

Corangamite Catchment Management Authority

FLOODPLAIN MANAGEMENT STRATEGY

April 2002



The swollen Barwon River, looking over Belmont Common

Corangamite Catchment Management Authority
Floodplain Management Strategy
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Executive Summary

Background

Flooding costs Victoria approximately \$100 million a year in damage to property, buildings, infrastructure and agriculture production. Floods cause social disruption and hardship to communities living on floodplains.

Flooding affects large areas of farmland and causes disruption to essential services such as transport, water supply, sewerage, electricity and communications. Without effective management of land use on floodplains and emergency response during flood events, damage costs and the community's exposure to flood risk will increase.

The Corangamite Catchment Management Authority (CCMA) is responsible for floodplain management in the Barwon River, Leigh River, Moorabool River, Lake Corangamite, the Otway Coast region and Hovells Creek catchments. The Authority's region stretches from Peterborough in the west, Ballarat in the north to Geelong and the Bellarine Peninsula in the east.

The estimated annual flood damage cost for this region is \$6 million. The highest damage cost and flood risk occurs in the Ballarat urban area with over 900 properties at risk with an estimated average annual damage of \$1.5 million. A total of 12,000 properties are affected by flooding in the region with 3,500 being in an urban/township area. The area of flood prone land within the region's floodplains is estimated to be approximately 1,300 square kilometres.

Floodplain management involves reducing flood risk through the implementation of planning controls, flood mitigation works and asset maintenance measures. Other activities include the provision of early warnings, and predicting the severity and impact of the flood events.

The Corangamite Floodplain Management Strategy (2002) provides the strategic direction for future floodplain management in this region over the next five years. It focuses on five programs incorporating the vision, objectives and targets necessary for their successful implementation.

Objectives

This Strategy's Vision "*Safe and healthy floodplains for the benefit of existing and future generations*" encompasses five objectives which seek to:

1. Facilitate sustainable management of strategic floodplain assets having regard for level of service, ownership, roles and responsibilities of maintenance and cost sharing arrangements;
2. Develop and implement flood management plans having regard for the full social, environmental, cultural heritage and economic costs and benefits;
3. Provide sound emergency response planning and identify opportunities to minimise the impacts of flood risk and flood damage;
4. Provide decision tools through the Victorian Planning Provisions (VPPs) to allow development and land use practices to be compatible with the flood risk and water quality objectives;
5. Develop and implement an integrated floodplain management information system, that provides high quality data for use in managing floodplains and that relevant development decisions are consistent and based on best practice.

Outcomes

This Strategy expects to achieve the following outcomes:

- To reduce flood risk and property flood damage costs to the community;
- To ensure flood protection assets are maintained to design standard;
- To ensure flood protection assets are always in a safe operating condition, thus minimising the asset owner's liability;
- To clarify roles and responsibilities associated with floodplain management in this region;
- To identify all flood prone properties, their relative flood risk and flood characteristics;
- Improved community awareness of floodplain issues and flood risk;
- To ensure the local flood authorities and flood affected residents are prepared for flood events;
- Informed decisions on planning development can be made in full knowledge of floodplain management constraints;
- Streamline the floodplain referral process between stakeholders;
- All flood data is kept up to date and consistent between CCMA and councils;
- Property flood information statements can be confidential made by councils without referral to CCMA;
- Best practice in floodplain management is maintained in the region which will provide a consistent basis to assess development applications.

Programs and Costs

A consolidated program of priorities, indicative costs and funding arrangements is shown in the five Program Management Plans in **Section 7** of this Strategy; a summary is shown in the table below.

The total cost of fully implementing these programs is \$6.2 million over five years (starting 2002/03) with an annual cost to the CCMA of approximately \$513,000. It is assumed that approximately 60% of the total funds required will be obtained via grants or partnerships with stakeholders.

Program		Indicative Costs (based on \$ for year 2002)			
		Funds over 5 years			CCMA Costs p.a.
		Total	External	CCMA	
1	Asset Management	\$4,666,000	2,922,000	1,744,000	\$349,000
2	Studies and FPM Plans	\$682,000	568,000	114,000	\$ 28,000
3	Flood Warning and Emergency Response	\$150,000	100,000	50,000	\$ 13,000
4	Statutory Land Use Planning	\$580,000	115,000	465,000	\$93,000
5	Development and Research	\$150,000	0	150,000	\$ 30,000
	TOTAL	\$6,228,000	3,704,000 (59%)	2,524,000 (41%)	\$ 513,000

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1. Introduction

The Corangamite Catchment Management Authority (CCMA) was established to facilitate the development of an integrated approach to catchment issues across the Corangamite region, in partnership with government and the community. The two major parts of its business consist of:

- A direct management role for works along waterways and on floodplains which ensures any development is safe and substantial for the environment;
- A planning and coordination role, where the Authority works in partnership with all stakeholders to protect and enhance the condition of the region's natural resources.

This Strategy focuses on Floodplain Management within the Corangamite region. It incorporates the vision, objectives and targets necessary for their successful implementation in addition to providing a planning framework for each of the Strategy's five programs.

This document incorporates many of the ideas and aspirations expressed during of the Authority's comprehensive community consultation process which involved:

- Meetings with CCMA Steering Committee and officers;
- Advertisements requesting information placed in local papers;
- Meetings and discussions with landholders and community groups;
- Site inspections and consultations with a number of landholders and community groups;
- Meetings with key stakeholders, including officers from each municipality;
- Consultation with government agencies;
- Three half-day workshops at Geelong and Ballarat to discuss the draft strategies.

2. Roles and Responsibilities

Management of regional flooding issues in an integrated, coordinated manner is one of the Authority's primary roles. It must have regard for the overall impact of works and activities within its catchment management area whilst considering waterway health and environmental values. The CCMA undertakes its catchment management functions under the Water Act, 1989 and the CALP Act, 1994. The CCMA's key roles are to:

- Determine the extent and height of floodwaters and provide flood advice;
- Declare flood levels, land liable to flooding, floodway areas, flood fringe areas and building lines;
- Control developments that have occurred or that may be proposed;
- Develop and implement plans and take any action necessary to minimise flooding and flood damage.

Municipal councils perform a major role in many of the operational aspects of flood management. They are required to:

- Have a lead role in developing and implementing floodplain management planning controls through their planning schemes;
- Set floor levels for buildings in flood prone land (CMAs would normally assist);
- Manage and maintain local approved works and measures (including levees) in accordance with the regional floodplain management strategy;
- Control new private levees and farm works through their planning schemes;
- Prepare and implement urban floodplain management plans in accordance with the regional floodplain management strategy.

The roles and responsibilities of key stakeholders are identified in **Appendix A**. They include a number of government agencies as well as municipalities and the CCMA. The key agencies for the implementation of this strategy are the municipal councils in partnership with the Authority.

3. Background

The Corangamite Catchment Management Authority was constituted on 1 July 1997 in a move which saw, for the first time, the establishment of one local organisation empowered to co-ordinate regional drainage, floodplain and waterways management. It is critical that the Authority develops sound management strategies and clearly identifies the roles, responsibilities, assets, liabilities, targets and regional priorities set by the communities it represents.

This Floodplains Management Strategy focuses on floodplain management, and it considers the strong links existing between the Authority's aims and objectives, and rural drainage and waterway management strategies across the region. This document is the culmination of extensive consultations, field investigations and reviews of existing flood studies, background reports and planning scheme documents. It provides vital background information designed to develop knowledge relating to the key flood management issues across the region.

An understanding of this document's contents will assist with the successful implementation of the five programs of the Regional Floodplain Management Strategy (RFMS). It provides a blueprint for the direction to be taken in floodplain management within the CCMA region. In addition to a planning framework for each of the Strategy's five programs, the Strategy incorporates the vision, objectives and targets necessary for their successful implementation.

Floodplains are the commercial, social and environmental arteries of the region. In conjunction with waterways they are generally the more fertile areas, upon which a significant proportion of the region's agricultural business is dependent.

Regular flooding enhances this 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. Flooding can also cause damage to buildings and infrastructure, as well as social disruption.

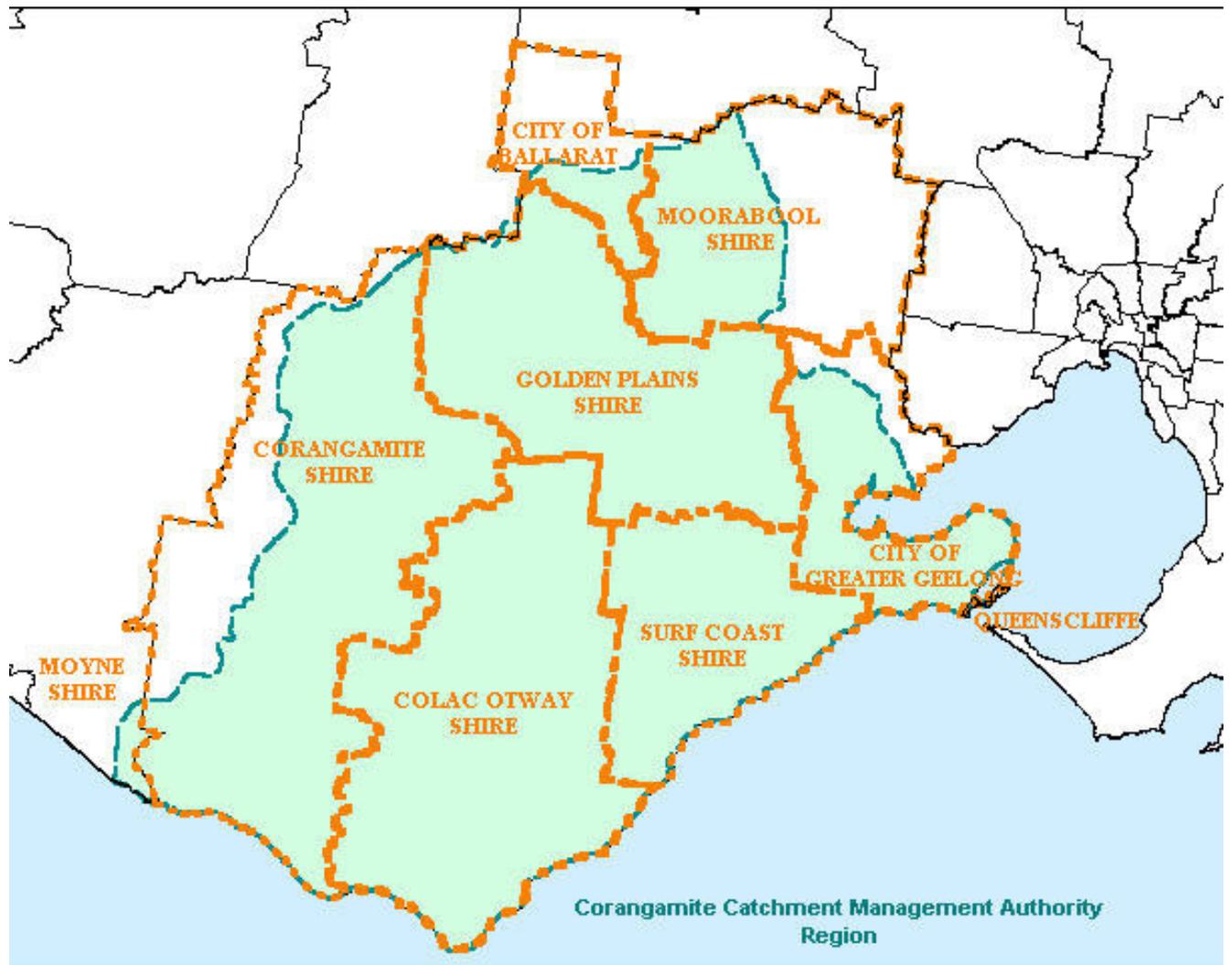
Over the past decade there has been increasing recognition of the ecological significance of floodplains, the interdependence between the health of the river and the floodplain, and the role periodic flooding plays in maintaining these connections.

There are conflicting pressures on the use of floodplains in the Corangamite region including:

- Urban expansion in floodplain areas;
- Water quality problems associated with development, including urban and industrial runoff;
- Construction of private levees;
- Infrastructure management (levees and utility assets);
- Loss of wetlands and flood storage areas.

The CCMA, as a floodplain manager, has a duty to future generations. It must ensure wise management decisions are made in relation to floodplains in order to ensure that land use and development is compatible with the flood risk.

Figure 3.1: Locality Map outlining the Corangamite CMA region



3.1 Floodplain Uses

The following issues are discussed in order to facilitate an understanding of the floodplain management problems within the CCMA's region.

3.1.1 Significant Floodplains

The extents of significant floodplains are shown in **Appendix B** as a series of maps. Information has been derived from the State government's recent Flood Data Transfer Project. Existing flood studies and historical mapping data have been supplemented with local knowledge where flood information was previously scant or not available. The accuracy of this delineation is the best available and of sufficient detail for the purposes of this Strategy. The Authority holds this information on hard copy plans and in digital format on its Geographic Information System (GIS).

Lower Barwon River Floodplain (Map B4)

The Lower Barwon floodplain extends along the Barwon River from Inverleigh, through Geelong to Lake Connewarre, then on to Barwon Heads and the sea. The catchment area upstream is 3,100 square kilometres consisting of three major sub-catchments, Upper Barwon River, Leigh River and Moorabool River. The significant flood risk areas are the industrial and commercial areas of South Geelong, caravan parks along the river in Belmont, and the Barwon Heads/Ocean Grove areas of the floodplain.



Barwon River at Queens Park Bridge Geelong in November 1995.

Upper Barwon River Floodplain (Maps B3, B4 and B6)

The Upper Barwon floodplain extends along the river upstream of Inverleigh. The catchment area above Inverleigh is 1,020 square kilometres. The topmost part of the catchment is located in the Otway Ranges, in a water catchment area with river flows controlled by the Upper Barwon Dam at Forrest. The floodplain below Forrest to Winchelsea is wide, open and used for farming purposes. From Winchelsea to Inverleigh the river goes through a series of large floodplain storages controlled by narrow gorge sections. These reaches offer significant flood storage and attenuation of major floods. The townships of Birregurra, Winchelsea and Inverleigh are threatened by flood flows. It usually takes approximately two days for flood peaks from this catchment to reach Geelong.

Hovells Creek Floodplain (Map B4)

Hovells Creek rises in the You Yangs and flows to Limeburners Bay in Port Phillip Bay through the township of Lara. The catchment area of Hovells Creek is 240 square kilometres. Significant flood risk exists in Lara where residential properties are now protected by levees constructed by council in 1985/86. These levees were over topped in 1988 by the largest known flood, inundating 32 homes along the creek. The City of Greater Geelong operates a local telemetry flood warning system for Lara township.

Leigh River Floodplain (Maps B2 and B4)

The Leigh River rises in the Great Divide above Ballarat and joins the Barwon River at Inverleigh. The catchment area is some 900 square kilometres and flood peaks take one and a half days to travel to Geelong. Significant flood risk exists on the Yarrowee River through Ballarat and the Leigh River at Inverleigh. The township of Shelford is affected to a lesser extent. Inverleigh can be affected by floods from both the Barwon and Leigh Rivers separately or a combination of both.



Junction of Yarrowee River and Canadian Creek, Ballarat.

Moorabool River Floodplain (Maps B2 and B4)

The Moorabool River extends from the Great Divide east of Ballarat to Fyansford near Geelong with a catchment area of 1,150 square kilometres. Several water supply reservoirs control river flows in the upper reaches. The river generally occupies an incised valley with Batesford being the only township threatened by flood flows. It usually takes one day for flood to peak at Batesford. The Moorabool River joins the Barwon near Queens Park in Geelong.



Moorabool River flooding the Midlands Highway at Batesford, November 1995.

Woody Yaloak River Floodplain (Maps B1 and B3)

The Woody Yaloak River extends from the Great Divide west of Ballarat down to Cressy where it naturally drains to Lake Corangamite. The catchment slopes vary from undulating country in the upper reaches and to the eastern side, to fairly flat areas from the middle of the catchment to its outfall. The total catchment area of the Woody Yaloak is 1,200 square kilometres and flood flows are expected to cause only nuisance flooding of townships along its length.

Lake Corangamite (Map B3)

Lake Corangamite is a terminal lake with no natural outlet. During the 1950s, after several wet years, extreme flooding of the lake occurred inundating a large area of **surrounding** grazing land around the lake. The level of the lake was high enough for it to naturally start draining easterly to Lake Murdeduke and onto the Barwon River.

The Woody Yaloak Drainage Scheme was constructed in May 1959 with the diversion structure located near Cressy. The diverted flows from the Woody Yaloak River are conveyed to Warrambine Creek via an earth channel. The creek discharges into the Barwon River upstream of Inverleigh. The Cundare pool was designed to act as a retarding basin for excess flows from the Woody Yaloak River. The CCMA is responsible for the operation and maintenance of this drainage scheme.

Lough Calvert (Map B3)

The Lough Calvert area is north-east of Lake Colac and, like Lake Corangamite, it has no natural outlet. In the early 1950s, Lake Colac overflowed into the Lough areas drowning out many hectares of grazing land. The water remained in these loughs until a drainage scheme was constructed during 1953/54. It diverts flood water east via a channel to Birregurra Creek which joins the Barwon River below Conns Lane. The CCMA is responsible for the operation and maintenance of this drainage scheme.

Tirrengower Drainage Scheme (Map B3)

Located south of and draining into Lake Corangamite, this drainage scheme was constructed to drain **naturally** water logged areas around Swan Marsh-Irrewillipe area. The Colac Otway Shire administers this drainage scheme.

Curdies and Gellibrand Rivers Floodplain (Maps B3 and B5)

The towns of Peterborough and Princetown are situated at the ocean outfall of these rivers. A large floodplain exists at each location and little residential development has occurred within them at this stage. The degree of flooding of these inlets is also governed by tides and by bar formations across their entrances.



Gellibrand River flooding Great Ocean Road at Peterborough.

South Eastern Coastal Floodplains (Maps B5 and B6)

A number of the coastal streams which rise in the Otway Ranges flow down through townships situated on the coast. These streams, which respond quickly to rainfall, create a large, flash type floods in Apollo Bay, Kennett River, Wye River, Lorne, Anglesea and Aireys Inlet.

Barongarook Creek (Map B3)

Barongarook Creek rises south-east of Colac and flows north-west through Colac where it naturally drains into Lake Colac. A number of residential blocks are affected by flooding in Colac.

3.1.2 Current Uses of Significant Floodplains

The predominant land use in the region is agriculture which supports around one third of its population. There is only a small area of the catchment used for urban, industrial, and commercial use, with 15 per cent of land covered by natural forests¹. The main land use on rural floodplains in local government areas is also agriculture (RUZ zone). Some municipal planning schemes have included Public Use Zones (PUZ), Rural Floodway (RF) and Stream and Floodway Overlays (SFO) along watercourses. The majority of the population of the region resides in two cities, Geelong (55%) and Ballarat (15 %).

3.1.3 Future Uses

Potential changes in the floodplain uses within the Corangamite region are likely to be minor, given the extensive rural zones and associated entrenched land use practices that have evolved since European settlement on or adjacent to the floodplains in the region.

¹ Corangamite Region Salinity Management Plan, NRE and CCMA (1999).

It is expected that little residential development will be encouraged in the smaller townships. Landowners will be encouraged to protect and enhance riparian corridors, and riparian revegetation will also be encouraged in both the higher and lower reaches of most river systems. However, these actions are expected to have a minor impact on the floodplain.

The encroachment of urban and business development on flood prone areas is of greater significance. The main areas of concern are the Barwon River through Geelong where industry and other businesses have traditionally established themselves along the river, setting a precedence that is seeing continued development.

The Yarrowee River, Gnarr Creek and Canadian Creek through Ballarat are of major concern due to the restriction of their effective flow area by channelisation and building development encroaching across natural floodways. As a result, over 900 properties would be affected by flooding from a major flood event in Ballarat.

The Moorabool River causes extensive flooding through Batesford where it enters a natural floodplain. In recent years Batesford's popularity has increased adding development pressures to its floodplain, and increasing the number of occupants at risk.

3.1.4 Cultural Heritage

Watercourses and their adjacent floodplains provide a focal point for human activity, consequently they are associated with cultural and heritage values that are important to us as a community.

Limited information is available for cultural and indigenous archaeological sites. Background reports and surveys have identified many sites of Aboriginal archaeological significance in the Corangamite region. However, it is recognised there are many more sites than already documented and this may be in part due to the lack of detailed archaeological surveys in the region and the desire of the indigenous groups to refrain from publicising the location of sites. A majority of registered sites of significance are associated with the major waterways, their floodplains and lakes of the region.

It should be noted that Aboriginal sites, places and objects are protected under the terms of the State Archaeological and Aboriginal Relics Preservation Act 1972 and the Commonwealth Aboriginal and Torres Strait Islander Heritage Protection Act 1984.

3.1.5 Environmental Factors

Flooding is a natural phenomenon upon which a number of environmental benefits depend. Floodplains, waterways and their associated wetlands, play 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 this process, protecting waterways from high sediment and nutrient loads and contributing to floodplain productivity.

In order to manage the environmental values of floodplains effectively communities require reliable inventories of natural assets, and an understanding of the environmental effects of a range of floodplain activities. These two things form a necessary part of the implementation of flood management measures and they should be comprehensively addressed in any future preparation of floodplain management plans. These factors must also be considered in conjunction with other plans outlined in the CCMA Waterway Health Strategy.

3.2 Flood Conditions

3.2.1 Major Floods

A summary of major historical floods within the CCMA region is given in **Table 3.1**. The frequency of any flood has been described in terms of the Average Recurrence Interval (ARI) during intervening years.

Table 3.1: Historic floods in the Corangamite CMA region

Month/Year	River/Stream	Towns Affected	Comments
1852	Barwon River	Geelong Barwon Heads	Second largest flood recorded on the Barwon River (5.47 m at Macintyre bridge)
1880	Barwon River	Geelong	Third largest flood recorded on the Barwon River (5.59 m at Macintyre bridge)
1909	Yarrowee River	Ballarat	
1933	Yarrowee River	Ballarat	
1951	Barwon River, Lake Corangamite and Lough Calvert	Geelong	Fourth largest flood recorded on the Barwon River (5.17 m at Macintyre bridge)
June 1952	Moorabool River Barwon River	Batesford Winchelsea Inverleigh Geelong	Largest flood recorded on the Barwon River. (5.82 m at Macintyre bridge)
1972	Barwon River	Geelong	
Feb 1973	Hovells Creek Leigh River	Lara Shelford Inverleigh	Second largest known flood at Lara. Largest known flood on the lower Leigh River.
1978	Barwon River Hovells Creek	Geelong Lara	
Oct 1983	Hovells Creek	Lara	
Dec 1988	Hovells Creek	Lara	Largest known flood. Overtopped levees, 32 homes flooded.
1991	Gnarr Creek and Yarrowee River	Ballarat	Serious flash flood affecting CBD.
Nov 1995	Moorabool River Barwon River	Batesford Inverleigh Geelong	\$30M damage cost, 35year ARI flood on the Barwon & fifth known highest recorded flood (5.23 m at Macintyre bridge)

3.2.2 Areas Liable to Flooding

The floodplain maps have been prepared by the Department of Natural Resources and Environment (NRE) from the Flood Data Transfer Project. They show the extent of inundation of the one hundred year ARI flood event (best estimate) and the extent of the floodway component for the floodplain. They are shown in **Maps B1 to B6** in **Appendix B**.

Every attempt has been made to capture areas that flood along most waterways however, there may be waterways in the areas with generally flat terrain, or in areas where little flooding characteristics are known, that have not been displayed on the maps. These maps will be amended by the CCMA whenever new flood data becomes available.

There are numerous instances where man-made features have been constructed with little or no consideration being given to the natural flow of water during periods of heavy rainfall. Some of these

obstructions date back to shortly after the arrival of European settlers. Assets that alter the natural floodplain characteristics include roadways, railways, channels, levee banks and land filling of the floodplain.



Looking up the Leigh River Valley. The Barwon River at Inverleigh, November 1995.

3.2.3 Flood Risk

Flood risk is defined under current best practice guidelines for floodplain management as a combination of frequency of flooding and the consequence of flooding. It has been assigned as follows:

<p>Low Risk</p>	<ul style="list-style-type: none"> • Nuisance flooding (eg. overland flooding). • Rare flooding to depths less than 0.5 metre in rural areas and 0.3 metre in urban areas, usually in areas designated as flood fringe. • Non-hazardous flooding of short duration (less than a day) with small damage costs and ample time for flood forecasting, flood warning and evacuation. • Children and the elderly could wade to safety with little difficulty over a short distance. • Evacuation routes remain trafficable for at least twice as long as the time required for effective flood warning and evacuation.
<p>Medium Risk</p>	<ul style="list-style-type: none"> • Areas protected by high standard levees or areas defined as flood storage. • Areas where flooding is infrequent and depth of flooding is generally less than 1 metre in rural areas and 0.5 metre in urban areas. • Fit adults can wade to safety, but children and the elderly may have difficulty over a longer evacuation route. • Evacuation route remains trafficable for at least 1.5 times as long as the necessary effective flood warning and evacuation times.

High Risk	<ul style="list-style-type: none"> • Floodways (by definition the high risk part of the floodplain). • Areas subject to deep flooding (usually greater than 1 metre with flow velocity > 0.5 m/s in a 1 in 100 year flood event). • Areas which flood frequently and where flood damages are potentially high, especially in residential areas. • Fit adults have difficulty in wading to safety. Vehicle access only available in the early stages of flooding. Boats and helicopters may be required for evacuation.
Extreme Risk	Maximum flood depths and flow velocities are over 1m and 1.5 m/s respectively. Wading is not an option and Boats and helicopters are required for flood evacuation.

The flood risk for each floodplain area has been identified and shown in **Tables 3.2** and **3.3** which follow.

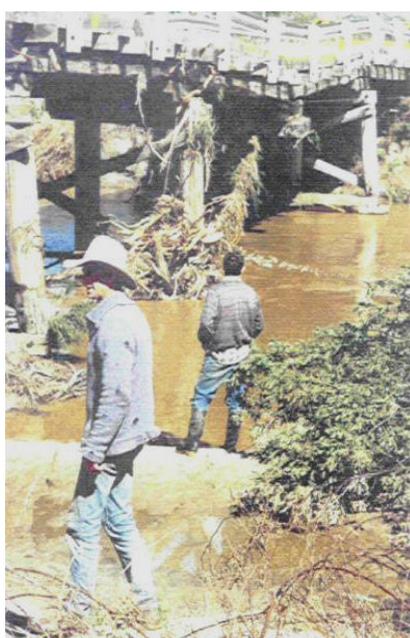
The following types of development are generally recommended for the flood risks above.

Development Type	Low Risk	Medium Risk	High Risk	Extreme Risk
Residential	√			
Commercial	√	√		
Industrial	√	√		
Open Space	√	√	√	√
Rural/ Non Urban	√	√	√	

Development categories are also considered when determining flood risk including:

- Existing development
- Infill development
- New development
- Redevelopment
- Minor additions to an existing development

More detail on flood risk criteria and development decision guidelines can be found in ‘Floodplain Management in Australia Best practice Principles and Guidelines’, *SCARM Report 73*, CSIRO Publishing (2000).



Bridge damage after a flood



Furniture removal during a flood

3.2.4 Annual Flood Damage

Estimates for flood damage of all floodplains and townships in the Region have been determined using a technique called RAM.² The consultants Read Sturgess & Associates completed this work.³

Table 3.2 and 3.3 below shows the respective flood damage costs for each major waterway and the damage costs for the top fourteen urban townships. **Table 3.4** details the distribution of damage components.

The damage costs used are July 2001 dollar value and do not include any damage associated with stream or bank erosion caused by low flow processes or streamside occupation use.

Table 3.2: Flood damage costs for the CCMA region

Basin	Average Annual Damage Cost (\$1000's)	No. of properties affected	General flood risk for Basin
Leigh River	1,760	1,600	High
Moorabool River	540	1,600	Low
Upper Barwon	1,620	3,300	Medium
Lower Barwon			
Hovells Creek	440	900	Medium
Corangamite	1,080	2,300	Low
Otway Coast Streams	710	2,100	Medium
Totals	6,000	11,800	-

² *Rapid Appraisal Method (RAM) for Floodplain Management*, NRE (May 2000).

³ *Economic Evaluation of Flood Damages for the CCMA*, Read Sturgess & Associates (July 2001).

Table 3.3: Urban Flood Damage & Risk

Urban/ Township Components	Average Annual Damage Cost (\$1,000's)	No. of properties affected	General flood risk for Urban Area
Ballarat (Canadian Creek)	1,510	910	High
Ballarat (Yarrowee River and tributaries)			
Geelong (Barwon River)	470	570	Medium
Lara (Hovells Creek)	300	540	Medium
Colac (Barongarook Creek)	260	240	Medium
Barwon Heads/Ocean Grove (Barwon River)	160	440	Medium
Inverleigh (Leigh River)	110	140	Medium
Geelong (Waurm Ponds Creek)	70	160	Medium
Pt Lonsdale (Lake Victoria)	60	240	Medium
Geelong (Cowie Creek)	70	61	Medium
Wye River and Kennett River	40	17	Medium
Smythesdale (Woody Yaloak)	30	66	Medium
Winchelsea (Barwon River)	26	51	Medium
Shelford (Leigh River)	21	36	Medium
Batesford (Moorabool River)	20	80	Medium
Totals	3,150	3,550	

More than half the average annual damage costs for the region occurs with the top 14 flooded urban townships shown in **Table 3.3**. The CCMA region was broken into 67 RAM study areas of which 28 were urban townships.

From the analysis the clear priority is Ballarat, with the Canadian Creek and the Yarrowee River featuring in many action plans with this Strategy's programs. A detailed list of flood damage characteristics for all the RAM study areas is shown in **Appendix D**.

Table 3.4: Flood Damage Costs by Component

Flood Damage Components	Average Annual Damage Cost (\$1000's)	No. of properties affected	No. of buildings flooded
Urban (Buildings)	2,400	4,180	1,740
Rural (Buildings and Agriculture)	1,700	7,650	550
Infrastructure	400		
Indirect	1,500		
Totals	6,000	11,830	2,290

A distinction is drawn between CCMA waterways and local urban drainage systems where municipalities have the responsibility. Local urban flood hazards or damage costs are not shown in this Strategy.

3.3 Flood Mitigation Effects

3.3.1 Local Flood Management Plans

Several formal flood mitigation schemes exist in the CCMA region. During 1985/86 levee banks within Lara were constructed as part of the adopted flood mitigation scheme to provide protection from flooding from the Hovells Creek for the one in one-hundred year flood event. The levees were breached during the 1988 flood event and further works based on a flood study report for the Corio Council (1991) have been carried out. The City of Greater Geelong maintains these levees.

Lough Calvert and Woody Yaloak Diversion Schemes are essentially flood protection schemes built in the 1950s by the then State Rivers & Water Supply Commission to protect low lying rural land around Lough Calvert and Lake Corangamite. Both these schemes are managed by the CCMA. More details on these drainage schemes can be found in the South West Victoria Panel Hearing⁴ and the Johnston Report.⁵

Private constructed levees are known to exist within the floodplains of rivers in the region and a typical example can be found along the Barwon River at Connewarre and Barwon Heads. Where possible, these have been identified and shown in the Assets Inventory shown in **Appendix C** with respective management responsibility and asset condition rating.

The City of Greater Geelong and City of Ballarat are currently developing local Flood Management Plans of urban flooding issues, including a flood mapping component. This Strategy will strongly support these projects.

Each municipality has the responsibility to develop and maintain Emergency Management Plans that respond to the threat of floods.

3.3.2 Flood Warning Systems

There are two existing flood warning systems in the CCMA Region:

- On Hovells Creek giving forecasts for Lara; and
- On the Lower Barwon River giving qualitative forecasts for Winchelsea, Inverleigh, Batesford (on the Moorabool River), Geelong and Barwon Heads.

Each of their respective components is shown in **Appendix E**.

The Hovells Creek system is operated and maintained by the City of Greater Geelong and forecasts made at a local level.

The Barwon River is larger consisting of 20 telemetry field stations returning rainfall and river level data. Qualitative forecasts are provided by The Bureau of Meteorology and conveyed to respective councils by the VICSES. The respective councils through their Flood Emergency Management Plans undertake an extensive flood alerting of effected people.

Flood forecasts are issued in terms of minor, moderate or major flooding with expected flood peak and timings. At least a 24 hours warning time of the flood peak is expected for the Barwon River floodplain through Geelong. CCT Consulting prepared the Barwon River Region Flood Warning System on behalf of the four local councils, Bureau of Meteorology, Victorian State Emergency Services and CCMA. Each council should be contacted for the details of local flood Emergency Management Plans.

⁴ 'South West Victoria Water Management Strategy', Panel Hearing into Water Resources Management in Victoria, Parliament of Victoria – NRE Committee (November 1989).

⁵ *Operation of the Lough Calvert Drainage Scheme*, Johnson (1991).

3.3.3 Water Storages

All water storages with a capacity greater than 1000 MI are shown in **Table 3.4**. No specific studies have been undertaken in the region to assess the impacts of the major storages on flood mitigation. Generally, major water storages will only have an effect in mitigating with small to moderate floods when they are substantially empty. Mitigation effects for major floods are considered to be minor. Most reservoirs offer some flood protection but their primary purpose is for water supply. Their secondary purpose is flood mitigation if levels allow, according to predetermined operating guidelines.

Each major dam owner will be aware of the likely impact these dams would have in the case of a catastrophic failure occurring and have made response plans for such an event.

Table 3.4: Major Water Storages on Waterways in the Corangamite CMA region

Storage	Owner	Capacity (MI)	Waterway	Impact from catastrophic failure
West Barwon Reservoir	BW	20,900	Upper Barwon River	Whole of the Barwon River
Wurdi Boluc Reservoir	BW	38,100	Thompson Creek, Local area around Lake Modewarre.	High local impact around Lake Modewarre
West Gellibrand Reservoir	BW	2,000	Gellibrand River	Impact on upper reaches
Wilson Reservoir	CHW	1,100	Lal Lal Creek	Impact on upper reaches
Lal Lal Reservoir	CHW & BW	59,100	Moorabool River (West Branch)	Large impact on river downstream and the Barwon in Geelong
Bostock Reservoir	BW	7,500	Moorabool Rive (East Branch)	Impact on East Branch and upper reaches of Moorabool River
Korweinguboora Reservoir	BW	2,100	Moorabool River (East Branch) upstream of Bostock Reservoir	Impact on upper reaches and Bostock Reservoir
Moorabool Reservoir	CHW	6,700	Moorabool River (West Branch) upstream of Lal Lal Reservoir	Impact on reaches to and on Lal Lal Reservoir
Stony Creek Reservoir	BW	9,500	Stony Ck and Little River	Large impact on upper reaches
Gong Reservoir	CHW	1,900	Yarrowee River	Impact on urban Ballarat
White Swan Reservoir	CHW	14,100	Yarrowee River	Large impact on urban Ballarat

3.3.4 Impact Of European Settlement

The major impacts of human activities on the floodplains within the CCMA region are detailed below. Information was obtained from available literature, therefore any gaps shown most likely identify a lack of information rather than indicate that a problem does not exist.

Clearing of vegetation

Anecdotal evidence suggests that large scale clearing practices which commenced shortly after European settlement have led to increased peak flood flows after heavy rains. This is attributed to an

increase in the volume of runoff and is more significant for the smaller floods. For large floods, however, vegetative cover is less likely to be significant, either because the ground has been saturated by prior rainfall or because the rainfall intensity greatly exceeds the capacity of the ground and vegetation to absorb moisture.

A large number of farm dams are also present in the catchments and they can to some extent balance the increase in runoff from land clearing. The effect of dams is minor for large flood events. Dams have a significant effect on stream flow in times of drought, usually capturing most of the runoff during rainfall events.

Land clearing can also accelerate erosion processes (bed and bank) as is evident in most parts of the Corangamite catchment region. This can lead to widening of river channels and siltation problems downstream, causing a redistribution of flows between the river channel and its floodplain, and in some cases changes in flood levels.

Where clearing has occurred in the riparian zone, erosion problems can occur, and this can be exacerbated by stock damage. Clearing of natural vegetation has also led to degradation of water quality and environmental habitat, which has in turn had a significant impact on terrestrial and aquatic wildlife. [The consequences of these actions are further elaborated upon in the CCMA's Waterway Health Strategy.](#)

Drainage

Drainage of wetlands for agriculture and an increasing demand to remove excess stormwater from crops efficiently places the rivers and their associated floodplains under further pressure. Impacts from drainage activities in the Corangamite region include:

- Accelerated flows leading to higher peak flow rates and flood levels in minor streams;
- Increased frequency of flooding for the more frequent flood events (ie. < 1 year ARI);
- Loss of wetlands;
- Increased erosion of bed and banks as streams try to adapt to the new flow regime.

The effects of these practices are dealt with in more detail in the CCMA's Waterway Health Strategy.

River Improvement Works

Over the last one hundred and fifty years so called 'river improvement works' have been undertaken within the region. Some of these include de-snagging, river straightening, re-alignment of water courses and artificial levee construction. These works were intended to increase the flow carrying capacity of the water courses they have, however,

- Accelerated flows, leading to erosion, water quality and habitat problems;
- Increased impact of flooding;
- Triggered instabilities in the watercourse, such as bed and bank erosion.

Although this type of work has been undertaken previously, none of the aforementioned activities are considered 'best practice' and they are strongly discouraged by modern waterway and floodplain practitioners.

Levee Construction

Constructed levees reduce the natural flood storage, thereby increasing flood flows and velocities downstream. In some areas within the Corangamite region, levees have been constructed causing isolation of wetlands whilst changing the hydrologic regime dramatically. Levees also alienate the natural floodplain, and as a consequence they do not allow the transportation of indigenous seed or periodic wetting, which is required for biological diversity. They can also create drainage problems on the land side where local runoff cannot naturally drain away. An example of this is at Grove Road, Connawarre where local runoff is confined by the Sparrowvale levees thereby causing a significant area of private land to be inundated for long periods.

4. Floodplain Management Vision and Objectives

The Corangamite Catchment Management Authority's floodplain management vision is to ensure:

Safe and healthy floodplains for the benefit of existing and future generations.

In working towards this vision, the CCMA will strive to ensure that:

- Land use planning measures have full regard for the flood risk and minimise future flood damages;
- Structural flood mitigation measures, both existing and new, are effective in reducing existing flood risk and potential flood damage costs, are cost effective, are environmental friendly and have community acceptance;
- Flood warning and emergency planning measures are in place for minimising the risk to life, health and safety of people and property flood damages;
- Mechanisms are in place for capturing flood data and maintaining a flood database;
- Mechanisms are in place for managing levees and associated assets;
- Local communities are working in partnership with the Authority and other stakeholders in flood risk decisions;
- Floodplain management has regard for preserving and enhancing the environmental values of floodplains; and
- Linkages are in place to coordinate drainage and waterway management practices with floodplain management.

4.1 Objectives

The objectives of this Strategy are to:

Objective	Description
1	Facilitate sustainable management of strategic floodplain assets having regard for level of service, ownership, roles and responsibilities of maintenance and cost sharing arrangements.
2	Develop and implement flood management plans having regard for the full social, environmental, cultural heritage and economic costs and benefits.
3	Provide sound emergency response planning and identify opportunities to minimise the impacts of flood risk and flood damage.
4	Provide decision tools through the Victorian Planning Provisions to allow development and land use practices to be compatible with the flood risk and water quality objectives.
5	Develop and implement an integrated floodplain management information system, that provides high quality data for use in managing floodplains and that floodplain development decisions are consistent and based on best practice.

5. The Strategy Plan

To be able to achieve the proposed strategy, five programs have been developed. Each program has its own goals, action plans and performance targets. They are summarised under Program Management Plans in **Section 7**.

5.1 Asset Management (Program 1)

Asset Management relates to identifying, locating and describing strategic assets, assigning roles and responsibilities for any investigations, upgrades and maintenance required, and cost sharing arrangements.

Strategic assets are generally considered to protect important areas or assets from flooding such as protection of urban areas or large, highly productive farming areas. Assets include structures like levee banks, retarding basins, flood protection walls and flood telemetry stations.

A distinction is made between ‘public’ and ‘private’ assets. Public assets are regarded as those with historic links to agencies or organisations such as water authorities or municipalities. Those without such linkages are regarded as private assets.

Only strategic assets are specifically addressed in this program. Management of non-strategic assets is addressed through statutory planning scheme controls mentioned in **Program 4**. An asset inventory⁶ has been developed as part of this Strategy and the key assets are summarised in **Appendix C**.

The City of Greater Geelong (CoGG) and the City of Ballarat (CoB) have implemented some flood mitigation measures involving the construction of retarding basins, levees and channel improvement works. Audits of these assets, including survey and geotechnical investigations need to be undertaken regularly to ensure that the performance of the structures is in accordance with the design intent. Each council is responsible for implementing and monitoring maintenance programs for these assets.

A number of new flood mitigation assets are proposed in this program. The South Geelong Industrial levee is the last remaining item in a strategy prepared for the CoGG following the November 1995 floods. This wall builds on the existing flood wall built around the Godfrey Hirst Carpet factory, but does have a low cost/benefit ratio. It has been given a low priority rating in this program.



Godfrey Hirst Office – Barwon Terrace South Geelong in November 1995.

⁶ *Asset Management Component of the Waterway and Floodplain Strategies*, Final Report by Sinclair Knight Merz for CCMA (July 2000).

The CCMA has very few rural asset management responsibilities – nearly all of these are owned by other authorities or private landowners. Maintenance costs for these assets are self funded by their respective owners. The exceptions are the two drainage schemes operated and maintained by the Authority, the Lough Calvert Drainage Scheme and the Woody Yaloak Diversion Scheme.

The CCMA performs other management functions pertaining to waterway management, including a licensing role for works constructed on waterways by any other authorities or private individual. Part of this licensing process will ensure any works do not impact adversely on the natural flow and storage capacity of the floodplain, and that the works which do take place minimise potential stream erosion.

Arrangements would be set in place with infrastructure authorities and municipalities regarding the incorporation of floodplain management principles into design of new works or alterations to existing works through guidelines within the planning scheme for floodplain overlays (see **Program 4**).

5.2 Local Flood Studies and Management Plans (Program 2)

Areas requiring further urban and rural flood studies and floodplain management plans have been identified in the Strategy and are summarised in the Program Action Plans attached. Study requirements vary from scoping studies to major investigations. All future flood studies will require flood mapping to be completed for each location.

A number of flood studies and flood mapping projects are recommended for parts of Geelong, Ballarat, Batesford, Lara, Inverleigh, and several coastal towns.

The lead agencies charged with undertaking flood studies and floodplain management plans are the:

- CCMA for regional flood studies, regional flood mapping and major waterways;
- Municipalities for urban flood studies, urban flood mapping and urban floodplain management plans.

The CCMA will review municipal urban flood studies, urban flood mapping and urban floodplain management plans.

All of the projects under this program will be subject to the availability of funding, which is expected to comprise Commonwealth, State and local contributions. Cost sharing arrangements for local contributions will generally be subject to negotiation and agreement between beneficiaries, predominantly the CCMA and municipalities.

5.3 Flood Warning and Flood Preparedness (Program 3)

The purpose of flood warning and flood emergency planning is to minimise the effects of floods that impact upon or overwhelm existing floodplain management measures.

5.3.1 Flood Warning

The role of the CCMA with respect to flood warning is primarily to assist with the regional planning and coordination of new and upgraded flood warning systems in consultation with the Victorian Flood Warning Consultative Committee and councils. In specific cases of regional significance, the CCMA would contribute to the capital and ongoing cost of flood warning systems and to the flood inundation mapping component of the flood warning systems. Other stakeholders will also be encouraged to contribute. Actions proposed for the Flood Warning and Emergency Program (FW&EP) are summarised in the attached Program Action Plan.

Under the Emergency Management Act, 1986 councils are required to manage floods and prepare municipal emergency management plans. These are referred to as 'flood sub-plans' and address specific flood related emergency response strategies.

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

- Reviewing and providing flood advice to assist their development (including assessing the impacts of flooding on communities);
- Ensuring they are consistent with floodplain management plans and/or flood maps developed as part of the regional floodplain management strategy; and by
- Being prepared to provide support services, if required, in the event of a flood.

5.3.2 Flood Monitoring

The collection of real time flood data is essential for informed decision making during flood events and as valuable input into future flood studies and floodplain management plans. Useful data includes flood flows and levels, records of flood extent and duration, information on damages and impacts, rainfall records and details of behaviour of major reservoirs. The CCMA will collect flood data along major waterways. A Flood Response Plan (FRP) has been prepared outlining the its flood response.

Municipalities are responsible for monitoring and collecting flood data for local floods, particularly in urban areas. The Authority has responsibility for coordinating and monitoring floods of regional significance and for collecting flood data for rural areas. It also plays a role in interpreting flood forecasts and improving the effectiveness of flood warning dissemination.

5.3.3 Community Flood Awareness

Generally, most urban and rural residents who do not live or work adjacent to watercourses have little knowledge of flooding, principally because flooding does not impact on them, or it is considered to be of nuisance value only. Those residents who experience relatively frequent flooding may not even be aware of the impact of larger floods.

The CCMA, in partnership with councils, has a role to play in raising community awareness about flood issues. Actions will include contributing to media articles, preparing and/or distributing existing brochures to community groups, promoting activities undertaken as part of the regional Floodplain Management Strategy, and ensuring community access to suitable publications from Victorian State Emergency Service, Bureau of Meteorology and Emergency Management Australia.



Victoria Police, VICSES and Fire Brigade involved in a flood rescue.

5.4 Statutory Land Use Planning (Program 4)

The inclusion of appropriate land use planning controls in municipal planning schemes (in order to ensure that land use activities on floodplains have regard for the flood risk) is one of the most effective ways to minimise potential increases in flood damages.

This program looks at introducing and updating planning controls for the nine municipalities within the Corangamite Catchment Management Authority's region. Arrangements for streamlining planning referrals by using schedules to the flood zone and overlays, and other measures, are also investigated, along with enforcement arrangements (as a last resort) for illegal works. Proposed statutory land use planning activities are summarised in the attached Program Action Plans. Arrangements need to be consistent with adjoining catchment management authority's (CMA's) strategies where council boundaries span multiple CMAs.

Partnership agreements are recommended between each municipality and the CCMA using the procedures and practices in the Victorian Planning Provisions (VPPs). These provisions will clarify referral and consultation arrangements and responsibilities, include reference to relevant decision guidelines and overlays, and provide guidelines to planning officers. Two VPP Practice Notes^{7 8} provide excellent references for this program.

All councils are required to review their planning schemes over the next two years. A goal of this strategy is to incorporate all flooding information into the planning schemes when each scheme is reviewed.

5.5 Development and Research (Program 5)

This program focuses on maintaining, enhancing and reviewing flood information available to the CCMA in order for it to carry out its floodplain management functions effectively. The Authority has identified the key needs for managing and improving flood data, including data storage and sharing the information with stakeholders. Actions proposed are summarised in the attached Program Action Plans.

5.5.1 Declaring Flood Levels

Under the Water Act, 1989⁹, the CCMA is the responsible authority for declaring flood levels, flood areas, and the extent of building envelopes with building lines. When the flood levels are declared on both the CCMA and council waterways and drains following major studies, a number of benefits are provided, including:

- Statutory backup for town planning overlays and zones;
- Provision of a level of protection from liability when quoted correctly by both council and CCMA officers;
- Makes sure provisions of the Building Act relating to flood prone land are followed;
- Councils can quote flood levels without referral to CCMA;
- Creation of a degree of certainty for landholders and future developers.

⁷ *Applying the Flood Provisions in Planning Schemes – A guide for Councils*, VPP Practice Note, DOI (2000).

⁸ *Applying for a Planning Permit Under the Flood Provisions – A guide for Councils, referral authorities and applicants*, VPP Practice Note, DOI (2000).

⁹ Water Act, 1989 – section 203, Victoria State legislation.

5.5.2 Development and Training

The ability of the CCMA (and other stakeholders) to fulfil their role in flood management to a high standard relies on all of the participants supporting the Authority's policy that they all remain 'up to date' on floodplain management issues and practices locally, state wide and nationally. 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 CCMA plays a role in 'best practice' development and training by:

- Facilitating and supporting training programs;
- Promoting use of best practice manuals and guidelines;
- Maintaining a library of appropriate manuals and best practice information;
- Supporting research projects relevant to flood management; and
- Encouraging networking and workshops for those involved in floodplain management.

Actions proposed for this program are listed in the attached Program Management Plans.

6. Priorities and Cost Sharing

A consolidated program of priorities, indicative costs and funding arrangements are shown in the five Management Plans in **Section 7**.

The total cost of fully implementing these programs is \$6.2 million over five years (starting 2002/03) has an annual cost to the CCMA of approximately \$513,000. Nearly 60% of the total funds required are assumed to come through grants or partnerships with stakeholders.

Priority Categories

Relative priorities have also been assigned, based on a weighted consideration of economic, social and environmental factors. Three priority categories (high, medium and low) are shown with their indicative characteristics.

Priority	Indicative characteristics
High	<ul style="list-style-type: none"> Average annual damage > \$300,000 (Flood Damage Cost) Number of urban buildings flooded > 50 and flood velocity times flood depth (VD) >0.8 (relative flood risk to residents) Value for money spent (B/C > 1), some environment improvement .
Medium	<ul style="list-style-type: none"> Average annual damage between \$50,000 and \$300,000 Number of urban buildings flooded between 20 & 50 and/or $0.4 < VD < 0.8$ Value for money spent is marginal ($0.8 < B/C < 1$), no environmental damage.
Low	<ul style="list-style-type: none"> Average annual damage < \$50,000 Number of urban buildings flooded < 20 and/or $VD < 0.4$ Low value for money spent ($B/C < 0.8$), may have some loss of environmental value.

Cost Sharing Arrangements

Cost sharing arrangements for this strategy have been determined by the criteria and principles in Victoria Flood Management Strategy¹⁰ (for more details refer to **Section 4.7**). At the broadest level cost sharing arrangements are based on ‘beneficiary pays’ principles. **Apportioning** of costs will be subject to negotiation between the stakeholders for each project. A summary of the criteria is shown below.

Arrangement	Description
Duty of care	All natural resource users and managers have a duty of care to ensure that they do not damage the natural resource base. The users should be responsible for making good any damage incurred as a result of their actions.
‘Beneficiary Pays’	When it is not possible to identify cause of damage then primary beneficiaries or users (developers) should pay. The context of ‘user pays’ in a floodplain sense can also mean where land use changes increase flood flows to waterways.
Public Benefit	Government contributes primarily for activities that produce public benefits. Existing and future users are both expected to pay for activities that provide private benefit. Governments may agree to contribute to land and water management activities that produce private benefit where the cumulative uptake of these activities provides significant public benefit.
Economic Viability	Before government will contribute to any land or water management activity, the activity must be technically sound and the benefits must justify the costs.
State wide Policy and Monitoring	Government will meet the cost of state wide planning, resources monitoring and assessment, and research and investigation, where they are crucial to sustainable resource management for the State.

¹⁰ Victoria Flood Management Strategy – section 4.7, NRE Victoria (July 1998).

Based on the **mentioned** guidelines, the indicative cost sharing arrangements for each of the Strategy's components are shown in the following table. Local **contributors** include the CCMA and councils.

Program Component	C'wealth	State	Local
Asset management – Strategic – Private, Non strategic	33% 0	33% 0	33% 100%
Flood mapping and floodplain mgmt studies	33%	33%	33%
Flood warning systems – Capital – Operational	33% 0	33% 0	33% 100%
Statutory Planning and Information Management	0	0	100%

Indicative costs for the individual programs are summarised as follows:

Program		Indicative Costs (\$2002's)			
		Funds over 5 years			CCMA Costs p.a.
		Total	External	CCMA	
1	Asset Management	\$4,666,000	\$2,922,000	\$1,744,000	\$349,000
2	Studies and FPM Plans	\$682,000	\$568,000	\$114,000	\$ 28,000
3	Flood Warning and Emergency Response	\$150,000	\$100,000	\$50,000	\$ 13,000
4	Statutory Land Use Planning	\$580,000	\$115,000	\$465,000	\$93,000
5	Development and Research	\$150,000	0	\$150,000	\$ 30,000
	TOTAL	\$6,228,000	\$3,704,000 (59%)	\$2,524,000 (41%)	\$ 513,000

Potential grants schemes that are currently available for floodplain programs are shown below.

Grant Scheme	Sponsor	Application Period
Regional Flood Mitigation Programme ¹¹	Federal govt – Dept of Transport and regional services	Mid-Jan each year
Natural Disaster Risk Management Studies Programme ¹²	Federal govt – Dept Finance & Administration	Mid-Feb each year

¹¹<http://www.dotrs.gov.au/regional/rfmp/eoi.htm>

¹²<http://www.dotrs.gov.au/ndr/risk.htm>

Assuming satisfactory agreement can be reached between stakeholders over cost sharing arrangements, all the actions with a priority of high and medium in each program can be implemented within a five year period. Low priority projects are unlikely to be considered for implementation over this time.

6.1 Performance Monitoring

The development and implementation of this Strategy provides an opportunity to establish performance goals and targets, not just within the Corangamite region, but also across Victoria. Preliminary targets for the ongoing monitoring and performance review of each program are shown in **Section 7**.

This Strategy needs to be a living document which is reviewed annually in order to ensure the priorities it establishes continue to meet the community needs. The CCMA's Waterway Management Implementation Committee could review the Program Management Plans in February each year as part of the Authority's budget preparation for the following year.

7. Program Management Plans

7.1 Program Management Plans – Asset Management (Program 1)

Objective

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

Outcomes

- To reduce flood risk and property flood damage costs to the community;
- To ensure flood protection assets are maintained to design standard;
- To ensure flood protection assets are always in a safe and operating condition (minimise asset owners liability).

Action Plan

Priority	Action	Responsibility	Performance Target	Funding Share	Indicative Cost
H	Kinnersly Ave Retarding Basin- Canadian Creek, Ballarat Stage 1	CoB	Works proposed to start Jan 2002	1/3 Federal, State, Local	\$700K
H	Kinnersly Ave Retarding Basin – Canadian Creek, Ballarat Stage 2 (extension of basin area to the south)	CoB	Works proposed in 2003/04	“	\$350K
H	Coordinate maintenance of Barwon River flood warning system	CCMA	Ongoing \$ 30,000 per year	5 Councils and CCMA	\$150K
H	Operation and Maintenance of the Drainage Schemes (LC & WY)	CCMA	Ongoing \$160,000 per year	CCMA	\$800K
H	Audit reports on significant flood assets every 3 years	Asset owner/ CCMA	All CCMA assets inspected every 3 years	CCMA	\$10K
H	Review operating guidelines for Lough Calvert and Woody Yaloak drainage schemes	CCMA	Complete catchment model by Sept 2002. Completed review by end of June 2003	\$172K NAP Funding, \$34K CCMA	\$206K
M	Gnarr Creek improvements through CBD of Ballarat	CoB/CCMA	Finalise design options by July 2002.	1/3 Federal, State, Local	\$1.2M
M	Replace culvert crossings with bridges, Lough Calvert main channel	CCMA	Replace one crossing a year with a bridge structure.	“	\$500K
M	Implement Lough Calvert and Woody Yaloak Scheme options following operating rules review	CCMA	Begin agreed options by Dec 2003 following NAP Study.	“	\$750K
L	South Geelong Industrial levee Option A	CoGG/CCMA		“	\$3.3M

Note – **The implementation of some projects is subject** to Commonwealth and State funding and commitment of local municipalities over the next five years.

7.2 Program Management Plans – Local Flood Studies and Flood Mapping (Program 2)

Objective

To develop and implement flood management plans having regard for the full social, environmental, cultural and economic costs and benefits.

Outcomes

- Identify all flood prone properties, their relative flood risk and flood characteristics;
- Identify opportunities and make plans to minimise community flood risk and flood damage.

Action Plan

Priority	Action	Responsibility	Performance Target	Funding Share	Indicative Cost
H	Flood Mapping – Canadian Creek, Gnarr Creek and Yarrowee River	CCMA & CoB	Govt funding 2002/03	1/3 GOVT, CCMA & SHIRE	\$105K
M	Flood Mapping – Leigh River at Inverleigh	CCMA & GPS	Govt funding 2002/03	“	\$42K
M	Flood Mapping – Ballarat urban drains (Redan Creek/Winter Creek)	CCMA & CoB	Govt funding 2003/04	“	\$25K
M	Flood Mapping – Geelong urban creeks (Cowies Creek)	CCMA & CoGG	Govt funding 2003/04	“	\$80K
M	Flood Mapping – Geelong urban creeks (Waurm Ponds Creek)	CCMA & CoGG	Govt funding 2004/05	“	\$70K
M	Flood Mapping – Moorabool River at Batesford	CCMA	Govt funding 2003/04	“	\$50K
M	Flood Mapping – Barongarook Creek at Colac	CCMA & COS	Govt funding 2004/05	“	\$50K
M	Flood Mapping – Wye and Kennett Rivers	CCMA & COS	Govt funding 2005/06	“	\$80K
M	Flood Mapping – Hovells Creek at Lara	CCMA & CoGG	CCMA funding 2001/02	CoGG & CCMA	\$80K
M	Flood Mapping – Smythesdale (Woody Yaloak River)	CCMA & MS	Govt funding 2004/05	1/3 GOVT, CCMA & SHIRE	\$40K
M	Flood Mapping – Barwon River at Winchelsea and Birregurra	CCMA & Shires	Govt funding 2005/06	“	\$60K
M	1% Tide level Study from Barwon Heads to Peterborough	CCMA	Govt funding 2005/06	“	\$20K
M	Flood Mapping – Leigh River at Shelford	CCMA & GPS	Govt funding 2006/07	“	\$30K
M	Flood Mapping – Native Hut Creek at Teesdale	CCMA & GPS	Govt funding 2006/07	“	\$30K

7.3 Program Management Plans – Flood Warning and Flood Preparedness (Program 3)

Objective

Provide sound emergency response planning and identify opportunities to minimise the impacts of flooding.

Outcomes

- To ensure the local flood authorities are prepared for flood events;
- Reduce flood risk and damage costs with affected properties being prepared and know what to do in a flood.

Action Plan

Priority	Action	Responsibility	Performance Target	Funding Share	Indicative Cost
H	Flood Preparedness Plan for Barwon River in Geelong	CCMA & CoGG	Govt funding 2002/03	1/3 GOVT, CCMA & SHIRE	\$25K
H	Flood Preparedness Plan for Canadian, Gnarr, Redan Creeks and Yarrowee River, Ballarat	CCMA & CoB	Govt funding 2003/04	“	\$25K
H	Flood Preparedness Plan for Leigh River, Shelford to Inverleigh	CCMA & GPS	Govt funding 2003/04	“	\$20K
H	Flood Preparedness Plan for Moorabool River in Batesford	CCMA & CoGG	Govt funding 2003/04	“	\$20K
M	Flood Preparedness Plan for coastal towns in Colac Otway Shire	CCMA & Shires	Govt funding 2004/05	“	\$30K
M	Study the viability of flood warning for Ballarat floodplains	CCMA & CoB	Govt funding 2004/05	“	\$10K
M	Publish Flood Preparedness brochure for region	CCMA	By June 2002	“	\$10K
H	Flood monitoring and reporting (significant floods only)	CCMA	Report within 4 weeks after flood event.	CCMA	\$10K

7.4 Program Management Plans – Statutory Land Use Planning (Program 4)

Objective

Provide decision tools to allow development and land use practices on floodplains to be compatible with the flood risk and water quality objectives.

Outcomes

- Reduce flood risk and flood damage by ensuring all new development is flood free;
- Informed decisions on planning development can be made in full knowledge of floodplain management constraints;
- Streamline the floodplain referral process between CCMA and council.

Action Plan

Priority	Action	Responsibility	Performance Target	Funding Share	Indicative Cost
H	In principle agreement that all appropriate flooding overlays be placed on municipal planning schemes based on the best available data set	CCMA	Process accepted by municipalities by June 2002;	CCMA	\$45K
H	Prepare local floodplain development plan for CoGG Incorporate flood overlays into scheme	CCMA/CoGG	Both by Jan 2003	½ share each	\$40K
H	Prepare local floodplain development plan for Ballarat Incorporate flood overlays into scheme	CCMA/CoB	Both by Jan 2004	“	\$60K
H	Reply to referrals by prescribed date	CCMA	90% of referrals replied within 14 days of receipt.	CCMA (\$60K yr)	\$300K
M	Provide technical advice on floodplain issues	CCMA	90% within 28 days	CCMA (\$10K yr)	\$50K
M	Prepare local floodplain development plan for Golden Plains Shire Incorporate flood overlays into scheme	CCMA & GPS	Both by July 2003	½ share each	\$20K
M	Prepare local floodplain development plan for Colac Otway Shire Incorporate flood overlays into scheme	CCMA & COS	Both by Jan 2005	“	\$20K
M	Prepare local floodplain development plan for Corangamite Shire Incorporate flood overlays into scheme	CCMA/Corang	Both by Jan 2005	“	\$30K
M	Prepare local floodplain development plan for Moyne Shire Incorporate flood overlays into scheme	CCMA/Moyne	Both by Jan 2006	“	\$20K
M	Prepare local floodplain development plan for Queenscliff Borough Incorporate flood overlays into scheme	CCMA/QCB	Both by Jan 2006	“	\$20K
M	Prepare local floodplain development plan for Moorabool Shire Incorporate flood overlays into scheme	CCMA/MS	Both by Jan 2006	“	\$20K

7.5 Program Management Plans – Development and Research (Program 5)

Objective

Develop and implement an integrated floodplain management information system which provides high quality data for use in managing floodplains, and ensure that floodplain development decisions are consistent and based on best practice.

Outcomes

- Flood data is to be kept up to date and remain consistent between CCMA and councils;
- Property flood information statements can be confidentially made by councils without referral to CCMA;
- Best practice in floodplain management is maintained in the region in order to provide a consistent basis for assessment of development applications;
- Improved community awareness of floodplain issues and flood risk.

Action Plan

Priority	Action	Responsibility	Performance Target	Funding Share	Indicative Cost
H	Declare existing Canadian Creek/Yarrowee River flood levels	CCMA	Declare by June 2003	CCMA	\$30K
M	Declare all flood levels resulting from flood studies by CCMA or council including Lake Victoria and Rippleside Drain	CCMA	Declare by Dec 2002	CCMA	\$20K
H	Develop and maintain a property GIS database of all flood prone properties resulting from flood studies.	CCMA	Complete database by June 2002	CCMA	\$30K
H	Floodplain 'best practice' – training with each municipality	CCMA	Run workshops for all municipalities by Dec 2002	CCMA	\$10K
H	Keep flood plans for the region up to date.	CCMA	Update changes and distribute to stakeholders four times per annum	CCMA	\$50K
H	Develop a referral decision process policy	CCMA	Complete by May 2002	CCMA	\$10K

Glossary

AAV – Aboriginal Affairs Victoria

AEP – Annual Exceedance Probability, a term used in hydrology to denote frequency of event, meaning that an event of a given magnitude or greater can be expected in this percentage of years.

AHD – Australian Height Datum. A universal reference level used in surveying.

ARI – Average Recurrence Interval, a term used in hydrology to describe the **average** interval in years between floods of a given magnitude or greater; and is the inverse of the AEP. Note that the actual intervals between such floods are subject to climatic variability and will not precisely match the average because their occurrence is irregular.

Asset – a structure which needs to be managed by its owner or custodian.

BOM – Commonwealth Bureau of Meteorology

BW – Barwon Regional Water Authority

CALP – Catchment and Land Protection Board

CoB – City of Ballarat

CoGG – City of Greater Geelong

CCMA – Corangamite Catchment Management Authority

CMA'S – Catchment management authorities

CHW – Central Highlands Water

DOI – State Department of Infrastructure

DTRS – Commonwealth Department of Transport and Regional Services

EMA – Emergency Management Australia

EPA – State Environment Protection Authority

Flood Management – in the broad context of emergency management, is the implementation of three clusters of overlapping activities: prevention, response and recovery.

Floodplain Management – the prevention activities of flood management together with related environmental activities.

FO – Floodway Overlay

FPM Plans – Floodplain Management Plans

FPMU – Floodplain Management Unit, Department of Natural Resources and Environment

FRP – Flood Response Plan

FW&EP – Flood Warning & Emergency Plan

GIS – Geographical Information System

Govt – Victorian State Government

GPS – Golden Plains Shire

Lead Agency – An organisation which contributes to a task by coordinating and managing the various inputs and outputs of the task. This agency is usually the main beneficiary of the outputs of the task.

Levee – a raised embankment, usually constructed of earth, which confines or alters the direction of natural surface water.

LSIO – Land Subject to an Inundation Overlay.

MEMP – Municipal Emergency Management Plan

MSS – Municipal Strategic Statement

MW – Melbourne Water Corporation

MS – Moorabool Shire

NDRA – Natural Disaster Relief Assistance

NHT – Natural Heritage Trust

NLP – National Landcare Program

NRE – Department of Natural Resources and Environment

PUZ – Public Use Zone

RAM – Rapid Assessment Method for evaluating flood damage costs. Procedure developed by Read Sturgess & Associates (2000).

RF – Rural Floodway

RFMS – Corangamite Region Floodplain Management Strategy

RUZ – Rural Urban Zone

RWC – Rural Water Corporation

SBO – Special Building Overlay

SCARM – Standing Committee for Agriculture and Resource Management

SR&WSC – State Rivers and Water Supply Commission

Support Agency – An organisation which contributes to a task by having input to the task, usually as a result of technical expertise or pecuniary interest in the outcomes of the task. This agency is usually one of the beneficiaries of the outputs of the task.

VCAT – Victorian Civil Administrative Tribunal

VFF – Victorian Farmers Federation

VFMS – Victoria Flood Management Strategy

VFWCC – Victorian Flood Warning Consultative Committee

VICPOL – Victoria Police

VICSES – Victoria State Emergency Service

VPMS – Victoria Floodplain Management Strategy

VPPs – Victorian Planning Provisions

References

1. *Corangamite Region Salinity Management Plan*, NRE and CCMA (1999).
2. *Rapid Appraisal Method (RAM) for Floodplain Management*, NRE (May 2000).
3. *Economic Evaluation of Flood Damages for the CCMA*, Read Sturgess & Associates (July 2001).
4. 'South West Victoria Water Management Strategy', Panel Hearing into Water Resources Management in Victoria, Parliament of Victoria – NRE Committee (November 1989).
5. *Operation of the Lough Calvert Drainage Scheme*, Johnson (1991).
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7. *Applying the Flood Provisions in Planning Schemes – A guide for Councils*, VPP Practice Note, DOI (2000).
8. *Applying for a Planning Permit Under the Flood Provisions – A guide for Councils, referral authorities and applicants*, VPP Practice Note, DOI (2000).
9. Water Act, 1989 – Section 203, Victoria State legislation.
10. *Victoria Flood Management Strategy*, NRE Victoria (July 1998).
11. Catchment and Land Protection Act, 1994, Victoria State legislation.

Appendices

Appendix	Title	Pages
A	Roles & Responsibilities	A1 to A7
B	Floodplain Maps	B1 to B6
C	CCMA Key Floodplain Assets	C1 to C2
D	RAM Study Area Flood Damage Costs	D1 to D3
E	Flood Warning Systems	E1

APPENDIX A – Roles & Responsibilities

A variety of flood and floodplain management activities are undertaken within the CCMA region by a number of stakeholders, including:

- Commonwealth government agencies;
- Victorian State government agencies;
- Regional authorities;
- Local authorities and community groups; and
- Steering Committees, professional bodies and other special groups.

It is considered that the management of flooding involves three main groups of activities – **Prevention**, **Response** and **Recovery**.

Prevention, relates to the elimination or reduction in the impact of flooding using both structural and non-structural measures. These include use of planning controls to minimise future flood damages and the development of flood warning systems. Prevention is undertaken in non-flood periods.

Response involves combating of emergencies and the provision of flood relief and rescue services during a flood. Examples include flood alerting, emergency evacuation and sandbagging.

Recovery relates to assisting communities affected by flooding and restoring services after a flood. It includes disaster assistance funding and counselling.

Successful implementation of the regional floodplain management strategy requires clarification and agreement on roles and responsibilities of all stakeholders. These have been broadly identified below, based on:

- The Commonwealth government being responsible for national flood management issues;
- The State government being responsible for statewide issues;
- CMAs being responsible for regional issues within their region;
- Local government being responsible for local issues; and
- Landholders being responsible for floodplain management on their own properties.

An overview of the roles applicable to flood management is given in **Table A.1**.

Some of the more significant roles of government agencies are summarised in **Table A.2**. Other government agencies are involved in a lesser capacity, particularly with regard to safeguarding or repairing infrastructure or providing back up services to other agencies. Further detail is given in **Appendix C** of the Victoria Flood Management Strategy (VPMS) – see **Reference 10**. Flood management activities undertaken by these agencies are directly funded from budget allocations.

Roles and responsibilities for the wide variety of activities undertaken in the Corangamite region largely follow those identified in the VPMS. They have been further developed during the consultation phase of the project. The roles and responsibilities applicable to Government agencies are summarised in **Table A.2**. Those applicable to the CCMA and to the municipalities, who are the ‘key players’ in the implementation of this strategy, are detailed further in the following sub-sections.

Table A.1: Stakeholder Roles in Flood Management

Stakeholder	Flood Management Role		
	Prevention	Response	Recovery
Commonwealth Government Agencies			
Bureau of Meteorology	✓	✓	
Department of Primary Industries and Energy	✓	✓	
Emergency Management Australia	✓	✓	
Department of Social Security			✓
State Government Agencies			
Victoria State Emergency Service	✓	✓ (1)	✓
Department of Human Services	✓	✓	✓ (3)
Victoria Police	✓	✓ (2)	✓
Environment Protection Authority	✓	✓	✓
Department of Natural Resources and Environment	✓	✓	✓
Department of Infrastructure	✓		
Department of Treasury and Finance			✓
Department of Premier and Cabinet		✓	✓
Department of Justice (Fire & Emergency Services Division)	✓	✓	✓
VicRoads, Public Transport Corporation	✓	✓	✓
Country Fire Authority		✓	✓
Regional Authorities			
Catchment management authorities	✓	✓	✓ (4)
Water authorities	✓ (5)	✓	
Local Government, Local Community, Local Authorities			
Municipal Councils	✓	✓	✓
Landholders, community groups	✓	✓	✓
Other Bodies			
Steering Committees	✓	✓	✓
Professional bodies	✓	✓	✓
Educational and research institutions	✓	✓	✓
Insurance companies			✓

Source: Victoria Flood Management Strategy (1998).

Notes:

- (1) Nominated Control Agency for response activities to a specified type of emergency
- (2) Principal Coordination Agency nominated to coordinate response activities of all agencies
- (3) Principal Coordination Agency nominated to coordinate recovery activities of all agencies
- (4) eg. Rehabilitation of rivers
- (5) eg. Operation of major storages

Table A.2: Roles and Responsibilities of Government Agencies

Agency	Role in Flood Management
Federal	
Bureau of Meteorology	<input type="checkbox"/> Weather forecasts and predict likelihood of flooding where warranted <input type="checkbox"/> Issue flood warnings <input type="checkbox"/> Establish new and improved flood warning systems
Department of Primary Industries and Energy	<input type="checkbox"/> Encourage strategies for sustainable development of floodplains <input type="checkbox"/> Provide financial assistance through the Natural Heritage Trust
Emergency Management Australia	<input type="checkbox"/> Provide printed material on flood awareness and emergency management arrangements <input type="checkbox"/> Coordinate Commonwealth physical assistance in a major emergency
Department of Social Security	<input type="checkbox"/> Counselling services for flood victims <input type="checkbox"/> Financial relief payments
State	
Victoria State Emergency Service	<input type="checkbox"/> Actively promotes awareness of emergency management principles to municipal councils, other agencies and the community <input type="checkbox"/> Assists municipal councils to develop emergency management plans <input type="checkbox"/> Lead combat authority for floods <input type="checkbox"/> Assists evacuation <input type="checkbox"/> Coordinates emergency relief services <input type="checkbox"/> Alerts municipal councils and others on flood warnings as per flood response plan
Victoria Police	<input type="checkbox"/> Responsible for preparation of regional emergency response plans <input type="checkbox"/> Coordinates resources for emergencies <input type="checkbox"/> Lead agency for arranging evacuations
Department of Human Services	<input type="checkbox"/> Conducts community training and awareness activities <input type="checkbox"/> Back up support to other flood response agencies <input type="checkbox"/> Lead agency in flood recovery phase (coordination, resources, administration of hardship grants, etc.)
Natural Resources and Environment	<input type="checkbox"/> State Flood Strategy <input type="checkbox"/> Approves regional floodplain management strategies and floodplain management plans <input type="checkbox"/> Provides real time stream flow information (input for flood warning) <input type="checkbox"/> Flood monitoring guidelines <input type="checkbox"/> Flood mapping <input type="checkbox"/> Assists in natural disaster relief claims <input type="checkbox"/> Agricultural advice to farmers in flood recovery phase <input type="checkbox"/> Monitors the way government money is spent (projects funded by government have to satisfy investment arrangements) <input type="checkbox"/> Supports CMAs in their floodplain management role <input type="checkbox"/> Develops State legislation on flooding issues <input type="checkbox"/> Provides advice through committees and working groups on emergency management and flood warning
Department of Infrastructure	<input type="checkbox"/> Planning scheme reforms (including flood overlays) <input type="checkbox"/> Uniform building standards and codes <input type="checkbox"/> Architectural and engineering advice and support post flood
Department of Treasury and Finance	<input type="checkbox"/> Post flood financial assistance
Department of Premier and Cabinet	<input type="checkbox"/> Advice to Premier on power to declare a state of disaster

Source: Victoria Flood Management Strategy (1998).

Corangamite Catchment Management Authority

The primary role of the CCMA is to manage regional flooding issues in an integrated and coordinated manner, having regard for the overall impacts of works and activities within its catchment management area with waterway health and environmental values.

More specific roles are as follows:

Prevention

- Develop, oversee and implement regional floodplain management strategies, which integrate local flood management issues and prioritise the development of urban and rural floodplain management plans within the region;
- Support and facilitate the implementation of regional land use planning measures (including input to planning schemes, responding to statutory planning referrals, providing flood advice and helping resolve planning issues);
- Prepare and implement floodplain management plans as required;
- Ensure effective management of specific strategic assets (including levees);
- Support and facilitate the conservation of natural resources, Aboriginal and European cultural heritage and environmental values of regional significance;
- Maintain and enhance flood information;
- Facilitate conflict resolution on flooding issues;
- Monitor and report on regional flood management performance; and
- Advise Government on regional flood management priorities.

Response

- Support and facilitate the implementation of regional flood warning systems (which also incorporate flood prevention measures);
- Coordinate monitoring of significant floods; and
- Collect flood data for significant floods.

Recovery

- Restoration and rehabilitation of waterways after flooding.

The CCMA has functions and powers under the Water Act, 1989 and the Catchment and Land Protection Act (1994) including to:

- Prepare and review its regional catchment strategy;
- Manage and control waterways, drainage and floodplains;
- Advise the Minister on requirements to implement the regional catchment strategy and on funding requirements;
- Provide community awareness of management of land and water resources;
- Collect fees for catchment works;
- Determine the extent and height of floodwaters;
- Declare flood levels, land liable to flooding, floodway areas, flood fringe areas and building lines;
- Control developments that have occurred or that may be proposed;
- Develop and implement plans and to take any action necessary to minimise flooding and flood damage;
- Provide advice on flooding; and
- Investigate and prepare flood management schemes.

Municipal Councils

There are nine municipalities either partially or wholly within the CCMA's area of responsibility. They are listed in **Table A.3**.

Table A.3: Municipal Councils within the CCMA Region

Municipality	Major towns with flooding issues
City of Ballarat	Ballarat CBD, Canadian
Shire of Colac Otway	Wye River, Kennett River, Apollo Bay, Colac
Shire of Corangamite	Princetown
City of Greater Geelong	South Geelong, Barwon Heads, Ocean Grove, Point Lonsdale, Batesford, Lara
Shire of Golden Plains	Inverleigh, Teesdale, Shelford
Shire of Moorabool	Smythesdale
Shire of Moyne	Peterborough
Borough of Queenscliffe	Parts of Point Lonsdale
Shire of Surfcoast	Anglesea, Lorne, Winchelsea

Municipal councils play a major role in many of the operational aspects of flood management. The main roles are to:

Prevention

- Develop and implement local floodplain management plans;
- Incorporate flood provisions into their planning schemes;
- Manage statutory planning schemes;
- Issue planning and building permits;
- Provide, own and manage local community infrastructure in accordance with agreed levels of service;
- Implement and maintain local flood warning systems;
- Maintain and enhance local flood information;
- Support, develop and resource the implementation of flood sub-plans (part of municipal emergency management plans); and
- Provide for the conservation of natural resources and environmental values of local significance.

Response

- Implement emergency management plans for flooding;
- Monitor significant local flood events;
- Implement road closures;
- Clearing of road debris;
- Provide and operate emergency relief centres and emergency shelter;
- Deliver flood warnings to the community in participation with other agencies;
- Provide information to the public and media in consultation with the control agency;
- Provide facilities for emergency services staging areas; and
- Provide resources, as needed by the community and response agencies.

Recovery

- Provide recovery/information centres and staffing;
- Carry out post flood impact assessment;
- Survey damaged buildings;
- Sponsor community recovery committees;
- Oversee and inspect rebuilding and redevelopment;
- Provide and manage community development services;
- Provide and/or coordinate volunteer helpers;
- Disseminate information to the affected community;
- Provide personal support services; and
- Carry out clean up activities.

Other Key Stakeholders

Other key stakeholders and their broad management functions are listed in **Table A.4**.

Table A.4: Key Stakeholders with Floodplain Management Roles

Stakeholder	Floodplain Role/Interest
Barwon Water, Central Highlands Water	Major service provider with assets, dam safety, operation of distribution system, assistance with flood response
Southern Rural Water	River Diversion Authority – diverters assets and farm dams
Department of Natural Resources & Environment (Regional offices at Ballarat, Colac & Geelong)	Land and water manager
Environment Protection Authority	Water quality (point sources)
VICROADS	Major service provider with assets
V-LINE	Major service provider with assets
Parks Victoria	Land and water body manager
Special interest groups eg Landcare, VFF.	Land manager
Floodplain land owners	Minimise flood damage to land and assets, especially private levees
Catchment authority implementation committees	Development of action plans and implementation of on ground works
Cultural heritage groups e.g. AAV, local Aboriginal communities and historical societies.	Land managers and protection of cultural and heritage values

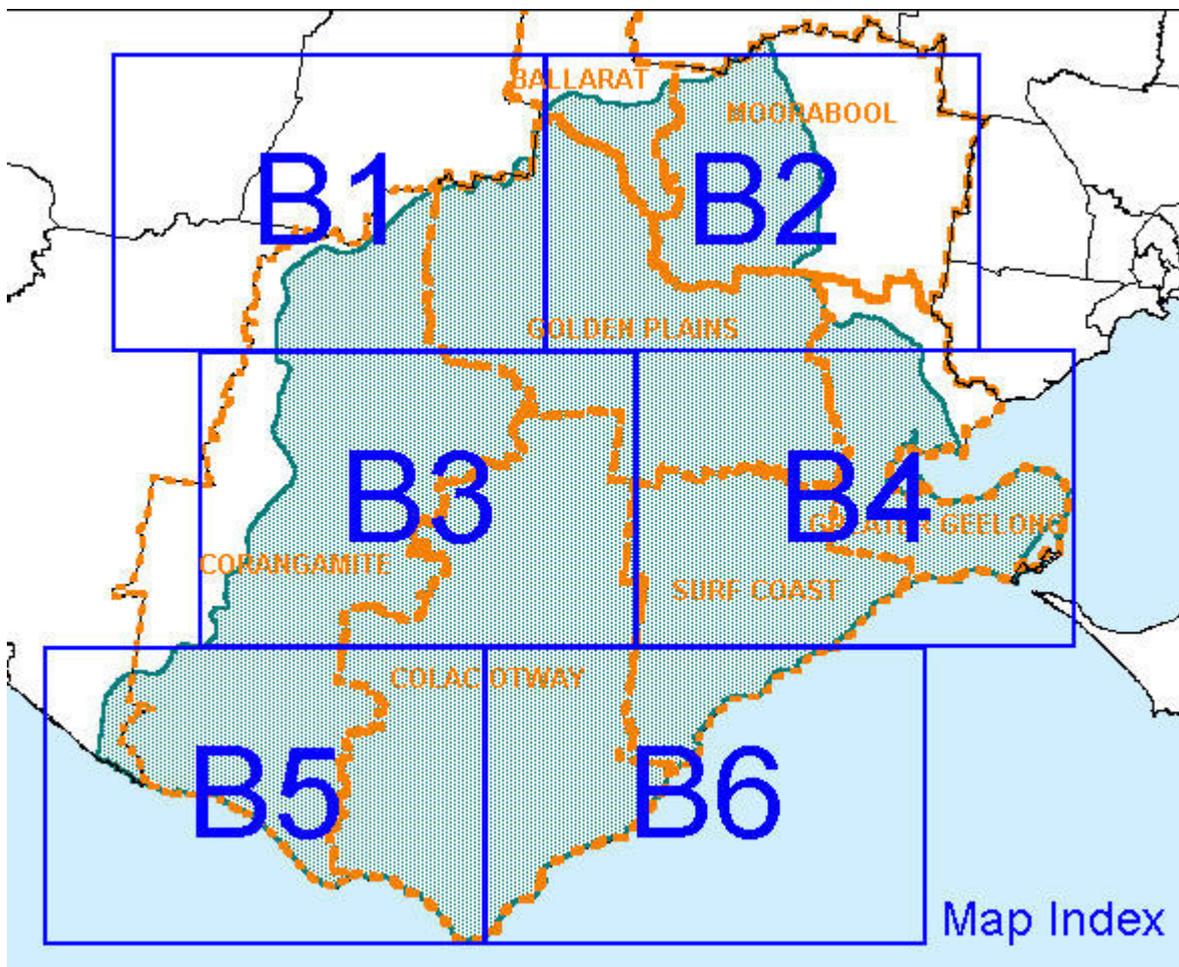
Links to Other Strategies

Strong links and synergies exist between this strategy and both the waterway health and rural drainage management strategies. These are shown in table below.

	Floodplain Management	Waterway Management	Rural Drainage
<u>Floodplains</u> <ul style="list-style-type: none"> • Essential for river health • Wetlands allow regeneration and preservation of flora and fauna • Filters nutrients and sediments (reduces sediment load in river channels and improves water quality) 	✓	✓	✓
<u>Land Clearing</u> <ul style="list-style-type: none"> • Can accelerate bed and bank erosion, leading to channel widening and silt deposition • Increased run off for minor to moderate storms increases impacts of minor floods 	✓	✓	✓
<u>Excessive Instream Waterway Vegetation</u> <ul style="list-style-type: none"> • Reduces waterway capacity, increasing frequency of flooding on adjacent floodplain • Forces water against banks which can trigger bed and bank erosion • Displaces vegetation which is more suitable for fauna habitat 	✓	✓	
<u>Large Woody Debris Management</u> <ul style="list-style-type: none"> • Affects fauna habitat • Improves capacity of waterway • Can trigger instabilities in waterway 	✓	✓	
<u>Waterway Widening and Straightening</u> Can accelerate flows, leading to increased erosion, silt deposition, ongoing maintenance problems	✓	✓	
<u>Levees</u> <ul style="list-style-type: none"> • Protects land from flooding up to the design standard of the levee • Can be overtopped or breached by larger floods • Can stabilise breakaway flowpaths (avulsions) but may translate the problem elsewhere • Can accelerate flows, leading to increased flood levels, bed and bank erosion, increased sediment loads and nutrient loads • Reduces frequency of flooding in adjacent floodplain • Reduces natural flood storage 	✓	✓	✓
<u>Drains</u> <ul style="list-style-type: none"> • Collect and dispose of flood water • If they connect lagoons and natural drainage paths can trigger avulsions • Accelerate flows and reduce flood storage • Drain swamps (and reduce wetlands) • Reduce capacity to filter sediments and nutrients 	✓	✓	✓

APPENDIX B – Floodplain Maps

Map No.	Map Description
B1	Upper Woody Yaloak and Leigh River Floodplains
B2	Upper Leigh and Moorabool River Floodplains
B3	Lower Woody Yaloak River and Lake Corangamite Tributary Floodplains
B4	Lower Leigh and Moorabool River, Barwon River and Thompson Creek Floodplains
B5	South Western Coastal streams Floodplains
B6	South Eastern Coastal streams Floodplains



APPENDIX C – Key Corangamite CMA Waterway Assets

Page	Waterway Asset description
C1	Key assets in the Moorabool, Otway Coast and Corangamite Basins
C2	Key assets in the Barwon Basin

Note – These assets are listed for information only.

APPENDIX D – RAM Study Area Flood damage costs

RAM ID	Study Area	Basin	Type	Municipality	Area Flood (ha's)	No. large non-residential Building	Number urban buildings flooded	Number of urban properties flooded	Number of rural buildings flooded	No. of rural properties flooded	AAPA	Average Annual Damages (\$)
1	Curdies River & tributaries	Otway Coast	Rural	Corangamite	4,767	0	0	0	26	383	4	112,845
2	Port Campbell Creek	Otway Coast	Rural	Corangamite	50	0	0	0	0	12	0	1,182
3	Peterborough (Curdies River)	Otway Coast	Urban	Corangamite	53	0	10	33	0	0	1	13,614
4	Port Campbell	Otway Coast	Urban	Corangamite	31	0	4	7	0	0	1	10,531
5	Gellibrand River & tributaries	Otway Coast	Rural	Colac	4,070	0	0	0	12	367	4	97,374
6	Princetown (Gellibrand River)	Otway Coast	Urban	Colac	63	0	6	28	0	0	2	22,182
7	Tirrengower Drain	Corangamite	Rural	Colac	5,100	0	0	0	16	247	4	115,857
8	Stafford Creek	Otway Coast	Rural	Colac	113	0	0	0	5	12	2	18,078
9	Aire River	Otway Coast	Rural	Colac	1,087	0	0	0	2	42	1	28,365
10	Barham River	Otway Coast	Rural	Colac	60	0	0	0	0	18	0	7,026
11	Apollo Bay (Barham River)	Otway Coast	Urban	Colac	190	0	0	88	0	0	0	12,029
12	Coast	Otway Coast	Rural	Mixed	38	0	0	0	1	37	0	5,817
13	Distillery Creek	Otway Coast	Rural	Surf Coast	125	0	0	0	3	17	0	6,566
14	Airies Inlet (Distillery Creek)	Otway Coast	Urban	Surf Coast	72	0	1	40	0	0	0	3,627
15	Anglesea River	Otway Coast	Rural	Surf Coast	869	0	0	0	4	18	1	11,732
16	Anglesea (Anglesea River)	Otway Coast	Urban	Surf Coast	42	0	4	12	0	0	1	7,789
17	Spring Creek	Otway Coast	Rural	Surf Coast	207	0	0	0	15	84	3	31,153
18	Thompson Creek	Otway Coast	Rural	Surf Coast	2,597	0	0	0	25	297	6	143,711
19	Modewarre	Otway Coast	Rural	Surf Coast	2,255	0	0	0	7	141	0	11,688
21	Point Lonsdale	Otway Coast	Urban	CoGG	56	0	36	241	0	0	6	55,547
21	Yarram Creek	Otway Coast	Rural	CoGG	405	0	0	0	4	77	1	13,257
22	Lake Victoria	Otway Coast	Rural	CoGG	610	0	0	0	21	56	3	41,353
23	Coast 2	Otway Coast	Rural	CoGG	570	0	0	0	28	139	4	45,564
24	St Leonards	Otway Coast	Urban	CoGG	168	0	3	159	0	0	0	7,268
25	Bruce Creek	Barwon River	Rural	Golden Plains	270	0	0	0	3	91	0	8,120
26	Native Hut Creek	Barwon River	Rural	Golden Plains	756	0	0	0	2	56	1	23,187
27	Teesdale (Native Hut Creek)	Barwon River	Urban	Golden Plains	156	0	6	130	0	0	1	15,239
28	Inverleigh	Leigh River	Urban	Golden Plains	110	0	81	141	0	0	12	107,030

RAM ID	Study Area	Basin	Type	Municipality	Area Flood (ha's)	No. large non-residential Building	Number urban buildings flooded	Number of urban properties flooded	Number of rural buildings flooded	No. of rural properties flooded	AAPA	Average Annual Damages (\$)
29	Shelford	Leigh River	Urban	Golden Plains	53	0	9	36	0	0	2	21,001
30	Williamsons Creek	Leigh River	Rural	Golden Plains	600	0	0	0	1	118	0	8,305
31	Leigh River	Leigh River	Rural	Golden Plains	3,566	0	0	0	33	436	7	153,065
32	Yarrowee River	Leigh River	Rural	Golden Plains	0	0	0	0	0	0	0	0
33	Warrambine Creek	Barwon River	Rural	Golden Plains	1,281	0	0	0	8	62	1	26,654
35	Mia Mia Creek	Barwon River	Rural	Golden Plains	2,996	0	0	0	3	56	0	28,714
35	Woody Yaloak	Corangamite	Rural	Golden Plains	11,653	0	0	0	38	504	7	220,320
36	Upstream Lake Corangamite	Corangamite	Rural	Corangamite	7,953	0	0	0	9	183	1	68,191
37	Colongulac Drains	Corangamite	Rural	Corangamite	14,867	0	0	0	13	201	2	82,892
38	Lake Logan	Corangamite	Rural	Corangamite	633	0	0	0	0	12	0	3,568
39	Deans Creek	Corangamite	Rural	Colac Otway	524	0	0	0	16	156	3	40,344
40	Colac (Barongarook Creek)	Corangamite	Urban	Colac Otway	267	0	114	242	0	0	31	262,187
41	Barongarook Creek	Corangamite	Rural	Colac Otway	51	0	0	0	1	30	0	5,147
42	Birregurra Creek	Barwon River	Rural	Colac Otway	1,693	0	0	0	9	105	3	90,479
43	Winchelsea (Barwon River)	Barwon River	Urban	Surf Coast	22	0	21	51	0	0	3	25,754
44	Cressy (Woody Yaloak)	Corangamite	Urban	Golden Plains	18	0	5	17	0	0	2	19,770
45	Moorabool River East Branch	Moorabool R	Rural	Moorabool	1,699	0	0	0	12	230	2	56,473
46	Moorabool River West Branch	Moorabool R	Rural	Moorabool	3,806	0	0	0	12	515	2	179,913
47	Canadian Rural	Leigh River	Rural	Ballarat	26	0	0	0	57	95	9	81,024
48	Hovells Creek	Hovells Ck	Rural	CoGG	1,296	0	0	0	0	252	0	25,788
49	Lara	Hovells Ck	Urban	CoGG	171	0	233	535	0	0	35	298,670
50	East of Hovells Creek	Hovells Ck	Rural	CoGG	807	0	0	0	14	52	3	41,090
51	Cowie Creek	Hovells Ck	Urban	CoGG	54	0	25	61	0	0	9	71,330
52	Waurm Ponds Creek	Barwon River	Urban	CoGG	230	0	22	159	0	0	7	70,093
53	Batesford (Moorabool River)	Moorabool	Urban	Moorabool	108	0	14	76	0	0	2	19,733
54	Moorabool River	Moorabool	Rural	Golden Plains	4,491	0	0	0	28	541	6	127,173
55	Sutherland Creek	Moorabool	Rural	Golden Plains	905	0	0	0	14	205	2	34,407
56	Barwon River	Barwon River	Rural	Mixed	15,819	0	0	0	78	1,165	17	514,206
57	Geelong (Barwon River)	Barwon River	Rural	CoGG	724	25	194	571	0	0	40	469,426
58	Modewarre (Thompson Creek)	Otway Coast	Urban	Surf Coast	37	0	0	13	0	0	0	856
59	Wye River (Wye River)	Otway Coast	Urban	Surf Coast	16	0	11	17	0	0	4	39,575

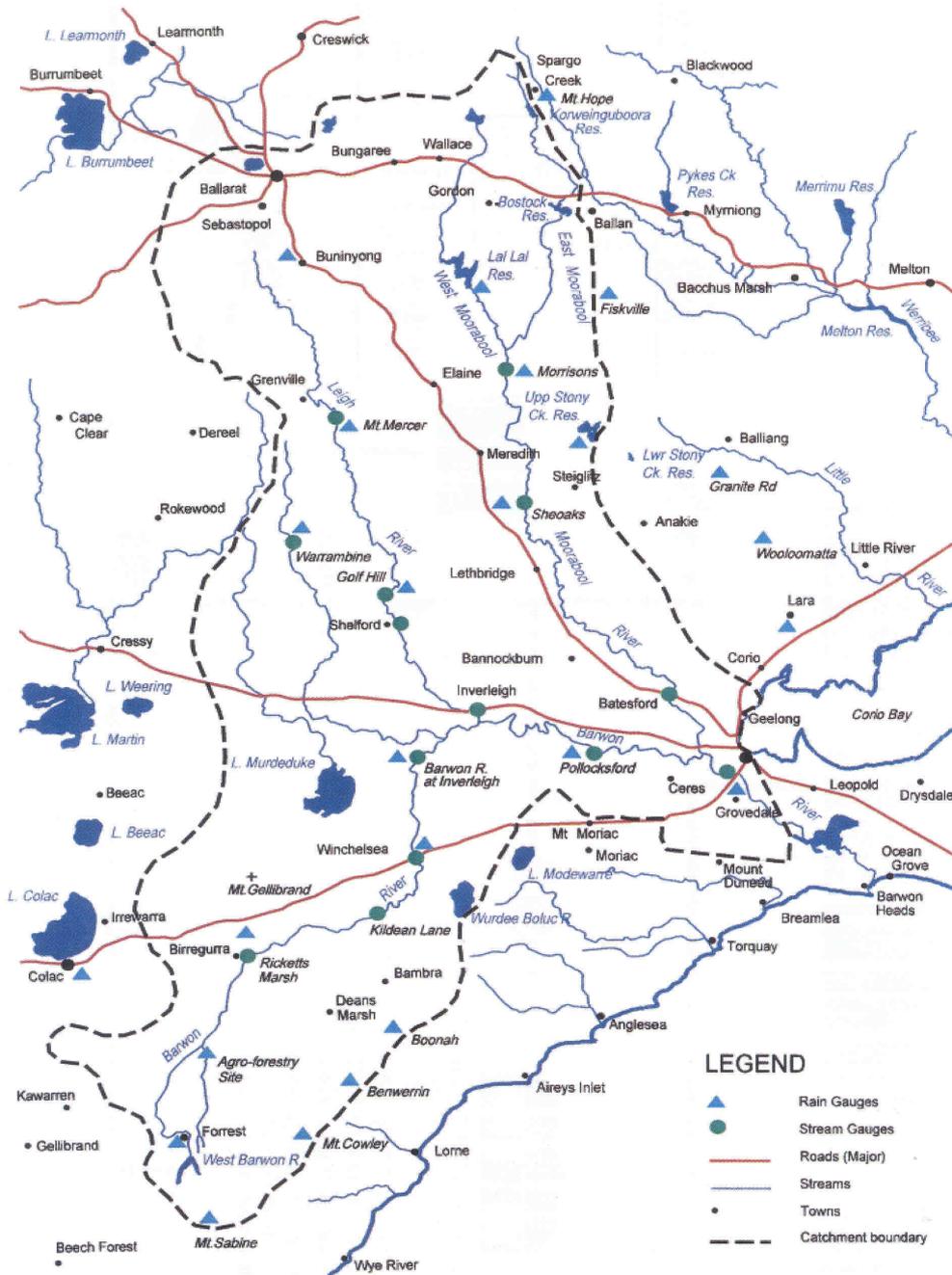
RAM ID	Study Area	Basin	Type	Municipality	Area Flood (ha's)	No. large non-residential Building	Number urban buildings flooded	Number of urban properties flooded	Number of rural buildings flooded	No. of rural properties flooded	AAPA	Average Annual Damages (\$)
60	Lismore (Browns Waterholes)	Corangamite	Urban	Corangamite	11	0	0	8	0	0	0	359
61	Linton (Springdallah Creek)	Corangamite	Urban	Golden Plains	34	0	7	63	0	0	1	9,920
62	Smythesdale (Woody Yaloak)	Corangamite	Urban	Golden Plains	68	0	24	66	0	0	3	29,587
63	Meredith (Coolebarghurk Ck)	Moorabool	Urban	Golden Plains	7	0	1	9	0	0	0	3,771
64	Gordon (Moorabool East)	Moorabool	Urban	Moorabool	15	0	3	30	0	0	0	4,799
65	Barwon Heads (Barwon River)	Barwon River	Urban	CoGG	326	0	146	444	0	0	21	156,818
66	Central Lakes	Corangamite	Rural	Mixed	31,185	0	0	0	29	636	5	224,507
67	Ballarat (Yarrowee River)	Leigh River	Urban	Ballarat	365	17	758	907	0	0	140	1,513,074
	Total				133,267	42	1,738	4,184	549	7,648	433	6,006,713

APPENDIX E – Flood Warning Systems

Plan	Flood Warning Network
E1	Barwon River and Howells Creek Flood Warning Network

Catchment Map

Barwon, Leigh and Moorabool Rivers



FM88 for continuous Flood advice
& Weather by Fax 1800 630 100

Source: *Flood Response Guidelines for the Flood Affected Community*, Barwon River FWCG (Nov 2000).