KEMPSEY SHIRE COUNCIL

LOWER MACLEAY
FLOODPLAIN MANAGEMENT PLAN

AUGUST, 1999

WEBB, McKEOWN & ASSOCIATES PTY. LTD.
CONSULTING ENGINEERS
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FOREWORD

The State Government's Flood Policy is directed at providing solutions to existing flooding problems in developed areas and to ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas.

Under the Policy, the management of flood liable land remains the responsibility of local government. The State Government subsidises flood mitigation works to alleviate existing problems and provides specialist technical advice to assist councils in the discharge of their floodplain management responsibilities.

The Policy provides for technical and financial support by the government through the following four sequential stages:

1. Flood Study
   • determine the nature and extent of the flood problem.

2. Floodplain Management Study
   • evaluates management options for the floodplain in respect of both existing and proposed development.

3. Floodplain Management Plan
   • involves formal adoption by Council of a plan of management for the floodplain.

4. Implementation of the Plan
   • construction of flood mitigation works to protect existing development,
   • use of Local Environmental Plans to ensure new development is compatible with the flood hazard.

The Lower Macleay Floodplain Management Plan constitutes the third stage of the management process for the Lower Macleay River. The study has been prepared for Kempsey Shire Council by Webb, McKeown & Associates, Consulting Engineers. It provides the basis for the future management of flood liable lands along the lower Macleay River.
1. INTRODUCTION

The Macleay River catchment covers some 11 500 square kilometres. The main tributaries including the Aspley, Muddy and Chandler Rivers rise in the Great Dividing Range and flow across the New England Tableland before falling into rugged gorge country. The Macleay itself emerges from the gorges some 35km upstream of Kempsey. Below Kempsey the river meanders through a wide expanse of low lying floodplain (Figure 1), which is subject to frequent and persistent flooding.

While the Macleay River is the dominant watercourse on the floodplain, significant tributaries are Christmas and Clybucca Creeks to the north and the Belmore River and Kinchela Creek to the south. The Macleay enters the ocean through a trained entrance at South West Rocks which was first breached during the flood of 1893. Previously the river entrance was at Grassy Head. The old channel between Grassy Head and South West Rocks has now become a complex backwater.

There are no dominant topographical features on the floodplain. The highest points east of Kempsey are the rocky headlands at Grassy Head, Smoky Cape, Hat Head and Crescent Head. These are linked by relatively high sand dunes which more or less confine the floodplain but are subject to breakouts during large floods.

The highest points in the floodplain itself are the levees adjoining the major watercourses. These levees were produced naturally but have been selectively raised as part of flood mitigation works over the past forty years.

Settlement on the floodplain consists of numerous farms and several small villages. The farms were originally principally used for dairying, but most have now moved to beef production. The major floodplain village, Smithtown, still supports an operating dairy factory while the village of Jerseyville is a centre of the local fishing industry. Other villages are Gladstone and Kinchela while parts of Frederickton are also flood liable.

During major events, floodwaters drain to the ocean via a number of routes in addition to the river entrance itself. Significant outflows occur at Korogoro Creek, Ryans Cut, Killlick Creek and South West Rocks Creek. Water can also flow either into or from the Hastings River catchment to the south via Connection Creek. In the major flood of 1949, other breakouts were reported at various points between Crescent Head and Grassy Head.

Significant flood mitigation works, including levees, drains and control structures, have been constructed over the last 30 years in an attempt to reduce the flooding problem. Although most of these works have fulfilled their design intentions some have not met with universal approval due to unforeseen adverse effects.

In February 1997, Council published the Lower Macleay Floodplain Management Study (The Study), which examined the floodplain in its present state and presented options to improve the future performance of the area during and after flooding and in non flood periods. The Study
included a review of the present mitigation scheme and an assessment of modifications or additions which might make it more effective or reduce adverse impacts. Many of the options presented were put forward at a series of public meetings, which produced a wide range of suggestions to reduce flood impacts in the valley or remedy perceived shortcomings of present works or practices.

The final outcome of The Study was a list of 30 recommendations covering works, practices and changes to planning instruments which would provide the framework for more effective management of the floodplain.

In accordance with the State Government’s Flood Policy, this Plan now draws the Study recommendations together into a formal plan of management for the floodplain. In adopting this Plan, Council has established the overall philosophy for management of the lower Macleay floodplain within which specific works and measures can be implemented.

The Plan was prepared by Webb, McKeown & Associates under the auspices of the Kempsey Shire Floodplain Management Committee which was responsible for identifying potential mitigation measures.
2. GLOSSARY OF TERMS

benefit cost ratio
for floodplain management studies the benefit cost ratio is normally expressed as the ratio of savings from proposed works or measures (present day sum of future annual damages prevented) to costs in carrying out the works or measures.

development
the erection of a building or the carrying out of work; or the use of land or of a building or work; or the subdivision of land.

flood
relatively high streamflow which overtops the natural or artificial banks in any part of a stream or river.

flood awareness
an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning and evacuation procedures. In communities with a high degree of flood awareness, the response to flood warnings is prompt and efficient. In communities with a low degree of flood awareness, flood warnings are liable to be ignored and residents are often confused about when to evacuate, what to take and where it should be taken.

flooding
the State Emergency Service (SES) uses the following definitions in flood warnings:

minor flooding: causes inconvenience such as closing of minor roads and the submergence of low level bridges. The lower limit of this class of flooding, on the reference gauge, is the initial flood level and the upper limit is determined by local conditions.

moderate flooding: low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic bridges may be covered. The range on the reference gauge is determined by local conditions.

major flooding: extensive rural areas are flooded with properties, villages and towns isolated and/or appreciable urban areas are flooded. The threshold for this class of flooding is the upper limit of moderate flooding.

flood fringe
the remaining area of land affected by flooding, after floodway and flood storage areas have been defined.

flood hazard
potential for damage to property or persons due to flooding.

flood liable land
land which would be inundated as a result of the standard flood.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>floodplain</td>
<td>the portion of a river valley, adjacent to the river channel, which is covered with water when the river overflows during floods.</td>
</tr>
<tr>
<td>floodplain management options</td>
<td>the measures which might be feasible for the management of a particular area.</td>
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<tr>
<td>flood standard (or designated flood)</td>
<td>the flood selected for planning purposes. The selection should be based on an understanding of flood behaviour and the associated flood risk. It should also take into account social, economic and ecological considerations.</td>
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<tr>
<td>flood storage</td>
<td>that part of the floodplain that is important for the temporary storage of floodwaters during the passage of a flood.</td>
</tr>
<tr>
<td>floodway</td>
<td>an area where a significant volume of water flows during floods. It is often aligned with obvious naturally defined channels. Floodways are areas which, even if only partially blocked, would cause a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, the areas of deeper flow or the areas where higher velocities occur.</td>
</tr>
<tr>
<td>freeboard</td>
<td>a factor of safety usually expressed as a height above the designated flood. Freeboard tends to compensate for factors such as wave action, localised hydraulic effects, etc.</td>
</tr>
<tr>
<td>high hazard</td>
<td>possible danger to life and limb; evacuation by trucks difficult; potential for structural damage; social disruption and financial losses could be high.</td>
</tr>
<tr>
<td>hydraulic</td>
<td>the term given to the study of water flow in a river, in particular, the evaluation of flow parameters such as stage and velocity.</td>
</tr>
<tr>
<td>hydrograph</td>
<td>a graph which show how the discharge changes with time at any particular location.</td>
</tr>
<tr>
<td>hydrology</td>
<td>the term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.</td>
</tr>
<tr>
<td>low hazard</td>
<td>should it be necessary, people and their possessions could be evacuated by trucks. Able-bodied adults would have little difficulty wading.</td>
</tr>
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<td>main stream flooding</td>
<td>inundation of normally dry land occurring when water conveyed to the locality from further upstream overflows the natural or artificial banks of the principal watercourse in the catchment. It generally excludes any watercourses constructed with pipes or artificial channels or considered as stormwater channels.</td>
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management plan

A document including, as appropriate, both written and diagrammatic information describing how a particular area of land is to be used and managed to achieve defined objectives. It may also include description and discussion of various issues, problems, special features and values of the area, the specific management measures which are to apply and the means and timing by which the plan will be implemented.

mathematical/computer models

The mathematical representation of the physical processes involved in runoff and streamflow. These models are run on computers due to the complexity of the mathematical relationships.

peak discharge

The maximum discharge occurring during a flood event.

probable maximum flood (PMF)

The flood calculated to be the maximum which is likely to occur.

probability

A statistical measure of the expected frequency or occurrence of flooding. Flood probabilities are expressed in terms of the chances of an event occurring, or being exceeded in any given year. For example, a "1 in 100" or "1%" AEP flood has 1 chance in 100 of occurring, or being exceeded, this year (AEP stands for annual exceedance probability).

On a LONG TERM average it will happen once every 100 years, but it is wrong to think it can only happen once in a century. Because floods are random events there is still a 1 in 100 chance of the flood occurring next year no matter what happens this year.
3. PREVIOUS STUDIES

A number of previous studies have looked at flooding of the Lower Macleay and these have provided useful background information and data. The following reports were of particular relevance (more details on these references are given in the Floodplain Management Study):

- Kempsey - Evaluation of Options for Flood Protection, April 1985
  
  This was prepared prior to the Flood Study. A mathematical model known as the CELLS model was set up and calibrated for the Macleay River between Aldavilla and Smithtown. The model was used to investigate four flood protection options for Kempsey.

- Macleay River Flood Study, April 1989
  
  This produced levels throughout the lower Macleay for floods of 1 in 20, 1 in 50, 1 in 100 AEP and an extreme event using the CELLS model. The study area consisted of the river and associated floodplains from Aldavilla to the ocean entrance near South West Rocks. Other ocean outlets were included in the modelling.

- Review of Kinchela Creek and Belmore River Floodway Capacities, November 1993
  
  During the Kinchela Creek Flood Channel investigation it was discovered that the capacities of the Kinchela Floodways were less than had been understood. This prompted a review of the capacities of the three major floodways in the area: the Belmore Floodway and the Kinchela Eastern and Western Floodways.

  The Study used a RUBICON model which was adapted from the CELLS model used in Flood Study referred to above.

- Kinchela Creek Flood Channel (Stages 1 & 2), July and October 1994
  
  This Study investigated a proposal to construct a flood channel between the Eastern Floodway on Kinchela Creek and the headwaters of Korogoro Creek. The Study was carried out in two stages.

  The Stage 1 report concluded that the proposal was hydraulically feasible, but that substantial engineering works would be required.

  The Stage 2 report concluded that the proposal was economically viable and worthy of further investigation. This report also looked at the possibility of opening the Belmore and Kinchela Floodways later than at present. It was found that this could be viable with some compensatory levee raising.
• Hat Head Levee - Hydraulic Review, October 1994

This Study produced 1 in 100 design flood levels and an indication of flood levels during an extreme event. The Study was commissioned as a result of an investigation of the structural security of the levee.

A supplementary report was issued in May 1996. This report revised the flood levels using the model developed in the Floodplain Management Study.

• Lower Macleay Floodplain Management Study

The Floodplain Management Study laid the foundations for this Plan. It incorporated a review of the modelling work carried out in 1989 with some subsequent changes in 1 in 100 flood levels. It then proceeded to consider the present status of the floodplain both with respect to flooding and drainage of flood storages. In the light of this, The Study produced a list of 30 recommendations for improved management of the floodplain.

The recommendations were the result of a comprehensive program of consultation with affected stakeholders. This was conducted through input from the Floodplain Management Committee; a series of public meetings; and public display and comment on a draft version of the Study report.
4. OVERVIEW

This Plan sets the parameters for control of development on the Lower Macleay floodplain downstream of Frederickton. It draws on the findings and recommendations of the Floodplain Management Study to provide a comprehensive framework for decision making.

The elements of the Plan are presented in Table 1 and discussed in five major sections of this report:
- Chapter 5 deals with matters relating to flooding over the whole area,
- Chapter 6 deals with matters relating to flooding in the villages,
- Chapter 7 deals with matters relating to flooding in rural areas,
- Chapter 8 deals with drainage and water quality,
- Chapter 9 covers other issues.

These chapters reflect the thirty recommendations of the Floodplain Management Study together with some other issues which have arisen since The Study was completed. Some of these additional matters are themselves the result of actions consequential to The Study. Chapter 10 provides a cross-reference between the various sections of the Plan and The Study recommendations.

Finally Chapter 11 provides a strategy by which the Plan could be implemented.

Appendix A presents recommended amendments to Council’s Floodplain Management Strategy Policy.

The Plan covers the lower Macleay Floodplain downstream of Frederickton. The southern limit of the floodplain is set at the Crescent Head Road.
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<th>Plan</th>
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<td>Flood Standard</td>
<td>• adopt 1 in 100</td>
<td>High</td>
<td>5.1</td>
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<td>• adopt levels shown on Figures 2 &amp; 3</td>
<td>High</td>
<td></td>
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<td>Flood Warning</td>
<td>• Council to upgrade dissemination</td>
<td>High</td>
<td>5.2</td>
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<td>• Council and LEMC to have desk top</td>
<td>High</td>
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<td>• flood planning exercise every 2 years</td>
<td>High</td>
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<td>Ongoing</td>
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<td>• interim floor levels</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Gladstone</td>
<td>• concept levee design</td>
<td>Medium</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>• interim floor levels</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Kinchela</td>
<td>• minimum floor level</td>
<td>High</td>
<td>6.4</td>
</tr>
<tr>
<td>Jerseyville</td>
<td>• investigate options</td>
<td>Medium</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>• interim floor level</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Belmore &amp; Kinchela Floodways</td>
<td>• raise levees</td>
<td>High</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>• modify operations</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Macleay Leves</td>
<td>• survey existing</td>
<td>High</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>• refurbish</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• resolve below Jerseyville</td>
<td>High</td>
<td></td>
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<td>Flood Mounds</td>
<td>• seek advice on funding</td>
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</tr>
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<td></td>
<td>• determine approval process</td>
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</tr>
<tr>
<td></td>
<td>• waive application fee</td>
<td>High</td>
<td></td>
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<td>Mitigation Scheme</td>
<td>• document procedures</td>
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<td>• continuing review</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>Drainage Management</td>
<td>• establish groups</td>
<td>High</td>
<td>8.1</td>
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<tr>
<td></td>
<td>• determine criteria</td>
<td>High</td>
<td></td>
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<tr>
<td></td>
<td>• produce DCP</td>
<td>Medium</td>
<td></td>
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<td></td>
<td>• consent protocol</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Clybucca Headworks</td>
<td>• modify operations</td>
<td>High</td>
<td>8.2</td>
</tr>
<tr>
<td>Belmore &amp; Kinchela Headworks</td>
<td>• modify operations</td>
<td>High</td>
<td>8.3</td>
</tr>
<tr>
<td>Upper Belmore</td>
<td>• consider providing gates</td>
<td>High</td>
<td>8.4</td>
</tr>
<tr>
<td>Yarrahapinni</td>
<td>• monitor rehabilitation</td>
<td>Ongoing</td>
<td>8.5</td>
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<tr>
<td>Water Quality Data</td>
<td>• monitor Upper Belmore</td>
<td>Ongoing</td>
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</tr>
<tr>
<td></td>
<td>• plan subsequent monitoring</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• produce database</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Bank Erosion</td>
<td>• investigate</td>
<td>Medium</td>
<td>9.1</td>
</tr>
<tr>
<td></td>
<td>• formulate Management Plan</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Land Ownership</td>
<td>• support realignment</td>
<td>Low</td>
<td>9.2</td>
</tr>
<tr>
<td>Indemnity</td>
<td>• seek legal advice</td>
<td>High</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>• approach Government</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Social Impacts</td>
<td>• fully consider</td>
<td>Ongoing</td>
<td>9.4</td>
</tr>
<tr>
<td>Stock Management</td>
<td>• exit signs</td>
<td>High</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>• prepare Stock Sub-plan</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• lobby to amend Act</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>RTA</td>
<td>• request liaison</td>
<td>High</td>
<td>9.6</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>• monitor information</td>
<td>Ongoing</td>
<td>9.7</td>
</tr>
</tbody>
</table>
5. FLOODING - GENERAL

5.1 Flood Standard

5.1.1 The Problem

The NSW Government's Floodplain Development Manual requires the formal adoption of a Flood Standard to be used as the benchmark in planning and development decisions. Previous studies have assumed the 1 in 100 event as the Flood Standard but this has not been formally adopted.

The introduction of a new hydraulic model in the Floodplain Management Study has also lead to a reassessment of some of the historical data and hence new values for design flood levels in parts of the lower floodplain. These new results should be adopted in preference to the old values.

The Floodplain Development Manual is presently under review. The review is likely to significantly change the approach to setting the Flood Standard. Flooding will be considered up to the limit of the Probable Maximum Flood with a Flood Standard, or series of Standards, set within this limit to reflect various planning regimes.

5.1.2 Discussion

The 1 in 100 flood level has traditionally been used as the de facto Flood Standard in the valley and has gained general acceptance. The 1 in 100 flood is about the same size as the two largest historical events (1949 and 1950) and this has helped its acceptance. There is no compelling reason to change the established practice at this time, however, it should be reviewed in the light of the anticipated revised Floodplain Management Manual when it is finalised.

Revised peak 1 in 100 levels for the lower floodplain are presented on Figures 2 and 3 and corresponding velocities on Figures 4 and 5.

5.1.3 The Plan

- The 1 in 100 flood is adopted as the Flood Standard.
- 1 in 100 levels and velocities are as shown on Figures 2 to 5 of this report.
- Review the Flood Standard in the light of the revised Floodplain Management Manual when it is published.

5.1.4 Social, Environmental, Economic and Hydraulic Appraisal

This decision confirms a long standing practice and will have no additional effects. The revised flood levels have not changed greatly from those previously used, with some going up and some down. The overall social and economic impact of the revised levels will be minimal.
The standard simply defines flood behaviour and does not involve any physical change to the floodplain. Hence there are no environmental or hydraulic effects.

5.1.5 Priority

The adoption of the revised Flood Standard levels should be High priority.

5.2 Flood Warning

5.2.1 The Problem

The present flood forecasting system is based on a series of automatic gauges (the 'Alert' system) backed by manual readings at other locations. The data from these recorders are used by the Bureau of Meteorology to prepare flood forecasts. These are combined with other explanatory information and disseminated by the SES as flood warnings.

The present system is effective in terms of the collection of data and estimation of flood behaviour. It should be possible to give 24 hours warning of a minor flood at Kempsey. There is concern within the affected community that this information is not being effectively communicated in order to make the best possible use of the time available. A further concern is that the long time between large floods has meant that the people now active in the SES may not have experienced a large flood and may not know how to respond in a flood emergency.

5.2.2 Discussion

Council is aware of the community’s concerns and is endeavouring to upgrade communications to enable more effective dissemination of flood warning advice. The effectiveness of these endeavours is to be assessed with the affected community on a regular basis and especially after significant floods.

To improve the awareness of Council staff and the Local Emergency Management Committee it is proposed that regular (say every two years) desk top exercises be held to simulate likely flood behaviour in a large flood so that members will be aware of the likely problems and their particular responsibilities when such a flood next occurs.

5.2.3 The Plan

- Council to upgrade dissemination of flood warning advice.
- Council and the Local Emergency Management Committee to have desk top flood emergency exercises every two years.
- Effectiveness of dissemination to be assessed with the affected community on a regular basis.
5.2.4 Social, Environmental, Economic and Hydraulic Appraisal

The proposal will have clear economic and social benefits as improved warning will allow better preparation. This will reduce losses, both within homes and of stock and equipment, and this will lead to reduced stress and post flood trauma.

There will be no actual physical changes to the floodplain, hence no environmental or hydraulic impacts.

5.2.5 Priority

The initial upgrading of communications is High priority. The implementation of regular desk top flood emergency exercises is High. The assessment of effectiveness is Ongoing.

5.3 Public Education

5.3.1 The Problem

It is vitally important that flood awareness and preparedness within the floodplain community be maintained at a high level in order to take maximum advantage of the reaction time provided by the flood warning system.

5.3.2 Discussion

The process of developing this Floodplain Management Plan has involved a considerable degree of public involvement. This involvement will be developed to ensure an ongoing awareness of flood hazard within the floodplain community.

The ongoing program will include, but not be limited to, the following:

- an annual leaflet sent to all affected residents with rate notices. Where people do not receive rate notices the leaflet will be forwarded separately. Among other things the leaflet will carry a reminder of the SES local flood plan and the need to follow directions from emergency personnel during flood events,
- encouraging the local media to occasionally highlight flood issues. The anniversary of the 1949 flood would be a good opportunity,
- special “celebration” of the 50th anniversary of the 1949 flood,
- preparation of a flood awareness kit for use by teachers in local schools. Council will also consider making Council officers available to speak in schools on flooding (possibly in conjunction with other matters such as bushfires),
- Council will consider placing markers on telegraph poles in urban areas to mark the level of the 1949 flood,
- Council will consider issuing flood certificates to all properties within the floodplain (below PMF) on a regular basis.
5.3.3 The Plan

- Establish an ongoing public education program.

5.3.4 Social, Environmental, Economic and Hydraulic Appraisal

The public education program will provide social and economic benefits by supplementing the improved warning dissemination as discussed in Section 5.2.

Again no physical changes will occur on the floodplain and hence there will be no environmental or hydraulic consequences.

5.3.5 Priority

Establishing an overall program should be High priority. The program should include priorities for individual elements.

5.4 Additional Telemetry

5.4.1 The Problem

The lower floodplain is now served by a series of telemetered gauges which give emergency staff a good understanding of flood behaviour in real time. The effectiveness of the network is compromised to some extent if one or more of the gauges malfunctions during a flood. There are also important sections of the river which are not fully covered.

5.4.2 Discussion

The Floodplain Management Study identified two, possibly three, sites for additional gauges. This would give better coverage of important reaches of the river and also provide some backup should a gauge fail during a flood.

Since the Study was concluded telemetry gauges have been installed at Seven Oaks Bend and Rainbow Reach. The installation of further gauges will depend on the availability of Government funding.

5.4.3 The Plan

- Council will consider the installation of a gauge at Summer Island and some selected drains.
5.4.4 Social, Environmental, Economic and Hydraulic Appraisal

The installations will enable more effective management of the flood mitigation scheme during a flood and better appraisal of the event afterwards. This will provide both social and economic benefits as stakeholders gain greater understanding of flooding and management techniques. The work involved in installing new gauges will have minimal environmental impact and no direct impact on flood hydraulics.

5.4.5 Priority

Consideration of extra gauges should be Medium priority.
6. FLOODING - VILLAGES

6.1 Frederickton

6.1.1 The Problem

The southern sections of Frederickton are flood liable, with 26 buildings being flooded in a 1 in 100 event. The average annual flood damages are estimated at $75,000.

6.1.2 Discussion

A levee can be constructed to protect the southern sections of Frederickton from main river flooding up to the 1 in 100 level. The Study estimated the construction cost at $910,000 with a benefit/cost ratio (direct damages only) of 0.96.

Council will produce a concept design of the proposed levee in order to confirm costs and potential benefits and to identify any likely social or environmental constraints on the work.

This design will include the following elements:

- detailed survey of the levee alignment including affected structures and properties,
- concept design of suitable embankment including alternative treatments where structures or private property are impacted,
- consideration of internal drainage,
- detailed costing including any land acquisition or services relocation costs,
- identification of potential social or environmental impacts,
- consideration of the impacts of an overtopping flood and suitable planning controls within the levee,
- assessment of the impacts of not proceeding.

Once the concept design is complete Council will decide whether to proceed with the project.

There is limited pressure for further development but any expansion would not be permitted unless the buildings are flood proofed. Minimum Floor Levels are dealt with in the review of the Policy (Appendix A). The minimum floor level in south Frederickton may be reconsidered if it is decided to proceed with the levee. As an interim measure the level will be retained at 7.23 mAHD.

6.1.3 The Plan

- Concept design of levee to provide 1 in 100 protection.
- Decide on levee when concept design complete.
- Set minimum floor level 500 mm above the current Flood Standard. On present (June 1997) estimates this means in the interim retain minimum floor level of 7.23 mAHD.
6.1.4 Social, Environmental, Economic and Hydraulic Appraisal

The levee will have no discernable impact on flood behaviour in the floodplain. The initial economic assessment in The Study gave a benefit cost ratio of 0.96. One aspect of the concept design would be to identify any environmental impacts although at this stage no serious problems are anticipated.

The social aspects of the levee are both positive and negative. The major positive consequence is protection from flooding up to the design event. The negatives are the possible visual impact; loss of flood awareness and increased risk in an overtopping flood.

Construction of an earth embankment close to the river bank clearly has the potential for environmental impact. This will need to be reviewed during the detailed design phase. It would appear at this stage that there are no environmental constraints that cannot be accommodated in the design.

6.1.5 Priority

The concept levee design should be Medium priority.

6.2 Smithtown

6.2.1 The Problem

Smithtown is protected by a small, artificial levee but this is of no benefit in a 1 in 100 flood. In such an event the whole town, with some 130 houses, would be inundated. There would also be significant damage in smaller floods down to, at least, the 1 in 5 year event.

6.2.2 Discussion

The Study carried out a preliminary analysis of a ring levee around Smithtown. The estimated construction cost was $3.4M with a benefit/cost ratio (direct damages only) of 1.2.

Council will proceed with a concept design of a ring levee at Smithtown. This design will include the following elements:

- detailed survey of the levee alignment including affected structures and properties,
- concept design of suitable embankment including alternative treatments where structures or private property are impacted,
- consideration of internal drainage,
- detailed costing including any land acquisition or services relocation costs,
- identification of potential social or environmental impacts,
- consideration of the impacts of an overtopping flood and suitable planning controls within the levee,
- assessment of the impacts of not proceeding.
When the concept analysis is completed Council will decide whether to proceed to detailed design and construction or to adopt alternative measures.

There is limited pressure for further development but any expansion would not be permitted unless the buildings are flood proofed. The final decision on minimum floor levels will not be made until the analysis of the ring levee has been completed.

As an interim measure the minimum floor level will be set as follows:

<table>
<thead>
<tr>
<th>Location</th>
<th>Floor Level (m AHD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NW corner</td>
<td>5.6</td>
</tr>
<tr>
<td>Southern point</td>
<td>5.3</td>
</tr>
<tr>
<td>NE corner</td>
<td>5.0</td>
</tr>
</tbody>
</table>

These levels are 500 mm above the modelled 1 in 100 flood level at the relevant points. Minimum floor levels at intermediate points will be interpolated.

The existing Policy sets the minimum floor level at 5.02 mAHD, the same as at Kinchela. The origin of this level is not known.

6.2.3 The Plan

- Concept design of levee to provide 1 in 100 protection.
- Decide on levee when concept design complete.
- Set minimum floor level 500 mm above the current Flood Standard. On present (June 1997) estimates this means: raise interim minimum floor level to 5.6 mAHD in the northwest corner, 5.3 mAHD at the southern tip and 5.0 mAHD at the north-east corner. Levels elsewhere to be interpolated.

6.2.4 Social, Environmental, Economic and Hydraulic Appraisal

The levee will have no discernable impact on flood behaviour in the floodplain. The initial economic assessment in The Study gave a benefit cost ratio of 1.2. One aspect of the concept design would be to identify any environmental impacts although at this stage no serious problems are anticipated.

The social aspects of the levee are both positive and negative. The major positive consequence is protection from flooding up to the design event. The negatives are the possible visual impact; loss of flood awareness and increased risk in an overtopping flood.

Construction of an earth embankment close to the river bank clearly has the potential for environmental impact. This will need to be reviewed during the detailed design phase. It would appear at this stage that there are no environmental constraints that cannot be accommodated in the design.
6.2.5 Priority

The concept levee design should be Medium priority.

The change in minimum floor level should be High priority.

6.3 Gladstone

6.3.1 The Problem

The entire town of Gladstone is flood liable in a 1 in 100 event. Approximately 100 houses are affected.

6.3.2 Discussion

The Study carried out a preliminary analysis of a ring levee around Gladstone. The estimated construction cost was $3.1M with a benefit/cost ratio of 1.2 (direct damages only).

Council will proceed with a concept design of a ring levee at Gladstone. This design will include the following elements:

- detailed survey of the levee alignment including affected structures and properties,
- concept design of suitable embankment including alternative treatments where structures or private property are impacted,
- consideration of internal drainage,
- detailed costing including any land acquisition or services relocation costs,
- identification of potential social or environmental impacts,
- consideration of the impacts of an overtopping flood and suitable planning controls within the levee,
- assessment of the impacts of not proceeding.

When the concept analysis is completed Council will decide whether to proceed to detailed design and construction or to adopt alternative measures.

There is limited pressure for further development but any expansion would not be permitted unless the buildings are flood proofed. The final decision on minimum floor levels will not be made until the analysis of the ring levee has been completed.

As an interim measure the minimum floor level will be set as 5.3 mAHD which is 500 mm above the modelled 1 in 100 flood level.

The existing Policy sets the minimum floor level at 5.02 mAHD, the same as at Kinchela. The origin of this level is not known.
6.3.3 The Plan

- Concept design of levee to provide 1 in 100 protection.
- Decide on levee when concept design complete.
- Set minimum floor level 500 mm above the current Flood Standard. On present (June 1997) estimates this means raising the interim minimum floor level to 5.3 mAHD.

6.3.4 Social, Environmental, Economic and Hydraulic Appraisal

The levee will have no discernable impact on flood behaviour in the floodplain. The initial economic assessment in The Study gave a benefit/cost ratio of 1.2. One aspect of the concept design would be to identify any environmental impacts although at this stage no serious problems are anticipated.

The social aspects of the levee are both positive and negative. The major positive consequence is protection from flooding up to the design event. The negatives are the possible visual impact; loss of flood awareness and increased risk in an overtopping flood.

Construction of an earth embankment close to the river bank clearly has the potential for environmental impact. This will need to be reviewed during the detailed design phase. It would appear at this stage that there are no environmental constraints that cannot be accommodated in the design.

6.3.5 Priority

The concept levee design should be Medium priority.

The change in minimum floor level should be High priority.

6.4 Kinchela

6.4.1 The Problem

Kinchela is flood liable in a 1 in 100 event.

6.4.2 Discussion

Because of the small number of properties involved, a levee here cannot be justified with a benefit/cost ratio of 0.1. Planning control on future development is the only viable option.

The minimum floor level has been revised to 4.7 mAHD, 500 mm above the 1 in 100 flood level. This compares with 5.02 mAHD in the existing policy.
6.4.3 The Plan

- Set minimum floor level 500 mm above the current Flood Standard. On present (June 1997) estimates this means lowering the interim floor level to 4.7 mAHD.

6.4.4 Social, Environmental, Economic and Hydraulic Appraisal

As there is little pressure for development there should be minimal impact. There may be a slight disincentive to build at Kinchela in favour of a leveed area.

As no physical works are proposed there will be no environmental or hydraulic impacts.

6.4.5 Priority

The revised minimum floor level should be High priority.

6.5 Jerseyville

6.5.1 The Problem

Jerseyville is flooded in major events with some 13 houses affected. Because of its location on an island it would be difficult, but not impossible, to build a levee. An alternative might be to ensure access routes to nearby high ground are kept open long enough to enable effective evacuation.

6.5.2 Discussion

The Study investigated a possible ring levee to protect Jerseyville from the 1 in 100 flood. In the context of the overall study the investigation was limited, however it did suggest that there could be difficulties in finding a suitable alignment for any embankment. The estimated construction cost was $1M with a benefit/cost ratio (direct damages only) of 0.3. This ratio is generally taken to imply economic advantage once indirect and intangible factors are included.

Because of its location, in reasonable proximity to high land, it is possible that a better flood management approach for Jerseyville would be to upgrade the access to provide increased evacuation time in a flood.

Council will initiate a feasibility study to investigate both options for the town. The levee component of the study will be similar to those discussed above. The access analysis will include:

- feasibility of providing access to selected flood levels (say, 1 in 100, 1 in 50, 1 in 20),
- costs involved, including land acquisition if needed,
- benefits, including an assessment of increased evacuation time available and the social and economic consequences,
disbenefits, including economic and social costs,
identification of possible environmental impacts.

The feasibility study will compare the two alternatives, and any others which might be identified, and make a firm recommendation to Council on the way ahead.

There is limited pressure for further development but any expansion would not be permitted unless the buildings are flood proofed. A final decision on minimum floor levels will await the findings of the feasibility study. As an Interim measure the minimum floor level has been set at 4.05 mAHD, 500 mm above the modelled 1 in 100 level. This compares with 4.1 mAHD in the existing policy.

6.5.3 The Plan

- Investigate the alternatives of a ring levee or upgraded access.
- Decide on appropriate response.
- Set minimum floor level 500 mm above the current Flood Standard. On present (June 1997) estimates this means reducing interim minimum floor level to 4.05 mAHD.

6.5.4 Social, Environmental, Economic and Hydraulic Appraisal

The levee should have little impact on flood behaviour in the floodplain. The initial economic assessment in The Study gave a benefit/cost ratio of 0.3. Raised access across Saltwater Inlet would have a similar hydraulic impact to the levee. One aspect of the consideration of both options would be to identify any environmental impacts although at this stage no serious problems are anticipated.

The social aspects of the alternative proposals are both positive and negative. The major positive consequence of a levee is protection from flooding up to the design event. The negatives are the possible visual impact; loss of flood awareness and increased risk in an overtopping flood. A high level road would not increase protection to property and would also present a possible visual impact. On the other hand it should not promote a false sense of security and would not increase risk in an overtopping flood. It would reduce the overall risk to life by increasing the time available for evacuation.

Construction of an earth embankment close to the river bank clearly has the potential for environmental impact. This will need to be reviewed during the detailed design phase. It would appear at this stage that there are no environmental constraints that cannot be accommodated in the design.

Improved evacuation access would not change the existing flooding of the town but would allow more time to remove personnel and valuables.
6.5.5 Priority

The investigations should be Medium priority and the revised floor levels High priority.
7. FLOODING - RURAL AREAS

7.1 Belmore and Kinchela Floodways

7.1.1 The Problem

Historically these structures have been opened when flood levels reached 4.1 m on the gauge at Kempsey Traffic Bridge. The gates were then closed several days later.

This practice has caused considerable inconvenience to local landholders whose property is flooded when the gates are opened. They have claimed increased stress, loss of productivity and inequity in flood affectation compared to others on the floodplain.

There are also potential significant affects on water quality as discussed in Section 8.1.1.

7.1.2 Discussion

In recent years Council has modified the operation of the floodways, especially in closing them earlier once the peak has passed. However, the possibilities for further operational changes are limited unless the levees along the Belmore and Kinchela are raised to contain floods to a higher level.

Council will raise the levees on Kinchela Creek and the Belmore River in order to allow the floodways to be kept closed longer. A Review of Environmental Factors (REF) has been presented for public exhibition. The Review specifies works required to allow the Belmore floodway to open at 4.6 m at Kempsey Traffic Bridge and the Kinchela floodways to open at 4.9 m.

The REF identifies that in addition to raising levees on Kinchela Creek and the Belmore River, low points of levees will also be raised at Rainbow Reach and elsewhere and drainage management plans introduced to raise water tables and reduce acid sulfate discharges in the affected areas (see Section 8.1).

The REF has been determined by Council, and funding has been sought from the Federal and State Governments to carry out the package of works. (This includes items discussed in this Plan under Section 7.2).

Once the works are in place Council will implement new operating procedures for the floodways. These will be monitored and refined to provide maximum possible flood protection to the lower floodplain while opening the floodways as infrequently and for as short a time as possible. The operational procedure adopted in February 1996 will be retained until the works covered by the REF are fully implemented.
7.1.3 The Plan

- Raise levees on Kinchela Creek, the Belmore River and the Macleay River at Rainbow Reach and elsewhere as required.
- Modify Belmore and Kinchela floodway gate operations to minimise frequency and duration of opening.
- Integrate with area based drainage management proposals.

7.1.4 Social, Environmental, Economic and Hydraulic Appraisal

The issues are well documented in the REF and associated studies. The economic and social impacts will be positive because of the reduced frequency of inundation of farmland and consequent stress.

The reduced flooding frequency will impact on the filling of wetlands, but this will be countered by improved water management to reduce overdrainage, and allow re-wetting of the swamp areas through modified floodgates and modified floodgate operation systems. This forms an essential part of the proposal as presented in the REF. Overall the environmental impact will be positive as increased groundwater levels will enlarge the wetlands and improve their drought resistance.

More small floods will be constrained to the main channel of the Macleay River. There will be indiscernible impact on larger floods which overtop the levees.

7.1.5 Priority

The proposal is progressing and all structural aspects should be considered High priority. The revised operations would be implemented when the major works are completed and are considered Medium priority.

7.2 Macleay River Levees

7.2.1 The Problem

The levees on the Macleay River between Frederickton and Jerseyville were constructed in the late 1970's. In the intervening years the embankments have been subjected to erosion, settlement, stock movement, etc., and some sections are now significantly lower than the design level. This has caused localised flooding to some properties in events where most of the floodplain has still enjoyed the protection of the levee system.

Levees on the river below Jerseyville have never been considered as part of the flood mitigation scheme. While there are some small artificial embankments in this area they have not been designed to specific flood profiles.
7.2.2 Discussion

Council will commission a survey of the levees to complement existing information and identify points which are below the design level. These will be refurbished as necessary.

The situation below Jerseyville has been an oversight which will be rectified. Council is already committed to raising low sections at Rainbow Reach in conjunction with the Kinchela Floodways REF (Section 7.1).

7.2.3 The Plan

- Survey Macleay levees from Frederickton to the ocean entrance along both banks.
- Refurbish as necessary to reach original design standards.
- Fill in low sections below Jerseyville to afford protection commensurate with the rest of the floodplain.

7.2.4 Social, Environmental, Economic and Hydraulic Appraisal

The work will address concerns that some landholders are suffering more in floods than others. This will remove an issue of potential conflict in the valley. The extra protection will also afford economic benefit to the affected properties as there will be a reduction in flood related costs.

The work will only involve filling of low points along the existing levee lines and, therefore, should not cause any adverse environmental impact. The amount of water retained in the river channel will increase slightly but the effect of this will be minimal.

7.2.5 Priority

The survey should be High priority. A plan to resolve the levee problem below Jerseyville should be High priority. Refurbishment and construction should be Medium priority as funding allows.

7.3 Connection Creek

7.3.1 The Problem

On occasions of high floods in the Hastings, catchment water will flow from that catchment into the upper reaches of the Belmore.

7.3.2 Discussion

Consideration was given to various works on Connection Creek which might prevent the inflow of floodwaters from the Hastings. However, no works were identified which would not worsen the
situation in the Hastings area or prevent the escape of Macleay water during a large flood in this catchment.

Both Kempsey Shire Council and Hastings Council are concerned with floodplain management issues in the Connection Creek area. The absence of any physical features to define the Council boundary in this vicinity indicates that a practical solution to the problem should involve a joint effort by both Councils.

7.3.3 The Plan

- Propose a joint Council study of the Connection Creek area.

7.3.4 Social, Environmental, Economic and Hydraulic Appraisal

These issues will be resolved in the proposed study.

7.3.5 Priority

The study is Medium priority.

7.4 Flood Mounds

7.4.1 The Problem

Flood mounds may prove effective for cattle refuge in areas where there is no natural high ground or evacuation routes to high ground.

7.4.2 Discussion

This is an issue which has not been worked through on any coastal river in NSW. Thus government policy on a number of important issues, such as funding and approval process, is not clear.

7.4.3 The Plan

- Council will seek advice from the Department of Land and Water Conservation (DLWC) on the availability of funding for flood mounds and also investigate other methods of funding.
- Council will determine the appropriate approval process, including the need for any environmental assessment.
- Council will waive the development application fee for mounds and will assist in identifying sources of fill material.
7.4.4 Social, Environment, Economic and Hydraulic Appraisal

The proposal will be positive economically and socially as it reduces stock losses and the personal risk and trauma involved in attempting to move cattle long distances during floods. The mounds may change the visual aspect of the floodplain. Any other potential environmental difficulties can be avoided by appropriate siting of the structures. There will also be localised hydraulic impacts in large floods but these should be minimal as the mounds will occupy a tiny proportion of the total floodplain and velocities will be low.

7.4.5 Priority

Investigation of funding and approval process should be High priority. Other matters are Medium priority.

7.5 Flood Mitigation Scheme

7.5.1 The Problem

The flood mitigation scheme was conceived and constructed in the 50's, 60's and 70's. Many of the basic principles of flood mitigation have been rethought since then and the community also has the benefit of several decades experience with the present scheme. A thorough reappraisal of the operation of the scheme is considered appropriate by some.

7.5.2 Discussion

One of the recommendations of the Floodplain Management Study was for a review of the scheme as it now stands and functions. Many of the decisions of this Plan amount to such a review and several major initiatives are in hand to modify the present operations. These initiatives, and any others subsequently introduced, should be subject to ongoing review.

The present operation of the scheme has been developed and refined over many years by Council staff. Much of the process involved relies on personal knowledge and experience and would be lost when staff leave Council or retire.

7.5.3 The Plan

- Document the operation and management procedure.
- Review the operation of the flood mitigation scheme after floods in consultation with affected stakeholders.
7.5.4 Social, Environmental, Economic and Hydraulic Appraisal

The consequences of ongoing review will depend on the issues identified.

7.5.5 Priority

Documentation of procedures is High priority. The review process is to be Ongoing.

7.6 Other Structural Works

The Floodplain Management Study investigated the impacts of dredging the main river and also constructing various major flood channels. None of these had any significant impact on flood levels and many of the options had serious environmental impacts.

Neither dredging nor the construction of flood channels is considered an effective measure for flood mitigation. Flood channel proposals for specific areas might be considered on their merits subject to detailed economic and environmental assessment.
8. DRAINAGE AND WATER QUALITY

8.1 Management Areas

8.1.1 The Problem

When the flood mitigation scheme was being evolved, one of the chief concerns was the amount of time floodwaters remained on farmland after the passage of the flood wave. It was considered that an essential part of any successful flood mitigation scheme would allow the rapid removal of ponded water.

The adopted scheme included a series of major drains linking the back swamps to either the main river, one of the major tributaries or the ocean. These drains were fitted with gates where they passed under the levees to prevent water entering the swamps from downstream. It was intended that individual farmers or Drainage Unions would construct branch drains to the trunk lines to further facilitate the removal of water.

The drains have worked very well in their intended purpose, however, they have introduced a number of problems not foreseen at the time which have adversely impacted on both the ecology and economic viability of the lower Macleay.

In most cases the drains have been dug too deep and have lowered the water table in the affected areas. As a result the semi-permanent wetlands scattered throughout the floodplain have been reduced in area and in sustainability. This has affected the wildlife, especially birds, which use the wetlands for breeding and has also impacted on the native grass species which formerly thrived in the marshy conditions. To a large extent the native grasses have been replaced by exotic species which are less water tolerant.

The loss of wetland and change of pasture types has had economic and environmental impacts. Economically, the traditional drought tolerance of the floodplain has been lost as has the opportunity benefit of lush vegetation after a flood. Environmentally, not only has valuable breeding habitat disappeared but the non water tolerant exotic vegetation dies when inundated in a flood. The decaying matter deoxygenates the floodwater which then drains back into the main rivers and presents a serious threat to marine fauna.

The lowered water tables have also exposed potential acid sulfate soils which underlie the floodplain. The acid from these soils is mobilised and tends to lie in drains until flushed out by a flood or fresh. Again this has serious consequences for the health of the main rivers and the life within them as well as for pasture land which can be "scalded" by released acid.

The adverse water quality impacts of poor drainage design and operation have recently been recognised as one of the most serious issues on the floodplain. The problem is exacerbated by diverse views on drainage operation and the fact that most drains are in private ownership.
8.1.2 Discussion

Council will continue to study water quality to identify the mechanisms causing fish kills and other water quality problems. This knowledge will be used to modify structures or flood control methods as appropriate to improve the water quality. Other aspects of land management, such as pasture species, may also require adjustment and the data collected will assist in encouraging that process.

A major factor in the water quality issue is the impact of acid sulfate soils. Council will consider the desirability of implementing specific planning instruments (DCP or LEP) to control and mitigate the impacts of acid sulfate soils. The experience of other Councils will be one element of the consideration.

Council will set up local Management Groups in each major wetland, swamp and drainage area. These groups will be made up of landowners, Council, technical experts, Departments of Agriculture, Fisheries, DLWC, National Parks, oyster growers, fishers, etc. The group structure will take account of existing bodies in each area, such as drainage unions, MASSLAG, Landcare groups, and users associations, and ensure their active participation. Each group will formulate a Local Management Plan which will document, amongst other things, objectives, strategies, outcomes, limits of activities, responsibilities, reporting and review. This will provide greater accountability and understanding in the planning process. An important role of the Management Group will be to set a “desired” water level to allow for pasture growth, fish nursery, wildlife, acid soil coverage, etc. This will be an optimum level to suit most needs and reflect the water level in “normal” or “post flood” times. Other criteria of pH, DO, etc., may also be set. An automatic telemetered water quality monitor will be set up in each group’s area of interest to enable them to gauge the water level and quality.

The Management group could request manipulation of water control structures. For example, when the water level gets low or quality is poor (e.g. in times of drought) the group could request farm drain gates to be opened. When monitoring devices indicate that the water quality is suitable, the group could request flood control gates to be opened.

Twelve management group areas have been identified. These are listed below and shown on Figure 1. The areas are:

- Austral Eden,
- Clybucca,
- Connection Creek,
- Cooroobongattii,
- East Kinchela,
- Jerseyville,
- Killick Creek,
- Seven Oaks,
- Upper Belmore,
- West Belmore,
- West Kinchela,
- Yarrahapinni.
Where possible the area boundaries are defined by physical constraints such as roads or waterways. There is clearly interaction between some areas with upstream areas needing to be addressed before those downstream (e.g. Upper Belmore will be considered before West Belmore).

The general approach in each case will be the same although modified where necessary to meet local constraints or opportunities. Clearly the Government Departments involved (and Council), do not have the resources to support the simultaneous establishment of 12 separate groups. Setting up the groups and completing the initial high intensity studies will therefore be staged over a number of years with priority given to those areas with the more serious problems. It is anticipated that lessons learnt in the early management groups will be applied in the later ones, i.e., the process will be dynamic and flexible.

Specific issues identified in the Floodplain Management Study are discussed in the following sections.

Concern has been expressed that even with a Local Management Plan in place, individual modifications to existing structures face a long and complex development approval process involving numerous government bodies. Council will initiate negotiations with the relevant government departments to streamline the development consent process for proposals which conform with the local management plan.

Council will also produce a Development Control Plan (DCP) for each area. If individual landowners are reluctant to raise water levels, or carry out other beneficial works or practices, Council could use this Plan to force compliance.

The Management groups will come under the umbrella of the Floodplain Management Committee which will be responsible for providing general guidelines and ensuring compatibility between the plans of adjoining areas. The Committee will also attempt to establish specific overall targets for water quality.

8.1.3 The Plan

- Council will establish twelve drainage management groups, under the auspices of the Floodplain Management Committee.
- Each group will establish criteria and management practices for its area, and prepare a Local Management Plan.
- Council will produce a Development Control Plan to formalise the adopted practices.
- Council will establish a protocol to streamline development consent.

8.1.4 Social, Environmental, Economic and Hydraulic Appraisal

The greatest effect of this proposal would be to restore the estuarine environment by improving the quality of drainage water. Improved management would also improve the quality of pasture by
raising groundwater levels. These two results would provide economic benefits through increased fishing, agriculture and tourism.

Flood hydraulics will not be affected but the impact on post flood drainage will be an important factor which will require careful consideration.

8.1.5 Priority

Establishing the management groups is High priority, although areas will be ranked to allow progressive development of plans, especially the first few. Establishing development consent protocol is Medium priority but should be in place when the first management plans are adopted.

8.2 Clybucca Creek Headworks (Seven Oaks, Clybucca Management Areas)

8.2.1 The Problem

The Clybucca Creek Headworks were designed to prevent the upstream penetration of saline water, and hence only allow flow in the downstream direction. This leads to excessive drawdown of creek levels (and hence groundwater levels) upstream of the gates. This in turn leads to water quality problems due to both acid sulfate activation and poor flushing, particularly during spring tides when the one-way action of the gates reduces upstream water levels to the spring low level.

8.2.2 Discussion

The Seven Oaks area, upstream of the gates, is already the scene of several initiatives to raise groundwater levels and improve water quality. Suitable modifications to the headworks operations will complement these initiatives.

8.2.3 The Plan

- Small and progressive modifications will be made to the Clybucca Creek headworks operations to control water levels and improve water quality upstream of the gates.
- The process will be monitored upstream and downstream of the gates in close co-operation with the Seven Oaks Drainage Union projects involving ponding and water table management.

8.2.4 Social, Environmental, Economic and Hydraulic Appraisal

The proposed changes will improve environmental conditions and the productivity of farmland in the Seven Oaks area. They are also likely to have a beneficial effect on oyster growing in Clybucca Creek.

There should be no impact on flood hydraulics nor any direct social effect.
8.2.5 Priority

The experiments should be given High priority and co-ordinated with other initiatives already underway in Seven Oaks.

8.3 Belmore and Kinchela Headworks (West Belmore, East Kinchela, West Kinchela Management Areas)

8.3.1 The Problem

The Belmore and Kinchela Headworks are kept open under normal conditions to allow tidal flushing of the upper reaches of both streams. When a flood is imminent the gates are lowered to stop flow from the downstream side to the upstream. This prevents main river floodwaters inundating the upper reaches. The gates will still allow flow from the upper reaches to the main river should the level permit, however, this is restricted by head losses through the structures. There are concerns that the headworks gates are raised too soon after the flood peak and this inhibits post flood drainage from the upper reaches.

8.3.2 Discussion

The Upper Belmore is presently being subjected to intensive water quality monitoring. This has led to some changes in drainage management with more anticipated. A local Floodplain Management Strategy Study has commenced and the issue of headworks control will be canvassed as part of the study.

8.3.3 The Plan

- The operation of the Belmore and Kinchela Headworks will be modified to improve post flood drainage in the early stages.

8.3.4 Social, Environmental, Economic and Hydraulic Appraisal

The issues in the Upper Belmore will be addressed in the Upper Belmore Floodplain Management Strategy Study. Similarly, the issues in the Kinchela area will be addressed in the future local study of this area.

8.3.5 Priority

The changed operations should be High priority.
8.4 Upper Belmore Gates (Upper Belmore Management Area)

8.4.1 The Problem

Two drains in the Upper Belmore are presently ungated and this has led to complaints of unnecessary flooding of the properties involved.

8.4.2 Discussion

As part of its investigations into the whole Upper Belmore system Council will consider the option of providing gates to these drains or any other proposal, such as moveable stopboards, which might be appropriate.

8.4.3 The Plan

- Consider providing floodgates suitable for two way flow.

8.4.4 Social, Environmental, Economic and Hydraulic Appraisal

These issues will be addressed in the Upper Belmore Floodplain Management Strategy Study.

8.4.5 Priority

The investigation should be High priority as part of the present upper Belmore study.

8.5 Yarrahapinni Wetland Rehabilitation (Yarrahapinni Management Area)

8.5.1 The Problem

The Yarrahapinni Wetland Reserve is a large (300ha) degraded coastal wetland which has substantial acid sulfate scald areas. The wetland was locally known as a significant estuarine habitat, but was drained and cut off from the estuary by flood gates and levee structures in 1969. The Yarrahapinni Wetland Reserve Trust, which was established to manage the Reserve, aims to reinstate tidal conditions by the staged opening of flood gates, to determine whether tidal inundation is an effective amelioration method for acid sulfate soils.

Potential negative short term impacts of the flood gate opening include poor water quality due to the mobilisation of sediment; acid waters; sporadic decreases in dissolved oxygen levels associated with decaying vegetation; and a substantial change in vegetation from fresh water swamp species to estuarine species over time.
8.5.2 Discussion

Council has accepted a 2:1 grant for design of modifications to the Yarrahapinni flood gates. This will allow a simple, one man operation for opening and closing any or all of the gates. This project is now in the review and design phase.

Council will assess the lessons arising out of this pilot project for use in the design of future estuarine wetland rehabilitation proposals. Consideration will be given as to how the positive aspects can be incorporated in other parts of the floodplain.

There are concerns within the community about the possible impacts of salt intrusion above the wetland and also the potential for acid runoff affecting oysters after rainfall. Council has been advised of potential litigation if either of these eventuate.

Council will encourage education of the community as to the importance and value of the Yarrahapinni Wetland Rehabilitation Project and other coastal wetlands.

8.5.3 The Plan

- Support and assist with the implementation of the project and continue to monitor project developments and outcomes.
- Encourage community awareness of the project.

8.5.4 Social, Environmental, Economic and Hydraulic Appraisal

The Yarrahapinni experiment will allow a good insight into the potential effects of many of the proposals suggested for other management areas. Overall it is anticipated that the experiment will be positive both environmentally and economically. There should be no discernible impact on flood hydraulics. Social benefits should flow from the improved environmental and economic factors.

8.5.5 Priority

Council monitoring and support should be Ongoing.

8.6 Water Quality Data

8.6.1 The Problem

There is widespread concern about the quality of water throughout the estuary, especially that coming from drains. Unfortunately, until very recently, there has been no systematic effort to establish a continuous water quality database covering all conditions.
8.6.2 Discussion

Council has acted on the recommendations of the Floodplain Management Study and purchased a series of water quality data loggers. These have been installed in the Upper Belmore and have already produced sufficient information to provide a preliminary understanding of the specific sources of some water quality problems.

The six water quality probes installed along the Belmore River from the Macleay River upstream to Seale Road continuously measure dissolved oxygen, pH, electrical conductivity, temperature and depth and transmit the data back to Council's central computer. Another gauge measures rainfall in the area. The gauges are also able to take physical samples for later laboratory analysis for Aluminium, Iron and Sulphides.

The data for all gauges and parameters is being collated into a single database for analysis. It is hoped over a period of, say, twelve months covering several seasons and rainfall conditions that some pattern will emerge to enable a judgement to be made on the cause of water quality problems and identify some possible solutions. Once data are available for Belmore River, some probes will be moved to other problem areas such as Kinchela Creek, Clybucca Creek or Maria River. Some permanent probes will be retained to provide long term monitoring.

To ensure the water quality monitoring programme is as effective as possible Council will also carry out physical fish counts and inspections in the river at regular intervals.

This information would provide significant input into the drainage management process discussed in Section 8.1.

8.6.3 The Plan

- Continue monitoring the Upper Belmore until a satisfactory database is available.
- Prepare a plan for subsequent monitoring of other areas.
- Produce the database in a format useable by all interested parties, especially the local water management groups.

8.6.4 Social, Environmental, Economic and Hydraulic Appraisal

The proposal will have no direct effects but, by providing a quantitative understanding of the factors influencing the estuary, it will have widespread indirect benefits in all areas.

8.6.5 Priority

The work is ongoing. Continued funding is High priority. The provision of a useable database is also a High priority as this will give invaluable assistance in formulating management plans.
9. OTHER ISSUES

9.1 Bank Erosion

9.1.1 The Problem

Concerns have been expressed about the potential impact of bank erosion, particularly in Clybucca Creek.

9.1.2 Discussion

Council will initiate a survey of bank erosion throughout the estuary. When this survey is complete, the cause of the erosion will be investigated and a Management Plan will be prepared with full public consultation. It should be noted that the erosion could be caused by a number of possibly interrelated actions such as loss of riparian vegetation, wave action (wind and/or boat), flood mitigation works, natural geomorphological changes, etc. The already identified problem areas on Clybucca Creek will be addressed in the Plan together with all other actual or potential erosion areas.

9.1.3 The Plan

- Survey and investigate bank erosion.
- Formulate a Management Plan.

9.1.4 Social, Environmental, Economic and Hydraulic Appraisal

Successful management of bank erosion will be environmentally positive and will also assist oyster production. There will be no discernable impact on hydraulics. Social benefits will accrue indirectly from the improved environmental and economic conditions.

9.1.5 Priority

The investigation should be considered Medium priority.

9.2 Land Ownership

9.2.1 The Problem

There are essentially three types of grazing land in the floodplain: levee, back levee and swamp. The best properties have all three types which gives them greater flexibility to handle varying climatic conditions. Some properties do not have this flexibility.
9.2.2 Discussion

The realignment of property boundaries to achieve better land mix and the principle of a Government sponsored buy and lease back scheme will be supported where there is willing and active support within a community.

9.2.3 The Plan

- Support realignment of boundaries where there is community support.

9.2.4 Social, Environmental, Economic and Hydraulic Appraisal

The proposal will have positive social and economic impacts as it would allow better operation of farm properties. Improved operation may also have environmental benefit as it should lead to better management of wetland areas. There will be no impact on flood hydraulics.

9.2.5 Priority

The proposal is Low priority.

9.3 Indemnity

9.3.1 The Problem

Most drains within the floodplain are privately owned but can affect adjoining landholders. There is some diversity in approach between landholders. Some want to modify drains or change their management, while others are concerned that any changes might adversely impact on flooding, local drainage and water quality issues.

As a consequence there is a fear that anyone who introduces changes could be sued by a neighbour.

9.3.2 Discussion

The Floodplain Management Study recommended an approach to government to provide indemnity to individuals against claims for damages arising from modifications to flood control, drainage works or practices carried out in accordance with the Plan. The indemnity would be similar to that now applied to councils in relation to flood advice and mitigation works.

It may be that many of the objectives of this indemnity can already be achieved by appropriate use of Council’s powers and planning instruments.
In the first instance Council will prepare a report, including legal advice, setting out the powers already available and extra powers seen to be required. If necessary, this report will form the basis of a submission to Government.

If this step is taken Council will seek the active support of other Councils and Regional bodies as well as Government Departments and peak industry bodies.

9.3.3 The Plan

- Council to seek legal advice.
- If necessary, Council will approach Government and seek the active support of other interested parties.

9.3.4 Social, Environmental, Economic and Hydraulic Appraisal

The positive effects of improved drainage on the environment and local economy are discussed in Section 8.1. This initiative will assist in the process.

9.3.5 Priority

The legal report should be High priority. If necessary the indemnity issue should be pursued as High priority as it has the potential to delay many initiatives in this Plan.

9.4 Social Impacts

9.4.1 The Problem

It is recognised that the social impacts of flooding and flood mitigation have not been given their due consideration to date. This has led to the perception that the welfare of some portions of the floodplain has been compromised when compared with others.

9.4.2 Discussion

Any further evaluation of the flood mitigation scheme and its operation will take full notice of social issues, including the trauma and stress associated with the flood experience and the possibility of generating employment under a more predictable flood regime.

9.4.3 The Plan

- All further evaluations of floodplain initiatives are to fully consider social issues.
9.4.4 Social, Environmental, Economic and Hydraulic Appraisal

This will ensure that the social ramifications of any proposal are properly evaluated.

9.4.5 Priority

This is an Ongoing priority.

9.5 Stock Management

9.5.1 The Problem

The Rural Lands Protection Act currently does not allow the movement of stock on public roads without a permit. This is clearly impractical in times of emergency such as a flood (or fire).

9.5.2 Discussion

The solution to this problem lies in an amendment to the Rural Lands Protection (RLP) Act. A suitable amendment is reportedly being considered but has not yet been finalised.

Council has been advised by the Minister for Agriculture, “that there is nothing in the RLP Act which would prevent Council displaying fixed signs” during times of flood - “this may provide a warning to motorists of the presence of stock, irrespective of whether the person in charge of any stock has displayed his or her own signs.”

Council has four signs ready to be erected on the Highway. Another ten should be provided for local main roads.

In light of the Minister’s advice a Stock Sub-Plan should now be prepared.

9.5.3 The Plan

- Council will lobby for amendment to the RLP Act to allow movement of stock without a permit in an emergency, subject to local authority approved signs being in place.
- Council to erect signs at appropriate locations.
- Stock Sub-Plan to be prepared.

9.5.4 Social, Environmental, Economic and Hydraulic Appraisal

This will allow more efficient evacuation of stock in emergency conditions thus reducing losses and stress. There will be no hydraulic or environmental impact.
9.5.5 Priority

Erection of signs and preparation of Stock Sub-Plan are High priority. The lobbying process should be considered Medium priority.

9.6 Roads & Traffic Authority Involvement

9.6.1 The Problem

The Roads & Traffic Authority (RTA) has historically carried out roadworks, including raising of the Pacific Highway, with minimal consultation with Council and residents. There are claims that this work has, on occasions, worsened flooding of properties.

9.6.2 Discussion

Council will request the RTA to liaise with both itself and local residents prior to implementing any works which may impact on flooding or drainage. The request will also include a review of some outstanding issues which have not yet been resolved to the satisfaction of the local communities.

9.6.3 The Plan

- RTA will be requested to liaise with Council and residents and to provide information on unresolved issues.

9.6.4 Social, Environmental, Economic and Hydraulic Appraisal

There will be a positive social benefit from allowing people a say in matters affecting their welfare and ensuring that the full ramifications of any proposal are considered. Economic, environmental and hydraulic issues will be addressed in the context of specific proposals.

9.6.5 Priority

The request to RTA should be High priority as the plans to upgrade the Pacific Highway between Hexham and Tweed Heads will impact on the Macleay River floodplain at some time.

9.7 The Greenhouse Effect

9.7.1 The Problem

There are predictions that the increase in Greenhouse gases will change rainfall patterns and raise ocean levels. The net local impact of these possible changes is unknown.
9.7.2 Discussion

There is still no clear cut, quantitative advice on the possible ramifications of Greenhouse. At this stage, the general approach in flood mitigation is to wait and see, although some Councils (e.g. Hastings) have increased freeboard allowances.

9.7.3 The Plan

- Council will monitor information and predictions regarding the Greenhouse Effect to determine if more advanced knowledge will adversely impact on any of the recommendations of this Plan.

9.7.4 Social, Environmental, Economic and Hydraulic Appraisal

The impact of the Greenhouse Effect is still not quantifiable.

9.7.5 Priority

The monitoring should be Ongoing.
10. CROSS-REFERENCE TO FLOODPLAIN MANAGEMENT STUDY RECOMMENDATIONS

Table 2: Cross - Reference to Floodplain Management Study Recommendations

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</table>
11. IMPLEMENTATION STRATEGY

Table 3 sets out a proposed timetable for the implementation of the policy outlined in the foregoing chapters and summarised in Table 1. The timetable recognises the priorities attached to the various issues but also accepts that some High priority issues will require significant time and funding. On the other hand some Medium priority issues can be resolved with relative ease and hence will be implemented earlier.

The proposed timetable is very much dependent on the availability of funding, both from within Council and from the government, and the overall priorities of Council. It is, therefore, intended to be indicative, not prescriptive.

The following have been implemented during preparation and discussion of the Plan:
- install new gauges at Seven Oaks Bend and Rainbow Beach,
- commence work on Belmore and Kinchela levees.
Table 3: Implementation Strategy

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>Work</th>
</tr>
</thead>
</table>
| 1999          | Adopt 1 in 100 Flood Standard.  
                | Adopt 1 in 100 flood levels.  
                | Establish interim floor levels.  
                | Upgrade warning dissemination.  
                | Plan public education program.  
                | Consider the need for more water level gauges.  
                | Commence structural work associated with Belmore and Kinchela levees.  
                | Survey Macleay levees.  
                | Flood mounds - seek advice on funding.  
                | - waive application fee.  
                | Document scheme operation and maintenance procedures.  
                | Establish first drainage management groups.  
                | Determine drainage management criteria to modify operations Belmore and Kinchela Headworks.  
                | Plan additional water quality monitoring areas.  
                | Produce Upper Belmore WQ database.  
                | Seek legal advice on indemnity.  
                | Install stock signs.  
                | Prepare Stock Plan.  
                | Lobby to amend Act on stock movement.  
                | Liaise with RTA. |
| 2000          | Commence public education program.  
                | Smithtown levee concept design.  
                | Investigate options for Jerseyville.  
                | Continue structural work associated with Belmore and Kinchela levees.  
                | Consider modifications to Belmore and Kinchela operations.  
                | Resolve works required below Jerseyville.  
                | Commence work on rehabilitating Macleay levees.  
                | Flood mounds - determine approval process.  
                | Establish further drainage management groups.  
                | Establish consent protocol.  
                | Begin to modify operations Clybucca Headworks.  
                | Initiate Estuary Processes Study, including bank erosion. |
| 2001          | Frederickton levee concept design.  
                | Gladstone levee concept design.  
                | Complete structural work associated with Belmore and Kinchela levees.  
                | Produce first drainage management DCP. |
| 2002          | Decide on village levees.  
                | Establish final drainage management groups. |
| After flood events | Assess effectiveness of flood warning and dissemination.  
                | Review operation of flood mitigation on scheme. |
| Ongoing       | Monitor Yarrahapinni.  
                | Fully consider social impacts of all proposals.  
                | Monitor Greenhouse.  
                | Desk top flood simulation exercise with LEC every two years.  
                | Continue water quality monitoring. |
GENERAL RECOMMENDATIONS

3. Minimum floor levels at each village
4. Public education program
5. Bank erosion, management plan
6. Dredging of the main river is not a practical option
7. Investigate funding for flood mounds
8. Continue to upgrade communications
9. Re-examine flood mitigation scheme performance
10. Modify management practices to raise water table
11. Consider buy back or lease back of land to assist environmental objectives
12. Consider realigning property boundaries
13. Seek indemnity for drainage changes to improve water quality
14. Consider employment opportunities in changing management practices
15. Investigate ASS management methods
16. Amend Act on stock movement
17. Monitor greenhouse impacts

LEGEND
- National Parks
- Rivers, Creeks and Drains
- Management Area
- Management Area Boundary

SCALE 1:100000
APPENDIX A: PROPOSED AMENDMENTS TO COUNCIL’S FLOODPLAIN MANAGEMENT STRATEGY POLICY

A1. Disclaimer

This Appendix suggests amendments to the Floodplain Management Strategy Policy (the Policy) where the Floodplain Management Plan (the Plan) indicates that the Policy should be updated or altered. The suggestions only cover issues and areas which fall within the ambit of the Plan. Areas of the Shire outside of the study area covered by the Plan (i.e. above Frederickton, including Kempsey, sections of South West Rocks and the area south of Crescent Head Road), are not included in this review.

All numbers below refer to the Policy section numbers.

1.1 Add “The policy was reviewed in the light of the Lower Macleay Floodplain Management Plan, 1999.”

1.2 Change “...the Government’s policy statements...” to “the Government’s floodplain management policy as presented in the Floodplain Development Manual”.

1.3 Change “Public Works Department” to “Department of Land and Water Conservation”.

Replace last sentence with “This study has now been supplemented by the Lower Macleay Floodplain Management Plan which covers the floodplain and villages below Frederickton”.

1.4 To be reconsidered. If Council do not intend to produce maps then this should be deleted.

1.5 Change “....Study, Public Works Department data” to “Studies, Department of Land and Water Conservation data”.

2.1 et seq.

All references to “1 in 100 year flood” are no longer correct terminology as per Australian Rainfall and Runoff. They should be replaced with “1 in 100 flood”.

2.2 The definition of the 1 in 100 flood should be replaced by that given in the Glossary of this report.

The note on this section is outside the scope of the Plan but reference to the Kempsey Flood Study suggests “8.70m” should be “8.70 mAHD or approximately 8.20 m gauge height.”

2.3 The definition of flood free land should be reconsidered, especially in the light of foreshadowed changes to the Manual. All land below the PMF level should be considered within the floodplain policy.
2.4 This might be replaced by the definition in the Glossary, which in turn is taken from the Manual.

4.2 This section could be deleted in the light of present State Government policy.

6.1.3 Serious consideration should be given to banning new residential development in designated floodways. The issue of flood evacuation should also be identified as a matter for consideration. The concern here is what areas are covered by the designated floodways and whether velocity and depth issues are a problem in these areas.

6.2.5 Delete “but this will not apply in respect of the villages of Smithtown, Gladstone, Kinchela and Jerseyville” as this exclusion is in conflict with Clause 12(1) of the LEP.

6.2.6 Amend to ban subdivisions within defined floodways.

7.2 Quote all levels in mAHID and amend the following levels:

- Smithtown: 5.6 mAHID
- Southern point: 5.3 mAHID
- NE corner: 5.0 mAHID

- Gladstone: 5.3 mAHID
- Kinchela: 4.7 mAHID
- Spencerville: 4.05 mAHID
- Jerseyville: 4.05 mAHID

Note: The levels to the west of Frederickton (Annexure No 8) and around South West Rocks (Annexures 9 and 10) are outside the scope of the FMP.

11.1 a. ii Do such maps exist? If so do they use current hydraulic information?

Additions: The Policy should contain a section discussing the need for evacuation planning. New developments should not be allowed unless a suitable practical evacuation plan is prepared which will demonstrate that the development will not place additional strain on emergency services.