

Local Flood Plan



July 2017

To be reviewed no later than August 2022

ILLAWARRA FLOOD EMERGENCY SUB PLAN

A Sub-Plan of the Illawarra Local Emergency Management Plan (EMPLAN)

**Volume 1 of the Illawarra Local Flood Plan for Wollongong City,
Shellharbour City and Kiama Local Government Areas**



AUTHORISATION

The Illawarra Flood Emergency Sub Plan is a sub plan of the Illawarra Local Emergency Management Plan (EMPLAN). It has been prepared in accordance with the provisions of the **State Emergency Service Act 1989 (NSW)** and is authorised by the Local Emergency Management Committee in accordance with the provisions of the **State Emergency and Rescue Management Act 1989 (NSW)**.

Recommended



NSW SES Wollongong City Local Controller

Date: 2 August 2017

Recommended



NSW SES Kiama Local Controller

Date: 3 August 2017

Recommended



NSW SES Shellharbour City Local Controller

Date: 3 August 2017

Approved



Chair, Local Emergency Management Committee

Date: 7/8/17.

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DISTRIBUTION LIST

This Local Flood Plan is distributed through the NSW State Emergency Service in electronic format and is maintained on the NSW SES FloodSafe (www.floodsafe.com.au) website.

VERSION HISTORY

The following table lists all previously endorsed versions of this plan.

Description	Date
Wollongong City Local Flood Plan	June 2010
Wollongong City Local Flood Plan	March 2004
Kiama/Shellharbour City Local Flood Plan	June 2008

AMENDMENT LIST

Suggestions for amendments to this plan should be forwarded to:

NSW SES Illawarra South Coast Region
 Deputy Region Controller
 PO BOX 1460
 Wollongong, NSW, 2500

Amendments promulgated in the amendments list below have been entered in this plan.

Amendment Number	Description	Updated by	Date

Document Issue: 07072015

LIST OF ABBREVIATIONS

The following abbreviations have been used in this plan:

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AIIMS	Australasian Inter-service Incident Management System
ARI	Average Recurrence Interval (Years)
ALERT	Automated Local Evaluation in Real Time
AWRC	Australian Water Resources Council
BUREAU	Australian Government Bureau of Meteorology
CBRN	Chemical, Biological, Radiation or Nuclear
DCF	Dam Crest Flood
DSC	Dams Safety Committee
DSEP	Dam Safety Emergency Plan
DVR	Disaster Victim Registration
EMPLAN	Emergency Management Plan
FRNSW	Fire and Rescue NSW
GIS	Geographic Information System
GRN	Government Radio Network
IAP	Incident Action Plan
IC	Incident Controller
IFF	Imminent Failure Flood
LEMC	Local Emergency Management Committee
LEOCON	Local Emergency Operations Controller
LO	Liaison Officer
LGA	Local Government Area
MHL	Manly Hydraulics Laboratory

NOW	NSW Office of Water
NSW RFS	New South Wales Rural Fire Service
NSW SES	NSW State Emergency Service
NSW VRA	Volunteer Rescue Association
OEH	Office of Environment and Heritage (previously DECCW)
PMF	Probable Maximum Flood
PMR	Private Mobile Radio
PMP	Probable Maximum Precipitation
PIIC	Public Information and Inquiry Centre
REMC	Region Emergency Management Committee
REMO	Regional Emergency Management Officer
RMS	Roads and Maritime Services
RFS	Rural Fire Service
SEOCON	State Emergency Operations Controller
SERCON	State Emergency Recovery Controller
SEWS	Standard Emergency Warning Signal
SITREPs	Situation Reports
WICEN	Wireless Institute Civil Emergency Network

GLOSSARY

Annual Exceedance Probability (AEP). The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood level (height) has an AEP of 5%, there is a 5% chance (that is, a one-in-20 chance) of such a level or higher occurring in any one year (see also Average Recurrence Interval).

Assistance Animal. A guide dog, a hearing assistance dog or any other animal trained to assist a person to alleviate the effect of a disability (Refer to Section 9 of the Disability Discrimination Act 1992).

Assembly Area. An assembly area is a designated location used for the assembly of emergency-affected persons before they move to temporary accommodation or a nominated evacuation centre. As such these areas do not provide welfare assistance nor are they used for long term sheltering or provision of meals. An assembly area may also be a prearranged, strategically placed area, where support response personnel, vehicles and other equipment can be held in readiness for use during an emergency.

Australian Height Datum (AHD). A common national surface level datum approximately corresponding to mean sea level.

Average Recurrence Interval (ARI). The long-term **average** number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods reaching a height as great as, or greater than, the 20 year ARI flood event will occur **on average** once every 20 years.

Catchment (River Basin). The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.

Coastal Erosion. The loss of land along the shoreline predominantly by the offshore movement of sand during storms.

Coastal Flooding. Flooding due to tidal or storm-driven coastal events, including storm surges in lower coastal waterways. This can be exacerbated by wind-wave generation from storm events (1).

Combat Agency. The agency, service, organisation or authority with the legislative responsibility for control of the incident.

Dambreak Study. A Dambreak Study is undertaken to determine the likely downstream inundation areas in case of a dam failure. Modelling is undertaken for a range of

dam breach possibilities and design floods. The dambreak study includes information such as the extent of flooding, flood travel times and flood water velocities. The study can assist dam owners, regulators, and emergency agencies in the preparations of evacuation plans, dam break and other flood warning systems, and hazard classification of affected areas.

Dam Failure. The uncontrolled release of a water storage. The failure may consist of the collapse of the dam or some part of it, or excessive seepage or discharges. The most likely causes of dam failure are;

- **Flood Induced Dam Failure:** Dam failure caused by flood, either due to overtopping erosion or by subsequent structural failure.
- **Sunny Day Dam Failure:** Dam Failure as a result of factors other than flood i.e. other than flood flow into the reservoir. Causes of "Sunny Day" dam failure can include internal erosion, landslide, piping, earthquake or sabotage.

Dam Safety Emergency Plan (DSEP). A DSEP outlines the required actions of owners and their personnel at dams in response to a range of possible emergency situations. The NSW Dam Safety Committee requires a quality controlled DSEP, with associated dambreak warning procedures to be prepared for prescribed dams where persons may be at risk downstream, if the dam failed.

Design Flood (or Flood Standard). A flood of specified magnitude that is adopted for planning purposes. Selections should be based on an understanding of flood behaviour and the associated flood risk, and take account of social, economic and environmental considerations. There may be several design floods for an individual area.

Emergency Alert. The national telephone warning system used by emergency services to send voice messages to landlines and text messages to mobile phones within a defined area, about likely or actual emergencies.

EMPLAN (Emergency Management Plan). The Plan established in accordance with the provisions in the *State Emergency Rescue Management Act 1989*. The object of an EMPLAN is to ensure the coordinated response by all agencies having responsibilities and functions in emergencies.

Essential Services. Those services, often provided by local government authorities, that are considered essential to the life of organised communities. Such services include power, lighting, water, gas, sewerage and sanitation clearance.

Evacuation. The temporary movement of people from a dangerous or potentially dangerous place to a safe location, and their eventual return. It is a safety strategy which uses distance to separate people from the danger created by the hazard.

Evacuation Order. Notification to the community, authorised by the NSW SES, when the intent of an Incident Controller is to instruct a community to immediately evacuate in response to an imminent threat.

Evacuation Warning. Notification to the community, authorised by the NSW SES, when the intent of an Incident Controller is to warn a community of the need to prepare for a possible evacuation.

Flash Flooding. Flooding which is sudden and often unexpected because it is caused by sudden local or nearby heavy rainfall. It is sometimes defined as flooding which occurs within six hours of the rain that causes it.

Flood. Relatively high water level which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences, including Tsunami.

Flood Classifications. Locally defined flood levels used in flood warnings to give an indication of the severity of flooding (minor, moderate or major) expected. These levels are used by the State Emergency Service and the Australian Government Bureau of Meteorology in flood bulletins and flood warnings.

Flood Intelligence. The product of collecting, collating, analysing and interpreting flood-related data to produce meaningful information (intelligence) to allow for the timely preparation, planning and warning for and response to a flood.

Flood Fringe. The remaining area of flood prone land after floodway and flood storage have been defined.

Flood Liable Land (also referred to as Flood Prone Land). Land susceptible to flooding by the Probable Maximum Flood (PMF) event. This term also describes the maximum extent of a **floodplain** which is an area of a river valley, adjacent to the river channel, which is subject to inundation in floods up to this event.

Flood of Record. Maximum observed historical flood.

Floodplain. Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land (2).

Floodplain Management Plan. A plan developed in accordance with the principles and guidelines in the New South Wales Floodplain Development Manual. Such a plan usually includes both written and diagrammatic information describing how particular areas of flood prone land can be used and managed to achieve defined objectives.

Flood Plan. A response strategy plan that deals specifically with flooding and is a sub-plan of an Emergency Management Plan. Flood plans describe agreed roles, responsibilities, functions, strategies and management arrangements for the conduct of flood operations and for preparing for them. A flood plan contains information and arrangements for all floods whereas an IAP is for a specific flood/event.

Flood Rescue. The rescue or retrieval of persons trapped by floodwaters.

Flood Storage Areas. Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.

Floodway. An area where a significant volume of water flows during floods. Such areas are often aligned with obvious naturally-defined channels and are areas that, if partially blocked, would cause a significant redistribution of flood flow which may in turn adversely affect other areas. They are often, but not necessarily, the areas of deeper flow or the areas where higher velocities occur.

Flood Watch. A Flood Watch is a notification of the potential for a flood to occur as a result of a developing weather situation and consists of short generalised statements about the developing weather including forecast rainfall totals, description of catchment conditions and indicates streams at risk. The Bureau will also attempt to estimate the magnitude of likely flooding in terms of the adopted flood classifications. Flood Watches are normally issued 24 to 36 hours in advance of likely flooding. Flood watches are issued on a catchment wide basis.

Flood Warning. A Flood Warning is a gauge specific forecast of actual or imminent flooding. Flood Warnings specify the river valley, the locations expected to be flooded, the likely severity of flooding and when it will occur.

Functional Area. A category of services involved in the preparations for an emergency, including the following:

- Agriculture and Animal Services;
- Energy and Utility Services;
- Engineering Services;
- Environmental Services;
- Health Services;
- Public Information Services;
- Telecommunication Services;

- Transport Services; and
- Welfare Services.

Geographic Information System (GIS). A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analysing, and displaying all forms of geographically referenced information.

Incident Controller. The individual responsible for the management of all incident control activities across a whole incident (3).

Incident Action Plan (IAP). An action plan for managing a specific event. Information from the Local Flood Plan is used to develop the flood IAP.

Indirect Effect. Indirect effects are generally a consequence of infrastructure damage or interruption of services and can affect communities distant from the actual flood footprint i.e. floodplain. Indirect effects can also refer to indirect losses due to disruption of economic activity, both in areas which are inundated or isolated. Indirect effects are one of the three primary sources of risk in the context of flooding (the other two are inundation and isolation).

Inundation. See definition for Flood.

Isolation. Properties and/or communities where flooding cuts access to essential services or means of supply. Isolation is one of the three primary sources of risk in the context of flooding (the other two are inundation and indirect effects).

Liaison Officer (LO). A person, nominated or appointed by an organisation or functional area, to represent that organisation or functional area at a control centre, emergency operations centre, or coordination centre. A liaison officer maintains communications with and conveys directions/requests to their organisation or functional area, and provides advice on the status, capabilities, actions and requirements of their organisation or functional area (3).

Local Controller. A NSW SES chain of command position with responsibility for day-to-day management and operational preparedness of Units within a Local Government Area.

Local Emergency Management Committee (LEMC). The LEMC is responsible for the preparation of plans in relation to the prevention of, preparation for, response to and recovery from emergencies in the local government area for which it is constituted. In the exercise of its functions, the Committee is responsible to the Region Emergency Management Committee (REMC) and may communicate with the REMC for matters associated with Functional Areas that are not represented at the local Level.

Local Overland Flooding. Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.

Major Flooding. Flooding which causes inundation of extensive rural areas, with properties, villages and towns isolated and/or appreciable urban areas flooded.

Minor Flooding. Flooding which causes inconvenience such as closing of minor roads and the submergence of low-level bridges. The lower limit of this class of flooding, on the reference gauge, is the initial flood level at which landholders and/or townspeople begin to be affected in a significant manner that necessitates the issuing of a public flood warning by the Australian Government Bureau of Meteorology.

Moderate Flooding. Flooding which inundates low-lying areas, requiring removal of stock and/or evacuation of some houses. Main traffic routes may be covered.

Moveable Dwellings. Any tent, or any caravan or other van or other portable device (whether on wheels or not), used for human habitation; or a manufactured home; or any conveyance, structure or thing of a class or description prescribed by the (Local Government) regulations (4).

Operations Commander. An operational management role that provides strategic advice and support to the Incident Controller when required. This position sits higher within the command structure.

Peak Height. The highest level reached, at a nominated gauging station, during a particular flood event.

Prescribed Dam. "Prescribed" dams are those listed in Schedule 1 of the Dams Safety Act 1978. The NSW Dam Safety Committee will prescribe those dams with the potential for a failure which could have a significant adverse effect on community interests.

Probable Maximum Flood (PMF). The largest flood that could conceivably be expected to occur at a particular location, usually estimated from probable maximum precipitation. The PMF defines the maximum extent of flood prone land, that is, the floodplain. It is difficult to define a meaningful Annual Exceedance Probability for the PMF, but it is commonly assumed to be of the order of 10^4 to 10^7 (once in 10,000 to 10,000,000 years).

Region Controller. A NSW SES chain of command position with responsibility for day-to-day management and operational capability of members and Units within a designated Region boundary.

Riverine Flooding. Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam. Riverine flooding

generally excludes watercourses constructed with pipes or artificial channels considered as stormwater channels (1).

Runoff. The amount of rainfall which ends up as stream flow, also known as ‘rainfall excess’ since it is the amount remaining after accounting for other processes such as evaporation and infiltration.

Stage Height. A level reached, at a nominated gauging station, during the development of a particular flood event.

Storm Surge. The increases in coastal water levels above predicted astronomical tide levels (i.e. tidal anomaly) resulting from a range of location dependant factors including the inverted barometer effect, wind and wave set-up and astronomical tidal waves, together with any other factors that increase tidal water level (1).

Stream Gauging Station. A place on a river or stream at which the stage height is routinely measured, either daily or continuously, and where the discharge is measured from time to time so as to develop a relationship between stage and discharge or rating curve.

Total Flood Warning System. A flood warning system is made up of components which must be integrated if the system is to operate effectively. Components of the total flood warning system include monitoring rainfall and river flows, prediction, interpretation of the likely impacts, construction and dissemination of warning messages, response by agencies and community members, and review of the warning system after flood events (6).

PART 1 - INTRODUCTION

1.1 PURPOSE

- 1.1.1 This plan covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures from flooding within the Wollongong City, Shellharbour City and Kiama LGAs. It covers operations for all levels of flooding within the Illawarra area.
- 1.1.2 The plan also covers arrangements for the management of coastal erosion in the Illawarra area.

1.2 AUTHORITY

- 1.2.1 This plan is issued under the authority of the *State Emergency and Rescue Management Act 1989* (NSW) and the *State Emergency Service Act 1989* (NSW). It has been approved by the NSW SES Wollongong City, Shellharbour City and Kiama Local Controllers and the NSW SES Illawarra South Coast Region Controller as a NSW SES plan and endorsed by the Illawarra Local Emergency Management Committee as a sub plan of the Local EMPLAN.

1.3 AREA COVERED BY THE PLAN

- 1.3.1 The area covered by the plan is the Wollongong City, Shellharbour City and Kiama LGAs.
- 1.3.2 The Wollongong City LGA includes a number of urban and suburban areas from Helensburgh to the north to Yallah and Windang in the south. The south LGA surrounds Lake Illawarra and contains many creek systems.
- 1.3.3 The Shellharbour City LGA is bounded to the north by Lake Illawarra and the Minnamurra River to the south.
- 1.3.4 The Kiama LGA is bounded to the north by the Minnamurra River and by Foxground and Gerroa to the south.
- 1.3.5 The LGAs and their principal rivers and creeks are shown in Attachments 3, 4 and 5.
- 1.3.6 The three LGAs are in the NSW SES Illawarra South Coast Region and for emergency management purposes are part of the Illawarra South Coast Emergency Management Region.

1.4 DESCRIPTION OF FLOODING AND ITS EFFECTS

- 1.4.1 The NSW SES maintains information on the nature of flooding and effects of flooding on the community in the Wollongong City, Kiama and Shellharbour City LGAs. This information can be found in the Wollongong City, Shellharbour City and Kiama Local Flood Plan Volume 2 – Hazard and Risk documents.

1.5 RESPONSIBILITIES

1.5.1 The general responsibilities of emergency service organisations and supporting services (functional areas) are listed in the Local and State Emergency Management Plans (EMPLAN). Some specific responsibilities are expanded upon in the following paragraphs. The extent of their implementation will depend on the severity of the flooding. Specific responsibilities of agencies and organisations as they relate to tsunami are detailed in the State Tsunami Emergency Sub Plan.

1.5.2 **NSW SES Wollongong City, Shellharbour City and Kiama Local Controllers.** The NSW SES Wollongong City, Shellharbour City and Kiama Local Controllers are responsible for managing floods as detailed in the State Flood Plan, and will;

Preparedness

- a. Maintain a Local Headquarters at:
 - i. Wollongong City Unit: Montague Street, North Wollongong
 - ii. Coniston Unit: Corner Masters and Drummond Roads, Coniston
 - iii. Shellharbour City Unit: 127 Tongarra Road, Albion Park
 - iv. Kiama Unit: 205 Terralong Road, Kiama
- b. Ensure that NSW SES members are trained to undertake operations in accordance with current policy as outlined in the NSW SES Controllers' Guide and the NSW SES Incident Management Framework.
- c. Coordinate the development and operation of a flood warning service for the community.
- d. Participate in floodplain and coastal risk management initiatives organised by Wollongong City Council, Shellharbour City Council or Kiama Municipal Council.
- e. Coordinate a community engagement and capacity building program regarding local flood issues and associated risks to assist communities in building resilience to floods.
- f. Identify and monitor people and/or communities at risk of flooding and coastal erosion.
- g. Ensure that the currency of this plan is maintained.

Response

- h. Exercise financial delegations relating to the use of emergency orders as laid down in the NSW SES Controller's Guide.

1.5.3 **NSW SES Incident Controller.**

- a. The NSW SES Incident Controller is responsible for managing floods as detailed in the State Flood Plan, and will;

Response

- b. The Incident Controller will;
 - i. Control flood and storm response operations. This includes;
 - Directing the activities of the NSW SES members operating within the Illawarra area.
 - Coordinating the activities of supporting agencies and organisations and ensuring that liaison is established with them.
 - Prepare an Incident Action Plan to provide information on incident objectives and strategies for the control of the flooding incident.
 - ii. Coordinate the provision of information services in relation to;
 - Flood heights and flood behaviour.
 - Coastal erosion / inundation.
 - Road conditions and closures.
 - Advice on methods of limiting property damage.
 - Confirmation of evacuation warnings and evacuation orders.
 - iii. Coordinate Flood Rescue operations.
 - iv. Coordinate the provision of the evacuation of people and/or communities.
 - v. Provide immediate welfare support for evacuated people.
 - vi. Coordinate the provision of emergency food and medical supplies to isolated people and/or communities.
 - vii. Coordinate operations to assist the community to protect property. This may include;
 - Arranging resources for sandbagging operations.
 - Lifting or moving household furniture.
 - Lifting or moving commercial stock and equipment.
 - viii. Where possible, arrange for support (for example, accommodation and meals) for emergency service organisation members and volunteers assisting them.
 - ix. Ensure that the managers of caravan/tourist parks are advised of flood warnings and the details of any evacuation order.
 - x. If NSW SES resources are available, assist with emergency fodder supply operations conducted by Agriculture and Animal Services.
 - xi. If NSW SES resources are available, assist the NSW Police Force, RMS and Council with road closure and traffic control operations.

- xii. Coordinate the collection of flood and coastal erosion / inundation information for development of intelligence.
- xiii. Submit Situation Reports to the NSW SES Illawarra South Coast Region Headquarters and agencies assisting within the Illawarra area. These should contain information on;
 - Significant incidents
 - Impact on critical infrastructure
 - Road conditions and closures
 - Current flood behaviour
 - Current operational activities
 - Likely future flood behaviour
 - Likely future operational activities
 - Probable resource needs
- xiv. Keep the Local Emergency Operations Controller advised of the flood situation and the operational response.
- xv. Issue the 'All Clear' when Evacuation Orders are lifted and people can return to their properties.

Recovery

- c. Ensure that appropriate After Action Reviews are held after floods.
- d. Where possible, encourage the inclusion of a Recovery Officer in the Incident Management Team to support the transition from Response to Recovery during an incident.
- e. Provide appropriate representation to the Recovery Committee as agreed during the Recovery phase.
- f.

1.5.4 **NSW SES Wollongong, Coniston, Kiama and Shellharbour City Unit Members**

- a. Carry out flood and coastal erosion response tasks. These may include;
 - i. The management of the NSW SES Wollongong City, Coniston, Kiama and Shellharbour City Local and Unit Headquarters facilities and Operations Centres.
 - ii. Assist in the collection of flood and coastal erosion/inundation information for the development of intelligence.
 - iii. Flood Rescue.
 - iv. Evacuation of at-risk or affected communities.
 - v. Providing immediate welfare for evacuated people.
 - vi. Delivery of warnings and information.
 - vii. Resupply.
 - viii. Sandbagging.

- ix. Lifting and/or moving household furniture and commercial stock.
 - x. Animal rescue.
 - xi. Assisting with road closure and traffic control operations.
 - xii. Assisting with emergency fodder supply operations.
 - b. Assist with preparedness activities.
 - c. Undertake training in flood and storm response operations.
- 1.5.5 Illawarra Local Emergency Operations Controller (LEOCON)**
- a. Monitor flood operations.
 - b. Coordinate support to the NSW SES Incident Controller if requested to do so.
- 1.5.6 Illawarra Local Emergency Management Officer**
- a. Provide executive support to the LEMC and LEOCON in accordance with the Illawarra Local Emergency Management Plan.
 - b. At the request of the NSW SES Wollongong City, Kiama or Shellharbour City Local Controller, advise appropriate agencies and officers of the start of response operations.
- 1.5.7 Wollongong City Council, Kiama Municipal Council and Shellharbour City Council**
- Preparedness**
- a. Develop and implement floodplain risk management plans in accordance with the NSW Government's Flood Prone Land Policy and the Floodplain Development Manual.
 - b. Establish and maintain floodplain and coastal risk management committees and ensure that key agencies are represented on such committees.
 - c. Provide flood studies, floodplain management studies and coastal management studies to the NSW SES.
 - d. Wollongong City Council to maintain Dam Safety Emergency Plans for the Barina Park Detention Basin, Brokers Road Retarding Basin, Dapto Heights Retarding Basin, Edgewood Detention Basin, Foothills Road Basin, Foothills Estate Retarding Basin 3, Gannet Place Retarding Basin, Gunyah Park Retarding Basin, Nyrang Park Retention Basin, Wollongong High School Detention Basin, and the Foothills Estate Retarding Basin 1 and provide copies to the NSW SES.
 - e. Kiama Municipal Council to maintain Dam Safety Emergency Plans for Fountaindale Dam and provide copies to the NSW SES.
 - f. Shellharbour City to maintain Dam Safety Emergency Plans for Blackbutt Reserve, Green Meadows Retarding Basin, Shellcove Estate Detention

Basin 1, Shellharbour City Centre Basin and St Josephs School Retarding Basin and provide copies to the NSW SES.

- g. Provide information on the consequences of dam failure to the NSW SES for incorporation into planning and flood intelligence.
- h. Maintain a plant and equipment resource list for the LGA.
- i. Work with NSW SES on the development and implementation of a community engagement and capacity building program.

Response

- j. At the request of the NSW SES Incident Controller, deploy personnel and resources for flood and coastal erosion related activities.
- k. Close and reopen council roads (and other roads nominated by agreement with the RMS) and advise the NSW SES Incident Controller and the Police.
- l. Provide information on the status of roads.
- m. Provide filled sandbags to urban and village areas in which flooding is expected.
- n. Assist with the removal of caravans from caravan parks.
- o. Provide back-up radio communications.
- p. In the event of evacuations, assist with making facilities available for the domestic pets and companion animals of evacuees.
- q. During periods of coastal erosion and/or inundation from ocean storms:
 - i. Assist the NSW SES with reconnaissance of coastal erosion and inundation risk areas.
 - ii. Liaise with the NSW SES Incident Controller to provide advice regarding the need for response actions by the NSW SES such as evacuations.
 - iii. Activate the Wollongong City Council, Kiama Municipal Council and Shellharbour City Council Coastal Zone Management Plan – Emergency Action Plan.

Recovery

- r. Provide for the management of health hazards associated with flooding. This includes removing debris and waste.
- s. Ensure premises are fit and safe for reoccupation and assess any need for demolition.
- t. Arrange for storage of evacuees' furniture as required.

1.5.8 Community Members

Preparedness

- a. Understanding the potential risk and impact of flooding;

- b. Preparing homes and property to reduce the impact of flooding;
- c. Understanding warnings and other triggers for action and the safest actions to take in a flood;
- d. Households, institutions and businesses developing plans to manage flood risks, sharing and practicing this with family, friends, employees and neighbours;
- e. Having an emergency kit;
- f. Being involved in local emergency planning processes.

1.5.9 **Agriculture and Animal Services Functional Area**

- a. When requested by NSW SES;
 - i. Activate the Agriculture and Animal Services Supporting Plan as required and coordinate the provision of required services which may include;
 - Co-ordinate response for all animals including pets, livestock and wildlife.
 - Supply and delivery of emergency fodder.
 - Emergency water replacement in certain circumstances.
 - Coordinate the management of livestock and farm animals.
 - Advice on dealing with dead and injured farm animals.
 - Financial, welfare and damage assessment assistance to flood affected farmers.
 - Co-ordinate the establishment of animal shelter compound facilities for the domestic pets and companion animals of evacuees.

1.5.10 **Australian Government Bureau of Meteorology (The Bureau)**

- a. Provide Flood Watches for the affected River Basins and catchment areas.
- b. Provide Flood Warnings, incorporating height-time predictions, for gauges in the Illawarra area.
- c. Provide Severe Weather Warnings when large waves and/or storm surge conditions are forecast to result in coastal erosion/inundation.
- d. Provide Severe Weather Warnings when flash flooding and/or damaging surf is likely to occur.

1.5.11 **Caravan Park Proprietor(s)**

- a. Prepare a flood emergency plan for the Caravan Park.
- b. Ensure that owners and occupiers of movable dwellings are aware that the caravan park is flood prone by;

- i. Providing a written notice to occupiers taking up residence. The notice will indicate that the caravan park is at risk of flooding and designate the location of flood liable land within the park.
 - ii. Displaying this notice and the emergency arrangements for the Caravan Park prominently in the park.
- c. Ensure that owners and occupiers of movable dwellings are aware that if they are expecting to be absent for extended periods, they should:
 - i. Provide the manager of the caravan park with a contact address and telephone number in case of an emergency.
 - ii. Leave any movable dwelling in a condition allowing it to be relocated in an emergency (i.e. should ensure that the wheels, axles and draw bar of the caravans are not removed, and are maintained in proper working order) (7).
- d. Ensure that occupiers are informed of Flood Information. At this time, occupiers should be advised to;
 - i. Ensure that they have spare batteries for their radios.
 - ii. Listen to a local radio station for updated flood information.
 - iii. Prepare for evacuation and movable dwelling relocation.
- e. Ensure that owners and occupiers of caravans are aware of what they must do to facilitate evacuation and movable dwelling relocation when flooding occurs.
- f. Coordinate the evacuation of people and the relocation of movable dwellings when floods are rising and their return when flood waters have subsided. Movable dwellings will be relocated back to the caravan park(s) by owners or by vehicles and drivers arranged by the park managers.
- g. Secure any movable dwellings that are not able to be relocated to prevent floatation.
- h. Inform the NSW SES of the progress of evacuation and/or movable dwellings relocation operations and of any need for assistance in the conduct of these tasks.

1.5.12 **Child Care Centres and Preschools**

- a. Prepare a flood emergency plan for the childcare facility.
- b. Childcare facilities may be contacted by the NSW SES in the event of possible flooding or isolation.
- c. When notified the child care centres and preschools should;
 - i. Liaise with the NSW SES and arrange for the early release of children whose travel arrangements are likely to be disrupted by flooding and/or road closures.

- ii. Assist with coordinating the evacuation of preschools and child care centres.

1.5.13 **Energy and Utility Services Functional Area**

- a. When requested by NSW SES;
 - i. Implement the Energy and Utilities Services Functional Area Supporting Plan.
 - ii. Where required, coordinate energy and utility services emergency management planning, preparation, response and recovery, including the restoration of services following a flood event.
 - iii. Coordinate advice to the NSW SES of any need to disconnect electricity, gas, water or wastewater services.
 - iv. Assist the NSW SES to identify infrastructure at risk of flooding for incorporation into planning and intelligence.
 - v. Identify any secondary impacts of flooding on utility services and advise the NSW SES.
 - vi. Assist the NSW SES with advisory notices relating to hazards from utility services during flooding.
 - vii. Coordinate with utilities on restoration of services, including advisory notices relating to estimated time for restoration and mandatory safety checks prior to reconnection. Advise the NSW SES and the relevant recovery committee and coordinator of the timetable for restoration.
- b. Local utility service distribution providers (electricity, gas, water, waste water):
 - i. Provide advice to the NSW SES Incident Controller of any need to disconnect power/gas/water/waste water supplies or of any timetable for reconnection.
 - ii. Advise the NSW SES of any hazards from utility services during flooding and coastal erosion/inundation.
 - iii. Advise the public with regard to electrical hazards during flooding and coastal erosion/inundation, and to the availability or otherwise of the electricity supply.
 - iv. Clear or make safe any hazard caused by power lines or electricity distribution equipment.
 - v. Reconnect customers' electrical/ gas/ water/waste water installations, when certified safe to do so and as conditions allow.
 - vi. Assist the NSW SES to identify infrastructure at risk of flooding for incorporation into planning and intelligence.

1.5.14 **Engineering Services Functional Area**

- a. When requested by NSW SES;

- i. Provide engineering advice regarding the integrity of damaged structures.
- ii. Assist the NSW SES with damage assessment.
- iii. Acquire and/or provide specialist technical engineering expertise.
- iv. Assist the NSW SES and councils with the assessment and operation of flood protection levees when requested.
- v. Assist with property protection, including the construction or repair of levees.
- vi. Coordinate the restoration of critical public facilities.
- b. When requested by the Recovery Coordinator:
 - i. Establish Recovery Centres by the procurement and fit-out of suitable properties.

1.5.15 **Environmental Services Functional Area**

- a. When requested by NSW SES;
 - i. Implement the Environmental Services Functional Area (Enviroplan) Supporting Plan if required.

1.5.16 **Fire and Rescue NSW, Wollongong, Coledale, Scarborough, Helensburgh, Balgownie, Unanderra, Corrimal, Warrawong, Bulli, Dapto, Thirroul, Albion Park Rail, Kiama and Shellharbour**

- a. FRNSW responsibilities are primarily confined to the FRNSW Fire District. Any deployment of FRNSW resources to assist NSW SES in flood events rests with the respective FRNSW Commander which must be a Senior Officer.
- b. The FRNSW Commander will assess the capability of FRNSW to assist NSW SES in the following tasks:
 - i. Assist the NSW SES with the warning and/or evacuation of at risk communities.
 - ii. Assist the NSW SES with the monitoring / reconnaissance of flood prone areas.
 - iii. Assist the NSW SES with the resupply of isolated communities and/or properties.
 - iv. Assist the NSW SES with property protection tasks including sandbagging.
 - v. Provide suitably qualified members for flood rescue operations.
 - vi. Provide resources for pumping flood water out of buildings and from low-lying areas.
 - vii. Assist with clean-up operations, including the hosing out of flood affected properties.

- viii. Coordinate the pre-deployment of fire resources to communities within Fire and Rescue NSW fire districts if access is expected to be lost, in consultation with the NSW SES (e.g. West Dapto area).

1.5.17 **Forestry Corporation of NSW**

- a. Close and evacuate at risk camping grounds in State Forest managed areas and advise NSW SES of its status.
- b. Close and reopen Forestry Corporation of NSW roads when affected by flood waters and advise the NSW SES of its status.
- c. Facilitate the safe reliable access of emergency resources on Forestry Corporation managed roads.
- d. Assist the NSW SES with identification of road infrastructure at risk of flooding.
- e. Manage traffic on roads managed by Forestry Corporation of NSW.
- f. Assist the NSW SES with the communication of warnings and information provision to the public through variable message signs and other appropriate means.

1.5.18 **Health Services Functional Area**

- a. When requested by NSW SES;
 - i. Activate Healthplan if required.
 - ii. Ensure that appropriate business continuity plans are developed for essential health infrastructure and are activated during floods.
 - iii. Provide medical support to the NSW SES.
 - iv. Establish health surveillance in affected areas.
 - v. Assess potential public health risks that either acutely endanger the health of human populations or are thought to have longer term consequences.
 - vi. Provide environmental health advice.
 - vii. Provide public health warnings and advice to affected communities.
 - viii. Provide psychological counselling support to the community and emergency response workers impacted, via NSW Health Mental Health Division.
 - ix. Assist the NSW SES with the warning and evacuation of public hospitals, private hospitals and residential aged care facilities.
 - x. Undertake vulnerable persons assessment for mental health and drug and alcohol dependant persons, dialysis, frail and/or aged and oxygen dependant persons in the community, known to the health service.

1.5.19 **Marine Rescue NSW**

- a. Assist the NSW SES with the delivery of evacuation warnings and evacuation orders.

- b. Assist the NSW SES with the conduct of evacuations.
- 1.5.20 **New South Wales Ambulance**
 - a. Assist with the evacuation of at risk communities (in particular elderly and/or infirm people).
 - b. Deploy ambulance resources to appropriate locations if access is expected to be lost.
 - c. Assist the NSW SES with flood rescue operations.
- 1.5.21 **NSW Office of Water**
 - a. Collect and maintain flood data including data relating to flood heights, velocities and discharges.
 - b. Provide the Bureau of Meteorology and NSW SES real-time or near real-time access to river height gauges and height data for the development of official flood warnings.
 - c. Provide flow rating charts for river height gauges.
 - d. Manage (with technical support from OEH) the approval process under the Water Act 1912 and Water Management Act 2000 for flood control works (earthworks, embankments and levees which can affect the distribution of floodwaters) including;
 - i. Assessment and approval of flood control works (including flood mitigation works) in rural areas designated under the Acts.
 - ii. Use of floodplain management plans prepared by OEH in rural areas designated under the Acts to assess flood control work approvals.
 - iii. Giving the NSW SES access to relevant studies regarding flooding and studies supporting floodplain management plans prepared by OEH including flood studies, floodplain risk management studies and flood behaviour investigations.
- 1.5.22 **NSW Police Force (Lake Illawarra and Wollongong Local Area Commands (LAC))**
 - a. Assist the NSW SES with the delivery of evacuation warnings and evacuation orders.
 - b. Assist the NSW SES with the conduct of evacuation operations.
 - c. Conduct road and traffic control operations in conjunction with councils and/or RMS.
 - d. Coordinate the registration of evacuees.
 - e. Secure evacuated areas.
 - f. Assist the NSW SES with flood rescue operations.
- 1.5.23 **NSW Rural Fire Service (RFS Illawarra)**
 - a. Provide personnel in rural areas and villages to;

- i. Inform the NSW SES Incident Controller about flood conditions and response needs in their own communities, and
 - ii. Disseminate flood information.
- b. Provide personnel and high-clearance vehicles for flood related activities.
- c. Assist the NSW SES with the delivery of evacuation warnings and evacuation orders.
- d. Assist the NSW SES with the conduct of evacuations.
- e. Provide equipment for pumping flood water out of buildings and from low-lying areas.
- f. Assist with the removal of caravans.
- g. Assist with clean-up operations, including the hosing of flood affected properties.
- h. Deploy fire resources to appropriate locations if access is expected to be lost (e.g. West Dapto area).
- i. Provide personnel in the following rural communities and villages to inform the NSW SES about flood conditions and response needs and disseminate flood information:
 - i. Wongawilli;
 - ii. Darkes Forest.

1.5.24 **Office of Environment and Heritage**

- a. Assist the NSW SES gain access to relevant studies regarding flooding, including Flood Studies and Floodplain Risk Management Studies undertaken under the Floodplain Management Program.
- b. Assist the NSW SES in obtaining required outputs from Flood Studies and Floodplain Risk Management Studies under the Floodplain Management Program which assist the NSW SES in effective emergency response planning and incorporating information into the NSW Floods Database.
- c. Coordinate the collection of post event flood data, in consultation with the NSW SES.
- d. Provide specialist advice to the NSW SES on flood related matters on;
 - i. The identification of flood risks.
 - ii. Conditions which may lead to coastal flooding or retarded river drainage near the coast.
- e. Collect and maintain flood data relating to flood heights, velocities and discharges in coastal areas of NSW (through a contract with MHL as referenced in Section 3.8.4 (d)).
- f. Provide data to the Bureau of Meteorology and NSW SES real-time or near real-time access to river height gauges and height data for the

development of official flood warnings (through a contract with MHL as described in the Response section of this plan).

- g. Assist the NSW SES in the exercising of this Flood Plan.
- h. **Parks and Wildlife Service**
 - i. Close and reopen Parks and Wildlife Service roads when affected by flood waters and advise the NSW SES of its status.
 - ii. Facilitate the safe reliable access of emergency resources on National Parks and Wildlife Service managed roads.
 - iii. Assist the NSW SES with identification of road infrastructure at risk of flooding.
 - iv. Manage traffic on Parks and Wildlife Service roads.
 - v. Assist the NSW SES with the communication of warnings and information provision to the public through variable message signs and other appropriate means.
 - vi. Monitor the effects of prolonged or intense rainfall in the Illawarra Escarpment State Conservation Area with a view to closing public access to management trails and evacuating the Scout and Guide camps at Mt Keira.

1.5.25 **Owners of Prescribed Dams within or upstream of Wollongong City, Kiama and Shellharbour City LGAs**

Dam	Owner
Barina Park Detention Basin	Wollongong City Council
Blackbutt Reserve Dam	Shellharbour City Council
Brokers Road Retarding Basin	Wollongong City Council
Bucklands Retarding Basin	Matt Crossingham
Coalcliff	Illawarra Coke Company
Cordeaux Dam	NSW Water
Dapto Heights Retarding Basin	Wollongong City Council
Edgewood Detention Basin	Wollongong City Council
Foothills Estate Retarding Basin 1	Wollongong City Council
Foothills Estate Retarding Basin 3	Wollongong City Council
Foothills Road Retarding Basin	Wollongong City Council
Fountaindale Dam	Kiama Municipal Council
Gannet Place Retarding Basin	Wollongong City Council
Green Meadows Retarding Basin	Shellharbour City Council
Gunyah Park Retarding Basin	Wollongong City Council

Dam	Owner
Kanahooka Retention Basin	Forest Grove Community Association
Nyrang Park Retention Basin	Wollongong City Council
Oak Flats Reservoir	Sydney Water Corporation
Shellharbour City Centre Basin	Shellharbour City Council
Shellcove Estate Detention Basin 1	Shellharbour City Council
St Josephs School Retarding Basin	Shellharbour City Council
South Bulli Basin 1	Allied Coal Pty Ltd
South Bulli Stormwater Dam	Wollongong Coal Pty Ltd
Upper Cordeaux 2 Dam	NSW Water
Wollongong High School Retarding Basin	Wollongong City Council

- a. Maintain and operate the Dam Failure Warning System for their Dam(s).
- b. Contribute to the development and implementation of community engagement and capacity building programs on flooding.
- c. Consult with NSW SES on the determination of dam failure alert levels and notification arrangements when developing Dam Safety Emergency Plans.
- d. Maintain a Dam Safety Emergency Plan and provide copies to the NSW SES.
- e. Provide information on the consequences of dam failure to the NSW SES for incorporation into planning and flood intelligence.

1.5.26 Public Information Services Functional Area

- a. When requested by NSW SES;
 - i. Assist the NSW SES in the establishment and operation of a Joint Media Information Centre.
 - ii. Assist NSW SES in the release of public information during an actual or imminent emergency as requested.

1.5.27 Roads and Maritime Services

- a. Manage traffic on state roads, state highways and waterways affected by flood waters and advise the NSW SES of their status including the Princes Highway, Illawarra Highway and Tongarra Road.
- b. Facilitate the safe reliable access of emergency resources on RMS managed roads.
- c. Assist the NSW SES with identification of road infrastructure at risk of flooding.

- d. Assist in Traffic management associated with evacuations where necessary.
 - e. Enter state road closure information into the Live Traffic site.
 - f. Assist the NSW SES and councils with the communication of warnings and information provision to the public through variable message signs.
 - g. Cooperate with the Transport Services Functional Area Coordinator.
- 1.5.28 **School Administration Offices (including Catholic Education Office Diocese of Wollongong, Department of Education Wollongong and Private Schools)**
- a. Liaise with the NSW SES and arrange for the early release of students whose travel arrangements are likely to be disrupted by flooding and/or road closures (or where required, for students to be moved to a suitable location until normal school closing time).
 - b. Pass information to school bus drivers/companies and/or other schools on expected or actual impacts of flooding.
 - c. Assist with coordinating the evacuation of schools when flooding or isolation is expected to occur.
 - d. Provide space in schools for evacuation centres where necessary.
- 1.5.29 **Surf Life Saving NSW**
- a. Assist the NSW SES with the warning and/or evacuation of at risk communities;
 - b. Provide space in Surf Life Saving facilities for evacuation centres where required; and
 - c. Assist the NSW SES with flood rescue operations.
- 1.5.30 **Telecommunication Services Functional Area**
- a. When requested by NSW SES;
 - i. Coordinate the restoration of telephone facilities damaged by flooding.
 - ii. Assist the NSW SES to identify infrastructure at risk of flooding for incorporation into planning and intelligence.
- 1.5.31 **Illawarra Transport Services Functional Area Coordinator (TSFAC)**
- a. The TSFAC will assist NSW SES, emergency services and other functional areas through the provision of transport services, including;
 - i. The movement of emergency equipment and personnel.
 - ii. The movement of emergency supplies and goods, including water, fuel and food.
 - iii. The evacuation of people and animals.
 - iv. Assistance for medical transport.
 - v. Transportation of animals and infectious material/dangerous goods.

- vi. Maintaining and operating a transport route advisory service to the NSW SES, emergency services organisations and other Functional Areas and members of the community.
- vii. Coordinate the provision of traffic and transport operations as consistent with the roles of transport organisations.

1.5.32 **NSW Train Link and Sydney Trains**

- a. Operate NSW regional rail services through the Wollongong City, Kiama and Shellharbour City LGAs including the management of railway services affected by flood waters and advise the NSW SES.
- b. Assist the NSW SES with the movement or evacuation of people during flood response operations if required.
- c. Convey flood information and flood warnings to passengers and travellers on NSW and Sydney trains.
- d. Cooperate with, and assist the NSW SES Incident Controller in relation to public safety during flood emergencies.
- e. Cooperate with the Illawarra Transport Services Functional Area Coordinator.

1.5.33 **NSW Volunteer Rescue Association (VRA)**

- a. Assist the NSW SES with the delivery of evacuation warnings and evacuation orders.
- b. Assist the NSW SES with the conduct of evacuations.

1.5.34 **Welfare Services Functional Area**

- a. When requested by NSW SES;
 - i. Establish and manage evacuation centres, and provide disaster welfare services from recovery centres.
 - ii. Administer the Personal Hardship and Distress component of the NSW Disaster Relief Scheme established to provide financial assistance to people affected by emergencies.

PART 2 - PREPAREDNESS

2.1 MAINTENANCE OF THIS PLAN

- 2.1.1 The NSW SES Wollongong City, Shellharbour City and Kiama Local Controllers will maintain the currency of this plan by;
- a. Ensuring that all agencies, organisations and officers mentioned in it are aware of their roles and responsibilities.
 - b. Conducting exercises to test arrangements.
 - c. Reviewing the contents of the plan;
 - i. After each flood operation.
 - ii. When significant changes in land-use or community characteristics occur.
 - iii. When new information from flood studies becomes available.
 - iv. When flood control or mitigation works are implemented or altered.
 - v. When there are changes that alter agreed plan arrangements.
- 2.1.2 The plan is to be reviewed no less frequently than every five years.

2.2 FLOODPLAIN AND COASTAL RISK MANAGEMENT

- 2.2.1 The NSW SES Wollongong City, Shellharbour City and Kiama Local Controllers will ensure that;
- a. NSW SES participates in local floodplain and coastal risk management committee activities when those committees are formed, in accordance with the protocols outlined in the NSW SES Controllers' Guide.
 - b. The NSW SES Illawarra South Coast Region Headquarters is informed of involvement in floodplain and coastal risk management activities.

2.3 DEVELOPMENT OF FLOOD INTELLIGENCE

- 2.3.1 Flood intelligence describes flood behaviour and its effects on the community.
- 2.3.2 The NSW SES maintains a centralised flood intelligence system.

2.4 DEVELOPMENT OF WARNING SYSTEMS

- 2.4.1 The NSW SES establishes total flood warning systems for areas affected by flooding. This requires;
- a. An identification of the potential clients of flood warning information at different levels of flooding (i.e. who would be affected in floods of differing severities).

- b. Available information about the estimated impacts of flooding at different heights.
- c. Identification of required actions and the amounts of time needed to carry them out.
- d. Appropriate means of disseminating warnings to different clients and at different flood levels.

2.5 COMMUNITY RESILIENCE

- 2.5.1 The community needs to be as prepared as emergency agencies for the impact of all hazards (6), including flooding.
- 2.5.2 As the combat agency, NSW SES has the primary responsibility for the collation, assessment and public dissemination of information relating to flooding (3). To do this, NSW SES will require assistance from other agencies, particularly local government councils, dam owners, and the Bureau of Meteorology in the development and delivery of materials.
- 2.5.3 During flooding incidents, the NSW SES Incident Controller is responsible for the collation, assessment and public dissemination of information relating to flooding (3).
- 2.5.4 During times of preparedness, the NSW SES Wollongong City, Kiama and Shellharbour City Local Controllers are responsible for community engagement strategies to be employed with NSW communities that may include:
 - a. Community planning programs.
 - b. Dissemination of flood-related brochures and booklets in flood liable areas.
 - c. Dissemination of coastal erosion related brochures in coastal erosion liable areas.
 - d. Talks and displays orientated to at-risk groups, community organisations, businesses and schools.
 - e. Publicity given to this plan and to flood-orientated NSW SES activities through local media outlets, including articles in local newspapers about the flood threat and appropriate responses.

2.6 TRAINING

- 2.6.1 Throughout this document there are references to functions that must be carried out by the members of the NSW SES Wollongong City, Shellharbour City and Kiama Units. The NSW SES Wollongong City, Kiama and Shellharbour City Local Controllers are responsible for ensuring that the members are;
 - a. Familiar with the contents of this plan.

- b. Trained in the skills necessary to carry out the tasks the NSW SES is responsible for.

2.7 RESOURCES

- 2.7.1 The NSW SES Wollongong City, Shellharbour City and Kiama Local Controllers are responsible for maintaining the condition and state of readiness of NSW SES equipment and the NSW SES facilities in the Illawarra area.

PART 3 - RESPONSE

CONTROL

3.1 CONTROL ARRANGEMENTS

- 3.1.1 The NSW SES is the legislated Combat Agency for floods and is responsible for the control of flood operations. This includes the coordination of other agencies and organisations for flood management tasks.
- 3.1.2 The NSW SES is the designated Combat Agency for damage control for storms. This includes damage control for coastal erosion and inundation from storm activity, specifically the protection of life and the coordination of the protection of readily moveable household goods and commercial stock and equipment. The NSW SES is not responsible for planning or conduct of emergency beach protection works or other physical mitigation works.
- 3.1.3 The Local EMPLAN will operate to provide support as requested by the NSW SES Incident Controller.

3.2 OPERATIONAL MANAGEMENT

- 3.2.1 NSW SES utilises the Australasian Inter-service Incident Management System (AIIMS), which is based on five principles;
 - a. Flexibility;
 - b. Functional management;
 - c. Management by objectives;
 - d. Unity of Command; and
 - e. Span of Control.
- 3.2.2 AIIMS provides for different incident levels based on the complexity of management.
- 3.2.3 The Illawarra Area may be divided into sectors and divisions to manage the flood and/or coastal erosion event (divisions are usually a group of sectors).
- 3.2.4 Sectors and divisions may be based on floodplain classifications, local government area, geographical, physical or functional boundaries. A town, city or suburb may be one sector or split into several sectors and divisions.

3.3 START OF RESPONSE OPERATIONS

- 3.3.1 This plan is always active to ensure that preparedness actions detailed in this plan are completed.
- 3.3.2 Response operations will begin;

- a. On receipt of a Bureau of Meteorology issued, Flood Watch, Flood Warning, Severe Thunderstorm Warning or a Severe Weather Warning for flash flooding or severe ocean conditions.
 - b. On receipt of a dam failure alert.
 - c. When other evidence leads to an expectation of flooding or coastal erosion within the Illawarra area.
- 3.3.3 Contact with the Bureau of Meteorology to discuss the development of flood warnings will normally be through the NSW SES Illawarra South Coast Region Headquarters and/or NSW SES State Headquarters.
- 3.3.4 The following persons and organisations will be advised of the start of response operations regardless of the location and severity of the flooding anticipated:
 - a. NSW SES Illawarra South Coast Region Headquarters.
 - b. NSW SES Wollongong City, Shellharbour City and Kiama Local Controllers.
 - c. NSW SES Wollongong, Coniston, Kiama and Shellharbour City Unit members.
 - d. Illawarra Local Emergency Operations Controller (for transmission to the NSW Police Force Local Area Command Headquarters).
 - e. Illawarra Local Emergency Management Officer (for transmission to appropriate council officers and departments).
 - f. Wollongong City Council Mayor.
 - g. Kiama Municipal Council Mayor.
 - h. Shellharbour City Council Mayor.
 - i. Other agencies listed in this plan will be advised by the Local Emergency Management Officer on the request of the NSW SES Incident Controller and as appropriate to the location and nature of the threat.

3.4 RESPONSE STRATEGIES

- 3.4.1 The main response strategies for NSW SES flood operations will follow the strategic priorities of the NSW SES State Controller including;
 - a. Information Provision and Warning
 - i. Issue of timely Flood Warnings and safety advice to affected communities.
 - ii. Inform the community regarding the potential impacts of a flood and what actions to undertake in preparation for flooding.
 - iii. Inform the community regarding the potential impacts of coastal erosion and what preparatory actions to undertake.
 - iv. Issue of Evacuation Warnings and Orders if and when necessary.

- v. Provide timely and accurate preparedness information to the community.
 - b. Property protection
 - i. Assistance with the protection of critical infrastructure.
 - ii. Protect the property of residents and businesses at risk of flood damage.
 - iii. Assistance with property protection by way of sandbagging and the lifting or transporting of furniture, personal effects, commercial stock and caravans.
 - iv. Assistance with the relocation of readily moveable household goods and commercial stock and equipment from properties threatened by coastal erosion.
 - c. Evacuation
 - i. Evacuation is a risk management strategy that may be used to mitigate the effects of an emergency on a community. It involves the movement of people to a safer location and their return. For an evacuation to be effective it must be appropriately planned and implemented (8).
 - d. Flood Rescue
 - i. The rescue or safe retrieval of persons or domestic animals trapped by floodwaters.
 - e. Resupply
 - i. Minimise disruption upon the community by resupplying areas which have become isolated as a consequence of flooding.
 - ii. Ensure supplies are maintained to property owners by coordinating the resupply of properties which have become isolated as a consequence of flooding.
- 3.4.2 The NSW SES Incident Controller will select the appropriate response strategy to deal with the expected impact of the flood in each sector and/or community. The impact may vary so a number of different strategies may need to be selected and implemented across the whole operational area. The available strategies for each sector and/or community are maintained by the NSW SES.
- 3.4.3 Supporting agency strategies may include;
- a. Protect the community from incidents involving fire and hazardous materials.
 - b. Support evacuations through the establishment of Evacuation Centres and maintaining a register of evacuated persons.
 - c. Maintain the welfare of communities and individuals affected by the impact of a flood.

- d. Minimise disruption to the community by ensuring supply of essential energy and utility services.
- e. Ensure coordinated health services are available to and accessible by the flood affected communities.
- f. Maintain the welfare of animals affected by the impact of a flood.

3.5 OPERATIONS CENTRES

- 3.5.1 The NSW SES Wollongong City Operations Centre is located at Montague Street, North Wollongong.
- 3.5.2 The NSW SES Kiama Operations Centre is located at 205 Terralong Street, Kiama.
- 3.5.3 The NSW SES Shellharbour City Operations Centre is located at 127 Tongarra Road, Albion Park.
- 3.5.4 Supporting Emergency Operation Centres are located at;
 - a. The Wollongong City Emergency Operations Centre is located at Level 10, Wollongong City Council Administration Building, 41 Burelli Street, Wollongong.
 - b. The Illawarra Emergency Operations Centre is located at 37 Airport Road, Albion Park Rail.
 - c. The Kiama Emergency Operations Centre is located at 205 Terralong St, Kiama.
 - d. The Shellharbour City Emergency Operations Centre is located at 127 Tongarra Road, Albion Park.

3.6 LIAISON

- 3.6.1 Any agency with responsibilities identified in this plan may be requested by the NSW SES to provide liaison (including a liaison officer where necessary) to the relevant NSW SES Operations Centre, or designated Emergency Operations Centre.
- 3.6.2 In accordance with NSW EMPLAN, Liaison Officers will;
 - a. Maintain communication with and convey directions/requests to their organisation or functional area;
 - b. Provide advice on the status, resource availability, capabilities, actions and requirements of their organisation or functional area, and
 - c. Where appropriate, have the authority to deploy the resources of their parent organisation at the request of the NSW SES Incident Controller.

3.7 END OF RESPONSE OPERATIONS

- 3.7.1 Where an evacuation product has been issued, and the immediate danger to life and property has passed the NSW SES Incident Controller will issue an 'All Clear' message signifying that response operations have been completed. The message will be distributed through the same media outlets as earlier evacuation messages. The NSW SES Incident Controller will also advise details of recovery coordination arrangements, arrangements made for clean-up operations prior to evacuees being allowed to return to their homes, and stand-down instructions for agencies not required for recovery operations.

PLANNING

3.8 COLLATING SITUATIONAL INFORMATION

Strategy

- 3.8.1 The NSW SES maintains and records situational awareness of current impacts and response activities.

Actions

- 3.8.2 The NSW SES Wollongong City, Shellharbour City and Kiama Local Headquarters will collate information on the current situation in the Wollongong City, Shellharbour City and Kiama LGAs and incorporate in Situation Reports.
- 3.8.3 The NSW SES Illawarra South Coast Region Headquarters collates Region-wide information for inclusion in NSW SES Region Situation Reports.
- 3.8.4 Sources of situational information during times of flooding are;
- a. **Agency Situation Reports.** Agencies and functional areas provide regular situation reports (SITREPs) to the NSW SES.
 - b. **Active Reconnaissance.** The NSW SES Incident Controller is responsible for coordinating the reconnaissance of impact areas, recording and communicating observations. Reconnaissance can be performed on the ground and using remote sensing (more commonly aerial). The NSW SES monitors the following problem areas:
 - i. Lake Illawarra
 - ii. Identified Flash Flood Hotspots
 - iii. Rivers and Creeks
 - c. The **Bureau of Meteorology's Flood Warning Centre** provides river height and rainfall information, data is available on the website <http://www.bom.gov.au/nsw/flood/>.
 - d. **Manly Hydraulics Laboratory** automated river watch system funded by the Office of Environment and Heritage. This system provides river

height and rainfall readings for a number of gauges in the Wollongong City, Shellharbour City and Kiama LGAs. Recent data from this system is available on the Manly Hydraulic Laboratory website:

<http://www.mhl.nsw.gov.au>. A history of area floods is also available upon request via the website.

- e. **NSW Office of Water.** Daily river reports containing information on gauge heights and river flows are available from the website: <http://waterinfo.nsw.gov.au/>.
 - f. **NSW SES Illawarra South Coast Region Headquarters.** The Region Headquarters provides information on flooding and its consequences, including those in nearby LGAs (this information is documented in Bulletins and Situation Reports).
 - g. **Water NSW.** Provide the NSW SES real-time or near real-time access to river height gauges and height data.
 - h. **Wollongong City Council, Kiama Municipal Council and Shellharbour City Council.** Councils provide situational awareness information in the form of road closures, impact on critical infrastructure and debris removal.
- 3.8.5 During flood operations sources of information on roads closed by flooding include;
- a. Wollongong City Council, Kiama Municipal Council and Shellharbour City Council (website/Facebook page)
 - b. Lake Illawarra and Wollongong Police Local Area Command.
 - c. Roads and Maritime Services (website and/or telephone service).
 - d. NSW SES Illawarra South Coast Region Headquarters.
 - e. NSW SES Wollongong City, Shellharbour City and Kiama Local Headquarters.
- 3.8.6 Situational information relating to consequences of flooding and/or coastal erosion should be used to verify and validate NSW SES Flood Intelligence records.

3.9 PROVISION OF FLOOD INFORMATION AND WARNINGS

Strategy

- 3.9.1 The NSW SES Wollongong City, Shellharbour City and Kiama Local Headquarters provides advice to the NSW SES Illawarra South Coast Region Headquarters on current and expected impacts of flooding in the Wollongong City, Shellharbour City and Kiama LGAs.
- 3.9.2 The NSW SES Illawarra South Coast Region Headquarters issues NSW SES Flood Bulletins, NSW SES Livestock and Equipment Warnings, Evacuation Warnings, Evacuation Orders and 'All Clear' notifications to media outlets and agencies on behalf of all NSW SES Units in the Region.

Actions

- 3.9.3 The **NSW SES Incident Controller** will ensure that the NSW SES Operations Commander is regularly briefed on the progress of operations.
- 3.9.4 **NSW SES Wollongong City, Shellharbour City and Kiama Local Headquarters staff** will be briefed regularly by the Incident Controller so they can provide information in response to inquiries received in person or by other means such as phone or fax.
- 3.9.5 **Bureau of Meteorology Severe Thunderstorm Warning.** These are issued direct to the media by the Bureau when severe thunderstorms are expected to produce dangerous or damaging conditions, including flash flooding. Severe thunderstorms are usually smaller in scale than events covered by Flood Watches and Severe Weather Warnings.
- 3.9.6 **Bureau of Meteorology Severe Weather Warnings for Flash Flooding.** These are issued direct to the media by the Bureau and provide a warning of the possibility for flash flooding as a result of intense rainfall. These warnings are issued when severe weather is expected to affect land based communities with 6 to 24 hours. Severe Weather Warnings may also include other conditions such as Damaging Surf, Dangerous Surf or tides, or Damaging Winds.
- 3.9.7 **Bureau of Meteorology Flood Watches.** Flood Watches are issued by the Bureau to advise people of the potential for flooding in a catchment area based on predicted or actual rainfall. Flood Watches will be included in NSW SES Flood Bulletins issued by the NSW SES Illawarra South Coast Region Headquarters.
- 3.9.8 **Bureau of Meteorology Flood Warnings.** The NSW SES Illawarra South Coast Region Headquarters will send a copy of Bureau Flood Warnings to the NSW SES Wollongong City, Shellharbour City and Kiama Units. On receipt the NSW SES Incident Controller will provide the NSW SES Illawarra South Coast Region Headquarters with information on the estimated impacts of flooding at the predicted heights for inclusion in NSW SES Region Flood Bulletins.
- 3.9.9 **NSW SES Livestock and Equipment Warnings.** Following heavy rain or when there are indications of significant creek or river rises (even to levels below Minor Flood heights), the NSW SES Incident Controller will advise the NSW SES Illawarra South Coast Region Headquarters which will issue NSW SES Livestock and Equipment Warnings.
- 3.9.10 **NSW SES Local Flood Advices.** The NSW SES Incident Controller may issue Local Flood Advices for locations not covered by Bureau Flood Warnings. They may be provided verbally in response to phone inquiries but will normally be incorporated into NSW SES Region Flood Bulletins.
- 3.9.11 **NSW SES Flood Bulletins.** The NSW SES Illawarra South Coast Region Headquarters will regularly issue NSW SES Flood Bulletins which describe information on the estimated impacts of flooding at the predicted heights (using information from Bureau Flood Warnings and NSW SES Local Flood

Advices) to NSW SES units, media outlets and agencies on behalf of all NSW SES units in the Region. When operations relating to coastal erosion/inundation are being undertaken, NSW SES Region Bulletins will contain information and advice about property damage mitigation measures and evacuation in affected areas.

- 3.9.12 **NSW SES Evacuation Warnings and Evacuation Orders.** These are usually issued to the media by the NSW SES Operations Commander on behalf of the NSW SES Incident Controller.
- 3.9.13 **Dam Failure Alerts.** Dam failure alerts are issued to NSW SES by the dam owner, in accordance with arrangements in the Dam Safety Emergency Plan (DSEP), the system involves the Dam Owner notifying NSW SES State Operations Centre, who in turn distribute the warning to the NSW SES Region and Unit Headquarters.
- 3.9.14 A flow chart illustrating the notification arrangements for potential dam failure is shown in Attachment 2.
- 3.9.15 Dam failure alert levels are set in consultation with the NSW SES and are used to trigger appropriate response actions. The conditions that define each of the alert levels are listed in the relevant DSEP. Responses escalate as the alert level migrates from white to amber to red. Table 1 briefly outlines example defining conditions and appropriate NSW SES responses associated with each alert.

Alert Level	Example Defining Condition	NSW SES Response	NSW SES Warning Product
White	May be a structural anomaly. May be increased monitoring in response to a heavy rainfall event	Implements notification flowchart. Check operational readiness.	This is a preliminary alert to assist the NSW SES in its preparation. This is not a public alert.
Amber	Failure possible if storage level continues to rise or structural anomaly not fixed	Implements notification flowchart. Warn downstream population at risk to prepare to evacuate	NSW SES Evacuation Warning
Red	Failure imminent or occurred	Implements notification flowchart. Evacuation of downstream populations	NSW SES Evacuation Order

Table 1: Dam Failure Alert Levels

Note: Some DSEPs will have alert levels that proceed directly from White to Red. This is the case if adequate time does not exist between the three alert levels to evacuate the downstream population at risk. The decision to omit the Amber Alert level, and the general setting of Alert levels should be undertaken in consultation with the NSW SES.

- 3.9.16 The NSW SES / Dam Owner will disseminate warnings to the population at risk of dam failure (these arrangements are specific to each dam, are negotiated between the Dam Owner and NSW SES, and are documented in the DSEP).
- 3.9.17 Special arrangements apply in the case of severe flooding that may have the potential to cause the failure of Barina Park Detention Basin and Wollongong High School R. Basin. Details of these arrangements are maintained by the NSW SES.
- 3.9.18 **Standard Emergency Warning Signal (SEWS).** This signal may be played over radio and television stations to alert communities to Evacuation Warnings, Evacuation Orders, Special Warnings or Dam-Failure Warnings. Approval to use the signal is the responsibility of the NSW SES Incident Controller.
- 3.9.19 **The Public Information and Inquiry Centre (PIIC)** (operated by the NSW Police Force) will answer calls from the public regarding registered evacuees.
- 3.9.20 **The Disaster Welfare Assistance line** is a central support and contact point for disaster affected people inquiring about welfare services advice and assistance. This normally operates during business hours, but can be extended when required.
- 3.9.21 **The RMS Transport Information Line** will provide advice to callers on the status of roads. The RMS website also lists road closure information.
- 3.9.22 Wollongong City Council, Kiama Municipal Council and Shellharbour City Council will provide information on the status of local roads.
- 3.9.23 Collation and dissemination of road information is actioned as follows:
 - a. As part of Situation Reports, the NSW SES Incident Controller provides road status reports for main roads in the LGAs to the NSW SES Illawarra South Coast Region Headquarters.
 - b. The NSW SES Illawarra South Coast Region Headquarters distributes information on main roads to NSW SES units, media outlets and agencies as part of NSW SES Flood Bulletins.

OPERATIONS

3.10 AIRCRAFT MANAGEMENT

- 3.10.1 Aircraft can be used for a variety of purposes during flood operations including evacuation, rescue, resupply, reconnaissance and emergency travel.
- 3.10.2 Air support operations will be conducted under the control of the NSW SES Region Headquarters, which may allocate aircraft to Units if applicable.
- 3.10.3 NSW SES maintains the following information for the Wollongong City, Kiama and Shellharbour City LGAs;
 - a. Locations of suitable helicopter landing points.

- b. Locations of suitable airports and records detailing aircraft size and type that can land at airports.
- c. Intelligence on when access to these locations is expected to be lost.

3.11 ASSISTANCE FOR ANIMALS

- 3.11.1 Matters relating to the welfare of livestock, companion animals and wildlife are to be referred to Agriculture and Animal Services Functional Area.
- 3.11.2 Requests for emergency supply and/or delivery of fodder to stranded livestock, or for livestock rescue, are to be referred to Agriculture and Animal Services Functional Area.
- 3.11.3 Requests for animal rescue should be referred to the NSW SES.

3.12 COMMUNICATION SYSTEMS

- 3.12.1 The primary means of communications between fixed locations is by telephone and email.
- 3.12.2 The primary means of communication to and between deployed NSW SES resources is by GRN and through the Beacon operational management system.
- 3.12.3 All liaison officers will provide their own communication links back to their respective agencies.
- 3.12.4 All other organisations will provide communications as necessary to their deployed field teams.
- 3.12.5 Back-up communications are provided as follows:
 - a. Wollongong:
 - i. GSM/CDMA Mobile telephones
 - ii. Alternatively all NSW SES GRN radios have capability to operate on UHF.
 - b. Kiama:
 - i. Council VHF radio network.
 - c. Shellharbour City:
 - i. Portable repeater and specialist communications equipment
 - ii. Illawarra Emergency Service VHF Liaison Channel.
 - iii. Bush Fire Brigades VHF radio network.
 - iv. Council UHF radio network.

3.13 PRELIMINARY DEPLOYMENTS

- 3.13.1 When flooding is expected to be severe enough to cut road access to communities, the NSW SES Incident Controller will ensure that resources are in place for the distribution of consumable items and medical supplies to the areas that could become isolated.
- 3.13.2 When access between locations is expected to be cut, the NSW SES Incident Controller will advise appropriate agencies so that resources (including sandbags, fire fighting appliances, ambulances, etc.) are pre-deployed to ensure that operational capability is maintained.

3.14 ROAD AND TRAFFIC CONTROL

- 3.14.1 A number of roads within the Illawarra area are affected by flooding. NSW SES maintains details of these at-risk roads.
- 3.14.2 The Council closes and re-opens its own roads. It may also close and re-open any road managed by the RMS in its capacity as an agent of the RMS.
- 3.14.3 The NSW Police Force has the authority to close and re-open roads but will normally only do so (if the Council or the RMS have not already acted) if public safety requires such action.
- 3.14.4 When resources permit, the NSW SES may assist Council, RMS or the Police by erecting road closure signs and barriers.
- 3.14.5 In flood events, the NSW SES Incident Controller may direct the implementation of traffic control measures. The entry into flood affected areas will be controlled in accordance with the provisions of the State Emergency Service Act, 1989 (Part 5, Sections 19, 20, 21 and 22) and the State Emergency Rescue Management Act, 1989 (Part 4, Sections 60KA, 60L and 61).
- 3.14.6 Police, RMS or Council officers closing or re-opening roads or bridges affected by flooding are to advise the NSW SES Incident Controller, who will then provide a road information service to local emergency services, the public and the NSW SES Illawarra South Coast Region Headquarters. All such information will also be passed to the Police, RMS and the Council.

3.15 STRANDED TRAVELLERS

- 3.15.1 Flood waters can strand travellers. Travellers seeking assistance will be referred to the Welfare Services Functional Area for the arrangement of emergency accommodation and provisions.

3.16 MANAGING PROPERTY PROTECTION OPERATIONS

Strategy

- 3.16.1 Protect the property of residents and businesses at risk of flood damage.

Actions

- 3.16.2 The NSW SES is the responsible agency for the coordination of operations to protect property.
- 3.16.3 Property may be protected from floods by;
 - a. Lifting or moving of household furniture.
 - b. Lifting or moving commercial stock and equipment.
 - c. Sandbagging to minimise entry of water into buildings.
- 3.16.4 The NSW SES maintains stocks of sandbags and will provide advice to the community on strategic sandbag pick up locations if, and when they are required.
- 3.16.5 Property protection options are however very limited in the Wollongong City, Shellharbour City and Kiama LGAs due to the large number of properties that can be affected by flash flooding.
- 3.16.6 Property protection measures for the threat of coastal erosion involves the relocation of readily moveable household goods and commercial stock and equipment. The NSW SES is not responsible for planning or conduct of emergency beach protection works or other physical mitigation works.

3.17 MANAGING FLOOD RESCUE OPERATIONS

Strategy

- 3.17.1 Rescue of people and domestic animals from floods.

Actions

- 3.17.2 The NSW SES Incident Controller controls all flood rescue in Wollongong City, Shellharbour City and Kiama LGAs during a flood emergency.
- 3.17.3 Flood rescues, may be carried out by accredited Units in accordance with appropriate standards.
- 3.17.4 Additional flood boats and crews can be requested through the NSW SES Illawarra South Coast Region Headquarters.
- 3.17.5 There may be some residual population which did not evacuate during the early stages of flooding and which require rescue.

3.18 MANAGING EVACUATION OPERATIONS

Strategy

- 3.18.1 When there is a risk to public safety by floodwater, evacuation is the primary strategy. Circumstances may include;
 - a. Evacuation of people when their homes or businesses are likely to flood.
 - b. Evacuation of people who are unsuited to living in isolated circumstances, due to flood water closing access.

- c. Evacuation of people where essential energy and utility services are likely to fail, have failed or where buildings have been made uninhabitable.
- d. Evacuation of people when their homes or business are at threat of collapse from coastal erosion.

Actions

- 3.18.2 The evacuation operation will have the following stages:
- a. Decision to evacuate.
 - b. Mobilisation (mobilisation may begin prior to the decision to evacuate).
 - c. Evacuation Warning delivery.
 - d. Evacuation Order delivery.
 - e. Withdrawal.
 - f. Shelter.
 - g. Return.
- 3.18.3 During floods evacuations will be controlled by the NSW SES Incident Controller.

Decision to evacuate

- 3.18.4 The decision to evacuate rests with the NSW SES Incident Controller who exercises their authority in accordance with Section 22(1) of The State Emergency Service Act 1989. However, the decision to evacuate will usually be made after consultation with the NSW SES Operations Commander and the Local Emergency Operations Controller.
- 3.18.5 Some people will make their own decision to evacuate earlier and move to alternate accommodation, using their own transport. This is referred to as self-managed evacuation (9).

Mobilisation

- 3.18.6 The NSW SES Incident Controller will request the following personnel for doorknock teams for designated Sectors/locations:
- a. NSW SES Wollongong City, Shellharbour City and Kiama Unit members.
 - b. RFS Illawarra members via the RFS Fire Control Officer.
 - c. Local Police Force officers via the local area command.
- 3.18.7 The NSW SES Operations Commander will assist with any additional personnel required to assist with doorknock teams using;
- a. NSW SES members from other NSW SES Regions.
 - b. FRNSW personnel arranged via the FRNSW Liaison Officer.
 - c. RFS personnel arranged via the RFS Liaison Officer.

- 3.18.8 The NSW SES Incident Controller may request the Chairperson of the LEMC to provide Council personnel to assist with traffic coordination within Sector(s)/Community.
- 3.18.9 The NSW SES Incident Controller will arrange liaison officers for Sector Command Centres.
- 3.18.10 The NSW SES Incident Controller may request support for the transport of evacuees within Sectors via the Transport Services Functional Area.

Delivery of Evacuation Warnings and Evacuation Orders

- 3.18.11 The NSW SES will advise the community of the requirements to evacuate. The NSW SES will issue an **Evacuation Warning** when the intent of an NSW SES Incident Controller is to warn the community of the need to prepare for a possible evacuation.
- 3.18.12 The NSW SES will issue an **Evacuation Order** when the intent of the NSW SES Incident Controller is to instruct a community to immediately evacuate in response to an imminent threat.
- 3.18.13 The NSW SES Incident Controller will distribute Evacuation Warnings and Evacuation Orders to;
 - a. Sector / Division Command Centres (where established).
 - b. All members of the Illawarra LEMC
 - c. Radio Stations.
 - d. Relevant media outlets and agencies.
 - e. Other local agencies and specified individuals.
- 3.18.14 The NSW SES Operations Commander will ensure distribution of Evacuation Warnings and Evacuation Orders to;
 - a. The NSW SES State Operations Centre.
 - b. The NSW SES Incident Controller.
 - c. Affected communities via dial-out warning systems where installed or applicable.
- 3.18.15 Evacuation Warnings and Evacuation Orders may be delivered through;
 - a. Radio and television stations.
 - b. Doorknocking by emergency service personnel.
 - c. Public address systems (fixed or mobile).
 - d. Telephony-based systems (including Emergency Alert).
 - e. Two-way Radio.
 - f. Direct access to local Radio Stations and ABC Emergency Broadcasting.
- 3.18.16 The Standard Emergency Warning Signal (SEWS) may be used to precede all Evacuation Orders broadcast on Radio Stations.

- 3.18.17 Sector Commanders, where established, will distribute Evacuation Orders via Emergency Service personnel in doorknock teams to areas under threat of inundation.
- 3.18.18 Doorknock teams will work at the direction of;
 - a. The Sector Commander if a Sector Command Centre is established.
 - b. The relevant Division Commander where a Sector Command Centre has not been established or,
 - c. The Incident Controller.
- 3.18.19 Field teams and supporting personnel conducting doorknocks will record and report back the following information to their Sector Commander/Division Commander/ Incident Controller;
 - a. Addresses and locations of houses doorknocked and/or evacuated.
 - b. The number of occupants.
 - c. Details of support required (such as transport, medical evacuation, assistance to secure house and/or property and raise or move belongings).
 - d. Details of residents who refuse to comply with the Evacuation Order.
- 3.18.20 Refusal to evacuate. Field teams and supporting personnel should not waste time dealing with people who are reluctant or refuse to comply with any Evacuation Order. These cases are to be referred to the NSW Police Force.

Withdrawal

- 3.18.21 Evacuations will generally be carried out in stages starting from the lowest areas, low flood islands and low trapped perimeters; and progressively to higher areas.
- 3.18.22 The most desirable method of evacuation is via road using private transport. This may be supplemented by buses for car-less people. However, other means of evacuation may also be used if available and as necessary (e.g. by foot, rail, air).
- 3.18.23 Evacuees who require emergency accommodation or disaster welfare assistance will be directed to designated evacuation centres. Evacuees who have made their own accommodation arrangements will not be directed to evacuation centres. It is not possible to determine in advance how many will fall into this category.
- 3.18.24 Evacuees will:
 - a. Move under local traffic arrangements from the relevant Sectors/Community if safe to do so;
 - b. Continue along the suburban/regional/rural road network to allocated Evacuation Centres.

- 3.18.25 **Welfare Services.** The Welfare Services Functional Area will, at the request of the NSW SES Incident Controller, assist in the identification and establishment of suitable locations to serve as Evacuation Centres.
- 3.18.26 **Health Services.** The Health Services Functional Area will coordinate the evacuation of hospitals, health centres and aged care facilities (including nursing homes).
- 3.18.27 **Schools.** School administration offices (Department of Education, Catholic Education Office and Private Schools) will coordinate the evacuation of schools if not already closed.
- 3.18.28 If there is sufficient time between the start of response operations and the evacuation of communities, the NSW SES Incident Controller will discuss the temporary closure of appropriate schools with the Regional Director, Illawarra and South East Region, Department of Education. This will enable pupils to stay at home or be returned home so they can be evacuated (if required) with their families.
- 3.18.29 Note that in the Wollongong City, Shellharbour City and Kiama LGAs, school principals may close some schools affected by flooding in the early stages of flooding.
- 3.18.30 **Caravan parks.** When an evacuation order is given occupiers of movable dwellings should:
- a. Isolate power to moveable dwellings.
 - b. Collect personal papers, medicines, a change of clothing, toiletries and bedclothes.
 - c. Lift the other contents in any remaining dwellings as high as possible.
 - d. Move to friends, relatives or a designated evacuation centre if they have their own transport, or move to the caravan office to await transport.
 - e. If undertaking self-managed evacuation, register their movements with the caravan park management upon leaving the park.
- 3.18.31 Where possible, dwellings that can be moved will be relocated by their owners. Park managers will arrange for the relocation of movable dwellings as required. Council and NSW SES personnel may assist if required.
- 3.18.32 Caravan park managers will ensure that their caravan park is capable of being evacuated in a timely and safe manner.
- 3.18.33 Advise the NSW SES Incident Controller of:
- a. The number of people requiring transport.
 - b. Details of any medical evacuations required.
 - c. Whether additional assistance is required to effect the evacuation.
- 3.18.34 Check that all residents and visitors are accounted for.
- 3.18.35 Inform the NSW SES Incident Controller when the evacuation of the caravan park has been completed.

- 3.18.36 Provide the NSW SES Incident Controller with a register of people that have been evacuated.
- 3.18.37 **Assistance Animals, Pets and Companion Animals of Evacuees:** Assistance animals (guide dogs, hearing assistance animals, etc.) will remain in the care of their owners throughout the evacuation. This includes transport and access into evacuation centres etc.
- 3.18.38 Where possible owners should take their companion animals with them when they are asked to evacuate. Due to safety restrictions, it may not be possible to allow companion animals to accompany their owners when being transported via aircraft or flood rescue boat. In such circumstances Agriculture and Animal Services will coordinate separate arrangements for evacuation and care of companion animals.
- 3.18.39 **Transport and storage:** Transport and storage of furniture from flood and/or coastal erosion threatened properties will be arranged by the NSW SES if time and resources permit.
- 3.18.40 **Security:** The NSW Police Force will coordinate the provision of overall security for evacuated areas.
- 3.18.41 **Assembly areas:** An assembly area may be used for the assembly of emergency-affected persons before they move to temporary accommodation or a nominated evacuation centre. As such these areas do not provide welfare assistance nor are they used for long term sheltering or provision of meals. An assembly area may also be a prearranged, strategically placed area, where support response personnel, vehicles and other equipment can be held in readiness for use during an emergency.

Shelter

- 3.18.42 **Evacuation Centres:** Evacuees will be advised to go to friends or relatives, or else be taken to the nearest accessible evacuation centre, which may initially be established at the direction of the NSW SES Incident Controller, but managed as soon as possible by Welfare Services.
- 3.18.43 The Illawarra EMPLAN identifies locations suitable for an evacuation centre.
- 3.18.44 **Registration:** The NSW Police Force will facilitate the requirement of Disaster Victim Registration for people evacuated to designated evacuation centres.
- 3.18.45 **Animal Shelter:** Facilities to hold and care for companion animals of evacuees will be coordinated by Agriculture and Animal Services if required. If required, Agriculture and Animal Services will also coordinate refuge areas for livestock (eg horses) where feasible.

Return

- 3.18.46 The NSW SES Incident Controller will advise when return to evacuated areas is safe after flood waters have receded and reliable access is available and will issue an "All Clear" notification.

- 3.18.47 The NSW SES Incident Controller will determine when it is safe for evacuees to return to their homes in consultation with:
- a. The Recovery Coordinating Committee (if established)
 - b. Welfare Services Functional Area Coordinator (welfare of evacuees)
 - c. Engineering Services Functional Area Co-ordinator (safety of buildings, structural integrity of levees/dams)
 - d. Health Service Functional Area Coordinator (public health)
 - e. Transport Services Functional Areas Coordinator (arrangement of transport)
 - f. The Illawarra LEOCON
 - g. The Wollongong City Council, Kiama Municipal Council and Shellharbour City Council
 - h. NSW SES Operations Commander
 - i. Other appropriate agencies/functional areas as required (mitigation and advice regarding identified risks resulting from the flood and/or coastal erosion event).
- 3.18.48 Once it is considered safe to do so, the NSW SES Incident Controller will authorise the return of evacuees.
- 3.18.49 The return will be controlled by the NSW SES Incident Controller and may be conducted, at their request, by the Recovery Coordinator.

3.19 MANAGING RESUPPLY OPERATIONS

- 3.19.1 The NSW SES is responsible for the coordination of the resupply of isolated communities and properties.
- 3.19.2 If isolation is expected to occur, residents should be encouraged to consider their needs and suitability for an unknown period of isolation.
- 3.19.3 If properties/communities are going to remain in locations expected to become isolated, households/retailers should be encouraged to stock up on essential supplies.
- 3.19.4 In certain circumstances, and where practicable, once supplies are delivered to the NSW SES designated loading point, the NSW SES Incident Controller will arrange for the delivery of essential foodstuffs, fuels or urgent medical supplies required by an isolated property or community.
- 3.19.5 All reasonable efforts will be made to deliver supplies, however where necessary the NSW SES will prioritise the delivery of items.

Resupply of Isolated Communities

Strategy

- 3.19.6 Minimise disruption upon the community by resupplying communities which have become isolated as a consequence of flooding.

Actions

- 3.19.7 The NSW SES is responsible for the coordination of the resupply of isolated communities.
- 3.19.8 If flood predictions indicate that areas are likely to become isolated, the NSW SES Incident Controller will issue warning advice that essential retailers (e.g. pharmacy and grocery stores) should stock up.
- 3.19.9 The NSW SES is prepared to deliver mail to isolated communities but may not be able to do so according to normal Australia Post timetables.
- 3.19.10 The NSW SES will assist hospitals with resupply of medical resources such as medications, essential equipment, linen and other consumables where able.

Resupply of Isolated Properties

Strategy

- 3.19.11 Ensure supplies are maintained to properties by coordinating the resupply of properties which have become isolated as a consequence of flooding.

Actions

- 3.19.12 The resupply of isolated properties is a common requirement during floods and coordination can be difficult because requests can emanate from a variety of sources. Isolated properties may call their suppliers direct, place their orders through their own social networks or contact the NSW SES.
- 3.19.13 The principles to be applied when planning for the resupply of isolated properties are;
- a. The NSW SES will coordinate resupply and establish a schedule.
 - b. Some isolated households will not have the ability to purchase essential grocery items due to financial hardship. If an isolated household seeks resupply from the NSW SES and claims to be, or is considered to be, in dire circumstances, he/she is to be referred to Welfare Services for assessment of eligibility. Where financial eligibility criteria are met, Welfare Services will assist with the purchase of essential grocery items. Welfare Services will deliver the essential grocery items to the NSW SES designated loading point for transport.
 - c. Local suppliers will liaise with the NSW SES regarding delivery of resupply items to the designated loading point.
 - d. Local suppliers are responsible for packaging resupply items for delivery.

- 3.19.14 A flowchart illustrating the Resupply process is shown in Attachment 1. Please note that the flowchart outlines the resupply process but does not encompass all potential situations and/or outcomes.

PART 4 - RECOVERY

4.1 RECOVERY COORDINATION AT THE LOCAL LEVEL

- 4.1.1 The NSW SES Incident Controller will ensure that planning for long-term recovery operations begins at the earliest opportunity, initially through briefing the Local Emergency Management Committee (LEMC). As soon as possible the LEMC will meet to discuss recovery implications including the need for a Local Recovery Committee. The LEMC will consider any impact assessment in determining the need for recovery arrangements. This is conveyed in the first instance to the State Emergency Operations Controller (SECON) for confirmation with the State Emergency Recovery Controller (SERCON).
- 4.1.2 Once the need for recovery has been identified, the SERCON, in consultation with the SECON, may recommend the appointment of a Local Recovery Coordinator and nominate an appropriate candidate to the Minister for Emergency Services.
- 4.1.3 The SERCON may send a representative to the LEMC and subsequent recovery meetings to provide expert recovery advice and guidance.
- 4.1.4 The NSW SES Incident Controller and Local Emergency Operations Controller (LECON) should attend recovery meetings to provide an overview of the emergency response operation.
- 4.1.5 The NSW SES Region Controller, the Regional Emergency Management Officer and appropriate Regional Functional Area Coordinators will be invited to the initial local meeting and to subsequent meetings as required.
- 4.1.6 The recovery committee will:
 - a. Develop and maintain a Recovery Action Plan with an agreed exit strategy and timeline.
 - b. Monitor and coordinate the activities of agencies with responsibility for the delivery of services during recovery.
 - c. Ensure that relevant stakeholders, especially the communities affected, are involved in the development and implementation of recovery objectives and strategies and are informed of progress made.
 - d. Provide the SERCON and NSW SES with an end of recovery report.
 - e. Ensure the recovery is in line with the National Principles of Disaster Recovery and the NSW tenets.

4.2 RECOVERY COORDINATION AT THE REGION AND STATE LEVEL

- 4.2.1 In the event that an emergency affects several local areas, a Region Emergency Management Committee (REMC) will meet to discuss recovery implications including the need for a Region Recovery Committee. This is

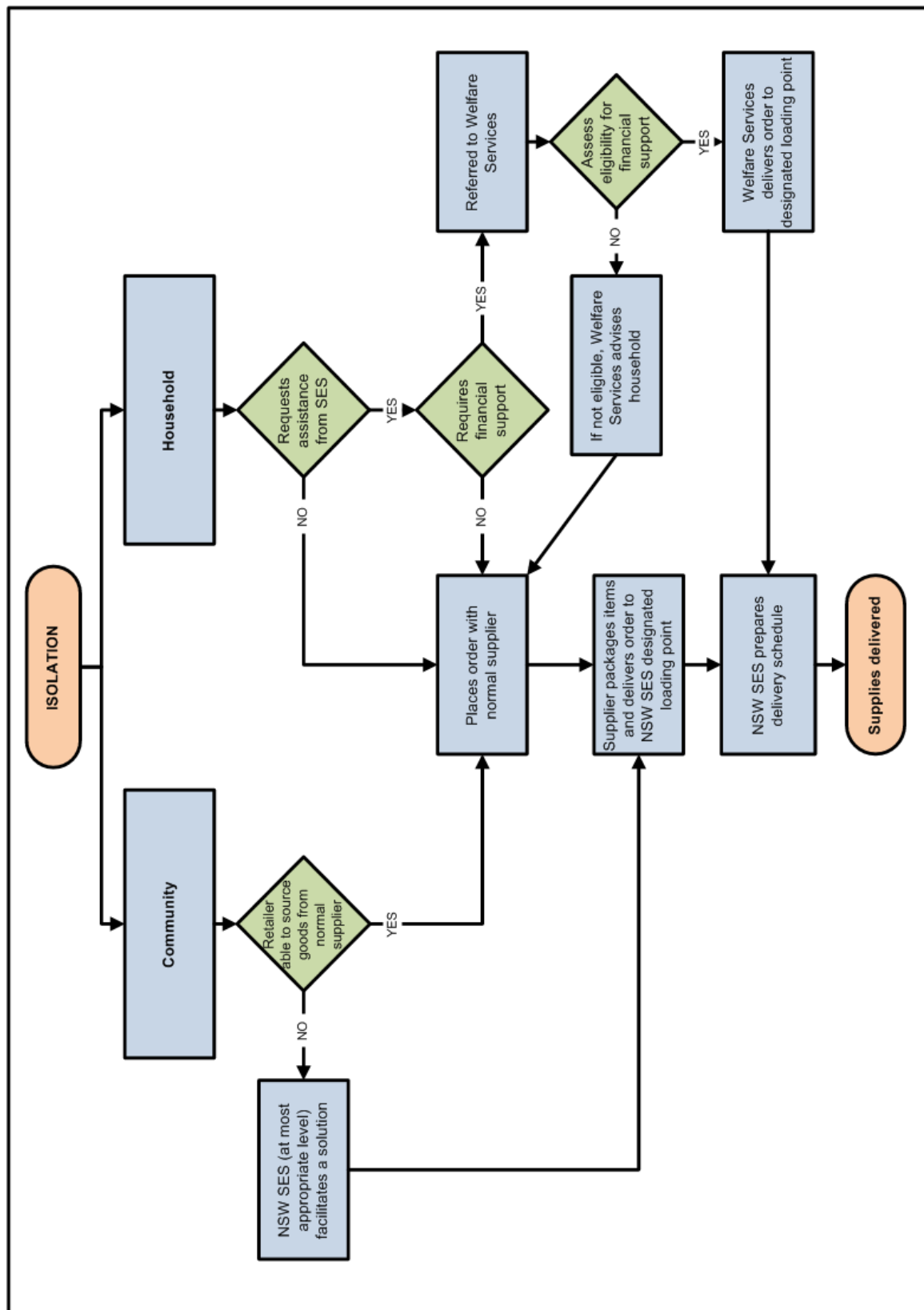
conveyed in the first instance to the SEOCON for confirmation with the SERCON.

- 4.2.2 In the event of an emergency which affects multiple regions, or is of state or national consequence, or where complex, long term recovery and reconstruction is required, it may be necessary to establish a State Recovery Committee and the appointment of a State Recovery Coordinator.

4.3 ARRANGEMENTS FOR DEBRIEFS / AFTER ACTION REVIEWS

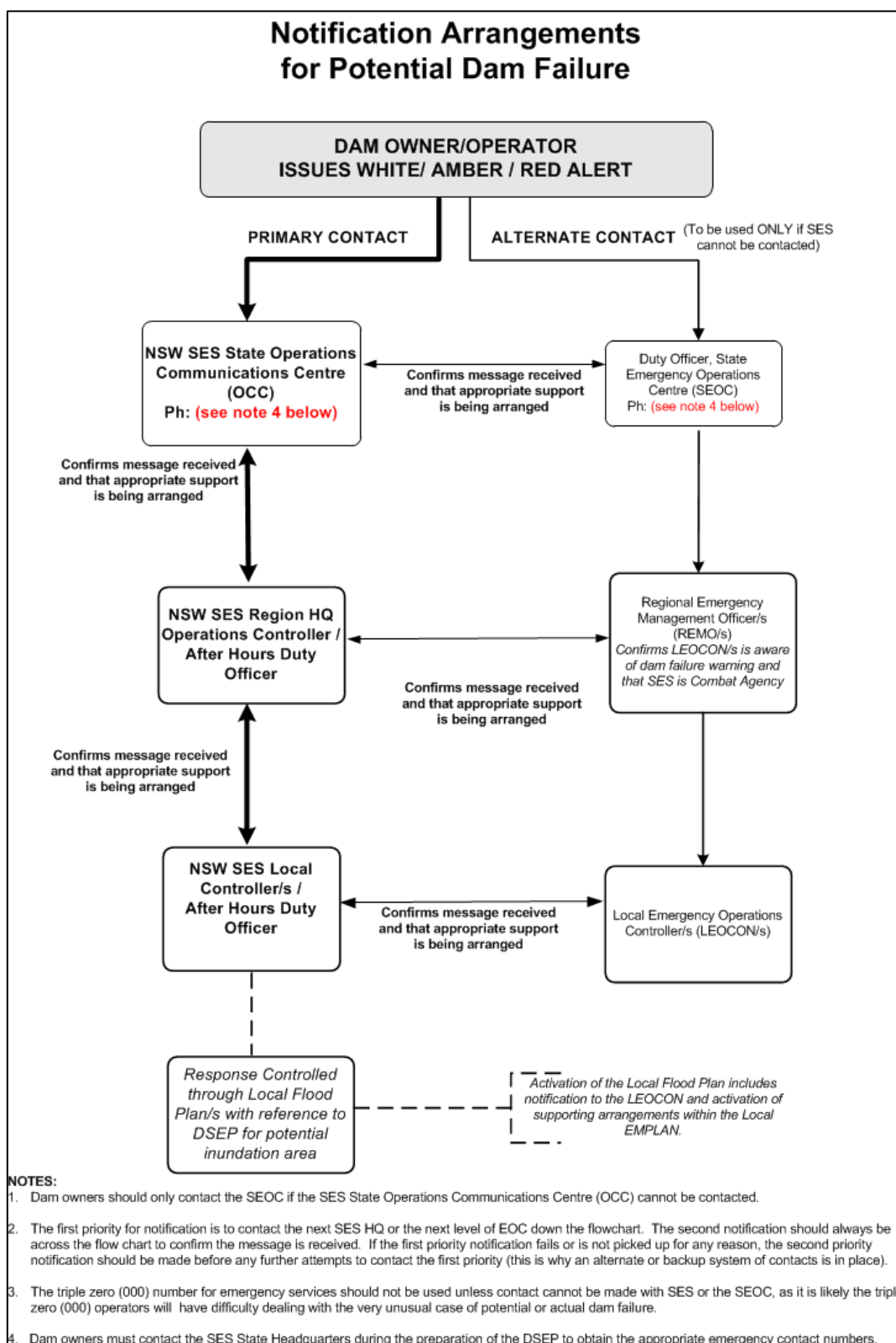
- 4.3.1 As soon as possible after flooding has abated, the NSW SES Incident Controller will advise participating organisations of details of response operation after action review arrangements.
- 4.3.2 The NSW SES Wollongong City, Shellharbour City and Kiama Local Controllers will ensure that adequate arrangements are in place to record details of the after action review and each item requiring further action is delegated to an organisation or individual to implement.
- 4.3.3 Follow-up to ensure the satisfactory completion of these actions will be undertaken by the Illawarra Local Emergency Management Committee.

ATTACHMENT 1 - RESUPPLY FLOWCHART

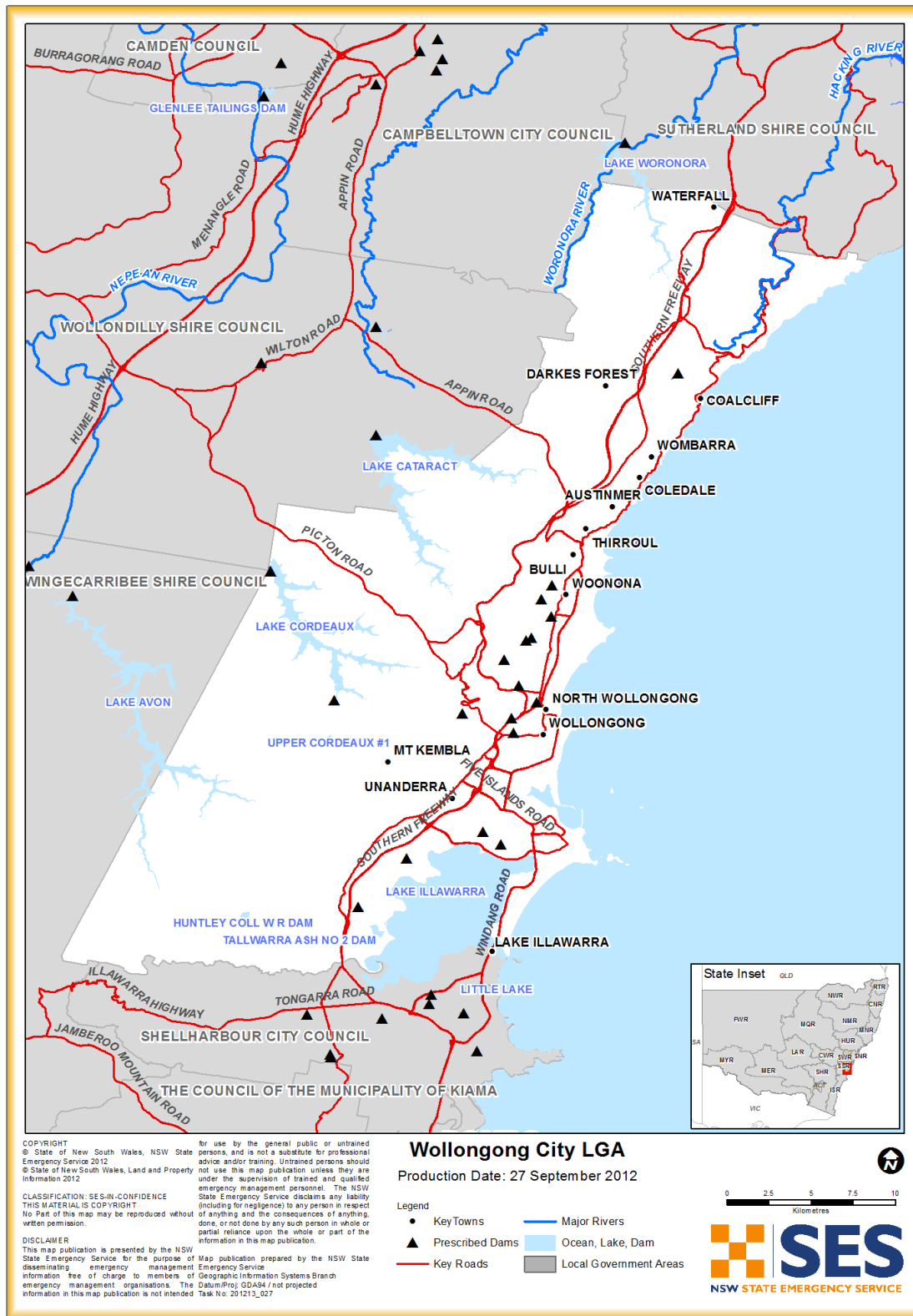


Please Note: The chart outlines the resupply process, but does not encompass all potential situations and outcomes.

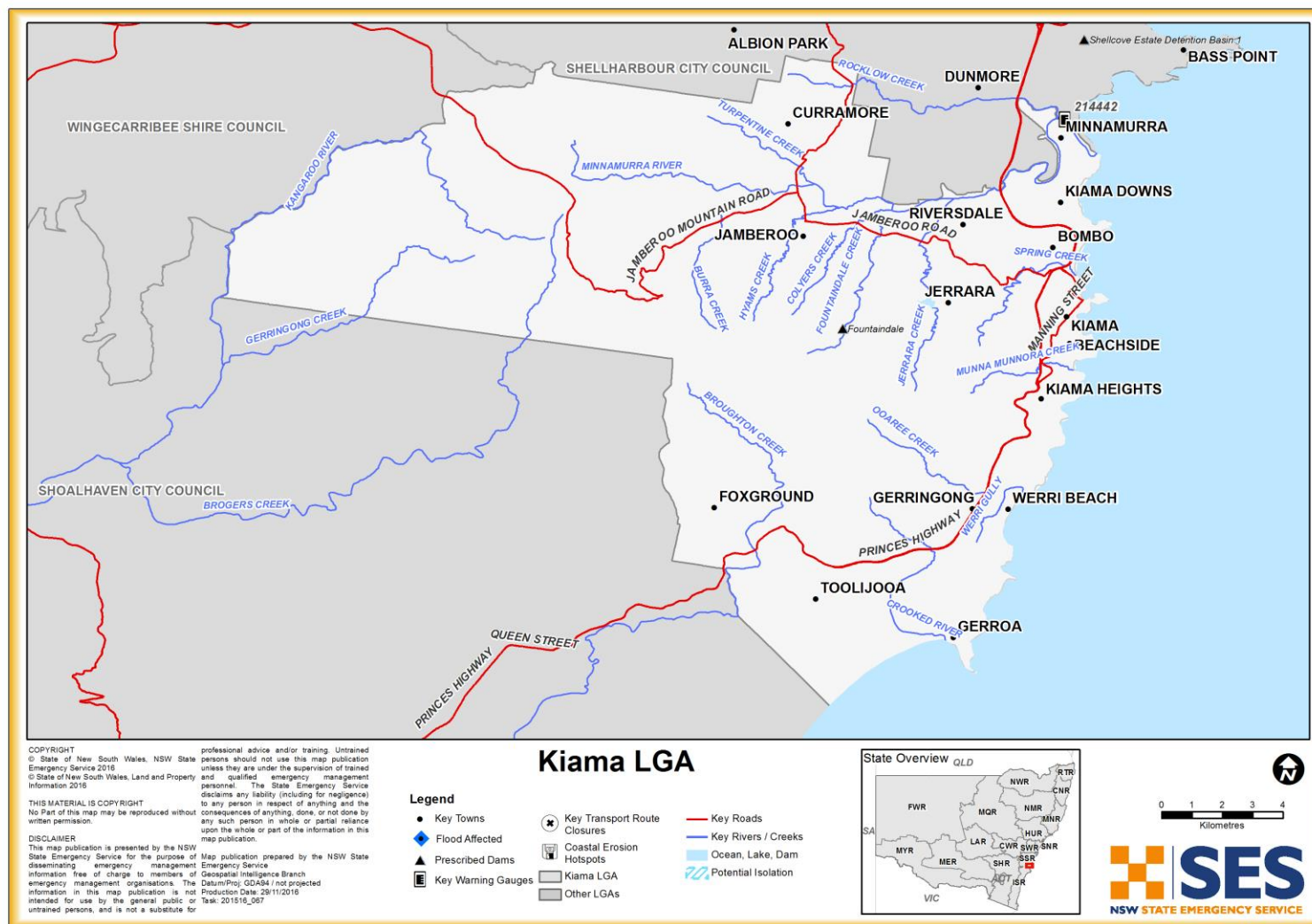
ATTACHMENT 2 - DAM FAILURE ALERT NOTIFICATION ARRANGEMENTS FLOWCHART



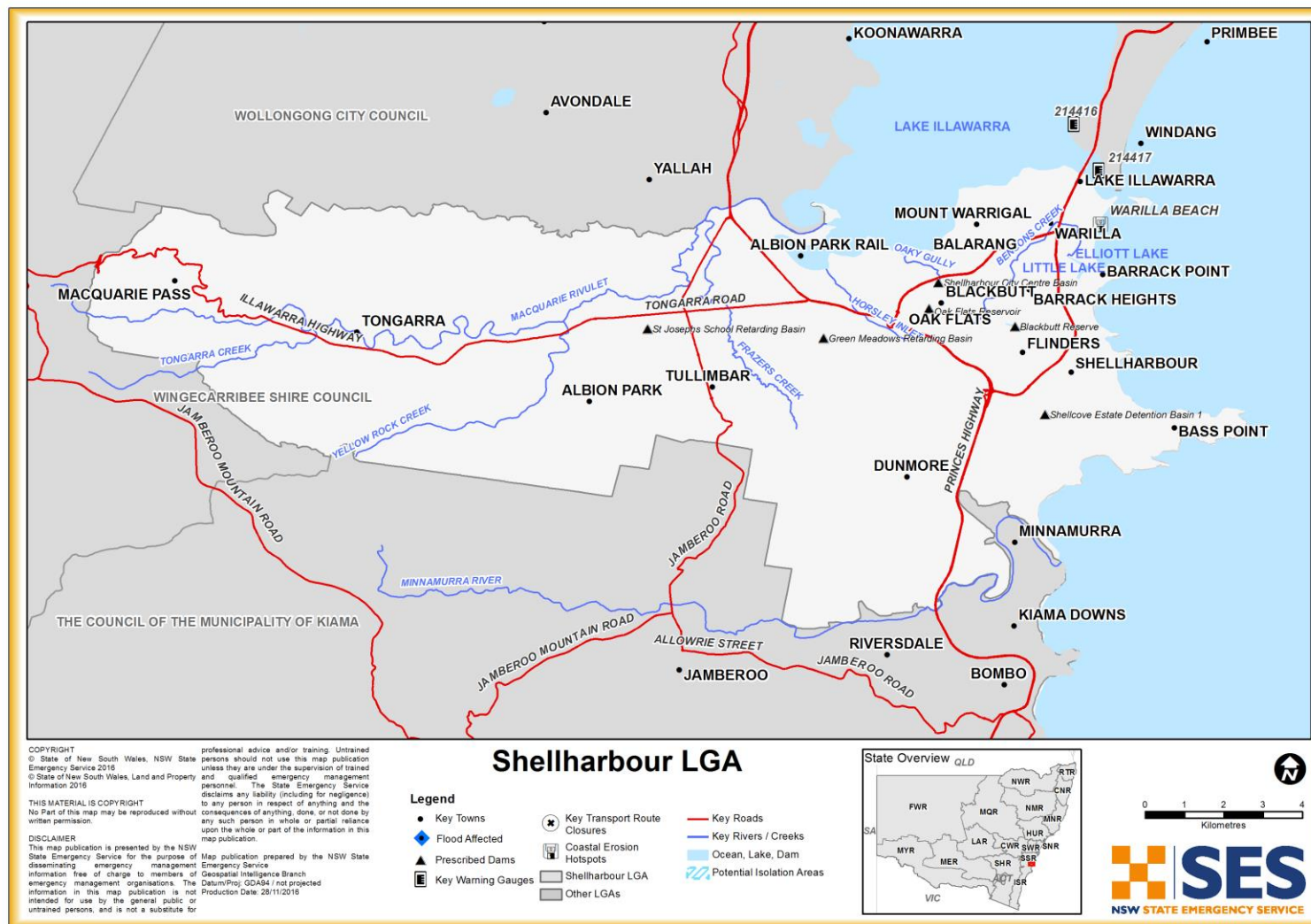
ATTACHMENT 3 - WOLLONGONG CITY LGA MAP



ATTACHMENT 4 - KIAMA LGA MAP



ATTACHMENT 5 - SHELLHARBOUR CITY LGA MAP



LIST OF REFERENCES

1. **Emergency Management Australia.** *Managing the floodplain: a guide to best practice in flood risk management in Australia.* s.l. : Attorney-General's Department, 2013.
2. **Department of Infrastructure, Planning and Natural Resources.** *Floodplain Development Manual.* 2005.
3. **Ministry for Police and Emergency Services (MPES).** *New South Wales State Emergency Management Plan (EMPLAN).* 2012.
4. **NSW Government.** *Local Government Act 1993 No 30.* 1993.
5. **Emergency Management Australia.** *Flood Warning: Australian Emergency Manuals Series Manual 21.* s.l. : Attorney-General's Department, 2009.
6. **NSW Government.** *Manufactured Home Estates, Caravan Parks, Camping Grounds and Moveable Dwellings Regulation.* 2005.
7. **Emergency Management Australia.** *Evacuation Planning: Australian Emergency Management Handbook Series Handbook 4.* s.l. : Attorney-General's Department, 2013.
8. **SEMC Evacuations Working Group.** *Evacuation Management Guidelines.* 2014.
9. **NSW SES.** *Incident Management Policy.* 2015.

HAZARD AND RISK IN WOLLONGONG CITY

Volume 2 of the Illawarra Local Flood Plan

Last Update: August 2017

AUTHORISATION

The Hazard and Risk in Wollongong City has been prepared by the NSW State Emergency Service (NSW SES) as part of a comprehensive planning process. The information contained herein has been compiled from the latest available technical studies.

Approved



Manager Emergency Risk Management

Date:

2/8/17

Approved



NSW SES Illawarra-South Coast Region Controller

Alexandra McFadden
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Date:

7th July 2017

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Date:

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VERSION LIST

The following table lists all previously approved versions of this Volume.

Description	Date
Wollongong City Local Flood Plan – Annexes A, B C and H	June 2010

AMENDMENT LIST

Suggestions for amendments to this Volume should be forwarded to:

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NSW State Emergency Service

PO Box 322

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Amendments promulgated in the amendments list below have been entered in this Volume.

Amendment Number	Description	Updated by	Date

Document Issue: Version 3-02052016

1 THE FLOOD AND COASTAL EROSION THREAT

1.1 OVERVIEW

- a. The Wollongong City Local Government Area (LGA) is located approximately 80km South of Sydney on the NSW coast. It extends from Helensburgh in the north to Lake Illawarra in the south and inland to the Illawarra Escarpment in the west. The major business centre is located in the Wollongong CBD, with smaller business centres located in surrounding suburbs.
- b. Major roads located within the LGA include the Princes Highway, M1, Illawarra Highway and Picton Road. The South Coast Rail line also runs parallel to the coast through the Council area. Port Kembla Harbour is located in the Wollongong LGA and is a major commercial location in the Illawarra Region with a high percentage of heavy vehicles accessing the port.
- c. The Wollongong Council area falls within the Wollongong Coast River Basin which contains numerous streams running off the Illawarra escarpment in an easterly direction towards the coast.
- d. The Wollongong City LGA boundary is shown on Map 1 – Wollongong Coast Basin.

1.2 LANDFORMS AND RIVER SYSTEMS

Wollongong Coast Basin

- a. The Wollongong Coast River Basin begins in the Illawarra Escarpment. The escarpment is 250 m in elevation in Wollongong's northern suburbs and 670 m to the west of Dapto, at which point it is about 20 km from the sea. East of the escarpment is a series of low ridges that divide small, steep stream catchments. The coast proper is lined with sand dunes, which impound small lagoons and swampy areas into which these creeks discharge. To the south of the city is the 35 square kilometre Lake Illawarra, a shallow tidal lake that occupies the area between plain and coastal dunes (1). The Wollongong Coast Basin is shown on Map 1 – Wollongong Coast Basin.
- b. The headwaters of the creeks are generally steep and heavily forested, with middle and lower sections grading from moderately steep down to relatively flat (2). The middle to lower reaches of the streams flow through the developed parts of the catchment.
- c. All creeks are interrupted by the major road and rail links and have a limited flow capacity at the bridges and culvert crossings (1).
- d. The Wollongong Coast Basin incorporates nine creek catchments and multiple smaller creeks and coastal lakes including (listed from north to south):

- i. Northern Suburbs Catchment
 - ii. Hewitts Creek Catchment
 - iii. Collins Creek Catchment
 - iv. Towradgi Creek Catchment
 - v. Fairy and Cabbage Creek Catchment
 - vi. Wollongong City Catchment
 - vii. Allens Creek Catchment
 - viii. Mullet Creek Catchment
 - ix. Minnegang Creek Catchment
 - x. Minor watercourses
 - xi. Lake Illawarra Catchment
- e. These are further described in Annex 1 – Illawarra River Basin Schematics and below.

Northern Suburbs Catchment

- f. The Northern Suburbs Catchment encompasses locations north of Austinmer. These include Coledale, Wombarra, Clifton, Coalcliff, Wombarra and Scarborough. The watercourses located in the northern suburbs include; Horse, Reeces, Stockyard, Denmark, Daly, Carricks, Wards, Hyde, Falces, Jacky Jones, Gladsenbury, Pinecourt, Hicks, Flanigans and L.B Kelly Creeks as well as Barton Gully. Creek systems located in the Northern Suburbs catchment run through culverts or under bridges (1). The Northern Suburbs Catchment is shown on Maps 2 & 3.
- g. The Hacking River flows through Otford and has historically caused flooding issues.
- h. Stanwell Creek flows through Stanwell Park and has historically caused flash flooding issues.

Hewitts Creek Catchment

- i. The Hewitts creek catchment encompasses the suburbs of Thirroul and Bulli and consists of Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creeks. The catchment drains an area of approximately 8.1km² (3). Hewitts Creek Catchment is shown on Maps 2 & 4.

Hewitts Creek

- j. Hewitts Creek has a catchment of 380ha and is drained by two creeks which convey runoff from the escarpment. These creeks (Hewitts and Woodlands) join approximately 400m above McCauley's Beach via an artificial diversion structure. Woodlands Creek has a length of 3km to its confluence with Hewitts creek with a total fall of 400m. Hewitts Creek has a length of 3.3km with a total fall of 350m. Hewitts

Creek discharges into the rear dune area of McCauley's Beach in Thirroul before entering the ocean (2).

Slacky Creek

- k. Slacky Creek has a catchment of 280ha and consists of a mix of residential, recreational and forested land, discharging to the sea south of Sandon Point, across Bulli Beach. The stream length is 5.5km and the catchment has a fall of 350m (2).

Tramway Creek

- l. Tramway Creek has a catchment area of 53ha and flows through a mixture of residential, retail and light industrial land in Bulli for 1.5km. The creek discharges into the low lying rear dune area of McCauley's Beach, 200m south of the outlet of Hewitts Creek. Flow from Slacky Creek may be diverted into Tramway Creek in larger flooding events (2).

Thomas Gibson Creek

- m. Thomas Gibson Creek has a catchment of 86ha and is located north of Hewitts Creek. The system is 1.6km long and comprises of three creeks that merge at the foot of the catchment before discharging into the sea at two locations across Thirroul Beach (2).

Collins Creek Catchment

- n. The Collins Creek catchment encompasses the combined catchments of Whartons, Collins, Farrahars Creeks, Bellambi Gully and Bellambi Lake and drains through the suburbs of Bulli, Woonona, Woonona East, Russell Vale, Bellambi, Corrimal and Corrimal East (4). The Collins Creek catchment is shown on Maps 2 & 5.
- o. The upper reaches of the catchment are fed by runoff which originates in the heavily wooded escarpment where gradients in excess of 50 percent are common (4).
- p. The middle to lower reaches of the streams flow through the developed parts of the catchment. The gradient of the streams in these parts flattens from around 20 percent where they drain developed areas west of the Princes Highway, to less than 1 percent where they discharge into a coastal estuary environment (4).
- q. This coastal estuary environment is subject to entrance filling and berm building as a result of wave action (4).

Towradgi Creek Catchment

- r. The Towradgi Creek catchment contains multiple watercourses. They are Towradgi Creek, South and North Angels Creeks, Carr Creek, South and North Corrimal Creeks, Parker Creek and Towradgi Lagoon. The catchment drains an area of about 7.2km² through the northern Wollongong suburbs of Tarrawanna, Corrimal, Towradgi and Fernhill. The Towradgi Creek catchment is shown on Maps 2 & 6.

- s. About 50% of the catchment is steep and forested and forms part of the Illawarra Escarpment. The lower half of the catchment is much flatter and mostly urbanised. Towradgi Creek flows into the Tasman Sea at Corrimal Beach (1).

Towradgi Creek

- t. The main channel of Towradgi Creek extends from the foothills of the Illawarra Escarpment in Balgownie and discharges to the Tasman Sea. The creek is joined by the tributaries at various locations along its length (5).

North and South Corrimal Creeks

- u. North Corrimal and South Corrimal Creeks run from the Illawarra Escarpment and drain the suburb of Corrimal. The main reach of North Corrimal Creek extends from Coxs Avenue in Corrimal to its confluence with Towradgi Creek immediately upstream of the Illawarra Railway. The main reach of South Corrimal Creek extends from Justine Avenue in Corrimal to its confluence with Towradgi Creek upstream of Memorial Drive in Tarrawanna (5).

North and South Angels Creeks

- v. North Angels and South Angels Creeks run from the Illawarra Escarpment and drain the suburb of Tarrawanna. The main reach of North Angels Creek extends from Bellambi Street in Tarrawanna to its confluence with South Angels Creek near Meads Avenue in Tarrawanna. The main reach of South Angels Creek extends from Corrimal Street in Tarrawanna to the Princes Highway where the creek joins Towradgi Creek (5).

Carr and Parker Creeks

- w. Carr Creek and Parker Creek are two shorter creeks which drain the lower urbanised area of the catchment. Carr Creek extends from Dalton Street in Towradgi to its confluence with Towradgi Creek approximately 160m upstream of Pioneer Road Bridge. Parker Creek runs from Carroll Road in Towradgi to its confluence with Towradgi Creek at Lake Parade in Towradgi (5).

Towradgi Lagoon

- x. Towradgi Lagoon is located at the downstream end of Towradgi Creek, next to Corrimal Beach (5).

Fairy and Cabbage Creek Catchment

- y. The catchment consists of both the Fairy and Cabbage Tree Creek Catchments. It also includes the Towradgi Arm and Fairy Lagoon. It includes the suburbs of Fernhill, Towradgi, Balgownie, Fairy Meadow, Mount Pleasant, Mount Ousley, Keiraville, North Wollongong, Gwynneville, Wollongong and West Wollongong. Fairy and Cabbage Creek catchment is shown on Maps 2 & 7.

- z. Fairy Creek is located immediately north of Wollongong. The four main branches of the creek rise high upon the slopes of the Illawarra escarpment east of Mount Keira. The Fairy Creek catchment occupies an area of approximately 7.6 square kilometres to the confluence with Cabbage Tree Creek. The catchment area is subject to rainfalls of high intensity and is characterised by steep slopes and a high degree of urbanisation. The confluence of Fairy and Cabbage Tree Creeks (catchment area 10.5 square kilometres) occurs at a tidal lagoon just upstream of the Squires Way Bridge (1).
- aa. Minor watercourses that make up the catchment include; Bootie Street branch, Cabbage Tree Creek, Wellington Drive branch, Hopewood Crescent branch, Dobinson Street branch, Alvan Parade branch, Parkview Grove branch, Dumfries Avenue branch, Dallas Street branch, Industrial branch, University branch, Botanic Gardens branch, Nyrang Park branch, Akuna Street branch, Gilmore Park branch, Gunyah Park branch and Gipps Street branch (6).

Wollongong City Catchment

- bb. The Wollongong City catchment is also known as Gurungaty Waterway Catchment and includes the suburbs of Wollongong, Coniston and Mangerton. Wollongong City catchment is shown on Maps 2 & 8.
- cc. The Wollongong City catchment is 730 ha and discharges into Port Kembla Inner Harbour via the Gurungaty Waterway. A high dune systems separates the Pacific Ocean from the catchment along the eastern side and rises very steeply to the west reaching elevations of 100m AHD in the suburbs of Coniston, Mangerton and Mount St Thomas (7). The northern boundary of the catchment is traced by Crown Street.
- dd. The catchment is extremely urbanised with a mixture of medium density housing, commercial and industrial development. The section of the catchment upstream of the South Coast railway line is predominantly low to medium density housing, the area to the north and north-east of the upper catchment is comprised of higher density commercial and residential development and the southern portion of the catchment in the vicinity of Port Kembla Inner Harbour is largely occupied by the BlueScope steel works site (7).

Allans Creek Catchment

- ee. Allans Creek catchment adjoins the Wollongong City catchment and includes Byarong Creek, Branch Creek, Brandy and Water Creek, American Creek, Ghost Creek, Nudjia Creek, Charcoal Creek, Jenkins Creek, Running Brook and Allans Creek. It includes the suburbs of West Wollongong, part of Mangerton, Figtree, Mount Saint Thomas, Mount Kembla, Kembla Heights, Cordeaux Heights, Unanderra, Spring Hill, Port Kembla and Farmborough Heights (1). Allans Creek catchment is shown on Maps 2 & 9.

- ff. The Allans Creek catchment is characterised by a low flat floodplain west of Port Kembla, which is dominated by the backdrop of the Illawarra Escarpment. The steep western areas of the catchment, near the Illawarra Escarpment are mainly forested or in rural nature, while closer to the coast the catchment floodplain is relatively flat with a blend of industrial, residential and commercial development (8).
- gg. Allans Creek drains to Tom Thumb Lagoon and Port Kembla Harbour through the Bluescope Street industrial area. Allans Creek is tidal as far upstream as the F6 Freeway (8).
- hh. Allans Creek and its tributaries are highly modified systems with both piped and open channel sections. The result is a hydrologically complex system in the lower reaches, with varied flood peaks providing several flooding mechanisms (8).

Mullet Creek Catchment

- ii. The catchment comprises of Mullet Creek and Brooks Creek, which drain areas of 74.48 km² and 5 km², respectively. Both watercourses discharge separately to Lake Illawarra (1). The Mullet Creek catchment is shown on Maps 2, 10 & 11.

Mullet Creek

- jj. The headwaters of Mullet Creek are located in the Illawarra Escarpment and the creek flows for 22km before reaching Lake Illawarra. The headwaters of Mullet Creek are mainly forested and much of the catchment is used for rural activities however the areas of Dapto, Horsley, Brownsville, Kembla Grange and Farmborough Heights within the Mullet Creek catchment are urban areas and the catchment is expected to see further urban and residential growth in the future in the West Dapto area (9).

Brooks Creek

- kk. The Brooks Creek catchment is almost completely urban development. Brooks Creek flows for 5km before reaching Lake Illawarra (9).

Minnegang Creek Catchment

- ll. The Minnegang Creek catchment is located 8.5km south of Wollongong and includes the suburbs of Lake Heights and Warrawong. Approximately 80% of the catchment is developed, mostly with low density residential housing, with the remaining 20% being recreational area or cleared open space (1). The Minnegang Creek catchment is shown on Maps 2 & 12.
- mm. The steep catchment rises from the northern shore of Lake Illawarra to the intersection of Lake Heights Road and Flagstaff Road (1).
- nn. Minnegang Creek has two main tributaries. The first follows Melinda Grove and passes under Gilgandra Street and meets Minnegang Creek just upstream of Mirrabooka Road. The second tributary flows from south west of Gordon Crescent, under Ranchby

Avenue and confluences with Minnegang Creek just upstream of Lake Heights Road. The system is comprised of a combination of open watercourses and pipe drains and discharges into Lake Illawarra (10).

Minor Watercourses

- oo. Several minor creeks located in the Wollongong City LGA flow westward from the escarpment through unpopulated country to a series of water storage reservoirs. The more important of these, and the storage's to which they feed, are:
 - i. Avon River and Gallahers Creek: to Lake Avon.
 - ii. Cordeaux River and Kembla Creek: to Lake Cordeaux.
 - iii. Rocky, Cataract, Bellambi and Allen Creeks: to Lake Cataract.
 - iv. Waratah Rivulet: to Lake Woronora (1).
- pp. O'Hares Creek, a tributary of the Georges River, also flows west from the escarpment (1).

Lake Illawarra Catchment

- qq. Lake Illawarra is a shallow coastal lagoon located on the undulating coastal plain between the ocean and the cliffs of the Illawarra Escarpment. The lake shares its shores with the Shellharbour City LGA. Lake Illawarra is shown on Map 1, 2 & 13.
- rr. The Lake Illawarra Catchment has an area of 270 km², including the 35 km² lake, rising from sea level to an elevation of 760m at Mount Murray. The Lake is generally open to the sea through an entrance channel that is affected by ocean storms, wave action, floods and tides (11).
- ss. Several surrounding water courses feed in to the Lake from both the Shellharbour City and Wollongong City LGAs including Minnegang Creek, Budjong Creek, Yallah Creek, Wollingurri Creek, Marshall Creek, Frazer Creek, Albion Creek, Oakey Gully, Macquarie Rivulet, Mullet Creek, Brooks Creek, Hooka Creek, Duck Creek and, Horsley Creek (11).

1.3 STORAGE DAMS

- a. Three dams (Cordeaux Dam, Upper Cordeaux 2 Dam and Cataract Dam) are located on the Illawarra Escarpment and flow out of the LGA towards the west. The Wollongong City LGA would not be affected by any dam break or spillage from any of these dams.
- b. Coalcliff Dam is located between Coalcliff and Stanwell Park in the northern suburbs catchment on a tributary of Stanwell Creek. This creek discharges to the ocean at Stanwell Park Beach. There is no dam failure information available for this dam.

- c. There are also 14 prescribed detention/retarding basins in the Wollongong LGA that could contribute to flood affects downstream were they to fail or overtop. These are further described in Section 1.7 and under Section 2 – Specific Risk Areas.
- d. These dam, detention and retarding basins locations are shown on Map 1 - Wollongong Coast Basin Map.

1.4 WEATHER SYSTEMS AND FLOODING

- a. Flooding in the Wollongong City LGA is dominated by 'flash' flooding. The streams respond quickly to high-intensity rainfall and flooding can begin very soon after the beginning of heavy rains.
- b. Average annual rainfall in the council area varies from less than 1,100 mm in the Dapto, Windang and Kemblawarra area to more than 1,600 mm along the escarpment southwards from Mt Keira. About 60-70 per cent of this falls in the summer and autumn quarters, most of it in February, March and April. Rainfall of more than 50mm in a day is recorded, on average, about eight times a year somewhere in the council area. Such rainfall frequently produces flooding, particularly when catchments are already wet. Very high daily falls (200 mm or more) almost always produce flooding, much of it severe (1).
- c. Flooding can occur at any time of the year, but in different seasons it is triggered by different rain-producing mechanisms. There is a slight bias towards the February-March period as well as August as far as flood occurrence is concerned. Within this period the concentration is in the late summer and early autumn months (1).
- d. Floods may result from any of the five weather patterns summarised below:
 - i. **Ex Tropical Cyclones:** Rainfall and flooding that results from a cyclone moving south and downgraded to a rain depression. Such weather systems can produce prolonged heavily rainfall. Heavy rainfall originating from these cyclones in the Illawarra can occur anytime between January and May and have historically resulted in widespread and localised flooding affecting dwellings.
 - ii. **Zonal Synoptic Patterns:** This pattern occurs when the centre of a high or low-pressure system is located south of New South Wales directing a moist onshore flow onto the coast. These pressure systems often combine with a low-pressure trough and/or upper air disturbances to create a state of prolonged instability. In February 1984, moist air behind a front and a high-pressure system centred southeast of Tasmania, along with small surface low-pressure systems, resulting in extreme instability and intense rainfall. Zonal synoptic patterns together with easterly lows account for 50% of the flooding in the Illawarra.

- iii. **Inland Depressions:** These inland depressions or low-pressure systems originating from continental northern Australia that can dip down into New South Wales and intensify over coastal areas. These often occur in autumn, just after the northern monsoon season.
- iv. **Easterly Lows:** Defined as low-pressure troughs moving south from Queensland, generally just off the NSW coastline, before heading in a south-easterly direction. They occur predominately in the winter months.
- v. **Continental Lows:** Low-pressure systems, which move across the continent towards the central NSW coastline. There is two types;
 - Lows originating from central and southern Queensland moving south towards Sydney, intensifying as they near or cross the coastline. Unlike inland depressions no trough structure is evident.
 - Where a low-pressure system moves eastwards across the southern continental areas, before intensifying near the coastline, thereby producing intense rainfall. East coast cyclones or lows would also fit into this category (these are easterly moving pressure systems, which develop into intense cyclonic depressions when they pass over mountainous coastal terrain and a warm poleward flowing current. Predominately occur in winter and autumn (1).
- vi. **Thunderstorms:** Localised thunderstorms have caused localised flooding in various areas, usually to only sections of a suburb at any one occasion (1).

1.5 CHARACTERISTICS OF FLOODING

- a. Flooding in the Wollongong City LGA is dominated by flash flooding from overbank flooding of its numerous streams (1). Due to the nature of the topography, rainfall can be concentrated within one catchment area without effecting other or neighbouring catchments (1).
- b. Overland flooding also occurs across the LGA due to the shape of catchments and drainage system overloads (1).
- c. Except for their headwaters, most of the catchments are heavily urbanised which increases the speed of rises in creek levels. Floodplain areas are of relatively limited size, and during periods of flooding only small proportions of total flow are carried within creek channels. The result is substantial floodplain inundation, often to considerable depths.
- d. Velocities of flow are usually high (often more than 2 metres per second) and flooding is characterised by very rapid rises and falls in water level. As it is common in urban catchments, flood peaks usually occur at night time. Overbank flows occur frequently,

even in the less severe events of approximately 20-50% AEP (that is, floods that occur on average every 2 to 5 years).

- e. Filling of land in the lower reaches of some of the catchments has also significantly reduced the pre-existing storage capacity of the floodplain leading to more flooding than would have naturally been the case (1).
- f. In previous flood events large quantities of flood debris washed down from the upper forested and urban catchments appeared to exacerbate upstream flooding by blocking culvert and bridge waterways (1). The design capacity of the urban stormwater drainage system in these areas is understood to be based on a 10 year or smaller Average Recurrence Interval (ARI) storm event. Hence, some properties have been flooded by surcharging of the stormwater drainage system and/or the inability of local runoff to enter the stormwater drainage system independent of, or in combination with mainstream flooding (1).
- g. Most of the creeks discharge into small coastal lakes, lagoons or swamps before reaching the sea. The mouths are prone to closure through build-up of sand at their outlets. This causes flood levels in the lakes and in the lower stream reaches to rise in the early stage of a flood before the flood waters scour the outlet. High velocities are often experienced at the outlets as the sand bars collapse (1).
- h. The north-south orientation of the road and rail links means that all the creeks are interrupted by culverts and bridges which have limited flow capacity that are prone to blockage by debris, worsening these effects. Few road culverts are capable of passing events more severe than those of about 10% AEP without overtopping. Inadequate waterway capacity or blockages are a frequent cause of flooding (1).
- i. Because of the short catchment response times, it is extremely difficult to accurately determine the timing and contribution of local flooding to overall flooding at a given built-up location in the study area. Thus, the determination of the likelihood and contribution of stormwater flooding requires some subjective assessment (1).

1.6 FLOOD HISTORY

- a. Severe floods are more common in the February-March period and in August than in other months (1). Significant flood events in Wollongong have occurred in 1950-52, 1958-61, 1973-78, 1983-84, 1991-92 and 1998-99, 2012, 2014 and most recently in 2016. Of these, the most severe was the 1998 flood event.

August 1998 Event

- b. A major storm occurred in 17 August 1998, during which about 1000 properties in Wollongong suffered above floor inundation. At least 144 of these properties were considered unfit for occupation immediately following the event, with 24 of these

properties voluntary purchased in the Fairy/Cabbage Creek catchment. In addition to damage to private homes, motor vehicles were also swept off roads (12).

- c. The main areas affected were the more populated central and northern suburbs of Wollongong, mainly within the Hewitts, Bellambi, Towradgi, Cabbage Tree and Fairy Creek catchments, and partially in the Allans Creek catchment to the south of the city centre (2). Additionally coal wash was washed into Keiraville from the Kemira Colliery, creating an additional hazard for emergency services.
- d. During this event the Wollongong Unit Headquarters located on Montague Street in North Wollongong experienced inundation (1m depth in Montague Street), became isolated and lost power, communications, and telephone connection.
- e. The total tangible damage for the flood event was estimated at \$75 million, and insurance companies paid out around \$42 million in claims. Apart from the tangible loss, the event also brought intangible losses, with one human life lost during the event. Services were also disrupted which caused major inconvenience to local residents. Train services were limited as a result of damage to the railway line, The University of Wollongong, schools and shops were closed for several days (12).
- f. The heavy rainfall was a result of the interaction between a localised low pressure system and a much more extensive upper level trough. The storm was further enhanced and intensified by convergence into the localised low and uplift over the Illawarra Escarpment (12). The most significant rainfall intensities occurred over a 3 to 6 hour period with some rainfall stations recording 1% AEP (100 year ARI) intensities. The highest 24 hour total of 445mm was recorded at Mt Ousley. Other factors such as flood debris, blockages and flow diversions increased flood levels at particular locations (2).
- g. Detailed mapping of the 1998 event can be found in the flood studies located on Wollongong City Council's website.

February 1984 Event

- h. This event was the largest flooding event in the Mullet Creek catchment and saw widespread flooding in the Wollongong area. Rainfall fell over the area from the 17th to 18th of February lasting approximately 48 hours and was non-stationary in nature (9).
- i. Anecdotal evidence from residents in the area suggest that this was a flash flood with reports of floodwaters rising 2m in an hour and 1.5m in 15 minutes at Darkes Road, Dapto. The event saw main roads in low lying areas inundated, including the Princes Motorway (M1) and Princes Highway (9).

March 1975 Flood

- j. The March 1975 flood event is considered the second largest storm in the Mullet Creek catchment and the Brooks Creek catchment; however, there are no recorded flood levels available for the event in Brooks Creek, only recordings of debris marks (9).

20 October 1987 Flood

- k. The event saw heavy rainfall over a 12 hour period with flooding reported in the commercial precinct at Woonona. Shops within the Main Street of Woonona were flooded and residents reported fences and outhouses being washed away by the event. Within the rainfall event, there were bursts of rain equivalent to 50% AEP (2 year ARI) events or 1 year ARI events (4).
- l. The event was attributed to the intense depression off the coast of NSW, which was registered at 1005 hectopascals (4).

April 1988 Event

- m. Heavy continuous rain was recorded throughout the City of Wollongong from the 3rd to 10th of April, 1988 (total approximately 250mm) leaving the area in a highly saturated state. 14 days later, after some light intermittent rain, heavy rain again developed with approximately 300 mm of rain being recorded over the three days from 28th to 30th April. The heaviest rain occurred at the end of this prolonged wet period, during the early hours of 30th April (2).
- n. Aside from widespread flooding, particularly in the northern suburbs of Wollongong, this storm lead to the collapse of a section of the Illawarra Rail embankment at Coledale in which a house was engulfed and lives lost (2).

9th February 2012 Event

- o. The event was caused by two separate storm cells originating north-west of Wollongong. The first storm cell propagated towards the coast and peaked in intensity between Wollongong and Ulladulla. The second storm cell followed a similar direction as the first storm cell but had less intensity (7).
- p. The storm event lasted for 5 hours, with the peak coinciding with high tide, exacerbating flooding in the low lying areas of Swan Street, Kembla Street, Corrimal Street and Evans Street. 11 residents in the Wollongong City Catchment reported above floor level flooding (7). Observed flood levels at Swan Street were 2.76m AHD (7).

24th March 2014 Event

- q. The 2014 event was a 12 hour event however, the peak coincided with the local low tide and as such didn't induce as much flooding in the Wollongong City Catchment area, with only 1 resident reporting above floor flooding (7).

5th June 2016 Event

- r. The June 2016 rainfall event occurred in conjunction with abnormally high tides and resulted in the flooding of properties in lower Wollongong (Kembla/Swan Streets) and Windang. Lower Wollongong flooding resulted in road closures in conjunction with the morning high tide 5 June 2016. Properties in this area reported experiencing over floor flooding.
- s. The MHL Cudgerie Bay gauge (214416) in Lake Illawarra near Windang recorded a peak lake height of 1.57m which persisted for approximately 4 hours from 22.00hrs 5 June 16 (evacuations occur at heights above 1.2m). In conjunction with the recorded height, accounts from NSW SES members on scene noted that flooding was exacerbated by strong winds causing a storm surge (13). The abnormally high tide occurred at 20:28hrs 5 June 2016 with a height of 1.99m at the lake entrance gauge (214417). A maximum of 327mm of rain was recorded in a 36hour period during the event over the Lake Illawarra catchment.
- t. The Jetty's by the Lake, South Pacific, and Oasis caravan parks in Windang were partially evacuated with 44 persons registered at the evacuation centre (13). Oaklands Village internally evacuated low-lying areas but no homes experienced over-floor inundation. Jetty's by the Lake had 5 vans left uninhabitable with 27 vehicles written off. South Pacific experienced over floor flooding while Oasis had no reports of over floor flooding. All parks experienced internal road flooding, with sections of Jetty's by the lake isolated.

Lake Illawarra

- u. Historical flood events within Lake Illawarra are summarised in Table 1. Note that Lake Illawarra was permanently opened in 2007.

Table 1: Historical Flood Levels at Lake Illawarra Entrance Gauge (214417)

Year	Height at Gauge (m AHD)	Estimated Average Recurrence Interval (ARI) (years)
1984 (14)	1.9	83
1975 (14)	1.8	62.5
1977 (14)	1.8	62.5
1991 (14)	1.8	62.5
1978 (14)	1.6	28
2011 (15)	1.6 (at Cudgerie Bay gauge 214416)	16
2016	1.58 (1.5 at Cudgerie Bay gauge 214416)	> 17
1974 (14)	>1.5	> 17.5

Year	Height at Gauge (m AHD)	Estimated Average Recurrence Interval (ARI) (years)
1919 (14)	>1.5	> 17.5
1930 (14)	>1.5	> 17.5
1959 (14)	>1.5	> 17.5
1943 (14)	>1.5	> 17.5
1988 (14)	1.5	17.5
1990 (14)	1.4	12.5
1998 (11)	1.2	5

1.7 FLOOD MITIGATION SYSTEMS

Levees

- a. A levee is located at the northern end of Austin Street, Woonona in the Collins Creek catchment. The levee comprises sections of earth bund and reinforced block wall. The levee is overtopped in a 1% AEP flood (100 year ARI) (12).

Prescribed Detention/Retarding Basins

- b. There are 25 detention or retarding basins located within the Wollongong LGA as outlined in Table 2. Further details regarding these basins can be found within Section 2 – Specific Risk Areas.

Table 2: Detention and Retarding Basins within the Wollongong LGA

Name	Owner / Catchment	Catchment	Location
Barina Park Detention Basin	Wollongong City Council	Minnegang Creek Catchment	Barina Ave, Lake Heights
Brokers Road Retarding Basin	Wollongong City Council	Cabbage Tree Creek Catchment	Brokers Road, Balgownie (Northern and Southern basins)
Bucklands Retarding Basin	Matt Crossingham	Allans Creek Catchment	Koloona Ave, Figtree
Corrimal High School Retarding Basin	Unknown	Collins Creek Catchment	Murray Road, Corrimal
Dapto Heights Retarding Basin	Wollongong City Council	Mullet Creek Catchment	Colvin Place, Dapto
Edgewood Detention Basin	Wollongong City Council	Collins Creek Catchment	Edgewood Estate, Woonona
Fisher Park Detention Basin	Unknown	Fairy Creek Catchment	Fisher Park, West Wollongong

Name	Owner / Catchment	Catchment	Location
Foothills Estate Retarding Basin 1	Wollongong City Council	Towradgi Creek Catchment	Tarrawanna
Foothills Estate Retarding Basin 3	Wollongong City Council	Towradgi Creek Catchment	Tarrawanna
Foothills Rd	Wollongong City Council	Cabbage Tree Creek Catchment	Foothills Rd, Mount Ousley
Gannet Place Retarding Basin	Wollongong City Council	unnamed catchment	Gannet Avenue, Berkeley
Gilmore Creek	Unknown	Fairy Creek Catchment	Gilmore Park, West Wollongong
Gunyah Park Basin	Wollongong City Council	Fairy Creek Catchment	Dempster St, West Wollongong
Kanahooka Detention Basin	Forest Grove Community Association	Mullet Creek Catchment	Stanthorpe Dr, Kanahooka
Nyrang Park Retarding Basin	Wollongong City Council	Fairy Creek Catchment	Nyrang St, Keiraville
South Bulli Basin 1	Allied Coal Pty Ltd	unknown	Russell Vale
South Bulli Stormwater	Gujarat NRE Minerals Limited	unknown	Russell Vale
Wollongong High School Retarding Basin	Wollongong City Council	Fairy Creek Catchment	Foleys Ln, North Wollongong
Gordon Hutton Park flood retarding basin	Unknown	Collins Creek Catchment	Bulli
Flood retarding basin Nos. 1, 2 & 3	Unknown	Bellambi Gully catchment	
Slacky Flat detention basin	Unknown	Hewitts Creek Catchment	Black Diamond Place, Bulli (eastern end) (15).
South Angels Creek detention basin	Unknown	Towradgi Creek Catchment	Located west of Corrimal Street, at the start of South Angels Creek (6).
North Angels Creek detention basin	Unknown	Towradgi Creek Catchment	Directly west of Bellambi Street in Tarrawanna at the start of North Angels Creek (6).
Corrimal Creek detention basin	Unknown	Towradgi Creek Catchment	Immediately west of South Corrimal Creek (6).
Wisemans Park	Unknown	Fairy Creek Catchment	Wisemans Park, Gwynneville

Other Flood Mitigation

- c. There is a voluntary purchase scheme run by Wollongong City Council. Many properties located in high risk locations have been purchased and demolished.

- d. Flood proof walls have been installed on the boundaries of properties located in Lemrac Avenue, Corrimal to divert floodwaters into North Corrimal Creek (16).
- e. Wollongong City Council has constructed a low earth mound at Cheryl Place, Corrimal to deflect floodwaters away from nearby houses (16).
- f. There is a weir located on North Corrimal Creek at the Coke Works in East Corrimal (5).

1.8 EXTREME FLOODING

- a. The effects of an extreme flooding (or the Probably Maximum Flood [PMF]) varies across the Wollongong catchment. In some areas, there is little difference between the 1% AEP and the PMF event, in others flood flows more than triple and peak levels can be more than five times higher.
- b. The effects of extreme flooding in the 1% AEP and PMF events within each catchment are outlined in Section 2 – Specific Risk Areas.

1.9 COASTAL EROSION AND COASTAL INUNDATION

- a. The Wollongong City Council area is bordered by the Pacific Ocean to the east.
- b. The coastal areas are subject to natural coastal processes and resultant coastline hazards that include coastal erosion, oceanic inundation, and shoreline recession (1).
- c. The coastal erosion/oceanic inundation problem in the Wollongong City LGA takes two forms:
 - i. Undercutting of dunes on their seaward sides, threatening the collapse of dwellings and other infrastructure.
 - ii. The potential breaking through of the dunes by sea water, causing flooding and isolation of property on the landward side of the dunes (1).
- d. The most severe problems of coastal erosion/inundation occur as a result of oceanic storm conditions associated with the passage of ex-tropical cyclones and temperate-zone low-pressure systems. These storms may cause temporary sea level rises with large associated waves. The worst erosion/inundation is likely when severe weather conditions occur in conjunction with high tides (1).
- e. There is an increasing risk to low lying areas in the Illawarra with the onset of sea level rise. Properties located in Wollongong around Swan Street and properties along Lake Illawarra are at the greatest risk of increased flooding.
- f. Refer to Specific Risk Areas – Coastal Erosion and Inundation 2.14 for detail on those locations within the Wollongong LGA that have been identified as being at risk of coastal erosion or inundation.

2 EFFECTS ON THE COMMUNITY

2.1 COMMUNITY PROFILE

Table 3: Census of Housing and Population data (2011)

Census Description	Wollongong LGA
Total Persons	192,418
Aged 0-4 yrs	12,077
Aged 5-14 yrs	23,592
Aged 65 + yrs	31,474
Of Indigenous Origin	4,228
Who do not speak English well	5,047
Have a need for assistance (profound/severe disability)	11,199
Living alone (Total)	18,583
Living alone (Aged 65+)	7,745
Residing in caravans, cabins or houseboats or improvised dwellings	771
Occupied Private Dwellings (Households)	71,764
No Motor Vehicle	8,201
Caravan, cabin, houseboat or improvised dwell	518
Rented via State or Housing Authority	5,796
Rented via Housing Co-Op or Community Church Group	362
No Internet Connection	16,650
Unoccupied Private Dwellings	5,874
Average persons per occup dwelling	2.5
Average vehicles per occup dwelling	1.6

SPECIFIC RISK AREAS - FLOOD

Wollongong Coast Basin

2.2 NORTHERN SUBURBS

2.2.1 Community Overview

- The northern suburbs of Wollongong consist of locations north of Austinmer. These include Coledale, Wombarra, Clifton, Coalcliff, Wombarra and Scarborough. The population in this area is 4,338 (1).
- The northern suburbs are shown on Map 3.

Table 4: Population and Dwellings in Northern Suburbs (17)

Suburb	Population	Private Dwellings
Stanwell Park	1,380	582
Wombarra / Scarborough / Clifton	864	403
Coledale	1,168	519
Coalcliff	196	84

2.2.2 Characteristics of flooding

- Historically the northern suburbs have been affected by flash flooding.
- Parts of this area have also been identified as being at risk of coastal erosion and coastal inundation (18).

2.2.3 Flood Behaviour

- Watercourses located in this area include Hicks Creek, Horse Creek, Stockyard Creek and Flanigans Creek (1).
- Floodplain behaviour from catchment flooding is unknown. There are no Flood Studies or Floodplain Risk Management Studies available for this area.

2.2.4 Classification of Floodplain

- No information available.

2.2.5 Inundation

- Flooding from rainfall, creek and overland flood is not well understood for this area. However Monash Street in Wombarra is a known flooding problem area (1).
- Properties and public infrastructure have been identified as being at potential risk from coastal inundation during a 1% AEP storm event at: Stanwell Park Beach, Coalcliff Beach, in Stanwell Park, Scarborough/Wombarra Beach, Coledale Beach, Sharkies Beach, Austinmer and Austinmer North Beaches. These are detailed **Error!**

Reference source not found. (Refer to Specific Risk Area- Coastal Erosion and Inundation Section **Error! Reference source not found.**4).

2.2.6 Isolation

- a. Isolations can occur throughout this area, with debris and landslips caused by heavy rainfall commonly occurring on Lawrence Hargrave Drive (1).
- b. Coledale Hospital can be isolated for short periods of time (1).
- c. No other information is available.

2.2.7 Flood Mitigation Systems

- a. No information available.

2.2.8 Dams

- a. There is no dam failure information regarding Coalcliff Dam, however discharge from this dam would flow into Stanwell Creek which flows through residential areas between Lawrence Hargrave Drive, Beach Road and Lower Coast Road prior to discharging to the ocean on Stanwell Beach (19).

2.2.9 At Risk Facilities

- a. **Coledale Hospital** is located on Lawrence Hargrave Drive in Wombarra and can be isolated for short periods of time. Major landslips or road inundation north and south of its location may affect the hospital's ability to obtain supplies or maintain functional operations in the short term. (1).
- b. **Surf Life Saving Clubs** at Helensburgh, Coalcliff and Scarborough/Wombarra have all been identified as being at potential risk of coastal erosion (18).

2.2.10 Other Considerations

- a. No information available.

2.3 HEWITTS CREEK CATCHMENT

2.3.1 Community Overview

- a. The Hewitts Creek catchment is located 10 km north of the Wollongong CBD, between the Illawarra Escarpment and the coastline to the east (2). The Hewitts Creek catchment incorporates the suburbs of Thirroul and Bulli. The population of Thirroul in 2011 was 5,620 and Bulli was 5,671 (17).

Table 5: Population and Dwellings in Hewitts Creek Catchment (17)

Suburb	Population	Private Dwellings
Thirroul	5,620	2,307
Bulli	5,671	2,215

- b. The Hewitts Creek catchment is shown on Map 4.

2.3.2 Characteristics of flooding

- a. Significant sections of the area are prone to flash flooding, particularly upstream of the railway and low lying areas behind the coastal dune. Floodwaters rise very quickly, resulting in too short a flood warning time to allow safe evacuation (20).
- b. Downstream portions of the catchment are also subject to oceanic conditions can be flooded due to coastal inundation (18).

2.3.3 Flood Behaviour

- a. Watercourses located within the Hewitts Creek catchment include; Hewitts Creek, Slacky Creek, Thomas Gibson Creek, Tramway Creek and Woodlands Creek (3).
- b. The presence of structures has a significant influence on flood behaviour within these areas which can be further exacerbated by blockages of culverts.
- c. Key areas where these structures exacerbate flooding include:
 - i. The coal haulage embankment in the Slacky Creek catchment diverts flows eastwards along Hobart Street to the Tramway Creek catchments when the capacity of culverts are exceeded (3).
 - ii. Once the capacity of the culvert beneath Lachlan Street, Thirroul in Hewitts Creek is exceeded, water flows east along Lachlan Street and into Thomas Gibson Creek (3).
 - iii. Once the capacity of the culverts beneath Cliff Parade, Thirroul in Thomas Gibson Creek are exceeded, water flows northwards along Cliff Parade and into Flanagan's Creek at the esplanade (3).

- iv. When the capacity of the culverts beneath the Illawarra Railway on Tramway Creek are exceeded upstream properties, particularly in Allenby Parade, Bulli are subject to flooding (3).
- d. Tidal surges in excess of 1.4m will directly affect flood outflows (1).
- e. The areas which are shown to have high hydraulic hazard, that is areas with fast and/or deep flowing waters, is generally limited to the within the stream channels, and land upstream of the railway line where significant flood depths occur (20).

2.3.4 Classification of Floodplain

- a. The majority of the study area is classified as High Trapped Perimeter, indirectly affected areas or those areas in between that are not flood affected (3). However there are a number of locations that can become Low Flood islands whereby they can be first isolated and then eventually flooded.
- b. Numerous areas throughout the catchment may become isolated, but not inundated in High Flood Islands, High Trapped Perimeters or indirectly affected areas.

Low Flood Islands

- c. These are all located on the western side of the railway line and include:
 - i. Properties on Hewitts Avenue, Thirroul;
 - ii. Properties at the base of Bulli Pass on the Princes Highway, and Sturdee Avenue (on the border of Bulli and Thirroul);
 - iii. Lawrence Hargrave Drive, Thirroul south of Lachlan Street;
 - iv. Lachlan Street (east of Pass Avenue), Thirroul;
 - v. Bulli Showground and Racing Complex, Bulli.

High Flood Islands

- d. High Flood Islands in particular have been identified in:
 - i. McCauleys Beach Estate, Thirroul (southern half)
 - ii. Properties located between George and Lachlan Streets, Thirroul (upstream of laneway);
 - iii. On either side of the railway line around the Thirroul CBD.

2.3.5 Inundation

- a. 80% of the estimated flood damages to property comes from within Hewitts Creek and Tramway Creek catchments.

- b. There are two flood level gauges, owned by MHL, on Hewitts Creek: Hewitts Creek Entrance Gauge (214408) and Hewitts Creek Upstream Gauge (214410). There are currently no warnings linked to these gauges.

Slacky Creek

- c. Properties in the Slacky Creek catchment that may experience inundation are located in Beacon Avenue, George Avenue, Beach Street and National Avenue (3) (20).

Tramway Creek

- d. Properties in the Tramway Creek catchment that may experience inundation are located upstream of the rail line, in Allenby Parade, Point Street, the Princes Highway Haig Street and Hobart Street (3) (20).

Woodlands Creek

- e. Properties in Bulli in the Woodlands Creek catchment that may experience inundation are located directly upstream of the rail embankment and include Sturdee Avenue and Hewitts Avenue. The Princes Highway may also be impacted. Areas downstream of the rail embankment including the McCauleys Beach Estate can become isolated (3) (20).

Hewitts Creek

- f. Properties in Thirroul located in the Hewitts Creek catchment that may experience inundation are located directly upstream of the rail embankment and adjacent to Hewitt Creek. Streets where properties may experience inundation include Lawrence Hargrave Drive, High Street, Lachlan Street, George Street, Pass Avenue, Hewitts Avenue, Corbett Avenue and Hamilton Road. Parts of McCauleys Beach estate downstream of the railway embankment may become isolated due to road and bridge closures (3) (20).

Thomas Gibson Creek

- g. Properties located in the Thomas Gibson Creek catchment that may experience inundation are located immediately upstream of the rail line on Lawrence Hargrave Drive, downstream of the rail embankment in Spray Street, Bath Street, Cliff Parade and The Esplanade. (3) (20).
- h. There is no flood warning system located in this catchment as the rate of rise of floodwaters is too quick to allow for a system to be implemented.

Table 6: Estimated No. Properties with Over Floor Flooding in the Hewitts Creek Catchment (20)

Design Flood Event (% AEP)	No. Properties with Over floor Flooding in Slacky Creek	No. Properties with Over floor Flooding in Tramway Creek	No. Properties with Over floor Flooding in Woodlands Creek	No. Properties with Over floor Flooding in Hewitts Creek	No Properties with Over floor Flooding in Thomas Gibson Creek	Total Properties with Over floor Flooding
PMF	6	15	5	70	29	125
1% AEP	1	11	5	58	22	97
2% AEP	1	10	5	57	18	91
5% AEP	1	10	4	47	13	75
20% AEP	0	0	0	6	5	11

Table 7: Estimated No. Properties with Over Ground Flooding in the Hewitts Creek Catchment (20)

Design Flood Event (% AEP)	No. Properties with Over ground Flooding in Slacky Creek	No. Properties with Over ground Flooding in Tramway Creek	No. Properties with Over ground Flooding in Woodlands Creek	No. Properties with Over ground Flooding in Hewitts Creek	No Properties with Over ground Flooding in Thomas Gibson Creek	Total Properties with Over ground Flooding
PMF	35	20	6	89	38	188
1% AEP	28	11	5	74	30	148
2% AEP	27	11	5	74	27	144
5% AEP	27	10	5	35	25	132
20% AEP	0	0	0	10	5	15

2.3.6 Isolation

- a. Isolation to single properties may occur due to road /access closures in the catchment. Access would be regained within 1-2 hours of cessation of rainfall (1).
- b. A number of areas can become isolated due to flooding of creeks and roads cutting off access to areas including:
 - Sandon Point residential area;
 - McCauleys Beach Estate

2.3.7 Flood Mitigation Systems

- a. Black Diamond Place Detention Basin is located adjacent to Slacky Creek in Bulli. There is no further information on this detention basin (20).

- b. There are no other known flood mitigation systems in the Hewitts Creek catchment.

2.3.8 Dams

- a. Old Bulli Mine Dam is located in Bulli. There is no further information on this dam (20).

2.3.9 At Risk Facilities

- a. **Bulli Public School** is located on Haig Road in Bulli. This area can become a high hazard floodway due to flooding in Tramway/Slacky Creek.
- b. **St Michael's Catholic Primary School** is located on Station Street in Thirroul and may become locally isolated due to road closures (3).
- c. **Thirroul Public School** is located on Roxburgh Avenue in Thirroul. It is located on a High Flood island and may become isolated from other parts of Thirroul (3).
- d. **Thirroul Early Childhood Centre** is located on Lawrence Hargrave Drive in Thirroul.
- e. **Thirroul Pre-School Centre** is located on Lawrence Hargrave Drive in Thirroul.
- f. **Bulli Community Preschool** is located on Quilkey Place in Bulli. This area can become a high hazard floodway due to flooding from Slacky Creek (3).
- g. **Sandon Point Children's Centre** is located on Point Street in Bulli and may become locally isolated due to road closures (3).
- h. **Southern Cross Court Retirement Village** is located on Raymond Road in Thirroul.
- i. **Tasman Court Retirement Village** is located on Tasman Parade in Thirroul.
- j. **McCauley Lodge Residential Care Service** is located on Tasman Parade in Thirroul.

2.3.10 Other Considerations

- a. The Thirroul Seaside Festival is held in the first weekend of April. The festival draws a large number of tourists to the area.
- b. Known trouble spots exist in George and Lachlan Streets and Hewitts Ave, Thirroul. The Princes Hwy and Lawrence Hargrave Drive at the bottom of Bulli Pass and the highway near Bulli Trotting Track have suffered damage in previous events.

2.4 COLLINS CREEK CATCHMENT

2.4.1 Community Overview

- a. The Collins Creek Catchment covers the suburbs of Bellambi, Bulli, Corrimal, Corrimal East, Russell Vale and Woonona. The total population of these suburbs was 32,191 in 2011 (17).
- b. The Collins Creek catchment is located to the north of the Wollongong CBD and is situated between the Illawarra Escarpment in the west and the Tasman Sea in the east.
- c. The catchment is made up of four smaller catchments. They are the Whartons Creek catchment, Collins Creek Catchment, Bellambi Gully/ Farrahars Creek catchment and Bellambi Lake catchment (12).
- d. The Collins Creek catchment is shown on Map 5.

Table 8: Population and Dwellings in Collins Creek Catchment

Suburb	Population	Private Dwellings
Bellambi	4,011	1,790
Bulli	5,671	2,215
Corrimal	6,325	2,776
Corrimal East	3,159	1,500
Russel Vale	1,518	585
Woonona	11,442	4,751

2.4.2 Characteristics of Flooding

- a. Because of the small size of the catchments and comparatively steep gradient of the creeks, flooding is of a “flash flooding” nature and is usually short duration (12).
- b. The catchment is subject to riverine and overland flooding and particularly in the middle and lower reaches flooding can occur as a result of blockages in culverts and bridges and the drainage network reaching capacity (4).

2.4.3 Characteristics of flooding

- a. Because of the small size of the catchments and comparatively steep gradient of the creeks, flooding is of a “flash flooding” nature and is usually short duration (12).
- b. The catchment is subject to riverine and overland flooding and particularly in the middle and lower reaches flooding can occur as a result of blockages in culverts and bridges and the drainage network reaching capacity.

2.4.4 Flood Behaviour

- a. The Collins Creek catchment is made up of Whartons, Collins, Farrahars and Bellambi Gully Creeks, and Bellambi Lake (1).
- b. The creeks have a capacity general less than a 20% AEP (5 year ARI). Depths are shallow up to the 10% AEP (12).

Whartons Creek Catchment

- c. In the 1% AEP event the floodway is generally contained to the creek, with additional floodways existing on Dumbrell Road, the Princes Highway between Station Street and Hopetoun Street and Ursula Road between Franklin Avenue and Benelong Street (12).
- d. Water can also break out of these floodways and inundate areas including Gordon Hutton Park, the Princes Highway and Illawarra Railway Line and the area between Ursula Road and Whartons Creek downstream of the Railway Line (12).

Collins Creek Catchment

- e. In the 1% AEP event the floodway is generally contained to the creek in the upper sections of the catchment. In the lower sections of the catchment the floodway crosses properties between High Street and the Princes Highway before crossing the Highway and flowing down Nicholson Road, Lang Street, Woonona Street and Bell Street. It then crosses over the Princes Highway and flows down Campbell Street and through properties to join the floodway in Nicholson Road. The floodway follows the creek before opening up into to Collins Park where a third of the park becomes a floodway. Another floodway also flows down Lawrence Street and Carrington Street before entering Collins Park (12).
- f. In the 1% AEP event floodwaters can accumulate in the Edgewood detention basin, on the western side of the Railway embankment, on the western side of Memorial Drive and on Lawrence and Carrington Streets adjacent to the floodway (12).
- g. In the 1% AEP event some shallower flooding (flood fringe areas) can be found adjacent to the floodways, in the area between the Princes Highway and Memorial Drive bounded but Russell Street and Gray Street and the area bounded by Memorial Drive, Collins Park, Kialoa Road and Campbell Street (12).

Farrahars Creek/Bellambi Gully Creek Catchment

- h. In the 1% AEP event floodways are generally located within the creeks. Sections of floodway can be found flowing through properties between Bellambi Lane and Albert Street, on York Road between Terania Street and Collaery Road, between Memorial Drive and the Illawarra Railway Line near Lode Lane and Brompton Road and following the creek, along Ellen Street, through the grounds of Holy Spirit College, along Railway Parade between Charlotte Harrison Drive and Lighthouse Drive, along Lighthouse Drive and Pendlebury Parade (12).

- i. In the 1% AEP event flood storage areas can be found adjacent to floodways, in Kathleen Crescent, on Stanhope Street, on the western side of Memorial Drive near the Albert Street intersection (12).
- j. In the 1% AEP event flood fringe areas can be found adjacent to floodways and creeks, in Hollymount Park, in Cawley Park and along Kerrong Avenue, between Bellambi Lane and Albert Street, between Memorial Drive and the Illawarra Railway Line and the entire area east of the Railway Line from Lighthorse Drive to Holy Spirit College (12).

Bellambi Lake Catchment

- k. In the 1% AEP event floodways can be found following the creek, along Robson Street and Rothery Street, between the Princes Highway and Wilga Street, along Eager Street, on Mountbatten Street and in Mountbatten Park, on the western side of the Illawarra Railway line near Louis Street, on Sellers Crescent and Turner Esplanade and in Bellambi Lagoon (12).
- l. In the 1% AEP event flood storage areas can be found between Rothery Street and Mountbatten Street, in the Corrimal High detention basin and in Bellambi Lagoon (12).
- m. In the 1% AEP event flood fringe areas can found between Wilford Street and the Princes Highway near the creek, between Eager Street and Rothery Street, the entire area between Memorial Drive and the Illawarra Railway Line, between Railway Street and McConnell Street, between Rothery Street and Turner Esplanade and Bellambi Lagoon (12).

2.4.5 Classification of Floodplain

- a. Note: Flood classifications are only available for the 1% AEP event. These may vary during other events.

Low Flood Islands:

- b. In the 1% AEP event Low Flood Islands in the Whartons Creek catchment can be found comprising of some residential properties located on Tulip Way and Gardenia Terrace, Woonona; Benelong Street, Bulli; Farrell Road, Bulli; and Colemans Lane, Bulli (12).

High Flood Islands:

- c. In the 1% AEP event a High Flood Island is located in the Collins Creek catchment and is comprised of some residential properties located on Campbell Street, Robert Street, Nicholson Road and Woonona High School, Woonona; Popes Road and Woonona Parade, Woonona; Cedar Terrace, Forestview Way, Woonona; Cooper Avenue, Collins Avenue and Parranweena Way, Woonona (12).
- d. In the 1% AEP High Flood Islands can also be found in the Bellambi Gully and Farrahars Creek catchments. They comprise of large areas of residential properties located on Lassiter Avenue and Pendlebury Parade, Woonona; properties bounded by Cornelius O'Brien Way and Grand Pacific Drive, Charlotte Harrison Drive, Harriet Spearing Drive,

and the coast, Woonona; Chester Street, Bellambi Lane, Kirton Road and Watts Lane, Bellambi; Brompton Road, Hardie Street, Daphne Street, Jones Place and Rothery Road, Corrimal (12).

- e. In the 1% AEP the Bellambi Lake Catchment is a High Flood Island comprising residential properties located on Rothery Road, Edwina Street and Mountbatten Street, Corrimal (12).

2.4.6 Inundation

- a. Damaging flooding will occur in the study area even at the 20% AEP (5 year ARI) level with shallow depths of inundation, and progressively increase with increasing AEP (12).
- b. There is one flood level gauge, owned by MHL, located on Bellambi Lake: Bellambi Gauge (214488). There are currently no warnings provided to this gauge.
- c. The Princes Highway is impacted upon in events as frequent as a 20% AEP (5 year ARI) and will reach depths of 1m at several locations during a major flood event (4).

Table 9: Estimated No. Properties with Over Floor Flooding in the Whole Collins Creek Catchment (12).

Design Flood Event (% AEP)	No. Residential Properties with Over floor Flooding	No. Commercial Properties with Over floor Flooding	No. Public Properties with Over floor Flooding	Total Properties with Over floor Flooding
PMF	1394	73	24	1491
0.2% AEP	689	52	9	750
0.5% AEP	578	48	8	634
1% AEP	511	47	6	564
2% AEP	428	47	6	481
5% AEP	356	46	5	407
10% AEP	62	11	2	75
20% AEP	38	8	1	47

Whartons Creek Catchment

- d. In the 20% AEP (5yr ARI) event inundation of land occurs in Gordon Hutton Park, upstream of Organs Road, in properties on Organs Road, Hospital Road, the Princes Highway, Dumbrell Road, Farrell Road, downstream of the Illawarra Rail Line adjacent to the creek, in the grounds of Bulli High School and Waniora Public School, Bulli Park and properties on Ursula Road, Benelong Street, Alroy Street, Jardine Street and Godolphin Street. Over floor flooding in the 20% AEP (5yr ARI) event occurs to properties located on the Princes Highway, Dumbrell Road, Alroy Street and Ursula Road (12).

- e. In the 10% AEP (10yr ARI) event inundation in addition to the 20% AEP (5yr ARI) occurs on land on Corrie Road, Railway Street, Colemans Lane and Trinity Row. Over floor flooding occurs in properties located in Alroy Street and Trinity Row (12).
- f. In the 5% (20yr ARI) and 2% (50yr ARI) events in addition to the 10% (10yr ARI) inundation of grounds occurs on Hopetoun Street, Agapantha Terrace, Tulip Way and Park Road. Over floor flooding occurs in properties located Godolphin Street, Jardine Street, Ursula Road, Benelong Street, Franklin Avenue, Colemans Lane, Princes Highway, Railway Street and Organs Road (12).
- g. In the 1% AEP (100yr ARI) event in addition to 2% (50yr ARI) event inundations, over floor flooding occurs on properties located on Hospital Road (12).
- h. In the 0.5% AEP (200yr ARI) and 0.2% AEP (500yr ARI) inundation occurs on Athol Street and McKinnon Street. Over floor flooding affects properties on Corrie Road and Hopetoun Street (12).
- i. In the PMF event over floor flooding occurs on Agapantha Terrace and Tulip Way (12).

Table 10: Estimated No. Properties with Over Floor Flooding in the Whartons Creek Catchment (12)

Design Flood Event (% AEP)	No. Residential Properties with Over floor Flooding	No. Commercial Properties with Over floor Flooding	No. Public Properties with Over floor Flooding	Total Properties with Over floor Flooding
PMF	170	22	10	202
0.2% AEP	59	12	5	76
0.5% AEP	49	11	5	65
1% AEP	40	11	3	54
2% AEP	29	11	3	43
5% AEP	21	11	3	35
10% AEP	5	2	1	8
20% AEP	3	2	0	5

Collins Creek Catchment

- j. In the 20% AEP (5yr ARI) event over ground flooding occurs in areas adjacent to the creeks. Properties impacted are located in Hollymount View, Peppermint Circuit, Popes Road, Mountain Avenue, Stephan Drive, Joseph Street, Lang Street, Woonona Parade, Bell Street, Princes Highway, Franklin Avenue, Fretus Avenue, High Street, Nicholson Road, Austin Street, Campbell Street, Haddon Lane, Russell Street, Thompson Street, Waterloo Street, Lawrence Street, Kialoa Road, Cooper Avenue, Kulgoa Road, and Ocean and Collins Parks. Over floor flooding occurs in properties located on Kialoa Road, Franklin Avenue, Thompson Street, Cotterill Avenue Princes Highway, Woonona Avenue and Lang Street (12).

- k. In the 10% AEP (10yr ARI) event over ground flooding occurs in Lilly Pilly Circuit and Carrington Street. Over floor flooding occurs to properties located on the Princes Highway (12).
- l. In the 5% AEP (20yr ARI) over ground flooding affects properties located in Adams Parade, Collins Avenue, Lighthouse Drive, Dorrigo Avenue, Royal Crescent, Robertson Road and Kareela Road. Over floor flooding occurs in properties located on Carrington Street, Lawrence Street, Cotterill Avenue, Royal Crescent, Waterloo Street, Adams Parade, Campbell Street, Nicholson Road, High Street, Fretus Avenue, Mountain Avenue and Popes Road (12).
- m. In the 2% AEP (50yr ARI) event over ground flooding affects properties located in Forestview Way, Park Road and Wynn Street. Over floor flooding occurs in the same locations as in the 5% AEP (20yr ARI).
- n. In the 1% AEP over ground flooding affects properties located in Muir Street. Over floor flooding occurs in Dorrigo Avenue and the same locations as the 5% and 2% AEP (12).
- o. In the 2% and 5% AEP over ground flooding affects properties located in Sussex Street, Park Street, Beach Drive and Ocean Avenue. Over floor flooding occurs in Robertson Street (12).
- p. Over ground flooding in the PMF occurs on Cedar Terrace, Hillcrest Avenue, Liamina Avenue, Corinda Road and Owen Street. Over floor flooding occurs in the same locations as the 5% and 2% AEP (12).

Table 11: Estimated No. Properties with Over Floor Flooding in the Collins Creek Catchment (12)

Design Flood Event (% AEP)	No. Residential Properties with Over floor Flooding	No. Commercial Properties with Over floor Flooding	No. Public Properties with Over floor Flooding	Total Properties with Over floor Flooding
PMF	318	21	2	341
0.2% AEP	144	17	2	163
0.5% AEP	125	15	2	142
1% AEP	112	15	2	129
2% AEP	97	15	2	114
5% AEP	79	14	1	94
10% AEP	12	3	1	16
20% AEP	9	1	1	11

Farrahars Creek/Bellambi Gully Creek Catchment

- q. In the 20% AEP (5yr ARI) event over ground flooding occurs in areas adjacent to the creek channels. Properties that may be affected include those located between the

Illawarra Railway Line and Memorial Drive, the Russell Vale Golf Course, Duke Street, Marlen Place, Watergum Way, Princes Highway, Albert Street (Woonona), Hale Street, Chenhalls Street, Monie Street, Stanhope Street, Greta Street, Rose Street, Alice Street, Mitchell Road, Kathleen Crescent, Pendlebury Parade, George Cheadle Place, Harriet Spearing Drive, John Cawley Crescent, Elizabeth Underwood Close, Doris Avenue, Collaery Road, Neville Avenue, Leslie Street, Williams Crescent, West Street, Moreton Street, Hicks Street, East Street, Terania Street, York Road, Nimbin Street, Keerrong Avenue, Bellambi Lane, Albert Street (Bellambi), Kirton Road, Hardie Street, Brompton Road, Lavender Street, Ellen Street, Pioneer Road, Gladstone Street and Lismore Street. Over floor flooding affects properties located on Monie Street, Stanhope Street, Princes Highway, Doris Avenue, Collaery Road, West Street, Ellen Street and Pioneer Road (12).

- r. In the 10% AEP (10yr ARI) event over ground flooding occurs in Halley Crescent, Ivor Street and Jones Place, in addition to those affected in the 20% AEP (5yr ARI). Over floor flooding occurs in Gladstone Street in addition to properties affected in the 20% AEP (5yr ARI) event (12).
- s. In the 5% AEP (20yr ARI) event overground flooding affects properties located on Gayantay Way, Linda Place, Channon Street, Eager Street, Chester Street, Frances Street and Hollebon Road in addition to those affected in smaller events. Over floor flooding affects properties located in Marlen Place, Albert Street (Woonona), Greta Street, Mitchell Road, Linda Place, Kathleen Crescent, Pendlebury Parade, Elizabeth Underwood Close, Neville Avenue, Williams Crescent, East Street, York Road, Keerrong Avenue, Bellambi Lane, Albert Street (Bellambi), Brompton Road and Frances Street in addition to those impacted in smaller events (12).
- t. In the 2% AEP (50yr ARI) event overground flooding affects properties located on Alfred Street and Noosa Avenue in addition to those impacted in smaller events. Over floor flooding occurs in properties located in George Cheadle Place in addition to properties impacted in smaller events (12).
- u. In the 1% AEP (100yr ARI) event overground flooding occurs in Pallier Place, George Tate Close and Narelle Crescent in addition to those affected in smaller events. Over floor flooding impacts properties located in Chenhalls Street, Jones Place and Lismore Street in addition to properties affected in smaller events (12).
- v. In the 0.5% AEP (200yr ARI) event overground flooding occurs in Thomas Collaery Place in addition to locations affected in smaller events. Over floor flooding occurs on properties in Alice Street in addition to properties affected in smaller events (12).
- w. In the 0.2 % AEP (500yr ARI) event overground flooding impacts properties located on John Street and Henry Fry Place in addition to those affected in smaller events. Over floor flooding affects properties located in Duke Street, Halley Crescent, Eager Street, Kirton Road and Lavender Street in addition to those affected in smaller events (12).

- x. In the PMF event overground flooding impacts properties located in Pat Geraghty Place, Cornelius O'Brien Way, Henry Fry Place, Edward Corrigan Close, Elizabeth Reynolds Circuit, Charlotte Harrison Drive, Broker Street and Daphne Street in addition to those impacted in smaller events. Over floor flooding affects properties located on John Cawley Crescent, Cornelius O'Brien Way, Edward Corrigan Close, Elizabeth Reynolds Circuit, Charlotte Harrison Drive, Thomas Collaery Place, Moreton Street, Hicks Street, Terrania Street and Chester Street in addition to those impacted in smaller events (12).

Table 12: Estimated No. Properties with Over Floor Flooding in the Farrahars/Bellambi Gully Creek Catchment (12)

Design Flood Event (% AEP)	No. Residential Properties with Over floor Flooding	No. Commercial Properties with Over floor Flooding	No. Public Properties with Over floor Flooding	Total Properties with Over floor Flooding
PMF	408	27	12	447
0.2% AEP	240	20	2	262
0.5% AEP	210	19	1	230
1% AEP	186	18	1	105
2% AEP	145	18	1	164
5% AEP	127	18	1	146
10% AEP	26	6	0	32
20% AEP	19	5	0	24

Bellambi Lake Catchment

- y. In the 20% AEP (5yr ARI) event over ground flooding occurs in areas adjacent to the creek and also affects properties located on Robson Street, Lyndon Street, Bloomfield Avenue, Annie Street, Midgley Street, Princes Highway, Wilga Street, Eager Street, Rothery Street, Edwina Street, Mountbatten Street, Louis Street, Collins Street, Park Road, Dalby Street, Coolgardie Street, Pioneer Road, Edyth Street, Thalassa Avenue, Cawley Street, Turner Esplanade, Birch Crescent, Sellers Crescent, Gleeson Crescent, Kells Crescent, Tressider Place, Hapgood Place and Sangstar Place. Over floor flooding affects properties located on Rothery Street and Mountbatten Street (12).
- z. In the 10% AEP (10yr ARI) event over ground flooding affects properties located in the same locations as the 20% AEP (5yr ARI). Over floor flooding affects properties located on Midgley Street, Park Road, Pioneer Road, Gleeson Crescent and Kells Crescent in addition to areas affected in the 20% AEP (5yr ARI) event (12).
- aa. In the 5% AEP (20yr ARI) event over ground flooding affects properties located on Hansen Street, Carroll Road and Connaghan Avenue in addition to locations impacted in smaller events. Over floor flooding affects properties located on Robson Street,

Princes Highway, Wilga Street, Eager Street, Louis Street, Collins Street, Coolgardie Street, Thalassa Avenue, Cawley Street and Connaghan Avenue in addition to those affected in smaller events (12).

- bb. In the 2% AEP (50yr ARI) event over ground flooding affects properties located in the same locations as those affected in smaller events. Over floor flooding affects properties located on Turner Esplanade in addition to properties affected in smaller events (12).
- cc. In the 1% AEP (100yr ARI) event over ground flooding affects properties located in the same locations as those affected in smaller events. Over floor flooding affects properties located on Carroll Street and Birch Crescent in addition to properties affected in smaller events (12).
- dd. In the 0.5% AEP (200yr ARI) event over ground flooding affects properties located in the same locations as those impacted in smaller events. Over floor flooding affects properties located on Bloomfield Avenue in addition to those impacted in smaller events (12).
- ee. In the 0.2% AEP (500yr ARI) event over ground flooding affects properties located on Ramela Street in addition to areas affected in smaller events. Over floor flooding affects properties located on Edwina Street in addition to those impacted in smaller events (12).
- ff. In the PMF event over ground flooding affects properties located in the same areas as those impacted in smaller events. Over floor flooding affects properties located on Edyth Street and Sellers Crescent in addition to those affected in smaller events (12).

Table 13: Estimated No. Properties with Over Floor Flooding in the Bellambi Lake Catchment (12)

Design Flood Event (% AEP)	No. Residential Properties with Over floor Flooding	No. Commercial Properties with Over floor Flooding	Total Properties with Over floor Flooding
PMF	498	3	501
0.2% AEP	246	3	249
0.5% AEP	194	3	197
1% AEP	173	3	173
2% AEP	157	3	160
5% AEP	129	3	132
10% AEP	19	0	19
20% AEP	7	0	7

2.4.7 Isolation

- a. Isolation in the catchment consist of the areas defined as High and Low Flood Islands above.

2.4.8 Flood Mitigation Systems

- a. **Gordon Hutton Park flood retarding basin** is located within the Whartons Creek catchment. The basin has been designed to surcharge during a 5% AEP (20 year ARI) event. Partial blockages of the spillway by fences can result in exacerbated flooding to properties which lie to the east of the Princes Highway near Hopetoun Street and Farrell Road (12).
- b. **Edgewood Estate flood retarding basin** is located in the Collins Creek catchment. The volume of flood storage in the basin is 11,900m³. This volume is equivalent to 17mm of rainfall excess falling in the catchment. The spillway operates during a 1% AEP (100 year ARI) event. The water from the basin discharges in a north-easterly direction across Hollymount View and discharges into a water quality pond to the east of Cedar Terrace (12).
- c. **Flood retarding basin Nos. 1, 2 & 3** are located in the Farrahars Creek/Bellambi Gully catchment. The spillway in basin 1 begins to spill during a 20% AEP (5yr ARI) event. The spillway and basin 2 surcharges in a 1% AEP (100 year ARI) event. During the PMF event flood water from basin 2 discharges into basin 3 via a 6 x 0.9m culvert which runs through the embankment. Basin 3 discharges through a 1500mm diameter pipe. This is overtopped during a 50 year ARI event. During a 100 year ARI event the Princes Highway is inundated to depths exceeding 500mm for up to 140m north of the basin outlet pipe (12).
- d. **Corrimal High School flood retarding basin** is located in the Bellambi Lake catchment. The spillway of the basin operates for a 15 AEP (100 year ARI) event. A number of properties located downstream of the basin in Edyth Street, Thalassa Avenue and Cawley Street may experience inundation in the 5% AEP (20 year ARI) (12).
- e. **Bulli Upper Railway Basin** previously existed at the top of Slacky Creek in Bulli however this dam has now been decommissioned.
- f. **Austin Street Levee:** A levee is located at the northern end of Austin Street, Woonona in the Collins Creek catchment. The levee comprises sections of earth bund and reinforced block wall. The levee is overtopped in a 1% AEP event (12).

2.4.9 Dams

- a. There are no dams located within the Collins Creek catchment.

2.4.10 At Risk Facilities

- a. **Schools:** There are nine schools and three childcare centres affected by flooding in the catchment. Details are shown in Annex 2 (12).
- b. **Aged Care/retirement:** There are four aged care /retirement facilities affected by flooding in the catchment. Details are shown in Annex 2 (12).

- c. **Hospitals:** The main access to Bulli hospital can be lost at the Princes Highway intersection road closure in a 5% AEP (1).

2.4.11 Other Considerations

- a. **Illawarra Railway line** may become compromised due to scouring, culvert blockage and inundation.

2.6 TOWRADGI CREEK CATCHMENT

2.6.1 Community Overview

- The Towradgi Creek catchment covers the suburbs of Corrimal, Tarrawanna, East Corrimal, Towradgi and Fernhill. The population of these suburbs was 15,680 with 6,711 dwellings in 2011 (17).
- The catchment is located north of the Wollongong CBD and is situated between the Illawarra Escarpment to the west and the Tasman Sea to the east.
- The Towradgi Creek catchment is shown on Map 6.

Table 14: Population and Dwellings in Towradgi Creek Catchment

Suburb	Population	Private Dwellings
Corrimal	6,325	2,776
Tarrawanna	1,996	832
Corrimal East	3,159	1,500
Towradgi	3,123	1,372
Fernhill	1,024	507

2.6.2 Characteristics of flooding

- The Towradgi Creek catchment is affected by flash flooding with the community having less than 1 hour warning time.

2.6.3 Flood Behaviour

- The Towradgi Creek Catchment incorporates Towradgi Creek, South and North Angels Creeks, Carr Creek, South and North Corrimal Creeks, Parker Creek and Towradgi Lagoon (5).
- Towradgi Lagoon is mechanically opened by Wollongong City Council when the lagoon reaches the trigger level of 1.6m AHD and rainfalls is expected to cause the lagoon to rise further (5).
- The only information currently available for the Towradgi Creek Catchment is for a 1% AEP flood event.

North Corrimal Creek

- In the 1% AEP event the floodway generally follows the creek channel and its immediate banks. It may impact properties that back onto the creek including those located on Lemrac Avenue, Frances Street, Collins Street, Underwood Street and Railway Street. The floodway also flows down Coxs Avenue, Lemrac Avenue, Willow Grove, Collins Street, Underwood Street, the Princes Highway, Russell Street, Wilga Street, Memorial Drive and Railway Street (5).

- e. In the 1% AEP event flood storage areas can be found on the north side of the floodway between Collins Street and Francis Street, in the commercial properties located on the southern side of Russell Street, around the floodway at the Memorial Drive and Railway Street intersection and to the west of the Illawarra Railway (5).
- f. In the 1% AEP event flood fringe areas can be found adjacent to the floodway, in the Corrimal Memorial Park and Ziems Park (5).

South Corrimal Creek

- g. In the 1% AEP event the floodway flows down Foothills Road before entering the creek system where it remains in its banks until it reaches The Avenue where it crosses the road and flows through properties located near The Avenue and Underwood Street intersection. The floodway flows down Tarrawanna Road and crosses the Princes Highway before flowing through the Corrimal Library carpark. The floodway then follows the creek channel until joining Towradgi Creek (5).
- h. In the 1% AEP event flood storage areas can be found mainly where South Corrimal Creek joins Towradgi Creek (5).
- i. In the 1% AEP event flood fringe areas can be found adjacent to the floodway and on the western side of Underwood Street between The Avenue and Collins Street (5).

North Angels Creek

- j. In the 1% AEP event the floodway flows across properties located between Crowther Place and Bellambi Street, crosses Bellambi Street and flows through properties located between Bellambi Street and Meadow Street. It then flows down Tarrawanna Road, impacting properties located between Karen Place and Tarrawanna Road and follows the creek channel, potentially affecting properties adjacent to the creek before joining South Angels Creek (5).
- k. In the 1% AEP event flood storage can be found in the detention basin at the start of the creek (5).
- l. In the 1% AEP event flood fringe areas can be found adjacent to the floodway and impacts properties located on Tarrawanna Road and between Meadow Street and Crowther Place (5).

South Angels Creek

- m. In the 1% AEP event the floodway follows the creek channel until it crosses Corrimal Street where it affects properties located adjacent to the creek between Corrimal Street and Meadow Street. The floodway crosses Meadow Street and flows into the field on Henry Street before crossing Williamson Street and following the creek channel until it joins with Towradgi Creek. Properties located on Meads Avenue and the Princes Highway may form part of the floodway (5).

- n. In the 1% AEP event flood storage areas can be found in the detention basin at the start of the creek and in areas adjacent to the floodway on the west and east side of Corrimal Street (5).
- o. In the 1% AEP event flood fringe areas can be found adjacent to the floodway and affects properties located on Corrimal Street, Brooker Street, Meadow Street and Henry Street (5).

Towradgi Creek

- p. In the 1% AEP event the floodway of the upper section of Towradgi Creek is contained to the creek channel until it reaches Meadow Street where it crosses the road and impacts the Keira Street intersection and affects properties located on Meadow Street. The floodway then follows the creek channel and crosses Charles Road before reaching the Princes Highway where South Angels Creek joins. Properties adjacent to the creek may also form part of the floodway. The floodway then flows east towards the Illawarra Railway Line where it joins with North and South Corrimal Creeks. Downstream of the Illawarra Railway the floodway follows the creek channel and spreads out into the floodplain areas adjacent to the creek. Properties on Colgong Crescent form part of the floodways and properties located on Pioneer Road, Lake Parade, Cassell Avenue and Augusta Street may be affected by the floodway (5).
- q. In the 1% AEP event flood storage areas can be found to the west and south of Prosser Close, at the Keira Street and Meadow Street intersection, to the west of the Illawarra Railway, near Augusta Street and Pioneer Drive and to the north of Juanita Avenue (5).
- r. In the 1% AEP event flood fringe areas can be found adjacent to the floodway, affecting properties on Caldwell Avenue, Wallace Road, Devenish Street, Gregory Avenue, Pioneer Road, Lake Parade, Payne Road and Spinks Road (5).

Carr Creek

- s. In the 1% AEP event the floodway is contained to the creek channel beginning at Carr Street before meeting Towradgi Creek near Colgong Crescent (5).
- t. In the 1% AEP event flood storage can be found on the western side of Memorial Drive and impacts properties located on Dalton Street (5).
- u. In the 1% AEP event flood fringe areas can be found adjacent to the floodway, in the area bounded by Ziems Avenue, Towradgi Road and Memorial Drive and between Memorial Drive and the Illawarra Railway affecting properties located on Carr Street and Waugh Avenue (5).

Parker Creek

- v. In the 1% AEP event the floodway is contained to the creek channel (5).
- w. In the 1% AEP event the flood storage areas can be found adjacent to the floodway, on Parker Road and on the western side of Corrimal Beach Tourist Park (5).

- x. In the 1% AEP event flood fringe areas can be found in the area bounded by Corrimal Beach Tourist Park, Murray Road, Towradgi Creek and Spinks Road (5).

2.6.4 Classification of Floodplain

- a. The majority of the study area is classified as High Trapped Perimeter (whereby the area can become isolated by road closures and the surrounding terrain / topography) or else is Not Flood Affected (5). There are also a number of areas that are Low or High Flood Islands. Mapping can be seen in the Towradgi Creek Flood Study 2015 available on Wollongong City Council's website.

Low Flood Islands

- b. A low flood island can develop in the 1% AEP event in the area bounded by Memorial Drive, Towradgi Road and the Illawarra Railway and includes all properties located in Carr Street and Waugh Avenue, Towradgi.
- c. In the PMF Low Flood Islands can also be found in Towradgi:
 - i. between Henrietta Street and Memorial Drive,
 - ii. in the block between Cassell Avenue, Juanita Avenue and Towradgi Creek and
 - iii. between Lake Parade and Towradgi Creek (6).

High Flood Islands

- d. In the 1% AEP event there is a High Flood Island that is expected to develop in the area bounded by the Illawarra Railway, Towradgi Creek, Sturdee Street and Glossop Street. It includes all properties located in Cologong Crescent and Raymond Parade, and properties located on the northern side of Sturdee and Glossop Street. It remains a High Flood Island up to the PMF (6).
- e. In the PMF event High Flood Islands can also be found:
 - i. north of Julius Street, in the block bounded by the Princes Highway, Towradgi Road and Ziems Avenue,
 - ii. in the block bounded by Memorial Drive, the Illawarra Railway and south of Railway Street,
 - iii. in the block bounded by The Avenue, Underwood Street, Tarrawanna Road, Meadow Street and Karen Place,
 - iv. the block bounded by Willow Grove, Lemrac Avenue, Francis Street and Collins Street,
 - v. the block bounded by Russell Street, the Princes Highway, Railway Street and Underwood Street and the area bounded by the Princes Highway, Railway Street, Wilga Street and Collins Street.

- f. These areas are all classified as High Trapped Perimeter Areas in the 5% and 1% AEP events (5).

Rising Road Access

- g. Areas with Rising Road Access away from floodwaters can be found north of Coxs Avenue, surrounding Caldwell Avenue and in the area bounded by the Illawarra Railway, Murray Road and Sturdee Street in all events (5).

2.6.5 Inundation

- a. There is one flood level gauge, owned by MHL, located on Towradgi Creek: Towradgi Creek Upstream Gauge (214475). There are currently no warnings issued to this gauge.
- b. In a 1% AEP flood, the majority of residential properties flooded above floor level are located in Towradgi Creek, Parker Creek, North Corrimal Creek and Carr Creek proximity (1).
- c. Properties affected by flooding are located on Angel Street, Bellambi Street, Betram Close, Brooker Street, Caldwell Avenue, Carr Street, Carroll Road, Cassell Avenue, Cawley Street, Colgong Crescent, Collins Street, Coxs Avenue, Dalton Street, Francis Street, Gregory Avenue, Henrietta Street, Juanita Avenue, Karen Place, Lake Parade, Lemrac Avenue, Meadow Street, Parker Road, Pioneer Road, Princes Highway, Railway Street, Raymond Parade, Spinks Road, St Andrews Place, Tarrawanna Road, The Avenue, Towradgi Road, Underwood Street, Waugh Avenue, Williamson Street, Willow Grove and Ziem Avenue.
- d. They begin to become affected at the 20% AEP event up to the PMF event with depths and extents of inundation in the streets increasing (5).
- e. Gauges are located at Towradgi Creek upstream and downstream (MHL), Corrimal (Sydney Water) and Towradgi (BoM) (1).

Table 15: Estimated No. Properties with Over Floor and Ground Flooding in the Towradgi Creek Catchment (21).

Design Flood Event (% AEP)	Average Over Floor Depths (m)	No. Residential Properties with Over floor Flooding	No. Commercial Properties with Over floor Flooding	No. Residential Properties with Over ground Flooding	No. Commercial Properties with Over ground Flooding
PMF	1.0m Max: 3.2m	451	23	626	22
1%	0.42m Max: 3.0m	115	16	339	14
2%	0.42m Max: 1.8m	86	15	285	14
5%	0.35m Max: 1.7m	67	15	238	13
20%	0.33m Max: 1.4m	34	12	171	11

2.6.6 Isolation

- a. Isolation in the catchment consist of the areas defined as High and Low Flood Islands and Trapped Perimeter areas above.

2.6.7 Flood Mitigation Systems

- a. Detentions Basins within the catchment are located downstream of Meadow Street, the confluence of Princes Highway, Pioneer Road and the outlet near South and North Angels Creek (21).
 - i. **Foothills Estate Retarding Basin 1** is owned by Wollongong City Council and is located on Towradgi Creek in Tarrawanna. The basin has a capacity of 21ML and in the event of failure would affect up to 100 properties (22).
 - ii. **Foothills Estate Retarding Basin 3** is owned by Wollongong City Council and is located in Tarrawanna (5).
 - iii. **South Angels Creek:** A detention basin is located west of Corrimal Street, at the start of South Angels Creek. No other information on this basin is known (5).
 - iv. **North Angels Creek:** A detention basin is located directly west of Bellambi Street in Tarrawanna at the start of North Angels Creek. No other information on this detention basin is known (5).
 - v. **South Corrimal Creek:** A formalised detention basin is located immediately west of South Corrimal Creek (5).
- b. Other flood mitigation measures within this catchment include:

- i. Flood proof walls have been installed on the boundaries of properties located in Lemrac Avenue to divert floodwaters into North Corrimal Creek (16).
- ii. Wollongong City Council has constructed a low earth mound at Cheryl Place to deflect floodwaters away from nearby houses (16).
- iii. There is a weir located on North Corrimal Creek at the Coke Works in East Corrimal (5).
- iv. The potential consequences to properties of these flood mitigation works has not been not documented.

2.6.8 Dams

- a. There are no dams located within or upstream of the Towradgi Creek catchment.

2.6.9 At Risk Facilities

- a. **Schools:** There is one school, two childcare centres and two aged care facilities located in the catchment. Details are shown in Annex 2.
- b. **Illawarra Railway:** In the PMF event floodwater depths of 0.6m can be reached on the Illawarra Railway at the Towradgi Creek crossing (21).

2.6.10 Other Considerations

- a. No other considerations

2.8 FAIRY AND CABBAGE TREE CATCHMENT

2.8.1 Community Overview

- a. The community area comprises the catchments of Fairy Creek, Cabbage Tree Creek and Towradgi Arm (6). The Fairy and Cabbage Creek catchments are shown on Map 7.
- b. The catchment includes the suburbs of Balgownie, Fairy Meadow, Mount Pleasant, Mount Ousley, Gwynneville, Keiraville, Wollongong, North Wollongong and West Wollongong. Sections of Fernhill and Towradgi are also included in this catchment (1).
- c. Mount Ousley and Towradgi have a high proportion of residents aged 65 and over. They also have high proportion of owned properties and a low turnover rate (6).
- d. Suburbs closer to the university have a lower median age, a higher rate of rentals (up to 60%), a high turnover rate, low median incomes and a high proportion over people born overseas that speak a language other than English (up to 27%). This is likely due to students studying at the University of Wollongong with many international students attending (6).

Table 16: Population and Dwellings in Fairy and Cabbage Tree Catchments (17)

Suburb	Population	Private Dwellings
Fairy Meadow	6,777	3,077
Mount Pleasant and Mount Ousley	2,743	1,056
Gwynneville	2,514	1,096
Keiraville	4,862	1,950
Wollongong	16,388	8,794
North Wollongong	2,115	1,071
West Wollongong	4,706	2,029
Balgownie, Fernhill and Towradgi	8,194	3,409

2.8.2 Characteristics of flooding

- a. The Fairy and Cabbage Tree catchment is affected primarily by flash flooding with rapid rises and falls. The catchment responds quickly to intense rainfall, often within less than an hour (23).

2.8.3 Flood Behaviour

- a. This catchment includes Fairy Creek, Cabbage Tree Creek, the Towradgi Arm and Fairy Lagoon (1).

- b. Fairy Lagoon is located in North Wollongong and is fed by Fairy Creek, Towradgi Arm and Cabbage Tree Creek. The Lagoon is opened by Wollongong City Council when heavy rain is predicted and the lagoon levels are likely to exceed 1.6m AHD (6).

2.8.4 Classification of Floodplain

Low Flood Islands

- a. Low Flood Islands from the 20% AEP event to the PMF event are located on Anama Street, Hay Street, College Place and Graham Avenue, the area bounded by Memorial Drive, Foleys Lane, Helen Street, Aristo Crescent, Mount Ousley Road, Princes Highway and Soudan Street, and the area between Braeside Avenue, Michael Street, John Street and south of Gipps Road (23).
- b. There is a Low Flood Island in the 20% AEP event located on Jardine Street and Kingsford Street east of the Princes Highway. In the 1% AEP event the island grows to include Hurley Street and Smith Street and in the PMF event includes Norman Street and Chapman Street (23).
- c. In the 20% AEP event to the 1% AEP event Low Flood Islands can be found in the area between Elliotts Road, Carters Lane, the Illawarra Railway and Dixon Street, and the area including Montague Street, Ajax Avenue, Exeter Avenue and Achilles Avenue. In the PMF event these join with the larger Low Flood Island east of the Illawarra Railway (23).
- d. There is a Low Flood Island located on Hillview Circuit from the 5% AEP event to the PMF event (23).
- e. There is a Low Flood Island located in the area between Elliotts Road, Princes Highway, Illawarra Railway and Soudan Street from the 1% AEP event to the PMF event (23).
- f. In the PMF event Low Flood Islands can be found on Lila Avenue, Waitangi Street, and Crawford Avenue (23).
- g. In the PMF event there is a large Low Flood Island located in the area bounded by the Illawarra Railway, Cannell Crescent, Edgar Street, Tasman Sea, Bourke Street, Noel Street, Virginia Street and Pleasant Avenue. This flood island incorporates some of the High and Low Flood Islands described above (23).

High Flood Islands

- h. There are three locations that remain High Flood Islands from the 20% AEP event to the PMF event. They are located in Helen Brae Avenue, the University of Wollongong campus and on Cabbage Tree Lane between Dawson Street and McLean Avenue (23).
- i. There is a High Flood Island located on Dixon Street and Carters Lane from Pioneer Road to Edgar Street in the 20% AEP event to the 1% AEP event. In the PMF event this changes to a Low Flood Island (23).

- j. There are High Flood Islands located on the TAFE NSW Wollongong Campus and Porter Street, Hindmarsh Street and Railway Crescent from the 20% AEP event to the 1% AEP event. In the PMF these areas change to Low Flood Islands (23).
- k. There are High Flood Islands located on Cowper Street, Stafford Street and Station Street in the 5% AEP event. These then change to Low Flood Islands in the 1% AEP. They then form part of the larger flood island in the PMF event described below (23).
- l. In the PMF event High Flood Islands can be found in Guest Avenue, Hopewood Crescent and Dymock Street, and the area bounded by Norman Street, Princes Highway, Daisy Street and Lila Avenue (23).

High Trapped Perimeter

- m. High Trapped Perimeter areas are located in Gore Street and Orton Street, west of Brokers Road between Wellington Drive and Lang Street, and west of Foothills Road between Greenslopes Avenue and Cabbage Tree Lane. These locations remain high trapped perimeters from the 20% AEP event to the PMF event (23).

Overland Access

- n. Overland access areas can be found in the area north of the University of Wollongong, Akuna Street and Nyrang Street, and west of Harkness Avenue. These location have overland access from the 20% AEP event to the PMF event (23).

Rising Road Access

- o. All other locations have Rising Road Access in all events (23).

2.8.5 Inundation

- a. There are three flood level gauges, owned by MHL, located in the Fairy and Cabbage Creek catchment: Balgownie Road Gauge (214409), Cabbage Tree Creek Upstream Gauge (214405) and Fairy Creek Downstream Gauge (214404). Currently there are no warnings provided to these gauges.
- b. Common flood affected areas include the Chalmers St culvert, Campus East, Brandon Park, west of the Illawarra Railway at Porter Street and east of the Illawarra Railway in Ajax and Exeter Streets (1).
- c. Major damage has occurred during past flood events in Anama Street and Montague Street (1).
- d. In the 20% AEP event in the highest risk area, 17 dwellings in Archilles Avenue, Ajax Avenue, Exeter Avenue, Montague Street, Rose Street, William Street, Ira Avenue, Weekes Street, Balmoral Street and Chalmers Street are affected by over floor flooding. Over floor flooding can also occur in Grey Street, Chapman Street, Jardine Street, Princes Highway, Carters Lane, Rann Street and Alvan Parade. Properties located in Ralph Black Drive, Akuna Street, Helen Brae Avenue, Hopewood Crescent,

Anama Street, Lang Street and Maroota Avenue have been identified as experiencing over floor flooding, however may have been included in Wollongong City Council's voluntary acquisition program and are no longer flood affected (6).

- e. In the 5 % AEP event an additional 480 dwellings will experience over floor flooding. Properties at the highest risk are located in Wellington Drive, Blanchard Crescent, Sherwood Drive, Church Street, Rae Crescent, Foothills Road, Kingsford Street, Smith Street, Norman Street, Daisy Street, Aristo Crescent, Jobson Avenue, Lysaght Street, Woodhill Street, Rosedale Avenue, Braeside Avenue, Anne Street, Gipps Street, College Place, Graham Avenue, Hillview Avenue, Porter Street, Crawford Avenue, Gipps Road, Robsons Road, Murranar Road, Storey Street, Donald Street and Elliotts Road in addition to those affected in the 20% AEP (6). Additional properties that may experience over floor flooding are located in Greenacre Road, Poulter Street, Rosemont Street, Akuna Street, Spearing Parade, Northfields Avenue, Ralph Black Drive, Anama Street, Dallas Street, Parkview Grove, McGrath Street, Helen Brae Avenue, Hopewood Crescent, Clifford Street, Hurley Avenue, Dobinson Street, Lang Street, Maroota Avenue, John Street, Foothills Road, Marlo Road and Edgar Street (23).
- f. In the 1% AEP event additional properties that experience overground flooding are located in Eastern Street, Foley Street, Stafford Street, Mount Ousley Road, Townsend Street, Hamilton Street, Dawson Street, Cabbage Tree Lane, Dixon Street, Brokers Road, Bootie Street and Robin Place (23).
- g. 20% AEP event over ground flooding occurs in Achilles Avenue, Akuna Street, Ajax Avenue, Anama Street, Anne Street, Aristo Crescent, Armstrong Street, Balgownie Road, Balmoral Street, Bootie Street, Braeside Avenue, Brynymor Place, Buckle Crescent, Cabbage Tree Lane, Camphora Avenue, Cannell Crescent, Carters Lane, Cassian Street, Chalmers Street, Chapman Street, Clifford Street, College Place, Cosgrove Avenue, Cowper Street, Crawford Avenue, Daisy Street, Dawson Street, Dobinson Street, Donald Street, Eastern Street, Edgar Street, Elliotts Road, Exeter Avenue, Fisher Street, Florence Street, Foley Street, Foothills Road, Georgina Avenue, Gilmore Street, Gipps Road, Gipps Street, Graham Avenue, Grafton Street, Greenacre Street, Grey Street, Guest Avenue, Gwynne Street, Hamilton Street, Harkness Avenue, Hay Street, Helen Brae Avenue, Hillcrest Street, Hindmarsh Avenue, Hopewood Crescent, Hurley Avenue, Ira Avenue, Irvine Street, Jardine Street, Jobson Avenue, Lang Street, Lila Avenue, Lysaght Street, Madeline Street, Marlo Road, Maroota Avenue, Matthews Street, McGrath Street, McLean Avenue, Mercury Street, Montague Street, Mount Ousley Road, Murphys Avenue, Murranar Road, Norman Street, Northcote Street, Northfields Avenue, Nyrang Street, Parkview Grove, Pioneer Road, Porter Street, Poulter Street, Princes Highway, Puckey Avenue, Rae Crescent, Railway Crescent, Ralph Black Drive, Rann Street, Robsons Road, Rose Street, Rosedale Avenue, Rosemont Street, Sherwood Drive, Smith Street, Spearing Parade, Stafford

Street, Storey Street, Squires Way, Townsend Street, Virginia Street, Watangi Street, Weekes Street, Wellington Drive, William Street, and Woodhill Street (23).

- h. In the 5% and 1% AEP events properties affected by over ground flooding are located in Andrew Avenue, Bourke Street, Brokers Road, Blanchard Crescent, Church Street, Cochrane Street, Collaery Avenue, Dallas Street, Dixon Street, Dumfries Avenue, Dymock Street, Fairy Avenue, Fairy Street, Flinders Street, Foleys Lane, George Bailey Drive, Gowan Brae Avenue, Helen Street, Hillview Avenue, Holder Street, Hoskins Street, John Street, Kingsford Street, Lonbard Avenue, Mt Keira Road, Mountview Avenue, Noel Street, Robin Place, Soudan Street, Strone Avenue and University Avenue, in addition to the locations affected in the 20% AEP (23).
- i. In the PMF event over ground flooding occurs in Gore Street, Hunter Street, Gownie Place, Sproule Crescent, Winton Place, Alvan Parade, Ryan Street, Russell Street, Sunninghill Circuit, Bellebrae Avenue, Winton Place, Cambridge Avenue, Michael Street, Moore Street, Sheppard Street, Dempster Street, Macquarie Street, Throsby Drive, Kiernan Street, Lucinda Street, Frances Street, Gaynor Avenue, Station Street, and all streets east of the Princes Highway, between Murranar Road/ Florence Street and Bourke Street/ Bode Avenue, in addition to the locations affected in smaller events (23).
- j. The Bureau of Meteorology provides Severe Thunderstorm Warnings, and detailed Severe Thunderstorm Warnings for the heavily populated Wollongong Region. These warnings are relatively good flash flood warnings for the catchment (7).

Table 17: Estimated No. Properties with Over Floor and Ground Flooding in the Fairy and Cabbage Tree Catchments (6)

Design Flood Event (% AEP)	No. Residential Properties with Over floor Flooding	No Residential Properties with Over ground Flooding	No. Commercial Properties with Over floor Flooding	No. Commercial Properties with Over ground Flooding
PMF	1,546	2,855	370	473
1% AEP	599	1,949	206	329
2% AEP	518	1,844	180	297
5% AEP	431	1,684	143	250
20% AEP	14	403	15	41

2.8.6 Isolation

- a. Isolations in the catchment consist of the High Trapped Perimeter Areas, Overland Access Areas and High and Low Flood Islands described above.

2.8.7 Flood Mitigation Systems

- a. There are a number of detention basins located in the Wollongong and Fairy Creek catchments as listed in **Error! Reference source not found..** The consequences to property from these detention basins are unknown.

Table 18: Detention basins located within the Fairy Creek and Wollongong Catchments

Location Details	Suburb	Catchment
Wollongong High School	Fairy Meadow	Fairy Creek Catchment
Gilmore Park	West Wollongong	Fairy Creek Catchment
Nyrang Park	West Wollongong	Fairy Creek catchment
Gunyah Park on Dempster St	West Wollongong	Fairy Creek Catchment
Fisher Park	West Wollongong	Fairy Creek Catchment
Wisemans Park	Gwynneville	Fairy Creek Catchment
Foothills Road	Mount Ousley	Cabbage Tree Creek catchment
Brokers Road northern basin near Duncan St intersection	Balgownie	Cabbage Tree Creek catchment
Brokers Road southern basin at southern end of Brokers Road	Balgownie	Cabbage Tree Creek catchment

2.8.8 Dams

- a. There are no dams located upstream of the Fairy and Cabbage Creek Catchment.

2.8.9 At Risk Facilities

- a. There are eleven schools, three child care facilities and one aged care centre affected by flooding in the catchment. Details are shown in Annex 2.

2.8.10 Other Considerations

- a. The University of Wollongong has increases in traffic at the morning and afternoon peaks during session.
- b. Areas that have experienced flooding and damage in previous events include:
 - i. Chalmers St culvert is a regular flood area.
 - ii. Major damage has occurred in Anama St, Fairy Meadow, Montague St, Nth Wollongong with Campus East and Brandon Park also subject to flooding.
 - iii. Porter St, North Wollongong west of the railway line has suffered flooding and then downstream water inundation occurs in Ajax and Exeter St's.

2.9 WOLLONGONG CITY CATCHMENT

2.9.1 Community Overview

- a. The catchment includes the suburbs of Wollongong, Coniston and Mangerton (7). The Wollongong City Catchment is shown on Map 8.
- b. The population of Wollongong in 2011 was 16,388 with 8,794 dwellings. Coniston (combined with Mt St Thomas) had a population of 3,741 with 1,597 dwellings and Mangerton had a population of 2,717 with 1,191 dwellings (17) (7).
- c. The Wollongong City Catchment is comprised of a higher percentage than the broader Wollongong Local Government Area of non-English speakers with 30% of the residents speaking a language other than English at home (7).
- d. The Wollongong City Catchment region has a lower car ownership percentage than the Wollongong LGA (7).
- e. 53% of residents in the Wollongong City Catchment rent compared to 30% across the LGA (7).
- f. Additionally, there is a high percentage of new residents in the area and are most likely residing in the new high density development around the golf course, train station and the Council building (7).

Table 19: Population and Dwellings in Wollongong City Catchment (17)

Suburb	Population	Private Dwellings
Wollongong	16,718	8,937
Coniston		
Mangerton	2,821	1,247

2.9.2 Characteristics of flooding

- a. The Wollongong City catchment is affected by overland flooding. During intense storm events runoff can exceed the capacity of the local subsurface drainage resulting in overland flow throughout the entire catchment. Additionally open channels in the lower catchment near JJ Kelly Park and the Golf Course are at a low elevation and have a low gradient causing flooding to occur via backwaters from tidal action within Port Kembla Inner Harbour. This can be exacerbated by coincident high tides (24).

2.9.3 Flood Behaviour

- a. In the 1% AEP event floodways can be found along Gurungaty Waterway, in the creek on the south side of Springhill Road adjacent to the train line in Port Kembla Harbour, along the defined creek channels in JJ Kelly Park, along Swan Street, Kembla Street, Evans Street, Church Street, Keira Street, Kenny Street, Auburn Street, West Street, Finlayson Street, Beach Street, Glebe Street, Bank Street, Ellen Street, Corrimal Street,

Osbourne Street and Gladstone Avenue, in MacCabe Park, along the gully running from the western end of Myuna Way through property boundaries between Staff Street and Rowland Avenue meeting with Osbourne Street, at the Illawarra Railway crossing points at Osbourne Street, South Street, Union Street and Robertson Street, through the council reserve located on South Street and behind properties located on Wonson Avenue and Robertson Street (7).

- b. In the PMF event the floodway can be found in the same locations as in the 1% AEP with the width of the floodway increasing and in many locations affecting properties located on the listed streets. Additional floodways can be found along Springhill Road, Grasmere Street, Gregory Street, Union Street, Atchinson Street, George Street, Stewart Street, Burelli Street and Crown Street. The Illawarra Railway at Wollongong Train Station and northern section on the Wollongong Cemetery also forms part of the floodway (7).
- c. In the 1% AEP event flood storage areas can be found on the eastern side of Corrimal Street in Wollongong Golf Course, in JJ Kelly Park, on and to the east of Springhill Road south of the Swan Street intersection, on the western side of the Illawarra at the Osbourne Street, South Street, Union Street and Robertson Street crossings, on the eastern side of the Springhill Road and Masters Road intersection including over the rail line, on Gladstone Avenue between Grasmere Street and John Street and along Beach Street. Small sections of flood storage can also be found on the low lying parts of properties located on Swan Street and Kembla Street and in locations throughout the Steelworks and Port Kembla Harbour complex (7).
- d. In the PMF event flood storage areas can be found in the same locations as in the 1% AEP with additional areas being found on Springhill Road and in the area surrounding Tate Street. Small sections of flood storage can also be found on low lying parts of properties located in the block bounded by Stewart Street, Kembla Street, Ocean Street, Church Street, Swan Street, Corrimal Street, Bank Street and Harbour Street (7).
- e. In the 1% AEP event flood fringe areas can be found adjacent to the floodway and in the block bounded by Corrimal Street, Bank Street, Harbour Street, Burelli Street, Church Street, Ellen Street, Kenny Street, West Street, Auburn Street and Swan Street. Flood fringe areas can also be found on the Illawarra Railway at the Wollongong Train Station and in locations throughout the Steelworks and Port Kembla Harbour complex.
- f. In the PMF event flood fringe areas can be found in the same locations as in the 1% AEP with additional areas being located on Robertson Street, north of Ellen Street in properties on Auburn Street, Atchison Street, Kenny Street and Keira Street, in properties on Union Street and Heaslip Street and south of Swan Street between Kenny Street and Keira Street (7).

2.9.4 Classification of Floodplain

Low Flood Islands

- a. Low Flood Islands which initially become isolated and then inundated can develop in the following parts of the Wollongong City Catchment:
 - i. Gladstone Avenue between Grasmere Street and John Street from the 5% AEP up to the PMF (7).
 - ii. Gladstone Avenue between South Street, Heaslip Street and the Illawarra Railway from the 5% AEP up to the PMF event (7).
 - iii. The block bounded by Frederick Street, Rowland Avenue, Ellen Street, Atchison Street and Dean Street from the 5% AEP to the PMF event (7).
 - iv. Auburn Street between Swan Street and Miller Street in the 5% to the PMF event (7).
 - v. The area bounded by Springhill Drive, Keira Street, Fox Avenue and Old Springhill Road in the PMF event. In events below the PMF the area has Rising Road Access (7).
 - vi. The block bounded by Swan Street, Corrimal Street, Beach Street and Kenny Street in the 5% AEP event (7).
 - vii. In the 1% AEP event the Low Flood Island at Swan Street is extended to the north to include the area bounded by Beach Street, Corrimal Street, Bank Street, Harbour Street, Stewart Street and Beatson Street. It also incorporates the area east of Corrimal Street including properties located on Ross Street and Swan Street. These areas change from High Flood Island to Low Flood Island between the 5% AEP and 1% AEP events (7).
 - viii. In the PMF event the Low Flood Island at Swan Street is extended to include the area bounded by the Illawarra Railways, Swan Street, Kenny Street and West Street, the area bounded by Corrimal Street, Bank Street, Kembla Street and Glebe Street and the eastern side of JJ Kelly Park. These areas were previously High Flood Islands (7).

High Flood Islands

- b. High Flood Islands which become isolated by surrounding floodwaters but still have some high ground flood free can develop in the following parts of the Wollongong City Catchment:
 - i. In the 5% AEP event there are High Flood Islands located in the industrial areas south of Springhill Road, in the area east of Corrimal Street including properties located on Ross Street and Swan Street and the area bounded by the Illawarra Railway, Swan Street, Kenny Street, Beach Street, Corrimal Street, Bank Street,

Harbour Street, Stewart Street, Beatson Street, Glebe Street, Kembla Street and Ellen Street (7).

- ii. In the 1% AEP event the High Flood Island located to the east of the Illawarra Railway is extended north to include properties located between Atchison Street and Keira Street. The area also has its eastern portion converted to a Low Flood Island (7).
- iii. In the PMF event the High Flood Island located to the east of the Illawarra Railway is extended to the north up to Stewart Street. Part of the south and east of the flood island are converted to Low Flood Islands (7).
- iv. In the PMF event there is a High Flood Island located to the north of Springhill Drive in the industrial area surrounding John Cleary Place (7).

Rising Road Access

- c. All other areas have Rising Road Access in all events (7).

2.9.5 Inundation

- a. In all events inundation occurs in industrial areas south of Springhill Road and Masters Road, in the area bounded by the Illawarra Railway, Bridge Street, Springhill Road, the Wollongong Golf Course, Harbour Street and Keira Street and to the west of the Illawarra Railway affecting all roadways and properties located in the valleys. The depths of water varies across the area however the areas at greatest risk of high depths are in the south eastern portion of the catchment and are listed as high and low flood islands above (7).
- b. Some high risk areas, in terms of property and risk to life, include:
 - i. Swan Street, and the southern parts of Kembla, Evans and Church Streets;
 - ii. Springhill Road, particularly between Swan Street and Keira Street;
 - iii. Springhill Road, 200m to 300m south of Masters Road;
 - iv. Springhill Road near Tom Thumb Road and Bridge Street;
 - v. Trapped depressions along Gladstone Avenue upstream of the railway line, particularly near Osborne Street, Union Street, Robertson Street, and Vale/Grasmere Streets;
 - vi. Auburn Street, just south of Swan Street;
 - vii. Allan Street behind Rowland Avenue and the retirement village on Staff Street;
 - viii. Vacant land at the northern end of Gregory Street; and
 - ix. Wollongong Golf Club.

- c. The Bureau of Meteorology provides Severe Thunderstorm Warnings, and detailed Severe Thunderstorm Warnings for the heavily populated Wollongong Region. These warnings are relatively good flash flood warnings for the catchment (7).

Table 20: Estimated No. Properties with Over Floor and Ground in the total Wollongong City Catchment (7)

Design Flood Event (% AEP)	No. Properties with Over floor Flooding	No. Properties with Over ground Flooding
PMF	940	2352
1% AEP	361	1539
2% AEP	337	1512
5% AEP	201	1410
10% AEP	172	1377
20% AEP	149	1339

Table 21: Estimated No. Properties with Over Floor and Ground Flooding in Wollongong City Catchment – upstream (west) of the Illawarra Railway (7)

Design Flood Event (% AEP)	No. Properties with Over floor Flooding	No. Properties with Over ground Flooding
PMF	358	1,220
1% AEP	118	538
2% AEP	113	538
5% AEP	47	537
10% AEP	43	536
20% AEP	40	534

Table 22: Estimated No. Properties with Over Floor and Ground Flooding in Wollongong City Catchment – downstream (east) of the Illawarra Railway (7)

Design Flood Event (% AEP)	No. Residential Properties with Over floor Flooding	No. Residential Properties with Over ground Flooding	No. Commercial Properties with Over floor Flooding	No. Commercial Properties with Over ground Flooding
PMF	321	690	261	442
1% AEP	107	608	136	393
2% AEP	95	590	129	384
5% AEP	64	533	90	355
10% AEP	55	501	74	340
20% AEP	47	478	62	327

2.9.6 Isolation

- a. Isolations in the catchment consist of the areas defined as High and Low Flood Islands above.

2.9.7 Flood Mitigation Systems

- a. There are no known detention basins in the Wollongong City Catchment (7).

2.9.8 Dams

- a. There are no dams located upstream of the Wollongong City Catchment.

2.9.9 At Risk Facilities

- a. There are nine child care centres, four aged care facilities and two schools that are affected by flooding. Details are shown in Annex 2 (7).

2.9.10 Other Considerations

- a. Win Stadium and the Entertainment Centre are located on Harbour Street in Wollongong. Additional traffic will be located around this precinct when events are scheduled. Access is affected by flooding on Corrimal Street and Masters Road prior to the 5% AEP event (7).

2.10 ALLANS CREEK CATCHMENT

2.10.1 Community Overview

- The Allans Creek catchment is located directly to the west and south west of the Wollongong CBD.
- The Allans Creek catchment includes the suburbs of Mount Keira, West Wollongong, Mangerton, Figtree, Mount Kembla, Cordeaux Heights, Farmborough Heights and Unanderra. Allans Creek Catchment is shown on Map 9.

Table 23: Population and Dwellings in Allans Creek Catchment (17)

Suburb	Population	Private Dwellings
West Wollongong	4,706	2,029
Mount Keira	1,522	
Mount Kembla & Cordeaux Heights	5,792	1,837
Mangerton	2,717	1,191
Unanderra	5,924	2,501
Figtree	10,625	4,038
Farmborough Heights	4,181	1,452

2.10.2 Characteristics of flooding

- Allans Creek catchment is affected by flash and overland flooding with short warning times (1).

2.10.3 Flood Behaviour

- The Allans Creek catchment includes Byarong, Branch, American, Ghost, Nudjia, Allans, Charcoal, Jenkins, Running, Brandy and Water Creeks. Allans Creek drains to Tom Thumb Lagoon and Port Kembla Harbour and is influenced by tidal conditions as far upstream as the M1 Motorway (8).
- A series of urbanised drainage systems also feed into these main tributaries along with a series of road areas and parks that act as floodways during rare and extreme event. These include: Arrow Avenue, Bellevue Road, Berkeley Road, Blackman Parade, Cleverdon Crescent, Cordeaux Road, Cummins Creek, Figtree Park, Five Islands Road, F6 Freeway, Govett Crescent, Grace Street, Hargraves Street, Princes Highway, O'Briens Road, Illawarra Railway, Resolution Drive, Rickard Road, Sheringa Grove, Springhill Road, Tresnan Road, Wallawa Street, Figtree Grove (shopping centre) and various drains in the Unanderra area (8).

2.10.4 Classification of Floodplain

Low Flood Islands

- In the 5% AEP event there are Low Flood Islands located in:

- i. the area between the Princes Highway, Illawarra Railway, Old Five Islands Road and Central Road,
- ii. the area between Five Islands Road, Princes Motorway and the Illawarra Railway and
- iii. The areas listed as High Flood Islands (see below) all become low flood islands in the 5% AEP (8).

High Flood Islands

- b. In the 20% AEP event High Flood Islands can be found in:
 - i. Figtree Grove, Princes Highway between Byarong Creek crossing and Bellevue Road,
 - ii. The Avenue between Cleverdon Crescent and Preston Street,
 - iii. the area bounded by Avalon Terrace, Grafton Avenue and Cleverdon Crescent and
 - iv. the area surrounding the Figtree Gardens Caravan Park.
- c. In the 5% AEP these all become Low Flood Islands (8).

Rising Road Access

- d. All other locations have Rising Road Access in all events (8).

2.10.5 Inundation

- a. There are three flood level gauges, owned by MHL, located in the Allans Creek catchment: Koloona Avenue Upstream Gauge (214425), Blackmans Parade Upstream Gauge (214430) and Byarong Creek Gauge (214420). There are currently no warnings issued to these gauges.
- b. Hazard mapping of the Allans Creek Catchment shows that some residential properties in Unanderra, Cordeaux Heights and Figtree are located in High Hazard Areas (8).
- c. Key risk areas identified as:
 - i. Koloona Avenue (Byarong Creek)
 - ii. Harry Graham Park (Byarong Creek)
 - iii. Govett Crescent / Suttor Place (American Creek)
 - iv. Old Five Islands Road (Unanderra)
 - v. Arrow Avenue (Byarong Creek)
 - vi. Rickard Road (Charcoal Creek)
 - vii. Preston & Seddon Streets (Byarong Creek)
- d. The Avenue to Lysaght Oval (Byarong Creek / American Creek)

- e. Major flooding in this area is in Wallawa St and Arrow Ave, Figtree then crossing through Figtree Shopping Centre. O'Brien's Rd, Unanderra flooding regularly with traffic disruptions to Springhill Rd at times.
- f. Most significant rain events results in reports of persons stuck in vehicles in flood waters at the junction of Five Islands Road and the F6 off ramp.
- g. In the 20% AEP event flooding affects properties located in Koloona Avenue, Valley Drive, Casurina Place, Coronata Drive, Eugena Place, Euroka Street, Whelan Avenue, Langson Avenue, Uralba Street, Risley Road, Darragh Drive, Jacaranda Avenue, Cypress Avenue, Thames Street, The Mall, Wallawa Street, Arrow Avenue, The Princes Highway, Seddon Street, Preston Street, Cleverdon Crescent, Grafton Avenue, O'Briens Road, Baker Crescent, Foy Avenue, Govett Crescent, Gibsons Road, Sheringa Grove, Chapman Street, Hutt Parade, Albert Street Carr Parade, Richards Street, Fraser Street, Grace Street, Nudjia Road, Hargraves Street, Marley Place, Cummins Street, Tresnan Street, Beatus Street, Coachwood Drive, Hibiscus Place, Rickard Road, Blackman Parade, Waples Road, River Oak Road, Normandie Place, Resolution Drive, Five Islands Road and Prince of Wales Avenue (8).
- h. In the 5% AEP event flooding affects properties located in Avalon Terrace, Arkell Drive, Northview Terrace, Platypus Close, Alandale Avenue, O'Donnell Drive, Edmund Avenue, Musgrave Place, Central Road, Leigh Crescent Alukea Road, Derribong Drive, Old Five Islands Road, First Avenue, O'Neil Street, Short Street, Second Avenue, Third Avenue, Fourth Avenue, Tannery Street and Gladstonbury Avenue in addition to the locations affected in smaller events (8).
- i. In the 1% AEP event flooding affects properties located in Springhill Road in addition to the locations affected in smaller events (8).
- j. In the PMF event flood affects properties located in Waynote Place in addition to the locations affected in smaller events (8).

Table 24: Estimated No. Properties with Over Ground Flooding in the Allans Creek Catchment (8)

Design Flood Event (% AEP)	No. Residential Properties with Over ground Flooding	No. Commercial Properties with Over ground Flooding	No. Industrial Properties with Over ground Flooding	Total Properties with Over ground Flooding
PMF	785	76	72	933
1%	590	37	37	664
2%	555	36	36	627
5%	498	31	32	561
10%	265	22	14	301
20%	217	21	11	249

Table 25: Estimated No. Properties with Over Floor Flooding in the Allans Creek Catchment (8)

Design Flood Event (% AEP)	No. Residential Properties with Over floor Flooding	No. Commercial Properties with Over floor Flooding	No. Industrial Properties with Over floor Flooding	Total Properties with Over floor Flooding
PMF	507	64	64	635
1%	317	25	34	376
2%	276	21	33	330
5%	230	18	29	277
10%	65	13	7	85
20%	44	12	4	60

2.10.6 Isolation

- a. Isolations in the Allans Creek catchment are listed above as High and Low Flood Islands.

2.10.7 Flood Mitigation Systems

- a. There are no known detention basins or flood mitigation systems located in the Allans Creek catchment (8).

2.10.8 Dams

- a. There are no known dams located upstream of the Allans Creek catchment (8).

2.10.9 At Risk Facilities

- a. **Figtree Gardens Caravan Park** is a particularly high hazard area. It is a large scale caravan park located in the lower parts of the American Creek floodplain and is classified as a low flood island in events above a 5% AEP. A number of the caravans are likely to be immovable in the time of flood, there is insufficient warning time to prepare for evacuation, and the access to and from the park is through a high hazard area (8).
- b. There are six schools, three aged care facilities, a hospital and a caravan park that are affected by floodwaters in the Allans Creek catchment. Details are shown in Annex 2 (8).

2.10.10 Other Considerations

- a. High density of population located within the Westfield Figtree shopping complex.

2.11 MULLET/BROOKS CREEK CATCHMENTS

2.11.1 Community Overview

- The Mullet Creek catchment is located 12 km south of Wollongong and sits between the Illawarra Escarpment to the west and Lake Illawarra to the east. The Mullet Creek and Brooks Creek Catchments are shown in Maps 10 & 11.
- The Mullet/Brooks Creek catchment includes the suburbs of Farmborough Heights, Dombarton, Kembla Grange, Wongawilli, Huntley, Avondale, Brownsville, Kanahooka, Horsley, Cleveland, Dapto, Penrose, Koonawarra and West Dapto. The population of these suburbs is shown below.
- A large proportion of the Mullet/Brooks Creek catchment is earmarked for urban development over the next 40 years. The West Dapto Masterplan has identified a developable area of 1.328 hectares, which is expected to provide space for 19,000 dwellings, housing 55,000 people potentially trebling the existing population. The development of the West Dapto Release Area could affect flood behaviour in a number of ways (9).

Table 26: Population and Dwellings in Mullet Creek Catchment (17)

Suburb	Population	Private Dwellings
Kembla Grange	5,924	2,501
Wongawilli	184	66
Huntley	307	
Avondale / Cleveland / Marshall Mount / Penrose	352	134
Kanahooka	5,167	2,062
Koonawarra	3,633	1,355
Horsley	7,056	2,322
Dapto, Penrose, Brownsville	12,725	5,128
West Dapto	10,735 (Dapto)	4,234 (Dapto)

2.11.2 Characteristics of flooding

- The Mullet Creek catchment and Brooks Creek catchment is subject to a combination of riverine flooding and overland flooding. The catchment is extremely steep, sloping from 600mAHD to 50mAHD and has been progressively urbanised in areas, resulting in very dynamic flash flooding with rapid rises and falls (9).
- Flooding occurring from Lake Illawarra is primarily a combination of overland and riverine flooding and is slow to rise and fall. The flooding is influenced by the tidal nature of the lake (9).

2.11.3 Flood Behaviour

- a. The Mullet Creek catchment includes Mullet Creek, its tributaries and Brooks Creek. The flow from these catchments discharge to Lake Illawarra at separate locations. (9)
- b. The Mullet Creek floodplain covers the entire golf course and racecourse area between the F6 Freeway and the Princes Highway with flood depths predicted to be greater than 1.5m in the 1% AEP (9).
- c. Flow discharges to Lake Illawarra by either the southern or northern outlet and the main flow path is via Mullet Creek and exits the catchment through the southern outlet. The remaining flow follows either Tank Trap Channel, Hooka Creek or becomes overland flow through the park before discharging into Lake Illawarra the northern outlet (9).
- d. The Brooks Creek floodplain is significantly narrower than the Mullet Creek floodplain and is mainly confined to the channel until reaching Fowlers Road and Byamee Street (9).
- e. Flow from the Brooks Creek catchment discharges to Lake Illawarra via three flow paths; the main creek channel, underneath Lakeside Drive and down Edgeworth Avenue (9).
- f. High velocities are predicted in the 1% AEP event in the area on the northern side of Horsley near Huxley Drive, near Sunnybank Crescent, the flow path parallel to Hamilton Street and near Ena Avenue (9).

2.11.4 Classification of Floodplain

- a. A High Flood Island is created in Bambil Crescent in the PMF event (9).
- b. Rural properties located to the west of Dapto become Overland Access Areas in all events from the 20% AEP event (9).
- c. Horsley becomes an Overland Access Area from the 20% AEP event (9).
- d. All other locations have Rising Road Access (9).

2.11.5 Inundation

- a. There is one flood level gauge, owned by MHL, located on Mullet Creek: Mullet Creek Gauge (214400). There are currently no warnings issued to this gauge.
- b. Properties affected by over-ground and over flood flooding within the Mullet and Brooks Creek catchments are shown in Tables 26 and 27.

Table 27: Estimated No. Properties with Over Ground Flooding in the Mullet and Brooks Creek Catchments (25).

Design Flood Event (% AEP)	No. Residential Properties with Over ground Flooding	No. Commercial Properties with Over ground Flooding	Total Properties with Over ground Flooding
PMF	1,061	97	1,158
1%	214	25	239
2%	183	21	204
5%	154	20	174
10%	39	16	55
20%	22	14	36

Table 28: Estimated No. Properties with Over Floor Flooding in the Mullet and Brooks Creek Catchments (25).

Design Flood Event (% AEP)	No. Residential Properties with Over floor Flooding	No. Commercial Properties with Over floor Flooding	Total Properties with Over floor Flooding
PMF	509	79	588
1%	77	21	98
2%	58	19	77
5%	44	18	62
10%	4	11	15
20%	1	5	6

20% AEP event

- c. In the 20% AEP event properties affected by flooding are located in Wongawilli Road, Homestead Drive, Shone Avenue, Horsley Drive, Greenbrook Place, Cleveland Road, Avondale Road, Ena Avenue, West Dapto Road, Princes Highway, Hooka Creek Road, Essex Street, Sussex Street, Darkes Road, Hamilton Street, Burringbar Street, Kembla Grange Pl, Marshall Street, Beltana Avenue, Lakelands Drive, Trackside Drive, Cambridge Road, Bambil Crescent, Edgeworth Avenue, Oaks Avenue and Valley Way (9).
- d. The Grange Golf Club and Kembla Grange Racecourse are inundated by floodwaters in the 20% AEP event (23).

10% AEP event

- e. In the 10% AEP event properties affected by flooding are located in Parkdale Avenue, Oakhurst Close, London Street, Rogers Avenue, William Beach Road, Culgoa Crescent, Byamee Street, Toronto Avenue, Julianne Street, Brown Avenue, St James Crescent and Bong Bong Road in addition to those affected in smaller events (9).

- f. Over floor flooding affects properties located on Cleveland Road, Bong Bong Road, West Dapto Road, Kembla Grange Place, Darkes Road, Trackside Drive, St James Crescent and Oaks Avenue (25).

5% AEP event

- g. In the 5% AEP event properties affected by flooding are located in Prince Edward Drive, Lakeside Drive, Palmer Avenue, Howell Avenue, Wallabah Way, Eleebana Crescent and Aldinga Avenue in addition to those affected in smaller events (9).

1% AEP event

- h. In the 1% AEP event properties affected by flooding are located in Dale Street, Pharlap Avenue, Hore Street, Windsor Crescent, Regal Place, Melrose Way Rondanella Drive, Hertford Street, Murra Murra Road and McCabe Street in addition to those affected in smaller events (9).
- i. In the 1% AEP event over floor flooding affects properties located on Avondale Road, Burringbar Street, Hamilton Street, Hore Street, Prince Edward Drive, Essex Street, Melrose Way, Shone Avenue, Horsley Drive, Brown Avenue, Beltana Avenue, Lakelands Drive, Cambridge Road, Culgoa Crescent and Edgeworth Avenue (25).

PMF event

- j. In the PMF event properties affected by flooding are located in Glen Ayre Avenue, Glenwood Grove, Winnilong Way, Dombarton Place, Ritchie Crescent, Huxley Drive, Sunnybank Crescent, Barlyn Circuit, Eastwood Place, Woodridge Road, Goodman Place, Reed Park Place, Sierra Drive, Trifecta Place, Manikato Place, Kingston Town Drive, Sailsbury Street, Oxford Street, Bedford Street, Kent Street, Brownsville Avenue, Kundle Street, St Lukes Avenue, Barham Place, Station Street, North Terrace, Unara Road, Elizabeth Street, Shell Place, Craig Crescent, Rink Road, Cirrus Street, Robert Street, Bangaroo Avenue, Bingara Avenue, Alcoomie Crescent, Caloola Crescent, Erang Place, Bundella Place, Lakeline Drive, Casurina Crescent, Callistemon Crescent, Willow Tree Avenue and Angophora Crescent in addition to those affected in smaller events (9).

Other

- k. Floodwaters also inundate rural lands located in the floodplains of each creek system (25).

2.11.6 Isolation

- a. Horsley becomes isolated in the 20% AEP event. The community is isolated for a short period (up to 6 hours) (9).
- b. Rural properties located in Cleveland, Avondale and Marshall Mount may experience isolations (1).

- c. West Dapto will become inaccessible if there is overtopping at West Dapto Road, Darkes Road and Bong Bong Road. These road closures will also cause the isolation of rural properties located to the west of Dapto in the 20% AEP event (9).

2.11.7 Flood Mitigation Systems

- a. The Kanahooka Detention Basin is located on Stanthorpe Dr in Kanahooka. Properties located in the areas adjacent to the basin and its culvert outlet on Stanthorpe Dr, Rondanella Dr and Olivia Pl are at risk of flooding in the event of the basin wall overtopping or failing (26).

2.11.8 Dams

- a. There are no dams located upstream of the Mullet and Brooks Creek catchments.

2.11.9 At Risk Facilities

- a. There is one school and one retirement village that are impacted by flooding. Details are listed in Annex 2.
- b. The Illawarra Railway line at Kembla Grange, near Darkes Road and near McCabe Street is affected by floodwaters (1).
- c. Possible loss of sewerage services to approx 2000 properties for up to 5 days and approx 4000 properties for up to 2 weeks.
- d. Possible loss of water supply to approx. 15,000 people for up to 5 days including Dapto High School.
- e. Flooding may cause pipe failure to Sydney water assets in area. This could impact on water supply to BlueScope Steel resulting in a loss of steel production.

2.11.10 Other Considerations

- a. Rural properties with livestock are located at the base of the escarpment. Illawarra Racecourse and numerous stable facilities and properties located at Kembla Grange.
- b. Existing coal operations may be interrupted or impacted due to flood events resulting in some economic loss due to delayed rail and truck movements. Coal wash stockpiles and runoff dams located at Wongawilli and Kembla Grange may require monitoring by owner.

2.12 MINNEGANG CREEK CATCHMENT

2.12.1 Community Overview

- a. Minnegang Creek flows through the suburb of Lake Heights, extending from the northern shore of Lake Illawarra to the intersection of Lake Heights Road and Flagstaff Road. The catchment is located to south of the Wollongong CBD, on the northern shore of Lake Illawarra. Minnegang Creek Catchment is shown in Map 12.
- b. The catchment is almost entirely developed with 80% of the catchment comprising low density residential housing and the remaining 20% recreational and cleared land (10). Lake Heights had a population of 3,404 with 1,477 dwellings in 2011 (17).

Table 29: Population and Dwellings in Minnegang Creek Catchment (17)

Suburb	Population	Private Dwellings
Lake Heights	3,259	1,405

2.12.2 Characteristics of flooding

- a. The Minnegang Creek catchment is affected by a combination of flash and overland flooding (27).

2.12.3 Flood Behaviour

- a. The Minnegang Creek catchment is steep and flows are normally contained within the creek system. Overland flooding can occur when the drainage systems capacity has been met. This flooding can be widespread and has shallow water depths. There is little difference between the flood extents of different sized events (27).
- b. High velocity flows can be found within the creek system, and through some drainage structures. High risk locations include Minnegang Creek's intersection with; Lake Heights Road, Barina Road, Gilgandra Street, Mirrabooka Road, Weringa Avenue and the exit of Barina Park detention basin (27) (10).
- c. Significant water depths can be found within Minnegang Creek, upstream of the Lake Heights Road culvert, upstream of the start of the drainage system and within the Barina Park detention basin where depths of up to 3m may occur (27).

2.12.4 Classification of Floodplain

- a. Lake Heights has Rising Road Access in all flooding events (28).

2.12.5 Inundation

- a. There is little difference between the flood extents of different sized events (27).
- b. The highest concentration of affected properties lies directly downstream of Barina Park (8).

- c. Properties upstream of the Barina Park detention basin that may be affected by flooding in the 1% AEP and PMF events are located adjacent to Minnegang Creek and the Melinda Grove flowpath on Ranchby Avenue, Lake Heights Road, Barina Avenue, Karrabah Crescent and Gilgandra Street (28).
- d. Properties downstream of the Barina Park detention basin that may be affected by flooding in the 1% AEP and PMF events are located adjacent to Minnegang Creek on Mirrabooka Road, Weringa Avenue, Denise Street, Trevor Avenue and Northcliffe Drive (28).

Table 30: Estimated No. Properties with Over Floor and Ground Flooding in Lake Heights (27).

Design Flood Event (% AEP)	No. Properties with Over floor Flooding	No. Properties with Over-ground Flooding
PMF	20	59
1% AEP	17	48
2% AEP	17	44
5% AEP	13	43
20% AEP	5	35

2.12.6 Isolation

- a. There are no known isolations within the Minnegang Creek catchment (28).

2.12.7 Flood Mitigation Systems

- a. There is one detention basin in the Minnegang Creek catchment, located at Barina Park. The Barina Park detention basin has sufficient capacity to prevent spilling in a flood event slightly smaller the 20% AEP event. Water depths of 3m can be found within the detention basin (27).
- b. The consequences of the failure of the embankment are unknown.
- c. There are no other flood mitigation systems located in the Minnegang Creek catchment (27).

2.12.8 Dams

- a. There are no dams located upstream of the Minnegang Creek catchment.

2.12.9 At Risk Facilities

- a. There are no at risk facilities identified in the catchment.

2.12.10 Other Considerations

- a. The Illawarra Yacht Club is located on Northcliffe Drive in Lake Heights at the base of Minnegang Creek, where it discharges into Lake Illawarra. The Club and its grounds may be impacted by floodwaters in the 1% AEP and PMF events (28).

2.13 LAKE ILLAWARRA

2.13.1 Community Overview

- a. Lake Illawarra is located to the south of the Wollongong CBD and lies within the Wollongong City Council and Shellharbour City Council local government areas. Suburbs located in the Wollongong City LGA within the Lake Illawarra catchment are Kemblawarra, Koonawarra, Warrawong, Lake Heights, Yallah, Windang, Berkeley, Primbee and Kanahooka (1). The Lake Illawarra catchment is shown on Map 13.

Table 31: Population and Dwellings in Lake Illawarra (17)

Suburb	Population	Private Dwellings
Kemblawarra	unknown	unknown
Warrawong	4,770	2,156
Lake Heights	3,404	1,477
Haywards Bay / Yallah	693	222
Kanahooka	5,255	2,109
Koonawarra	3,490	1,305
Windang / Primbee	4,177	1,964
Berkeley	7,235	2,907

2.13.2 Characteristics of flooding

- a. The Lake Illawarra catchment is affected by a combination of flash, riverine and overland flooding. Flood heights are dependent on the ocean tides however can rise quickly with inflows from Mullet Creek and Macquarie Rivulet (11).
- b. Flooding can occur as a result of runoff from the creek systems entering the lake, or wind set-up, tides, wind-wave action and wave set-up from the lake and entrance (11).
- c. Lake Illawarra is also at risk of coastal inundation with up to 179 land parcels considered to be at risk under 2010 sea level conditions (18).

2.13.3 Flood Behaviour

- a. Floodwaters within the lake body usually have slow velocities. Floodwaters accelerate into the entrance channel out to the Tasman Sea. The rate and depth of flooding of the lake and its foreshores are controlled not only by the rate of catchment runoff but also to a large extent by the size and degree of shoaling of the lake entrance channel and the ocean level (11).
- b. Hazard mapping for the PMF and 1% AEP event is provided in the Lake Illawarra FRMS (11). In the 1% AEP event some of the properties on the lake foreshore are in High or Low hazard areas, particularly surrounding Griffins Bay, Primbee and Windang. The Tallawarra Power is also located in the high hazard area, as is Windang Bridge. A similar

pattern is shown in the PMF event, although a more extensive area is High Hazard, particularly at Primbee and Windang (11).

Table 32: Flood Heights on Lake Illawarra at the Cudgerie Bay Gauge (214416) (11)

Event	Level (AHD)
PMF	3.19m
1%	2.24m
2%	1.99m
5%	1.81m
10%	1.54m
20%	1.40m
50%	1.08m

2.13.4 Classification of Floodplain

- Windang is a low flood island in the 1% AEP event (2.24m at Cudgerie Bay Gauge). It is not known at what height this begins (11).
- Primbee can become a high flood island in the PMF (3.19m at the Cudgerie Bay Gauge (214416)) (11).
- All other locations have Rising Road Access in events from the 1% AEP event (2.24m at Cudgerie Bay Gauge (11)).

2.13.5 Inundation

- There are three gauges, owned by MHL, located in Lake Illawarra: Koonawarra Point Gauge (214440), Lake Illawarra Entrance Gauge (214417) and Cudgerie Bay Gauge (214416). An alert system, sends notifications to Wollongong City Unit for the Cudgerie Bay Gauge (214416) when the water level reaches particular thresholds.
- Flooding primarily occurs around the lake foreshore, and in particular at Primbee, Albion Park Rail, Yallah, Oak Flats and Kanahooka (11).

1% AEP Event

- In the 1% AEP (2.24m at Cudgerie Gauge) event, all of the urban areas of Windang Peninsula are inundated (excluding a few properties on Ocean Street) including major and minor access roads. In the PMF event the entire urban area experiences inundation. Inundation can occur for long periods of time (18 -24 hours) (11).
- In the 1% AEP event properties affected by floodwaters are located on Windang Road, Lakeview Parade, Bundah Place, Purry Burry Avenue, Fairymeadow Parkway, Kiara Place, Nicolle Road, Werrang Road, Government Road, Golf Place, King Street, Shellharbour Road, Kemblawarra Road, Carlotta Crescent and Northcliffe Drive (11).

PMF event

- e. In the PMF event (3.19m at the Cudgerie Bay Gauge) properties affected by floodwaters are located on Hoskins Avenue, Cowper Street, First Avenue, Margaret Street, Stuart Road, Kully Way, Minnegang Street, Venn Street, Wilkinson Street, Yawang Street, Narrawan Street, Bourke Way, Winnima Way and Holborn Street in addition to those impacted in the 1% AEP event (11).

Table 33: Estimated No. Properties with Over Floor Flooding in the Lake Illawarra Catchment Related to the Cudgerie Bay Gauge (214416) (11)

Design Flood Event (% AEP)	No. Properties with Over floor Flooding	No. Caravans Flooded
PMF (3.19m)	620-627	644-645
1% AEP (2.24m)	139-157	458-459
2% AEP (1.99m)	37-45	200
5% AEP (1.81m)	10	-
10% AEP (1.54m)	1	20
20% AEP (1.4m)	0	0
50% AEP (1.08m)	0	0

2.13.6 Isolation

- a. The suburb of Windang is isolated in the 1% AEP event (2.24m at Cudgerie Bay Gauge). The exact height isolation occurs is unknown but will occur prior to the 1% AEP event. In the 1% AEP event isolation can occur for up to 18 hours and during the PMF event can occur for up to 24 hours (11).

2.13.7 Flood Mitigation Systems

- a. There are no existing levees in the Lake Illawarra catchment and no information regarding detention basins was documented.

2.13.8 Dams

- a. There are no dams located upstream that affect flooding in Lake Illawarra.

2.13.9 At Risk Facilities

- a. There are five caravan parks, one school and one preschool affected by flooding in the Lake Illawarra catchment. They are described in Annex 2.
- b. The Tallawarra Power Station, located on the western foreshore of Lake Illawarra is at risk of flooding in the 1% AEP event (2.24m at Cudgerie Bay gauge) (11).

2.13.10 Other Considerations

- a. No other considerations.

SPECIFIC RISK AREAS – COASTAL EROSION AND INUNDATION

2.14 COASTAL EROSION AND INUNDATION

- The locations outlined in Table 34 have been identified as being at risk of coastal erosion and/or coastal inundation within the Wollongong LGA based on 2010 sea levels. These are also shown on Map 1.
- Of these locations, the largest number of properties at risk of coastal inundation are those located near Lake Illawarra and Thirroul Beach.
- Coastal erosion is currently mainly a risk to public facilities rather than residential dwellings along the Wollongong coast including Surf Life Saving Clubs, rock pools and parking and road infrastructure.
- Additional facilities and properties have been identified as being at risk in the future with sea level rises (18).

Table 34: Coastal Erosion and Inundation Risk during a 1% AEP storm event along the Wollongong LGA Coastline based on 2010 sea level modelling (18)

Beach Name	Coastal Erosion Risk	Coastal Inundation Risk
Stanwell Park Beach	Helensburgh-Stanwell Park SLSC & car park	24 land parcels Roads
Coalcliff Beach	SLSC & car park Coalcliff Coalcliff Tidal Rock Pool	16 land parcels
Scarborough/Wombarra Beach	SLSC Illawarra Park (off Monash Street, Wombarra)	1 land parcel Roads
Coledale Beach	No impacts expected	2 land parcels Roads
Sharkies Beach, Austinmer	Austinmer boat harbour car park	3 land parcels
Austinmer and Austinmer North Beaches	Tuckerman Park car park Austinmer Rock Baths	10 land parcels
Thirroul Beach	SLSC & car park Thirroul Thirroul Saltwater Pool	173 land parcels Roads
McCauleys Beach, Bulli	Cycleway Sandon Point Tent Embassy	29 land parcels Roads
Sandon Point Beach, Bulli	SLSC Sandon Point	24 land parcels Roads
Bulli Beach	Bulli Rock Baths Cycleway	24 land parcels

Beach Name	Coastal Erosion Risk	Coastal Inundation Risk
Woonona/Bellambi Beach	No impacts expected	66 land parcels Roads
Bellambi Harbour, Bellambi Point and Corrimal Beach	Bellambi Tidal Rock Pool	58 land parcels Roads
Towradgi/Fairy Meadow and North Wollongong Beaches	SLSC North Wollongong Towradgi Tidal Rock Pool Cycleway	13 land parcels Roads
Wollongong City / Coniston Beach	Wollongong Golf Course	12 land parcels
Perkins Beach, Primbee	No impacts expected	7 land parcels
Lake Illawarra	No impacts expected	176 land parcels Roads

ROAD CLOSURES AND ISOLATED COMMUNITIES

2.15 ROAD CLOSURES

- a. Tables 35-45 list roads liable to flooding in the Wollongong City LGA.

Table 35: Main roads liable to flooding in Wollongong City LGA.

State Highways and Major Roads (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Princes Hwy	Bulli	Bulli Pass	Can be closed for periods exceeding 24 hours due to rain related mudslides and road undermining. Not unusual for closure of over 1 week		
Princes Hwy	Bulli	Junction of Lawrence Hargrave Drive	Depths may exceed 1.5m		
Princes Hwy	Bulli	Cnr of Hobart St			
Princes Hwy	Bulli	Between Point St and Black Diamond Place. Slacky Creek crossing	Depths may exceed 1.5m		
Princes Hwy (1)	Bulli	Between Hopetoun & Organs Road	Can reach approx. 0.7m depth.		
Princes Hwy (1)	Corrimal	North of Rothery Road	Can reach depths of approx. 0.9m		
Princes Hwy (21)	Corrimal	At Towradgi Creek crossing	Depths of 0.1m in 1% AEP & 1.7m in PMF		
Princes Hwy (21)	Corrimal	Cnr Tarrawanna Rd	Depths range from 1.0m in 20% AEP to 1.8m in PMF.		
Princes Hwy (21)	Corrimal	Between Railway St & Russell St	Depths range from 0.9m in 20% AEP to 1.8m in PMF.		

State Highways and Major Roads (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Princes Hwy (1)	Fairy Meadow	Various locations			
Princes Hwy (1)	Figtree	Junctions of Bellevue Rd, The Avenue, O'Briens Road and Gibsons Road – between London Drive and the Avenue	High velocity with depths recorded at over 0.8m in some locations		
Princes Hwy (1)	Kembla Grange	Near racecourse entrance	Water stays for up to a week if lake levels are high. In major flooding only suitable for high clearance vehicles.		
Princes Hwy (1)	Russell Vale	Outside Golf Course	Can reach depths exceeding 0.6m.		
Princes Hwy (1)	Russell Vale	Between Albert St & Bellambi Lane	Bellambi Creek crossing. Can reach depths of approx. 0.6m with high velocity.		
Princes Hwy	Russell Vale	Between Broker & Moreton Sts	Nuisance flooding. Remains passable.		
Princes Hwy	Tallawarra	Duck Creek Culvert/Bridge			
Princes Hwy (1)	Unanderra	Between of Cordeaux Road and Farmborough Road			
Princes Hwy	Woonona (1)	Between Gray St & Hillcrest Ave	Can exceed depths of 1.0m at Woonona shopping precinct.		

State Highways and Major Roads (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Princes Hwy	Woonona (1)	Between Alfred St & Hale St	Can exceed depths of 1.0m		
Princes Hwy		Allans Creek crossing	Overtopped for 2 hrs in PMF with ~0.7m depth (8)		
Princes Hwy		American Creek crossing	Overtopped for 8 hrs in 1% AEP with ~1.7m depth (8)		
Princes Hwy		Byarong Creek	Overtopped for 4 hrs in 1% AEP with ~0.9m depth (8)		
Princes Hwy		Charcoal Creek	Overtopped for 8 hrs in 1% AEP with ~1.0m depth (8)		
Princes Hwy		Jenkins Creek	Overtopped for 4 hrs in 1% AEP with ~0.9m depth (8)		
Princes Hwy		Unanderra Drain	Overtopped for 8 hrs in 1% AEP with ~0.4m depth (8)		
Princes Hwy (6)	North Wollongong	Ajax Avenue to Bourke Street	Impacts 22,000 vehicles per day when closed		
Princes Motorway (M1)		At Cataract Creek crossing			
Princes Motorway (M1) (1)	Figtree	Between Masters Road on and off ramp both directions	Recorded depths of over 1m		

State Highways and Major Roads (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Princes Motorway (M1)	Unanderra	Approx 200m south of Masters Rd off ramp	Depths reported at 300-500mm		
Princes Motorway (M1) (6)	Mount Ousley		water flows across near the University and Nyrang Park in the 1% AEP. 60,000 vehicles affected.		
Princes Motorway (M1)		American / Byarong Creek crossing	Overtopped for 8 hrs in 1% AEP with ~2.2m depth (8)		
Princes Motorway (M1)		Allans Creek / Unanderra Drain	Overtopped for 5 hrs in PMF with ~1.2m depth (8)		
Princes Motorway (M1)		Freeway Trib Branch	Overtopped for 3 hrs in 1% AEP with ~0.4m depth (8)		
Memorial Drive (21)	Corrimal	Junction of Railway Street	Depths range from 0.8m in 20% AEP to 1.3m in PMF.		
Memorial Drive (1)	Corrimal	Between Rothery St & Bellambi Lane	Can reach depths of approx. 0.5m south of Rothery St.		
Memorial Drive	Corrimal	At the Carr Creek crossing north of Towradgi Road	Depths range between 0.1m in 20% AEP to 1.1m in PMF (21).		
Memorial Drive (6)	Fairy Meadow	Between Chapman Street and Elliots Road, and between the Botanic	In conjunction with Princes Highway closure impacts 40,000		

State Highways and Major Roads (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
		Gardens and Woodhill Street in the 1% AEP.	vehicles per day		

Table 36: Roads liable to flooding in the Northern Suburbs

Local Roads Northern Suburbs (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Lady Carrington Dr	Otford	Hacking River			nil
Lawrence Hargrave Drive		Various locations where creeks cross roadways	May close for a number of days post rain event due to landslips or road undermining		nil
	Thirroul	Between Hewitts Ave & Phillip St, and Cnr Railway Parade			
Otford Road	Otford	Hacking River			nil

Table 37: Roads liable to flooding in the Hewitts Creek Catchment

Local Roads Hewitts Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Hobart Street		From Princes Hwy to approx 200m west of Haig Road	Reports of depths exceeding 2m		

Table 38: Roads liable to flooding in the Collins Creek Catchment

Local Roads Collins Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Birch Cres (1)	Bellambi	Northern end at Sellers Cres intersection			nil
Blackall St	Bulli	At Slacky Creek			nil
Brompton Rd	Bellambi	Between Daphne St and Bellambi Ln			nil
Campbell Street (1)	Woonona	Between Northern Distributor & Robert St			nil
Carrington Street (1)	Woonona	Cnr Lawrence St			nil
Cawley Street (1)	Bellambi	Between Connaghan Ave & Rothery St			nil
Culgoa Road (1)	Woonona	Between Kareela Rd & Campbell St			nil
Farrell Road (1)	Bulli	Cnr Trinity Road	New drainage has been installed and may alleviate past flooding problems		nil
Gahans Lane (1)	Woonona	Intersection with High Street			nil
Hollymount View (1)	Woonona	At both intersections			nil
Liddle Street	Woonona	Between Nicholson Road and Gray Street			nil
Pioneer Road (1)	East Corrimal	Between Railway St & Owen Park Rd			nil
Pioneer Road (1)	Bellambi	Between Union St & Lismore St			nil
Railway Parade (1)	Woonona East	Southern End			nil
Rothery Street (1)	Corrimal	Between Hardie St and Bloomfield Ave			nil
Stanhope St (1)	Woonona	At both intersections			nil

Local Roads Collins Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Thompson Street	Woonona	At Collins creek bridge			nil

Table 39: Roads liable to flooding in the Towradgi Creek Catchment

Local Roads Towradgi Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Angel Street/ Meads Avenue footbridge (21)	Corrimal	footbridge	Flood depths range from 0.1m in the 5% AEP to 2.8m in the PMF		nil
Colgong Crescent footbridge (21)	East Corrimal	footbridge	Flood depths range from 1.3m in the 20% AEP event to 4.1m in the PMF.		nil
Lake Parade/ Towradgi Park footbridge (21)	East Corrimal	footbridge	Flood depths range from 0.2m in the 20% AEP to 1.8m in the PMF		nil
Meads Avenue/ Princes Highway footbridge (21)	Corrimal	footbridge	Flood depths range from 0.9m in the 20% AEP to 4.0m in the PMF.		nil
49 Tarrawanna Road access bridge (21)	Tarrawanna	footbridge	Flood depths range from 0.3m in the 20% AEP to 1.3m in the PMF.		nil
Bellambi St (21)	Tarrawanna	At North Angels Creek crossing	Depths range from 1.1m in 20% AEP to 1.6m in PMF		nil
Brooker Street (21)	Tarrawanna	At South Angels Creek crossing	Depths range from 0.7m in		nil

Local Roads Towradgi Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
			5% AEP to 1.0m in PMF		
Carr Street	Towradgi	Northern end	Depths range between 0.9m in 20% AEP & 2.3m in PMF (21).		nil
Carroll Road	East Corrimal	Parker Creek crossing	Depths range from 0.2m in 20% AEP to 2.2m in PMF (21).		nil
Charles Road	Corrimal	At the Towradgi creek crossing	Depths range from 1.1m in the 20% AEP to 3.0m in the PMF event (21).		nil
Colgong Crescent	Towradgi	Carr Creek crossing	Depths range from 0.4m in 20% AEP to 1.4m in PMF (21).		nil
Collins Street (1)	Corrimal	At both intersections at North Corrimal Creek crossing	Depths range from 0.7m in 20% AEP to 1.7m in PMF (21).		nil
Cross Street (21)	Corrimal	Near intersection with Rothery Street	Depths range from 1.3m in 20% AEP to 2.3m in PMF.		nil
Lake Parade	East Corrimal	Parker Creek crossing	Depth range from 0.1m in 20% AEP to 2.1m in PMF (21).		nil
Lake Parade (1)	East Corrimal	Total closure to whole road	One of two egress routes from Corrimal beach Tourist Park		nil
Lemrac Avenue	Corrimal	North Corrimal Creek crossing	Depths range from 0.9m in 20% AEP to 2.9m in PMF (21).		nil

Local Roads Towradgi Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Meadow Street (1)	Tarrawanna	Between Caldwell Ave & Keira St at the Towradgi Creek crossing	Depths range from 0.7m in the 20% AEP to 2.2m in PMF (21).		nil
Meadow Street (21)	Tarrawanna	North of Kendall St	Depths range from 0.3m in 20% AEP to 0.9m in PMF.		nil
Meadow Street (21)	Tarrawanna	Between Tarrawanna Rd & Karen Pl	Depths range from 0.7m in 20% AEP to 0.6m in PMF.		nil
Parker Road	East Corrimal	Parker Creek crossing	Depths range from 0.5m in 20% AEP to 2.5m in PMF (21).		nil
Pioneer Road	East Corrimal	Between Sturdee St & Lake Parade at the Towradgi Creek crossing	Depths range from 0.2m in 20% AEP & 3.5m in PMF (21).		nil
Railway Street (21)	Corrimal	Between Harbinger St & Gilbert St	Depths range from 1.4m in the 20% AEP to 2.5m in the PMF.		nil
Tarrawanna Road (21)	Corrimal	Near Underwood Street	Depths range from 0.1m in 2% AEP to 0.3m in PMF.		nil
Tarrawanna Road (21)	Tarrawanna	Between Meadow Street and Angel Street	Depths range from 0.7m in 20% AEP to 1.3m in PMF.		nil
The Avenue (21)	Corrimal	South Corrimal Creek crossing	Depths range from 1.3m in 20% AEP to 3.1m in PMF.		nil
Underwood St (1)	Corrimal	At The Avenue & Francis St intersection up to Russell St	Depths range from 0.7m in 20% AEP to 2.2m in PMF at North Corrimal		nil

Local Roads Towradgi Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
			Creek Crossing (21).		
Ursula Road (1)	Bulli	At both intersections			nil

Table 40: Roads liable to flooding in the Fairy and Cabbage Creek Catchments

Local Roads Fairy and Cabbage Creek Catchments (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Achilles Avenue (6)	North Wollongong	Whole length	Affected by floodwaters in the 1% AEP.	nil	nil
Ajax Ave (6)	North Wollongong	Junction of Montague Street	Flooded in 1% AEP	Yes access via Flinders St	nil
Balgownie Road (1)	Balgownie	Between Weekes St and Sproule Cres	nil	Yes via local roads	nil
Cabbage Tree Lane (1)	Fairy Meadow	At 3 locations; Brynymor Pl, Dawson St and Mclean Ave intersections			nil
Carters Lane	Fairy Meadow	Pioneer Road Junction			nil
Exeter Avenue (6)	North Wollongong	Whole length	Is affected by flooding in the 1% AEP	no	nil
Flinders Street	North Wollongong	Between Bourke and Ajax Streets	No access to properties in Stafford St, or those on Flinders St	no	nil
Foleys Lane (1)	North Wollongong	At the TAFE entrance	Loss of vehicle access to the TAFE	May be able to use pedestrian footbridge	nil
Gipps Road (1)	Keiraville	Between William Street and Eastern Street			nil

Local Roads Fairy and Cabbage Creek Catchments (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Graham Ave (23)	Gwynneville	Closes first at the College Pl intersection before closing at the University Ave intersection	Causes isolation of College Pl and Graham Ave area (area becomes a low flood island)	no	nil
Mt Ousley Rd (1)	Fairy Meadow	Junction with Princes Highway in the 1% AEP	Impacts 15,000 vehicles per day		nil
Montague Street	North Wollongong	From Ajax Ave to road rise at Para Ck bridge	SES HQ flooded, access to SES HQ lost	no	nil
Murphys Avenue (1)	Keiraville	Between John St and Eastern St, and at the Irvine Street intersection	nil	Yes via local roads	nil
Northfields Avenue	Gwynneville	Outside the University of Wollongong campus	Loss of access to the university	no	nil
Squires Way (1)	Fairy Meadow	Overflowing Sewer			nil

Table 41: Roads liable to flooding in the Wollongong City Catchment

Local Roads Wollongong City Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Corrimal Street (7)	Wollongong	Swan Street Intersection	Depths range from 0.1m in 20% AEP to 0.65m in 1% AEP.	Yes via local roads	nil
Gladstone Avenue (7)	Coniston	Near Union Street	Depths range from 1.15m in 20% AEP to	Yes via local roads	nil

Local Roads Wollongong City Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
			1.3m in 1% AEP.		
Gladstone Avenue (7)	Wollongong	Near Osbourne Street	Depths range from 0.9m in 20% AEP to 1.1m in 1% AEP.	Yes via local roads	nil
Kembla Street (7)	Wollongong	Swan Street intersection	Frequently closed Depths range from 0.6m in 20% AEP to 1.18m in 1% AEP.	Yes via local roads	nil
Springhill Road (7)	Wollongong	Near John Cleary Place	Depths range from 0.4m in 20% AEP to 0.35m in 1% AEP.		nil
Springhill Road (7)	Wollongong	Near Bridge Street	Depths range from 0.35m in 20% AEP to 0.62m in 1% AEP.		nil
Springhill Road (7)	Spring Hill	Just south of Masters Road intersection	Depths range from 0.7m in 20% AEP to 1.1m in 1% AEP		nil
Springhill Road (7)	Wollongong	Port Kembla Road intersection	Depths range from 1.6m in 20% AEP to 2.6m in 1% AEP.		nil

Table 42: Roads liable to flooding in the Allans Creek Catchment

Local Roads Allans Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Cordeaux Road (1)	Figtree	Various locations from Gibsons Road to Mount Kembla	Depths may reach 300-500mm but includes high velocity		nil

Local Roads Allans Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Five Islands Road (1)	Unanderra/Coniston	Junction of Princes Hwy and Five Islands Rd, and On and Off ramps from F6 and Roundabout at junction of Glastonbury Avenue And Between the F6 and Springhill Road	Regular reports of vehicles trapped in flood waters at this location		nil
Gladstone Avenue (7)	Mount Saint Thomas	Near Vale Street	Depth range from 1.6m in 20% AEP to 2.6m in 1% AEP.		nil
Gibsons Road (1)	Figtree	Where road crosses American Creek.			nil
O'Briens Road (1)	Figtree	Between Princes Hwy and Murray Park Road, and East of Church of Christ	Depths of over 600mm recorded Affected by flooding in the 20% AEP event		nil
Old Port Road	Port Kembla	Near railway over-bridge			nil
Springhill Road (1)	Springhill	Various locations at and between Masters Road and Five Islands Road.	Have recorded depths of 2.0m		nil
Uralba Street (1)	Figtree	At Byarong Creek	Depths of over 1.2m recorded.		nil

Table 43: Roads liable to flooding in the Mullet Creek Catchment

Local Roads Mullet Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Avondale Road (1)	Avondale	East and west of South Avondale Road Low point between Oakhurst Cres and Dale St	Depths >1m can be reached.		nil
		Mullet Creek bridge	Can reach depths of over 1.5m		nil
Byamee Street (1)	Dapto	At the Brooks Creek crossing between Aldinga Ave and Bambil Cres			nil
Bong Bong Road (1)	Dapto	Near Hamilton and Burringbar Sts From Princes Highway to Parkdale Avenue	Can reach depths of >1.5m. May be impassable for over 24hours		nil
Burringbar Street	Dapto	Whole length	No access to properties on Burringbar St	no	nil
Cambridge Road (1)	Dapto	Whole length	Loss of access to properties on Cambridge Rd	yes	nil
Cleveland Road (1)	Dapto	For 1km west from railway line and at Mullet Creek crossing near junction of Avondale Road.	May exceed 1m		nil
Darkes Road (1)	Dapto	Rail line and creek crossings	Depths calculated to exceed 2m		nil
Emerson Road (1)	Dapto	At the Beltana Ave intersection		yes	nil
Fowlers Road (1)	Dapto	Junctions of Rink Rd and Julianne St	Can reach depths of over 1.5m		nil

Local Roads Mullet Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Lakelands Drive (1)	Dapto	At the Oxford Rd intersection		Yes via local road	nil
Lakeside Drive	Kanahooka	Between Edgeworth Ave & Wallabah Way	Affect known to remain for over 48 period or until lake able to release to ocean.		nil
West Dapto Road (1)	Dapto	All creek crossings and low lying areas. Junction of Sheaffes Road	Can reach depths of >0.6m		nil

Table 44: Roads liable to flooding in the Minnegang Creek Catchment

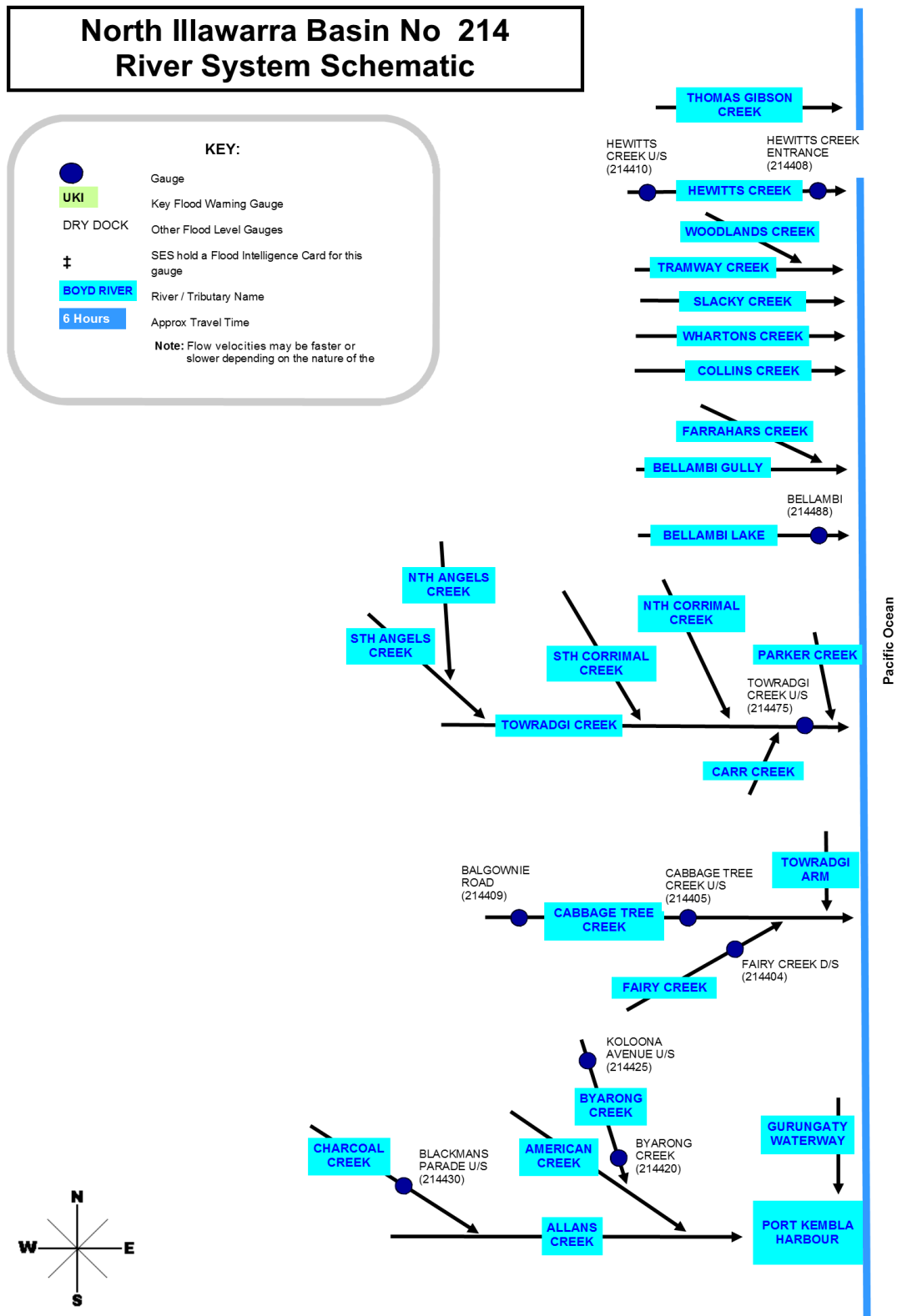
Local Roads Minnegang Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Barina Avenue (1)	Lake Heights	Between Culburra St and Derowie Cres	nil	Yes via local roads	nil
Denise Street (1)	Lake Heights	Between Weringa Ave and Canberra Rd, and	nil	Yes via local roads	nil
		Between Canberra Rd and Northcliffe Dr	nil	Yes via local roads	nil
Karrabah Street (1)	Lake Heights	At the intersection with Melinda Grove	nil	Yes via local roads	nil
Lake Heights Road (1)	Lake Heights	Between Buena Vista Ave and Culburra St	nil	Yes via local roads	nil
Mirraboooka Road (1)	Lake Heights	Just east of the Derowie Cres intersection	nil	Yes via local roads	nil
Ranchby Avenue (1)	Lake Heights	At 6 locations along the entire length of the Avenue	nil	Yes via local roads	nil

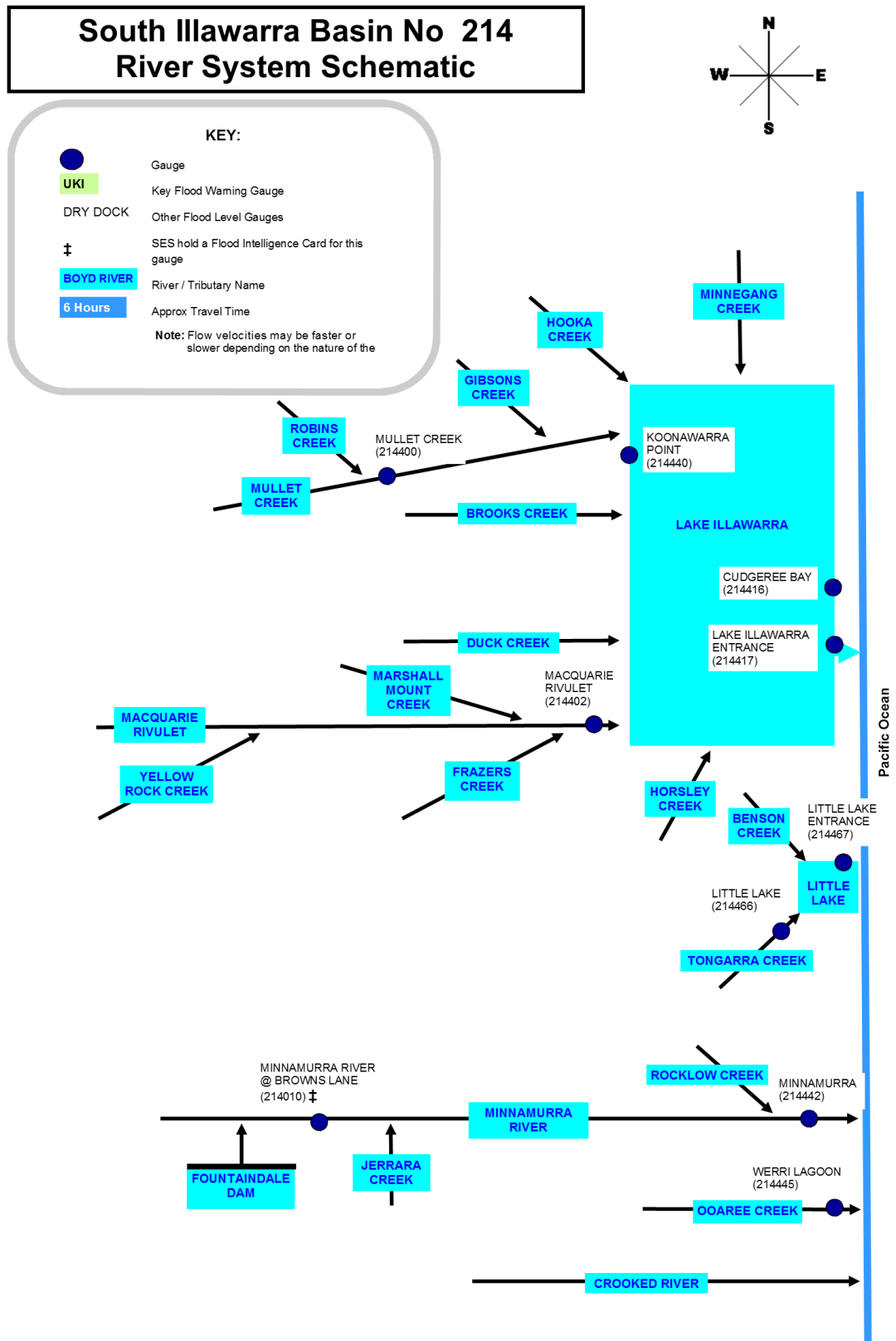
Local Roads Minnegang Creek Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Trevor Avenue (1)	Lake Heights	Near the St Cloud Cres intersection	nil	Yes via local roads	nil
Weringa Avenue (1)	Lake Heights	Between Denise St and Katrina St	nil	Yes via local roads	nil

Table 45: Roads liable to flooding in the Lake Illawarra Catchment

Local Roads Lake Illawarra Catchment (1)					
Road	Nearest Suburb	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Boundary Road	Windang	Near Windang Road			nil
King Street	Warrawong	Intersection of Hoskins Ave			nil
Northcliffe Drive (1)	Warrawong/ Lake Heights	Between First Ave & Denise St and The intersection of Wilkinson St (eastern end)			nil
Windang Road	Windang	Between the suburbs of Primbee & Lake Illawarra			nil

ANNEX 1: ILLAWARRA RIVER BASIN SCHEMATICS





ANNEX 2: FACILITIES AT RISK OF FLOODING AND/OR ISOLATION

Table 46: Facilities at risk of flooding in the Collins Creek Catchment

Facility Name	Street	Suburb	Comment
Schools			
Waniora Public School	Ursula Road	Bulli	Grounds experience inundation in 20% AEP and buildings in 5% AEP (12)
Bulli High School	Ursula Road	Bulli	Grounds experience inundation in the 20% AEP and buildings in the 0.5% AEP (12)
Woonona High School	Nicholson Lane	Woonona	Grounds experience inundation in the 20% AEP. The buildings begin to experience over floor flooding in the 2% AEP (12).
Woonona East Public School	Royal Crescent	Woonona	Grounds experience inundation in the 5% AEP. The buildings do not experience over floor flooding (12).
Russell Vale Public School	Terania Street	Russell Vale	Grounds experience inundation in the 20% AEP. Buildings do not experience over floor flooding (12).
Holy Spirit Collage	Cawley Street	Bellambi	Grounds experience inundation in the 20% AEP. Buildings experience over floor flooding in the PMF event (12).
Corrimal Public School	Princes Highway	Corrimal	Grounds experience inundation in the 5% AEP. Buildings do not experience over floor flooding (12).
Bellambi Public School	Owen Park Road	Bellambi	Grounds experience inundation in the 5% AEP. Buildings do not experience over floor flooding (12).
Corrimal High School	Murray Road	Corrimal	Northern ovals experience inundation in the 20% AEP. Southern grounds experience inundation in the PMF. Buildings are not affected by over floor flooding (12).
Child Care Centres			
Bulli Childrens Centre		Bulli	
Bulli Pre School	Hospital Road	Bulli	Grounds experience inundation in the 20% AEP. Buildings do not experience over floor flooding (12)

Facility Name	Street	Suburb	Comment
Balls Paddock Children's Centre	Luxor Street	Woonona	Grounds experience inundation in the 20% AEP. Building experiences over floor flooding in the 5% AEP (12)
Coolgardie Children's Centre	Coolgardie Street	Corrimal	Grounds experience inundation in the 5% AEP. Building does not experience over floor flooding (12).
Facilities for the aged and/or infirm			
Tasman Court Retirement Village	23 Tasman Parade	Thirroul	40 low-care hostel units
IRT Sid Wearne Court Retirement Facility	Farrell Road	Bulli	The grounds are impacted in the 5% AEP. The buildings do not experience over floor flooding (12).
Northern Family Care Cottage	Ball Street	Woonona	The grounds are affected by flooding in the 0.2% AEP. The building does not experience over floor flooding (12).
IRT Woonona Aged Care	Popes Road	Woonona	The grounds are affected by flooding in the 20% AEP. The buildings experience over floor flooding in the 0.2% AEP (12).
Chesalon Care Woonona	Alice Street	Woonona	Grounds experience inundation in the 20% AEP. Buildings do not experience over floor flooding (12).
Utilities and infrastructure			
-	-	-	-
Camping Ground / Caravan Parks			
Bulli Beach Tourist Park	Farrell Road	Bulli	Park is impacted by floodwaters in the PMF event (12)
Hospitals			
Bulli Hospital	Hospital Road	Bulli	Main access at Hospital Road/Princes Highway intersection closed in the 5% AEP event (1).
Coledale Hospital	Lawrence Hargrave Drive	Wombarra	Not affected by floodwaters but may become isolated for short periods of time (1).

Table 47: Facilities at risk of flooding in the Towradgi Creek Catchment

Facility Name	Street	Suburb	Comment
Schools			
Corrimal East Public School	Duff Parade	Corrimal	South eastern corner of grounds is affected by flooding in the PMF event (5).
Tarrawanna Public School	Kendall Street	Tarrawanna	Is affected by flooding in the PMF event (5).
Child Care Centres			
Gumnut Village Preschool	Dalton Street	Towradgi	Is affected by flooding before the 20% AEP event (5).
Corrimal Community Preschool	Short Street	Corrimal	Access to the Preschool is lost in the 20% AEP event (5).
Facilities for the aged and/or infirm			
Bishop McCabe Retirement Village	Ziems Avenue	Towradgi	Is affected by flooding in the 20% AEP event (5).
IRT Birch Villa	Underwood Street	Corrimal	Is affected by flooding in the PMF event. Access is lost in the 1% AEP event (5).
Utilities and infrastructure			
Illawarra Railway	Towradgi Creek crossing	Corrimal	In the PMF event a floodwater depth of 0.6m can be reached (21).
Camping Ground / Caravan Parks			
Corrimal Beach Tourist Park	Lake Parade	East Corrimal	The park becomes isolated in the 20% AEP event (5).
Hospitals			
-	-	-	-

Table 48: Facilities at risk of flooding in the Fairy and Cabbage Creek Catchments

Facility Name	Street	Suburb	Comment
Schools			
TAFE Illawarra – Wollongong Campus	Foleys Road	Wollongong	Is affected by over floor flooding in the 5% AEP event. Over ground flooding occurs in the 20% AEP event (23).
University of Wollongong	Northfields Avenue	Keiraville	Is affected by over ground flooding in the 20% AEP event. No over floor flooding is experienced (23).
Keiraville Public School	Gipps Road	Keiraville	Over ground flooding occurs in 20% AEP event, no over floor flooding (23).
Keira High School	Lysaght Street	Fairy Meadow	Over floor flooding occurs in the 1% AEP event, over ground flooding occurs in the 20% AEP event (23).
Elonera Montessori School	Mount Ousley Road	Mount Ousley	Is affected by overground flooding in the 20% AEP event. No over floor flooding (23)
Good Samaritan Catholic Primary School	McGrath Street	Fairy Meadow	Is affected by over ground flooding in the 5% AEP event (23).
Fairy Meadow Public School	Princes Highway	Fairy Meadow	Is affected by over ground flooding in the 1% AEP event (23).
Pleasant Heights Public School	Alvan Parade	Mount Pleasant	Is affected by over ground flooding in the 5% AEP event (23).
Towradgi Public School	Carters Lane	Fairy Meadow	Is affected by over ground flooding in the 2% AEP event (23).
Edmund Rice College	Mount Keira Road	West Wollongong	Is affected by over ground flooding in the 20% AEP event. Not affected by over floor flooding (23).
Child Care Centres			
Willy Wagtail's Garden Childcare Centre	Florence Street	Fairy Meadow	Is affected by overground flooding in the 20% AEP event. No over floor flooding (23).
Shining Starts Early Learning	Greenacre Road	Wollongong	Is affected by over ground flooding in the 20% AEP event. No over floor flooding (23).
Tinkerbelle Pre-school and Day Care Centre	Gwynne Street	Gwynneville	Is affected by over ground flooding in the 20% AEP event. No over floor flooding (23).

Facility Name	Street	Suburb	Comment
Facilities for the aged and/or infirm			
IRT Towradgi Park	Murrarar Rd	Towradgi, 2518	68 units. Is affected by over floor flooding in the 5% AEP event and over ground flooding in the 20% AEP event (23).
IRT Braeside Close	155 Gipps Road	Gwynneville, 2500	50 self care units. Affected by overfloor flooding in the 5% AEP event. Affected by over ground flooding in the 20% AEP event (23).
Utilities and infrastructure			
NSW SES Wollongong City Unit	Montague Street	North Wollongong	Access is impacted in the 20% AEP. Grounds are impacted in the 20% AEP event (23).
Illawarra Railway (6)	Dixon Street to Elliots Road	Fairy Meadow	Railway would be overtopped in the 1% AEP.
Illawarra Railway (6)	Soudan Street to North Wollongong Station	North Wollongong	1.1km on line would be flooded in the 1% AEP.
Beaton Park Sporting Complex	Foleys Road	Gwynneville	The facility is affected by flooding in the 20% AEP event (23).
Camping Ground / Caravan Parks			
-	-	-	-
Hospitals			
-	-	-	-
Hotels / Motels			
Quality Suites Pioneer Sands	Carters Lane	Fairy Meadow	Is affected by over floor and over ground flooding in the 20% AEP event (23).
Wollongong Surf Leisure Resort	Pioneer Road	Fairy Meadow	Is affected by over ground flooding in the 1% AEP event (23).
UOW Campus East	Cowper Street	Fairy Meadow	Is affected by over ground flooding in the 20% AEP. No over floor flooding (23).
UOW International House	Porter Street	North Wollongong	Is affected by overground flooding in the 20% AEP event (23).

Table 49: Facilities at risk of flooding in the Wollongong City Catchment

Facility Name	Street	Suburb	Comment
Schools			
TAFE Illawarra – West Wollongong Campus	Gladstone Avenue	Wollongong	Is affected by flooding prior to the 5% AEP event (7).
Coniston Public School	Auburn Street	Coniston	The oval is affected by flooding in the 20% AEP event (24).
Child Care Centres			
Kenny Street Community Preschool	Kenny Street	Wollongong	Is affected by flooding in the 20%, access to the facility is affected in the 20% AEP event (24).
Ocean View Preschool	Harold Street	Coniston	Access to the facility is affected in the 1% AEP event (7).
Wollongong Preschool Kindergarten	Atchison Street	Wollongong	Is affected before the 20% AEP event (24).
Grandma Rosie's Childcare	Kenny Street	Wollongong	Is affected by flooding in the 20% AEP event (24).
Wollongong City Community Preschool	Keira Street	Wollongong	Is affected by flooding in the 20% AEP event (24).
South Workers Child Care Centre	Ellen Street	Wollongong	Is affected by flooding in the 20% AEP (24).
Stewart Street Community Preschool	Stewart Street	Wollongong	Is affected by flooding in the 20% AEP (24).
Boombalee Kidz	Church Street	Wollongong	Is affected by flooding prior to the 20% AEP event (24).
Wollongong Lollipop Kidz	Keira Street	Wollongong	Is affected by flooding in the 20% AEP event (24).
Facilities for the aged and/or infirm			
Warrigal Care	Bridge Street	Coniston	Access to the facility is impacted in the 1% AEP event (7).
IRT Diment Towers	Staff Street	Wollongong	Is affected by flooding in the 1% AEP event (7).
IRT Howard Court – Retirement Village	Stewart Street	Wollongong	Is affected by flooding in the 5% AEP event (24).
IRT Links Seaside	Ross Street	Wollongong	Is affected by flooding prior to the 20% AEP event (24).
Utilities and infrastructure			
Illawarra Railway	Wollongong Station and south	Wollongong/Coniston	The Railway is affected by flooding prior to the 20% AEP event (24).

Table 50: Facilities at risk of flooding in the Allans Creek Catchment

Facility Name	Street	Suburb	Comment
Schools			
Farmborough Road Public School	Farmborough Road	Unanderra	Northern fields are affected by flooding in the 5% AEP event (8).
St Pius X Catholic Primary School	Cnr Cummins St & Hargraves St	Unanderra	Is affected by floodwaters in the 20% AEP event (8).
Figtree Public School	Gibsons Road	Figtree	Is affected by floodwater in the 5% AEP event (8).
Figtree High School	Gibsons Road	Figtree	Is affected by floodwaters in the 20% AEP event (8).
Lindsay Park Public School	Thames Street	West Wollongong	Is affected by flooding in the PMF event (8).
Cedars Christian College	Waples Road	Farmborough Heights	Is affected by floodwaters in the 20% AEP event (8).
Child Care Centres			
The Ants Pants Pre School	Northview Terrace	Figtree	Is affected by floodwaters in the 5% AEP event (8).
Little People's Early Learning Centre	Gibsons Road	Figtree	Is affected by floodwaters in the 5% AEP event (8).
Figtree Early Childhood Centre	Princes Highway	Figtree	Is affected by floodwaters in the 5% AEP event (8).
Facilities for the aged and/or infirm			
Farmborough Aged Care Centre	Waples Road	Farmborough Heights	Is affected by flooding in the 20% AEP event (8).
Marco Polo Aged Care Services	Waples Road	Farmborough Heights	Is affected by floodwaters in the 20% AEP event (8).
Kennedy Health Care Group	Suttor Place	Figtree	Is affected by floodwaters in the 1% AEP event (8).
Utilities and infrastructure			

Facility Name	Street	Suburb	Comment
Illawarra Railway (8)	Jenkins Creek Crossing		In the 1% AEP event the railway is overtopped by 0.97m for 4.5hrs. In the PMF event the railway is overtopped by 1.2m for 7.5hrs.
Illawarra Railway (8)	Charcoal Creek crossing	Unanderra	In the 1% AEP event the railway is overtopped by 1.76m for 4.5hrs. In the PMF event the railway is overtopped by 3.04m for 7.5hrs.
Illawarra Railway (8)	Allans Creek crossing	Unanderra	In the PMF event the railway is overtopped by 0.81m for 3hrs.
Illawarra Railway (8)	Unanderra drain crossing	Unanderra	In the 1% AEP event the railway is overtopped by 0.55m for 4.5hrs. In the PMF event the railway is overtopped by 2.27m for 7hrs.
Illawarra Railway (8)	American Creek crossing	Figtree	In the PMF event the railway is overtopped by 0.38m for 2hrs.
Camping Ground / Caravan Parks			
Figtree Gardens Caravan Park	Woodrow Place	Figtree	Is affected by floodwaters in the 5% AEP event. The park becomes isolated in the 20% AEP event (8).
Hospitals			
Illawarra / Figtree Private Hospital	Suttor Place	Figtree	Is affected by floodwaters in the 1% AEP event (8).
Hotels / Motels			
Sovereign Inn	Princes Highway	Figtree	Is affected by floodwaters in the 20% AEP event (8).
Figtree Hotel	Princes Highway	Figtree	Is affected by floodwaters in the 5% AEP event (8).
Unanderra Hotel	Central Road	Unanderra	Is affected by floodwaters in the PMF event (8).

Table 51: Facilities at risk of flooding in the Mullet Creek Catchment

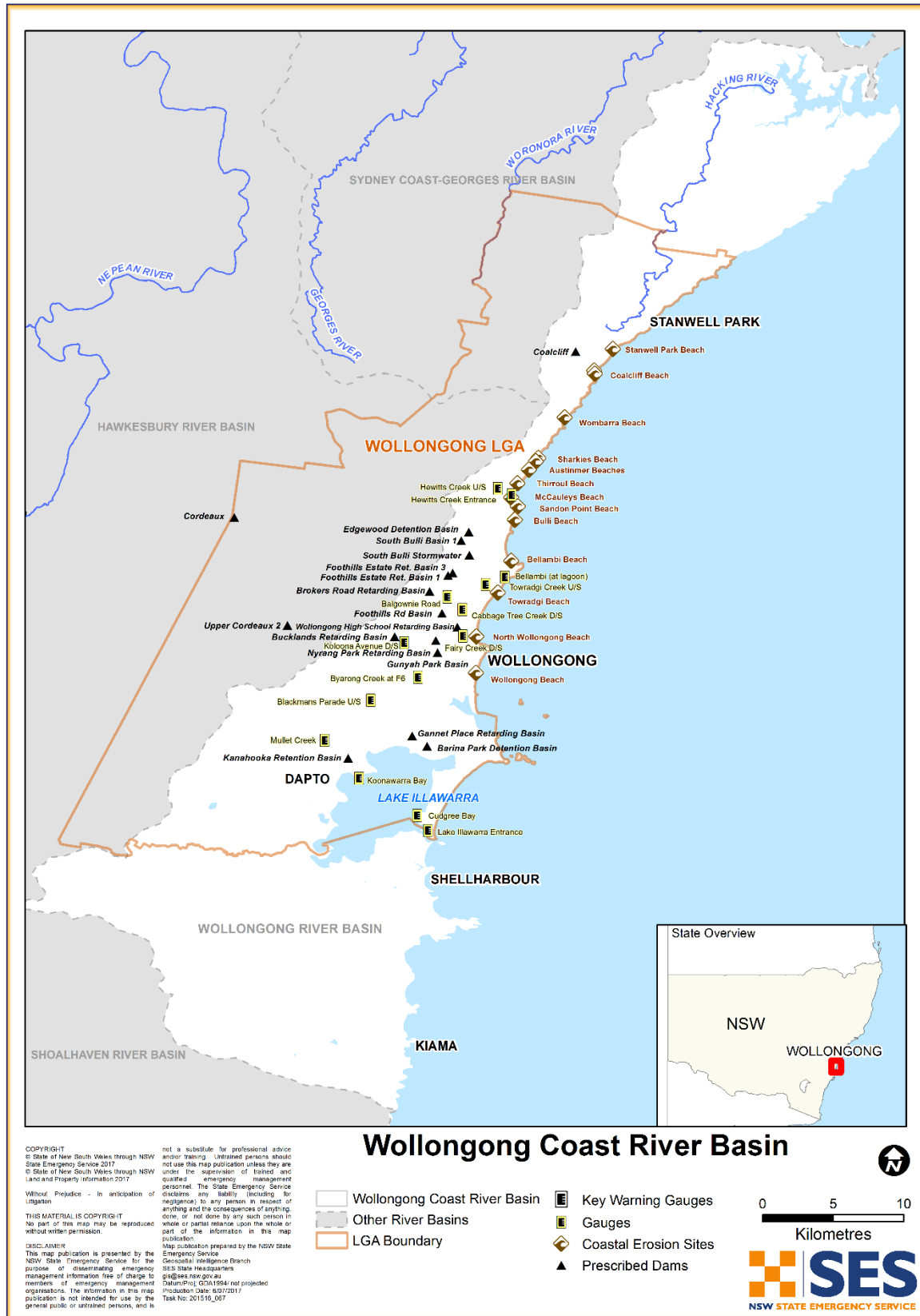
Facility Name	Street	Suburb	Comment
Schools			
Dapto High School	Cleveland Road	Dapto	Grounds are affected by flooding in the 20% AEP event. Over floor flooding occurs in the 10% AEP event (25).
Child Care Centres			
-	-	-	-
Facilities for the aged and/or infirm			
Lakeline Estate	Kanahooka Road	Kanahooka	Is affected by flooding in the PMF event (25).
Utilities and infrastructure			
-	-	-	-
Camping Ground / Caravan Parks			
-	-	-	-
Hospitals			
-	-	-	-

Table 52: Facilities at risk of flooding in the Lake Illawarra Catchment

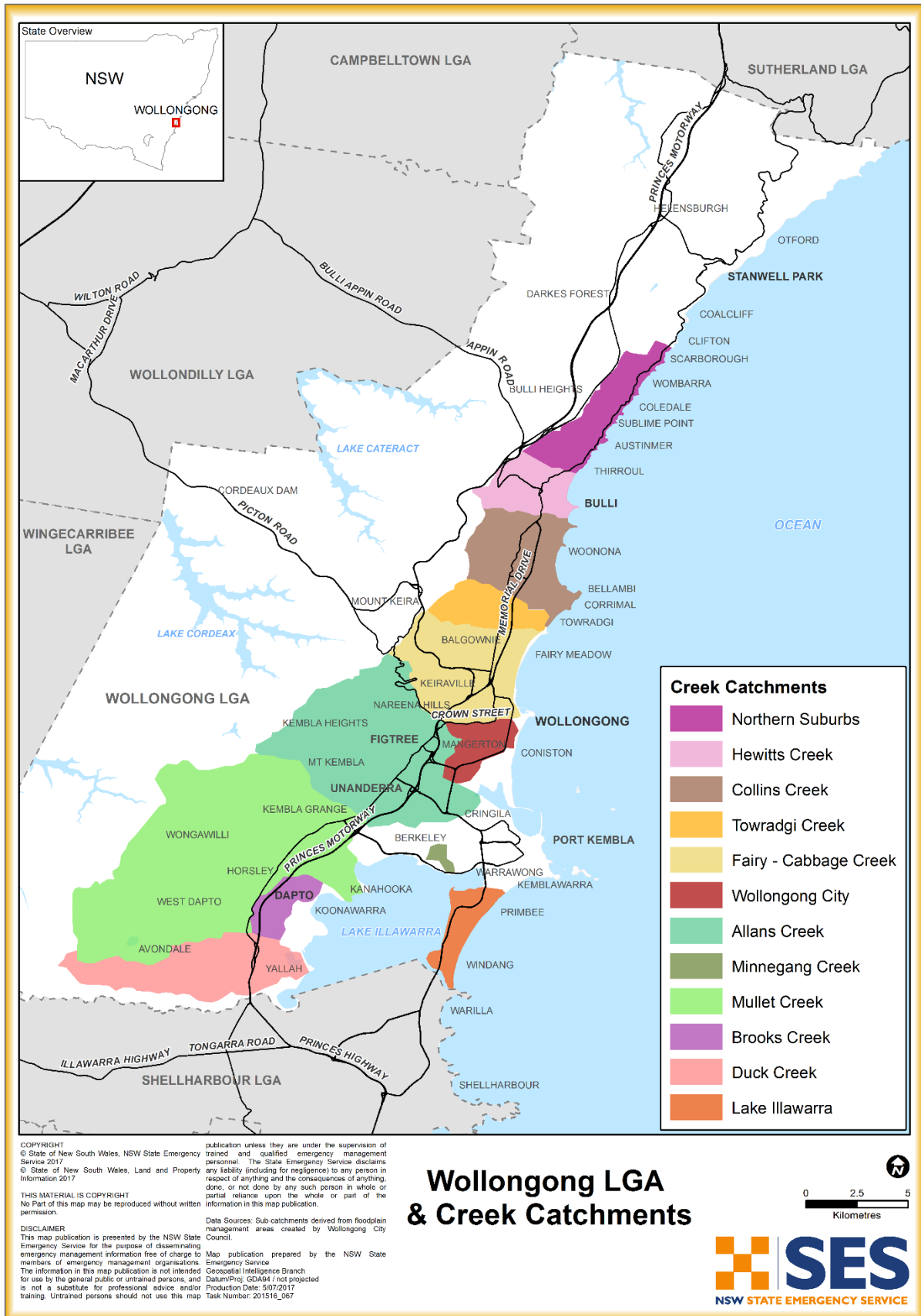
Facility Name	Street	Suburb	Comment
Schools			
Windang Public School	Oakland Avenue	Windang	Is affected by flooding prior to the 1% AEP (2.24m at Cudgere Bay Gauge) (11).
Child Care Centres			
Lakeview Pre-School	Windang Road	Primbee	Is affected by floodwaters prior to the 1% AEP event (2.24m at Cudgere Bay Gauge) (11).
Facilities for the aged and/or infirm			
-	-	-	-
Utilities and infrastructure			
-	-	-	-
Camping Ground / Caravan Parks			
Oasis Resort	Windang Road	Windang	Is affected by floodwaters prior to the 1% AEP event (11). No overfloor flooding in 2016 (1.57m at Cudgere Bay Gauge (214416)).
South Pacific Park Village	Windang Road	Windang	Is affected by floodwaters prior to the 1% AEP event (11). Over floor flooding was reported in 2016 (1.57m at Cudgere Bay Gauge (214416)).
Jetty's by the Lake	Windang Road	Windang	In 2016 (1.57m at Cudgere Bay Gauge (214416)) the island section became isolated, 5 vans were left uninhabitable and most internal roads inundated.
Windang Beach Tourist Park	Fern Street	Windang	Affected by floodwaters prior to the 1% AEP event (11).

Facility Name	Street	Suburb	Comment
Oaklands Village	Judbooley Parade	Windang	In 2016 (1.57m at Cudgerie Bay Gauge (214416)) internal road were flooded – some waist deep with no over floor flooding. Is evacuated at 1.5m at the Cudgerie Bay Gauge (1).
Lake Illawarra Village	Windang Road	Windang	Affected by floodwaters prior to the 1% AEP event.
Hospitals			

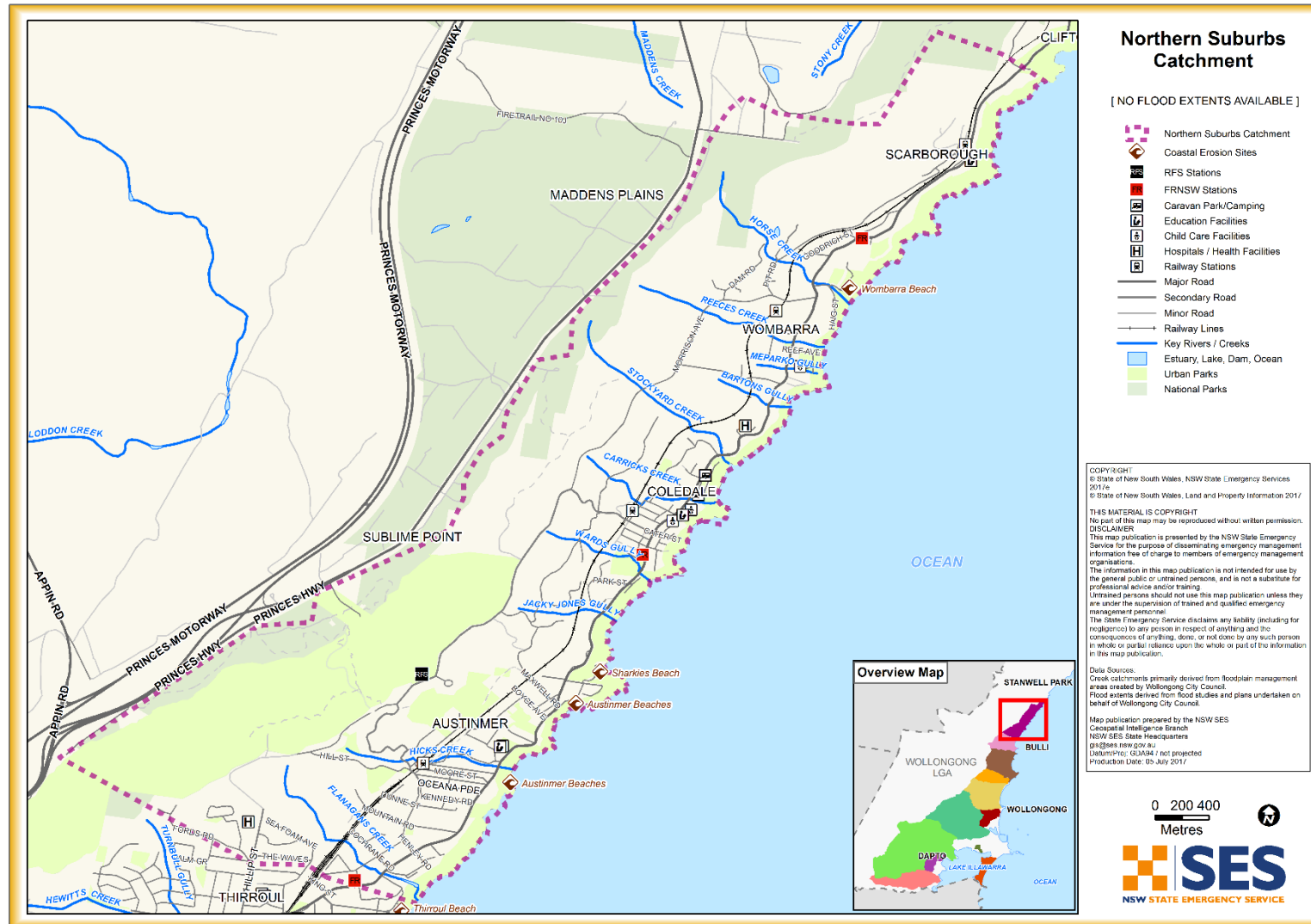
MAP 1: WOLLONGONG COAST BASIN



MAP 2: WOLLONGONG LGA AND CATCHMENT OVERVIEW MAP



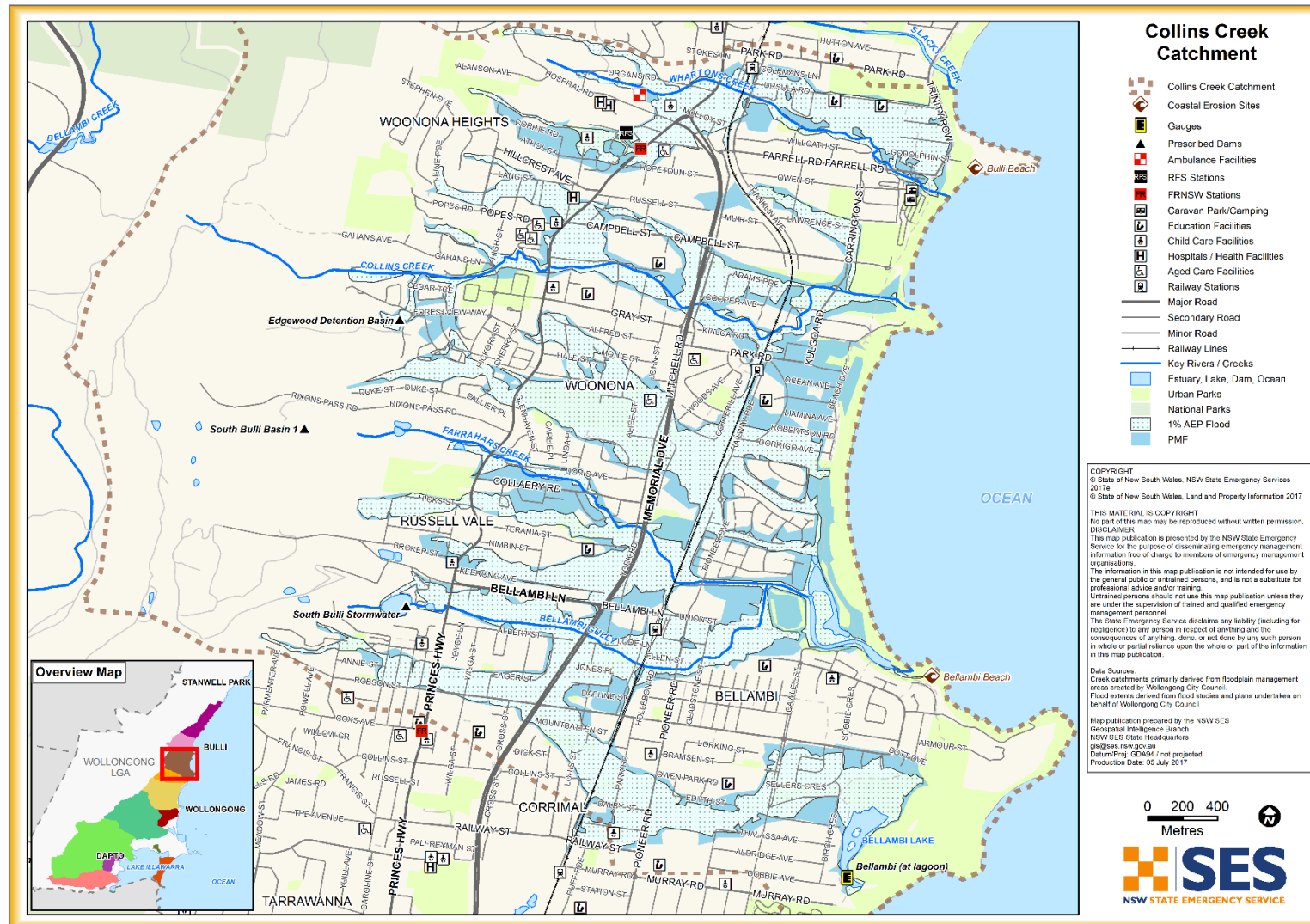
MAP 3: NORTHERN SUBURBS CATCHMENT MAP



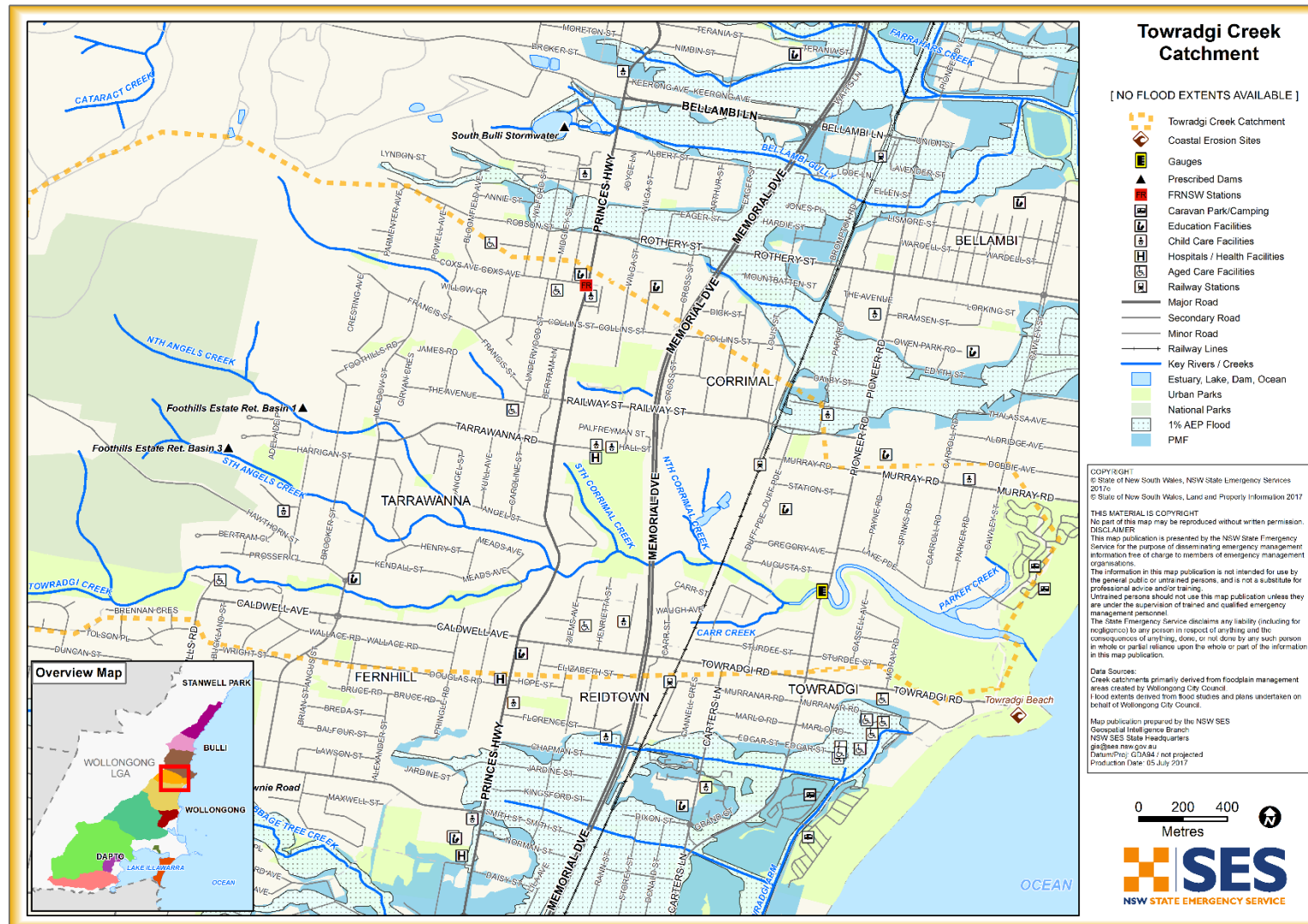
MAP 4: HEWITTS CREEK CATCHMENT MAP



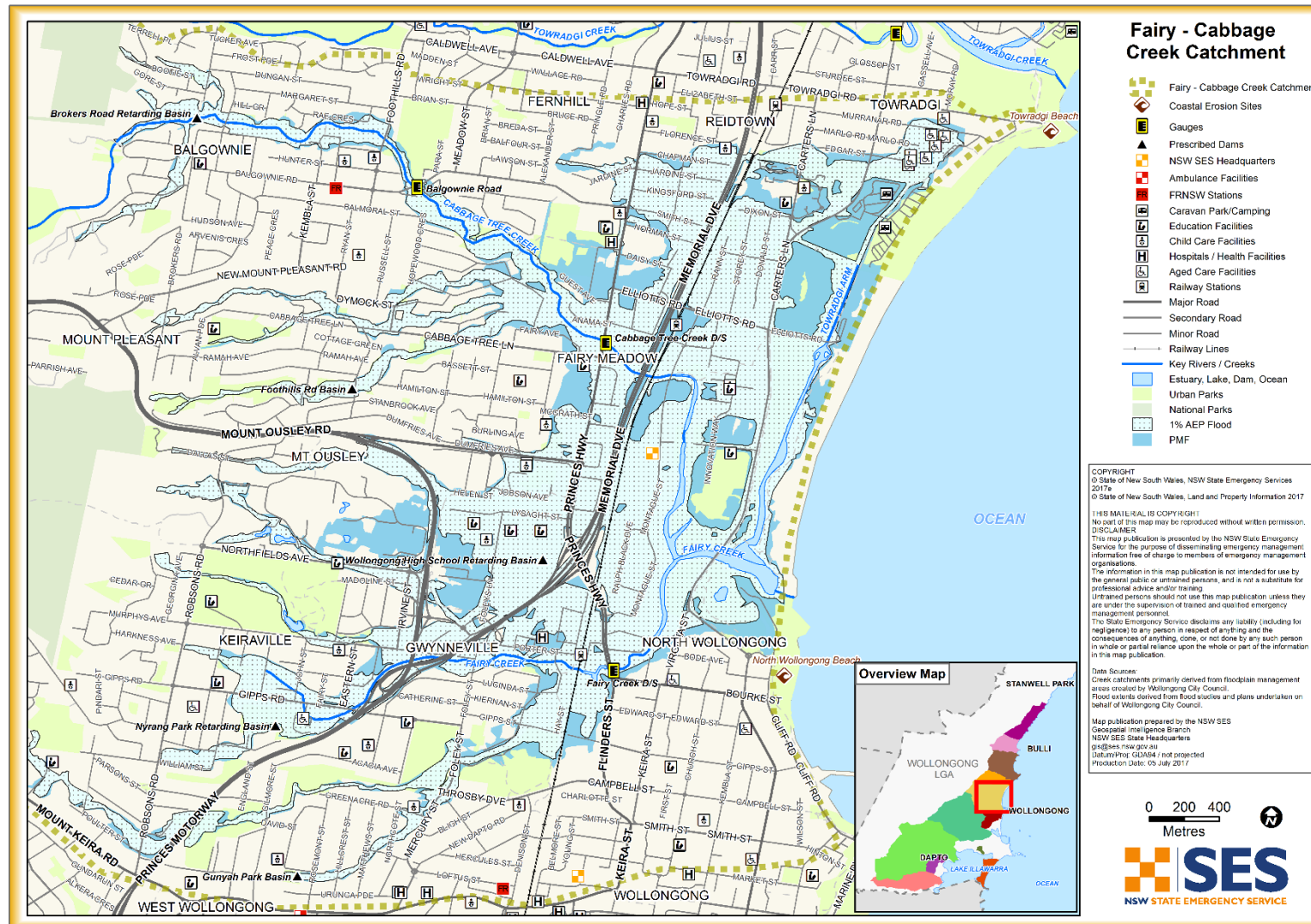
MAP 5: COLLINS CREEK CATCHMENT MAP



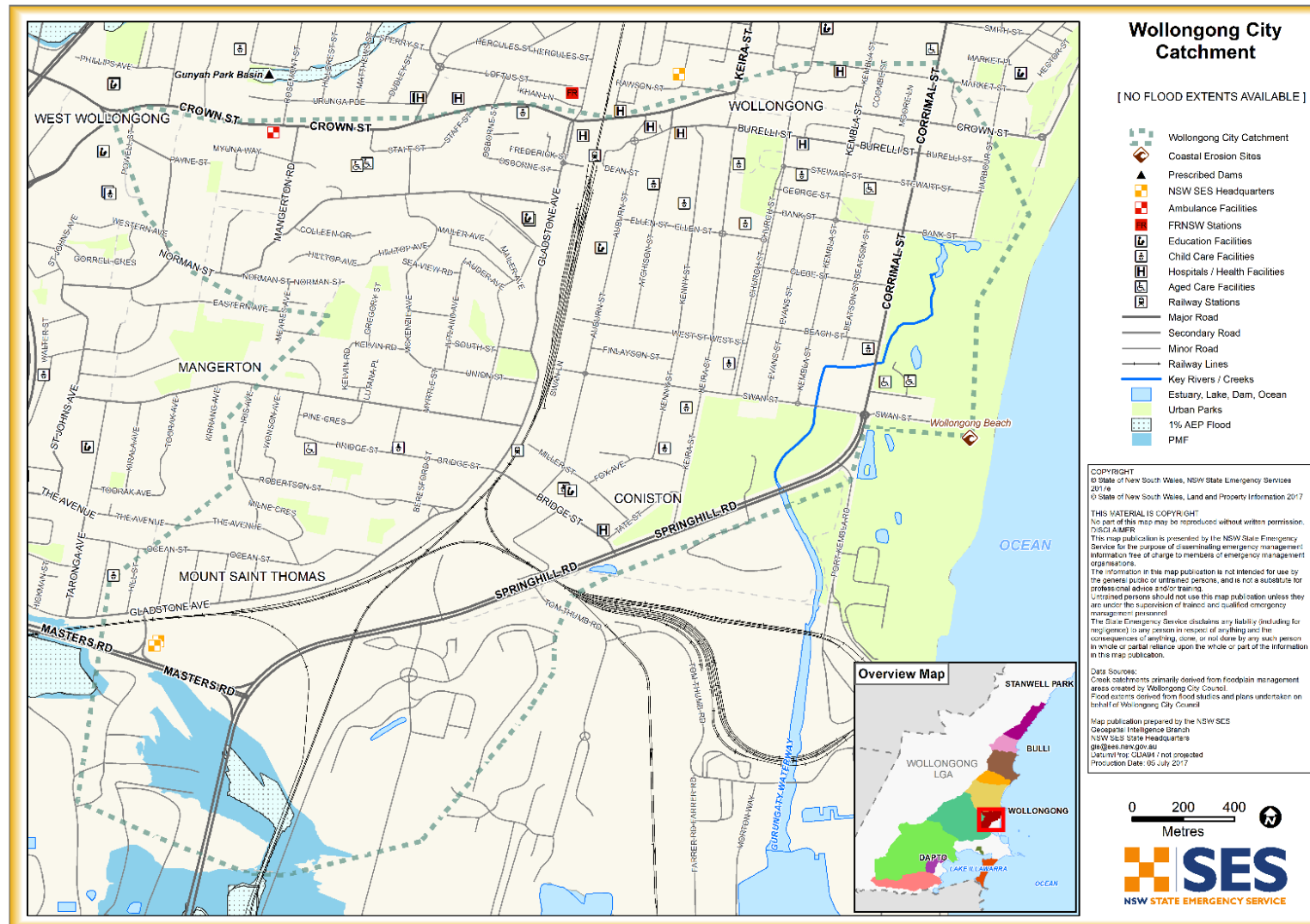
MAP 6: TOWRADGI CREEK CATCHMENT MAP



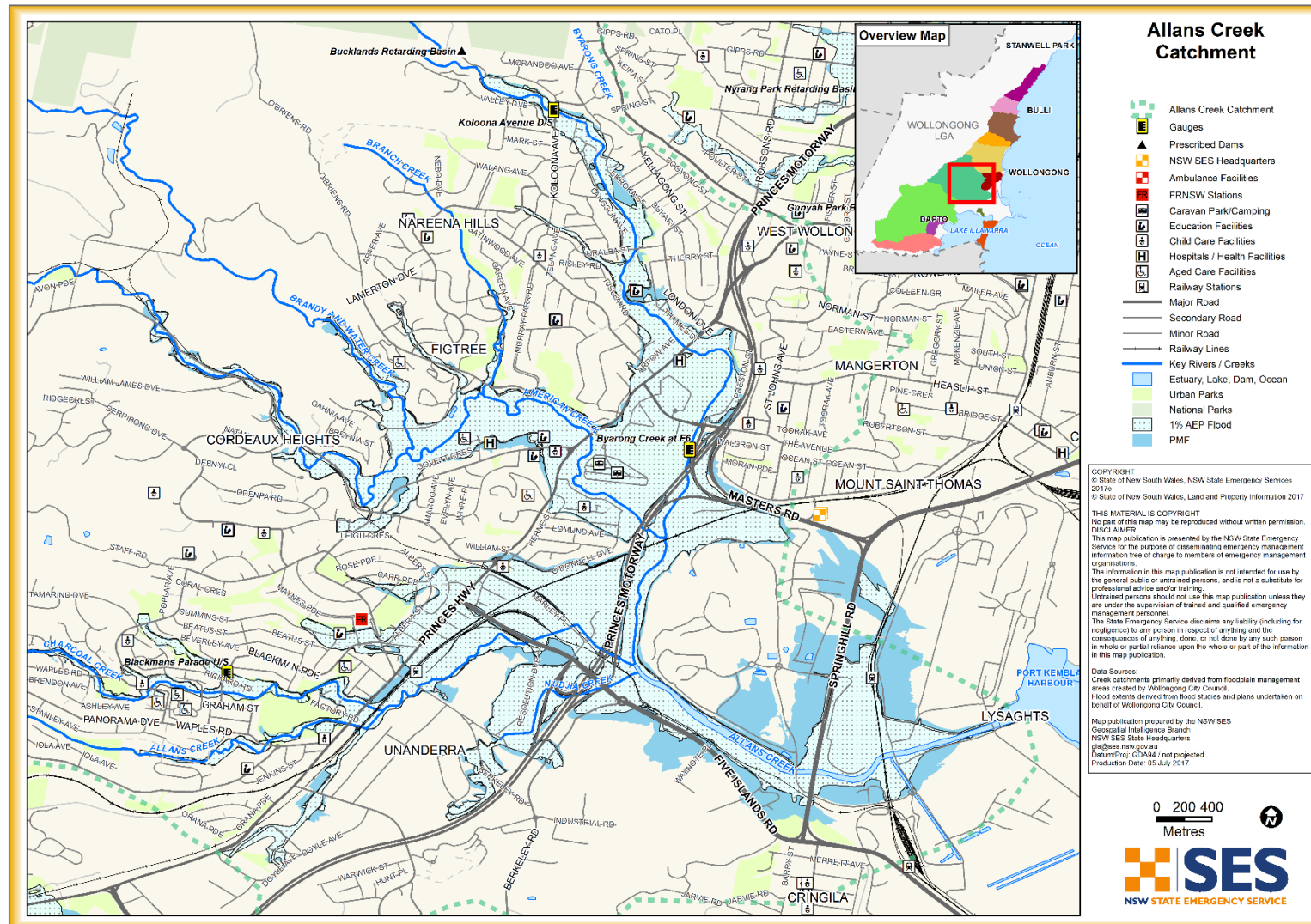
MAP 7: FAIRY AND CABBAGE TREE CATCHMENT MAP



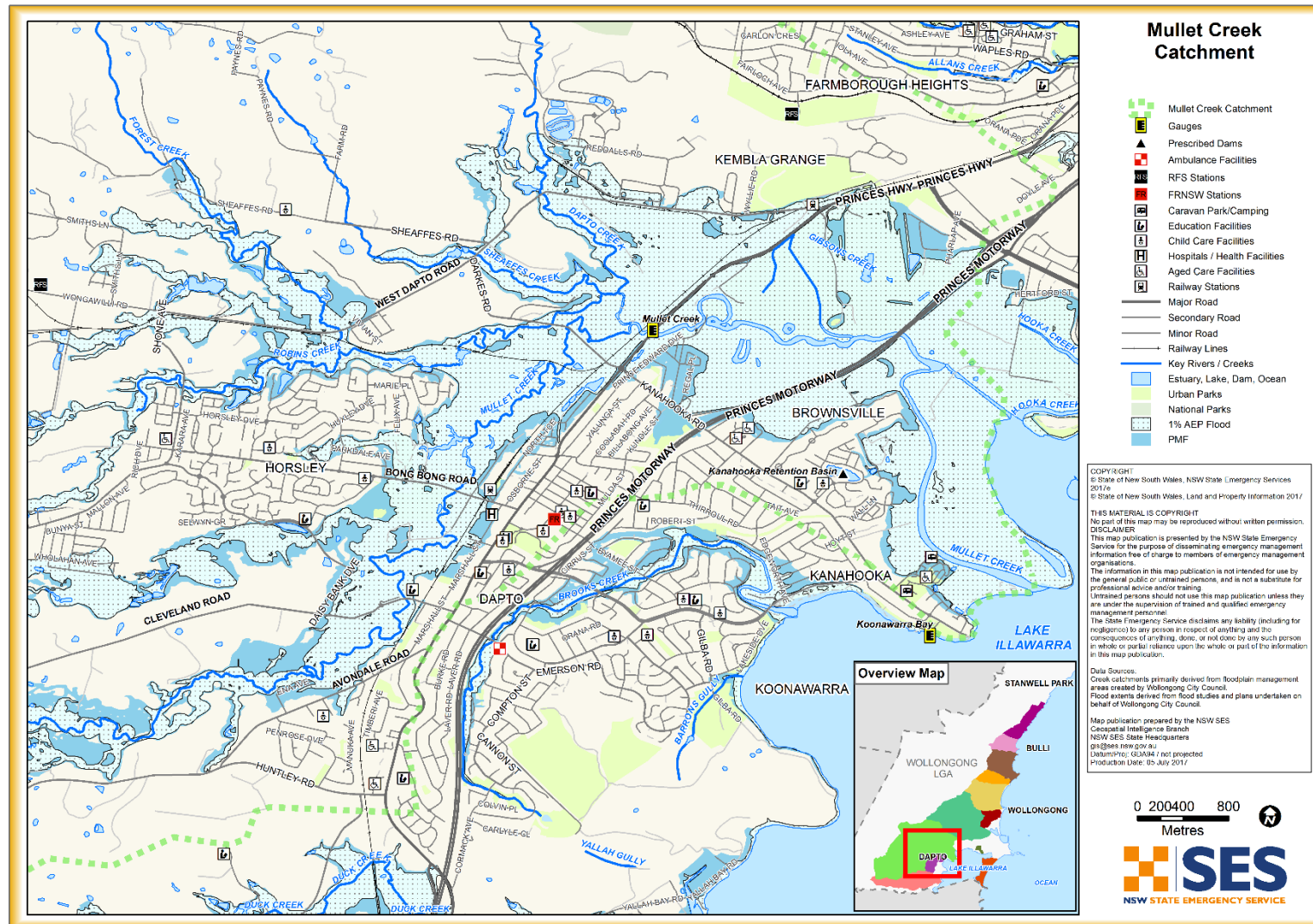
MAP 8: WOLLONGONG CITY CATCHMENT MAP



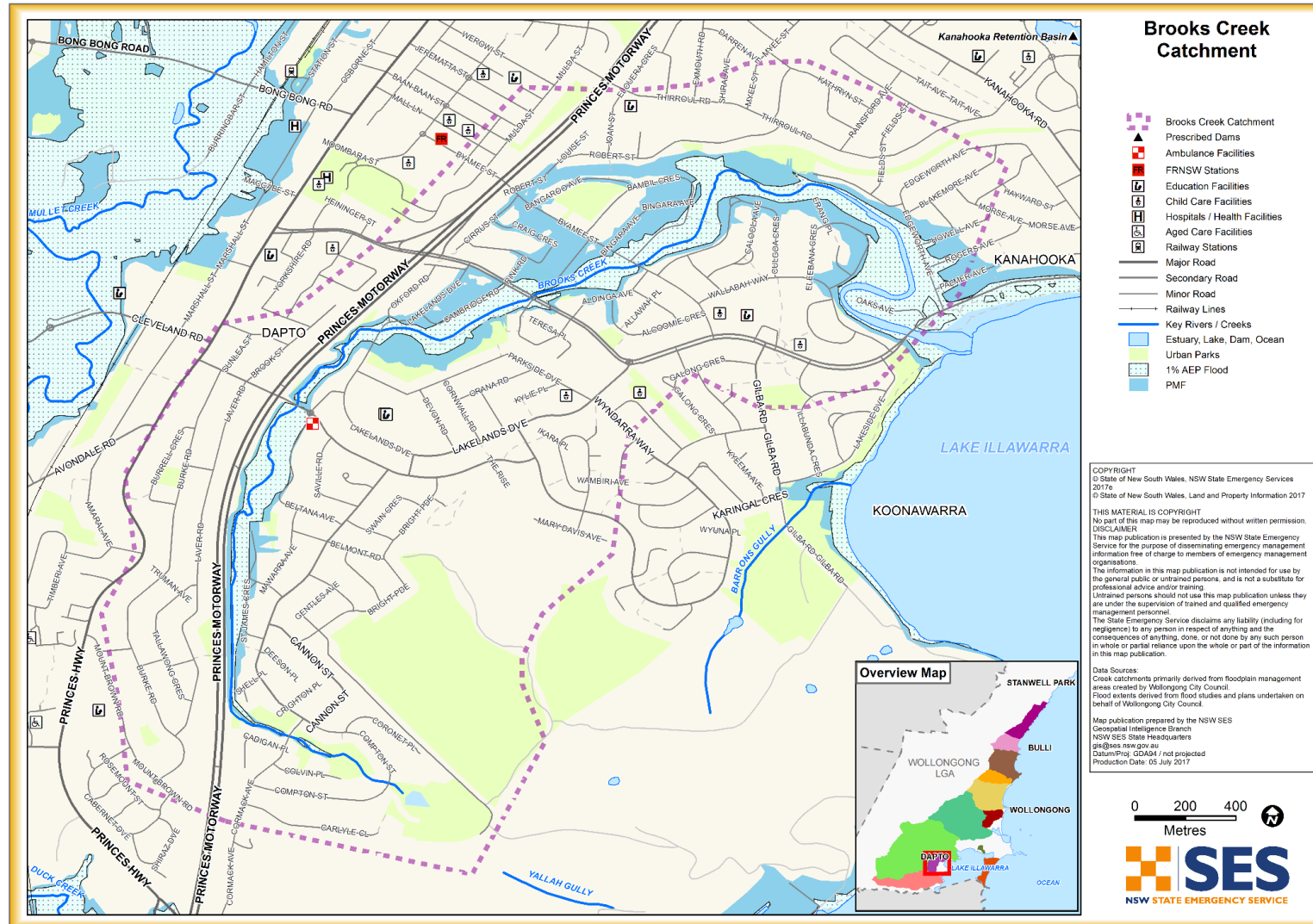
MAP 9: ALLANS CREEK CATCHMENT MAP



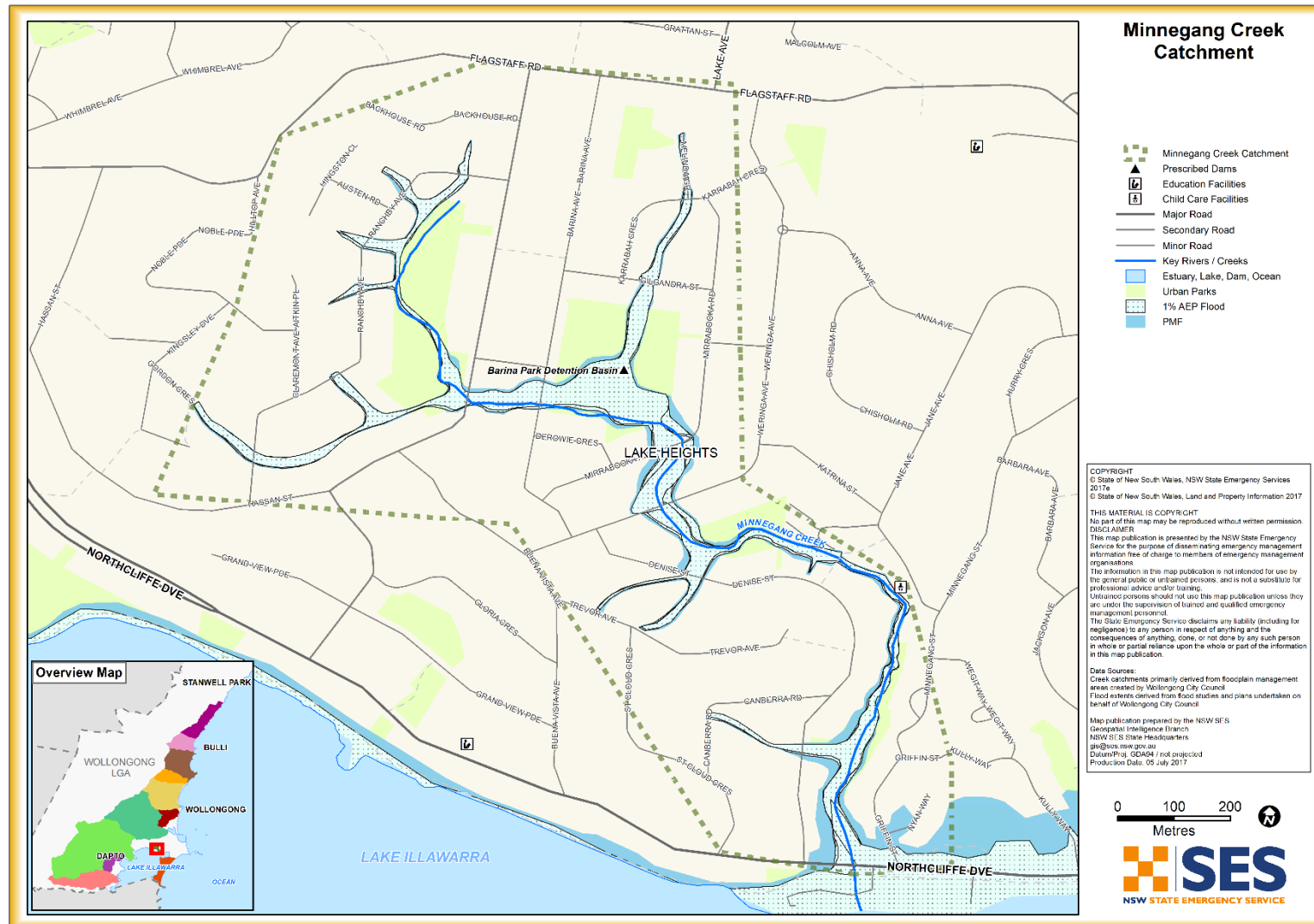
MAP 10: MULLET CREEK CATCHMENT MAP



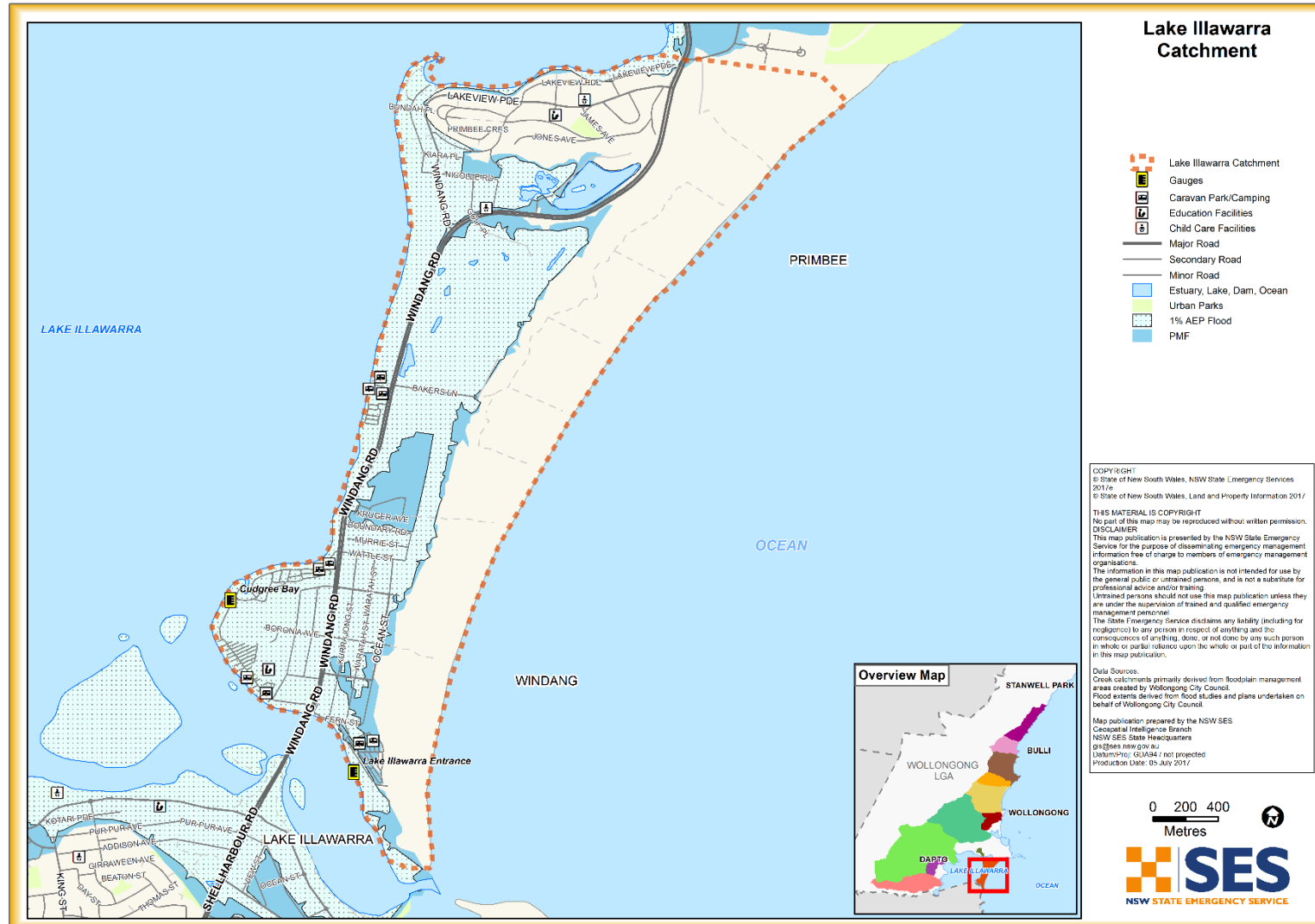
MAP 11: BROOKS CREEK CATCHMENT MAP



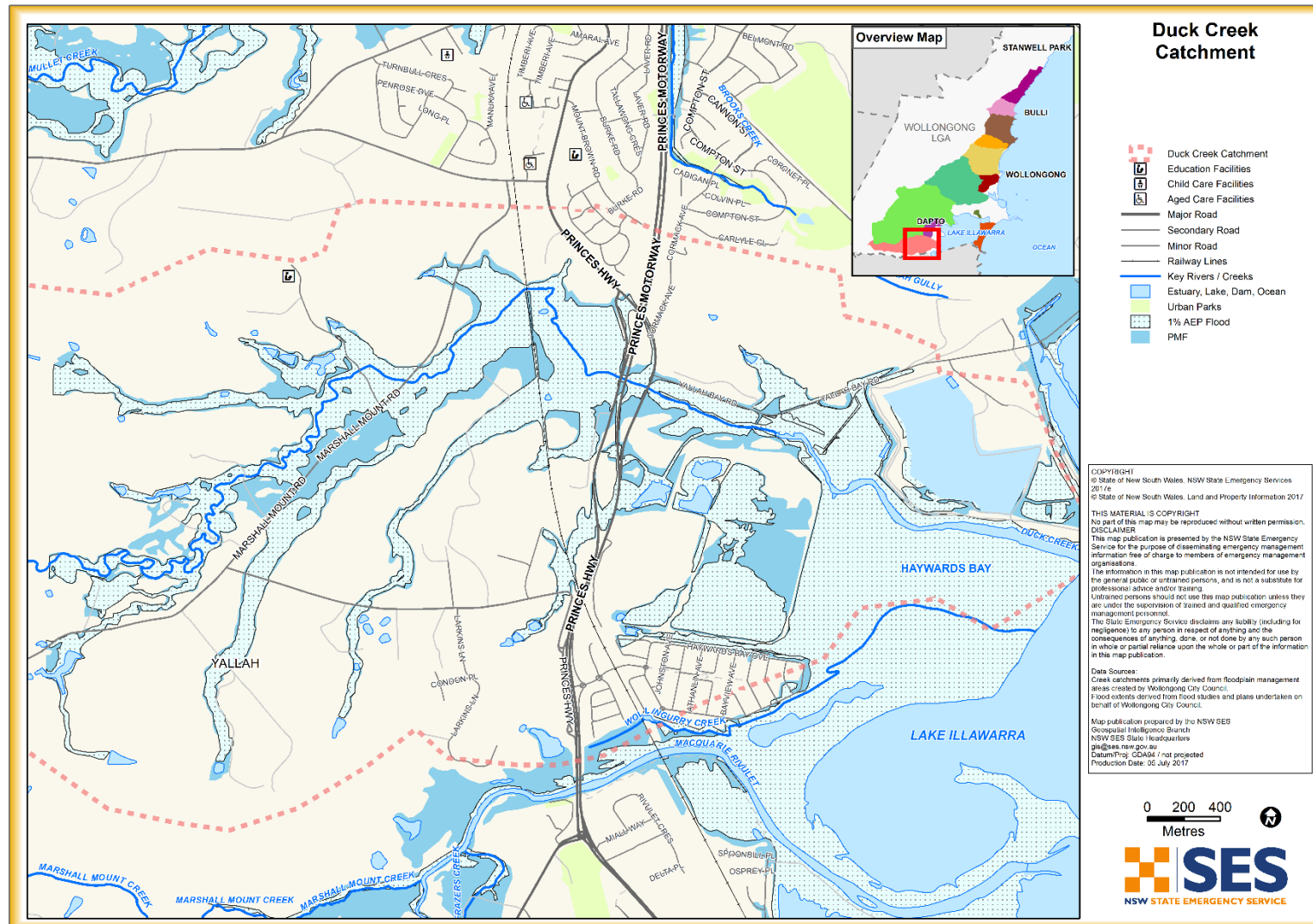
MAP 12: MINNEGANG CREEK CATCHMENT MAP



MAP 13: LAKE ILLAWARRA CATCHMENT MAP



MAP 14: DUCK CREEK CATCHMENT MAP



LIST OF REFERENCES

1. **NSW State Emergency Service.** *Wollongong City Local Flood Plan.* Jun 2010.
2. **Wollongong City Council.** *Hewitts Creek Flood Study.* Dec 2002.
3. **BMT WBM.** *Review of Hewitts Creek Flood Study.* s.l. : Wollongong City Council, 2015.
4. **Lyall & Associates.** *Combined Catchments of Whartons, Collins and Farrahars Creeks, Bellambi Gully and Bellambi Lake Flood Study.* Sydney : s.n., 2011.
5. **BMT-WBM.** *Review of Towradgi Creek Flood Study.* Feb 2015.
6. **Bewsher.** *Fairy and Cabbage Tree Creeks Floodplain Risk Management Study and Plan.* Dec 2010.
7. **WMAwater.** *Wollongong City Floodplain Risk Management Study & Plan.* Sydney : s.n., 2015.
8. **Lawson and Treloar.** *Allans Creek Floodplain Risk Management Study.* Sep 2006.
9. **BMT WBM.** *Mullet & Brooks Creek Flood Study Final Report.* 2010.
10. **Kellogg Brown & Root Pty Ltd.** *Minnegang Creek Flood Study.* Sydney : s.n., 2002.
11. **Cardno.** *Lake Illawarra Floodplain Risk Management Study.* Jan 2012.
12. **Lyall & Associates.** *Combined Catchments of Whartons, Collins and Farrahars Creeks, Bellambi Gully and Bellambi Lake, Floodplain Risk Management Study and Plan.* Jun 2014.
13. **NSW SES.** *Accounts from NSW SES Members.* 2016.
14. **Cardno.** *Lake Illawarra Floodplain Risk Management Study.* s.l. : Cardno, 2012.
15. **Risk Frontiers.** *An integrated research assessment of the physical and social aspects of the March 2011 flash flooding in Shellharbour, Kiama and Bega Valley, NSW.* s.l. : Risk Frontiers, 2013.
16. **Wollongong City Council.** *Wollongong City Council. Towradgi Catchment.* [Online] 25 01 2016. [Cited: 12 08 2016.]
<http://www.wollongong.nsw.gov.au/services/sustainability/floodplainmanagement/Pages/towradgi.aspx>.
17. **Australian Bureau of Statistics.** *2011 Census of Population and Housing.* 2012.
18. **Cardno Lawson Treloar Pty Ltd.** *Wollongong City Council Coastal Zone Study.* s.l. : Wollongong City Council, 2010.

19. **Illawarra Coke Company Pty Ltd.** *Coalcliff Dam - Dam Safety Emergency Plan*. Sep 2010.
20. **Wollongong City Council.** *Hewitts Creek Floodplain Risk Management Study and Plan*. Dec 2002.
21. **Bewsher Consulting Pty Ltd.** *Towradgi Creek, Wollongong Floodplain Risk Management Study and Plan*. June, 2003.
22. **Wollongong City Council.** *Foothills Estate Basin 1 DSEP*. s.l. : Wollongong City Council, 2006.
23. **BMT-WBM.** *Fairy and Cabbage Tree Creeks Flood Study*. 2009.
24. **WMAwater.** *Wollongong City Flood Study*. Apr 2013.
25. **Bewsher Consulting.** *Mullet and Brooks Creeks Floodplain Risk Management Study and Plan*. s.l. : Bewsher Consulting, 2010.
26. **K.F Williams & Associates Pty Ltd.** *Kanahooka Detention Basin DSEP*. 2012.
27. **Kellogg Brown & Root.** *Minnegang Creek Floodplain Risk Managment Study*. Jan 2004.
28. **Kellogg Brown & Root Pty Ltd.** *Minnegang Creek Floodplain Risk Management Plan*. s.l. : KBR, 2004.
29. **WaterNSW.** *Cordeaux Dam - Dam Safety Emergency Plan*. Jul 2015.
30. **BMT-WBM.** *Duck Creek Flood Study*. Feb 2012.
31. **Wollongong City Council.** *Dapto Heights Basin DSEP*. s.l. : Wollongong City Council, 2008.
32. —. Hewitts Creek Catchment. *Wollongong City Council*. [Online] 1 June 2016. [Cited: 4 August 2016.]
<http://www.wollongong.nsw.gov.au/services/sustainability/floodplainmanagement/Pages/hewitts.aspx>.
33. **Patterson Britton & Partners Pty Ltd.** *Moruya River Floodplain Management Study*. s.l. : Patterson Britton & Partners Pty Ltd, 1995.
34. **OEH.** Coastal Erosion 'hot spots'. *NSW Office of Environment and Heritage*. [Online] 26 February 2011. [Cited: 13 01 2017.]
<http://www.environment.nsw.gov.au/coasts/coasthotspots.htm>.

SES RESPONSE ARRANGEMENTS FOR WOLLONGONG CITY

Volume 3 of the Illawarra Local Flood Plan

Last Update: June 2010

ANNEX C - ROAD CLOSURES

STATE HIGHWAYS AND MAJOR ROADS			
ROAD	NEAREST SUBURB	USUAL POINT OF CLOSURE	COMMENTS/ IMPLICATIONS
Princes Hwy	Bulli	Bulli Pass	Can be closed for periods exceeding 24 hours due to rain related mudslides and road undermining. Not unusual for closure of over 1 week
		Junction of Lawrence Hargrave Drive	Depths may exceed 1.5m
		Cnr of Hobart St	
		Between Point St and Black Diamond Place. Slacky Creek crossing	Depths may exceed 1.5m
		Between Hopetoun & Organs Road	Can reach approx. 0.7m depth.
	Corrimal	North of Rothery Road	Can reach depths of approx. 0.9m
		Between Towradgi Rd & Thurston Cres	
		Cnr Tarrawanna Rd	
		Between Railway St & Russell St	
	Fairy Meadow		
	Figtree	Junctions of Bellevue Rd, The Avenue, O'Briens Road and Gibsons Road	High velocity with depths recorded at over 0.8m in some locations
	Kembla Grange	Near racecourse entrance	Water stays for up to a week if lake levels are high. In major flooding only suitable for high clearance vehicles.
	North Wollongong		
	Russel Vale	Outside Golf Course	Can reach depths exceeding 0.6m.
		Between Albert St & Bellambi Lane	Bellambi Creek crossing. Can reach depths of approx. 0.6m with high velocity.
		Between Broker & Moreton Sts	Nuisance flooding. Remains passable.
	Tallawarra	Duck Creek Culvert/Bridge	
	Unanderra	Between of Cordeaux Road and Farmborough Road	

STATE HIGHWAYS AND MAJOR ROADS			
ROAD	NEAREST SUBURB	USUAL POINT OF CLOSURE	COMMENTS/ IMPLICATIONS
Princes Hwy	Woonona	Between Gray St & Hillcrest Ave	Can exceed depths of 1.0m at Woonona shopping precinct.
		Between Alfred St & Hale St	Can exceed depths of 1.0m
F6		At Cataract Creek crossing	
	Figtree	Between Masters Road on and off ramp both directions	Recorded depths of over 1m
	Unanderra	Approx 200m south of Masters Rd off ramp	Depths reported at 300-500mm
	Mount Ousley		Water velocity travelling down roadway makes it unusable
Northern Distributor	Corrimal	Junction of Railway Street and to the south	
		Between Rothery St & Bellambi Lane	Can reach depths of approx. 0.5m south of Rothery St.

LOCAL ROADS			
ROAD	NEAREST SUBURB	USUAL POINT OF CLOSURE	COMMENTS/ IMPLICATIONS
Ajax Ave	North Wollongong	Junction of Montague Street	
Avondale Road		East and west of South Avondale Road Low point between Oakhurst Cres and dale Street	Depths >1m can be reached.
		Mullet Creek bridge	Can reach depths of over 1.5m
Bellambi St	Tarrawanna	Southern End	
Birch Cres	Bellambi	Northern end	
Blackall Street	Bulli	At Slacky Creek	
Bong Bong Road	Dapto	Near Hamilton and Burringbar Sts	Can reach depths of >1.5m. May be impassable for over 24hours
Boundary Road	Windang	Near Windang Road	
Brompton Road	Bellambi		
Campbell Street	Woonona	Between Northern Distributor & Robert St	
Carrington Street	Woonona	Cnr Lawrence St	
Carters Lane		Pioneer Road Junction	
Cawley Street	Bellambi	Between Connaghan Ave & Rothery St	
Cleveland Road	Dapto	For 1km west from railway line and at Mullet Creek crossing near junction of Avondale Road.	May exceed 1m
Collins Street	Corrimal	At both intersections	
Cordeaux Road		Various locations from Gibsons Road to Mount Kembla	Depths may reach 300-500mm but includes high velocity

LOCAL ROADS			
ROAD	NEAREST SUBURB	USUAL POINT OF CLOSURE	COMMENTS/ IMPLICATIONS
Culgoa Road	Woonona	Between Kareela Rd & Campbell St	
Darkes Road		Rail line and creek crossings	Depths calculated to exceed 2m
Farrell Road	Bulli	Cnr Trinity Road	New drainage has been installed and may alleviate past flooding problems
Five Islands Road	Unanderra	Junction of Princes Hwy and Five Islands Rd, <i>and</i> On and Off ramps from F6 <i>and</i> Roundabout at junction of Glastonbury Avenue	Regular reports of vehicles trapped in flood waters at this location
Fowlers Road		Junctions of Rink Rd and Julianne St	Can reach depths of over 1.5m
Gahans Lane	Woonona	Eastern end	
Gibsons Road	Figtree	Where road crosses American Creek.	
Hobart Street		From Princes Hwy to approx 200m west of Haig Road	Reports of depths exceeding 2m
Hollymount View	Woonona	At both intersections	
King Street	Warrawong	Intersection of Hoskins Ave	
Lady Carrington Dr		Hacking River	
Lake Parade	East Corrimal	Total closure to whole road	One of two egress routes from Corrimal beach Tourist Park
Lakeside Drive		Between Edgeworth Ave & Wallabah Way	Affect known to remain for over 48 period or until lake able to release to ocean.
Lawrence Hargrave Drive		Various locations where creeks cross roadways	May close for a number of days post rain event due to landslips or road undermining
	Thirroul	Between Hewitts Ave & Phillip St, <i>and</i> Cnr Railway Parade	
Liddle Street	Woonona		
Meadow Street	Tarrawanna	Between Caldwell Ave & Keira St, <i>and</i> North of Kendall St, <i>and</i> Between Tarrawanna Rd & Karen Pl	
Montague Street	North Wollongong	From Ajax Ave to road rise at Para Ck bridge	SES HQ flooded

LOCAL ROADS			
ROAD	NEAREST SUBURB	USUAL POINT OF CLOSURE	COMMENTS/ IMPLICATIONS
Northcliffe Drive	Warrawong	Between First Ave & Denise St <i>and</i> The intersection of Wilkinson St (eastern end)	
Old Port Road		Near railway over-bridge	
O'Briens Road	Figtree	Between Princes Hwy and Murray Park Road, <i>and</i> East of Church of Christ	Depths of over 600mm recorded
Oxford Road	Oxford	Hacking River	
Pioneer Road	Bellambi	Between Bellambi Lane & Lismore St	
	East Corrimal	Between Coolgardie St & Owen Park Rd, And Between Sturdee St & Lake Parade	
Railway Parade	Woonona East	Southern End	
Railway Street	Corrimal	Between Harbinger St & Gilbert St	
Rothery Street	Corrimal		
Squires Way		Overflowing Sewer	
Springhill Road	Springhill	Various locations at and between Masters road and Five Islands Road	Have recorded depths of 2.0m
Stanhope St	Woonona	At both intersections	
Thompson Street		At Collins creek bridge	
Underwood St	Corrimal	At The Avenue & Francis St intersection up to Russell St	
Uralba Street	Figtree	At Byarong Creek	Depths of over 1.2m recorded.
Ursula Road	Bulli	At both intersections	
West Dapto Road	Dapto	All creek crossings and low lying areas. Junction of Sheaffes Road	Can reach depths of >0.6m
Windang Road	Windang	Between the suburbs of Primbee & Lake Illawarra	

ANNEX D - GAUGES MONITORED BY THE SES

AUTOMATIC RAINFALL RECORDERS		
Gauge Name	Owner	Catchment
Balgownie Reservoir	WCC	Cabbage Tree Creek
Bellambi		Bellambi Creek
Berkeley (Northcliffe Dr)		Harbour Creek
Cleveland Road		Mullet Creek
Dapto Bowling Club		Mullet Creek
Darkes Road		Mullet Creek, Robins Creek
Dombarton Loop		Mullet Creek, Robins Creek, Forest Creek
Figtree Reservoir	WCC	Brandy and Water Creek/American Creek
Glennifer Brae	WCC	
Huntley Colliery		Mullet Creek
Kembla Grange Golf Course	WCC	Mullet Creek
Mount Kembla		American Creek
Mount Pleasant		Cabbage Tree Creek
Port Kembla		
Rixons Pass		Collins Creek Hewitts Creek
Russell Vale	MHL	Collins Creek Towradgi Creek Cabbage Tree Creek
Scarborough	WCC	
Wollongong (AWS)		
Wollongong City Council		J.J. Kelly
Wongawilli Colliery	WCC	Mullet Creek, Robins Creek
Wongawilli Reservoir	WCC	Mullet Creek
Woonona (Popes Rd)		Collins Creek

Notes:

In addition to these gauges active reconnaissance of known trouble spots is also carried out by Wollongong City SES members during operations involving flooding and heavy rainfall.

AUTOMATIC RIVER HEIGHT RECORDERS				
Gauge Name	AWRC No	Stream	Owner	Response Trigger Levels
Allans Creek	10004	Allans Creek	MHL	0.7m
American Cree	10005	American Creek	MHL	
Bellambi Creek (DS)	10112	Bellambi Creek		
Bellambi Creek (US)	10350	Bellmabi Creek		
Berkeley	10021	Lake Illawarra		
Byarong Creek (F6)	10069	Byarong Creek	MHL	
Cabbage Tree Creek	214405	Cabbage Tree Creek	MHL	5.3m
Cudgerie Bay	214416	Lake Illawarra		
Dapto High School	10114	Mullet Creek		
F6 (Near Uni)	10142	Fairy Creek	MHL	
Foothills Road	10147	Cabbage Tree Creek		
Hewitts Creek Entrance		Hewitts Creek	MHL	
Hewitts Creek		Hewitts Creek	MHL	11.4m
Kaloon Ave	10195	Byarong Creek		
Kanahooka Point	214415	Lake Illawarra		
Koonawarra	10206	Mullet Creek		
Lake Entrance	214417	Lake Illawarra		
Lake Illawarra Village	10211	Lake Illawarra		
Mullet Creek	214200	Mullet Creek	MHL	3.0m
Pioneer Road	10297	Towradgi Creek		
Princes Hwy No 3	214404	Fairy Creek		
Prince Hwy No 4	10454	Mullet Creek		
Robsons Road	10331	Fairy Creek		
Tallawarra Power Station	10362	Lake Illawarra		
Towradgi Creek DS		Towradgi Creek	MHL	1.3m
Towradgi Creek US		Towradgi Creek	MHL	

Notes:

Some of these, e.g. Cudgerie Bay, are configured to generate proactive warnings when pre-determined levels are reached. In addition to these gauges active reconnaissance of known trouble spots is also carried out by Wollongong City SES members during operations involving flooding and heavy rainfall.

ANNEX E - DISSEMINATION OF SES FLOOD BULLETINS

The Illawarra South Coast SES Region Headquarters distributes SES Flood Bulletins and other flood related information (including Flood Warnings) to the following regional media outlets:

Television Stations:

Station	Location
Win TV	Wollongong
Prime TV	Wollongong
Southern Cross Ten	Wollongong
SBS	Crows Nest
ABC TV	Sydney

Radio Stations:

Station	Location	Frequency
Wave FM	Warrawong	96.5
ABC Illawarra	Wollongong	97.3
i98 FM	Coniston	98.1
Power FM	Nowra	94.9
VOX FM	Wollongong	106.9
Living Sound FM	Coniston	94.1

Newspapers:

Name	Location
Illawarra Mercury	Wollongong
Wollongong Advertiser	Wollongong
Northern Leader	Corrimal
Lake Times	Shellharbour

ANNEX F - EVACUATIONS ARRANGEMENTS

Arrangements

1. **Control.** During floods evacuations will be controlled by the NSW SES. Small-scale evacuations will be controlled by the Wollongong City SES Operations Controller. Should the evacuations operations escalate beyond the capabilities of local resources control may be handed over to the Illawarra South Coast SES Region Operations Controller.
2. **Conduct.** Evacuations will be controlled by the SES Operations Controller and conducted with assistance from the NSW Rural Fire Service, NSW Police, NSW Fire Brigade, Ambulance of NSW and service club personnel.
3. Evacuations will be controlled by the SES and conducted in four phases:
 - Phase 1 - Warning.
 - Phase 2 – Withdrawal.
 - Phase 3 – Shelter.
 - Phase 4 – Return.

Decision to Evacuate

4. The responsibility for issuing any general evacuation order during flooding rests with the Local SES Operations Controller who exercises his/her authority in accordance with section 22 (1) of The State Emergency Service Act 1989. During the possibility of large-scale evacuations the decision to evacuate will usually be made after consultation with the Wollongong City LEOCON and the Illawarra South Coast Region Operations Controller.
5. **When evacuations should occur.** As far as possible, evacuations will be carried out before inundation occurs. Due to the flash flood nature of flooding in the Wollongong LGA this may not be able to occur.
The SES will retain intelligence that identifies “hot spots” that lie within high hazard areas. These areas are identified at the end of this section.
6. **What to consider.** When deciding to evacuate the following should be considered.
 - a. Predicted flood level and rate of rise.
 - b. Rainfall situation and rainfall predictions.
 - c. Condition of evacuation routes.
 - d. Characteristics of the at risk population.
 - e. Time of day.
 - f. Likely duration of evacuation operations and time available to conduct evacuations.
 - g. Likely duration of any isolation and preparedness of the community to cope with isolation.
 - h. Condition of essential services
7. **Voluntary Evacuations.** Some people will make their own decision to evacuate earlier and move to alternative accommodation using their own transport. These evacuees will be advised, via the media, to inform the Police or SES of their evacuation and their temporary address. Where possible, people

will be given the opportunity to evacuate voluntarily at an early stage of a potentially severe flood. Elderly people and mothers with young children will especially be encouraged to evacuate voluntarily under such circumstances.

8. Evacuation triggers.
 - a. **Failure of Essential Services.** The failure of public utilities such as sewerage, power, telephones and water pose a significant health risk to residents on the floodplain or in flood affected areas. In the event of any or all of these systems failing or potentially failing, the need for evacuations will be discussed with the members of the LEMC.
 - b. **Flooding affecting properties.** Evacuations are to occur, if it is likely properties will be flooded. (See Community cards for Trigger levels/rainfall)
 - c. **Isolation of properties.** Persons who are not prepared for isolation or unsuited due to medical conditions etc, should be encouraged to evacuate
 - d. **Dam Failure.** Evacuations are to occur when advised of Imminent Dam failure

Groupings and Tasks

9. **Operational Sectors.** For the purpose of managing flood response operations and evacuations during severe floods the Wollongong Local Government Area will be divided into operational sectors based on the flood plain management areas.
10. **Tasks.** Tasking will align with the agreed responsibilities as outlined in Part 2 – Responsibilities.

Phase 1 – Warning

11. **Evacuation Warnings.** On receipt of flash flood warnings or observations predicting rainfall that may result in flooding, public health concerns or prolonged isolation, the Local SES Operations Controller will consult as necessary to determine the level of the threat and the need to consider evacuations. As soon as possible after the decision to evacuate is made, the Local SES Operations Controller will issue evacuation warnings to the ‘at risk’ residents, indicating what people should do before evacuating and when actually doing so.
12. **Content of Evacuation Warnings/Orders** will include:
 - a. The rainfall situation and the state of tributaries.
 - b. The condition of transport routes.
 - c. Location of evacuation shelters
13. **Dissemination of Evacuation Warnings.** These are disseminated via:
 - a. The radio and TV stations listed in Annex E.
 - b. Door-knocks by emergency service personnel.
 - c. Public address systems from emergency service vehicles.
 - d. Telephone.
 - e. SES Flood Bulletins.

Phase 2 – Withdrawal

14. **Introduction.** Withdrawal involves the actual removal of the community/individuals from dangerous or potentially dangerous areas to safer areas.
15. **Movement.** Evacuees are to be encouraged to move using their own transport where possible. The Local SES Operations Controller will arrange transport for those people without their own vehicles. This may include the provision of buses. Evacuees will be taken or advised to go to the nearest accessible Assembly Point or Evacuation Centre. Evacuees who cannot reach an evacuation centre unaided will be transported from their homes or from designated assembly points nearby.
16. **Phasing/Priority.** In evacuations priority will be given to assist in the movement and management of people. These priorities will be determined at the time of the operations and are dependent upon many circumstances.
17. **Traffic Control.** When large-scale evacuations are likely, evacuation routes are to be secured by the NSW Police and kept clear by the following means:
 - a. Denying access to all traffic except for emergency vehicles (including buses and private vehicles being used for the purposes of evacuation).
 - b. Keeping one lane clear at all times for use by emergency vehicles.
 - c. Positioning a tow truck or similar vehicle at appropriate entry points, road blocks and exit points along the evacuation routes.
18. **Evacuation routes.** Most roads within the Illawarra become quickly inundated from creek overflows as well as storm water drain spill. Due to the possibility of storm water drain spill occurring in any area it is difficult to pre-define evacuation routes within this plan. Therefore evacuation route advice will be provided according to intelligence gathered at the time of the event.
19. **Special Needs Groups.** A large number of elderly persons and tourists reside in urban areas of the Wollongong Local Government Area. When evacuations are ordered Ambulance Service personnel will be deployed to assist with the safe evacuation of these people.
20. **Animals.** Evacuees with their own transport will be encouraged to take their pet such as cats, dogs and horses with them as they evacuate. These animals will therefore be transported by car, truck or horse float along the evacuation routes designated in this plan. Animals so shifted will be collected from their owners at evacuation centres and taken to pre-arranged facilities. Due to safety restrictions, it may not be possible to allow animals to accompany their owners when being transported via aircraft or flood rescue boats. In these cases, provision will be made for animals to be picked up as the people are evacuated. Arrangements will also be made to pick up animals that are left behind. Assistance animals (guide dogs, hearing assistance animals, etc), however, will remain in the care of their owners throughout the evacuation. This includes transport and access into evacuation centres.
21. **Doorknocking.** Field teams conducting doorknocks will record and report back the following information back to the Operations Centre:
 - a. Addresses and locations of houses doorknocked and/or evacuated.
 - b. The number of occupants.

- c. Details of the location evacuees are intending to present at.
 - d. Details of how the evacuees will register.
 - e. Details of support required (such as transport, medical evacuation, assistance to secure house and/or property and raise or move belongings).
 - f. Details of residents who refuse to comply with the evacuation order.
22. Properties, which have been doorknocked, should be marked with survey tape. Written on the survey tape should be the name of the doorknocking unit and the time of doorknock.
 23. **Refusal to Evacuate.** Field teams should not dedicate additional time dealing with people who are reluctant or refuse to comply with any evacuation order. These cases should be referred to the Local Emergency Management Operations Controller who will arrange for Police to ensure their evacuation.
 24. **Security.** The NSW Police will provide security for evacuated premises. Details of evacuated premises are to be passed to the Wollongong and Lake Illawarra Police stations.
 25. **Transport and storage.** Transport and storage of furniture from flood threatened properties will be arranged as time and resources permit.

Phase 3 – Shelter

26. **Evacuation Centres.** The usual purpose of evacuation centres is to meet the immediate needs of victims, not to provide them with accommodation. Evacuees will be advised to go to or be taken to the nearest accessible evacuation centre, which may initially be established at the direction of the Local SES Operations Controller but managed as soon as possible by the Welfare Services. Any of the following sites may be suitable as evacuation centres:
27. **Action on arrival.** On arrival, evacuees will be:
 - a. Registered;
 - b. Medically checked, if necessary; and
 - c. Provided with their immediate welfare needs.
28. **Registration.** The NSW Police are responsible for the registration of evacuees.

Phase 4 – Return

29. Once it is considered safe to do so, the Local SES Operations Controller will authorise the return of evacuees to their normal or alternative place of residence. This decision will be made in consultation with appropriate.
30. The return will be controlled by the Local SES Operations Controller and may be conducted, at his/her request, by Welfare Services

Evacuation Areas (“Hot Spots”)

The following locations will be monitored by SES as to determine if evacuations will be required. Only in extreme rainfall events will SES consider evacuations.

AREA 1		NORTH FROM THIRROUL TO CLIFTON
No data available at time of publication		
AREA 2		HEWITTS CREEK CATCHMENT
Suburb	No of properties	Creek
Thirroul	50	Hewitts Creek
Thirroul	15	Thomas Gibson
Thirroul	5	Woodlands
AREA 3		COLLINS CREEK CATCHMENT
No data available at time of publication		
AREA 4		TOWRADGI CREEK CATCHMENT
Suburb	No of properties	Creek
Bellambi	2	Towradgi Creek
Bulli	10	Tramway Creek
Corrimal	240	Towradgi Creek
East Corrimal	1	Towradgi Creek
Fernhill	5	Towradgi Creek
Tarrawanna	15	Towradgi Creek
Towradgi	125	Towradgi Creek

AREA 5		FAIRY & CABBAGE TREE CREEKS CATCHMENT
Suburb	No of properties	Creek
Fairy Meadow	TBC	
North Wollongong	TBC	
AREA 6		ALLENS CREEK CATCHMENT
Suburb	No of properties	Creek
Cordeaux Heights	7	Allens Creek
Farmborough Heights	2	Allens Creek
Figtree	299	Allens Creek
Mangerton	26	Allens Creek
Mt Keira	2	Allens Creek
Port Kembla	5	Allens Creek
Unanderra	104	Allens Creek
West Wollongong	37	Allens Creek
AREA 7		MULLET CREEK CATCHMENT
Suburb	No of properties	Creek
Berkeley	5	Mullet Creek
Brownsville	1	Mullet Creek
Dapto	19	Mullet Creek
Dapto	27	Brooks Creek
Horsley	2	Mullet Creek
Horsley	1	Robins Creek
Kanahooka	9	Brooks Creek
Koonawarra	4	Brooks Creek
AREA 8		MINNEGANG CREEK CATCHMENT
Suburb	No of properties	Creek
Lake Heights	8	Minnegang Street
LAKE ILLAWARRA		
No data available at time of publication		

ANNEX G - ARRANGEMENTS FOR THE EVACUATION OF CARAVAN PARKS AND THE RELOCATION OF CARAVANS

General

1. The following caravan parks are flood liable:
 - a. Corrimal Beach Tourist Park
 - b. Oasis Caravan Park
 - c. Lake Illawarra Village
 - d. Oaklands Village
 - e. Figtree Gardens, Prince Hwy, Figtree

Advising Procedures

2. Caravan Park proprietors will be encouraged to ensure that the owners and occupiers of caravans are:
 - a. Made aware that the caravan park is flood liable by:
 - Handing a printed notice to occupiers taking up residence.
 - The notice should indicate that the caravan park is liable to flooding and outline the evacuation and van relocation arrangements as detailed in this Annex.
 - b. Displaying this notice prominently in each van. Made aware that if they are expecting to be absent from their vans for extended periods, they can:
 - Provide the manager with a key; in a sealed envelope; to the van.
 - Provide a contact address and telephone number.
 - Inform the manager if a vehicle will be required to relocate the van during flood time.
 - Leave any mobile van in a condition allowing it to be towed in an emergency (ie: tyres inflated, jacks wound up, personal effects secured and annexes and lines for water, sewer, electricity and gas readily detachable).
 - c. Informed when a flood is rising. At this time, occupiers will be advised to:
 - Ensure that they have spare batteries for their radios.
 - Listen to a local radio station for updated flood information.
 - Prepare for evacuation and van relocation.
3. The Local SES Operations Controller will ensure that the managers of caravan parks are advised of flood warnings and the details of any evacuation order.

Evacuation of Occupants and Relocation of Vans

4. Caravan park proprietors will be encouraged to install flood depth indicators and road alignment markers within their caravan parks.
5. When an evacuation order is given:
 - a. Occupiers of non-movable vans should:
 - Secure their vans by tying them down to prevent flotation.
 - Isolate power to their vans.
 - Collect personal papers, medicines, a change of clothing, toiletries and bedclothes.
 - Lift the other contents of their vans as high as possible within the van.
 - Move to a designated evacuation centre if they have their own transport, or move to the caravan office to await transport.
 - b. Where possible, vans that can be moved will be relocated by their owners. Park managers will arrange for the relocation of mobile vans whose owners do not have a vehicle. Council and SES personnel may assist if required and may be able to provide additional vehicles.
6. Occupants of vans that are being relocated should go to a designated evacuation centre if they have their own transport. Those without their own transport are to report to the caravan park office.
7. Caravan park managers should:
 - a. Ensure that their caravan park is capable of being evacuated within the following times.
 - Corrimal Beach Tourist Park – 3 hours
 - Oasis Caravan Park – 6 hours
 - Lake Illawarra Village – 6 hours
 - Oaklands Village – 6 hours
 - Figtree Gardens – 3 hours
 - b. Advise the Local SES Operations Controller of:
 - The number of people requiring transport.
 - Details of any medical evacuations required.
 - Whether additional assistance is required to effect the evacuation.
 - c. Check that no people remain in non-removable vans that are likely to be inundated.
 - d. Inform the Local SES Operations Controller when the evacuation of the caravan park has been completed.
 - e. Provide the Local SES Operations Controller with a register of people that have been evacuated.
8. Caravan parks south of the Wollongong Catchment, due to the short warning time available, should concentrate on the evacuation of persons rather than vans.

9. The Local SES Operations Controller, using Council resources as necessary, will advise when it is safe for the caravan parks to be re-occupied.

Return of Occupants and Vans

10. Vans will be towed back to the caravan parks by van owners or by vehicles and drivers arranged by the park managers. Again, Council and SES personnel will assist if available.

ANNEX H - THE MANAGEMENT OF COASTAL EROSION

Background

1. The Wollongong City Council area is bordered by the Pacific Ocean to the east. There are three main types of beach units within the LGA's boundaries: compartmentalised, sheltered, and exposed. The coastal areas are subject to natural coastal processes and resultant coastline hazards that include coastal erosion, oceanic inundation, and shoreline recession.
2. The coastal erosion/oceanic inundation problem in the Wollongong City LGA takes two forms:
 - a. Undercutting of dunes on their seaward sides, threatening the collapse of dwellings and other infrastructure
 - b. The potential breaking through of the dunes by sea water, causing flooding and isolation of property on the landward side of the dunes
3. The most severe problems of coastal erosion/inundation occur as a result of oceanic storm conditions associated with the passage of ex-tropical cyclones and temperate-zone low-pressure systems. These storms may cause temporary sea level rises with large associated waves. The worst erosion/inundation is likely when severe weather conditions occur in conjunction with high tides

At Risk Beaches

4. The following are classified as "Hot Spots" for coastal erosion within the Wollongong City LGA:

Beach Name	Risk	Beach Name	Risk
Stanwell Park	Extreme	Cliffs between Stanwell Park & Coalcliff	Medium
Coalcliff	Extreme	Coledale Beach	Medium
Thirroul	Extreme	Sandon Point Beach	Medium
Bellambi Point	Extreme	Bellambi Point	Medium
Flagstaff Point	Extreme	North Wollongong Beach	Medium
Wollongong (South Beach)	Extreme	Belmore Beach	Medium
Wollongong	Extreme	Red Point	Medium
Sharkey Beach	High		
Port Kembla Harbour	High		

Table 7: Erosion risk levels of beaches

Concept of Operations

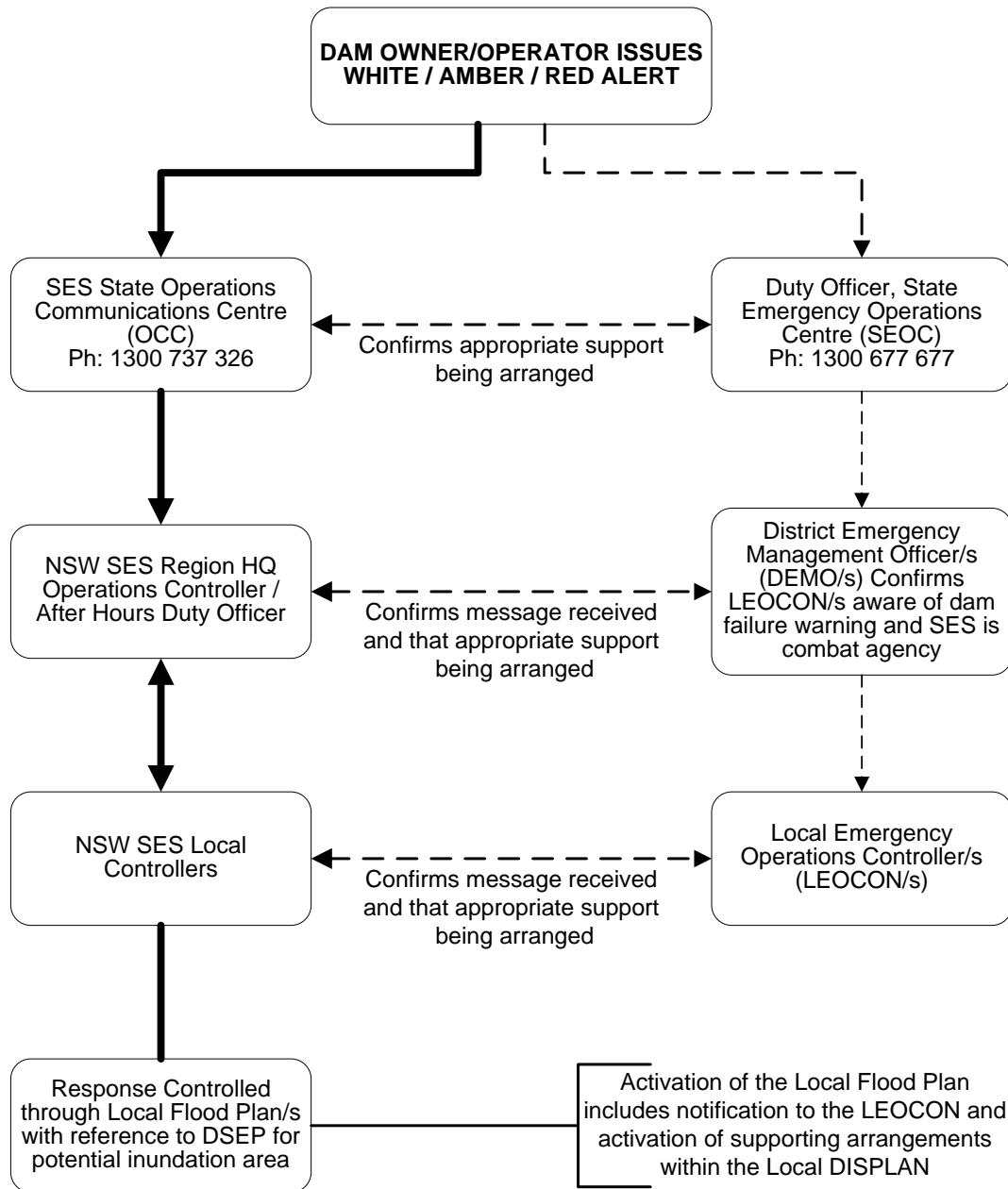
5. **Control.** The SES is the designated combat agency for damage control from storms, including coastal erosion from storm activity.
6. Evacuation arrangements for Wollongong City LGA are contained in Annex F.
7. Within this role and as specified under the State Storm Plan the SES is responsible for the following during and in the period immediately prior to a storm event occurring out at sea:

- a. Advising the community at risk of the likely problem and actions they should take;
 - b. The protection of life through the warning and evacuation of residents at risk; and
 - c. The coordination of the lifting and/or relocation of readily movable household items and commercial stock and equipment.
8. The role of the SES as the combat agency for storms does not include coastal erosion and inundation caused by astronomical high tides when severe weather is not actually developing or occurring.
9. The SES is not responsible for controlling or conducting any physical mitigation works to protect properties or structures at risk from coastal erosion/inundation, either during or outside the period of storm activity. This includes, but is not limited to:
 - a. The placement of rocks or other materials on beaches or foreshore areas
 - b. The construction of temporary walls made of sandbags, geo-technical tubes, or other material
10. DECC will provide ongoing advice to local councils and coastal zone management committees on the formulation and implementation of coastal zone management plans including procedures for addressing coastal processes, coastline hazards and risks, management options and coastal policies.
11. BoM will issue Severe Weather Warnings.

ANNEX I - PRESCRIBED DAMS IN THE WOLLONGONG LGA

1. Wollongong City Council has 10 Dams Prescribed under the NSW Dams Safety Committee:
 - Edgewood - Woonona
 - Foothills Estate 1&2 - Tarrawanna
 - Foothills Estate 3 – Tarrawanna
 - Brokers Road - Balgownie
 - Foothills Road - Mount Ousley
 - Wollongong High School – North Wollongong
 - Nyrang Park – Gwynneville
 - Gunyah Park – Keiraville
 - Gannet Avenue – Berkeley
 - Dapto Heights
2. The emergency Management Sub Committee of the NSW Dams Safety Committee has not rated these dams as having either a significant or a high risk ranking so no specific dam details are outlined in this plan. Current arrangements outlined in the relevant DSEP will be implemented should it be required.

Notification Arrangements for Potential Dam Failure



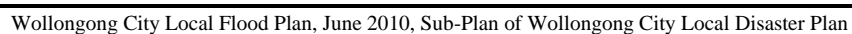
NOTE: dam owners should take every attempt to call SES State Operations in the first instance and only use the SEOC if the SES cannot be contacted

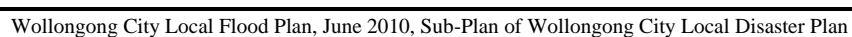
The '000' emergency contact number is not the preferred method of contacting the NSW Police in the context of dam failure. It is likely that the '000' operators will have difficulty dealing with the very unusual case of potential or actual dam failure. If '000' is used, the caller must give the details of the incident to the '000' operator before asking to be transferred to the duty Operations Inspector (DOI).

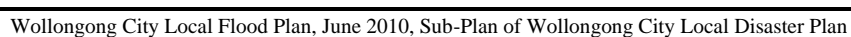
ANNEX J - EVACUATION RECORDING SHEET

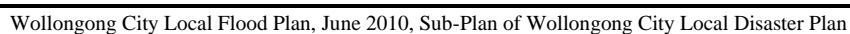


House No	Street	Suburb	Number of Occupants	Evacuating to: (Tick as appropriate)		Registration by: (Tick as appropriate)		Type of Support Required (Tick as appropriate)				Notes
				Private address	Evac Ctr	Phone	Evac Ctr	Transport	Medical	Animal	Other	

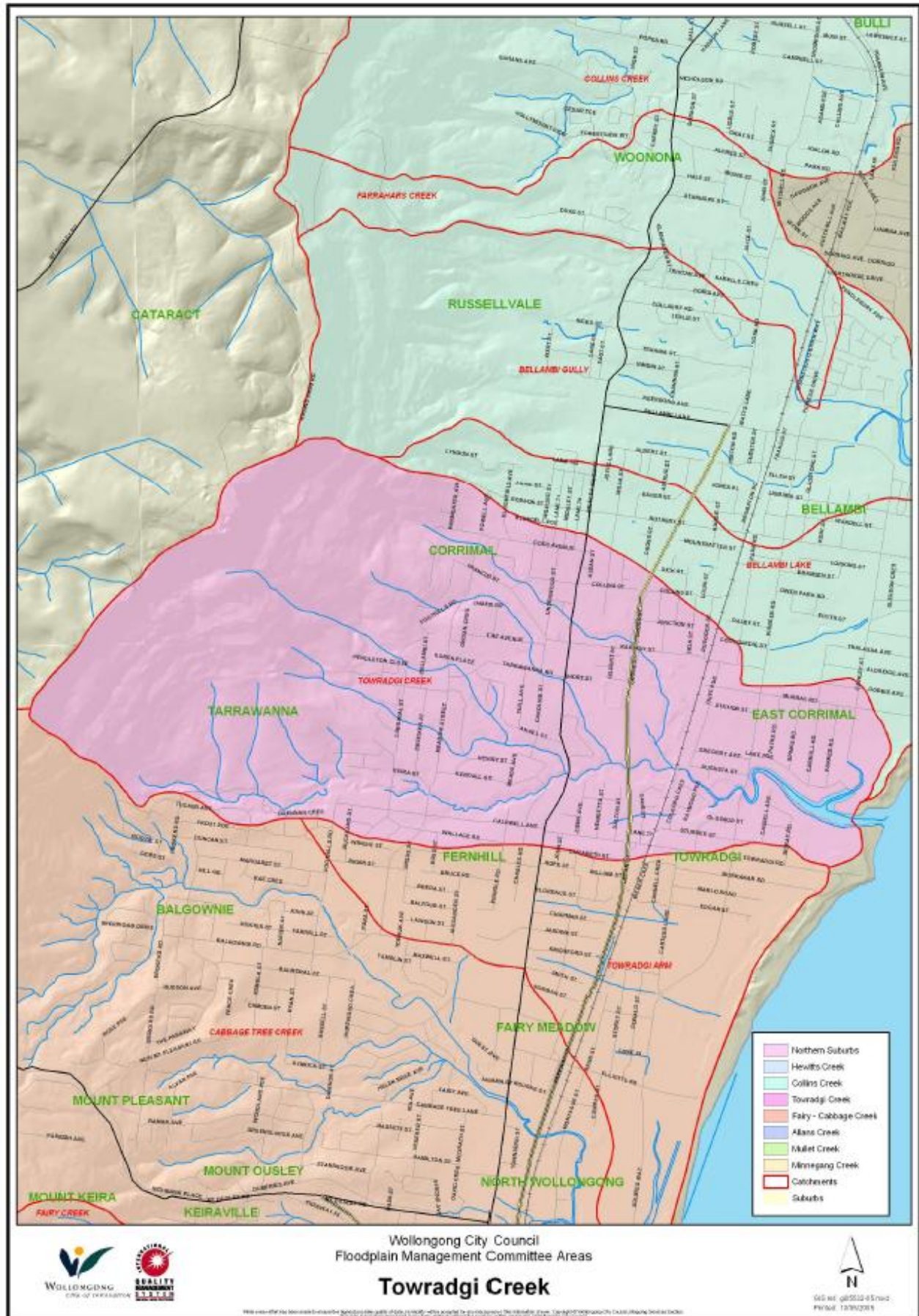


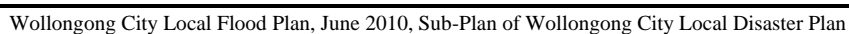






MAP 5 - AREA 4: TOWRADGI CREEK CATCHMENT





MAP 7 - AREA 6: ALLANS CREEK CATCHMENT

