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TABLE OF CONTENTS

PREAMBLE ......................................................................................................................... iii

1.0 INTRODUCTION .............................................................................................................. 1
1.1 Overview ....................................................................................................................... 1
1.2 Vision Statement ......................................................................................................... 1
1.3 Objectives ................................................................................................................... 1
1.4 The Study Area
   1.4.1 Overview ............................................................................................................. 1
   1.4.2 Flooding .............................................................................................................. 2

2.0 LEGISLATION AND POLICY OVERVIEW .................................................................. 5
2.1 The Flood Prone Land Policy .................................................................................... 5
2.2 Water Act 1912 and Water Management Act 2000 .................................................. 5
2.3 Additional Floodplain Management Controls ......................................................... 5
2.4 Relevant Management Plans .................................................................................... 5

3.0 HYDRAULIC ASSESSMENT OVERVIEW .................................................................. 6
3.1 Overview ..................................................................................................................... 6
3.2 Modelling Procedure ............................................................................................... 6

4.0 FLOODPLAIN MANAGEMENT PRINCIPLES ............................................................. 7

5.0 DEVELOPMENT ASSESSMENT CRITERIA ................................................................. 8
5.1 Overview ..................................................................................................................... 8
5.2 Adopted Criteria ........................................................................................................ 8
   5.2.1 Design Flood Event ............................................................................................ 8
   5.2.2 Historical (for existing flood control works only) ............................................. 8
   5.2.3 Socio-Economic ............................................................................................... 9
   5.2.4 Ecological ....................................................................................................... 9
   5.2.5 Flooding Behaviour ....................................................................................... 9

6.0 FLOODPLAIN MANAGEMENT ISSUES ..................................................................... 11
6.1 General ....................................................................................................................... 11
6.2 Staging ....................................................................................................................... 11
6.3 General Issues
   6.3.1 Unauthorised Works ....................................................................................... 12
   6.3.2 Supply Channels ............................................................................................. 12
   6.3.3 Probable Maximum Flood (PMF) ..................................................................... 12
6.4 Specific Issues ........................................................................................................... 13

7.0 THE FMP FLOODWAY NETWORK ............................................................................ 19

8.0 ENVIRONMENTAL ASSESSMENT ............................................................................. 21
8.1 Overview .................................................................................................................... 21
8.2 Environmental Assessment Summary ...................................................................... 21
8.3 Instream Works ....................................................................................................... 22
8.4 Downstream Floodplains ......................................................................................... 22
8.5 SWMOP Target NO. 25 ......................................................................................... 23
9.0 RELATED ISSUES AND MANAGEMENT PRACTICES

9.1 Landuse Management

9.1.1 General

9.1.2 Best Management Practices

9.1.3 Specific Limited Landuse Areas

9.2 Maintenance of Floodways

9.3 Monitoring

9.3.1 Flood Monitoring

9.3.2 FMP Review

9.4 Riparian Buffer Zones

9.5 Road Raising

10.0 IMPLEMENTATION STRATEGY

10.1 General

10.2 Performance Assessment

10.3 Approval of Flood Control Works

10.3.1 General

10.3.2 Works That Require Approval

10.3.3 Applying for Approval

10.3.4 Determination Process

10.3.5 Possible Determinations

10.3.6 Typical Approval Conditions

10.4 Unauthorised Flood Control Works

10.5 Complying and Non-Complying Works

10.5.1 Complying Works

10.5.2 Non-Complying Works

10.5.3 Roads and Railways

APPENDIX A – GLOSSARY & ABBREVIATION

FIGURES

Figure 1 – FMP Study Area

Figure 2 – FMP Sub-Areas

Figure 3 – Specific Modifications Floodway Network & Existing & Proposed Works (Area A)

Figure 4 – Specific Modifications Floodway Network & Existing & Proposed Works (Area B)

Figure 5 – Specific Modifications Floodway Network & Existing & Proposed Works (Area C)

Figure 6 – Pre-development Floodway Network Area A, B & C

Figure 7 – Floodplain Vegetation and Wetlands

TABLES

Table 1 - Assessment Criteria – Maximum Permissible Velocities

Table 2 – Required Modifications (Area A)

Table 3 – Required Modifications (Area B)

Table 4 – Required Modifications (Area C)

Table 5 – Environmental Assessment Summary
PREAMBLE

The Caroona - Breeza Floodplain Management Plan (hereafter the Caroona - Breeza FMP) has been prepared by the Water Administration Ministerial Corporation (hereafter WAMC) under Part 8 of the Water Act 1912 and in accordance with the processes outlined in the NSW Governments Floodplain Management Manual (2001). The preparation of the FMP was overseen by the Caroona - Breeza Floodplain Management Committee (hereafter FMC), which comprises representatives from the community, various stakeholder groups and government agencies. Funding for the project was provided by the Natural Heritage Trust (NHT) and the NSW Government.

Please note, that the Department of Natural Resources (hereafter DNR) acts on behalf of WAMC for all matters relating to Part 8 of the Water Act 1912. WAMC is the body who prepares, adopts and administers FMPs, as well as receives and determines Part 8 applications.

A Floodplain Management Plan aims to minimise the flood risk faced by occupiers of the floodplain and to support the natural functions of the floodplain environment. The Caroona-Breeza Floodplain Management Plan provides a framework for improving the drainage of the floodplain system, as well as resolving landuse management issues. Implementation of the plan will provide the community with greater security against flood risk and will allow for the sustainable management of riparian and floodplain ecosystems.

Since the 1970’s there has been major landuses changes within the Caroona – Breeza floodplain system with many properties moving to cultivation and irrigation development. While the area is a very successful farming and irrigation area, incidences of flood damage over the last forty years have triggered the uncoordinated construction of crop protection works. In common with many other rural areas that have undergone irrigation development, the Mooki River floodplain is showing signs of stress related to alterations in flow patterns across the floodplain and unsustainable landuse practices. As such it was considered necessary to undertake a floodplain management study for the Caroona – Breeza floodplain area.

Due to the need to achieve effective long-term management of rural floodplain systems based on ecological sustainable development FMPs are gradually being developed and adopted. FMPs encourage community involvement in identifying catchment issues and developing management strategies that are consistent with and reflect natural resource policies within the integrated catchment management framework. Such strategies also attempt to balance resource sustainability with social and economic objectives.

Development of the FMP has progressed through three (3) primary phases -

- **Flood Study** – defines the nature and extent of flooding and flood-related issues (hydraulic, environmental, and cultural) in technical terms;

- **Floodplain Management Study** – evaluates management options in consideration of social, environmental, and economic factors, in order to address existing and future flood risk and flood management issues; and

- **Floodplain Management Plan** – outlines strategies to manage flood risk and flood management issues, and support the natural functions of the floodplain environment.
1.0 INTRODUCTION

1.1 Overview

A Floodplain Management Plan (FMP) is the hub of an effective floodplain management process. The Plan has been developed on the basis of detailed analysis of flood flows and conforms with the NSW Government’s (2001) *Floodplain Management Manual and its predecessor the 1986 Floodplain Development Manual*. In formulating the *Caroona - Breeza FMP* a detailed evaluation of all factors relating to the use of flood prone land was undertaken. This includes consideration of hydraulic, environmental, cultural and socio-economic factors.

The *Caroona - Breeza FMP* aims to:

- Provide a floodway network that will improve the current drainage of the floodplain system and allow for the orderly passage of flood flows; and
- Balance the expressed requirements of landholders with the requirement to minimise the impact of floodplain development on natural flood flow patterns and ecological functions.

The FMP incorporates the key points and main outcomes of the *Caroona - Breeza Flood Study* and the *Caroona - Breeza Floodplain Management Study*. The Floodplain Management Study deals with many issues, including legislative/policy matters and the floodplain environment, in substantial detail. The reader should refer to Floodplain Management Study where background and/or greater detail are available.

Once adopted under the provisions of Part 8 of the *Water Act 1912*, the FMP must be considered by DNR when reviewing and determining approval applications for flood control works under the Act or its forthcoming replacement the *Water Management Act 2000*.

1.2 Vision Statement

Implementation of the *Caroona - Breeza FMP* will provide the community with greater security against flood risk and allow for the sustainable management of agricultural lands and flood-dependent ecosystems.

1.3 Objectives

The primary objectives of the *Caroona - Breeza FMP* are to -

- Coordinate floodplain development in order to minimise adverse changes to surface flow patterns;
- Develop and adopt floodplain management principles and development assessment criteria;
- Increase the sustainable social, economic and ecological benefits of using the floodplain; and
- Improve and maintain the diversity and well being of native riverine and floodplain ecosystems that depend on regular flood inundation.

1.4 The Study Area

1.4.1 Overview

This Floodplain Management Study is concerned with the right bank floodplain of the Mooki River between Caroona and Breeza. The study area, as identified on Figure 1, is located within the Liverpool Plains. Any land within the Liverpool Plains that has a slope of less then 2% slope is designated floodplain under Section 166 of the *Water Act 1912*. This designated floodplain area within the Caroona – Breeza study area is also illustrated on Figure 1.
The study area covers an area of approximately 285 square kilometres (km²) and is bounded by Quirindi Creek to the south, Mooki River to the west, Cana Road to the east and Breeza – Currabubula Road to the north. It lies primarily within the Local Government Area (hereafter LGA) of Gunnedah Shire and the Liverpool Plains Shire Council.

The main features of the study area are the wide plains of low surface gradient, the constriction of the plains at Breeza, the Melville Range and Nicholson Ridge. Cropping and grazing are the two primary landuses within the study area. Dryland and irrigation cropping occurs on the lower slopes and plains, whilst grazing occurs on the upper slopes.

The study area has been divided into three sub-areas for ease of investigation. These sub-areas are illustrated on Figure 2 and comprise the following:

- **Area A** – east of the Mooki River bounded by Werris Creek – Caroona Road in the south and Kamilaroi Highway in the east;
- **Area B** – east of Kamilaroi Highway bounded by Cana Road to the east, Currabubula – Breeza Road to the north and Werris Creek – Caroona Road to the south; and
- **Area C** – triangular area in the south bounded by Quirindi Creek, Werris Creek – Caroona Road and the Melville Range.

Refer to the Floodplain Management Study for a detailed overview of the floodplain environment.

### 1.4.2 Flooding

The Caroona – Breeza study area has floodwater contributions from several major drainage lines including Mooki River, Quirindi Creek, Quipolly Creek, Werries Creek, and Cana Creek. The study area is subject to flooding from a variety of sources. In addition to overflow from the above drainage lines, local runoff from the ranges in the east and Nicholson Ridge can add to flooding.

The impact of the wide plains of low surface gradient is slow moving floodwaters, which can spread out in these areas and subsequently move at slow velocities and deposit sediment. Within these areas earthworks can have a major influence on flood flows. Infrastructure such as roads and railways can dominate the behaviour of floodwaters (ERM 2001:3.23).

A number of barriers to the passage of floodwaters exist within the study area. These include the two branches of the railway (North Western Branch and Werris Creek Binnaway Branch), the Quirindi – Breeza Road, and to a lesser extent the Caroona – Breeza Road and Werris Creek – Caroona Road.

The constrictions at Breeza and that caused by Nicholson Ridge lead to concentration of the floodwaters, resulting in water moving at greater velocities. However due to the low surface gradient this increase does not directly cause any scouring. Scouring can be attributed to major earthworks rather than the topography of the area (ERM 2001:3.23).
FMP Designated Floodplain Area *

*Any land within the Liverpool Plains that has a slope of less than 2% is designated floodplain under Section 166 of the Water Act 1912.

Figure 1 - Study Area
Figure 2: FMP Sub Areas
2.0 LEGISLATION AND POLICY OVERVIEW

The management of the Caroona – Breeza floodplain must be undertaken within the current legislative and policy framework. A brief summary of the relevant primary pieces of legislation and policy is presented below. Refer to the Caroona-Breeza Floodplain Management Study (FMS) for a detailed overview of the legislation and policy framework for floodplain management.

2.1 The Flood Prone Land Policy

The primary objective of the Government’s Flood Prone Land Policy is to reduce the impacts of flooding on individual owners/occupiers of flood prone land, and to reduce private and public losses caused by flooding. A central tenet of the policy is that land use proposals for flood prone land be treated within the framework of a strategically generated floodplain risk management plan prepared using a merit approach. The Floodplain Management Manual (2001) supports the policy and outlines a merit approach to floodplain management.

2.2 Water Act 1912 and Water Management Act 2000

DNR takes the lead role for floodplain management in the western rural areas of NSW through its administration of Part 8 of the Water Act 1912. Part 8 was gazetted in 1984 and makes provisions to control rural works that affect, or are likely to affect, flooding and/or floodplain functions. Part 8 was amended in 1999 to allow for more strategic control of rural flood control works through the preparation of FMPs and a more streamlined and resource efficient approval process. The amended Water Act provides for a broader consideration of issues in the approval of existing and proposed flood control works and strengthened WAMC’s ability to deal with unauthorised works.

At the time of preparing this FMP the State Government initiated wide-ranging reform of water legislation, with the outcome being the new Water Management Act 2000. While the water licensing and flood control provisions of the Water Management Act are not yet in operation, the new Act will eventually replace the Water Act.

2.3 Additional Floodplain Management Controls

There are several additional legislative acts and policies that are relevant to floodplain management and the approval process for flood control works. The majority of these relate to floodplain environmental matters such as flora and fauna, wetlands, threatened species, and fish habitat.

Of particular importance is the Environmental Planning and Assessment Act 1979. As the determining authority for flood control works, DNR is required to assess the environmental impact of all proposed works under Part 5 of the Act.

2.4 Relevant Management Plans

Floodplain management comes under the umbrella of catchment planning. The Caroona Breeza FMP should be viewed as one component of the integrated planning process, with other components including –

- Water Sharing Plan for Phillips Creek, Mooki River, Quirindi Creek and Warrah Creek Water Sources
- Namoi Catchment Action Plan (in progress);
- Upper Namoi Ground Water Sharing Plan;
- Namoi Catchment Blueprint; and
- State Water Management Outcome Plan.
3.0 HYDRAULIC ASSESSMENT OVERVIEW

3.1 Overview

Implementation of floodplain management measures requires a detailed understanding and knowledge of flooding behaviour within the study area. To supplement available information on historical flood events, computer-based hydraulic models can be used to simulate flooding behaviour. Information derived from hydraulic modelling includes flood flow distribution, flood levels and flood flow velocities within the floodplain. A hydraulic model can also be used to assess the impact on flood behaviour of structural management options and any proposed flood control works.

The hydraulic modelling of the Caroona - Breeza area was undertaken using a numeric model known as RMA-2, which is a commercially available engineering package. RMA-2 is a two-dimensional finite element hydrodynamic model used for the simulation of river and floodplain flows. The model is widely used throughout Australia and overseas.

Refer to the Caroona - Breeza Flood Study for detailed information regarding the hydraulic modelling of the system including input data and calibration methods.

3.2 Modelling Procedure

Modelling of the Caroona - Breeza study area involved two distinct phases.

- **Flood Study Modelling**
  - **Pre-Development Conditions Modelling** - modelling of the floodplain system prior to the commencement of landuse change from grazing to cropping and development. This modelling was undertaken in order to obtain information on the natural flooding behaviour within the study area; and
  - **Existing Conditions Modelling** - modelling of the floodplain system after the area had experienced significant irrigation development. The modelling was undertaken in order to quantify any changes to the natural flooding characteristics within the study area.

- **Floodplain Management Study Modelling** - areas with flood-related issues were modelled with various modifications in order to determine potential and optimised solutions. In most instances, issues were treated collectively in order to determine the impact on surrounding areas and any cumulative impacts. The identified issues included –
  - Specific issues raised by the FMC or the community with regard to existing conditions; and
  - Areas where significant disparities were identified between the flooding behaviour of the pre-development conditions model and the existing conditions model.

The models are well suited to predicting the change in flood behaviour due to existing or proposed floodplain development and served as an aid to the FMC in their decision making process.
4.0 FLOODPLAIN MANAGEMENT PRINCIPLES

A FMP typically aims to cater for flood flows, provide flood mitigation, encourage sustainability and maintain flooding to flood-dependent ecosystems. It will need to adhere to an overall set of management principles. The principles adopted by the Caroona - Breeza FMC are listed below:

- Defined floodways must possess adequate hydraulic capacity and continuity to enable the orderly passage of floodwaters through the floodplain.
- Any system of defined floodways should conform as closely as is reasonable to the natural drainage pattern after taking into account the existing floodplain development.
- Floodway areas should be equitably allocated (between adjacent landholders) consistently with natural/historical flowpaths.
- Environmental issues related to the floodplain management plan need to be identified and investigated including developing strategies for flood dependent ecosystems such as wetlands, riparian vegetation, and any other environmentally sensitive areas.
- The exit of floodwaters from defined floodways should be at rates and depths similar to those that would have been experienced under natural/historical conditions and should discharge as close as practicable to the location of natural/historical floodways.
- Sufficient pondage must be retained on the developed floodplain so that the flood peak travel time is not unduly accelerated to downstream users or its height increased.
- Velocities of flood flow in defined floodways should be minimised and be of an order which would not cause erosion or increased siltation under various land uses.
- There should be no detrimental impact from floodplain development on any individual landholder or community infrastructure including increases in peak flood levels and increased drainage times.
- Floodplain development should not cause significant redistribution of floodwater.
- Socio-economic issues relating to floodplain management need to be identified and investigated. This includes considering both tangible damages (can be readily measured in monetary terms) and intangible damages (includes increase levels of emotional stress, physical illness and disruption to daily life).

These principles are adhered to and reflected within the FMP through adopted assessment criteria and will be applied by DNR when considering Part 8 applications under the Water Act.
5.0 DEVELOPMENT ASSESSMENT CRITERIA

5.1 Overview

In order to apply the floodplain management principles the Caroona - Breeza FMC developed and adopted specific hydraulic, environmental and socio-economic criteria. Such criteria support the decision making process and assists in balancing flood risk, socio-economic and environmental factors.

Assessment criteria can be applied when assessing proposed modifications or proposed new flood control works under Part 8 of the Water Act 1912. In this manner, criteria provide a consistent approach by ensuring all issues are considered and can assist in formulating approval conditions. While the criteria cannot make the final decision when assessing proposals, they can ensure that all issues will be considered. Ultimately an informed decision has to be reached by DNR.

5.2 Adopted Criteria

5.2.1 Design Flood Event

The design event is the flood event adopted as the basis for planning and controlling development on flood liable land. Within the Mooki River system records indicate that the 1955, 1998 and 2000 flood events are the largest events that have been experienced within the area. However the Caroona – Breeza FMC was more concerned about catering for the more common smaller nuisance floods than the infrequent significant events.

The Caroona – Breeza Floodplain Management Committee has selected the following Design Flood Events.

- 1-20 yr (ARI) Mooki River and Quirindi Creek
- 1-10 yr (ARI) Local Creeks eg – Cana creek
- 1-1 yr (ARI) Low flow drainage lines eg – Residual flow drains

Refer to Appendix A for the definition of ARI and AEP.

5.2.2 Historical (for existing flood control works only)

- Licensed / Long standing works – works that comply with the ‘original’ licensed works will normally be accepted, unless additional information and/or flood observations illustrate that the works have a significant adverse impact on flood flows. This may mean that these works may not necessarily meet the criteria contained in the Plan.

- Concerns and Objections – any on-going concerns and/or objections from neighbouring landholders must be taken into consideration during the assessment process.

5.2.3 Socio-Economic

- Disruption to Daily Life – unless previously agreed between all affected landholders, flood control works should not result in significant disruption to the daily life of surrounding landholders (eg. property access).

- Health Impact – flood control works should not impose potential negative health impacts or stress on surrounding landholders.

- Cost of the Works – is the associated cost and benefit(s) of undertaking the work(s) warranted? In some cases it may be necessary to undertake a cost/benefit analysis (preliminary assessment may be adequate) in order to weigh up the hydraulic and/or environmental benefit(s) of undertaking the work(s) against the required expenditure. This must be determined through consultation with the affected stakeholders and DNR.

- Infrastructure Damage – flood control works should not pose detrimental impact on any individual landholder or on community infrastructure including increases in peak flood levels and drainage times.
- **Equity** – previous agreements between landholders regarding floodways should hold when a new landholder buys in. That is the onus is on the new landholder (the ‘buyer beware’ principle). This is a legal issue and not one that the FMP attempts to cover, however it is strongly suggested that written proof regarding these agreements be kept in case a legal issue arises.

   It should be noted that one development proposal cannot limit the future potential of other landholders to develop.

5.2.4 **Ecological**

- **Wetland Connectivity** – flood control works should not block or restrict natural flowpaths or floodways that feed wetland areas nor alter the flooding regime to these areas.

- **Floodplain Flora and Fauna** – flood control works should not isolate flood-dependent ecosystems from flood flow. The potential impact on habitat availability and threatened species may need to be assessed.

- **Soil Condition and Structure** – flood control works should not impose negative impacts on soil structure or condition. For example, works should not increase the potential for scour and erosion and should not block flow to significant areas of floodplain soils.

- **Fish Passage** – flood control works should not significantly block or restrict the free passage and migration of fish within the floodplain environment.

- **Cultural Sites** – unless an agreement has been reached with the NPWS and the local Aboriginal lands council, flood control works should not destroy or damage any Aboriginal site or relic and should not block or restrict the delivery of flood flows to scarred and carved trees that rely on flooding regimes.

- **Groundwater Recharge** – flood control works should not block or restrict flood flow to identified groundwater recharge areas.

5.2.5 **Floodling Behaviour**

- **Natural Flooding Characteristics** - flood control works should not result in a significant departure from the natural flooding pattern of the floodplain (after taking into account existing floodplain development).

- **Hydraulic Capacity** – flood control works should not reduce the hydraulic capacity and continuity of floodway areas (should enable the orderly passage of floodwaters through the floodplain).

- **Pondage and Flow Duration** – flood control works should not significantly impact on pondage duration on the developed floodplain or cause flood peak travel time to unduly accelerate to downstream users.

- **Works in Floodways** – generally proposed flood control works will not be approved within the FMP Floodway Network, with the exception of farm access roads below 150mm above ground level and supply channels at or below ground level (assuming that such works do not result in significant redistribution or trigger other assessment criteria).

- **Redistribution** – acceptable increases in peak flood levels and percentage peak flow redistribution, as a result of flood control works, should be assessed against the following guideline values:
  - Increase in peak levels on a neighbours boundary to be a maximum of 0.1 metres of pre-development levels;
  - Influence of floodwaters onto a neighbour’s property must be no greater than 100 metres.
  - Duration of standing floodwaters on a neighbour’s property must not exceed 12 hours.
  - A 0.3 metre increase in peak flood level is unacceptable. Consultation needs to happen with neighbours between a 0.1 metre and 0.3 metre increase in peak flood level and;
  - Water must continue on its normal path, no more than 2% of it can be redistributed.

Each case should be assessed individually against the above guideline values and a more satisfactory outcome may be achieved by holding discussions with all affected landholders. Applications for works that exceed the above redistribution guidelines will be considered as non-complying works and must be subject to the Part 8 approval application process. Such works will generally not be approved unless an agreement has
been reached between the applicant, DNR and surrounding landholders and the relevant environmental criteria met.

- **Flow Velocities** – flood control works should not significantly increase velocities of flood flow within floodways. Velocities should be of an order that does not significantly increase erosion and siltation under various landuses. As a general rule and using the figures in Table 1 as the maximum/limiting flow velocities, velocities should not increase by more than 50% from the pre-development flow velocities.

<table>
<thead>
<tr>
<th>Ground Condition</th>
<th>Maximum Permissible Velocity (m/s)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bare soil</td>
<td>0.4</td>
</tr>
<tr>
<td>Crop</td>
<td>0.6</td>
</tr>
<tr>
<td>Native tussocky grass</td>
<td>0.8</td>
</tr>
</tbody>
</table>

* Values based on soil classification of medium to heavy clay, highly pedal with moderate dispersibility (NSW Soil Conservation Service)
6.0 FLOODPLAIN MANAGEMENT ISSUES

6.1 General

In order to finalise the adopted FMP Floodway Network, identified floodplain management issues needed to be investigated. These issues included existing flood control works that were identified during the consultation phase as possibly resulting in flooding problems, as well as proposed new flood control works. To address the identified issues, hydraulic modelling was undertaken and the adopted assessment criteria were applied in order to determine the best possible options.

It is important to remember that all proposed and existing flood control works within the study area require approval under Part 8 of the *Water Act 1912*. Where no approval exists, DNR may take the relevant action(s) under the Act.

With regard to the issues outlined in Sections 6.3 and 6.4 please note the following:

- Required modifications to existing works will be administered under the relevant sections of Part 8;
- Minor modifications to existing approved works identified to be necessary will be administered through modifying the Part 8 approval conditions under Section 176A of the *Water Act 1912*; and
- With regard to unapproved works, directions for remedial work(s) may be used as a means of encouraging landholders to bring the subject work(s) within the *Water Act 1912* by lodging an application for approval that is complying (refer to Section 11.6) with the FMP. It is envisaged that the approval process for complying works will be more expedient.

Please refer to Section 11.4 for further details regarding approval of flood control works and administration of the FMP under the *Water Act 1912*.

6.2 Staging

The staging of any works and modifications need to be considered by the Caroona – Breeza FMC. Please refer to the following tables with regard to these works. The following should be noted with regard to the staging timeframes identified:

- **12 months** - modification works that need to be undertaken within 12 months of the FMP being gazetted. They are considered critical and mostly require major works. They include works that should be undertaken in order to rectify existing problems prior to the next significant flood event.
- **6 months** - modification works that need to be undertaken within 6 months of the FMP being gazetted. While they are considered less critical and require minor works, they are still significant in terms of the effective floodplain functioning.
- **Landholder Discretion** – it has been determined that these proposed works will not have a significant impact on surrounding properties and as such landholders can lodge of Part 8 application at their discretion.
6.3 General Issues

6.3.1 Unauthorised Works

For the purposes of this section, an unauthorised work is a flood control works that have been constructed other than in accordance with an approval that is in force under Part 8 of the Water Act 1912.

In order to improve flooding and floodplain management issues, all unauthorised flood control works within the study area must be modified or repaired to render the work in accordance with its Part 8 approval conditions. This is the responsibility of individual landholders and should be carried within 12 months of this FMP being gazetted.

6.3.2 Supply Channels

Supply channels that encroach into floodways have the potential to redistribute flood flow. Channels that are above ground level have the potential to act as weirs, restricting the passage of flow and increasing upstream water levels during flood events. Although the impact from an individual channel may not be of concern, the cumulative impact of all supply channels above ground level within the study area is likely to contribute to significant downstream distribution issues.

Unless otherwise approved by DNR, all existing and proposed supply channels that encroached into floodway areas must be lowered to ground level with the spoil removed. This is the responsibility of individual landholders and should be carried out within 12 months of this FMP being gazetted.

Where necessary, this requirement will be attached to new applications and renewal applications for supply channels as an approval condition under Part 8 of the Water Act 1912.

6.3.3 Probable Maximum Flood (PMF)

The PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Typically this works out to be 3 to 5 times a 1 in 100 year flood event. Generally, it is not physically or economically possible to provide complete protection against this event FMP defines the extent of flood prone land.

The extent, nature and potential consequence of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event should be considered in a floodplain management. The PMF or extreme event provides an upper limit of flooding and associated consequences for the problem being investigated. In Urban areas it is used for emergency response planning purposes to address the safety of people and to assist in the location of critical infrastructure such as hospitals.

The Caroona-Breeza FMP land use is predominantly rural and therefore the PMF has not been investigated, however if a change in land use or development is proposed then the PMF or extreme event may need to be considered.
6.4 Specific Issues

In order to improve the current flood flow distribution and contribute to a coordinated flooding system within the study area, the modifications outlined in Tables 2 - 4 and illustrated on Figures 3 - 5 are necessary. These are legitimate issues that the committee nominated to be addressed. In circumstances where ever it is relevant appropriate conditions to be attached to the approved works to ensure no damage to RLPB land. Any access roads that cross the Stock Route must adhere to the RLPB Act and any damage by the watercourse to be met by landholders.

Table 2 – Required Modifications (Area A)

<table>
<thead>
<tr>
<th>Area or Stakeholder</th>
<th>Required and/or Recommended Modification Works</th>
<th>Staging*</th>
<th>Responsibility</th>
</tr>
</thead>
</table>
| Gunnedah Shire Council | • Culverts to remain as they are. DNR will provide a longitudinal section along the Gunnedah – Quirindi road. Water is proposed to drain parallel to road on the western side (A)  
• Council indicated that the two causeways are in place. Any future causeways must be constructed in a manner so that they will not affect the adjoining landholder. (B) | 12 Months  | GSC            |
| “Five Mile” | • A 60 to 80 metre wide floodway is required. Consideration will be given to the effectiveness of the floodways during a flood event.  
• Care to be taken to ensure exit condition of the floodway are to the satisfaction of the down stream neighbours (C&D) | 12 Months  | Landholder     |
| “Ridge Station” | • Re-establish level control on the outlet of Dirty Lagoon for flood flows, with aim to return dirty lagoon to its former state (Issue F) (Level to be at 301.50 meters AHD)  
• Construct the current proposed works (Works include a 80m-floodway and training banks to accommodate a 50/50 flow distribution from "Dirty Lagoon", Refer to Fig 3 for details.) Appropriate conditions to be attached to the approved works to ensure no damage to RLPB land. Any access roads that cross the Stock Route must adhere to the RLPB Act. | 12 Months  | Landholder     |
| “Garawan” | • Maintain uninterrupted floodways (minimum 80 metres) between the floodways from “Five Mile” and the two natural drainage points to the Mooki River; (H) | 12 Months  | Landholder     |
| “Glencohen” | • Cater for low flow drainage in the irrigation in conjunction with limited height earthworks (I) | 12 Months  | Landholder     |

* Time period from when the FMP is gazetted
**Figure: 3:**
Specific Modifications
Floodway Network & Existing & Proposed Works
(Area A)

*Excepting storages, all existing works have a maximum height of 0.5m above the natural surface unless specified.*

Caroona - Breeza Floodplain Management Plan
June 2006

Prepared by: DN R
Date Printed: August 2005

Refer to the Floodplain Study for details regarding data used & DN R responsibilities
Table 3 – Required Modifications (Area B)

<table>
<thead>
<tr>
<th>Area or Stakeholder</th>
<th>Discussion</th>
<th>Required and/or Recommended Modification Works</th>
<th>Staging*</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Side of Railway</td>
<td>The low flow channel through “Boala” and “Coburn” is currently causing erosion at the outlet area on “Bourkes Block” (J)</td>
<td>Removal of existing drain and construction of bank to train flows is to be considered within the shaded area. The effect of these works is to be consistent with the agreed criteria. The criteria for this is that there are to be no impact up on ‘Alpha’ and the exit velocity is to be assessed.</td>
<td>12 Months</td>
<td>Landholder</td>
</tr>
</tbody>
</table>
| Northern Side of Railway | The 460 m long levee bank on “Coburn” is:  
- Concentrating flows between the western portion of the levee and the railway line; and  
- Causing inundation of “Alpha”. (K) |  
- To remain as it is.  
- Further investigation is needed to assess erosion problems | 12 Months | Landholder |
| Northern Side of Railway | The 2400 m long supply channel running east to west on “Bourkes Block” is causing:  
- Flood waters to back-up on the upstream face of the channel; and  
- Inundation of “Boala”. (L) |  
- The supply channel will remain as it is | 12 Months | Landholder |

* time period from when the FMP is Gazetted
**Figure 4:** Specific Modifications
Floodway Network & Existing
& Proposed Works
(Area B)

*Excepting storages, all existing works have a maximum height of 0.5m above the natural surface unless specified.*

Caroona - Breeza Floodplain Management Plan June 2006

Prepared by DNR, Date Printed: August 2005

Refer to the Floodplain Study for details regarding data used & DNR responsibilities.
### Table 4 – Required Modifications (Area C)

<table>
<thead>
<tr>
<th>Area or Stakeholder</th>
<th>Discussion</th>
<th>Required and/or Recommended Modification Works</th>
<th>Staging*</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Spring Creek”</td>
<td>The bank on “Spring Creek” impacts upon the Woodland Road breakout. (M)</td>
<td>▪ The bank will be maintained at a minimum height of 0.4 m and a 100 m wide waterway be established in line with breakout flows travelling in a westerly direction.</td>
<td>12 Months</td>
<td>Landholder</td>
</tr>
<tr>
<td>“Berega”</td>
<td>The 1300 m levee bank on “Berega” impacts upon the downstream property. (N)</td>
<td>▪ 500m of the downstream portion of the bank will be lowered to a minimum height of 0.3m.</td>
<td>12 Months</td>
<td>Landholder</td>
</tr>
</tbody>
</table>

* time period from when the FMP is Gazetted
500m of the downstream portion of the bank will be lowered to 0.3m.
7.0 THE FMP FLOODWAY NETWORK

The FMP Flood Way Network delineates areas of the floodplain that allow the orderly passage of flows. The floodway network has been designed at a strategic level and the accuracy of it at the property level is relatively coarse.

The FMP Floodway Network is required to achieve natural flood flow distribution for two primary requirements:

- Hydraulic Requirements – floodway network is required to establish and maintain the orderly passage of flood flow through the Caroona - Breeza system and onto downstream floodplain environments; and

- Environmental Requirements – floodway network is required to ensure all identified flood-dependent ecosystems of conservation value are exposed to the flooding regime in order to improve their long-term sustenance and regeneration.

The Pre-developed Floodway Network and the Proposed Floodway Network can both be seen together on Figure 6. The pre-developed floodway network depicts the natural flowpath of floodwaters, which can be seen in contrast to the proposed floodway network, which shows the modified flowpaths of floodwaters due to the proposed works and the modification of existing works.

While flood control works proposed within the FMP Floodway Network are not prohibited, it is unlikely that they will be approved due to the need to maintain natural flooding patterns to these areas for hydraulic and/or environmental requirements. Works proposed within the floodway network will be identified as non-complying works. Refer to Section 10.5 for details regarding complying and non-complying works.
Figure 6: Pre-Development Floodway Network Areas A, B & C

Caroona - Breeza Floodplain Management Plan
June 2006

Prepares by: DN R
Date Printed: August 2005

Refer to the Floodplain Management Study for details regarding data used & DNR responsibilities.
8.0 ENVIRONMENTAL ASSESSMENT

8.1 Overview

The Caroona - Breeza FMP will influence the floodplain environment through aiming for a floodway network that conforms as closely as is reasonable to the natural drainage pattern of the floodplain. This allows for the orderly passage of flood flow through the system, as well as inundation of the floodplain and improved flood-access to flood–dependent ecosystems.

When assessing the environmental impact of the FMP, current floodplain conditions were used as the benchmark. The impacts of the FMP were assessed at a strategic level (as opposed to property level) by considering the potential impacts on components of the floodplain environment. Refer to the Caroona-Breeza Floodplain Management Study for a detailed environmental assessment.

8.2 Environmental Assessment Summary

Table 5 summarises the findings of the environmental assessment undertaken in order to determine the anticipated impact(s) of the Caroona - Breeza FMP on components of the floodplain environment.

<table>
<thead>
<tr>
<th>Anticipated Impacts of the Caroona - Breeza FMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soils</td>
</tr>
<tr>
<td>Flooding benefits floodplain soils by contributing moisture, sediment and nutrients. These soils regain their porosity and structure through a wetting and drying cycle. The FMP will improve floodplain inundation and as such will assist in maintaining soil condition and stability within the FMP Floodway Network.</td>
</tr>
<tr>
<td>In addition the FMP will allow the orderly passage of flood flow through the system, reducing the potential for scour and erosion. It should be noted that the FMP Floodway Network is designed for the orderly passage of a 20-year ARI flood event. A larger event would likely result in localised erosion and scour due to the overtopping of flood control works.</td>
</tr>
</tbody>
</table>

| Vegetation                                    |
| Vegetation stands containing River Red Gums and Flood dependent vegetation are adapted to periodic wetting and drying cycles, and depend (to varying degrees) on periodic flooding for their long term sustenance. |
| Figure 7, along with field inspections, confirmed that within the study area flood-dependent vegetation is now largely limited to riparian and wetland areas. The FMP ensures that all riparian and wetland areas are exposed to the flooding regime. This ensures that flood access to floodplain vegetation will be maintained and that regeneration and ongoing health of the vegetation is facilitated. |

| Wetlands                                      |
| The only wetland areas identified within the study area are 3 relatively small ephemeral or semi-permanent waterbodies that become inundated during major flooding events. These wetlands are known as Nicholson’s Lagoon, Nicholas Ridge Lagoon and Dirty Lagoon. Naturally functioning and healthy wetlands are adapted to a regime of wetting and drying. Nutrient cycling, invertebrate life cycles and aquatic plant life cycles are also linked to this regime. |
| Figure 7 illustrates the identified wetlands in relation to the FMP Floodway Network and as is evident all of wetlands are within the floodway limits. This ensures that flood flow connectivity to these wetlands is maintained and that the productive capacity and life cycle processes supported by periodic flooding of the wetlands are maintained. |

| Fauna                                         |
| Although there have been no fauna surveys carried out, the Caroona – Breeza floodplain is expected to support a range of species including up to 47 threatened species and 2 migratory waterbird species that potentially inhabit the area. Wetlands and floodplain vegetation provide key habitat for these species. The FMP will ensure that flood flow connectivity to identified wetlands and floodplain vegetation is maintained, thereby improving habitat quality and availability for fauna species. |

| Fish                                          |
| 13 native fish species, including the threatened Silver Perch and endangered populations of Olive Perchlet and Purple-Spotted Gudgeon are known or expected to inhabit the Caroona – Breeza floodplain. The inundated floodplain provides important flood resources for these species as well as nursery habitat for Golden Perch and Silver Perch that spawn in response to flooding. The FMP will improve floodplain inundation and will ensure that flood connectivity between the river and the floodplain is maintained. This will assist in maintaining fish passage and access to spawning and feeding locations. |

| Water                                         |
| The FMP will allow the orderly passage of flood flow through the system, reducing the potential for scour and erosion and subsequently improving surface water quality by minimising sedimentation and |
Quality Turbidity. In addition the FMP will improve floodplain inundation which will assist in minimising existing and future salinity issues by flushing salts from the soil surface and leaching salts through the soil profile.

Groundwater The FMP will assist in maintaining and improving natural groundwater recharge by aiming to achieve a more natural flood flow distribution and improving floodplain inundation. This will increase the likelihood (and duration) of natural groundwater recharge areas being subjected to flood flow inundation. If further information on natural recharge areas becomes available, the FMP may need to be altered to ensure that they are exposed to natural flooding.

Cultural Significance 4 Aboriginal sites have been recorded within the study area. It is highly likely that additional sites of significance exist (undiscovered) within the study area. Scarred/carved trees may be species adapted to cycles of wetting and drying that depend on periodic flooding for their long-term health. The FMP includes known scarred/carved trees and floodplain vegetation within the floodway network. As a result, the FMP ensures that flood connectivity to Aboriginal sites that may rely on flooding is maintained.

8.3 Instream Works

There is a number of instream works within the study area that may present physical barriers to the natural migration and movement of fish within their environment. These works are primarily used as access roads and range from low-level gravel crossings to structures at bankfull height. Only two of the works are currently licensed and while some works have piped openings, it is unlikely that they were designed with fish passage in mind.

As a result of these works it is likely that fish passage is obstructed in certain locations and during flood events spawning opportunities for certain species is restricted. The cumulative impact of these barriers can lead to population decline and extinctions of fish species. These barriers can also reduce water quality and create environments that favour introduced species such as Carp.

Under the Water Management Act 2000, these works are classified as ‘controlled activities’ for which an approval is required. It is recommended that DNR, in conjunction with NSW fisheries, undertake a field review of all instream works within the study area immediately after implementation of the new approvals system under the Act. The review should identify and prioritise the works in terms of environmental impact, particularly fish passage. A strategy should then be developed in consultation with individual landholders to modify or replace problem works with NSW fisheries approved structures. The NSW Fisheries publication Policy and Guidelines for Bridges, Roads, Causeways and Similar Structures (1999) should be referred to. The document outlines how roads and watercourse crossings can be designed and constructed in a ‘fish friendly’ way and also considers social, economic, safety and legal considerations.

8.4 Downstream Floodplains

It is anticipated that the Caroona - Breeza FMP will have a positive influence on downstream floodplain environments through –

- Allowing a more natural flood flow distribution through the system and onto downstream floodplain environments;
- Allowing the orderly passage of flood flow through the system and onto downstream floodplain environments; and
- Improving the connectivity between the study area and downstream floodplains by ensuring that there are no significant barriers to flood flow. The downstream boundaries of the study area will be largely open and as such promote the free passage of flood flow to downstream floodplains.

These features indicate that the FMP will better control flow velocity and concentration and will improve flood flow redistribution. It is anticipated that implementation of the FMP will have a positive influence on the hydrological regime and flooding characteristics of downstream floodplains. It will ensure the long-term maintenance of flood flow to downstream floodplains and assist in maintaining productivity and biodiversity.
8.5 SWMOP Target NO. 25

Target No. 25 of the State Water Management Outcomes Plan (hereafter SWMOP) is “action taken to (re) connect at least 60 percent of the natural 1 in 5 year flooded area to the river for 11 key rural floodplains” (NSW Government 2002:62). The Liverpool Plains is identified as one of these key rural floodplains. Based on available information, it is anticipated that the Caroona - Breeza FMP will meet the target due to the following:

- Within the Caroona - Breeza system a 1 in 5-year flood event would largely be contained within the watercourses and adjacent depressions. The FMP will ensure that these areas are open, with all identified wetlands exposed to the flooding regime. This indicates that the FMP will ensure connection of the majority of the 1 in 5 year flooded area to the watercourses.

- Information regarding smaller flood events was obtained from several events that have occurred within the study area. This information will ensure that the lower flow paths that would be active in a 1 in 5-year event will be identified and remain unobstructed in the FMP.

- The FMP will allow the orderly passage of a 1 in 10-year flood discharge. Information from various historical flood events was included in the hydraulic and environmental investigations. Some of these floods were significant events and by making allowance for the passage of such events, it is considered that all lower flow paths relevant to the SWMOP target will be unobstructed.
Figure 7 - Floodplain Vegetation & Wetlands
9.0 RELATED ISSUES AND MANAGEMENT PRACTICES

9.1 Landuse Management

9.1.1 General

In order to maintain and enhance the natural attributes of the floodplain environment, the following management activities should be considered: These should be undertaken in accordance with the Namoi Catchment Action Plan (in progress).

- Establish and maintain a minimum riparian vegetation buffer zone along all waterways.
- Increase permanent vegetation cover with locally occurring native species, especially around environmentally sensitive and erosion risk areas;
- Preserve all remnant vegetation (including dead trees and fallen timber) and remove competitive weeds;
- Exclude or limit stock from remnant vegetation and wetland areas in order to maintain and protect vegetation structure and diversity of habitat, as well as reduce soil compaction;
- Minimise chemical use in the vicinity of wetlands and undertake chemical activities (storing, loading and mixing) within a controlled or bunded area;
- Undertake nutrient balance calculations in order to apply only as much fertiliser as the crop requires and limit or avoid the use of residual chemicals when cropping floodways; and
- Undertake best management practices.

9.1.2 Best Management Practices

It is the responsibility of all landholders to cooperate in minimising the negative impacts of soil erosion and degraded water quality. Practices that can be implemented for land and stream management include:

- Undertake conservation farming practices for cultivated area, include reduced or zero tillage, stubble retention and well-designed erosion control works;
- Undertake opportunity cropping for the efficient utilisation of soil profiles (avoid a long fallow period and utilise seasonal conditions);
- Retain tailwater and stormwater on irrigation farms (refer to the document Australian Cotton Industry Best Management Practices published by the Cotton Research and Development Corporation 2000);
- Avoid farming and grazing of gullies and depressions; and
- Improve stream management practices to reduce bed lowering, bank erosion and siltation (refer to DNRs Riverwise notes).

9.1.3 Specific Limited Landuse Areas

Some of the floodways within the FMP Floodway Network have been identified to have significant erosion potential based on the hydraulic characteristics of historical flood events. It is anticipated that flood flows will typically travel at high velocities and have the potential to cause erosion and scour. The high velocities are largely a result of narrow flood flow widths.

In order to minimise erosion, scour and sedimentation within the study area, it is necessary to recommend landuse management practices within these areas. Where necessary, landuse and/or environmental conditions can be attached to applications for flood control works as approval conditions under Part 8 of the Water Act 1912.
Within the study area, there are three primary land uses: cropping and grazing. The land within the study area is primarily freehold title. Cropping occurs on the lower slopes and plains, whilst grazing and timber production occurs on the upper slopes.

Cropping includes both dryland and irrigation cropping. The primary cropping systems include wheat and sorghum, with others incorporating barley, faba beans, chickpeas and cotton. Irrigation cropping includes cotton, soybeans, sorghum, maize, sunflower and fodder crops. Irrigation methods include flood irrigation, (head ditches and tail water drains) and spray irrigation.

Grazing intensities vary throughout the study area including mainly cattle, with some sheep. Generally the pastures on the lower slopes have a higher stocking rate. Pastures have sometimes been improved through the introduction of legumes and grass species and top dressing with superphosphate. In areas of frequent flooding and the upper to mid slopes where timber cover is denser, native grasses are commonly found. Native grass communities, in particular plains grass, are found in the travelling stock routes and road reserves. ("Mooki River Floodplain Management Plan – environmental assessment", June 2001, Environmental Resources Management.)

The following management activities are highly recommended –

- Establish perennial grassland species and/or permanent pasture in order to provide vegetation cover and erosion protection;
- Limit cropping activities due to the absence of protective vegetation cover, particularly during the initial stages of cropping. If cropping of these floodways is desired, undertake no tillage and stubble retention;
- Maintain the floodways clear of dense vegetation growth in order to maintain floodway capacity and flow distribution; and
- Undertake grazing with care in order to avoid aggravated erosion problems.

9.2 Maintenance of Floodways

To ensure the integrity of flow distribution, floodways/waterways and buffer zones require on-going maintenance. Siltation and growth of dense vegetation will reduce the operational efficiency and channel capacity of floodways/waterways and in turn will increase flood flow breakouts.

The Native Vegetation Act regulates thinning for regrowth control within the study area. Native vegetation may be thinned without development consent on areas of land to which the exemptions under the Namoi Catchment Action Plan (in progress) apply. There are limitations on the type and age of vegetation to be cleared. The method of thinning should be one that minimises soil disturbance and reduces damage to non-target species.

It is equally important that floodways be maintained and regularly inspected for damage, with identified problems promptly fixed. Such maintenance should include slashing and desilting activities.

9.3 Monitoring

9.3.1 Flood Monitoring

Any surface water management scheme will require monitoring in mainstream flood and local catchment flow events to assess performance efficiency, identify problem areas and identify whether any modifications or upgrades are required. An effective monitoring program will require input from both DNR and landholders. The following is recommended:

- DNR should undertake aerial photography, survey, collation of environmental data, stream gaugings and flow measurements; and
- Where safe to do so landholders should observe the performance of their part of the floodway network, including marking high flood levels, estimating flow velocities, and taking photographs. Landholders should also collate environmental data such as the extent of floodplain vegetation regeneration, and waterbird and fish observations.

Refer to the Floodplain Management Study for detailed advisory notes on flood monitoring

9.3.2 FMP Review

FMPs adopted as Minister’s Plans under the Water Management Act 2000 are required to be reviewed at 5 yearly intervals in order to determine whether their provisions adequately implement the water management principles of the Act. In addition to this requirement, it is recommended that the Caroona - Breeza FMP be reviewed after the incidence of a 1 in 20-year flood event through the system. This review process would include reconvening the FMC in order to consult the various interest groups on their opinion of the flood event and the performance efficiency of the FMP floodplain management system.

9.4 Riparian Buffer Zones

The Native Vegetation Act and the Namoi Catchment Action Plan (in progress) allows for the protection of riparian zones and is the appropriate mechanism for active management to restore these areas. The Caroona - Breeza FMP complements the Plan by enabling flood connectivity to these areas.

Riparian land is any land that adjoins or directly influences a body of water. It includes:
- the land immediately alongside small creeks and rivers, including the river bank itself;
- gullies and dips which sometimes run with water;
- areas surrounding lakes; and
- wetlands and river floodplains which interact with the river in times of flood.

Depending on the nature of the land (floodplain, gorge or valley) and the adjacent land use (national park, farming, forestry, urban housing), the width of riparian land that needs special management will range from very narrow to a wide, densely vegetated corridor. (Land and Water Australia 2002)

The FMP does reflect the above riparian buffer distances. While the identification of these riparian zones does not mean that current agricultural practices within these areas must cease, no further approvals will be granted for any clearing activities and there are very few exemptions. Landholders will be encouraged to regress from the riparian areas and undertake revegetation and conservation.

Landholders will benefit from maintaining adequate riparian buffer zones in terms of improving water quality, minimising land degradation and restoration expenses. For more information regarding the Native Vegetation Act and The Namoi Catchment Action Plan and riparian buffer zones contact the Vegetation Management Officer at your local DNR office.

9.5 Road Raising

The FMC identified road raising as an issue. The FMC felt it was important that landholders be consulted when road raising is being considered as it can have an affect on flood flows and landholders normally have a good understanding of localised flooding.

For any work undertaken on regional roads, state and national highways, the local council should follow the procedure set out in Section 29 of the Roads Act 1993. Under the Act, local councils are required to go through a public consultation process before undertaking the proposal. The public consultation process should include newspaper advertisements and public notices, along with making the proposal available for public viewing. Landholders may make submissions to the council with respect to the proposed road levels. After considering any submissions, the roads authority may decide to proceed with the proposal, with or without alteration, or to abandon the proposal.
For work undertaken on Shire Roads, a simplified informal procedure is usually adopted. For example, a new construction is usually based on existing levels of the road and the final levels determined on-site. At the construction phase, Councils should approach landholders to discuss matters that may affect their interests and their suggestions and objections are incorporated as appropriate.

Prior to undertaking any work on public roads, the local council should consider the aim of achieving and maintaining natural flood flow distribution. Councils need to consider the potential impact(s) of road works for all flood sizes on a cumulative basis and for the entire floodplain system, not simply on a local scale.

Road and railway infrastructure authorities should be advised that sections of road/railway have a direct impact on flood flows and that any maintenance or upgrade works must take this into account. Although not bound by relevant legislation, local councils should consult DNR and consider the FMP for the area in which the work is proposed when planning roads works.
10.0 IMPLEMENTATION STRATEGY

10.1 General

The Caroona - Breeza FMC considers that a coordinated approach to the implementation of the FMP will allow the hydraulic and environmental benefits of the recommendations to be maximised throughout the catchment. Such an approach will eliminate the historical piecemeal approach to floodplain management. The basis of efficient floodplain management is community ownership. Landholders should encourage one another to undertake appropriate landuse management practices and undertake the required modifications to as detailed in Sections 6.3 and 6.4 as soon as possible.

The implementation of the Caroona - Breeza FMP is currently regulated under Part 8 of the Water Act 1912. It should be seen as one of a set of complementary strategies being developed within the Barwon Region for natural resource management, with other components including the Namoi Catchment Action Plan (in progress), catchment blueprint and water sharing plans. It should be considered in conjunction with the broader components of catchment planning and recognising the natural resource links within the larger catchment.

10.2 Performance Assessment

To measure the success of the Caroona - Breeza FMP, DNR will refer to the detailed performance indicators that will be developed as part of a state floodplain management policy. These indicators will be closely linked with the FMP objectives and will largely be based on monitoring and assessment information as outlined above and detailed in the Floodplain Management Study.

There are a number of data sources that can be used to report on the performance indicators such as flood monitoring, audit of complying flood control works and results from fauna and flora surveys. While interrogation of these data sources will yield detailed indicators, the following broad indicators are provided to give the reader an understanding:

- Minimal disruption to the passage of flood waters within the defined study area;
- Natural flooding regimes maintained to identified wetlands and other flood-dependent ecosystems; and
- Increased security against flood risk.

10.3 Approval of Flood Control Works

10.3.1 General

All activities associated with flood control works are administered under the relevant sections of Part 8 of the Water Act 1912. In short, please note the following:

1. All flood control works require an approval under Part 8 of the Act;
2. All Part 8 applications for new and existing (unapproved) works within the study area will be determined in accordance with the FMP and Part 8 of the Act; and
3. Any existing unauthorised works for which a Part 8 application is not lodged, may be served a notice under Section 180D of the Act for removal or DNR may consider prosecution action.

Refer to Section 10.4 for further details regarding unauthorised works and Part 180D of the Water Act 1912.
10.3.2 Works That Require Approval

Works referred to as flood control works are defined under the *Water Act 1912* as ‘controlled works’. Controlled works require approval under the Act and are defined as:

- An earthwork, embankment or levee that is situated, or proposed to be constructed, on land that:
  - is, or forms part of, the bank of a river or lake, or is within a floodplain, or

- Any work that is situated, or proposed to be constructed, on land that:
  - is, or forms part of, the bank of a river or lake, or is within a floodplain and
  - that is declared by order of the Ministerial Corporation published in the Gazette to be a controlled work, or

- An earthwork, embankment or levee, wherever situated or proposed to be constructed, that:
  - affects or is reasonably likely to affect the flow of water to or from a river or lake, and
  - is used or is to be used for, or has the effect or likely effect of, preventing land from being flooded by water, or

- Any work, wherever situated or proposed to be constructed, that:
  - affects or is reasonably likely to affect the flow of water to or from a river or lake, and
  - is used or is to be used for, or has the effect or likely effect of, preventing land from being flooded by water, and
  - is declared by order of the Ministerial Corporation published in the Gazette to be a controlled work.

It should be noted that the amended Act has expanded the location of works that need to be licensed by including works which affect the flow of floodwater to or from a river. As such works situated or proposed some distance away from a river that are in the path of floodwaters will need to be licensed.

10.3.3 Applying for Approval

The following is an outline of the steps required by an applicant in applying for approval a flood control work:

**Step 1** - Obtain an application form and discuss your proposal with neighbouring landholders.

**Step 2** - Contact a DNR Floodplain Licensing Officer to arrange a site inspection, discuss the application and get advice on the information required for the approval process.

**Step 3** - Gather supporting information as your application will require you to supply technical information.

**Step 4** - Fill in the application form. Complete additional information requirements on the form including condition of the existing surrounding environmental.

**Step 5** - Lodge the application with the supporting information and application fee at your local DNR office.
10.3.4 Determination Process

All applications under Part 8 of the Water Act 1912 must proceed through a set process prior to DNR (on behalf of WAMC) determining the application under Section 171 of the Act. This process includes (but not limited to):

- **Section 166C of the Water Act 1912** - DNR must have regard to the matters for general consideration outlined in Section 166C including (but not limited to):
  - The contents of any relevant FMP or any other relevant Government policy;
  - The need to maintain the natural flood regimes in wetlands and related ecosystems and the preservation of any habitat animals (including fish) or plants that benefit from periodic flooding;
  - The effect or likely effect on water flows in downstream river sections;
  - Any geographical features, or other matters of Aboriginal interest that may be affected by a controlled work;
  - The effect or likely effect of a controlled work on the passage, flow and distribution of flood waters;
  - The effect or likely effect of a controlled work on existing dominant floodways or exits from floodways, rates of flow, flood water levels and the duration of inundation;
  - The protection of the environment; and
  - Any other matters relating to the desirability or otherwise of a controlled work.

- **Part 5 of the Environmental Planning and Assessment Act 1979** - all proposals must undergo assessment under Part 5. The factors to be considered include (but not limited to):
  - Any environmental impact on a community;
  - Any environmental impact on the ecosystem of a locality;
  - Any reduction of aesthetic, recreational, scientific or other environmental quality or value of a locality;
  - Any impact on the habitat of protected fauna;
  - Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air;
  - Any reduction in the range of beneficial uses of the environment; and
  - Any cumulative environmental effect with other existing or likely future activities.

- **Floodplain Management Plan** - DNR must consider the FMP and information contained within the FMP including principles, assessment criteria, and any recommendations.

- **Additional Information** - DNR must consider any investigation information that has been provided by the applicant.

10.3.5 Possible Determinations

DNR will inform the applicant at the earliest opportunity of the determination of an application for a flood control work. Under the Water Act 1912, there are three (3) possible determinations - approval of the application, approval of the application subject to conditions, or refusal of the application.

There are provisions within the Water Act 1912 for a corporation or individual to object to an application approval if their interest(s) are affected by the approval. There are also provisions for an applicant and/or objector to appeal against the determination to the Land and Environment Court. Refer to the Water Act 1912 for further details regarding these matters.
10.3.6 Typical Approval Conditions

The following is a list of typical conditions that can be attached to an approval. Please note that this list is not exhaustive and conditions more specific to the property and proposal are likely.

- Works may be constructed on the property ‘X’ in accordance with the location, nature, heights, floodway width and boundary corridors as specified in the plan.

- The works shall be constructed and maintained in a manner that will minimise the possibility of damage being occasioned by them, or resulting from them, to any public or private interest.

- If during the currency of this approval a floodplain investigation by DNR reveals that the work(s) should be modified in the public interest so as to permit a more satisfactory flow of water within the floodplain, the landholder shall upon receipt of notice by DNR modify the work(s) in accordance with such notice.

- The height of the controlled work(s) between the points marked ‘A’ and ‘B’ on the plan shall not exceed ‘X’ metres above the natural surface level.

- The controlled works between the points marked ‘B’ and ‘C’ on the plan shall be set back not less than ‘X’ metres from the nearest boundary of the property.

10.4 Unauthorised Flood Control Works

The amended Water Act 1912 strengthened DNRs ability to deal with unauthorised works. An unauthorised work is where:

- There is no approval in force with respect to a controlled work;

- A controlled work has been constructed in contravention of an approval; or

- A controlled work does not comply with the conditions to which an approval is subject.

In the instance of an unauthorised work, any one or more of the following types of work may be directed to be carried out by a notice under Section 180D of the Water Act 1912:

(a) Work to remove, modify, repair or restore the controlled work or to render the work ineffectual;

(b) Work to repair any damage caused by the controlled work (including any damage caused to any specified land, structure, river, lake or vegetation, or to the environment);

(c) Work to ensure that any specified land, structure, river, lake or vegetation, or the environment, will not be damaged or adversely affected or further damaged or adversely affected, by the controlled work;

(d) Without limiting paragraphs (a)–(c), work to correct or restore any alteration caused by the controlled work to the flow of water in, to or from, or the quantity of water contained in, any specified river or lake.

If an occupier fails to comply with such a requirement, DNR can carry out the work and recover the expenses incurred from the occupier or from the person who constructed the controlled work in contravention to Part 8. DNR is not required to give any prior notice of its decision to exercise these powers. A person distressed by such a decision is be able to appeal against the decision to the Land and Environment Court.

10.5 Complying and Non-Complying Works

Once the Caroona - Breeza FMP has been adopted, applications for flood control works under Part 8 of the Water Act 1912 will be assessed by DNR as either complying works or non-complying works with regard to the FMP. Regardless of whether a proposed work is complying or non-complying, an application for approval under Part 8 is required and the determination process outlined in Section 10.3.4 is necessary.
10.5.1 Complying Works

Under Section 168B(2) of the Water Act 1912, a flood control work is to be assessed as a complying work if DNR is satisfied that the work complies with the FMP for the area in which the work is situation or proposed to be constructed.

Within the Caroona - Breeza study area a work complies with the FMP if the work does not trigger any issues when considering the adopted assessment criteria detailed in Section 5.2.

When lodging the Part 8 application, the applicant will be required to provide the necessary technical details to demonstrate that the application is a complying work. Where an existing unapproved or proposed flood control work is determined to be complying and the required environmental assessment is satisfactory, it is envisaged that the approval process will be more expedient. For example, the application for approval will be determined by DNR without the need for advertising or third party objections.

10.5.2 Non-Complying Works

Under Section 168B(3) of the Water Act 1912, a flood control work is to be assessed as a non-complying work if DNR is not satisfied that the work complies with the FMP for the area in which the work is situated or proposed to be constructed.

Within the Caroona – Breeza study area a work is non-complying if the work triggers one or more issues when considering the adopted assessment criteria detailed in Section 5.2.

Non-complying works may be approved after a detailed investigation of the hydraulic, environmental, social and economic impacts of the proposal. The cumulative impact of the proposal on flooding characteristics will need to be comprehensively addressed. It is important to understand that it is the applicant’s responsibility to organise a suitably qualified consultant to undertake the investigation and pay for the investigation. DNR will provide direction and guidance for the consultant. Where the requested supporting information is not furnished, DNR can refuse to deal with the application.

Applications for non-complying works must be advertised and third party objections sought prior to the determination of the application. If an objection is received that cannot be resolved, compulsory mediation will be required. DNR may request additional supporting information from the party who lodged the objection, with failure to do so possibly resulting in the objection being rejected.

10.5.3 Roads and Railways

Roads and railways (and associated bridges, road works and railway works) vested in Local or State Government transport agencies are prescribed works under Part 8 of the Water Act 1912 and the regulations of the Water Management Act 2000. While these works do not require an approval under these pieces of legislation, agencies are required to assess the impacts of these works under the Environmental Planning and Assessment Act 1979.
## APPENDIX A – GLOSSARY AND ABBREVIATIONS

### GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Exceedance Probability (AEP)</td>
<td>The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage (%). For example, a flood with an AEP of 5% means there is a 5% chance that a flood of same size of larger will occur in any one year.</td>
</tr>
<tr>
<td>Annual Recurrence Interval (ARI)</td>
<td>The long-term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years.</td>
</tr>
<tr>
<td>Calibration</td>
<td>The process by which a hydrologic or hydraulic model is adjusted so that it best represents the real world situation that the model is intended to simulate.</td>
</tr>
<tr>
<td>Cumeecs</td>
<td>An abbreviation for cubic metres per second (m³/s).</td>
</tr>
<tr>
<td>Discharge</td>
<td>The rate of flow of water measured in terms of volume per unit time, for example cumeecs.</td>
</tr>
<tr>
<td>Flood</td>
<td>Relatively high stream flow when water overtops the natural or artificial banks or a stream and spreads over adjoining land.</td>
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<tr>
<td>Flood Hazard/Risk</td>
<td>Potential for damage to property or persons due to flooding.</td>
</tr>
<tr>
<td>Floodplain</td>
<td>The portion of a river valley, adjacent to the river channel, which is covered with water when the river floods. It includes the area inundated by all floods up to the probable maximum flood.</td>
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<tr>
<td>Floodways</td>
<td>Those areas where a significant volume of water flows during floods. They are often aligned with obvious naturally defined channels. Floodways are areas which, even if partially blocked would cause a significant redistribution of flood flow and are often areas of deeper flow or higher velocities.</td>
</tr>
<tr>
<td>Gauging Station</td>
<td>A place on a river or stream at which the stage is routinely measured, either daily or continuously, and where the discharge is measured from time to time so as to develop a relationship between water level and discharge.</td>
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<tr>
<td>Flood Slope</td>
<td>The slope of the water surface elevation along the direction of flow.</td>
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<tr>
<td>Hydraulics</td>
<td>Term given to the study of water flow in waterways.</td>
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<tr>
<td>Management Plan</td>
<td>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.</td>
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<tr>
<td>Peak Discharge</td>
<td>The maximum discharge occurring during a flood event.</td>
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<tr>
<td>Probable Maximum Flood (PMF)</td>
<td>A PMF is the largest flood that could conceivably occur at a particular location. See section 6.3.1 for more details.</td>
</tr>
<tr>
<td>Runoff</td>
<td>The amount of precipitation which ends up as streamflow.</td>
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</table>

### ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEP</td>
<td>Annual Exceedance Probability</td>
</tr>
<tr>
<td>AHD</td>
<td>Australian Height Datum</td>
</tr>
<tr>
<td>ARI</td>
<td>Annual Recurrence Interval</td>
</tr>
<tr>
<td>DNR</td>
<td>Department of Natural Resources</td>
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<tr>
<td>EIS</td>
<td>Environmental Impact Statement</td>
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<tr>
<td>FMC</td>
<td>Floodplain Management Committee</td>
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<td>FMP</td>
<td>Floodplain Management Plan</td>
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<tr>
<td>LEP</td>
<td>Local Environmental Plan</td>
</tr>
<tr>
<td>LGA</td>
<td>Local Government Area</td>
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<tr>
<td>NHT</td>
<td>Natural Heritage Trust</td>
</tr>
<tr>
<td>NPWS</td>
<td>National Parks and Wildlife Service</td>
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<tr>
<td>SEPP</td>
<td>State Environmental Planning Policy</td>
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