

# Wollombi Floodplain Risk Management Study & Plan

Final Report  
R.N1310.003.03  
November 2012



# Wollombi Floodplain Risk Management Study & Plan Final Report

Prepared For: Cessnock City Council

Prepared By: BMT WBM Pty Ltd (Member of the BMT group of companies)

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<b>Title :</b>	Wollombi Floodplain Risk Management Study and Plan – Final Report
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<b>Synopsis :</b>	This report documents the Wollombi Village Floodplain Risk Management Study and Plan which investigates and presents a flood risk management strategy for the catchment. The study identifies the existing flooding characteristics and canvasses various measures to mitigate the effects of flooding. The end product is the Floodplain Management Plan, which describes how flood liable lands within Wollombi are to be managed in the future.

### REVISION/CHECKING HISTORY

REVISION NUMBER	DATE OF ISSUE	CHECKED BY		ISSUED BY	
0	08/06/2011	DJL		DJL	
1	25/08/2011	DJL		DJL	
2	30/05/2012	DJL		DJL	
3	19/11/2012	DJL		DJL	

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## EXECUTIVE SUMMARY

### Introduction

Wollombi Village is located at the confluence of the two main tributaries of Wollombi Brook:

- Wollombi Brook South Arm (also known simply as Wollombi Brook): This tributary drains the southern and western sections of the catchment; and
- Congewai Creek (also known as the northern arm of Wollombi Brook): This tributary drains areas of the catchment to the east of Wollombi Village.

Downstream of the confluence, Wollombi Brook, also known as Cockfighter's Creek, flows northwards towards the Hunter River. Wollombi Brook's confluence with the Hunter River is some 45 km north of Wollombi Village and around 16 km to the west of Singleton.

The Wollombi Flood Study Review and Model Update was completed by BMT WBM in December 2010. The outcome of this study was the production of flood inundation and flood risk mapping for the Wollombi Village locality, generated from detailed hydrologic and hydraulic modelling of the catchment. The flood study represents the initial stage in the floodplain management process and establishes the basis for the current floodplain risk management study.

The objectives of the Wollombi Village Floodplain Risk Management Study (FRMS) are to:

- Identify and assess measures for the mitigation of existing flood risk;
- Identify and assess planning and development controls to reduce future flood risks; and
- Present a recommended floodplain management plan that outlines the best possible measures to reduce flood damages in the Wollombi Village locality.

The following provides an overview of the key findings and outcomes of the study, incorporating a review of design flood conditions within the catchment, assessment of potential floodplain management measures and a recommended Floodplain Management Plan.

The Project was funded by the NSW State Government under the State Assisted Floodplain Management Program, the Commonwealth Government under the Natural Disaster Mitigation Program and Cessnock City Council.

### Flooding Behaviour

The Wollombi Valley has a long history of recorded flooding with major floods occurring in the valley on numerous occasions since European settlement in the early 1800's. The largest recorded flood occurred in June 1949, when up to 500mm of rainfall fell over two days in the upper catchment. Other major events to have occurred in the catchment include August 1857, June 1867, April 1927 and most recently June 2007.

The catchments of the two tributaries upstream of Wollombi Village are typically steep sided and forested with a cleared, relatively narrow floodplain on the incised valley floors. From the headwaters in the Watagan Ranges, at some 640m AHD at the highest points, the catchment rapidly descends to



Wollombi Village at approximately 100m AHD. The combination of these features results in a 'flashy' catchment that converts rainfall rapidly into relatively large flow rates and elevated flood levels.

The natural rainfall response of the Congewai Creek and Wollombi Brook catchments is such that the timing of the flood peaks tends to coincide, thereby exacerbating flooding at Wollombi Village.

The Wollombi Valley Flood Study Review and Model Upgrade (BMT WBM, 2010) defined design flood levels at Wollombi for a range of design event magnitudes, utilising detailed hydrologic and hydraulic models (XP-RAFTS /TUFLOW) calibrated to June 1949 and June 2007 historical event data. These design flood characteristics were presented in a series of flood maps for the study area in association with flood risk maps defining low, medium and high hazard areas, which have been considered as the basis for investigating floodplain management options.

Being a relatively narrow valley, flood behaviour in Wollombi in large events is characterised by high depths and relatively high velocity flow. Floodwaters can rise rapidly, thereby limiting available warning time. These risks are exacerbated given the propensity for extensive road inundation and accordingly limited opportunity for evacuation from properties, particularly isolated property, and limited opportunity for assistance from external emergency response agencies due to lack of road access.

A flood damages database has been developed to identify potentially flood affected properties and to quantify the extent of damages in economic terms for existing flood conditions. In developing the damages database, a floor level survey of all existing properties identified with the Extreme Flood extent was undertaken. Key results from the flood damages database indicate:

- 67 residential homes and 14 commercial/industrial buildings would be flooded above floor level in the Extreme Flood event;
- 9 residential homes and 4 commercial buildings would be flooded above floor level in the 100-year ARI flood;
- The predicted flood damage costs in the 100-year ARI flood is of the order of \$1.7M.

### **Community Consultation**

Consultation with the community was undertaken, and was aimed at informing the community about the development of the floodplain management study and its likely outcome as well as improving the community's awareness and readiness for flooding. The consultation process provided an opportunity to collect information on the community's flood experience, their concern on flooding issues and to collect feedback and ideas on potential floodplain management measures and other related issues. The key elements of the consultation program involved:

- Consultation with the Floodplain Management Committee through meetings, presentations and workshops;
- Distribution of questionnaires (in association with the flood study);

- Two community information sessions, firstly to outline the study objectives following completion of the Flood Study Review and identify key community concerns, and secondly to workshop potential floodplain risk management options;
- Public exhibition of the Draft Floodplain Risk Management Study and Plan.

The key community concerns expressed through the questionnaires and workshops included:

- Need for investigation of improved flood warnings for Wollombi;
- Improved communications during flood events including options for backup power for communications networks;
- Council to provide relevant flood information to landholders on a regular basis to ensure the community are informed (and stay informed) of potential flood risk; and
- Requirement for appropriate development controls on new development with due consideration of flood risks.

### **Floodplain Management Options Considered**

The Wollombi Village Floodplain Risk Management Study considered and assessed a number of floodplain management measures, summarised below.

- *Flood Modification Options* - The nature of flooding in the Wollombi Valley, characterised by high flood volumes, flow depths and velocities, limit the opportunities for implementation of effective flood modification measures. Options such as levees, retarding basins and channel improvements, would have minimal overall influence on flooding in the valley and offer little reduction in flood risk to properties. Accordingly, proposed floodplain management options for Wollombi will be focused on property and response modification measures.
- *Planning and development controls* - Cessnock City Council does not have a specific floodplain risk management Development Control Plan (DCP), though clauses related to flood planning are incorporated in Council's consolidated Cessnock DCP 2010. The purpose of this DCP is to provide a practical application of Council's Cessnock Flood Policy and is to be taken into consideration by Cessnock City Council when exercising its environmental assessment and planning functions in relation to new development within the Cessnock LGA. The recommended DCP provisions include:
  - i. minimum floor levels;
  - ii. the use of flood compatible building components below a certain level;
  - iii. that structures located in high flood risk areas are structurally sound;
  - iv. that development does not increase flood behaviour elsewhere;
  - v. maximising opportunities for people to safely evacuate; and
  - vi. other specific considerations regarding the use of the property.
- *Flood Planning Level (FPL)* – the Wollombi Flood Prone Policy includes the adoption of the 100-year Flood Level plus 0.5m freeboard FPL for habitable rooms for dwellings within Wollombi Village. This current level is consistent with FPL across the broader Cessnock LGA as noted in the Cessnock LEP 2011. Consideration was given to a change in FPL for Wollombi Village

taking due account of potential flood risks as identified in the floodplain risk management study. Noting these risks and options for alternative flood planning levels, it is recommended that the flood planning level be maintained as the 100-year flood level plus 0.5m freeboard. This recommendation is justified on the basis of:

- The level reflects an acceptable level of risk to property (in terms of potential flood damage);
  - Risk to life more effectively managed by other controls/measures;
  - Consistency across the Cessnock LGA is maintained; and
  - The setting of the FPL does not preclude property to be constructed at a higher level.
- *Flood Warning* – There is no dedicated flood warning service for Wollombi Village and surrounds. The formal flood warning service for the Wollombi Brook provided by the Bureau of Meteorology largely benefits the residents in the lower part of the Valley. In the upper part of the Valley, including Wollombi Village, there is no site specific flood warning system, however there are a number of general warning services provided by the Bureau.
  - *Improved emergency management operations* – At present there is no specific Local Flood Plan covering the Wollombi Village area though additional flood information developed as part of the study can now be utilised. The additional detail on flood risk mapping, design flood conditions and the property database developed through the Wollombi FRMS should be used to update and supplement existing databases and to refine the Local Flood Plan where relevant. Given the potential for most of the major access roads to be cut early by floodwaters, the opportunity for external assistance, particularly by road access, is somewhat limited. The development of the flood database of property flood affectation will assist emergency management authorities to prioritise and target the highest risk properties. In the most extreme cases, vertical evacuation will remain the most suitable evacuation means. The nature of flooding in the Valley is such that properties may remain isolated for a number of days for which food/medical supply assistance may be required from emergency management authorities.
  - *Improved public awareness* – raising flood awareness in the community through the issue of flood certificates, community education programs, and the construction of historical flood markers. The transient population particularly on weekends raises the level of exposure to potential flood risk, and the level of flood awareness is likely to be significantly lower than within the resident community. Specific measures to address this risk through local tourism facilities should be targeted. Improved access to flood information through Council (e.g. availability of reports, flood mapping, key flood emergency contacts and information on Council website).
  - *Voluntary Purchase* - Voluntary Purchase Schemes are generally applicable only to areas where flood mitigation is impractical and the existing flood risk is unacceptable. No property has been identified as appropriate for voluntary purchase within the Wollombi Village. Therefore there is no recommendation for such a scheme in the Floodplain Risk Management Plan.
  - *Voluntary House Raising* - Voluntary house raising is aimed at reducing the flood damage to houses by raising the habitable floor level of individual buildings above an acceptable design standard (e.g. 1% AEP Flood Level +0.5m). There is also the requirement for the property access road to have a similar level of flood immunity to ensure there is opportunity for egress prior to

inundation above floor level. Investigations should be undertaken to establish if a voluntary house raising program is viable. A voluntary house raising scheme would not commence until it is known whether there will be a funding mechanism available to raise buildings from high hazard areas. Investigations should commence with confirming which properties would be offered voluntary house raising, through more detailed property analysis and consultation with owners.

- *Flood Proofing* – Flood proofing is proposed as part of the Wollombi Floodplain Management Plan for those residential properties that are below the 100 year ARI flood level. Voluntary house raising may also be considered after other flood mitigation measures have been exhausted. A detailed list of individual property levels relative to predicted flood levels has been established. For those properties identified within the 100-year ARI flood envelope, advice may be provided to individual landowners on available opportunities to reduce on-site flood damages.

### **The Recommended Floodplain Management Plan and Implementation**

A recommended floodplain management plan showing preferred floodplain management measures for Wollombi Village is presented in Section 9 in the main body of the report. The key features of the plan are outlined below with indicative costs, priorities and responsibilities for implementation.

*Due to the nature of flooding in the Valley, no options are recommended options that modify flood behaviour.*

*Recommended options that modify property include:*

- Flood proofing of individual buildings (including potential raising of some property); and
- Controls on new development that provides guidance on appropriate land uses and other development controls.

*Recommended options that modify flood response include:*

- Improved flood awareness through issue of flood information (Council and SES);
- Update of Local Flood Plans with current design flood information; and
- Update emergency evacuation procedures in the Local Flood Plan based on revised flooding information.
- Further investigation of potential flood warning system improvements, to be undertaken with assistance from the Bureau of Meteorology and the SES

The steps in progressing the floodplain management process from this point forward are as follows:

1. Council allocates priorities to components of the Plan, based on available sources of funding and budgetary constraints;
2. Council negotiates other sources of funding as required such as through OEH and the "Natural Disaster Mitigation Package" (NDMP); and

3. as funds become available, implementation of the Plan proceeds in accordance with established priorities.

The Plan should be regarded as a dynamic instrument requiring review and modification over time. The catalyst for change could include new flood events and experiences, legislative change, alterations in the availability of funding or changes to the area's planning strategies. In any event, a thorough review every five years is warranted to ensure the ongoing relevance of the Plan.

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# 1 INTRODUCTION

Cessnock City Council (Council) engaged BMT WBM to undertake the Wollombi Village Floodplain Risk Management Study and Plan as a two stage commission as described below.

## *Stage 1 - Flood Study Review and Model Upgrade:*

The study objectives are to undertake a comprehensive review of the Wollombi Valley Flood Study (Patterson Britton & Partners, 2005) including data, results and computer modelling techniques, to establish the existing models as necessary, and the development of a two-dimensional (2D) hydraulic model for the Wollombi Village area. The study will produce information on flood flows, velocities, levels and extents for a full range of flood magnitudes under existing catchment and floodplain conditions.

## *Stage 2 - Floodplain Risk Management Study and Plan:*

The outcomes of the Flood Study Review and Model Upgrade will form the basis for the Floodplain Management Study and Plan. This study will aim to derive an appropriate mix of management measures and strategies to effectively manage flood risk in accordance with the Floodplain Development Manual. The findings of the study will be incorporated in a Plan of recommended works and measures and program for implementation.

The Wollombi Flood Study Review and Model Upgrade completed in 2010 represents the initial stage in the floodplain management process and establishes the basis for the current floodplain risk management study.

The objectives of the Wollombi Floodplain Risk Management Study are to:

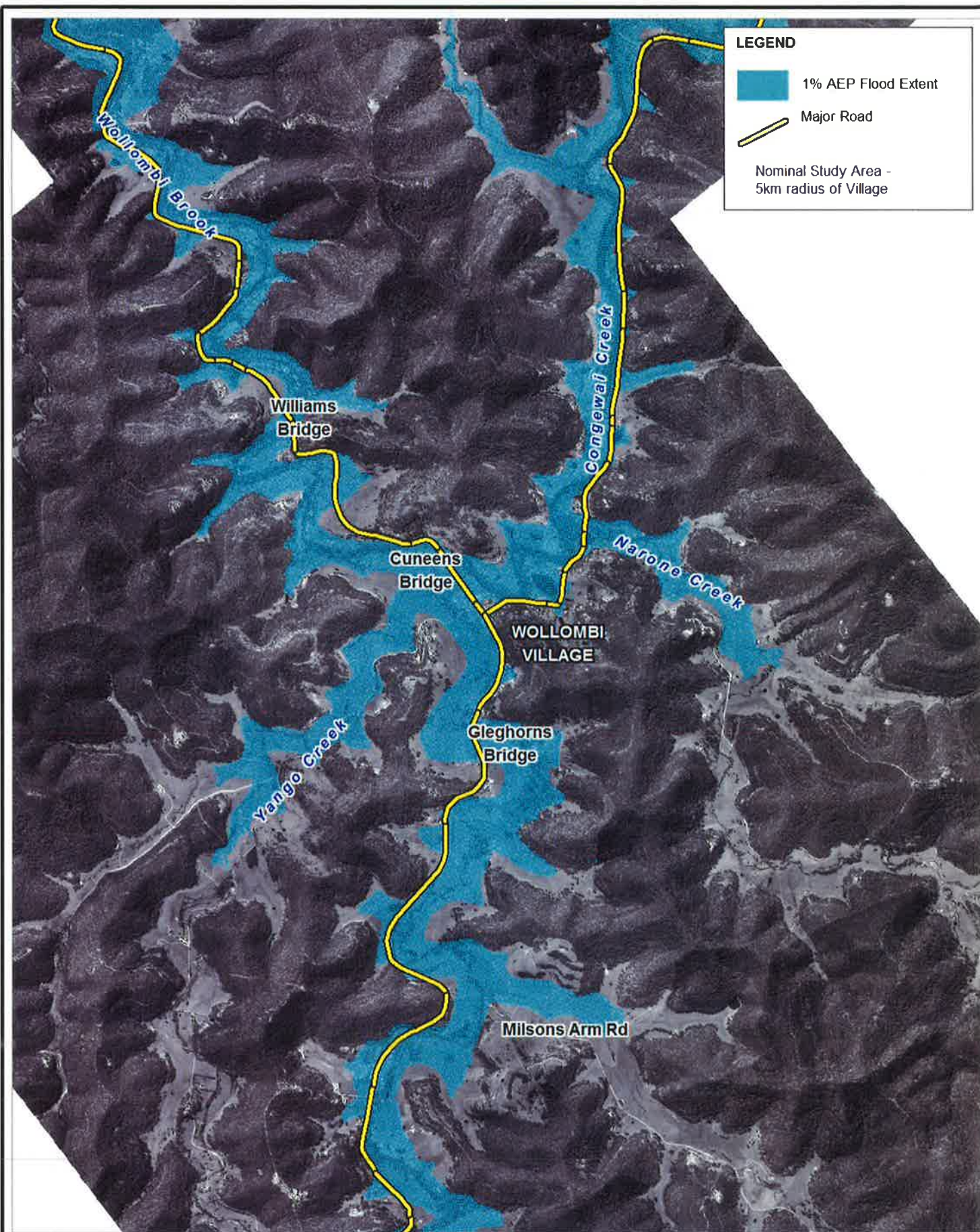
- Identify and assess measures for the mitigation of existing flood risk;
- Identify and assess planning and development controls to reduce future flood risks; and
- Present a recommended floodplain management plan that outlines the best possible measures to reduce flood damages in the Wollombi locality.

This report documents the Floodplain Risk Management Study and presents a recommended Floodplain Risk Management Plan for the Wollombi Village.

The Project was funded by the NSW State Government under the State Assisted Floodplain Management Program, the Commonwealth Government under the Natural Disaster Mitigation Program and Cessnock City Council.

## 1.1 Study Area

The Wollombi Brook catchment is located within the Hunter Valley of New South Wales draining a catchment area of some 2150km<sup>2</sup> as shown in Figure 1-1. The Wollombi Brook flows in a general south-north direction from its source in the Watagan Ranges to its confluence with the Hunter River near Warkworth, some 16km upstream of Singleton.



Title:  
**Study Area for Floodplain Risk Management Study**

Figure:  
**1-1**

Rev:  
**A**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.





The village of Wollombi is located approximately 30km south west of Cessnock at the junction of Congewai Creek and Wollombi Brook. Other significant settlements within the catchment include Paxton, Millfield, Laguna, Broke and Bulga.

The study area for the preparation of the Floodplain Risk Management Study and Plan is the village of Wollombi and the surrounding floodplain within a radius of 5km of the village as shown in Figure 1-1. The nominal modelling boundaries defined in Council's brief extend from 5km upstream of Wollombi village to Paynes Crossing, some 15km downstream of Wollombi. With consideration to the available survey information and local topographical and hydraulic controls, the models were extended to Watagan Creek Road on Wollombi Brook and Ellalong Lagoon on Congewai Creek. The downstream boundary has also been extended to Brickmans Bridge, 4km downstream of Paynes Crossing, corresponding to the location of the operational flow gauging station.

## 1.2 The Need for Floodplain Management at Wollombi

As evidenced in the recent June 2007 flood, a significant risk is posed to residents in the Wollombi Valley given the nature of flooding in the catchment. This is characterised by rapid response of the waterway to rainfall in the steep upper catchments and large flood depths within the relatively narrow valley.

In addition to the primary concern of the safety of people and property, flooding can result in significant isolation and access problems, and a disruption to services such as electricity, water supply and telecommunications.

In recent times there have been increased development pressures in the Wollombi Valley with increasing demand for weekenders, hobby farmers and "tree-change" aspirants. This in time will increase the number of people potentially exposed to flood risk, many of whom would be oblivious to existing flood risk given no previous experience of flooding in the valley.

Floodplain risk management considers the consequences of flooding on the community and aims to develop appropriate floodplain management measures to minimise and mitigate the impact of flooding. This incorporates the existing flood risk associated with current development, and future flood risk associated with future development and changes in land use.

Accordingly, Council desires to approach local floodplain management in a considered and systematic manner. This study comprises the initial stages of that systematic approach, as outlined in the Floodplain Development Manual (NSW Government, 2005). The approach will allow for more informed planning decisions within the floodplain of Wollombi Brook.

## 1.3 The Floodplain Management Process

The State Government's Flood Prone Land Policy is directed towards providing solutions to existing flooding problems in developed areas and ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas. Policy and practice are defined in the Government's Floodplain Development Manual (2005).

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 State Government through the following four sequential stages:

**Table 1-1 Stages of Floodplain Management**

Stage	Description
1 Flood Study	Determines the nature and extent of the flood problem.
2 Floodplain Risk Management Study	Evaluates management options for the floodplain in respect of both existing and proposed developments.
3 Floodplain Risk Management Plan	Involves formal adoption by Council of a plan of management for the floodplain.
4 Implementation of the Floodplain Risk Management Plan	Construction of flood mitigation works to protect existing development. Use of environmental plans to ensure new development is compatible with the flood hazard.

Cessnock City Council is responsible for local planning and land management within the Cessnock Local Government Area (LGA) including the management of the floodplain of the Wollombi Brook catchment.

The first stage of the floodplain risk management process, the Wollombi Village Flood Study Review and Model Upgrade (BMT WBM, 2010) defines the existing flood behaviour and establishes the basis for future floodplain management activities.

The Wollombi Floodplain Risk Management Study and Plan (this document) constitutes the second and third stages of the management process. It has been prepared for Cessnock City Council and the Cessnock Floodplain Management Committee to provide the basis for future management of flood liable land within the catchment. **The study has been commissioned by Cessnock City Council with funding assistance from the Federal Government under the National Disaster Mitigation Program.**

## 1.4 Structure of Report

This report documents the Study's objectives, results and recommendations.

Section 1 introduces the study.

Section 2 provides background information including a catchment description, history of flooding and previous investigations.

Section 3 outlines the community consultation program undertaken.

Section 4 describes the flooding behaviour in the catchment.

Section 5 provides a summary of the flood damages assessment including identification of property potentially affected by flooding.

Section 6 provides a review of relevant existing planning measures and controls.

Section 7 provides an review of the June 2007 flood experience highlighting community concerns and the relative performance of existing floodplain management measures.

Section 8 provides an overview of potential floodplain risk management measures.

Section 9 presents the recommended measures and an implementation plan.



## 2 BACKGROUND INFORMATION

### 2.1 Catchment Description

Wollombi Village is located at the confluence of the two main tributaries of Wollombi Brook:

- Wollombi Brook South Arm (also known simply as Wollombi Brook): This tributary drains the southern and western sections of the catchment; and
- Congewai Creek (also known as the northern arm of Wollombi Brook): This tributary drains areas of the catchment to the east of Wollombi Village.

Downstream of the confluence, Wollombi Brook, also known as Cockfighter's Creek, flows northwards towards the Hunter River. Wollombi Brook's confluence with the Hunter River is some 45 km north of Wollombi Village and around 16 km to the west of Singleton.

The catchments of the two tributaries upstream of Wollombi Village are typically steep sided and forested with a cleared, relatively narrow floodplain on the valley floors. The combination of these features results in a 'flashy' catchment that converts rainfall rapidly into relatively large flow rates and elevated flood levels. From the highest point in the upper catchment in the Watagan Ranges, at some 640m AHD, the Wollombi Brook catchment rapidly descends to Wollombi Village at approximately 100m AHD.

In contrast to the Wollombi Brook, the upper floodplains of Congewai Creek and Quorrobolong Creek are relatively wide in the vicinity of Paxton and Millfield, flowing through broad lowland (at approximately 120m AHD) which includes the Ellalong Lagoon. However, from the Cedar Creek confluence, the Congewai Creek returns to a highly incised channel characterised by steep and narrow valley profile.

In the locality of Wollombi Village, the Wollombi Brook, Congewai Creek and Yango Creek converge. The total contributing catchment area to the confluence is some 815km<sup>2</sup>. The relative contributions to this total catchment area are 470km<sup>2</sup>, 285km<sup>2</sup> and 60km<sup>2</sup> for the Wollombi Brook, Congewai Creek and Yango Creek catchments respectively. As noted in previous events, the coincident flooding of the Congewai Creek and Wollombi Brook catchments has a major influence on flood levels in the village area.

Downstream of Wollombi Village, Wollombi Brook remains a highly incised channel with a narrow floodplain until Broke. From downstream of Broke, the floodplain widens progressively for the remaining 42km to the confluence with the Hunter River.

The great majority of the catchment is forested, particularly beyond the floodplain fringes. Land use on the relatively narrow valley floor is predominantly livestock grazing and other small farming enterprise.

Development is predominantly centred on the Village area and immediate surrounds, with sparse rural development occupying the remainder of the study area. Other settlements in the Wollombi catchment include Laguna, Millfield and Paxton, however, these settlements lie beyond the study area of the Floodplain Risk Management Study.

## 2.2 History of Flooding

The Wollombi Valley has a long history of recorded flooding with major floods occurring in the valley on numerous occasions since European settlement in the early 1800's. The largest identified floods on record are summarised in Table 2-1, including an indicative peak flood level at Wollombi Village.

**Table 2-1 Historical Flood Levels in Wollombi Village**

Flood Event	Peak Flood Level (m AHD)
August 1857	~99.0m AHD
June 1867	~100.5m AHD
April 1927	~99.0m AHD
June 1949	101.6m AHD
June 2007	99.0m AHD

For the two most recent events in Table 2-1, being June 1949 and June 2007, there is relative confidence in the estimated peak flood levels on the basis of recorded flood marks. For the other events however, the flood level estimations have been based on anecdotal reports of relative flood heights and references to known landmarks.

Historical newspaper reports for the floods in 1857 and 1867 provide firsthand accounts of the flooding by Wollombi residents. Examples of these articles are included in Appendix B. A key reference point for the 1867 event is St. Johns Anglican Church in which the following quote enables an estimate of the peak flood level:

*"About twelve o'clock of the night of Friday, the 21<sup>st</sup>, the flood was at its highest, and was then about six inches in the Church of England, where most of the inhabitants had taken refuge".*

There is some uncertainty in regard to the true flood height given the uncertainty in the accuracy of the report and indeed if the reported six inch flood depth was at the peak. Nevertheless, other reports confirm the inundation of the Church above floor level. Based on the floor level of the Church (refer to Section 5) and the approximate flood depth, a peak flood level of 100.5m AHD in Wollombi Village is considered appropriate. Accordingly, the June 1867 event represents the second highest flood event on record since European settlement in the area.

During the many reports of the 1867 flood, a number of references were made to the relative height of the 1857 event some 10 years previous. A summary of relevant quotes is provided hereunder.

*"In the disastrous flood at Wollombi, which was about **three feet** higher than that of August 1857.."*

*"This district has been visited with the highest and most disastrous flood within the memory of the oldest settler on the brook [sic] - the water in 1857 being at least **four feet** lower."*

*"Water now up to the highest flood known.... Water rose **four feet** higher."*

*"The rain commenced early in the week, and continued with very little intermission until Friday, midnight, when the flood reached its greatest height, which was **five feet** higher than the remarkable one of 1857."*

*"All accounts agree it was fully **six feet** higher than any flood ever known up here. One house that was to a depth of three weatherboards in 1857 was submerged to the doorhead, so that will tell."*

There is some variance in the relative difference reported between the 1857 and 1867 event, typically between three to six feet. Some of the variance may be due to the different locations at which the event is being reported. In order to approximate a peak flood level for the 1857 event, a five feet difference has been assumed between the 1857 and 1867 events. Accordingly, this places the 1857 event at a similar order to the recent event in June 2007 at 99.0m AHD.

Searches for historical flood information for the 1927 flood event in Wollombi have been less fruitful. There is a photograph in the Wollombi Museum of the flood inundation outside the Willis Store during the 1927 event, shown in Figure 2-1. The former Willis Store site is located on the corner of Maitland Road and the Great North Road, opposite the Wollombi Tavern (community hall can be seen in the right background of the image). The inundation shown in the photograph is again of the order of the June 2007 flood event. No peak flood level record has been identified and it is unknown if the photograph is at or near the peak of the event. For comparative purposes however, the 1927 event has been assumed to be at least equal to the peak flood level of the June 2007 event, approximately 99.0m AHD.



(Cessnock City Council, 2008, image from Carl Hoipo)

**Figure 2-1 Willis Store in the 1927 Flood**

Detailed investigation of the 1949 and 2007 flood events was included in the Flood Study Review and the event data formed the basis of the model calibration and validation. As noted the flood peak levels are based on recorded flood marks for the respective events. A plaque showing the peak flood level of the 1949 event is located on the Museum wall, as shown in Figure 2-2. This level represents the recorded peak flood level inside the Anglican Church transferred to the Museum wall.





**Figure 2-2** 1949 Flood Level Plaque on Museum Wall (level from St John's Church)



(Cessnock City Council, 2008, image from John L Coombes)

**Figure 2-3** Wollombi June 2007 Flood

It is important to recognise that floods larger than the 1949 event have occurred in the catchment previously. Based on analysis of sediment deposits, Erskine (1994) suggests that at least four paleofloods, much larger than the 1949 flood, have occurred during the last 4,300 years. In considering future floodplain management in the catchment, floods in excess of the 1949 event are likely to be experienced again.

## 2.3 Previous Studies

The Wollombi Flood Study Review and Model Upgrade (BMT WBM, 2010) represents the most recent comprehensive flood study of the catchment and forms the basis for the current floodplain risk management study. The Flood Study Review incorporated the following activities:

- Collation of database of historical flood information for the June 2007 flood in the Wollombi Brook;
- Acquisition of topographical data for the catchment including photogrammetric analysis and cross section survey;
- Consultation with the community to acquire historical flood information and liaison in regard to flooding concerns/perceptions and future floodplain management activities;
- Development of a hydrological model (using RAFTS-XP software) and hydraulic model (using TUFLOW software) to simulate flood behaviour in the catchment;
- Calibration of the developed models using the June 2007 flood event and model validation using the June 1949 flood event;
- Prediction of design flood conditions in the catchment, particularly at Wollombi Village, using the calibrated models, and
- Production of design flood mapping series.

The Flood Study Review supersedes the Wollombi Flood Study (Patterson Britton & Partners, 2005). This previous study originated from the requirement to determine appropriate flood planning levels in the assessment of development applications. The analyses were extended to developing a one-dimensional hydrodynamic computer model using the HEC-RAS modelling software. The key outcome of the 2005 Flood Study was the determination of design 1% AEP flood level for Wollombi, and the recommendation to adopt the level with appropriate freeboard allowances as the flood planning level. This recommendation was subsequently adopted by Council in the revised Policy B30.11.

The flood levels determined in Wollombi Flood Study Review and Model Upgrade (BMT WBM, 2010) have been utilised for flood planning purposes since the adoption of the study by Council.

## 2.4 Heritage

The Wollombi region has a rich cultural history, both indigenous and European. Heritage issues is an important consideration in the flood planning process to ensure that flood mitigation measures do not unduly impact upon the heritage of the study area.

The following buildings are listed in the State Heritage inventory:

- Former Courthouse and Police Station
- Post Office
- Public School Buildings
- St. John Anglican Church
- St. Michael Catholic Church; and
- Mulla Villa

Other heritage listings include the Wollombi Cemetery and sections of the Great North Road between Mt Manning and Wollombi.

## 3 COMMUNITY CONSULTATION

### 3.1 The Community Consultation Process

Community consultation has been an important component of the current study. The consultation has aimed to inform the community about the development of the floodplain risk management study and its likely outcome as a precursor to the development of the floodplain risk management plan. It has provided an opportunity to collect information on their flood experience, their concern on flooding issues and to collect feedback and ideas on potential floodplain management measures and other related issues.

The key elements of the consultation process have been as follows:

- Consultation with the Floodplain Management Committee through meetings, presentations and workshops;
- Distribution of questionnaires (in association with the flood study);
- Two community information sessions, firstly to outline the study objectives following completion of the Flood Study Review and identify key community concerns, and secondly to workshop potential floodplain risk management options;
- Public exhibition of the Draft Floodplain Risk Management Study and Plan **(to be undertaken)**.

These elements are discussed in detail below.

### 3.2 The Floodplain Management Committee

The study has been overseen by the Floodplain Management Committee (Committee). The Committee has assisted and advised Council in the development of the Wollombi Village Flood plain Risk Management Study. Members of the Floodplain Management Committee include representatives from the following:

- Cessnock City Council - Councillors;
- Staff from Cessnock City Council;
- Representative from the Office of Environment and Heritage (formerly DECCW) Hunter Region;
- Representatives from the Hunter Central Rivers Catchment Management Authority (CMA); and
- Representatives from the State Emergency Service (SES); and
- Community representatives.

The Committee is responsible for recommending the outcomes of the study for formal consideration by Council.



### 3.3 Community Questionnaires

Questionnaires were distributed to the community during the Flood Study in which respondents were asked to provide information on previous flood history, and concerns or issues in regard to ongoing floodplain risk management in Wollombi.

The key information provided in the responses includes:

- General appreciation that major flooding occurs in the Valley and the need to live with and respond appropriately;
- Experiences from the June 2007 event which highlight areas of concern in terms of flood warning, emergency response and post-flood recovery;
- Concern over the appropriateness of development with due consideration of flood risk; and
- Differing opinions on the appropriate flood planning level.

### 3.4 Community Information Sessions

A community information session was held at Wollombi Village Hall in the evening of Wednesday 28th October 2009 in association with the public exhibition period of the Draft "Wollombi Flood Study Review and Model Upgrade" report. The information session had a dual purpose in giving the community an opportunity to provide feedback on the Draft Flood Study, and also initiate discussion on the objectives of the floodplain risk management study and canvassing of potential flood management options.

The information session was supported by 8 community attendees in addition to Council staff and the consultant. In relation to floodplain risk management in Wollombi, the key themes contributed by the community members present included:

- Acknowledgment of the contention surrounding flood planning levels in Wollombi and surrounds; and
- Provide the study team with a means to obtain feedback from the local community on the direction of the study and additional information/comment arising from flooding in the catchment.

A second information session was held at Wollombi Village Hall in the morning of Saturday 16th April 2011. The information session was attended by 7 community attendees in addition to Council staff, a representative of the State Emergency Service and the consultant. A working paper comprising a summary of the preliminary flood damages and options assessment was made available to the community prior to the information session. This working document was produced for the Floodplain Management Committee and community in order to provide some feedback on the direction of the floodplain risk management study, and in particular to provide opinion/commentary on the some of the potential options as a representative community body.

Despite the relatively low attendance at the workshop, some beneficial discussion/feedback emanated from the session, with key issues including:

- Need for investigation of improved flood warnings for Wollombi;

- Improved communications during flood events including options for backup power for communications networks;
- Council to provide relevant flood information to landholders on a regular basis to ensure the community are informed (and stay informed) of potential flood risk; and
- Requirement for appropriate development controls on new development with due consideration of flood risks.

The inputs from the community during both of the community information sessions have been incorporated into the formulation of the proposed floodplain risk management plan presented in subsequent sections of this report.

### 3.5 Public Exhibition

The Draft Wollombi Floodplain Risk Management Study and Plan was placed on public exhibition from 11<sup>th</sup> June to 20<sup>th</sup> July 2012 (42 days). Copies of the report were made available to the public in the following locations:

- Cessnock City Council Chambers;
- Cessnock and Kurri Kurri libraries; and
- Wollombi, Laguna, Millfield, Paxton and Ellalong Villages.

In addition to the six-week public exhibition, the period for submissions was extended to 10<sup>th</sup> August 2012 (additional 3 weeks).

Formal submissions were received from:

- Wollombi Progress Association; and
- Wollombi Rural Fire Service.

Copies of the above submissions are included in Appendix C for reference. The submissions received were considered by a technical Sub-Committee of the Floodplain Management Committee (consisting of Council, Office of Environment and Heritage, State Emergency Service) and were generally considered to support and reinforce the priorities and actions identified by the Floodplain Risk Management Plan. The submissions provided for a review of these recommendations and have been incorporated as presented in Section 9 of the Final Report.

## 4 EXISTING FLOOD BEHAVIOUR

### 4.1 Flood Study Review

The objective of the Flood Study review was to undertake a comprehensive review of the Wollombi Valley Flood Study (PBP, 2005) and establish models as necessary for accurate flood level prediction. Central to this was the development of a two-dimensional hydraulic model of the floodplain for the Wollombi Village area.

The central components of the flood study review and model upgrade included the following activities:

- Consultation with the community to acquire historical flood information and liaison in regard to flooding concerns/perceptions and future floodplain management activities;
- Development of detailed numerical models to simulate flood behaviour in the catchment;
- Calibration of the developed models using the June 2007 flood event and model validation using the June 1949 flood event;
- Prediction of design flood conditions in the catchment, particularly at Wollombi Village, using the calibrated models, and
- Production of design flood mapping series.

The revised flood study (adopted by Council 21 March 2011 Resolution No. 1928) forms the basis for the floodplain risk management study, being the next stage of the floodplain management process.

### 4.2 Flooding Behaviour

Wollombi Village lies at the confluence of the two principal watercourses in the upper Wollombi Valley – the Congewai Creek (also known as Wollombi Brook North Arm) and Wollombi Brook (South Arm). The catchments of the two tributaries upstream of Wollombi Village are typically steep sided and forested with a cleared, relatively narrow floodplain on the incised valley floors. From the headwaters in the Watagan Ranges, at some 640m AHD at the highest points, the catchment rapidly descends to Wollombi Village at approximately 100m AHD. The combination of these features results in a 'flashy' catchment that converts rainfall rapidly into relatively large flow rates and elevated flood levels.

The natural rainfall response of the Congewai Creek and Wollombi Brook catchments is such that the timing of the flood peaks tends to coincide, thereby exacerbating flooding at Wollombi Village.

The Wollombi Valley Flood Study Review and Model Upgrade (BMT WBM, 2010) defined design flood levels at Wollombi for a range of design event magnitudes, utilising detailed hydrologic and hydraulic models (XP-RAFTS /TUFLOW) calibrated to June 1949 and June 2007 historical event data. Table 4-1 presents a summary of design peak flood levels at Wollombi Village along with peak historical event levels for comparison.

**Table 4-1 Comparison of Historical and Design Peak Flood Levels at Wollombi Village**

Flood Event	Peak Flood Level (m AHD)
5% AEP	98.0m AHD
2% AEP	98.9m AHD
June 2007	99.0m AHD
April 1927	~99.0m AHD
August 1857	~99.0m AHD
1% AEP	99.7m AHD
0.5% AEP	100.4m AHD
June 1867	~100.5m AHD
June 1949	101.6m AHD
3 x 1% AEP	105.8m AHD

The comparison of historical and design flood levels at Wollombi highlight the significance of the historical events previously experienced in the catchment. Moreover, the significant increases in flood depth with flood magnitude highlight the nature of flooding in the deeply incised valley.

The sensitivity of peak flood levels in Wollombi to increasing flow magnitude is further exemplified by the results of the sensitivity testing presented in the Flood Study Review. Sensitivity to increase design rainfall was investigated by applying 10%, 20% and 30% increases to the adopted 1% AEP design rainfalls for the catchment. These rainfall intensity increases yield increases in design peak flood levels of Wollombi of 0.6m, 1.2m and 1.78m above the base 1% AEP flood level respectively.

Considering the 10% increase rainfall alone, the change in peak water level of 0.6m provides for a peak flood level closer to the 0.5% AEP flood condition as shown in Table 4-1. It is important to recognise that a 10% change in the adopted 1% AEP flow condition is indicative of the order of accuracy of the modelling. Typically for flood planning purposes, a 0.5m freeboard above the predicted 1% AEP flood level is adopted to account for model uncertainties, potential climate change impacts and other factors such as wave action.

Significantly for the Wollombi catchment, the order of typical model uncertainty and indeed potential climate change influences (i.e. increased rainfall intensity) exceed this nominal freeboard allowance.

## 4.3 Flood Risk Mapping

The flood results from the Flood Study Review were presented in a flood mapping series for each design event magnitude simulated, incorporating a map of peak flood depth, velocity and hydraulic hazard within a 5km radius of Wollombi Village. Additional mapping has been undertaken in the floodplain risk management study to define the hydraulic category and flood hazard distributions.

### 4.3.1 Hydraulic Categorisation

There are no prescriptive methods for determining what parts of the floodplain constitute floodways, flood storages and flood fringes. Descriptions of these terms within the Floodplain Development

Manual (NSW Government, 2005) are essentially qualitative in nature. Of particular difficulty is the fact that a definition of flood behaviour and associated impacts is likely to vary from one floodplain to another depending on the circumstances and nature of flooding within the catchment.

The hydraulic categories as defined in the Floodplain Development Manual are:

- **Floodway** - Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas.
- **Flood Storage** - Areas that are important in the temporary storage of the floodwater during the passage of the flood. If the area is substantially removed by levees or fill it will result in elevated water levels and/or elevated discharges. Flood Storage areas, if completely blocked would cause peak flood levels to increase by 0.1m and/or would cause the peak discharge to increase by more than 10%.
- **Flood Fringe** - Remaining area of flood prone land, after Floodway and Flood Storage areas have been defined. Blockage or filling of this area will not have any significant affect on the flood pattern or flood levels.

A number of approaches were considered when attempting to define flood impact categories across the Wollombi Brook catchment. Approaches to define hydraulic categories that were considered for this assessment included partitioning the floodplain based on:

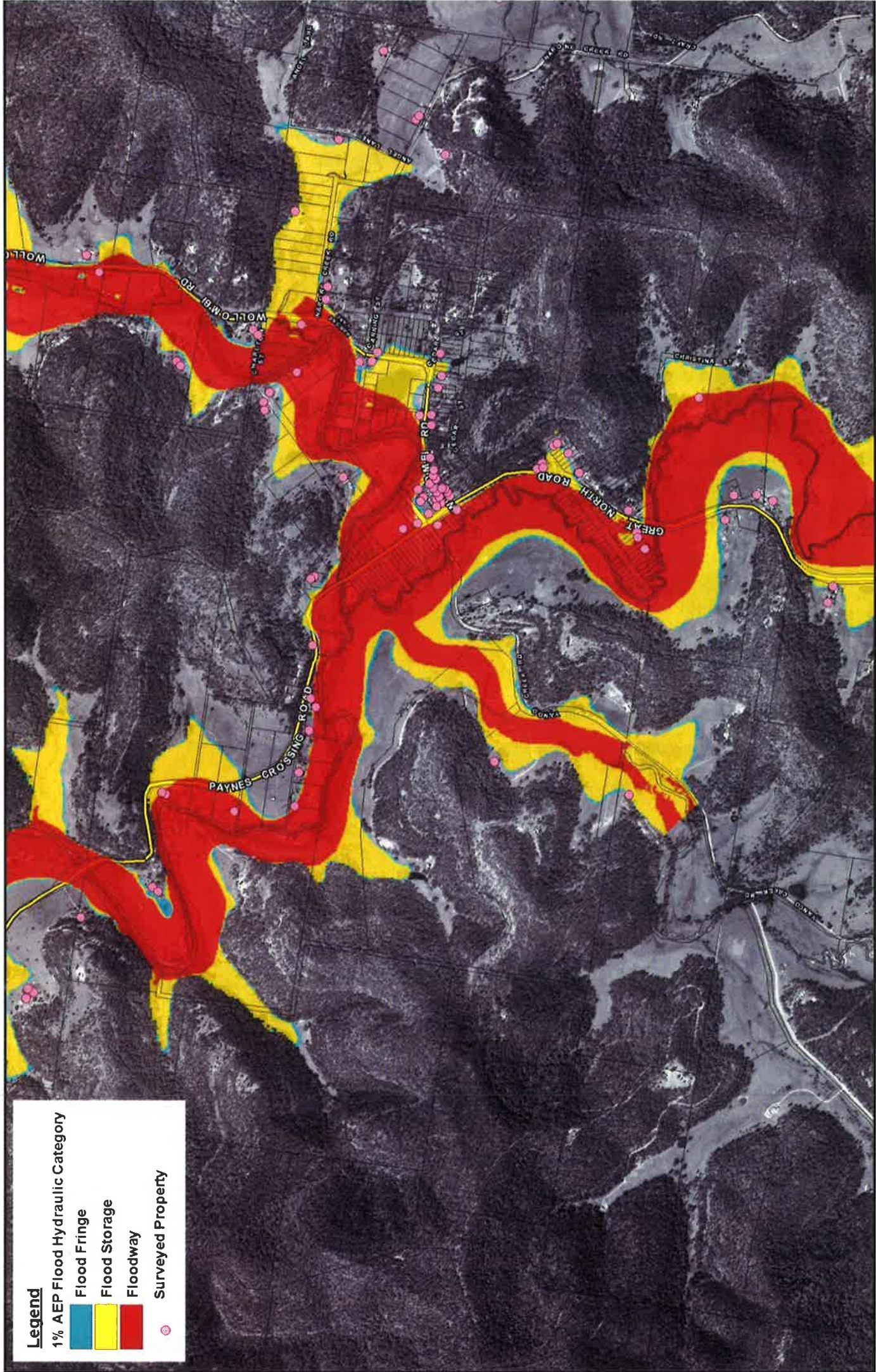
- Peak flood velocity;
- Peak flood depth;
- Peak velocity \* depth (sometimes referred to as unit discharge);
- Cumulative volume conveyed during the flood event; and
- Combinations of the above.

The definition of flood impact categories that was considered to best fit the application within the Wollombi Brook catchment, was based on a combination of velocity\*depth and depth parameters. The adopted hydraulic categorisation is defined in Table 4-2. Hydraulic category mapping for the 1% AEP and Extreme Flood design events is shown in Figure 4-1 and Figure 4-2.

**Table 4-2 Hydraulic categories**

<b>Floodway</b>	Velocity * Depth > 0.5	Areas and flowpaths where a significant proportion of floodwaters are conveyed (including all bank-to-bank creek sections).
<b>Flood Storage</b>	Velocity * Depth < 0.5 and Depth > 0.5 metres	Areas where floodwaters accumulate before being conveyed downstream. These areas are important for detention and attenuation of flood peaks.
<b>Flood Fringe</b>	Velocity * Depth < 0.5 and Depth < 0.5 metres	Areas that are low-velocity backwaters within the floodplain. Filling of these areas generally has little consequence to overall flood behaviour.





**Legend**

- 1% AEP Flood Hydraulic Category
- Flood Fringe
- Flood Storage
- Floodway
- Surveyed Property

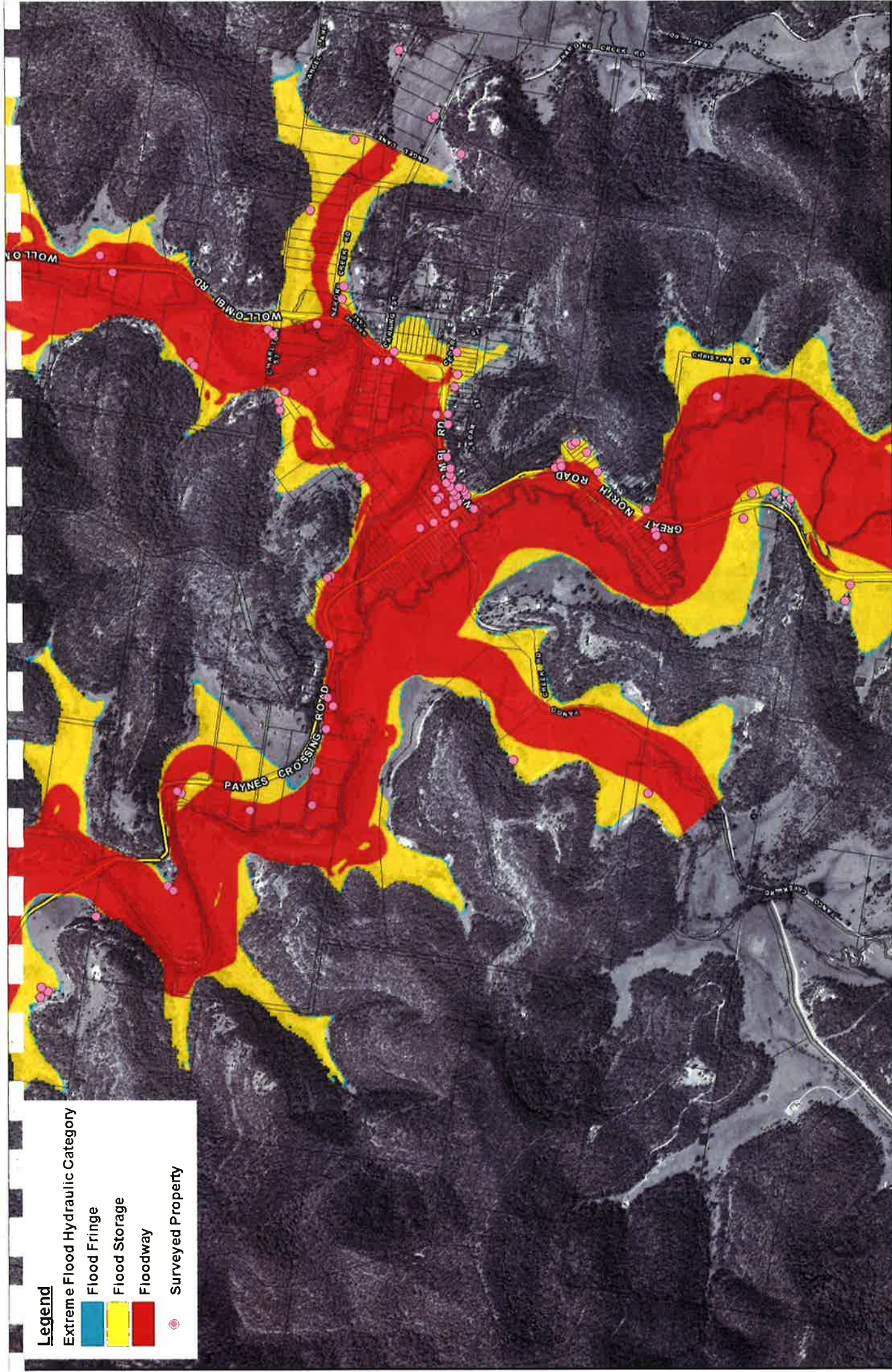
Figure Wollombi\_1%AEP\_hydcats\_R1

Wollombi Floodplain Risk Management Study  
 Design Event: 1% AEP  
 Hydraulic Category - Village Area



Wollombi Floodplain Risk Management Study - 2024





**Legend**

**Extreme Flood Hydraulic Category**

- Flood Fringe
- Flood Storage
- Floodway
- Surveyed Property

Wollombi Floodplain Risk Management Study  
 Design Event : Extreme Flood Event  
 Hydraulic Category - Village Area

Figure Wollombi\_Extreme\_hydcat\_R1

0 375 750m  
 Approx. Scale

**NORTH**



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Properties identified within the Extreme Flood extent for which floor level survey has been undertaken (refer to Section 5.1) are shown for reference. It is also noted that mapping associated with the flood hydraulic categories may be amended in the future, at a local or property scale, subject to appropriate analysis that demonstrates no additional impacts (e.g. if it is to change from floodway to flood storage). The mapping shown in Figure 4-1 and Figure 4-2 focuses on the Village area, with additional mapping extending over the full study area included in Appendix A.

### 4.3.2 Provisional Hazard

The NSW Government's Floodplain Development Manual (2005) defines flood hazard categories as follows:

- **High hazard** – possible danger to personal safety; evacuation by trucks is difficult; able-bodied adults would have difficulty in wading to safety; potential for significant structural damage to buildings; and
- **Low hazard** – should it be necessary, trucks could evacuate people and their possessions; able-bodied adults would have little difficulty in wading to safety.

The provisional flood hazard level is often determined on the basis of the predicted flood depth and velocity. This is conveniently done through the analysis of flood model results. A high flood depth will cause a hazardous situation while a low depth may only cause an inconvenience. High flood velocities are dangerous and may cause structural damage while low velocities have no major threat.

Figures L1 and L2 in the Floodplain Development Manual (NSW Government, 2005) are used to determine provisional hazard categorisations within flood prone land. These figures are reproduced in Figure 4-3.

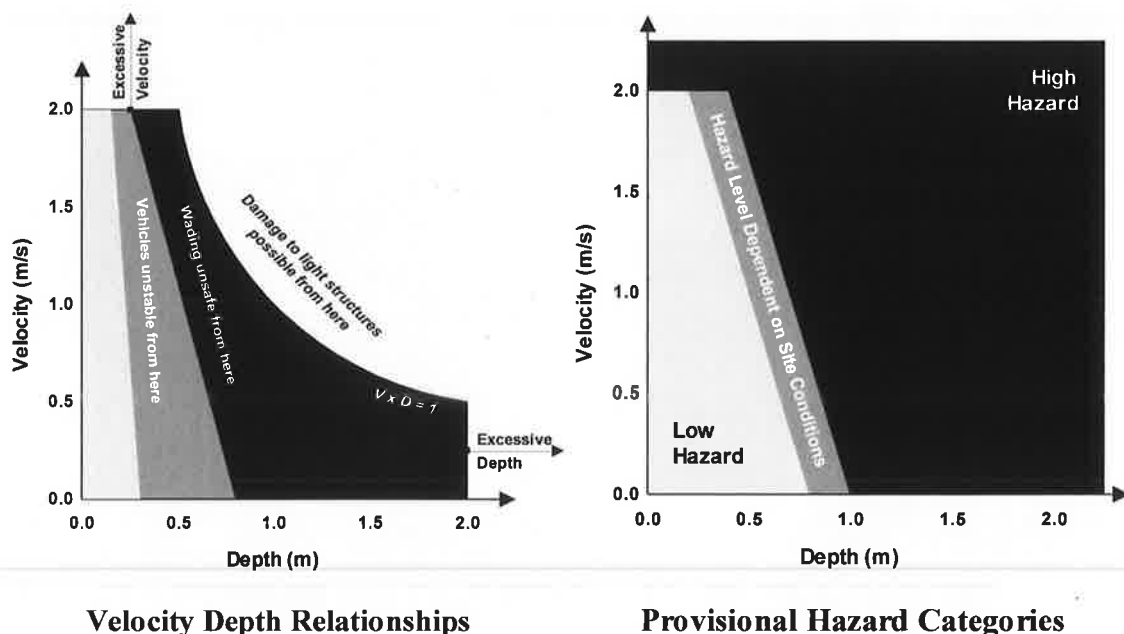
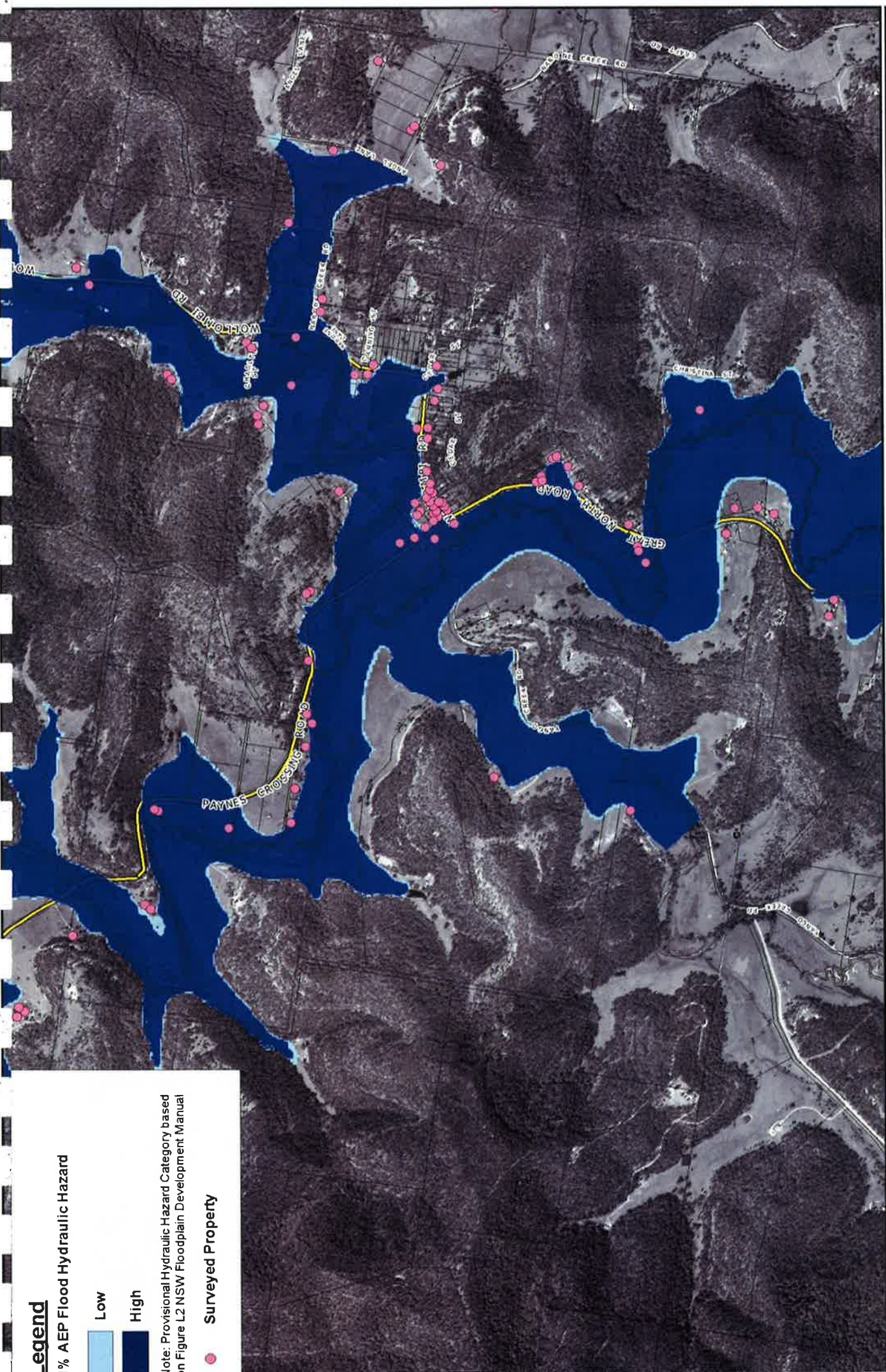


Figure 4-3 Provisional Flood Hazard Categorisation

Hydraulic hazard mapping for the 1% AEP and Extreme Flood events are shown in Figure 4-4 and Figure 4-5 respectively, focusing on the Village area. Additional mapping extending over the full study area included in Appendix A.



**Legend**

1% AEP Flood Hydraulic Hazard

Low

High

Note: Provisional Hydraulic Hazard Category based on Figure L2 NSW Floodplain Development Manual

● Surveyed Property

Figure Wollombi\_1%AEP\_z\_R1

Wollombi Flood Study Review and Model Upgrade  
 Design Event : 1% AEP  
 Provisional Hydraulic Hazard Category - Village Area

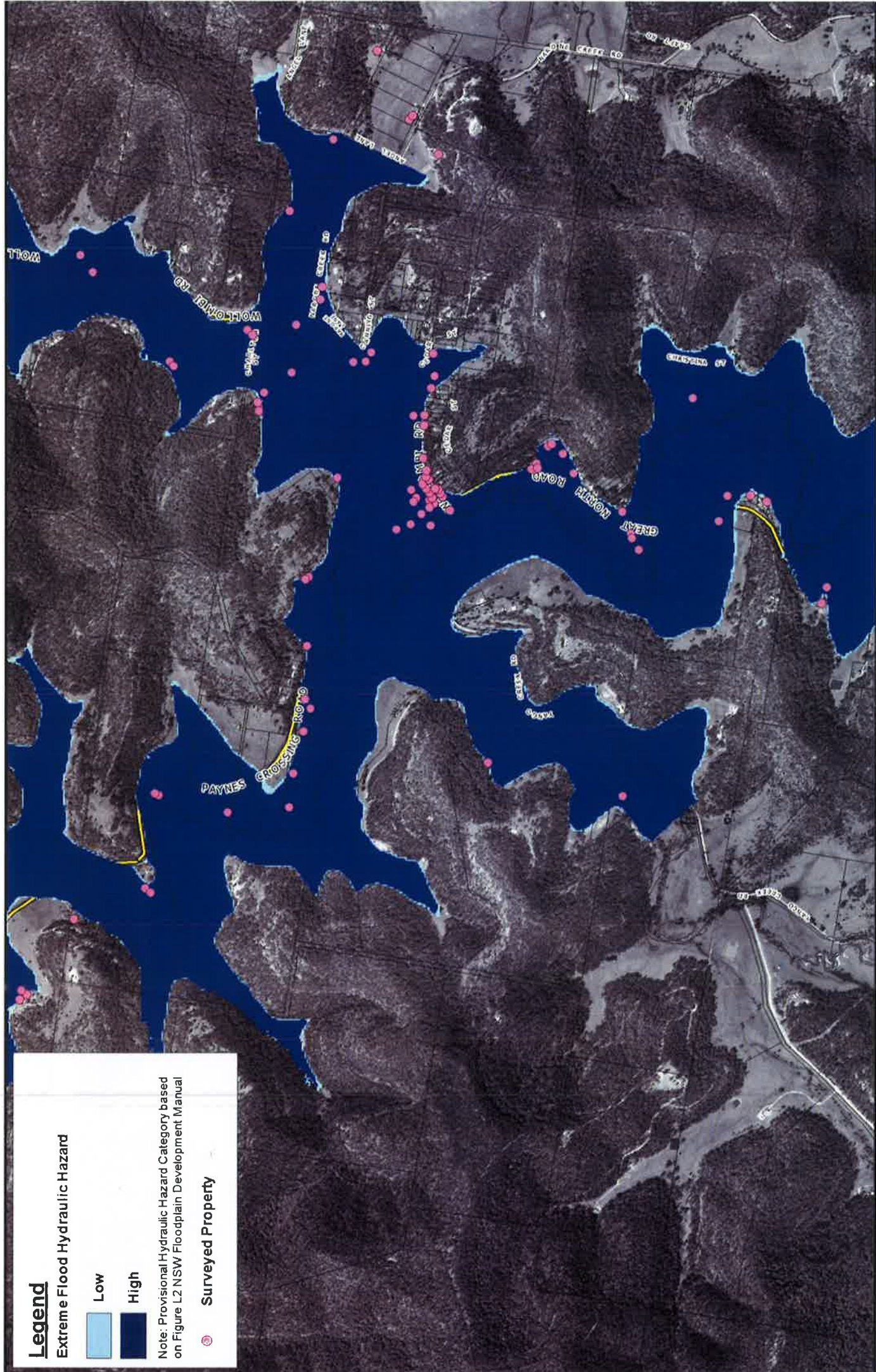
0 375 750m

Approx. Scale



V:\PROJECTS\Wollombi\FloodMap\_1%AEP\_z\_C11.mxd





**Legend**

Extreme Flood Hydraulic Hazard

Low

High

Note: Provisional Hydraulic Hazard Category based on Figure L2 NSW Floodplain Development Manual

Surveyed Property



Wollombi Flood Study Review and Model Upgrade  
 Design Event : Extreme Flood (3 times 1% AEP)  
 Provisional Hydraulic Hazard Category - Village Area

Figure Wollombi\_3times\_1%AEP\_z\_R1



AMT WBM

The key factors influencing flood hazard or risk are:

- Size of the Flood
- Rate of Rise - Effective Warning Time
- Community Awareness
- Flood Depth and Velocity
- Duration of Inundation
- Obstructions to Flow
- Access and Evacuation

These issues are discussed in further detail in Section 8 with respect to assessment of appropriate planning and development controls.

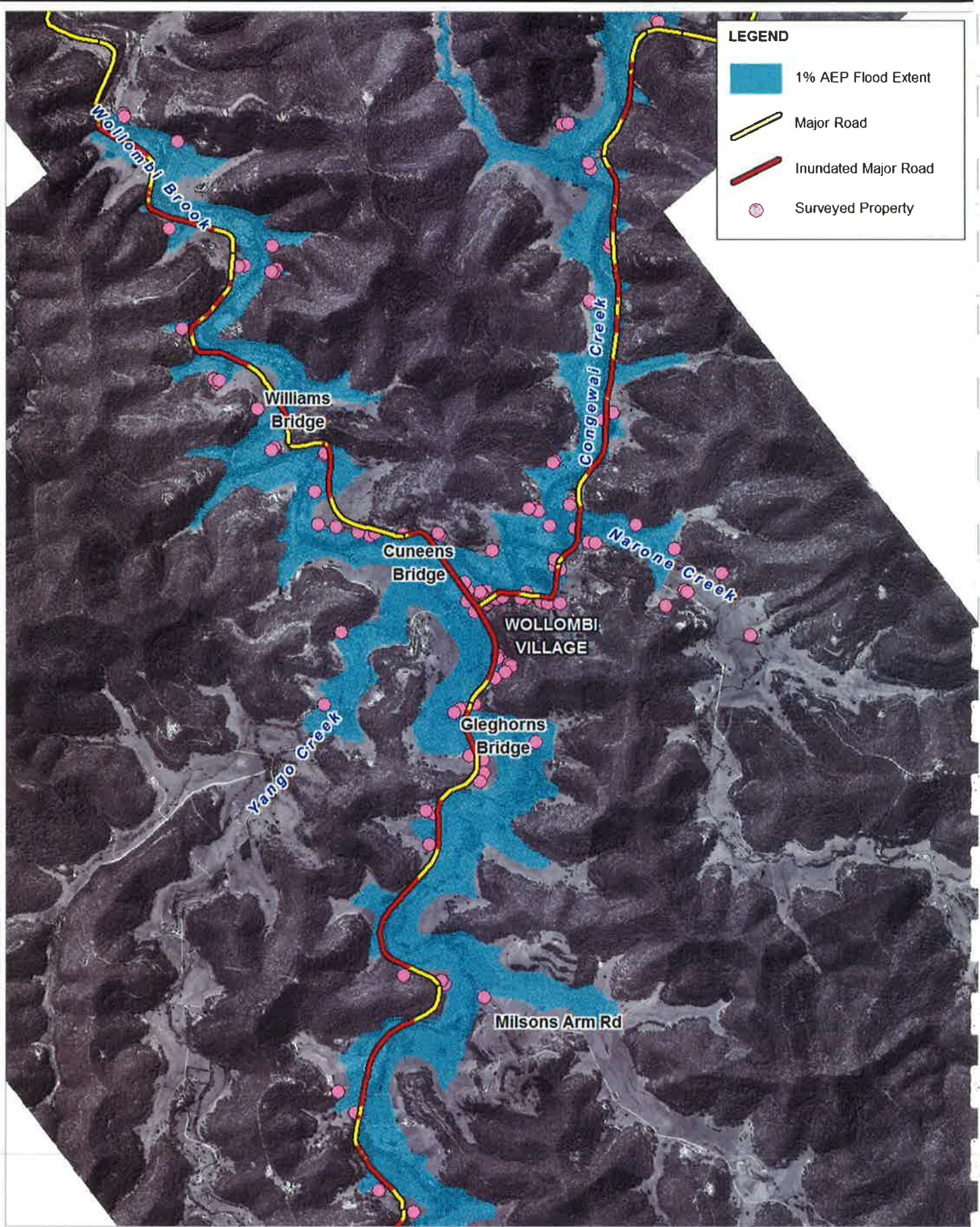
## 4.4 Road Inundation

As evidenced during the June 2007 flood event, extensive inundation of major access roads to Wollombi is expected in major flood events. This extensive road closure adds to the isolation of flood affected property and serious implications for emergency response.

Figure 4-6 shows the extent of road inundation at the peak of the 1% AEP event on the major routes to Wollombi including Wollombi Road, The Great North Road and Paynes Crossing Road. Many of the locations shown however are inundated at lesser flood magnitudes. There are also numerous minor valley roads and property access roads that are not shown on Figure 4-6. Many of these access roads have low level crossing points with flood level immunity significantly less than even a 5-year event.

The main road inundation at the peak of the 5% AEP and 20% AEP events is shown in Figure 4-7 and Figure 4-8 respectively. Even at these magnitude flood event, the main access road through the study area is inundated at numerous locations. This reinforces the fact that many properties would be isolated during the flood, with limited opportunity for access.





Title:  
**Road Inundation at 1% AEP Flood Level**

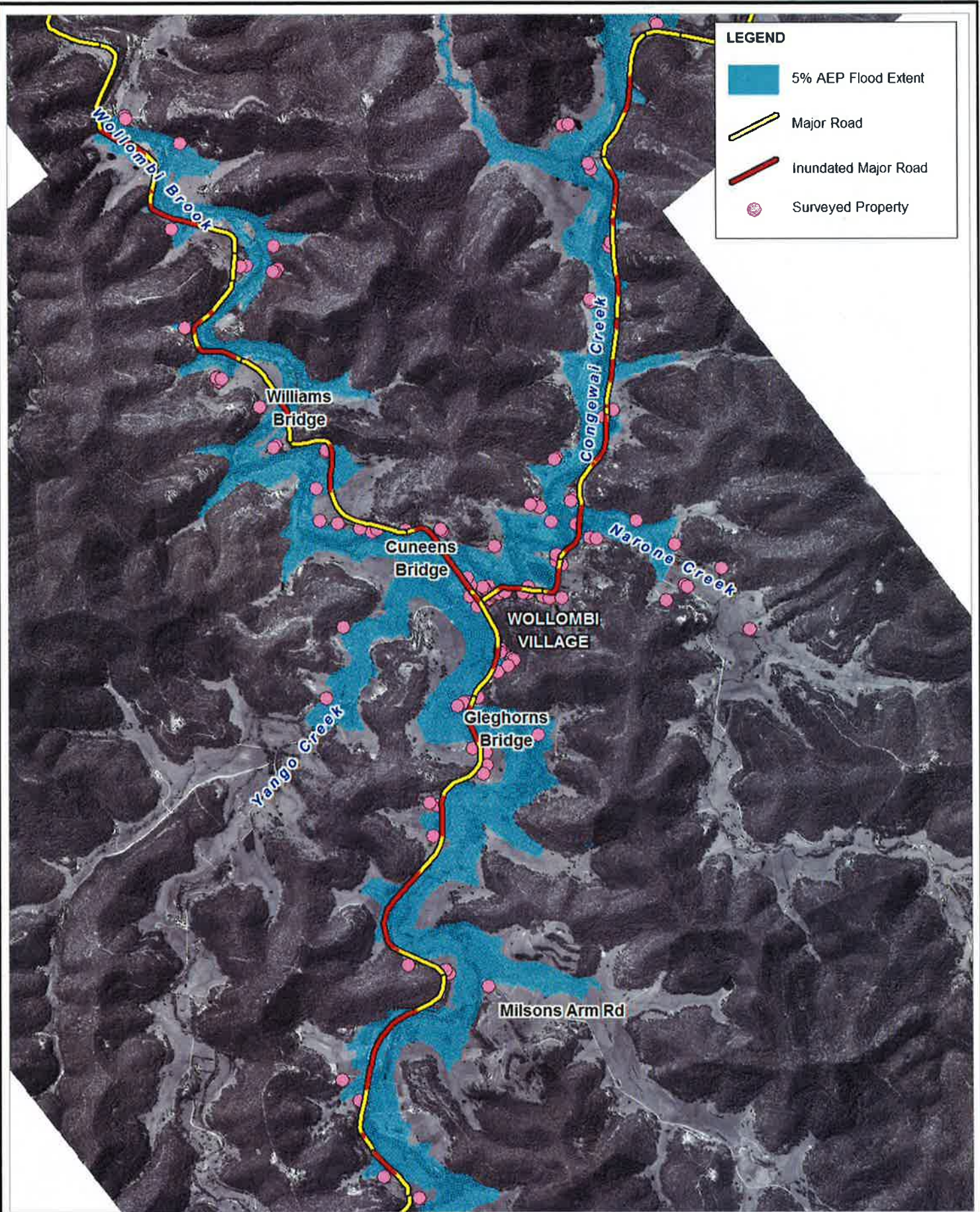
Figure:  
**4-6**

Rev:  
**A**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.







Title:  
**Road Inundation at 5% AEP Flood Level**

Figure:  
**4-7**

Rev:  
**A**

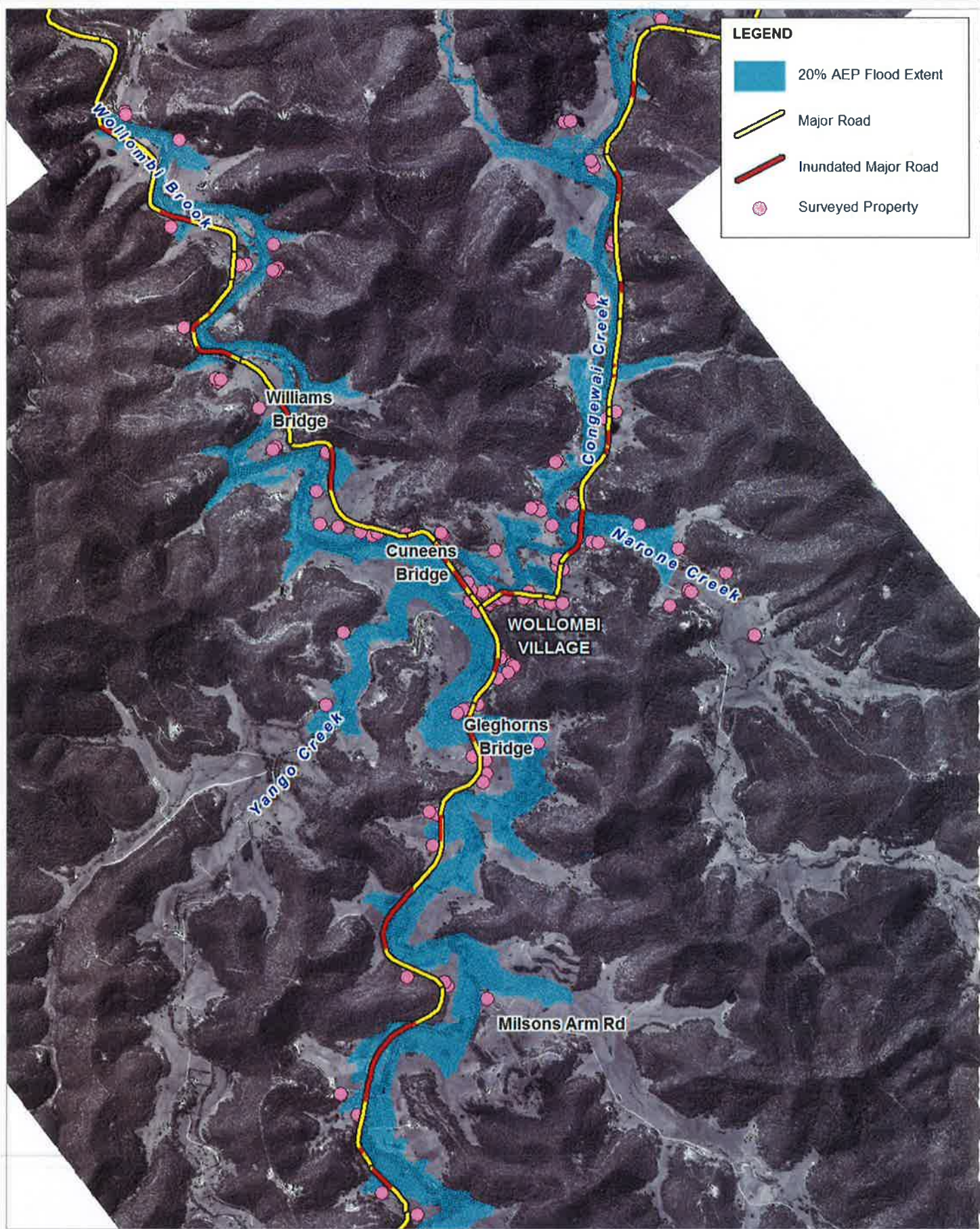
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0 0.75 1.5km  
Approx. Scale





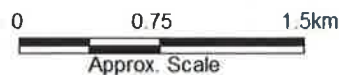


Title:  
**Road Inundation at 20% AEP Flood Level**

Figure:  
**4-8**

Rev:  
**A**

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## 5 FLOOD DAMAGES

A flood damage assessment has been undertaken to identify flood affected property, to quantify the extent of damages in economic terms for existing flood conditions and to enable the assessment of the relative merit of potential flood mitigation options by means of benefit-cost analysis.

The general process for undertaking a flood damages assessment incorporates:

- Identifying properties subject to flooding;
- Determining depth of inundation above floor level for a range of design event magnitudes;
- Defining appropriate stage-damage relationships for various property types/uses;
- Estimating potential flood damage for each property; and
- Calculating the total flood damage for a range of design events.

### 5.1 Property Data

#### 5.1.1 Location

Property locations have been derived from Council's cadastre information and associated detailed aerial photography of the catchment. Linked within a GIS system, this data enables rapid identification and querying of property details.

A property database has been developed detailing individual properties subject to flood inundation, i.e. within the predicted flood envelopes discussed in Section 4.

#### 5.1.2 Land Use

For the purposes of the flood damage assessment, property was considered as either residential or commercial. Commercial properties have been identified from the property survey. Outside of the Village locality, most commercial property is small scale operations typically related to local tourism.

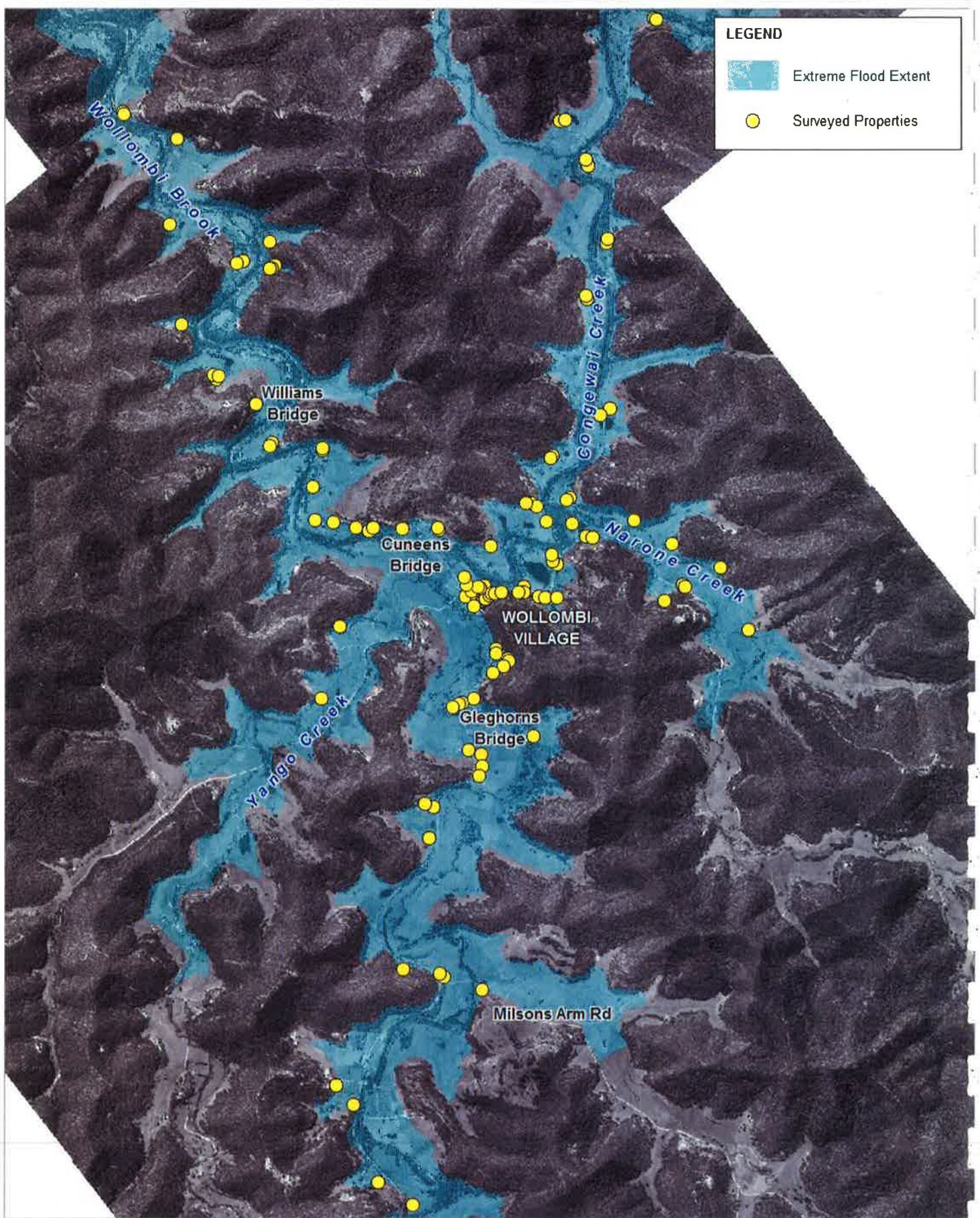
A number of residential properties are small weekender/hobby farm type property which typically is not permanently occupied. These type of developments are also typically of a smaller scale and lower economic value which has been factored into the flood damage assessment.

Public infrastructure and utility assets have been excluded from the damages assessment at this stage, however, will be incorporated in the final analysis and documentation.

#### 5.1.3 Ground and Floor Level

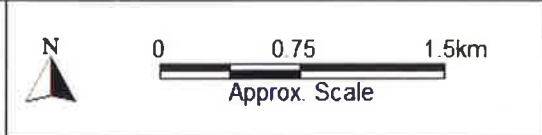
A floor level survey of identified property within the extreme Flood extent was undertaken by Carman Surveyors. The survey provided ground levels at the building, building floor level, geographic co-ordinate and photographic record to identify property type.

The distribution of surveyed properties within the study area with reference to the Extreme Flood extent is shown in Figure 5-1.



<p>Title</p> <p><b>Location of Property Surveyed</b></p>	<p>Figure</p> <p><b>5-1</b></p>	<p>Rev.</p> <p><b>A</b></p>
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The output from the floor level survey is included in Appendix D. The general format of the data for each individual property includes a site photograph, location coordinates, surveyed floor level, indicative ground level and additional comments on property particulars

### 5.1.4 Flood Level

The design flood levels across the catchment were adopted from the Wollombi Flood Study Review and Model Upgrade as discussed in Section 2. The flood modelling results, derived on a 10m x 10m grid, were used to generate a continuous flood profile across the floodplain. Flood levels calculated from the TUFLOW model were queried from TUFLOW's GIS output at each property reference point. The resulting output was used to identify flooding characteristics such as the number and type of properties affected, frequency of inundation and the depth of inundation.

## 5.2 Property Inundation

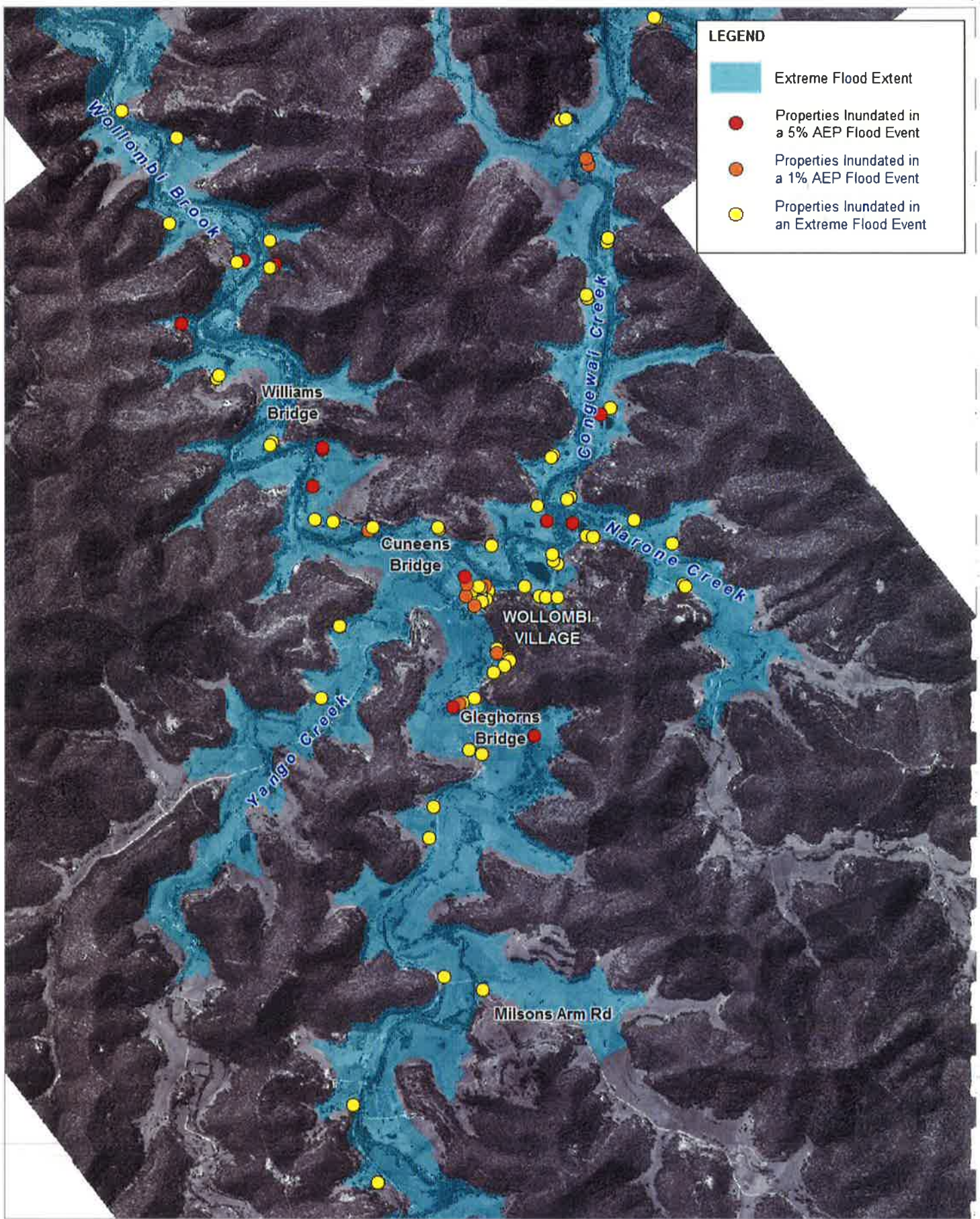
A summary of the number of properties potentially affected by flooding for a range of flood magnitudes is shown in Table 5-1. The counts in the table represent numbers of properties with potential for flooding *above floor level* for each flood magnitude. The property type has been distinguished, represented by:

- Residential – assumed permanent residences;
- Weekender – typically smaller/lower value property (not permanent residence); and
- Commercial – a place of business/commercial operation.

**Table 5-1 Number of Properties affected by Flooding above Floor Level**

Design Return Period	Residential	Weekender	Commercial
5-year ARI	0	3	0
10-year ARI	2	4	0
20-year ARI	4	4	2
50-year ARI	4	6	2
100-year ARI	8	6	4
200-year ARI	9	6	5
Extreme Flood	50	17	13

A total of 18 properties (all type) have been identified with floor levels lower than the 100-year ARI flood level.



**LEGEND**

- Extreme Flood Extent
- Properties Inundated in a 5% AEP Flood Event
- Properties Inundated in a 1% AEP Flood Event
- Properties Inundated in an Extreme Flood Event

<p>Title</p> <p><b>Inundation of Property at Selected Return Periods</b></p>	<p>Figure</p> <p><b>5-2</b></p>	<p>Rev.</p> <p><b>A</b></p>
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## 5.3 Flood Damages Assessment

### 5.3.1 Types of Flood Damage

The definitions and methodology used in estimating flood damage are summarised in the Floodplain Development Manual. Figure 5-3 summarises the "types" of flood damages as considered in this study. The two main categories are 'tangible' and 'intangible' damages. Tangible flood damages are those that can be more readily evaluated in monetary terms, while intangible damages relate to the social cost of flooding and therefore are much more difficult to quantify.

Tangible flood damages are further divided into direct and indirect damages. Direct flood damages relate to the loss, or loss in value, of an object or a piece of property caused by direct contact with floodwaters. Indirect flood damages relate to loss in production or revenue, loss of wages, additional accommodation and living expenses, and any extra outlays that occur because of the flood.

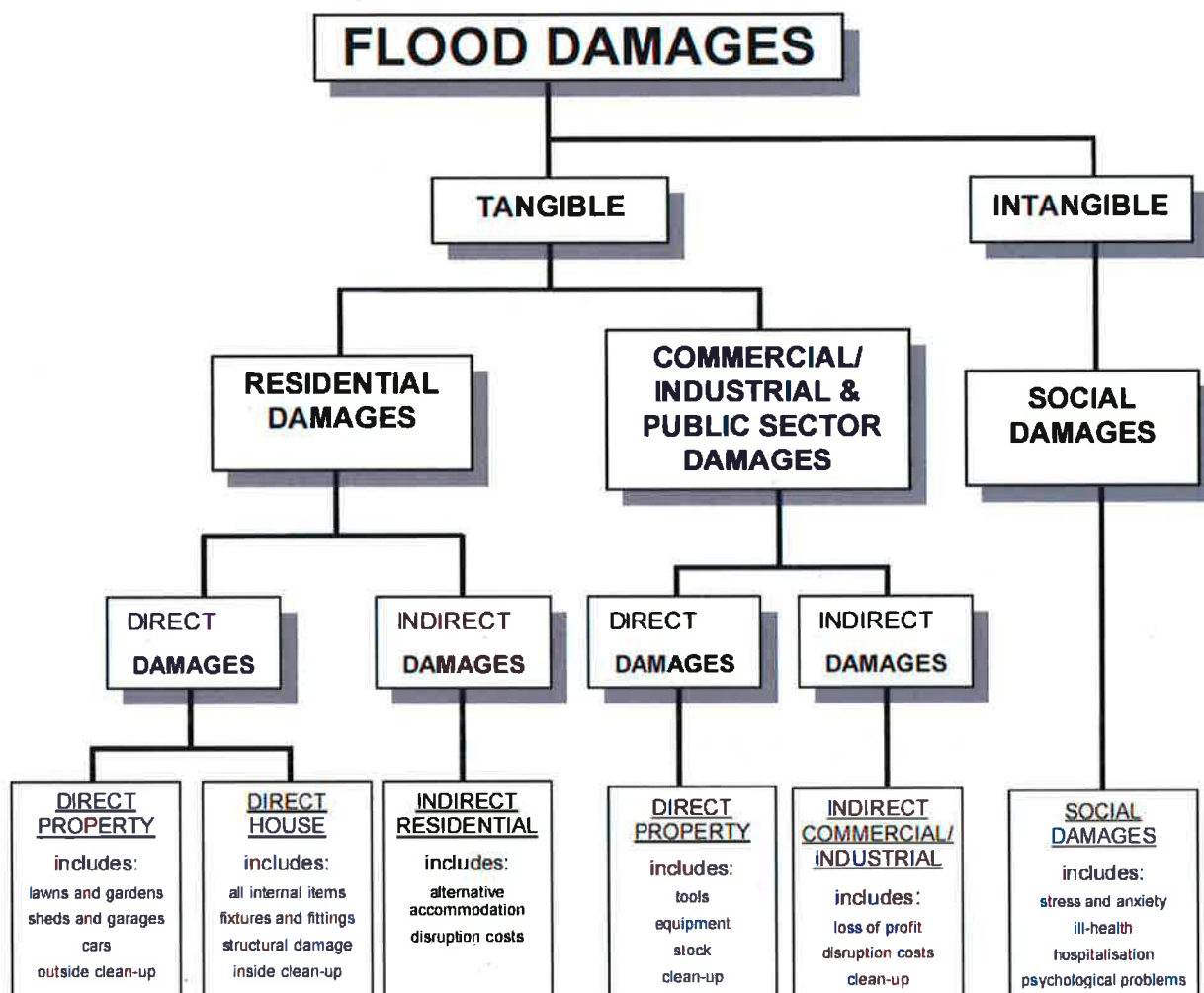


Figure 5-3 Types of Flood Damage

### 5.3.2 Basis of Flood Damage Calculations

Flood damages have been calculated using the data base of potentially flood affected properties and a number of stage-damage curves derived for different types of property within the catchment. These curves relate the amount of flood damage that would potentially occur at different depths of

inundation, for a particular property type. Residential damage curves are based on the DECCW guideline stage-damage curves for residential property.

Different stage-damage curves for direct property damage have been derived for:

- Residential dwellings (categorised into small, typical or raised categories); and
- Commercial premises (categorised into low, medium or high damage categories).

Apart from the direct damages calculated from the derived stage-damage curves for each flood affected property, other forms of flood damage include:

- Indirect residential, commercial and industrial damages, taken as a percentage of the direct damages;
- Infrastructure damage, based on a percentage of the total value of residential and business flood damage; and

Intangible damages relate to the social impact of flooding and include:

- inconvenience,
- isolation,
- disruption of family and social activities,
- anxiety, pain and suffering, trauma,
- physical ill-health, and
- psychological ill-health

The damage estimates derived in this study are for the **tangible damages only**. Whilst intangible losses may be significant, these effects have not been quantified due to difficulties in assigning a meaningful dollar value.

### 5.3.3 Summary of Flood Damages

The peak depth of flooding was determined at each property for the 5, 10, 20, 50, 100 and 200 -year ARI events and the Extreme Flood Event. The associated flood damage cost to each property was subsequently estimated from the stage-damage relationships. Total damages for each flood event were determined by summing the predicted damages for each individual property.

Table 5-2 provides a summary of the flood damages calculations for Wollombi.

The Average Annual Damage (AAD) is the average damage in dollars per year that would occur in a designated area from flooding over a very long period of time. In many years there may be no flood damage, in some years there will be minor damage (caused by small, relatively frequent floods) and, in a few years, there will be major flood damage (caused by large, rare flood events). Estimation of the AAD provides a basis for comparing the effectiveness of different floodplain management measures (i.e. the reduction in the AAD).

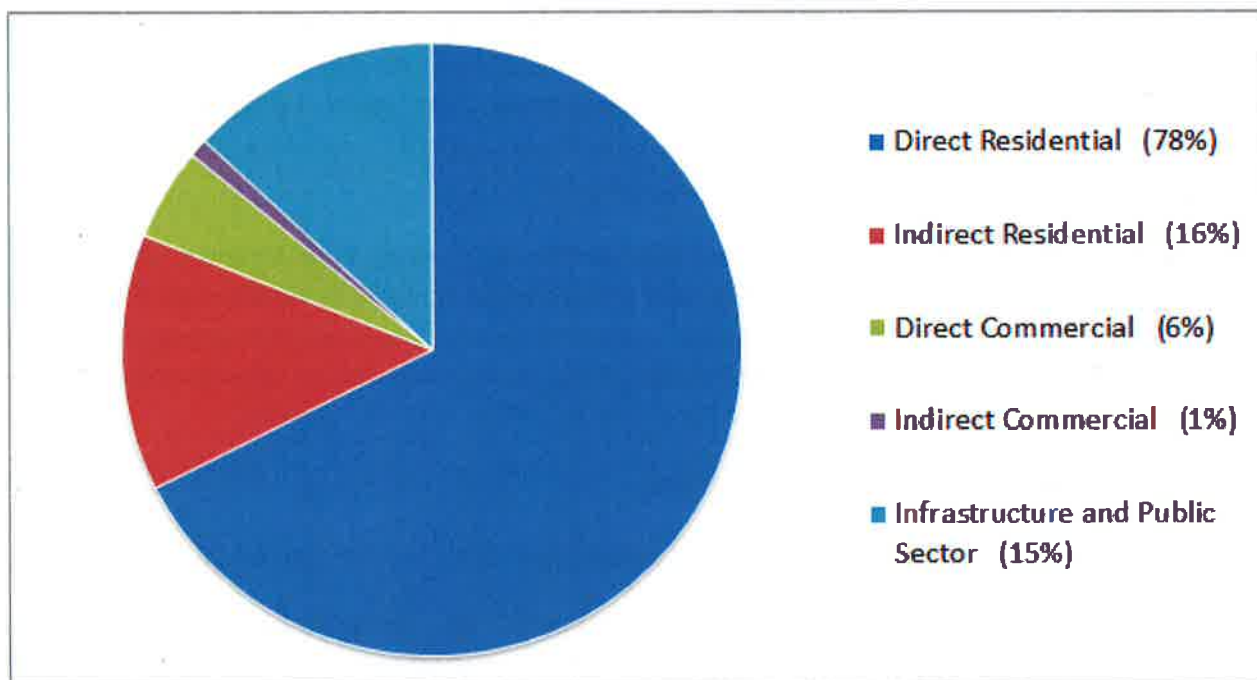


**Table 5-2 Predicted Flood Damages for Existing Conditions**

Damage Sector	Damage in Flood Event (\$,000)				Average Annual Damage
	20-year ARI	50-year ARI	100-year ARI	Extreme Flood	
Direct Residential	583	817	1,212	7,612	135
Indirect Residential	117	163	242	1,522	27
Direct Commercial	21	147	214	1,153	10
Indirect Commercial	4	29	43	231	2
Infrastructure and Public Sector	109	174	257	1,578	26
<b>Total</b>	<b>725</b>	<b>1,157</b>	<b>1,711</b>	<b>10,518</b>	<b>173</b>

The total estimated flood damage to occur in a 100-year ARI flood event is \$1.7M, increasing to an estimated \$11M worth of damage for the Extreme Flood.

The different components of flood damage in Wollombi are shown in Figure 5-4.



**Figure 5-4 Flood Damage Components for Wollombi (Average Annual Damage)**

## 6 REVIEW OF EXISTING PLANNING PROVISIONS

Land use planning and development controls are key mechanisms by which Council can manage some of the flood related risks within flood-affected areas of the Wollombi Brook catchment (as well as across the wider LGA).

A review of existing planning controls has been undertaken with the objective to:

- review the existing planning and development controls framework relevant to the formulation of planning instruments and the assessment of development applications in the Wollombi Brook floodplain, and
- make specific planning recommendations in regards to flood risk management, including an outline of suggested planning controls.

### 6.1 Local Environmental Plan

A Local Environmental Plan (LEP) is prepared in accordance with Part 3 Division 4 of the EP&A Act 1979 and operates as a local planning instrument that establishes the framework for the planning and control of land uses. The LEP defines zones, permissible land uses within those zones, and specific development standards and special considerations with regard to the use or development of land.

The Cessnock Local Environmental Plan 2011 (LEP 2011) came into effect on 23 December 2011. The Cessnock LEP 2011 has been prepared in accordance with the NSW State Government's Standard Instrument (Local Environmental Plans) Order 2006, which requires local Council's to implement a Standard Instrument LEP. The State Government has created the Standard Instrument LEP to assist in streamlining the NSW Planning system.

Clause 7.3 of the Cessnock Local Environmental Plan 2011 relates to development on flood liable land. The LEP provisions incorporate general considerations in regard to development of flood liable land. These provisions require the approval process to consider the impact of proposed development on local flood behaviour, the impact of flooding on the development and the requirements of adopted Floodplain Management Plans that are applicable. Specifically Clause 7.3 states:

(1) The objectives of this clause are as follows:

- a) to minimise the flood risk to life and property associated with the use of land,
- b) to allow development on land that is compatible with the land's flood hazard, taking into account projected changes as a result of climate change to avoid significant adverse impacts upon flood behaviour,
- c) to avoid significant adverse impacts on flood behaviour and the environment.

(2) This clause applies to land at or below the flood planning level

(3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:

- a) is compatible with the flood hazard of the land, and

- b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and
- c) incorporates appropriate measures to manage risk to life from flood, and
- d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and
- e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.

(4) A word or expression used in this clause has the same meaning as it has in the *Floodplain Development Manual* (ISBN 0 7347 5476 0), published in 2005 by the NSW Government, unless it is otherwise defined in this clause.

(5) In this clause, **flood planning level** means the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard.

### 6.1.1 Land Use

The Cessnock LEP 2011 identifies a number of broad land use zones including Rural, Residential, Business, Industrial, Special Uses, Recreation, Environment Protection and National Parks/Nature Reserves. There is no specific zoning category related to flooding.

The new LEP template introduces a new suite of pre-defined land use zoning categories, aimed at providing consistency from one LGA to the next. Council will be required to assign land use zonings to all areas within the LGA, including existing and future development areas, based on stated objectives for each zoning and provisions made for each zoning.

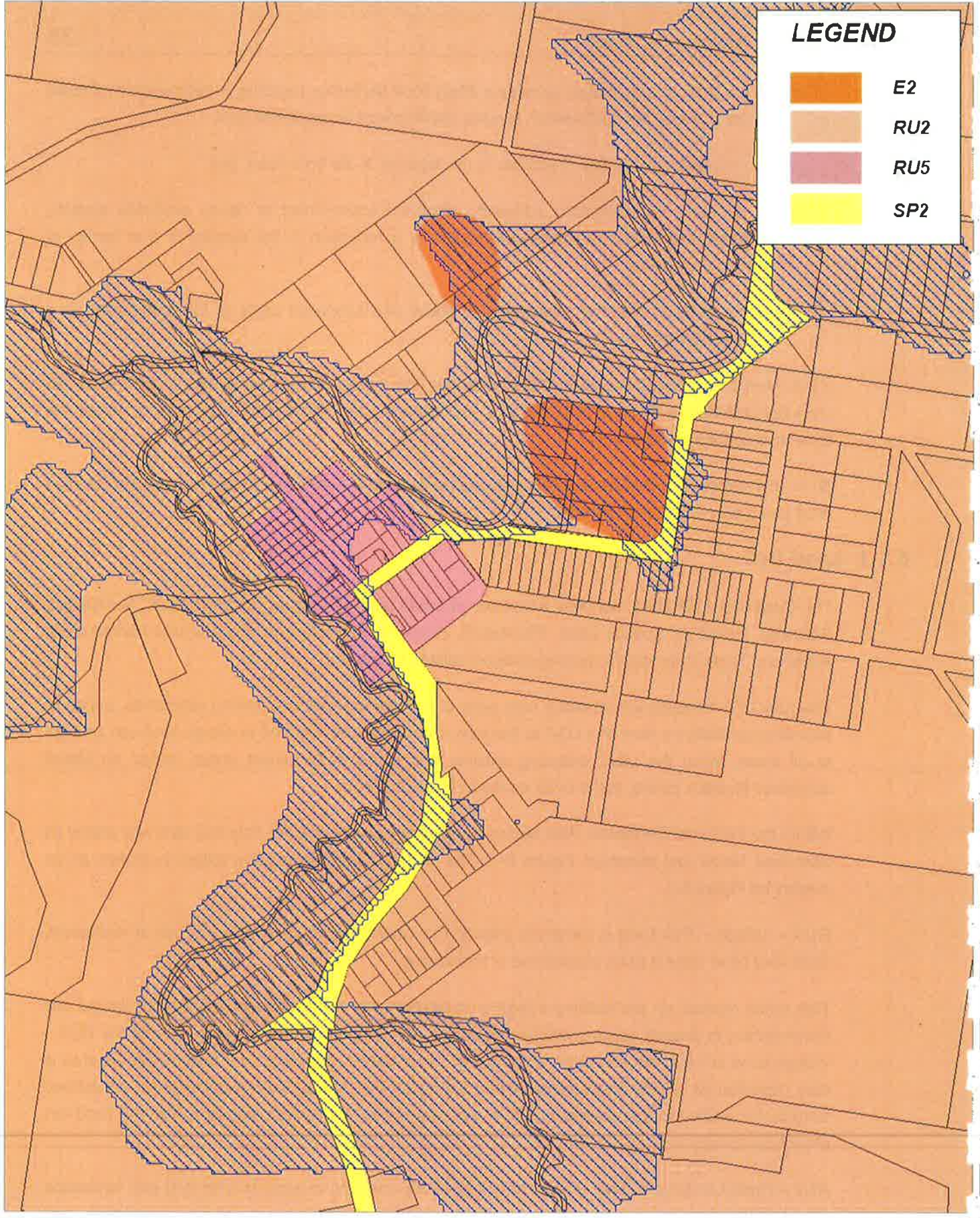
Within the Wollombi Floodplain Risk Management Study area there are only four land use zones as described below and shown in Figure 6-1. The 1% AEP flood inundation extent is shown as an overlay on Figure 6-1.

**RU5 – Village** - This zone is generally intended to cover rural villages where a mix of residential, retail, and other uses is to be established or maintained.

This areas centred on the existing village is consistent with the settlement strategy for limited mix development to support existing local services and the community. A large proportion of the RU5 – Village zone in Wollombi lies within the 1% AEP flood extent. Moreover, the majority of this area is also classified as a high flood hazard (refer to Figure 4-4) and typically would not be considered suitable for residential development. Future rezoning of this land more compatible with the flood risk should be considered.

**RU2 – Rural Landscape Zone** – This zone is generally intended to apply to rural land with landscape values and/or land that has reduced agricultural capability due to gradient, soil type, vegetation, rock outcrops, salinity but which is suitable for grazing and other forms of extensive agriculture.





**LEGEND**

- E2
- RU2
- RU5
- SP2

Title: <b>Land Use Zoning with 1% AEP Flood Extent</b>	Figure: <b>6-1</b>	Rev. <b>A</b>
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This RU2 zone covers the majority of the study area. Notwithstanding, the City Wide Settlement Strategy 2010 recommends that the constrained rural lands in the south-western corner of the LGA (between forestry lands and National Parks) are recognized by investigating the suitability of zoning and/or an Environmentally Significant Land overlay to be added to the suite of maps supporting the comprehensive LEP to protect, maintain or improve the diversity of landscapes. Such investigations will also include appropriate zoning for the Wollombi Brook floodplain. *E2 – Environmental Conservation* - This zone is generally intended to protect land that has high conservation value.

In the Wollombi Village area this incorporates two small wetland systems on Congewai Creek (South Arm).

*SP2 – Infrastructure* - This zone relates to some infrastructure uses.

In Wollombi this includes the major roads being the Great North Road, Wollombi Road and Paynes Crossing Road.

## 6.2 Wollombi Flood Prone Land Policy

### OBJECTIVE:

To state Council's policy with respect to flood planning levels for development applications within the Wollombi Valley, including flood prone lands at Wollombi.

### POLICY:

In relation to flooding and flood related issues in the upper Wollombi Valley (i.e. above Paynes Crossing):

1. The peak 100 year average recurrence interval (ARI) flood levels listed in the "Wollombi Valley Flood Study" report prepared by Patterson Britton & Partners Pty Ltd (March 2005) are adopted for Congewai Creek between Paxton and Sweetmans Creek (i.e. just downstream of Millfield); and Wollombi Brook between Watagan Creek and Warrewong Homestead.
2. A design 'planning level' is adopted corresponding to the 100 year average recurrence interval (ARI) flood plus 500 mm freeboard for habitable rooms of building assessments for dwellings within Wollombi Village.
3. Design 'planning levels' for other development assessments are to be in accordance with the NSW State Government's Floodplain Development Manual April 2005 (Appendix K).
4. The peak level for the Extreme Flood as detailed in the "Wollombi Valley Flood Study" report, is to be documented on all Section 149 Certificates to ensure public awareness that floods rarer than the 100 year average recurrence interval (ARI) flood (such as the 1949 flood) can occur.

It is understood that following the adoption of the Wollombi Flood Study Review and Model Upgrade (BMT WBM 2010), the peak 100 year average recurrence interval (ARI) and Extreme Flood levels derived from this study are to be utilised.

The revised flood 1% AEP (100 year) flood levels across the study area plus the nominated freeboard of 0.5m represent the adopted Flood Planning Level.



### 6.3 Cessnock Development Control Plan

A Development Control Plan (DCP) is established under the provisions of Part 3 Division 6 of the EP&A Act 1979. A DCP provides more detailed provisions with respect to development in particular areas, and is to be considered by Council in determining development applications.

Cessnock City Council does not have a specific floodplain risk management DCP, though clauses related to flood planning are incorporated in Council's consolidated DCP - the Cessnock Development Control Plan (2010). The Cessnock Development Control Plan 2010 (DCP 2010) has been updated by Council to coordinate with the new structure of Cessnock LEP 2011 and comes into effect along with the Cessnock LEP 2011. The new DCP contains detailed planning controls that support Cessnock LEP 2011 and both must be considered when planning the development of land within Cessnock LGA.

The purpose of this DCP from a floodplain risk management perspective is to provide a practical application of Council's Flood Policy and is to be taken into consideration by Cessnock City Council when exercising its environmental assessment and planning functions in relation to new development within the Cessnock LGA.

The DCP should address the directions in flood risk management that are embodied in the NSW Government's *Flood Prone Land Policy* and which are emphasised in the 2005 edition of the government's *Floodplain Development Manual*.

The general objectives of a DCP in relation to flooding are:

- a) Minimise the potential impact of development and other activity upon the aesthetic, recreational, and ecological value of the waterway corridors;
- b) Ensure essential services and land uses are planned in recognition of all potential floods;
- c) Reduce the risk of loss to human life and damage to property caused by flooding through controlling development on land affected by all potential floods;
- d) Limit developments with high sensitivity to flood risk (e.g. critical public utilities) to land with minimal risk from flooding;
- e) Permit development with a lower sensitivity to the flood hazard to be located within the floodplain, subject to appropriate design and siting controls; and
- f) Ensure that development should not detrimentally increase the potential flood impacts on other development or properties either individually or in combination with the cumulative impact of development that is likely to be occurring the same floodplain.

### 6.4 Future Catchment Development

The Stage 1 City Wide Settlement Strategy (Cessnock City Council, 2003) set future direction for population growth throughout the Cessnock LGA providing the basis for sustainable planning policy which balances growth with the natural, scenic and cultural assets of the LGA. The Strategy identified the community visions in regard to future development in the Wollombi Brook catchment including:

- Strong desire to maintain the heritage character and rural lifestyle qualities of the catchment and limit the extent of future development.
- Limited rural residential development (around the existing village) to ensure the viability of existing services and the local school.
- Encourage services such as medical, post-office and banking to the village.
- Encourage small scale tourist development based on the rural and heritage characteristics of the catchment.
- Industrial development, mining, intensive agricultural uses, large-scale forest industries, fast food premises, caravan parks, strip development, large car parks in the village and billboards were seen as inappropriate land uses.
- Conservation of floodplains, riparian zones, wildlife corridors, vegetation on steep slopes, rural atmosphere, village boundaries and Aboriginal and European heritage.

A revised Cessnock City Wide Settlement Strategy (2010) largely reflects these objectives and is consistent with the current LEP provisions. Accordingly, future catchment development is likely to be limited such that increased flood risk exposure through population growth may be small. The limited growth potential may give opportunity to provide a higher degree of development control in high risk areas of the floodplain.

## 7 JUNE 2007 FLOOD REVIEW

The June 2007 flood event in the Valley provided an opportunity to not only collect valuable flood data to aid in assessment of the physical flood behaviour, but also provided an opportunity to critically assess flood emergency response and inadequacies in existing floodplain management.

### 7.1 Event Summary

The flood of the 8<sup>th</sup> and 9<sup>th</sup> June in the Wollombi Valley was associated with an East Coast Low (ECL) pressure system that developed off the coast over this period. Consistent light rainfall fell across the Wollombi catchment throughout the day or so leading up to the main storm event. This provided for a “wetting-up” period for the catchment which ultimately would lead to higher run-off during the main storm burst that occurred during the evening and early morning of the 8<sup>th</sup> and 9<sup>th</sup>. The most intense period of rainfall as indicated by the recorded hyetographs (refer Figure 7-1) occurred in the period between 6pm and 3am on Friday 8<sup>th</sup>, with 113mm and 116mm recorded at the Wollombi and Watagan Central gauges respectively.

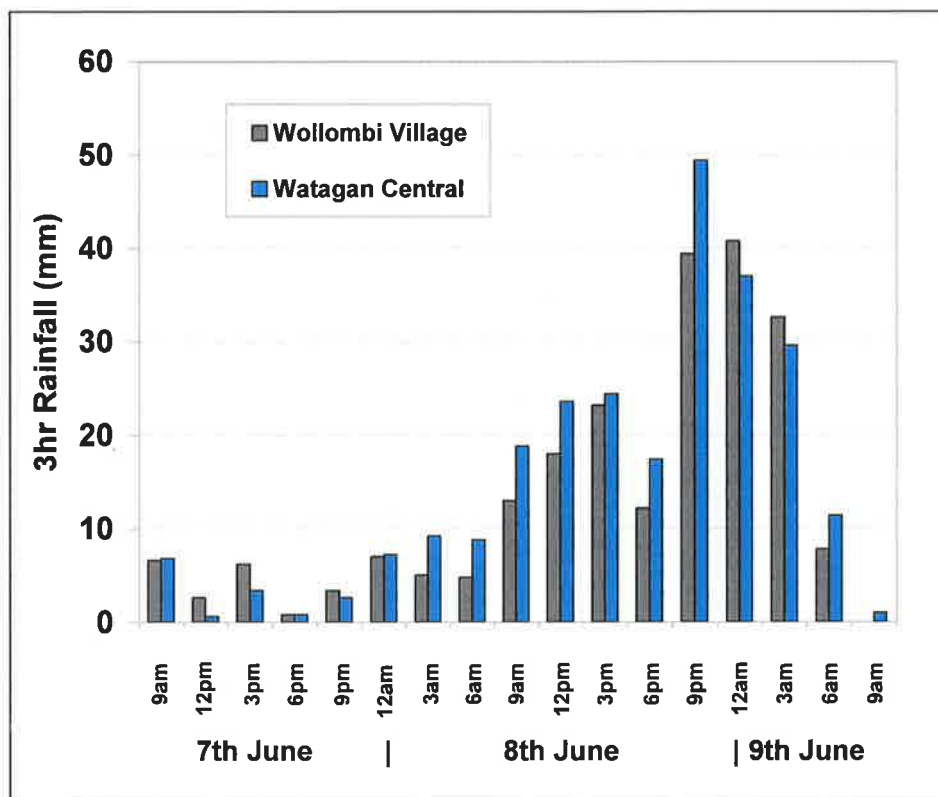


Figure 7-1 Recorded Rainfall Hyetograph (Wollombi and Watagan Central)

Many residents had commented that they went to bed with a “trickle” in the Wollombi Brook on Friday evening to awake to a “torrent” in the early hours of Saturday 9<sup>th</sup>. The Wollombi Brook at Wollombi Village peaked around mid morning on Saturday 9<sup>th</sup>, the swollen watercourses taking many days to subsequently recede. Peak flood conditions occurred earlier in the upper catchment tributaries.

The June 2007 flood in the Wollombi Valley was the largest event experienced since 1949 and subsequently for many residents the largest flood of personal experience. The peak water level in

Wollombi Village for the event was 99.0m AHD, compared to a peak level of 101.6m AHD for June 1949. The rapid rise of floodwaters within the valley, which predominantly occurred during the night, cut the majority of access roads and resulted in the isolation of many residents. The severe weather and extensive flood inundation led to significant disruption to services and some damage to infrastructure. Numerous residential and commercial properties were inundated.

## 7.2 Flood Warning

The Bureau of Meteorology (BoM) prepares and disseminates flood forecasts and warnings and information to the public in close cooperation with state, territory and local government agencies and other stakeholders. Users of flood warning services include emergency management agencies and members of the public, particularly those in flood-prone areas. More detailed local interpretation of BoM flood warning products and information is provided directly to the public by flood response agencies. BoM warning products include early alerts to the possibility of flooding through a flood watch product, with site-specific forecasts of river height and the expected impact in terms of minor, moderate or major flooding in specific river basins.

Where dedicated flood forecasting systems have not been installed, more generalised products are issued on a regional basis. The free exchange of data in real time among stakeholder agencies and the timely availability of warnings, data reports and flood information to the public are cornerstones of the flood warning service. (Bureau of Meteorology, 2007)

### 7.2.1 BoM Flood Watch

A general flood watch for the Hunter Valley was issued around 5:30pm on the 7<sup>th</sup> June 2007. This was on the basis of predicted heavy rainfall across the region. At this stage in the Wollombi Valley, less than 40mm of rainfall had fell in the previous 24 hours.

### 7.2.2 BoM Flood Warning

In an escalation from the Flood Watch, a series of Flood Warnings were issued for the Hunter River as heavy rainfall occurred across the region. Summarised hereunder is the initial five Flood Warnings issued for the Hunter. The italic text represents information directly included in the warnings with additional comments added in bold providing some context to the flooding at Wollombi.

#### *Flood Warning 1*

##### Issued:

*Issued at 9:09pm on Friday the 8th of June 2007*

**The timing of issue corresponds to the start of the most intense rainfall period in the upper Wollombi Valley.**

##### River Height Predictions

**No current warning was in place at this stage for Wollombi Brook.**

##### Reference Gauges:

<i>Wollombi Brook at Brickmans Bridge</i>	<i>1.12m steady</i>	<i>at 1200am Wed 06/06/07</i>
<i>Wollombi Brook at Bulga</i>	<i>1.12m rising</i>	<i>at 901pm Fri 08/06/07</i>



*Wollombi Brook at Warkworth* 1.44m rising at 400pm Fri 08/06/07

**Note that the Wollombi Brook at Brickmans Bridge gauge had failed and accordingly no up to date water level information was available at this site, and remained the case through the remainder of the flood warning series.**

### **Flood Warning 2**

Issued:

*Issued at 1:29am on Saturday the 9th of June 2007*

River Height Predictions

**No current warning was in place at this stage for Wollombi Brook. This warning is at the height of the rainfall event in the upper valley, but no response yet recorded at the lower valley water level gauges.**

Reference Gauges:

<i>Wollombi Brook at Brickmans Bridge</i>	<i>1.12m steady</i>	<i>at 1200am Wed 06/06/07</i>
<i>Wollombi Brook at Bulga</i>	<i>1.77m steady</i>	<i>at 117am Sat 09/06/07</i>
<i>Wollombi Brook at Warkworth</i>	<i>1.21m falling</i>	<i>at 100am Sat 09/06/07</i>

### **Flood Warning 3**

Issued:

*Issued at 5:10am on Saturday the 9th of June 2007*

River Height Predictions

*Bulga [Wollombi Brook] - reach 6 metres by noon 9/6/07 with major flooding.*

**Note that this is the first direct reference to Wollombi Brook, albeit with reference only to the Bulga gauge. Peak flood conditions in Wollombi are expected at least 12 hours before Bulga.**

Reference Gauges:

<i>Wollombi Brook at Brickmans Bridge</i>	<i>1.12m steady</i>	<i>at 1200am Wed 06/06/07</i>
<i>Wollombi Brook at Bulga</i>	<i>4.69m rising</i>	<i>at 427am Sat 09/06/07</i>
<i>Wollombi Brook at Warkworth</i>	<i>1.27m rising</i>	<i>at 400am Sat 09/06/07</i>

### **Flood Warning 4**

Issued:

*Issued at 7:58am on Saturday the 9th of June 2007.*

**At this stage peak flood conditions were occurring on the two arms of the Brook upstream of Wollombi.**

River Height Predictions

*Bulga [Wollombi Brook] - reach 6 metres by noon 9/6/07 with major flooding.*

Reference Gauges:

Wollombi Brook at Brickmans Bridge	1.12m steady	at 1200am Wed 06/06/07
Wollombi Brook at Bulga	6.03m rising	at 748am Sat 09/06/07
Wollombi Brook at Warkworth	1.27m rising	at 400am Sat 09/06/07

**Flood Warning 5**Issued:

Issued at 10:32am on Saturday the 9th of June 2007

River Height Predictions

The Wollombi River (sic) at Bulga is currently approaching a peak near 6.3 metres.  
Bulga [Wollombi Brook] - reach 6.3 metres by noon 9/6/07 with major flooding.

**A dual peak was recorded at Bulga. Water levels at Bulga held steady at a gauge height around 6.3m for a period, before the main flood wave from the upper Wollombi Valley came through with water levels eventually peaking at 7.6m gauge height around noon on the 10/06/07 – some 24 hours after the peak in Wollombi.**

Reference Gauges:

Wollombi Brook at Brickmans Bridge	1.12m steady	at 1200am Wed 06/06/07
Wollombi Brook at Bulga	6.24m rising	at 1019am Sat 09/06/07
Wollombi Brook at Warkworth	1.17m falling	at 1000am Sat 09/06/07

**Other warning updates continued to be issued for the Hunter Valley over the course of a few days.**

The main point of interest from the flood warning series is that the warnings issued had little direct relevance to Wollombi Village and other parts of the upper valley. The timing of the warnings, which are based on water level predictions at the Bulga gauge, are for the most too late to provide effective warning time for residents in the upper valley.

## 7.3 Emergency Response

Given the inaccessibility of the Valley due to extensive road flooding, SES services were unable to be deployed in the area during the event. In any case, given the regional nature of the event across the Hunter and Central Coast, SES resources were already stretched.

Significant effort was provided by the local volunteer Fire Brigade and other local residents to provide assistance where possible to flood affected residents.

In the most part, flood affected residents were largely left to deal with the flooding themselves given the inaccessibility to property as a result of access road flooding. Given the nature of flooding in the catchment, this is likely scenario whenever major flooding in the Valley occurs. Accordingly, the emergency response effort and co-ordination must recognise the requirement for "self-help".

Figure 7-2 shows an example of local ingenuity in getting essential supplies to isolated residents, whereby a pulley system was constructed from electric fence tape at the back of the Tavern to ferry supplies by dinghy and surfboard to those families stranded on the other side of the Brook.



(Cessnock City Council, 2008, image from Jamie Gilmore)

**Figure 7-2 Ferrying supplies to isolated residents**

The combination of the severe flood inundation and isolation amplified the risks to residents of the Valley. The Westpac Rescue Helicopter service answered 4 callouts to the Wollombi Valley as summarised in Table 7-1. The brief commentaries on the nature of the callouts reinforce the potential critical endangerment of residents during major flooding in the Valley.

**Table 7-1 Westpac Rescue Helicopter Missions to Wollombi June 2007 Flood**

Mission Date	Mission Description
09 June 2007	Tasked by Police to rescue a family of seven trapped in their home at Cedar Creek by rising flood waters. They were winched on board and taken to safety.
09 June 2007	Called to Wollombi to rescue two females trapped in the loft of a house by rising flood waters. They were winched on board and taken to safety.
09 June 2007	Called to Wollombi to rescue a female from the roof of her house after she was trapped by floodwaters. She was flown to John Hunter Hospital suffering leg injuries and shock.
10 June 2007	Called to Wollombi to rescue an 88-year old female who was trapped by floodwaters. She was taken on board the aircraft and flown to Wollombi and taken by road ambulance.

(Source: Mission Log extract from Westpac Rescue Helicopter Service website [www.rescuehelicopter.com.au](http://www.rescuehelicopter.com.au))



The last two rescues in the above table highlight the problems associated with extended isolation as a result of floodwaters. Significant risk is posed to highly vulnerable members of the community, such as the elderly, and others requiring medical attention.

## 7.4 Community Feedback

Through post-event questionnaires and subsequent community information sessions, residents were asked to provide comment on personal experiences or opinion in regard to the June 2007 flood or general flooding and floodplain management within the Wollombi Valley. The common themes from the responses given are summarised below.

- No flood warnings – many respondents indicated that almost no warning of the rising floodwater was available. This was exacerbated in the upper reaches of the catchment where peak flooding occurred during the night. With no flood warning system in place, many residents awoke to the flooding problem and limited lead time (if any) to undertake appropriate action. Given the rapid rise of floodwaters within the valley, this posed a considerable risk.
- Lack of coverage on local media – whilst local media provided general coverage of the widespread flooding throughout the Hunter Valley, in particular major centres of Singleton, Maitland and Newcastle, very little publicity was given to the situation in Wollombi. Wollombi residents indicated very little Wollombi specific information.
- Limited flood support – acknowledgment was made of the contribution of the rescue helicopter service, rural fire service and local community members. However there was a concern about the lack of coordinated response and support, and the feeling that the community was effectively left to fend for itself.
- Phone and electricity downtime – the severity of storm coupling intense rainfall, high winds and flooding led to a loss of services. Aside from the obvious inconvenience, the loss of these services severely impacted on communication and limited any effective and coordinated flood response amongst residents in the valley. Alternative power supplies and communication means were considered essential for future flood response.
- Access problems – the extent of flooding in the valley saw many access roads cut and resulted in a significant number of residents to be isolated and unable to leave their property. In addition to the safety issues posed with respect to the flood risk, the restricted access in conjunction with lost services/communication led to considerable anxiety. With access cut for a number of days, some residents indicated problems with limited food supplies. Concern over the lack of safe crossing points and adequacy of flood depth markers was also raised.
- Development planning controls - a number of references were made to Council's planning policy with respect to flood levels in Wollombi. The responses generally indicated concern over the lowering of the design flood standard, considering the magnitude of the 1949 and 2007 flood events and potential flood risks posed.
- State of the river - a number of respondents indicated concern over the extent of vegetation with the Wollombi Brook and its potential to increase flood levels. Also, the potential for contamination

was raised given various drums/containers of oil, paint and other chemicals being transported down the river by floodwaters.

## 8 POTENTIAL FLOODPLAIN MANAGEMENT MEASURES

Measures which can be employed to mitigate flooding and reduce flood damages can be separated into three broad categories:

**Property modification measures:** modify property and land use including development controls. This is generally accomplished through such means as flood proofing (house raising or sealing entrances), planning and building regulations (zoning) or voluntary purchase.

**Response modification measures:** modify the community's response to flood hazard by informing flood-affected property owners about the nature of flooding so that they can make informed decisions. Examples of such measures include provision of flood warning and emergency services, improved information, awareness and education of the community and provision of flood insurance.

**Flood modification measures:** modify the flood's physical behaviour (depth, velocity) and includes flood mitigation dams, retarding basins, on-site detention, channel improvements, levees, floodways or catchment treatment.

The nature of flooding in the Wollombi Valley, characterised by high flood volumes, flow depths and velocities, limit the opportunities for implementation of effective flood modification measures. As an example, levees to protect individual property would not be suitable given the large increases in flood depth with increasing flood magnitude, and therefore high potential for overtopping and actual increases in flood risk. Accordingly, proposed floodplain management options for Wollombi will be focused on property and response modification measures.

Property Modification Measures	Response Modification Measures	Flood Modification Measures
Zoning Voluntary Purchase Voluntary House Raising Building and Development Controls Flood Proofing Buildings Flood Access	Community Awareness Community Readiness Flood Prediction and Warning Local Flood Plans Evacuation Arrangements Recovery Plans	<del>Flood Control Dams Retarding Basins Levees Bypass Floodways Channel Improvements Flood Gates</del>

**NOT SUITED TO WOLLOMBI**

Figure 8-1 Floodplain Management Options Categories

### 8.1 Planning and Development Controls

Land use planning and development controls are key mechanisms by which Council can manage flood-affected areas within the study area. Such mechanisms will influence future development (and redevelopment) and therefore the benefits will accrue gradually over time. Without comprehensive floodplain planning, existing problems may be exacerbated and opportunities to reduce flood risks may be lost.

The flood planning level (FPL) is the level below which a Council places restrictions on development due to the hazard of flooding. Traditional floodplain planning has relied almost entirely on the definition of a singular FPL, which has usually been based on the 100 year ARI flood level for the purposes of applying floor level controls. Adoption of a single FPL can provide for:



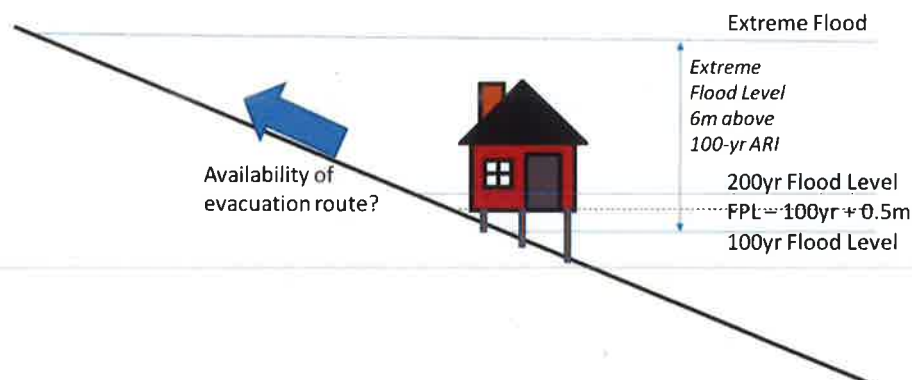
- unnecessary restriction of some land uses from occurring below the FPL, while allowing other inappropriate land uses to occur immediately above the FPL; and
- lack of recognition of the significant flood hazard that may exist above the FPL (and as a result, there are very few measures in place to manage the consequences of flooding above the FPL).

The latter point above is particularly relevant to Wollombi. As discussed, the nature of flooding is such that there are significant increases in flood depth with increasing flood magnitude. For example, the 200-year ARI (0.5% AEP) flood level lies on average some 0.7m above the 100-year (1% AEP) flood level. Accordingly, even with a 0.5m freeboard provision above the 100-year level, above floor flooding would be expected for a 200-year ARI event.

It is important also to recognise the inherent uncertainties in design flood prediction. For example, sensitivity tests on design flow rates undertaken in the Flood Study again show potential large variations in peak flood level over and above the adopted design levels. A 10% and 20% increase in the adopted 100-yr ARI design flow (within a typical range of sensitivity) provides for increases in predicted 100-year ARI flood level of 0.6 and 1.1m respectively.

Similarly, the Extreme Flood level lies some 6m above the 100-year ARI level. Typically this scale of event is used to assess risk to life, however, it must be considered in conjunction with other development controls applied at lower flood thresholds. Approving development within the floodplain (defined up to the Extreme flood level) inherently provides for flood risk. Some considerations of the impact of events of greater magnitude than the flood planning levels include:

- Evacuation opportunity – appreciating that with the combination of minimal warning times and extensive access road inundation, residents would largely be confined to their property and immediate surrounds, with only pedestrian access. Given the local topography, in most instances a constantly rising evacuation route (i.e. walk up the hill) will be available in the case of major flooding. Should residents fail to evacuate prior to property becoming inundated, there is the possibility that flood levels could exceed roof levels. Personal flood action plans should recognise this risk.
- Property damage – with potential for high depth/high velocity flow above the FPL, structural integrity of property constructed on the floodplain is essential. Whilst evacuation is the primary objective, structural integrity of the property is required for people sheltering in place.



**Figure 8-2 The FPL and relation to a range of flood event magnitudes**

The flood planning level is a contentious issue within the Wollombi community with opposing opinions on the desired magnitude of future development within the area. To some degree, the opportunity for

future development is linked with design planning levels, and as such, community confidence in the procedure to establish this level is important. The community's reservations about design water level estimations stem from concern over the potential impact on flood planning level determination in Wollombi Village, particularly with respect to historical flooding.

One of the key outcomes from the 2005 Flood Study was the determination of a design 1% AEP flood levels for Wollombi, and the subsequent adoption of the levels with appropriate freeboard allowances as the flood planning level. This represented a significant lowering of the flood planning level previously based on recorded peak 1949 flood conditions. There is again opposing community opinion on the appropriateness of the change in adopted flood planning level. On one hand is the view that consistency across the LGA is provided (in terms of 1% AEP design flood standard) and that development is not unduly constrained, the other view being concern on the increase in flood risk exposure from future development. The latter concerns are based particularly on the experiences from previous flood events and an appreciation that floods of similar and greater magnitude will happen again.

Current design planning levels in Wollombi are at the 100-year flood level plus 0.5m freeboard. This is consistent across the Cessnock LGA. Lowering of the flood planning level from existing standards is not recommended given the unacceptable increase in flood risks and damages.

Consideration is given to adopting a higher flood planning level in Wollombi than the current 100-year flood level plus 0.5m freeboard. Such a change may be justified on the basis of the following:

- Historical flooding – there is a history of significant flooding in Wollombi. Indeed two of the recorded historical events in 1867 and 1949 well exceed the adopted 100-year flood level.
- Freeboard - A freeboard allowance is added to design flood levels when determining floor level controls for future development. The freeboard allowance caters for a range of uncertainties in the estimation procedure, including uncertainty in modelling predictions, changes in rainfall patterns as a result of climate change. The freeboard level currently applied by Cessnock City Council is 0.5m. The majority of Councils in NSW adopt a minimum 0.5m freeboard. The Floodplain Development Manual also refers to the freeboard allowance being 'typically 0.5m'. As demonstrated by the model sensitivity tests undertaken for the 100-year design event, current freeboard allowance s may not be adequate to fully cater for the inherent uncertainties in the design flood estimation and potential impacts of climate change over time.
- Flood Damage – further to the issue of freeboard, it is significant to note that the average difference between the 100-year and 200-year peak flood levels is of the order of 0.7m. Accordingly, habitable floor levels of dwellings approved at the 100-year +0.5m planning level would be subject to above floor flooding for an event of the 200-year magnitude (as experienced in 1867 and 1949).
- Evacuation – given the relatively large increases in flood level with increasing flood magnitude, the risk to life is significant in the Wollombi catchment for flood events in excess of the current flood planning level. Residents would be required to evacuate their premises in major flood events. Given the isolation of property in the locality, it may be expected that alternative shelter (possibly outdoors) may be required for an extended period before assistance is able to be provided. There is a significant risk in "shelter in place" given the potential for extreme flood

depths which may completely inundate property and is not recommended in the floodplain risk management plan.

- Limitation on Development – an increased flood planning level is unlikely to provide a significant limitation on development in the Wollombi flood planning area. Given the topography of the valley being naturally steep sided at the floodplain fringe, there is little horizontal variation between the 100-year and Extreme Flood extents. As such, an increase in flood planning level would not provide a significant reduction in development potential. Development would not be unreasonably restricted on the relatively few number of lots affected by an increase in flood planning level. Again, given the natural topography, dwelling siting on individual lots to satisfy the flood planning level requirements would typically be achievable. The opportunity for filling exists to provide suitably raised building levels for residential dwellings, subject to confirmation of no adverse impact on general floodplain flows.

Options for a changed flood planning level include:

- Maintain existing flood standard (i.e. 100-year flood) with increased freeboard provision;
- Increased design flood standard with retained freeboard provision of 0.5m (e.g. 200-year flood level + 0.5m freeboard); and
- Extreme Flood Level with all residential development excluded from the floodplain.

Noting the risks above and options for alternative flood planning levels, it is recommended that the flood planning level be maintained as the 100-year flood level plus 0.5m freeboard. This recommendation may be justified on the basis:

- The level reflects an acceptable level of risk to property (in terms of potential flood damage) considering likelihood of flooding and relative consequences, albeit with potentially reduced freeboard given uncertainties in design flood estimation. The adopted flood levels represent the best estimates of design flood levels given available information and established by industry best practice.
- Risk to life more effectively managed by other controls/measures such as specific requirements for evacuation route provisions in the DCP, effective flood warning and emergency response. Risk to life is not managed effectively in the Wollombi catchment through a raised flood planning level due to the nature of flooding (i.e. residual risks up to the Extreme Flood event).
- Consistency across the Cessnock LGA is maintained.
- The setting of the flood planning level does not preclude property to be constructed at a higher level. Flood risk information across the range of flood events, including events greater than the 100-year event, should be made available to landholders and development proponents. DCP provisions may be included to encourage development at higher levels where opportunities exist on appropriate lots, noting available flood level information.

### 8.1.1 Other Planning and Development Controls

Land use planning and development controls are key mechanisms by which Council can manage flood-affected areas within the catchment. Such mechanisms will influence future development (and redevelopment) and therefore the benefits will accrue gradually over time. The appropriate



mechanism for stipulating flood related development controls is through a Development Control Plan (DCP). A Local Environmental Plan (LEP) should also provide some reference to floodplain management, including key definitions in relation to the floodplain.

The proposed floodplain risk management controls would form a chapter in Council's consolidated DCP 2010. The recommended DCP provisions include:

- vii. minimum floor levels;
- viii. the use of flood compatible building components below a certain level;
- ix. that structures located in high flood risk areas are structurally sound;
- x. that development does not increase flood behaviour elsewhere;
- xi. maximising opportunities for people to safely evacuate; and
- xii. other specific considerations regarding the use of the property.

Some recommendations for the general context of the above provisions in relation to the Wollombi Brook floodplain are provided hereunder.

#### Development Exclusion

- No buildings or structures should be permitted in area designated High Hazard areas.

A large proportion of the land area zoned RU5 Village lies within the 1% AEP flood extent, and more significantly, is also classified as high hazard flood zone. This area is not considered suitable for future development and future rezoning of this high flood risk area may be appropriate. Specific development controls however could be considered at the time the DCP is being reviewed on an LGA basis.

#### Floor Levels

- Habitable floor levels to be no lower than the 100 year flood level plus 0.5m freeboard.
- Lowest habitable floor levels should be elevated above finished ground level.
- Consideration of lower floor levels where compatibility issues arise with existing floor levels or adjacent building heights (floor levels to be as high as practical, no lower than existing floor level for redevelopment).
- Proponents encouraged to construct at higher levels with available flood level information across range of design flood magnitudes (up to Extreme Flood Level).

#### Building Materials/Components

- All structures should have flood compatible building components below the 100-year level plus 0.5m freeboard.

#### Structural Soundness

- Applicant to demonstrate that the structure can withstand the forces of floodwater, debris and buoyancy up to and including an Extreme Flood event.

### Flood Effects

- The flood impact of the development to be considered to ensure that the development will not increase flood effects elsewhere, having regard to: (i) loss of flood storage; (ii) changes in flood levels and velocities caused by alterations to the flood conveyance ; and (iii) the cumulative impact of multiple potential developments in the floodplain. An engineer's report may be required.

### Evacuation

- Reliable access for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest habitable floor level to an area of refuge above the Extreme Flood level.

### Other Special Site Considerations

- Applicant to demonstrate that an area is available to store goods above the 100 year flood level plus 0.5m freeboard.
- No storage of materials below the design floor level which may cause pollution or be potentially hazardous during any flood.

## **8.1.2 Other Property Modification Measures**

Some of the other property modification measures (beyond flood planning levels) include:

- **Voluntary Purchase Schemes:** are generally applicable only to areas where flood mitigation is impractical and the existing flood risk is unacceptable. No property has been identified as suitable for voluntary purchase within the Wollombi catchment and therefore there is no recommendation for such a scheme in the Floodplain Risk Management Plan. Whilst there are a number of properties identified with high hazard flood zones, alternative flood modification options such as house raising would be considered more appropriate and generally suitable for the type of construction and nature of the lots.
- **Voluntary house raising -** raising floor levels where practical to elevate habitable floor levels to required levels above the flood planning level. Not all houses are suitable for raising. Houses of brick construction or slab on ground construction are generally not suitable for house raising due to expense and construction difficulty. Generally this technique is limited to structures constructed on piers, which is predominantly the type of construction of Wollombi property.

Voluntary house raising is aimed at reducing the flood damage to houses by raising the habitable floor level of individual buildings above an acceptable design standard (e.g. 1% AEP Flood Level +0.5m). Voluntary house raising generally only provides a benefit in terms of reduced economic damages but does not eliminate the risk. Larger floods than the design flood (used to establish minimum floor level) will still provide building damages and the option does not address personal safety aspects. These risks are still present as the property and surrounds are subject to inundation and therefore the flood access and emergency response opportunity is still compromised.

A voluntary house raising scheme would not commence until it is known whether there will be a funding mechanism available to raise buildings from high hazard areas. Investigations should commence with confirming which properties would be offered voluntary house raising, through

more detailed property analysis. Given the high costs associated with house raising, and the limited State Government funding (to date), it is expected that the scheme would take many years to implement fully. Also, being voluntary schemes there is the need for the co-operation of property owners, which may further delay implementation and completion of the schemes.

The viability of such a scheme is dependent on establishing a suitable funding model and the uptake of the scheme given that it is on a voluntary basis. Further investigation is recommended to establish the level of community support and therefore uptake potential, to assess the merit of including a Voluntary House Raising scheme in the Floodplain Risk Management Plan.

- Flood resistant construction - using appropriate construction techniques and material able to withstand inundation, debris and buoyancy forces can be an effective measure to reduce potential flood damages. Generally these works would be undertaken on a property by property basis at no cost to Council. These measures would be applicable for all new developments in this area and redevelopment of existing property.

## 8.2 Flood Warning

### 8.2.1 Existing Flood Warning System

The formal flood warning service for the Wollombi Brook provided by the Bureau of Meteorology largely benefits the residents in the lower part of the Valley. In the upper part of the Valley, including Wollombi Village, there is no site specific flood warning system, however there are a number of general warning services provided by the Bureau including:

- **Flood Watches** – typically provide 24-48 hour notice. These are issued by the NSW Flood Warning Centre providing initial warnings of potential flooding based upon current catchment conditions and future rainfall predictions.
- **Severe Thunderstorm Warnings** – typically provide 0.5 to 2 hours notice. These short range forecasts are issued by the Bureau's severe weather team and are based upon radar, data from field stations, reports from storm spotters as well as synoptic forecasts.
- **Severe Weather Warnings** – for synoptic scale events that cause a range of hazards, including flooding. Examples of synoptic scale events are the deep low pressure systems off the NSW coast such as that which produced the 2007 flood in the Wollombi Brook catchment.

As highlighted in Section 7.2 with the experiences of the June 2007 event, the existing flood warning system is not highly effective for Wollombi Village and surrounds. Whilst flood watches and regional flood warnings should activate personal flood action plans, the level of existing flood awareness in the community meant that little effective action was taken in June 2007, and is perhaps typical of what would happen in any major flood event at present.

### 8.2.2 Method of Flood Warning

Flood warnings to residents can be issued by a variety of measures, from automated messaging to door knocking. A comparison of various warning methods is provided Figure 8-3.

	Informative	Accurate/Trustworthiness	Timeliness	Audience reach	Varying audience capacities	Reliable/Resilient	Little labour required	
								<ul style="list-style-type: none"> <li>Works well for this aspect</li> <li>Satisfactory for this aspect</li> <li>Limited use for this aspect</li> <li>Does not support this aspect</li> <li>Variable for this aspect</li> </ul>
<b>Sirens/alarms</b>								<ul style="list-style-type: none"> <li>Quick; reliable; limited information and reach, but becoming more versatile with voice and remote capabilities</li> </ul>
<b>Text message</b>								<ul style="list-style-type: none"> <li>Can reach wide audience very quickly; no power needed</li> <li>Less reliable for areas with poor mobile phone coverage</li> </ul>
<b>Automated telephone</b>								<ul style="list-style-type: none"> <li>Landlines becoming less common; people often not at home/indoors</li> </ul>
<b>Radio message</b>								<ul style="list-style-type: none"> <li>Electricity not required; widest reach – home, work, travelling</li> <li>Variable accuracy; requires public to be listening</li> </ul>
<b>Television</b>								<ul style="list-style-type: none"> <li>Electricity required; variable accuracy; limited reach; requires public to be listening</li> </ul>
<b>Websites/ social media</b>								<ul style="list-style-type: none"> <li>Quick dissemination; becoming very widespread; capacity for images</li> <li>Electricity/internet required; variable accuracy</li> </ul>
<b>Email</b>								<ul style="list-style-type: none"> <li>Quick dissemination, but usually has to be actively accessed; power and telecommunication infrastructure needed; internet required</li> </ul>
<b>Speaker phone</b>								<ul style="list-style-type: none"> <li>Direct, specific communication</li> <li>Requires access to flooded area; difficult to hear</li> </ul>
<b>Doorknocking</b>								<ul style="list-style-type: none"> <li>Direct communication; chance to ask questions; high credibility</li> <li>Resource intensive; requires access to flooded area</li> </ul>
<b>Letterbox drop</b>								<ul style="list-style-type: none"> <li>Ability to reach almost all audiences, but may miss youth</li> <li>Slow; requires access to flooded area</li> </ul>
<b>Noticeboards</b>								<ul style="list-style-type: none"> <li>Useful for roads, infrastructure and location-specific information; can be controlled remotely</li> </ul>
<b>Print media</b>								<ul style="list-style-type: none"> <li>Informative/detailed; ability to reach wide audience</li> <li>Time needed; variable accuracy</li> </ul>
<b>Word of mouth</b>								<ul style="list-style-type: none"> <li>Uses info from multiple sources; persuasive</li> <li>Variable accuracy</li> </ul>

Office of the Queensland Chief Scientist, 2011

**Figure 8-3 Comparison of Flood Warning Communication Methods**

In recent riverine floods the NSW SES has used the new national telephone warning system Emergency Alert to issue flood warnings and evacuation orders in addition to traditional methods such as media broadcasts, internet postings and door knocking. During floods in NSW, Victoria and Queensland in 2011, social media emerged as a significant flood warning dissemination tool. The use of social media to enhance other warning dissemination channels should be considered further for Wollombi.

### 8.2.3 Interpreting Flood Warnings

In order to get the most benefit from flood warnings people in flood prone areas will need to know what, if any, effect the flood will have on their property and some knowledge of how best to deal with a flood situation. Sources of such information could include



- Flood Bulletins/Warnings issued by the Bureau and/or the local Council or emergency services which often contain details of areas affected by flooding, road closures and other advice on what the community should do if they are likely to be flooded;
- Long term residents who may have experienced a similar flood in the past and remember how it affected them;
- Local Councils that have conducted flood studies and have maps of areas that are likely to be flooded by a range of floods; or
- Information pamphlets.

The flood warning, emergency response and community education measures built in into the Wollombi Floodplain Risk Management Plan will incorporate a number of measures for the issue and dissemination of flood warnings.

### 8.2.4 System Upgrade

Investigation into the upgrade of the existing flood warning system to provide Wollombi Village specific flood warnings and improved warning generally in the upper valley is to be a recommendation of the Wollombi FRMP. The detailed feasibility assessment and design of such a system is expected to be undertaken as a recommendation of the Plan.

The amount of warning available for an approaching flood can have a significant impact on the risk to life. Less warning time clearly represents a greater risk to the community as there is less opportunity to implement risk-reduction measures. Minimal warning time also means that emergency services are unlikely to be able to provide any assistance or direction for affected communities. Indeed during the June 2007 event, emergency response personnel were unable to reach affected areas and property due to impassable roads.

Consideration should be given to the following levels of warning times in designing an appropriate flood warning system for Wollombi.

**Table 8-1 Target flood warning time categories**

<b>no effective warning</b>	<1 hr	No time for pro-active and systematic organisation of flood mitigation, evacuation, emergency response etc.
<b>minimal warning</b>	1-6 hrs	Limited assistance likely from emergency services. Measures requiring minimal time for implementation would be appropriate for flood management.
<b>moderate warning</b>	6-12 hrs	Assistance likely from emergency services, depending on time of day. Measures requiring moderate time, or less, for implementation would be appropriate for flood management.
<b>good warning</b>	12+ hrs	Significant assistance from emergency services can be expected, including assistance with evacuation. Most measures requiring some form of on-demand implementation would be appropriate for flood management.

The nature of flooding in Wollombi is such that the minimal to moderate warning categories would largely be applicable depending on the location in the Valley with reference to flood warning monitoring/trigger points.

At present the nearest continuous water level gauge is Brickmans Bridge some 19km downstream of Wollombi Village. For effective flood warning, gauges need to be located upstream of Wollombi Village. Given the contribution of flood flows from both the North and South Arms of the Brook, it is anticipated water level gauges would be required on both tributaries. The following combination of gauge locations is an example of a potential system that could provide adequate warning to Wollombi (refer to Figure 8-4 for locations):

*South Arm:*

- Watagan Creek Road (Laguna) - Located some 10km upstream of Wollombi Village and incorporating approximately 90% of the South Arm catchment to Wollombi.

*North Arm:*

- Cedar Creek Road – Located some 12km upstream of Wollombi Village and incorporating approximately 90% of the North Arm catchment to Wollombi. Millfield Bridge is an alternative location a further 6km upstream and therefore potentially more warning time, however would not have the contribution from the Cedar Creek catchment.

*Confluence:*

- Downstream of Cuneens Bridge – representative of Wollombi Village flood levels with total combined north and south arm flows.

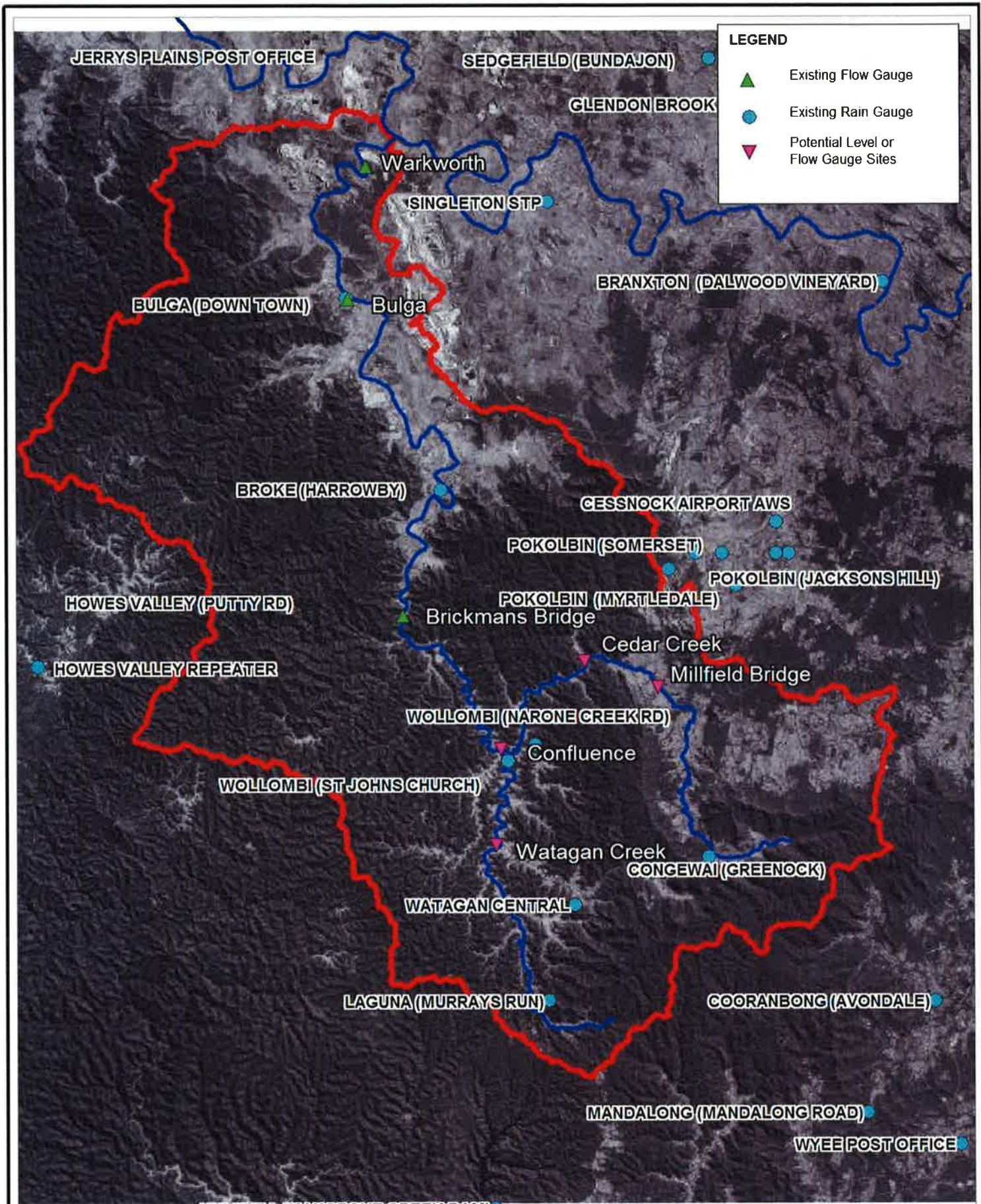
## 8.2.5 Flood Warning System Design

Emergency Management Australia (Australian Government) has published a Flood Warning Manual (EMA, 2009) in which the components of an effective flood warning system are defined as:

- **Monitoring and prediction:** detecting environmental conditions that lead to flooding, and predicting river levels during the flood;
- **Interpretation:** identifying in advance the impacts of the predicted flood levels on communities at risk;
- **Message construction:** devising the content of the message which will warn people of impending flooding;
- **Communication:** disseminating warning information in a timely fashion to people and organisations likely to be affected by the flood;
- **Protective behaviour:** generating appropriate and timely actions and behaviours from the agencies involved and from the threatened community; and
- **Review:** examining the various aspects of the system with a view to improving its performance.

The Manual highlights for a flood warning system to work effectively, these components must all be present and they must be integrated rather than operating in isolation from each other. Design an appropriate system based on the above model represents a significant undertaking, and accordingly has been recommended in the Plan as an additional investigation.



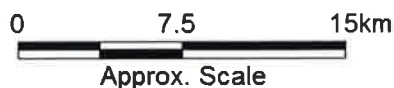


Title:  
**Potential Flood Warning Gauge Locations**

Figure:  
**8-4**

Rev:  
**A**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



In further defining the requirements of such an investigation and developing an effective flood warning system, EMA (2009) suggest the following points need to be addressed:

- The system must meet the needs of its clients in terms of identifying:
  - levels of flooding for which warnings are required (including the level at which flooding begins and critical levels such as levee heights),
  - what the impacts of flooding will be at different levels,
  - the warning time(s) the community requires and the amounts of time which can be provided,
  - appropriate subject matter content for warning messages,
  - the ways in which warning messages are to be disseminated, and
  - the frequency of warning updates.
- The system must be part of the emergency management arrangements established by the relevant State or Territory as defined in disaster or emergency management plans. Warning arrangements must be detailed in all plans relating specifically to flooding and should indicate the conditions under which warnings will be issued and the organisations or officers who will issue the warnings.
- The agencies concerned with prediction, interpretation, dissemination and response (including local government) must all be involved in system development and review, as must the community itself.
- The roles of the various agencies must be clearly identified for each element of the system.
- The flood warning system must be incorporated within the wider floodplain management perspective, with recognition that the inter-relationship between flood warning and other floodplain management measures needs to be planned for.
- The organisation, resourcing, public education, training and exercising necessary to ensure the system operates effectively must be carried out.

### 8.3 Emergency Response

The State Emergency Service (SES) has formal responsibility for emergency management operations in response to flooding. Other organisations normally provide assistance, including the Bureau of Meteorology, council, police, fire brigade, ambulance and community groups. Emergency management operations are usually outlined in a Local Flood Plan.

The June 2007 flood event highlighted the limited opportunity for the SES to provide support both during and post event, due in part to the isolation of the community through road closures, and the stretched resourcing of the SES in dealing with a region-wide event. Consideration therefore needs to be given to developing community based action plans that anticipate limited external support, at least in the early stages of a major flood event.

As a summary of the emergency response issue to be addressed/incorporated in the study include:

- Update of Local Flood Plan – in consultation with SES utilising updated Flood Study information and cross linkage to flood warning/gauge sites and local property database:



- Design flood mapping
  - Property database and inundation statistics
  - Key levels at gauge locations (event references design and historical)
  - Evacuation arrangements
  - Recovery Plans
- Inter-agency arrangements
    - Clear roles of responsibility during flood
    - Warning issue and dissemination
    - Potential increased use of Rural Fire Service resources (additional training/equipment requirements)
  - Personal Flood Action Plans – in recognition of the potential for limited external support and requirement for self-help.

One of the key community concerns identified through the community consultation process and emanating as a result of the June 2007 flood experience, was the loss of electricity and telephone services that severely impacted on communication and limited any effective and coordinated flood response amongst residents in the valley. Residents generally considered that alternative power supplies and communication means were considered essential for future flood response.

Given the relative size of the Wollombi community, it is unlikely that utility companies would provide for permanent backup services to the community considering cost –effectiveness and prioritisation of communities for provision of such infrastructure. Nevertheless, alternative power supply and communication methods are considered a key component of a total flood warning and emergency response system. Accordingly, alternative power supply and communication methods should be investigated as a component of as part of the investigation of the provision of additional flood warning services.

As noted in Section 4.4, most access roads would be cut during significant flood events in the Wollombi Valley, severely restricting opportunity for evacuation and for access for emergency response services. Accordingly, it is recognised that in some circumstances residents may be isolated on properties for a number of days. In developing Personal Flood Action Plans individual households can consider:

- Installing emergency backup power source (e.g. generator, solar etc.)
- Access to alternate communication devices (e.g. satellite phone/solar powered phone)

These initiatives should be encouraged through the ongoing community education and awareness program as discussed below.

## 8.4 Community Awareness

Raising and maintaining flood awareness provides residents with an appreciation of the flood problem and what measures can be taken to reduce potential flood damage and to minimise personal risk during future floods.

The basic objectives of the community awareness program are to:

- Make people aware they are living / working in a flood zone
- Receiving, understanding and reacting to flood warnings
- Appropriate actions - e.g. where to evacuate to, what to do if caught in car

Community awareness is an on-going process and complicated in the Wollombi area given a large transient population, particularly on weekends. There is also the inherent danger of complacency between events. There are numerous mechanisms to inform the community, with the following recommended to be incorporated in the Wollombi FRMP.

- Distribution of SES Flood-safe brochure / other brochures.
- Section 149 / Flood certificates - Consideration could also be given to providing information on the flood risk and the flood levels that apply to a particular property on a special flood certificate. These certificates could be appended to the Section 149(5) certificates; provided whenever flood information is requested for a property; or provided on a regular basis to all residents in the study area.
- Flood mapping availability (Council website) - Consolidation of the recent flood risk mapping, flood data and flood damages database prepared during the floodplain management study into Council's computer based GIS system. This will provide Council with valuable flood information that can be easily retrieved, and which will form the basis of information that can be supplied to the public when requests are made, or on a periodic basis.
- Community displays to provide easily interpreted flood risk information, e.g.
  - Tourist information displays which may assist with the transient population.
  - Historical Flood Height Markers - the installation of flood markers at various locations to indicate the height of past floods, act as a constant reminder of the threat of flooding.
- Flood information page on community websites (e.g. – . This can include links to BoM rainfall and flood warning pages, a how to guide in understanding and reacting to flood warnings. This may be extended to other media including community newsletters/publications (e.g. Our Own News) with Council providing regular input regarding flood awareness/preparedness, commemoration of historic events etc.
- Upgrade of flood depth markers at road crossings. Given the large range of flood depth, many flood markers can be completely inundated. It is suggested that road flood depth markers be installed at all locations where the 20% AEP flooding cuts the road in the study area (i.e. Millfield-Laguna-Paynes Crossing). Markers should be installed such that they are visible up to the peak 1% AEP flood level.

There are a number of generic existing resources in addition to the above specific measures for Wollombi. For people who live in flood prone areas, detailed information on flood preparedness, safety and recovery is available in the free booklet 'What to do Before, During and After a Flood' published by Emergency Management Australia (EMA) and available through the State Emergency Service (SES).

## 9 RECOMMENDED FLOODPLAIN MANAGEMENT PLAN

### 9.1 Recommended Measures

The floodplain management measures that are recommended for inclusion in the Wollombi Floodplain Risk Management Plan are summarised below. The Plan covers the area investigated in the Flood study extending from Millfield and Laguna at the upstream extents on the north arm and south arm of Wollombi Brook respectively, downstream to Paynes Crossing.

It is noted that no major on-ground works to change the flood behaviour are included in the Plan given the nature of flooding in the catchment.

#### 9.1.1 Planning and Development Controls

Land use planning and development controls are key mechanisms by which Council can manage flood-affected areas within the Wollombi Brook catchment. This will ensure that new development is compatible with the flood risk, and allows for existing problems to be gradually reduced over time through sensible redevelopment.

The following planning measures are recommended:

- Adoption of 100-year flood level plus 0.5m freeboard as the flood planning level (maintains the existing design flood standard)
- Inclusion of proposed floodplain risk management controls in Council's consolidated DCP 2010. The recommended DCP provisions as summarised in Section 8.1 include:
  - a) Restriction of development in high-hazard flood zones;
  - b) minimum floor levels;
  - c) the use of flood compatible building components below a certain level;
  - d) that structures located in high flood risk areas are structurally sound;
  - e) that development does not increase flood behaviour elsewhere;
  - f) maximising opportunities for people to safely evacuate;
  - g) other specific considerations regarding the use of the property: and
  - h) Consideration of the requirement for proponents to provide an emergency management plan for all new developments.

- Review of current land-use zoning with respect to high-hazard flood areas.

Estimated Cost - **\$20,000**    Responsibility – **Cessnock CC**    Priority - **High**

#### 9.1.2 Investigate Improved Emergency Egress and Voluntary House Raising

Investigations should be undertaken to establish if a program is viable to undertake voluntary access road raising and house raising for existing properties in high hazard flood zones. The priority for the scheme would be to establish appropriate flood egress for the property, providing the opportunity for



safe evacuation from a property prior to inundation of the dwelling. Voluntary house raising can be considered in the worst cases, but would not be undertaken in isolation and would require the establishment of an appropriate access. A scheme would not commence until it is known whether there will be a funding mechanism available to raise access/buildings from high hazard areas. Investigations should commence with confirming which properties may be offered assistance through more detailed property analysis and consultation with owners. Council may consider opportunity for a funding assistance package to encourage and support existing affected landowners.

Estimated Cost - **\$20,000**    Responsibility – **Cessnock CC**    Priority - **Medium**

### 9.1.3 Emergency Management Operations

Information from the current floodplain management study and flood damages database will provide valuable data to enable specific Wollombi catchment detail to be included in the Cessnock Local Flood Plan. Whilst this is normally the responsibility of the SES, assistance could be offered through the floodplain management committee to assist in the development and review of a Local Flood Plan.

The flood mapping and property database including property locations, floor levels will be provided to the SES for incorporation into existing systems and emergency management procedures.

The Rural Fire Service may be able to provide local assistance in flood emergency management operations. The NSW State Emergency Service will work with the NSW Rural Fire Service in accordance with their February 2012 Memorandum of Understanding.

Estimated Cost - **\$20,000**    Responsibility – **Cessnock CC/SES**    Priority - **High**

### 9.1.4 Improved Public Awareness

Raising and maintaining flood awareness provides residents with an appreciation of the flood problem and what measures can be taken to reduce potential flood damage and to minimise personal risk during future floods.

An ongoing public awareness campaign is recommended, that includes:

- Consolidation of the recent flood risk mapping, flood level data and flood damages database prepared during the floodplain management study into Council's computer based GIS system.
- Providing information concerning the flood risk and flood levels for properties on a flood certificate, which could be appended to Section 149(5) certificates or provided when requests about flooding are made.
- Maintaining flood markers indicating the height of past floods throughout the study area.
- Distribution of appropriate brochures / education material on how to plan for a major flood event and personal flood action plans.
- Installation of road flood depth markers at locations where the road is cut up to the 20% AEP flood level.
- Consideration by Council to provide more comprehensive flooding information on its website, including Flood Study reports, Floodplain Risk Management Study reports, LGA wide 1% AEP inundation maps, emergency contact details, links to relevant flood information (e.g. SES Flood Safe, BoM warning systems and live data, NSW Floodplain Development Manual etc.).

Estimated Cost - **\$60,000**    Responsibility – **Cessnock CC/SES**    Priority - **Medium**

### 9.1.5 Flood Warning Enhancements

Further investigation is recommended on potential flood warning system improvements, to be undertaken with assistance from the Bureau of Meteorology and the SES. The study should investigate the merit of an enhanced warning system for Wollombi over and above the better dissemination and resident action to existing flood warning services.

The scope of the study should include investigation of options for flood warning enhancement, appropriate gauge/reporting locations, integration into existing flood warning systems, installation and operating costs, ownership, management and maintenance requirements, liability and responsibility. Alternative power supply and communication methods (such as internet, social media and SMS notifications) should be investigated as a component of as part of the investigation of the provision of additional flood warning services. The study should also identify opportunities for funding of a proposed system.

Estimated Cost - **\$50,000**    Responsibility – **Cessnock CC/BoM/SES**    Priority - **High**

## 9.2 Funding and Implementation

The recommended Plan contains relatively modest financial implications for Council and other responsible authorities. This is largely as a result of no major capital works in terms of flood modification being recommended.

The timing of the implementation of recommended measures will depend on the available resources, overall budgetary commitments of Council and the availability of funds and support from other sources. It is envisaged that the Plan would be implemented progressively over a 2 to 5 year time frame.

There are a variety of sources of potential funding that could be considered to implement the Plan. These include:

- i) Council funds;
- ii) Section 94 contributions;
- iii) State funding for flood risk management measures through the Office of Environment and Heritage;
- iv) State Emergency Service, either through volunteered time or funding assistance for emergency management measures;

State funds are available to implement measures that contribute to reducing existing flood problems. Funding assistance is likely to be available on a 2:1 (State:Council) basis. Although much of the Plan may be eligible for Government assistance, funding cannot be guaranteed. Government funds are allocated on an annual basis to competing projects throughout the State. Measures that receive Government funding must be of significant benefit to the community. Funding is usually available for

the investigation, design and construction of flood mitigation works included in the floodplain management plan.

### **9.3 Plan Review**

The Plan should be regarded as a dynamic instrument requiring review and modification over time. The catalyst for change could include new flood events and experiences, legislative change, alterations in the availability of funding, or changes to the area's planning strategies.

A thorough review every 5 years is warranted to ensure the ongoing relevance of the Plan.

## 10 REFERENCES

BMT WBM (2010), *Wollombi Village Flood Study Review and Model Upgrade*, Prepared for Cessnock City Council.

Department of Environment and Climate Change (DECC) (2007) *Floodplain Risk Management Guideline – Practical Consideration of Climate Change*. NSW Government

Department of Infrastructure, Planning and Natural Resources (DIPNR) (2005), *Floodplain Development Manual: The Management of Flood Liable Land*, NSW Government.

Emergency Management Australia (EMA) (2009) *Flood Warning*, Australian Emergency Manual Series Manual 21, Australian Government.

Office of the Queensland Chief Scientist (2011), *Understanding Floods: Questions and Answers*, Queensland Government.

Patterson Britton & Partners (2005) *“Wollombi Valley Flood Study”*, Prepared for Cessnock City Council.

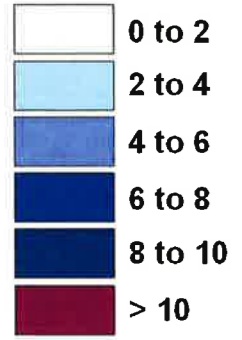


## APPENDIX A: FLOOD MAPPING

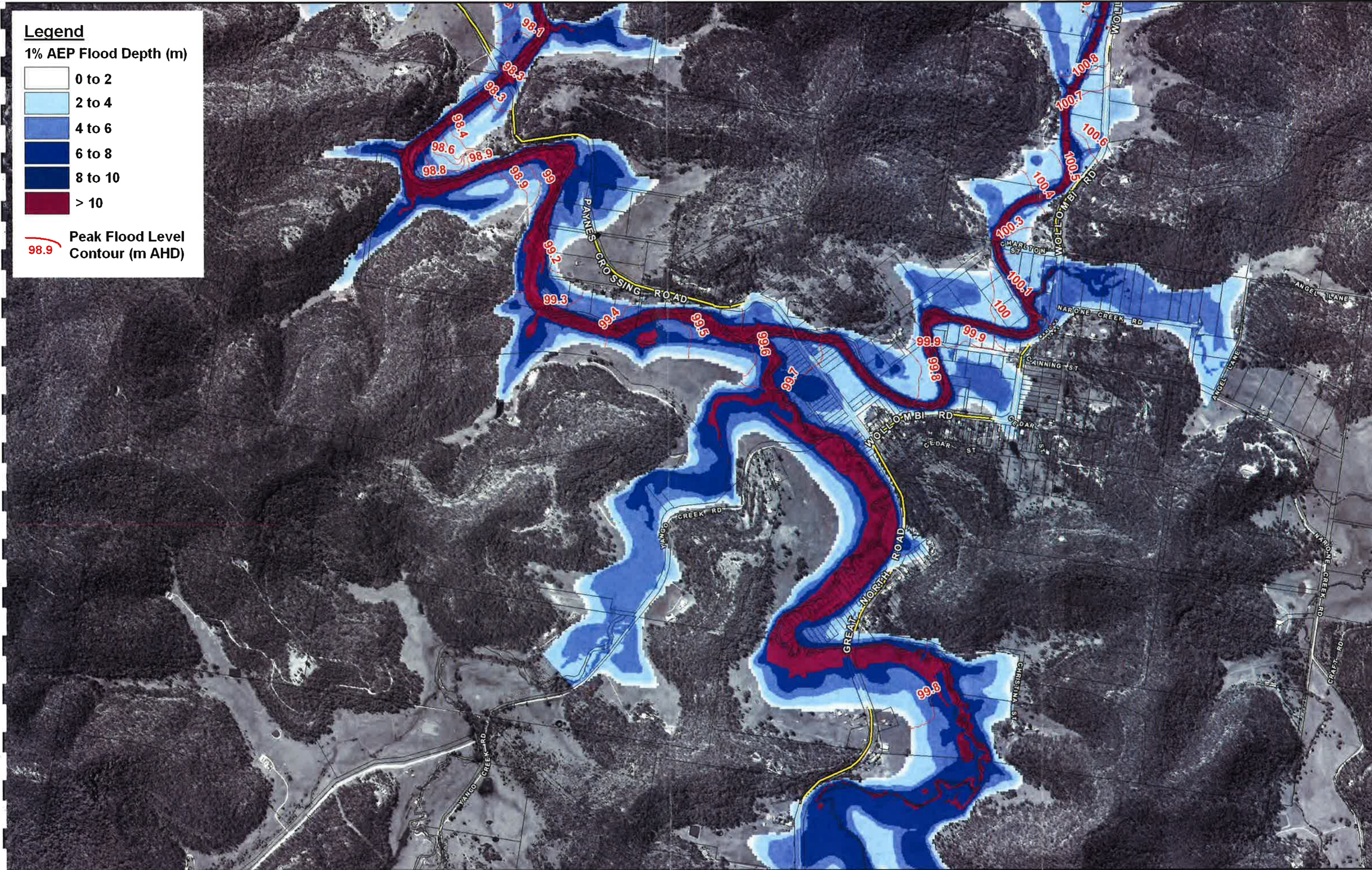


**Legend**

1% AEP Flood Depth (m)



Peak Flood Level Contour (m AHD)  
98.9



Wollombi Flood Study Review and Model Upgrade  
Design Event : 1% AEP  
Peak Flood Depth

Figure Wollombi\_1%AEP\_d\_R1

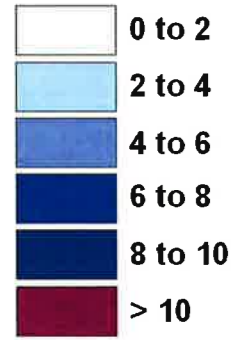
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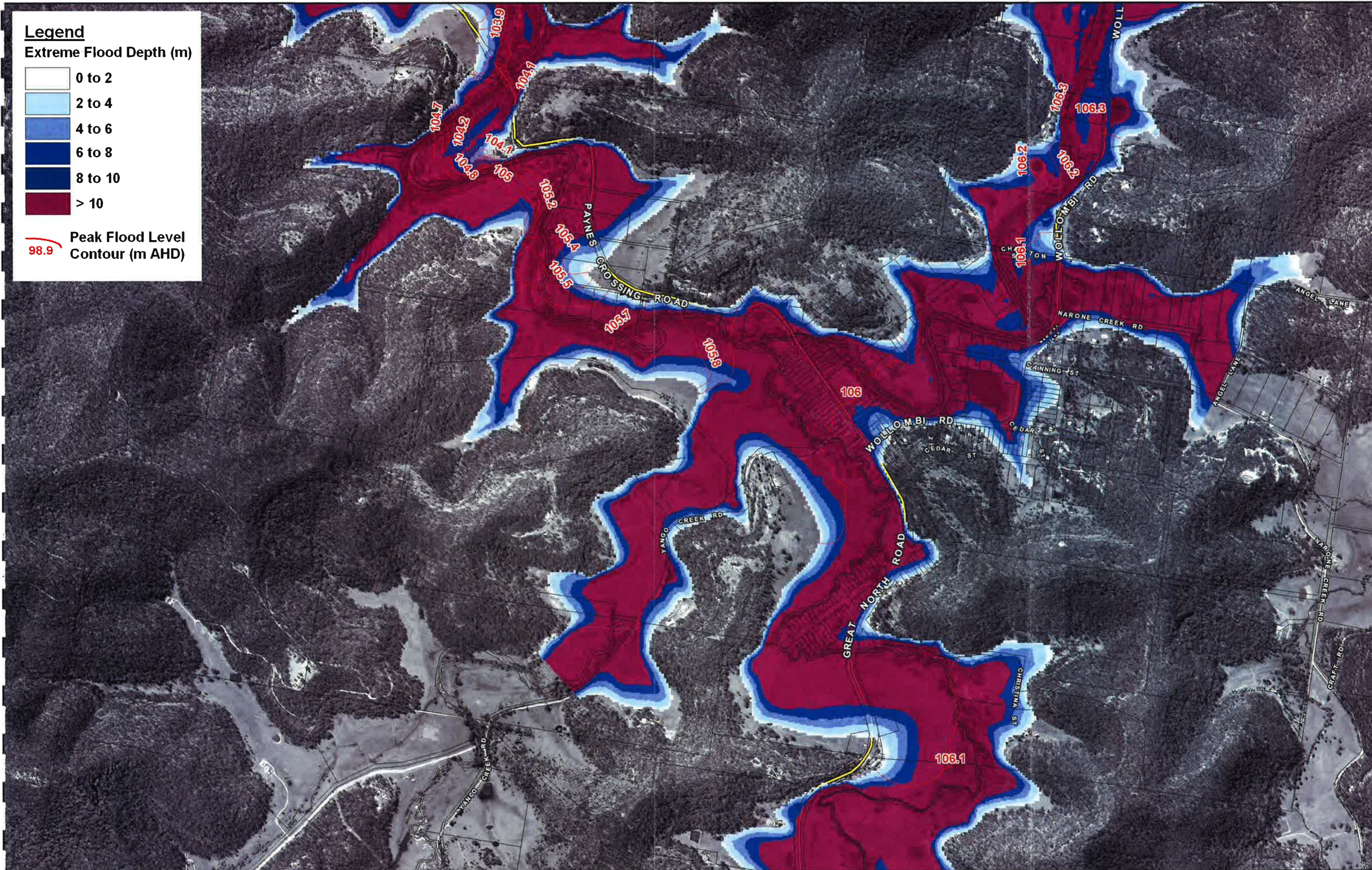


**Legend**

Extreme Flood Depth (m)



98.9 Peak Flood Level Contour (m AHD)







Wollombi Flood Study Review and Model Upgrade  
Design Event : Extreme Flood (3 times 1% AEP)  
Peak Flood Depth

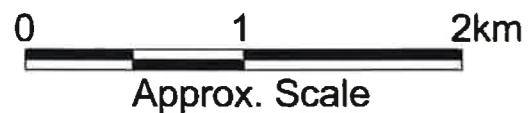
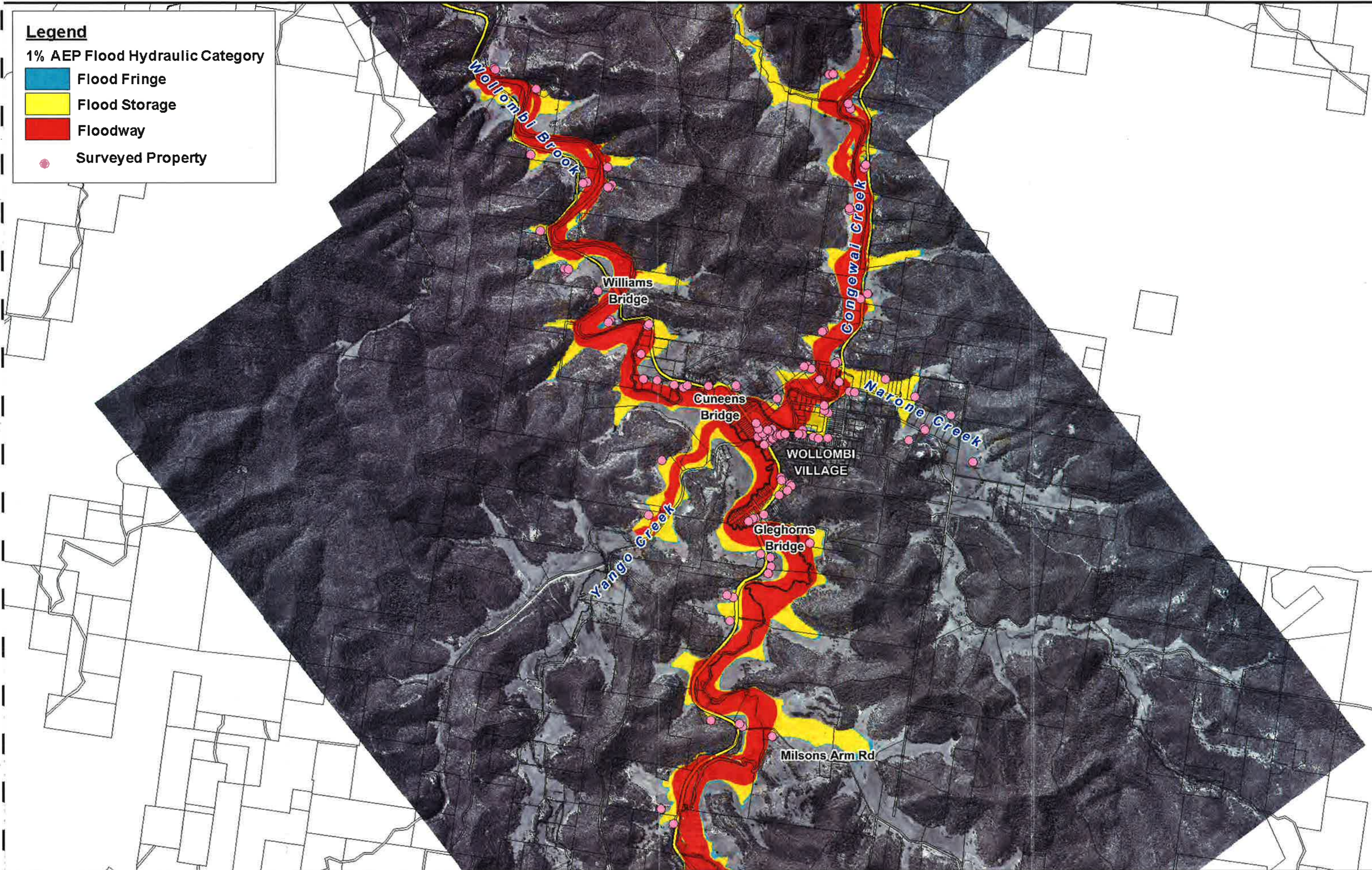
Figure Wollombi\_3times\_1%AEP\_d\_R1



**Legend**

**1% AEP Flood Hydraulic Category**

-  Flood Fringe
-  Flood Storage
-  Floodway
-  Surveyed Property



**Wollombi Floodplain Risk Management Study**  
Design Event : 1% AEP  
Hydraulic Category - Study Area

**Figure Wollombi\_1%AEP\_hydcats\_R1**

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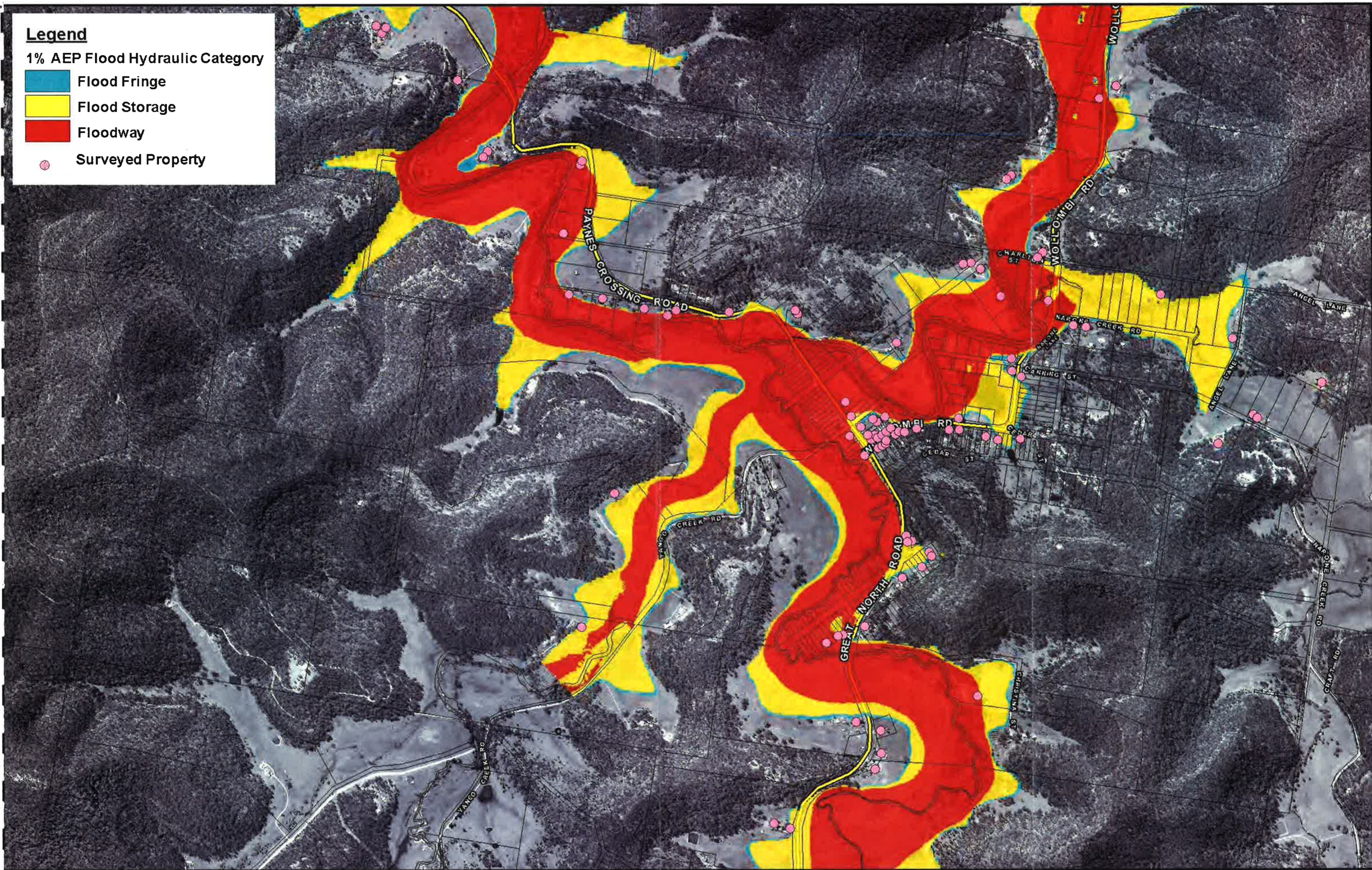




**Legend**

**1% AEP Flood Hydraulic Category**

- Flood Fringe
- Flood Storage
- Floodway
- Surveyed Property



**Wollombi Floodplain Risk Management Study**  
**Design Event : 1% AEP**  
**Hydraulic Category - Village Area**

**Figure Wollombi\_1%AEP\_hydcats\_R1**

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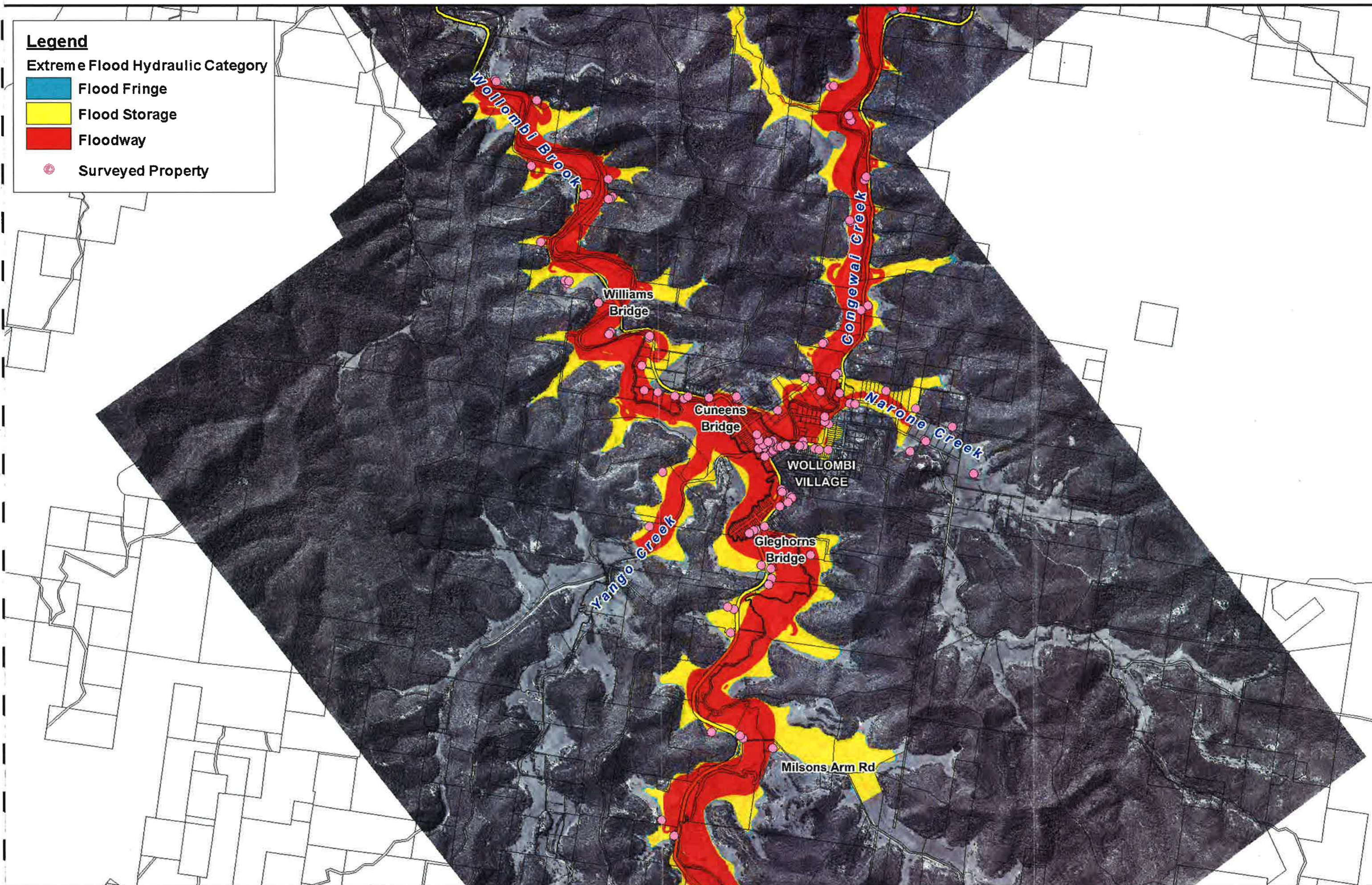




**Legend**

**Extreme Flood Hydraulic Category**

- Flood Fringe
- Flood Storage
- Floodway
- Surveyed Property



**Wollombi Floodplain Risk Management Study**  
Design Event : Extreme Flood Event  
Hydraulic Category - Study Area

**Figure Wollombi\_Extreme\_hydcap\_R1**

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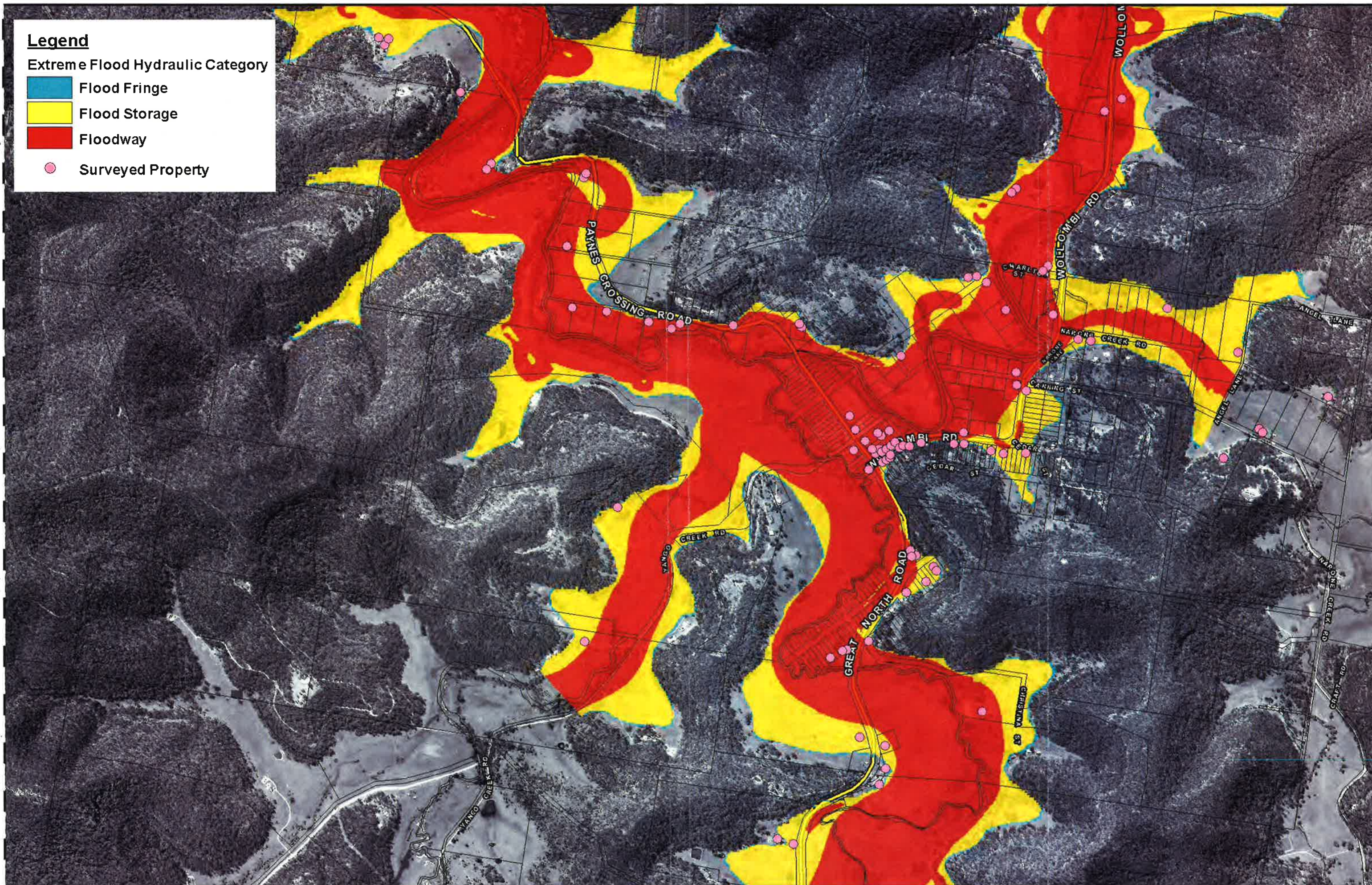




**Legend**

Extreme Flood Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway
- Surveyed Property



**Wollombi Floodplain Risk Management Study**  
**Design Event : Extreme Flood Event**  
**Hydraulic Category - Village Area**

**Figure Wollombi\_Extreme\_hydcats\_R1**

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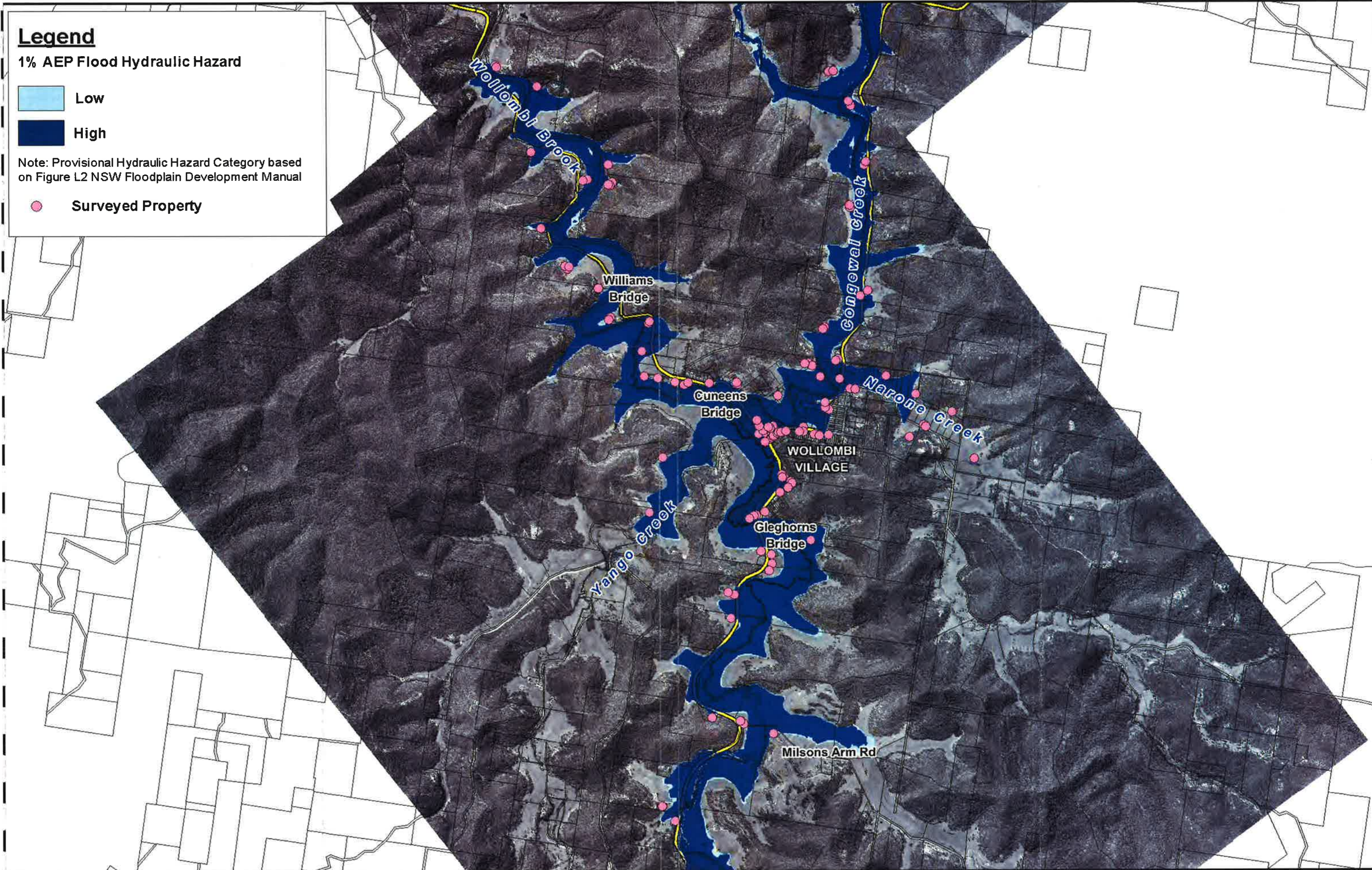
### Legend

1% AEP Flood Hydraulic Hazard

- Low
- High

Note: Provisional Hydraulic Hazard Category based on Figure L2 NSW Floodplain Development Manual

Surveyed Property



0 1 2km  
Approx. Scale



Wollombi Flood Study Review and Model Upgrade  
Design Event : 1% AEP  
Provisional Hydraulic Hazard Category - Study Area

Figure Wollombi\_1%AEP\_z\_R1

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### Legend

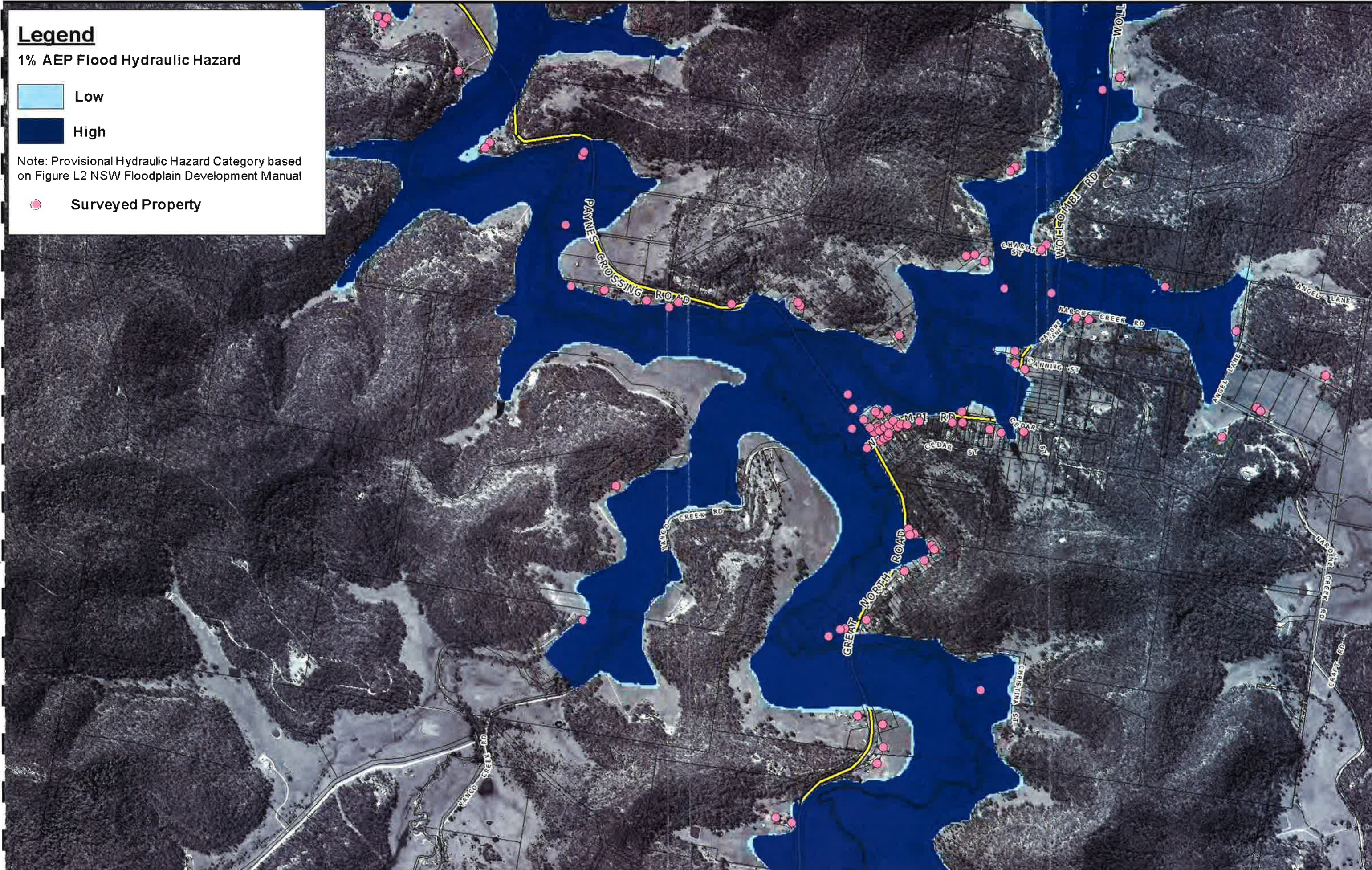
1% AEP Flood Hydraulic Hazard

Low

High

Note: Provisional Hydraulic Hazard Category based on Figure L2 NSW Floodplain Development Manual

Surveyed Property



Wollombi Flood Study Review and Model Upgrade  
Design Event : 1% AEP  
Provisional Hydraulic Hazard Category - Village Area

Figure Wollombi\_1%AEP\_z\_R1

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**Legend**

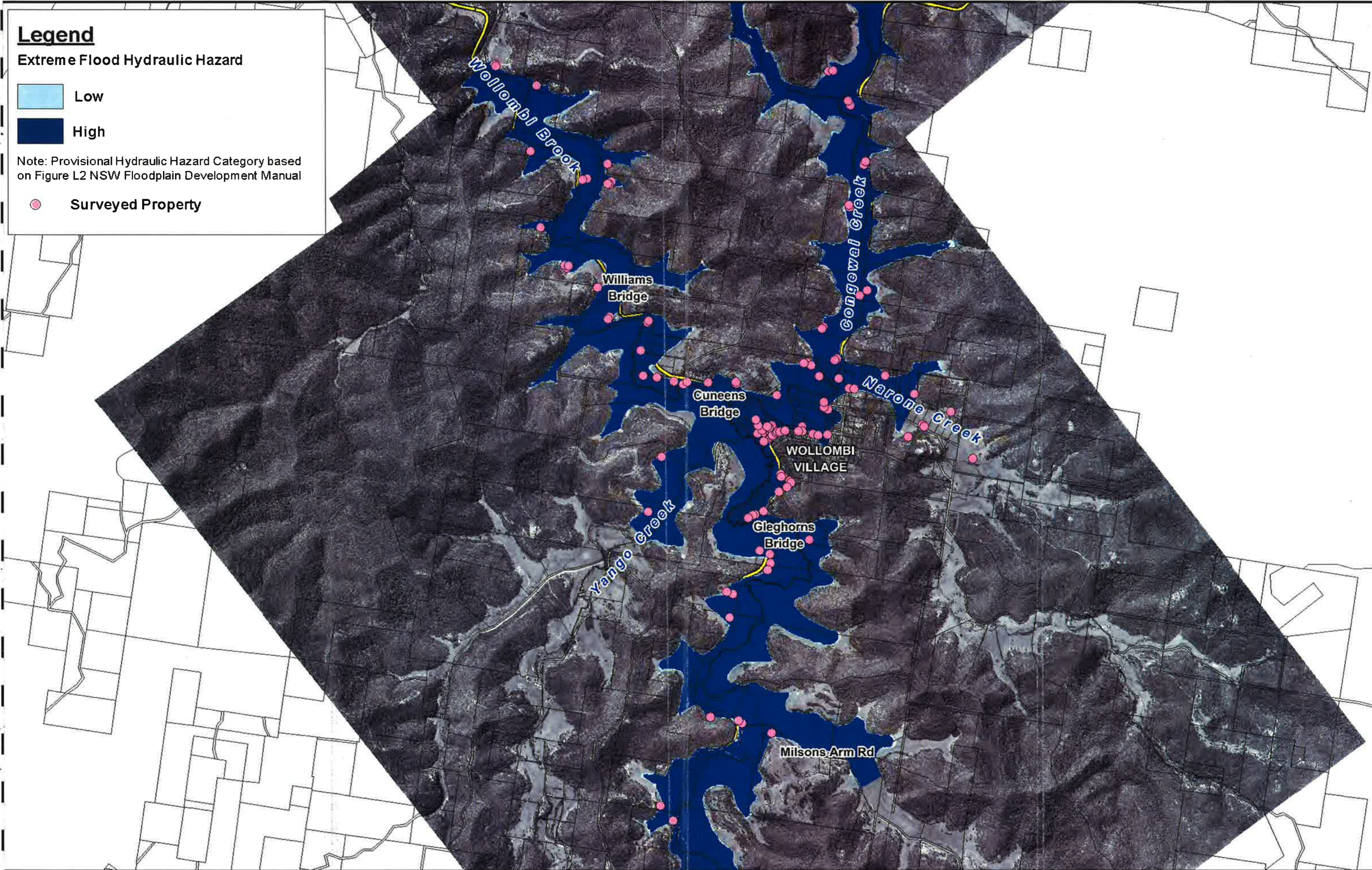
**Extreme Flood Hydraulic Hazard**

Low

High

Note: Provisional Hydraulic Hazard Category based on Figure L2 NSW Floodplain Development Manual

Surveyed Property



0 1 2km  
Approx. Scale



**Wollombi Flood Study Review and Model Upgrade**  
Design Event : Extreme Flood (3 times 1% AEP)  
Provisional Hydraulic Hazard Category - Study Area

**Figure Wollombi\_3times\_1%AEP\_z\_R1**

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# Legend

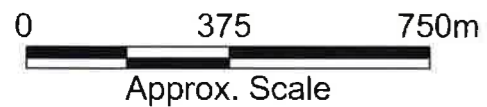
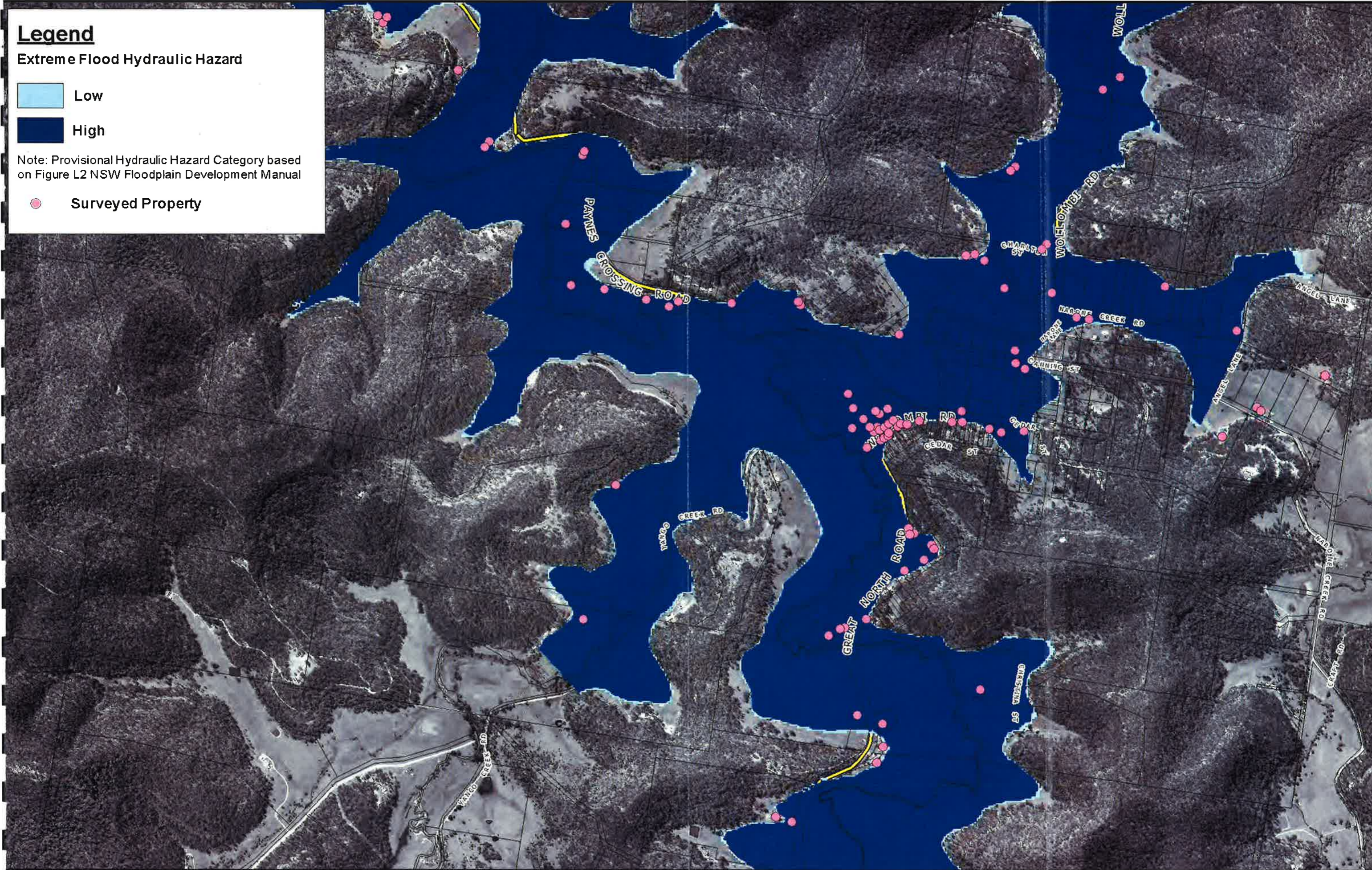
## Extreme Flood Hydraulic Hazard

Low

High

Note: Provisional Hydraulic Hazard Category based on Figure L2 NSW Floodplain Development Manual

Surveyed Property



Wollombi Flood Study Review and Model Upgrade  
Design Event : Extreme Flood (3 times 1% AEP)  
Provisional Hydraulic Hazard Category - Village Area

Figure Wollombi\_3times\_1%AEP\_z\_R1



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## APPENDIX B: HISTORICAL EVENT NEWSPAPER ARTICLES



## THE FLOOD AT WOLLOMBI.

(From a Correspondent.)

Wollombi, Aug. 21st, 1857.

As the mail is just starting, I send you a few hurried lines to say that it has now (10 a.m.) been raining almost continually for the last 33 hours, and that our creeks are now overflowing their banks, with every prospect of inundating at least the lower portion of the township, from which the residents have been busily employed since daylight in removing their goods to the houses situate on higher land. Although in a hurry, and the waters approaching my residence, I must take time to notice the praiseworthy endeavours of Messrs. Higgins, Allen, and Co., to rescue the goods of their neighbours from the rapidly rising waters; at an early hour they were on the alert with their team, removing the property of those living on the lower portion of the township to a place of safety. More by next post.

Wollombi, 26th August, 1857.

I write from the midst of a scene of desolation, and I fear, of ruin to many, to inform you that about 10 o'clock on Friday night, after a continuous fall of rain for forty-four hours, we were visited by a flood, which, at that hour, attained a height unprecedented—being just 17 inches higher than the flood of the 26th ultimo. It may give to those acquainted with our locality some idea of the altitude and extent of the water on that melancholy night, when they are informed that in the Catholic Church it stood at the height of 10 feet; nearly submerging the National School, and all the buildings situate on the low land of the township, and approached to within a couple of perches of the Protestant Church and Court House. It may naturally be expected that many have experienced severe loss from this dire and quickly-repeated calamity. I believe the greatest sufferers in the township are

severe loss from this fire and quickly-repeated calamity. I believe the greatest sufferers in the township are Messrs. Cooper, Ingry, Conneen, Bourne, Rogers, Kenny, Plant, Meadows, and Joseph Bridge—in fact, hardly one escaped damage of more or less amount. The news from the surrounding country may be condensed into a few words, such as bridges swept away, destruction of crops, and a few buildings, fences, and top soil carried away, &c., but happily I have not heard of any loss of human life. It may be mentioned as something remarkable that on Friday, while the water was rising, a flock of seagulls passed over the township. It must be remembered, also, to the undying honour of our inhabitants that the energy they displayed, and their devotedness to the help of their neighbours in the hour of peril, was beyond all praise and my power of description.



### WOLLOMBI.

Our usual correspondent at Wollombi confirms the reports we have already published, as to the fearful height of the flood there, which he states at three feet higher than the great flood of 1857; and he gives some further details as to the narrow escape from drowning of several persons. He says:—

“In the disastrous flood at Wollombi, which was about three feet higher than that of August, 1857, five lives were nearly lost, viz., Rev. Mr. Shaw, Messrs. D. Kenny, John Moore, G. Elliott, jun., and young Davis—two through the capsizing of a boat, and two through the turning over of a canoe, and Mr. Shaw in trying to rescue a cow that was being surrounded with water. Mr. Dopping, P.M., rescued Mr. Shaw with a boat, while clinging to a tree. G. Elliott was saved by Mr. A. Moore with a canoe, while he was sitting in a tree in the centre of the flood, and the current running fearfully at the time. Mr. Kenny swam in to save Davis, while in a sinking position, being about eighteen inches under the water, when he reached him by catching hold of his hair, and pulled him somewhat out of the water, when Davis grasped him tight round the neck, and both went down; a third person, Mr. J. Wellings, went and rescued both, and managed by his good swimming, to push them towards land till they got foothold. John Moore managed to swim out, but could not stand when he reached the shore; fortunately for him, there were persons on the spot at the time. I may also add a great loss of property throughout the whole district, besides two of the principal bridges being partly carried away, to say nothing of the damage done to the various portions of the road. It is quite true about the Wesleyan Chapel and three other houses being carried away.

Wollombi, June 28th, 1867.

## THE FLOOD AT WOLLOMBI.

This district has been visited with the highest and most disastrous flood within the memory of the oldest settler on the brook—the water in 1857 being at least four feet lower.

About twelve o'clock of the night of Friday, the 21st, the flood was at its highest, and was then about six inches in the Church of England, where most of the inhabitants had taken refuge. The Court-house was thrown open for the use of the inhabitants, and all whose houses were free from water gave shelter to those who had to quit. It would be invidious to mention names—all, without exception, doing their utmost to save their neighbours' goods and chattels, the police magistrate, C.P.S., and police being foremost in their endeavours to render assistance. Some narrow escapes from drowning occurred, the Rev. Mr. Shaw, endeavouring to save his stock, having had a narrow escape, and was only saved by Mr. Dopping's (P.M.) promptness in a small dingy. Much anxiety was caused by two men being missing all Friday night, the boat having upset with them. They turned up on Saturday afternoon; every endeavour was used to render them assistance or life would have been lost. The township on Sunday morning presented a desolate appearance. The Wesleyan Chapel, a portion of Mr. Whiteman's and Mr. Bourne's residences being swept completely away, chimneys here and there down, and fencing washed away or down in every direction. Few, if any, have escaped some loss.

This is only the damage done to the townfolk; the farmers will suffer immensely, the wheat sown being destroyed and the ground so saturated with water that it will be impossible to plough for weeks, the soil turned by the plough being carried away.

There is a movement to do something with the present Public School, which I hope will be successful; the buildings are in such a low position that every year they are flooded, and this time the whole was several feet under water.

Wollombi, 24th June, 1867.

*(From another Correspondent)*

June 24.—Only for the great and persevering industry of the people of this district, the name of the place might be altogether erased from the map of Northumberland. Against all their misfortunes they have borne up and struggled with persevering energy. The wheat blight, with occasional floods (rather too frequent lately) has put the population, which is agricultural, to their best efforts. This last affliction (the flood of the last few days) has



This last affliction (the flood of the last few days) has destroyed all the prospect of a future harvest. The crop was almost in. I am not aware of an exception. The wheat is either washed away or covered with mud and sand. The rain commenced early in the week, and continued with very little intermission until Friday, midnight, when the flood reached its greatest height, which was five feet higher than the remarkable one of 1857. I am told too (so far as regards the Wollombi) that they both occurred on the same day of the month, the 22nd of June.

The greatest loss is on the farmers, but other classes have suffered very considerably, and have had to put up with a great deal of inconvenience. More than half the people had to leave their homes, and many who had shown hospitality were obliged, as the flood rose beyond expectation, to seek the same from others. In the hurry the furniture, &c, were left, but on the subsidence of the flood it was found that nearly in all cases they had been carried away.

The Wesleyan Chapel, a very insignificant slab structure, was totally carried away. The Catholic Church had thirteen feet of water in it. The English Church had a few inches, just enough to cause a trifle of inconvenience. There were a few hairbreadth escapes from drowning. On Friday morning a gentleman was saved by our very worthy and highly respected Police Magistrate, Mr. Dopping, who at his own expense had purchased a boat, and by the skilful use of it saved the gentleman's life. Not only Mr. Dopping's individual exertions (which were very great indeed), but his residence, were at the service of those who needed them. His humane feelings are of a very high order; they arise from a good head and a good heart.

On Sunday, at noon, a canoe sank. The three men in it were saved—one by Mr. D. Kenny, and at very great risk of his own life, the drowning man, like most in that condition, acting anything but wisely for himself and benefactor.

This communication has gone on a greater length than I intended, though endeavouring to be as concise as possible. I have left untold numberless cases of hardship, and only given a faint idea of the disastrous flood of the past week. Though much property has been lost, it is pleasing to relate that no accident to life has occurred. We have no account from the surrounding portions of the district. No mail from Maitland since Thursday. Most probably it will proceed thither this morning (Monday).

morning (Monday).

In addition to the above letters, we are favoured by Mr. Wright, builder, of East Maitland, who (with his son) is building the court-house at Wollombi for the Government, with a letter from his son, Mr. T. H. Wright, giving a very full and graphic description of the fearful flood there and some of the losses it has caused. We give it nearly verbatim,—the "Joe" spoken of is Mr. T. H. Wright's brother:—

Wollombi, Thursday, June 20 —There is another flood here. It began to rain on Monday, about three p.m. On Tuesday and Wednesday it rained lightly, but last night it poured in torrents. It did not rain much to-day, but to-night it is coming down much heavier than ever; the creek rose about twenty feet in the night, but very little during the day. It now wants about five feet to go over the banks. I think it will be much higher through to-night's rain.

Thursday morning, 4 a.m.—The river has risen very high during the night. It is all over the parson's paddock, six feet deep.

10 a.m.—Mr. Shaw had a narrow escape from drowning. He came into the water to get at a cow that was swimming about, and the stream carried him down, but he hung to a tree. Mr. Dopping, the P.M., took him off in a boat, just in time, as he was cramped.

On Friday morning, at three a.m. helping to shift Jones. At four the water just come in on the floor; by the time we cleared out at 6 a.m. it was half up the counter. Creek rising fifteen inches per hour. Rained in torrents the last twenty hours. At ten o'clock it was up to the top of the doors. At this time, Mr. Arnott, Jo', Patrick, myself, and Elliott went off in a boat to get the wires (telegraph) out of the flood, round by Summers's garden, posts four feet under water; hoisted seven hundred yards of wire into trees. Went on to Cobcroft's, and hoisted wire there. Raining so heavy had to keep baling out boat. Came back at four o'clock p.m. Water into Kenny's first floor. Out all night shifting people; raining very heavy all night; creek rising a foot an hour. At 7 p.m., Friday, had to shift people out of the church [Church of England, a building so high that it had never before been flooded, and was habitually a place of refuge for the people of Wollombi in times of high flood]. Water just up to foundations. Still raining. Arnott had 20 people at his place, 13 at our place, Elliott full, Summers and the police barracks full. Water now up to the highest flood known. 11 p.m. Water rose four feet higher.



flood known. 11 p.m. Water rose four feet higher.

Saturday morning, half-past one.—Frightful flood; water level from Johnny Neill's to the road in front of our place; still rising, and pouring rain. 2 a.m. Flood in Nancarrow's store, over the floor of the church, and up to the base of the new court-house. Kenny's store under water to the eaves [a two-story building]. Water enough to pull a boat clean round the church. Water steady, but still raining.

Saturday morning, 6 a.m.—Water down about 4 feet 6 inches. 10 p.m. Water down about 15 feet. Been raining all day.

Whiteman's stable, store, the Wesleyan Chapel-house next to it, Bourne's house and shop—all swept away. Seven or eight chimneys down from other houses. G. Elliott and T. Moore went out in boat when we had done lifting the telegraph wire, and got upset down by Drew's cottage, and had to swim nearly half a mile; Albert Moon saved Elliott from a tree, Moore swam ashore, and then became insensible; they only got home this afternoon. Me and Joe were out 47 hours, without sleep, and most of the time without grub; in fact there was none to be had, as the only houses out of the flood were Summers's, the barracks, Arnot's, ours, and Elliott's. It came very near Summers's stable, and into the police stable. From all accounts it was fully six feet higher than any flood ever known up here. The flood rose about 58 feet above the usual level of the creek, as near as I can tell. It is now, 10 p.m. Saturday night, about 7 feet deep on the parson's flat opposite. It stood higher than the 1857 flood nearly twenty hours; that will tell the body of water. No news by telegraph either way. I expect Maitland will be washed away; if it has rained up the country like it has here, you will see a fearful flood.

Monday morning, nine o'clock.—Flood fallen 31 feet by level measure from the highest mark; still about 20 feet above ordinary level of creek. Weather fine. Kenny's kitchen has gone with the flood. All accounts agree it was about six feet higher than any flood ever known here. One house that was to a depth of three weatherboards in 1857 was submerged to the doorhead, so that will tell.

## WOLLOMBI ISOLATED.

WEST MAITLAND. Sunday.

The lower Hunter districts have had the heaviest rain experienced for a long time. The Hunter and its tributaries rose quickly, and farm lands in many parts are flooded.

The river rose to 28 feet at West Maitland, at times the rise being at the rate of 3 to 4 feet an hour. As is always the case with a rise like this, it overflowed at Pitnacree and McRae's Hollow, cutting off traffic between East Maitland and Largs. The Paterson River also being in flood held the waters of the Hunter back, and the latter overflowed on to the Phoenix farms. Low lands around Hinton are submerged. Fishery Creek, to the south of Maitland, has never been known to rise so quickly as it did on Friday, and the farms at Louth Park, Dagworth, and Fishery Creek, which received a severe flooding at Christmas time, are again under water, but this time the water is deeper. On the road to Mulbring it is more than half-way up the telegraph poles. On very few farms can fences be seen. Some dairymen brought their stock to the show ground. The prospects for the winter for these farmers is gloomy. All winter feed crops have been destroyed. This part of the district is a vast expanse of water, which stretches across to the South Maitland railway.

Stanhope Creek at Branxton has not been so high since the record flood of 1893. It became a raging torrent, and both bridges on the upper road, which were damaged a few months ago, have been again washed out. Residents are cut off. Much damage has been done to roads and fences.

Cockfighter Creek at Wollombi rose 50 feet. All bridges are submerged, and the town is isolated. The bridge at Millfield was never before covered. Only the roof of the hostel at Wollombi was visible above the flood. Stock and crops suffered severely. Fortunately for the lower parts the rainfall in the Upper



and crops sunered severely. Fortunately for  
the lower parts the rainfall in the Upper  
Hunter was very light above Singleton.

## APPENDIX C: PUBLIC EXHIBITION SUBMISSIONS

- Wollombi Progress Association
- Wollombi Rural Fire Service

Please note that for privacy reasons, individual names and contacts details have been removed from submissions.



**SUBMISSION**

IN RESPONSE TO

**WOLLOMBI FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN**

FROM

**WOLLOMBI PROGRESS ASSOCIATION**

**8 August 2012**

ADDRESS ALL CORRESPONDENCE TO:

**Secretary, Wollombi Progress Association**

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To The General Manager

Thank you for giving Wollombi Progress Association members an opportunity to comment on the Floodplain Risk Management Study and Plan for Wollombi.

Our community acknowledges the valuable resource that Council has produced.

At our meeting of 28 July, our members were finally in a position to discuss the proposed Plan. Comments arising from that meeting have been collated and are supplied in this document.

Our Association is happy to assist Council further if it wishes to clarify any of the issues raised in this submission.

Chairperson, Wollombi Progress Association  
8 August 2012

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## **SUMMARY OF RESPONSES**

### **Improved Public Awareness**

We support the actions nominated under 9.1.4, with one modification.

### **Flood Warning Enhancements**

We do not support further lengthy investigations nominated under 9.1.5. We propose that the nominated budget for this item should mainly be spent on on-ground works.

### **Moving to Higher Ground**

We propose a scheme of assistance to improve emergency egress of existing high risk households.

### **Staying Put**

We propose that Council encourages the uptake of generators or solar panels as a means of providing backup power after flood events.

### **Keeping in Contact and Calling for Assistance**

We propose that Council support the improvement of communications in the area.

### **Emergency Management Operations**

We support the actions nominated under 9.1.3.

### **Planning and Development Controls**

We support the actions nominated under 9.1.1.

### **Investigate Voluntary House Raising**

We do not support the actions nominated under 9.1.2.

### **Funding and Implementation**

We do not support the anticipated timeframe.

### **Area of Coverage**

We propose that the implementation of three actions arising from the Plan should be increased beyond the 5 kilometre limit.

## Improved Public Awareness

Section 9.1.4 of the draft report states:

An ongoing public awareness campaign is recommended, that includes:

- Consolidation of the recent flood risk mapping, flood level data and flood damages database prepared during the floodplain management study into Council's computer based GIS system.
- Providing information concerning the flood risk and flood levels for properties on a flood certificate, which could be appended to Section 149(5) certificates or provided when requests about flooding are made.
- Maintaining flood markers indicating the height of past floods throughout the study area.
- Distribution of appropriate brochures / education material on how to plan for a major flood event and personal flood action plans.

Estimated Cost - **\$60,000** Responsibility – **Cessnock CC/SES** Priority – **Medium**

### **Comment**

*The 2007 flood occurred at night. When travelling back from Sydney on that night, she encountered water over the main road. No depth markers were present and there was no way to judge the depth of the water at that location.*

### **Comment**

*Section 149(5) certificates apply to properties deemed flood prone. However, flooding over private and public roads is endemic in the area, and some roads can be cut by even modest flooding events.*

### **Discussion**

*The consensus was that it was more important to have flood markers that showed current depth rather than the depth experienced in past flood events.*

### **Conclusion:**

**The Association supports the actions nominated under 9.1.4, with the exception that all deployed flood markers should indicate current depth of water.**



## Flood Warning Enhancements

Section 9.1.5 of the draft report states:

Further investigation is recommended on potential flood warning system improvements, to be undertaken with assistance from the Bureau of Meteorology and the SES. The study should investigate the merit of an enhanced warning system for Wollombi over and above the better dissemination and resident action to existing flood warning services.

The scope of the study should include investigation of options for flood warning enhancement, appropriate gauge/reporting locations, integration into existing flood warning systems, installation and operating costs, ownership, management and maintenance responsibilities. Alternative power supply and communication methods should be investigated as a component of as part of the investigation of the provision of additional flood warning services. The study should also identify opportunities for funding of a proposed system.

Estimated Cost - **\$50,000** Responsibility – **Cessnock CC /BoM/SES** Priority - **High**

### **Comment**

*The latest technology now deployed by flood management authorities is known as IoT (Internet of Things or M2M machine to machine communications). These are basically sensors installed at strategic positions along the river (or elsewhere) that provides an early warning system (They are linked to mobile, radio or satellite networks). There are a few of these systems now in place (Victoria) so there is experience we can tap into.*

### **Comment**

*Kurri Kurri Landcare is willing to provide solar powered siren kits at approximately \$700 per set, which represents the cost of materials.*

### **Comment**

*It is important to recognise that there are two responses to a flood warning –*

- 1) To relocate to high ground (perhaps by crossing the creek early) before the creek comes up*
  - 2) To discontinue any efforts to cross the creek because it has become too dangerous to do so.*
- Preliminary BOM/SES flood warning could be despatched through the phone network.  
Immediate threat of flooding could then be triggered by in-stream gauges (reporting to Wollombi RFS)  
Siren could be located at and managed through Wollombi RFS base station  
Siren could be viewed as a signal to immediately stop any further attempts to cross floodways*

### **Discussion**

*There was strong support for a warning system, consisting of direct phone communications and sirens. There was support for this system to be deployed quickly and for the technology to be supplied to the wider community, including Laguna.*

*The consensus was that investigations into a warning system could be brought to a conclusion without extensive further investigation – Attendee has indicated that he would be willing to assist with the remaining investigations. Representatives from the local fire brigades were keen to collaborate on the finalisation and implementation of the proposal.*

*The consensus was that the warning system could be fully installed and operational for less than the cost of the proposed "further investigations".*

### **Conclusion:**

**The Association supports the establishment of a warning system as referred to in 9.1.5.**

**However, the Association proposes that the majority of the budget should be allocated to implementation, as follows -**

- 1) Finalisation of investigations, not to exceed \$10,000, and**
- 2) Implementation of a warning system, not to exceed \$40,000.**

## **Moving to Higher Ground**

### ***Discussion***

*The report noted that it was important for residents to be able to move easily to high ground when flooding occurs. However, the report did not list any recommendations that addressed the need for safe egress from existing residences (though this was to be addressed in relation to new dwellings).*

*The consensus was that Council should encourage residents of existing dwellings, especially those who have been identified as in "high risk locations", to provide safe egress to higher ground. This was considered of such importance that Council should develop and provide some form of financial assistance package to improve egress (ensuring the escape route is on level or rising ground, and/or placing gateways through fences that currently block the escape route). This package could be provided on a proportional basis (such as a \$1 contribution for \$4 of actual costs).*

### **Conclusion:**

**The Association proposes a scheme of assistance to improve emergency egress from existing high risk households.**

**The following funding is proposed:**

- 1) A maximum of \$5,000 for the evaluation of egress conditions, and**
- 2) A maximum of \$15,000 for a scheme of assistance to improve egress.**



## Staying Put

### **Discussion**

*The report noted that often, the safest course of action for residents is to stay put. But they may need to stay put for several days – longer, if roads have been damaged or vehicles flood damaged. The report also noted that in a major flood event, this community is largely left to its own devices because SES resources are likely to be focussed on supporting the major population centres.*

*The draft Plan mentions the need for residents to develop a personal flood management plan. This plan may include references to such things as keeping an emergency supply of food and water available, but it needs to recognise the significance of a possible loss of power for several days after a flood event.*

*Council should not only recognise the importance of a personal flood management plan, but should also recognise the usefulness of an emergency backup power source. This could merely require Council to acknowledge the usefulness (during flood events) of household backup generators, the acquisition of items like solar powered phones, or even the usefulness of houses having solar power connected, and for Council to encourage households to take up one or more of these alternatives..*

### **Conclusion:**

**The Association proposes that Council encourages the uptake of generators or solar panels as a means of providing backup power after flood events.**

**The anticipated cost of this proposal is NIL.**

## Keeping in Contact and Calling for Assistance

### **Discussion**

*The report does not address the fundamental problem of how people are going to call for assistance in the first place if communications are down or the power infrastructure supporting communications is down.*

### **Comment**

#### **Infrastructure**

*Obviously any technology can fail so nothing is bullet proof. However, in a flood situation, as long as the base stations are properly situated the mobile signal should remain in place. In Bucketty we have made further arrangement for the possibility of the fire brigade to assist in maintain power through generators (there are arrangements in place with Optus –yet to be tested). Another option could also be to have a few satellite phones strategically stored (they need to be tested regularly).*

#### **Services**

*On a high strategic level emergency services are emergency services and there are now several well established system in place that can be used as examples/templates for our service **there is no need to start from scratch***

*SMS based services based on mobile phones would be the cheapest and simplest solution. Telstra is developing the national service so this would be the first port of call. Just listening to what they have and are doing would be the best exercise to start.*

*Increasingly communities are also using social media there are closed sites used by communities to stay in contact for many different reasons and of course this could be another avenue that could be explored. The advantage of these social media is that they **don't cost anything** and have many applications attached to it. Perhaps one of the most important applications are maps. These maps can be totally custom made to the needs of the community, could have all relevant information on it in minute detail if needed, complete with pics and videos and most importantly are instantly available to everybody in the community (unlike similar applications but only available to the emergency services).*

*Critical in all of these situations is to have an understanding what media are people using in the Valley. This need to be well documented in order to ensure that everybody (in vulnerable situations) can be reached or that there is a plan on how to contact people that are not connected (eg via neighbours, family, etc).*

***There is now enough reliable and credible information available to start implementing services.** I would question the need for an expensive research project, yes certainly some research is needed (eg talk to Telstra, look in social media, talk to emergency services in other parts of Australia (re folds Victoria, Brisbane) etc) but basically it now comes down to implementation.*

### **Conclusion:**

**The Association proposes that Council supports the deployment of an SMS based service for the area during flood events.**

**The following funding is proposed:**

- 1) A maximum of \$5,000 to complete investigations into communications,**
- 2) A maximum of \$5,000 for any costs associated with implementation.**



## Emergency Management Operations

Section 9.1.3 of the draft report states:

The flood mapping and property database including property locations, floor levels will be provided to the SES for incorporation into existing systems and emergency management procedures.

Estimated Cost - **\$20,000** Responsibility – **Cessnock CC/SES** Priority – **High**

### **Comment**

*Representatives from local Rural Fire Services were present at the meeting, and were keen to have a follow-on meeting to develop a coordinated plan for emergency service during flood events.*

### **Conclusion:**

**The Association supports Section 9.1.3.**

## Planning and Development Controls

Section 9.1.1 of the draft report states:

The following planning measures are recommended:

- Adoption of 100-year flood level plus 0.5m freeboard as the flood planning level (maintains the existing design flood standard)

- Inclusion of proposed floodplain risk management controls in Council's consolidated DCP 2010. The recommended DCP provisions as summarised in Section 8.1 include:

- a) Restriction of development in high-hazard flood zones;
  - b) minimum floor levels;
  - c) the use of flood compatible building components below a certain level;
  - d) that structures located in high flood risk areas are structurally sound;
  - e) that development does not increase flood behaviour elsewhere;
  - f) maximising opportunities for people to safely evacuate; and
  - g) other specific considerations regarding the use of the property.
- Review of current land-use zoning with respect to high-hazard flood areas.

Estimated Cost - **\$20,000** Responsibility – **Cessnock CC** Priority – **High**

### **Conclusion:**

**The Association supports Section 9.1.1.**



## Investigate Voluntary House Raising

Section 9.1.2 of the draft report states:

Investigations should be undertaken to establish if a voluntary house raising program is viable. A voluntary house raising scheme would not commence until it is known whether there will be a funding mechanism available to raise buildings from high hazard areas. Investigations should commence with confirming which properties would be offered voluntary house raising, through more detailed property analysis and consultation with owners.

Estimated Cost - **\$20,000** Responsibility – **Cessnock CC** Priority - **Medium**

### **Discussion**

*This proposal will make residents more likely to be trapped in their houses – because they are in effect, encouraged to stay in their houses longer, even as their safe egress is becoming inundated.*

*The consensus was that this is both unnecessarily dangerous, and would be an expensive option. The preferred alternative was for Council to focus on improving egress (see separate section).*

### **Conclusion:**

**The Association does not support Section 9.1.2.**

## Funding and Implementation

The draft report states:

The timing of the implementation of recommended measures will depend on overall budgetary commitments of Council and the availability of funds from other sources. It is envisaged that the Plan would be implemented progressively over a 2 to 5 year time frame.

### ***Discussion***

*The Plan does not define when on ground works will be completed. In particular, items 9.1.5 and 9.1.2 merely propose that further investigations should occur.*

*The consensus was that the remaining investigations should be brought to a conclusion as quickly as possible (and that the community would assist with this process), and that the money saved could then be spent on actual implementation.*

*The consensus was that a timeframe of up to 5 years was excessive. A period of six months was considered enough to bring the remaining investigations to a conclusion. There was a strong desire for all aspects of implementation to be in place within 12 months.*

*The revised approach would also save the Council money.*

### **Conclusion:**

**The Association does not support the current timeframe.**



## Area of Coverage

### **Discussion**

*The report identifies that the study area is limited to a 5 kilometre radius from the town centre. This means that the report does not serve the needs of the majority of the local community. Indeed, the community sees itself as a cohesive but dispersed community that includes Laguna and beyond.*

*The consensus was that a follow-on study should be done as soon as possible to extend the study area to include all or the majority of the community in the Wollombi valley.*

*In the meantime, the following are proposed:*

- 1) Flood markers (displaying current depth of water over the road) as discussed in 9.1.4 should be reviewed and extended for public roads between Millfield and Furnance's Crossing,*
- 2) The flood warning system discussed in 9.1.5 should include a warning system for Laguna,*
- 3) The proposed emergency SMS service discussed under the heading "Keeping in Touch and Calling for Assistance" should be offered to residents beyond the nominated study area.*

### **Conclusion:**

**The Association proposes that the implementation of three actions arising from the Plan should be increased beyond the 5 kilometre limit.**

Wollombi Volunteer Bushfire Brigade

2810 Wollombi Road,

Wollombi. 2325

Ph. 49983293

9/8/2012

### **Submission to the Wollombi Floodplain Risk Management study**

In my position as Captain of Wollombi Volunteer Bushfire Brigade I would like to make the following submission. I wish to note the following points;

- Wollombi Brigade has not been approached or invited to provide input into the study or plan, and as such, has made no submissions to the formulation of the plan. Despite this, several references exist throughout the plan involving the Brigade in a response capacity.
- Due to the short timeframe for receipt of submissions, the Brigade has not been able to discuss a submission at length. This submission is provided by myself with the general agreement of the Brigade without the Brigades final approval. Similarly, other Brigades in the area have not been consulted.

As stated in the study/plan, floods may occur in the Wollombi Valley with minimal warning. Road access may be lost quickly and not be regained for extended periods. Communication networks throughout the valley are limited and fragile.

The combat agency for floods in the valley is the State Emergency Service. The ability of the SES to respond to flood emergencies in the valley is limited because of the preceding reasons. Responsibility may be delegated to the RFS, but again, the ability to respond in major floods is limited due to distance from the Fire Station and lack of access, lack of communications, safety issues of members working alone or without relevant qualifications and members working without access to equipment.

The role of the RFS in major flood events in the Wollombi Valley would most likely be confined to salvage and overhaul of flood affected properties. Normal emergency response is not an option, and if it were, RFS personnel do not have the Flood specific training necessary for many of the expected tasks, that is swift water rescue, evacuation by boat and similar operations.

Emergency response in the plan is mainly left to Helicopter rescue of Flood affected persons, however I feel it should be noted that this option is highly limited by weather conditions and availability. Flood events in Wollombi would normally be accompanied by similar events elsewhere in the Hunter and it would be unreasonable to expect exclusive use of such resources.



### Recommendations for action

- Community awareness of floods and their effects in the valley appears to be low. Community education is vital. A program designed to cater for residents and the high level of visitor population would likely have large effect.
- A better system for early warning of major flooding is necessary. Community education would hopefully fulfil the need for the community to assess their own situations and make informed decisions. A system providing timely advice to back up personal judgement would provide a highly prepared and resilient community. I would envisage additional BOM stream gauges on the north and south arms of the Wollombi Brook enabling the SES and BOM to provide early assessment and warnings.
- Flood markers at strategic points showing past flood levels to aid community knowledge of past events and likelihood of future floods.
- Basic flood operations training to be provided to Valley RFS brigades by the SES
- More detailed warning signs at major bridges and crossings. Lack of risk awareness when driving through flood waters is very high.
- SES to carry out pre-incident planning to identify at risk properties and residents. A response plan based around this plan to be developed by SES in conjunction with the RFS.
- Maintaining communications during major flood events is critical. After discussions following the 2007 flood, the best apparent option would seem to be the upgrade of backup power (minimum 48 hours supply) supplies at valley exchanges or the facility for the SES/RFS to supply external power.
- I would personally like to urge Council to consider the extreme potential for unmitigated flooding in the Wollombi valley, which can most likely have no emergency response, when considering the flood level for planning purposes. I would be disturbed to see an already poor situation made worse through an ill-advised planning decision.

Yours Sincerely,

Captain, Wollombi Volunteer Bushfire Brigade.

## APPENDIX D: FLOOR LEVEL SURVEY DATABASE

Details removed from public document for privacy reasons.





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