in Appendices A.3 and C. Municipalities are responsible for ensuring their planning schemes incorporate the best information on flooding available, with technical assistance from DOI, NRE and GBCMA. The GBCMA has overall responsibility for managing the program through the Regional Floodplain Manager.

Benalla, 1993.

Tasks

The main tasks under this program are as follows:

- draft "Victoria Planning Provision" amendments to planning schemes;
- incorporate flood maps into municipal planning schemes; and
- review planning measures every 5 years.

Works Program

This program will be coordinated by the GBCMA through the Floodplain Manager. A rolling three-year works plan will be developed each year, prioritised from the consolidated Implementation Program outlined in Appendix D. The works plan will outline:

- tasks to be completed by the GBCMA, together with budget, targets and priorities;
- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

The update of the VPPs and incorporation of flood maps into municipal planning schemes will be implemented by the relevant municipalities. Under standard conditions of the VPP format planning schemes, monitoring and review must be undertaken at least once every three years.

Linkages to Other Plans and Strategies

Tasks associated with this program are linked to municipal planning scheme processes.

Implementation

Considerable work has already gone into implementing this program. Further work remains, particulalry in finalising VPP amendments for each Shire and updating and incorporating FDT flood maps into municipal planning schemes.
A schedule for implementing these measures is given in Table A5 in Appendix A.3.

Program 4: Development Assessment Guidelines

(Refer Appendix A.4)

Objective

The objective of this program is to ensure development proposals in floodplains are dealt with in a consistent, efficient and effective manner, in accordance with sound floodplain management.

Description

Guidelines for assessing buildings, subdivisions, whole farm plans/raised earthworks and fences have been included as an appendix to a separate report. They are intended to help municipalities and the GBCMA assess planning permit applications from a flood perspective, and to supplement to other programs, in particular Program 3 (Statutory Planning). They supplement other best practice guidelines for dealing with statutory planning matters, in particular:

Title	Comment
"Floodplain Management in Australia" (Ref 1):	Contains general principles for floodplain management from a nation-wide perspective.
VPP Practice Note: Applying for a Planning Permit Under the Flood Provisions" (Ref 5):	Contains guidelines for decision making and for setting building floor levels, flood-proofing buildings, freeboard and flood estimation techniques.

Roles and Responsibilities

The GBCMA has overall responsibility for ensuring the guidelines are reviewed regularly.

Specific roles and responsibilities have been identified in Appendices A.4 and C.

Tasks

The sole task for this program is to refine, amend and review best practice guidelines prepared as an Appendix to the main report.

Works Program

This program will be coordinated by the GBCMA through the Floodplain Manager. A rolling three-year works plan will be developed each year, prioritised from the consolidated Implementation Program outlined in Appendix D. The works plan will outline:

- tasks to be completed by the GBCMA, together with budget, targets and priorities;
- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

As part of this Strategy it is desirable that the GBCMA is committed to amending and adding to the guidelines to ensure they address local conditions and issues as they arise.

Links to Other Plans or Strategies.

This program has strong links to the statutory planning process.

Implementation

A schedule for implementing these measures is given in Appendix A.4.

Program 5: Control of Works and Activities

(Refer Appendix A.5)

Objective

The objective of this program is to develop an integrated program for controlling works on floodplains.

Description

A common concern of the community, municipalities, CMAs and a number of government agencies, is how to take action against a person who has constructed works that have, or would have, a potential to change the passage of water and cause damage. There are essentially seven courses of action to control works on a floodplain, namely:

- municipal planning controls (VPPs);
- declaration of land as "land liable to flooding" or as "floodway" under the *Water Act, 1989*;
- enforcing Section 195 of the *Water Act, 1989* (Control over connections and

Shepparton, 1974.

discharges into designated waterways or designated land or works);
- Victorian Civil and Administrative Tribunal process under the *Water Act, 1989*;
- Land Management Notice under the *CALP Act 1994*;
- by-laws under the *Water Act, 1989*; and
- Section 173 Agreements under the *Planning and Environment Act, 1987*.

All have merit; however careful consideration needs to be given to how and under what circumstances they are used. These are discussed in Appendix A.5.

For new works on floodplains, statutory planning controls remain the most effective means of control.

Declaration of flood prone land may however be a useful measure if the GBCMA desires to modify or remove inappropriate works. This has implications for some of the floodplain management plans, particularly along Broken Creek.

Other controls such as the use of by-laws under the *Water Act, 1989* to control works on floodplains and Section 173 Agreements under the *Planning and Environment Act, 1987* may have merit in some instances.

Roles and Responsibilities

The GBCMA has overall responsibility for implementing the program. Specific roles and responsibilities have been identified in Appendices A.5 and C.

Municipalities have overall responsibility for controlling works on floodplains through municipal planning schemes and for using Section 173 Agreements. The GBCMA is the responsible agency for Declarations under the *Water Act, 1989*, or for monitoring any by-laws under the same Act. Land Management Notices under the *CALP Act 1994* may be served upon an owner by the Secretary of the Department of Natural Resources and Environment or the Secretary's delegate.

Where works are undertaken in contravention of planning controls, it would seem appropriate, for the GBCMA and relevant municipal Council to combine planning, administrative and technical skills of Council officers and the GBCMA Floodplain Manager, in order to negotiate a favourable outcome.

Tasks

Tasks under this program are as follows:
- introduce declarations, bylaws and other measures for controlling existing and new development on floodplains; and
- develop arrangements with municipal councils and other relevant groups over statutory enforcement of illegal works.

Works Program

This program will be coordinated by the GBCMA through the Floodplain Manager. A rolling three-year works plan will be developed each year, prioritised from the consolidated Implementation Program outlined in Appendix D. The works plan will outline:
- tasks to be completed by the GBCMA, together with budget, targets and priorities;

Aerial view of flooding in the commercial centre of Benalla, 1993.

Photograph: Shepparton News.

- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

Links to Other Plans or Strategies

This program has strong links to the statutory planning process. There may also be indirect links to the Waterways Strategy if controlling works benefits environmental values.

Implementation

A schedule for implementing these measures is given in Table A7 in Appendix A.5. Indicative costs are included, although they cannot be accurately forecast and will evolve over time.

Program 6: Emergency Response Planning

(Refer Appendix A.6)

Objective

The objective of this program is to articulate stakeholder roles in emergency response activities, community flood awareness and flood warning.

Description

Emergency Management

Flood emergency management planning and flood warning are fundamental components of the floodplain management process. Their purpose is to manage floods to maximise public safety and to reduce preventable flood damages.

At the regional level Victoria Police has established committees for police districts to plan for a coordinated response to all emergencies.

At the local level Councils have prepared municipal emergency management plans, which include flood sub plans and local flood response plans where appropriate.

A generic "CMA Flood Response Action Plan" that focuses on what a Catchment Management Authority should do before, during and after a flood has been prepared to assist CMAs prepare for, respond to and build local expertise on flooding. The plan provides a firm basis for ensuring that the GBCMA can assist the community and other agencies in reducing community flood risk and damage costs and for integrating its actions and commitments with emergency response.

During and immediately after a flood, the GBCMA may be required to carry out emergency works to alleviate the effect on assets it is directly responsible for and/or to reduce the risk of flooding. Where possible actions taken to minimise damage to waterways should be incorporated into asset management plans.

Flood Warning System Development

Flood warning in Australia (in the context of a "whole of catchment" approach) relies on a cooperative and partnership approach between the three tiers of government as well as the local community.

The main components of a flood warning system are:

- data collection – detecting changes in the environment that lead to flooding;

Residents transferring to evacuation centre in Benalla, 1993.

Photograph: Shepparton News.

- flood prediction – flood severity and onset of particular levels of flooding;
- construction of warning messages – describing what is happening and predictions;
- message dissemination – to the right people and in a timely manner;
- interpretation of the prediction and other flood related information to determine expected impacts and action to be taken by whom;
- response to the warning by involved agencies and the community; and
- review and improvement of the warning.

Recent projects aimed at providing an integrated flood warning system have been successfully implemented at Benalla, Euroa, Seymour and generally through the mid-Goulburn catchment. There are some areas where improvements could be beneficial (refer Appendix A.6).

In developing this program, some specific issues have emerged:

- the capacity of local government to contribute financially to improved services is being stretched;
- there are some potential liability and duty of care issues for both Goulburn-Murray Water and BoM, in respect of the regional water authority providing technical assistance to BoM to enable BoM to provide flood warnings;
- resources within BoM are stretched; and
- any improvements to existing arrangements must be carefully weighed against the capacity of stakeholders to pay.

Empowering the Community and Information Dissemination

The effectiveness of flood warning and emergency response arrangements can be improved by introducing measures to help communities know what information is available, where to get it and what it means. These include flood awareness training, community guides on how to help communities minimise their flood risk, establishing locally based flood information dissemination services to communicate relevant information and communication strategies.

Integration of Flood Warning Systems and Data Collection Networks

The capital cost of upgrading a flood data network is relatively high and imposes a significant on-going financial commitment on stakeholders. Simply expanding the number of data collection stations will not increase the effectiveness of flood warnings or forecasts unless resources are available for interpreting and disseminating the information.

It would seem appropriate for the existing data collection network to be integrated with plans for flood warning upgrades. It would also seem appropriate for the responsibilities for operating and maintaining the flood data collection network, and associated software and hardware, to be covered under a regional monitoring partnership, to be funded by respective beneficiaries. This arrangement would be subject to concurrence from the current owners and would overcome a problem expressed by some municipalities, that they do not have

Goulburn River.

the technical ability to operate and maintain the systems.

Roles and Responsibilities

The GBCMA has overall responsibility for coordinating the program. Specific roles and responsibilities have been identified in Appendices A.6 and C

Tasks

The main tasks under this program are as follows:

- identification of flood warning system needs;
- data network management; and
- community awareness activities.

Works Program

This program will be coordinated by the GBCMA through the Floodplain Manager. A rolling three-year works plan will be developed each year, prioritised from the consolidated Implementation Program outlined in Appendix D. The works plan will outline:

- tasks to be completed by the GBCMA, together with budget, targets and priorities;
- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

Links to Other Plans or Strategies

This program has strong links to regional emergency management plans and (at the local level) to flood sub plans developed by municipalities. In particular, flood sub plans are required to be consistent with local flood studies and floodplain management plans.

When considering flood warning upgrades, there are also linkages to the VFWCC's statewide flood warning system development plan.

Implementation

Proposed actions other than those regarded as core business of the GBCMA, or covered in other programs, are listed in Table A8 in Appendix A.6.

Program 7: Flood Monitoring Action

(Refer Appendix A.7)

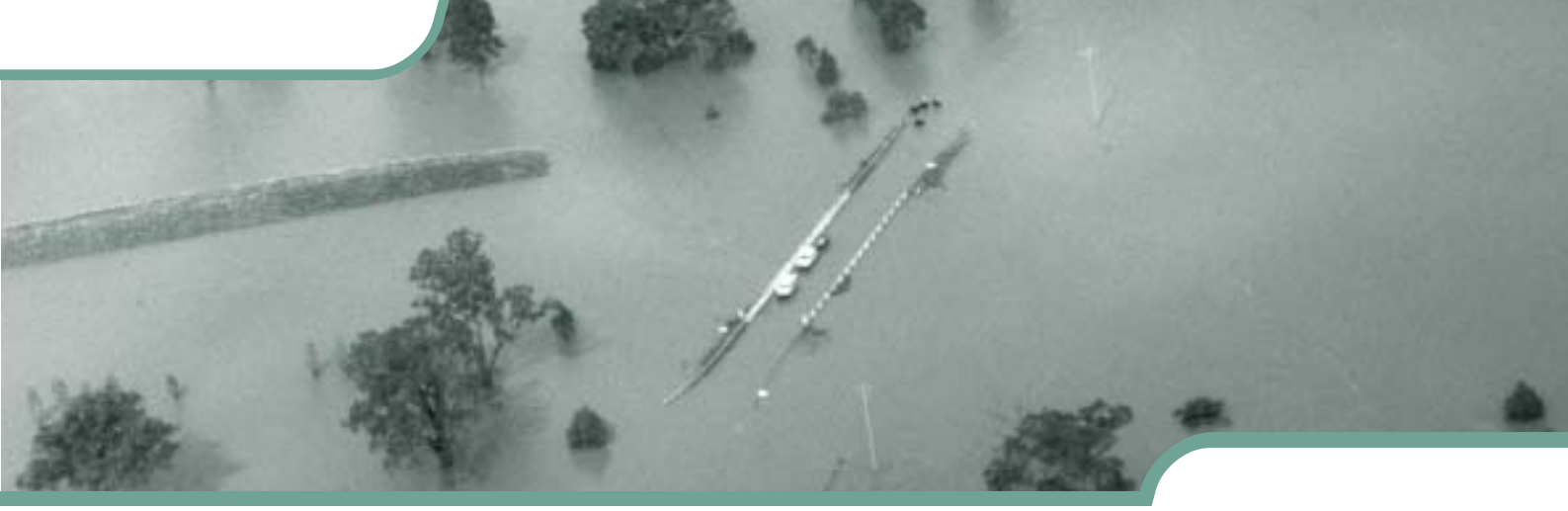
Objective

The objective of flood monitoring action is to facilitate effective flood monitoring and timely flood data collection to improve flood knowledge within the catchment.

Description

Flood monitoring can be divided into three components, described in detail in Appendix A.7:

- Assessing the impacts of floods, ie gathering, analysing and documenting all available flood information to ascertain the likely impacts/effects on the community and assets before, during and after a flood. A "Flood Assessment Manual" has been developed in conjunction with the regional floodplain management strategy, as a supplement to the "Flood Response Action Plan", to assist this process.
- Communicating this information to other stakeholders. This relies on two-way communication between all relevant agencies, with the GBCMA providing technical advise on flood impacts and



Benalla, 1993.

relying on flood information from BoM, G-M Water, municipalities and other stakeholders.
- Collecting flood data. The collection and documentation of real time flood data is an essential input for future flood studies, floodplain management plans and land use planning. Flood data is best gathered during and immediately after a flood.

Roles and Responsibilities

The GBCMA has overall responsibility for ensuring the guidelines are reviewed regularly and will require assistance from municipalities and other stakeholders. Specific roles and responsibilities have been identified Appendices A.7 and C.

Tasks

The main tasks under this program are as follows:
- test and update the GBCMA's "Flood Response Action Plan regularly;
- review asset performance when tested by floods; and
- collect flood data.

Works Program

This program will be coordinated by the GBCMA through the Floodplain Manager. A rolling three-year works plan will be developed each year, prioritised from the consolidated Implementation Program outlined in Appendix D. The works plan will outline:
- tasks to be completed by the GBCMA, together with budget, targets and priorities;
- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

Linkage to Other Plans or Strategies

This program is linked to flood sub plans prepared as part of municipal emergency management plans, though the Flood Response Action Plan (FRAP).

Implementation

Actions proposed for this program are listed in Table A9 of Appendix A.7.

Program 8 Information Management Systems

(Refer Appendix A.8)

Objective

The objective of this program is to develop and implement an integrated floodplain information system that provides high quality data for use in floodplain management decisions.

Description

This program focuses on maintaining, enhancing and improving flood information available to the Authority in order for it to carry out its floodplain management functions effectively. A key requirement is to have capability for accessing and utilising digital flood data. This requirement is discussed in greater detail in Appendix A.8.

North Eastern Railway Line near Whiteheads Creek Crossing, Seymour 1973.

Development of ArcView Interface and IT Needs

During the development of this Strategy, a GIS interface was designed, linking an access database with an ArcView interface to enable levee features to be identified on screen. A general training session was also held to give CMA users some conceptual understanding of the software functions. This process needs to continue.

As GIS becomes more prominent in the day to day business of the Authority, consideration will need to be given to ensuring computer upgrades will support GIS technology. Provision needs to be made for storing an increasing amount of data (eg aerial photography digital images, satellite imagery and scanned records), for plotting these digital images, for updating software and datasets and for keeping licences up to date.

It will be essential for CMA staff to upgrade and maintain skills in use of ArcView software and its utilisation for information access and retrieval to ensure a continuing progress of the CMA towards digital spatial technology.

Roles and Responsibilities

The GBCMA has overall responsibility for implementation of this program. Specific roles and responsibilities have been identified in Appendices A.8 and C. A dedicated GBCMA officer should be given responsibility for overall coordination, including ensuring licences are kept up to data and that all updates and renewals are implemented.

Tasks

The main tasks under this program are as follows:

- improve the quality of flood data; and
- continue to develop GIS capability.

Works Program

This program will be coordinated by the GBCMA through the Floodplain Manager. A rolling three-year works plan will be developed each year, prioritised from the consolidated Implementation Program outlined in Appendix D. The works plan will outline:

- tasks to be completed by the GBCMA, together with budget, targets and priorities;
- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

Linkages to Other Plans or Strategies

There are no direct linkages. However, the development of GIS capability has benefits, not just for floodplain management, but also for other activities undertaken by the GBCMA.

Implementation

Actions to be undertaken for this program are identified in Table A10 in Appendix A.8. It is expected that implementation of these measures will lead to efficiency gains and improvements in the accessibility and efficiency of using information.

Euroa, 1993.

Program 9
Education, Promotion and Communication

(Refer Appendix A.9)

Objectives

The objectives of this program are:

- to improve the community and other stakeholders' knowledge of flood management issues; and to
- ensure that flood management decisions are made in accordance with best practice principles.

Description

In order for the GBCMA (and other stakeholders) to perform their role in flood management to a high standard, it needs to keep up to date on floodplain management issues and practices locally, statewide, nationally and internationally. This requires an understanding of current best practice principles, a commitment to training programs and seminars for those involved in flood and floodplain management activities, and supporting and contributing to community flood education and awareness.

Training programs for improving the skills and capabilities of floodplain practitioners have been identified in Appendix A.9.

Roles and Responsibilities

The GBCMA has overall responsibility for implementing/coordinating this program. Specific roles and responsibilities have been identified in Appendices A.9 and C. Generally they are to:

- facilitate and support community education and training programs;
- promote the use of best practice manuals and guidelines and to maintain an up to date library;
- support (or at least take an interest in) relevant research projects; and to
- encourage networking and workshops of those involved in flood management.

Tasks

The main tasks under this program are as follows:

- organise and implement training programs, conferences and workshops; and
- prepare public awareness material.

Works Program

This program will be coordinated by the GBCMA through the Floodplain Manager. A rolling three-year works plan will be developed each year, prioritised from the consolidated Implementation Program outlined in Appendix D. The works plan will outline:

- tasks to be completed by the GBCMA, together with budget, targets and priorities;
- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

Links to Other Plans or Strategies

This program is linked to the RCS (standard 1, GBCMA Communications Strategy – refer Appendix A), which includes developing educational and promotional material training programs.

Implementation

Actions to be undertaken for this Program are identified in Table A12 in Appendix A.9.

7 Implementation – Investment Plan Costs

Shepparton, 1974.

The total cost of implementing all program tasks in the regional floodplain management strategy is:

- $22.9 million capital cost; and
- $0.7 million per annum recurrent costs.

Further details are provided in Appendix D.

They exclude GST and do not include works associated with implementing the Lower Goulburn Floodplain Rehabilitation Scheme or the Shepparton-Mooroopna Floodplain Management Study.

Capital and average recurrent costs to GBCMA are approximately $5 million and $0.5 million per annum respectively (refer Table E1 in Appendix E). This assumes all tasks will be implemented within a 10-year timeframe.

Benefits

The adoption and implementation of the Strategy will bring a significant number of benefits to the Goulburn Broken Region, including:

- improved community awareness of floodplain management issues;
- acceptance of roles and responsibilities for floodplain management and identification of opportunities for partnership arrangements, particularly between the Authority and Local Government;
- clarification of cost sharing arrangements;
- adoption of best practice principles in floodplain management, particularly in relation to land use planning;
- a reduction in flood damages, when the studies, works, flood warning systems, asset management systems and statutory planning measures are implemented;
- identification of information needs and information systems required for sound decision making; and
- adoption of floodplain management measures that will reduce the flood risk.

Cost Benefit Analysis

No detailed cost benefit analyses were undertaken for the Strategy. However a cost benefit analysis will be required where flood studies and floodplain management plans consider structural flood mitigation measures or flood warning upgrades.

Some indication of the relative benefits of non structural measures can be obtained by considering the reduction in the growth of annual average damages. This was calculated as $30.6 million by Read Sturgess and associates (Ref. 6).

From census information the current estimated average rate of growth for the Goulburn Broken region is 1.03%. The discounted value of damages over the next 30 years at this rate is $383.265 million assuming a discount rate of 8%. If a reduction of 0.15% in AAD could be achieved the discounted value of damages would fall to $377.186 million resulting in a 'net benefit' of $6.079 million.

The total cost of statutory planning and other supportive measures to introduce non structural controls (Programs 3, 4 and 5) is less than $1.5 million, indicating, at this discount rate, a benefit cost ratio of at least 4.

To test the sensitivity of this analysis, the discounted value of benefits over a 30 year

period were tested for a range of interest rates and assumed reduction in growth rates. Results are shown in Table 6. They clearly indicate the value of these measures.

Priority Setting

Priority setting for the various tasks within each program was based on an assessment of the economic, social and environmental benefits of each task. Where appropriate a "Rapid Appraisal Method," developed by Read Sturgess and Associates for NRE was used (Ref. 4). In many cases however this method was not suitable and priority setting was based on a subjective analysis. Further details are given in Appendix F.

Funding and Cost Sharing Arrangements

Implementation of the regional floodplain management strategy can only be achieved when all components are based on a realistic assessment of the capacity of beneficiaries to pay for the required floodplain management measures. This needs to be considered in the context of:

- a user pays philosophy wherever possible;
- an understanding of funding sources; and
- identification of opportunities for cost sharing.

A number of high cost activities in the strategy require substantial government subsidies for their implementation, in particular:

- flood studies and floodplain management plans;
- structural flood mitigation works arising out of an approved scheme process; and
- flood warning systems[2].

Table 6: Benefits from Reduced Rate of Growth in Flood Damages

Reduction in growth of damages			Discounted value of benefits over next 30 years ($M)		
From	To	Difference	8%	6%	4%
1.03%	1.0%	0.03%	1.227	1.689	2.389
1.03%0.98	0.05	2.042	2.810	3.975	
1.03%0.93	0.1	4.068	5.598	7.914	
1.03%0.88	0.15	6.079	8.362	11.820	
1.03%0.83	0.2	8.075	11.104	15.691	
1.03%0.78	0.25	10.055	13.824	19.529	
1.03%0.73	0.3	12.021	16.521	23.333	
1.03%0.68	0.35	13.971	19.196	27.104	
1.03 0.63	0.4	15.906	21.850	30.843	
1.03 0.58	0.45	17.827	24.482	34.549	
1.03	0.53	0.5	19.734	27.092	38.223

These tasks typically address issues of public concern or have a substantial public benefit. Funding guidelines have been developed to ensure compliance with government policy. Among other things, they set out cost sharing arrangements and require local beneficiaries, typically municipal councils and the Authority, to contribute to the overall costs. Funding for specific projects is not guaranteed and will generally depend on Federal funding allocations and statewide priorities for similar works and measures in other catchments.

For the purpose of this Strategy, cost apportionment has set in accordance with Table 7, which consistent with principles/ guidelines set out in the Victoria Floodplain Management Strategy.

[2] *No flood warning system upgrades have been proposed unless they link with a floodplain management plan.*

Table 7: Indicative Cost Sharing Arrangements

Program	Commonwealth	State	Local[1]
Flood Studies and Floodplain Management Plans (see Program 2)	1/3	1/3	1/3
"Approved Scheme" Flood Mitigation Works (excluding the PWD & Lower Goulburn Levees – see Program 2)	1/3	1/3	1/3
Future PWD Levee Upgrades (see Program 2)	0	0	1
Lower Goulburn Floodplain Rehabilitation Scheme.	Unknown	Unknown	Unknown
Flood Warning Systems – Operating and Development Costs (see Program 6)	0	0	1
Private & Non-Strategic Flood Mitigation Works (see Program 1)	0	0	1
Collection of real time flood data for major floods of State significance (see Program 7)	0	Substantial contribution	Balance
All other Tasks	0	0	1

Note 1 Local cost is apportioned among beneficiaries, primarily the GBCMA, municipalities, local groups

Federal Funding Arrangements

Funding for projects can come from three funding streams:

- National Landcare Program (NLP) within the Natural Heritage Trust (NHT);
- National Disaster Risk Management Studies Program (NDRMSP);
- Regional Flood Mitigation Program (RFMP); and
- National Action Plan (NAP).

NLP funding is administered through Agriculture, Fisheries and Forestry Australia and applies to projects that achieve natural resource objectives. Its focus is therefore wider than studies or works that aim towards flood mitigation. NLP funding will generally be used for new natural resource/ environmental type projects, and to finish off ongoing floodplain management projects.

NDRMSP funding is available for providing financial assistance for "risk management" studies for all natural hazards in Australia. This funding source applied to flood investigations but not for the implementation of flood mitigation works. The Federal Department of Finance and Administration administers this program.

RFMP funding is specifically available for flood mitigation projects outside the Melbourne metropolitan area, including flood control dams, retarding basins, levees, bypass floodways, channel improvements, purchase of flood prone properties, house raising, flood proofing, flood access improvements, community awareness and flood warning systems. The Federal Department of Transport and Regional Services administers this program.

NAP finding is eligible for projects that assist in the protection and/or enhancement of biodiversity, water quality, and protection and/or mitigation against salinity threats. Across Australia, the Federal and respective State Governments have signed Bilateral Agreements, which provide specific guidance for eligible initiatives.

Wreckage of Rickman House washed downstream onto Hume Highway.

Photograph: Tha Age.

State Government Funding

Funding sources include:

- contributions to NHT, NDRMSP, RFMP and NAP programs to complement Commonwealth Government contributions; and
- annual budget allocations to the Goulburn Broken Catchment Authority to meet their corporate costs and to implement floodplain management, waterway management and rural drainage activities outlined in their business plans.

Local Funding

Local funding will generally come from the budgets of the relevant beneficiaries (typically local government, the GBCMA and in some cases other agencies such as Goulburn-Murray Water). Local government and Goulburn-Murray Water have a rate base. Other agencies (including the GBCMA) rely on budget allocations at the State or Federal level.

Apportionment will be subject to negotiation on a case by case basis and needs to be done prior to the submission of funding bids.

8 References

Stanhope Depression, Midland Highway, 1958.

1. Agriculture and Resource Management Council of Australia and New Zealand (2000): Floodplain Management in Australia: Best Practice Principles and Guidelines. SCARM Report 73.

2. Dept. of Natural Resources and Environment/ Dept. of Justice (1998): Victoria Flood Management Strategy.

3. Victorian Flood Warning Consultative Committee, Bureau of Meteorology (February 2001): Arrangements for Flood Warning Services in Victoria.

4. NRE (2000): Rapid Appraisal Method (RAM) for Floodplain Management.

5. Dept. of Infrastructure/ Dept. of Natural Resources and Environment/ Melbourne Water (2000): VPP Practice Notes (2 volumes).

6. Read Sturgess and Associates (2001): Economic Evaluation of Flood Damages for the GBCMA.

A Appendix A - Programs

A.1 Program 1: Asset Management

Objective

The primary objective of asset management is to facilitate sustainable management of existing strategic floodplain assets, having regard for level of service, ownership, roles and responsibilities of maintenance and cost sharing arrangements.

This will be achieved by:

- the preparation of an inventory of strategic assets;
- identifying and clarifying existing and future roles and responsibilities;
- developing maintenance programs for specified groups of assets;
- establishing principles for cost sharing among stakeholders;
- identifying any needs for audits or special investigations; and
- evaluating costs and benefits of groups of assets to establish overall priorities in respect of management.

Background

Assets are those structures that can have an impact upon flooding characteristics. They are usually associated with levees but can also include channels, raised roads, spoil banks, railway embankments and other works that protect or obstruct flows. In this report, "assets" and "levees" are used synonymously. A reference to a levee or levees also implies a reference to their associated structures.

Levees are regarded as strategic if they protect important areas or assets from flooding. They will generally protect significant urban areas, or large, highly productive areas, but also can include levees which protect single properties, yet have significant adverse flooding effects on a large number of other properties. Levees that control potentially undesirable river avulsions are also considered strategic.

For effective asset management at the regional level, strategic levees have to be identified, future needs established, management responsibilities defined and assigned, and best practice measures and mechanisms put into place.

It is the GBCMA's policy that no new levees are to be constructed other than to protect an existing dwelling and its immediate curtilage of, unless they are part of an Approved Scheme.

For the purpose of this strategy, levees have been divided into a number of categories.

Public Rural Levees

These are regarded as rural levees constructed from public funds or by a public authority. There are three such levees in the GBCMA's area: the so called "PWD levee," extending along the Murray River from Cobram to Piree Creek; the Lower Goulburn River levees, extending along both sides of the Goulburn River floodplain downstream of Loch Garry; and the Beattie Depression floodway, east of Echuca.

Public Urban Levees

These are levee schemes arising from implementation of a government-sanctioned scheme. There are two such levee systems in the GBCMA's catchment: the Nathalia town levees and the Cobram town levees.

Private Strategic Levees

These are levees having a strategic impact but which have been constructed as the need arose by private individuals. There are six private rural strategic levee systems of significance to the GBCMA:

- private levees along the Murray River between Piree Creek and Barmah (the Barmah forest levees);
- three private levee systems along Deep, Warrigal Wells Creek in the Lower Goulburn floodplain;
- an informal network of private levees, raised channels, roads and other obstructions along Broken Creek from Walsh's Bridge Road to the River Murray; and
- an ad hoc collection of levees in the Corop Lakes area.

There are also two urban levee systems of strategic significance at Numurkah and Shepparton. Their origins are obscure, and for the purposes of this report, they are regarded as private levees.

Management of Levees

PWD Levees

The PWD (and Ulupna Island) levees extend approximately 75 km from Cobram to where Piree Creek enters the

Murray River, 62 kilometres downstream. Their construction history dates back to the 1890's, when the Public Works Department constructed four sections of levee between Cobram and Ulupna. However, private levees had been constructed prior to this. It is generally accepted that the GBCMA will eventually be responsible for their maintenance, subject to resolution of a number of liability, maintenance and funding issues.

Based on the recommendations of a 1997 levee audit, and with the assistance of government funding, the GBCMA has adopted a policy of reinstating the worst parts of the levee to preserve its integrity without raising its general level of protection. The levees will generally overtop when floods exceed the 1975 flood level assuming no levee failure beforehand. Maintenance programs will be prepared in the near future to ensure the reinstated sections of levee meet engineering standards and the 1975 level of protection (assuming no freeboard and no levee failure) is achieved where possible. Reinstatement of sections currently below the 1975 level of protection is subject to the availability of continued funding.

Having regard for the current condition of the levees and unpopularity of rating the beneficiaries of these levees at the present time, it is recommended that the GBCMA refrain from assuming responsibility for maintaining those sections of the PWD levee it has not reinstated until:

- the levees are upgraded to an standard acceptable to the GBCMA;
- any issues arising from legal liability if levees fail are resolved; and
- resolution is reached on funding for operation and maintenance.

Assuming satisfactory resolution of these issues, the GBCMA will need to prepare and implement a management plan.

Lower Goulburn Levees

The Lower Goulburn levees extend along both sides of the Goulburn River downstream of Shepparton. Available records indicate that levee construction commenced on a significant scale during 1898 as an unemployment relief initiative. The main levee system, which exists today, was virtually complete before World War I. There are now approximately 140 kilometres of levees with an average height of 1.8 metres. In comparison with contemporary standards the levees were constructed too close to the waterways, generally reflecting the limits of Crown land river frontage rather than hydraulic flow criteria.

Consultants audited the Lower Goulburn Levees in 1998 and 1999. The auditors identified a number of deficiencies, including (in comparison with current best practice) inadequate compaction, steep sides, inadequate crest width, trees growing along almost the entire length, inadequate foundations and poor fill material being used. The consultants evaluated a number of options for managing the Lower Goulburn levees, including the alternative preferred by the GBCMA – the "Lower Goulburn Floodplain Rehabilitation Scheme."

As with the PWD levees, it is generally accepted that the GBCMA will accept responsibility for maintenance, subject to resolution of a number of liability, maintenance and funding issues.

Recommended management arrangements for the Lower Goulburn levees are therefore:

- resolve legal liability issues and funding requirements for operation and maintenance;
- implement the Lower Goulburn Floodplain Rehabilitation Scheme;
- identify the major outlet structures to be operated and maintained by Goulburn-Murray Water (and for which they have statutory responsibilities) and formalise agreement to cover this process;
- identify which of the levees are to be maintained by the GBCMA and prepare a maintenance schedule;
- incorporate the maintenance schedule and formal agreements in a management plan.

Beattie Depression Levees

These levees confine the outflows from Deakin Main Drain and Mosquito Creek to the Beattie Depression between Echuca Village and the Kanyapella Basin in order to minimise flooding of the surrounding low lying areas. There are approximately 21 kilometres of earthen levees for this system, whose height is generally between 1.2 and 1.8 metres.

Goulburn-Murray Water maintains the levees up to the Murray River and they are believed to be in good condition. No changes to these arrangements are proposed in this Strategy.

The lower reach of the levee system also needs to be maintained to an acceptable standard. It would seem appropriate for the Catchment Management Authority to combine management of these sections with management of the Lower Goulburn River.

Urban Levees

There are two publicly funded urban levees in the Goulburn Broken catchment: the Nathalia town levees

and the Cobram town levees (recently completed at a cost of approximately $3.4 million). Other urban levees exist (eg at Murchison, Numurkah and Barmah) but these appear to have been constructed as the need arose by private individuals or with local funding. Municipalities have a traditional role in constructing and maintaining urban levees and funding has been conditional upon their accepting a role in ongoing operation and maintenance. This arrangement should continue.

Therefore, having regard for the GBCMA's role in promoting best practice at the regional level and for the lead role of the municipalities in urban asset management, the following management arrangements are recommended:

- urban assets continue to be funded and managed by the relevant municipalities[1] ;
- each municipality managing urban assets prepares and implements a maintenance plan and keeps records of maintenance and performance;
- any outstanding recommendations from the 1996 levee audits for Nathalia are to be implemented or reviewed in a floodplain management plan;
- each municipality managing urban assets ensures easement rights are acquired for protecting its assets;
- each municipality managing urban assets provides reports on asset performance to the CMA after floods.

Private Strategic Rural Assets

Of the six private rural strategic levee systems of significance to the GBCMA, three (along Deep Creek, Warrigal Creek and Wells Creek) are intrinsically linked to the Goulburn River levees.

The other three systems are the Barmah Forest levees, an informal network of private levees, raised channels, roads and other obstructions along Broken Creek Walsh's Bridge Road to the River Murray; and an ad hoc collection of levees in the Corop Lakes area.

While the impact of these levees varies, the recommended management arrangements are similar, namely:

- no new levees (other than protection of an existing dwelling and its immediate curtilage) unless they are part of an approved scheme;
- monitor levee performance, but allow self management by landholders, either individually or through community or advisory committees; and
- as the lead agency (but not the implementing agency) advise owners on best practice and facilitate any disputes between adjoining landowners.

The GBCMA should not become directly involved in managing private assets. However if community concern over potential impacts, inadequate maintenance or a similar issue becomes significant it is recommended that the levees be reviewed as part of a rural floodplain management plan. While the GBCMA may choose to facilitate the process, responsibility for funding and supervision of the plan should be with the beneficiaries. In general the floodplain management plan should:

- determine by survey and inspection the height, length, level of protection, ownership and condition of levees;
- ascertain the impacts of the levees on adjoining properties;
- make appropriate recommendations on removal or maintenance or other management measure; and
- identify a mechanism for regular maintenance, either by individual landholders or by contracting out, based on the capacity of beneficiaries to pay.

The GBCMA should collect details of the levees for its Asset Register when these become available.

Raised Earthworks and Structures

These include channels, drains, raised roads, bridges and abutments. Unless properly designed they have the potential to obstruct and possibly divert flows. While provisions are in place for controlling private works some agencies and authorities may be exempt from seeking planning permits for their works.

It is recommended that the GBCMA inform Vic-Roads, V-Line, Goulburn-Murray Water, Power Authorities and municipalities of their obligations, as the need arises, for example when channel remodelling is proposed or road or bridge upgrades are being investigated.

Private Assets

New private assets or upgrades to existing private assets will be controlled through municipal planning schemes.

Implementation

Proposed actions are outlined in Table A1.

1 Management to include inspection, maintenance and emergency planning.

Table A1: Asset Management Tasks for Implementation

	Item	Implementation Agency and Indicative Costs $				Funding Sources	Priority
		GBCMA	Municipal	Local	TOTAL		
Asset Register							
AR1	Upgrade and maintain asset register	2,000 pa			2,000 pa	GBCMA	High
PWD Levees							
PWD1	Resolve legal liability issues	5,000			5,000	GBCMA	High
PWD2	Resolve arrangements for funding for O&M	5,000			5,000	GBCMA	High
PWD3	Prepare a management plan	10,000			10,000	GBCMA	High
PWD4	Maintain levees	190,000 pa			190,000 pa	GBCMA	High
Lower Goulburn Levees – includes part of Beattie Depression levees along the Murray							
LG1	Resolve legal liability issues	5,000			5,000	GBCMA	High
LG2	Resolve arrangements for funding for O&M	5,000			5,000	GBCMA	High
LG3	Formalise agreement with G-M Water over future arrangements for managing assets they currently maintain	5,000			5,000	GBCMA	High
LG4	Prepare and implement a management plan, including maintenance	10,000			10,000	GBCMA	High
LG5	Maintain levees	190,000 pa			190,000 pa	GBCMA	High
Beattie Depression Levees							
BD1	Maintain as required	Nil.		20,000 pa	20,000 pa	G-M Water	High
Cobram Town Levees							
CTL1	Prepare a management plan		5,000		5,000	S/Moira	High
CTL2	Maintain the levees		74,000 pa		74,000 pa	S/Moira	High
Nathalia Town Levees							
NTL1	Prepare a management plan		5,000		5,000	S/Moira	High
NTL2	Maintain the levees		36,000 pa		36,000 pa	S/Moira	High
NTL3	Acquire easement rights for levees		10,000		10,000	S/Moira	High
Private Strategic Levees							
PSR1	Allow self management either individually or through community or advisory committees via a floodplain management plan	2,000 pa		Unknown	2,000 pa	GBCMA	High
	Asset Management Review						
AMR1	Review/audit asset management plans every 5 years	10,000	10,000		20,000	GBCMA/ S Moira	High
	TOTAL CAPITAL	55,000	30,000		85,000		
	TOTAL RECURRENT	384,000pa	110,000pa	20,000pa	514,000pa		

A.2 Program 2: Flood Studies and FPM Plans

Objective

The objective of this Program is to develop and implement flood studies and floodplain management plans having regard for social, environmental, cultural and economic costs and benefits.

This will be achieved by:

- identifying future needs for both urban and rural studies and floodplain management plans;
- undertaking future urban and rural flood studies and floodplain management plans;
- establishing priorities and principles for cost sharing;
- reviewing priorities annually, having regard for budget constraints; and
- implementing any recommended works and measures.

In accordance with current best practice, flood studies and floodplain management plans are formulated in accordance with a risk management approach advocated in AS/NZ Standard 4360:1995. The risk management steps are illustrated in Figure A1.

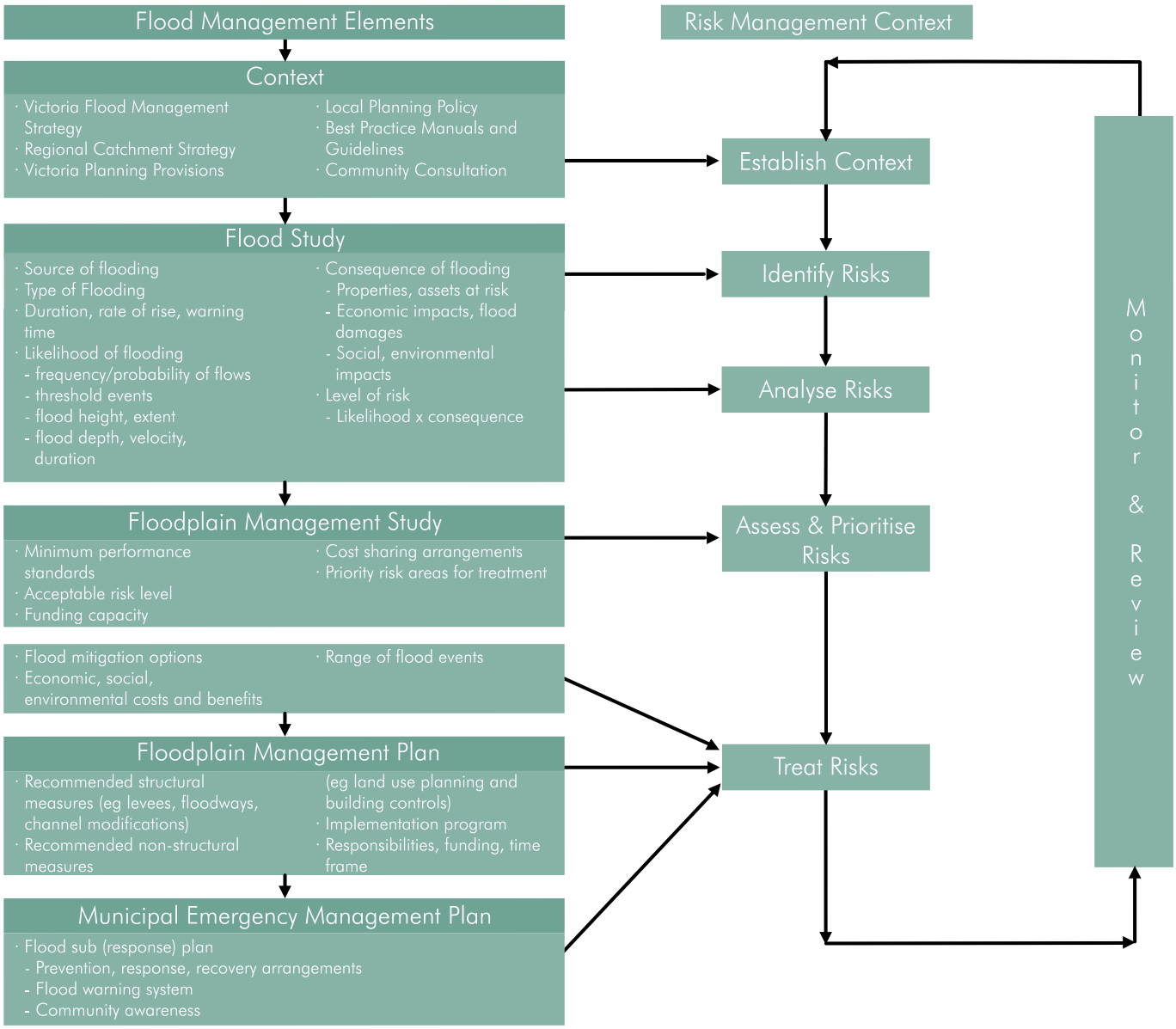
Background Information

In this program flood studies, floodplain management plans, and any associated works, are identified, costed and prioritised. Roles and responsibilities for implementation are also determined.

Flood studies generally involve a detailed technical investigation of flood data (usually for several floods) to provide a better understanding of flood risk. They may involve detailed hydrologic and hydraulic investigations, review of previous studies and in some cases, levee audits or scoping studies. Findings are documented in a report, often with flood inundation maps.
A floodplain management (FPM) plan integrates the results of a flood study (or flood studies) with recommended structural and non-structural flood management measures, thereby providing a basis for guiding management activities on floodplains.

When undertaking a flood study or floodplain management plan, or when implementing any associated works or measures, a steering committee will need to be formed, with representation from community groups, Implementation Committees, municipalities and State and Federal agencies where appropriate. The steering committee will provide information and direction to the relevant Implementation Committee, with technical support from the Floodplain Manager.

Figure A1: Flood Management in the Risk Management Context



Roles and Responsibilities for Implementation

Flood studies and FPM plans in urban areas and their immediate surrounds generally are fairly detailed and have a narrow focus, concentrating on local problems and solutions. Those benefiting from the studies, and any associated works and measures, are usually concentrated in a relatively small area. While cost apportionment and assignment of specific roles and responsibilities will be developed on a case by case basis, it is expected that the municipality in which the flood study or FPM plan is located will be responsible for its implementation, together with any recommended works and measures. Local municipalities are better positioned to drive the process and from a funding perspective, they are able to recoup costs through rating.

For rural areas, flood studies and FPM plans will generally focus on either improving the GBCMA's knowledge of flooding in a region and/or recommending non-structural measures for minimising its impacts; or fixing some strategically significant problem (such as resolving the Lower Goulburn levees management issue). The focus is more widespread, and less detailed and the issues are often focused across more than one municipality. The GBCMA is more strategically placed to be the implementation agency in these investigations.

Implementation

Table A2 below provides details of the type, cost, implementation agency and priority for a number of studies and FPM plans in the Goulburn Broken Region. Their costs and scope are provisional and intended solely for the development of the GBCMA's consolidated works program and budget. Certain assumptions have had to be made in relation to the scope of survey, level of detail for hydrological/ hydraulic investigations and other matters. Generally, costs have been based on a moderate level of field survey and hydraulic analysis. They exclude GST and do not include allowances for managing the studies.

Table A2: Flood Studies and FPM Plans – Capital Costs (Ref. FSU & FSR)

	Item	Study Type	Indicative Cost $	Municipalities Involved	Priority
Abbreviations					
USS = Urban Scoping Study	UFMS = Urban Floodplain Management Study		RFMP = Rural Floodplain Management Plan		
RSS = Rural Scoping Study	RFMS = Rural Floodplain Management Study		UFS = Urban Flood Study		
UFMP = Urban Floodplain Management Plan	RFS = Rural Flood Study				
Murray River Basin					
MU1	Barmah Urban Study	UFMS	25,000	Moira	Low
MU2	Yarrawonga Urban Study	UFS	35,000	Moira	Medium
MR1-1	Murray River: Dick's Levee to Piree Creek – Stage 1	RSS	45,000	Moira	High
MR1-2	Murray River: Dick's Levee to Piree Creek – Stage 2	RFS	310,000	Moira	High
MR1-3	Murray River: Dick's Levee to Piree Creek – Stage 3	RFMP	250,000	Moira	High
MR2-1	Murray River – Piree Creek to Barmah – Stage 1	RSS	45,000	Moira	Low
MR2-2	Murray River – Piree Creek to Barmah – Stage 2	RFMP	480,000	Moira	Low
Goulburn River Basin					
GU1	Avenel Urban Study	UFS	40,000	Strathbogie	Low
GU2	Buxton Urban Study	UFS	25,000	Murrindindi	Low
GU3	Jamieson Urban Study	USS	20,000	Delatite	Medium
GU4	Kilmore Urban Study	UFS	50,000	Mitchell	Medium
GU5	Mansfield Urban Study	UFS	60,000	Delatite	Medium
GU6	Merrigum Urban Study	UFS	40,000	COGS	Medium-High
GU7	Molesworth Urban Study	UFS	35,000	Murrindindi	Low
GU8	Murchison Urban Study	UFS	30,000	COGS	Low
GU9	Nagambie Urban Study	USS	35,000	Strathbogie	Medium
GU10	Rushworth Urban Study	USS	40,000	Campaspe	Low
GU11	Seymour Urban Study	UFMP	35,000	Mitchell	High
GU12	Stanhope Urban Study	USS	15,000	Campaspe	Low
GU13	Tallarook Urban Study	UFS	40,000	Mitchell	Low
GU14	Tatura Urban Study	UFMP	100,000	COGS	High
GU15	Thornton Urban Study	USS	15,000	Murrindindi	Medium-High
GU16	Toolamba Urban Study	UFMS	50,000	COGS	Low
GU17-1	Violet Town Study – Stage 1	USS	20,000	Strathbogie	High

Table A2: Flood Studies and FPM Plans – Capital Costs (Ref. FSU & FSR), Continued.

	Item	Study Type	Indicative Cost $	Municipalities Involved	Priority
Abbreviations					
USS = Urban Scoping Study	UFMS = Urban Floodplain Management Study	RFMP = Rural Floodplain Management Plan			
RSS = Rural Scoping Study	RFMS = Rural Floodplain Management Study	UFS = Urban Flood Study			
UFMP = Urban Floodplain Management Plan	RFS = Rural Flood Study				
Goulburn River Basin, Continued					
GU17-2	Violet Town Study – Stage 2	UFMP	80,000	Strathbogie	High
GU18	Yea Urban Study	UFS	80,000	Murrindindi	Medium-High
GR1-1	Goulburn River: Eildon to Seymour – Stage 1	RSS	25,000	70% Murrindindi 30% Mitchell	Low
GR1-2	Goulburn River: Eildon to Seymour – Stage 2	RFMS	240,000	70% Murrindindi 30% Mitchell	Low
GR2-1	Goulburn River: Seymour to Shepparton – Stage 1	RSS	30,000	50% COGS 40% Strathbogie 10% Mitchell	Low
GR2-2	Goulburn River: Seymour to Shepparton – Stage 2	RFMS	280,000	50% COGS 40% Strathbogie 10% Mitchell	Low
GR3-1	Goulburn River: Shepparton to Murray River – Stage 1	RFS	250,000	29% COGS 38% Moira 33% Campaspe	Under way
GR3-2	Goulburn River: Shepparton to Murray River – Stage 2	RFS	50,000	29% COGS 38% Moira 33% Campaspe	Very High
GR4	Castle & Seven Creeks Downstream of Euroa	RFS	65,000	65% Strathbogie 35% COGS	Medium High
GR5	Corop Lakes	RFS	60,000	Campaspe	Low-Medium
GR6	King Parrot & Strath Creeks	RFS	120,000	Murrindindi	Low
GR7	Murrindindi Creek and Yea River	RFS	120,000	Murrindindi	Low
GR8	Sunday & Dry Creeks, Including Broadford	RFS	135,000	Mitchell	Low
Broken River Basin					
BR1	Broken River: Benalla to Shepparton	RFS	135,000	40% Delatite 60% COGS	Medium
Broken Creek Basin					
BCU1	Katamatite Urban Study	USS	15,000	Moira	Low-Medium
BCU2	Nathalia Urban Study	UFMP	150,000	Moira	Under way
BCU3	Numurkah Urban Study	UFMP	100,000	Moira	High
BCU4	Tungamah Urban Study	UFMP	80,000	Moira	High
BCU5	Wunghnu Urban Study	USS	35,000	Moira	Low
BCR1	Pine Lodge, Daintons, Congupna & O'Keefe Creeks	RFS	120,000	COGS	Low
BCR2-1	Nine Mile, Boosey, Muckatah Creeks – Stage 1	RFS	150,000	90% Moira 10% COGS	Low-Medium
BCR2-2	Nine Mile, Boosey, Muckatah Creeks – Stage 2	RFMS	160,000	90% Moira 10% COGS	Low-Medium
		TOTAL	4,320,000		

Structural measures recommended from recent flood studies are included in Table A3 along with details of the cost, implementation agency and priority. Note that additional structural measures will arise out of future studies and floodplain management plans and this Table will need to be revised regularly. For the purpose of budget setting, an allowance of $400,000 per annum for urban works and $200,000 per annum for rural works has been assumed over a ten year planning horizon.

Funding for studies, floodplain management plans and associated works will rely heavily on state and federal funding allocations, which will vary from year to year. About one third of the costs will be met by municipalities, the GBCMA and possibly other local beneficiaries, and cost apportionment will be determined on a case by case basis.

Table A3: Floodplain Works

	Item	Implementation Agency	Indicative Cost$	Municipality (ies) Involved	Priority
Water Management Schemes - Urban Areas					
FPW1	Implement Benalla Water Management Scheme	Shire of Delatite	2 million	Delatite	V. High
FPW3	Implement Euroa Water Management Scheme	Shire of Strathbogie	0.8 million	Moira	V. High
FPW4	Implement Shepparton-Mooroopna Water Management Scheme	City of Greater Shepparton	Unknown	Moira	V. High
FPWU	Implement works from future urban studies and FPM plans	Relevant municipality	4 million	Unknown	Unknown
Rural Areas					
FPW5	Implement Lower Goulburn Floodplain Rehabilitation Scheme	GBCMA	22 million	29% COGS 33% Campaspe 38% Moira	V. High
FPW6	Upgrade PWD levees	GBCMA	3 million	Moira	V. High
FPWR	Implement works from future rural studies and FPM plans	GBCMA	2 million	Unknown	Unknown
		Total	**33.8 million plus Shepparton works**		

A.3 Program 3: Statutory Land Use Planning

Objectives

The objectives of this program are to:

- *provide decision tools to allow development and land use practices to be compatible with the flood risk;*
- *Streamline the referral process to screen out unnecessary referrals, and to provide a consistent performance-based criteria to all stakeholders.*

This will be achieved by:

- reviewing NRE flood maps and identifying where improved flood mapping is desirable;
- preparing draft amendments to the VPPs that reflect best practice floodplain management principles and reduce the need for referral;
- improving referral arrangements with local government; and
- identifying options for cost recovery.

Background

Adequate planning scheme controls are the most effective means of controlling developments in floodplains so as not to increase future flood damages or place unnecessary risk to life, health and safety on occupants of floodplains. Prevention is more cost effective than cure.

The Planning and Environment Act provides for the control of land use and associated development and works through planning schemes which operate within each municipal area. The planning controls can be made specific to each area, type of use or development and can vary widely within any municipality to reflect differences in location, or differences in social, environmental or economic factors. In Victoria, all planning schemes have been reformed to use a model structure (the Victoria Planning Provisions or VPPs) which includes the following four elements:

- the State Planning Policy Framework (SPPF);

- the Municipal Strategic Statement (MSS) - a statement of the overall land use objectives and supporting strategy that will be followed;
- the Local Planning Policy Framework (LPPF), which provides the local policies by which the MSS will be implemented); and
- specific land use planning controls which are selected from the suite of zones, overlays and additional provisions of the VPPs.

The Statutory Land Use Planning program essentially concentrates on those actions which are aimed at improving the existing policies and statutory planning framework and those which aim to improve the efficiency and effectiveness of planning permit processing.

Planning Referrals

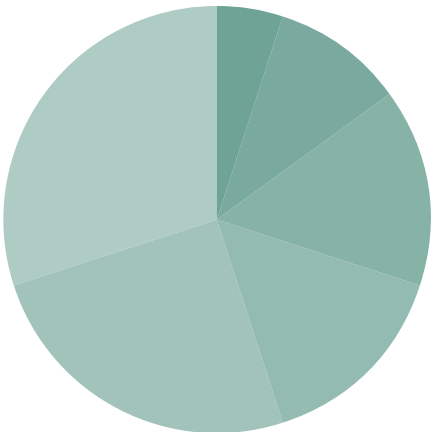
Section 55 referrals, under the *Planning and Environment Act, 1987*, are the main means by which the GBCMA can ensure development on floodplains is consistent with the flood risk. Referral provisions in the new format planning schemes are couched in the following terms:

> *"An application* (for planning permit) *must be referred to the relevant floodplain management authority under Section 55 of the* (Planning & Environment) *Act unless in the opinion of the responsible authority the proposal satisfies requirements or conditions previously agreed in writing between the responsible authority and the floodplain management authority".*

Such arrangements generally apply to development proposals on land identified as liable to flooding in the Urban Floodway Zone, Floodway Overlay, Land Subject to Inundation Overlay, and Special Building Overlay (which can be used for areas subject to stormwater flooding). The GBCMA can direct that a permit must be refused by the responsible authority or can offer no objections provided certain conditions specified by the GBCMA are met.

Alternatively the GBCMA can enter into agreements with councils that would effectively delegate the GBCMA's decision-making role to the council, or prepare local floodplain development plans which are linked to the decision guidelines in the relevant flood overlays in the VPPs, that will generally exempt the need for referral.

Currently, the CMA processes about 1,000 – 1,500 planning permit applications and requests for flood advice per year, broken up into:



- Other forms of development (eg sheds, dams, minor works) 5%
- Whole farm plans 10%
- Commercial/industrial development . 15%
- Flood level advice 15%
- Subdivisions (mainly into 2 lots) 25%
- New buildings and house extensions . 30%

TOTAL 100%

One of the key aims of the GBCMA in statutory land use planning is to reduce the number of planning referrals it sees and the time taken to process them without compromising its functions as a floodplain management authority. To help achieve this aim, draft VPP amendments have been written for the key municipalities in the Goulburn Broken catchment. They were developed in consultation with the respective municipalities and the GBCMA and were modelled on Planning Practice Notes developed for this purpose by DOI, in conjunction with NRE and Melbourne Water. The draft VPP amendments will provide all stakeholders a consistent set of performance-base criteria, which reflects best practice in floodplain management.

Each of the draft amendments contains relevant statements and clauses in relation to:

- municipal strategic statements;
- local policies;
- schedules to the flood overlays;
- agreements (where appropriate); and
- local floodplain development plans.

They have been drafted to recognise the importance of flooding in each municipality, and to minimise the effort required and simplify the process for obtaining planning permits on flood prone land.

There is considerable scope to vary the composition of these draft amendments, as floodplain management is only one of a number of significant issues that each municipality needs to consider. The GBCMA will need to liaise with each municipality and modify the documents where appropriate.

Improved Flood Maps

Good flood mapping across the entire Goulburn-Broken Region is considered to have a high priority compared to other programs because it will lead to improved statutory planning decisions, thereby reducing potential flood damages. A number of municipalities have incorporated the flood maps from NRE's "Flood Data Transfer Project" into the relevant flood zone and overlays in the VPPs. This information has only recently become available for the other municipalities and they will need to incorporate the flood maps into their planning schemes in the next planning scheme review. Furthermore, there are flood prone areas where there is inadequate or non-existent flood information, which require further "infill mapping" and incorporation into municipal planning schemes. The areas are identified in Table A4 but exclude flood mapping to be undertaken as part of an urban or regional study.

Map costs do not include the costs incurred in obtaining the data to be mapped (typically flood photography and flood level surveys).

Cost Recovery

A way of minimising the impacts on the GBCMA's limited resources is to charge fees for its services, as prescribed in Sections 158 or Section 264 of the Water Act, 1989. On 1 January 2001 the GBCMA Board signalled its intention to charge applicants a flat fee of $120 for all applications for flood advice. There were some exceptions (eg planning scheme amendments, whole farm plans and minor works such as carports or sheds). Administrative procedures were put into place whereby flood advice was to be in writing and no advice on flooding was offered until a fee was received. The system was geared towards only partial cost recovery. However, the GBCMA was recently directed by NRE not to charge a fee for the provision of flood advice. The Board is considering its position on this issue and in future, the GBCMA may require applicants to engage appropriately qualified engineers and surveyors to provide the flood advice necessary for the GBCMA to make its decision in relation to statutory planning referrals.

Implementation

Considerable work has already gone into implementing this program. Further work remains, namely:

- developing draft VPP amendments for the Shires of Murrindindi and Mitchell and finalising these in consultation with each Shire;
- incorporating FDT flood maps and VPP amendments into municipal planning schemes;
- developing agreements between the GBCMA and each municipality;
- improving flood maps where required and when appropriate;
- incorporating improved flood maps into planning schemes in a timely manner; and
- reviewing effectiveness of statutory planning controls.

A program for implementing these measures is given in Table A5. Their satisfactory implementation will introduce efficiencies in floodplain management and/or reduce the rate of growth of average annual damages.

Table A5: Infill Flood Mapping

Location	Cost ($)	Ranking
Murray Catchment		
Murray/Ovens River confluence near Bundalong	5,000	Low
Goulburn Catchment		
Delatite River, Howqua River, Merton Creek and Fords Creek (cleared areas only)	18,000	Low
Goulburn River tributaries between Eildon and Seymour (eg Rubicon River, Acheron River, Home Creek, Dabyminga Creek, Yea River, Murrindindi Creek, King Parrot Creek, Strath Creek)	22,000	Low
Goulburn River tributaries between Seymour and Shepparton (eg Major Creek, Sugarloaf Creek, Mollison Creek, Gardener Creek, Hughes Creek, Castle Creek, Seven Creeks*, Pranjip Creek, Honeysuckle Creek, Stony Creek)	36,000	Medium
Western floodplain north of Waranga Basin covering the numerous drainage lines and depressions through this area (update of 1950 flood extent information required)	30,000	High
Cornella Creek and Wanalta Creek	14,000	Low-Medium
Broken River Catchment		
Broken River and Holland Creek upstream of Benalla (cleared areas only)	8,000	Low
Baddaginnie Creek	8,000	Medium
Broken River effluents between Benalla and Lake Mokoan and Stockyard Creek.	5,000	Medium
Broken Creek Catchment		
Upper reaches of Broken and Boosey Creeks, including effluent flowpaths from Broken River between Broken Creek and Nalinga, and also near the Dookie Hills	14,000	Medium-High
Muckatah Depression and nearby depressions and areas of low lying land	11,000	Medium-High
Natural depressions between Broken Creek and the Murray River, north of Numurkah and Nathalia, including Drain 13 area near Nathalia	14,000	High
Broken Creek, downstream of Nathalia.	14,000	Medium-High
TOTAL	199,000	

Table B3B: Implementation Program for Statutory Planning

	Item	Total Costs ($) Municipalities	GBCMA	Implementation Agency	Funding Sources	Priority
SP1	Draft VPP amendments for Murrindindi & Mitchell		8,000	GBCMA	GBCMA	V. High
SP2	Incorporate FDT maps into planning schemes	210,000		Municipality	Relevant Municipality	V. High
SP3	Improved flood maps where required		199,000	GBCMA	GBCMA	V. High
SP4	Incorporate improved flood maps into planning schemes	105,000		Municipality	Relevant Municipality	V. High
SP5	Review performance of planning measures every 5 years	70,000	70,000	GBCMA	GBCMA/ Relevant Municipality	V. High
SP6	Inform VicRoads, V-Line, Goulburn-Murray Water & Power Authorities of recommended referral and consultation arrangements when appropriate		1,000 pa	GBCMA	GBCMA	V. High
	TOTAL CAPITAL	385,000	277,000			
	TOTAL RECURRENT	Nil	1,000 pa			

A.4 Program 4: Development Assessment Guidelines

Objective

The objective of this program is to ensure development proposals in floodplains are dealt with in a consistent, efficient and effective manner, in accordance with sound floodplain management.

This will be achieved by preparing relevant guidelines on assessing planning applications for use by appropriate staff from the GBCMA and municipalities. The guidelines may also be useful to prospective developers by indicating how applications are likely to be assessed.

The guidelines are intended as a supplement to other programs, in particular Program 3 (Statutory Planning).

Background

Best Practice guidelines for assessing buildings, subdivisions, whole farm plans/raised earthworks and fences have been prepared as part of the Strategy.

Best practice guidelines for dealing with statutory planning matters have also been prepared by other Authorities, in particular:

Title	Comment
"Floodplain Management in Australia" (SCARM 2000):	Contains general principles for floodplain management from a nation-wide perspective.
VPP Practice Note: Applying for a Planning Permit Under the Flood Provisions" (Ref 5):	Contains guidelines for decision making and setting building floor levels, flood-proofing buildings, freeboard and flood estimation techniques.

Implementation

As part of this Strategy it is desirable that the GBCMA commits itself to amending and adding to the guidelines to ensure they address local conditions and issues as they arise. A program for implementing these measures is given in Table A6.

Like the statutory land use planning measures in Program 3, the satisfactory implementation of the guidelines will introduce efficiencies in floodplain management and/or possibly reduce the rate of growth of average annual damages.

Table A6: Implementation Program for Development Assessment Guidelines

	Item	Recurrent Costs to Authority	Funding Sources	Priority
AG1	Refine, amend and review the guidelines: • refine guidelines to meet different needs • prepare new guidelines • review guidelines	$5,000 pa	GBCMA	V. High

A.5 Program 5: Control of Works and Activities

Objective

The objective of this program is to develop an integrated program for controlling works on floodplains.

This will be achieved by:

- identifying and documenting the procedures on how works and activities on floodplains can be controlled under the VPPs;
- identifying and documenting the procedures and resources for controlling works and activities under the Water Act;
- identifying the strengths and weaknesses of the various options under the VPPs and the Water Act; and by
- recommending a strategy that identifies the most appropriate form of action to be undertaken.

Background

A common concern of the community, municipalities, CMAs and a number of government agencies, is how to take action against a person who has constructed works that have, or would have, a potential to change the passage of water and cause damage. There are essentially seven courses of action to control works on a floodplain, namely:

- municipal planning controls (VPPs);
- declaration of land as "land liable to flooding" or as "floodway" under the Water Act;
- enforcing Section 195 of the Water Act (Control over connections and discharges into designated waterways or designated land or works);
- Victorian Civil and Administrative Tribunal process under the Water Act;
- Land Management Notice under the CALP Act 1994;
- by-laws under the Water Act; and
- Section 173 Agreements.

All have merit; however careful consideration needs to be given to how and under what circumstances they are used.

For new works on floodplains, statutory planning controls remain the most effective means of control. Declaration of floodway areas or land liable to flooding is unlikely to have any more advantages than incorporating flood maps into planning schemes and if anything will increase rather than reduce the GBCMA's workload.

Declaration of flood prone land may however be a useful measure if the GBCMA desires to modify or remove inappropriate works. This has implications for some of the floodplain management plans, particularly along Broken Creek.

The use of by-laws under the Water Act to control works on floodplains may have merit in some instances. However, they should not be used as an alternative to planning scheme controls and the GBCMA would have to convince the Minister why this particular course of action is desirable. The GBCMA would also have to be prepared to enforce any by-laws it creates. Furthermore, the potential for using by-laws to prescribe fees through regulating works would have to be considered against the strong community opposition to rating and other forms of revenue raising.

Section 173 Agreements can be used for controlling building densities on floodplains and to minimise authority's liability exposure from the consequences of flooding. There are however legal arguments about their validity. For instance, the use of Section 173 Agreements ensures acknowledgment, which promotes education and awareness about flood risk.

Recommendations and Future Actions

Having regard for the strengths and weaknesses of the various control mechanisms discussed above the following strategy is recommended:

- Continue to use statutory planning controls as the main mechanism for managing new works on floodplains, and consider supporting municipal councils in the use of Section 173 Agreements, where appropriate.
- Liaise with municipal councils over the use of declarations under the Water Act, by law development or other mechanisms discussed above to control existing development for problem areas, as identified in a floodplain management plan, or by the GBCMA or relevant Council.
- Consider, where appropriate, developing cooperative arrangements with Council over statutory enforcement where works are undertaken in contravention of planning controls, by combining the planning, administrative and technical skills of Council officers and the GBCMA's Floodplain Manager to attempt to negotiate a favourable outcome. If negotiation fails, consider taking the matter to the Victorian Civil and Administrative Tribunal.

A program for implementing these measures is given in Table A7. Indicative recurrent costs are included. The cost of implementing these measures cannot be accurately forecast and will evolve over time.

Like the statutory land use planning measures in Program 3, the satisfactory implementation of this program will introduce efficiencies in floodplain management and/or possibly reduce the rate of growth of average annual damages.

Table A7: Implementation Program for Control of Works and Activities

	Item	Recurrent Costs	Funding Sources	Priority
CWA1	Introduce declarations, by laws and other measures for controlling existing and new development on floodplains, in support of VPPs, where required: · use Section 173 Agreements · Water Act declarations · By-law development	GBCMA: $5,000 per annum	GBCMA	V. High
CWA2	Develop arrangements with Councils and other relevant groups over statutory enforcement of illegal works: · Joint inspections · Survey in some instances VCAT hearings	GBCMA: $10,000 per annum Municipalities: $5,000 per annum each (7 key municipalities)	GBCMA	V. High

A.6 Program 6: Emergency Response Planning

Objective

The objective of this program is to articulate the GBCMA's role in emergency response activities, community flood awareness and flood warning.

This will be achieved by:

- reviewing regional arrangements and resources in emergency response;
- identifying the role of the GBCMA in emergency response, including its role in Regional and Municipal Emergency Management Plans;
- identifying flood warning priorities and arrangements in consultation with the VFWCC;
- preparing a prioritised program of flood warning system development and maintenance;
- identifying community flood awareness issues and preparing outline program of community awareness activities within the catchment; and
- ensuring the GBCMA's emergency response activities are integrated with those of other authorities.

Background

Flood emergency management planning and flood warning are fundamental components of the floodplain management process. Their purpose is to manage floods to maximise public safety and to reduce preventable flood damages.

Emergency Response Planning

Regional Emergency Response Plans

Under the *Emergency Management Act 1986*, Victoria Police can establish committees at the regional level to plan for a coordinated response to all emergencies by all agencies having emergency management roles and responsibilities. Regional committees currently exist in all emergency response regions (or police districts).

VICSES is the control agency in planning for and responding to flood emergencies and is supported by a number of other agencies, including municipalities. Victoria Police is the coordinating authority to ensure that response capacity is in place.

While CMA's do not have a legislated role in the development or implementation of regional emergency response plans, they are however encouraged to participate in planning activities both at municipal and regional levels. The GBCMA can provide valuable input at the regional level by ensuring that details of expertise, personnel and other resources that can be called on in a flood, are documented and acknowledged in the regional plan. The regional plan should also acknowledge the CMA flood response action plan.

Municipal Emergency Management Plans (Flood Sub Plans)

Under *Emergency Management Act 1986*, councils are required to prepare municipal emergency management plans. For flood prone areas, councils are encouraged to incorporate plans (flood sub plans and local flood response plans) that specifically address flooding.

Specific flood related emergency response strategies include:

- operation, maintenance and improvement of flood warning systems;
- dissemination of flood information (including forecasts and warnings);
- flood evacuation plans;
- emergency works and actions (eg sand bagging, road closures, temporary levee banks);
- flood monitoring; and
- agreement on roles, responsibilities and contacts during flood emergencies.

Flood sub plans are required to be consistent with local flood studies and floodplain management plans. They should cover not just major floods up to the 100 year ARI event but more extreme floods such as the Probable Maximum Flood (or the Probable Maximum Precipitation flood) and those arising from catastrophic levee failure and dam break.

The GBCMA has a role to play in the development of flood sub plans by:

- reviewing and providing advice on flood matters in order to assist plan development (including assessing the impacts of flooding on communities);
- ensuring they are consistent with:
  - floodplain management plans,
  - flood planning maps and GIS layers developed as part of a the NRE Flood Data Transfer Project, and
  - flood inundation maps developed as part of a flood study and/or the regional floodplain management strategy; and by
- being prepared to provide support services if possible in the event of a flood.

GBCMA Flood Response Plan

A generic "CMA Flood Response Action Plan" that focuses on what a Catchment Management Authority should do before, during and after a flood has been prepared to assist the GBCMA prepare for, respond to and build local expertise on flooding. It addresses such issues as flood monitoring and the collection, collation and communication of real-time flood data. The plan thereby provides a firm basis for ensuring that the GBCMA is positioned as well as possible to assist the community and other agencies in reducing community flood risk and damage costs and for integrating its actions and commitments with emergency response. The plan needs to be tested annually and reviewed after major floods.

During and immediately after a flood, the GBCMA may be required to carry out emergency works to alleviate the effect on assets it is directly responsible for and/or to reduce the risk of flooding. Where possible actions taken to minimise damage to waterways should be incorporated into asset management plans.

Flood warning System Development

Flood warning in Australia (in the context of a "whole of catchment" approach) relies on a cooperative and partnership approach between all tiers of government as well as the local community. An effective flood warning service is therefore founded on cooperation between the:

- Commonwealth (eg BoM);
- State (eg VICSES, NRE);
- Regional Authorities (eg CMAs, water authorities);
- Local Government; and
- Private interests (eg the Community).

The main components of a flood warning system are:

- data collection – detecting changes in the environment that lead to flooding (eg rainfall and stream flow/level data, information about water storages, weather watch radar, satellite imagery, local observations on flood effects and weather forecasts);
- flood prediction – flood severity and onset of particular levels of flooding (eg flood routing and rainfall-runoff models);
- construction of warning messages – describing what is happening and predictions;
- message dissemination – to the right people and in a timely manner (eg flood advice, flood forecasts and warnings and local flood details provided by radio, fax, phone, personal communications and the electronic media);
- interpretation of the prediction and other flood related information to determine expected impacts and action to be taken by whom;
- response to the warning by involved agencies and the community; and
- review and improvement of the warning system after each significant flood and/or on a routine basis.

For a flood warning system to work effectively, all components must be present and fully integrated.

Current Arrangements

The Bureau of Meteorology (BoM) currently provides flood warning services for a number of streams and locations in the Goulburn-Broken region. These are summarised as follows:

- Quantitative flood forecasts (predicted level and time) for the:
  - Goulburn River at Seymour, Murchison, Shepparton and McCoys Bridge,
  - Seven Creeks at Euroa,
  - Broken River at Benalla, Casey Weir and Orrvale, and
  - Murray River at Yarrawonga, Cobram, Tocumwal, Barmah and Echuca.
- Outflows from Lake Eildon (expected stage and flow) with assistance from Goulburn-Murray Water.
- A flood category warning service (minor, moderate, major) for most other Goulburn River tributaries based on the exceedance (or expected exceedance) of flood class levels at stream gauges.
- Quantitative flood forecasts for Broken Creek at Numurkah and Nathalia based on forecasts provided to BoM by Goulburn-Murray Water.
- A generalised "flood advice" service provided by BoM when meteorological conditions indicate a high probability of rainfall sufficient to lead to flooding.

Recent projects aimed at providing an integrated flood warning system have been successfully implemented at Benalla, Euroa, Seymour and generally through the mid-Goulburn catchment. Indications are that the capacity of local government to contribute financially to improved services is being stretched and that, without continued and adequate attention to check and review the processes in place, the gains made during and immediately after the projects, soon begin to erode.

Recent upgrades of flood warning systems have addressed or will soon address the more significant areas in the Goulburn-Broken region. There are some areas where improvements could be beneficial. In particular:

- Goulburn-Murray Water has expressed a strong desire to increase rain/river instrumentation in the Goulburn River catchment upstream of Eildon as an aid to the operation of Lake Eildon. Communications and cost issues are significant barriers to network development.
- Improved flood warning services in the mid-Goulburn catchment may be desirable to address flood problems at Jamieson, Thornton, Buxton, Molesworth, Yea and Violet Town (further investigation required to establish needs).
- Flash flooding systems could be helpful for Seymour, Kilmore, Mansfield, Violet Town and possibly Tatura.
- Flood data networks, flood prediction techniques and flood awareness developments could be useful along Broken Creek, particularly to assist Numurkah, Nathalia and Katamatite respond to floods.
- Improved flood prediction for a number of Goulburn River tributaries downstream of Seymour would assist flood response planning for the Chinaman's Bridge caravan park at Lake Nagambie (seen by BoM to be very much a municipal responsibility).
- There is a need to improve dissemination systems throughout the Goulburn-Broken region to ensure flood warning information is conveyed to the right people in a timely manner.

Services at Shepparton and for Broken Creek are provided with significant input from G-MW, which:

- provides real time access for flood warning purposes to those data collection networks that are managed by G-M Water; and
- participates in the provision of flood warnings for areas directly affected by the operation of G-M Water supply storages (Ref. 2).

There is no statutory basis for G-MW's involvement. The fine line between providing technical information and advice, and having this information being relied upon by BoM in providing flood warnings, may raise potential liability and duty of care issues for both G-MW and BoM.

A further constraint is the current level of resources within BoM. There is no surety that flood warning services will be provided for all locations, particularly for streams that are currently covered by qualitative services, in the event of significant widespread and/or prolonged flooding.

Any improvements to existing arrangements must be carefully weighed against the capacity of stakeholders to pay. Furthermore, without substantial justifications, including supporting cost/benefit analyses and a comprehensive floodplain management plan, requests for improved flood warning services are unlikely to receive much attention.

Empowering the Community and Information Dissemination

The effectiveness of flood warning and emergency response arrangements can be improved by introducing measures to help communities know what information is available, where to get it and what it means. These include:

- Flood awareness training, aimed at increasing the flood warning lead time available by providing communities with access to existing data and information on which they can make informed decisions. This will help generate an appropriate pro-active individual and community response in the lead up to and during a flood event.
- Community Flood Guides framed around a generic document but particularised for each community by the inclusion of relevant local flood data and knowledge. The aim of the guides would be to:
  - assist individuals in understanding the flood warning system and therefore what assistance they could expect,
  - provide details on the sources of information and past flood behaviour, and to
  - provide information to assist individuals take responsibility for their safety and their possessions.
- Establishing locally based flood information dissemination services to communicate relevant information.
- Periodically reminding communities of the significance and impact of flooding through media articles, brochures, talks to community groups and schools, and facilitating community involvement in the GBCMA's floodplain management projects.

Integration of Flood Warning Systems and Data Collection Networks

The capital cost of upgrading a flood data network is relatively high and imposes a significant on-going financial commitment on stakeholders. Simply expanding the number of data collection stations will not increase the effectiveness of flood warnings or forecasts unless resources are available for interpreting and disseminating the information.

It would seem appropriate for:

- the existing data collection network to be integrated with plans for flood warning upgrades; and for
- the responsibilities for operating and maintaining the flood data collection network and associated software and hardware to be covered under a regional monitoring partnership, to be funded by respective beneficiaries.

This arrangement would be subject to concurrence from the current owners and would overcome a problem expressed by some municipalities, that they do not have the technical ability to operate and maintain the systems. As a "first step" in what could be a lengthy but worthwhile process, it is recommended that the GBCMA, in consultation with respective municipalities and VICSES, develop an initial service charter for each river basin that identifies specific needs and standards of performance. This would then need to be conveyed as a formal request to the Victoria Flood Warning Consultative Committee and the National Director of the Meteorology.

Recommended Actions

Proposed actions other than those regarded as the core business of the GBCMA or covered in other programs are listed in Table A8.

Table A8: Implementation Program for Emergency Response Planning

	Item	Costs to Authority ($)	Funding Sources	Priority
ERP1	Identify Flood Warning System Needs:		GBCMA	High
	• Develop flood warning service charter	1,800		
	• Establish prioritised program based on needs	4,600		
	• Advise BoM of requirements	1,600		
	• Review & update service charter as required	1,000 pa		
	• Identify funding opportunities.	500 pa		
	Subtotal: Capital	8,000		
	Recurrent	1,500 pa		
ERP2	Data Network Management:		GBCMA	High
	• Develop policy for CMA involvement in flood data network management	4,000		
	• Facilitate the development and implementation of a regional monitoring partnership (in consultation with NRE).	4,500		
	Subtotal: Capital	8,500		
ERP3	Empower Community:		GBCMA	High
	• Explore opportunities for public dissemination of BoM "Flood Advice" warning/information	2,000		
	• Develop Community Flood Response Guides (Consultancy)	20,000		
	• Help raise and maintain community awareness by contributing to media articles, preparing brochures, speaking to community groups, etc	1,700 pa		
	• Review and document actions undertaken by municipalities with improved flood warning systems to ensure all elements of the flood warning system are ready for future flood events.	2,300 pa		
	Subtotal: Capital	22,000		
	Recurrent	4,000 pa		
ERP4	Resolve Anomalies in Roles and Responsibilities:			
	• Work with G-M Water and BoM to resolve anomalies in existing roles and responsibilities for flood forecasting and warning activities.	1,500	GBCMA	High
	Subtotal: Capital	1,500		
	TOTAL Capital	40,000		
	Recurrent	5,500 pa		

Note: GBCMA is the lead agency for these measures, supported where appropriate by municipalities and NRE. Costs to these agencies are comparatively minor ($3,000 and $6,000 respectively).

A.7 Program 7: Flood Monitoring Action

Objective

The objective of flood monitoring action is to facilitate effective flood monitoring and timely flood data collection to improve flood knowledge within the catchment

This will be achieved by:

- clarifying the roles of key stakeholders in flood monitoring and flood data collection;
- preparing a flood monitoring program for the catchment, building on the generic CMA Flood Response Action Plan; and
- identifying trigger points for initiating flood data collection for the Broken, Goulburn and Murray River systems.

Background Information

Flood monitoring can be regarded as assessing the impacts of floods, communicating this information to other stakeholders and collecting flood data.

Flood Assessment

The objective of flood assessment is to gather, analyse and document all available flood information to ascertain the likely impacts/effects on the community and assets before, during and after a flood. This information is vital. The GBCMA has to be able to decide on what actions it needs to take to protect its assets and whether or not to collect flood data. Municipalities and flood combat agencies need to know what the likely impact of a flood is before they can decide how to respond and they also need meaningful information to pass on to others.

The prime means of achieving this objective is through the "Flood Assessment" sub plan in the GBCMA's Flood Response Action Plan (FRAP). This includes a "Flood Assessment Manual", which has been developed in conjunction with the regional floodplain management strategy, to assist the GBCMA assess the potential impacts of future floods by considering the data currently available.

Flood Communications

An effective and coordinated flood response relies on two-way communication between all relevant agencies and also within the GBCMA. Those involved in emergency response activities (VICSES, Victoria Police, municipalities, rural water authorities and the community) rely on information and technical advice on flooding that can be provided by the GBCMA, particularly in relation to the assessment of potential impacts. The GBCMA relies on the advice of these agencies and authorities to update its knowledge of floods and assessment of impacts.

The FRAP identifies specific internal and external communication requirements and includes a number of contact forms for the GBCMA to complete.

Flood Data Collection

The collection and documentation of real time flood data is an essential input for future flood studies, floodplain management plans and land use planning. Flood data is best gathered during and immediately after a flood. Useful data includes:

- rainfall;
- hydrological information (peak flood flows and levels);
- flood extents (pegging, land owner interview/site inspection and annotation on plans, aerial flood photography, ground based photography, satellite imagery);
- flood levels (surveyed from flood pegging, ground based photography, anecdotal information, flood marks);
- emergency management activities;
- reservoir performance;
- flood damage data (including damage to bed and banks, structural damage, asset performance and agricultural losses);
- information on evacuations, road closures, injuries and fatalities; and
- information on flood relief payments.

Information on rainfall, flood flows and gauge heights at stream gauges and reservoir performance can be obtained fairly easily by contacting the appropriate sources (NRE, BoM, rural water authorities) or from flood bulletins issued by BoM. This information should be collected and documented for major regional floods, and locally significant floods. Where appropriate ground based flood photography can also be taken during a flood.

Information on flood damages, flood relief payments and emergency management activities can be obtained from a number of government agencies. Generally, this is more difficult to obtain, but the information is essential for assessing the full flood impacts of major regional floods.

Information requiring careful planning by the GBCMA and/or municipalities relates to the following types of information:

a) flow measurement at ungauged sites;
b) flood mark reconnaissance and flood level surveys;
c) aerial flood photography and/or satellite imagery;
d) asset audits;
e) flood damages assessment; and
f) documentation of major regional floods.

This work is generally undertaken by contractors and can be expensive. Therefore the work needs to be targeted at the specific needs for each of the various catchments and sub-catchments in the GBCMA's management area. In relation to (a), (b) and (c), it is not possible to predict when and where a flood will occur (until it is triggered by significant rainfall), and the decision to collect flood data must be made on its own merits.

Actions required for (d), (e) and (f) need to be done to some degree for all floods, and the level of detail will usually be dictated by the regional significance of the flood and the resources available. Further guidance is provided in the FRAP and its accompanying Flood Data Assessment Manual.

Implementation

A program for implementing these measures is given in Table A9. The satisfactory implementation of this program will help to introduce efficiencies in floodplain management and/or possibly reduce the rate of growth of average annual damages. They will also assist in flood studies and floodplain management plans.

Table A9: Implementation Program for Flood Monitoring Action

	Item	Indicative Costs $		Funding Sources	Priority
		GBCMA	Municipal		
FMA1	Test the FRAP annually and upgrade it and the Flood Data Assessment Manual at timely intervals, generally after major flooding	1,200 pa		GBCMA	High
FMA2	Review the effectiveness of levees and associated structures when tested by floods	1,000 pa		GBCMA	High
FMA3	Collect flood data	8,000 pa	2,000 pa	GBCMA Municipalities[1]	High
	TOTAL	10,200 pa	2,000 pa		
Note 1	NRE may contribute additional funding for the collection of flood data for major floods of regional significance				

A.8 Program 8: Information Management Systems

Objective

The objective of this program is to develop and implement an integrated floodplain information system that provides high quality data for use in floodplain management decisions.

This will be achieved by:

- reviewing the available information and estimating requirements for managing additional information;
- developing an Access database capable of geo-linking to an ArcView interface that can be used for extracting information stored digitally;
- identifying needs for computer hardware and software upgrades; and
- developing a program for reviewing and developing the GBCMA's flood information database.

Background

This program focuses on maintaining, enhancing and improving flood information available to the GBCMA in order for it to carry out its floodplain management functions effectively. A key requirement is to have capability for accessing and utilising digital flood data. The GBCMA already has approximately 100 study reports and 500 correspondence files, and in excess of 5,000 plans. New data arising from flood studies, floodplain management plans and real time flood data will be collected as part of the implementation of the regional floodplain management strategy or as the need or opportunity arises.

<u>Collection and Storage of New Data</u>

New data arising from flood studies, floodplain management plans and real time flood data will be collected as part of the implementation of the regional floodplain management strategy or as the need or opportunity arises. These should be stored in electronic form wherever possible, with capability for producing hard copies when required. Copies of all information should be made available to NRE's Floodplain Management Unit, for its statewide database.

Review of Data

It is recommended that the GIS flood maps and (hardcopies) pioneered as part of NRE's "Flood Data Transfer Project" be reviewed every 5 years and updated if required or if new information comes to hand. Updates need to be in accordance with the metadata standards adopted by NRE for the FDT project. The work is additional to improved flood mapping undertaken in Program 3.

Reviews of other flood data need to be undertaken periodically to ensure the database is up to date. It is not feasible to set a fixed review period. However, generally:

- flood frequency analyses, stream flow records and rating tables should be reviewed after each flood study or following a major regional flood;
- flood inundation maps should be superseded when better information becomes available;
- flood damage assessments should be reviewed when better data becomes available;
- the asset inventory should be revised every 5 years;
- municipal maps, cadastral and topographic digital information, and hard copy maps showing natural resource assets, sites of special and/or scientific interest, topography, soil and geological features, etc. should be updated frequently.

The GBCMA should also pursue opportunities for exchanging flood data in return for other useful information with municipalities, Goulburn-Murray Water, NRE Tatura and other parties.

Development of ArcView Interface and IT Needs

During the development of this Strategy, a GIS interface was designed, linking an access database with an ArcView interface to enable levee features to be identified on screen. A general training session was also held to give CMA users some conceptual understanding of the software functions.

In ascertaining requirements for developing GIS capability, which has benefits not just for floodplain management but also for other activities undertaken by the GBCMA, a phased introduction is proposed. A gradual introduction of the system will encourage acceptance by users, ensure the benefits of GIS training are maximised, and allow the GBCMA keep abreast of continually developing software and hardware.

As GIS becomes more prominent in the day to day business of the GBCMA, consideration will need to be given to ensuring computer upgrades will support GIS technology. It will be particularly essential that any future systems will cater for the acquisition of aerial photography digital images, satellite imagery and scanned records. The facility to plot these digital images should also be considered in the near future.

The GBCMA also needs to update software and datasets regularly as changes and upgrade become available, and to keep licences up to date. This is particularly important where digital information is required as an output to a flood study or flood mapping project.

It will be essential for CMA staff to upgrade and maintain skills in use of ArcView software and its utilisation for information access and retrieval to ensure a continuing progress of the CMA towards digital spatial technology. A training program that continually addresses the expected growing needs for digital data access, retrieval and output, has been allowed for in Program 9 (Education, Promotion and Communication). Preliminary training should be continued at regular intervals followed by a certified introductory and advanced course provided by the software supplier.

Databases

The CMA has purchased topographic and cadastral digital data under a licence agreement from the State and has received digital data outputs from the FDT Program. This licence agreement ought to be the responsibility of a dedicated officer to ensure that all updates and renewals are implemented. All recent and future projects with spatial information output should be downloaded into the CMA existing data base. Opportunities should be sought to acquire additional data from government agencies, Goulburn-Murray Water and other providers.

Implementation

Actions to be undertaken for the Flood Information Management program are identified in Table A10. They exclude GIS training, which has been included in Program 9. It is expected that implementation of these measures will lead to efficiency gains and to improvements in the accessibility and efficiency of using information.

Table A10: Implementation Program for Information Management

	Item	Costs to Authority($)	Funding Sources	Priority
IM1	Improve and collate existing flood data by maximising the benefits of electronic storage and retrieval, and reducing the volume of hard copy information: • Sorting out existing information and cull redundant plans • Obtaining copies of NRE scanned photos and plans • Scanning information that has not been previously scanned • Arranging separate storage of originals • Improving access database of FDT plans to suit specific requirements and develop capability for updating GIS information (standing contract recommended) • Updating ground contour plans, topographic maps, soil maps, etc. (Sources of information are Dept. of Lands and Survey, and NRE - Minerals and Petroleum) • Pursuing opportunities for sharing and exchanging data with municipalities, G-M Water and other stakeholders	5,000 per annum	GBCMA	High
IM2	Upgrade GIS capability (software & hardware): • Develop works program for upgrading software and hardware • Update digital cadastral and topographic data and ArcView software • Upgrade computers and peripherals	6,000 per annum including licence fees of around $3,200 per annum	GBCMA	High
IM3	Review flood data: • Review flood flow records and rating tables • Update FDT maps when better information becomes available and expand asset inventory fields	5,000 per annum	GBCMA	High
	TOTAL	16,000 pa		

A.9 Program 9: Education, Promotion and Communication

Objectives

The objectives of this program are:

- to improve the community and other stakeholders' knowledge of flood management issues; and to
- ensure that flood management decisions are made in accordance with best practice principles.

These will be achieved by:

- clarifying the role of the GBCMA in promoting best practice flood management practices and training, having regard for the programs and resources of State and Federal government agencies;
- facilitating, developing and supporting best practice training programs;
- developing a library of appropriate manuals and best practice information;
- supporting or taking an interest in research projects relevant to flood management;
- encouraging networking and workshops of those involved in flood management; and
- preparing a draft brochure on the Regional Strategy to raise public awareness.

Background Information

In order for the GBCMA (and other stakeholders) to perform their role in flood management to a high standard, it needs to keep up to date on floodplain management issues and practices locally, statewide, nationally and internationally. This requires an understanding of current best practice principles, a commitment to training programs and seminars for those involved in flood and floodplain management activities, and supporting and contributing to community flood education and awareness.

The GBCMA has a role in best practice development, education and training by:

- facilitating and supporting community education and training programs;
- promoting the use of best practice manuals and guidelines and maintaining an up to date library;
- supporting, or at least taking an interest in, research projects relevant to flood management; and
- encouraging networking and workshops of those involved in flood management.

Best Practice Training Programs and Other Measures

Training programs should concentrate on improving the skills and capabilities of floodplain practitioners. Where possible, costs should be minimised by making use of existing courses, and undertaking cooperative ventures with other CMAs and municipalities. A program of training needs is included in Table A11. The program will need to be flexible, having regard for the specific needs of the target groups and the available budget.

The training program should be supplemented by other measures, including:

- continued augmentation of the GBCMA's reference library as additional reports, best practice publications and other documents become available;
- maintaining an awareness of floodplain management research projects and studies being undertaken by Monash University's Cooperative Research Centre for Catchment Hydrology (CRC), NRE, DOI, BoM, other universities and specialist agencies such as Emergency Management Australia;
- pursuing opportunities for networking through floodplain management conferences and meetings/workshops with other floodplain management practitioners, in order to of share ideas, identify common issues and solutions and keep abreast of floodplain management issues;
- maintaining and raising public awareness by:
  - preparing brochures and fliers on relevant floodplain management issues
  - contributing to media articles
  - talking to schools and community groups about flood issues
  - promoting activities undertaken as part of the regional floodplain management strategy
  - encouraging the installation of flood markers in prominent places; and
- arranging for a community awareness training program focusing on the local impacts of flooding and how local communities could use available information to trigger flood response activities.

Program Development

Actions to be undertaken for the Education, Promotion and Communication program are identified in Table A12. These activities are regarded as best practice measures which have the potential to reduce flood damages by making the community more aware of flood impacts, and floodplain management practitioners better equipped to make appropriate decisions.

Table A11: Training Needs

Topic and Typical Elements	Course Duration Days	Target Groups	Indicative Cost per Person	Comments
Flood Awareness: • nature of flooding • consequences of flooding • community awareness • impact of unplanned development • available resources	1	Municipal & GBCMA staff and selected community groups	$400	Use existing flood information kits and brochures.
Flood Response: • emergency response training • flood response plans • asset monitoring	1	VICSES , municipal & GBCMA staff and selected community groups VICSES	$400	Arrange in conjunction with VICSES and municipalities.
Flood Monitoring: • flood warning • flood monitoring guidelines • CMA Flood Response Action Plan	1	Municipal Officers & Field Staff GBCMA staff	$400	If a trial run is included to test the procedure, the costs and course duration will at least double.
Flood Recovery: • roles and responsibilities • agencies involved • coordination	1	VICSES GBCMA Dept Human Resources Selected community groups Other stakeholders	$400	Suggest a work shop of key players to discuss respective roles and responsibilities and flag problems or resource issues.
Statutory Planning: • planning process • flood zone & overlays • administration • planning appeals	1	Those involved in statutory planning from municipalities and GBCMA	$400	Arrange with municipalities and incorporate administrative guidelines for assessing permits.
Floodplain Management: • hydrologic analysis • hydraulic analysis • control of works on floodplains • whole farm plans • simple flood estimation techniques	3 average	Municipal & GBCMA staff	External $1,200	Tap into CRC's Courses when available.
General Management: • project management • time management • business planning • negotiation skills • computer skills • contract management • risk management	3 average for each topic	Middle managers (GBCMA & Municipal)	External $1,200	Tap into NRE's Guidelines for Technical Project Briefs when available.
GIS Development overview	1	GBCMA staff	Internal $400	Suggest general information workshop
GIS Development specialised training • overview of GIS capability • data base development	2	GBCMA staff	$1,600	One on one training for operators

Table A12: Implementation Program for Education, Promotion and Communication

	Item	Indicative Cost to Authority($)	Funding Sources	Priority
EPC1	Organise and implement best practice training programs for staff	5,000 per annum	GBCMA	V. High
EPC2	Maintain library	1,000 per annum	GBCMA	V. High
EPC3	Networking and attending conferences (eg floodplain management conferences in Victoria and interstate, regular meetings with CMA floodplain managers).	2,000 per annum	GBCMA	V. High
EPC4	Prepare and print public awareness fliers and brochures.	2,000 per annum	GBCMA	V. High
EPC5	Run 2 workshops on Flood Awareness at strategic locations, aimed at increasing community awareness and use of available information (BoM to lead, assisted by VICSES)	3,000 per annum assuming participating agencies agree to lead the workshops without charge and venues are provided without cost to the GBCMA.	GBCMA Participating agencies & authorities[1]	V. High
EPC6	Undertake Community Education: • Contribute to media articles • Hand out relevant material • Talk to groups about flood issues • Promote floodplain management activities • Encourage installation of flood markers • Include relevant material in library.	Nil. Cost to be part of a flood study or normal duties of floodplain manager.	GBCMA	V. High
	TOTAL	13,000 per annum		

Note 1 For EPC5 it is suggested BoM leads, VICSES helps, GBCMA facilitates and municipalities or other participating authorities provide the venue free of charge.

B Appendix B - Building Capacity and Catchment Standards

The Regional Floodplain Management Strategy will be implemented in accordance with the Regional Catchment Strategy Best Practice Standards. This section outlines the standard, the relevant standard's objectives and how this strategy will be meeting that standard. Detailed actions arising from the standard have been identified costed and prioritised in Section 6.

B.1 Standard 1 – Partnerships

RCS Objectives

- Engage our diverse communities and agencies
- Build capacity
- Optimise communication

RCS Tasks	RFMS Response / Tasks	Actions & Comments
• Achieve appropriate representation through existing Catchment processes such as through Implementation Committees, Co-ordination Committees and Regional Assessment Panel.	• Implementation of program tasks will be undertaken in consultation with relevant community-based committees. • Projects eligible for State and Federal funding subsidies will be coordinated through the Regional Assessment Panel. • Where private strategic assets are to be managed by community or advisory committees rather than individuals, this will be in accordance with a floodplain management plan • When undertaking a flood study or floodplain management plan, or when implementing any associated works or measures, a steering committee will be formed, with representation from community groups, Implementation Committees, municipalities and State and Federal agencies where appropriate. The steering committee will provide information and direction to the relevant Implementation Committee, with technical support from the Floodplain Manager. • Any declarations, by laws or other legislative measures for controlling existing and new development on floodplains will involve informing the public, with opportunities for hearing objections as prescribed in legislation.	Program 1, Appendix A.1, Table A1, ref. PSR1 Program 2, Appendix A.2 Program 5, Appendix A.5, Table A7, ref. CWA1
• List opportunities for investment in natural resource management and prepare prospectuses.	• Stakeholders (municipalities, community groups, etc.) will be consulted to establish cost sharing arrangements.	Refer Section 7: "Funding & Cost Sharing Arrangements"
• Include RCS principles and priorities in agency programs with Local Government Authorities, Goulburn-Murray Water, NRE and Parks Victoria.	• GBCMA will encourage Local Government Authorities and other agencies with an interest in flood issues to adopt best practice floodplain management practice when managing floodplain assets, undertaking flood studies and floodplain management plans, preparing municipal planning schemes and developing planning controls. • Agencies, municipalities and community groups will be included in steering committees and will be involved in consultative processes, where appropriate.	Section 6, Programs 1 to 4 Section 6, Program 2

RCS Tasks	RFMS Response / Tasks	Actions & Comments
• Develop synergies by reviewing staffing arrangements in all organisations, recognising that some staff are dedicated to working solely on specific issues while many others contribute via integrated programs.	• Opportunities for partnership arrangements have been established by identifying roles and responsibilities for program tasks and through cost sharing arrangements.	Section 7, "Funding and Cost Sharing Arrangements", Appendix C, Table C1
• Continuously update and implement the GBCMA's Communications Strategy, which includes developing: - educational and promotional material - training programs - reports on research and catchment condition	• Educational and promotional material has been allowed for in Program 6 – "Emergency Response Planning." • Training opportunities have been developed in Program 9 – "Education, Promotion and Communication."	Appendix A.6, Table A8 (ref. ERP3) Appendix A.9, Table A11
• Revise Regional Catchment Strategy by 2007 with agreement by State and Commonwealth.	• The Regional Floodplain Management Strategy will be reviewed every five years for inclusion in the five- yearly reviewed RCS	Section 4, "Performance Monitoring"
• Prepare rolling three (five) year business plan in line with RCS.	• A three-year rolling works plan will be prepared and reviewed yearly. This will provide input into the CMA Business Plan, IC Schedules and other funding processes	Section 4, "Performance Monitoring"
• Prepare annual works program with agreement by State	• An annual works program will be prepared each year for input into relevant works programs.	Section 4, "Performance Monitoring"
• Prepare Operating Agreement that defines roles and responsibilities.	• Roles and responsibilities will be identified in the annual works program, which will include outside agencies responsible for specific tasks (eg municipalities).	Section 4, "Performance Monitoring"

B.2 Standard 2 – Priorities

RCS Objectives

- Base priorities on best science, economic and environmental information
- Ensure feasibility by engaging community throughout priority setting process
- Target causes of problems in geographic areas that maximise community return on investment

RCS Tasks	RFMS Response / Tasks	Actions & Comments
• Clearly articulate principles for priority setting.	• Principles and processes have been articulated, with opportunities for review in place.	Section 7, "Priority Setting" & Appendix F.
• Develop Catchment-scale and cascading sub-Catchment goals and priority maps for each issue.	• Catchment-scale objectives have been determined for all nine Programs. • Tasks have been allocated and prioritised at the sub-catchment level. • Sub-catchment areas have been identified. • Specific tasks will need to be listed in annual business planning process.	Section 4, "Program Objectives" Section 6, Appendix D
• Clearly provide accountable targets (such as area of remnant fenced) for each fund source so that: - a Catchment-wide perspective can be gained for each issue - investors gain greater certainty about expected returns - these can be built into Implementation Committee processes to maximise integration.	• Targets applicable for each Program task have been listed. • Annual targets will be prepared as part of annual works program, for incorporation into relevant business plans.	Section 4, Table 5
• Document community input into annual priority setting that is part of the business planning process.		

Process for Priority Setting

- Priority setting has been based on a "Rapid Assessment Method" (RAM) developed by NRE and a methodology developed for assessing tasks that could not be prioritised using the RAM (refer Appendix F).
- Community education processes, monitoring and evaluation statutory planning activities and other non-structural activities have a high priority.
- At some stage the priority setting process may need review in light of the RCS standards.
- Priorities will be reviewed annually by the GBCMA and relevant stakeholders.

B.3 Standard 3 – Fairness

RCS Objectives

- Share costs and benefits transparently and equitably
- Be triple bottom line accountable (social, economic and environment)
- Be supported by legislation

RCS Tasks	RFMS Response / Tasks	Actions & Comments
• Refine cost-sharing arrangements by firstly identifying - beneficiaries - costs - contributors to costs.	• These have been identified. • Cost sharing arrangements will be reviewed on a case by case basis where more than stakeholder is involved.	Section 7 & Appendix D, Table D1
• Develop an investment plan by compiling information on inventory of assets, threats and management opportunities including costs and benefits.	• An asset inventory was prepared (refer to full report prepared during the preparation of the Strategy). • This will need regular updating. • Broad information on values, threats and management opportunities has been prepared but will need regular review.	Section 6, Program 1 & Appendix A.1
• Identify duty of care for land and water managers and recommend changes where legislation is lagging community expectations.		
• Take into account the social, economic and environmental benefits and costs.	• Assess the social, economic and environmental benefits and costs of implementing tasks	Appendix F

B.4 Standard 4 – Multiple Benefits

RCS Objectives

- Integrate planning and implementation at all levels

RCS Tasks	RFMS Response / Tasks	Actions & Comments
• Build on the multi-benefit approach to grants for landholders so that it covers all programs of the GBCMA.		

B.5 Standard 5 - Land Use and Land Capability (Large Scale)

RCS Objective

- Achieve large-scale matching of land-use with land capability

RCS Tasks	RFMS Response / Tasks	Actions in Section 6 & Comments
• Develop framework to allow local community-driven Local Area Plans to show contributions to Implementation Committee goals which in turn show contributions to whole of Catchment goals.	• Best practice guidelines have been prepared for developments in floodplains. • Guidelines to be refined, amended and reviewed as a program task.	Section 6, Program 4 & Appendix A.4, Table A6.
• Identify areas for which the land-use is no longer appropriate and develop alternative management options for large tracts of land.	• Flood maps have identified areas where development needs to consider the flood risk. Map upgrades have been listed as a program task. • Incorporation of improved flood maps into municipal planning schemes has been listed as a program task	Section 6, Program 3 & Appendix A.3, Tables A4 & A5 (ref. SP2 to SP4)

B.6 Standard 6 - Cultural Heritage

RCS Objective

- Include Aboriginal and non-Aboriginal values in all RCS elements

RCS Tasks	RFMS Response / Tasks	Actions in Section 6 & Comments
• Establish framework to show how cultural heritage issues are clearly considered in all projects implemented by the GBCMA.	• Include cultural heritage values where appropriate when undertaking flood studies and floodplain management plans. • Consult local aboriginal community organisations and Aboriginal Affairs if works are contemplated in the vicinity of river courses, lakes and wetlands.	See comments under "Cultural Heritage" in Section 2

B.7 Standard 7 - Accountability

RCS Objectives

- Report clearly and in a meaningful manner.
- Clearly link but separate goals (and reporting) of what community aspires to in long-term from what is funded in short-term.
- Base goals, targets etc on agreed national and state guidelines.

RCS Tasks	RFMS Response / Tasks	Actions & Comments
• Establish framework for Implementation Committee to use to enable land managers (eg private land, Parks Victoria, G-MW) to demonstrate accountability.	• Reporting quarterly to the GBCMA Board, ICs and senior management on budgets and outputs where appropriate.	Section 4, "Performance Monitoring"
• Reporting of long-term *aspirational goals* for each issue based on national and state guidelines.	• Annual reporting against program vision and objectives, which are listed in Section 4.	Section 4, "Performance Monitoring"
• Establish short-term *accountable goals* (based on aspirational goals) and *accountable actions* linked with funding levels and include in annual business planning process, based on national and state guidelines.	• Directly link accountable goals and accountable actions of annual business planning process with goals and actions listed in this strategy.	Section 4, "Performance Monitoring"
• Establish database for Implementation Committee to contribute to CMA's report on Catchment Condition, as legislated (CALP Act).	• Contribute to development of a database which will streamline and facilitate reporting by the Floodplain Manager, the 3 ICs and the CMA in general.	Section 4, "Performance Monitoring"

B.8 Standard 8 – Adaptive Management Systems

RCS Objective

- Achieve management systems approach for
- Individuals
- Sub-Catchments
- Whole of Catchment
- Industries
- Optimise databases
- Review assumptions underpinning RCS regularly via Monitoring & Evaluation, Research & Investigation Program to inform Adaptive Management process

RCS Tasks	RFMS Response / Tasks	Actions & Comments
• Establish Environmental Management Systems that incorporate elements of the RCS with individuals, sub-Catchments, and land mangers and Industries.	• Provide input into holistic environmental planning processes at the farm, local and catchment levels.	Could be developed in support of Program 3, Appendix A.3
• Use existing systems as a basis for progressing systems approach e.g. Codes of Forest Practice.		
• Clearly identify how risks are considered in all levels of planning and implementation.	• Develop decision checklist for managing risk when planning and implementing FPM projects.	Could be developed in support of Program 3, Appendix A.3
• Establish a program that monitors via Implementation Committees • Resource (or Catchment condition) condition changes.		
• Evaluate the RCS's implementation at least annually, and prepare an Annual Report that shows progress on issues on Implementation Committee area and whole of Catchment scales. This might include auditing.	• Contribute to annual report on floodplain management issues.	Section 4, "Performance Monitoring"
• Include data custodianship agreements in all projects.	• Ensure data is managed in all FPM projects.	Section 6, Program 8 and Appendix A.8, Table A10 (ref IM 2)
• Establish a single body to co-ordinate all Catchment natural resource management research. Major Research and Investigation needs reviewed at least annually.		

Strategy implementation performance needs to be reported to stakeholders and to those who are paying for strategy implementation. We therefore need to identify what's happening and if we are achieving results. The success of strategy implementation is determined by assessing progress against targets for individual actions.

C Appendix C - Roles and Responsibilities

C.1 Consolidated Program – Roles and Responsibilities

Effective floodplain management requires the coordinated involvement of all parties concerned. Specific roles and responsibilities are summarised in C1.

In general terms:

- the Commonwealth Government is responsible for national flood management issues;
- the State Government is responsible for statewide issues;
- the GBCMA is responsible for regional issues within their catchment;
- local government is responsible for local issues; and
- landholders are responsible for floodplain management on their own properties.

Table C1: Roles and Responsibilities of Stakeholders

Ref	Task	Implementation Responsibilities		
		Implementation Agency	Support Agency	Consultation
Abbreviations:				
G-MW = Goulburn-Murray Water NRE = Dept. of Natural Resources & Environment PLO = Private land owners/general community PSB = Public statutory bodies within study area or possibly affected by works DOI = Department of Infrastructure EMA = Emergency Management Australia		CG = Community & Landowner Groups S/Moira = Shire of Moira COGS = City of Greater Shepparton PLM = Public Land Managers AAV = Aboriginal Affairs Victoria BoM = Bureau of Meteorology (Vic. Div.)		
Asset Management – Program 1				
	General			
AR1	Upgrade and Maintain Asset Register	GBCMA		NRE
	PWD Levees			
PWD1	Resolve legal liability issues	GBCMA	NRE	CG
PWD2	Resolve arrangements for funding for O&M	GBCMA	NRE	Municipalities, CG & PLO
PWD3	Prepare a management plan	GBCMA	NRE	Municipalities, CG & PLO
PWD4	Maintain levees	GBCMA		Municipalities, CG & PLO
	Lower Goulburn Levees			
LG1	Resolve legal liability issues	GBCMA	NRE	CG
LG2	Resolve arrangements for funding for O&M	GBCMA	NRE	Municipalities, PLO & CG
LG3	Formalise agreement with G-MW over future arrangements for managing assets they currently maintain	GBCMA	G-MW	NRE
LG4	Prepare a management plan	GBCMA	NRE	Municipalities, CG, PLO & G-MW
LG5	Maintain levees	GBCMA		Municipalities, CG & PLO
	Beattie Depression Levees			
BD1	Maintain as required	G-MW		GBCMA

Table C1: Roles and Responsibilities of Stakeholders, Continued

Ref	Task	Implementation Responsibilities		
		Implementation Agency	Support Agency	Consultation
Abbreviations:				
G-MW = Goulburn-Murray Water NRE = Dept. of Natural Resources & Environment PLO = Private land owners/general community PSB = Public statutory bodies within study area or possibly affected by works DOI = Department of Infrastructure EMA = Emergency Management Australia		CG = Community & Landowner Groups S/Moira = Shire of Moira COGS = City of Greater Shepparton PLM = Public Land Managers AAV = Aboriginal Affairs Victoria BoM = Bureau of Meteorology (Vic. Div.)		
Asset Management – Program 1, Continued				
	Cobram Town Levees			
CTL1	Prepare a management plan	S/Moira	GBCMA	
CTL2	Maintain the levees	S/Moira		GBCMA
	Nathalia Town Levees			
NTL1	Prepare a management plan	S/Moira	GBCMA	
NTL2	Maintain the levees	S/Moira		GBCMA
NTL3	Acquire easement rights for levees	S/Moira		GBCMA, NRE
	Private Strategic Rural Assets			
PSR1	Allow self management either individually or through community or advisory committees via a floodplain management plan	CG & PLO		GBCMA
	Review Asset Management			
AMR1	Review/audit asset management plans every 5 years	GBCMA	Municipalities	NRE, CG & PLO
Flood Studies and Floodplain Management Plans – Program 2				
Note that support agency roles have been determined by the requirements set out in Section 214 of the Water Act for a committee to be formed to guide the process of obtaining ministerial approval for "approved schemes." The Committee also includes community representatives. For studies not associated with the preparation of a Water Management Scheme under the Water Act, the number of support agencies could drop. They should however be consulted.				
FSU	Prepare urban studies and floodplain management plans according to priorities listed in Table 5.1.	Municipalities	GBCMA, G-MW, CG, PLO & PSB	NRE, PLM, AAV
FSR	Prepare regional studies and floodplain management plans according to priorities listed in Table 5.1.	GBCMA	Municipalities, G-MW, CG, PLO & PSB	NRE, PLM, AAV
FPW1	Implement Benalla Water Management Scheme	S/Delatite	GBCMA	NRE, G-MW, CG, PLO, PSB, PLM, AAV
FPW2	Implement Euroa Water Management Scheme	S/Strathbogie	GBCMA	NRE, G-MW, CG, PLO, PSB, PLM, AAV
FPW3	Implement Shepparton Water Management Scheme	COGS	GBCMA	NRE, G-MW, CG, PLO, PSB, PLM, AAV
FPW4	Upgrade PWD levees to approx. 30 year ARI standard (subject to resolution of liability issues)	GBCMA	NRE	Municipalities, G-MW, CG, PLO, PSB, PLM, AAV
FPW5	Implement Lower Goulburn Floodway Rehabilitation Scheme (subject to resolution of liability issues)	GBCMA	NRE	Municipalities, G-MW, CG, PLO, PSB, PLM, AAV
FPWU	Implement works recommended in future urban studies and FPM plans according to set priorities:			
	- public urban levees/works	Municipalities	GBCMA	NRE, G-MW, CG, PLO, PSB, AAV
	- private urban strategic levees/works	Asset owners	CG	NRE, G-MW, CG, PLO, PSB, AAV

Table C1: Roles and Responsibilities of Stakeholders, Continued

Ref	Task	Implementation Responsibilities		
		Implementation Agency	Support Agency	Consultation
Abbreviations:				
G-MW = Goulburn-Murray Water NRE = Dept. of Natural Resources & Environment PLO = Private land owners/general community PSB = Public statutory bodies within study area or possibly affected by works DOI = Department of Infrastructure EMA = Emergency Management Australia		CG = Community & Landowner Groups S/Moira = Shire of Moira COGS = City of Greater Shepparton PLM = Public Land Managers AAV = Aboriginal Affairs Victoria BoM = Bureau of Meteorology (Vic. Div.)		
Flood Studies and Floodplain Management Plans – Program 2, Continued				
FPWR	Implement works recommended in future rural studies and FPM plans according to set priorities: - public rural strategic levees/works	GBCMA	Municipalities	NRE, G-MW, CG, PLO, PSB, AAV
	- private rural	CG, PLO, asset owners		GBCMA, Municipalities, NRE, G-MW, CG, PLO, PSB
Statutory Land Use Planning – Program 3				
The GBCMA has a general responsibility to: (1) advise municipal councils on floodplain management issues; (2) review VPPs; (3) inspect approved works (with Council); (4) ensure compliance with planning scheme conditions; (5) enforce removal of illegal works; (6) continue to monitor and modify planning scheme maps and controls to ensure they reflect up to date flood information; (7) respond to planning permit applications; and (8) attend VCAT hearings as required.				
SP1	Draft VPP amendments	GBCMA	Municipalities	NRE, DOI
SP2	Incorporate FDT maps into planning schemes	Municipalities	GBCMA	NRE, DOI,
SP3	Prepare improved flood maps	GBCMA	Municipalities	NRE
SP4	Incorporate improved flood maps into planning schemes	Municipalities	GBCMA	NRE, DOI, PSB, G-MW, PLM
SP5	Review performance of planning measures	GBCMA	Municipality	NRE, DOI
SP6	Inform VicRoads, V-Line, Goulburn-Murray Water & Power Authorities of recommended referral and consultation arrangements when appropriate	GBCMA	VicRoads, V-Line, G-MW, Power Authorities	
Development Assistance Guidelines – Program 4				
AG1	Refine, amend and review the guidelines developed in the Strategy	GBCMA	Municipality	NRE
Control of Works and Activities on Floodplains – Program 5				
CWA1	Introduce declarations, bylaws and other measures for controlling existing and new development on floodplains, in support of VPPs, where required.	GBCMA	Municipality	NRE
CWA2	Develop arrangements with Councils and other relevant groups over statutory enforcement of illegal works.	GBCMA	Municipality, G-MW, CG, PLM	PLO
Emergency Response Planning – Program 6				
ERP1	Identify flood warning system needs	GBCMA	BoM, NRE , G-M Water	VICSES, Municipalities,
ERP2	Data Network Management	GBCMA	BoM, NRE, G-M Water	PLO, Municipalities
ERP3	Empower community	GBCMA	BoM, VICSES, Municipalities	PLO, NRE
ERP4	Resolve anomalies in roles and responsibilities	GBCMA	BoM, NRE, G-M Water, Municipalities	

Table C1: Roles and Responsibilities of Stakeholders, Continued

Ref	Task	Implementation Responsibilities		
		Implementation Agency	Support Agency	Consultation
Abbreviations:				
G-MW = Goulburn-Murray Water NRE = Dept. of Natural Resources & Environment PLO = Private land owners/general community PSB = Public statutory bodies within study area or possibly affected by works DOI = Department of Infrastructure EMA = Emergency Management Australia		CG = Community & Landowner Groups S/Moira = Shire of Moira COGS = City of Greater Shepparton PLM = Public Land Managers AAV = Aboriginal Affairs Victoria BoM = Bureau of Meteorology (Vic. Div.)		
Flood Monitoring Actions – Program 7				
FMA1	Test the Flood Response Action Plan annually and upgrade it and the Flood Data Assessment Manual at timely intervals, after major floods	GBCMA	Municipalities, VICSES, BoM,	MERCs (Victorian Police)
FMA2	Review the effectiveness of levees and associated structures when tested by floods	GBCMA	Municipalities	
FMA3	Collect flood data	GBCMA Municipalities	Various – see Table 11.2	
Information Management Systems – Program 8				
IM1	Improve and collate existing flood data	GBCMA	Municipalities & other providers of information	NRE
IM2	Upgrade GIS capability (software & hardware)	GBCMA		
IM3	Review flood data	GBCMA	NRE, BoM	Thiess Environmental Services
Education, Promotion and Communication – Program 9				
EPC1	Organise and implement best practice training programs	GBCMA	Municipalities	G-MW, NRE, CG, and any other stakeholders
EPC2	Maintain library	GBCMA	NRE, BoM, EMA	
EPC3	Networking and attending conferences	GBCMA	Stakeholders	
EPC4	Prepare and print public awareness fliers	GBCMA	NRE, EMA	Municipalities
EPC5	Community workshops on flood awareness	GBCMA	BoM. VICSES, Municipalities	EMA, NRE
EPC6	Undertake Community Education	GBCMA		NRE, EMA, Municipalities

D Appendix D - Works Actions and Costs

D.1 Consolidated Program – Works Actions and Costs

A consolidated Program of works, actions and costs is detailed in Table D1. More specific information for the purposes of budget setting is included in Appendix E.

Costs associated with implementing the Lower Goulburn Floodplain Rehabilitation Scheme (current estimate is $22 million) and any works arising out of the current Shepparton-Mooroopna Floodplain Management Study are excluded. Costs do not include GST.

The consolidated program is indicative only and task budgets, priorities and target dates for completion will need to be revised at the start of each financial year. The GBCMA will develop a rolling 3-year implementation program, outlining:

- tasks to be completed by the GBCMA, together with budget, targets and priorities;
- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

Table D1: Consolidated Implementation Program

	Task	Primary Responsibility	Priority/ (Timeline)	Capital Cost ($)	Annual Cost ($)
Asset Management – Program 1					
	General				
AR1	Upgrade and Maintain Asset Register	GBCMA	High (ongoing)		2,000
	PWD Levees				
PWD1	Resolve legal liability issues	GBCMA	High (Year 1)	5,000	
PWD2	Resolve arrangements for funding for O&M	GBCMA	High (Year 1)	5,000	
PWD3	Prepare a management plan	GBCMA	High (Year 2)	10,000	
PWD4	Maintain levees	GBCMA	High (ongoing)		190,000
	Lower Goulburn Levees				
LG1	Resolve legal liability issues	GBCMA	High (Year 2)	5,000	
LG2	Resolve arrangements for funding for O&M	GBCMA	High (Year 3)	5,000	
LG3	Formalise agreement with G-MW over future arrangements for managing assets they currently maintain	GBCMA	High (Year 3)	5,000	
LG4	Prepare a management plan	GBCMA	High (Year 4)	10,000	
LG5	Maintain levees	GBCMA	High (ongoing)		190,000
	Beattie Depression Levees				
BD1	Maintain as required	G-MW	High (ongoing)		20,000
	Cobram Town Levees				
CTL1	Prepare a management plan	S/Moira	High (Year 1)	5,000	
CTL2	Maintain the levees	S/Moira	High (ongoing)		74,000
	Nathalia Town Levees				
NTL1	Prepare a management plan	S/Moira	High (Year 1)	5,000	
NTL2	Maintain the levees	S/Moira	High (ongoing)		36,000
NTL3	Acquire easement rights for levees	S/Moira	High (Year 2)	10,000	
	Private Strategic Rural Assets				
PSR1	Allow self management either individually or through community or advisory committees via a floodplain management plan	Levee owners	High (ongoing)		2,000

Table D1: Consolidated Implementation Program, Continued

	Task	Primary Responsibility	Priority/ (Timeline)	Capital Cost ($)	Annual Cost ($)
Asset Management – Program 1, Continued					
	Review Asset Management				
AMR1	Review/audit asset management plans every 5 years	GBCMA/ Municipalities	High (every 5 years)	20,000	
Flood Studies and Floodplain Management Plans – Program 2					
FSU	Prepare urban studies and floodplain management plans.	Municipalities/ GBCMA	Various (when appropriate)	1,250,000	9,375
FSR	Prepare regional studies and floodplain management plans	Municipalities/ GBCMA	Various (when appropriate)	3,070,000	23,025
FPW1	Implement Benalla Water Management Scheme	S/Delatite	High (Years 2-6)	8,000,000	20,000
FPW2	Implement Euroa Water Management Scheme	S/Strathbogie	High (years1-4)	800,000	2,000
FPW3	Implement Shepparton Water Management Scheme	City of Greater Shepparton	High (Years 1-4)	Unknown	Unknown
FPW4	Upgrade PWD levees to approx. 30 year ARI standard (subject to resolution of liability issues)	GBCMA	High (Years 1-5)	3,000,000	7,500
FPWU	Implement works recommended in future urban studies and FPM plans according to set priorities:	Municipalities/ GBCMA	Various (when appropriate)	4,000,000	10,000
FPWR	Implement works recommended in future rural studies and FPM plans according to set priorities:	Municipalities/ GBCMA	Various (when appropriate)	2,000,000	5,000
Note, annual administration and maintenance costs have been averaged out over 10 years.					
Statutory Land Use Planning – Program 3					
SP1	Draft VPP amendments	GBCMA	Very High (Year 1)	8,000	
SP2	Incorporate FDT maps into planning schemes	Municipalities	Very High (Years 1-5)	210,000	
SP3	Prepare improved flood maps	GBCMA	Very High (Years 1-3)	199,000	
SP4	Incorporate improved flood maps into planning schemes	Municipalities	Very High (Years 4-6)	105,000	
SP5	Review performance of planning measures	Municipalities/ GBCMA	Very High (every 5 years)	140,000	
SP6	Inform VicRoads, V-Line, Goulburn-Murray Water & Power Authorities of recommended referral and consultation arrangements when appropriate	GBCMA	Very High (where appropriate)		1,000
Development Assistance Guidelines – Program 4					
AG1	Refine, amend and review the guidelines in Appendix D	GBCMA	Very High (ongoing)		5,000
Control of Works and Activities on Floodplains – Program 5					
CWA1	Introduce declarations, bylaws and other measures for controlling existing and new development on floodplains, in support of VPPs, where required.	GBCMA	Very High (ongoing)		5,000
CWA2	Develop arrangements with Councils and other relevant groups over statutory enforcement of illegal works.	GBCMA	Very High (ongoing)		45,000
Emergency Response Planning – Program 6					
ERP1	Identify flood warning system needs (Year 1 and ongoing)	GBCMA	High	14,000	1,500
ERP2	Data Network Management	GBCMA	High (Year 2)	10,500	
ERP3	Empower community	GBCMA	High (Year 3 & ongoing)	22,000	4,000
ERP4	Resolve anomalies in roles and responsibilities	GBCMA	High (Year 1)	2,500	
Flood Monitoring Actions – Program 7					
FMA1	Test the Flood Response Action Plan annually and upgrade it and the Flood Data Assessment Manual at timely intervals, after major floods	GBCMA	High (annually)		1,200
FMA2	Review the effectiveness of levees and associated structures when tested by floods	GBCMA	High (when appropriate)		1,000

Table D1: Consolidated Implementation Program, Continued

	Task	Primary Responsibility	Priority/ (Timeline)	Capital Cost ($)	Annual Cost ($)
Flood Monitoring Actions – Program 7, Continued					
FMA3	Collect flood data	GBCMA Municipalities	High (when appropriate)		10,000
Information Management Systems – Program 8					
IM1	Improve and collate existing flood data	GBCMA	High (ongoing)		5,000
IM2	Upgrade GIS capability (software & hardware)	GBCMA	High (ongoing)		6,000
IM3	Review flood data	GBCMA	High (ongoing)		5,000
Education, Promotion and Communication – Program 9					
EPC1	Organise and implement best practice training programs	GBCMA	Very High (ongoing)		12,000
EPC2	Maintain library	GBCMA	Very High (ongoing)		1,000
EPC3	Networking and attending conferences	GBCMA	Very High (ongoing)		9,000
EPC4	Prepare and print public awareness fliers	GBCMA	Very High (ongoing)		2,000
EPC5	Community workshops on flood awareness	GBCMA	Very High (ongoing)		9,000
EPC6	Undertake Community Education	GBCMA	Very High (ongoing)		Nil
	TOTAL			22,916,000	713,600

E Appendix E - Consolidated Budget

Consolidated schedules of works, actions and costs for implementing the Regional Floodplain Management Strategy are listed in Tables E1 to E5. They are based on more detailed information compiled during the preparation of the Strategy.

Costs associated with implementing the Lower Goulburn Rehabilitation Scheme and any works arising out of the current Shepparton-Mooroopna Floodplain Management Study are excluded. Costs do not include GST.

The consolidated budget is indicative only and costs, priorities and target dates for completion will need to be revised periodically. The GBCMA will develop a rolling 3-year implementation program, outlining:

- tasks to be completed by the GBCMA, together with budget, targets and priorities;
- tasks to be completed by other organisations, together with budget, targets and priorities;
- timetable for funding bids; and
- performance indicators.

Table E1: Consolidated Budget – Expenditure – GBCMA ($)

	Program		Year 1	Year 2	Year 3	Year 4	Year 5	Years 6-10	Total
1	Asset	C	10,000	15,000	10,000	10,000	5,000	5,000	55,000
	Management	R	384,000	384,000	384,000	384,000	384,000	1,920,000	3,840,000
		T	394,000	399,000	394,000	394,000	389,000	1,925,000	3,895,000
2	Flood Studies &	C	725,000	740,000	758,333	745,000	733,333	998,334	4,690,000
	FPM Plans	R	34,625	36,750	36,375	36,250	34,125	131,625	309,750
		T	759,630	776,750	794,708	781,250	767,458	1,129,959	4,999,750
3	Statutory Land	C	38,000	50,000	50,000	30,000	74,000	35,000	277,000
	Use Planning	R	1,000	1,000	1,000	1,000	1,000	5,000	10,000
		T	39,000	51,000	51,000	31,000	75,000	40,000	287,000
4	Development	C	0	0	0	0	0	0	0
	Assessment	R	5,000	5,000	5,000	5,000	5,000	25,000	50,000
	Guidelines	T	5,000	5,000	5,000	5,000	5,000	25,000	50,000
5	Works and	C	0	0	0	0	0	0	0
	Activities	R	15,000	15,000	15,000	15,000	15,000	75,000	150,000
	On Floodplains	T	15,000	15,000	15,000	15,000	15,000	75,000	150,000
6	Emergency	C	9,500	8,500	22,000	0	0	0	40,000
	Response	R	5,500	5,500	5,500	5,500	5,500	27,500	55,000
	Planning	T	15,000	14,000	27,500	5,500	5,500	27,500	95,000
7	Flood	C	0	0	0	0	0	0	0
	Monitoring	R	10,200	10,200	10,200	10,200	10,200	51,000	102,000
	Actions	T	10,200	10,200	10,200	10,200	10,200	51,000	102,000
8	Information	C	0	0	0	0	0	0	0
	Management	R	16,000	16,000	16,000	16,000	16,000	80,000	160,000
	Systems	T	16,000	16,000	16,000	16,000	16,000	80,000	160,000
9	Education,	C	0	0	0	0	0	0	0
	Promotion and	R	13,000	13,000	13,000	13,000	13,000	65,000	130,000
	Communication	T	13,000	13,000	13,000	13,000	13,000	65,000	130,000
	TOTAL	C	782,500	813,500	840,333	785,000	812,333	1,028,334	5,062,000
		R	484,325	486,450	486,075	485,950	483,825	2,380,125	4,806,750
		T	1,266,825	1,299,950	1,326,408	1,270,950	1,296,158	3,408,459	9,868,750

Table E2: Consolidated Budget – Expenditure – Municipalities ($)

	Program		Year 1	Year 2	Year 3	Year 4	Year 5	Years 6-10	Total
1	Asset	C	10,000	10,000	0	0	5,000	5,000	30,000
	Management	R	110,000	110,000	110,000	110,000	110,000	550,000	1,100,000
		T	120,000	120,000	110,000	110,000	115,000	555,000	1,130,000
2	Flood Studies &	C	278,333	810,000	768,333	793,333	721,667	1,311,667	4,683,333
	FPM Plans	R	48,125	49,000	44,125	46,875	45,250	225,875	459,250
		T	326,458	859,000	812,458	840,208	766,917	1,537,542	5,142,583
3	Statutory Land	C	90,000	90,000	30,000	30,000	65,000	80,000	385,000
	Use Planning	R	0	0	0	0	0	0	0
		T	90,000	90,000	30,000	30,000	65,000	80,000	385,000
4	Development	C	0	0	0	0	0	0	0
	Assessment	R	0	0	0	0	0	0	0
	Guidelines	T	0	0	0	0	0	0	0
5	Works and	C	0	0	0	0	0	0	0
	Activities on	R	35,000	35,000	35,000	35,000	35,000	175,000	350,000
	Floodplains	T	35,000	35,000	35,000	35,000	35,000	175,000	350,000
6	Emergency	C	3,000	0	0	0	0	0	3,000
	Response	R	0	0	0	0	0	0	0
	Planning	T	3,000	0	0	0	0	0	3,000
7	Flood	C	0	0	0	0	0	0	0
	Monitoring	R	2,000	2,000	2,000	2,000	2,000	10,000	20,000
	Actions	T	2,000	2,000	2,000	2,000	2,000	10,000	20,000
8	Information	C	0	0	0	0	0	0	0
	Management	R	0	0	0	0	0	0	0
	Systems	T	0	0	0	0	0	0	0
9	Education,	C	0	0	0	0	0	0	0
	Promotion and	R	15,000	15,000	15,000	15,000	15,000	75,000	150,000
	Communication	T	15,000	15,000	15,000	15,000	15,000	75,000	150,000
	TOTAL	C	381,333	910,000	798,333	823,333	791,667	1,396,667	5,101,333
		R	210,125	211,000	206,125	208,875	207,250	1,035,875	2,079,250
		T	591,458	1,121,000	1,004,458	1,032,208	998,917	2,432,542	7,180,583

Table E3 Consolidated Budget – Expenditure – State & Federal Gvt ($)

Note Costs exclude government contributions to flood data collection for major floods of regional significance.

	Program		Year 1	Year 2	Year 3	Year 4	Year 5	Years 6-10	Total
2	Flood Studies &	C	806,667	1,900,000	1,853,333	1,876,667	1,710,000	4,600,000	12,746,667
	FPM Plans	R	0	0	0	0	0	0	0
		T	806,667	1,900,000	1,853,333	1,876,667	1,710,000	4,600,000	12,746,667
6	Emergency Response	C	4,000	2,000	0	0	0	0	6,000
	Planning	R	0	0	0	0	0	0	0
		T	4,000	2,000	0	0	0	0	6,000
9	Education,	C	0	0	0	0	0	0	0
	Promotion and	R	5,000	5,000	5,000	5,000	5,000	25,000	50,000
	Communication	T	5,000	5,000	5,000	5,000	5,000	25,000	50,000
	TOTAL	C	810,667	1,902,000	1,853,333	1,876,667	1,710,000	4,600,000	12,752,667
		R	5,000	5,000	5,000	5,000	5,000	25,000	50,000
		T	815,667	1,907,000	1,858,333	1,881,667	1,715,000	4,625,000	12,802,667

Table E4 Consolidated Budget – Expenditure – G-M Water ($)

Note The only costs attributed to Goulburn-Murray Water are for maintaining the Beattie Depression Levees in Program 1.

Program		Year 1	Year 2	Year 3	Year 4	Year 5	Years 6-10	Total
1 Asset	C	0	0	0	0	0	0	0
Management	R	20,000	20,000	20,000	20,0000	20,000	100,0000	200,000
	T	20,000	20,000	20,000	20,0000	20,000	100,0000	200,000

Table B5 Consolidated Budget – Total Expenditure

	Program	Year 1	Year 2	Year 3	Year 4	Year 5	Years6-10	Total
1	Asset Management							
	GBCMA	394,000	399,000	394,000	394,000	389,000	1,925,000	3,895,000
	Municipalities	120,000	120,000	110,000	110,000	115,000	555,000	1,130,000
	Gvt	0	0	0	0	0	0	0
	G-M Water	20,000	20,000	20,000	20,000	20,000	100,000	200,000
	Total	534,000	539,000	524,000	524,000	524,000	2,580,000	5,225,000
2	Flood Studies & FPM Plans							
	GBCMA	759,625	776,750	794,708	781,250	767,458	1,119,959	4,999,750
	Municipalities	326,458	859,000	812,458	840,208	766,917	1,537,542	5,142,583
	Gvt	806,667	1,900,000	1,853,333	1,876,667	1,710,000	4,600,000	12,746,667
	G-M Water	0	0	0	0	0	0	0
	Total	1,892,750	3,535,750	3,460,499	3,498,125	3,244,375	7,257,501	22,889,000
3	Statutory Land Use Planning							
	GBCMA	39,000	51,000	51,000	31,000	75,000	40,000	287,000
	Municipalities	90,000	90,000	30,000	30,000	65,000	80,000	385,000
	Gvt	0	0	0	0	0	0	0
	G-M Water	0	0	0	0	0	0	0
	Total	129,000	141,000	81,000	61,000	126,000	120,000	672,000
4	Development Assessment Guidelines							
	GBCMA	5,000	5,000	5,000	5,000	5,000	25,000	50,000
	Municipalities	0	0	0	0	0	0	0
	Gvt	0	0	0	0	0	0	0
	G-M Water	0	0	0	0	0	0	0
	Total	5,000	5,000	5,000	5,000	5,000	25,000	50,000
5	Control of Works and Activities on Floodplains							
	GBCMA	15,000	15,000	15,000	15,000	15,000	75,000	150,000
	Municipalities	35,000	35,000	35,000	35,000	35,000	175,000	350,000
	Gvt	0	0	0	0	0	0	0
	G-M Water	0	0	0	0	0	0	0
	Total	50,000	50,000	50,000	50,000	50,000	250,000	500,000
6	Emergency Response Planning							
	GBCMA	15,000	14,000	27,500	5,500	5,500	27,500	95,000
	Municipalities	3,000	0	0	0	0	0	3,000
	Gvt	4,000	2,000	0	0	0	0	6,000
	G-M Water	0	0	0	0	0	0	0
	Total	22,000	16,000	27,500	5,500	5,500	27,500	104,000
7	Flood Monitoring Actions							
	GBCMA	10,200	10,200	10,200	10,200	10,200	51,000	102,000
	Municipalities	2,000	2,000	2,000	2,000	2,000	10,000	20,000
	Gvt	0	0	0	0	0	0	0
	G-M Water	0	0	0	0	0	0	0
	Total	12,200	12,200	12,200	12,200	12,200	61,000	122,000

Table B5 Consolidated Budget – Total Expenditure, Continued

Program	Year 1	Year 2	Year 3	Year 4	Year 5	Years6-10	Total
8 Information Management Systems							
GBCMA	16,000	16,000	16,000	16,000	16,000	80,000	160,000
Municipalities	0	0	0	0	0	0	0
Gvt	0	0	0	0	0	0	0
G-M Water	0	0	0	0	0	0	0
Total	16,000	16,000	16,000	16,000	16,000	80,000	160,000
9 Education, Promotion and Communication							
GBCMA	13,000	13,000	13,000	13,000	13,000	65,000	130,000
Municipalities	15,000	15,000	15,000	15,000	15,000	75,000	150,000
Gvt	5,000	5,000	5,000	5,000	5,000	25,000	50,000
G-M Water	0	0	0	0	0	0	0
Total	33,000	33,000	33,000	33,000	33,000	165,000	330,000
TOTAL							
GBCMA	1,266,825	1,299,950	1,326,408	1,270,950	1,296,158	3,408,459	9,868750
Municipalities	591,458	1,121,000	1,004,458	1,032,208	998,917	2,432,542	7,180,583
Gvt	815,667	1,907,000	1,585,333	1,881,667	1,715,000	4,625,000	12,802,667
G-M Water	20,000	20,000	20,000	20,000	20,000	100,000	200,000
Total	2,693,950	4,347,950	4,209,199	4,204,825	4,016,075	10,566,001	30,052,000

Note that costs exclude the implementation of the Lower Goulburn Floodplain Rehabilitation Scheme and any flood mitigation measures rising from the implementation of a floodplain management plan for Shepparton-Mooroopna.

F Appendix F - Priority Setting

Introduction

Priority setting for various components of the strategy was based on an assessment of the economic, social and environmental benefits of each task, using a "Rapid Appraisal Method," developed by Read Sturgess and Associates for NRE (Ref. 4) where appropriate, and by subjective analysis where this method was not appropriate.

Rapid Appraisal Method

The RAM has been designed to provide a set of simple and rapid evaluation tools, useful for estimating flood damages and determining the benefits and costs of certain types of works and measures.

In terms of assessing relative priorities for program tasks, RAM had most application in assessing flood studies and floodplain management plans. Given that is usually not possible to define their potential benefits until after they are completed, it is perhaps more appropriate to consider flood studies and floodplain management plans as pre-requisites for the subsequent implementation of other works and/or measures.

The RAM therefore proposes a non-monetary scoring system, based on an assessment of the advantages of the additional knowledge obtained by undertaking a particular flood study or floodplain management plan, the relative extent of flood damages and the relative rate of growth in those flood damages.

The RAM was used to determine priorities for the flood studies and floodplain management plans identified in Program 2. The RAM was found to favour large population centres and/or large study areas and in some cases did not adequately take into account community feelings. Therefore some adjustments were made to the ranking process.

Priority Setting for Areas where RAM is Inappropriate

Where RAM was inappropriate, a qualitative analysis was carried out. For each task within a program, a score between 1 (low) and 5 (high) was given for economic, social and environmental factors, using guidelines described below. Scores were then weighted by multiplying each category by:

- 2 for economic factors;
- 1 for social factors; and
- 1 for environmental factors.

The higher weighting for economic considerations reflects the strong pressure from the community and the government to ensure that projects are economically viable, and competitive, having regard for comparable projects for other CMAs.

A total weighted score was then calculated and the following priorities were assigned:

Score	Ranking
16 - 20	Very High
12-15	High
9-11	Medium
6-10	Low
Below 5	Very Low

Economic Considerations

A high economic score applied to the following:

- Works or measures having a high benefit/cost ratio (estimated from experience if figures aren't available) or having a relatively low cost and likely to lead to a significantly reduced potential for existing or future flood damages.
- Non-structural measures such as flood mapping and land use planning controls.
- Asset maintenance programs and agreements having the potential to reduce future flood damages.
- Measures that encourage best practice, training and community awareness programs.

Social Considerations

A high social score applied to projects which result in substantial reductions in the human cost of flooding, measured by a number of factors such as:

- A reduction in the community's exposure to flood risk, measured in terms of flood frequency and consequences of flooding (in turn determined by considering factors such as the combination of flood depth and flow velocities[4].
- A reduction in the number of properties affected by flooding. A large number of properties benefiting from the implementation of a project indicated significant reductions in community health risk, disruption and hardship.
- The introduction of agreements and arrangements that identified or clarified roles and responsibilities or led to improved asset management.

4 A velocity-depth curve, developed by NRE as part of its statewide flood mapping project was used as a guide.

Environmental Factors

A high environmental score reflected positive improvements to the environment by proposed works and measures. Generally the adoption of non-structural measures in preference to structural measures, and restoration of environmental values (such as by removing structural measures) attracted a high score.

A score of 4 or 5 applied for areas identified as floodway land in flood inundation maps. The identification of floodway areas helped to preserve wetland habitats because of the tight planning controls applicable to floodway areas. Removal of rural levees to enhance wetlands or maintenance of specific levees that prevent stream evulsions also attracted a high score (although if these were only part of a levee system the score was reduced).

G Acronyms and Glossary

Abbreviation	Description
AAD	Average annual damage, the average damage per year that would occur in a particular area from flooding over a very long period of time. This provides a basis for comparing the economic effectiveness of different projects.
AEP	Annual exceedance probability, the likelihood of occurrence of a flood of a given size or larger occurring in any one year. A 1% AEP event is effectively a 100 year ARI flood.
AHD	Australian Height Datum, height above sea level.
ARI	Average Recurrence Interval, the likelihood of occurrence of flooding, expressed in terms of the long-term average number of years between the occurrence of a flood as large as or greater than the flood being referred to. For example, a flood with a discharge as large or greater than the 100 year ARI flood will occur on average every 100 years.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand.
BoM	Bureau of Meteorology, Commonwealth Government.
Catchment	The area draining to a particular site. It always relates to a specific location and includes the catchments of the main stream and its tributaries.
CALP	Catchment and Land Protection (Board or Region).
CMA (GBCMA)	Catchment Management Authority (Goulburn Broken CMA).
CRC	Cooperative Research Centre for Catchment Hydrology. A research organisation.
Development	The erection of a building or the carrying out of works, or the use of land or of a building of works, or the subdivision of land.
DHS	Department of Human Services.
DOI	Department of Infrastructure.
DPIE	Department of Primary Industries and Energy.
Effective Warning Time	The time available for residents in flood prone areas to defend their properties and/or evacuate themselves and their moveable possessions after having received a warning to do so. The longer the available warning time and the more flood aware the population, the more effective defence and evacuation procedures will be.
EMA	Emergency Management Australia.
Floodway	The channel, stream and that portion of land liable to flooding necessary to convey the main flow of floodwater. It usually comprises the high hazard portion of the floodplain where most development is to be avoided. Floodways are usually areas where a significant volume of water flows during floods and are areas, which even if only partially blocked, would cause a significant redistribution of flood flow or a significant increase in flood levels, which in turn may adversely affect other areas.
Flood Awareness	An appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures. A high level of flood awareness usually means the community's response to flood warning is prompt and efficient. Conversely a low degree of flood awareness means people are likely to ignore or misunderstand flood warnings, and be confused about what they should do, when to evacuate, what to take and where it should be taken.
Flood Management	In the context of emergency management, the implementation of three clusters of overlapping activities: prevention, response and recovery.
FMP	Floodplain Management Plan.
Floodplain Management	The planning and flood impact prevention/minimisation activities of flood management together with related environmental activities.

Floodplain Management Authority	An Authority with "direct" or "delegated" functions for floodplain management under Part 10, Division 4 of the Water Act, 1989. CMAs and Melbourne Water are the main delegated floodplain management authorities. In areas not covered by a "delegated authority", the Minister for Agriculture and Resources is the GBCMA.
FRAP	Flood Response Action Plan, a generic plan which has been prepared to assist CMAs prepare for and respond to floods.
Flood Warning	In general terms, the timely collection, interpretation and dissemination of flood information before and during a flood event to enable the community to respond effectively to the flood threat.
Freeboard	A factor of safety above design flood levels, generally expressed as a margin above the design flood level, typically used in setting floor levels and levee crest heights. It is intended to compensate for flood prediction uncertainties and for factors that affect flood levels or in the case of levees, affect the level of protection. These include wave action, localised hydraulic effects and settlement of levees. Freeboard should not be relied upon to provide protection for events larger than the design flood.
GBCMA	(The) Goulburn Broken Catchment Management Authority.
GIS	Geographical Information Systems. A computer tool that enables geographical data about places on the planet to be arranged and displayed in a variety of ways, such as maps, charts and Tables.
G-M Water	Goulburn-Murray Water.
Hydraulics	The study of water flow, in particular the evaluation of flow parameters such as water level and flow velocity in a river, stream or adjacent floodplain.
Hydrology	The study of the rainfall and runoff process as it relates to the derivation of flow in watercourses.
Level of Flood Risk	A measure of flood risk, which may loosely be defined as the chance of something happening that will have an impact on flood management objectives. Derivation is by assessing the combination of the likelihood of flooding and the consequence of flooding. The likelihood of flooding is a qualitative or quantitative description of the likelihood of occurrence of flooding, often expressed as the AEP or ARI. The consequence of flooding is a qualitative or quantitative description of the outcome of a flood event in terms of loss, injury, disadvantage or gain.
LSI	Land Subject to Inundation. Land that will be inundated by a design flood. This will differ for different floods. Unless stated otherwise, LSI is usually taken to mean land inundated by the 100 year ARI flood or the flood of record.
LSIO	Land Subject to Inundation Overlay. A planning scheme overlay for controlling developments in LSI areas.
LPPs	Local Planning Policies adopted by municipalities in their planning schemes.
MEMP	Municipal Emergency Management Plan. A plan prepared and maintained by each municipality under the *Emergency Management Act, 1986*. The plan identifies the municipal resources available, and how they are to be used for emergency prevention, response and recovery. A flood sub plan is a part of the MEMP, and is geared specifically for responding to floods.
MMBW (MW)	Melbourne Metropolitan Board of Works (Melbourne Water).
NDRA	Natural Disaster Relief Arrangements.
NHT	Natural Heritage Trust.
NRE	Department of Natural Resources and Environment
PMF	Probable Maximum Flood. The largest flood that could conceivably occur at a particular location. Generally it is not physically or financially possible to provide general protection against this event. However, consideration should be given to adopting the PMF or similar extreme event as the design event for determining the location and floor levels of important facilities such as telephone exchanges, police stations, VICSES centres and hospitals.
Prevention	The elimination or reduction of the incidence or severity of emergencies and the mitigation of their effects.
RAM	Rapid Assessment Method (for assessing the merits of schemes)
RCS	Regional Catchment Strategy.
Recovery	The assisting of people and communities affected by emergencies to achieve a proper and effective level of functioning.
Response	The assisting of communities affected by emergencies and the provision of rescue and immediate relief services.
Responsible Authority	The specified body or agency which administers and enforces a planning scheme.
Risk Management	The systematic application of management policies, procedures and practices to the tasks of identifying, analysing, assessing, treating and monitoring risk.
Runoff	The portion of rainfall which actually ends up as streamflow.
RWA	Rural Water Authority.
RWC	Rural Water Corporation (previously Commission). Successor to State Rivers & Water Supply Commission). Predecessor to RWAs.
SBO	Special Building Overlay. A planning scheme overlay for controlling developments in urban areas. It is usually associated with localised flooding or drain overflows.
SCARM	Standing Committee for Agriculture and Resource Management.
SEPP	State Environmental Protection Policy.
SR&WSC	State Rivers and Water Supply Commission.
Stakeholder	A person, group, authority or organisation which has an interest or involvement in floodplain management.
Stormwater Flooding	Inundation by local runoff. This occurs when the capacity of stormwater drainage systems is exceeded. It can also occur when high flood levels at their point of discharge into rivers and streams prevents stormwater systems from functioning properly, leading to drain overflows.
UFZ	Urban Floodway Zone. A planning scheme zone for controlling developments in floodways in urban areas.
VICSES	Victoria State Emergency Service.
VEMC	Victoria Emergency Management Council.
VFWCC	Victorian Flood Warning Consultative Committee.
VPPs	Victoria Planning Provisions.
Works	Any change to the natural or existing condition or topography of land including the removal, destruction or lopping of trees and removal of vegetation or topsoil. (Definition from the *Planning and Environment Act, 1987*).



SINCLAIR KNIGHT MERZ

Victoria
The Place To Be