Ourimbah Creek Catchment Flood Study

Final Report

VOLUME 1: Report and Appendices

Revision 3
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Catchment Simulation Solutions

Ourimbah Creek Catchment Flood Study

Final Draft Report

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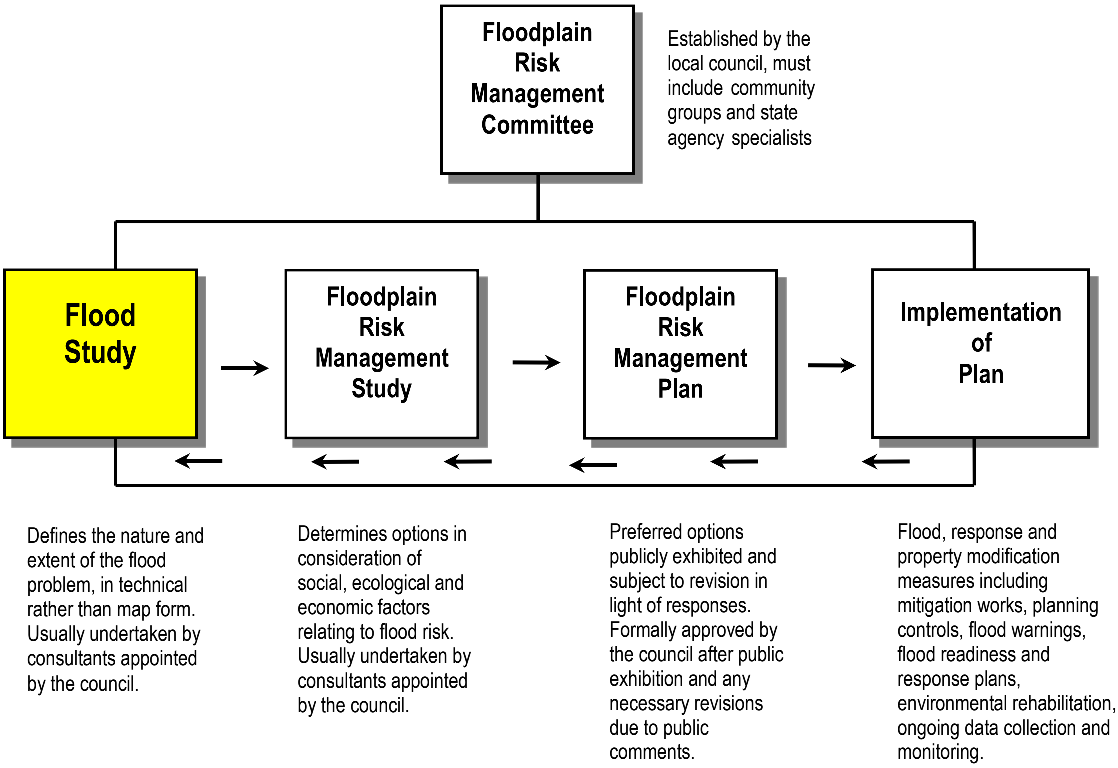
FOREWORD

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

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

The Policy provides for technical and financial support by the State Government through the following stages:



The Ourimbah Creek Flood Study represents the first of the four stages in the process outlined above. The aim of the Ourimbah Creek Flood Study is to produce information on flood discharges, levels, depths and velocities, for a range of flood events under existing topographic and development conditions. This information can then be used as a basis for identifying those areas where the greatest flood damage is likely to occur, thereby allowing a targeted assessment of where flood mitigation measures would be best implemented as part of the subsequent Floodplain Risk Management Study and Plan.

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GLOSSARY

acid sulphate soils	are sediments which contain sulfidic mineral pyrite which may become extremely acid following disturbance or drainage as sulfur compounds react when exposed to oxygen to form sulfuric acid. More detailed explanation and definition can be found in the NSW Government Acid Sulfate Soil Manual published by Acid Sulfate Soil Management Advisory Committee.
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. Eg, if a peak flood discharge of 500 m^3/s has an AEP of 5%, it means that there is a 5% chance (that is one-in-20 chance) of a 500 m^3/s or larger events occurring in any one year (see ARI).
Australian Height Datum (AHD)	a common national surface level datum approximately corresponding to mean sea level.
average annual damage (AAD)	depending on its size (or severity), each flood will cause a different amount of flood damage to a flood prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time.
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 with a discharge as great as or greater than the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.
caravan and moveable home parks	caravans and moveable dwellings are being increasingly used for long-term and permanent accommodation purposes. Standards relating to their siting, design, construction and management can be found in the Regulations under the Local Governments Act.
catchment	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.
consent authority	the council, government agency or person having the function to determine a development application for land use under the EP&A Act. The consent authority is most often the council, however legislation or an EPI may specify a Minister or public authority (other than a council), or the Director General of OEH, as having the function to determine an application.

development	is defined in Part 4 of the Environmental Planning and Assessment Act (*EP&A Act*). infill development: refers to development of vacant blocks of land that are generally surrounded by developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development. new development: refers to development of a completely different nature to that associated with the former land use. For example, the urban subdivision of an area previously used for rural purposes. New developments involve rezoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power. redevelopment: refers to rebuilding in an area. For example, as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either rezoning or major extensions to urban services.
disaster plan (DISPLAN)	a step by step sequence of previously agreed roles, responsibilities, functions, actions and management arrangements for the conduct of a single or series of connected emergency operations, with the object of ensuring the coordinated response by all agencies having responsibilities and functions in emergencies.
discharge	the rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
ESD	Ecologically Sustainable Development (ESD) using, conserving and enhancing natural resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be maintained or increased. A more detailed definition is included in the Local Government Act, 1993. The use of sustainability and sustainable in this manual relate to ESD.
effective warning time	The time available after receiving advice of an impending flood and before floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions.
emergency management	a range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding.
flash flooding	flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. Often defined as flooding which peaks within six hours of the causative rain.

flood	relatively high stream flow 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 major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
flood awareness	Awareness is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures.
flood education	flood education seeks to provide information to raise awareness of the flood problem so as to enable individuals to understand how to manage themselves and their property in response to flood warnings and in a flood event. It invokes a state of flood readiness.
flood fringe areas	the remaining area of flood prone land after floodway and flood storage areas have been defined.
flood liable land	is synonymous with flood prone land, i.e., land susceptible to flooding by the PMF event. Note that the term flood liable land covers the whole floodplain, not just that part below the FPL (see flood planning area).
flood mitigation standard	the average recurrence interval of the flood, selected as part of the floodplain risk management process that forms the basis for physical works to modify the impacts of flooding.
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.
floodplain risk management options	the measures that might be feasible for the management of a particular area of the floodplain. Preparation of a floodplain risk management plan requires a detailed evaluation of floodplain risk management options.
floodplain risk management plan	a management plan developed in accordance with the principles and guidelines in this manual. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.
flood plan (local)	A sub-plan of a disaster plan that deals specifically with flooding. They can exist at state, division and local levels. Local flood plans are prepared under the leadership of the SES.
flood planning area	the area of land below the FPL and thus subject to flood related development controls.
flood planning levels (FPLs)	are the combinations of flood levels (derived from significant historical flood events or floods of specific AEPs) and freeboards selected for floodplain risk management purposes, as determined in

management studies and incorporated in management plans.

flood proofing
a combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate flood damages.

flood prone land
land susceptible to flooding by the PMF event. Flood prone land is synonymous with flood liable land.

flood readiness
Readiness is an ability to react within the effective warning time.

flood risk
potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below.

<u>existing flood risk</u>**:** the risk a community is exposed to as a result of its location on the floodplain.

<u>future flood risk</u>: the risk a community may be exposed to as a result of new development on the floodplain.

<u>continuing flood risk</u>: the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.

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. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.

floodway areas
those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.

freeboard
provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the flood planning level.

hazard
a source of potential harm or a situation with a potential to cause loss. In relation to this study the hazard is flooding which has the potential to cause damage to the community.

Definitions of high and low hazard categories are provided in Appendix L of the *Floodplain Development Manual* (*2005*).

historical flood a flood which has actually occurred.

hydraulics term given to the study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.

hydrograph a graph which shows how the discharge or stage/flood level at any particular location varies with time during a flood.

hydrology term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.

local overland flooding inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.

local drainage smaller scale problems in urban areas. They are outside the definition of major drainage in this glossary.

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

major drainage councils have discretion in determining whether urban drainage problems are associated with major or local drainage. Major drainage involves:

- the floodplains of original watercourses (which may now be piped, channelised or diverted), or sloping areas where overland flows develop along alternative paths once system capacity is exceeded; and/or
- water depths generally in excess of 0.3m (in the major system design storm as defined in the current version of Australian Rainfall and Runoff). These conditions may result in danger to personal safety and property damage to both premises and vehicles; and/or
- major overland flowpaths through developed areas outside of defined drainage reserves; and/or
- the potential to affect a number of buildings along the major flow path.

mathematical / computer models the mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain.

merit approach	the merit approach weighs social, economic, ecological and cultural impacts of land use options for different flood prone areas together with flood damage, hazard and behaviour implications, and environmental protection and well-being of the State's rivers and floodplains. The merit approach operates at two levels. At the strategic level it allows for the consideration of social, economic, ecological, cultural and flooding issues to determine strategies for the management of future flood risk which are formulated into council plans, policy, and EPIs. At a site specific level, it involves consideration of the best way of conditioning development allowable under the floodplain risk management plan, local flood risk management policy and EPIs.
minor, moderate and major flooding	Both the State Emergency Service and the Bureau of Meteorology use the following definitions in flood warnings to give a general indication of the types of problems expected with a flood. minor flooding: Causes inconvenience such as closing of minor roads and the submergence of low level bridges. The lower limit of this class of flooding on the reference gauge is the initial flood level at which landholders and townspeople begin to be flooded. moderate flooding: Low lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic routes may be covered. major flooding: Appreciable urban areas are flooded and/or extensive rural areas are flooded. Properties, villages and towns can be isolated.
modification measures	measures that modify either the flood, the property or the response to flooding.
peak discharge	the maximum discharge occurring during a flood event.
probable maximum flood (PMF)	the PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event should be addressed in a floodplain risk management study.
probable maximum precipitation (PMP)	the PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to PMF estimation.

probability	A statistical measure of the expected chance of flooding (*see annual exceedance probability*).
risk	chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
runoff	the amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
stage	equivalent to water level (both measured with reference to a specified datum).
stage hydrograph	a graph that shows how the water level at a particular location changes with time during a flood. It must be referenced to a particular datum.
survey plan	a plan prepared by a registered surveyor.
TUFLOW	is a 1-dimensional and 2-dimensional flood simulation software. It simulates the complex movement of floodwaters across a particular area of interest using mathematical approximations to derive information on floodwater depths, velocities and levels.
velocity	the speed or rate of motion (*distance per unit of time, e.g., metres per second*) in a specific direction at which the flood waters are moving.
water surface profile	a graph showing the flood stage at any given location along a watercourse at a particular time.
wind fetch	the horizontal distance in the direction of wind over which wind waves are generated.
XP-RAFTS	is a non-linear runoff routing software. It incorporates subcatchment information such as area, slope, roughness and percentage impervious and is used to simulate the transformation of historic or design rainfall into runoff (i.e., discharge hydrographs).

1 INTRODUCTION

1.1 Catchment Description

The Ourimbah Creek catchment is located on the Central Coast of New South Wales and occupies a total area of 160 km^2. The extent of the catchment is shown in **Figure 1** (refer Flood Study: Volume 2).

The headwaters of the Ourimbah Creek catchment are located within the Great Dividing Range near Kulnura. The creek generally flows in an easterly direction through State Forest and rural properties before passing beneath the Sydney-Newcastle (F3) Freeway and Pacific Highway near Palmdale. It continues to flow in a northern and then easterly direction before passing beneath the Main Northern Railway Line and Wyong Road and eventually discharging into Tuggerah Lake at Chittaway Point.

The Ourimbah Creek catchment also incorporates a number of significant tributaries that are typically contained east of the Sydney-Newcastle Freeway and Pacific Highway. This includes:

- **Bangalow Creek**, originates in bushland between Tumbi Umbi and Ourimbah. It drains in a westerly and then northerly direction through the township of Ourimbah before joining Ourimbah Creek. Bangalow Creek drains a subcatchment area of 27 km^2 to its confluence with Ourimbah Creek.
- **Cut Rock Creek**, which form part of the larger Bangalow Creek subcatchment. The creek originates within the Gosford City Council Local Government Area and drains in a northerly direction through Lisarow, beneath the Main Northern Railway Line, Pacific Highway and Teralba Street before joining Bangalow Creek near Ourimbah. The Cut Rock Creek subcatchment occupies an area of 10 km^2.
- **Chittaway Creek**, which has its headwaters along Brush Road and drains in a westerly direction through Fountaindale before making its way north beneath Old Chittaway Drive and then west beneath Enterprise Drive and the Main Northern Railway line before entering Bangalow Creek. Chittaway Creek drains a subcatchment area of 6 km^2 to Bangalow Creek.
- **Dog Trap Gully**, which originates in bush land west of Ourimbah and drains in a northerly direction before turning east and flowing through the township of Ourimbah, beneath the Pacific Highway and Main Northern Railway and into Bangalow Creek. The Dog Trap Gully subcatchment occupies an area of 5 km^2.
- **Canada Drop Down Creek**, which has its headwaters in State Forest and drains in an easterly direction through Palmdale before joining Ourimbah Creek just upstream of the Sydney-Newcastle Freeway. The Canada Drop Down Creek subcatchment occupies an area of 22 km^2.
- **Kangy Angy Creek**, which originates in State Forest / bush land and drains in a south – easterly direction though the village of Kangy Angy before flowing east beneath the

Sydney-Newcastle Freeway and Pacific Highway and into Ourimbah Creek. The Kangy Angy Creek subcatchment drains an area of 4 km^2.

The Ourimbah Creek catchment west of the Sydney-Newcastle Freeway is typically characterised by State Forest and rural land uses. The catchment area on the eastern side of the Freeway is significantly more developed and incorporates a range or residential, commercial, industrial and rural land uses. A number of major transportation links also extend across the eastern section of the catchment including the Main Northern Railway, Pacific Highway, Wyong Road, Enterprise Drive and Chittaway Drive.

1.2 Purpose of Study

During periods of heavy rainfall across the Ourimbah Creek catchment, there is potential for water to overtop the banks of the creek system and inundate the adjoining floodplain. Accordingly, there is potential for inundation and damage to properties and roadways located in close proximity to the creeks and drainage lines. Flooding has been experienced across the catchment on a number of occasions in the past including 1953, 1974, 1977, 1990, 1992, 2007, 2011 and 2013.

A number of flooding investigations have previously been completed in an effort to understand and define flood behaviour across different sections of the Ourimbah Creek catchment. However, a comprehensive flood study of the entire Ourimbah Creek catchment using modern computer models has not previously been prepared.

In recognition of this limitation and the significant damage and inconvenience that has been caused by past flooding, Wyong Shire Council and Gosford City Council decided to revise the Floodplain Risk Management Plan for the Ourimbah Creek catchment. The first stage in the development of a Floodplain Risk Management Plan involves the preparation of a Flood Study. The Flood Study provides a technical assessment of flood behaviour.

This report forms the Flood Study for the Ourimbah Creek catchment. It documents flood behaviour across the catchment for a range of design floods for existing topographic and development conditions. This includes information on flood discharges, levels, depths and flow velocities for a range of design floods. It also provides estimates of the variation in flood hazard and hydraulic categories across the catchment and provides an assessment of the potential impacts of climate change on existing flood behaviour.

The Flood Study comprises two volumes:

- **Volume 1**: (i.e., this document) comprises the report text and appendices.
- **Volume 2**: contains all accompanying report figures.

1.3 Additional Investigations

During the preparation of the Ourimbah Creek catchment Flood Study, additional investigations were completed to quantify the impact that the proposed upgrade of the Pacific Highway at Lisarow may have on existing flood behaviour. The outcomes of this investigation are presented in **Appendix P**. Additional investigations were also completed to determine the potential hydraulic benefits of channel modifications works in the vicinity of Tall Timbers Estate, Lisarow. The outcomes of this assessment are presented in **Appendix O**.

2 METHODOLOGY

2.1 Objectives

The objectives of the Ourimbah Creek Catchment Flood Study are:

- to review available flood-related information and data for the Ourimbah Creek catchment;
- to develop a hydrologic model to simulate the transformation of rainfall into runoff and generate flow hydrographs across the catchment;
- to develop a hydraulic computer model to simulate how the flows generated by the hydrologic model would be distributed/move across the catchment;
- to calibrate the hydrologic and hydraulic computer models to reproduce past floods;
- to use the calibrated computer models to define peak discharges, water levels, depths and velocities for the design 20%, 10%, 5%, 2%, 1% and 0.5% AEP floods, and the Probable Maximum Flood (PMF);
- to produce maps showing the extent, depth and velocity of floodwaters for the range of design floods; and,
- to produce maps showing flood hazard and hydraulic categories for the range of design floods.

2.2 Adopted Approach

The general approach and methodology employed to achieve the study objectives involved:

- compilation and review of available flood-related information (Chapter 3);
- the development and calibration of a computer based <u>hydrologic model</u> to simulate the transformation of rainfall into runoff (Chapter 4);
- the development and calibration of a computer based <u>hydraulic model</u> to simulate the movement of floodwaters across the Ourimbah Creek catchment (Chapter 5);
- use of the computer models to determine peak discharges, water levels, depths, flow velocities and flood extents for the full range of design events up to and including the PMF (Chapter 6);
- use of the computer model results to generate flood hazard and hydraulic category mapping (Chapter 7),
- assessment of potential climate change implications on existing flood behaviour (Chapter 8).
- testing the sensitivity of the results generated by the computer model to variations in model input parameters (Chapter 9);
- Identification of flooding “trouble spots” as well as key infrastructure and transportation links impacted by floodwaters (Chapter 10).

3 Review of Available Information

3.1 Overview

A range of data were made available to assist with the preparation of the Ourimbah Creek Flood Study. This included previous reports, hydrologic data, photographs and GIS data.

A description of each dataset along with a synopsis of its relevance to the flood study is summarised below. Particular emphasis was placed on identifying information that could be used to assist with the hydrologic and hydraulic model development and calibration.

3.2 Previous Flood Reports and Investigations

3.2.1 Lower Ourimbah Creek Floodplain Risk Management Study Review and Plan (July, 2011)

The "Lower Ourimbah Creek Floodplain Risk Management Study Review and Plan" was prepared for Wyong Shire Council by Paterson Consultants. The report was commissioned to review the draft "Ourimbah Creek Floodplain Management Study" (Hyder Consulting Pty Ltd, January, 2001) and then develop a floodplain risk management plan. The study covers the lower 8 kilometres of Ourimbah Creek extending from the Wyong Road crossing of Ourimbah Creek (i.e., Lees Bridge) upstream to the confluence of Ourimbah Creek and Bangalow Creek. Only the section or Ourimbah Creek upstream of Wyong Road was considered as flood levels downstream of Wyong Road are dominated by Tuggerah Lake.

This study is the most recent flood-related investigation completed across the Ourimbah Creek catchment. It incorporates a review of previous flooding investigations across the lower Ourimbah Creek catchment. It notes that a number of flood studies have been prepared for the catchment although the investigations have been conducted over a variety of different study areas. It goes on to say that each of the previous studies can be criticised for:

- failing to adequately represented the routing of flow through the catchment;
- failing to consider all available historic information in the calibration and verification of models;
- adopting high Manning's 'n' coefficients in the hydraulic model; and/or,
- trying to represent the complex 2-dimensional movement of floodwaters using simplified 1-dimensional hydraulic models.

The report also notes that large spatial variations in rainfall are common across the Central Coast area during storms and available stream gauging stations are not reliable at high stages. Accordingly, this hampers hydrologic and hydraulic model calibration and verification.

The report also provides comparisons between peak 1% AEP flood discharges and flood levels at various locations throughout the Ourimbah Creek catchment from a range of previous Ourimbah Creek flood studies. This information is reproduced in **Tables 1** and **2** respectively. However, as all of the studies were completed over ten years, the discharge and associated flood level estimates may not provide a reliable description of contemporary design flood conditions.

Table 1 Summary of peak 1% AEP discharges from previous flooding investigations

Location	Peak 1% AEP Discharge (m^3/s)				
	SKP[1]	WMA[2]	PC[3]	Hyder[4]	Hyder[5]
Bangalow Creek @ Ourimbah	-	220	-	260	260
Ourimbah Creek @ Pacific Highway	-	-	-	677	550
Ourimbah Creek @ Stn 211005	850	-	990	930	750
Ourimbah Creek @ Wyong Road	870	-	-	960	740

Notes: 1: “Lower Ourimbah Creek Flood Study, Preliminary Report” (Sinclair Knight & Partners, 1990)
2: “Bangalow Creek and Cut Rock Creek Flood Study” (Webb McKeown & Associates, 1994)
3: “Catamaran Drive Flood Study” (Paterson Consultants, 1989)
4: “Ourimbah Creek Floodplain Management Study” (Hyder Consulting, 2001) using ARR temporal patterns
5: “Ourimbah Creek Floodplain Management Study” (Hyder Consulting, 2001) using adjusted temporal patterns

Table 2 Summary of peak 1% AEP flood levels from previous flooding investigations

Location	Peak 1% AEP Flood Levels (mAHD)			
	SKP[1]	PC[2]	Hyder[3]	Wyong Council[4]
Ourimbah Creek @ Pacific Highway	12.73	-	12.28	12.61
Ourimbah Creek @ Stn 211005	11.01	11.3	10.46	11.40
Ourimbah Creek @ Corella Close	5.86	6.6	6.2	6.50
Ourimbah Creek @ Wyong Road	4.23	4.0	4.5	4.5

Notes: 1: “Lower Ourimbah Creek Flood Study, Preliminary Report” (Sinclair Knight & Partners, 1990)
2: “Catamaran Drive Flood Study” (Paterson Consultants, 1989)
3: “Ourimbah Creek Floodplain Management Study” (Hyder Consulting, 2001)
4: Wyong Shire Council: Flood Level Sheets

3.2.2 Tuggerah Lakes Floodplain Risk Management Study – Public Exhibition Draft (November, 2010)

The “Tuggerah Lakes Floodplain Risk Management Study” was prepared by WMAwater for Wyong Shire Council. The study was prepared to examine a range of measures that could potentially be implemented to reduce the impact of flooding across the floodplains of the Tuggerah Lakes system (i.e., Tuggerah Lake, Budgewoi Lane and Lake Munmorah). The study was mainly concerned with land that is located below 3 mAHD. That is, it did not consider flooding along each of the major tributary inflows to the lake system, including Ourimbah Creek. Nevertheless, it does provide useful information regarding flooding mechanisms across Tuggerah Lake. As shown in **Figure 1**, Ourimbah Creek discharges into Tuggerah Lake. Accordingly, the prevailing water levels in Tuggerah Lake can strongly influence flood behaviour along the downstream reaches of Ourimbah Creek.

The study notes that Tuggerah Lake discharges to the Pacific Ocean across a sandy beach berm at The Entrance, which is intermittently open and closed. The severity of flooding across the lake system is influenced by the level of the beach berm and whether there are elevated ocean levels at the time of a flood (elevated ocean levels may prevent the egress of floodwaters from the lake). The report also notes that rainfall over a period of 2 to 5 days is typically required to elevate lake levels significantly.

The study notes that the non-flood water level within the lake is typically 0.3 mAHD with no apparent tidal fluctuation. However, the water level can typically fluctuate from 0.1 to 0.5 mAHD depending on the volumes of inflow from the contributing catchments at the time.

The study includes a summary of peak lake water levels for significant historic floods, which is reproduced below in **Table 3**.

Table 3 Summary of peak historic Tuggerah Lake levels extracted from "Tuggerah Lakes Floodplain Risk Management Study"

Rank	Date	Peak Lake Water Level (mAHD)
1	18th June 1949	2.1
2	Easter 1946	1.9
3	2nd May 1964	1.9
4	1927	1.8
5	1931	1.8
6	10th June 2007	1.65
7	4th February 1990	1.6
8	4th March 1977	1.6
9	1963	1.5
10	1953	1.5

The study provides an overview of previous flooding investigations that have been completed for the lake system. This includes the "Tuggerah Lakes Flood Study" (Lawson & Treloar, September, 1994), which included the development of a WBNM hydrologic model of the entire Tuggerah Lakes catchment (including Ourimbah Creek) and a MIKE-11 hydraulic model of the lake system. The models were calibrated/verified using historic data for the February 1992, February 1990 and May 1974 floods.

The flood study provides design flood levels for Tuggerah Lake which were prepared based on frequency analysis and hydrologic/hydraulic computer modelling (refer **Table 4**). The peak design lake levels compare favourably with those documented in the "Lower Ourimbah Creek Flood Study" (Sinclair Knight and Partners, October, 1986). The design flood levels listed in **Table 4** are based on an entrance breach model that was calibrated against historic floods. However, the outcomes of sensitivity analysis showed that peak 1% AEP water levels could change by up to 0.1 metres if alternate breach parameters were adopted.

Table 4 Summary of peak design flood levels for Tuggerah Lake taken from "Tuggerah Lakes Flood Study"

Location	Peak Lake Water Level (mAHD)				
	50% AEP	20% AEP	5% AEP	1% AEP	Maximum Probable Flood
Tuggerah Lake	0.91	1.36	1.80	2.23	2.70

3.2.3 Upper Ourimbah Creek Flood Study (June, 1997)

The "Upper Ourimbah Creek Flood Study" was prepared by Webb McKeown & Associates for Wyong Shire Council. The purpose of the report was to define the nature and extent of the existing flooding problem along Ourimbah Creek upstream of the Pacific Highway.

The report outlines that the February 1992 flood is the largest on record for Ourimbah Creek and that a comprehensive data collection and survey exercise was carried out following the flood. This includes 76 surveyed flood marks across the Upper Ourimbah Creek floodplain. Five surveyed flood marks were also available for the August 1995 flood.

The report notes that negligible flood mark information is available from flood events prior to the February 1992 flood. Therefore, resident surveys were completed in an attempt to uncover additional historic flood information. The survey provided several descriptive estimates of the March 1977 flood relative to the February 1992 (the 1977 flood being between 0.1 and 1.0 metre lower than the 1992 flood). All historic flood level information extracted from the report is provided on **Figure 4**.

The report identifies significant floods have occurred across the Upper Ourimbah Creek catchment on the following dates:

- 14-18th April 1927;
- 17-19th June 1930;
- 17-19th June 1949;
- 8th May 1953;
- 4th June 1974;
- 4th March 1977;
- 6th July 1988;
- 10th February 1992;

A hydrologic model of the Ourimbah Creek catchment draining to the Main Northern Railway was developed using the WBNM software as part of the study. The hydrologic model was not calibrated as there was no reliable stream flow data available for any significant historic floods. Therefore, the WBNM model parameter values were populated based on values extracted from similar hydrologic models for nearby catchments (e.g., Chittaway/Bangalow Creeks).

A hydraulic model of the Upper Ourimbah Creek catchment was developed using the RUBICON software. The hydraulic model was calibrated against historic flood mark information for the February 1992 event. An estimate of the March 1977 flood was also simulated and the resulting flood profile was found to be significantly lower than the 1992 event. However, given the uncertainty associated with the 1977 flood mark information, no definitive conclusions could be drawn from this simulation as to the suitability of the model calibration.

A range of design events were simulated from the 20% AEP flood up to and including the 1%AEP event. The probable maximum flood (PMF) was also simulated, however, it is uncertain whether the PMF estimate was derived using actual probable maximum precipitation calculations or whether an approximation was employed.

The study also includes floor level elevations for 52 buildings within the Upper Ourimbah Creek catchment. The peak design flood level information extracted from the hydraulic model was extracted and used with the available floor level information to provide an indication of the number of buildings subject to inundation during each of the design floods. This determined that approximately 24 buildings would be subject to inundation during the design 1% AEP flood and a further 24 buildings are located less than 300 mm above the predicted peak 1% AEP flood level.

It should be noted that the study was prepared fifteen years ago. Although the upper Ourimbah Creek catchment is still largely undeveloped, changes to the upstream catchment (e.g., clearing of vegetation, construction of farm dams) may mean the discharge and flood level estimates presented in the report no longer provide a reliable description of contemporary flood behaviour.

3.2.4 Bangalow Creek and Cut Rock Creek Floodplain Management Study (January, 1996)

The "Bangalow Creek and Cut Rock Creek Floodplain Management Study" was prepared by Webb McKeown & Associates for Wyong Shire Council and Gosford City Council. The study outlines a range of flood mitigation measure that could potentially be implemented to reduce the existing flood problem across the Bangalow, Cut Rock and Chittaway Creek catchments and ensure future development is completed in a manner that recognises the variation in flood hazard across different sections of the floodplain.

The results of design flood simulations completed as part of the "Bangalow Creek and Cut Rock Creek Flood Study" (Webb McKeown & Associates, December, 1994) were used to define the nature and extent of the existing flooding problem. The following locations were identified as areas where significant flood damages are likely to be incurred:

- Pluim Park / Tall Timbers Estate / Manning Road *(12 buildings inundated in 1% AEP flood)*;
- Donna Close / Janine Close / Narelle Close *(1 building inundated in 1% AEP flood)*;
- Subdivisions east of Tuggerah Street *(1 building inundated in 1% AEP flood)*;
- Brands Place / Lisarow Street (*23 buildings inundated in 1% AEP flood)*;
- Shirley Street *(1 building inundated in 1% AEP flood)*;
- Mill Street Industrial Area *(2 buildings inundated in 1% AEP flood)*;
- Dog Trap Gully *(1 building inundated in 1% AEP flood)*; and,
- Chittaway Creek *(3 buildings inundated in 1% AEP flood).*

This study does not provide any new survey or historic flood information relative to the 1994 flood study. Accordingly, there was little additional information that could be extracted and used as part of the current study.

3.2.5 Bangalow Creek and Cut Rock Creek Flood Study (December, 1994)

The "Bangalow Creek and Cut Rock Creek Flood Study" was prepared by Webb McKeown & Associates for Wyong Shire Council and Gosford City Council. The purpose of the flood study was to define the nature and extent of the existing flood problem across Bangalow Creek (including Cut Rock Creek and Dog Trap Gully) and Chittaway Creek downstream to their confluence with Ourimbah Creek. Combined, the Bangalow and Chittaway Creek catchments occupy approximately 20% of the overall Ourimbah Creek catchment.

The report included a significant review of historic flood information. This included a review of information from various local and state government agencies, newspapers, previous reports as well as resident interviews. The report did note that prior to the mid-1970s the quantity and quality of historic data was insufficient for the purposes of model calibration.

The review identified a total of nineteen flood events between 1974 and 1992. The most significant floods for which significant information is available included:

- 29th January 1978;
- 7th February 1981;
- 8th November 1984;
- 14th October 1985;
- 30th April 1988;
- 7th January 1989;
- 2-4th February 1990;
- 7th February 1990;
- 10th February 1992;

Historic flood level information extracted from the report is provided on **Figure 4**. This includes peak water levels extracted from maximum height recorders, automatic water level recorders and surveys completed after the February 1992 flood by Wyong Council and after the February 1990 flood by Gosford City Council.

A hydrologic model of the Bangalow Creek and Chittaway Creek catchments was developed using the WBNM software. The hydrologic model could not be calibrated independently as there were no stream gauges located in either catchment.

A hydraulic model of Bangalow Creek, Cut Rock Creek, Dog Trap Gully and Chittaway Creek was also developed as part of the study using the RUBICON software. The report includes details of major hydraulic structures (i.e., bridges and culverts) including invert elevations and dimensions as well as roadway centreline elevations. The extent of this information is shown in **Figure 3** and can be extracted and used to assist with the development of the hydraulic model for this study. The January 1989, February 1990 and February 1992 floods were used to calibrate / verify the hydraulic model.

The computer models were used to simulate the 10%, 2% and 1% AEP floods. An approximation of the probable maximum flood (PMF) was also made by doubling the 1% AEP design flows.

It should be noted that subsequent investigations completed by Paterson Consultants for the “Bangalow Creek near Shirley St & Brush Rd Ourimbah Flood Analysis” (Paterson Consultants Pty Ltd, September, 1998) identified some anomalies in design flood results generated as part of this flood study in the vicinity of Sohier Park. In particular, the Paterson Consultant report identified the need to incorporate additional “branches” in the hydraulic model layout to reliably model overland flow paths and “break outs” across the floodplain during large floods. As the study was completed twenty years ago, it is also considered that the hydrologic and hydraulic parameters and associated discharge and design flood estimates may not provide a reliable representation of contemporary flood behaviour.

3.2.6 Lower Ourimbah Creek Flood Study - Draft (October, 1986)

The draft “Lower Ourimbah Creek Flood Study” was prepared by Sinclair Knight & Partners for the NSW Public Works Department. The flood study was prepared to define design flood levels, velocities and discharges along Ourimbah Creek between the Pacific Highway and Tuggerah Lake. Main stream flooding as well as flooding from elevated water levels in Tuggerah Lake was considered as part of the investigation.

The report explains that the Tuggerah Lake system has a typical water level of between 0.2 and 0.3 mAHD and a very small tidal range. The report goes on to say that flood levels along the lower reaches of Ourimbah Creek are strongly influenced by the water levels in Tuggerah Lake. The lake levels rise in response to rainfall over the lake area and can be exacerbated by catchment runoff, the constriction in The Entrance channel and/or elevated ocean levels, which reduce the potential for excess water to escape from the lake to the ocean.

The design water levels listed in **Table 5** are provided in the report for Tuggerah Lake:

Table 5 Summary of peak design flood levels for Tuggerah Lake taken from “Lower Ourimbah Creek Flood Study”

Location	Peak Lake Water Level (mAHD)			
	5% AEP	2% AEP	1% AEP	Maximum Probable Flood
Tuggerah Lake	1.9	2.2	2.4	2.7

The report notes that peak flood levels during low to medium recurrence events are sensitive to the formation or opening of sandbars across The Entrance channel. Accordingly, when these lake water levels were derived (i.e., 1974), it was assumed that the entrance would function in a similar manner to other historic floods. However, since 1993, Wyong Shire Council has employed a policy of maintaining a permanently open entrance to allow for tidal interchange. Accordingly, the levels presented in **Table 5** may be overestimated.

The report discusses a report prepared by Weatherex (Weatherex Meteorological Services, August, 1982) that investigates the interaction between ocean storm surge conditions and high rainfall events over the lake catchment. The outcomes of this investigation determined that conditions which maximise storm surge are unlikely to result in major flood producing rainfall over the catchment.

The report also investigated the relative timing/coincidence of peak flood levels within Tuggerah Lake and Ourimbah Creek. It notes that during catchment runoff events lake levels rise because the capacity of The Entrance channel is less than the flow entering the lake from the various tributary inflows (e.g., Wyong River, Ourimbah Creek). The study determined that the lake levels listed in **Table 6** would be appropriate to adopt at the peak of an Ourimbah Creek flood.

Table 6 Summary of peak design flood levels for Tuggerah Lake at time of Ourimbah Creek flood peak taken from "Lower Ourimbah Creek Flood Study"

Location	Peak Lake Water Level (mAHD)		
	5% AEP	2% AEP	1% AEP
Tuggerah Lake	0.6	0.7	0.9

Although the report does provide a significant amount of useful information, the study was never finalised. In addition, a significant amount of development has occurred in the catchment since the report was prepared. Accordingly, it is likely that contemporary flood conditions will now differ from those documented in the report.

3.2.7 Cut Rock Creek Valley Flood Plain Management Study (June, 1982)

The "Cut Rock Creek Valley Flood Plain Management Study" (June, 1982) was prepared by Cameron McNamara Consultants for the NSW Department of Public Works. The report outlines the results of investigations into various floodplain management strategies aimed at reducing the losses and disruption caused by flooding within the Cut Rock Creek catchment. The study area incorporated the Bangalow Creek, Dog Trap Gully, Chittaway Creek and Cut Rock Creek catchments, which are all major tributaries of Ourimbah Creek.

A hydrologic computer model of the various catchments was developed using the RORB software. A hydraulic model of the major watercourses within the study area was also developed using the HEC-2 software. It is considered that the 1-dimensional HEC-2 software would fail to represent the complex 2-dimensional movement of floodwaters that can occur across the floodplain of the creek system. In addition, the results produced by the hydrologic and hydraulic model are no longer considered to be reliable due to the significant development that has occurred across the catchment since the models were originally produced (i.e., over 30 years ago).

The report incorporates some information for a flood that occurred overnight on 6^{th} and 7^{th} of February 1981 as well as 29^{th} January 1978. Although the study mentions that flood level information was collected for the 1981 flood, this information does not appear to be reproduced in the report. The report does document peak flows for the 1978 and 1981 floods, however, they are flows simulated by a hydrologic model using recorded rainfall data rather than flows recorded at stream gauging stations.

The study identified several flooding problem areas including Brands Place (Lisarow), Sohier Park (Ourimbah), Chittaway Road area (Ourimbah) as well as the lower reaches of Chittaway Creek. A total of 15 of 35 residences were identified as being flood liable across these areas.

This study was prepared thirty years ago. Accordingly, it is considered that changes that have occurred in the catchment over that period (e.g., increased development, bridge/culvert replacements) will result in changes in rainfall-runoff and flood behaviour. Therefore, the results presented in this study are not considered to provide a reliable description of contemporary flood behaviour.

3.2.8 Flood Impact Assessments

In addition to the major flood studies, floodplain risk management studies and floodplain risk management plans described above, a number of smaller flood impact assessments have also been prepared. The flood impact assessments were typically prepared to assess the flood-related impacts of various developments that were proposed across the Ourimbah Creek catchment. Flood impact assessments that were provided include:

- Gutteridge Haskins & Davey Pty Ltd (GHD) (August 1993), Roads and Traffic Authority Lot 11 DP 748273, Old Maitland Road, Ourimbah, Flood Report, prepared for Roads and Traffic Authority, NSW
- Hyder Consulting Pty Ltd (June 2010),HW10 Pacific Highway - Narara to Ourimbah Upgrade - Flood Impact Assessment Report, prepared for Roads and Traffic Authority, NSW
- Kinhill Engineers (March 1989), Chittaway Road Crossing Design, prepared for Wyong Shire Council
- Parsons Brinkerhof (December 2008), University of Newcastle, Ourimbah Campus Central Tributary Flood Study, prepared for the University Of Newcastle for submission to Wyong Shire Council
- Parsons Brinckerhoff (PB) (July 2008), University of Newcastle, Ourimbah Campus Flooding Assessment for Proposed Car Park Facilities, prepared for University Of Newcastle, Ourimbah Campus for submission to Wyong Shire Council
- Paterson Consultants (September 1990), Extension of Enterprise Dr Drain Review of Design Discharges Catchment 2JA, prepared for Wyong Shire Council
- Paterson Consultants, (May 1993), Flood Study Lot 1 DP 499720, Teralba St, Ourimbah, prepared for Mr R.Davis for submission to Wyong Shire Council
- Paterson Consultants Pty Ltd (September 1998), Bangalow Creek near Shirley St & Brush Rd Ourimbah Flood Analysis Amended Final report, prepared for Wyong Shire Council
- Paterson Consultants Pty Ltd (October 1998), Bangalow Creek at Shirley St Ourimbah Flood Analysis Supplementary Report, prepared for Wyong Shire Council
- Paterson Consultants (August 1989), Ourimbah Creek 2JA Interconnection Study Development DP 615308, prepared for Wyong Shire Council
- Paterson Consultants (May 1989), Ourimbah Creek 2JA Interconnection Study, prepared for Wyong Shire Council
- PPK Consultants (September 1991), University of Newcastle and Ourimbah College of TAFE Central Coast Campus Flood Study Report

- Webb McKeown & Associates (April 1993), Bangalow Creek University of Newcastle Ourimbah Campus Hydraulic Report, prepared for Central Coast Campus of the University of Newcastle and the Ourimbah College of TAFE
- Webb McKeown & Associates (October 1994), Bangalow Creek Arterial Flood Investigation, prepared for Wyong Shire Council
- Webb McKeown & Associates (March 1995), Hydraulic impacts Sohier Park Community Hall, Ourimbah, prepared for Wyong Shire Council
- Willing and Partners (Aug 1983), Bangalow Creek Ourimbah Preliminary Flood Plain Drainage & Culvert study for road crossing, prepared for Wyong Shire Council
- Willing and Partners (February 1985), Bangalow Creek Burns Rd Crossing Report on Hydraulic Effects of Alternative Culvert Design, prepared for Wyong Shire Council
- Willing and Partners (October 1986), Chittaway Rd Ourimbah Road Alignment Study, prepared for Wyong Shire Council

Most of the flood impact assessments were prepared based on computer models that were developed as part of previous flood studies or floodplain risk management studies. As a result, they typically did not include the development of any new computer models (or used simplified hydrologic/hydraulic calculations), incorporated only small amounts of new survey/hydraulic structure information and contained no additional historic flood information.

Nevertheless, some of the flood impact assessments did incorporate some additional information that could be of use in this study. A brief synopsis of these reports is presented below.

HW10 Pacific Highway - Narara to Ourimbah Upgrade - Flood Impact Assessment Report (June, 2010)

The "HW10 Pacific Highway - Narara to Ourimbah Upgrade - Flood Impact Assessment Report" was prepared by Hyder Consulting for the NSW Roads and Traffic Authority. The report was prepared to quantify the potential flood impacts associated with a proposed upgrade of the Pacific Highway between Lisarow and Ourimbah, which traverses Cut Rock Creek.

The study included the development of a hydrologic model of the Cut Rock Creek catchment that was developed using the XP-RAFTS software. As there are no stream flow gauges located within the catchment, calibration of the hydrologic model was not completed. It was also noted that initial and continuing loss rates of zero were adopted in the hydrologic model for design conditions, which is not strictly in accordance with procedures set out in "Australian Rainfall and Runoff - A Guide to Flood Estimation".

The study also included the development of a fully 2-dimensional 5 metre grid TUFLOW hydraulic model (the only 2-dimensional that has been developed within the Ourimbah Creek catchment). The hydraulic model was calibrated against the February 1990 and February 1992 floods based on peak flood level data extracted from previous flood studies.

The computer models were used to simulate flood behaviour along Cut Rock Creek for the 1% AEP event for a variety of different durations. The TUFLOW model was used to generate estimates of peak floodwater depths, levels and extents for existing conditions as well as for the proposed highway upgrade scenario.

The report notes that detailed ground survey of the creek and drainage structures was also gathered. However, this information was not reproduced in the report.

"University of Newcastle, Ourimbah Campus Central Tributary Flood Study" and "Ourimbah Campus Flooding Assessment for Proposed Car Park Facilities"

The "University of Newcastle, Ourimbah Campus Central Tributary Flood Study" and "Ourimbah Campus Flooding Assessment for Proposed Car Park Facilities" were prepared by Parsons Brinkerhoff for the University of Newcastle. The reports were prepared to quantify the impact that various developments across the Ourimbah campus may have on existing flood behaviour along Bangalow Creek, which adjoins the campus, as well as a major tributary of Bangalow Creek, which bisects the campus.

The study included the development of a HEC-RAS hydraulic model of the tributary and Bangalow Creek. The models were developed using surveyed cross-section of the tributary and Bangalow Creek channels. The location of the cross-sections is shown in **Figure 3.** Each of the surveyed cross-sections is provided in the report and were extracted and used as part of this flood study. The details of the Chittaway Road culvert crossing of Bangalow Creek were also provided.

3.2.9 Summary

This section has presented an overview of all flood-related investigations that have previously been completed for the Ourimbah Creek catchment. It shows that a large number of studies have been completed to better define the nature of the flooding problem across catchment over the past 30 years. However, the review shows that a single flood study of the entire catchment has not been completed. In addition, the previous studies typically used simplified 1-dimensional hydraulic models to simulate flood behaviour and did not fully satisfy the requirements of the NSW Government's "Floodplain Development Manual" (2005) (e.g., did not consider climate change impacts).

Nevertheless, the previous flooding investigations did provide considerable amount of information that could be used to assist with this current flood study. This includes survey information (e.g., creek cross-sections and bridges/culverts), areas where flood damages have been incurred in the past, as well as flood marks for historic floods.

3.3 Hydrologic Data

3.3.1 Historic Rainfall Data

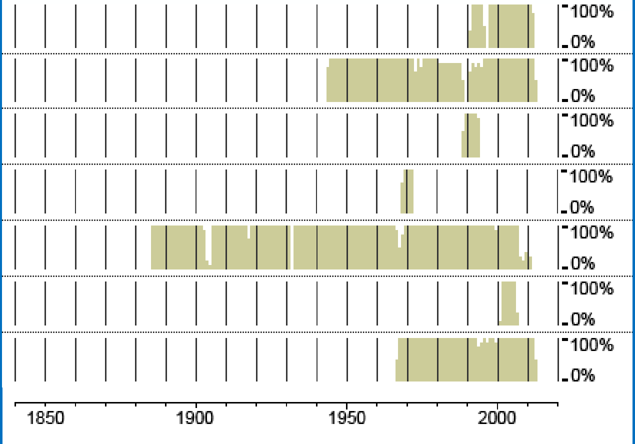
A number of daily read and continuous (i.e., pluviometer) rainfall gauges are located within and adjacent to the Ourimbah Creek catchment. The location of each gauge is shown in **Figure 5**. Key information for each gauge is summarised in **Table 7**.

The information provided in **Table 7** indicates that daily rainfall records are available dating back to 1885, while continuous rainfall records are available from 1965 onwards. **Table 7** also shows that most of the gauges have a relatively complete record of rainfall data.

Table 7 Available rain gauges in the vicinity of the Ourimbah Creek catchment

Gauge Number	Gauge Name	Gauge Type	Source*	Period of Record		Percentage of Total Record Complete	Temporal Availability and Percentage of Annual Record Complete source: http://www.bom.gov.au/climate/data/
				From	To		
61378	Bateau Bay (Rotherham St)	Daily	BOM	29/09/1993	31/10/1997	99	
561134	Berkeley Vale at Berkely Vale Road	Continuous	MHL	24/11/1988	30/06/2011	N/A	
561072	Chittaway at Enterprise Drive	Continuous	MHL	31/12/1989	09/08/2010	N/A	
61383	Gears (Wyong River)	Daily	BOMNS	01/12/2000		97	
61023	Gertrude Place	Daily	BOM	01/05/1877	31/8/1993	96	
61087	Gosford (Narara Research Stn)	Continuous	BOM	01/07/1917		58	
61319	Gosford North (Glennie St)	Daily	BOM	01/12/1971		80	
61355	Kariong (Greenway Close)	Daily	BOM	01/01/1986	30/11/1997	55	
61380	Jilliby (Jilliby Ck)	Daily	BOMNS	01/12/2000		99	
61384	Kangy Angy (Ourimbah Ck)	Daily	BOMNS	01/12/2000		95	
61029	Kulnura (William Rd)	Daily	BOM	30/01/1969	9/09/1981	90	
561078	Kulnurra	Continuous	MHL	21/06/1989		NA	
561079	Lisarow at Fagans Rd	Continuous	MHL	06/04/1989		NA	
561082	Mardi Dam at Old Maitland Road	Continuous	MHL	5/10/1988		NA	
61381	Wyong (Mount Elliot)	Daily	BOMNS	01/12/2000		93	
61093	Ourimbah (Dog Trap Rd)	Daily	BOM	14/5/1985	30/6/2012	99	
61351	Peats Ridge (Waratah Rd)	Continuous	BOM	30/09/1981		97	

Gauge Number	Gauge Name	Gauge Type	Source*	Period of Record		Percentage of Total Record Complete	Temporal Availability and Percentage of Annual Record Complete source: http://www.bom.gov.au/climate/data/
				From	To		
61369	Terrigal Memorial Country Club	Daily	BOM	19/08/1990		91	
61074	The Entrance (Eloora Street)	Daily	BOM	27/02/1943	30/6/2012	93	
61362	Warnervale (Hakone Rd)	Daily	BOM	30/05/1988	29/12/1993	96	
61253	Wattle Tree Rd	Daily	BOM	29/04/1968	29/12/1971	94	
61083	Wyong (Wyong Golf Club)	Daily	BOM	01/01/1885	29/3/2010	94	
61386	Wyong U/S Bridge (Wyong River)	Daily	BOMNS	21/05/1999	29/3/2010	96	
61220	Yarramalong (Lewensbrook)	Daily	BOM	29/11/1962		89	



NOTE: * BOM = Bureau of Meteorology (Australia), BOMNS = Bureau of Meteorology (NSW), MHL = Manly Hydraulics Laboratory

A review of the available rainfall data was completed to identify when significant historic rainfall events have occurred and, consequently, when flooding may have been experienced in the catchment. The details of the top ten rainfall events, based on accumulated daily total rainfall depths, are summarised in **Table 8**. Note that the dates provided in **Table 8** are the dates on which the rain fell and may not necessarily coincide with when flooding was experienced.

As shown in **Table 8**, the most significant rainfall event on record occurred in February 1992, where over 300 mm of rain fell within a 24 hour period. It was also preceded with over 150 mm of rainfall, indicating the catchment would have been saturated prior to the main rainfall event.

Table 8 also indicates that significant rainfall events also occurred in February 1990 and June 2007. Accordingly, the three largest rainfall events since records commenced have occurred relatively recently.

Table 8 Significant Historic Rainfall Events

Rank	Year	Day/Month	Rainfall in 24 hour Period (mm)	Rainfall in Preceding 24 Hour Period (mm)	Rainfall in Following 24 Hour Period (mm)
1	1992	9th February	320	173	1
2	1990	2nd February	279	28	126
3	2007	8th June	263	135	60
4	1946	15th April	239	50	90
5	1942	22nd March	212	0	0
6	1956	9th February	212	16	77
7	1977	3rd March	207	26	0
8	1927	15th April	205	0	0
9	1985	13th October	170	10	6
10	1978	28th January	155	19	0

NOTE: Information in the above table is based upon interrogation of long term daily rainfall records from Wyong (Wyong Golf Club) and Ourimbah (Dog Trap Road) rain gauges.

3.3.2 Historic Stream Gauge Data

Five stream gauges are located within the Ourimbah Creek catchment, although only four of the gauges are currently operational. The stream gauges record the time variation in water height (referred to as a "stage hydrograph"). The location of each stream gauge is shown in **Figure 5**. Key information for each stream gauge is summarised in **Table 9**.

When combined with a rating curve, the stage hydrograph at each stream gauge can be converted to a discharge hydrograph describing the time variation in discharge throughout a particular flood event. The rating curve provides a relationship between the stage at the gauge location and the corresponding stream discharge and is developed based upon manual recordings of stream discharges for a range of different water levels (the manual recordings are referred to as a "gauging"). Therefore, the reliability of the rating curve is largely dependent on the number of individual gaugings collected as well as the range of water levels over which the gaugings were collected.

Table 9 Available Stream Gauge Data

Gauge Number	Gauge Name	Source	Period of Record		Rating Curve?
			From	To	
211425	Ourimbah Creek at Lees Bridge	MHL	05/1993	30/6/2011	No
211013	Ourimbah Creek at U/S Weir	NSW Office of Water	11/1976	30/6/2012	119 gaugings between 1976 and 2010
211015	Ourimbah Creek downstream of Bangalow Creek	NSW Office of Water	10/2003	30/6/2012	28 gaugings between 2003 and 2010
242464	Lisarow at Fagans Road	MHL	07/2009	30/6/2011	No
211005	Ourimbah Creek at Ourimbah	NSW Office of Water	1965	1989	No

Table 9 shows that only two of the stream gauges contain rating curves. The rating curve for gauge #211013 was developed from over 100 gaugings. This includes approximately 20 gaugings over 1 metre, six gaugings over 2 metres and 1 gauging over 5 metres. Accordingly, the rating curve and the associated discharge estimates are likely to be reliable although discharge estimates at very high stages (i.e., above 5.0 metres) will be prone to some uncertainty. Conversely, the rating curve for gauge #211015, was developed from less than 30 gaugings over a limited range of stages. Accordingly, the discharge estimates for gauge #211015 may be less reliable, particularly at high stages.

As shown in **Table 9**, most of the stream gauges in the Ourimbah Creek catchment have a relatively short length of record. Only gauge #211013 comprises more than 30 years of data. A review of the available stream gauge data indicates the largest flood at gauge #211013 occurred in February 1992 and generated a peak discharge of approximately 370 m^3/s.

3.3.3 Historic Flood Mark Data

Gosford City Council completed a survey of peak water elevations at several locations within the Ourimbah Creek catchment during the 2007 and 2011 floods. Wyong Shire Council also collected flood mark information following the 2007 flood. The flood marks are shown on **Figure 4**.

3.3.4 Flood Photographs

Wyong Shire Council and Gosford City Council also provided a range of flood photographs showing the extent of inundation across the Ourimbah Creek catchment during the 2007 and 2011 floods. The photos are reproduced in **Appendix A**.

It should be noted that the photos may not have been taken at the peak of the flood. Therefore, they may not reliably represent the maximum extent of inundation during each flood.

3.4 Survey Data

3.4.1 Light Detection and Ranging (LiDAR) Survey

LiDAR data across different sections of the Ourimbah Creek catchment was collected on the following dates:

- May 2005: Gosford City Council section of Ourimbah Creek catchment;
- January 2007: Wyong Shire Council section of Ourimbah Creek catchment located east of F3 Freeway;
- April 2011: Wyong Shire Council section of Ourimbah Creek catchment located west of F3 Freeway.

The extent of each LiDAR coverage is shown in **Figure 2**. The LiDAR data was subsequently combined to form a Digital Elevation Model (DEM) of the Ourimbah Creek catchment. The DEM is also shown in **Figure 2**.

The Wyong Shire Council LiDAR has a stated absolute horizontal accuracy of better than 0.3 metres and an absolute vertical accuracy of better than 0.3 metres. The Gosford City Council LiDAR has a stated absolute horizontal accuracy of better than 1.25 metres and an absolute vertical accuracy of better than 0.3 metres. According the absolute vertical accuracy of both LiDAR datasets is similar, although the Gosford Council LiDAR has a lower horizontal accuracy. Nevertheless, it is considered that the vertical and horizontal accuracy provided by the LiDAR data is suitable for use in this study.

It should be noted that the Wyong Council LiDAR data provides a complete, unfiltered dataset of all LiDAR strikes (including ground and non-ground points). This provides an average point spacing of 0.8 metres. However, the Gosford Council LiDAR comprises a filtered and thinned dataset which provides only ground elevation points at a regular spacing of 5 metres. Accordingly, the level of topographic detail provided by the Gosford Council LiDAR is considerably lower than the Wyong Council data and may limit the potential hydraulic model resolution across the Gosford City Council LGA.

The 2011 LiDAR was collect relatively recently, so should provide a reliable representation of contemporary topographic conditions. However, the 2005 and 2007 LiDAR was collected over 5 year ago, so would not reflect any topographic modifications that have been completed across the catchment since this time. Although major topographic modifications across the catchment during this time have generally been limited, some recent developments were identified that may impact of flood behaviour. This includes:

- Cut Rock Creek Detention Basin at Lisarow, which was constructed in 2009;

Accordingly work-as-executed survey information for the Cut Rock Detention basin was obtained and used to supplement the LiDAR information to ensure a reliable representation of contemporary conditions was provided.

LiDAR can provide a less reliable representation of the terrain in areas of high vegetation density as well as water bodies. This is associated with the laser ground strikes often being restricted by the vegetation canopy and not being able to penetrate water. Errors can also arise if non-ground elevation points (e.g., vegetation canopy) are not correctly removed from the raw LiDAR dataset. Therefore, additional checks were completed along the vegetated creek corridors to confirm if the terrain representation was reliable.

Plate 1 provides an example of the LiDAR point density along Chittaway Creek. It shows the point density is much higher across the non-vegetated sections of the floodplain relative to the creek channel. Accordingly, there are concerns that the point density along the creek corridors may be insufficient to reliably define the conveyance capacity of the main creek system.

Therefore, cross-sections were extracted along Chittaway Creek (where vegetation density is high) and Cut Rock Creek (where vegetation density is considerably lower) from the LiDAR-based DEM and these cross-sections were compared against surveyed creek cross-sections. This check aimed to determine if there were sufficient LiDAR data points along the creeks to reliably define the geometry of the creek channel. The cross-sections are presented in **Plates 2** and **3**.

Plate 2 shows that although the general shape of both cross-sections is similar, there are some noticeable differences, namely:

- The LiDAR cross-section does not reliably define the invert of the main channel. This is likely associated with the smaller number of ground strikes in the main channel as well as the presence of water within the creek at the time the LiDAR was captured.
- The surveyed cross-section provides only a simplified representation of the cross-section. The LiDAR provides a more detailed representation of the topography.

Accordingly, the LiDAR appears to provide a relatively poor representation of the creek geometry in areas of high vegetation density. However, it provides a more detailed representation of the variation in topography across the broader floodplain areas, where vegetation density is lower.

Although the LiDAR generally provides a poor topographic representation across highly vegetated areas, **Plate 3** shows that in areas of low vegetation density, the LiDAR provides a good reproduction of the surveyed cross-section. Accordingly, it should be possible to extract creek cross-sections from the LiDAR information in areas that aren't obstructed by vegetation or significant depths of water. However, it should be noted that the Gosford Council LiDAR data only provides elevation data points at a 5 metre spacing. Accordingly, this dataset won't be sufficiently detailed to extract creek cross-sections. That is, creek cross-sections can only be extracted across the Wyong Council LGA in areas of low vegetation density and water depths.

Further comparisons between creek cross-sections were also completed based on surveyed creek cross-sections from 1997 and 2011 along with a creek cross-section extracted from 2011 LiDAR (refer **Plate 4**).

The comparison provided in **Plate 4** shows a reasonably close agreement between the surveyed cross-sections despite the fact that they were surveyed fourteen years apart. The surveyed cross-sections indicate that some sediment may have been despotised during this fourteen year period leading to a slight increase in the channel invert elevation. But otherwise the surveyed cross-sections are very similar.

Plate 1 LiDAR data points along Chittaway Creek immediately upstream Chittaway Road showing reduced point density in areas of high vegetation density

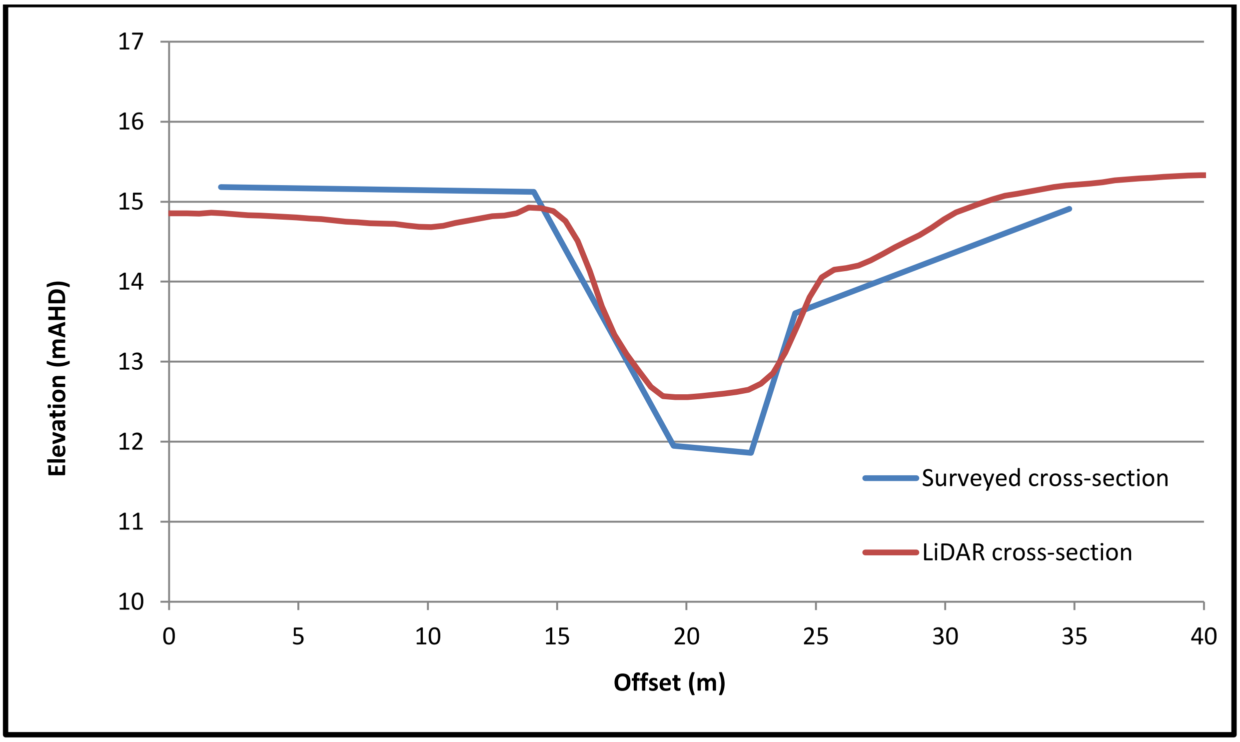


Plate 2 Comparison of LiDAR-based creek cross-sections with surveyed cross-sections extracted from "Ourimbah Campus Flooding Assessment for Proposed Car Park Facilities" (Parsons Brinckerhoff, 2008)

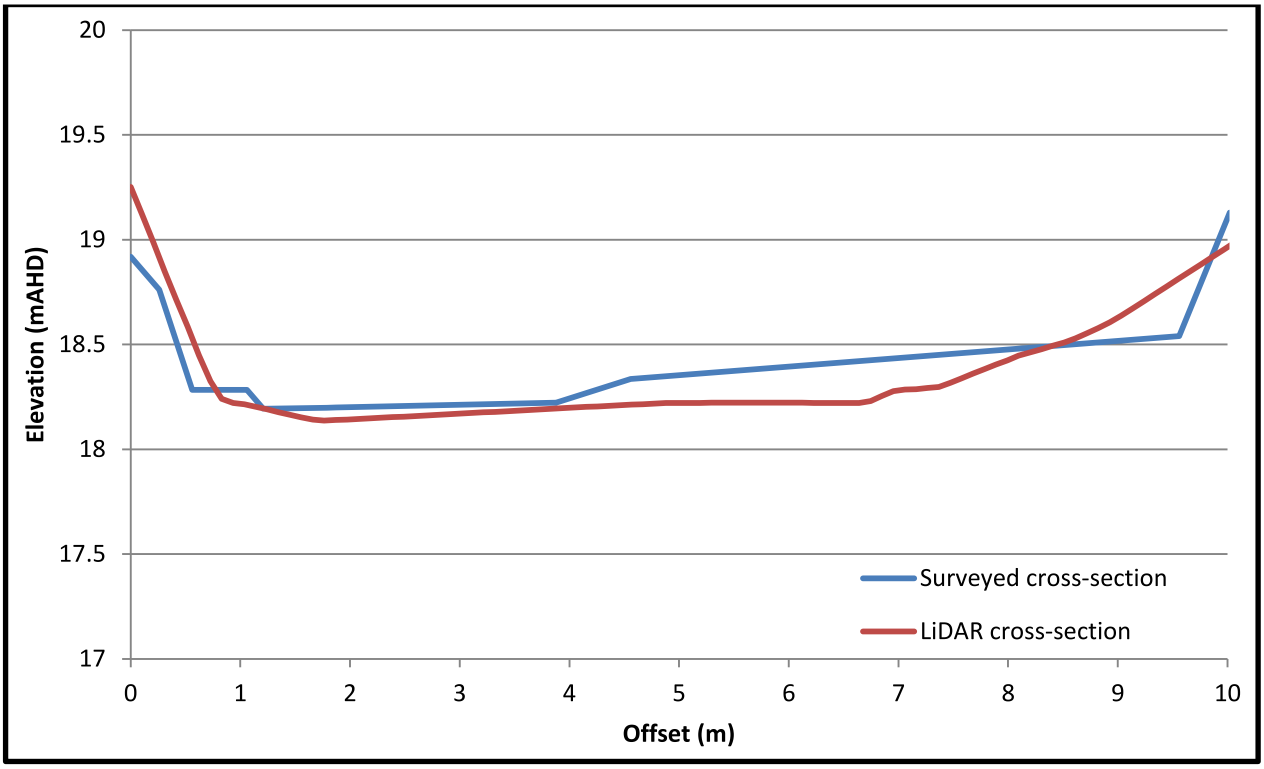


Plate 3 Comparison of LiDAR-based creek cross-sections with work-as-executed cross-sections extracted from "Cutrock Creek – Teralba Street to Pacific Highway: Proposed Creek Improvement Works" (Web McKeown & Associates, 1998) plans

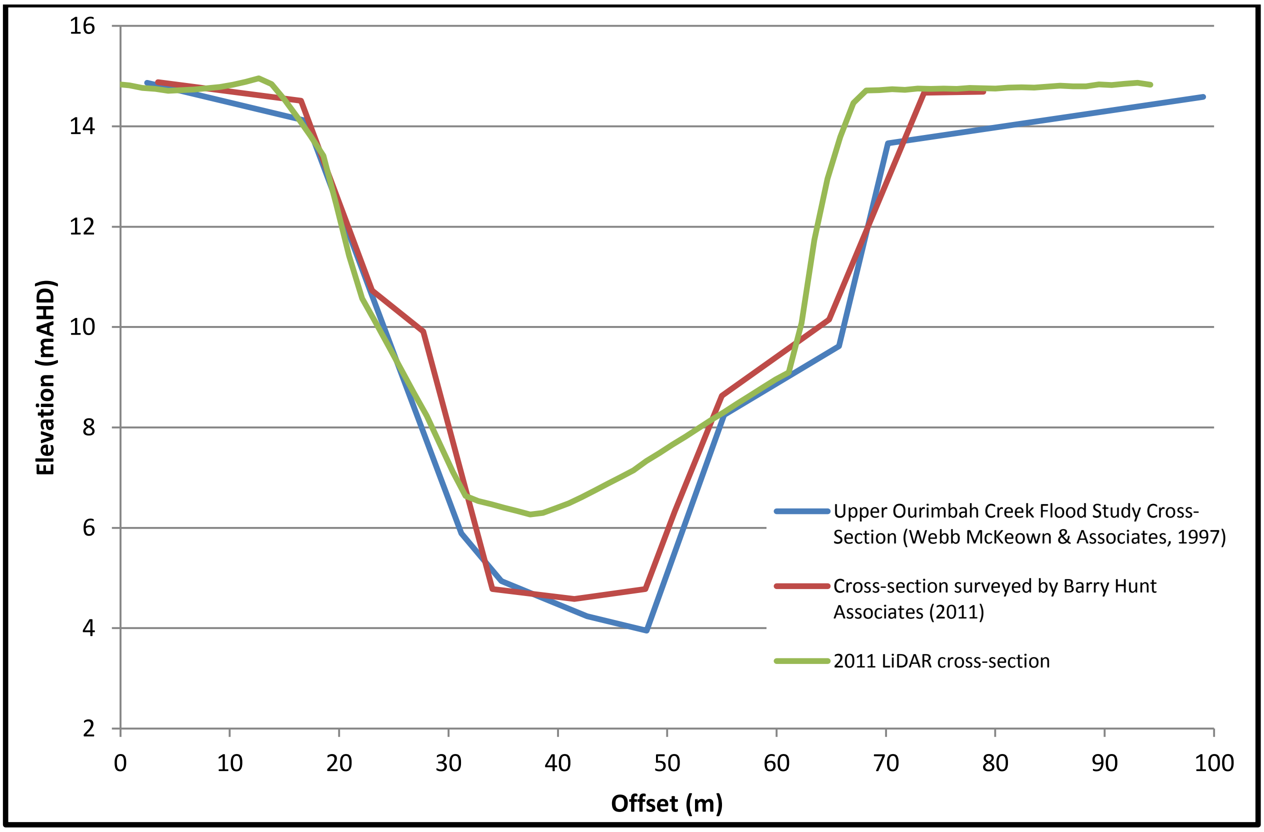


Plate 4 Comparison between 2011 LiDAR cross-section, 2011 surveyed cross-section and 1997 surveyed cross-section for Ourimbah Creek upstream of Pacific Highway

Plate 4 also shows that the LiDAR cross-section does not provide a reliable representation of the main creek channel relative to the surveyed cross-sections (although the creek banks and floodplain appears to be reasonably well reproduced). As shown in **Plate 5**, this section of Ourimbah Creek contains water as well as dense vegetation. This tends to confirm that the LiDAR provides a relatively poor representation of the creek channel in areas where water or dense vegetation is present.

Plate 5 Pacific Highway crossing of Pacific Highway showing water and vegetation in creek channel

It should be recognised that a large proportion of the creeks within the catchment are obscured by vegetation. It should also be recognised that the LiDAR data will not pick up the details of topographic and drainage features that are obscured from aerial survey techniques, such as culvert invert/obvert elevations. Accordingly, it was considered necessary to supplement the LiDAR data with additional survey to ensure a reliable representation of the conveyance capacity of the various watercourses and hydraulic structures was provided.

3.4.2 Structure Survey

Detailed survey of twenty three (23) bridges and culverts was completed by Consulting Surveyors, Barry Hunt Associates in June, July and August 2011. The location of the structures that were surveyed is shown in **Figure 3**.

The survey provides bridge and culvert dimensions, invert and obvert elevations, roadway/railway embankment elevations, bridge/culvert guardrail and handrail details as well as details of the creek geometry immediately upstream and downstream of the bridge/culvert.

It is considered that this information is sufficient to define these structures in the hydraulic model.

However, this information does not cover all structures within the catchment. Accordingly, it was necessary to collect additional structure survey to ensure the conveyance capacity of each structure was reliably defined (refer Section 3.8).

3.5 Engineering Plans

Several sets of engineering plans were provided by Wyong and Gosford Council that included work-as-executed survey information as well as information on drainage structures. This included:

- "Cut Rock Creek – Teralba to Pacific Highway: Proposed Creek Improvement Works" (Webb McKeown & Associates, 1998) – Provides work-as-executed cross-sections of Cut Rock Creek between Teralba Street and the Pacific Highway at Lisarow
- "Cut Rock Creek – Teralba Street, Lisarow: Proposed Timber Bridge Replacement & Road Approaches" (Webb McKeown & Associates, 1998) – Provides design drawings of the proposed replacement of a timber bridge with a triple cell box culvert at Teralba Street, Lisarow. Construction work for the replacement commenced in October 2012.
- Design Drawings for the Extension of Timber Drive to The Ridgeway at Lisarow (Bannister & Hunter Pty Ltd, 2011) – provides work-as-executed creek cross-sections for an unnamed tributary of Cut Rock Creek that drains beneath a newly constructed bridge that links Timber Drive to The Ridgeway at Lisarow.

3.6 GIS Data

A number of GIS data layers were also provided by Wyong Shire Council and Gosford City Council to assist with the study. This included:

- Aerial Photography – provides 2010 ortho-rectified aerial imagery at a 0.1 metre pixel size;
- Cadastre – provides property boundary polygons;
- Contours – 0.5 metre contours derived from LiDAR data covering the Wyong Shire Council section of the catchment and 2 metre and 10 metre contours covering the Gosford City Council section of the catchment;
- Vegetation – provides polygons representing the extent of major vegetation groupings across the catchment;
- Watercourses – GIS layer identifying major creek lines; and,
- Zoning – GIS layer showing extent of Local Environmental Plan zones.

3.7 Community Consultation

A key component of the flood study involves development and calibration of hydrologic and hydraulic computer models. Calibration involves using the computer models to replicate floods that have occurred in the past.

Although a significant amount of historic flood information could be sourced from the previous investigations, additional information on past flooding was sought from the community. Accordingly, several community consultation devices were developed to inform the community about the study and to obtain information from the community about their past flooding experiences. Further information on each of these consultation devices is provided below.

3.7.1 Flood Study Website

A flood study website was established for the duration of the study. The website address is: http://www.ourimbah.floodstudy.com.au/

The website was developed to provide the community with detailed information about the study and also provide a chance for the community to ask questions and complete an online questionnaire (this online questionnaire was identical to the questionnaire distributed to residents and business owners, as discussed below).

During the course of the study (up to April 2013), the website was visited 680 times by 515 unique visitors.

3.7.2 Community Information Brochure and Questionnaire

A community information brochure and questionnaire was prepared and distributed to approximately 3,500 households and businesses within the Ourimbah Creek catchment. A copy of the brochure and questionnaire is included in **Appendix A**.

The questionnaire sought information from the community regarding whether they had experienced flooding, the nature of flood behaviour, if roads and houses were inundated and whether residents could identify any historic flood marks. A total of 435 questionnaire responses were received. Approximately 17% of questionnaires were completed online via the website. A summary of all questionnaire responses is provided in **Appendix A**. The spatial distribution of questionnaire respondents is shown in **Figure A1**, which is also enclosed in **Appendix A**.

The following information was gleaned from the responses to the questionnaire:

- The majority of respondents have lived in or around the catchment for over 10 years. The average length of residence within the catchment was 20 years and the average length of residence in the general area was 24 years. Accordingly, most respondents experienced flooding in 2007 and 2011, however, were not living in the catchment during the 1992 flood (i.e., the largest flood on record).
- Nearly a quarter of respondents have experienced some form of disruption as a result of flooding in the catchment. Approximately 20% of respondents have experienced traffic disruption, 10% of respondents have had their back or front yard flooded, 3% of respondents have had their house or business inundated and 3% of respondents have had the sewer or water to their property cut-off as a result of flooding. The spatial distribution of respondents that have reported past flooding problems at their property is shown in **Figure A1** (refer red dots).
- The responses to the questionnaire indicate that flooding can occur as a result of creeks overtopping their banks was well as from overland flows when the stormwater system capacity is exceeded. However, the majority of respondents identified main stream flooding from major creeks in conjunction with elevated water levels in Tuggerah Lake as the major source of flooding.
- A number respondents consider that flooding is exacerbated by lack of routine maintenance along heavily vegetated creeks, increased development in the catchment, build-up of debris (e.g., tree branches) on bridges/culverts, insufficient stormwater system capacity, excessive siltation in Tuggerah Lake and elevated water levels in Tuggerah Lake resulting from the lack

of a sufficiently sized opening at The Entrance. Tuggerah Lake and the associated entrance conditions were the most readily identified cause of excessive flooding by respondents.

A number of respondents provided photos of past flood events. The majority of respondents provided photos of the 2007 flood as well as two separate floods that occurred in June and December 2011. A selection of these photographs is provided in **Appendix A**.

3.8 Additional Data Collection

3.8.1 Cross-Section and Structure Survey

To enable development of a hydraulic model capable of providing reliable estimates of flood behaviour within the study area it was necessary to collect additional survey across the Ourimbah Creek catchment. Consulting surveyors, Lawrence Group, collected the additional survey information.

The additional data collection comprised the survey of 7 creek cross-sections and 38 hydraulic structures (i.e., culverts and bridges). Additional cross-sections were also surveyed upstream and downstream of each structure. The location of cross-sections and structures that were surveyed is shown in **Figure 6**.

4 HYDROLOGIC MODEL

4.1 General

The most common method of quantifying flood flows (*i.e., discharges*) at a particular location in a catchment is via a hydrologic computer model. A hydrologic model is a mathematical representation of the various processes that transform rainfall into runoff. The model is developed so that it incorporates key hydrologic characteristics of the catchment such as area, slope and roughness. The model can then be used to simulate the transformation of rainfall into runoff for either historic or statistically derived (i.e., design) rainfall.

The XP-RAFTS software was used to develop a hydrologic computer model of the Ourimbah Creek catchment. XP-RAFTS is a lumped hydrologic software product that is developed by XP Software (XP Software, 2009) and is used extensively across Australia for deriving discharge estimates. The following sections provide a summary of how the model was developed, the adopted input parameters and the outcomes of the model calibration and verification.

4.2 Hydrologic Model Development

4.2.1 Subcatchment Parameterisation

The Ourimbah Creek catchment was subdivided into 426 subcatchments based on the alignment of major flow paths and topographic divides. The subcatchments were delineated with the assistance of the CatchmentSIM software (Catchment Simulation Solutions, 2011) using a 5 metre Digital Elevation Model (DEM). The subcatchment layout is presented in **Figure 7**.

The eastern sections of the Ourimbah Creek catchment include significant urban areas that are relatively impervious. Urbanisation effectively separates the catchment into two hydrologic systems, i.e.,:

- rapid rainfall response and low infiltration potential across impervious areas; and,
- slower rainfall response and high infiltration potential across pervious areas.

In recognition of the differing characteristics of the two hydrologic systems, each XP-RAFTS subcatchment was subdivided into two sub-areas. The first sub-area was used to represent the pervious sections of the subcatchment and the second sub-area was used to represent the impervious sections of the subcatchment. The division of each subcatchment into pervious and impervious sub-areas allows different rainfall losses and roughness coefficients to be specified, thereby providing a more realistic representation of rainfall-runoff processes from the two different hydrologic systems.

Key hydrologic properties including area and average vectored slope were calculated automatically for each subcatchment using CatchmentSIM. The adopted subcatchment slopes and areas are provided in **Appendix B**.

The catchment was also subdivided into different land use types based on 2010 aerial imagery. Percentage impervious and Manning's 'n' values were assigned to each land use and are summarised in **Table 10**. The percentage impervious and Manning's 'n' values were subsequently used to calculate weighted average percentage impervious and 'n' values for each subcatchment. The adopted pervious and impervious areas and weighted 'n' values are provided in **Appendix B**. A summary of key hydrologic statistics for each of the major subcatchments within the Ourimbah Creek catchment is also provided in **Table 11**.

Table 10 Adopted Impervious Percentage and Manning's 'n' Values for Hydrologic Model

Land Use Description	Manning's 'n'	Impervious (%)
Concrete	0.015	100
Roads	0.016	85
Industrial & Commercial Areas (excluding roadways and buildings)	0.020	90
Car Parks	0.022	100
Buildings	0.025	100
Residential Areas (excluding roadways and buildings)	0.030	30
Water bodies (e.g., dams)	0.030	100
Short Grass	0.030	2
Streams with Sandy Bed	0.035	100
Railway Corridor	0.045	50
Grass with Sparse Trees	0.050	5
Grass with Medium Trees	0.075	2
State Forest / Dense Trees	0.100	2

Table 11 Subcatchment Parameters for Major Ourimbah Creek Subcatchments

Subcatchment	Area		Impervious (%)	Main Stream Length (km)	Main Stream Slope (%)
	km^2	%#			
Bangalow Creek*	26.9	17	14.4	14.6	0.32
Canada Drop Down Creek	22.1	14	2.8	12.6	0.67
Chittaway Creek	5.92	3.7	8.68	7.1	0.38
Cut Rock Creek	9.94	6.2	17.8	6.9	0.57
Dog Trap Gully	4.97	3.1	11.0	6.4	1.38
Kangy Angy Creek	4.12	2.6	8.0	4.8	1.27
Ourimbah Creek	160	100	7.5	46	0.20

NOTE: *. The Bangalow Creek subcatchment includes the Cut Rock Creek and Dog Trap Gully subcatchments
#: refers to the percentage of the overall Ourimbah Creek catchment area covered by this particular subcatchment

4.2.2 Stream Routing

In addition to local subcatchment runoff, most subcatchments will also carry flow from upstream catchments along the main watercourses. The flow along the watercourses in XP-RAFTS is represented using a "link" between successive subcatchment "nodes".

"Routing" type links were used to represent the routing of runoff along the main watercourses into downstream subcatchments. The routing links employ Muskingum-Cunge routing procedures and require a representative cross-section, slope, length and Manning's 'n' values to be defined for each channel reach. Cross-sections were extracted from the available ALS data and main stream slopes and lengths were calculated automatically by CatchmentSIM. Manning's 'n' values for the main channel and overbank areas were defined by hand based on inspection of aerial photography in conjunction with the Manning's 'n' values listed in **Table 11**.

In addition to the "routing" links, a diversion link was included in the model to represent the potential for water to discharge from Ourimbah Creek along the Bangalow Creek "flood runner" during large floods. Manning's calculations determined that water will start to spill out of Ourimbah Creek and into the flood runner once the discharge reaches 265 m^3/s. Once the discharge exceeds this threshold, approximately 60% of the excess flow is predicted to be conveyed along Ourimbah Creek and the residual flow would be conveyed along the flood runner.

4.2.3 Rainfall Loss Model

During a typically rainfall event, not all of the rain falling on a catchment is converted to runoff. Some of the rainfall may be intercepted and stored by vegetation, some may be stored in small depressions and some may infiltrate into the underlying soils.

To account for rainfall "losses" of this nature, the hydrologic model incorporates a rainfall loss model. For this study, the "Initial-Continuing" loss model was adopted, which is recommended in *"Australian Rainfall and Runoff – A Guide to Flood Estimation"* (Engineers Australia, 1987) for eastern NSW.

This loss model assumes that a specified amount of rainfall is lost during the initial saturation/wetting of the catchment (referred to as the 'Initial Loss'). Further losses are applied at a constant rate to simulate infiltration/interception once the catchment is saturated (referred to as the 'Continuing Loss Rate'). The initial and continuing losses are deducted from the total rainfall over the catchment, leaving the residual rainfall to be distributed across the catchment as runoff.

Initial and continuing losses were applied based on standard design values documented in *"Australian Rainfall and Runoff – A Guide to Flood Estimation"* (Engineers Australia, 1987). The losses were then refined as part of the model calibration process, which is discussed in Section 4.3.

4.2.4 Flood Storage Basins

The Ourimbah Creek catchment incorporates one formal flood detention basin along Cut Rock Creek (located immediately north of McDonalds Road) that was constructed in 2009. This basin is designed to attenuate downstream flows during significant storm events by temporarily storing runoff from the upstream catchment. Due to the potential for the basin to impact on downstream flows, it was incorporated as a flood storage basin in the XP-RAFTS model.

The representation of flood storage basins in XP-RAFTS requires the outflow and storage characteristics of the basin to be defined. The outflow characteristics were specified using a stage-discharge relationship and the storage characteristics were defined using a stage-storage relationship. The stage-storage relationship was developed based upon work-as-executed survey for the basin.

The basin outlet comprises 2 separate box culverts as well as a weir to cater for high flows. The stage-discharge relationship for this outlet configuration was developed with the assistance of the HY-8 software (version 7.2), which automates the hydraulic calculations for pipes, culverts and weirs in accordance with 'Hydraulic Design Series Number 5 – Hydraulic Design of Highway Culverts' (U.S. Federal Highway Administration, 2005). The stage-storage and stage-discharge relationship that was developed for the Cut Rock Creek basin are provided in **Figure B1**, which is enclosed in **Appendix B**.

4.3 Hydrologic Model Calibration

4.3.1 General

Hydrologic computer models are developed using parameters that are not known with a high degree of certainty and/or are subject to natural variability. This includes imperious proportions, rainfall losses and catchment roughness. Accordingly, the model should be calibrated using rainfall and stream flow data from historic flood events to ensure the adopted parameters are producing reliable estimates of rainfall-runoff behaviour. Calibration is typically completed by routing recorded rainfall through the hydrologic model. Simulated discharge hydrographs are extracted from the model results at locations where recorded stream flow records are available. Calibration is completed by adjusting model parameters to achieve the best match possible between recorded and model-generated hydrographs.

4.3.2 Calibration Events

Available Rainfall Data

Continuous rainfall data are required to define the temporal (i.e., time-varying) distribution of rainfall in the hydrologic computer model for the nominated calibration / verification event. There are several continuous rainfall gauges located within or adjacent to the Ourimbah Creek catchment. Data for one continuous gauge dates back to 1981, however, the majority of the continuous gauges came into service between 1988 and 1990.

There are also several daily read rainfall gauges located in close proximity to the catchment. The daily read rainfall records can be used to provide an indication of the spatial variation in rainfall during any historic event. At least seven daily read gauges have been in operation since 1990 in close proximity to the catchment. When this daily data is combined with the continuous gauge data, there is sufficient information to describe the spatial and temporal variation in rainfall during any significant rainfall event that has occurred since 1990.

Available Stream Flow Data

Recorded stream flow records are required to perform a meaningful hydrologic model calibration. Recorded stream flow data are generally obtained using gauges that record the time variation in stream water height in conjunction with a suitable rating curve to convert the stream heights to an equivalent discharge. Although four stream height gauges are located within catchment, only two have rating curves. Of the two gauges with rating curves, one gauge has records dating back to 1976 and has a good rating curve available. The other gauge only dates back to 2003 and has more limited rating data. Accordingly, this gauge may provide less reliable flow estimates, particularly at high stages.

Therefore, there are historic stream flow data available for floods dating back to 1976. An additional stream gauge was installed in 2003, however, the flow estimates may be less reliable during large floods.

Adopted Events

The following criteria were employed to select events suitable for the purpose of model calibration and verification:

- A minimum of three significant flood events;
- Floods after 1990 preferred as it provides the most complete stream flow and rainfall information;
- Events where flood marks are available are preferred so the same events can be used for both hydrologic and hydraulic model calibration.

Based on these criteria, the following events were selected for model calibration and verification:

- February 1992;
- June 2007; and,
- June 2011.

The February 1990 flood was also considered. However, it was not selected as the only recorded flow hydrograph for the event was incomplete.

4.3.3 Results of Calibration and Verification Simulations

February 1992 Simulation

Rainfall pluviographs for the February 1992 event are provided in **Figure C1**, which is enclosed in **Appendix C**. A review of the rainfall records indicates that approximately 350 mm of rain fell over a 2 day period between the 8th and 10th of February 1992. It is the largest event on record at the "Ourimbah Creek Upstream of Weir" stream gauge (Gauge #211013), where it produced a peak discharge of approximately 370 m^3/s early on 10th February, 1992. Key hydrologic statistics for the February 1992 flood are provided in **Table 12** and Intensity-Duration curves for the 1992 event are provided in **Figure C4** in **Appendix C**.

Accumulated daily rainfall totals for each rainfall gauge that was operational during the 1992 event are provided in **Figure 8**. The accumulated daily rainfall totals were also used to develop a rainfall isohyet map for the 1992 event, which is also included on **Figure 8**.

The isohyet map indicates that there was significant spatial variation in rainfall across the catchment during the 1992 event. Accordingly, the isohyet maps were used to calculate average rainfall depths for each subcatchment. The average rainfall depths were applied to each XP-RAFTS subcatchment. That is, unique rainfall depths were applied to each subcatchment to ensure the historic spatial distribution of rainfall was represented in the XP-RAFTS model.

Table 12 Hydrologic Statistics for Calibration and Verification Events

Event	Accumulated Average Rainfall Depth (mm)	Accumulated Runoff Depth (mm)#		Approximate Flood Lag (hours) ^		Approximate AEP*
		#211013	#211015	#211013	#211015	
February 1992	369	157	NA	2.5	NA	2%->1%
June 2007	327	178	380	4.25	5.6	~5%
June 2011	130	88	279	9.8	10.1	~50%

NOTE: #: Runoff depth was calculated as the area under the discharge hydrograph at each gauge location divided by the catchment area draining to the same gauge location
^ Flood lag was calculated as the difference in time between the peak rainfall intensity and peak discharge at each gauge location
* AEP is approximate and is based on consideration of continuous rainfall data only. It does not reflect the influence of other factors that can impact on AEP such as antecedent moisture conditions (refer to **Figure C4** for IFD curves)

The temporal distribution of rainfall that was applied to each subcatchment was defined based on Thiessan polygons. That is, the closest continuous rainfall gauge to the centroid of each subcatchment was used to describe the temporal distribution of rainfall applied to that subcatchment.

A review of the daily read rainfall records indicates the 1992 event was preceded by between 10 and 20 mm of rainfall. Therefore, the catchment would have been wet at the start of the main storm event. Accordingly, an initial loss at the lower end of the suggested "Australian Rainfall and Runoff" range was applied to pervious areas for the 1992 event. A summary of the adopted initial losses is provided in **Table 13**.

Table 13 Adopted XP-RAFTS Parameters for Calibration and Verification Simulations

Event	Rainfall Losses				Bx
	Pervious Initial Loss *(mm)*	Pervious Continuing Loss *(mm/hr)*	Impervious Initial Loss *(mm)*	Impervious Continuing Loss *(mm/hr)*	
February 1992	10	4.5	1	0	1.00
June 2007	10	4.0	1	0	1.05
June 2011	15	4.0	1	0	1.05

The continuing loss rates were modified to replicate the recorded volume of runoff (i.e., the area under the hydrograph). The XP-RAFT storage coefficient (i.e., Bx) was adjusted to replicate the shape of the hydrograph, the timing of the peak discharge and magnitude of the peak discharge. A summary of the adopted input parameters are provided in **Table 12**. It should be noted that the Cut Rock Creek Basin was excluded from the 1992 simulation as construction of the basin was not completed until 2009.

The simulated discharge hydrograph at Gauge #211013 is provided in **Figure 9**. The recorded hydrograph is superimposed for comparison. **Table 14** provides a comparison between the simulated and recorded peak discharge and the relative timings of the peak discharges. A summary of peak discharges that were generated by the XP-RAFTS model at the downstream end of each subcatchment for the 1992 simulation is also provided in **Appendix C**.

Table 14 Summary of XP-RAFTS Model Calibration to 1992 Event

Gauge #	Peak Discharge (m^3/s)		Timing of Peak	
	Recorded	Simulated	Recorded	Simulated
211013	372	374	10/2/1992 3:27am	10/2/1992 2:54

Figure 9 indicates that the simulated hydrograph generally provides a good reproduction of the recorded hydrograph at Gauge #211013. The magnitude of the peak discharge as well as the timing of the peak discharge is well replicated by the XP-RAFTS model.

June 2007 Simulation

The June 2007 storm event was associated with an East Coast Low that formed off the coast of NSW, just north of Newcastle. The storm produced strong winds, elevated ocean levels and sustained heavy rainfall and caused widespread damage across the Central Coast and Hunter regions (Bureau of Meteorology, 2007).

Rainfall pluviographs for the June 2007 event are provided in **Figure C2**, which is enclosed in **Appendix C**. A review of the rainfall records indicates that over 300 mm of rain fell over a 3 day period between the 8th and 10th of June 2007 (refer **Plate 6**). Although the overall rainfall depth during the 2007 event was only slightly lower than the 1992 event, the rainfall occurred over a period of 3 days instead of just 2 days. As a result, the 2007 event only produced a peak discharge of approximately 170 m^3/s at the "Ourimbah Creek Upstream of Weir" stream gauge (Gauge #211013). Key hydrologic statistics for the June 2007 flood are provided in **Table 12** and Intensity-Duration curves for the 2007 event are provided in **Figure C4**.

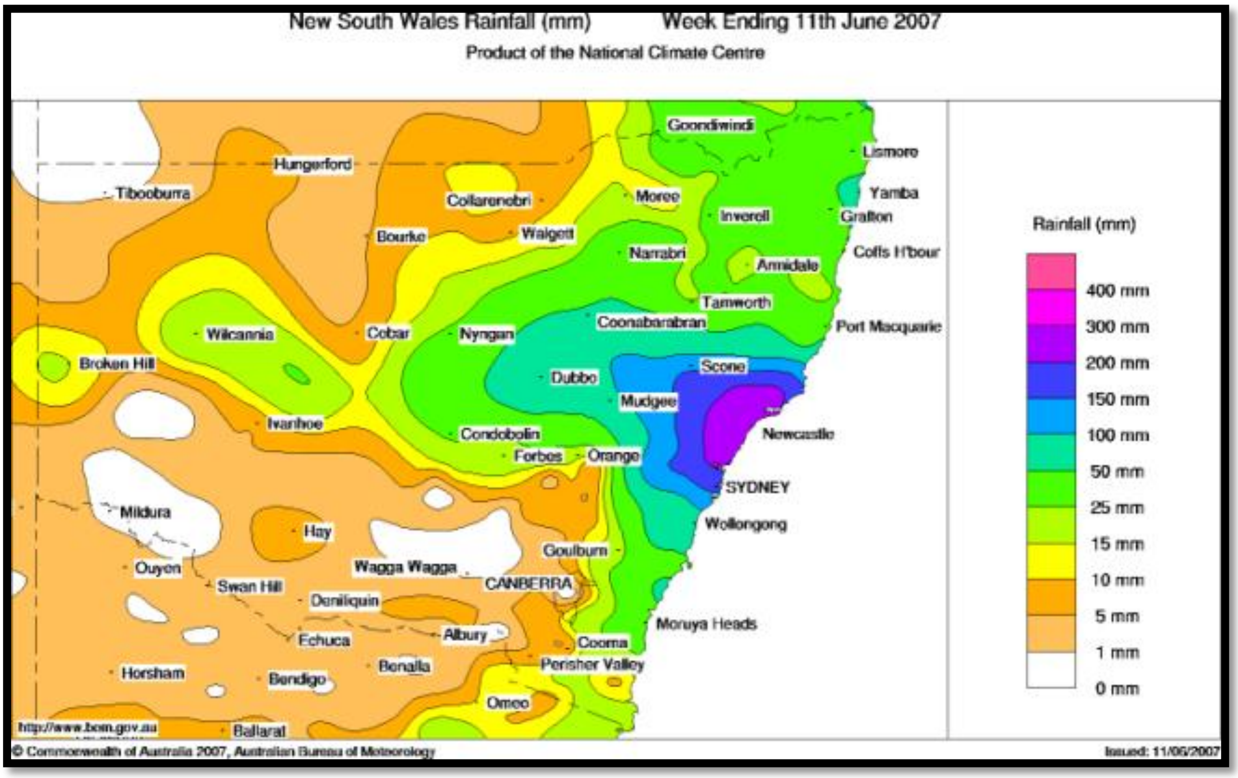


Plate 6 Accumulated rainfall depths across NSW for the June 2007 storm (Bureau of Meteorology, 2007)

Accumulated daily rainfall totals for the 2007 event for each rainfall gauge are provided in **Figure 10**. The accumulated daily rainfall totals were used to develop a detailed rainfall isohyet map, which is also included on **Figure 10**.

The isohyet map indicates that there was over 150 mm variation in rainfall across the catchment between the 7th and 10th June 2007. Accordingly, the isohyet maps were used to calculate average rainfall depths for each subcatchment. The average rainfall depths were applied to each XP-RAFTS subcatchment. That is, unique rainfall depths were applied to each subcatchment to ensure the historic spatial distribution of rainfall was represented in the XP-RAFTS model. The closest continuous rainfall gauge to the centroid of each subcatchment was used to describe the temporal distribution of rainfall applied to each subcatchment.

A review of the daily read rainfall records indicates the 2007 event was preceded by around 30 mm of rainfall. Therefore, the catchment would have been relatively "wet" at the start of the main storm event. Accordingly, an initial loss at the lower end of the suggested "Australian Rainfall and Runoff" range was applied to pervious areas for the 2007 event. A summary of the adopted initial losses is provided in **Table 13**.

The same XP-RAFTS input parameters that were adopted for the 1992 simulation were generally retained for the 2007 simulation. However, the following modifications were completed to the 1992 XP-RAFTS model to ensure a reliable representation of 2007 conditions was provided:

- The XP-RAFTS storage factor (Bx) was increased by 5% to reflect the potential for increased vegetation density between 1992 and 2007; and,
- The continuing loss rates were reduced to ensure the recorded volume of runoff was replicated.

A comparison between simulated and recorded discharge hydrograph at Gauge #211013 and Gauge #211015 is provided in **Figure 11** and **Figure 12** respectively. **Table 15** also provides a comparison between the simulated and recorded peak discharges and timings of the peak discharges. A summary of peak discharges generated by the XP-RAFTS model for each subcatchment is also provided in **Appendix C**.

Table 15 Summary of XP-RAFTS Model Verification to 2007 Event

Gauge #	Peak Discharge (m^3/s)		Timing of Peak	
	Recorded	Simulated	Recorded	Simulated
211013	166	167	9/6/2007 7:30am	9/6/2007 7:36am
211015	347	306	9/6/2007 8:45am	9/6/2007 9:00am

Figure 11 shows that the recorded 2007 hydrograph at Gauge #211013 comprises three peaks. All three peaks are also reproduced by the simulated hydrograph, although the timing of the second peak is not particularly well reproduced by the XP-RAFTS model. Nevertheless, the magnitude and the timing of the main peak is well replicated by the XP-RAFTS model.

Figure 12 shows that the XP-RAFTS model provided a poor reproduction of the recorded hydrograph at Gauge #211015. Further inspection on the rainfall depths and runoff depths provided in **Table 12**, indicates the runoff volume at Gauge #211015 actually exceeds the rainfall volume. As this is unlikely to be correct, it may indicate that water levels and therefore, discharge estimates, may be influenced by elevated downstream water levels (e.g., from Tuggerah Lake). As discussed in Section 3.3.2, the rating curve for Gauge #211015 may not be reliable at high stages. Accordingly, it is considered that it would be difficult and unproductive to reproduce the recorded hydrograph at this gauge. Nevertheless, it can be used to evaluate the timing of the main peak discharge, which is well replicated by the XP-RAFTS model.

June 2011 Simulation

The most recent significant storm occurred in June 2011. Rainfall pluviographs for the June 2011 event are provided in **Figure C3**, which is enclosed in **Appendix C**. The rainfall records indicate that approximately 130 mm of rain fell over a 2 day period between the 11th and 13th of June 2011. Accordingly, the 2011 event comprised a significantly lower rainfall relative to the 1992 and 2007 events and only produced a peak discharge of approximately 50 m^3/s at the "Ourimbah Creek Upstream of Weir" stream gauge (Gauge #211013). Key hydrologic statistics for the June 2011 flood are provided in **Table 12** and Intensity-Duration curves for the 2011 event are provided in **Figure C4**.

Accumulated daily rainfall totals for the 2011 event for each rainfall gauge are provided in **Figure 13**. The accumulated daily rainfall totals were also used to develop a rainfall isohyet map, which is also included on **Figure 13**.

The isohyet map indicates that there was a significant spatial variation in rainfall during the 2011 flood. Accordingly, the isohyet maps were used to calculate average rainfall depths for each subcatchment. The average rainfall depths were applied to each XP-RAFTS subcatchment to ensure a reliable spatial representation of the variation in rainfall was provided. The closest continuous rainfall gauge to the centroid of each subcatchment was used to describe the temporal distribution of rainfall applied to each subcatchment.

A review of the daily read rainfall records indicates the 2011 event was preceded by approximately 10mm of rainfall. Therefore, it is unlikely that the catchment would not have been completely saturated at the start of the main storm event. Accordingly, an initial loss in the middle of the suggested "Australian Rainfall and Runoff" range was applied to pervious areas for the 2011 event. A summary of the adopted initial losses is provided in **Table 13**.

The same XP-RAFTS input parameters that were adopted for the 2007 simulation were generally retained for the 2011 simulation. However, the following modifications were completed to the 2007 XP-RAFTS model to ensure a reliable representation of 2011 conditions was provided:

- The Cut Rock Creek detention basin was included within the XP-RAFTS model as construction of the basin was completed in 2009.

A comparison between simulated and recorded discharge hydrograph at Gauge #211013 and Gauge #211015 is provided in **Figure 14** and **Figure 15** respectively. **Table 16** also provides a comparison between the simulated and recorded peak discharges and timings of the peak discharges. A summary of peak discharges for each the XP-RAFTS model subcatchment for the 2011 event is also provided in **Appendix C**.

Figure 14 shows that the simulated 2011 hydrograph at Gauge #211013 provides a reasonable reproduction of the recorded hydrograph. The timing of the second peak is also replicated well by the XP-RAFTS model.

Figure 15 shows that the XP-RAFTS model provided a poor reproduction of the recorded hydrograph at Gauge #211015. As with the 2007 event, the rainfall and runoff depths listed in **Table 12** for this gauge indicates the runoff volume at Gauge #211015 exceeds the rainfall volume. Accordingly, it is unlikely that the recorded hydrograph can be reproduced by the XP-RAFTS model. Nevertheless, the XP-RAFTS model appears to provide a reasonable reproduction of the timing of the peak discharge.

Table 16 Summary of XP-RAFTS Model Verification to 2011 Event

Gauge #	Peak Discharge (m^3/s)		Timing of Peak	
	Recorded	Simulated	Recorded	Simulated
211013	52	58	13/6/2007 1:30am	13/6/2007 1:42am
211015	110	339	12/6/2007 23:48pm	13/6/2007 12:15am

4.3.4 Summary

The previous sections have presented the outcomes of the XP-RAFTS model calibration. In general, the XP-RAFTS model provides a good reproduction of recorded hydrographs at Gauge #211013 for the 1992, 2007 and 2011 floods. The reproduction of recorded hydrographs at Gauge #211015 for the 2007 and 2011 floods is not as reliable. However, it is considered that this may be associated with unreliable recorded stages and rating curve for this gauge.

It is noted that the continuing loss rates adopted for each of the historic simulations are higher than standard 'design' values listed in *"Australian Rainfall and Runoff – A Guide to Flood Estimation"*. However, the continuing loss rates are similar to median recorded loss rates for the Hunter River catchment (located approximately 40 km north of the Ourimbah Creek catchment), which are also listed in *"Australian Rainfall and Runoff"*. Accordingly, it is considered that the adopted loss rates are reasonable and the XP-RAFTS model provides a reliable description of rainfall-runoff behaviour across the Ourimbah Creek catchment.

5 Hydraulic Model

5.1 General

Hydraulic computer models are the preferred method of simulating flood behaviour through a particular area of interest. They can be used to predict flood characteristics such as peak flood level and flow velocity and the results of the modelling can also be used to define the variation in flood hazard and hydraulic categories across the study area.

The TUFLOW software was used to develop a hydraulic computer model of the Ourimbah Creek catchment. TUFLOW is a fully dynamic, 1D/2D finite difference model developed by BMT WBM (BMT WBM, 2012). It is used extensively across Australia to assist in defining flood behaviour.

The following sections describe the model development process as well as the outcomes of the model calibration and verification.

5.2 Hydraulic Model Development

5.2.1 Model Extent

A linked 1-dimensional/2-dimensional hydraulic model of the creek, floodplain and overland flow system was developed for the Ourimbah Creek catchment using the TUFLOW software. The model extends across 65.8km^2 of the Ourimbah Creek catchment downstream to Tuggerah Lake. The extent of the hydraulic model is shown in **Figure 16**.

The TUFLOW software uses a uniform grid to define the spatial variation in topography and hydraulic properties (e.g., Manning's 'n') across the 2D model domain. As shown in **Figure 16**, a multi-domain model was developed for the study. A 4 metre grid size was adopted for the urbanised areas to the east of the F3 Freeway where manmade flow obstructions (e.g., roadway embankments, buildings) are more prevalent. A less detailed 8 metre grid size was adopted across the rural areas to the west of the F3 Freeway. The adoption of a variable grid geometry helps to ensure that the model resolution and associated terrain representation is cognisant of the spatial variation in development and topography across the entire model area, while ensuring simulation times are kept to a reasonable level.

A dynamically linked 1-dimensional (1D) network was embedded within the 2D domain to represent areas that would not be well represented by the 4 metre/8metre grid (e.g., narrow creek channels). The hydraulic structures (e.g., bridge/culvert crossings at roads and railway lines) were also represented as a separate 1D domain. The extent of the 1D (i.e., channels, culverts and bridges) and 2D model domains are shown in **Figure 16**.

5.2.2 Model Topography

Elevations were assigned to grid cells within the 2D domain based on the Digital Elevation Model derived from 2005, 2007 and 2011 LiDAR data. As the LiDAR data was collected in 2005, 2007 and 2011, the terrain representation in TUFLOW is representative of topographic conditions at that time. That is, any topographic modifications completed since 2011 will not be reflected in the model.

The 2011 LiDAR should provide a reliable representation of contemporary topographic conditions since it was collected relatively recently. However, the 2005 and 2007 LiDAR was collected over 5 years ago, so would not reflect any topographic modifications that have been completed across the catchment in this time. Therefore, the DEM was also updated to include the Cut Rock Creek Detention Basin at Lisarow, which was constructed in 2009.

The elevations assigned to grid cells located within building footprints were elevated by 0.3 metres based on the assumption that the floor level of houses will typically be elevated above the natural ground surface.

The details of hydraulic structures and creek cross-sections within the 1D domain were defined based on information contained in previous flood studies, work-as-executed survey plans, previous ground survey as well as additional survey completed by Lawrence Group specifically for this study.

5.2.3 Material Types / Manning's 'n' Roughness

The TUFLOW software employs material polygons to define the variation in hydraulic roughness (i.e., Manning's 'n' values) across the study area. Aerial photography was used as a basis for subdividing the catchment into different material types. Different Manning's 'n' values were assigned to each material type to define the resistance to flow afforded by the different material types. The spatial distribution of the different material types is shown in **Figure 16**.

1D cross-sections, pipes and culverts within the 1D domain of the TUFLOW model also require the specification of Manning's 'n' values. These values were defined based on field assessments and inspection of high resolution aerial photography of the creek channels.

The adopted materials types and the corresponding Manning's 'n' values are provided in **Table 17**.

5.2.4 Culverts/Bridges

Culverts and bridges can have a significant influence on flood behaviour. For circular or rectangular culverts, the physical dimensions and invert elevations of the structures were included directly in the TUFLOW model. Entry and exit loss coefficients were defined based on default values provided in the TUFLOW Manual (BMT WBM, 2012). Typically, an entry loss coefficient of 0.5 and an exit loss coefficient 1.0 were adopted for all culverts.

The Ourimbah Creek catchment also includes three irregular shaped arch culvert crossings (refer **Plate 7**). The irregular shape of the crossings was defined using a flow height versus flow width relationship. An entry loss coefficient of 0.5 and an exit loss coefficient of 1.0 were also adopted for irregular culverts.

The catchment also includes a number of bridge crossings. The available waterway area beneath the bridge deck was specified using a surveyed cross-section. Energy losses were defined using a height versus loss coefficient relationship that was developed based on procedures outlined in *"Hydraulics of Bridge Waterways"* (Bradley, 1978).

Table 17 TUFLOW Manning's 'n' Roughness Values

Material Description	Manning's 'n'
Grass	0.035
Grass with isolated trees	0.040
Grass with sparse trees	0.060
Grass with medium density trees	0.080
Dense tree coverage	0.120
Concrete surfaces	0.015
Car Park (with parked cars) Depth < 0.3m - water in contact with vehicle tyres only, Depth > 0.3m - water in contact with vehicle bodies	Depth < 0.3m = 0.08 Depth > 0.3m = 0.50
Roadways	0.020
Waterbodies (e.g., Dams)	0.040
Railway corridor	0.060
Buildings	3.0
Creek channels	0.030-0.080
Concrete pipes/culverts	0.015

Plate 7 Arch culvert draining water beneath Ourimbah Creek Road

The location of bridges and culverts included within the TUFLOW model is shown in **Figure 16**.

5.2.5 Water Storages

The Ourimbah Creek catchment includes a number of farm dams, water bodies and remnant creek channels that have the potential to store water and attenuate flows during floods. To ensure the hydraulic model provided a conservative estimate of flood behaviour across the catchment, it was assumed that all water storages were full at the start of each simulated flood.

5.2.6 Bridge/Culvert Blockage

During a typical flood, sediment, vegetation and urban debris (e.g., shopping trolleys, fences) from the catchment can become mobilised leading to blockage of downstream culverts and bridges (refer **Plate 8**). Consequently, bridges and culverts will not operate at full efficiency during most floods. This can increase the severity of flooding across areas located adjacent to these structures.

Plate 8 View showing build-up of debris on upstream side of culvert

In recognition of this, blockage factors were applied to all bridges and culverts. The blockage factors were applied based on findings documented by Rigby et al (2002) following the 1998 Wollongong floods. This paper notes that bridges/culverts with a diagonal dimension greater than 6 metres showed minimal blockage (ranging from no blockage to 20% blockage). Accordingly, all structures with a diagonal dimension of greater than 6 metres were assigned 10% blockage.

Rigby et al (2002) also determined that structures with a diagonal dimension less than 6 metres have the potential to suffer considerable blockage during large floods (ranging from no blockage to 100% blockage). In recognition of this, a blockage factor of 50% was applied to all structures with a diagonal dimension less than 6 metres.

5.2.7 Fences

Fences can provide a significant impediment to flow in urbanised catchments (refer **Plate 9**). Therefore, it was also considered important to include a representation of fences within the TUFLOW model. An automated approach was employed to extract approximate fence alignments across urbanised sections of the floodplain based on information contained in cadastre, roadway and LEP GIS layers. The extent of fence lines that were generated based on this approach is shown in **Plate 10**.

Plate 9 Example of wire mesh fence that has collected debris during a flood, which may cause blockage of flow paths in urban environments (Engineers Australia, 2009).

It was recognised that even relatively permeable fence types can become partially blocked during the course of a flood. During the early stages of a flood, debris (e.g., leaves, branches) will be mobilised and conveyed down major flow paths until it reaches an obstruction whose aperture is too small to transmit the debris. Therefore, by the peak of the flood there is a significant probability that most fences will be at least partially blocked with debris. In recognition of this, all fences were implemented with a blockage of 75%. That is, a 75% reduction in conveyance capacity is provided through the fence lines. Although there is likely to be considerable variability in the degree of blockage provided by different fence types, it was felt that a 75% blockage factor provided a conservatively realistic estimate of the average degree of blockage provided by all fence types across the Ourimbah Creek catchment. It was also assumed that all fences were 1 metre high since the hydrodynamic forces associated with water depths over 1 metre was considered sufficient to cause failure of the fences.

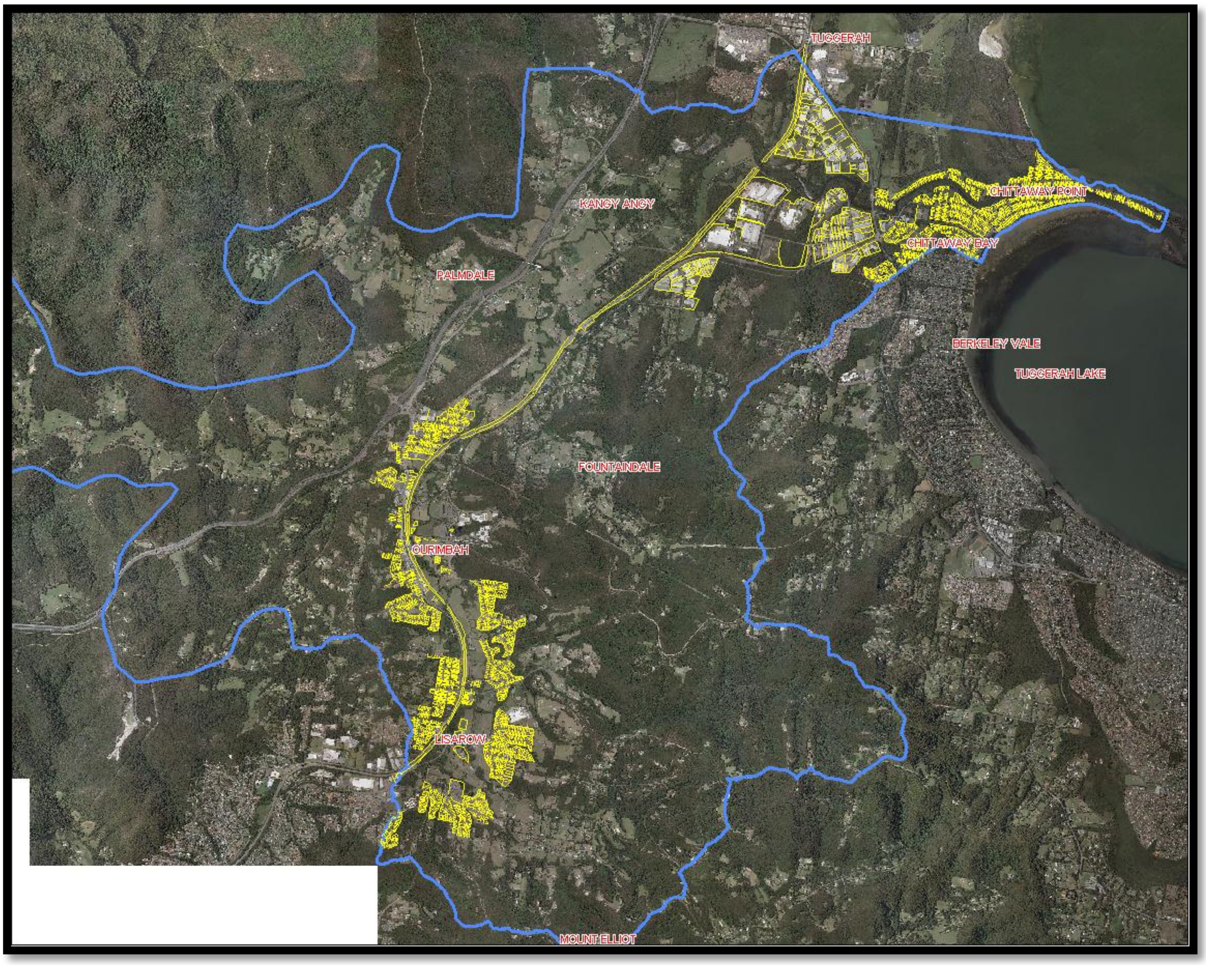


Plate 10 Extent of fences (yellow lines) extracted using cadastre, zoning and roadway GIS layers

5.2.8 Levees

The Ourimbah Creek catchment incorporates two levees:

- **Tuggerah Business Park Levee**: located on the northern floodplain of Ourimbah Creek between Wyong Road and the Main Northern Railway. The levee provides protection to the Tuggerah Business Park, which is located on the northern side of the levee. It is understood that the height of the levee was designed to protect the business park during all floods up to and including the 1% AEP event (Paterson Consultants, 2011).
- **Railway Levee**: Located on the western side of the Main Northern Railway line, directly west of the Berkley Vale Industrial area. The levee is designed to prevent overtopping and subsequent “wash out” of the railway line ballast.

Work-as-executed / design plans for both levees were provided by Wyong Shire Council. Elevations along the crest of both levees were extracted from the plans were used as the basis for including a representation of the levees systems in the hydraulic model.

5.3 Hydraulic Model Calibration

5.3.1 General

Hydraulic computer models are developed using parameters that are not known with a high degree of certainty and/or are subject to natural variability. This includes catchment roughness as well as blockage of hydraulic structures. Accordingly, the model should be calibrated using flow and flood mark information from historic floods to ensure the adopted parameters are producing reliable estimates of flood behaviour.

Calibration is typically completed by routing flows from historic floods through the hydraulic model. Simulated flood levels are extracted from the model results at locations where recorded flood marks are available. Calibration is completed by iteratively adjusting hydraulic model parameters to achieve the best possible match between recorded flood marks and simulated flood levels.

5.3.2 Calibration/Verification Events

The following criteria were employed to select events suitable for the purpose of model calibration and verification:

- A minimum of three significant flood events;
- Contemporary floods preferred as the currently available topographic datasets are likely to provide a good reproduction of topographic conditions at the time of the floods; and,
- Events also used for hydrologic model calibration preferred.

Based on these criteria, the following events were selected for the hydraulic model calibration and verification:

- February 1992;
- June 2007; and,
- June 2011.

5.3.3 Model Boundary Conditions

Flow Boundary Conditions

Upstream boundary conditions define the variation in flows with respect to time across the hydraulic model domain. Inflows to the TUFLOW hydraulic model were defined using discharge hydrographs extracted from the XP-RAFTS hydrologic modelling discussed in Section 4.3.

Tuggerah Lake Boundary Conditions

Hydraulic computer models also require the adoption of a suitable downstream boundary condition in order to reliably define flood behaviour throughout the area of interest. The downstream boundary is typically defined as a known water surface elevation (i.e., stage).

As shown in **Figure 16**, the downstream boundary of the TUFLOW model is located at the point where Ourimbah Creek drains into Tuggerah Lake. Accordingly, the downstream water elevation will be governed by the water surface elevation within Tuggerah Lake at the time of the flood.

Therefore, historic stage hydrographs for each historic flood were obtained from a MHL water level recorder located on Tuggerah Lake at Long Jetty (Long Jetty is located directly opposite the Ourimbah Creek entrance into Tuggerah Lake). The adopted Tuggerah Lake stage hydrographs for the 1992, 2007 and 2011 simulations are included in **Appendix D** as **Figures D1** to **D3**.

5.3.4 Modifications to Represent Historic Floodplain Conditions

A number of modifications were completed to the "existing" conditions TUFLOW model in order to represent catchment and floodplain conditions at the time of each historic flood.

February 1992

As the F3 freeway wasn't constructed in 1992 it was necessary to remove all embankments and/or cuttings associated with the freeway from the DEM. The Tuggerah Business Park levee and Cut Rock Creek channel remediation works between Teralba Street and the Pacific Highway were also removed from the model.

The Cut Rock Creek Retarding Basin at Lisarow was constructed in 2009. Therefore, the basin and associated structures were removed from the hydraulic model of 1992 conditions.

June 2007

The Cut Rock Creek Retarding Basin at Lisarow was not constructed until 2009. Therefore, the basin and associated outlet structures were removed from the 2007 TUFLOW model.

The Cut Rock Creek channel remediation works between Teralba Street and the Pacific Highway were also removed from the model for the 2007 simulation.

June 2011

No modifications were completed to the "existing" conditions model for the 2011 simulations.

5.3.5 Results of Calibration and Verification Simulations

February 1992 Simulation

Calibration of the TUFLOW hydraulic model was attempted using 55 flood marks for the February 1992 flood. The calibration was undertaken by routing the discharge hydrographs generated by the XP-RAFTS model for the 1992 event through the TUFLOW model and adjusting roughness parameter values until a reasonable agreement between simulated flood levels to the recorded flood marks was achieved.

The roughness values listed in **Table 17** were ultimately adopted for the 1992 flood simulation. All roughness parameter values are within reasonable limits.

A comparison between the peak flood levels generated by the TUFLOW model and the recorded flood marks for the 1992 flood is provided in **Figure 17**. A comparison between recorded flood marks and simulated flood levels is also presented in **Table 18**.

Peak floodwater depths and flow velocity vectors were also extracted from the results of the 1992 simulation. The depths and velocity vectors are also included on **Figure 17**.

The comparison provided in **Table 18**, shows that there is generally a good agreement between recorded flood mark elevations and simulated flood levels for the 1992 event. Most simulated and recorded flood levels agree to within 0.15 metres and the average difference is -0.09 metres

Table 18 Comparison between simulated flood levels and recorded flood marks for 1992 flood simulation

Location		Recorded Flood Mark (mAHD)	Simulated Flood Level (mAHD)	Difference (metres)
Bangalow Creek	Upstream Shirley Street Bridge, Ourimbah	16.62	16.52	-0.10
	Cnr Shirley St & Ourimbah St, Ourimbah	16.37	16.46	0.09
	Upstream Chittaway Rd, Ourimbah	16.19	15.85	-0.33
	Upstream Chittaway Rd, Ourimbah	15.86	15.79	-0.07
	Upstream Burns Rd, Ourimbah	14.39	14.33	-0.06
	Confluence Bangalow Creek and Ourimbah Creek Flood Runner	12.36	12.26	-0.10
	Turnpentine Rd Railway underpass (Chittaway Creek)	12.28	12.23	-0.05
Cut Rock Creek	Tuggerah St Bridge (downstream of Lisarow Public School)	23.82	23.76	-0.07
	Tuggerah St Bridge (downstream of Lisarow Public School)	23.73	23.73	0.00
	44 Lisarow St, Lisarow	21.45	21.36	-0.09
	51 Lisarow St, Lisarow	20.94	20.69	-0.25
	47 Lisarow St, Lisarow	20.94	20.82	-0.12
	55 Lisarow St, Lisarow	20.66	20.58	-0.08
	49 Lisarow St, Lisarow	20.66	20.64	-0.02
	16A Teralba St, Lisarow	20.48	20.52	0.04
	Upstream Main Northern Railway	19.55	19.77	0.12
Dog Trap Gully	Dog Trap Rd, Ourimbah	20.97	20.62	-0.35
	Dog Trap Rd, Ourimbah	20.75	20.57	-0.18
	Upstream Pacific Hwy, Ourimbah	17.99	18.05	0.06
	Downstream Pacific Hwy, Ourimbah	17.07	17.21	0.14
Ourimbah Creek	4.6km upstream of Moores Point Rd	26.50	26.54	0.04
	4.3km upstream of Moores Point Rd	26.00	26.08	0.08
	4km upstream of Moores Point Rd	25.55	25.72	0.18
	3.3km upstream of Moores Point Rd	25.10	25.19	0.09
	3km upstream of Moores Point Rd	24.70	24.73	0.03
	1.5km upstream of Moores Point Rd	22.80	22.92	0.12
	Confluence of Brumbles Creek and Ourimbah Creek	22.50	22.44	-0.06
	300m downstream of Moores Point Rd	21.40	20.28	-0.12
	2.1km upstream Footts Rd West	20.90	20.81	-0.09
	1.75km upstream Footts Rd West	20.50	12.42	-0.08
	900m upstream Footts Rd West	18.70	18.64	-0.06

	Location	Recorded Flood Mark (mAHD)	Simulated Flood Level (mAHD)	Difference (metres)
	850m upstream Footts Rd West	18.60	18.48	-0.12
	Footts Road Bridge West	17.70	17.48	-0.22
	800m upstream of Old Footts Bridge East	17.30	16.57	-0.73
	Upstream Old Footts Road	16.80	16.02	-0.78
	Footts Road Bridge West	16.10	15.92	-0.08
	Footts Road East	15.00	14.91	-0.09
	250m downstream Footts Road	14.50	14.43	-0.07
	Upstream Bangalow Creek Flood Runner	14.35	14.17	-0.18
	Upstream Palmdale Rd Bridge	13.10	13.04	-0.06
	Confluence Canada Drop Down Creek & Ourimbah Creek	12.40	12.38	-0.03
	Pacific Hwy Bridge	11.80	11.76	-0.04
	Confluence Bangalow Creek & Ourimbah Creek	11.70	11.55	-0.15
	Confluence Windy Drop Down Creek & Ourimbah Creek	11.20	11.13	-0.07
	500m downstream of Windy Drop Down Creek confluence	7.05	6.89	-0.16
	Main Northern Railway Bridge	3.91	3.66	-0.25
	Wyong Road (Lees) Bridge	2.06	2.04	-0.02
	Southern end of Sunshine Avenue, Chittaway Point	26.50	26.54	0.04
	Palmdale Rd Bridge (Canada Drop Down Creek)	16.22	16.05	-0.17
			Average:	0.09

Some more significant differences occur at isolated locations. This includes:

- Upstream of the old Footts Road bridge crossing of Ourimbah Creek. During the 1992 flood, there was a bridge crossing at this location which has since been removed. Efforts were made to include this bridge within the hydraulic model, however, plans could not be uncovered. As a result, this bridge was not included in the 1992 hydraulic model. Flood marks upstream and downstream of the old bridge suggest this crossing caused around 0.7m afflux during the 1992 flood. Accordingly, it is suggested that if this bridge was included in the TUFLOW model and the 0.7 m afflux was reproduced, a much closer correlation between simulated and recorded flood levels would be achieved (i.e., better than 0.1 m). The backwater effects of the old Footts Road bridge also appears to impact on some additional flood marks located upstream of the old bridge location.
- A 0.33 m difference was identified along Bangalow Creek, upstream of Chittaway Road. However, another flood mark immediately adjoining this location shows a comparatively good agreement (i.e., 0.07 m). Given the agreement between simulated and recorded flood levels at this additional flood mark location as well as generally good agreements upstream and downstream of this location, it is considered that this recorded flood mark

may not be a true representation of the peak flood level at this location during the 1992 flood.

- There is a 0.25 m difference between simulated and recorded flood levels at 51 Lisarow Street, Lisarow. However, this area has a number of other flood marks, which generally show a good correlation between simulated and recorded flood levels. Accordingly, it is suggested that this flood mark may also be less reliable.

June 2007 Simulation

The TUFLOW hydraulic model was verified using 14 historic flood marks for a flood that occurred in June 2007. The verification was completed by routing the discharge hydrographs generated by the XP-RAFTS model for the 2007 event through the TUFLOW model while retaining the same roughness parameter values that were adopted for the 1992 calibration simulation.

A comparison between the peak flood levels generated by the TUFLOW model and the recorded flood levels for the 2007 flood is provided in **Figure 18**. A comparison between recorded flood marks and simulated flood levels is also presented in **Table 19**. Peak floodwater depths and velocities were also extracted from the results of the 2007 simulation and are included on **Figure 18**.

The flood level comparisons provided in **Table 19** indicate that the simulated flood levels are typically within 0.2 metres of recorded flood levels. **Table 19** also shows that the average difference between simulated and recorded flood levels is -0.11 metres.

However, there were two historic flood marks that could not be well reproduced by the hydraulic model. Both flood marks are located in close proximity to one another on Kangy Angy Creek. At this location the simulated flood levels are over 0.4 metres lower than recorded flood levels. Given that both flood marks are located in reasonably close proximity and are of a similar order of magnitude, it is considered unlikely that both flood marks would be in error.

The nearest flood mark to this location is located approximately 1000 metres downstream, which is reasonably well reproduced by the TUFLOW model. Accordingly, it is considered that the Ourimbah Creek receiving water elevation is reasonably well defined. Therefore, the differences may be attributed to a poor reproduction of 2007 discharges along Kangy Angy Creek. That is, there may have been more intense rainfall over the Kangy Angy Creek that was not represented by the rainfall distribution adopted in the XP-RAFTS hydrologic model. However, in the absence of more detailed spatial descriptions of rainfall in the vicinity of the Kangy Angy Creek subcatchment for the 2007 event, it is unlikely that this discrepancy can be rectified.

June 2011 Simulation

The TUFLOW hydraulic model was also verified using 4 historic flood marks for the June 2011 event. The verification was completed by routing the discharge hydrographs generated by the XP-RAFTS model for the 2011 event through the TUFLOW model while retaining the same parameter values that were adopted for the 1992 and 2007 simulations.

Table 19 Comparison between simulated flood levels and recorded flood marks for 2007 flood simulation

Location		Recorded Flood Mark (mAHD)	Simulated Flood Level (mAHD)	Difference (metres)
Bangalow Creek	Western end of Bristowe Cl	18.46	18.31	-0.15
	Chittaway Road Bridge, Ourimbah	15.80	15.66	-0.14
	Shirley St (near Sohier Park)	15.78	15.80	0.02
	Burns Road underpass of Main Northern Railway	13.31	13.44	0.13
	Unnamed underpass of Main Northern Railway	12.85	12.68	-0.17
Canada Drop Down Creek	322 Palmdale Road, Palmdale	21.38	21.26	-0.12
	Palmdale Road Bridge	16.02	15.86	-0.16
	Palmdale Road near Crematorium	15.62	15.48	-0.14
Cut Rock Creek	Tuggerah St Bridge (downstream Lisarow Public School)	23.78	23.69	-0.09
	Railway Culvert	21.88	21.95	0.07
	Upstream of Teralba Rd Bridge	20.75	20.59	-0.16
	Downstream of Teralba Rd Bridge	20.68	20.53	-0.15
Kangy Angy Creek	Downstream Pacific Hwy, Kangy Angy	10.23	9.71	-0.52
	Downstream Pacific Hwy, Kangy Angy	10.09	9.68	-0.41
Ourimbah Creek	Eastern end of Orchard Road	9.21	9.57	0.16
	136 Geoffrey Rd, Chittaway Point	1.65	1.69	0.04
	191 Palmdale Road, Palmdale (Toobys Creek)	16.8	16.78	-0.02
			Average:	-0.11

A comparison between the peak flood levels generated by the TUFLOW model and the recorded flood levels for the 2011 flood is provided in **Figure 19**. Peak floodwater depths and velocities for the 2011 simulation are also included on **Figure 19**. A comparison between recorded flood marks and simulated flood levels is also presented in **Table 20**.

The results presented in **Table 20** shows that there is generally a good agreement between recorded flood mark elevations and simulated flood levels for the 2011 event. Simulated peak flood levels are typically within 0.1 m of recorded flood mark elevations, with the average difference being 0.03 metres.

The most significant difference occurs near the Ourimbah Rugby club where the simulated flood level is 0.2 metres higher than the recorded flood mark elevation. However, it should be noted that this flood mark is based upon a photograph taken before the peak of the flood. Accordingly, the agreement between the simulated flood level and recorded flood mark elevation at this location would likely be much closer if the photograph had been taken at the peak of the flood.

Table 20 Comparison between simulated flood levels and recorded flood marks for 2011 flood simulation

Location		Recorded Flood Mark (mAHD)	Simulated Flood Level (mAHD)	Difference (metres)
Bang. Creek	Shirley St (near Sohier Park)	15.55	15.614	0.06
	Ourimbah Rugby Club*	15.35	15.552	0.20
Cittaway Creek	Orange Rd	14.40	14.378	-0.02
	Old Chittaway Road	12.74	12.699	-0.04
	Turpentine Rd railway underpass	10.59	10.637	0.05
Cut Rock Creek	Tall Timbers Estate	20.98	21.037	0.06
	Teralba Street Bridge	20.02	19.898	-0.12
			Average:	0.03

Note: * Flood mark is based upon a photograph taken before the peak of the flood. Accordingly, the actual peak flood level at this location is likely to be higher.

5.3.6 Summary

The outcomes of the hydraulic model calibration indicate that the TUFLOW hydraulic model provides a realistic description of recorded flood levels across the Ourimbah Creek catchment. In general, simulated flood levels are within 0.15 metres of recorded flood mark elevations, with the average difference being better than 0.1 metres.

There are some more significant differences at isolated locations, however, these are generally associated with flood marks that are thought to be less reliable.

Overall, it is considered the hydraulic model provides a reliable description of flood behaviour across the Ourimbah Creek catchment and provides a suitable tool to assist in defining design flood behaviour.

6 Design Flood Simulations

6.1 General

Design floods are hypothetical floods that are commonly used for planning and floodplain management investigations. Design floods are based on statistical analysis of rainfall and flood records and are typically defined by their probability of exceedance. This is typically expressed as an Annual Exceedance Probability (AEP).

The AEP of a particular flood level or discharge at a particular location is the probability that the flood level/discharge will be equalled or exceeded in any one year. For example, a 1% AEP flood has a 1% chance of being equalled or exceeded in any one year.

Design floods can also be expressed by their Average Recurrence Interval (ARI). For example, the 1% AEP flood can also be expressed as a 1 in 100 year ARI flood. That is, the 1% AEP flood will occur, on average, once every 100 years.

It should be noted that there is no guarantee that a 1% AEP flood will occur just once in a 100 year period. It may occur more than once, or at no time at all in the 100 year period. This is because design floods are based upon a long-term statistical average. For example, there is a 50% chance that a 1% AEP flood will occur once within a 70 year period and a 15% chance that it will occur twice within the same 70 year period. Therefore, it is prudent that the community understands that the occurrence of recent large floods does not preclude the potential for another large flood to occur in the immediate future.

Design floods are typically estimated by applying design rainfall to the hydrologic model to develop design flood hydrographs at various locations throughout the catchment. The design flood hydrographs are then routed through the hydraulic model to derive design flood level, depth and velocity estimates. The procedures employed in deriving design flood estimates for the Ourimbah Creek catchment are outlined in the following sections.

6.2 Hydrology

6.2.1 Design Rainfall

Design rainfall for the 20%, 10%, 5%, 2%, 1% and 0.5% AEP events were derived using standard procedures outlined in *'Australian Rainfall and Runoff – A Guide to Flood Estimation'* (Engineers Australia, 1987). This involved extracting design intensity-frequency-duration values from Volume 2 of *'Australian Rainfall and Runoff – A Guide to Flood Estimation'* (Engineers Australia, 1987) (refer **Table 21**). This base design rainfall information was used as the basis for interpolating design rainfall for other design rainfall frequencies and durations. Adopted rainfall intensities for each design storm and duration are summarised in **Table 22**.

For all design storms up to and including the 0.5% AEP event, it was assumed that the design rainfall was evenly distributed across the entire catchment. That is, there was no spatial variation in design rainfall across the catchment.

Table 21 Design IFD Parameters

Parameter	Value	Parameter	Value
$^{2}I_{1}$	37.2	$^{50}I_{1}$	71.7
$^{2}I_{12}$	9.2	$^{50}I_{12}$	18.1
$^{2}I_{72}$	3.1	$^{50}I_{72}$	6.4
F2	4.31	Skew	0.01
F50	15.9	Temporal Pattern Zone	1

The design rainfall estimates were then used in conjunction with standard design temporal patterns to describe how the design rainfall varies with respect to time throughout each design storm.

Table 22 Design Rainfall Intensities

DURATION	AEP / Average Rainfall Intensity (mm/hr)						
	20%	10%	5%	2%	1%	0.5%	PMP
30 minutes	69	78	89	105	116	126	320
45 minutes	56	62	71	83	92	102	280
1 hour	47.4	54	62	72	80	88	250
2 hour	31.5	35.6	41.1	48.3	54	60	185
3 hour	24.6	27.9	32.1	37.7	42.0	48.1	153
6 hour	16.1	18.2	21.0	24.7	27.5	32.7	100
12 hour	10.6	12.0	13.8	16.3	18.1	22.3	66
24 hour	6.99	7.93	9.17	10.8	12.0	15.3	45.8
48 hour	4.51	5.14	5.96	7.05	7.88	10.3	29.8
72 hour	3.39	3.88	4.50	5.33	5.96	7.97	24.9

6.2.2 Probable Maximum Precipitation (PMP)

As part of the flood study it was also necessary to define flood characteristics for the Probable Maximum Flood (PMF). The PMF is estimated by routing the Probable Maximum Precipitation (PMP) through the hydrologic and hydraulic modela. The PMP is defined as the greatest depth of precipitation that is meteorologically possible for a given duration at a specific location at a particular time of year. Accordingly, it is considered the largest quantity of rainfall that could conceivably fall within a particular catchment.

PMP depths were derived for the Ourimbah Creek catchment for a range of storm durations up to and including the 6 hour event based on procedures set out in the Bureau of Meteorology's “Generalised Short Duration Method” (GSDM) (Bureau of Meteorology, 2003).

For storm durations in excess of 6 hours, the Generalised Southeast Australia Method (GSAM) (Bureau of Meteorology, 2006) or Generalised Tropical Storm Method Revised (GTSMR) (Bureau of Meteorology, 2005) must be used to develop PMP estimates. The Ourimbah Creek catchment falls within the GSAM-GTSMR Coastal Transition Zone. Therefore, PMP depths were calculated using both approaches and the highest overall PMP depth was adopted.

Spatially varying rainfall was applied to all PMP rainfall estimates in accordance with recommendations in each of the Bureau of Meteorology documents. That is, the PMP rainfall estimates varied temporally as well as spatially.

The GSDM, GSAM and GTSMR PMP calculations are included in **Appendix E.** The final PMP intensities are also summarised in **Table 22**.

6.2.3 Rainfall Loss Model

In a typical rainfall event, not all of the rainfall that falls onto the catchment is converted to runoff. Depending on the prevailing "wetness" of the catchment at the commencement of the storm some of the rainfall may be lost through infiltration into the soil, or may be intercepted by vegetation and stored.

To account for rainfall losses of this nature, the Initial-Continuing Loss Model was utilised. This rainfall loss approach is recommended in *'Australian Rainfall and Runoff – A Guide to Flood Estimation'* (*1987*) (Engineers Australia, 1987) for design flood estimation.

The adopted rainfall losses are summarised in **Table 23**. The adopted rainfall losses for all design events were consistent with those adopted in the calibration / verification simulations.

Table 23 Adopted XP-RAFTS Design Rainfall Losses

Land Use Description	Initial Loss *(mm)*	Continuing Loss *(mm/hr)*
Pervious	15.0	4.0
Impervious	1.5	0.0

6.2.4 Peak Discharges

The XP-RAFTS model was used to simulate the 20%, 10%, 5%, 2%, 1% and 0.5% AEP events as well as the PMF.

A range of storm durations were modelled for each design storm to establish the critical storm duration for each Ourimbah Creek subcatchment. Peak discharges were extracted from the XP-RAFTS model for each subcatchment and each storm duration, and are provided in **Appendix F**. Peak discharges at select locations throughout the Ourimbah Creek catchment are also summarised in **Table 24**.

The results presented in **Appendix G** indicate that the critical storm duration throughout the catchment varies between 2 hours and 48 hours for all events up to and including the 0.5% AEP event. The most common critical storm duration is 6 hours.

Table 24 Peak Design Discharges for Existing Conditions

Location		XP-RAFTS ID	Peak Discharge (m^3/s)						
			20%	10%	5%	2%	1%	0.5%	PMP
Ourimbah Creek	Lyrebird Lane	1.28	286	353	441	536	625	825	2,820
	Moores Point Rd	1.36	297	369	470	586	688	937	3,350
	Footes Rd*	1.42	312	369	472	600	709	984	3,580
	Palmdale Rd*	1.47	312	371	471	600	709	990	3,620
	Sydney Newcastle Freeway	1.49	336	393	454	534	610	819	2,860
	Main Northern Railway	1.57	486	583	715	832	972	1,320	5,280
	Wyong Road	1.59	499	599	735	857	1,000	1,340	5,410
	Tuggerah Lake#	1.60	492	593	730	853	998	1,340	5,370
Canada Drop Down Creek	Palmdale Rd	89.13	70.2	84.6	110	133	153	212	8,58
	Ourimbah Ck Confluence	89.17	102	122	148	177	211	297	1,320
Kangy Angy Creek	Old Tuggerah Rd	171.02	8.69	10.3	12.6	14.5	16.7	22.7	79.0
	Pacific Hwy	171.06	20.3	24.1	29.4	33.6	38.9	53.0	187
Chittaway Creek	Enterprise Dr	163.05	25.5	30.4	36.9	43.2	50.2	70.0	224
	Old Chittaway Rd	163.07	26.8	32.1	39.2	46.0	53.9	75.3	246
Bangalow Creek	Coachwood Dr	119.08	28.3	33.7	42.5	51.1	59.6	80.0	245
	Cut Rock Ck confluence	119.10	34.1	40.5	51.1	61.9	73.0	98.2	315
	Shirley St	119.14	75.0	88.6	108	128	153	213	746
	Chittaway Rd	119.18	112	134	164	190	220	305	1,140
	Burns Rd	119.20	112	134	164	191	221	307	1,150
	Ourimbah Ck Confluence	119.23	137	166	229	283	346	494	2280
Cut Rock Creek	Detention Basin Outflow	137.03	4.86	5.65	7.17	8.11	9.62	13.9	44.8
	Tuggerah St	128.03	27.9	32.7	41	50	59.3	79.9	263
	Railway Upstream	128.07	38	44.6	55.2	67.3	79.3	108	368
	Teralba St	128.08	39.3	46.1	57.2	68.8	80.9	111	376
	Railway Downstream	128.11	42.1	49.7	61.4	72.9	85.2	117	402
Dog Trap Gully	Pacific Hwy	153.06	26.7	31.8	40.1	48.1	56.2	75.4	286

NOTE: * The peak discharges for Ourimbah Creek at Palmdale Road are lower than at Footes Road for some AEPs. This is associated with some of the flow being diverted from Ourimbah Creek via the Bangalow Creek flood runner and, therefore, bypassing Palmdale Road.
Reductions in peak discharge are also evident downstream of Wyong Road. This is associated with the very flat channel slope along this section of Ourimbah Creek which serves to attenuate the peak discharge.

6.2.5 Verification of Peak Design Discharges

Previous Studies

To help verify the veracity of the XP-RAFTS model results, the peak 1% AEP discharges generated by the XP-RAFTS were compared against peak 1% AEP discharges documented in previous flooding investigations at various locations across the Ourimbah Creek catchment. This comparison is presented in **Table 25**.

Table 25 Comparison between peak 1% AEP XP-RAFTS discharges and peak 1% AEP discharges documented in previous flooding investigations

Location	Peak 1% AEP Discharge (m^3/s)					
	SKP[1]	WMA[2]	PC[3]	Hyder[4]	WMA[5]	XP-RAFTS
Cut Rock Creek @ Teralba Street		101				**81**
Bangalow Creek @ Baileys Road		78				**69**
Dog Trap Gully @ Main Northern Railway		55				**56**
Ourimbah Creek @ Stn 211013					784	**708**
Bangalow Creek @ Ourimbah Ck confluence	-	220	-	260		**302**
Ourimbah Creek @ Pacific Highway	-	-	-	677		**610**
Ourimbah Creek @ Stn 211015	850	-	990	930		**944**
Ourimbah Creek @ Wyong Road	870	-	-	960		**1,000**

Notes: 1: "Lower Ourimbah Creek Flood Study, Preliminary Report" (Sinclair Knight & Partners, 1990)
2: "Bangalow Creek and Cut Rock Creek Flood Study" (Webb McKeown & Associates, 1994)
3: "Catamaran Drive Flood Study" (Paterson Consultants, 1989)
4: "Ourimbah Creek Floodplain Management Study" (Hyder Consulting, 2001)
5: "Upper Ourimbah Creek Flood Study" (Webb McKeown & Associates, 1997)

The comparison presented in **Table 25** indicates that the XP-RAFTS model produces peak discharges that are generally within ± 10% of previous investigations. Some more significant differences occur at some locations including:

- The peak 1% AEP XP-RAFTS discharge is approximately 20% lower than the peak discharge documented in the "Bangalow Creek and Cut Rock Creek Flood Study" (Webb, McKeown & Associates, 1994). This reduction in peak 1%AEP discharge relative to the 1994 study is considered to be associated with:
  - the construction of the Cut Rock Creek Detention basin;
  - higher overall loss rates adopted in this study; and,
  - lower adopted impervious proportion for this study.
- There is a ~15% difference between peak 1% AEP discharges at the Pacific Highway crossing of Ourimbah Creek and the downstream end of Bangalow Creek. It is likely that this difference is associated with the inclusion of a "diversion" link in the XP-RAFTS model to represent the Bangalow Creek flood runner, which wasn't represented in the previous hydrologic model. As a result, a proportion of the flow from Ourimbah Creek is diverted into Bangalow Creek, leading to a decrease in peak discharge along Ourimbah Creek and an increase in peak discharge at the downstream end of Bangalow Creek.

- The XP-RAFTS model typically produces peak 1% AEP discharges that are over 10% higher than those documented in the "Lower Ourimbah Creek Flood Study (Sinclair Knight and Partners, October, 1986). This is considered to be primarily associated with the increase in development and, therefore, impervious surfaces that have occurred across the catchment over the past 20 years. It should be noted that all other previous studies also predict higher peak 1% AEP peak discharges than the 1986 study.

Overall, the XP-RAFTS model typically produces peak 1% AEP discharges that are comparable to those documented in previous studies. Where more significant differences occur, this is typically associated with physical changes in the catchment (e.g., detention basin, increase in development) or differences in the representation of the catchment within the hydrologic model (e.g., Bangalow Creek flood runner).

Probabilistic Rational Method

Peak 1% AEP discharges produced by the XP-RAFTS model were also verified against peak discharges calculated using the Probabilistic Rational Method (PRM). A complete listing of 1% AEP XP-RAFTS discharges and PRM discharges at the outlet of each subcatchment are provided in **Appendix G**.

In general, the XP-RAFTS and PRM discharges provided in **Appendix G** show a reasonable correlation. The average difference between XP-RAFTS and PRM discharges is 11%. The PRM typically predicts lower discharges relative to the XP-RAFTS model, particularly across the urbanised section of the catchment. This is not unexpected as the PRM fails to account for the increased runoff potential across impervious sections of the catchment.

Overall, the verification shows that the XP-RAFTS model is producing realistic design 1% AEP discharge estimates.

6.3 Hydraulics

6.3.1 General

The calibrated TUFLOW hydraulic model was used to simulate design flood behaviour across the Ourimbah Creek catchment for the 20%, 10%, 5%, 2%, 1% and 0.5% AEP events as well as the Probable Maximum Flood (PMF).

The procedures employed in developing the design flood estimates are outlined in the following sections.

6.3.2 Model Boundary Conditions

Flow Boundary Conditions

Flow boundary conditions provide a description of the spatial and time variation of flows across the hydraulic model area. They are defined by the design discharge hydrographs generated by the XP-RAFTS hydrologic model.

As shown in **Figure 16**, the TUFLOW hydraulic model extends across all of the local catchments located east of the F3 Freeway. However, the hydraulic model does extend across all of the Ourimbah Creek catchment to the west of the F3 Freeway (a significant proportion of the catchment located west of the Freeway is State Forest and was not required to be included as part of the study brief). Therefore, flows entering the upstream boundaries of the hydraulic model west of the F3 Freeway as well as flows from the local catchments located east of the Freeway must be accounted for using boundary conditions.

Accordingly, 'total' inflow hydrographs (i.e., hydrographs describing the total upstream contributing flow) were applied to all watercourses with an upstream contributing catchment area that was not fully contained within the hydraulic model extent. This included:

- Ourimbah Creek;
- Brumbles Creek’
- Lowes Gully;
- Footes Gully;
- Canada Drop Down Creek;
- Toobys Creek;
- Windy Drop Down Creek; and,
- Kangy Angy Creek.

In addition, 'local' discharge hydrographs (representing flows from the local subcatchments only) were also extracted from XP-RAFTS and were used to represent inflows from local catchment runoff. This approach was used to define inflows for all catchments fully contained within the hydraulic model domain. This included:

- Dog Trap Gully;
- Cut Rock Creek;
- Bangalow Creek; and
- Chittaway Creek.

The local inflow hydrographs were applied to the lowest point within each subcatchment.

Tuggerah Lake Boundary Conditions

Hydraulic computer models also require the adoption of a suitable downstream boundary condition in order to reliably define flood behaviour throughout the area of interest. The downstream boundary is typically defined as a known water surface elevation (i.e., stage).

As shown in **Figure 16**, the downstream boundary of the TUFLOW model is located at the point where Ourimbah Creek drains into Tuggerah Lake. Therefore, the water elevation at the downstream end of Ourimbah Creek during any flood will be influenced by the prevailing water elevation within Tuggerah Lake at the time of the flood. It is important to define a reliable “design” stage hydrograph for Tuggerah Lake to ensure the interaction between catchment runoff induced flooding and flooding from elevated Tuggerah Lake levels is reliably represented during each of the design flood simulations.

A review of previous studies as well as historic stage hydrographs was completed in an effort to define a reliable design tailwater estimate for Tuggerah Lake for each design flood. A detailed description of the outcomes of the investigations is provided in **Appendix H**.

As noted in **Appendix H**, the peak outflow from Ourimbah Creek does not typically coincide with the peak stage within Tuggerah. As a result, it would be unrealistic to assume that peak

Tuggerah Lake stages occur at the same time as peak outflows from Ourimbah Creek. Nevertheless, it is important that the potential for both flooding mechanisms is represented realistically. As a result, a time-varying (i.e., dynamic”) tailwater was thought to provide the best way to represent the interaction between catchment runoff and Tuggerah Lake flooding.

Accordingly, design stage hydrographs were developed to represent the variation in Tuggerah Lake level during the course of each design flood. The adoption of a dynamic lake water level in conjunction with dynamic inflow hydrographs should ensure that:

- both flooding mechanisms are represented; and,
- design flood elevations are not overestimated along the lower reaches of the creek by assuming peak catchment runoff induced flood levels and Tuggerah Lake levels occur at the same time.

The resulting design stage hydrographs for Tuggerah Lake are provided in **Appendix H** as **Figures H4** to **H10**. Adopted Tuggerah Lake design stages (peak Tuggerah Lake stage and Tuggerah Lake stage at peak Ourimbah Creek outflow) are presented in **Table 26**.

Table 26 Tuggerah Lake Design Water Levels

Time	AEP / Peak Stage (mAHD)						
	20%	**10%**	**5%**	**2%**	**1%**	**0.5%**	**PMF**
Peak Tuggerah Lake Stage	1.36	1.60	1.80	2.05	2.23	2.30	2.70
Tuggerah Lake Stage at Peak Ourimbah Creek Outflow	1.02	1.20	1.35	1.54	1.67	1.73	2.03

6.3.3 Bridge and Culvert Blockage

As noted during the hydraulic model calibration, debris from the catchment can become mobilised during floods leading to blockage of downstream bridges and culverts. As a result, most bridges and culverts will not operate at full efficiency during most floods. This can increase the severity of flooding across areas located adjacent to these structures.

Only a limited amount of literature is available documenting blockage of hydraulic structures during floods. Blockage factors were applied as part of the hydraulic model calibration based on information documented in Rigby et al (2002) following the 1998 Wollongong floods. The blockage factors were applied based on the following criteria:

- all structures with a diagonal dimension of greater than 6 metres were assigned 10% blockage;
- all structures with a diagonal dimension of less than 6 metres were assigned 50% blockage

The outcomes of the calibration indicated that these blockages assumptions provided a reasonable reproduction of recorded flood levels. Accordingly, these blockage assumptions are supported by the limited amount of literature available and are known to provide a reasonable reproduction of past peak flood levels in the vicinity of structures. Therefore, they were also considered to be appropriate for design conditions.

However, the blockage factors applied to the Railway and Pacific Highway culverts immediately downstream of Tall Timbers Estate (Lisarow) were reduced from 50% to 10% as it was deemed unlikely that both culverts would be subject to increased levels of blockage given their close proximity to each other and the potential for the Tall Timbers access road bridge to collect the majority of upstream debris.

6.3.4 Design Flood Envelope

The TUFLOW hydraulic model was used to simulate flood behaviour across the Ourimbah Creek catchment for a range of design floods and a range of storm durations. The model produced information on flood levels, depths and velocities across the Ourimbah Creek catchment for each design flood and each duration.

As discussed, a range of critical durations are evident across the study area. Therefore, a single storm duration will not necessarily produce the “worst case” flooding across all sections of the catchment.

An important requirement of this study was to ensure that the "worst case" flooding conditions were defined across the Ourimbah Creek catchment. Therefore, a design flood envelope was developed for each design flood based on analysis of each storm duration, at each TUFLOW grid cell. This involved extracting and comparing peak flood levels, depths and velocities at each TUFLOW model grid cell for each simulated duration and the highest depth, level and velocity at each grid cell was subsequently adopted. It is this ‘design flood envelope’, comprising the worst case depths, velocities and levels at each grid cell that forms the basis for the results documented in the following sections.

Accordingly, it is important to recognise that the following design flood results are a composite of results from a range of different durations. It is also important to note that the peak flood levels, depths and velocities do not necessarily occur at the same time.

6.3.5 Floodwater Depths, Levels and Velocities

Peak flood levels, depths and velocities for the 20%, 10%, 5%, 2%, 1% and 0.5% AEP events as well as the Probable Maximum Flood (PMF) were extracted from the results of the TUFLOW model. Peak floodwater depths, levels and velocity vectors are presented in **Figures 20** to **25**. It should be noted that the depths, levels and velocities are maximum values based on consideration of all storm durations and may not necessarily occur at the same time.

Peak flood levels were also extracted from the results of the modelling and are presented in **Table 27** at various locations throughout the Ourimbah Creek catchment. Design stage hydrographs were extracted at key stream gauge and road crossing locations and are presented in **Appendix I**. The stage hydrographs also include bridge/culvert roadway and obvert elevations to allow the flood proneness of the various roadway crossings to be evaluated.

6.3.6 Verification of Peak Design Flood Levels

To help verify the reliability of the TUFLOW design flood level estimates, the peak 1% AEP flood levels were compared against peak 1% AEP flood levels documented in previous flooding investigations at various locations across the Ourimbah Creek catchment. This comparison is presented in **Table 28**.

Table 27 Comparison between peak 1% AEP TUFLOW flood levels and peak 1% AEP flood levels documented in previous flooding investigations

Location	Peak 1% AEP Flood Levels (mAHD)						
	SKP[1]	PC[2]	Hyder[3]	WMA[5]	Wyong Council[4]	PB[6]	TUFLOW
Cut Rock Creek @ Main Northern Railway				22.94		22.60	**22.42**
Cut Rock Creek @ Teralba St				21.16		20.92	**20.70**
Dog Trap Gully @ Main Northern Railway				17.06			**16.87**
Chittaway Creek @ Chittaway Rd				16.38			**16.10**
Ourimbah Creek @ Pacific Highway	12.73		12.28		12.61		**12.24**
Ourimbah Creek @ Stn 211015	11.01	11.3	10.46		11.40		**11.20**
Ourimbah Creek @ Corella Close	5.86	6.6	6.2		6.50		**6.35**
Ourimbah Creek @ Wyong Road	4.23	4.0	4.5		4.5		**4.49**

Notes: 1: "Lower Ourimbah Creek Flood Study, Preliminary Report" (Sinclair Knight & Partners, 1990)
2: "Catamaran Drive Flood Study" (Paterson Consultants, 1989)
3: "Ourimbah Creek Floodplain Management Study" (Hyder Consulting, 2001)
4: Wyong Shire Council: Flood Level Sheets
5: "Bangalow Creek and Cut Rock Creek Flood Study" (Webb McKeown & Associates, 1994)
6: "Upgrade or HW10 Pacific Highway Stage 3 Ourimbah Street, Lisarow to Glen Road, Ourimbah – Hydrology and Hydraulic Assessment Report" (Parsons Brinckerhoff, 2012)

Table 28 Peak Design Floodwater Elevations

Tributary	Location	Peak Stage *(mAHD)*						
		20%	10%	5%	2%	1%	0.5%	PMF
Ourimbah Creek	Platypus Creek Road	33.70	34.03	34.41	34.75	34.93	35.30	39.04
	Lyrebird Lane	29.20	29.37	29.63	29.88	30.03	30.32	33.81
	Moores Point Road	20.95	21.14	21.37	21.60	21.79	21.99	25.75
	Footes Road	16.14	16.34	16.59	16.88	17.14	17.40	21.39
	Palmdale Road	13.11	13.42	13.72	14.00	14.22	14.44	17.83
	Sydney-Newcastle Freeway	11.33	11.55	11.88	12.15	12.41	12.94	17.32
	Pacific Highway	11.24	11.45	11.74	12.00	12.25	12.48	16.65
	Main Northern Railway	5.40	6.02	6.72	7.30	7.80	8.30	10.86
	Wyong Road	2.99	3.33	3.72	4.11	4.49	4.82	6.91
	Eastern end of Geoffrey Road (near Vesta Close)	1.76	1.80	1.85	2.11	2.31	2.42	3.46
Kangy Angy Creek	Prestons Road	11.04	11.14	11.29	11.39	11.53	11.74	14.09
	Sydney-Newcastle Freeway	9.98	10.13	10.40	10.77	11.11	11.40	14.06
	Pacific Highway	9.42	9.89	10.35	10.70	11.01	11.29	14.00
Windy Drop Down Creek	Sydney-Newcastle Freeway	10.71	10.85	11.09	11.33	11.59	11.86	16.24
Chittaway Creek	Berrys Lane	19.27	19.36	19.48	19.59	19.73	19.90	21.09
	Orange Road	15.02	15.18	15.37	15.50	15.62	15.74	17.03
	Old Chittaway Road	13.08	13.16	13.25	13.32	13.38	13.45	14.89
	Enterprise Drive	11.63	11.85	12.05	12.18	12.30	12.42	14.77
	Main Northern Railway	11.62	11.84	12.03	12.16	12.28	12.40	14.74

Tributary	Location	Peak Stage *(mAHD)*						
		20%	**10%**	**5%**	**2%**	**1%**	**0.5%**	**PMF**
Bangalow Flood runner	Sydney-Newcastle Freeway	12.03	12.53	12.99	13.44	13.78	14.07	17.69
	Pacific Highway	11.84	12.23	12.67	13.11	13.41	13.67	16.88
	Bridge Street	11.76	11.99	12.18	12.30	12.41	12.53	14.74
Dog Trap Gully	Dog Trap Road	19.67	19.74	19.83	19.91	19.98	20.05	21.65
	Pacific Highway	17.11	17.60	17.76	17.83	17.90	17.96	18.93
	Main Northern Railway	15.33	15.47	15.95	16.44	16.85	17.13	18.45
Cut Rock Creek	Detention Basin (near Chamberlain Rd)	24.32	24.34	24.41	24.44	24.48	24.51	24.81
	Tuggerah Street	23.57	23.67	23.76	23.81	23.86	23.90	24.59
	Tall Timbers Estate Bridge	21.75	21.93	22.14	22.29	22.47	22.65	23.81
	Main Northern Railway (upstream)	21.57	21.78	22.02	22.18	22.38	22.57	23.69
	Pacific Highway (upstream)	21.34	21.51	21.70	21.83	21.99	22.12	23.31
	Teralba Street	20.27	20.38	20.51	20.61	20.68	20.84	22.15
	Pacific Highway (downstream)	19.68	19.87	20.08	20.23	20.34	20.55	21.72
	Main Northern Railway (downstream)	19.61	19.79	19.99	20.13	20.24	20.44	21.38
Bangalow Creek	Pryor Road	24.96	25.06	25.25	25.38	25.70	25.87	27.24
	Coachwood Drive	23.35	23.56	23.88	24.01	24.15	24.27	25.72
	Baileys Road	21.03	21.15	21.36	21.47	21.62	21.75	22.97
	Shirley Street	16.22	16.30	16.40	16.50	16.59	16.67	18.63
	Chittaway Road	15.80	15.85	15.92	15.99	16.09	16.21	18.40
	Main Northern Railway	14.27	14.45	14.68	14.85	15.05	15.23	17.59
	Burns Road	14.12	14.28	14.49	14.65	14.84	15.00	17.09

The comparison indicates that the TUFLOW model is producing peak 1% AEP flood levels along the downstream reaches of Ourimbah Creek (i.e., between Wyong Road and the Pacific Highway) that are comparable to previous investigations. Elsewhere across the catchment, the TUFLOW model is producing 1% AEP discharges that are slightly lower than previous investigations. It is considered that this could be a result of:

- **Generally**: The majority of previous investigations made use of simplified 1-dimensional hydraulic models. In general, the ability of 1-D models to account for floodwaters to "escape" along secondary flow paths / flood runners is reliant on the representation of those flow paths in the setup of the model. For example, **Plate 11** shows how secondary flow paths were represented in the 'Bangalow and Cut Rock Creek Flood Study' (1994) in the vicinity of Sohier Park. However, this was the only location in this particular 1D model where secondary flow paths were specifically accounted for. Accordingly, any other locations across the catchment where "breakouts" could occur (in particular, upstream of rail/road embankments) would not be represented by the 1D model (refer **Plate 12** showing an example of a location where breakouts across the floodplain occur that were not previously represented by the 1D model schematisation). The 2D model uses the terrain model to determine how floodwaters move across the catchment. Accordingly, 2D models can better represent these secondary flow paths as well as flood storage areas. The representation of the additional flow paths and full floodplain will typically produce lower flood levels as the flows are not restricted to just the main creek cross-sections.

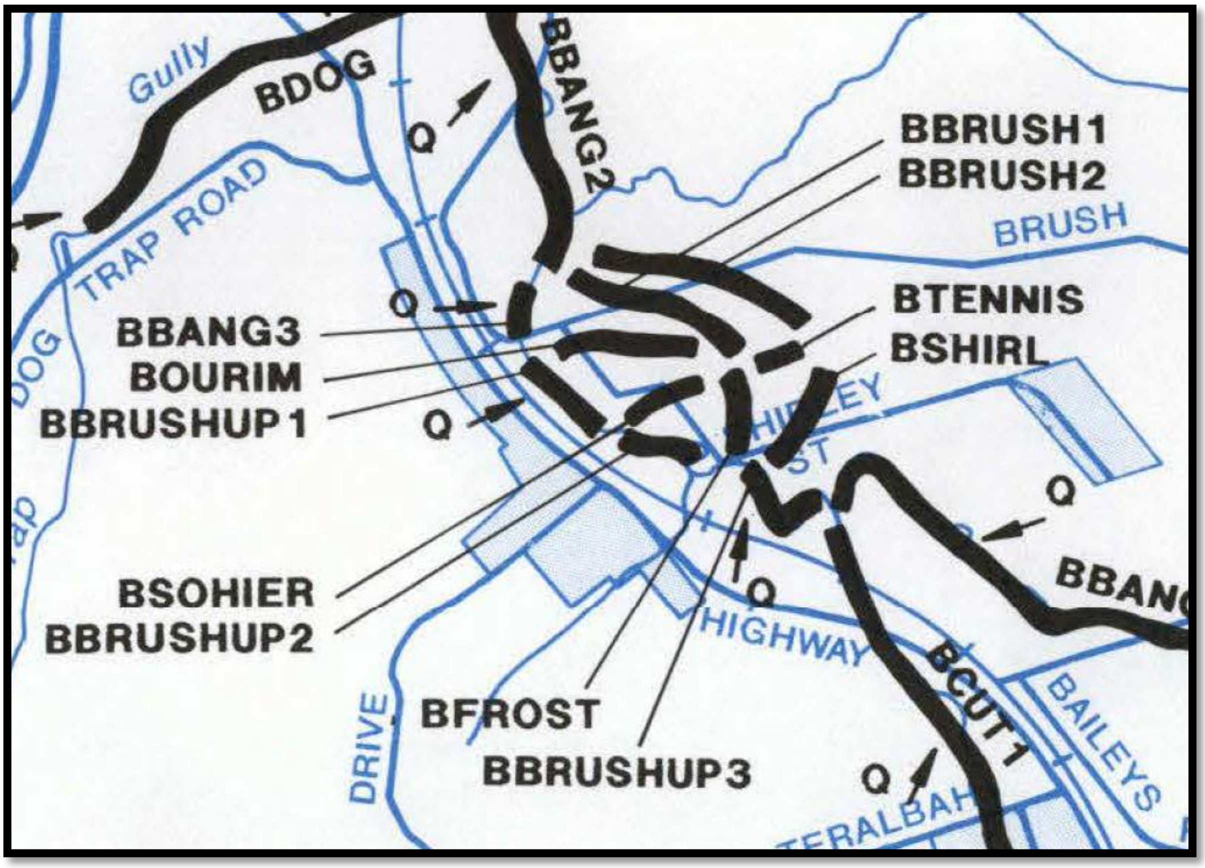


Plate 11 Example of 1D model "branches" setup to represent "break outs" and secondary flow paths across the floodplain (Webb McKeown & Associates, December, 1994)

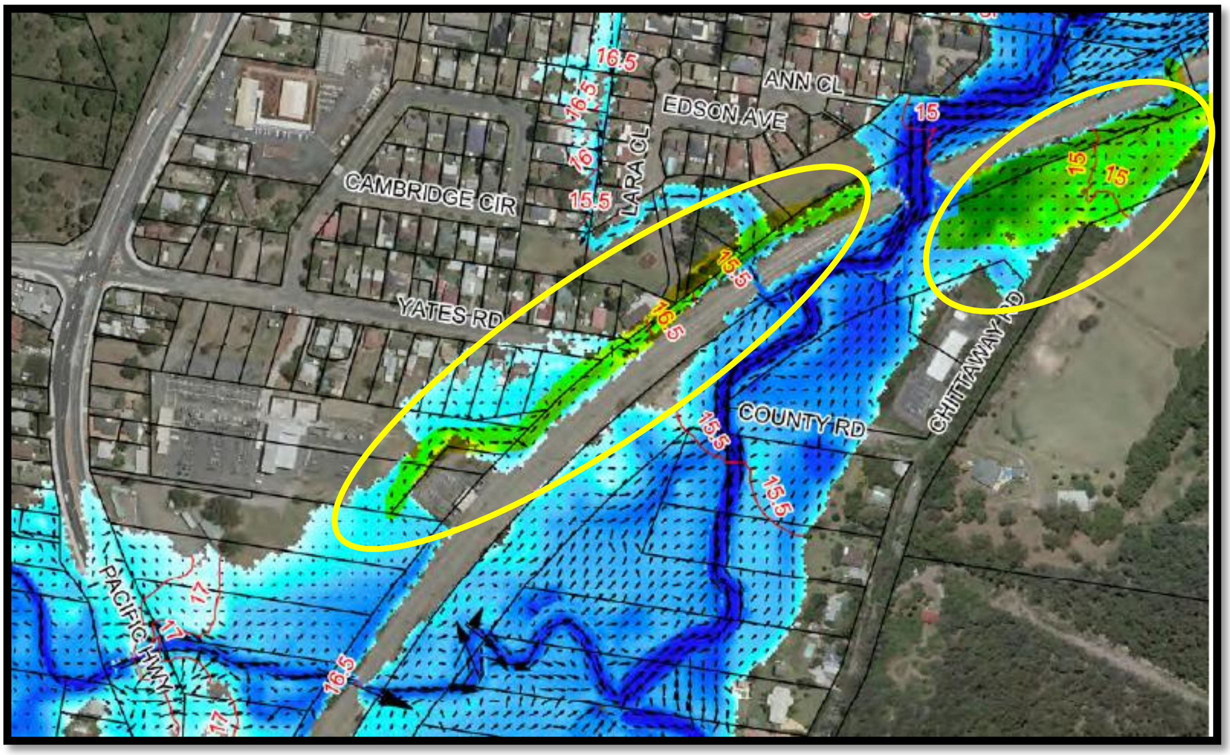


Plate 12 1% AEP floodwater depths and velocities in the vicinity of Ourimbah showing secondary flow paths (highlighted) across floodplains of Dog Trap Gully and Bangalow Creek

- **Cut Rock Creek**: lower flood levels in the vicinity of Teralba Street and Tall Timbers estate relative to previous investigations could be attributed to:
  - lower design peak discharges (refer Section 4.3.5)
  - construction of the Cut Rock Creek Detention Basin
  - the "breakout" of water that occurs upstream of the Main Northern Railway along the eastern side of the railway embankment (refer **Figure 24.17**); and,
  - full representation of the available flood storage area upstream of the Main Northern Railway Line (the hydraulic model cross-sections in the 1994 flood study don't appear to extend laterally to fully 'contain' the 1% AEP flood extent, artificially increasing flood levels in this area - refer **Plate 13**).

Accordingly, although some difference in peak 1% AEP flood levels are observed across the catchment, it is considered these are generally associated with lower peak design discharges as well as more advanced hydraulic modelling software. Overall, it is considered that the outcomes of the verification indicate that the TUFLOW model is producing realistic design flood level estimates.

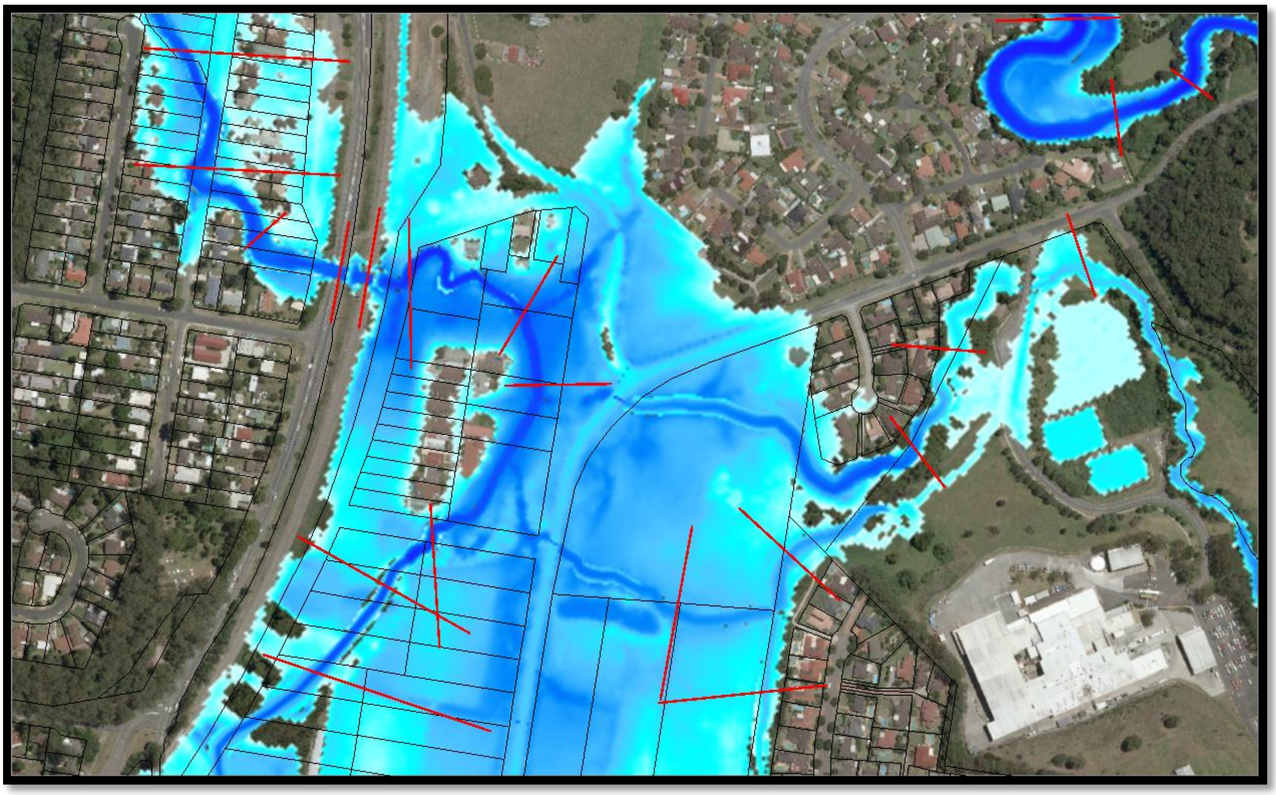


Plate 13 Cross-sections from 'Bangalow and Cut Rock Creek Flood Study (1994) (red lines) and % AEP floodwater depths in the vicinity of Tall Timbers Estate. The cross-sections do not extend far enough to fully contain the 1% AEP extent leading to increases in design floodwater levels.

7 Flood Hazard and Hydraulic Categorisation

7.1 Flood Hazard

Flood hazard effectively defines the impact that flooding will have on development and people across different sections of the floodplain.

The determination of flood hazard at a particular location requires consideration of a number of factors, including (NSW Government, 2005):

- depth and velocity of floodwaters;
- size of the flood;
- effective warning time;
- flood awareness;
- rate of rise of floodwaters;
- duration of flooding; and,
- potential for evacuation.

Consideration of the depth and velocity of floodwater in isolation is referred to as the provisional flood hazard. The provisional flood hazard at a particular area of a floodplain can be established from **Figure L2** of the *'Floodplain Development Manual'* (NSW Government, 2005). This figure is reproduced on the right.

As shown in **Figure L2**, the *'Floodplain Development Manual'* (NSW Government, 2005) divides provisional hazard into two categories, namely high and low. It also includes a "transition zone" between the low and high hazard categories. The provisional hazard categories can subsequently be modified based on consideration of the other factors listed above to form true hazard categories.

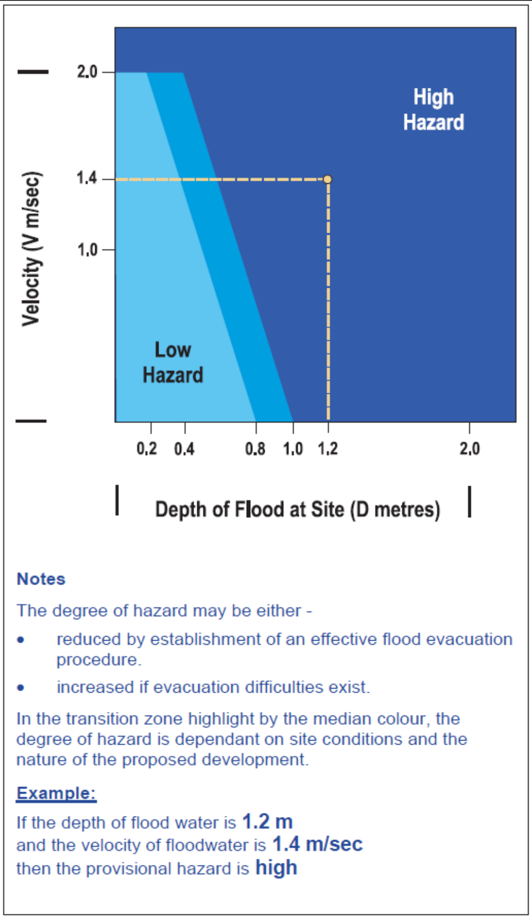


FIGURE L2 - Provisional Hydraulic Hazard Categories

Further discussion on the derivation of provisional and preliminary true hazard categories is provided in the following sections.

7.1.1 Provisional Flood Hazard

The TUFLOW hydraulic software was used to automatically calculate the variation in provisional flood hazard across the Ourimbah Creek catchment based on the criteria shown in Figure L2 for the 1% AEP flood and PMF. These hazard categories are shown in **Figures 29** and **30**.

It needs to be reinforced that the hazard represented in this mapping is provisional only. This is because it is based only on an interpretation of the flood hydraulics and does not reflect the effects of other factors that influence flood hazard (refer following sections).

7.1.2 Flood Emergency Response Planning Classifications

The provisional hazard mapping presented in **Figures 29** and **30** can provide an indication of the risk to life and property across different sections of the floodplain based on the depth and the velocity of floodwaters. Those areas subject to a low flood hazard can, if necessary, be evacuated by trucks and able-bodied adults would have little difficulty wading to safety (NOTE: evacuation by car may not be possible). Those areas of the floodplain exposed to a high flood hazard would have difficulty evacuating by trucks, there is potential for structural damage to buildings and there is possible danger to personal safety (i.e., evacuation by wading may not be possible).

Accordingly, the provisional hazard categories provide an initial appraisal of the variation in flood hazard across the Ourimbah Creek catchment based on the depth and velocity of floodwaters. However, a number of other factors need to be considered to determine the potential vulnerability of the community during specific floods.

In an effort to quantify the other factors that impact on the vulnerability of the community during floods, the Office of Environment and Heritage (formerly Department of Environment and Climate Change), in conjunction with the State Emergency Service (SES) developed the "Flood Emergency Response Planning Classification of Communities" (2007). The guideline was also developed to assist the SES in planning and implementing response strategies for different sections of the floodplain.

The guideline provides a basis for the categorisation of floodplain communities into various Emergency Response Planning (ERP) classifications. The ERP classifications are summarised in **Table 32** and can be used to provide an indication of the type of emergency response required.

Table 29 Response Required for Different Flood ERP Classifications (Department of Environment & Climate Change, 2007)

Classification	Response Required		
	Resupply	**Rescue/Medivac**	**Evacuation**
High Flood Island	Yes	Possibly	Possibly
Low Flood Island	No	Yes	Yes
Area with Rising Road Access	No	Possibly	Yes
Area with Overland Escape Routes	No	Possibly	Yes
Low Trapped Perimeter	No	Yes	Yes
High Trapped Perimeter	Yes	Possibly	Possibly
Indirectly Affected Areas	Possibly	Possibly	Possibly
Not Flood Effected	No	No	No

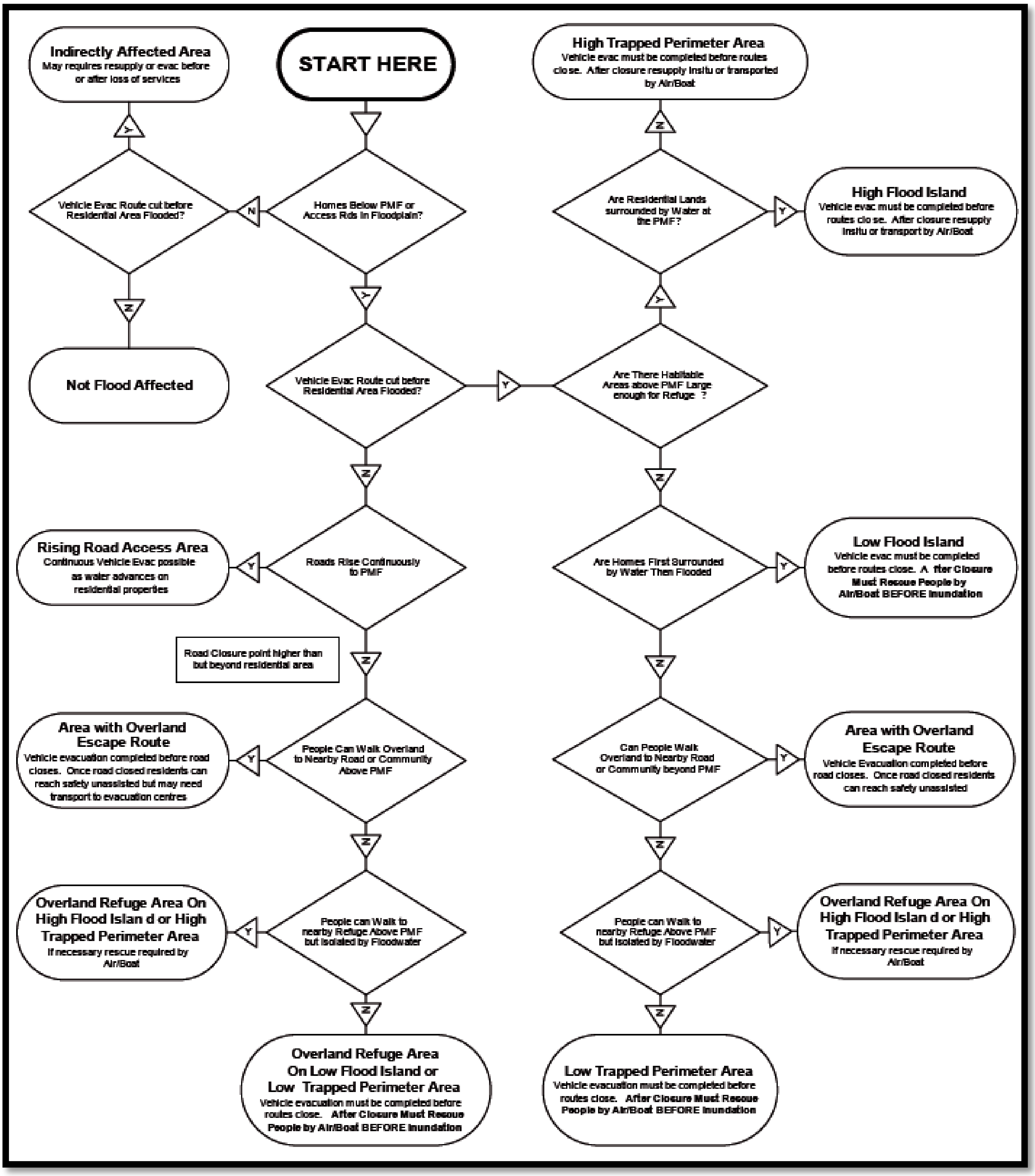


Plate 14 **Flood Emergency Response Classification Flow Chart (Department of Environment & Climate Change, 2007)**

Each allotment within the Ourimbah Creek catchment was classified based upon the flow chart provided in the ERP guideline for both the 1% AEP and PMF (refer **Plate 14**). This was completed in an automated fashion using proprietary software based upon consideration of:

- whether evacuation routes/roadways get "cut off" and the depth of inundation (a 200mm depth threshold was used to define a "cut" road);
- whether evacuation routes continuously rise out of the floodplain (based upon roadway alignments provided by Gosford and Wyong Council's and a 2m LiDAR-based DEM developed for this study);

- whether an allotment gets inundated during the nominated design flood and whether evacuation routes are cut or the lot becomes completely surrounded (i.e., isolated) by water before inundation (a lot was considered inundated when there was less than 250 m^2 of "dry" land area available);
- if evacuation by car was not possible, whether evacuation by walking was possible (a 800mm depth threshold was used to define when a route could not be traversed by walking).

The resulting ERP classifications for each design flood are provided in **Figures 31** to **37**. A range of other datasets were also generated as part of the classification process to assist the SES. This includes the locations were roadways first become cut by floodwaters, the time at which the roadways first become cut, the length of time the roadways are cut as well as the maximum depth of inundation. A selection of this information is also presented in **Figures 31** to **37**.

7.1.3 Preliminary True Flood Hazard

The provisional hazard mapping presented in **Figures 29** and **30** was used in conjunction with the ERP classifications to prepare preliminary true hazard categories for the Ourimbah Creek catchment. The preliminary true hazard categories reflect consideration of the depth and velocity of floodwaters as well as other factors that influence flood hazard, including the potential for isolation and evacuation difficulties.

In general, the provisional hazard categories were retained in the preliminary true hazard mapping. However, the "transitional" provisional flood hazard was changed to a high true flood hazard when subject to the following ERP classifications (due to the flood liability of the land in conjunction with potential evacuation difficulties):

- Low Flood Island;
- Low Trapped Perimeter Area; and,
- Overland Refuge area on Low Flood Island or Low Trapped Perimeter Area.

The preliminary true hazard mapping is presented in **Figures 38** and **39**.

It should be noted that the true hazard categories provided in **Figures 38** and **39** are preliminary and will be finalised during the subsequent Floodplain Risk Management Study for the Ourimbah Creek catchment.

7.2 Hydraulic Categories

The NSW Government's *'Floodplain Development Manual'* (NSW Government, 2005) also characterises flood prone areas according to the hydraulic categories presented in **Table 30**. The hydraulic categories provide an indication of the potential for development across different sections of the floodplain to impact on existing flood behaviour and highlight areas that should be retained for the conveyance and storage of floodwaters.

7.2.1 Adopted Hydraulic Categories

Unlike provisional hazard categories, the *"Floodplain Development Manual"* (NSW Government, 2005) does not provide explicit quantitative criteria for defining hydraulic categories. This is because the extent of floodway, flood storage and flood fringe areas are typically specific to a particular catchment.

However, the *"Floodplain Development Manual"* (NSW Government, 2005) does provide qualitative guidelines to assist in the delineation of hydraulic categories. The *"Floodway Definition"* guideline (Department of Environment and Climate Change, 2007) also provides additional guidance for the definition of floodway extents. These qualitative guidelines are summarised in **Table 30**.

Table 30 Qualitative and Quantitative Criteria for Hydraulic Categories

Hydraulic Category	Floodplain Development Manual Definition	Adopted Criteria*
Floodway	• those areas where a significant volume of water flows during floods • often aligned with obvious natural channels and drainage depressions • they are areas that, even if only partially blocked, would have a significant impact on upstream water levels and/or would divert water from existing flowpaths resulting in the development of new flowpaths. • they are often, but not necessarily, areas with deeper flow or areas where higher velocities occur.	The following criteria were used to provide an initial appraisal of floodway extents. - V x D > 1 m^2/s - D > 0.5 m and - V > 1 m/s Based on this information, floodways were delineated by hand.
Flood Storage	• those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood • if the capacity of a flood storage area is substantially reduced by, for example, the construction of levees or by landfill, flood levels in nearby areas may rise and the peak discharge downstream may be increased. • substantial reduction of the capacity of a flood storage area can also cause a significant redistribution of flood flows.	Areas that are not floodway and where the depth of inundation is greater than 0.3 metres
Flood Fringe	• the remaining area of land affected by flooding, after floodway and flood storage areas have been defined. • development (e.g., filling) in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels.	Areas that are not floodway where the depth of inundation is less than 0.3 metres

NOTES: *Hydraulic categories were only applied to areas subject to inundation (i.e., D > 0m)*
**The adopted criteria were developed specifically for the Ourimbah Creek Catchment only and may not be appropriate for any other areas.*

The results of the design flood simulations were interrogated to assess the potential extent of floodway areas based on the qualitative guidelines listed in **Table 30**. In general, floodways were defined as an area where there was a significant velocity depth product (VxD >1 m^2/s), floodwater depths (i.e., > 0.5 metres) and/or velocities (i.e., >1 m/s). This aimed to identify areas where the majority of flood flows were being conveyed. However, hand delineation of the floodway extents was subsequently completed to refine the final floodway extent and to help ensure continuity of floodways.

The remaining areas of the floodplain (i.e., those areas not designated as floodways) were subdivided into either flood storage or flood fringe areas. Flood storage areas were designated as areas where the depth of floodwater was greater than 0.3 metres and flood fringe areas were designated as areas where the depth of water was less than 0.3 metres.

The resulting hydraulic category maps for the 1% AEP flood and PMF are shown in **Figures 40** and **41**.

7.2.2 Hydraulic Category Verification

Floodway

In order to verify the suitability of the delineated floodways, additional checks were performed in accordance with recommendations outlined in the former DECC (now OEH) *"Floodway Definition"* (Department of Environment & Climate Change, 2007) guideline. This involved blocking sections of the delineated floodways and quantifying the impact that this blockage had on peak flood levels as well as the distribution of floodwaters in the vicinity of the blockage during the 1% AEP flood. The outcomes of this assessment are presented in **Appendix J** as **Plates J1** to **J4** (blockage locations are highlighted in Black/Red).

The flood level difference mapping shows that partial blockage of the delineated floodway extents would increase peak flood levels by ~0.3 metres in most instances. This is considered to be a "significant impact" on upstream water levels. The depth and velocity mapping also shows that the blockages would cause a significant redistribution of floodwaters in most instances. That is, a significant proportion of floodwaters would be forced into areas that weren't previously conveying a significant amount of the total flow.

The results depicted in **Plates J1** to **J4** are considered to be consistent with the qualitative floodway descriptions outlined in the *'Floodway Definition'* guideline and indicate that the delineated floodway extents are reasonable.

Flood Storage

The *"Floodplain Development Manual"* (NSW Government, 2005) states that flood storages are areas that are important for the temporary storage of water during the passage of a flood. Therefore, they are areas that are typically exposed to deep, but slow moving water.

The suitability of the delineated flood storage areas was verified by increasing the Manning's 'n' value assigned to storage areas to 0.2 and re-simulating the 1% AEP flood. The results of the simulations were then reviewed to determine if the increases in Manning's 'n' produced an unacceptable increase in flood level. Flood level difference mapping was prepared and is presented in **Appendix J** as **Plates J5** to **J6**.

The difference mapping indicates that increasing the roughness of all flood storage areas will increase peak 1% AEP flood levels by less than 0.25 metres. In most cases, the increases in peak 1% AEP flood level are between 0.05 and 0.15 metres. Given the significant increase in Manning's 'n' across the flood storage areas it is considered that increases in peak flood level of this magnitude are reasonable. Accordingly, it is suggested the extent of the flood storages is appropriate.

Flood Fringe

Flood fringes are areas that, by definition, can be completely filled without having a significant impact on flood behaviour. Therefore, in order to verify the suitability of the delineated flood fringe areas, an additional 1% AEP simulation was completed incorporating filling of all flood fringe areas. Flood level difference mapping was prepared based on the outcomes of the additional simulation and is presented in **Appendix J** as **Plate J7**.

The difference mapping indicates complete filling of all flood fringe areas will typically increase peak 1% AEP flood levels by between 0.05 and 0.08 metres. The maximum increase in peak flood in predicted to be about 0.12 metres. This is considered to be a relatively minor impact and indicates that adopted flood fringe extents are reasonable.

8 Climate Change Assessment

8.1 General

Climate change refers to a significant and lasting change in weather patterns arising from both natural and/or human induced processes. The Office of Environment and Heritage's (formerly Department of Environment, Climate Change and Water) *'Practical Consideration of Climate Change'* states that climate change is expected to have adverse impacts on sea levels and rainfall intensities into the future.

Increases in rainfall intensities would produce increases in runoff volumes and discharges across the catchment. This, in turn, would likely produce an increase in the depth, extent and velocity of floodwaters.

Although the lower reaches of Ourimbah Creek are not influenced by the tide, it is likely that an increase in ocean level would produce a commensurate increase in Tuggerah Lake level. This has the potential to increase the depth and extent of inundation across the lower reaches of the Ourimbah Creek catchment during flood and non-flood times. Elevated lake levels would also make it more difficult for water from the Ourimbah Creek catchment to drain into Tuggerah Lake during floods.

This flood study will form the basis for defining flood behaviour for a number of years into the future. It will also form the basis for the future Floodplain Risk Management Study, where a range of flood risk mitigation measures will be evaluated. Therefore, it is important that potential climate change impacts are quantified so that development decisions and the robustness of flood risk mitigation measures can be assessed in an informed manner.

The following sections describe the process that was employed to quantify potential climate change impacts on flooding across the Ourimbah Creek catchment.

8.2 Rainfall Intensity Increases

8.2.1 General

It is forecast that the projected frequency of weather patterns responsible for the formation of east coast lows (the main flood producing weather mechanism for the Ourimbah Creek catchment) will increase in the future. This will likely produce a commensurate increase in the frequency of high rainfall events (Blackmore & Goodwin, 2009). Available information indicates that extreme rainfall intensities could increase by between 2% and 24% by 2070 (Department of Environment and Climate Change, 2007).

Due to the wide potential variability of future increases in rainfall intensities, the *'Practical Consideration of Climate Change'* (Department of Environment and Climate Change, 2007) provides guidelines for quantifying the potential impacts of these changes. The guideline states that additional simulations should be completed with 10%, 20% and 30% increases in rainfall intensities to quantify the potential impacts associated with climate change on future rainfall.

8.2.2 Increase in Rainfall Intensity Simulations

The XP-RAFTS model was used to perform additional simulations incorporating increases in rainfall intensity of 10%, 20% and 30% of the 1% AEP design rainfall in accordance with the OEH guideline. Complete listings of peak discharges for each subcatchment for each simulation are provided in **Appendix K**.

The results provided in **Appendix K** show that a 10% increase in peak 1% AEP design rainfall intensities will increase peak 1% AEP discharges by about 14%, on average. The results also show that a 20% and 30% increase in design rainfall intensities will increase peak 1% AEP discharges by about 29% and 44% respectively. Accordingly, increases in future rainfall intensities of this magnitude have the potential to significantly increase design discharge estimates across the catchment. The most significant increases in design discharge are predicted to occur across the developed sections of the catchment, where there is less opportunity for rainfall infiltration/interception.

The discharge hydrographs from the XP-RAFTS simulations were also applied to the TUFLOW hydraulic model to determine the impact of increases in rainfall intensity on peak 1% AEP flood levels. Peak flood levels at select locations were extracted from the results of the modelling and are included in **Appendix L**.

The peak flood levels provided in **Appendix L** indicate that increases in rainfall intensity of 10%, 20% and 30% have the potential to increase average peak 1% AEP flood level estimates by 0.2m, 0.4m and 0.5m respectively. Accordingly, if increases in rainfall intensity at the upper end of this range do occur in the future, it does have the potential to cause a significant increase in the severity of flooding across the entire catchment. The most significant increases in flood level are predicted to occur across the downstream sections of the catchment (i.e., east of the Pacific Highway) and, in particular, in the vicinity of bridges/culverts where the increased flows in conjunction with partial blockage of structures amplifies the flood level impacts.

8.3 Sea Level Rise Impacts

8.3.1 General

Historic analysis of sea levels between 1870 and 2001 indicate that global mean sea levels rose by 0.2 metres. However, the current global average rate of increase is approximately twice the historical average and sea levels are expected to continue rising throughout the twenty first century (New South Wales Government, October 2009). The best projections of sea level rise along the NSW coast are for an increase of 0.4 metres by 2050 and an increase of 0.9 metres by 2100 (New South Wales Government, October 2009).

In recognition of the potential for increases in sea level to increase the flood risk across the downstream reaches of Ourimbah Creek, additional analyses were completed. This involved assessing the potential impact of the following sea level rise scenarios on flooding across Ourimbah Creek catchment.

- 2050 projected sea level rise: 0.4 metres; and,
- 2100 projected sea level rise: 0.9 metres.

8.3.2 Sea Level Rise Simulations

To assess the potential for sea level rise to increase the severity of flooding across the catchment, additional 1% AEP simulations were completed incorporating the projected 2050 and 2100 sea level increases. Accordingly, the 'base' 1% synthetic stage hydrographs for Tuggerah Lake were modified to incorporate the 0.4 metre and 0.9 metre sea level increase and were used to re-simulate the 1% AEP flood. A summary of the adopted Tuggerah Lake design stages for both scenarios are included on **Table 31**.

Table 31 Tuggerah Lake Design Water Levels for Sea Level Increase Analysis

Time	**AEP / Peak Stage** (mAHD)		
	'Base' Conditions	**0.4m Sea Level Increase**	**0.9m Sea Level Increase**
Peak Tuggerah Lake Stage	2.23	2.63	3.13
Tuggerah Lake Stage at Peak Ourimbah Creek Outflow	1.67	2.07	2.57

The resulting depth and velocity vector mapping is presented in **Figures 42** (0.4m sea level increase) and **Figure 43** (0.9m sea level increase). The predicted extent of inundation for "baseline" 1% AEP conditions is superimposed on **Figures 27** and **28** for comparison. Peak flood levels at select locations were also extracted from the results of the modelling and are included in **Appendix L**.

The inundation extents presented in **Figure 42 and 43** show that extensive lake foreshore, roadways and residential properties are predicted to be inundated across the lower reaches of Ourimbah Creek (i.e., downstream of Wyong Road). Increases in the extent and depth of inundation are predicted to extend upstream to Janian Close (500m downstream of Wyong Road) for the 0.4 metre increase scenario and to Wyong Road for the 0.9 metre scenario. Upstream of these locations, sea level/Tuggerah Lake stage increases are predicted to have negligible impact on existing flood behaviour.

Accordingly, sea level rise and the associated rise in Tuggerah Lake level does have the potential to increase the number of properties exposed to inundation. However, the impacts are generally restricted to that section of the Ourimbah Creek floodplain located downstream of Wyong Road.

9 Sensitivity Analysis

9.1 General

Hydrologic and hydraulic computer models require the adoption of several parameters that are not necessarily known with a high degree of certainty. Each of these parameters can impact on the results generated by the model.

Hydrologic and hydraulic computer models are typically calibrated using recorded rainfall, stream flow and/or flood mark information. Calibration is achieved by adjusting the parameters that are not known with a high degree of certainty until the computer models reproduce the recorded flood information. Calibration is completed in an attempt to ensure the adopted model parameters are generating realistic estimates of flood behaviour.

As discussed in Section 4.3 and 5.3, the XP-RAFTS hydrologic and TUFLOW hydraulic models were calibrated and verified against three past floods. In general, the models were found to provide a reasonable reproduction of past floods.

Nevertheless, it is important to understand how any uncertainties in model input parameters may impact on the results produced by the model. Therefore, a sensitivity analysis was undertaken to establish the sensitivity of the results generated by the computer model to changes in model input parameter values. The outcomes of the sensitivity analysis are presented below.

This section also includes a discussion on the confidence limits that can be expected based on statistical assessment of the sensitivity analysis and climate change simulation results.

9.2 Hydrologic Model

9.2.1 Initial Loss / Antecedent Conditions

An analysis was undertaken for the 1% AEP storm to assess the sensitivity of the results generated by the XP-RAFTS model to variations in antecedent wetness conditions (i.e., the dryness or wetness of the catchment prior to the design storm event). A catchment that has been saturated prior to a major storm will have less capacity to absorb rainfall. Therefore, under wet antecedent conditions, there will be less “loss” of rainfall and consequently more runoff.

The variation in antecedent wetness conditions was represented by increasing and decreasing the initial rainfall losses in the XP-RAFTS model and re-simulating the 1% AEP flood. A complete listing of peak discharges for each XP-RAFTS subcatchment is provided in **Appendix M**.

The results of the initial loss sensitivity analysis show that decreasing the initial losses (i.e., representing a “saturated” catchment) would typically increase the peak discharges generated by the model by 8%, on average. Increasing the initial losses (i.e., representing a “dry” catchment) would decrease peak discharges by 5% (on average).

Therefore, it can be concluded that the XP-RAFTS model is moderately sensitive to changes in the adopted initial losses. *'Australian Rainfall & Runoff'* (Engineers Australia, 1987) suggests adopting an initial loss of between 10 mm and 30 mm for design flood estimation. The adopted initial loss of 15 mm is towards the lower end of the suggested range and would, therefore, provide reasonably conservative design flood discharge estimates.

9.2.2 Continuing Loss Rate

An analysis was also undertaken to assess the sensitivity of the results generated by the XP-RAFTS model for the 1% AEP event to variations in the adopted continuing loss rates. Accordingly, the XP-RAFTS model was updated to incorporate increased and decreased continuing loss rates and was used to re-simulate the 1% AEP flood. A complete listing of peak discharges for each XP-RAFTS subcatchment is provided in **Appendix M**.

The results of the sensitivity analysis show that the XP-RAFTS model is relatively insensitive to changes in continuing loss rates. Increasing the adopted continuing loss values is predicted to decrease peak 1% AEP discharges by an average of 2%. Decreasing the adopted loss rates is predicted to increase peak discharges by an average of about 3%.

Therefore, it can be concluded that any uncertainties associated with the adopted continuing loss rates are not predicted to have a significant impact on the results generated by the XP-RAFTS model.

9.3 Hydraulic Model

9.3.1 Bridge/Culvert Blockage

As discussed in Section 6.4.3, blockage factors ranging between 10% and 50% were applied to all bridges and culverts in the TUFLOW hydraulic model. Additional TUFLOW simulations were completed to determine the impact that alternate blockage scenarios would have on simulated flood behaviour. Specifically, additional 1% AEP simulations with no blockage as well as complete blockage of culverts/bridges at the following locations were completed:

- Wyong Rd Bridge crossing of Ourimbah Creek
- Railway Bridge crossing of Ourimbah Creek (Upstream of Tuggerah Business Park)
- Pacific Hwy crossing of Ourimbah Creek
- Northbound Sydney Newcastle Freeway crossing of Ourimbah Creek
- Footes Rd crossing or Ourimbah Creek
- Palmdale Road culvert crossing of Canada Drop Down Creek
- Railway Crossing of Chittaway Creek (near Turpentine Road underpass)
- Burns Road crossing or Bangalow Creek
- Chittaway Road crossing of Bangalow Creek
- Pacific Highway crossing of Dog Trap Gully
- Shirley Street crossing of Bangalow Creek
- Teralba Street crossing of Cut Rock Creek

- Pacific Hwy crossing of Cut Rock Creek
- Railway crossing of Cut Rock Creek)
- Tuggerah St crossing of Cut Rock Creek (immediately downstream of Lisarow Public School)

Peak floodwater depths, levels and velocity vectors were extracted from the results of the modelling and are presented in **Figure 27** (no blockage) and **Figure 28** (complete blockage). The predicted extent of inundation for "baseline" 1% AEP conditions is superimposed on **Figures 27** and **28** for comparison. Tabulated flood level comparisons are also provided at select locations across the catchment in **Appendix N**.

The results documented in **Figure 27**, **Figure 28** and **Appendix N** show that complete blockage typically increases the severity of flooding upstream of blocked bridges and culverts, while decreasing the severity of flooding downstream of blocked bridges and culverts. For example, complete blockage of the Pacific Highway / Main Northern Railway crossings of Cut Rock Creek at Lisarow is predicted to significantly increase the extent and depth of inundation across Tall Timbers Estate. However, the “damming” effect caused by this blockage is predicted to reduce the extent of flooding downstream of the Pacific Highway (e.g., Teralba Street) (refer **Figure 28.17**).

With complete blockage of bridges and culverts, water must typically “build up” behind the road/rail embankment until it overtops. Accordingly, the magnitude of the flood level increase is largely driven by the height of the embankment. As a result, the most significant increases in flood level associated with blockage typically coincide with locations where the embankment height is greatest (e.g., Wyong Road, Main Northern Railway). Peak 1% AEP flood level increases of over 2 metres are predicted at some of these locations. It is noted that upstream of the Pacific Highway/F3 Freeway crossing, water does not actually overtop the roadway embankments, but is forced along the Bangalow Creek flood runner. Accordingly, blockage of structures not only has the potential to increase peak water levels, but it also has the potential to divert water along other flow paths.

The no blockage scenario typically increases the severity of flooding downstream of the pipes/culverts and decreases the severity of flooding upstream of pipes/culverts. The magnitude of the reduction in peak 1% AEP flood level is typically less than 50 mm, although decreases of over 0.5 metres are predicted at isolated locations. The smaller magnitude of the flood level decreases is associated with the majority of bridges and culverts having just 10% blockage applied. Accordingly, a reduction in blockage of just 10% is predicted to have only a relatively small impact on peak 1% AEP flood levels.

The results of the blockage simulations show some significant changes in 1% AEP flood levels at some locations relative to the “standard” blockage scenario. Accordingly, it is considered that the hydraulic model is relatively sensitive to variations in culvert and bridge blockage. This outcome emphasises the need to ensure key drainage infrastructure and bridges/culverts are well maintained (i.e., debris is removed on a regular basis).

9.3.2 Manning’s ‘n’

Manning’s’ ‘n’ roughness coefficients are one of the primary hydraulic model inputs and calibration parameters. They are used to describe the resistance to flow afforded by different land uses / surfaces across the catchment. However, they can be subject to variability (e.g., vegetation density in the summer would typically be higher than the winter leading to higher Manning's 'n' values). Therefore, additional analyses were completed to quality the impact that any uncertainties associated with Manning's 'n' roughness values may have on predicted design flood behaviour.

The TUFLOW model was updated to reflect an increase and a decrease in the adopted design Manning's 'n' values of 20% and additional 1% AEP simulations were completed. Peak flood levels were extracted from the results of the modelling at select locations across the catchment and are presented in **Appendix N**.

The results listed in **Appendix N** show that increasing or decreasing the Manning's 'n' values by 20% will alter peak 1% AEP flood levels by around 0.1 metres, on average. More significant changes in peak flood level are predicted in the vicinity of bridges and culverts, where the combined effect of increases in Manning's 'n' and culvert/bridge blockage amplify the flood level differences.

In general, it is considered that the model is relatively insensitive to changes in Manning's 'n' values. However, flood level differences in the vicinity of bridges and culverts can be more substantial. Therefore, care should be taken when interpreting flood level results in the vicinity of hydraulic structures.

9.3.3 Tailwater / Tuggerah Lake Level

Hydraulic models require the adoption of a suitable downstream water level as part of any flood simulation. Synthetic design stage hydrographs were derived for each design simulation based upon observations of past floods. However, it is unlikely that all future floods will be consistent with these assumptions. Therefore, the results of the climate change ocean increase simulations were reviewed to quantify the potential for the adopted tailwater to impact on peak flood level estimates.

As previously discussed in Section 8.3, increases in Tuggerah Lake level do have the potential to increase 1% AEP flood levels. However, the increases are restricted to the lower reaches of Ourimbah Creek located downstream of Wyong Road.

9.4 Computer Model Confidence Limits

As discussed, the development of computer models requires the specification of parameters that are not always known with a high degree of certainty. The computer models that were created as part of this study were developed based upon best estimates of model parameters. The models were subsequently shown to produce realistic results relative to available historic flood information. Accordingly, the computer models are considered to provide a reasonable estimate of design flood behaviour across the catchment for existing conditions.

However, the outcomes of the climate change assessment and sensitivity analysis indicate that the design flood level estimates may be subject to variations if one or more of the input variables change (e.g., culvert blockage, rainfall intensities, hydraulic roughness). Accordingly, the model input parameters and design flood level estimates presented in this report are subject to some uncertainty.

In recognition of this uncertainty, additional statistical analyses were completed based upon the outcomes of the various sensitivity and climate change analyses in an attempt to assign "confidence limits" to the peak 1% AEP flood level estimates. Peak 1% AEP flood levels from each sensitivity/climate change run were extracted at each TUFLOW model grid cell and compared with "base" 1% AEP flood levels. This enabled flood level differences to be calculated at over three million different locations across the catchment which, in turn, enabled basic flood level difference statistics to be calculated (e.g., mean flood level difference and standard deviation of difference). Assuming a normal distribution of flood level differences, the 95% confidence limits can be estimated as the mean flood level difference ± two standard deviations.

Plate 15 shows an example of the distribution of flood level differences from one of the sensitivity analyses. It indicates the normal flood level distribution assumption is a reasonable approximation. It also shows that small differences in water levels are much more common than large differences.

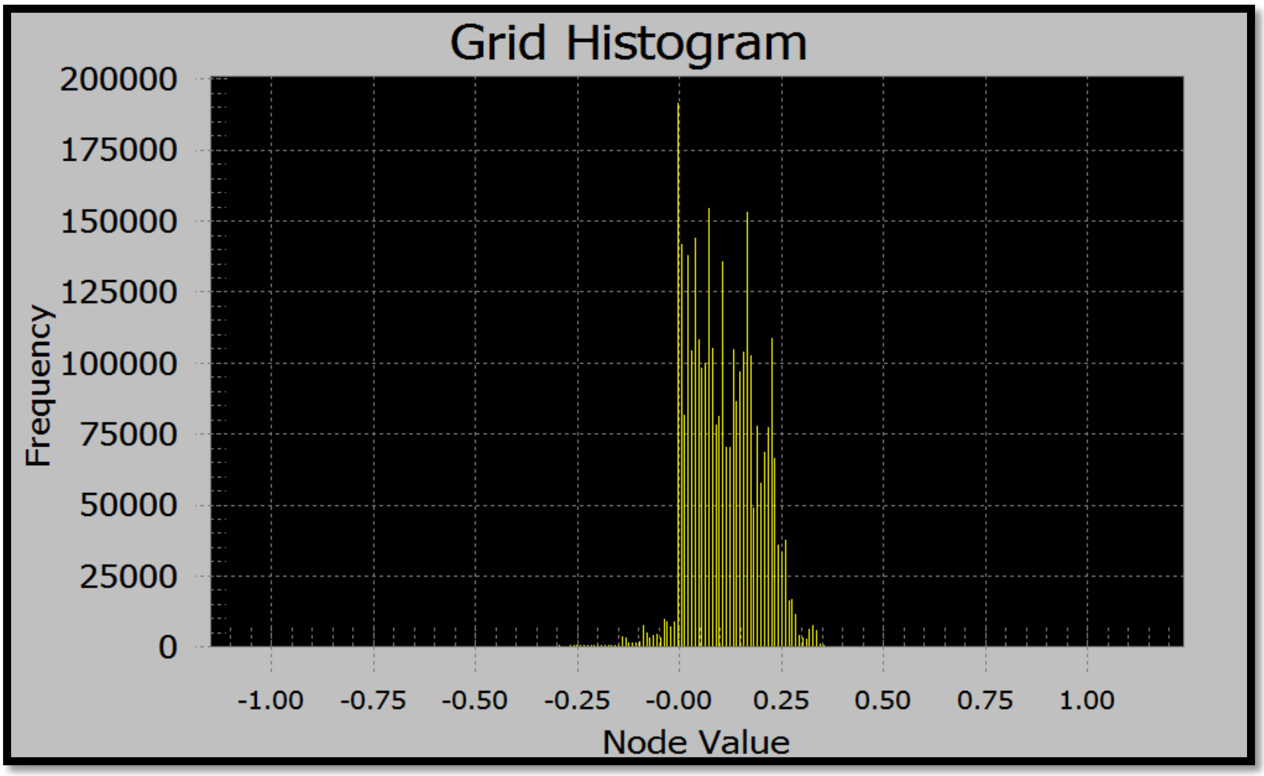


Plate 15 **Distribution of differences in 1% AEP flood levels between 20% increase in Manning's 'n' simulation and "base" 1% AEP flood simulation**

The outcomes of this analysis are summarised in **Table 32**. It shows that the mean difference in flood levels across most of the sensitivity / climate change simulations is typically less than 0.3 metres.

The outcomes of the blockage sensitivity analysis show that blockage of structures has a potential to cause some large differences in peak 1% AEP flood levels (refer Section 9.3.1). Consequently, the 95% confidence limits are quite large. However, it should be noted that in most circumstances, bridges and culverts will not be completely blocked during a flood. Accordingly, the 100% blockage scenario is considered to be conservative. Nevertheless, it does show the large impact that blockage of structures has on flood behaviour and the key role that these blockage assumptions have on flood behaviour.

Table 32 Summary of Peak Flood Level Confidence Limits

Sensitivity Analysis		Flood Level Difference Statistics* (m)		95 % Confidence Limits
		Mean	Std Deviation	
Initial Loss	10mm	0.09	0.07	+0.23 -0.04
	30mm	-0.08	0.06	+0.05 -0.20
Continuing Loss	2.5mm/hr	0.10	0.07	+0.25 -0.05
	5.0mm/hr	-0.08	0.07	+0.07 -0.22
Manning's 'n'	-20%	-0.11	0.10	+0.09 -0.31
	+20%	0.15	0.10	+0.35 -0.05
Bridge / Culvert Blockage	No Blockage	-0.04	0.12	+0.20 -0.28
	Complete Blockage	0.35	0.65	+1.65 --0.95
Climate Change	10% Increase in 1% AEP Rainfall Intensity	0.16	0.13	+0.42 -0.10
	20% Increase in 1% AEP Rainfall Intensity	0.30	0.20	+0.70 -0.10
	30% Increase in 1% AEP Rainfall Intensity	0.45	0.32	+1.09 -0.19
	1% AEP Event with 0.4m Increase in Ocean Level	0.02	0.10	+0.22 -0.18
	1% AEP Event with 0.9m Increase in Ocean Level	0.08	0.23	+0.54 -0.38
Adopted 95% Confidence Limits (excluding climate change)				± 0.3
Adopted 95% Confidence Limits (including climate change)				± 0.5

NOTE: * Flood level difference statistics were calculated based upon the difference in peak flood level estimates from the various sensitivity analyses relative to the 'base' 1% AEP flood results documented in Section 6.4. The flood level comparisons were completed at every TUFLOW model grid cell (i.e., every 8m west of F3 Freeway and every 4m east of F3 Freeway).

The mean difference for the 30% increase in rainfall intensity climate change assessment does approach 0.5 metres. This confirms the outcomes of the climate change sensitivity analysis discussed in Section 8.3, which indicates that increases in rainfall intensity of 30% has the potential to significantly increase the severity of flooding across the Ourimbah Creek catchment.

Table 32 also indicates that the 95% confidence limits for the non-climate change sensitivity simulations is generally less than ± 0.3 metres. That is, if considering computer model-related uncertainties only, the 1% AEP flood levels presented in Section 6.4 are reliable to within ± 0.3 metres. However, as previously discussed, blockage of structures does have the potential to increase flood levels beyond these confidence limits. Accordingly, larger confidence freeboard limits should be considered in the vicinity of structures to account for blockage potential.

When climate change uncertainties are also considered, there is also a greater level of uncertainty. Specifically, if increases in rainfall intensity of 30% do occur in the future, it has the potential to increase flood levels significantly in some locations leading to comparatively large confidence limits. Current best estimates indicate extreme rainfall intensities in the Hunter/Central Coast will increase by up to 12% by 2030 and 10% by 2070 with a decrease in rainfall intensity just as likely as an increase (Department of Environment and Climate Change, 2007). So it is considered that the 30% increase in rainfall intensity and potentially the 20% increase in rainfall intensity scenarios may be overly conservative for establishing climate change confidence limits. As more information becomes available regarding climate-change induced rainfall impacts, more definitive confidence limits can be provided. However, based on current knowledge it is suggested that confidence limits of ± 0.5 metres be adopted for consideration of climate change uncertainties (based on the outcomes of the 10% increase in rainfall results). Larger confidence limits may be considered across the lower reaches of Ourimbah Creek (i.e., downstream of Wyong Road) where climate change –induced increases in Tuggerah Lake levels may cause increase in 1% AEP flood levels of up to 0.9 metres by 2100.

As previously discussed, the confidence limits are based upon a comparison of flood levels at each TUFLOW model grid cell (i.e., 8m intervals for the hydraulic model area west of the F3 Freeway and 4 metre intervals for the model area east of the Freeway). Localised increases beyond the 95% limits may occur at some locations. Therefore, consideration of larger confidence limits/freeboard may be considered in particularly sensitive areas of the catchment (e.g., in the immediate vicinity of bridges/culverts where blockage may be prevalent).

10 Discussion

10.1 General

The results of the design flood modelling show that:

- Flood behaviour across the lower reaches of Ourimbah Creek is strongly influenced by the prevailing water level in Tuggerah Lake at the time of the flood. During the 1% AEP flood, design flood levels are influenced by Tuggerah Lake as far upstream as Wyong Road. However, it is only the lower 1.5 km of Ourimbah Creek where Tuggerah Lake generates the "worst case" flood levels relative to catchment runoff-induced flood levels.
- Floodwaters are predicted to impact on a number of properties, key infrastructure and transportation routes. Areas that are particularly susceptible to inundation include:
  - Cut Rock Creek between Teralba Street and Pluim Park (including Tall Timbers Estate).
  - Rural residential properties serviced by Enterprise Drive/Orchard Road.
  - Sohier Park/University of Newcastle area.
  - Isolated rural properties upstream of the Sydney-Newcastle Freeway (e.g., Palmdale Crematorium).
  - Chittaway Point (this area can be impacted by flooding from catchment runoff as well as elevated water levels within Tuggerah Lake).
- The Tuggerah Business Park and railway levees are predicted to offer protection during all events up to the 1% AEP flood. The railway levee is predicted to overtop during the PMF and the Tuggerah Business Park levee is predicted to be overtopped during the 0.5% event.
- Significant depths of inundation and velocities are predicted across large sections of the catchment during the 1% AEP flood. Accordingly, a large proportion of the catchment would be exposed to a high flood hazard.

Further detailed discussion on the impact of flooding on key infrastructure and transportation routes is provided below.

10.2 Impact of Flooding on Key Facilities

10.2.1 Key Infrastructure

There is significant infrastructure located within the Ourimbah catchment that can play a key role in emergency response management during floods. As such, it was considered important to assess the impact of flooding on these facilities to determine their suitability for use during floods.

Such infrastructure includes:

- **Fire Stations**:
  - ***Berkeley Vale Fire and Rescue*** (8 Craftsman Avenue, Berkeley Vale): not predicted to be directly impacted by floodwaters during the 1% AEP flood. However, it is predicted to be inundated to depths of around 2 metres during the PMF. Accordingly, it may not be suitability for use during very rare floods.

  - ***Ourimbah Rural Fire Brigade*** (10 Ourimbah Creek Road, Ourimbah): not predicted to be directly impacted by floodwaters during the 1% AEP flood or PMF. However, access along the Pacific Highway and Ourimbah Creek Road to the fire station may be cut during both events.
- **Police Stations**: There are no police stations located within the catchment;
- **State Emergency Service**: There are no SES buildings located with the catchment;
- **Ambulance Stations**: There are no ambulance stations located within the catchment;
- **Hospitals**: There are no hospitals located within the catchment;
- **Schools:**
  - ***Lisarow High School*** (Chamberlain Road, Lisarow): this school is not predicted to be inundated during any design flood up to and including the PMF. However, access to and from the school may be cut for a period during large floods due to overtopping of Chamberlain and Taylor Roads.
  - ***Lisarow Public School*** (Macdonalds Road, Lisarow): although the habitable areas of the school are predicted to remain flood free at the peak of the 1% AEP flood, the school is predicted to be completely surrounded by water. Accordingly, access to the school may be prevented during the 1% AEP flood for several hours.
  - ***University of Newcastle*** (The Boulevard, Ourimbah): Although the majority of buildings across the campus are predicted to remain above the peak 1% AEP flood level, the main access roads to/from the campus (i.e., Shirley Street, Chittaway Road) are predicted to be inundated. The southern car park is also predicted to be inundated. Accordingly, there is potential for evacuation difficulties and/or damage to cars. During the PMF a significant number of campus buildings are predicted to be inundated.
  - ***Ourimbah Public School*** (Pacific Highway, Ourimbah): A small watercourse drains through the middle of the school and is predicted to overtop its banks during the 1% AEP flood. Accordingly, floodwaters are predicted to surround several buildings during the 1% AEP event. Access to/from the school may also be prevented for a few hours due to inundation of the Pacific Highway on either side of the school.
  - ***Chittaway Bay Public School*** (Chittaway Road, Chittaway Bay): The school is not predicted to be inundated during the 1% AEP flood. However, depths of 1-1.5 metres are predicted at the peak of the PMF.
- **Aged Care Facilities**
  - ***The Orchard Retirement Village*** (Taylor Road, Lisarow): Habitable areas of the retirement village are predicted to remain "flood free" during all floods up to an including the PMF. However, the water feature near the north-eastern corner of the development would function as a high hazard floodway during the 1% AEP and PMF events. Access to the village may also be cut for a period due to inundation of Chamberlain and Taylor Roads.
- **Other Facilities**
  - ***Chickadee Factory*** (off Cut Rock Road): is predicted to remain above the peak level of the PMF. Accordingly, it has the potential to serve as a local evacuation refuge during all floods. The main access to the property is predicted to be overtopped by floodwaters during the 1% AEP flood. However, the depths of inundation are typically less than 0.3 metres indicating they could potentially be traversed by vehicles.

The outcomes of this assessment are also summarised in **Table 33**.

Table 33 Impact of Flooding on Key Infrastructure

Key Infrastructure		1% AEP Flood		PMF	
		Inundated?	Access Cut?	Inundated?	Access Cut?
Fire Stations	*Berkeley Vale Fire and Rescue* (8 Craftsman Avenue, Berkeley Vale)			☑	☑
	Ourimbah Rural Fire Brigade (10 Ourimbah Creek Road, Ourimbah)		☑	☑	
Police Stations		There are no police stations located within the catchment			
State Emergency Service		There are no SES buildings located with the catchment			
Ambulance Stations		There are no ambulance stations located within the catchment			
Hospitals		There are no hospitals located within the catchment			
Schools	*Lisarow High School* (Chamberlain Road, Lisarow)				☑
	Lisarow Public School (Macdonalds Road, Lisarow)	☑	☑	☑	☑
	University of Newcastle (The Boulevard, Ourimbah)	☑	☑	☑	☑
	Ourimbah Public School (Pacific Highway, Ourimbah)	☑	☑	☑	☑
	Chittaway Bay Public School (Chittaway Road, Chittaway Bay)			☑	☑
Aged Care Facilities	*The Orchard Retirement Village* (Taylor Road, Lisarow)		☑		☑
Other Facilities	*Chickadee Factory* (off Cut Rock Road)				☑

10.2.2 Transportation Links

There are several major roadways within the Ourimbah Creek catchment which may be required for evacuation or emergency services access during floods. It is important to have an understanding of the impacts of flooding on these roads so that appropriate emergency planning can occur.

- ***Sydney-Newcastle Freeway***: The freeway is predicted to remain largely flood free during the 1% AEP flood. Some water is predicted to extend across the road near the Kangy Angy Creek crossing, however, the depths of inundation are generally predicted to be less than 0.15 metres. More extensive inundation is predicted during the PMF, whereby the Freeway would be "cut" for approximately 6 hours.
- ***Pacific Highway:*** The Pacific Highway is predicted to be inundated at several locations during the 1% AEP flood. This includes:
  - near Kangy Angy Creek crossing where maximum depths are predicted to be around

1 metre.
- near Ourimbah Freeway Interchange where depths of inundation are less than 0.15 metres.
- At Dog Trap Gully crossing where maximum depths of inundation are around 0.5 metres.
- Near Glen Road intersection, Ourimbah, where maximum depths of inundation are predicted to be about 0.6 metres.

- ***Teralba Street:*** Teralba Street runs off the Pacific Highway near Lisarow. Cut Rock Creek discharges beneath Teralba Street via a newly constructed culvert. Teralba Street provides access to a number of residential properties on the western side of Cut Rock Creek. The street is predicted to be inundated during all design floods considered as part of the study. The maximum depth of inundation during the 20% AEP flood is predicted to be around 0.5 metres. Accordingly, vehicular access along Teralba Street would not be possible during any of the simulated design floods and a number of residential properties would also be subject to inundation.
- T***all Timbers Estate:*** Tall Timbers Estate is located immediately upstream of where Cut Rock Creek first discharges beneath the Main Northern Railway and Pacific Highway at Lisarow. Access to Tall Timbers Estate is provided via an access road/low level bridge crossing of Cut Rock Creek, which runs off Tuggerah Street near the intersection with Baileys Road. The low level bridge crossing is predicted to be inundated during all of the design events considered as part of this study. The maximum depth of inundation during the 20% AEP flood is predicted to be around 1 metre. Accordingly, vehicular access to Tall Timbers Estate would be prevented during relatively frequent floods (i.e., <20% AEP event). Correspondence received from Tall Timbers Estate residents as part of the community questionnaire indicates that access is cut at least once a year, on average. Accordingly, residents at Tall Timbers Estate are frequently isolated as a result of flooding posing a significant risk to residents and emergency services should evacuation become necessary.
- ***Enterprise Drive:*** some shallow depths of inundation are predicted near the intersection with Wyong Road during the 1% AEP flood (<0.2 metres). Accordingly Enterprise Drive would likely remain trafficable during all design events up to and including the 1% AEP flood.
- ***Turpentine Road:*** Turpentine Road provides access to a number of rural properties located on the western side of the Main Northern Railway from Enterprise Drive. The Turpentine Road railway underpass is predicted to be inundated during floods as frequent as the 20% AEP event**.** The depth of inundation across turpentine Road during the 20% AEP event is predicted to be about 3 metres. Accordingly, vehicular access along Turpentine Road would not be possible during any of the simulated design floods.
- ***Burns Road:*** Burns Road provides access between the main commercial and residential areas of Ourimbah and Chittaway Road via a railway underpass. It is predicted to be overtopped during floods as frequent as the 20% AEP flood, where water depths are predicted to exceed 2 metres. Accordingly, Burns Road would not be trafficable at the peak of any of the design floods considered as part of this study.
- ***Howes Road:*** Howes Road is located off the eastern end of Burns Road and provides access to several rural properties located on the western side of the Main Northern Railway. It is predicted to be inundated during the 20% AEP flood where the typical maximum depth of inundation is around 1 metre. Therefore, vehicular access along Howes Road would not be possible at the peak of any of the design floods considered as part of this study.

- ***Chittaway Road:*** Predicted to be inundated at several locations including near the Burns Road railway underpass (maximum depth = 0.5 metres) and University of Newcastle (maximum depth = 0.6 metres) during the 1% AEP flood. The roadway is also prepdicted to be inundated around the University of Newcastle during floods as frequent as the 20% AEP flood.
- ***Ourimbah Creek Road***. This roadway is predicted to be overtopped at a number of locations. The maximum depth of inundation is typically between 1 and 2 metres during the 1% AEP flood. Sections of the roadway are also predicted to be inundated during relatively frequent floods, including the 20% AEP event.
- ***Wyong Road***: is predicted to be inundated to depths of less than 0.15 metres during the 1% AEP flood. Accordingly, the roadway would remain trafficable. However, during the PMF, depths of over 2 metres are predicted.
- ***Main Northern Railway:*** The railway line is predicted to be overtopped at the following locations during the 1% AEP flood:
  - near Lisarow Railway station, where the depth of inundation is around 0.3 metres.
  - near Ourimbah Railway station, where the maximum depth of inundation is predicted to be 0.4 metres.

The outcomes of this assessment are also summarised in **Table 34**. As discussed in Section 9, the degree of blockage can significantly impact flood levels in the vicinity of bridge and culvert crossings. Accordingly, roadway crossings may be cut more frequently if structures become partially or fully blockage during the course of a flood. Conversely, the level of service may improve if the structures remain free from blockage.

Table 34 Impact of Flooding on Key Transportation Links

Roadway	Access Cut During 20% AEP Flood?	Access Cut During 1% AEP Flood?	Access Cut During PMF?
Sydney-Newcastle Freeway			☑
Pacific Highway		☑	☑
Teralba Street	☑	☑	☑
Tall Timbers Estate	☑	☑	☑
Enterprise Drive		☑	☑
Turpentine Ropad	☑	☑	☑
Burns Road	☑	☑	☑
Howes Road			
Chittaway Road	☑	☑	☑
Ourimbah Creek Road	☑	☑	☑
Wyong Road			☑
Main Northern Railway		☑	☑

10.3 Levees

The Ourimbah Creek catchment includes two levees:

- **Tuggerah Business Park Levee**: Located on the northern floodplain of Ourimbah Creek between Wyong Road and the Main Northern Railway. It affords protection to the Tuggerah Business Park area during all design floods up to the 1% AEP event. Overtopping and inundation of the Tuggerah Business Park is predicted during the PMF and 0.5% AEP flood. It is noted that a drainage channel adjoining Wyong Road, which drains local runoff from the Tuggerah Business Park is predicted to be exposed to "backwater" flooding from Ourimbah Creek during the 1% AEP flood. However, this is predicted to cause only minor inundation of roadways adjoining the drain age channel.
- **Railway Levee**: Located on the western side of the Main Northern Railway line, directly west of the Berkley Vale Industrial area. It is designed to prevent overtopping and subsequent "wash out" of the railway line ballast. It offers protections to the railway line and Berkley Vale Industrial area during all design events up to and including the 1% AEP flood. During the PMF, the levee and railway line is predicted to be overtopped and exposed to very high velocities (up to 10 m/s).

11 Conclusion

This report documents the outcomes of investigations completed to quantify contemporary flood behaviour across the Ourimbah Creek catchment for a full range of design. It provides information on design flood discharges, levels, depths and velocities as well as hydraulic and flood hazard categories.

Flood behaviour across the study area was defined using a hydrologic computer model of the Ourimbah Creek catchment as well as a two-dimensional hydraulic model of the lower 60 km^2 of the catchment. The hydrologic computer model was developed using the XP-RAFTS software and the hydraulic model was developed using the TUFLOW software.

The computer models were calibrated/verified using rainfall data, stream flow records and historic flood marks for floods that occurred in 1992, 2007 and 2011. The models were subsequently used to simulate a range of design floods including the 20%, 10%, 5%, 2%, 1% and 0.5% AEP floods as well as the PMF. The following conclusions can be drawn from the results of the investigation:

- Flooding across the Ourimbah Creek catchment can occur as a result of major watercourses overtopping their banks as well as inundation from elevated water levels within Tuggerah Lake.
- Flooding has been experienced across the catchment on a number of occasions in the past including 1953, 1974, 1977, 1990, 1992, 2007, 2011 and 2013.
- Flooding can occur as a result of a variety of different storm durations. However, a storm duration of 6 hours typically produces the worst case flooding conditions across most of the catchment. Longer storm durations (up to 48 hours) tend to produce higher flood levels across the downstream reaches of Ourimbah Creek (e.g., around Chittaway Point). Historic evidence indicates that most floods across the Ourimbah Creek catchment occur as a result of east coast lows.
- Significant floodplain areas are predicted to be inundated during large floods within the catchment. This is predicted to inundate 670 properties during the 1% AEP flood (out of a total of ~4,500 properties located within the catchment). The most notable flooding 'problem areas' include:
  - Cut Rock Creek between Teralba Street and Pluim Park (including Tall Timbers Estate) at Lisarow. Access to Tall Timbers Estate and along Teralba Street is predicted to be cut off during very frequent floods (i.e., less than 20% AEP event)
  - Sohier Park / University of Newcastle area near Ourimbah
  - Rural properties in the vicinity of Turpentine Road and Howes Road (access to these properties is predicted to be cut off during very frequent floods, i.e., less than 20% AEP event)
  - Chittaway Point
- A number of roadways as well as the Main Northern Railway are predicted to be overtopped during the 1% AEP flood. This would typically render the roadways/railway impassable for at least 2 hours.

- The catchment incorporates a large number of bridges and culverts to convey flood flows. The results of a blockage sensitivity analysis shows that the severity of flooding upstream of these structures can be significantly increased due to blockage. This highlights the importance of routine maintenance on this infrastructure, particularly immediately after a flood.

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Appendix A

Community Consultation

JUNE 2007 FLOOD PHOTOS

Chittaway Point

Chittaway Point

Chittaway Point

Chittaway Point

Chittaway Point

Chittaway Point

Geoffrey Road, Chittaway Point

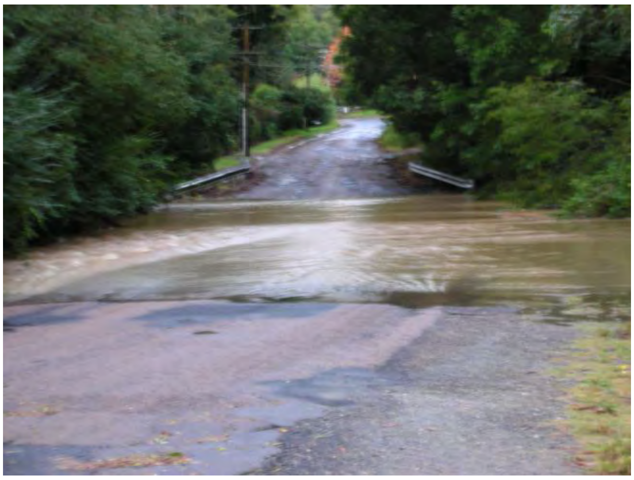
Geoffrey Road, Chittaway Point

Teralba Street, Lisarow

Teralba Street, Lisarow

Turpentine Road underpass of Railway Line

Ourimbah Road (western end)


Old Chittaway Road, Kangy Angy


Chittaway Road, Ourimbah


Moores Point Lane, Palm Grove


Moores Point Lane, Palm Grove


Palmdale Road, Palmdale


Shirley Street, Ourimbah

Chittaway Road near Burns Road

Orange Road, Fountaindale

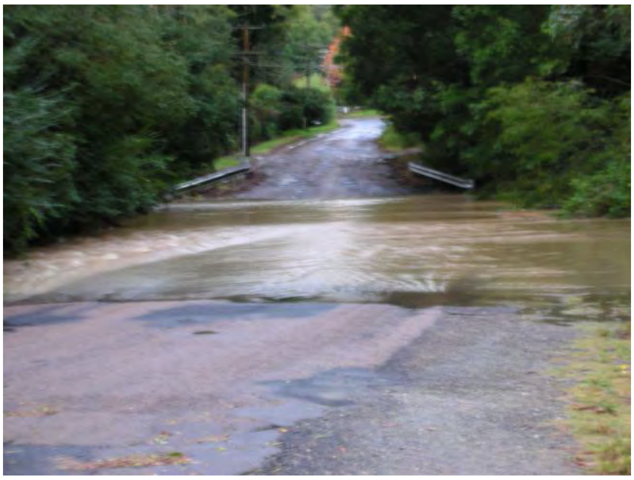
JUNE 2011 FLOOD PHOTOS

Peach Orchard Road, Fountaindale

Teralba Street, Lisarow

Peach Orchard Road, Fountaindale

Tall Timbers Estate, Lisarow



Old Chittaway Road crossing of Chittaway Creek

Pluim Park, Lisarow

Pluim Park, Lisarow

Brands Place, Lisarow

Knight Close, Ourimbah

Burns Road, Ourimbah

DECEMBER 2011 FLOOD PHOTOS

Teralba Street, Lisarow

Teralba Street, Lisarow

Teralba Street, Lisarow

Turpentine Road underpass of Railway Line

Orchard Road, Kangy Angy

Knight Close, Ourimbah

Miscellaneous Flood Photos

1992 Flood at Orchard Road, Lisarow

Unknown date, Knight Cl, Ourimbah

JOINT MEDIA RELEASE

31 July 2012

Councils call for resident input to Ourimbah Creek Flood Study

Wyong Shire Council and Gosford City Council are calling on residents and business owners within the Ourimbah Creek catchment to provide information to assist with the preparation of a flood study for the area.

The catchment includes a number of rural, commercial and residential areas including **Lisarow**, **Fountaindale**, **Kangy Angy**, **Ourimbah**, **Chittaway Bay** and **Chittaway Point**.

The Councils have jointly resolved to prepare a flood study for the Ourimbah Creek catchment as part of their Floodplain Risk Management Programs, which aim to reduce the impact of flooding on the community.

“By understanding the potential risks of flooding to our region, we can better prepare our community against significant flood damage and possible loss of life,” says Wyong Shire Council Mayor, Bob Graham.

“Flooding can place a significant financial burden on communities, so we must be proactive in understanding the potential impacts on our catchment areas.”

Local residents and businesses can get involved in the flood study by sharing their local flood knowledge via a questionnaire that will be sent to them shortly, or via the online questionnaire at www.ourimbah.floodstudy.com.au

Both Councils will also be seeking nominations from members of the community to be part of the Floodplain Risk Management Committee which will ensure that the diverse range of issues encountered in formulating a floodplain risk management plan are considered through all stages of the project.

Gosford City Council’s Mayor, Laurie Maher, says the involvement of local residents will enable both Councils to better understand, plan and manage the risk of flooding across the catchment.

“Local residents may have historical information, photographs and experiences of past floods which will be a valuable contribution to the flood study,” says Mayor Maher.

“We would encourage residents to complete the questionnaire or get involved in the Committee to ensure all their knowledge and recommendations are captured.”

Residents interested in becoming a committee member or who would like additional information about the study can contact Wyong Shire Council’s Shah Alam on (02) 4350 5710 or email Shah.Alam@wyong.nsw.gov.au or Gosford City Council’s Sue Stanford on (02) 4325 8818 or email sue.stanford@gosford.nsw.gov.au.

-Ends-

Media contacts: Alison McLeod (Gosford) 4325 8262
Janine Crawford (Wyong) 4350 5705

Why do we need to prepare a flood study?

Flooding in Australia is estimated to cause over $250 million worth of damage each year. Over 2,300 people have also lost their lives due to floods in Australia over the past 200 years. Accordingly, flooding can impose significant financial burdens and place lives at risk.

The preparation of a flood study will help Wyong and Gosford Councils to understand the existing flooding problem within the Ourimbah Creek catchment. It will also help to identify where flood damage reduction measures may be best implemented to reduce the cost of flooding to the community, assist with emergency management and evacuation processes and guide future development in a way that is compatible with the flood hazard.

How you can help!

The flood study will include the development of computer models to simulate flood behaviour across the catchment. To ensure the computer models are providing reliable descriptions of flood behaviour they will be calibrated so they reproduce floods that have occurred in the past.

Enclosed with this brochure is a questionnaire that aims to collect as much historic flood information as possible to assist with the model calibration. Anybody with information and/or historic flood photographs is encouraged to complete the questionnaire and return it by **31st August 2012**. Alternatively, the questionnaire can be completed online via the Ourimbah Creek Flood Study website:

www.ourimbah.floodstudy.com.au

Further Information:

To obtain further information on the Ourimbah Creek Flood Study or to submit any information that you think may be valuable to the study, please contact:

David Tetley
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney NSW 2000
(02) 9223 0882
dtetley@csse.com.au

Shah Alam
Wyong Shire Council
PO Box 20
Wyong NSW 2259
(02) 4350 5710
SAlam@wyong.nsw.gov.au

Sue Stanford
Gosford City Council
PO Box 21
Gosford NSW 2250
(02) 4325 8818
sue.stanford@gosford.nsw.gov.au

Alternatively, you can visit the flood study website:
www.ourimbah.floodstudy.com.au

Your contribution to this study is greatly appreciated!

Brochure prepared by:
Catchment Simulation Solutions

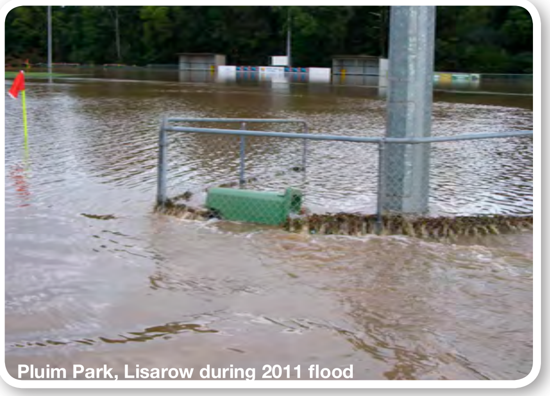
Ourimbah Creek Flood Study

Community Information Brochure

Chittaway Point during 2007 flood
(photo courtesy of State Emergency Service)

Introduction

Wyong Shire Council, in association with Gosford City Council, is currently preparing a flood study for the Ourimbah Creek catchment. The catchment includes Ourimbah Creek, Bangalow Creek, Cut Rock Creek, Dog Trap Gully and Chittaway Creek as well as a number of smaller tributaries. The streams drain through a number of rural, commercial and residential areas including Lisarow, Fountaindale, Kangy Angy, Ourimbah, Chittaway Bay and Chittaway Point before entering Tuggerah Lake.



Pluim Park, Lisarow during 2011 flood

Significant flooding across the Ourimbah Creek catchment has occurred on a number of occasions. Flooding across the catchment can occur as a result of the streams overtopping their banks as well as from elevated water levels within Tuggerah Lake. This flooding can cause signifiant disruption and inconvienience to residents and business owners within the catchment. There is also potential for damage to property as well as risk to life.

In recognition of these issues, Wyong and Gosford Councils have decided to prepare an updated flood study for the Ourimbah Creek catchment. The current flood study will serve to update and improve upon previous studies and will ultimately provide both Councils with a better understanding of the flood risk across the catchment.

Background

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

Under the Policy, the management of flood liable land is the responsibility of Local Government with financial and technical support provided by the State Government. The Policy specifies a staged approach to the floodplain management process:

Wyong and Gosford Councils have initiated this process by commissioning the Ourimbah Creek Flood Study. The main purpose of the flood study is to determine the nature and extent of the existing flood problem across the catchment.

Once the flood study is completed, a floodplain risk management study and plan can be prepared. This will weigh up the benefits of applying a range of measures aimed at reducing the damage and inconvenience caused by flooding.

So what's a flood study?

A considerable amount of work is involved in the preparation of a flood study. This work typically includes:

- Collection and review of all available flood-related information for the catchment
- Consultation with stakeholders and the community to obtain additional information on flooding
- Development of computer models to imitate catchment rainfall and runoff and how the runoff is distributed across the catchment
- Calibration of the computer models to reproduce historic floods
- Use of the computer models to simulate a range of hypothetical floods ranging from relatively frequent storms right up to the largest flood that could possibly occur
- Interpretation of the computer model outputs to identify the variation in floodwater depths, velocities, levels and hazard across the catchment and to identify areas that should be preserved in the future for the conveyance of flood flows
- Preparation of a flood study report and maps summarising the outcomes of all stages of the investigation

The flood study will ultimately provide Wyong and Gosford Councils with information on flood flows, extents, levels, depths and velocities throughout the catchment. The Councils have commissioned specialist flood consultants, Catchment Simulation Solutions, to prepare the flood study.

Thank you for taking the time to complete this questionnaire!

The questionnaire can be returned without a postage stamp or scanned and emailled to dtetley@csse.com.au by 31st August 2012. Flood photos and videos can also be sent to this email address. “Hard copies” of photos or VHS tapes can be posted to:

David Tetley
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW 2000

If you would like to have items returned please note this and the items will be returned at the conclusion of the study.

Fold Here

How to send back this questionnaire...

Please fold this questionnaire using the ‘Fold Here’ lines as a guide to form a business sized evelope with the address on the front and this text box on the back. Seal the folded pages with a piece of tape to help maintain privacy (but not so much tape that we can’t open it) and then post it back.

Fold Here

No stamp required
if posted in Australia

Delivery Address:
PO Box 20
WYONG NSW 2259

Wyong Council
Reply Paid 20
WYONG NSW 2259

Ourimbah Creek Flood Study

Ourimbah Creek Flood Study

Community Questionnaire

Wyong Shire Council and Gosford City Council are completing a flood study for the Ourimbah Creek catchment. The flood study is the first step in assisting both Councils to better understand, plan and manage the risk of flooding across the catchment.

The information that you provide in the following questionnaire will prove invaluable in the calibration of computer models that are being developed as part of the flood study. It will also provide each Council with an understanding of existing flooding problems and areas where flood damage reduction measures should be investigated in the future.

The following questionnaire should only take around 10 minutes to complete. Try to answer as many questions as possible and give as much detail as possible (attach additional pages if necessary). Once complete, please return the questionnaires via email or mail (no postage stamp required) by **31st August 2012**. Alternatively, if you have internet access, an online version of the questionnaire can be completed at: www.ourimbah.floodstudy.com.au

If you have any questions, require any further information or would like to contribute additional information to the study, please contact:

David Tetley
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney NSW 2000
(02) 9223 0882
dtetley@csse.com.au

Shah Alam
Wyong Shire Council
PO Box 20
Wyong NSW 2259
(02) 4350 5710
Shah.Alam@wyong.nsw.gov.au

Sue Stanford
Gosford City Council
PO Box 21
Gosford NSW 2250
(02) 4325 8818
sue.stanford@gosford.nsw.gov.au

QUESTION 1 (OPTIONAL)

Can you please provide the following contact details in case we need to contact you for additional information?

Note that your personal information will remain confidential at all times and will not be published unless you give us permission to do so (refer to following question).

Name:______________________ **Phone:**______________

Address:____________________ **email:**______________

____

Do you give permission for your contact details to be published as part of the flood study?

☐ **Yes** ☐ **No**

QUESTION 2

How long have you lived and/or worked in the area?

At current address: ________ **Years** ________ **Months**

In the general area: ________ **Years** ________ **Months**

QUESTION 3

Have you been affected by flooding in the past?

☐ Yes ☐ No

If 'Yes', how have you been affected?

☐ Traffic was disrupted (please provide a description below if possible)

☐ My back/front yard was flooded (please provide a description below if possible)

☐ My house/business and its contents were flooded (please provide a description below if possible)

☐ Sewer or water was turned off at my property (please provide a description below if possible)

☐ Other (please provide a description below if possible)

Description: ________________________________

QUESTION 4

Can you provide specific details of how high floodwaters reached?

☐ Yes ☐ No

If 'Yes', please give as much detail as possible (e.g., location, dates, times, description of water movement, depth of water, flood mark location, high water mark on building, level on flood depth indicator).

QUESTION 5

What do you think may have been the main source/cause of the flooding (e.g., creek banks overtopping, elevated lake levels, blockage of bridges)?

QUESTION 6

Did you keep any rainfall records during any past storm events, or do you know someone locally that does?

☐ Yes ☐ No

If 'Yes', can you please include a copy of the records or provide a description of the records below?

QUESTION 7

Are you concerned that your property could be flooded in the future?

☐ Yes ☐ No

If 'Yes', what makes you concerned?

QUESTION 8

Do you have any other comments or information that you think would be useful for this investigation?

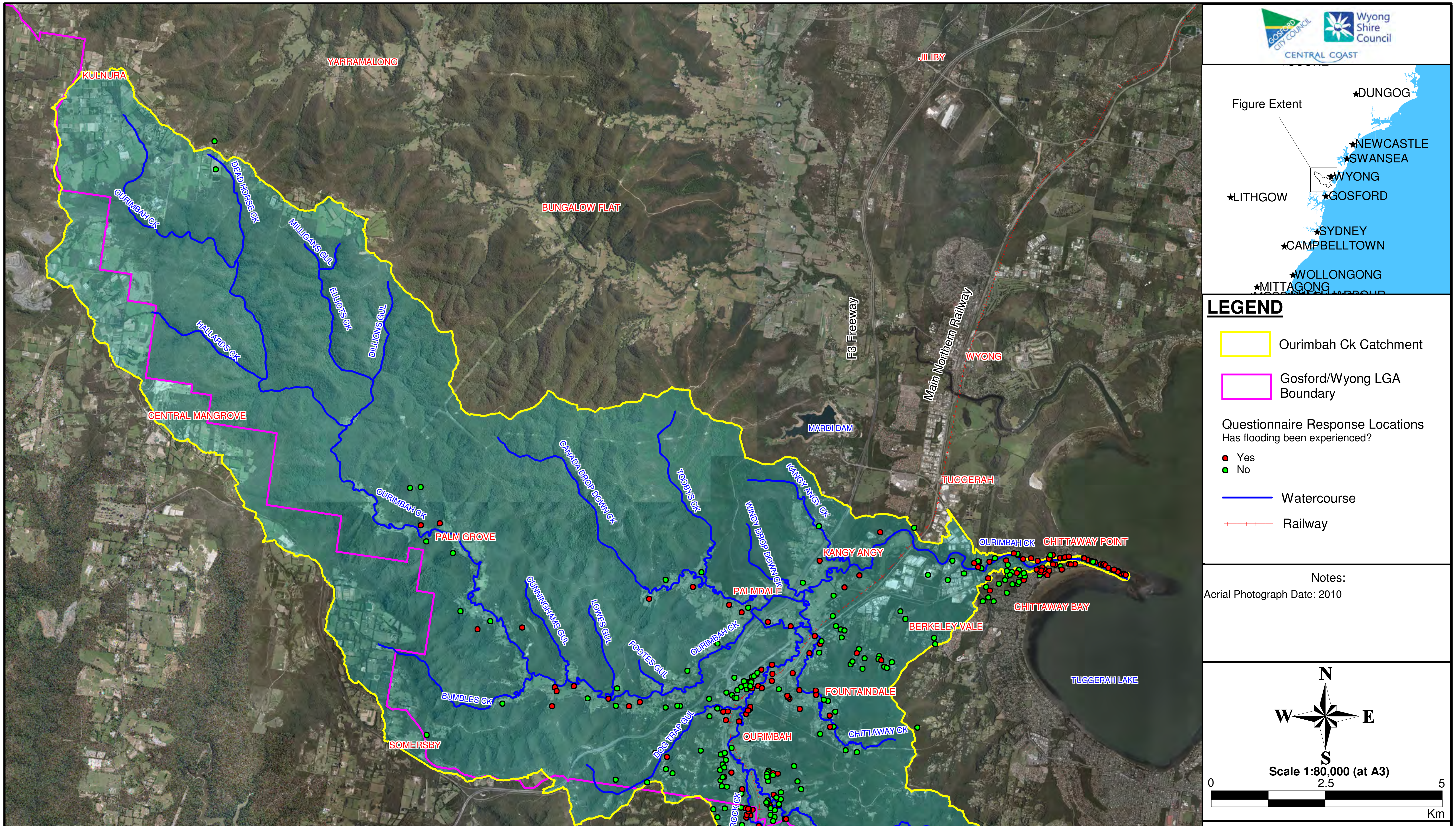


Figure A1: Spatial Distribution of Questionnaire Responses

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter St
Sydney, NSW 2000

File Name: FigureA1 Spatial Distribution of Questionnaire Responses.wor

Community Questionnaire Responses - Ourimbah Creek Flood Study

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
1	3.5 years	5 years	Yes	Yes	No	No	No						
2	2 years	7 years	Yes	No	No	No	No	Traffic was banked up due to road closure		Heavy rain and creeks overflowing causing closure of underpass			Living fairly high up on a hill the direct impacts of water haven't been felt on the property but access roads and underpasses have been affected which in turn caused access issues for me
4	25 years	25 years	Yes	Yes	Yes	No	Yes	Moderate floods cut Ourimbah Creek Rd. 1992 flood disrupted my son's business (he subsequently moved away). Tank water was OK. Septic tank recovered OK. Other impacts: deposition of fine sediment - a +ve impact as it nourishes our floodplain rainforest. Main impact: alerted us to adapt to living with floods.	Council staff measured flood height on the poles supporting our house after the 1992 flood, so these should be in the archives	East coast low developing subsequent to a period of steady rain	Unfortunately, our rain gauge was swept away by the 92 flood	Yes. We are accustomed to floods and, over the years have adapted to them	Experiencing floods showed how they can deposit nutrient-rich material on the floodplain. Our property is covered by rainforest that responds positively to this.
5	11 years		Yes	Yes	Yes	No	No	We moved to this address in July 2001. Since that time we have been flooded numerous times. 2003 - Cut Rock Creek flooded, street covered with water, water reached under our house, water flooded into garage, destroyed landscaping in yard. 2007 - Cut Rock Creek flooded, street covered with water, water reached under our house and was only approx 2cm off flooding the inside of our house, garage was flooded. (Our house is elevated approximately 600mm) Destroyed landscaping in yard. 2010 - Cut Rock Creek flooded, street covered with water, water destroyed landscaping in yard, garage was flooded. 2011 - June - Cut Rock Creek flooded, street covered with water, water destroyed landscaping in yard. 2011 - July - Cut Rock Creek flooded, street covered with water, water destroyed landscaping in yard.	We moved to this address in July 2001. Since that time we have been flooded numerous times. 2003 - Cut Rock Creek flooded, street covered with water, water reached under our house, water flooded into garage, destroyed landscaping in yard. 2007 - Cut Rock Creek flooded, street covered with water, water reached under our house and was only approx 2cm off flooding the inside of our house, garage was flooded. (Our house is elevated approximately 600mm) Destroyed landscaping in yard. 2010 - Cut Rock Creek flooded, street covered with water, water destroyed landscaping in yard, garage was flooded. 2011 - June - Cut Rock Creek flooded, street covered with water, water destroyed landscaping in yard. 2011 - July - Cut Rock Creek flooded, street covered with water, water destroyed landscaping in yard. Photos and video available and can be emailed.	The issue at hand is the free flow of water in Cut Rock Creek to prevent flooding of properties. Cut Rock Creek runs across Teralba Street, between 12 & 14 Teralba Street, and then into 1 Teralba Street. This block of land is covered in vegetation, and this vegetation is constricting the natural flow of water in Cut Rock Creek. The result of this build up of vegetation is innundation/flooding of Teralba Street & Lisarow Street, and the resultant damage to residential property in these streets. Gosford Shire Council have done creek remediation works on Cut Rock Creek up to the bridge at Teralba Street. This includes clearing the creek, and building retaining walls to allow for free flow of water. Over the past 7 years, I have had numerous phone conversations with staff at WSC, requesting that WSC complete creek remediation works on Cut Rock Creek from Teralba Street to Pacific Highway, with no result. I have been told that the block of land is private property, and as such WSC cannot do anything. In answer to this, Lot 104 DP 876413 is owned by Wyong Shire Council, and is zoned 7a (Conservation Zone). I am not asking for the natural vegetation of this piece of land be destroyed. All I am asking is that the waterway be cleared so as to allow the water flow to get away. In the 11 years that we have owned this property, Cut Rock Creek has flooded 4 times. The first time the water was low lying, yet it covered our entire block of land. The second time, in the June 2007 floods, the water was mid thigh height, and was only 1 inch off coming into our house. The third and fourth times the water was low lying, and reached into our yard. This could all be prevented by WSC carrying out creek remediation works on Lot 104 DP 876413. The residents of Teralba Street & Lisarow Street have been living with this major problem for many years, and the damage that water has caused to our homes. In our case, our fences have rotted, and the joists and flooring under our house have suffered water damage. Our garage has been flooded, and equipment ruined, and vehicles have been submerged. Hot water systems and air conditioning units etc have been submerged. We have had to re-landscape our garden twice due to the damage incurred by flood waters.		Yes. This issue at hand is the free flow of water in Cut Rock Creek to prevent flooding of properties. Cut Rock Creek runs across Teralba Street, between 12 & 14 Teralba Street, and then into 1 Teralba Street. This block of land is covered in vegetation, and this vegetation is constricting the natural flow of water in Cut Rock Creek. The result of this build up of vegetation is innundation/flooding of Teralba Street & Lisarow Street, and the resultant damage to residential property in these streets. The flooding in the Teralba Street area could be alleviated if Wyong Shire Council were to finish the remediation of Cut Rock Creek from Teralba Street to Pacific Highway on Lot 104 DP 876413.	This also has a knock on effect south of our property, and we have been in contact with numerous neighbours in surrounding areas, and all agree that this area is one of the major problem areas. If this area was resolved, then a lot of the flooding problems experienced in this area and adjacent areas could be alleviated.
6	3 years	45 years	Yes	Yes	No	No	Yes	Flotsem and debris left after water flooded our property. Creek bank constantly faces erosion after each flooding. Debris blocking normal creek flow after flooding. Cuts property in half for days to weeks after, can't access due to high level of water in creek bed	Every time there is heavy rain constant for several hours to a day.Several times a year, and raises approx 1.8 to 2 meters above the creek bed level.	excess water entering the creek causing banks to overtop and possibly as aslo meeting with the tides with the lake		yes the excess debris and rubbish pollution left behind and the errosion of the creek beds passing through our poroperty also cuts traffic access not permitting us to our destination	may have some photos that we will email later
7	83 years	83 years	Yes	Yes	No	Yes	No		have photos of the flood in 1942 which was bigger than the one in 2007, and information from my farther who lived here at that time. Pictures of the river showing concrete fixtures which are still in the same place today as well as the current buildind showing boats tied to the rear deck, Ourimbah creek in the background		the water in the river rising and not being able to get out of the river mouth due to the channel at the lake being silted up, also escapping out at the entrance channel to the ocean, due to it being silted up too, and not big enough to let the large volume of water escape.	Yes. The coubcil does nothing to prevent it. all the sediment that was dredged from the channel at Ourimbah creek mouth is STILL sitting in a 20 foot high pile at the end of Geoffrey rd. some 20 or more years after it was pumped there !!!! the water used to flow through that area , but nolonger can.Also the amount of surage and chemicals that are flushed into the creek each time it rains.	the amount of change to the lake floor, areas which were once 5' deep are now 1' deep thus not allowing any water flow out to the blocked channel , out to sea.
8	8 years	26 years	Yes	Yes	No	No	No	Burns Road closed when Bangalow Creek rises several times a year - blocking access to Enterprise Drive by car or pedestrian as the water level is strong enough to wash vehicles away (including 4x Wheel Drives). Our backyard gets swilleys in the right hand corner, and takes some time to drain away. Water creep occurs onto back patio, but drains away over a short time when rain eases.	Burns Road Bangalow creek flooding. I.5 metres at various times through the year during flooding rains. Backyard swilleys 20 cm and water creep 5 -10 cm during very heavy rain	Burns Road - heavy run off to Bangalow Creek under and over Burns Road small traffic bridge which sometimes gets clogged by tree branchs, old logs, rubbish. Tidal movement in the lake would also have some causative effect. In backyard - heavy runoff from adjacent properties and hill at the back of the area.			Routine clean up of the Bangalow Creek banks, removal of rubbish, old timbers,checking of drainage pipes under roads through which the creek passes would enable a better flow of water and lessen the risk of property damage during flooding rains. Mapping and monitering of where the creeks seep underground and where they surface would also enable maintenace and clearing of these areas. Expensive process and it would take a designated team from council to be assigned the work
9	15 years	50 years	Yes	No	No	No	Yes	Ourimbah University was closed due to flooding around the campus. Several vehicles were still in the main car park. The fact that a small creek flows beside the campus has always caused a problem when heavy rains occur.		Over flowing creek after heavy rain		Yes. I am concerned that a student enrolled in courses at the Ourimbah University may suffer the loss of a vehicle or is stranded at the University until the water level decreases.	The current creek running beside the University is congested with reeds etc. This shows a healthy water catchment and is an appealing area to sit and watch but unfortunately the University was not built high enough to prevent flood waters entering the grounds and car park. My only suggestion would be to construct an earthen mound along the creek edge (if that is possible?) to prevent flooding.
10	2 years	16 years	Yes	No	No	No	No	Burns Rd underpass Intersection is constantly closed (when pretty much a bee burps!)	above the top of the yellow "give way" sign before the bridge on the freeway side, which is way over the 2m mark.	tuggerah lake overflow. It's kind of normal I guess			Yes, when this intersection is closed,, it would be nice if more signage was available (eg, before the turn right onto chittway rd from the station) as it is near impossible to turn around once you've made the fateful turn and you end up at Tuggerah pretty much. Also, perhaps lockable boom gates near the bridge would be good to stop the fruitcakes who think it's okay to drive their dinky cars and 4wds through 2m of water and get stuck. (A helicopter rescue this time last year comes to mind). Such simple things, yet council doesn't respond. They do it in the Wakehurst Parkway in Sydney, so it's not that hard!
11	2.5 years		Yes	Yes	No	No	Yes	The acreage was flooded the following areas, Chittaway Road, Rugby oval, the areas backing onto Bangalow Creek and water all coming over to our property. The storm water drain that starts at Chittaway Road soccer oval and the surrounding properties at the rear was flooded over onto the property due to inadequate drainage wide enough to take the pressure of the water. It then went to the next property which the drain is not wide enough to take the flow. Therefore it was flooded on the property. The cabana, garage sheds, sheds, bird avairies, chicken sheds, gardens, surrounding pool area, dam were all affected. When we had showers or baths, the drains were full and the bathroom had excess water and took a while to go down the drain. Debris was left on our property and within the creek making the flow of water slower.	Photos I can provide but not the exact depth sorry.	Creek banks full and no retraining walls, rugby oval full of water and water running over to our property and no where else to go. Storm water drain that goes through soccer oval and surrounding properties and through our property cannot handle the amount of water because the storm water drains are not wide enough for the strong flow of the water. Therefore it runs onto our property.		Yes. The fact that there is no retraining walls around the creek or any retraining walls around the storm water drain or wide enough for the amount of water. The fact that the rugby oval has no drainage there and there water comes directly onto our property. Inadequate drainage in the this area and we pain for drainage on our council rates.	The comments I wish to let you know is that we are concerned for future flooding if the retraining walls are not put up by the council and if the storm water drain is not fixed with retraining walls or a much wider drain for the water to flow through. That the bridge surrounding the Bangalow Creek area will callapse due to the amount of water that can be build up on Chittaway Road. Our drive way that keeps getting flooded and still has water out the front and mud which has not be fixed by the council since they made the road higher due to fixing the road. That the debris in the creek is not cleaned out so often for the flow of the water to run.

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
12	21 years		Yes	No	No	No	No	Run-off from the hill behind Red Cedar Close impacts a number of properties in this location, including houses in Jarrah Court which at times are severly effected. Most of the run off finds its way onto an old fire trail, then decends down the hill and flows into an easement drain on our property at no. 7. Over time, the fire trail has been blocked by falling trees etc causing rain water to leave the fire trail and impact local properties, albiet mostly just backyard flooding. This fire trail is not maintained in any way so this flooding will only continue. We believe this fire trail should be cleared and steps taken to ensure rain water stays on the fire trail. Council will have records of past flooding events in this location, however, with the fire trail in its current state, the next big storm will no doubt cause problems.	During a storm, the easement drain referred to above has at times been completely covered by debris brought down the hill by water run off, blocking the drain and causing local flooding. Council is supposed to inspect this easement on a regular basis, however we have not noticed a team here for some time now. Might by worth checking on this stuation. (We do have photos which I will dig out and provide to council.)	Storm water run-off from hill behind Red Cedar Close, Ourimbah.		Yes. As stated above, run-off from the fire trail behind Red Cedar Close, Ourimbah will cause mainly backyard flooding for our property, but may cause more trouble for other properties in this location.	
13	2 years	10 years	Yes	Yes	No	No	No	Traffic - flooding on main road and side road to our house Yard - flood everytime there is a large amount of rain	photos & video will be emailed. Taken end of May or beginning of June 2011	run off from surrounding area		Yes. nothing in the area has changed	
14	13 years		No	No	Yes	No	No			Rain	You guys have to be kidding, LOL	Yes. Are you for real? Just what do you think it is that concerns me?	Yes! Stop wasting our rates on stupid surveys which will result in the blatenly obviuos, rate payers are now doing the councils work. A reduction in rates would be very much apprieciated...have a nice day is there an election coming up?
15	5 years	5 years	No	No	No	No	No					Yes. There is a creek at the rear of our property which rises quickly in heavy rain. It is within 15 metres of the house.	
16	5 years	21 years	Yes	No	No	No	No	Heavy rain I am unable to get to my home due to McDonalds Rd, Cutrock Rd Lisarow and Shirley Street Ourimbah been flooded.Some occasions the road is closed at the roundabout at the railway bridge on Chittaway Rd due to Enterprise Dr and the Uni been flooded. On the overall I can have trouble getting in or out of my home.	No. I don'thave any photos.	Flooded roads half due to blocked drains.	Yes. I no longer have them		When Shirley Street Floods it can flood the whole of Sohier Park through to the carpark and tennis courts
17	1.5 years	1.5 years	Yes	Yes	No	No	No	The road/bridge outside has been under water at least 5 times in the time we have been here and water has come into the front yard of our property on two of those ocasions.	The flood depth indicater on the bridge has been under water to a depth of at least 0.4 on 12 June 2011 and again on 12 Dec 2011	Creek banks overflowing		Yes. As our front yard has been underwater already, i am concerned that water may rise and damage property in and around the house	I will email some photo's shortly
18	3 years	3 years	Yes	No	No	No	Yes	My place of work (University) has been closed a few times in the last few years due to flooding		creek banks overtopping			
19	13 years		Yes	No	No	No	No	Shirley Street and Mcdonalds Road flooded so very difficult to get out.		Due to maintenance not being carried out by council drains are blocked, creeks are full of weed and fallen trees, pipes are full of rubbish and road side open drains full of rubbish including, shopping trollies, signs, grass clippings, for sale signs and silt.			Start cleaning up the drains and creeks so the water can flow. Repair the drains that are falling apart. Clean out the road side drains that are full of silt and rubbish and we would not have this problem. Happy to meet and show you the problems anytime.
20	10 years	23 years	No	No	No	No	No						
21	10 years	23 years	Yes	Yes	No	No	Yes	In the june 2006 floods our backyard was dry but the front yard was 50% under water another 400 to 600mm would have seen the garage become water logged.we lost a tree due to the water logged grounds we lost power for approx 5 days. My thoughts are to open the lake to releave the flood water tension, I know there are some properties that are very low but with the amount of land that is infront of these properties there is a great deal of room to place leavey banks and some for of pump system to releave preasure during flood times. The lake as a kid I remember was so white and clear we would run in the water beside the long jetties while our parents walked them , NOW I would not even put my small dinge there !!! I think one thing they (the council) have missed is that with every home that goes on a block there is more silt running into the lake which should or has to be flushed, the other benifit is that the tourist from Newcastle and Sydney would come to enjoy just like Forster. I have more thoughts on this matter if would be so kind to ask.		WATER COULD NOT GET OUT OF THE LAKES ENTRANCE ......JUST SILTED UP !!!		YES IF THEY DO NOT DO ANYTHING WITH THE LAKES ENTRANCE !!!!!! Just have a look at the central coast tourist web site of the airial veiw of the lake , that will tell the story. P.S hope this helps and would love to talk to somebody about this matter.	
22	2.5 years	2.5 years	Yes	No	No	No	No	Road closures around Ourimbah university (Chittaway Road) and Burns Road underpass. Ponding to local streets and intersections.		Elevated creek and lake levels.			
23	2.5 years	20 years	No	No	No	No	No			Creek at Erina via the ridgeway			With Chambeline road open to the Ridgeway, major roadworks are required, especially during wet season
24	10 years	10 years	Yes	Yes	No	No	No	Living on Enterprise Dve my concern if flood are higher than 2007 and 2011 how we can leave our property as at the Ourimbah end the roads are closed and at the Chittaway end, there is flooding also. On both these occasions, the road at Ourimba end was closed due to flood waters. Getting to highter ground may be impossible? as Chittaway Creek is the rear boundary of our property and our only access out is north on Enterprise Dve. Our back paddock and yard were both flooded in both the 2007 and 2011 but no water entered our house. If it was to go higher, then that is an absolute likelihood. Our 2 neighbours to the north are affected much more quickly than us. Our other issue is that being on tank water, that much rain overflows the tanks, and then the excess water is dumped around the house, making the water on the ground situation much worse. I	I will email some photos. However, the water levels arent as high in the photos as they really were as the peak of the tidal waters coming back into the property occured in the night-time periods, and once the tide goes down, the flooding levels decrease quite quickly - in a matter of hours.	I do believe that creek cleaning of debris is important. Just 20 meteres down the creek from us is a small bridge on our rear neighbours property and also about 200 metres down the creek is another bridge (on Old Chittaway Rd - ourimbah end) and these get blocked very quickly with debris from the flood waters. Mainly trees branches etc. Chittaway creek in its natural state is quite small and therefore excess rain causes it to overtop its banks very easily. When the lake is at high tide, this causes the worst of the flooding as the creek waters have no where to go.		Yes. The fact that we have come so close to flooding now twice in 2007 and 2011	no. but thankyou for looking in to this.
25	1.6 years	4 years	Yes	Yes	No	Yes	No	Could not access my property for up to 8 hours each time. Fisrt flood experienced was Nov 2010, then had a further 8 floods in 2011 where we could not access our property on each occasion. Water quality was compromised i.e. running red and brown from the taps	20th July 2011 where Lisarow Station 561079 recorded 21mm in 24 hours which blocked access for over 8 hours, clearly it does not take much rain for us to get flooded out. On all 8 occasions in 2011, the water reached the first and secound railing of the bridge leading into Tall Timbers Estate.	Incorrect flood water direction in my opinion. Cut Rock creek is simply not capable of holding so much runoff flood water, it should be channeled else where.	I will try and locate them and send them to the email address advised.	Yes. Every time we have a downpour, our property floods.	You need to understand exactly where all this run off water is coming from and make arrangements for it to be captured and directed away from peoples properties, I believe redirecting the flood water through a pipeline from Pluim park along the railway line to join up with the creek on the same side will eliviate all the flooding issues experienced by residents at Tall Timbers estate and Teralba Str.

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
26	2 years	9 years	Yes	No	No	No	Yes	Burns road has been cut off By water many times and every time it is flooded the property behind me floods to about 150 cm below our property line and about 200 cm from our fence line	The water was flowing at i would estimate 5 Klms an hour at about 2 metres deep..June 2012 long weekend about the 12th and again in December about the 4th.and then again in april i think	in my opinion there is insignificant area for the water to go.Maybe try checking the creek to see if it can be widened down near kangi angi		Yes. I concerns me that we might loose our beautiful location to the floods	
27	2 years	7 years	Yes	Yes	No	No	No	Howes Rd floods on a regular basis due to the run-off flowing from Enterprise Drive (through the railway underpass) and meeting the swollen causeway at Burns Rd. Flood waters over the roadway (Howes Rd) have peaked at 1.3metres on several occasions in the last 12 months. Flood waters over the roadway at Burns Rd have reached levels of more than 2 metres on several occasions in the last 12 months. Flood waters flow through our property at a level of at least 1.2metres. This results in the destruction of stock fencing and the risk of stock drownings on a regular basis.	I will email photographs.	The main flooding occurs during high tide periods. At the point, I believe that the tidal flow back up Ourimbah creek, reduces the creeks ability to dispense with the water entering from the flooded Bangalow creek. Bangalow creek is extremely clogged with debri and rubbish and doubles back on itself at least 5 or 6 times as it passes through our property alone, reducing it's ability to clear the flooded water.		Yes. The only changes occurring are the build up of rubbish and debri in the creek system, hindering the flow of water.	
28	3 years	24 years	No	No	No	No	No					Yes. No stormwater drains on Geoffrey Road, Chittaway Point Increased levels in Ourimbah Creek, due to increased rains/ storms	In the past 3 years, in heavy rains, we have had sewerage back up in our drains and overflow. We have been informed by council workers, that this is because the pump stations are unable to cope and have not been upgraded in some time. I believe that this needs urgent attention, as it is a direct result of heavy rains in the area.
29	10 years	12 years	Yes	Yes	Yes	No	No	We where flooded across our land which came into our garage and half way up the side of my car. We lost the car as a result. However as we were a newbuild in 2002 we were well above the flood level. The water only covered up to the second steps of our entry. No water entered the main part of the house, only the garage. The road of course was underwater for a few days which meant no real access other than by boat or 4WD.	Our land at 286 Geoffrey Road was covered by water as the river burst its banks at 4am on Saturday morning of the June Long weekend 2007. Our home was only effected by water coming into the garage as it is on ground level. we have photos which I can email to the above address. The water became much faster as the level grew as to be expected but we were still able to walk around with care. It was not enough to sweep an adult off their feet but would have been dangerous for a small child, until the water level peaked then it was calm.	It was a masive storm which hit a huge area. That much water has to go somewhere until it reaches sea level. Ourimbah Creek became a masive storm water drain and once the level in the lake filled to it's capacity it has nowhere else to go but up and over the low lying land. If the Entrance had been properly open then the water could have escaped, or if a second entrance to the lake was open as it used to be. Provided the sea level was lower than the lake level of course.		Yes. Not really concerned as such, as we are in a flood area and we have built accordingly. But as nothing has changed if we where to get hit by another storm of that magitude or a rain event that will drop the same amount of water then we will be flooded again.	
30	9 years	9 years	Yes	No	No	No	No	Access to the Pacific Highway via the University or Shirley Road cut off on numerous occassions. In the last ?12 to 18 months access to Pacific Highway via MacDonalds Road also cut off. McDonalds Road only seems to be a problem at high tide and only since work/excavations has been effected along the east side of the Pacific Highway between MacDonalds Road and Lisarow Railway Station. Effectively this means the whole area is cut off in times of excessive rain.		probably low lying area and creeks overflowing		Yes. The fact that the whole area is cut off is of major concern	
31	8 years	40 years	No	No	No	No	Yes	Any minor flooding to the area which I live in, is caused by insuficient creek and road gutter management by council to keep debris clear to allow water to escape cleanly' This issue has been brought to councils attention on numerous occasions in the past with out any response other than that the area which were we live in is of no priority concerne to council.This reponse is typical of council because we are seen as having no visual exposure to passing traffic to reflect councils efforts to provide services to rate payers. This Questionnaire is an example of councils attitude to rate payers by only giving notice for consultancy with rate payers with such short and minimal response time I am presently in Western Australia and without being told of this Questionnaire I would not of been able to respond.How many other residence fall into the same catorgary as me	Any water ingress to my property has been marked at heights and dates at datum spots around my property. Note all datums are no where neare the 1:100 flood datum	previously explaned	No. What records dos'e council keep on these issues	Yes. Peviousley explained. Council should do more to reduce flooding areas	Yes but it would be a waste of time, as these issues have been brought to councils attention in the past and with the response from council that we are not interested
32	4 years	4 years	Yes	No	No	No	No	Had to drive around flooded areas by using and alternative route		creek banks overtiopping			The areas adjacent to the University of Newcastle Ourimbah, next to the creek, becomes flooded easily during high rain periods and threatens to flow back towards the east along Shirley Road.The bridge over the Creek on Shirley St is prone to flooding during such an occurrence. This always causes traffic flow to stop causing drivers to find and alternate route to Coachwood Drive, Cutrock St etc
33	18 years	34 years	Yes	No	No	No	No	Railway cres at Niagara Park flooded. Pacific Hwy closed (trees down) Burns Rd flooded		creek banks overflowing			
34	4.5 years	22 years	No	No	No	No	No		Despite flooding up the Orumibah Crrek Valley, my property was not impacted in any way. There was no water on the property and the road was always acessible.	Excessive rainfall caused flooding of Ourimbah Creek.			Have witnessed significant flooding at Kangi Angi, although the old highway remained open. This was on the June long weekend of 2007 in the massive downpour. Burns Road at Ourimbah where the underpass for the train line connects Enterprise, often goes under.
35	6 years	24 years	Yes	Yes	No	No	No	Roads closed (Burns Rd, Shirley ST,) or water over roads. Back yard pools water due to poor drinage in Bullock Rd, it backs up and stopsflow from my property into the street and on to storm drians, this causes flow thorugh my garage.		elevated lake levels, co-incidence of high tide with high flow down the creeks		Yes. back flow from the street happens every time we get very heavy rain as the street drins are inadequate.	
36	16 years	23 years	Yes	No	No	No	No	The intersection of MacDonalds Rd and Tuggerah Street Lisarow has been flooded several times.		Creek bank overtopping, possible too narrow pipe under the road. Low lying part of the road			
37	13 years	13 years	No	Yes	No	No	No	Northern rear corner of the property floods after long term heavy rain due to water being unable to drain fast enough thru the railway line culvert....the frequency of raised water levels has increased with the widening of the Pacific Highway around Dog Trap Rd from addition catchment and quicker drainage from the road. We would never flood if additional drainage under the railway was added.	We have some photos of various flooding around our area and yard plus locations of maximum levels reached within the yard and at work in Mill Street behind Ourimbah Station.	Main cause of regular flooding is water cannot drain quick enough thru the railway line culvert....highest level was reached in 2007 floods due to cut trees & debris, cleared by the RTA road works being washed down and blocking the culvert under the railway line.			
38	10 years		Yes	Yes	No	No	No	Traffic was disrupted on Friday 8th June 2007 at first Ourimbah University on Enterprise Dr, water was about 30cms or more across the road. After turning around and heading to Tuggerah Public School a tree had fallen down blocking the road. This could have been about 6-8pm. We went to a friends at Tumbi Umbi and stayed overnight. The next day about 10am I called neighbours next door they said middle of road clear to drive on only at the moment.But that I may not get from road up to driveway due to height of water.	When I got home at 1pm on 9th June 2007 to check on the place water was sitting about 20cm high I could see water marks on bottom of front fence cross beams. Water was flowing from Freeway (behind my property) and down to Pacific Highway and across the road.(This often flows like this after heavy rain down sides of the property).I was able to enter my driveway in a station wagon,as water level had dropped a little about 15cm by this time on 9/6/12. We came home on 10th June 2007 late in the afternoon. We have gas cooktop and BBQ which we used. We were not home during the day just to sleep.Power was on 12/6/2007 and water was on.	I could not see alot but creeks on either side of my property up an dodwn the road were overflowing.		Yes. 3 Creeks close by and all our ditches need to be cleaned out regularly to remove, fallen trees and growth in ditches that would stop water flowing away.	Maybe we could look at planting trees that love water, like different types of willows, and lillypilly plants which seem to tolerate wet conditions to help absorb excess water when it rains heavily on our nature strips or in our gardens.

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
39	16.25 years	17 years	No	No	Yes	No	No	My place of business was evacuated and flooded in 2007 and again twice in 2011	Ourimbah campus, June 2007, 10:00am water cascading off side of mountain and torrent of water through the stream that runs through the campus. Campus security or Facilities Management would have the details of height and damage to the campus. Can't recall specific dates for the two times we were evacuated in 2011. My residential address was not affected but the surrounding streets were which isolated the residents in my street for 3 days in 2007.	Amount of water reaching drains in a short period of time that water had no where to go. My personal opinion is still that Tuggerah Lakes needs to have two breakwalls placed on the north & south side of The Entrance Channel. Dredging is a waste of time as any sand deposited over the North Entrance side is washed back in on the first high tide. This is a waste of tax payers money and councils resources			Listen to the local fisherman and people that have lived and worked around Tuggerah Lakes for decades. They have the local knowledge, they have watched the changes in and around the lake e.g. changing the flow of Picnic Point when this area was refurbished to include a picnic area and boat ramp. Building breakwalls may initially be expensive but putting the cost against flood damage would be more costly.
40	3 years	3 years	No	Yes	No	No	No	The water floods the back of the garden, behind the house. The garden is right next to the creek. The water is usually coming up to about 3m from the house. At the fence it's around 50cm deep when it's at its worst. It's also leaving lots of flotsam - and often garbage - around, too. The blockage seems to be at the Teralba St Bridge. Its throughput just does not seem to be able to cope with it.	around 50cm at the fence (which is on the bank) I'll email a couple of photos in.	Huge amounts of rain quickly, the blockage seems to be the bridge at Teralba St. The creek just could not stay in its bed, it was around 50cm higher than what the banks could contain.		Yes. If the rain keeps falling for more than half a day like it does when this happens, there's a good chance the water can flood the shed & the garage area (the high water levels were just a cm or two below the shed floor level) . I don't think our house is in any danger, it's on stilts, so the creek would have to gain another 50cm or more vertically. That's nearly impossible, the amount of water the cover all surrounding areas is insane. and at that point the water is actually flowing over the bridge, too.	
41	16 years	26 years	Yes	No	No	No	Yes	Road was cut by flooding both up stream and down stream of our property. Our paddocks to the north of Ourimbah Creek Road were covered by floodwater,causing damage to fences. Irrigation pump is removed to prevent flood damage.	On the weekend of the Pasha Bulka storm the water reached to the edge of Ourimbah Creek Road approx 20m above the creek bed.	Creek Banks over topping.Creek ceases to flow lagging the high water periods in Tuggerah Lakes.		Yes. Since their has been no flood mitigation work in the vicinity. Flooding of paddocks accepted as a fact of geography	We have noticed over the years that to flood waters rise, cut the road, subside and then rise again. This seems to follow the tidal cycle.
42	9 years	9 years	No	No	No	No	No						
43	12 years		Yes	Yes	No	No	Yes	My property runs down to Ourimbah Creek although my little house is well above the flood point, being on the side of the hill. In June 2008 the creek rose about two metres above the road, so I was unable to leave my property until the water subsided. While my neighbours horse float was washed away I only lost my rubbish and recycling bins which were located a few days later some way down the creek. I also had some fence damage.	Refer to emailed photos taken 8-6-2008 - water moved fast enough to carry my neighbours horse float away down stream and through a couple of fences.	Natural causes, a hell of a lot of rain.		Yes. Only regarding the loss of creek bank and possible damage to my access bridge. I am concerned that another big flood might result in loss of the access to the bridge by the bank being eroded away.	
44	22 years	24 years	Yes	No	No	No	No	Most commonly flooding occurs at Burns Rd railway underpass or near University entrance and football fields. Flooding has also occurred at the Chittaway end of Enterprise drive. On one occassion it has been flooded in both places simultaneously		Not sure. I think many things contribute. sometimes the shear volume of rain that has fallen just takes some time to dissipate			Generally I feel more preventative measures like clearing of roadside drains maybe effective.
45	10 years		Yes	Yes	No	No	No	road closuer		the entrance was closed		Yes. in the last few years the creek rose about a half metre after a lot of rain, fell continuously over many days the creek was running like a river. but because the entrance was open we had no floods.i wish the entrace kept open at oll times permanetley.	
46	16 years		Yes	No	No	No	No	Flooding on corner of MacDonalds Road and Tuggerah Street making it impossible to reach the highway. Also flooding on the road beside the University so could not get through that way either. Would have had to go up Fagans Road and over the Ridgeway to Erina to reach Gosford etc.		Not sure but this year was the first time I have experienced this problem			
47	0 years	16 years	No	No	No	No	No						
48	12 years	20 years	Yes	No	No	No	No	Unable to leave or return to area.					
49	7.5 years	15 years	Yes	Yes	No	Yes	Yes	Small bridge at end of Orange Road, adjacent to our property floods and vehicle from the property on the other side cannot pass. In June 2007 when there was major flooding, we lost power for 4 days. Orange road wold typicaly suffer major erosion during sustained rain events	Yes we can, but someone would need to come and visit us. We also have rain charts for the past 7 years for our property.	Creek banks over topping. Blockages - primarily due to weed infestation of privot, lantana and camphalaurel. Also the structure of the bridge. It would be bettwe if it did not have a middle support where blockages also occur.	Sure	Yes. It has in the past !	No - but would be happy to answer any further questions related to our property. Also, the run off from Peach Orchard Rd is poorly controlled which effects a lot of people - something needs to be done about that !
50	20 years	37 years	Yes	No	No	No	No	The roundabout at the Lisarow plaza was flooded	Floodwater was not very deep and it was possible to drive through	Blockage of the creek and the drains due to build-up of tree debri and leaf matter along the road	I have been keeping a record of the rainfall since the year 2000		I feel that there is not enough cleaning of drains and pruning of trees in the area around the small creeks in this area so therefore there will always be a build-up of debri and this mats together and causes blockages, what ever happened to the street sweeper?
51	4 years	4 years	No	No	No	No	No						
52	15 years	61 years	Yes	Yes	No	No	No	Water across Macdonalds road at intersection with Pacific Hwy. I am on 8 acres and part of the land around the drain has had water on it. Up to about 200mm to 300mm on less than a 10th of the propertyproperty. Drained away very fast.	I am on 8 acres and there is an open drain that runs through it. This drain can fill on intense rain and over flow on to some parts of the property. Have not seen it deeper than about 200 to 300mm along the banks of the drain. In the 15 years that I have been here I have seen this happen maybe 6 times. Do nopt remember dates, however, in the last 12 to 18 months I have seen it this high twice (wet year). Water builds up over a few hours but seems to drain much faster.	Creek banks over topping causing drain to fill. I would imagine this is due to the whole Cutrock creek not being upgraded in line with development in the whole catchment area.			I have lived in this area on and off for over 60 years, as a child walking to school, we were reasonably often (maybe once or twice a year) stopped from going to school because of flood waters over MacDonalds road. In those days the water did not go down very quickly. My observation over the last 20 odd years traveling the same roads is that the floods are not as severe and the water goes down much faster
53	22 years	32 years	No	No	No	No	Yes	Limited to an hour or so -- but none since successful flood mitigation work a few years back. Occasionally heavy sustained rain can cause very temporary cover over driveway (which includes a causeway and two large diameter pipes). This gushing water has never (to date) caused any delay and is under 3 " - 5" over the driveway at the highest level at that point. Maybe there have been episodes in Mann's Rd - we never saw them.	Have just given some info on previous page. Adding: Water movement is temporary but very fast and flood-like as the water-course under driveway is well drained. This water is from back-up of the valley catchment (I have never seen its height at full-bore - but which has obviously been higher than this). Our house is some five-six meters above the peak of this water and 25 metres away. There would have to be a huge flood to bother our home as down-stream flood works are very successful..	Creek overtopping.			
54	10 years		Yes	No	No	No	Yes	We have regularly been cut off from being able to access or leave the area, from extended periods to one to two days, depending on the level of flooding under the railway bridge on Turpentine Road. In 2007 we lost our car and I nearly drowned getting to dry land when attempting to get home along Orchard Road after looking for a way to exit the area..	In 2007 the flood waters almost reached our house which is just above the 99 year flood level. Regularly after any extended rain period, Turpentine Road under the railway bridge, which is our only access to the area floods at levels up to 3 metres. Typical wet periods quickly raise the underbridge levels to one metre, limiting access to 4WD vehicles only. Anything over that blocks all traffic. Photos supplied.	Heavy rain coupled with insufficient drainage on Ourimbah Creek causing backup at the railway bridge on Turpentine Road.		Yes. While not directly flooding our property (although it did come close in 2007), we are very concerned about our inability to exit the area, particularly in emergencies. Our property could get flooded if the levels exceed the 99 year level.	I have been in regular communication with Wyong Council about suggesting various options to both alleviate the problem under the railway bridge and also to provide an alternative exit from the Turpentine Road, Ourimbah Road and Orchard Road area in times of heavy rain and bridge flooding. Copies of those letters are available. Contact the Wyong Council's Mr Peter Sheath for recent examples.

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
55	25 years	40 years	Yes	Yes	No	No	Yes	Street was closed to traffic. Whole peninsula was under water from the lake and Ourimbah Creek. No electricity for 5 days in 2007 flood.	My house is elevated and the land slopes up from the lake. The water was at different depths in different spots, and just over the top of my gum boots at its deepest where I was walking. Will email photos. The bottom floor of my house which only has the laundry area and stair well on that level stands on a 50cm concrete slab. No water got onto the floor area. My garage is up a ramp so the car remained dry as well	Because of storms and heavy rain for some days both Tuggerah Lake at Chittaway Bay and Ourimbah Creek from Kalua Street overflowed and met thus flooding all the streets in that vicinity		Yes. We have no control over the weather systems which cause this to happen or to the King Tides at The Entrance which keep the water trapped in the lake and thus backed up the creek and Wyong River. This area also has no kerb and guttering drainage to take away the water into constructed storm water drains. My property will flood, but my house is not affected by flood water.	
56	>40 years		Yes	Yes	Yes	Yes	No	In a typical flood event, Tuggarah Lakes water level rises in combination with rises in Ourimbah Creek. Initially Geoffrey road floods and becomes impassible and the lake water spreads across the road eventually meeting up with the Creek. The water levels of the lake and Creek then rise in concert flooding the lower level of the house and detached garage.	June 2007, flood waters reached 400mm up internal walls of ground floor of house and garages June 2010?, road became impassable and minor flooding of garages (70mm) but no flooding of house interior.	Rise in Lake level followed by creek banks overtopping		Yes. Failure of any meaningful widening and deepening of The Entrance mouth of Tuggarah Lakes to enable sufficient volumes of water to escape to the ocean and to allow flushing of the lakes regularly to maintain deep channels within the lakes to be re-established.	Major flood events mostly appear to be associated with storm systems where major East Coast lows combine with very high tides that block egress of increased runoff from the catchment from draining from the lake.
57	22 years	22 years	Yes	No	No	No	No		Ouimbah creek flooding along Enterprise road and around the university.				
58	11 years	34 years	Yes	Yes	No	No	No	In the past many roads have flooded in my sorounding areas mainly near Ourimbah Soccer field, but nothing that I can recall in recent years. I have never experienced flooding in my residential street. During the last 11 years there has only been one occasion that flooding has risen from the direct creek/catchment area behind my premises onto my property. the flooding in question did not enter the residential premises and only came approximately 1 meter onto the property. This was quite some time ago approx 9-11 years ago.	Refer to details in previous question	Creeks banks overtopping			
59	19 years	19 years	Yes	No	No	No	No	Road closures at Cutrock Road and Shirley Street		Creek banks overtopping		Yes. Creek behind house flooding	
60	20 years	21 years	Yes	No	No	No	No	Had to find alternate route home or out of home. At worst, had to park my car and walk through the bush to my home		creek banks overtopping			
61	28 years	28 years	Yes	No	No	No	Yes	Palmdale Road has been cut off fairly regularly over the years - usually only for a period of several hours after prolonged or very heavy rainfall. High tides in Tuggerah Lakes seem to slow the rate of drainage out of the creeks. There are at least 5 points where water can cut the road in the first 2 km. We also have creeks running through our acreage and these have flooded low lying areas of the farm several times. Since we know these areas flood we have structured the farm so there is little impact on us. Some of the floods we can remember are: July 1984, November 1984, 1988 multiple, January 1989, April 1989, February 1992 (big flood), March 2002, October 2004, June 2007 (big flood), August 2007, October 2010, June 2011 and April 2012.	I think we have some photos but I'll have to search for them - I'll try to send more information in an email.	With so many floods over the years all of the suggested causes played their part. Creek banks overtopping is consistently a cause. The road is also cut by stormwater runoff from hills in lower land contours that would not normally be considered creeks. Elevated lake levels seem to play a part in the timing of flood peaks for major floods. Natural debris in creek beds seems to be more of an issue than blocked bridges though an old bridge near Fern Tree Lane has been replaced by a concrete pipe with a smaller opening so this may be a problem in future	I will email details separately.	Yes. Nothing has changed as far as the road, bridge heights, creeks are concerned. With global warming we may go through longer dry periods but we can expect more extreme weather events like east coast lows so flooding will continue. Between logging in our valley a few years ago and the combined impact of several years of drought in the early 2000's and the destructive impact of bellbirds we are losing eucalypts along the creek catchments meaning potentially more runoff.	
62	31 years	31 years	Yes	No	No	No	Yes	On numerous occasions we have been unable to get in or out of MacDonalds Road to go to work or get home. Our children have been evacuated from Lisarow Primary School due to severe flooding also when they were in Primary School (they are now aged 27 and 30). Our property remains high above the flood but neighbours have been unable to cross the creek that goes between our property and theirs via the Orchard Road bridge when it was lower, to access their properties. We have had huge pieces of timber left high above the normal creek level after the flooding.	When we moved to the area 31 years ago there were a number of large floods over the next few years that were over the top of the flood level indicator on the old Orchard Road bridge. Severe floods have continued to occur regularly over the years though recently the levels have not been as high. It seems to depend on the waters ability to escape and when the the lake is at high tide the flood seem to be longer and of a greater height. One flood aproximately 22- 26? years ago only had to go a about 1/3 of a metre higher and it would have gone into the house that is on the other side of the creek from our home, the house mentioned is actually up quite high- I will indicate the house and level in a photo taken during a lesser flood. I have some photos taken during flooding and showing what it is like normally. These were taken when the flood levels were dropped from the full height as we did not venture out during the heavy rain fall period. One lot of photos are taken aprox 20-25 years ago and the others are recent in 2011 . Re the severity on MacDonalds Road I have seen a semi trailer size truck just getting through the flood waters on the corner of MacDonalds Road and Tuggerah Street to take worker to the chicken factory. If the tide was high in the lake when the rain was severe the floods waters go very high. On numerous occasions we had to get the children from the local Lisarow Public School before we were all cut off due to the water in a number of places along MacDonalds Road being too deep to cross.	The cause of the flooding in my area is the creek banks overtopping. At my property 2 creeks meet and the water overflows the banks in a very dramatic way spreading out extensively on the lower lying property below us. Also during really heavy rain the water cascades in "streams" like a waterfall down the hill from the Fagan Roads area into the Creek on the western side of Orchard Road and also into the overflowing dam on the eastern side of Orchard Road. As previously mentioned the tide in the lake seems to have some impact on the level of the flood waters and how quickly they are able to get away. The works done on the railway line culvert seem to have also had some impact on lessening the levels to some degree but we haven't had the same type of conditions and the tide high at the wrong time for many years. Recent flood level 100 year predictions re a development 2 properties west of our home we believe are wrong - flood are much higher that their estimates, based on our local knowledge and that of those who have lived around here longer.	However Peter Nesbit Hawes who lives a few properties up (east) from us in MacDonalds Road does.		I have photos which I will try to email to you. Please note they are not at full flood level (due to my reluctance to get wet in the heavy rain during the fullest flood time). I have been told Doug Catt in Orchard Road has photos showing very extensive flooding on the properties near the corner of MacDonalds Road and the Ridgeway.

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
63	48 years		No	Yes	Yes	No	No	Several times our house and property have been flooded. The water can either rise from the creek first and flood the land or it can come from the lakeside. On one occasion the whole of the front yard was covered in kelp which was as high as our knees. We rolled it up like a carpet to dispose of it.	Sorry we can't give specific dates, however, roughly about 20 years ago we had a very high flood which left a water mark inside the house on the doors about 1.2 metres high. More recent floods have been close to 1 metre.	In all cases I think that the flooding was due to elevated lake levelsdue to the entrance to the lake being narrowed because of sand drifts.		Yes. Because of the land flooding there is more cleaning up of property and loss of equipment. Also it brings down the value of the land.	The aboriginies say that years ago there were two entrances to the lake. We have heard that it was looked at a few years ago for possibly opening up a small passage where the second opening was. This information may not be correct about opening up a small passage but it may help the situation as the lake's entrance does continually narrow with sand drifts. As mentioned previously, our land has flooded many times. Years ago it flooded frequently so they dredged the entrance to the lake and for a long time we had no floods. But time makes people forget and new and perhaps younger members join the council and they perhaps have no idea of what has happened before. Decisions are made not to dredge the entrance to the lake and we start to get flooded again. The lake used to have beautiful clean sand and plenty of fish. The water was lovely and clear and you could look down in parts where it was shallower when fishing and see the sand and grass weed. Prawns were very plentiful where you could get bucket loads during prawing season. Long Jetty was a fantastic place to take little ones as you could walk out on the sand a long way and it would only go to your knees. It didn't smell. Now the water seems to be getting stagnant. There aren't many fish. The Ourimbah creek is dirty and polluted - perhaps partly due to the changes in farm land being turned into industrial land and other developments happening along the creek causing the creek to silt up. It is difficult to find the clean sand and it is becoming muddy. Perhaps having two openings to the lake might help clean it out a bit. It may have been because of man's interference in the first place that closed up the second smaller channel.
64	22 years	years	Yes	Yes	No	No	No	Lower section of property gets up to 1.5 to 1.8 metres over it. Bridge over Bangalow Creek near Rugby Club can get blocked, and on severe flooding Chittaway Rd at Burns Rd can be blocked by back water (not flowing) about 0.6m - 0.9m deep	Some photos have been sent to above address. The flood levels had lowered some by the time the photos were taken	All of the above.		No. The lower half of the property is "flood plain". It didn't get named that for nothing.	
65	10 years	14 years	Yes	Yes	No	No	Yes	In the 2007 floods, many roads in my neighbourhood were closed. Returning home from work (Sydney) was difficult due to closed/flooded roads in Ourimbah, Tuggerah and Chittaway Bay. Over that weekend, power was also disrupted due to flooding and freezer contents had to be discarded. More recently, in 2011, the stormwater drain out the back of our house flooded and a portion of my street was impassable when I left for work in the morning. This flooding also flooded my back yard (athough it was only a few centimeters deep in my yard).		Unsure			
66	22 years		Yes	Yes	No	Yes	Yes	Water covered the street in many places making it unsafe for most traffic - 4 wd vehicles managed O.K (2007) Back yard flooded to within 6 feet of house (1991) not much in the front as only about 1 inch of water flowed thru the garage from the front. In 2007 the sewerage pumps failed & so sewerage was added to the flooding. 2007 - electricity was cut off for 5 days.	1991 - Ourimbah Creek rose about 2 feet & came to appro\x. 6 feet of the house. From memory the water in the front was about 1 inch in the yard & there was water over the road. 2007 - Ourimbah Creek rose maybe a little less than the previous flood as the water only came to withing 18-20 feet of the house. However, the front yard & road were flooded - the yard not more than 1-2 inches but the road was aminly inpassable. Houses not threatened.	Creek bank over topping & poor drainage			Proper care of Tuggerah Lakes may help reduce flooding & the cleaning of gutters & stormwater drains may also help.
67	10 years	10 years	No	No	No	No	No						
68	23 years		Yes	Yes	Yes	Yes	No	Ourimbah Campus is impacted by floods during heavy rainfall events. The first stage is the flooding of Shirley Street, which generally is quickly inundated to a depth of @ 1.5 metres. Often cars are trapped in this water after failing to drive through. The creek area next to Shirley Street then overflows and fast flowing water travels across the bottom carparks to a depth of around 2 meters towards the Rugby Club. At this stage the bridge over the creek on Chittaway Bay Road near the campus is covered to a depth of 1 metre. Large vehicles can usually still cross. The main water problem is from the surrounding hills to the South East of campus, particularly the Brush Road area, which act as a catchment. Large volumes of water come to the lowest point, which is the Southern entry to Ourimbah Campus on Shirley Street, but then quickly overwhelm the drainage system as Shirley Street is usually already flooding before this new influx of water hits. Additionally, the creek line cutting through the middle of campus leads to a large pond near between the tennis courts and Campus Central shops. In recent flood events this pond has broken its banks, cutting off the main access through campus.	The creek backs up and floods Shirley Street which is the access to the railway station, then the secondary car parks followed by the main car parks. Buildings are not at risk by this form of rising water. Of greater concern is the change in the overland flow from the upper end of Brush Road, due possibly from changes made to the stormwater drainage by WSC. This caused flooding into the FM Services Building for the first time and scour damage to other parts of the southern slope. June long weekend 2007 Flood waters reached under 1 m adjacent Soheir Park on Shirley street. The first step leading to the North car park from the overflow carpark Creek through the centre of the campus overflowed with ingress into the IRC 23rd March 2012 had similar heights though creek did not break it's banks, though flowed over the boulevard. We have a significant collection of photos in the flood times. Please contact Donna Farragher if required. 0249216691 Shirley street adjacent to Sohier park, the wooden traffic bridge, the path and foot bridge leading to Uni access from the Rail station, Shirley street entrance to the Uni (dip in the road at the entrance) The creek at the overflow car park at the rear of carpark north (the Union footy oval) the overflow carpark at the rear of the south carprak. Chittaway road adjacent to the Soccer fields and the widely known Burns road under pass. Down Burns road at the back of the FM office with ingress into the FM building.	Yes, as far as the land elements only. It may cause some building flooding if a very extreme protracted rainfall event were to occur. Main risk of building flooding is from the internal stream flow.	The University does not keep local rainfall records.	Yes. Yes, as far as the land elements only. It may cause some building flooding if a very extreme protracted rainfall event were to occur. Main risk of building flooding is from the internal stream flow.	The main creek watercourse needs a complete flood study for a considerable length upstream from its outfall and that incorporates any influencing items such as waterway restriction, culvert sizes, low bridges, undergrowth, high tide effects, retention basin options, increased runoff due to development.
69	1 years	1 years	Yes	No	No	No	No	I live off Coachwood Drive. In may or June this year I was unable to get home due to flooding. Access to Macdonalds Rd from the Pacific Hwy was cut off (near Lisarow Public School) and all roads around Ourimbah uni cut off so there was no access from the other side at Shirley St.	I am unsure of exact measurements but there were 3 cars submerged (water up to midway drivers window) on Chittaway Rd near the rugby park, 2 cars under on Shirley st I between the uni and playing fields and 1 car near Lisarow Public School.	I would say a mixture of the above examples			
70	12 years	20 years	Yes	No	No	No	No	Flooding on Macdonalds rd and Pacific hwy Lisarow disrupts traffic access to the hwy. alternative route via Shirley rd Ourimbah is often also closed due to flooding causing traffic build ups and redirection through the University		Overflowing creeks and poor road drainage			
71	5 years	5 years	No	Yes	No	No	No	During the past 5 years following heavy rain, our southern paddock has been flooded on numerous occasions up to a depth of approximately 2 meters	Refer to photos attached. Water flows back from a small creek in neighbors land that ultimately feeds into Bangalow Creek and flooding is exacerbated by storm water inflow to our property from Knight Close and Alex Close through Council installed drains. (If unable to attach photos, will e-mail).	Inflow of storm water from Alex Close and Knight Close with creek bank overtopping and ebbing back into our property.		Yes. Past history of flooding and lack of drainage in Bangalow creek.	

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
72	13.5 years	13.5 years	Yes	Yes	No	No	No	Unable to leave or get into property at various times - absolutely no vehicular access for some hours to days. The whole bottom paddock was completely underwater	The first year we were there (1999) at Easter time it flooded and we are unable to leave the property for several days. Since then to approximately 2007 we were only flooded in on about three occasions. In the June 2007 storm we were flooded in for many days and this continued on and off for the next couple of months due to the mass amount of water that was still around from the storm. 2007 was by far the highest water level reached. Since 2007 due to a number of factors (changes by railway, electricity and council) we have had many occasions when we have been unable to access our property or leave it.	We feel that one of the main factors that we have experienced increased flooding is due to the railway filling in the natural water course along the side of the railway which enabled water to escape. This together with further filling in works by the electricity commission up towards the university and the changes to our roadway by the council, it is continually dug down when graded instead of built up - drains have been dug into our property and the creek and this has created a "damming" of our property. We only need heavy rain for a approx. 5 hours and we are completely flooded in. Whereas previously it would take a 24 hour plus period to be completely flooded in. The main difference is that our billabong used to get wider and the water from the flooded creek would eventually meet the billabong. Now, the water just comes from the creek end and builds up and floods to whole area. Because the council has dug drains from the road down to the creek the road floods much earlier too.		Yes. Every single time it rains for 4-5 hours it floods - it has nothing to do with having a wet winter - it is every time there is heavy rain for 4-5 hours. I have been out for the day and unable to get home to feed horses and attend to the other animals.	I think that something urgently needs to be done in relation to the flooding of our area. Natural watercourses have been filled in and this has created major problems. The road needs to be built up to a height where it used to be. eg. If you come to our gate, there is another gate to the right of the entry gate. That gate was the access to the property in 1999 when we purchased it - you cannot even drive through it if you wanted to - there is a 60 cm bank to scale.
73	24 years	24 years	Yes	No	No	No	No	Road submerged at bottom of our driveway.		Natural flooding of Ourimbah Creek, perhaps partly affected by tide via Tuggerah Lake	Yes		
74			Yes	No	No	No	Yes	The house was rented out with long term tenants during the big June flood, (5 years ago I think it was?). Our tenants, were inconvenienced ina number of ways by the flood water. They were unable to get into town, while our property wasn't affected, parts of Ourimbah Creek Road were closed to all cars initially and then only accessible by 4-wheel drives. We are on rainwater and have a septic tank, so while there wasn't a problem with water supply, however the power was out for over a week. This caused great inconvenience for a family with a young baby. The pumps for all toilets and showers etc did not work. Water to flush toilets and drink etc had to be collected by bucket from a gravity fed tap.		All of the above on Ourimbah Creek Road			
75	25.25 years		Yes	No	No	No	No	Brush Rd at Sohier Park. The uni flooded preventing exiting our home (Anderson Rd was also flooded). Following some drainage upgrades, maybe related to the uni, exiting our home has been a little easier when flooded.	Brush Rd – now Shirley St – was too deep for cars thereby preventing us getting to work to home again	High tide of Tuggerah Lakes causes rain water to back up flooding the subject area. Flood mitigation of recent years works well, but there was serious flooding disruption a couple of years ago.	No	Yes. We live on the top of the Brush Rd hill. Flooding causes concern should there be an emergency preventing emergency vehicles accessing our property.	It would appear that our flooding problem is as a result of silting Tuggerah lake (?)
76	13 years		Yes	No	No	No	No	Road closed in Turpentine Rd under railway bridge	June 2007 flash flooding. 30Cm hight on land at rear of property. Main building did not have flooding - only stables. Ourimbah creek broke its banks.	Creek bands. I have in drought times removed obstructions and kept water flowing. I believe instigation of a policy of gearing trees and grass stabilisation planting on banks should be mandatory.	No	Yes. Perhaps but so could 75% of NSW (2011)	I think landowners adjourning the creek should have regular consultations with council officers (annually) to inspect the creek management to allow some advice and grants to maintain slip off slopes and natural pools and riffles which is npart of fluvial geomorphology management.
77	0.9 years		No	No	No	No	No						Drainage out front of properties need attention as after heavy rainfall water lays stagnate in ditch has no escape.
78	20 years	20 years	No	No	No	No	No	Coorara Rd made impassable for up to a day or two on a few occasions	Up to ½ a meter deep at point where pipe goes under road. Approx 100m from intersection with Cutrock Rd.	Water unable to get away through Inghams Chicken Factory property – creek needs better channelling and clearing through Inghams property			
79	10 years	25 years	Yes	Yes	Yes	No	No	Could not leave my property only by boat. Flooded my front and backyard but not from the river. The flood came from the street (front of property) <u>not the river</u>. I have attached photos.	Please see attached photos. May '07 this is my year next to evsement and backing onto river reserve as you can see the water came from the front and side not the river.	Elevated lake levels from 14 days rain and blocked drains		Yes. Still no proper drainage and every time we get rain for more than 24 hours we get bad drain smells and sewer back up.	Storm water drains all need attention.
80	3.3 years	22 years	Yes	No	No	No	No	Fagans road closed to traffic	2ft or 600mm	Creek bands overtopping		Yes. The paddock next to our property floods.	
81	17.2 years	17.2 years	Yes	No	No	No	No	Cut Rock break between public school and Fagans Rd flooded and cut Fagans rd; exit was blocked at Newcastle University, junction of Tuggerah St and Fagans Rd which was also blocked 3 or 4km up the hill due to fallen trees.	I believe our block used to flood until the developers "Maranba Estates" raised the ground level by placement of filling – They claim to have raised level by one meter – we are closed to "Cut Rock Break" - we have experienced surface water in our yard but not due to break flooding.	Much more rain than could be drained by the creeks.	Copy of records for 2011 + 2012 enclosed. If required can copy back to 2000.	Yes. Only if a major flood occurred.	
82	31 years		No	No	No	No	No						
83	5.5 years		Yes	Yes	Yes	Yes	Yes	No power for 72 hours. Entire property (4.5 acres) though did not enter the house as it is elevated on poles.	8/6/2006 – by 1630 unable to enter the property as the water visibly moving rapidly. Estimated depth 2m from the top of the verandah just below. 9/6/2007 – water had subsided to 1m. 10/6/2007 – Able to enter the property and rescue the dog inside the house and leave.	Rainfall from the catchment area into Ourimbah creek which borders our property.		Yes. The estimated H2O rose to 8.4m (the creek). Concerned if it rose higher and unable to leave the property. I never want to experience the episode ever again.	Read enclosed. I received a counselling session by Wyong council to deal with the enclosed. "A telegraph line warning system" should be set up for the flood and fire. Prevention better than cure!
84	23 years	40 years	No	Yes	No	No	No		Yes. Covered the road. This happened a number of years ago.				
85	26 years		Yes	No	No	No	No	Road blocked in Chittaway Rd. Drains not cleaned by leaves in gutters.					
86	4 years		Yes	Yes	No	No	No	Traffic on enterprise drive (near Ourimba uni) and our back yard flooded but only half of the garden and no where near the house.	Levels were about 1 foot at the very back of the garden. The creek behind overflowed.				
87	3 years		No	No	No	No	No						
88	25 years	40 years	No	No	No	No	No						
89	18.3 years		Yes	No	No	No	No	Roads were closed for up to two or three hours. 1) Shirley St @ Sohier park. 2)Mcdonalds Rd @ Pacific Hwy. 3) Chittaway Rd @ soccer ovals and Burns Rd via duct	Average a worst roads have reached over 600mm. Never seems over 800mm. Buses and trucks can at times get through – large 4x4s etc.				
90	15.75 years		Yes	No	No	No	No	Road cut off at the corner of Mcdonalds Rd and Cut Rock Rd. Alternatives such as Shirley Rd and Fagans Rd also cut.	Not really. Roads were cut off.				
91	24 years		Yes	No	No	No	No	Lakedge Ave flooded.					
92	605 years		Yes	No	No	No	No	Unable to get passed by floodwaters on roads – waited hours unexeptable (sic). Local school flooded unable to take children to school and get to work :(	About door level on medium size cars on Tuggerah St and McDonalds roads Lisarow Shirley St at University Ourimbah both are only access to get to the Pacific Hwy or you have to go all the way to Erina to get back on the Pacific Hwy. That is a joke.				
93	10 years	46 years	No	Yes	No	Yes	No	2007 floods	2007 floods once in a blue moon. Stop wasting rate payers money with this kind of survey.				
94	13.2 years	34 years	Yes	No	No	No	No	Area of lower Chittaway Rd and Lakedge Ave were covered by up to 2 metres of water	Queen's birthday weekend 2007: Corner of Chittaway Rd and Lakedge under by about 2 metres. Lower parts north were also under. Flooding came in from the Lake mainly due to high tide and high flow down Ourimbah Creek.				
95	12 years	33 years	Yes	Yes	No	Yes	No	2007 flood – 150mm of water across most of the property. Garage floor was flooded, very little damage except a muddy clean up. The house was high and dry. The sewer was disconnected for 7-8 days. No power was available for the sewer pumps and the house had no power. I vacated to a friend's house in Lisarow.	7 June 2007 – Approx 150mm above garage floor. Flood water flowed from Henry St. The river had not broken its bank. Approx 300mm before river water would have overboarded the bank . 1983 – the flood cut Geoffrey Rd at about No. 200 - No problems at 136. 1994 – the flood cut Geoffrey Rd at about 200 – n o problems at 136.				
96	17.3 years	years	No	No	No	No	No						Nothing.
97	18 years	18 years	No	No	No	No	No		Did not reach the said property. no flood.				
98	32 years	years	No	No	No	No	No				Yes (see attached documents)		

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
99	2 years	10 years	Yes	Yes	No	No	No	I am a medical practitioner and have to be on call once a month for 1 week. On numerous occasions I have been unable to stay at my property in case I could not get out. Once I could not attend a call.	18/4/12 – Flood level under Turpentine Rd Bridge up to level of railway overpass. I have photographic evidence of flooding of this underpass on many occasions. June long weekend 2011 there was 2+ metres of water over my property. June long weekend 2012 saw significant flooding of my property.	The bridge on turpentine is built in a creek and the flooding is inevitable. The creek going to Ourimbah creek is overgrown and water backs up worsening the problem.		Yes. I am frequently unable to access and egress my property when Turpentine Rd floods. The Wyong council will not repair the north extent of Orchard Rd. Can this be addressed?	Please could something be done about the Turpentine Rd underpass or to provide repair to the alternate exit by the north part of Orchard Rd to the rail underpass at Ourimbah Creek.
100	12 years	40 years	No	No	Yes	No	Yes	I was unable to attend work at the University Campus as the campus was flooded.		Tides + heavy rainfall			
101	years	years	No	No	No	No	No						
102	8.25 years	34.2 years	Yes	Yes	No	No	No	Traffic – Flooding occurs at bridge on Burns Rd Ourimba leading to the Rail [illegible] entry to Enterprise Drive (can be 2 metres deep – strong enough to [illegible] away). Backyard – Right hand corner of backyard becomes a "[swilley?]" during very heavy flooding [illegible] rain – the water drains away over time when rain ceases.	Bangalow Creek crosses Burns Rd at traffic bridge – fast flowing in flood - has swept cars including 4WD to the side of the rails. Depth as reached 2 metres at the bridge flood depth indicator occasionally – usually about 1.5 metres.	Burns Rd: 1) Blocking of bridges – logs/flotsem/rubbish, 2) Elevated lake levels. Backyard: 1) Run off from hill at back and adjacent properties, 2) Right side fence slows down water drainage – depression in ground creates "[swilley?]"	Various photos taken over the past 3-4 years of Burns Rd flooding at bridge. See photos 3,4,5,6. Various photos taken of flooding in backyard (see photos 1&2)		Routine maintenance and clean up of Bangalow Creek areas – old logs, debris under bridge areas. Clean up areas where Bangalow Creek goes underground to Lake areas. Dredging of problem lake areas so water (flood) run off can drain [illegible].
103	33 years	34.7 years	Yes	No	No	No	No	Easement drains need to be checked as tree roots block them which causes road to flood.		Blocking of drain (easement)			
104	10 years	27.8 years	Yes	No	No	No	No	Main road at Ourimbah/Lisarow flooded up to 1.5m. But 20 years ago.	20 years ago – 1.5 metres. On road storm water. Heavy rainfall.	Creeks and heavy rains	No records, simply memory. No floods in 20 years. Lisarow and Ourimbah.		Simply clear creeks for ease of flood water to flow properly.
105	47 years	56 years	No	No	No	No	No						
106	3.7 years	15 years	No	No	No	No	No			all of the above			
107	1.2 years	1.2 years	No	No	No	No	No			Blockage of bridges restricts flow of water			
108	32 years		Yes	No	No	No	No	1) My house was former P.O. It was the point in severe floods where cars parked and then they paddled along the point. When flooded, cars cannot drive along Geoffrey Rd. 2) Several floods in area in 32 years. I can show someone where yards flooded.	Too much detail for here. I can brief someone on site where different floods reached. The original house that became the P.O was built in the 1930s. We rebuilt in 1988. We can show the levels except the last storm/flood when we were overseas.The SES used our slipway to evacuate residents.	Creek bands overtopping is main reason. On some occasions the lake elevation contributes. On the worst occasion the river and the lake "met" alongisde our home.	Yes. I have a book with rainfall records but only for less than 10 years. Rain guage is on my slipway.	Yes. Continued land development reduces capacity for rain take-up and speeds run-off to the creek	I have some comments from previous owners (now deceased) about levels of flooding/creek. I can show you where different floods peaked. I am N halfway along Geoffrey Rd.
109	23 years	25 years	Yes	No	No	No	No	The underpass at Burns Rd gets flooded	Bangalow Creek runs through approx 2 mts. Have seen nearly to railway lines.	All of the above + lot more housing			
110	30.7 years		No	No	No	No	No						During heavy rain some water may accumulate in the yard of our properties, it never enters the house and drains away via natural and piped drainage. The creek that runs along the side of Dog Trap Rd certainly has more water and stronger flow but minimal water across road at our end of Dog Trap Rd. Water coming off the hills further up have caused damage to the road and a big wash-away area in 2007
111	12.7 years	12.7 years	Yes	Yes	No	Yes	Yes	No water in house. Unable to use road (was flooded). Power was turned off for 8 days owing to tree falling on powerlines. Because the house was built in 2000 it was built to flood plan.		Elevated lake levels, mouth of creek entering lake clotted up with excessive weed.		Yes. Entrance to ocean needs to be opened up permanently. Try a break wall, it works everywhere else. Also deepen channel at entrance or build an opening at Budgewoi	Try a sandbag breakwall at the entrance. If it doesn't work we can use sand on beach. At least we will have tried something!!!
112	19.8 years	30 years	Yes	No	No	No	No	Flooding to road and roads in Oberon and Magnolia	Yes. Flood waters reached the start of my driveway. However the water in the street did not come up the driveway and my front yard was not flooded. Flooding occurred June long weekend 3 years ago. Approx location Magnolia Cl Chittaway Bay.	Certainly the creek flooded across the road but I believe the drains could not cope with all the water run-off.			Although Magnolia Close was flooded especially at the start of the street. No houses on the opposite side to the creek were effected (sic) by flooding in their yards.
113	15 years	25 years	No	No	No	No	No					Yes. The Councils concern us as to whether they have put in place the right drainage for the area to support us Rate Payers if a flood does occur as we feel both Councils over the years have been disappointing.	Make Council employees more accountable for their decisions, be more proactive with improving the Central Coast.
114	19 years	19 years	Yes	No	No	No	No	Flooding of Burns Rd underpass	Yes. Regularly reaches 1m level 2/3 times per year. In June 2007 flooding at one stage was over 2m (covered the depth marker)	Creek run-off path too narrow to accommodate persistent heavy rain			
115	42.5 years	60 years	No	No	No	No	No	Dog Trap Gully Creek is sufficiently deep enough below our house to not be able to cause flooding to us.			Yes. Accurate rainfall records have been kept sine 1984 to present day and supplied with this study questionaire		Obviously all of my rainfall registrations were not recorded at exactly 9am on the date shown for the amount recorded. However, the figures on my registration charts are a reasonably accurate record of the rainfall for the 24hrs tp 9am of the date recorded.
116	25 years	48 years	Yes	No	No	No	No	Minor traffic disruption only in Mill St, Ourimbah St and Brush Rd. Minor transfer of water from Mill St to Ourimbah St at the north of Lot 12 bcause of different levels of the two roads. This could be rectified with a 2m wide drainage easement (with 600 dia pipe) on North side of Lot 12	No invasion of building or surrounds on Lot 1 (was Lots 13&14) or 15-16-17 crt premises previously owned by myself. Lots 1-9 subject to flooding. Creek bands overtopping in recent high rainfall (6 months ago) at Mill St opp Lot 12 and Ourimbah St lots. Did not invade Lots 10&11 and most of 12.	Creek bands overtopping. The flooding levels have been reduced since the flood mitigation works 400m north in University grounds (3yrs ago?)			See attached schedule including 2 flood assessments carried out by Paterson Consultants of Lismore. Also please note plan of existing levels of Lots 10, 11 &12 as basically the same as the levels on existing light industrial land of Lot 1. Plan prepared by Bannister and Hunter of Gosford.
117	28.4 years		Yes	No	No	No	No	Overroad Carlton near Grammar school and bottom of McDonald's Rd near primary school only exit via Tumbi Umbi	Too high for traffic				No
118	10.3 years		No	No	No	No	No	Road flooded. Others driving through which I did also but in doing so my car was damaged to the extent the insurance company wrote it off	Causeway at Burns Rd, Ourimbah. One Saturday late Nov 2011, around 26th	too much rain cause creek and river banks overtopping			
119	18 years	35 years	No	No	No	No	No						Would help if road drains were kept clean of overgrown grass and rubbish
120	22 years	30 years	Yes	Yes	No	No	No	Limited access to residence as Chittaway Rd floods with the soccer ovals and the creek floods my yard and at times enters my garage. When I lived on 15 Chittaway Rd, had flood water 150mm through the house but the flood levels have improved with the construction of the uni	Yes. 19/23 Chittaway Rd 1985 the 2nd [imloo?] flood the water level I can show you but I don't have datum heights if you know the area the large shed opposite the uni entrance level with the iron.	many of the above contribute but it has improved in the last 4 0 years		Yes. The entry of water to my shed. But as from conversations with people who have 100yrs of knowledge of the area and told the 1985 flood was the largest one they had experienced my home is built 300mm above that (1985 flood positive the year but may stand corrected)	
121	7 years	25 years	Yes	Yes	No	No	No	Could not park at residence. House completely surrounded by flood waters.	At my current address I was informed by previous owners that flood waters entered the property at one stage between '94 and '06. My previous residence in Lisarow St was on numerous occasions (lost count) affected by flooding.	Cut Rock Creek Lisarow		Yes. More stormwater from developments on eastern side of railway line at Lisarow (Phuim Park direction)	Creek systems not able to cope with stormwater from development
122	13 years	30 years	No	No	No	No	No						
123	45 years	years	No	No	No	No	No						
124	11.7 years	years	No	No	No	No	No					Yes. Creek out the rear of my property. No one has inspected it since I moved here. Never been cleaned.	Yes. Clean out the creek of tree branches and stumps so the water can flow as it was designed. If you never inspect these waterways then you will have problems twice as bad

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
125	12.1 years	12.1 years	Yes	No	No	No	No	Diversions to get back to my house, estimated time 40mins as Enterprise dr blocked, Ourimbah Campus and underpass of Burns Rd	At least 1m at the underpass Burns Rd, over half a metre on Enterprise Dr near Ourimbah Campus	Continual rain, blockages under and near bridges, not enough periodital maintenance or inspections			As soon as the water has resided to get crews to check damage, not only to bridges but roads as well
126	50 years	64 years	Yes	No	No	No	No	McDonald Rd cut between school and highway. Cut Rock Rd flooded in lower areas	Lower Cut Rock Rd – In about 1962 my father waded along lower Cut Rock Rd with water up to his chest. In this spot the water runs as part of the creek as opposed to standing as overflow. The water rose in similar fashion many times but I remember this specific occasion	Creek Banks overtopping. Mrs Anne Docherty (now deceased) lived in a property in lower Cut Rock Rd. She was always sure lake levels made a difference and kept a close eye on lake levels as part of her preparation to deal with flooding (which did not come into her home)			I do notice building has been allowed along lower Cut Rock Rd in areas that traditionally have always flooded in very heavy sustained wet weather. It is difficult to understand why this has been allowed given the history of the area.
127	14.7 years	26 years	Yes	No	No	No	No	Pacific Highway at Niagara Park/Lisarow Border flooded and ½ road closed which caused major traffic issues at 5pm.	At the intersection of Chamberlain Rd and Pacific Hwy the Lisarow Wetland was lapping the edges of the pond and at times covered the pedestrian walkway on the east side of the Pacific Hwy.	Huge downpour coupled with high tide and perhaps some blocking of the drains			
128	19 years	45 years	No	No	No	No	No						
129	23 years	23 years	No	No	No	No	No		My property borders Cut Rock Creek and at the flooding early this year the creek rose by about 3m plus. It needed to rise at least another 2m to spill over the embankment	Blockages			
130	10.4 years	43 years	Yes	No	No	No	No	My youngest child goes to Folly Foot Fare childcare Old Chittaway Rd Ourimbah. Enterprise dr was closed when the uni floods most times. Had to drive home via Tumbi rd due to road closures	Wednesday night at the beginning of the year, unsure of date	The creeks need to be cleaned out near the rugby club at Ourimbah. Soccer fields flood all the time.		Not at 49 Pacific Hw as it is on the higher side of the road	Cut Rock Rd near LisarowPrimary School needs to be cleared of debris, fallen trees and general (rubbish). But since landcare has control of the area nothing is able to be done. The school has contact the council regarding vegetation and debris being clearedand there is so much red tape involved this needs to be reviewed as the school floods a lot.
131	1.3 years	1.3 years	No	Yes	Yes	No	No	Our backyard flooded and water got into our sunroom. This has happened on about 3 occasions	Haven't kept records sorry	Too much water (it was pouring). Poor drainage on our neighbours property so our drains couldn't cope with our water and theirs.		Yes, our sunroom floods whenever there is really heavy rain. Unless drainage improves it will keep happening.	Drainage from our backyard to the mains seems poor (not enough incline to keep water flowing quickly). Not sure how previous owners got this approved. Possibly the same issue our neighbours have hence why their water ends up in our backyard. Tighter controls on this would help
132		15 years	Yes	Yes	Yes	Yes	Yes	Road blocked off east end Chittaway Rd, Backyard approx 700mm under water. Front ok. Shed in backyard 300mm deep water inside. Sewer blocked for approx 2 days. Electricity off for about 2 days.	Back boundary fence water was approx 700mm up from ground level, water reached to approx halfway up to front of land. Water level still 400mm below floor level. Water level dropped in about 14 hours.	Creek flowing fast and high lake levels not getting out to sea		Yes. Not enough flow to sea	Open up channel at the entrance
133	8 years	42 years	Yes	No	No	No	Yes	Road cut at Sohier Park (Shirley St) stopping traffic. Other: The reserve at the back of my property after flooding leaves logs, dead animals and other rubbish which creates odours for days	I have not recorded dates and times but I can give an idea the highest point that floods have reached	The creek at the back of my property is clogged with old tyres and other garbage that clogs the creek		Yes. Erosion of bank at the rear of my property	I would like to see the creek system in our area systematically cleaned and an effort made to bring the creeks alive
134	12.3 years	60.6 years	No	No	No	No	No			Silt build up at creek mouth into Tuggerah Lake			
135	50.75 years	years	No	No	No	No	No			Blocked creeks, drains, bridges			
136	17.1 years	17.1 years	Yes	No	No	No	Yes	Buses stopped going through Shirley St. At Glen Rd and trying to get across to the station when it has been flooded due to drains not being able to drain away the rain water you do have to wade through the water		Drains and lack of guttering. Water pools at the bottom of our driveway even though there is a stormwater drain next to it.		Yes and No. Only water coming from the townhouses behind me	
137	15 years	15 years	Yes	No	No	No	No	Brush Rd. Road flooded from uni entrance to Ourimbah St, and road closed several times a year – disrupts customers coming to business and our deliveries to and from business	So deep cars were stalled – to the bonnet of small cars	high tide combined with heavy rain			The creek behind our property in Mill St needs clearing off overgrown privelt and lantana on its banks
138	12 years	years	No	No	No	No	No						
139	12 years	years	Yes	No	No	No	No	We have had to divert to travel to Gosford via Holgate due to flooding on McDonalds Rd and at Ourimbah, Shirley St. There have been times when this diversion was not suitable due to flooding at Erina or due to fallen trees on Fagans Rd. At these times we have been cut off waiting for water to subside.		Creeks have overflowed after days of persistent heavy rain and run-off from residential areas has banked up unable to reach creeks (as seen on Fagans Rd just before school zone when approaching from East during last flood) ??			
140	57.7 years	60.9 years	No	No	No	No	No						
141	25 years		Yes	No	No	No	No	Water across road		Creek banks overtopping			
142	7 years	7 years	No	No	No	No	No					Yes. Within 100m of creek	
143	5.25 years	25.3 years	Yes	No	No	No	No	Access to previous residence in Lyrebird Lane (Palm Grove) was often blocked by water over road especially the bridge over Ourimbah Creek at Lyrebird Lane turnoff	Feb 1990 when 634mm of rain recorded at Lyrebird lane in the month. On 3/2/90 the paddocks on both sides of Lyrebird lane (John Youngmans and Dick Smith) were both covered to a depth above fence post height	Just sustained heavy rain in the catchment	Yes. Records for the past 25 years availabe upon request but you probably already have them in a mathematical modelling of Ourimbah creek floods by the late Fred Bell		Now living near Cut Rock Creek which has a smaller catchment, thus less serious flooding. As President of the Palm Grove/Ourimbah Creek Landcare I am very interested in floods past and future on our R.M.S site between freeway and Ourimbah Creek
144	8.75 years	17 years	Yes	Yes	No	No	No	The run-off from the street goes through our property brings it, rubbish, [?], floods which stay for ever too long. I need to pay someone every few weeks to clean it out and clean the run-off.	Came up to our back steps on 2 occasions in the last 3 years.	rain, flood, inappropriate drainage to handle this kind of extreme weather		Yes. More housing in the hill beyond which means we have greater run-off as families garden, wash cars etc	Would like advice of the best way to deal with this catchment
145	4 years	8 years	Yes	Yes	Yes	No	No		Came through front (road) into garage. All contents had to be removed. Unable to get in and out for 4 days. Slight damage.	All of the above – the entrance needs to be opened all year round		Yes. We are at the lowest point of the area	Open the entrance. Drain off excess.
146	12 years	12 years	No	No	No	No	No		We have not been affected by flooding				
147	15 years	20 years	No	No	No	No	No			Local public school and high school in Lisarow have had grounds flood			
148	15 years	19 years	Yes	No	No	No	No	Oak Rd flooded - Could not get out Wattle tree road flooded.	Creeks were 60-80cm over road. Too deep and fast flowing to attempt to drive through	Very heavy rain – too much for creeks to handle		No. We are high up on the ridgeway	
149	14 years		Yes	No	No	No	No	Roads near Plum Park were flooded at Lisarow	June long weekend and June long weekend 2006?	Possibly drains		Yes. The farm behind us where the creek runs through could overflow in Lisarow	
150	15 years	25 years	No	No	No	No	No					Yes. The Councils make us concerned as to whether they have put in place the right drainage for the area and to support us if a flood does occur as we feel both Councils over the years have been disappointing.	Make Council employees more accountable for their decisions, don't procrastinate, be more proactive with improving the Central Coast.
151	5.5 years	10 years	No	No	No	No	No						
152	21 years	21 years	Yes	No	No	No	No	Usual access to property via Ourimbah Creek road flooded	About 2m above level of Lyrebird Lane bridge	Very heavy rain → overtopping of creek bank	No formal records but most floods occur with a wet catchment then 100mm plus rain in less than 24hr.	No.	
153			No	No	No	No	No						
154	8 Years	42 years	Yes	No	No	No	No	Flooding over bridge in Teralba St	No	Creek banks	No		
155	1.25 Years	1.25 years	Yes	No	No	No	No	Fagans Road outside public school was flooded and MacDonalds road		Volume of water not being able to get away due to insufficient drainage etc. and the creeks are overgrown		Yes, Cut Rock Creek runs behind our property if the creek is not cleaned/cleared it will over flow in large down pours	Preventative work needs to be carried out to clear the creek and permit the flow of water

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
156	34 years		No	Yes	No	No	No	Water did not enter house or garage. Reached up to garage pathway	Garage pathway	Elevated lake level and creek level	No	No	
157	13.1 years	32 years	No	Yes	No	No	No	Excessive run off from Hillside Reserve at our back floods back garden (½ acre) and encroaches on back veranda	Several occasions at all major flood events in the area water level reaches 2cm from back door (which I seal with tape!)	Fire trail at rear of property collects and directs entire Hillside catchment into our backyard. The grading and installed drains have not been maintained ever!	No	Yes. See above – grading of fire trail and opening of drain would greatly assist	Our problem is excess run off during heavy downpours – rather than rising creeks or dams
158	9 years	9 years	No	No	No	No	No	My home is on a hilly area	Yes. Can't remember what year it was, Showground Rd, Narara flooded and Railway Rd Lisarow near Sara Lee factory this year from heavy rain	Blocked drain and creek banks overtopping	No	No	Nil comments
159	8.2 years	43 years	Yes	No	No	No	No	Fagans Rd flooded Nov 2011. School was closed. Children not able to go to the school. Uni is flooded. Shirley st closed. Enterprise Dr closed as my youngest is at Folly Foot Farm Old Chittaway Rd had to drive the long way home via Tumbi Rd to get back to LIsarow		Creeks need to be cleared more often. The creek near Lisarow Public School is full of Debris, tree trunks and general [rubbish]. Have requested it be cleaned out but as it is under "Landcare" has so many restrictions on the clean out which is WRONG.		Yes. Cut Rock Creek near Woodview Ave has never been cleared in the 8 years we have lived there. We live 2 doors down from the creek. Who's to say it won't ever flood!	Please over ride or reassess the whole situation of cut rock creek next door to the Lisarow Public school. Work needs to be done there
160	8.25 years	20.3 years	No	No	No	No	No			Stormwater from catchment reaches Ourimbah Creek too quickly. Largely due to development			Development approvals in Flood plans should not be given without effective conditions placed on them to mitigate the risks and effects of significant rain events
161	14 years	14 years	Yes	Yes	Yes	Yes	Yes	Geoffrey Rd closed. Unable to leave house due to water lapping at doors		Elevated lake levels – lake entrance needs dredging. Unusually heavy and prolonged rain.	No	No	Drainage in Geoffrey Road needs to be improved so that floodwaters can drain away. Entrance to Tuggerah lake needs dredging.
162	9 years	9 years	Yes	Yes	Yes	No	No	Third bedroom (previously a carport) received water to a depth of approx 200mm in 2007 – Geoffrey Rd was closed to traffic – front yard was fully submerged and back yard partially submerged	Year 2007 – I believe month of June. Water reached a level just under the floor joists of main structure.	Ourimbah creek level rising and Tuggerah lake level also	No	Yes. Property has flooded twice during our nine years of ownership and I see no change to any factors that might mitigate the situation	
163	9.2 years		No	No	No	No	No		N/A	N/A	No	No	No
164	5 years	16 years	No	No	No	No	No	No. Never		Elevated lake levels. As the lake fills up the lower land is flooded	No	No	No
165	20 years	20 years	No	No	No	No	No			Heavy rain and high tides	Yes – attached	Yes. Our concern is more in regards to our staff being able to both get to and from work safely. This was an issue in the flooding seen over the long weekend June 2007 the site was not flooded by many of our workers were stuck in floodwater in the local area.	
166	3 years		No	No	No	No	Yes	Creek reached the banks		Lack of council maintenance in cleaning vegetation, obnoxious weeks etc from waterways/streams			No
167	2 years		No	No	No	No	No						Thank you for the opportunity to be part of this survey, however as I live on top of a hill I doubt I would ever be flooded
168	1.1 years		No	No	No	No	No					No	
169	11 years		Yes	Yes	No	No	Yes	4WD vehicles could get through. Backyard flooded to our patio – no house damage. Sewer and water supply ok – power off for 6 days	Water to edge of our patio and a small amount through our garage	The entrance of lake was not fully open. As soon as it was water dropped about 900mm overnight		No. The house has been in the family since 1964 and has had no damage	The water level looked as though it would take about 2 weeks to drop, but once the entrance of lake opened up it went down overnight. The local roads would be in much better condition if the entrance were opened when flooding was imminent
170	28 years	28 years	Yes	No	No	No	Yes	Only 2 occasions in 28 years, Palmdale Rd flooded near the creeks. Low lying area of our property beside creek briefly flooded well away from buildings, damage to fences only	On our property, [Toobys?] creek about 6" depth in small area by creek	creek banks overtopping	Yes. What do you call a "storm event"? I kept daily rainfall readings for a couple of years before discarding so no longer have readings for our floods.	No	
171	3.1 years	13 years	Yes	No	No	No	No	Burns Rd underpass underwater. No left turn out of Nellie Rd, have to drive around	Flood depth indicator reached 1.8m quite often with heavy rain	Too much water		No.	1) Better signage is needed for 2 reasons. People from out of town using a Sat Nav can't find their way around Burns Rd underpass because it is the shortest and fastest route when coming off the freeway. Flood signs stay up after water is gone so people don't pay attention to them when they're up which causes major bank ups of people turning around. 2) Automated boom gates would be useful everytime the creek floods someone gets trapped in the creek. Maybe flashing lights like school zones at start of Burns Rd and signage for alterate routes
172	10.5 years		Yes	Yes	Yes	No	No	WE had to re-carpet our home under an insurance claim. Lost power for 3 days, lost all food and had bad mould thereafter	No. June floods (can't remember year)	creek banks overflowed	No	Yes. If the same amount of rainfall happens it will	No
173	12.7 years	30 years	No	No	No	No	No					No	
174	3.75 years	3.75 years	Yes	Yes	Yes	No	No	Flooding at Ourimbah Uni causing closure of Shirley St and at Plain Park the road was once closed there too. Backyard flooded to the extent it looked like swimming pool, besides taking grates our of drainage pipes we had to manually direct water into gully (deep drop) by sweeping with brooms etc., forcing water in that direction. House not flooded although separate rumpus/pool room flooded. This room/building is adjacent to retaining wall which fills when flooding and storming	In between rumpus/pool room and retaining wall (see previous comments) water rose at least one metre. In backyard approximately one foot in areas.	Not sure but we're at top of street and although being high we are at base of mountain. Water (in heavy storms) can seem like "rapids" when escaping the mountain.		Yes. Same occurrences as in earlier question.	
175	4 years		No	No	No	No	No	No	No		No	No	
176	4.2 years	4.7 years	No	No	No	No	Yes	Cannot access Burns Rd, Ourimbah from enterprise drive, have to turn around and drive back to Pacific Hwy and Kangy Rd		The creek overflows			
177	15 years	25 years	No	Yes	No	No	No	The drain at the bottom of our driveway always overflows into our yard and is also very very dangerous		excessive heavy rain			Attention should be paid to all drains in our streets
178	0.5 years		No	Yes	No	No	No	Creek level rose up over onto lawn		creek banks overtopping due to lots of rain in May this year		Yes. Due to previous experience	
179	4 years		Yes	No	No	No	No	Shirley St is often blocked outside of the Uni, which is sometimes closed to access also. Meaning the motorists have to U-turn and proceed to Coachwood Dr to get out of this area		Water over the road lack of proper drainage			
180	18 years		Yes	Yes	No	Yes	No	2007 flood water entered the property and flooded the garage, blocked the road. The sewer that operated in Geoffrey Rd was flooded	2007 flood water reached up to our 2nd stop at the front of the house	The main reason was Ourimbah Creek broke its banks and flooded the park. Water then came down Geoffrey Rd and into properties		Yes. The blocked drains water in Geoffrey Rd that occur all the time particularly outside 86 Geoffrey Rd and 200 Geoffrey Rd.	I believe that if a sea wall was built along the park near the boat ramp would prevent the water from Ourimbah Creek flooding properties from 80 Geoffrey Rd down to the lake.
181	24 years		No	No	No	No	No			N/A			Street water heavy rain collects corner St Thomas Walker Drive/Platypus Rd – insufficient flow floods onto road
182	15.5 years	45 years	Yes	No	No	No	No	The bottom end of Teralba St gets flooded easily		Creek			
183	2.5 years	30 years	No	No	No	No	No						
184	5 years	30 years	Yes	No	No	No	No	Ourimbah creek at Burns Rd					
185	21 years		Yes	Yes	Yes	No	No	Water flow from road flooded downstairs bedroom and business. Mud in pool, garden shed and machinary shed flooded	15cm of water in downstairs rooms	Lack of curb and guttering on road		Yes. Lack of curb and guttering on road rains [ISO?]	Attention need to drainage from Chittaway Rd

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
186	10 years		Yes	No	No	No	No	Ourimbah creek Rd flooded on 4 occasions in the last 10 years affecting our ability to access or leave our property	No. Does not affect our property directed as we are too high	Creek banks overtopping, elevated lake levels			Ourimbah creek Rd is poorly constructed and many pot holes. Some sections have been recently repaired but there are still extensive stretches/kms that warrant re-building
187	82 years		Yes	No	No	No	No	Road flooded	Yes. Have level marked on post	lots of rain			I think it floods a bit quicker since the creek has silted up over the last 50-60 years. Have some photos.
188	6.5 years		Yes	No	No	No	Yes	Peach Orchard Ard, Fountaindale and Chittaway Rd/Enterprise Drive have been flooded which meant I cannot access roads until water subsides. Local flooding in Peach Orchard Rd often occurs	No. Other than to say road east of Barry's Lane floods in hollow to a depth of approx 3 feet+ and covers both sides of road up to 20 feet in length	creek banks overtopping			Localised flooding of road in rural area which does seem to subside fairly quickly once rain eases.
189	8 years		Yes	Yes	No	No	No	Backyard flooded despite easement draining hole in backyard	June 2010 floods came up to back step	lack of drainage and high tide		Yes. Flooding everytime heavy rain. Unable to access home when cut off both sides.	Ourimbah and surrounding areas have developed rapidly without enough foresight into drainage and infrastructure.
190		5 years	No	No	No	No	No						No
191	2.7 years		Yes	Yes	No	Yes	No	Any heavy rainfall floods the entire property and the sewer pump becomes blocked. The road becomes dangerous to drive on		creek banks overtopping. Blockage of bridges		Yes. There is no system in place to provide for heavy rainfall in the area	Countil should build some kind of drainage system in place
192			No	No	No	No	No					No	
193	25 years		Yes	No	Yes	No	Yes	Road was cut off at [peak?]. Approx 400cm [mm?] through the ground floor of the house. Road blocked by broken down in water site [?]		Elevated lake levels		No. It will definitely flood in the future.	In recent heavy rainfall periods we have not been affected due to the lake being able to handle the runoff due to the lake being at lower levels at the start of the event.
194	15 years	21 years	Yes	Yes	No	No	No	Total block of land flooded including garage and contents probably at least 30cm to 50cm from ground level – we had no power for over a week – hda to leave the property as surrounded by floodwaters, no access in or out by car, a lot of damage to gates, sheds etc + mess	Not definitely	Storms – excess rain that couldn't get away quick enough, not really sure		Yes. Because it has happened before and several occasions since when roads were partly flooded but it didn't quite go through our land however very stressful.	
195	13 years	13 years	Yes	No	No	No	No	Pacific Hwy at Niagara Park – water over the road. Enterprise Rd, Ourimba – water over the road.		Blockage of drains			
196	6.75 years	years	No	No	No	No	No						
197	13 years	63 years	Yes	Yes	Yes	No	No	600mm water through downstairs area of house	600mm Kalua Drive, Chittaway Bay June long weekend 2007	elevated lake levels		Yes. Keep opening to sea open.	No
198	6.2 years	23 years	No	Yes	No	No	No	Water level rose to our back fence	June long weekend 2007 (I think). Friday afternoon we had torrential rain and due to (I believe) high tide and roadworks on Pacific Hwy, caused the creek near our property to overflow	High tide and road works (bridge works or Ourimbah creek near Pony Club)			
199	6.4 years	6.4 years	Yes	Yes	No	No	No	Our pergola area floods out the back. We have a reserve next to our property and it floods in heavy rain then gushes out over our driveway.	In heavy rain it floods our pergola area and in 2007 floods it almost came into our back door, so it would have been as high as brick.	All the water in our backyard (which is higher than our pergola area) runs down into the pergola area		Yes. Currently when it gets to a height it runs out into our carport, but if we get enough rain all at once it could flood our house. Also the reserve next door could also cuase some flooding if we get heaps of rain.	
200	40 years		No	No	No	No	No						
201	8 years	8 years	Yes	Yes	No	No	No	In the last big flood, June long weekend 2007, a couple of years ago, road access to our proerty was cut. Our paddocks were covered with over 1m of flood waters.	Our paddocks had at least 1m of floodwaters covering them	The water backed up from the creek. I am guessing that this was because of elevated lake levels		Yes. Our paddocks will be flooded with chance of loss of life of the sport horses we keep at the property	
202	55.25 years	25 years	No	No	No	No	No						
203	6.3 years	25 years	Yes	Yes	No	No	Yes	Property including car destroyed or written off	1991, 1992, 1996 – water through garages and boatshed – no entry to residence. 2007 – same – but car in driveway had water penetration to bottom of steering wheel. 1990 – floodwater rose to top of letter box i.e. 2.5 feet. Launches were driven down Geoffrey Road exacerbating the [bottom cut off]	Our frontage to Ourimbah Creek flooded after Tuggerah Lake overflowed – water from both locations met and merged.		Yes. Inability of Lake to discharge into sea at the Entrance.	Ourimbah Creek contains many fallen trees which cause build-up of water. No authority accepts responsibility for their removal and provides no alternative.
204			Yes	Yes	No	No	No	Two major floodings occurred since 1980 – front and backyards were about 9 inches under water for short period – lost about 8 feet of river bank from the reserve – also lost aluminium boat. Road closure on 2 occasions	Yes. As started in previous question re: our property – however the reserve was under water for some time	Owners of waterfront reserve properties digging out and lowering the riverbanks – causing creek water to flow onto the reserve and stagnate for weeks after.			"Suggestion" - perhaps pool companies should be allowed to dump clean soil in low lying reserve areas, under council supervision of course.
205	11.7 years	22.3 years	No	No	No	No	Yes	The street to the station at Ourimbah as well as beside the oval was flooded and I can't get to work on that day	Ankle-deep	Not sure			
206	20 years		No	No	No	No	No						Someone has put a sheet of iron across their fence stopping the creek water running down into Ourimbah Creek. This is on Foots Road between Ourimbah Ck Rd and the Bridge
207	27 years		Yes	No	No	No	No	Access along OCR is often affected. Sometimes around O'Donnells property, at other times further along. Access across bridges can cut off property owners. Our bridge at Lyrebird Lane has often gone under with water covering the road on the north side of the creek	Ask older property owners – Waeganers, O'Donnells, Troys, Ken Fraser or Nicolls, Pemberton	The creek floods when there is high rainfall west (eg end of OCR) and this flows down all the hills and creeks draining into creek. Also the tide (and lake level) affects the water levels and we can tell when we can get across creek by watching water level.	Ian Playford (622093) kept records – don't know if he still has them		I was under the impression that the pump on OCR was to be used to avoid flooding by pumping water to Mardi Dam etc and onward. Also surprised Council doesn't have records as this has been happening since this area was settled. New property buyers need to be advised re: moving animals to higher paddocks they don't believe us until they go through a flood.
208	3 years		No	No	No	No	No	We are not aware of flooding at the property					
209	17 years		Yes	No	No	No	No	Water over Shirley St near the entrance to the uni has occurred on a couple of occasions. It's not a big issue for me, I just work from home. Flooding of Cut Rock Ck over Tuggerah Rd near Plum Park only occurred this year in storms march this year.	Usually when it floods the water breaks the bank of Bangalow Creek which is on the west/rear boundary of my property. The creek channels disappear and the water flows like a sheet across the field. Water rises to within a few meters of my back fence. I has never come into my yard	Overtopping primarily. Sohier park floods once the capacity of storm pipes (which follow Old Creek Bed) beneath it is reached.		No.	I moved into the area knowing that there would be times that my movement woud be hampered by flood. It's not so serious that money should be spent improving things.
210	13.2 years	11.9 years	No	No	No	No	No						
211	0 years	0 years	No	No	No	No	No			Not sure, we do not live in the area		Yes. Best to be safe in one's thought	
212	15 years		No	Yes	No	No	No			Poor drainage on Enterprise Drive – it's never maintained!		Yes.	
213	10 years	89 years	No	No	No	No	No	We have a creek behind us and it has come as high as our land but never to cuase us any trouble. We are built up about 4ft. I have a grate each end of my property with steps.					My husband had a tyre run to Newcastle twice a week and we had often been held-up on the highway where the creek crosses the highway for quite some time.
214	14 years	40 years	Yes	No	No	No	No	Two Max. heights in general area of Ourimbah over past 70 years can be pointed out if contact with myself is made.	As for previous question	combination of all above	We know of a local who might be willing to give records if still available		Please phone to arrange meeting for above
215	14 years	14 years	No	Yes	No	No	No	Regularly (if there has been continued heavy rain our backyard floods up to approx 3-5m from our back door	Lisarow St – (long weekend June 2011) – flooded up to 5m from backdoor. Depth of water varies as the block drops away at back end of yard (flat rock creek end of property). The creek also cuts through the street and also floods the front yard on very bad flooding times.	All of the above. Flood mitigation work was completed in 1999 by Gosford Council but not continued by Wyong Council that carries over from the end of the street		Yes. Previous experience.	If Wyong Council continued the creek clearing/flood mitigation work that Gosford Council completed 12 years ago would be immense help. Creeks cleared of overgrown vegetation, drains cleared regularly of rubbish eg plastic/garbage.
216	0.3 years	8 years	No	Yes	No	No	No	Creek runs through property and flooded our paddock/yard. Could not leave property via our driveway	Don't know specific details but can provide pictures	Creek overflowing due to where it joins Ourimbah Creek, it is blocked. And also when Tuggerah Lake and Ourimbah creek are full this creek's water has nowhere to go.		Yes. We cannot leave our property to get to work or if there was an emergency	A rock wall from Tuggerah Lakes to the ocean

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
217	23 years		Yes	Yes	No	No	No	When Burns Rd and the Uni floods we can't get through, have to turn right and go via Berkeley Vale. In deluges we have had our backyard flood but not to a level which can come anywhere near our buildings. It subsides quickly once the rain stops	As mentioned above only our back yard floods, probably to about half a metre. This poses no danger of flooding our buildings. We have been through many floods in 23 years but have never had any water endangering our buildings.	We are on the low side of the road and get a huge volume of water from across the road in torrential downpours			
218	33 years	30 years	No	Yes	No	No	No	Front and Backyard cause by flooding of Ourimbah creek at Chittaway Bay 1978.		Clean up creek up to the mouth to Tuggerah Lake			Wyong Council knew this was prone to flooding way back in 1960. Did they clean our the creek? No.
219	14 years		Yes	No	No	No	No	Shirley Rd closed by flood water. Slow for flood water to recede. Anderson Rd covered by flood water (fast to recede). Above only access to and from property.		Rain. Creek banks overtopping.	Details included. Some more daily details available if required.		
220	8 years		No	No	No	No	No						
221	28.4 years		Yes	Yes	No	No	No	Traffic is disrupted due to bridge Lyrebird Lane flooding. Our front paddock floods if the creek breaks its banks	I usually take some photos. Cannot locate at the moment. Possibly around easter 2012 we could not cross Lyrebird Lane Bridge. Our front paddock went under water 2007 possibly in June. Feb maybe 2001.	Creek banks could be a problem from time to time. Council has just completed restoration work on our property. Sometimes it appears to be tidal, but I am told this is not the case.		Yes. If there is heavy rainfall at Somersby or Mangrove Ourimbah Creek is always going to experience flooding.	As I mentioned earlier, I do have photos I am looking at least 20 photo albums. They are dated but if someone could get back to me with specific dates I would be prepared to go through them. It would be good to go online with all this.
222	1.75 years		No	No	No	No	No						
223	25 years	25 years	Yes	No	No	No	No	Roads flooded through and around Ourimbah Campus – Shirley St	Around 12" to 18" through campus and Shirley st Ourimbah	Creek blocked preventing run-off to escape			Ourimbah creek needs to be cleared of fallen trees and other debris then shored up to enhance a clear run for excess water to escape.
224	10.25 years	10.3 years	Yes	Yes	No	No	No	Access to the property is over a bridge, which becomes submerged when there is flooding. At these times there is no vehicular access to the house. One time, Fountain Rd was so badly damaged that we couldn't drive on it even after the water subsided. Backyard gets flooded/becomes part of creek.		Creek banks overtopping		Yes. It happens every time there is heavy rain and flooding in the area. So far, it has only been in the yard.	
225	0.8 years	10 years	No	Yes	No	No	No	Our backyard regularly floods whenever there is heavy rain, which then runs into our neighbour's house (No 4)	Approx 20cm deep in our backyard. I have photos on phone if you would like	The slope off the road and over the [?] patch		Yes. Because all of the neighbours' houses have flooded and the road works will make it worse and when it floods out the corner of Teralba and Lisarow we won't be able to get out our driveway as they are putting an unnecessary median strip there.	
226	44 years		No	No	No	No	No	The Ourimbah creek valley is completely under water	Our mailbox on the side of the road is under water if we have a big flood				
227	60 years		Yes	Yes	No	No	No	Have a creek going through back paddock known as Platypus creek with heavy storms and rain comes down the gullies and floods as it goes into Ourimbah creek. My house is not affected.	After reaching flooded Ourimbah creek it banks up and it can be higher than the fences. It also brings down sand and debris which cause rubbish to be left on fences.	Storms and heavy rain. Can go some years without a flood and then have three in a year.		Yes.	
228	30.1 years	30.1 years	Yes	Yes	No	No	No	Water flowed down my backyard and through to Lisarow St. Lisarow St has been covered by water and dangerous to drive down. As a result, I couldn't access the Pacific Hwy (via Teralba St) which was also partly submerged.	The highest flooding experienced on my property was in October 1985. This reached the back step of the house, which has the floor level of 500mm above ground level. There have been other floods (nuisance flooding), but this was the highest I personally experienced.	Extreme weather conditions, plus creek banks overtopping and elevated lake levels. I believe the creek is also tide affected.			Since Gosford Council did flood mitigation works on Cut Rock Crreek in our area, I believe flooding of my property has not been as greatly impacted. I have photos of previous floods available and I'm sure copies were given to Gosford Council when they did their flood study.
229	8.9 years	23.3 years	No	No	No	No	No		Never been flooded.	N/A			No
230	38.4 years		Yes	Yes	No	Yes	No	Unable to use sewer due to water not getting away from toilets. This lasts only about 2 days. Just inconvenient. Back and frontyards flooded – storm water drain backs up when creek reaches drain. Only 4WDs can usually get through. Usually from Sunshine Ave to end of Point		Excessive rain in catchment area up river and creeks rising and lake levels high. During high tides the lake is unable to empty, enlarging the Entrance only works if the tides are right. Also some houses have been permitted to be build on the lake edge.		No	We have experienced nuisance flooding only on about ½ dozen occasions in 38 hears with approx 25cm of water across property. In our opinion if you purchase land on a river, you must expect to be waterlogged at some stage.
231	9 years	11 years	Yes	Yes	Yes	Yes	No	In severe rain, we lose all power (including water) as we are on septic system. Our road floods and at stages can block us in. Our yard has been flooded.	Height 1m across road – so access could not be to road. Gradually reduced to 0.5m but could not access street for a few days – and had to locate family into different accomodation.	Drainage not deep enough could not cope with the amount of water from properties. Creek banks/dams bursting.		Yes. That we cannot get out of street.	
232	10 years	22 years	Yes	Yes	No	Yes	Yes	Electricity turned off	June 11th, 12th, 13th 2007. Initially from Ourimbah Creek then from wetlands at rear of house. Highest water level was topstep of front verandah	Excessive rain – creek overflow – water backing up in lake. Lake outlet to ocean backed up.	Daily rainfall records taken at property since January 2007 (Recorded in diaries)	Yes. Heavy rainfall will always generate flooding.	Some photos.
233	7 years	7 years	No	No	No	No	Yes	Manns rd Fountaindale experienced up to 0.5m rainwater across rd due to the existing creek being unable to discharge runoff from surrounding hills adequately. There has been no engineering clearing of this creek for as long as I can remember.	Current drainage ditches in Manns Rd (off Vaterman Cres) not deep enough and runoff into Industrial estate inadequate to cater for drainage flowing down Manns road into Industrial area.	The one bridge on Manns rd in times of non-flooding has water flow stagnant due to existing growth and lack of servicing over the years by council.		No.	Due to the nature of the natural flood plain from the Industrial Estate to Chittaway Lake. A series of levee banks should be considered similar to that at Georges Hall in Sydney at Moorebank where similar conditions have been experienced.
234	19 years		Yes	Yes	No	No	No	Road flooded half way up drive and half way up backgarden	As stated halfway up front garden and halfway up back garden	Creek banks at back. Elevated lake levels at front. The entrance channel not very wide. Needed dredging.			Drains need to be kept clear of rubbish (papers etc)
235	20 years		Yes	Yes	No	No	Yes	1) Traffic disrupted on Palmdale Rd. 2) Front paddock flooded. 3) Bridge previously often flooded now replaced and raised. Will still flood under severe flood conditions.	Highest water levels have been to about 2m [cm?] above the highest point in the front paddock below the front of the house (to my knowledge)	creek banks overtopping			Flood levels rise and fall really quickly due to the relatively short and steep catchment.
236	5 years	5 years	Yes	Yes	No	No	Yes	Oberon Rd under water 30-100cm. Loss of power and telephone 4 days. ¾ backyard under about 30cm water.	Rough guide above.	Drains and gutter in street not regularly cleaned and therefore blocked.		Yes. No ongoing maintenance performed in drain and gutter.	
237	43 years	68 years	Yes	No	No	No	No	Road flooded at mcdonalds Rd Lisarow and Holgate	My workshop at 2 Ourimbah St Lisarow – the water came within 25mm of my floor. My rented home at 978 Pacific Hwy Lisarow – the water came in the laundry often.		My brother – for the last 12 years.	Yes. My workshop.	The [?] are planning up grade of Hwy which should improve the situation. Australia is a land of fire, flood and drought. The lakes and waterways need dredging – this may help.
238	22.3 years	22.3 years	No	Yes	No	No	No	Water came into the garage	As high as a foot deep. Water had crept in under the garage door and when I stepped into the garage my foot had sunk into the water.	Creek overtopping – not really sure?		Yes. All my personal belongings could be carried off in the flood. The work involved in cleaning up and replacement of all items.	Warnings via Council/Fire depts/ Police before it gets to that level of urgency.
239	15 years	15 years	No	No	No	No	No			Elevated lake levels. Blockage of drains.			The lakes are in need of real cleaning and dredging to clear away at least 50% of residue.
240	20 years	43 years	Yes	No	No	No	No	Road closed in 3 places.		Creek banks overtopping			
241	31 years		Yes	Yes	No	Yes	No	Traffic disrupted for 2 days on roads near Lakefront. Property was covered by approx 0.5m in rear and 0.6m front year and 1.2m across road. Sewer was replaced by Porta potts for duration.	On the 2 occasions Late '80s and early '90s the flooding commenced from Ourimbah creek at rear meeting a rising lake caused by entrance being closed by high tides and sand blockage after heavy rains inland swelled the creek.	A "dog-leg" at the lake end of Ourimbah Ck (since removed) impeded the creek water entering the lake – flow (now) assists clearing the entrance channel.			Keep the entrance channel wide open and deep [?] ought to maintain a safe level under all seasonal conditions.
242	7 years	11 years	Yes	Yes	No	No	No		Approx 20cm of water in the garage. Entire yard flooded with thehouse unaffected.	Silted Tuggerah Lake. Flood water unable to escape through the entrance channel at low tide.		Yes. Nothing being done to change the current situation.	Yes. Dredge a substantial entrance channel, install floodgates allowing flushing of the sediment from the lake. This would control lake water levels during floods and for the foreshore environment. Salt marsh, bird sanctuaries etc.
243	15 years		No	No	No	No	No						If the channel at The Entrance was kept more open if would alleviate most problems around the Chittaway/Berkeley Vale area.
244	15 years		No	No	No	No	No						
245	28 years	65 years	No	Yes	No	No	No	Low level water around creek at bottom of paddock – 3 times in past 28 years – caused no problems.		Creek backing up with incoming tide.			
246	6 years		No	Yes	No	No	No	Front and backyard flooded and car also flooded and unable to be repaired.		Build up of undergrowth in easement.		Yes. Previous history and height of dwelling.	Clearing of easement needs to be a scheduled maintenance issue.

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
247	1.4 years	15.9 years	Yes	Yes	Yes	No	Yes	Power off for 2 weeks. Been through numerous floods since '87. Front and backyard flooded, house flooded, streets etc.	[???] - Over the road at Chittaway school. Lake and river combined at Cnr Aston Wilde/Chitt Rd. Water level at back dock of Bilo Chittaway. 2007 – water through yard front/back garage 147 Geoffrey Rd. Water in sea[?] TLE B/Vale "42"	Lees bridge has had trees held up against them road level. Ourimbah creek littered with trees, cars. Lake has had sediment going in it for how long? Not as deep as it once was. Entrance channel was closed.		Yes. If we have a repeat of the bigger floods real possibility being that lake is not as deep as once was, Entrance channel issues, and creeks clogged with trees, cars, rubbish.	Maybe set up system to pump to mandi Dam (similar to Porters Creek wet land) under F3 (Ourimbah creek) to pump/harvest water during flooding rains or inclement weather. Make lake deeper. Blow rocks up at The Entrance.
248	5.5 years	17 years	No	No	No	No	No			Elevated lake levels		Maybe. As long as the constructed wet land beside our property does its job we have no concerns.	
249	11.25 years		Yes	No	No	No	No	Trying to get to and from work. Road blocked at Ourimbah (Newcastle) Campus – The Boulevarde.	Ourimbah – rose from road about 0.5m.	Low lying road and elevated sides of road.		No. Our house is on the high side of the hill so we have not been affected by roads in and out of our area floods.	Needs drainage – water falls when raining faster than it drains away, especially roads in our area.
250	7.3 years	17.2 years	Yes	No	No	Yes	No	My car was written off after I was trapped at Ourimbah Campus of Newcastle Uni trying to reach my daughter at Fountaindale. Roads were flooded at around Ourimbah, Chitterway, Berkeley Vale etc. We were trapped. NO water at home for 3 days.	2007 – Massive flooding when above event toook place. Up to 2m high in that area.	Poor drainage			
251	11.8 years	11.8 years	Yes	No	No	No	No	Access to area impacted by floodwater over roads at McDonalds Rd and Shirley St	Approx. 0.5m. Hard to say but sufficient to make driving difficult. Shirley Rd near Uni entrance constantly flooding despite a spillway or flood plain being near.	Poor drainage and blocked creeks. These need to be more regularly cleared of tree debris and silt etc.		Yes. Has not been flooded yet but work needs to be regularly done to keep drains and creeks clear.	No
252	38 years		No	No	No	No	No						
253	2.6 years		No	No	No	No	No						
254	26 years		Yes	No	No	No	No	Water across the road (McDonalds Rd) Lisarow. Water buildup/backup at the corner of McDonalds Rd-Pacific Hw-Tuggerrah St-Fagans Rd (flooding of creeks-school-road etc)	Cnr McDonald Rd and Pacific Hwy – water level approx 1m date?2012. Lisarow Primary School - creek overflowed approx 50cm over food bridge - date? 2012. Lisarow shipping centre - cnr Parson and Newwing – water off the vacant land next to Lisarow shipping centre southern side pipe were either blocked or unable to take the volume of water therefore water over flowed through to carpark at lisarow shopping centre – date? 2012 – twice this year.	Overtopping – excessive rainfall. Blockages			
255	20 years		No	Yes	No	No	No	1990 floods – roads flooded up to Sunshine Park – my property water lapping top of land – no house damage. At this end of street river has only risen to top of land. Also similar in 2005.	As above – road flooded from point to Sunshine Park – 1990. 2005 – at 38 Geoffrey water on both occasions only just lapped top of land – 2005. Very intense overnight rain saw rapid rise – no damage to property.	1990 – elevated lake levels			
256	12 years	12 years	No	No	No	No	No	Flooding in the paddock next door penetrated through the [?] into our warehouse.	Not very high bu twater on the floor of our warehouse even at 10mm was too much for our [?]	Our neighbour property not draining off to the creek.		Yes. It is possible.	No
257	30 years		No	No	No	No	No						
258	16 years	38 years	Yes	No	No	No	No	water over roads at Bruns Rd, Ourimbah Uni, Manns Rd		Creek banks overflowing, drains not regularly cleaned in dry periods by council			
259	18 years		No	No	No	No	No	We are not affected directly. Only the traffic is disrupted under the Railway Bridge.	Under Railway Bridges about 1.5[cm?] over road.			Yes. Ourimbah Creek could be blocked.	
260	5 years		No	No	No	No	No						
261	13 years		No	No	No	No	No		Flood water crossed Lake edge Rd and parts of Chittaway Point but at no time was there any risk of flood here.	As far as I know the lake itself flooded and ran into lower areas.			Before I bought the property I researched flooding and found no history of this area of Chittaway Bay flooding and if my research is correct council records will show that.
262	21.8 years	21.8 years	Yes	No	No	No	No	Causeway under railway crossing at Burns Rd/Enterprise Dr intersection floods 3-4 times per year making it necessary to take alternative route when travelling east.	Floodwaters generally rache 1.5-2m at causeway.	Unknown			No
263	3.7 years	19 years	Yes	Yes	No	No	No	Geoffrey Rd was under water and so too was our front yard	Geoffrey Rd – approx 200mm deep immediately outside our property during the 2011 June long weekend floods. Ourimbah creek rose by approx 400-500mm durnig the same time. The water came nowhere near to entering our home.	Excessive rain over a short period of time. High seas and king tides also meant the water could not get out of the creek or lake.		Yes. I do not believe water will ever enter our home but excessive rainfall will definitely result in flash flooding.	Providing kerb and gutterin with retention pits to our area would help and regularly dredging of the Entrance channel is required in my opinion.
264	7.1 years		Yes	No	No	No	No	Shirley St at Ourimbah Uni often floods and sometimes McDonald's Rd near Lisarow Public School	Approx 30cm of water over both Shirley St and Macdonalds Rd	Excess rain periods, local creeks overflow			No
265	10 years		No	No	No	No	No		Only during June 2007 flood – water lapped at Burragh Dr – did not disrupt motel operations. No real threat to motel – had to come up another metre.	Too much rain			
266	13.5 years	13.5 years	Yes	No	No	No	Yes	Burns Rd underpass flooded. Ourimbah Uni section of Enterprise Dr flooded. Other end of Moloki Ave (nearer creek) flooded 2006.					
267	11.7 years		Yes	Yes	No	No	No	2007. Half road flooded for half day. All grass area clovered for 1 day then ½ area took 3 days to return to river completely. The water reached the wall on one side of the house, well below floor level. Creek height up but no flooding in 2011.	Possibly 2m – give or take – June 2007.	Several weeks of heavy rains plus king tide plus strong onshore wind. Photos sent via computer.		Yes. Similar conditions to Q5.	
268	years		No	No	No	No	No			High tides combined with sudden torrential rainfall		Yes. Overdevelopment in catchment area. Overgrown waterways – creeks etc. No sufficient run off facilities.	
269	11.2 years		No	No	No	No	No						
270	23 years		No	No	No	No	No	Burns Rd railway underpass often floods about twice a year. Enterprise Dr can also flood at Ourimbah Rugby club and sometimes at Chittaway/Wyong Rd roundabout		Elevated lake levels followed by very heavy rain.			
271	10 years		No	No	No	No	No	2007 storm	You should know this already if Wyong Countil did its job property	High volume of rain in short period of time unable to escape rivers or lake because of poor drainage management and Wyong Council's inability to property manage Entrance outflow.		Yes. Wyong council incompetence. We pay high rates to live beside water only thave properties devalued because of poor management. Our rates also buy us poor water quality and the most pot-holed road in our area.	Suspect this is yet another information gathering attempt to raise rates because of assumed high flood risk. Why have you waited 5 years after flood to ask these questions and decide to act. June/July high rainfall is PREDICTABLE!!!
272	12.4 years	12.4 years	No	No	No	No	No						
273	years	15 years	No	No	No	No	No			Tuggerah Lake overflowing due to rain.		No. My property has never flooded. It is a bit higher up.	
274	11.1 years	24 years	No	No	No	No	No						
275	14.7 years	14.7 years	No	No	No	No	No		Road only – minor	Creek overflow			

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
276	18 years	26 years	Yes	Yes	No	Yes	No	Bad storm brought down power lines. Back yard was flooded. Power wasn't back on for 4 days so we had no water as we have pumps for water and sewer. Back street was also flooded.	Peach Orchard Rd, approx 1.3 down Rd at an S-bend. Water over road 3 feet overnight.	Creek bank overtop. Freak storm with too much rain in short period		Yes. We have lose part of our creek embankment. We have put in long poles to try and help retain the embankment, but in the last few heavy rains they have moved. My husband was on our ride-on mower when the embankment collapsed and he was trapped under the water with the mower.	No
277	12.7 years		Yes	No	No	No	No	Bridge has been under water closing street.		Heavy rain and maybe tide			
278	10.75 years	15 years	Yes	Yes	No	No	No	June 2007 with combination of a kingtide and heavy rain, Ourimbah Creek rose above bank, across reserve and came just inside my garden. The water also came up from Kaluah Dr into our Close. I couldn't get my car onto the road in safety. My home was not affected by water.	Into the back garden (half way) only a few cm. We do not have a bank at the bottom of garden, so we were not badly affected. The road way would have been at least 30-40cms in the middle	Combination of king tide and extremely heavy rain for many days.			I have forwarded by email to Shah Alam some photos showing the water levels in Magnolia Cl and Oberon Rd. I would be happy to supply others if they would help (My privacy assured of course).
279	15 years		No	No	No	No	No		Minor flooding of the creek between our property and the railway station, but did not encroach on the property.	Heavy rains			Council have overreacted following the Brisbane floods, and have thus adversely affected the value of properties not affected by flooding and not in the previous 1:100 year rainfall flood affected area.
280	17 years		Yes	No	No	No	No		High enough at Shirley St at uni and onto the highway at Lisarow				
281	7.4 years		Yes	No	No	No	No	Flooding at intersection of Tuggerah St/MacDonalds Rd + Pacific Hwy		Prolonged heavy rain.		No. Floor level is 51m above sea	Experienced localised flooding because of blocked drains (→ maintenance?)
282	15 years		Yes	Yes	Yes	No	No	The last km of Geoffrey Rd was impassable to 2WD traffic. The water level was above the toilet seat in the house.	See previous Q	Big rain, lake level rising.		Yes. Water damage inconvenience	
283	30 years		No	No	No	No	No			N/A		No. Way up top of mountain	
284	6 years	30 years	No	Yes	No	No	No	The "Platypus Ck" occasionally overflows. In 2007 this was particularly acute. Approx four times in past 6 years our property has been fut off form access, with considerable erosion damage to our driveway and front yard.	Can demonstrate level of flooding by partiulcar landmarks – eg water over our bridge by 1m. Car park of "Forest of Tranquility" across [?] was 1m underwater	No suggestion of how to buffer effect of very heavy rainfall to relatively small catchment of "our" creek.		No. Well – we expect occasional events of the order of the past few breaches of the creek.	None.
285	21.6 years	years	No	No	No	No	No						
286	11 years	22 years	No	No	No	No	Yes	Can't report to work as streets leading to train station is flooded.	ankle deep				
287	22.2 years	22.2 years	Yes	No	No	No	No	Creek at the bottom of Berrys Lane flooded. Also Uni and Pacific Hwy at the uni, soccer fields flood as well as Burns Rd, causing problems getting home.		Creeks overtopping due to excess rainfall			Only one which may help in level of flooding – keep creeks clean of weeds and debris.
288	18 years		Yes	No	No	No	No	Water over bridge. Unable to drive over.		Bridge too low.		No. Only that bridge goes under water and not able to get out.	No
289	years	43 years	Yes	No	No	No	No	Delays through Wyong and North Entrance		Drains unable to cope with high downpour			
290	71 years		Yes	Yes	No	No	No	The creek in the railway property overflowed		I think at the time it flooded the creek was overgrown.		Yes. I think it may be flooded again if the creke is not cleaned out of the reeds behind the RSL club. I have photos showing how high the creek ran when we had that heavy rain on April 18 this year.	I think that the creek shold be cemented as it is now behind my place right along to Burns Rd and I think it will stop some of the flooding along some of the backyards along the creek.
291	19.25 years	66 years	Yes	No	No	No	No	Flooding only affected me when I lived in Teralba Rd Ourimbah – this was only inconvenience when the bridge flooded – we lived on the top of the hill (Cutrock creek?)		Blockage of the bridge in Teralba Rd affected by the ocean tides. Creek banks require constant cleaning of weed and debris rubbish this would aid water to get away.			
292	12 years	23.5 years	Yes	Yes	Yes	No	No	Couldn't drive on road. Ourimbah creek at back – Tuggerah lakes in front. Water entered downstairs in 2007 approx 150cm.	Pictures shown are taken before king tides which took place A.M on sunday 10th June 2007.	If I fall out of my boat in Tuggerah Lake, I could stand up and walk home. Too much silt – we need a sea wall to stop sand coming from Nth side to channel.		Yes. Nothing has been done about the creeks and lakes to maintenance them. All the money goes on studies and nothing comes out of it. Dredger missing from Tuggerah Lakes for 2 years needs ot be ongoing dredging concern.	From 192 Geoffrey Rd, the rd drops approx 100mm till about 156 then it comes back up for 3 blocks and drops 100mm again. Road needs to be raised to stop nuisance flooding.
293	15 years		Yes	Yes	No	No	No	Lower part of property was covered by floodwater for 4 days at worst recent flood time 2010?	It covered our section (218) of Ourimbah Ck Rd and just touched our front gate entrance – June long weekend.	Prolonged rainy weather saturating the ground then stormwater dropping an unsuually high amount of water on top of this.		My property is both sides of Ourimbah Ck Rd – all fences on the lower side have been erected and disgned with flooding in mind as they are not abnormal. The buildings and house are on high side of road and I feel they are above flood level.	The council maintenance of roadside drains is not done, and even after several phone calls and being given report job numbers no work is evident. This means paddocks remain wet and not drained of water due to Council lack of [bottom cut off] over drains. In summer this breeds mosquitoes, paddock plant species are becoming aquatic, grazing area divided, trucks and cars are bogging in [?] and leaving deep tyre tracks. Response from Countil to phone calls Is NIL over several months.
294	3.7 years	3.7 years	No	Yes	No	No	No	Back of paddock flooded (approx 1m at lowest point of paddock)	No. 1m high floodwaters in back paddock.	High tides and excessive rainfall.		Yes. Concerned for paddocks (not house). Excessive water renders paddocks too wet to mow or to be grazed.	As we are on the lower side of the road the run-off from the opposite neighbours paddocks floods our garage. Our drainage ditch (or nature strip) cannot cope with too much rain.
295	17.5 years		No	No	No	No	No			Creek banks overtopping - the water from Ourimbah creek did not come over Chittaway Rd to my property in June 2007			
296	1.3 years	13 years	No	No	No	No	No						
297	19 years		No	Yes	No	No	No	Every time it rains heavy my backyard floods up to 30cm and I live in fear of my house being flooded.		Creek in O'Donnell St overflows		Yes. Neighbours redirecting the flow of rain water by building gardens and fences which block the natural flow to lower groundq	Re: O'Donnell St creek put higher sides, keep water flowing away from houses.
298	13.2 years	28 years	Yes	No	No	No	No	Unable to return home due to flooding Pluim Park Lisarow school area on other side also Uni Sohier Park area, unable to go from both sides. I work at Point Clare, to go back and out to work.	Yes. On one specific occasion my daughter used her 4WD patrol to take myself and fellow worker who lives at Lisarow to work. The water was over the top of her car. We had to go to work one weekend near Pluim Park. The creek at the back of my property 2011 flood reached the top.	the creek needs cleaning our blockage of rubbish etc. tree's falling over, the creek beds need cleaning our of lantana, privet etc.	I have a friend who lives in Yate's Road Ourimbah who has a water meter in his backyard	Yes. After last flood the amount of water in the creek at the back (my neighbours down from us do not have back fences) was the highest I have seen ever.	Over the last 2 years the owners strata Plan 43839 have taken out flood insurance due to flood possibly ounto our 'property's we have pool fencing at the back if and when it does overflow.
299	6.8 years	23 years	No	No	No	No	No						We are located very high up on Taylor Rd, therefore flooding is not one of our main concerns.
300	3 years	3 years	Yes	No	No	Yes	No	Reported by neighbours – no personal experience	Last flood (2006?) from neighbours' reports of levels reached and any other subsequent measurements, flood level reached approx 0.7-0.8m below level of my front yard.	Unseasonal heavy rain and high tides → lake unable to empty sufficienty fast across sandbar at The Entrance.		No. Highly unlikely in my lifetime.	Natural water exit points used to be kept clear of silt build-up eg. Creek outlets into lake and esp. lake exit into ocean at The Entrance. Weirs at all stormwater channels leading into lake to prevent tidal backflow. Some levee work may also be required. Consider creating additional channel to ocean at north end of lake.
301	66 years		No	No	No	No	No		No. Actual level at creek has risen up to 4m but has been retained within banks with no effect to our property and only in severe floods i.e. 1955 etc.	Elevated lake levels and extreme volume of water			
302	13.2 years	13.2 years	No	No	No	Yes	No	Utilities turned off during the June 2007 floods which affected Chittaway Point	June 2007 (?) floods. Overnight the Ourimbah river rose by approx 1.8m. No water came into our yard or breached the bank at the rear of our property	Excessive run-off from storm water west of our property running into Ourimbah river. Inability for water to escape at sea entrance (The Entrance)			
303	27 years		No	Yes	No	No	No	Ourimbah Creek rose quickly and water levels covered half of our backyard, causing dmage to garden shed and garden implements stored. Also, garden was ruined.		Elevated lake levels, mainly due to Entrance channel being blcoked. Also channel to lake from Ourimbah creek was not cleared.		Yes. If channels (Ourimbah Creek to Lake, and The Entrance channel) are not maintained and kept cleared, flooding is inevitable in extreme rain conditions.	

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
304	16 years	17.5 years	Yes	No	No	No	No	Took a couple of hours to get down to Westfields from Geoffrey Rd, flood waters other end of road only one way out onto Wyong Rd. No power for a day or so, no phone limes, flooded all around Church Rd etc.	Not really! Only one flood at the end of Geoffrey Rd the long weekend in June 1997 (River and Lake end). A lot of houses down there flooded. We were fine our end no water laying or damage at all.	Elevated lake levels. Creek banks overtopping.		No. When bought our block 1995 we knew we wouldn't flood in here, up the high end of Geoffrey Rd, also my husband has lots of pitpes all around when we built	Not really.
305	5 years	years	No	No	No	No	No					Yes. Not the house, I expect the low laying areas to be flooded as we are a catchment for the water off the F3 and the Valley behind us. The water floods across our Rd when rain is heavy, the drains are not cleaned out by Council so therefore, logs, debris and large objects are littere dacross the rd being a hazard to all drivers. More maintenance is required to protect against this.	
306	3 years	40 years	Yes	No	No	No	No			Blockage of creeks.			Creeks in our area have blockages due to silt, sticks, logs and leaves.
307	1 years		Yes	No	No	No	No		1/2m at south intersection to Enterprise Dr	Ourimbah Creek			Road gets badly damaged as a result of high rainfall
308	1 years	17 years	Yes	Yes	No	No	No		Only back paddock, house raised. 2 investment properties also but raised house area.	Natural rainfall heavy		Yes.	Clean gutters on road area.
309	33.5 years		No	No	No	No	No		In the last 33.5 years water has <u>never</u> been on our property through flood.				One thing I will say – the creek does need to be cleared of fallen trees and debris
310	24 years	years	Yes	Yes	No	No	Yes	Traffic – I was evacuated after moving car to higher ground – then couldn't come back for [cut off] day[s?]. Yard – water approx 25cm over most of land. House/business – My house elevated so only garage/laundry junk room affected → mostly only needed house out [side cut off – something about a washing maching?]. Sewer/water – not sure as not there. Other – electricity off → came back to rotten food.	? June 2007 – water approx 25-30cm in front yard and through lower story of house – unsure how deep over rest of yard as did not go there, but think was lower. In floods in lake 80s early 90s (don't recall exactly) I was not present, but came to find dirty water mark approx 25cm and lots of silt to be hosed. (First floods I got caught out with some stored things ruined, but now nothing of any value downstairs)	Elevated lake level and king tide at Entrance		Yes. Past experience.	I may not know what I am talking about, but have wondered if in some low lying areas some artifical lakes might be created, fed by causeways (possibly land could be leased to soil companies for few years to create these lakes) → then in times of flood water could flow over causeways helping reduce level in main waterways. Also? - would opening 2[nd] entrance help or hinder.
311	27 years	32 years	Yes	No	No	No	No	we live next to a gully with non-permanent water – ie it runs only during wet weather. During periods of high rainfall in very short periods - ("flooding rain") Peach Orchard Rd can be gut off in 2 places. The water does escape quickly and the longest period of road closure has been about 12-18 hours.	Road was covered with maximum of 600cm depth of fast flowing water. There are no flood indicator depth signs at these locations.	This is just the natural water flow of the land. No specific man-made causes can be blamed in my opinion.		No. Houses are all on the high sides of the gully	
312	65 years		Yes	Yes	No	Yes	No		Approx 350mm above ground level last flood with high flood waters was in 2007 (june)	Mouth of Tuggerah Lake not open to the ocean at the Entrance. Elevated lake levels due to silting.		Yes. If the mouth of the lake at The Entrance is not kept there will always be flooding – refer to attachment to Q8	Please see attachment.
313	29 Years	46 years	No	No	No	No	No	Unable to use Chttaway to get to Ourimbah or to the expressway via Burns Rd.	Burns Rd: Ourimbah Creek flooded at the eastern end and cars had to be rescued by helicopter. Can't recall the exact date during 2011.	Extremely heavy rainfall + ?			
314	16 years	16 years	No	No	No	No	No						
315	9 years	42 years	Yes	Yes	Yes	No	No	The eastern end of Geoffrey Rd goes underwater quite regularly. We have to leave our cars at friends houses 1[km?] up the road and walk. Yard totally flooded 1 week Juen 2007. Had to relocate business and family for 1 week till flood receeded.	2007 June Long weekend. Water broke banks Ourimbah creek and flowed thigh deep through property into the Lake at front. I have flood markings in back yard going back to 5/7/1988.	The channel at the endtrance was good as closed. Water pressure had to build up in creeks, rivers and lake sufficienty to blow sand out of channel then water started to recede.		Yes. I am paying astronomical insurance for house and contents.	The Entrance channel MUST be kept WIDE open at all times to prevent build up of water in rivers, creeks and lake.
316	1.7 years	3 years	Yes	No	No	No	No	Traffic around Ourimbah Uni was affected and I had to park my car outside the uni grounds and wade through water to pick up my children from childcare.		Blockages of creeks so water cannot drain quickly enough when there are a few days of heavy rain.			I'd like to see improved guttering and draingage around the uni.
317	8 years		Yes	No	No	No	No	Couldn't get home from work because all the low lying areas were blocked and created enormous 'pot holes'	Most of seawind Tce was underwater	Rain excessive down pour			Fix the roads in our area and drains. Expecially Chittaway Roundabout – it creates enormous amounts of run off
318	33 years	42 years	Yes	Yes	Yes	No	No	Water was unable to exit Hereford St Properties onto Wyong Rd due to inadequate drainage	Intersection of wyong Rd and enterprise Dve was partially cut. Unit 3, 6 Hereford St had 50-60mm throughout the warehouse	Wyong Rd was upgraded without allowing for adequate drainage. Hereford St properties now retain water which they had not done previously.	See Rob Harris. 3/6 Hereford St, Berkeley Vale.	Yes. History	Council needs to ensure all drains on the western side of Wyong Rd, adjacent to Hereford St, are kept clean at all times.
319	21 years	32 years	Yes	No	No	No	No	Prior to mitigation works on University land at Brush Rd flooding of Shier park and surrounding environs (circa 1990-1992). Since this time, heavy rains see water at varying levels close Brush Rd Ourimbah and Chittaway Rd (near Ourimbah Rugby Club) and Burns Rd railway underpass.	As mentioned (c. 1990-1992) flooding reeached a depth of minimum 0.5m on the then roadway (prior to Shirley St road realignment. The flood water inundated Sohier Park and environs from the west, south and north. Current flooding of Brush rd relates to flood water "backing up" as the flood water is unable to get away until rain eases. Depth has been as high as 0.7m.	The main source of the flooding is the natural flood plain. Mitigation works "cut-away" a proposition of the creek bank and a "detention basin" was "engineered". However with extensive rain, once the "detention basin" is at capacity Brush Rd floods.		Yes. Opposite my home is a long ridge. There ar a number of drainage pipes that direct water off this ridge. In the case of a severe or long period of heavy rain and the prevailing slope from the north/east I have some concerns of overland flooding.	I would be interested to know if a "climate change factor" forms part of this study. MacDonald Rd at Lisarow, particularly near its intersection with Pacific Hwy generates nuisance flooding in heavy rain.
320	21 years	70 years	No	No	No	No	Yes	Roads impassable to Gosford High School		Entrance to Tuggerah Lakes blocked by ocean sand.	Since retirement ~ 1997 have old calendars where I've written rain falls.	No. All "old timers" say its a must to keep mouth of Tuggerah Lake open to the ocean as its when this closes in low flats at Tuggerah, Berkeley Vale and Lisarow flood and block roads.	
321	28 years	28 years	Yes	Yes	No	No	No	part of Chittaway Rd was flooded. My back yard was flooded (1-4m) (1992)	At my property in the backyard it reached 1.4m in 1992, 1.0m in 2002 and 1.2m in 2007.	Elevated lake levels. Blockage of Entrance channel in 1996 and 2002.			Same thing has to be done on the Entrance channel.
322	19 years		Yes	Yes	No	No	No	Ourimbah Creek comes up very high at times and floods our paddocks. We are also not able at those times to leave our property.	1.5m over our bridge.	All of the above. It also leaves a lot of debris behind so it involves days of cleaning up afterwards		No. Our house is high up and is not affected by the floods.	We believe that high water level in Tuggerah Lakes is the problem.
323	13.7 years	13.7 years	No	No	No	No	No			Not affected by floods.			
324	35 years		No	No	No	No	No	Our property is on a ridge which runs into The Ridgeway only one defined gully – not possible to flood.					
325	18.2 years	18.2 years	Yes	No	No	No	No		water as about 2m deep on Shirley St between the uni and Sohier Park. Queens birthday weekend several years ago.	Huge amount of rain and not enough stormwater capacity.			
326	8 years	17 years	No	No	No	No	No			Not enough drainage. Drains may have been blocked.			
327	16 years		No	Yes	Yes	Yes	No	Fencing, ride-on mower, Barn	2006 – 3ft round house, front gate 5ft, 1ft over embankment, garage 4ft, foyer 1ft, granny flat 1ft, the water level is marked in and out our house.	The creek which rises quickly and floods our paddocks and the roads to Turpentine bridge which still stops us getting out. I have a disabled husband who has to go to the doctors so I sometimes have to cancel appointments.		Yes. The creek needs to be cleared out with big trees that have fallen over through past floods.	It is mainly winter time when the rainy season comes that we seem to flood. I have no idea what to suggest, very sorry.
328	50 years	74 years	Yes	No	No	No	No	Travel past Sohier Park was halted 2012 on several days. The water that crossed the road had not dispersed into the dispersal pond beside now Shirley St (Brush Rd) indicating choked outlets.	During 1986-1988 Rugby season I marked on the outside wall of the Rugby cottage. The highest mark is 100mm below floor level. [G?] couts were markers in ground lighting poles but they have been removed. I do not know if the markers are now the new metal poles.	The silting of the creek channels, foliage etc need to be addressed in the Ourimbah area. I have a photo of Sohier park in flood early 1950s. The silt from the citrus orchards farms occupied flat land beside the creeks in the Ourimbah Lisarow palmgrove areas. The metres of deposited silt in the creek systems needs clearing.			
329	15 years	15 years	Yes	Yes	No	Yes	Yes	Electricity cut off	June 2007 – 2m higher than usual				
330	25 years	years	No	No	No	No	No						
331	11.1 years	20 years	Yes	Yes	No	No	No	Traffic disruption occurs during heavy partially due to clogged drains. In 2007 (June) our garage and laundry level were underwater up to 45cm.	45cm through garage and laundry in June 2007. Swirling waters caused by levels rising in Lake and creek at the same time caused movement of contents around the garage and laundry.	Closure of the Entrance was a huge factor as deluge of water could not escape quickly enough		Yes. Lack of action from Wyong Council in dredging sand from The Entrance. The Entrance is a source of embarrassment and Wyong councillors should be ashamed.	Council needs to employ younger, smarter, forward thinking people who won't take action only when an election is imminent. The Entrance needs a break wall, a permanent solution, not a useless stop gap.

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
332	16 years		Yes	Yes	No	Yes	Yes	parts of road flooded. Full flood of back/front yards. Sewerage overflow. No electricity.	I am 5ft 3inches tall. Flood water came to my knees 1 June long weekend approx 6 years ago. 1st flood approx 15 years ago.	Creek banks. Blockages in drains near house.		Yes. Opening at Entrance to Tuggerah Lakes not wide enough drains not cleaned out.	Open up the Entrance channel. Clean drains and roads up.
333	20 years		Yes	Yes	No	No	Yes	When flood peaked, was 300mm back/front yard. Power was turned off for 6 days.	Chittaway Bay, Kalua Dr. June 2006 long weekend floods. Lake level rose up and peaked about 1:30am sunday. Was 300mm around house then receded by sunday afternoon, but street still flooded (live about halfway along Kalua drive). Flood back in Jan 1991 (I think) the rover broke its bank, water then flowed through properties flooding mine, which was being constructed at the time, with 600mm over land. Lake rose as well.	Large amounts of rain falling in short time further up in catchment area of Ourimbah Ck causing creek banks overtopping. But generally lake levels becoming elevated due to masses of rain water trying to push out to sea.			The floods don't worry me. I think the best thing residents can do is to be aware that floods can occur around the lake and be prepared and aware of any imminent bad weather systems which could cause flooding.
334	15 years		No	No	No	No	No						
335	3 years		Yes	No	No	No	No		McDonalds Rd has been flooded along with roads around CC Grammar School – alternative routes were sought.	Low lying areas; limited drainage/currents directed to creeks.			I'm assuming there is a flood mitigation plan in place, if not there should be.
336	4 years	12 years	No	No	No	No	No			Elevated lake level			
337	7.3 years		Yes	Yes	No	No	No	We live off Burns Rd and next to Bangalow creek. In 2007 the storms of the June long weekend brought excessive rain and flooding. Our front yard was flooded within a few of metres of the corner of our house. This is even though the block of land has been built up [?] above creek line. The Burns Rd railway underpass is regularly blocked by flood waters.	Our house borders council reserve, Bangalow Creek and the main Northern Railway line. The front corner of the brick veneer dwelling has had water in 2007 approx 3-4m to corner of house. Cover letterbox and drain from road water run off. Depth above normal creek flow approx 4-5m	In 2007, there was excessive rainfall and as a result normal flood mitigation found it difficult to cope with run off of excess water flow. However there was rubbish and vegetation that blocked the road bridge and cause water to flow over road at Burns Rd and Bangalow Creek intersection.		Yes. There is a lack of natural vegetation, noxious weeks (privet, camphor laurel) choke and clog water course of Bangalow Creek, natural flow is impeded. Debris – man made, dead trees, clog up next to bridges. Railway line acts as an unwanted levy and causes water to back up along the creek.	Landcare or environmental groups should be encouraged or commissioned to clear creeks of debris and replant natural species indigenous to Ourimbah Creek Catchment. Current work (if any) is tokenistic as debris is still gathering and increasing and weeds and introduced species are taking hold on creek banks.
338	20 years		No	No	No	No	No						It would take a flood of Noah's proportions to reach the top of the bank on this side of the creek.
339	13.1 years	37.4 years	Yes	Yes	No	No	No	Creek water rises ¾ way up the front yard towards the house. Right of carriage also floods at the same time making access to and from the house impossibel.	In general terms only, but could indicate in person.	Any or all of the above. 1 notable flood in 2001 was the first I experienced but since 2006/7 there have been many.		Yes. That a medical emergency may arise and help would not have access.	I live in the Gosford Council area. Why am I sending this to wyong council?
340	10 years		No	No	No	No	No						
341	5.5 years		Yes	Yes	No	No	No	Back/frontyard flooded in June 2007, during floods that affected all areas. Road is often closed because of flooding when we have very heavy rain in short period of time.		poor drainage system in Geoffrey Rd. The road is disgusting. There is no guttering in most of the road (surely this would allow the water to run into the lake and the creek)			Come down and have a look at the road and drainage system that we pay for in our rates, but haven't got.
342	1.5 years		No	No	No	No	No						
343	12.7 years	74.3 years	Yes	No	No	No	No	Flooding occurred between back corner of garage across creek/Ourimbah and Palmdale Rd.	June 2007 – 14[?]	In past flooding occurred when Entrance to lake was blcoked. No wit happens when high tide coincides.	Just noted on calendars. My neighbour (No 64) keeps better records.		
344	1.75 years	6.2 years	Yes	No	No	No	No	Burns Rd, Ourimbah rail underpass. Berkeley Rd flooding over rd in dip.	After heavy rainfalls.	Excessive rainfalls on flat low lying land bordering Tuggerah lake.			
345	20.4 years	24.7 years	Yes	Yes	No	No	No	As the lake reached peak of 800mm the Entrance (as always) is potentially blcoked giving the lake surface to break its banks and flood most of our street.	At the last flood rains some 5 years the water depths in our property reached over 230mm [?] & [?] caused riffles to low line homes otherwise still waters to rise and falls.	Elevated lake levels caused by rain in Ourimbah creek and other creeks and not allowing the lake waters to drain through the Entrance.		The Lake floor is contaminated and over the 20 years we have been here the tide marks of some 160m have vanished to little	Please use the machinery you possess to dredge [?] particularly at the bottom of the point (Chittaway) as the south and north mark has been moved closer together over the years and will form another lake or billabong.
346	1.7 years	20 years	Yes	No	No	No	No	Generally the road is cut and a few times we have been unable to return home.	The neighbours property was flooded completely except for the house and out buildings. Our property has 2 billabongs on it and the water level on both these rose several metres due to the backwash of the creek flooding.	Generally when there is a lot of rainfall up the mountain this is when flooding occurs. This is why it may flood even if you get fine days in the valley.		Possibly. We purchased the property basically knowing that the house had never flooded but there can always be a risk when you are near known areas that flood.	
347	16 years	16 years	Yes	No	No	No	No	Overflow on lowest part of Anderson Rd when storm water pipes under road were subjected to an extreme event.		Inability of water (storm) to drain into Tuggerah lakes.			Dish drains and swales at the side of Brush road become clogged with leaves and debris from time to time
348	4.5 years	4.5 years	Yes	Yes	No	No	No	Traffic is very congested around local area – the uni, around Lisarow school and Bill Sohier Park. Also O.R.Park -a shocker! We got a deluge of water rundown from behind our property either side of our house – it's a torrent		Drainage, overflow of creeks.		Yes. When it rains heavy – the water flows heavy around the sides of our house from the mountain behind.	Yes. We need drainage – no storm water drainage on or around our property or on the road outside our driveway – it always floods – needs drains.
349	15.3 years	15.3 years	Yes	Yes	Yes	Yes	No	House/business – granny flat and garage. Street was flooded back and front yard. Sewer and water were cut off.	Water reached about 2ft high (in my yard and granny flat and garage)			Yes. Because the drains in the street have not been done property- the water has no where to go.	
350	2 years	2 years	Yes	No	No	No	No	The timber underbridge at the bottom of the street (only way out) has flooded over 4 times in the last 12-18months up to 0.5m above road level preventing passage for sedan vehicles.	0.5m above road level at the timber bridge at lower end of Teralba St.	1) The bridge isn't wide enough (replace with 3 cell box Culvert structure). 2) The downstream side of the bridge requires widening and clearing (Wyong council side).			It usually takes 16 hours of heavy rain continuous to cause flooding of the bridge. A new structure is suggested with channel widening on down stream side.
351	27 years	40 years	Yes	Yes	Yes	No	No	No insurance	2002 – worse flood because council let the dam go – now got no water? 2007 – because Entrance was closed so flooded from Lake!!	2002 – council let dam water go = flooded Ourimbah creek. Now we have a water shortage. 2007 – lake entrance was closed – so water flooded from lake.		Yes. Because lake Entrance not wide enogh. Needs to be made wider.	Be nice if council could fix road re: floods – cnr Church Rd, Geoffrey Rd!!
352	27.7 years	27.7 years	No	Yes	No	No	No	My back/front yard was flooded due to ourimbah Creek breaking its banks and water coming across road from neighbouring property and F3 freeway.	Yes. 1992 – Feb. Water entered garage, rumpus room and laundry. 2007 – june long weekend – water entered garage, rumpus room and laundry.	Torrential rain, water breaking banks of Ourimbah Creek.	In the 1992 flood we had over 16" of rain during the day and night, king tides in Tuggerah lakes. 2007 flood we had 12" of rain during day and night.	Yes. Ourimbah creek is full of silt, fallen down trees and debris, it is never cleaned out. It only takes a day of constant heavy rainfall and it can be almost to the bridge in Footts Rd.	
353	7 years	12 years	No	No	No	No	No			Increase level of trees and debris becoming caught and blocking creek. Especially in narrow areas		Yes. But please see below – not too worried but the potential is increasing.	Rear of property that backs onto creek has numerous trees and other debris that slows the flow of water and is gradually getting worse.
354	1.3 years	1.3 years	Yes	No	No	No	No	Water over road and could not drive through unless you had a 4WD. Road is always in very bad condition even when dry because of it.	01/06/11	Elevated lake levels with insufficient drainage to the ocean at the Entrance.			No. Just keep dredging and keep the lake entrance open enough to allow excess water to escape (as it is now)
355	8 years	47 years	No	No	No	No	No		1) The "wet lands" at Pacific Hwy and Chamblian Rd has flooded into the road in Pacific Hwy on 2 occasions. It has gone d[?]. 2) The intersection of Pacific Hwy-Parson Rd was also flooded causing people to travel up Parsons Rd to H'way.	1) "wet lands" - pipes under Parson Rd [insufficient?] in size. 2) Narara Creek – pipes under h'way [insufficient?] in size.	A copy of the past 8 years of the rain, temp etc in a notebook is kept by my wife and self. It is a too bulky to include in this letter. However if required a phonecall to collect at above address can be arrnaged.	["Yes" box circled but "No" box ticked?]. Our property backs onto the "wet land" with a levy bank of RL 100 year [?] BIT Gosford council etc has raised its flood level to RL 150year. Why! Which means our property is now in the 150y flood level.	The 150 year flood level should be revised as our property was approved by "GC" back in 1992 on 100yr flood level. This act with other residents in the area feel, have cause our "houses" unsaleable and the insurance rate has gone through the roof.

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
356	5 Years	42.5 Years	No	No	No	No	No			Elevated lake levels		Yes. The amount of stormwater does not drain quickly enough through the stormwater drainage system in front and side of my property.	
357	0.7 Years	2 Years	Yes	No	No	No	No	Roads were blocked by floodwater near Lisarow Public school (Fagans Rd, Tuggerah Rd, McDonalds Rd) and near Ourimbah campus/Ourimbah Rugby club shed on Chittaway Rd.	Flood water rose quickly and fell quickly and while I was in these areas the water probably reached approx 700mm (h)	Too much rain in too short a period and not enough space in creeks for it to fit			The cutrock creek and other smaller creeks that flow into the Ourimbah ck are jam packed with weekds and debris. They need a good clean out so water can flow a bit faster to escape and be cleaned at least twice each year.
358	6 years	6 years	Yes	Yes	No	No	No	Emergency access still blocked due to council's inaction to date to rectify situation	Council has inspected my property and my neighbour's on numerous occasions so you have the records. Gosford Council slowed the flow to benefit Wyong Council residence. Great system between you well done!	Boulders placed by Council to slow down flow. We now have more property and more regular property flooding since Council placed boulders!		Most definitely thanks to Council placing boulders in path of flow.	We have been complaining for years but still we answer surveys. We need action not talk.
359	30 years	62 years	No	No	No	No	No						
360	25 years	years	No	No	No	No	No						
361	22 years		Yes	No	No	No	No	Matchum and Holgate (Ridgeway Rd) road closed from Lisarow to Erina		Low road level and flooded creeks.		Yes. I have been told that the whole of Chamberlain Rd was under water 30 years ago. Therefore my home at Lisarow may one day be flooded.	
362	7 years	7 years	Yes	Yes	No	No	No	Traffic on MacDonalds Rd stopped at crossing near our property. Water approx 0.6m over road. Back orchard inundated when creek broke banks.	Highest level in June (1995?) when east coast low off central coast caused major flooding. Back creek rose approx [0.?]2m from normal flow level. Water approx 0.6[.cm?] over MacDonalds Rd crossing.	Heavy rain from east coast low combined with high level in Tuggerah lakes (high tides?)	Yes Normally monitor daily rainfall records available but nore readily accessible.	Yes. New development (exclusive Brethren Church) up valley has large run off potential to front creek. Council dismissed suggestion for on site containment dam. Development to use permeable pavement of unknown (at this time) effectiveness.	
363	7.2 years		Yes	No	No	No	No	We had our driveway flooded so we couldn't leave our property	Our property is accessed by a bridge over Ourimbah Creek. The water came over the driveway at the front and back side of the bridge so we couldn't drive across. The water level was approx 1m or more (2007 floods) it lasted approx 2 days until we had access.	Creek banks overtopping		Yes. Because there is a long history of our creek flooding and so far it has happened twice since we bought our property.	No
364	1.2 years		Yes	No	No	No	No	Showground Rd in Narara was closed due to flooding		water drains too fast down the hills because the emphasis is on stormwater drainage instead of water harvesting.	On 18th and 19th April 2012, we got nearly 200mm of rain.		The council could encourage landowners uphill to catch or slow down rainwater run-off with new dams, leaky weirs, gabions, contour swales... water moving slowly underground is less likely to cause flooding downhill.
365	11 years		Yes	No	No	No	No	Railway Cres, Enterprise Dr and Showground Rd, Turpentine Rd.	Turpentine Rd regularly gets up to [0.?]4 to [0.?]6 under bridge	Creek banks overtopping and blockages		Yes and no. Depends as we are on the low side of the road but on a hill.	
366	10.3 years	10.3 years	Yes	No	No	No	No	Unable to leave area except via Cutrock Rds eastern exit through to erina, but cut off from Gosford and Wyong via flooding over Cutrock, Fagans and MacDonalds as well as Shirley St at uni. This was in June long weekends of 2007 and in 2012 we were cut off at Shirley St only.	30-45cm on Fagans and Macdonalds Rd – similar on Shirley in 2007. 30cm high in 2012 at uni (Ourimbah)	elevated lake levels.	Attached – please not that when we area away on holidays for a week or more I record the total in the rain gauge at our return. Also round all figures to 0.5, but record to 0.25 occasionally when there is a heavy dew.		
367	20.9 years		No	Yes	Yes	No	No	Flood in Feb 1992 was quite high. Flood in 2007 not quite as high. Numerous small floods did not reach house.	No. Cannot give actual measurements but can show level of water. Water flow has varied.	We think that high tide would be part of the problem.		Yes	
368	3.2 years	3.2 years	No	No	No	No	No			All of the above.			The general drainage along our road has blocked natural gutters with no run off access.
369	18 years	52 years	No	No	No	No	Yes	The power board/switch for pumping water was under flood water.	Yes. 3M to cover switch board. June holiday weekend 2007	Excessive rain.			
370	35 years		No	No	No	No	No						
371	46 years		Yes	No	No	No	No	water across road in low areas preventing traffic clow in and out. Heavy rain, flash flooding has cuased water well above the water level markers on MacDonalds Rd also near Fagans Rd and Lisarow Public school.					Being a long term resident, things have improved over time with cleaning out the creak near MacDonalds Rd entrance and subdivisions putting in drainage. My problem is water rushing down from the Ridgeway.
372	4.8 years		No	No	No	No	No						
373	21 years	50 years	Yes	Yes	No	No	No	Our home is built high off the ground. Water over road – water from Lakes at nuisance levels. We have never needed to ask for assistance. Lost power once.	Floods have varied from a few cms to about 1m. 2007 highest since we have been here but my mother had much higher flood years early and local fishermen related to me there had been 2 much higher, I believe late 30's	The Entrance water surging in with big seas and closed Entrance channel being blocked by sand bar stopping water flowing out to sea and increasing lake level			The fact that blanket laws are enforced on our properties for both flood and [?] and the values have been [?]. Blanket regulations [?] landowners from subdivision area [?] grossly unfair. Each [?]/should b e carried out with individual assessments.
374	13 years	13 years	Yes	Yes	No	No	No	Road from Bridge and Lisarow St was flooded as was my front and rear yards as was my garage. Our house is some few (4) feet off the ground and the waters was up to 3'0" over ground level.	2007 flood – June 7. Flood though front and rear yard up some 3' above ground level. Three floods since then the waters have come through the front yard [?] ½ way to Lisarow St. Over the height of the front yard tap.	Creek blocked from the bridge [?] not allowing the waters or free run through the creek bed.		Yes. See Q5 and the fact that there is no flood mitigation work.	Spoke to a number of your engineers re: this matter
375	25 years	30 years	Yes	No	No	No	No	Flooded from Chittaway Rd from creek to Kauai Ave	On 3 occasions has flooded from the creek at end of Kauai ave to Chittaway Rd.	Infrastructure to the area – double the residential to years ago. Blockage of creek from railway bridge to weir due to fallen and sunken trees.		Yes. The last flood in June a few years ago was worst and concerns us that with more residential growth it could get worse.	My concern is that the insurance companies have adjusted premiums because of the history of the area in regards to flooding they are becoming extremely unaffordable.
376	1.2 years		Yes	No	No	No	No	Tuggerah St flooded blocked way in to my house and Brush Rd flooded blocking way to my house.					
377	12.8 years	50.6 years	Yes	No	No	No	No	Traffic disrupted McDonalds rd		Minor Creeks that discharge into Chittaway and drains not kept clean – blockages of bridges etc.			The water retention pond at rear of our property is being filled up with soil and rubble from building activities in streets off Timber Dr. More inspections by Council to make builders comply with continuing maintenance of silt fences not just that they put them up to comply at first.
378	24.7 years		Yes	No	No	No	Yes	Creek flooded across bottom paddock. Road cut off temporarily for access		Just high rainfall event. Flooding drained fairly quickly (day or so)			We live in a rural area on a dirt road with no infrastructure or drainage. It has never been a priority area of Council!
379	5.4 years	5.4 years	No	No	No	No	No						It might be good practice to clear the creeks etc of reeds, weeds and silt build up to ensure water flow.
380	5.8 years	12 years	Yes	Yes	Yes	No	No	Road goes under water then backs up onto our property. Dogs had to be evacuated from business via the caravan park next door.	June 2007. Came up over verandah of house and was lapping at doorways. Seeped into the house through brickwork as it was over damp course. Kennels and grounds were completely under water by 18["or!?]	Water from freeway is collected in dams to the west of our property. This overflows onto our road and property because drain is blocked.		Yes. Every time it rains we get water coming from the freeway. Our road turns into a river. It runs for days , even weeks after the rain has stopped and is still running when it starts raining again.	We have sent many photos and emails to the RTA and Council and received no cooperation. We have had a client's child swept away in the water and cars damaged.
381	28 years	36 years	No	No	No	No	No			Rain			Wyong shire has areas that are flood prone. Always had and always will. Population growth will always impact on these areas. People are aware so there should be no problems.
382	27 years	40 years	No	No	No	No	No		No flooding				
383	15 years	30 years	No	No	No	No	No						My property is zero risk to flooding.

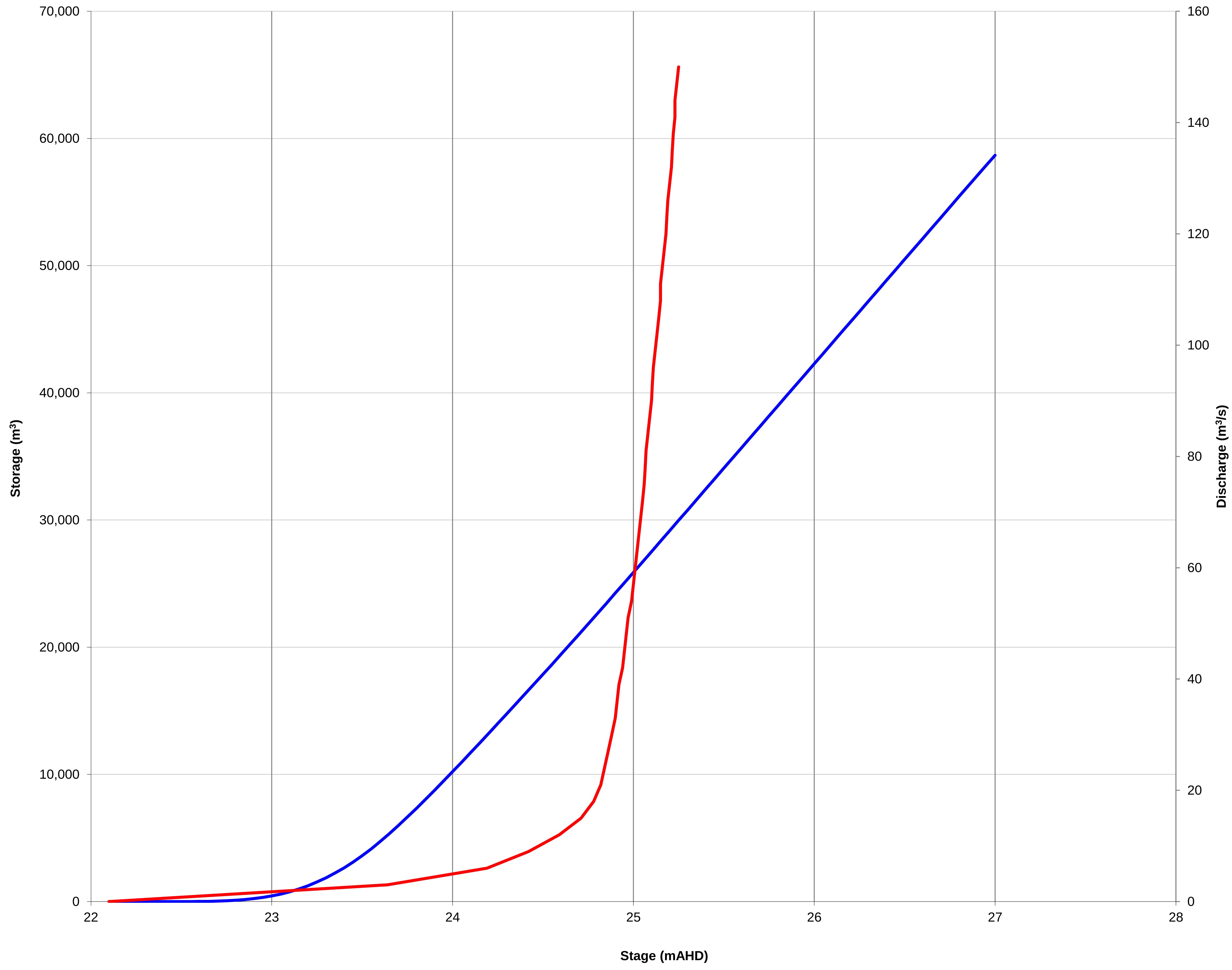
Catchment Simulation Solutions

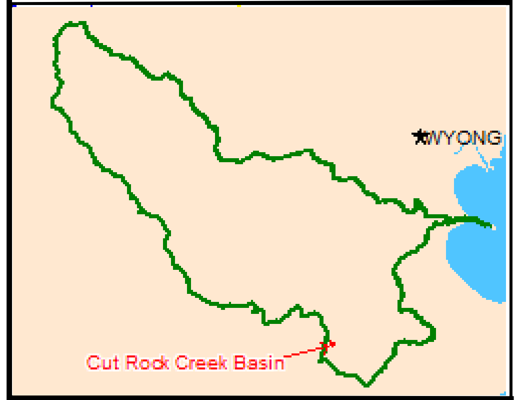
#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
384	2.7 years		Yes	Yes	Yes	No	No	I live on acerage. During heavy rain the run-off from the hills (other properties and [?] runs onto my property and is channelled into my shed area – flooding it several times during 2010, 2011 and earlier this year with damage to feed, equipment and Palmdale rd cut several times by creek. Lower paddock floods.	Shed floods to 7cm or more. No to road but cut to traffic for short times (several hours) on at least 3 or 4 occasions in past 24 months.	Not enough drainage along lane, inadequate drainage under lake therefore water banks up on my property	Not on individual days, just monthly	Yes. I am unable to prevent it without [?] earthworks and unsightly drains – better if water did not enter my property ie better drains along laneway!	[?] of land clearing on hills without consideration for management of excess run off.
385	0.8 years	17 years	Yes	Yes	No	No	No	Road closures due to flooding at Anderson Rd, Glenning Valley, Enterprise Drive and Shirley St, near uni and Burns Rd Ourimbah, have affected my ability to go to work. Presently – flooding on both sides of Lisarow school has inhibited/jprevented acces to work and home. 2 occasions in last 10 months.	Backyard flooding reached a depth of approx 5cm across entire backyard both times – Nov 2011 (monday) and April 18 2012 (wed). Road closures prevented access on both occasions.	Inability of drainage system to cope with heavy and continuous rainfall over sustained time.		Yes. I have upgraded drainage system and guttering at my property in the hope that I don't have to experience this problem again. I also hope that Council will be able to do the same for the road system.	Gathering information from residents is a good idea but I hope that specialists in flood management will also be employed. Some feedback to residents about future proposals to accommodate this widespread problem would be appreciated.
386	10.3 years	10.3 years	Yes	Yes	Yes	Yes	No	About 2 foot of water in June 2007 long weekend floods.	June 2007 long weekend – about 2ft of water for about 3 days at front and rear of property	Tuggerah lakes backed up with heavy rain that could not escape through the Entrance channel quick enough	neighbour	Yes. Ourimbah creek overflow again.	Yes, open the entrance channel – make it wider
387	0 years		No	No	No	No	No						
388	30 years		No	No	No	No	No		Never had any problem	Never had a problem			Open up lake at the Entrance
389	30 years	30 years	No	No	No	No	No						It's a good idea ot live on higher ground – at the top of a slope in my case! I've certainly seen O.Creek rise and flood Footts Rd and low-lying land nearby, also along O.Creek Rd to the west.
390	5.75 years	34 years	Yes	No	No	No	No	Bottom end of Fagans Rd closed due to water over road.		Creek banks overtopping			
391	12 years		No	Yes	No	No	No	Yes. My nature strip (Wyong Rd side) normally floods during periods of heavy rain. Once it flooded due to burst water main. This area together with my backyard (northside) also flooded once during a recent period of exceptionally heavy rain.	No. But at no time did the water threaten to enter the house but just reached the threshold of the rear (N.E facing) garage door.	Purely rain (apart from an isolated water mains burst) as this property is well above the creek (estimated average is 2-3m below Wyong Rd)			Drainage alongside the footpath between Geoffrey Rd and Canntree Rd could do with some improvement at some time in the future.
392			Yes	No	No	No	Yes	water over Ourimbah creek bridge on Palmdale Rd. Loss of citrust fruit on trees along creek area.	Ourimbah creek rises approx 35ft	Rain plus all of the above	1992 – Feb 9-11 – 341mls. Total Feb 463.5mls. Rough records kept since 1963 not dated each day until 1994	Yes. Only low areas of pasture near creek not house sheds etc.	
393	36 years		Yes	No	No	No	No	Floods where tributary of Cut Rock Creek crossees MacDonalds Rd		Creek overflowing			
394	10 years	15 years	Yes	No	No	No	No	2007 floods flooded Pacific Hwy and Enterprise Dr		Heavy rain overtops Ourimbah and Cut Rock Creeks			
395	20 years	38 years	Yes	Yes	No	No	No	Traffic disrupted when creek in MacDonalds Rd floods – not a problem since Timber Dr ext completed. Front yard floods because council doesn't conduct regular road maintenance of table drains	Yes. Road outside my property floods – height of 150-250mm causing water to flood down my driveway into garages. Council won't construct property formed gutter to prevent this. Been requesting for 15 years only to be told owner must pay (road and gutters council responsibility)	No maintenance of table drains. Water flooding off ridgeway		Yes. Previous history. Development by Exclusive Brethren including proposed road works in MacDonalds Rd Lisarow.	Council should listen to long term residents when approving DAs. In particular issues regarding water run-off drainage and road guttering and storm water.
396	35 years		No	Yes	No	Yes	No	Access road and bottom paddocks under water. Power cut off. Unable to leave for up to 3 days. 3-4 times.	up to 1-2m above the bridge. Kept no record of dates.	Very heavy continuous rain. Ourimbah Creek is fed by a very large catchment basin with numerous feeder creeks – including one on my property		Concerned – no. But it will happen. I make provision.	I have already suggested a system of smallish earth dams on feeder creeks.
397	1.3 years	7 years	Yes	Yes	No	No	Yes	Our house did flood just below waist height in 2007. Whole house before we moved in. June long weekend 2011. Backyard and front flooded. Sink downstairs water coming up [?] bubbling in top of sink couoldn't drive well around lake edge aloha and Haleni st in Chittaway.	Kalua Dr. June 2007 floods. Had friends living in our house before we bought it. Whole house under just below waist height. Also sewerage went through house from overflowing in the park next door.	Creek and lake elevated areas.		Yes. We have already gone under. Only a matter of time before it happens again. House built in 1991 and has gone under 3 times since.	Open the channel. Curb and guttering would be great! Better drainge.
398	14.5 years	19 years	Yes	No	No	No	No	Water over road on Berkeley Rd, Chittaway Rd and Anzac Rd Tuggerah (roadworkds to Berkeley Rd may well have cured the problem)	Np - road impassable for access to school children	Heavy rain and poor drainage			
399	24 years	24 years	Yes	No	No	No	No	Roads blocked – McDonalds and Tuggerah/Pacific Hwy. Brush Rd Ourimbah, Carlton Rd Matcham	In 1988 water reached intersection of Fagans Rd and Tuggerah St.	Drainage	No – contact Bureau of Meteorology. Get the records from the Gosford automatic weather station	No – unless there is a sea level rise >180m	Gosford – stop further development as these lead to more run off into the catchment as soakage is compromised – same with wyong. Make developers PAY!
400	50 years	50 years	No	No	No	No	No		2m Burns Rd	Blockage of bridges and water ways			Clean out water ways of rubbish and keep clear and clean out creeks. A good clean out is the way to go.
401	30.6 years		No	No	No	No	No		waters rise no higher than meter box. Has never touched the road at my place.	creek beds overtopping.		If my property floods people will be in a lot of trouble. My house is much higher than neighbours.	No
402	9.4 years		No	No	No	No	No						We live on the high side of Old Chittaway Rd
403	20 years	20 years	No	No	No	No	No			Creek banks overtopping. Rubbish build up			More overflow catchment.
404	15 years	15 years	Yes	No	No	No	No	Road flooded up to a depth of 3m sometimes making access or exit impossible. No other way out/in. V.dangerous as people are tempted (and do) to use the railway to get out/in.	Under railway bridge on Turpentine Rd, fast moving creek; depth of water varies from 1m to 3.3m depending on rainfall.	Water overload on blocked creek: water can't get away fast enough		Yes. Because it has happened 5 times (approx) on the lower part of our property this year alone... submerging fence lines and endangering horses	Many, many requiests have been submitted to council with limited response over a long time (years)
405	47 years		Yes	Yes	No	No	No		To top step of dwelling – not inside the main dwelling but through garage.	Creek banks overtopping and lake levels		Yes.	
406	28 years	28 years	Yes	No	No	No	No			Blockage of bridges. Fall trees in creeks not cleaned out.			
407	2.75 years	23 years	Yes	No	No	No	No	Flooding on Shirley Rd, outside the uni causing traffic to be diverted		Insufficient drainage			
408	4 years		No	No	No	No	No						
409	12.2 years	12.2 years	Yes	No	No	No	No	1) Dog Trap Gully Creek flooded over the bridge/culvert crossing of Dog Trap Rd many times cutting off access to the Pacific Hwy until the flood peak had subsided. 2) Embankment of road has been washed away in 2 sections resulting in major rockwall repairs to the road.	Flood markers on the side of the road indicated 0.2m-0.4m height of water crossing rd. Velocity of water running across was quite fast making it very unsafe for a normal car to traverse through the water.	Volume of water coming down mountain sides into Dog Trap Gully was huge. The floodplain was covered but was then channelled into a narrow exit point under the road and even narrower creek outlet around parallel to road and out to Pacific Hwy.			1) Dog Trap Rd has had 2 major wash-outs on the eastern side of the freeway, one each side of my property. Run-off from the surrounding hills onto the road needs monitoring and better provision made to re-direct the water away and into the Gully below. 2) Exit from bridge needs widening and reinforcing with [bottom cut off]
410	0.25 years	10 years	Yes	No	No	No	No	Burns Rd, Ourimbah Uni	Burns Rd highest level I've seen was 1.8m often gets to 1.4-1.6	Rain – lots of it	I have a rain guage but don't keep records though Burns Rd flooded when 100mm falls when 200+mm it floods. Deep at Burns Rd the uni roads will flood too.	On a hill now – no chance of flood.	
411	23 years	23 years	Yes	Yes	No	No	No	June long weekend 2007 – high tide and over abundant rainfall	As above			Yes. The concrete drain at nature reserve at back of house/ no longer cleaned out it now overflows with greenery.	Keep drains unblocked.
412	12 years		Yes	Yes	No	No	No	Oberon Rd was under water during June 2007 floods. Floodwaters came up to our driveway in the front. Ourimbah Creek flooded up to our clothes line. House was unaffected	June 2007 long weekend – up to driveway in the front and clothesline in the back. Started on the friday – did not recede until about thursday. Road opened on Tuesday.	Lake and creek levels rose up into natural flood zone due to heavy rainfall		No – could happen – part of living in a flood plain between a lake and a river.	Residents need to be prepared that properties here could become flood affected!

#	How long have your lived in area?		Have you been affected by flooding in the past?						Can you provide historic flood information?			Are you worried your property could be flooded in the future?	Any additional nformation?
	At Current Address	In General Area	Traffic Disrupted	Yard Flooded	House / Business Flooded	Sewer or water was turned off	Other	Description	Flood Descriptions	Source of Flooding	Rainfall Records		
413	47.6 years	70 years	No	Yes	No	No	No	We spent a lot of money on our Ourimbah Creek retaining wall and it and our small "wharf" was washed away in the early 90s. We have since rebuilt it and we have had several floods since, but no damage. In the backyard the highest water level was in 2007 when it rose approx 2.2m which flooded 20m of our backyard but did not enter our garage (our cement slab) and our home is 1m higher	The above answer is the highest in 47 years on our land	Disrupting the natural drainage with the building of new developments (eg roof, paving and run-off from same). In our "big flood" (Q3) from memory I think the Entrance channel was closed and there were very big tides and a lot of rain at the head of creek.		No – global warming?! We won't be here to worry about it!	Lake weed clearing from channels to assist water flow? Opening the Entrance channel when required.
414	10.5 years	10.5 years	No	No	No	No	Yes	Provide shelter to people that were flooded		King tides and heavy rain			
415	6.8 years	35.8 years	Yes	No	No	No	Yes	Traffic – Closure of parts of Lakedge Ave and Chittaway Rd. Other – Flood insurance – premiums and availability	Will email photos of Lakedge Ave and Chittaway Rd if needed – 2007 flood.	Combination of the following: extra heavy rain, onshore winds, king tides, overdevelopment, closure of The Entrance channel.		Maybe. Depends what action is taken. Good to hear the news that the dredge is returning to the Entrance.	
416	12.4 years		Yes	No	No	No	No	Chittaway Rd and Burns Rd underpass flooded – unable to get from freeway to our home.		Creek banks overtopping			
417	42 years	50 years	Yes	No	No	No	No	Dog Trap Creek has washed away the council culvert 3 times.	12feet	Heavy rains, silted creek bed		Yes	
418	5 years	8 years	Yes	Yes	No	No	No	Along Lake edge was flooded and the corner of our street which joins Aston wilde I was unable to get out to work at B.V.P Hospital	Couple of years ago when we had the big flood the Lake was right over the road on Lake edge and the river was right up to the road.	Creek banks overtopping, elevated lake levels, extremely beavy and lots of rain also drains blocked or insufficient drainage on the corner of our st and Aston Wilde		Yes. Probably only our backyard which is low lying and does not drain off properly	
419	28 years		Yes	Yes	No	Yes	No	Traffic – water over road, slowing traffic. Drains under road unable to cope with volume of water. Rain inside [laundry/boundary?] overflows and floods front/side of house having to sandbag front and garage doors. Sewer – septic tank under water when flooding	Back paddocks flood to top of fences causing soil erosion and damage to fences. Have to move horses to higher ground. Creek at rear of property continually blcoked with debris which is maintenance by myself.	Flooding front of property mainly due to water off road and from neighbouring properties across rd. water at rear subsides over time according to tides.		Yes. If water enters the house causing financial hardship. Continual erosion and clean up.	
420	1 years	11 years	Yes	No	No	No	No	Ourimbah Creek burst its banks frequently at end Burns Rd. Our exit uses this road.	1.4+ using flood depth indicators. Up to car rood thanks to some good trying to drive through it! 12/12/11. 16.16.58 16.25.40 Plus again in June 2012.	Creek bank overtopping – creek flow normally too low to allow self cleaning so bed silts up		No. we are built up on a fill so should miss most floods.	Am very glad no-one can build in the area shown by photos (? Lot 17) as very flood prone.
421	22 years		Yes	No	No	No	No	Access to area blocked by flooding at Tuggarah st and Shirley st, Ourimbah.		Creek banks overtopping. Poor drainage.	Yes. Monthly rainfall totals for past 10 years.		
422	5 years	10 years	Yes	Yes	Yes	No	No	As we are on Fern Rd, during the June long weekend storms ~4-5 years? Ago, our house flooded and retaining walls (structural) collapsed.		Unbelievably heavy rain		Yes. Lie of the land.	
423	20 years		Yes	Yes	No	No	No		Came across road covered flat and covered paddocks	Creek overflowing.		Yes – the land and outbuildings. No – not the house.	
424	21.5 years		Yes	Yes	No	No	No	Feb 1991 – severe storm (Pasha Bulka) and one other	Yes – 1991 c300m Pasha Bulk event knee deep. Follwoing 1991 had house raised to [?] requirements.	This property, each flood event, has had water come from lake initially, not Ourimbah creek which suggests lake outlet is not adequate.		Yes – lake entrance is basically as is.	
425	12 years	25 years	No	No	No	No	No						
426	10 years	20 years	No	No	No	No	No						Flooding does not apply to property
427	19 years		Yes	No	No	No	No		The water level along Shirley St adjacent to the Uni obscured the pedestrian refuge in the centre of the road	Creek overflowing	I have my rainfall recordings at home. I am currently in central QLD. I will be home on Oct 8.		
428	22 years		No	Yes	No	No	No	Backyard floods, probably because of blockages in reserve drains and/or poor drainage from streets Thomas Walker, lake edge		Insufficient drainage, blocked run offs, blocked drains, gutters		Yes. As I am a widoe pensioner, the continual dampness and water damage to garden sheds.	
429	15 years		No	No	No	No	No			Excess water from council land			
430	40 years	40 years	No	No	No	No	No						My property will never flood.
431	55 years		No	No	No	No	No			Channel at Entrance blocked			Never floods between Wyong Road and Church Rd
432	7.3 years	17 years	Yes	No	No	No	No		Underpass at Burns Rd completely blocked off to through traffic, cars floating in water	blockage			
433	32.7 years		Yes	No	No	No	No	[messy/crossed out words] shirley st between Sohier Park and Uni wetlands. Creek below Anderson Rd and Glenning Rd.		Burns Rd underpass inadequate. Run off from hills into valley. Creek banks overtopping. Elevated lake levels (tidal). Drains inadequate.			
434	18 years	30 years	No	Yes	No	No	No	Flash flooding in valley to 1-2m depth. Usually draining in 24-48hrs.	Yes. Bottom paddock at road level to depth of 1-2m with flow.	rain exess 4-5 days torrential level. High tides/lake levels.			
435	24.75 years		Yes	Yes	Yes	No	No	Street cut by flood – impassable, flooding through our property and garage – have to move vehicles to higher ground, unable to access property by vehicle. Our property is at the lowest point of the street. When Cutrock Creek breaches its banks and water level rises, the creek impeaches into our front yard. If the water level rises far enough, we may have water through both our front and back yards. The creek actually ends up flowing from the back yard, through to the front yard and continues across road to meet the main creek body again. Minor damage to gardens and garden walls occurs. Contents of garage have been inundated (house elevated). Small amounts of property loss and damage. Cars have been flooded previously. If risk of flood is imminent, we usually move contents to higher ground (as long as we are home at time). As soon as the creek level rises, pipes gurgle (waste rises up drains) and we are unable to flush toilets, and bath and shower etc won't drain.	Please refer to attached photographs. At worst, flood level has been approx 300mm - 400mm through garage and back yard. Property falls to the front, so depths are higher at road level.	Creek banks overtopping due to congestion/overgrowth of Cutrock Creek north of the Teralba St bridge. Gosford Council has undertaken flood mitigation works upstream, Wyong Shire Council continues to do nothing. The creek is very overgrown, silted and congested north of Teralba St. As a result, the creek backs up and breaches its banks.		Yes. Past experience and the fact that nothing has been done by Wyong Council to rectify the problem.	In the 25 years we have lived at this address, we've probably had in the vicinity of 8-10 flood events that have caused us inconvenience, stress, expense and minor property damage. The situation seems to be worsening in recent years as Cutrock Creek becomes more restricted downstream of Teralba St and more development occurs upstream. We live right on the border of the two council areas, pay rates to Gosford Council, but are affected and inconvenienced by the inaction of Wyong Council.

APPENDIX B

XP-RAFTS MODEL INPUT PARAMETERS





LEGEND:

- Stage-Discharge Relationship
- Stage-Storage Relationship

Notes:

Figure B1: Stage-Storage and Stage- Discharge Relationships for the Cut Rock Creek Detention Basin

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Cut Rock Basin Stage Storage and Stage Discharge.xls

XP-RAFTS INPUT PARAMETERS - Ourimbah Creek

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
1.01	1	91.28	4.10	0	0.057
	2	7.40	4.10	100	0.015
1.02	1	86.69	4.38	0	0.060
	2	7.19	4.38	100	0.015
1.03	1	38.89	8.27	0	0.089
	2	1.65	8.27	100	0.015
1.04	1	50.11	15.41	0	0.077
	2	2.01	15.41	100	0.015
1.05	1	22.91	15.16	0	0.099
	2	0.47	15.16	100	0.015
1.06	1	28.25	13.28	0	0.095
	2	0.58	13.28	100	0.015
1.07	1	3.02	16.66	0	0.100
	2	0.06	16.66	100	0.015
1.08	1	55.38	11.01	0	0.095
	2	1.30	11.01	100	0.015
1.09	1	34.40	11.17	0	0.100
	2	0.70	11.17	100	0.015
1.1	1	52.59	5.95	0	0.100
	2	1.07	5.95	100	0.015
1.11	1	31.32	10.29	0	0.100
	2	0.64	10.29	100	0.015
1.12	1	5.93	16.23	0	0.100
	2	0.12	16.23	100	0.015
1.13	1	6.69	18.42	0	0.100
	2	0.14	18.42	100	0.015
1.14	1	18.66	15.16	0	0.100
	2	0.38	15.16	100	0.015
1.15	1	37.11	15.03	0	0.100
	2	0.76	15.03	100	0.015
1.16	1	71.63	5.11	0	0.100
	2	1.46	5.11	100	0.015
1.17	1	10.17	11.38	0	0.100
	2	0.21	11.38	100	0.015
1.18	1	11.93	6.18	0	0.100
	2	0.24	6.18	100	0.015
1.19	1	67.35	7.81	0	0.100
	2	1.37	7.81	100	0.015
1.2	1	92.96	4.87	0	0.099
	2	1.90	4.87	100	0.015
1.21	1	30.23	2.51	0	0.099
	2	0.62	2.51	100	0.015
1.22	1	32.69	4.40	0	0.099
	2	0.67	4.40	100	0.015
1.23	1	27.43	4.18	0	0.095
	2	1.82	4.18	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
1.24	1	25.02	5.23	0	0.090
	2	2.11	5.23	100	0.015
1.25	1	12.74	3.16	0	0.076
	2	2.40	3.16	100	0.015
1.26	1	47.65	3.67	0	0.085
	2	5.52	3.67	100	0.015
1.27	1	9.29	3.97	0	0.074
	2	1.75	3.97	100	0.015
1.28	1	31.34	2.13	0	0.082
	2	4.26	2.13	100	0.015
1.29	1	26.19	2.75	0	0.081
	2	3.03	2.75	100	0.015
1.3	1	5.50	1.97	0	0.069
	2	0.75	1.97	100	0.015
1.31	1	15.12	4.00	0	0.086
	2	1.78	4.00	100	0.015
1.32	1	34.81	1.64	0	0.083
	2	2.82	1.64	100	0.015
1.33	1	0.54	0.10	0	0.070
	2	0.32	0.10	100	0.015
1.34	1	68.08	2.10	0	0.082
	2	5.51	2.10	100	0.015
1.35	1	76.00	1.90	0	0.089
	2	5.68	1.90	100	0.015
1.36	1	41.74	1.76	0	0.075
	2	4.53	1.76	100	0.015
1.37	1	35.70	3.82	0	0.083
	2	3.42	3.82	100	0.015
1.38	1	17.47	0.81	0	0.080
	2	2.36	0.81	100	0.015
1.39	1	7.74	1.86	0	0.084
	2	1.08	1.86	100	0.015
1.4	1	26.85	1.84	0	0.081
	2	2.31	1.84	100	0.015
1.41	1	16.45	2.89	0	0.079
	2	1.50	2.89	100	0.015
1.42	1	7.28	0.10	0	0.068
	2	1.32	0.10	100	0.015
1.43	1	4.56	0.66	0	0.078
	2	0.93	0.66	100	0.015
1.44	1	0.15	4.27	0	0.062
	2	0.19	4.27	100	0.015
1.45	1	47.99	0.67	0	0.078
	2	6.17	0.67	100	0.015
1.46	1	53.91	1.41	0	0.068
	2	13.57	1.41	100	0.015
1.47	1	30.34	1.16	0	0.070
	2	4.52	1.16	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
1.48	1	5.51	2.48	0	0.062
	2	0.97	2.48	100	0.015
1.49	1	13.81	0.93	0	0.073
	2	2.86	0.93	100	0.015
1.5	1	7.78	1.94	0	0.048
	2	2.50	1.94	100	0.015
1.51	1	0.17	3.12	0	0.054
	2	0.25	3.12	100	0.015
1.52	1	3.78	0.81	0	0.059
	2	1.39	0.81	100	0.015
1.53	1	22.65	0.82	0	0.052
	2	8.10	0.82	100	0.015
1.54	1	0.80	0.10	0	0.071
	2	0.46	0.10	100	0.015
1.55	1	23.53	0.94	0	0.074
	2	4.02	0.94	100	0.015
1.56	1	3.14	0.85	0	0.072
	2	1.16	0.85	100	0.015
1.57	1	77.15	0.85	0	0.074
	2	8.78	0.85	100	0.015
1.58	1	35.59	0.24	0	0.059
	2	29.59	0.24	100	0.015
1.59	1	1.28	0.10	0	0.061
	2	1.23	0.10	100	0.015
1.6	1	36.60	0.10	0	0.043
	2	45.61	0.10	100	0.015
2.01	1	47.42	5.58	0	0.066
	2	5.44	5.58	100	0.015
3.01	1	27.07	16.19	0	0.060
	2	1.84	16.19	100	0.015
4.01	1	140.13	2.89	0	0.060
	2	9.53	2.89	100	0.015
4.02	1	114.89	10.17	0	0.083
	2	6.80	10.17	100	0.015
5.01	1	104.16	2.71	0	0.068
	2	5.66	2.71	100	0.015
5.02	1	38.28	19.08	0	0.084
	2	1.18	19.08	100	0.015
6.01	1	19.07	4.70	0	0.056
	2	2.45	4.70	100	0.015
7.01	1	99.45	5.13	0	0.062
	2	5.56	5.13	100	0.015
7.02	1	58.25	15.62	0	0.088
	2	1.19	15.62	100	0.015
8.01	1	16.55	6.48	0	0.065
	2	0.34	6.48	100	0.015
9.01	1	54.52	18.93	0	0.095
	2	1.11	18.93	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
10.01	1	108.65	15.08	0	0.085
	2	4.58	15.08	100	0.015
11.01	1	27.98	24.82	0	0.099
	2	0.57	24.82	100	0.015
12.01	1	49.80	15.66	0	0.069
	2	3.86	15.66	100	0.015
12.02	1	31.83	13.65	0	0.099
	2	0.65	13.65	100	0.015
12.03	1	31.79	13.80	0	0.100
	2	0.65	13.80	100	0.015
12.04	1	45.92	16.87	0	0.100
	2	0.94	16.87	100	0.015
13.01	1	22.18	18.16	0	0.072
	2	0.58	18.16	100	0.015
14.01	1	33.31	17.81	0	0.092
	2	0.82	17.81	100	0.015
15.01	1	43.65	19.08	0	0.095
	2	0.89	19.08	100	0.015
16.01	1	19.77	21.12	0	0.100
	2	0.40	21.12	100	0.015
16.02	1	8.11	32.17	0	0.100
	2	0.17	32.17	100	0.015
16.03	1	2.10	28.32	0	0.100
	2	0.04	28.32	100	0.015
17.01	1	26.80	18.73	0	0.100
	2	0.55	18.73	100	0.015
18.01	1	32.33	25.91	0	0.100
	2	0.66	25.91	100	0.015
19.01	1	27.89	21.68	0	0.100
	2	0.57	21.68	100	0.015
20.01	1	42.44	23.69	0	0.100
	2	0.87	23.69	100	0.015
21.01	1	22.89	27.61	0	0.100
	2	0.47	27.61	100	0.015
22.01	1	34.01	22.68	0	0.100
	2	0.69	22.68	100	0.015
23.01	1	149.93	10.36	0	0.074
	2	4.22	10.36	100	0.015
23.02	1	118.86	15.86	0	0.100
	2	2.43	15.86	100	0.015
23.03	1	41.25	13.90	0	0.100
	2	0.84	13.90	100	0.015
23.04	1	9.99	6.66	0	0.100
	2	0.20	6.66	100	0.015
24.01	1	41.84	8.15	0	0.070
	2	1.68	8.15	100	0.015
24.02	1	54.72	15.11	0	0.090
	2	1.32	15.11	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
25.01	1	23.88	9.69	0	0.094
	2	1.01	9.69	100	0.015
26.01	1	23.97	30.67	0	0.100
	2	0.49	30.67	100	0.015
27.01	1	123.90	15.34	0	0.082
	2	5.70	15.34	100	0.015
27.02	1	19.03	19.94	0	0.100
	2	0.39	19.94	100	0.015
27.03	1	2.64	14.83	0	0.100
	2	0.05	14.83	100	0.015
28.01	1	50.25	21.05	0	0.085
	2	1.50	21.05	100	0.015
29.01	1	131.07	14.79	0	0.094
	2	3.51	14.79	100	0.015
30.01	1	104.53	13.75	0	0.092
	2	2.13	13.75	100	0.015
31.01	1	96.89	16.07	0	0.073
	2	1.98	16.07	100	0.015
31.02	1	6.83	13.15	0	0.100
	2	0.14	13.15	100	0.015
31.03	1	2.44	16.57	0	0.100
	2	0.05	16.57	100	0.015
31.04	1	15.51	12.41	0	0.100
	2	0.32	12.41	100	0.015
31.05	1	46.19	12.53	0	0.100
	2	0.94	12.53	100	0.015
31.06	1	60.69	13.06	0	0.100
	2	1.24	13.06	100	0.015
31.07	1	80.72	6.76	0	0.100
	2	1.65	6.76	100	0.015
31.08	1	73.18	7.26	0	0.099
	2	1.51	7.26	100	0.015
31.09	1	18.22	8.55	0	0.084
	2	0.42	8.55	100	0.015
32.01	1	52.73	16.68	0	0.100
	2	1.08	16.68	100	0.015
33.01	1	109.42	13.65	0	0.091
	2	2.39	13.65	100	0.015
34.01	1	55.07	12.20	0	0.100
	2	1.12	12.20	100	0.015
35.01	1	43.10	12.23	0	0.100
	2	0.88	12.23	100	0.015
36.01	1	25.99	21.47	0	0.100
	2	0.53	21.47	100	0.015
37.01	1	34.92	24.50	0	0.100
	2	0.71	24.50	100	0.015
38.01	1	61.85	11.27	0	0.100
	2	1.26	11.27	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
38.02	1	7.07	18.40	0	0.100
	2	0.14	18.40	100	0.015
38.03	1	58.53	12.00	0	0.100
	2	1.19	12.00	100	0.015
38.04	1	6.73	12.04	0	0.100
	2	0.14	12.04	100	0.015
39.01	1	38.69	16.42	0	0.100
	2	0.79	16.42	100	0.015
40.01	1	29.22	13.28	0	0.100
	2	0.60	13.28	100	0.015
40.02	1	17.43	21.03	0	0.100
	2	0.36	21.03	100	0.015
41.01	1	16.92	23.87	0	0.100
	2	0.35	23.87	100	0.015
42.01	1	132.49	12.60	0	0.099
	2	2.81	12.60	100	0.015
42.02	1	14.29	10.58	0	0.100
	2	0.29	10.58	100	0.015
43.01	1	101.71	14.04	0	0.100
	2	2.08	14.04	100	0.015
44.01	1	34.98	18.38	0	0.099
	2	0.71	18.38	100	0.015
45.01	1	74.13	15.33	0	0.099
	2	1.55	15.33	100	0.015
46.01	1	101.50	13.20	0	0.095
	2	6.04	13.20	100	0.015
46.02	1	36.38	9.37	0	0.100
	2	0.74	9.37	100	0.015
47.01	1	40.70	21.93	0	0.099
	2	0.83	21.93	100	0.015
48.01	1	57.41	12.01	0	0.098
	2	1.86	12.01	100	0.015
49.01	1	164.06	7.29	0	0.084
	2	17.89	7.29	100	0.015
50.01	1	46.34	12.23	0	0.099
	2	1.03	12.23	100	0.015
51.01	1	18.21	32.50	0	0.076
	2	1.07	32.50	100	0.015
51.02	1	7.82	29.57	0	0.100
	2	0.16	29.57	100	0.015
51.03	1	39.34	6.08	0	0.099
	2	0.95	6.08	100	0.015
52.01	1	37.71	32.76	0	0.089
	2	3.76	32.76	100	0.015
53.01	1	26.46	30.89	0	0.082
	2	1.26	30.89	100	0.015
54.01	1	25.33	16.20	0	0.099
	2	0.64	16.20	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
55.01	1	90.38	8.46	0	0.098
	2	1.94	8.46	100	0.015
56.01	1	118.77	14.01	0	0.100
	2	2.42	14.01	100	0.015
56.02	1	68.88	2.61	0	0.094
	2	1.67	2.61	100	0.015
56.03	1	1.79	5.33	0	0.068
	2	0.04	5.33	100	0.015
57.01	1	91.19	10.12	0	0.099
	2	1.93	10.12	100	0.015
58.01	1	40.85	14.15	0	0.099
	2	0.83	14.15	100	0.015
59.01	1	23.95	6.96	0	0.091
	2	1.32	6.96	100	0.015
60.01	1	71.91	8.84	0	0.097
	2	1.62	8.84	100	0.015
60.02	1	14.31	3.72	0	0.074
	2	0.47	3.72	100	0.015
61.01	1	59.42	10.18	0	0.099
	2	1.21	10.18	100	0.015
62.01	1	25.08	7.61	0	0.096
	2	0.54	7.61	100	0.015
63.01	1	172.83	5.72	0	0.091
	2	4.16	5.72	100	0.015
63.02	1	5.99	1.96	0	0.087
	2	0.97	1.96	100	0.015
64.01	1	62.06	8.16	0	0.096
	2	1.29	8.16	100	0.015
65.01	1	54.97	7.62	0	0.091
	2	1.78	7.62	100	0.015
66.01	1	67.65	6.31	0	0.096
	2	2.18	6.31	100	0.015
67.01	1	90.84	3.59	0	0.065
	2	2.51	3.59	100	0.015
67.02	1	24.31	21.89	0	0.067
	2	1.27	21.89	100	0.015
67.03	1	155.68	8.99	0	0.092
	2	4.76	8.99	100	0.015
67.04	1	8.45	11.74	0	0.100
	2	0.17	11.74	100	0.015
67.05	1	86.14	6.13	0	0.099
	2	1.91	6.13	100	0.015
67.06	1	67.03	2.67	0	0.092
	2	3.01	2.67	100	0.015
67.07	1	5.02	0.10	0	0.068
	2	0.52	0.10	100	0.015
68.01	1	32.06	4.63	0	0.070
	2	1.84	4.63	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
69.01	1	46.82	19.48	0	0.064
	2	3.73	19.48	100	0.015
70.01	1	40.22	9.27	0	0.069
	2	5.39	9.27	100	0.015
70.02	1	18.34	21.48	0	0.096
	2	0.37	21.48	100	0.015
71.01	1	28.35	9.98	0	0.058
	2	4.58	9.98	100	0.015
72.01	1	31.78	20.12	0	0.086
	2	1.42	20.12	100	0.015
73.01	1	46.93	6.89	0	0.098
	2	1.65	6.89	100	0.015
74.01	1	111.15	11.73	0	0.087
	2	11.06	11.73	100	0.015
74.02	1	66.11	8.67	0	0.097
	2	2.41	8.67	100	0.015
74.03	1	17.97	10.12	0	0.100
	2	0.37	10.12	100	0.015
74.04	1	8.54	12.16	0	0.100
	2	0.17	12.16	100	0.015
74.05	1	32.06	7.07	0	0.099
	2	0.80	7.07	100	0.015
74.06	1	23.42	1.18	0	0.083
	2	1.09	1.18	100	0.015
74.07	1	1.62	3.18	0	0.092
	2	0.15	3.18	100	0.015
75.01	1	31.13	15.87	0	0.094
	2	1.82	15.87	100	0.015
76.01	1	23.22	15.33	0	0.098
	2	0.47	15.33	100	0.015
77.01	1	66.95	8.43	0	0.094
	2	4.02	8.43	100	0.015
78.01	1	91.40	5.94	0	0.099
	2	1.87	5.94	100	0.015
78.02	1	34.66	8.53	0	0.100
	2	0.71	8.53	100	0.015
78.03	1	33.88	4.36	0	0.088
	2	1.44	4.36	100	0.015
79.01	1	52.51	9.80	0	0.100
	2	1.07	9.80	100	0.015
80.01	1	23.99	15.14	0	0.100
	2	0.49	15.14	100	0.015
81.01	1	65.39	4.91	0	0.094
	2	2.34	4.91	100	0.015
82.01	1	111.85	6.68	0	0.100
	2	2.28	6.68	100	0.015
82.02	1	55.34	4.16	0	0.098
	2	1.22	4.16	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
83.01	1	62.40	5.57	0	0.092
	2	4.40	5.57	100	0.015
83.02	1	7.68	2.62	0	0.059
	2	0.96	2.62	100	0.015
84.01	1	59.88	5.50	0	0.097
	2	1.80	5.50	100	0.015
84.02	1	3.52	1.39	0	0.069
	2	0.31	1.39	100	0.015
85.01	1	15.12	9.80	0	0.075
	2	4.62	9.80	100	0.015
85.02	1	33.58	0.93	0	0.063
	2	5.81	0.93	100	0.015
86.01	1	16.04	2.02	0	0.049
	2	7.60	2.02	100	0.015
87.01	1	63.59	3.69	0	0.093
	2	2.15	3.69	100	0.015
87.02	1	4.14	1.72	0	0.071
	2	0.26	1.72	100	0.015
88.01	1	39.36	4.10	0	0.096
	2	1.49	4.10	100	0.015
89.01	1	160.96	8.78	0	0.100
	2	3.29	8.78	100	0.015
89.02	1	9.14	17.63	0	0.100
	2	0.19	17.63	100	0.015
89.03	1	35.94	9.96	0	0.100
	2	0.73	9.96	100	0.015
89.04	1	10.77	11.02	0	0.100
	2	0.22	11.02	100	0.015
89.05	1	19.64	12.28	0	0.100
	2	0.40	12.28	100	0.015
89.06	1	46.46	5.78	0	0.100
	2	0.95	5.78	100	0.015
89.07	1	69.66	2.84	0	0.100
	2	1.42	2.84	100	0.015
89.08	1	4.23	6.00	0	0.100
	2	0.09	6.00	100	0.015
89.09	1	19.26	5.30	0	0.099
	2	0.46	5.30	100	0.015
89.1	1	1.09	3.67	0	0.060
	2	0.41	3.67	100	0.015
89.11	1	8.93	5.10	0	0.084
	2	1.12	5.10	100	0.015
89.12	1	41.03	3.81	0	0.083
	2	3.54	3.81	100	0.015
89.13	1	19.63	1.12	0	0.067
	2	3.31	1.12	100	0.015
89.14	1	0.31	0.10	0	0.058
	2	0.07	0.10	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
89.15	1	1.40	0.10	0	0.052
	2	0.57	0.10	100	0.015
89.16	1	14.97	2.62	0	0.068
	2	1.27	2.62	100	0.015
89.17	1	58.93	0.62	0	0.078
	2	5.81	0.62	100	0.015
90.01	1	24.00	15.29	0	0.100
	2	0.49	15.29	100	0.015
90.02	1	37.40	13.46	0	0.100
	2	0.76	13.46	100	0.015
91.01	1	36.14	10.94	0	0.100
	2	0.74	10.94	100	0.015
92.01	1	63.13	12.93	0	0.100
	2	1.29	12.93	100	0.015
93.01	1	114.80	10.84	0	0.100
	2	2.34	10.84	100	0.015
94.01	1	71.81	11.82	0	0.100
	2	1.47	11.82	100	0.015
95.01	1	37.82	16.56	0	0.100
	2	0.77	16.56	100	0.015
96.01	1	137.85	6.91	0	0.100
	2	2.81	6.91	100	0.015
96.02	1	8.23	8.22	0	0.100
	2	0.17	8.22	100	0.015
97.01	1	29.97	12.61	0	0.100
	2	0.61	12.61	100	0.015
98.01	1	59.62	10.02	0	0.100
	2	1.22	10.02	100	0.015
99.01	1	23.20	11.23	0	0.100
	2	0.47	11.23	100	0.015
100.01	1	22.38	5.98	0	0.099
	2	0.61	5.98	100	0.015
101.01	1	24.86	6.86	0	0.090
	2	1.04	6.86	100	0.015
102.01	1	37.26	6.04	0	0.096
	2	0.93	6.04	100	0.015
103.01	1	39.07	8.64	0	0.099
	2	1.03	8.64	100	0.015
104.01	1	15.91	3.95	0	0.081
	2	1.48	3.95	100	0.015
105.01	1	84.22	11.34	0	0.100
	2	1.72	11.34	100	0.015
105.02	1	4.36	14.51	0	0.100
	2	0.09	14.51	100	0.015
105.03	1	17.10	10.93	0	0.100
	2	0.35	10.93	100	0.015
105.04	1	10.71	7.65	0	0.100
	2	0.22	7.65	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
105.05	1	11.66	5.65	0	0.100
	2	0.24	5.65	100	0.015
105.06	1	17.37	4.71	0	0.100
	2	0.35	4.71	100	0.015
105.07	1	2.98	13.86	0	0.100
	2	0.06	13.86	100	0.015
105.08	1	4.54	9.63	0	0.100
	2	0.09	9.63	100	0.015
105.09	1	57.06	4.74	0	0.099
	2	1.19	4.74	100	0.015
105.1	1	47.42	3.47	0	0.095
	2	1.63	3.47	100	0.015
105.11	1	17.70	2.02	0	0.077
	2	1.92	2.02	100	0.015
106.01	1	21.72	22.59	0	0.100
	2	0.44	22.59	100	0.015
107.01	1	66.87	10.51	0	0.100
	2	1.36	10.51	100	0.015
108.01	1	43.14	15.11	0	0.100
	2	0.88	15.11	100	0.015
109.01	1	58.47	9.46	0	0.100
	2	1.19	9.46	100	0.015
110.01	1	50.37	10.61	0	0.100
	2	1.03	10.61	100	0.015
111.01	1	98.12	5.38	0	0.100
	2	2.00	5.38	100	0.015
111.02	1	19.53	7.57	0	0.100
	2	0.40	7.57	100	0.015
112.01	1	30.94	14.97	0	0.100
	2	0.63	14.97	100	0.015
113.01	1	30.16	7.89	0	0.100
	2	0.62	7.89	100	0.015
114.01	1	31.65	11.45	0	0.100
	2	0.65	11.45	100	0.015
115.01	1	30.01	12.69	0	0.099
	2	0.69	12.69	100	0.015
116.01	1	21.00	14.19	0	0.098
	2	0.46	14.19	100	0.015
117.01	1	50.18	3.98	0	0.081
	2	2.30	3.98	100	0.015
118.01	1	17.87	8.54	0	0.095
	2	0.60	8.54	100	0.015
119.01	1	51.86	7.08	0	0.097
	2	2.42	7.08	100	0.015
119.02	1	3.86	12.01	0	0.100
	2	0.08	12.01	100	0.015
119.03	1	60.24	4.50	0	0.099
	2	1.49	4.50	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
119.04	1	28.57	5.83	0	0.099
	2	0.60	5.83	100	0.015
119.05	1	2.42	19.61	0	0.100
	2	0.05	19.61	100	0.015
119.06	1	61.53	4.34	0	0.098
	2	2.29	4.34	100	0.015
119.07	1	47.09	2.90	0	0.088
	2	6.31	2.90	100	0.015
119.08	1	17.48	0.10	0	0.071
	2	2.76	0.10	100	0.015
119.09	1	3.92	0.74	0	0.056
	2	2.93	0.74	100	0.015
119.1	1	5.24	0.49	0	0.056
	2	2.05	0.49	100	0.015
119.11	1	2.59	1.49	0	0.055
	2	0.63	1.49	100	0.015
119.12	1	1.85	0.84	0	0.079
	2	0.32	0.84	100	0.015
119.13	1	10.71	5.25	0	0.051
	2	7.70	5.25	100	0.015
119.14	1	3.43	1.22	0	0.049
	2	1.18	1.22	100	0.015
119.15	1	11.75	0.12	0	0.044
	2	5.20	0.12	100	0.015
119.16	1	23.77	3.02	0	0.088
	2	2.37	3.02	100	0.015
119.17	1	3.66	0.10	0	0.077
	2	0.75	0.10	100	0.015
119.18	1	15.89	5.90	0	0.085
	2	1.82	5.90	100	0.015
119.19	1	1.89	2.39	0	0.043
	2	1.62	2.39	100	0.015
119.2	1	26.80	1.84	0	0.062
	2	9.20	1.84	100	0.015
119.21	1	52.06	0.59	0	0.067
	2	6.46	0.59	100	0.015
119.22	1	5.53	1.44	0	0.067
	2	0.59	1.44	100	0.015
119.23	1	14.75	0.56	0	0.058
	2	2.82	0.56	100	0.015
120.01	1	50.56	5.91	0	0.098
	2	1.85	5.91	100	0.015
121.01	1	20.34	10.39	0	0.097
	2	0.88	10.39	100	0.015
122.01	1	53.58	8.73	0	0.097
	2	2.56	8.73	100	0.015
123.01	1	32.20	7.65	0	0.095
	2	2.12	7.65	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
124.01	1	31.69	10.60	0	0.097
	2	1.46	10.60	100	0.015
125.01	1	61.75	4.26	0	0.098
	2	2.28	4.26	100	0.015
125.02	1	7.54	2.57	0	0.095
	2	0.31	2.57	100	0.015
126.01	1	31.84	6.80	0	0.092
	2	3.37	6.80	100	0.015
127.01	1	17.37	7.52	0	0.085
	2	2.78	7.52	100	0.015
127.02	1	2.73	1.00	0	0.044
	2	2.40	1.00	100	0.015
128.01	1	88.38	1.90	0	0.077
	2	10.78	1.90	100	0.015
128.02	1	44.56	1.43	0	0.067
	2	6.26	1.43	100	0.015
128.03	1	4.57	0.10	0	0.062
	2	1.68	0.10	100	0.015
128.04	1	2.11	0.10	0	0.063
	2	0.39	0.10	100	0.015
128.05	1	3.36	0.96	0	0.078
	2	0.56	0.96	100	0.015
128.06	1	0.56	6.70	0	0.045
	2	0.29	6.70	100	0.015
128.07	1	7.86	0.92	0	0.035
	2	8.09	0.92	100	0.015
128.08	1	19.37	2.37	0	0.056
	2	12.66	2.37	100	0.015
128.09	1	4.82	0.83	0	0.056
	2	3.48	0.83	100	0.015
128.1	1	4.02	1.65	0	0.046
	2	4.46	1.65	100	0.015
128.11	1	1.41	2.83	0	0.045
	2	1.18	2.83	100	0.015
128.12	1	3.07	2.04	0	0.055
	2	0.28	2.04	100	0.015
129.01	1	68.95	5.30	0	0.091
	2	3.90	5.30	100	0.015
129.02	1	8.87	7.51	0	0.079
	2	0.21	7.51	100	0.015
129.03	1	14.19	1.72	0	0.082
	2	0.65	1.72	100	0.015
130.01	1	26.00	8.19	0	0.086
	2	2.37	8.19	100	0.015
131.01	1	57.91	3.43	0	0.081
	2	8.03	3.43	100	0.015
132.01	1	56.59	7.19	0	0.092
	2	3.21	7.19	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
132.02	1	13.42	3.11	0	0.066
	2	1.73	3.11	100	0.015
132.03	1	2.37	6.74	0	0.075
	2	0.13	6.74	100	0.015
132.04	1	13.98	3.20	0	0.063
	2	2.22	3.20	100	0.015
132.05	1	2.04	1.47	0	0.060
	2	1.47	1.47	100	0.015
133.01	1	23.24	4.46	0	0.077
	2	2.09	4.46	100	0.015
134.01	1	26.54	6.14	0	0.081
	2	2.82	6.14	100	0.015
135.01	1	27.19	6.98	0	0.084
	2	2.83	6.98	100	0.015
136.01	1	18.73	5.53	0	0.061
	2	6.85	5.53	100	0.015
136.02	1	19.34	0.10	0	0.048
	2	8.94	0.10	100	0.015
137.01	1	47.03	2.78	0	0.087
	2	4.33	2.78	100	0.015
137.02	1	2.32	3.63	0	0.032
	2	4.29	3.63	100	0.015
137.03	1	5.63	1.42	0	0.054
	2	2.68	1.42	100	0.015
137.04	1	2.63	0.10	0	0.062
	2	0.92	0.10	100	0.015
137.05	1	4.42	0.70	0	0.073
	2	1.48	0.70	100	0.015
138.01	1	17.41	4.40	0	0.082
	2	4.07	4.40	100	0.015
139.01	1	8.58	2.09	0	0.046
	2	6.48	2.09	100	0.015
140.01	1	8.43	4.58	0	0.043
	2	8.22	4.58	100	0.015
141.01	1	22.82	3.03	0	0.063
	2	7.42	3.03	100	0.015
141.02	1	12.32	1.48	0	0.035
	2	11.84	1.48	100	0.015
141.03	1	2.42	1.60	0	0.057
	2	0.30	1.60	100	0.015
141.04	1	5.43	0.97	0	0.041
	2	1.04	0.97	100	0.015
142.01	1	2.78	2.49	0	0.038
	2	3.17	2.49	100	0.015
143.01	1	4.32	0.99	0	0.054
	2	0.30	0.99	100	0.015
144.01	1	39.90	2.19	0	0.061
	2	8.96	2.19	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
144.02	1	6.06	1.44	0	0.046
	2	3.59	1.44	100	0.015
145.01	1	16.98	4.76	0	0.088
	2	2.11	4.76	100	0.015
146.01	1	34.23	2.73	0	0.088
	2	3.79	2.73	100	0.015
147.01	1	11.20	0.57	0	0.042
	2	4.14	0.57	100	0.015
148.01	1	28.53	4.17	0	0.064
	2	13.53	4.17	100	0.015
148.02	1	2.04	0.10	0	0.057
	2	0.23	0.10	100	0.015
149.01	1	12.98	5.92	0	0.062
	2	6.13	5.92	100	0.015
149.02	1	1.36	3.87	0	0.055
	2	0.22	3.87	100	0.015
150.01	1	86.56	3.67	0	0.095
	2	3.63	3.67	100	0.015
150.02	1	9.55	1.28	0	0.074
	2	2.76	1.28	100	0.015
150.03	1	9.72	2.22	0	0.063
	2	4.05	2.22	100	0.015
150.04	1	0.55	1.53	0	0.036
	2	0.44	1.53	100	0.015
150.05	1	0.11	0.10	0	0.098
	2	0.00	0.10	100	0.015
151.01	1	17.59	3.19	0	0.077
	2	3.88	3.19	100	0.015
152.01	1	30.25	2.00	0	0.071
	2	9.16	2.00	100	0.015
152.02	1	6.51	3.81	0	0.089
	2	0.75	3.81	100	0.015
152.03	1	5.53	0.10	0	0.037
	2	2.03	0.10	100	0.015
152.04	1	8.66	1.09	0	0.043
	2	4.75	1.09	100	0.015
153.01	1	76.63	6.17	0	0.087
	2	12.06	6.17	100	0.015
153.02	1	56.95	2.00	0	0.096
	2	2.35	2.00	100	0.015
153.03	1	11.25	10.59	0	0.088
	2	0.56	10.59	100	0.015
153.04	1	5.10	10.66	0	0.086
	2	0.59	10.66	100	0.015
153.05	1	22.87	4.50	0	0.093
	2	2.08	4.50	100	0.015
153.06	1	44.56	1.78	0	0.076
	2	11.10	1.78	100	0.015

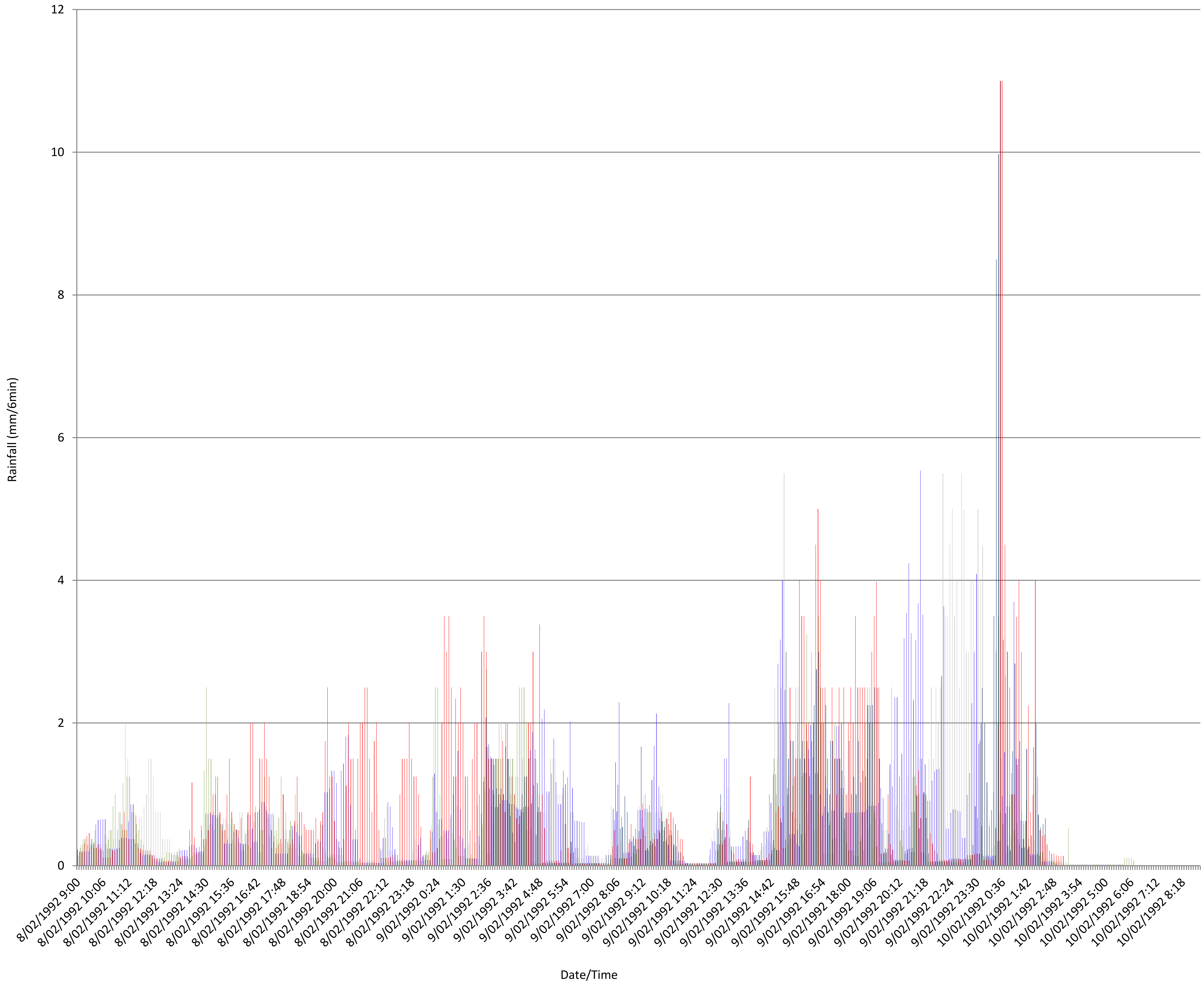
Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
153.07	1	1.71	2.22	0	0.040
	2	2.13	2.22	100	0.015
153.08	1	6.84	0.10	0	0.042
	2	4.09	0.10	100	0.015
154.01	1	31.14	10.44	0	0.095
	2	2.15	10.44	100	0.015
155.01	1	23.27	4.44	0	0.074
	2	4.50	4.44	100	0.015
156.01	1	75.77	6.65	0	0.098
	2	2.84	6.65	100	0.015
157.01	1	41.19	6.39	0	0.080
	2	3.71	6.39	100	0.015
158.01	1	22.96	6.49	0	0.092
	2	1.33	6.49	100	0.015
159.01	1	19.00	7.27	0	0.076
	2	3.08	7.27	100	0.015
159.02	1	2.84	1.75	0	0.043
	2	2.45	1.75	100	0.015
160.01	1	9.65	0.98	0	0.057
	2	2.78	0.98	100	0.015
160.02	1	7.75	2.03	0	0.045
	2	6.33	2.03	100	0.015
160.03	1	3.91	1.70	0	0.030
	2	6.00	1.70	100	0.015
160.04	1	0.24	12.62	0	0.062
	2	0.04	12.62	100	0.015
161.01	1	7.75	3.27	0	0.049
	2	4.59	3.27	100	0.015
161.02	1	8.52	3.27	0	0.075
	2	1.13	3.27	100	0.015
161.03	1	19.13	1.41	0	0.064
	2	3.43	1.41	100	0.015
162.01	1	12.53	7.84	0	0.098
	2	0.27	7.84	100	0.015
163.01	1	43.71	9.39	0	0.095
	2	2.51	9.39	100	0.015
163.02	1	3.98	5.27	0	0.090
	2	0.22	5.27	100	0.015
163.03	1	82.45	1.95	0	0.088
	2	7.98	1.95	100	0.015
163.04	1	17.47	1.39	0	0.061
	2	4.82	1.39	100	0.015
163.05	1	85.61	1.06	0	0.077
	2	12.09	1.06	100	0.015
163.06	1	5.66	3.68	0	0.055
	2	2.63	3.68	100	0.015
163.07	1	15.82	2.44	0	0.057
	2	6.01	2.44	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
163.08	1	5.27	0.10	0	0.067
	2	0.81	0.10	100	0.015
164.01	1	53.58	8.24	0	0.098
	2	1.89	8.24	100	0.015
165.01	1	53.14	5.79	0	0.095
	2	3.77	5.79	100	0.015
166.01	1	32.29	5.61	0	0.090
	2	1.93	5.61	100	0.015
167.01	1	115.67	1.62	0	0.097
	2	5.24	1.62	100	0.015
168.01	1	26.00	6.75	0	0.090
	2	1.77	6.75	100	0.015
169.01	1	58.06	8.33	0	0.100
	2	1.18	8.33	100	0.015
169.02	1	81.00	1.16	0	0.092
	2	3.05	1.16	100	0.015
169.03	1	2.98	2.98	0	0.053
	2	1.15	2.98	100	0.015
170.01	1	28.55	2.62	0	0.072
	2	4.52	2.62	100	0.015
170.02	1	20.99	0.87	0	0.052
	2	2.21	0.87	100	0.015
170.03	1	44.84	0.75	0	0.059
	2	5.15	0.75	100	0.015
171.01	1	107.64	4.60	0	0.099
	2	2.36	4.60	100	0.015
171.02	1	55.07	1.10	0	0.088
	2	5.42	1.10	100	0.015
171.03	1	0.40	0.10	0	0.060
	2	0.18	0.10	100	0.015
171.04	1	13.56	3.35	0	0.078
	2	1.97	3.35	100	0.015
171.05	1	5.20	0.45	0	0.043
	2	4.03	0.45	100	0.015
171.06	1	6.51	1.43	0	0.065
	2	1.19	1.43	100	0.015
172.01	1	34.64	1.89	0	0.063
	2	3.56	1.89	100	0.015
173.01	1	34.20	2.02	0	0.081
	2	5.00	2.02	100	0.015
174.01	1	10.75	5.00	0	0.078
	2	3.13	5.00	100	0.015
175.01	1	73.69	1.98	0	0.094
	2	2.25	1.98	100	0.015
175.02	1	2.42	1.05	0	0.051
	2	1.48	1.05	100	0.015
176.01	1	34.58	1.96	0	0.077
	2	2.49	1.96	100	0.015

Subcatchment ID	Sub-Area	Area [ha]	Catchment Slope [%]	Percentage Impervious [%]	Mannings 'n'
177.01	1	40.53	1.04	0	0.058
	2	3.14	1.04	100	0.015
178.01	1	22.72	11.64	0	0.096
	2	0.90	11.64	100	0.015
178.02	1	17.43	5.08	0	0.062
	2	2.53	5.08	100	0.015
179.01	1	57.43	2.78	0	0.086
	2	5.24	2.78	100	0.015
179.02	1	27.82	3.23	0	0.073
	2	2.16	3.23	100	0.015
179.03	1	30.42	0.81	0	0.069
	2	10.11	0.81	100	0.015
179.04	1	27.79	0.17	0	0.082
	2	3.89	0.17	100	0.015
179.05	1	3.70	1.04	0	0.095
	2	0.24	1.04	100	0.015
179.06	1	19.06	0.78	0	0.073
	2	7.56	0.78	100	0.015
179.07	1	11.99	1.55	0	0.041
	2	23.83	1.55	100	0.015
180.01	1	40.35	3.75	0	0.087
	2	3.11	3.75	100	0.015
181.01	1	18.67	0.73	0	0.047
	2	15.60	0.73	100	0.015
182.01	1	18.47	7.82	0	0.092
	2	1.11	7.82	100	0.015
182.02	1	36.54	1.80	0	0.091
	2	2.16	1.80	100	0.015
183.01	1	52.40	0.75	0	0.092
	2	3.32	0.75	100	0.015
184.01	1	19.43	0.36	0	0.040
	2	41.85	0.36	100	0.015
185.01	1	5.35	0.66	0	0.027
	2	23.46	0.66	100	0.015
186.01	1	7.85	1.60	0	0.051
	2	8.68	1.60	100	0.015
186.02	1	1.57	1.12	0	0.033
	2	6.37	1.12	100	0.015

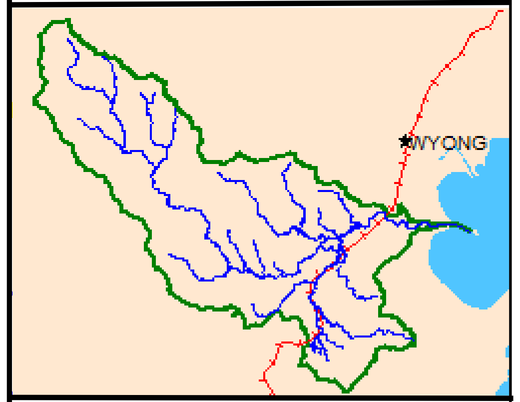
Appendix C

XP-RAFTS Model Results For Historic Simulations



Wyong Shire Council

CENTRAL COAST



LEGEND:

- Peats Ridge (BOM)
- Mount Elliot (MHL)
- Mardi Dam (MHL)
- Lisarow (MHL)
- Whitemans (MHL)

Notes:

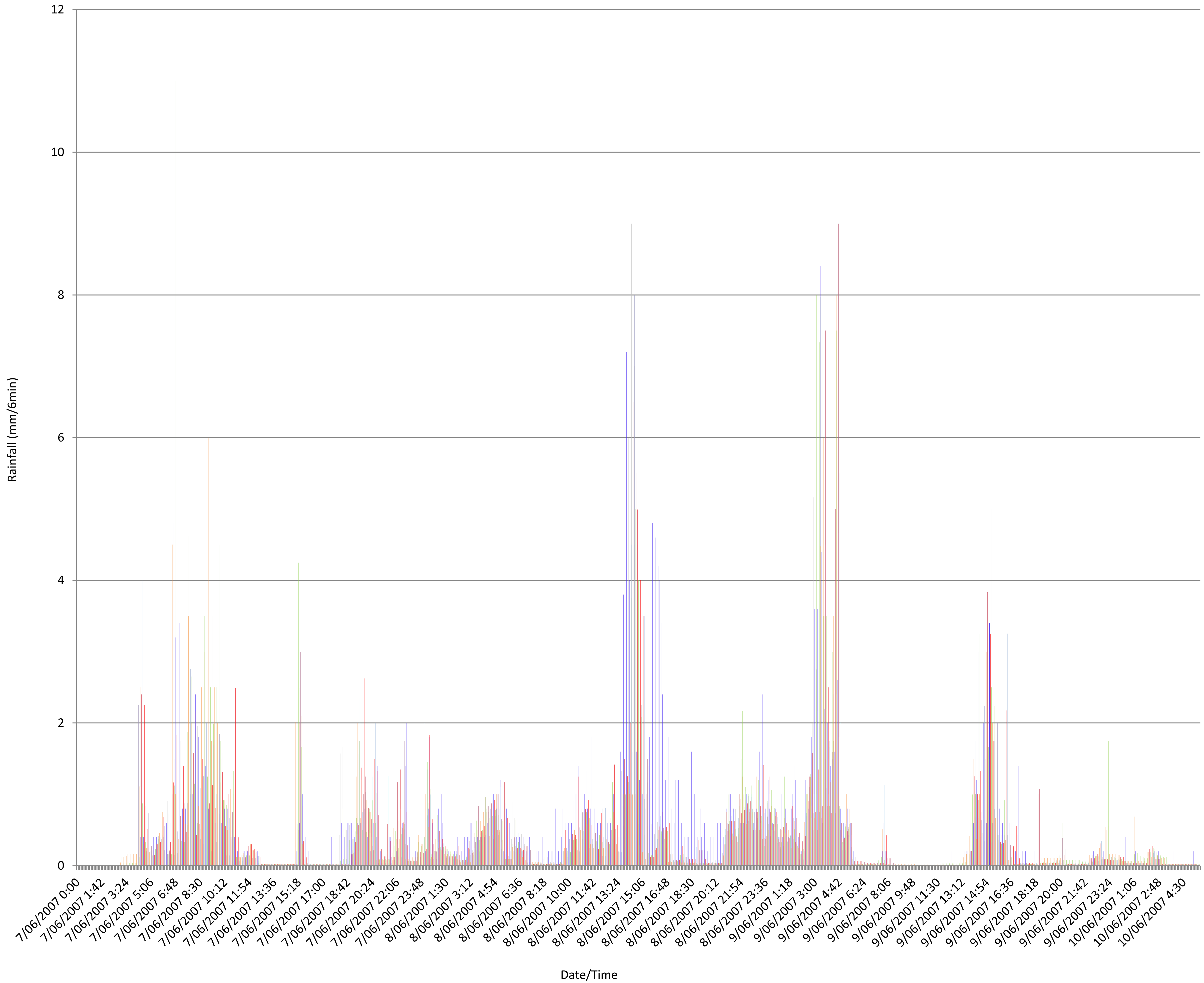
The NSW Office of Environment and Heritage is the owner of "MHL" rain gauge data. "MHL" data is collected and provided by Manly Hydraulics Laboratory

Figure C1: Continuous Rainfall Data for the February 1992 Event

Prepared By:

Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: .xls



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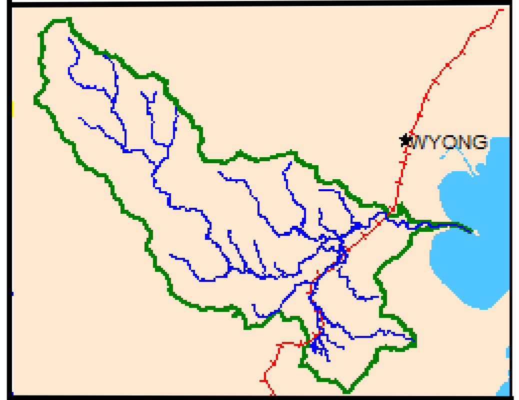
Wyong Shire Council

CENTRAL COAST



LEGEND:

- Peats Ridge (BOM)
- Mount Elliot (MHL)
- Mardi Dam (MHL)
- Lisarow (MHL)
- Chittaway (MHL)
- Berkeley Vale (MHL)
- Narara (MHL)

Notes:

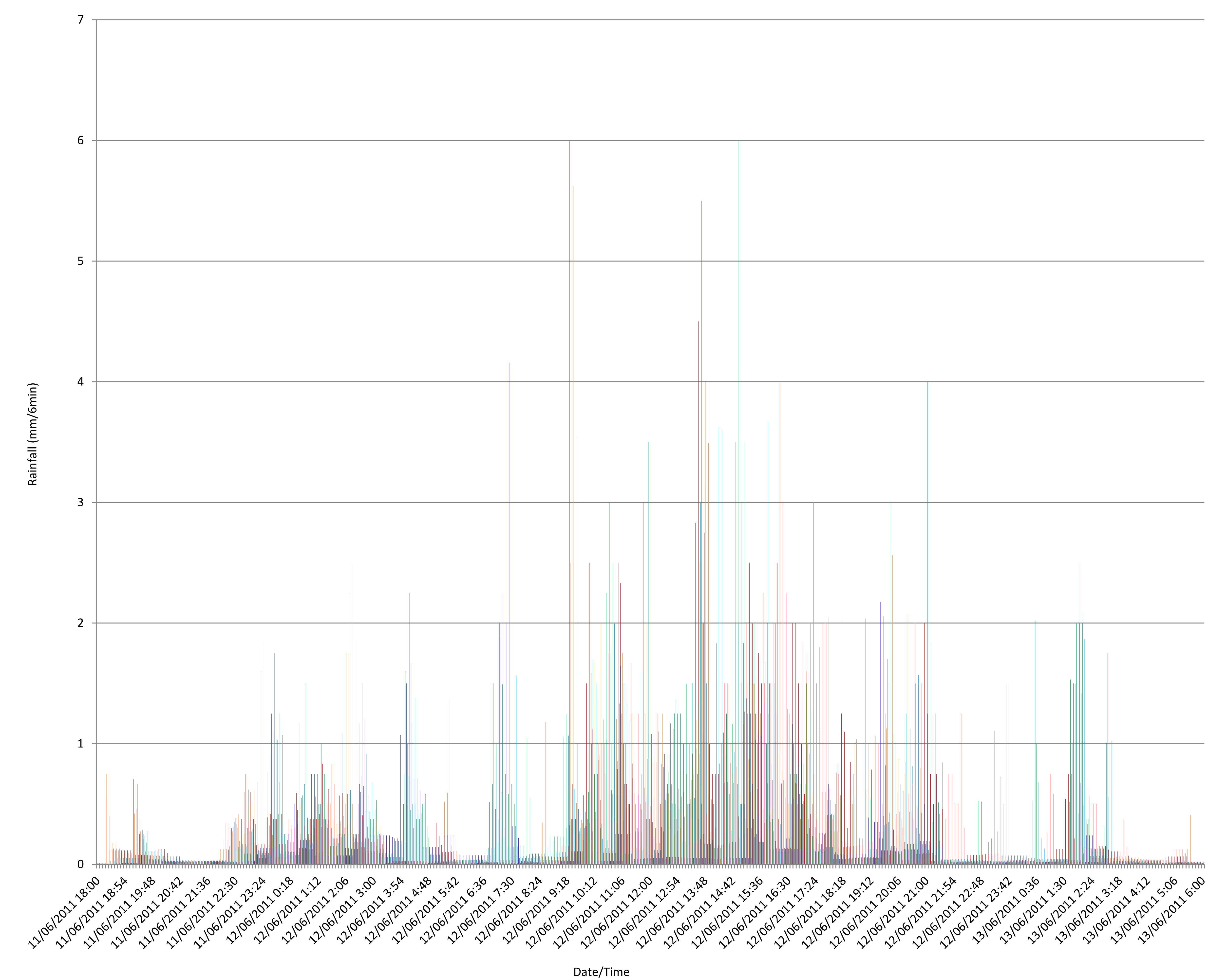
The NSW Office of Environment and Heritage is the owner of "MHL" rain gauge data. "MHL" data is collected and provided by Manly Hydraulics Laboratory

Figure C2: Continuous Rainfall Data for the June 2007 Event

Prepared By:

Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: .xls



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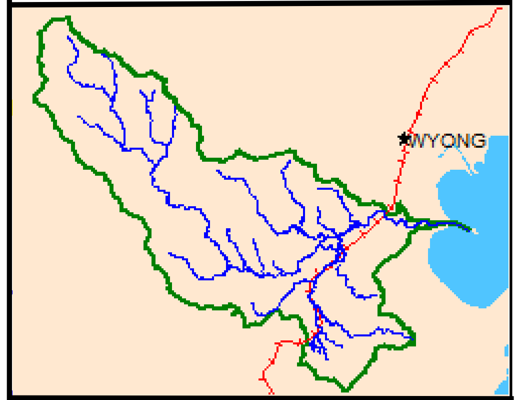
CENTRAL COAST



LEGEND:

- Berkeley Vale (MHL)
- Mount Elliot (MHL)
- Mardi Dam (MHL)
- Lisarow (MHL)
- Whitemans (MHL)
- Narara (MHL)
- Kulnura (MHL)
- Kangy Angy (MHL)

Notes:

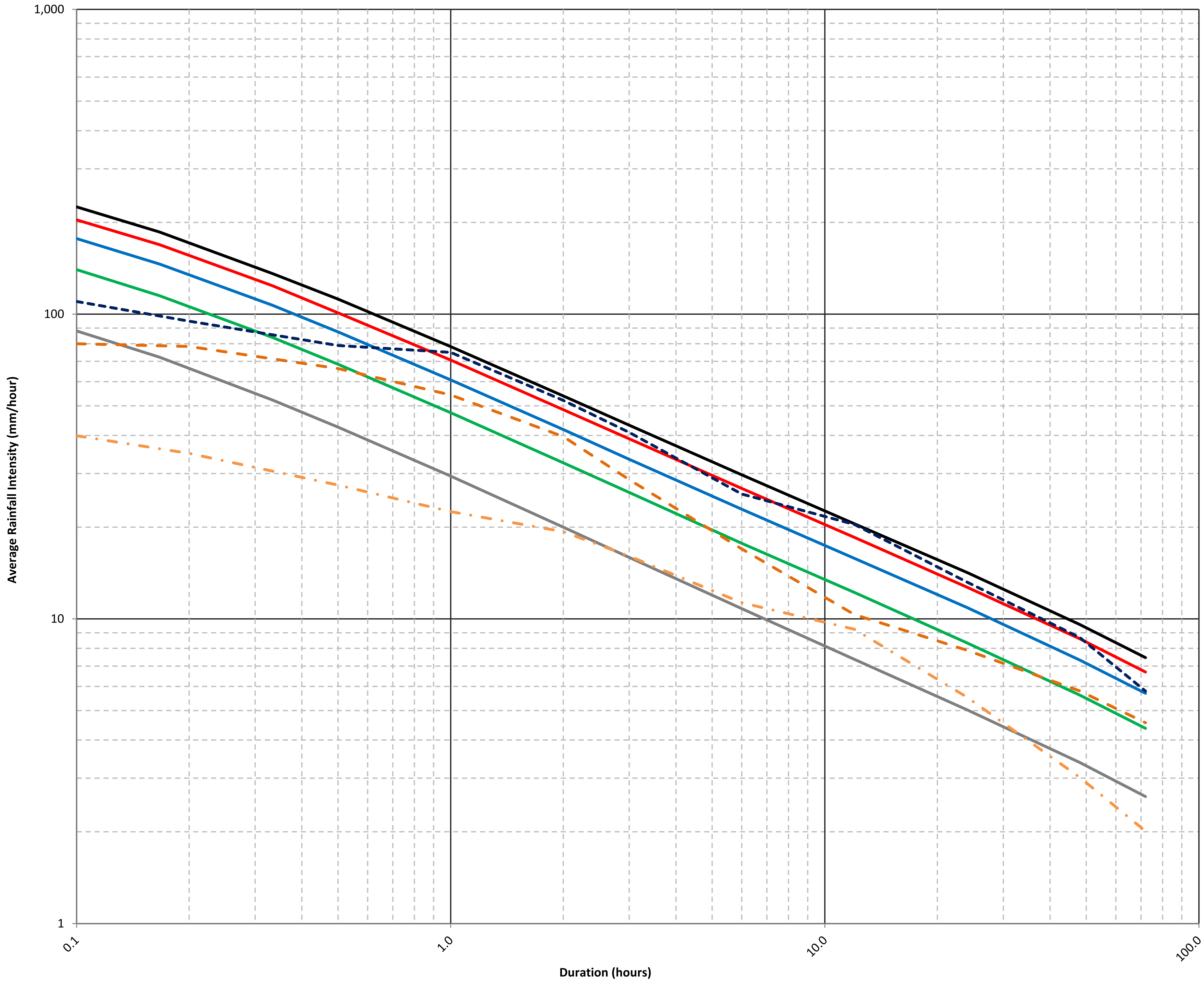
The NSW Office of Environment and Heritage is the owner of "MHL" rain gauge data. "MHL" data is collected and provided by Manly Hydraulics Laboratory

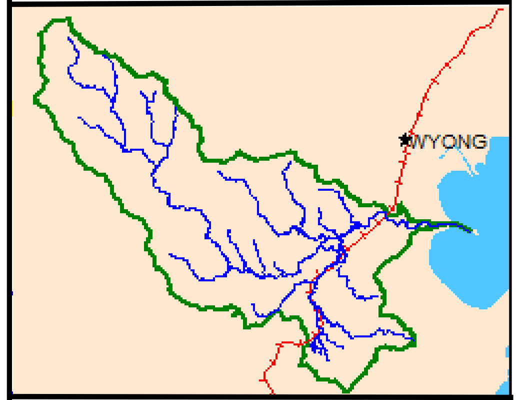
Figure C3: Continuous Rainfall Data for the June 2011 Event

Prepared By:

Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: .xls





LEGEND

- 1% AEP
- 2% AEP
- 5% AEP
- 20% AEP
- 100% AEP
- February 1992 Event
- June 2007 Event
- June 2011 Event

Notes:

Figure C4: Intensity-Frequency-Duration Curves for the Ourimbah Creek Catchment

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: IFD_Curves.xls

PEAK FLOOD DISCHARGES - Calibration/Verification Events

Subcatchment ID	Peak Discharge (m^3/s)		
	Feb-92	Jun-07	Jun-11
1.01	7.97	1.45	3.57
1.02	13.95	2.82	4.31
1.03	21.34	5.02	5.02
1.04	27.29	6.88	5.80
1.05	48.23	11.27	10.63
1.06	62.58	14.05	12.27
1.07	77.41	22.55	13.72
1.08	85.21	27.35	14.35
1.09	95.73	29.65	15.33
1.10	101.47	32.78	15.89
1.11	123.28	42.62	18.09
1.12	128.90	45.82	18.78
1.13	130.89	47.07	19.09
1.14	134.73	49.54	19.54
1.15	137.98	51.61	19.94
1.16	144.07	54.92	20.56
1.17	175.95	78.36	24.86
1.18	199.05	91.13	28.07
1.19	201.07	91.55	28.30
1.20	203.21	92.54	28.56
1.21	288.48	139.19	42.04
1.22	289.03	139.23	42.51
1.23	290.71	141.39	43.39
1.24	291.11	141.60	44.24
1.25	296.67	144.54	45.55
1.26	297.85	144.04	47.55
1.27	298.18	144.12	47.64
1.28	298.70	144.16	48.36
1.29	302.69	145.52	50.58
1.30	303.16	145.35	50.64
1.31	305.33	144.19	51.57
1.32	300.79	139.95	51.24
1.33	304.32	140.60	51.86
1.34	308.72	139.50	51.97
1.35	313.91	138.49	52.20
1.36	335.95	148.00	53.15
1.37	366.06	166.70	56.87
1.38	365.42	164.67	57.45
1.39	379.66	170.69	58.60
1.40	378.49	169.34	58.52
1.41	380.96	169.77	58.65
1.42	386.87	171.66	59.00
1.43	388.77	172.01	59.19
1.44	388.91	172.03	59.33
1.45	388.39	172.40	59.73

Subcatchment ID	Peak Discharge (m^3/s)		
	Feb-92	Jun-07	Jun-11
1.46	389.15	172.68	59.90
1.47	388.87	171.80	59.87
1.48	339.30	171.80	59.86
1.49	389.15	218.36	75.61
1.50	389.10	218.30	75.62
1.51	566.31	301.32	112.13
1.52	567.12	302.10	112.87
1.53	566.46	301.73	113.05
1.54	567.06	302.05	113.48
1.55	570.64	304.75	116.01
1.56	570.39	304.76	116.10
1.57	568.31	303.82	116.37
1.58	566.46	303.01	116.27
1.59	571.52	306.80	118.69
1.60	558.27	304.11	116.86
2.01	4.53	1.41	0.85
3.01	2.61	1.02	0.60
4.01	10.26	1.71	4.31
4.02	19.38	4.15	5.13
5.01	7.25	2.67	1.16
5.02	12.42	5.98	2.17
6.01	1.95	1.17	0.36
7.01	8.70	5.16	1.27
7.02	14.97	9.14	2.14
8.01	1.51	1.16	0.25
9.01	4.97	3.58	0.80
10.01	9.84	3.85	1.52
11.01	2.54	1.93	0.50
12.01	4.77	2.43	0.94
12.02	9.62	3.75	1.76
12.03	15.38	6.83	2.65
12.04	23.28	12.50	3.82
13.01	2.03	1.26	0.44
14.01	3.01	2.13	0.55
15.01	3.93	2.83	0.69
16.01	1.81	1.66	0.33
16.02	5.00	4.24	0.90
16.03	8.15	7.15	1.46
17.01	2.45	1.95	0.41
18.01	2.96	2.78	0.56
19.01	2.56	2.44	0.45
20.01	3.86	3.21	0.68
21.01	2.10	2.19	0.41
22.01	3.12	2.91	0.55
23.01	13.11	10.03	1.83
23.02	33.42	28.20	4.55
23.03	36.67	30.82	4.98

Subcatchment ID	Peak Discharge (m^3/s)		
	Feb-92	Jun-07	Jun-11
23.04	39.49	33.28	5.35
24.01	3.84	3.68	0.59
24.02	10.86	10.40	1.57
25.01	2.19	2.24	0.31
26.01	2.20	2.98	0.44
27.01	11.20	9.96	1.64
27.02	17.49	14.75	2.75
27.03	28.99	18.58	4.26
28.01	4.60	4.83	0.80
29.01	11.33	11.64	1.54
30.01	9.11	9.78	1.24
31.01	8.61	6.29	1.48
31.02	13.81	10.03	2.22
31.03	23.37	16.21	3.53
31.04	29.43	20.50	4.38
31.05	36.70	25.74	5.41
31.06	43.58	30.92	6.46
31.07	51.85	36.50	7.65
31.08	89.32	57.79	14.63
31.09	90.39	58.04	15.01
32.01	4.66	3.47	0.75
33.01	9.39	6.09	1.39
34.01	4.78	3.28	0.71
35.01	3.79	2.88	0.57
36.01	2.36	2.15	0.42
37.01	3.22	3.20	0.57
38.01	5.21	3.60	0.76
38.02	9.26	6.79	1.44
38.03	19.67	15.21	2.95
38.04	40.82	30.72	7.48
39.01	3.46	2.79	0.56
40.01	2.58	2.10	0.38
40.02	5.66	4.85	0.92
41.01	1.53	1.61	0.30
42.01	11.26	8.35	2.82
42.02	20.96	15.73	5.23
43.01	8.67	6.59	2.23
44.01	3.31	3.06	0.86
45.01	6.69	6.72	0.92
46.01	9.20	10.09	1.31
46.02	15.91	17.18	2.44
47.01	3.75	4.64	0.61
48.01	5.39	4.57	1.27
49.01	14.67	12.52	4.22
50.01	4.46	3.72	0.99
51.01	1.98	2.74	0.67
51.02	6.90	8.87	2.24

Subcatchment ID	Peak Discharge (m^3/s)		
	Feb-92	Jun-07	Jun-11
51.03	13.25	13.36	3.22
52.01	4.13	5.20	1.31
53.01	2.86	3.56	0.87
54.01	2.58	2.28	0.64
55.01	8.58	5.79	1.85
56.01	10.64	8.10	2.52
56.02	22.70	15.82	5.33
56.03	25.85	17.72	5.96
57.01	8.04	5.88	1.93
58.01	4.07	3.30	0.88
59.01	2.64	1.91	0.57
60.01	6.70	9.30	1.50
60.02	12.69	16.61	2.50
61.01	5.92	8.35	1.22
62.01	2.70	3.76	0.54
63.01	14.85	8.37	3.26
63.02	22.15	15.35	4.45
64.01	6.79	8.43	1.27
65.01	6.43	7.66	1.17
66.01	10.13	7.98	1.40
67.01	8.74	5.68	1.86
67.02	15.11	10.01	2.69
67.03	23.33	29.54	4.73
67.04	27.52	41.61	5.93
67.05	46.44	56.89	7.01
67.06	53.10	56.46	7.02
67.07	60.39	60.64	7.76
68.01	3.72	2.62	0.38
69.01	6.05	5.74	0.87
70.01	8.93	8.45	0.71
70.02	18.73	19.75	1.58
71.01	6.45	7.25	0.59
72.01	6.49	7.23	0.52
73.01	8.10	6.09	0.99
74.01	24.45	18.44	1.61
74.02	36.45	27.47	2.10
74.03	46.07	35.29	2.58
74.04	52.60	39.15	2.96
74.05	72.07	40.29	4.00
74.06	71.65	36.08	4.10
74.07	71.78	36.03	4.12
75.01	7.58	6.43	0.46
76.01	5.39	4.62	0.32
77.01	14.91	6.46	0.84
78.01	8.22	6.15	1.76
78.02	15.22	13.12	3.35
78.03	23.20	16.81	4.34

Subcatchment ID	Peak Discharge (m^3/s)		
	Feb-92	Jun-07	Jun-11
79.01	8.00	4.51	1.07
80.01	4.26	2.38	0.57
81.01	10.90	4.56	1.35
82.01	13.50	7.39	2.17
82.02	19.37	9.99	2.90
83.01	11.02	5.11	1.44
83.02	12.47	5.82	1.54
84.01	7.85	4.03	1.18
84.02	7.81	3.64	1.10
85.01	4.14	2.49	0.74
85.02	7.81	3.65	1.31
86.01	4.45	2.97	0.97
87.01	4.57	3.62	1.20
87.02	4.62	4.00	1.27
88.01	3.14	2.65	0.75
89.01	11.59	16.60	3.20
89.02	20.78	32.61	5.28
89.03	28.61	42.23	7.14
89.04	38.57	56.08	9.12
89.05	45.11	57.02	10.60
89.06	51.15	56.05	11.79
89.07	68.39	55.20	15.45
89.08	72.19	54.90	16.34
89.09	74.34	54.47	16.76
89.10	75.40	54.65	16.95
89.11	76.54	54.40	17.13
89.12	79.88	55.61	17.56
89.13	82.28	56.04	17.99
89.14	82.72	56.26	17.97
89.15	92.69	67.31	26.21
89.16	94.89	67.76	26.62
89.17	96.37	67.62	27.00
90.01	2.45	4.32	0.59
90.02	8.66	15.56	2.07
91.01	3.03	5.47	0.78
92.01	5.24	9.37	1.33
93.01	9.63	14.25	2.37
94.01	5.75	6.33	1.49
95.01	3.70	3.60	0.85
96.01	10.84	8.90	2.63
96.02	14.59	11.72	3.20
97.01	3.47	2.84	0.64
98.01	5.04	5.15	1.20
99.01	2.69	2.20	0.49
100.01	2.32	1.90	0.47
101.01	2.76	2.32	0.55
102.01	3.46	2.92	0.74

Subcatchment ID	Peak Discharge (m^3/s)		
	Feb-92	Jun-07	Jun-11
103.01	3.18	3.39	0.80
104.01	1.59	1.45	0.38
105.01	5.77	7.19	1.77
105.02	8.02	9.84	2.34
105.03	12.74	16.22	3.18
105.04	14.09	15.97	3.55
105.05	16.08	18.13	4.06
105.06	18.63	20.03	5.03
105.07	23.86	23.62	6.42
105.08	24.93	25.09	6.90
105.09	28.88	27.45	7.97
105.10	28.53	26.60	8.46
105.11	29.05	26.59	8.93
106.01	1.95	2.30	0.62
107.01	3.87	5.82	0.74
108.01	3.56	4.04	0.92
109.01	3.27	5.02	0.64
110.01	3.74	4.41	1.04
111.01	4.00	5.33	0.90
111.02	6.60	9.97	1.86
112.01	2.20	3.55	0.70
113.01	2.28	2.64	0.63
114.01	2.68	3.21	0.66
115.01	2.20	3.29	0.63
116.01	2.05	2.58	0.48
117.01	4.00	3.29	0.99
118.01	1.56	1.97	0.35
119.01	3.66	3.71	1.95
119.02	7.02	7.24	4.05
119.03	11.64	12.34	6.11
119.04	16.58	17.81	8.48
119.05	18.72	20.06	9.41
119.06	24.47	25.78	11.30
119.07	27.97	28.44	12.02
119.08	26.91	25.89	11.16
119.09	31.16	28.68	12.72
119.10	32.92	29.06	13.10
119.11	79.38	49.62	27.42
119.12	80.09	49.86	27.99
119.13	80.40	49.92	28.31
119.14	80.45	49.89	28.30
119.15	92.47	55.29	31.40
119.16	92.99	55.21	31.55
119.17	114.41	77.81	38.39
119.18	115.49	78.04	38.51
119.19	115.48	78.02	38.51
119.20	114.70	77.14	38.78

Subcatchment ID	Peak Discharge (m^3/s)		
	Feb-92	Jun-07	Jun-11
119.21	114.33	76.77	38.77
119.22	152.89	76.80	39.26
119.23	177.55	87.87	46.37
120.01	3.18	3.24	1.82
121.01	1.85	2.20	0.98
122.01	4.14	4.38	2.31
123.01	2.72	2.94	1.44
124.01	2.78	3.21	1.41
125.01	3.92	3.28	1.37
125.02	6.69	6.56	2.31
126.01	2.94	2.87	1.09
127.01	2.05	2.07	0.75
127.02	2.36	2.10	0.52
128.01	6.11	3.96	3.30
128.02	18.82	17.73	7.32
128.03	28.79	22.35	9.96
128.04	29.73	22.74	10.62
128.05	33.16	23.81	12.08
128.06	36.76	24.11	13.17
128.07	40.86	24.56	13.88
128.08	41.94	25.77	14.10
128.09	43.36	26.79	14.30
128.10	45.66	28.90	14.69
128.11	45.65	28.98	14.71
128.12	46.52	29.81	14.86
129.01	4.61	4.49	2.42
129.02	7.27	7.83	3.62
129.03	11.72	12.41	5.26
130.01	2.42	2.79	1.25
131.01	4.36	3.89	1.94
132.01	4.29	4.03	2.07
132.02	6.86	7.14	3.25
132.03	8.99	9.61	4.20
132.04	11.08	10.78	4.57
132.05	11.12	10.81	4.64
133.01	2.01	2.12	1.01
134.01	2.50	2.67	1.25
135.01	2.68	2.90	1.30
136.01	3.76	3.20	1.27
136.02	5.08	2.22	1.07
137.01	3.56	2.72	1.30
137.02	7.38	5.44	2.71
137.03	7.72	6.20	2.03
137.04	8.35	2.04	1.04
137.05	10.00	9.66	2.78
138.01	2.44	1.94	0.79
139.01	3.01	8.04	2.55

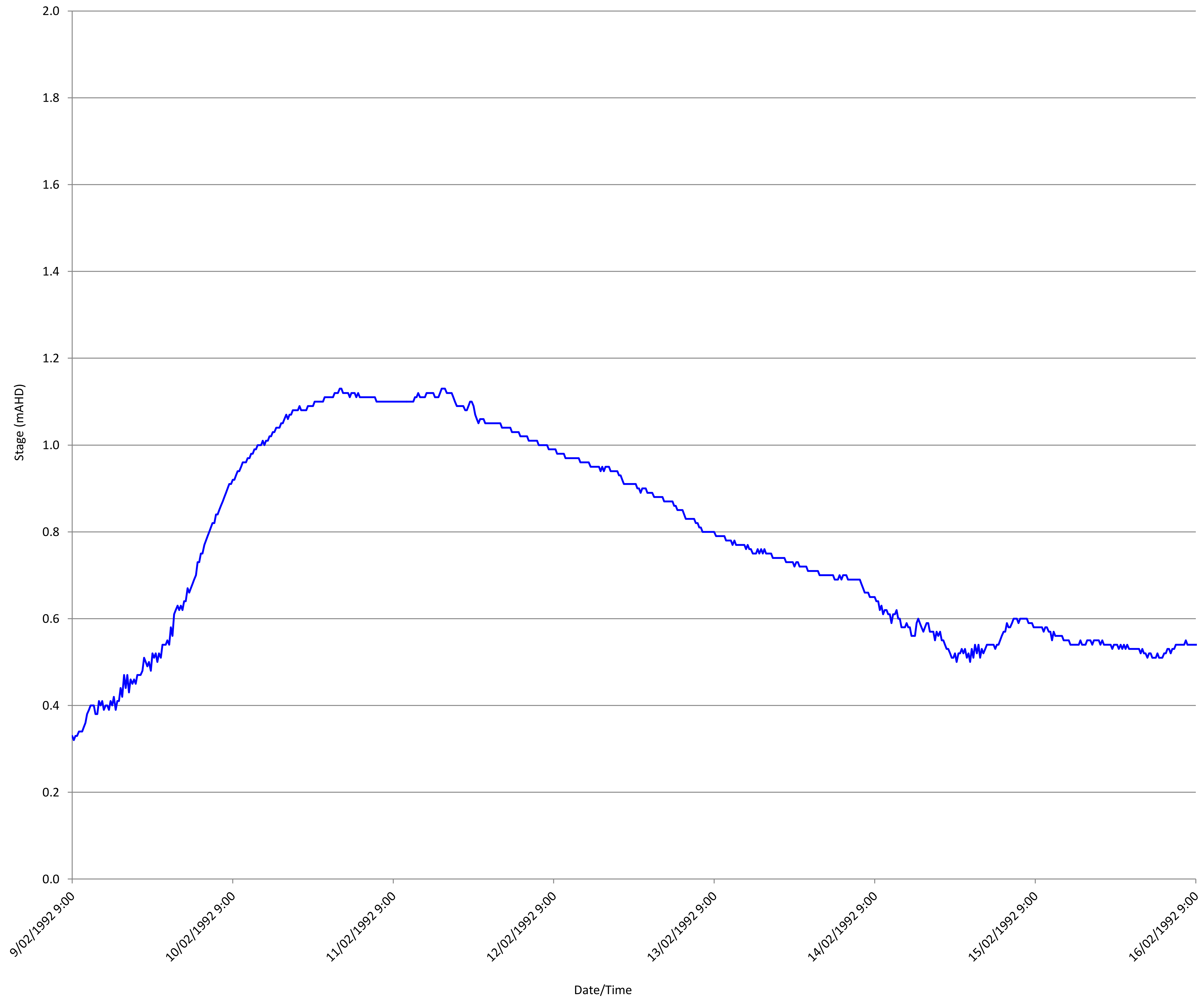
Subcatchment ID	Peak Discharge (m^3/s)		
	Feb-92	Jun-07	Jun-11
140.01	4.17	2.79	1.41
141.01	3.56	2.94	1.29
141.02	7.42	6.09	2.49
141.03	8.65	7.24	2.86
141.04	8.67	8.00	2.85
142.01	1.45	1.03	0.52
143.01	0.40	0.39	0.13
144.01	4.26	3.51	1.77
144.02	4.46	4.37	1.68
145.01	1.89	1.63	0.57
146.01	2.91	2.01	1.07
147.01	1.78	1.14	0.67
148.01	8.09	4.17	2.29
148.02	7.11	3.85	1.51
149.01	3.81	2.29	1.12
149.02	3.79	2.46	1.13
150.01	5.61	3.48	1.95
150.02	5.92	4.01	1.76
150.03	8.23	5.69	2.28
150.04	8.25	5.70	2.24
150.05	12.45	7.95	3.23
151.01	2.08	2.04	0.79
152.01	4.06	2.63	1.64
152.02	3.85	3.01	1.32
152.03	3.25	2.59	0.98
152.04	4.41	2.91	1.57
153.01	18.24	8.80	1.38
153.02	28.41	11.49	2.26
153.03	33.05	12.51	3.16
153.04	44.71	17.38	4.65
153.05	54.31	20.06	5.72
153.06	62.71	22.71	6.83
153.07	63.18	22.75	6.81
153.08	66.46	24.36	7.27
154.01	7.10	5.70	0.41
155.01	5.18	2.46	0.77
156.01	12.44	5.72	1.57
157.01	7.61	3.72	1.01
158.01	3.93	2.05	0.53
159.01	3.84	2.25	0.62
159.02	4.34	2.27	0.66
160.01	1.33	1.16	0.39
160.02	3.07	2.69	0.85
160.03	4.12	3.28	1.03
160.04	4.13	3.26	1.06
161.01	49.56	1.90	0.54
161.02	49.46	2.05	0.46

Subcatchment ID	Peak Discharge (m^3/s)		
	Feb-92	Jun-07	Jun-11
161.03	49.37	3.71	1.10
162.01	1.19	1.18	0.22
163.01	3.60	3.97	2.11
163.02	7.51	8.44	4.59
163.03	14.48	13.76	7.39
163.04	16.57	15.77	8.22
163.05	25.47	18.34	11.39
163.06	25.43	18.16	11.45
163.07	25.73	18.14	11.87
163.08	25.37	17.59	11.72
164.01	3.81	4.22	2.44
165.01	3.76	3.64	2.15
166.01	2.59	2.44	0.94
167.01	6.32	3.15	2.86
168.01	2.34	2.33	0.80
169.01	3.13	4.66	1.12
169.02	5.31	6.93	2.11
169.03	5.36	6.99	1.99
170.01	2.28	2.17	1.11
170.02	3.28	3.34	1.23
170.03	4.84	4.82	1.77
171.01	3.57	5.33	0.97
171.02	4.86	6.79	1.38
171.03	6.80	10.39	2.70
171.04	7.36	11.08	3.18
171.05	11.36	15.32	4.67
171.06	11.46	15.22	4.70
172.01	1.61	2.40	0.83
173.01	1.37	2.00	0.94
174.01	0.90	1.51	0.49
175.01	2.43	2.65	1.18
175.02	3.92	4.51	1.63
176.01	1.68	2.01	0.68
177.01	1.83	1.99	1.11
178.01	1.31	2.68	0.54
178.02	2.49	4.92	1.00
179.01	3.47	2.97	2.64
179.02	7.89	7.70	4.85
179.03	9.23	8.70	4.87
179.04	9.42	8.60	5.06
179.05	10.92	9.17	5.82
179.06	12.90	10.24	7.17
179.07	14.92	14.35	8.69
180.01	2.74	2.61	1.25
181.01	3.02	3.61	2.24
182.01	1.48	2.03	0.61
182.02	2.99	3.55	1.36

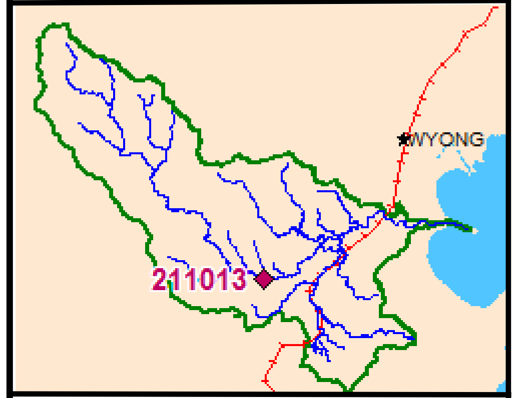
Subcatchment ID	Peak Discharge (m^3/s)		
	Feb-92	Jun-07	Jun-11
183.01	1.62	1.51	0.92
184.01	5.50	8.99	5.35
185.01	2.73	5.08	3.39
186.01	1.60	2.20	0.85
186.02	1.91	3.49	1.83

Appendix D

Historic Stage Hydrographs



Gosford City Council
Wyong Shire Council
CENTRAL COAST



LEGEND:

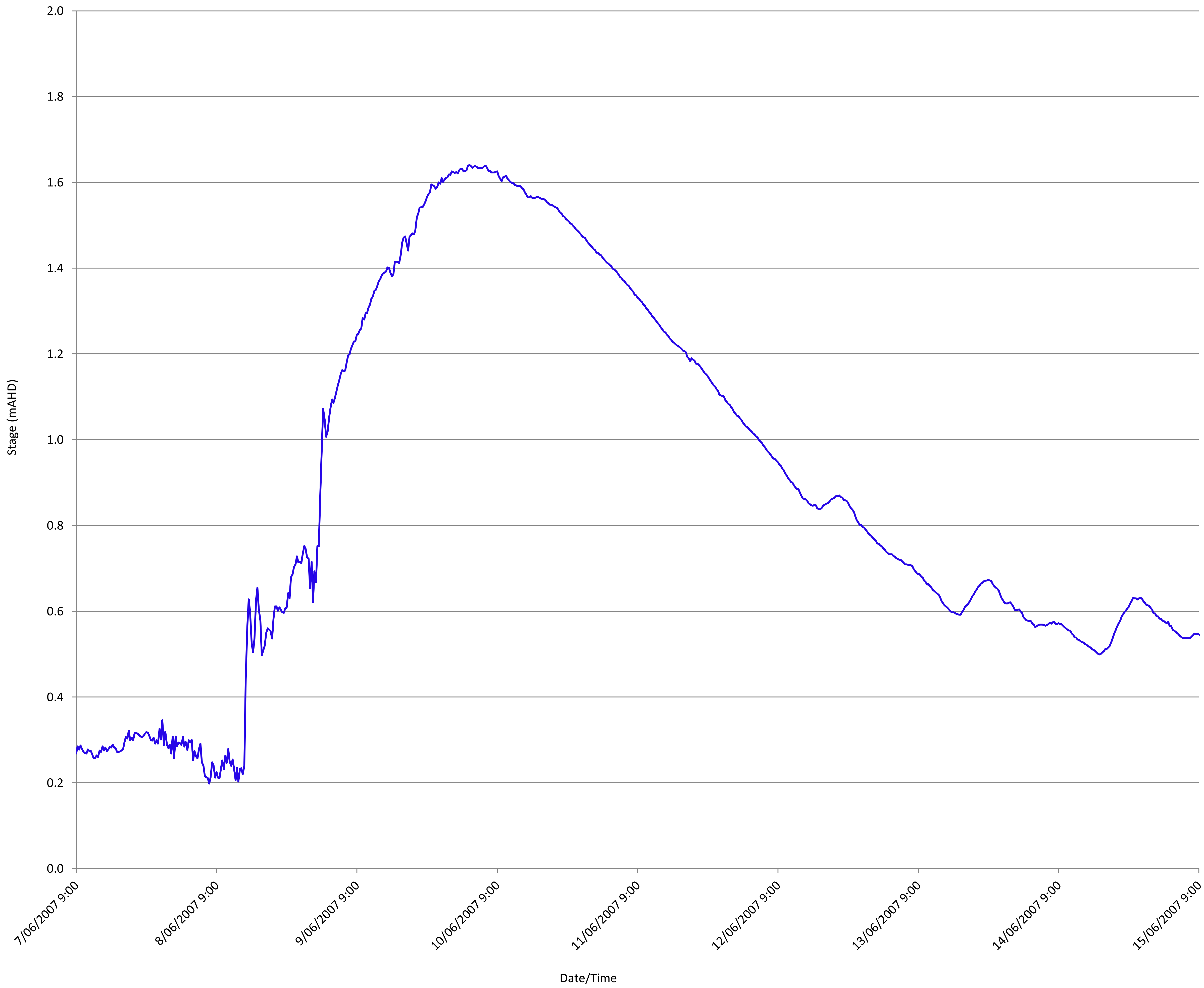
Recorded Stage Hydrograph at Long Jetty Gauge

Notes:

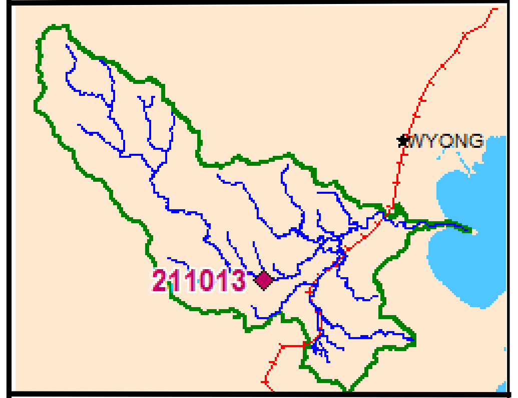
Figure E1: Tuggerah Lake Stage Hydrograph for 1992 Flood

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name:
Ourimbah_Calibration_Hydrographs.xlsx



GOSFORD CITY COUNCIL
Wyong Shire Council
CENTRAL COAST



LEGEND:

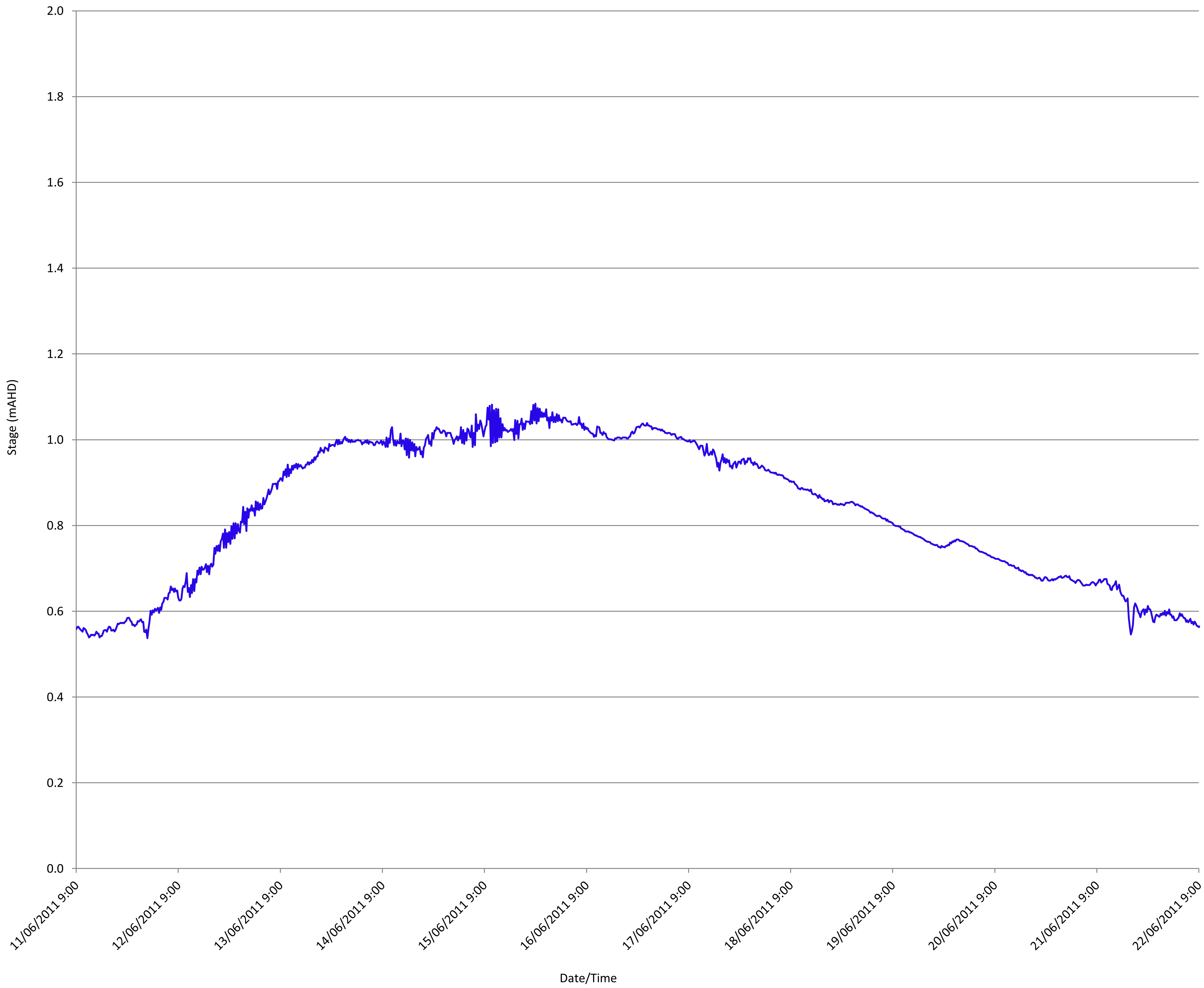
Recorded Stage Hydrograph at Long Jetty Gauge

Notes:

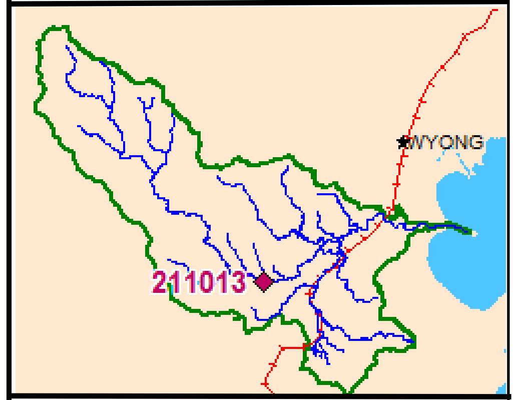
Figure E2: Tuggerah Lake Stage Hydrograph for 2007 Flood

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name:
Ourimbah_Calibration_Hydrographs.xlsx



Gosford City Council
Wyong Shire Council
Central Coast



LEGEND:

Recorded Stage Hydrograph at Long Jetty Gauge

Notes:

Figure E3: Tuggerah Lake Stage Hydrograph for 2011 Flood

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name:
Ourimbah_Calibration_Hydrographs.xlsx

Appendix E

PMP Calculations

GSDM CALCULATION SHEET

LOCATION INFORMATION

Catchment Ourimbah Creek   Area 160.23 km^2

State New South Wales   Duration Limit 6.0 hrs

Latitude 33.3184^{0}S   Longitude 151.3258^{0}E

Portion of Area Considered:

Smooth, **S** = 0.00 (0.0 - 1.0)   Rough, **R** = 1.00 (0.0 - 1.0)

ELEVATION ADJUSTMENT FACTOR (EAF)

Mean Elevation 137 m

Adjustment for Elevation (-0.05 per 300m above 1500m) 0.00

EAF = **1.00** (0.85 – 1.00)

MOISTURE ADJUSTMENT FACTOR (MAF)

MAF = **0.72** (0.40-1.00)

PMP VALUES (mm)

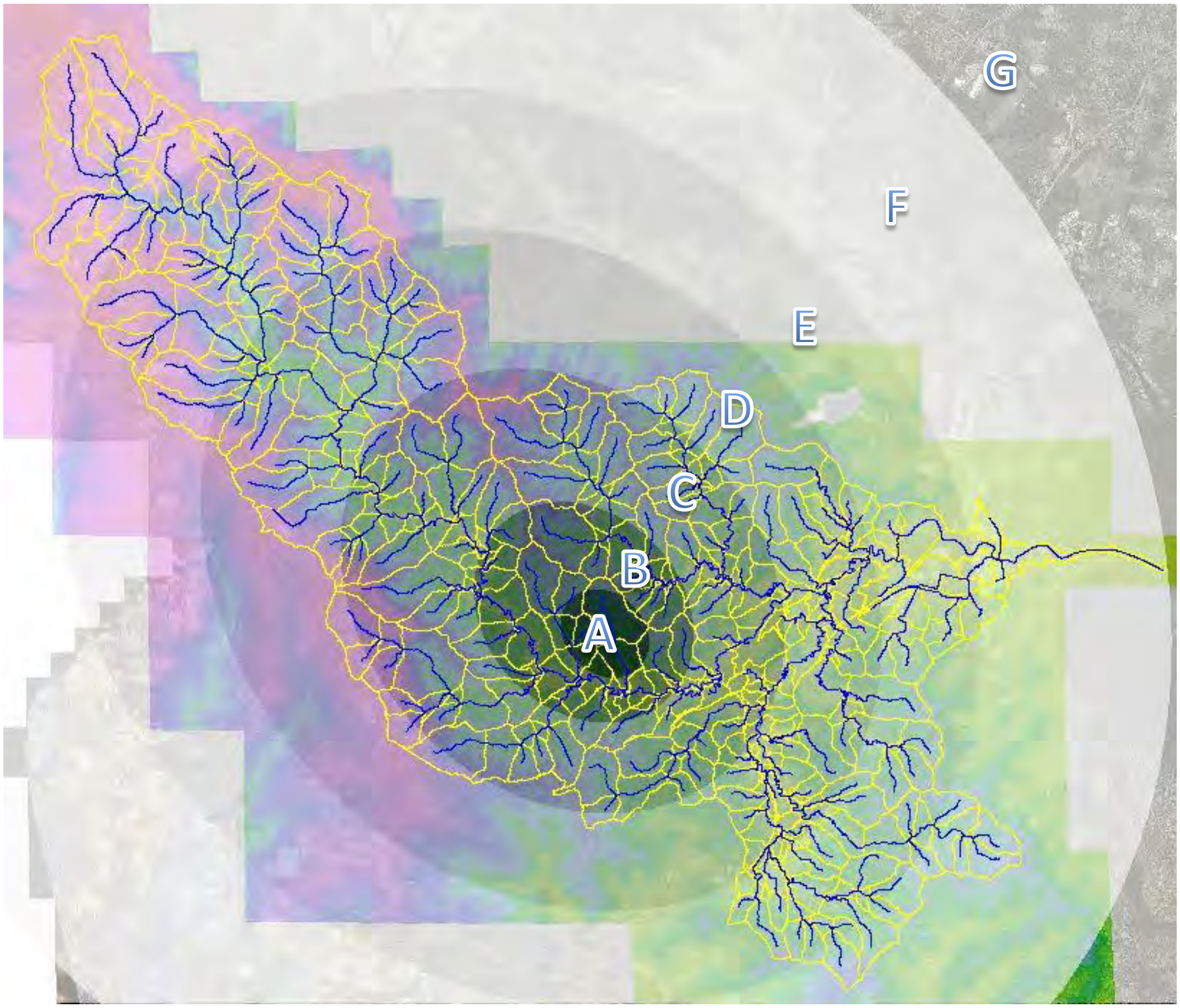
Duration (hours)	Initial Depth -Smooth (D_S)	Initial Depth -Rough (D_R)	PMP Estimate = (D_SxS + D_RxR) x MAF x EAF	Rounded PMP Estimate (nearest 10 mm)
0.25	156	156	111	110
0.50	228	228	163	160
0.75	290	290	207	210
1.00	353	353	252	250
1.50	402	456	326	330
2.00	456	524	374	370
2.50	490	595	425	430
3.00	525	643	460	460
4.00	588	724	518	520
5.00	636	789	564	560
6.00	676	840	600	600

Prepared By D. Fedczyna   Date 13/09/2012

Checked By D. Tetley   Date 8/02/2013

Catchment Simulation Solutions

GSDM SPATIAL DISTRIBUTION



GSDM SPATIAL DISTRIBUTION

DURATION = 0.25 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	232	166	430	430	166
B	13.38	15.97	204	146	2330	1900	142
C	46.77	62.73	178	127	7980	5650	121
D	42.12	104.85	166	119	12451	4471	106
E	37.46	142.31	159	114	16175	3724	99
F	17.14	159.46	156	112	17789	1615	94
G	0.77	160.23	156	111	17862	73	94
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

DURATION = 0.50 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	336	240	622	622	240
B	13.38	15.97	301	215	3437	2815	210
C	46.77	62.73	262	187	11743	8306	178
D	42.12	104.85	244	174	18266	6522	155
E	37.46	142.31	233	167	23724	5458	146
F	17.14	159.46	229	163	26068	2344	137
G	0.77	160.23	228	163	26176	107	139
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

GSDM SPATIAL DISTRIBUTION (continued)

DURATION = 0.75 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	425	304	787	787	304
B	13.38	15.97	383	274	4373	3585	268
C	46.77	62.73	332	237	14883	10510	225
D	42.12	104.85	309	221	23184	8301	197
E	37.46	142.31	296	211	30095	6911	184
F	17.14	159.46	290	207	33085	2990	174
G	0.77	160.23	290	207	33220	135	175
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

DURATION = 1.0 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	493	353	913	913	353
B	13.38	15.97	449	321	5127	4213	315
C	46.77	62.73	398	285	17868	12741	272
D	42.12	104.85	374	267	28043	10175	242
E	37.46	142.31	359	257	36537	8494	227
F	17.14	159.46	353	252	40253	3716	217
G	0.77	160.23	353	252	40421	168	218
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

GSDM SPATIAL DISTRIBUTION (continued)

DURATION = 1.5 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	636	455	1178	1178	455
B	13.38	15.97	575	411	6565	5387	403
C	46.77	62.73	513	367	23001	16436	351
D	42.12	104.85	484	346	36249	13248	315
E	37.46	142.31	464	332	47256	11007	294
F	17.14	159.46	457	326	52052	4795	280
G	0.77	160.23	456	326	52270	218	283
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

DURATION = 2.0 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	744	532	1378	1378	532
B	13.38	15.97	672	481	7673	6294	471
C	46.77	62.73	592	423	26565	18893	404
D	42.12	104.85	556	398	41689	15124	359
E	37.46	142.31	534	382	54297	12607	337
F	17.14	159.46	524	375	59753	5456	318
G	0.77	160.23	524	374	60002	249	323
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

GSDM SPATIAL DISTRIBUTION (continued)

DURATION = 2.5 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	821	587	1521	1521	587
B	13.38	15.97	742	531	8472	6951	520
C	46.77	62.73	665	476	29839	21368	457
D	42.12	104.85	630	450	47215	17376	413
E	37.46	142.31	605	433	61568	14353	383
F	17.14	159.46	595	425	67833	6265	365
G	0.77	160.23	595	425	68119	286	372
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

DURATION = 3.0 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	901	644	1669	1669	644
B	13.38	15.97	810	579	9249	7579	567
C	46.77	62.73	720	515	32282	23033	493
D	42.12	104.85	681	487	51024	18742	445
E	37.46	142.31	654	468	66585	15561	415
F	17.14	159.46	644	460	73390	6805	397
G	0.77	160.23	643	460	73700	310	402
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

GSDM SPATIAL DISTRIBUTION (continued)

DURATION = 4.0 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	1030	737	1908	1908	737
B	13.38	15.97	926	662	10573	8665	648
C	46.77	62.73	815	582	36539	25965	555
D	42.12	104.85	767	548	57506	20968	498
E	37.46	142.31	737	527	74964	17458	466
F	17.14	159.46	724	518	82596	7631	445
G	0.77	160.23	724	518	82946	351	455
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

DURATION = 5.0 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	1135	812	2103	2103	812
B	13.38	15.97	1018	728	11624	9521	712
C	46.77	62.73	894	639	40082	28458	609
D	42.12	104.85	839	600	62932	22850	542
E	37.46	142.31	804	575	81833	18901	505
F	17.14	159.46	790	565	90025	8192	478
G	0.77	160.23	789	564	90400	375	487
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

GSDM SPATIAL DISTRIBUTION (continued)

DURATION = 6.0 Hours							
Ellipse	Catchment Area Between Ellipse (km^2)	Catchment Area Enclosed by Ellipse (km^2)	Initial Mean Rainfall Depth (mm)	Adjusted Mean Rainfall Depth (mm)	Rainfall Volume enclosed by Ellipse ($mm.km^2$)	Rainfall Volume between Ellipses ($mm.km^2$)	Mean Rainfall Depth between ellipses (mm)
A	2.59	2.59	1200	858	2223	2223	858
B	13.38	15.97	1084	775	12377	10154	759
C	46.77	62.73	955	682	42814	30437	651
D	42.12	104.85	894	639	67026	24212	575
E	37.46	142.31	856	612	87085	20059	535
F	17.14	159.46	840	601	95810	8725	509
G	0.77	160.23	840	600	96209	400	518
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A

GSAM CALCULATION SHEET

LOCATION INFORMATION			
Catchment:	Ourimbah Creek	Catchment Area:	160.23 km^2
State:	New South Wales	GSAM zone:	Coastal Transition (GTSMR & GSAM Coastal)

CATCHMENT FACTORS

Topographical Adjustment Factor **TAF =** 1.54 (1.0 – 2.0)

Annual Moisture Adjustment Factor

$$MAF = \frac{EPW_{seasonal\ catchment\ average}}{EPW_{seasonal\ standard}}$$

Season	$EPW_{seasonal\ catchment\ average}$	$EPW_{seasonal\ standard}$	MAF	
Summer (Annual)	74.19	80.80	0.92	(0.60 – 1.05)
Autumn	61.24	71.00	0.86	(0.56 – 0.91)

PMP VALUES (mm) - Annual			PMP VALUES (mm) - Autumn		
Duration (hours)	Initial Depth (D_{summer})	PMP Estimate (D_s x TAF x MAF_a)	Duration (hours)	Initial Depth (D_{autumn})	PMP Estimate (D_a x TAF x MAF_a)
24	777.81	1102	24	532.82	706
36	865.76	1227	36	662.15	877
48	916.69	1299	48	779.93	1033
72	962.99	1364	72	988.94	1310
96	1003.13	1421	96	1060.45	1404

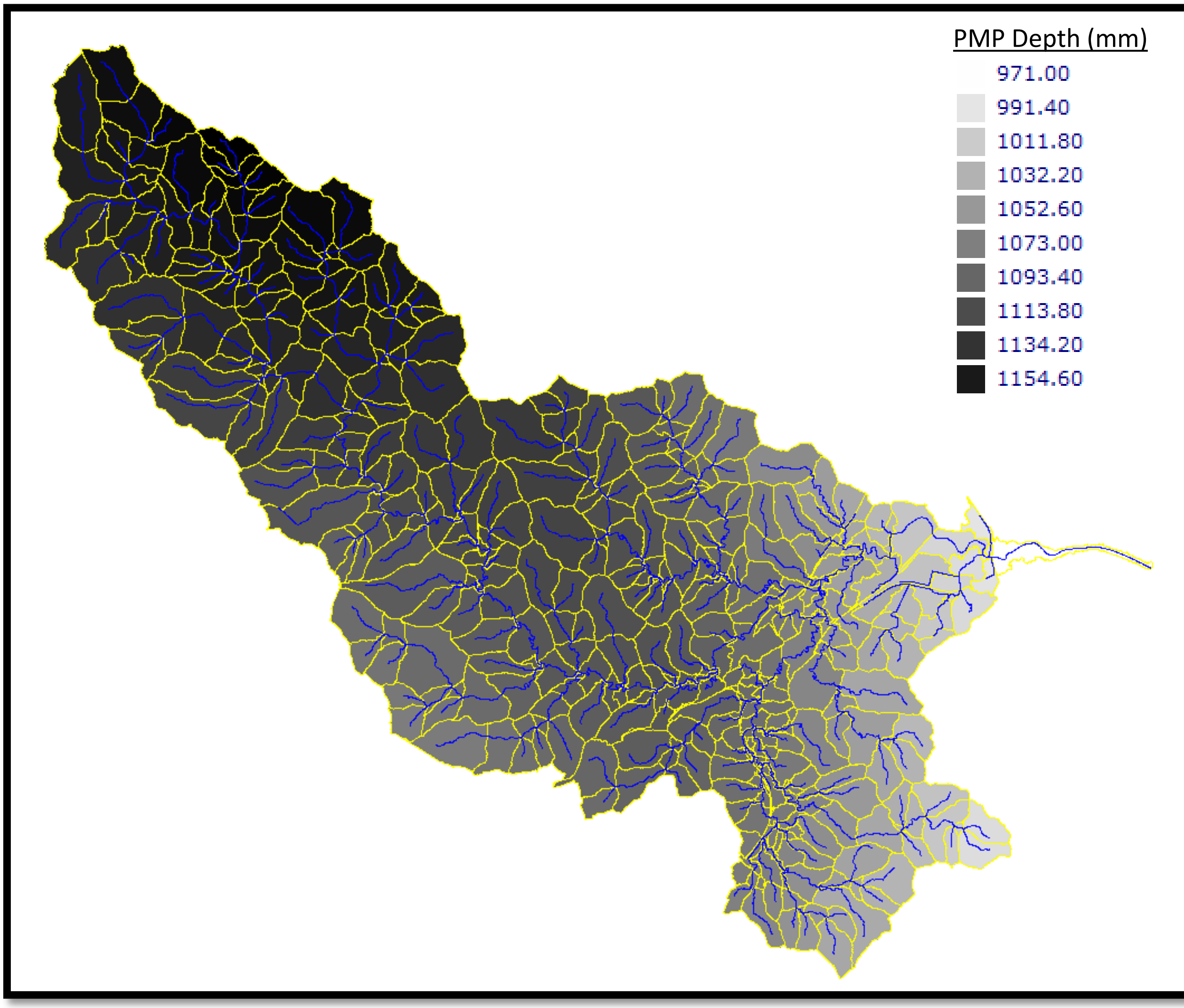
Final GSAM PMP Estimates

Duration (hours)	Maximum of the Seasonal Depths	Preliminary PMP Estimate (nearest 10mm)	Final PMP Estimate (from envelope)
24	1102	1100	1100
36	1227	1230	1230
48	1299	1300	1300
72	1364	1360	1360
96	1421	1420	1420

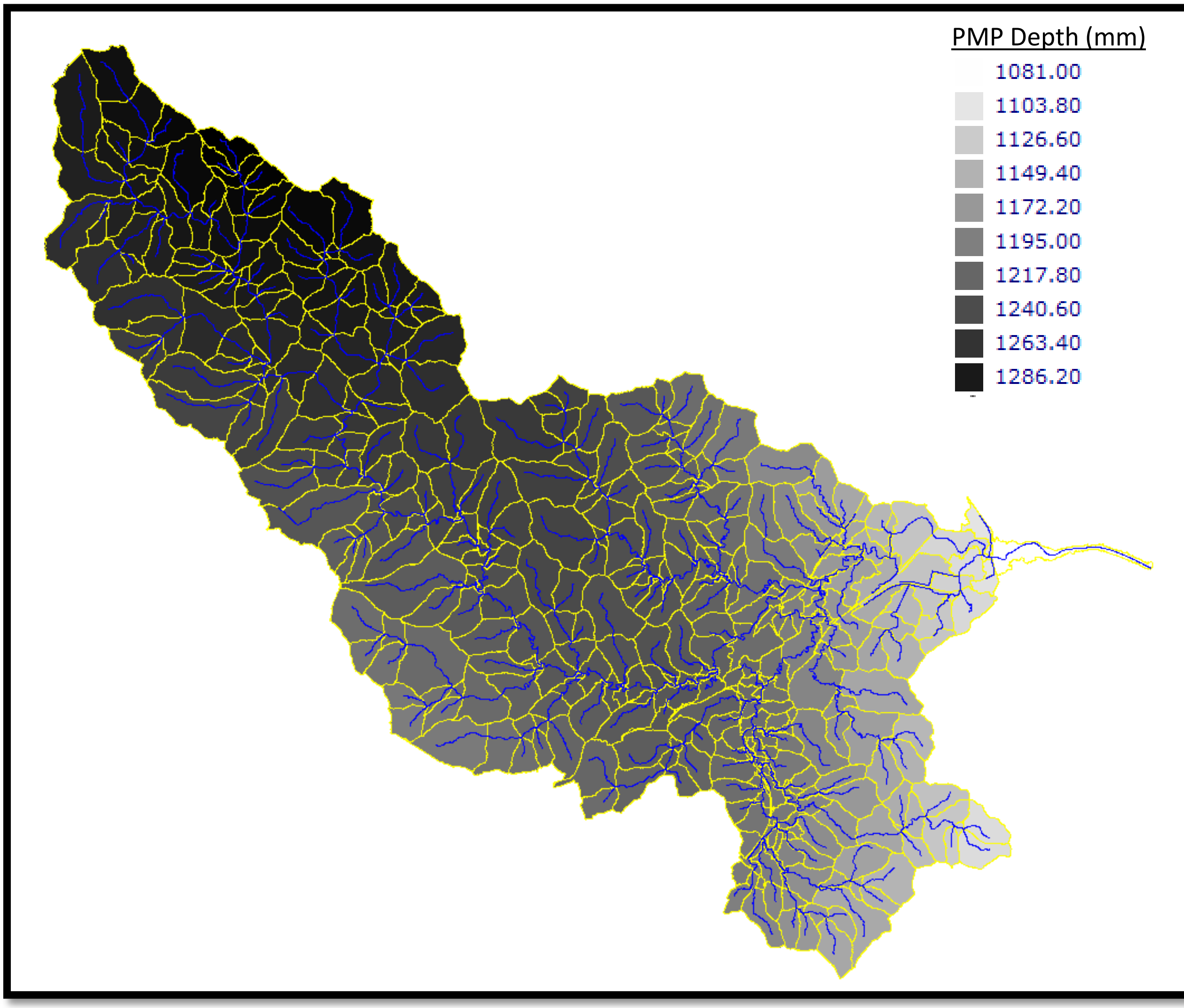
Prepared By	D.Tetley	Date	13-01-2013
Checked By	D. Fedczyna	Date	18-01-2013

Catchment Simulation Solutions

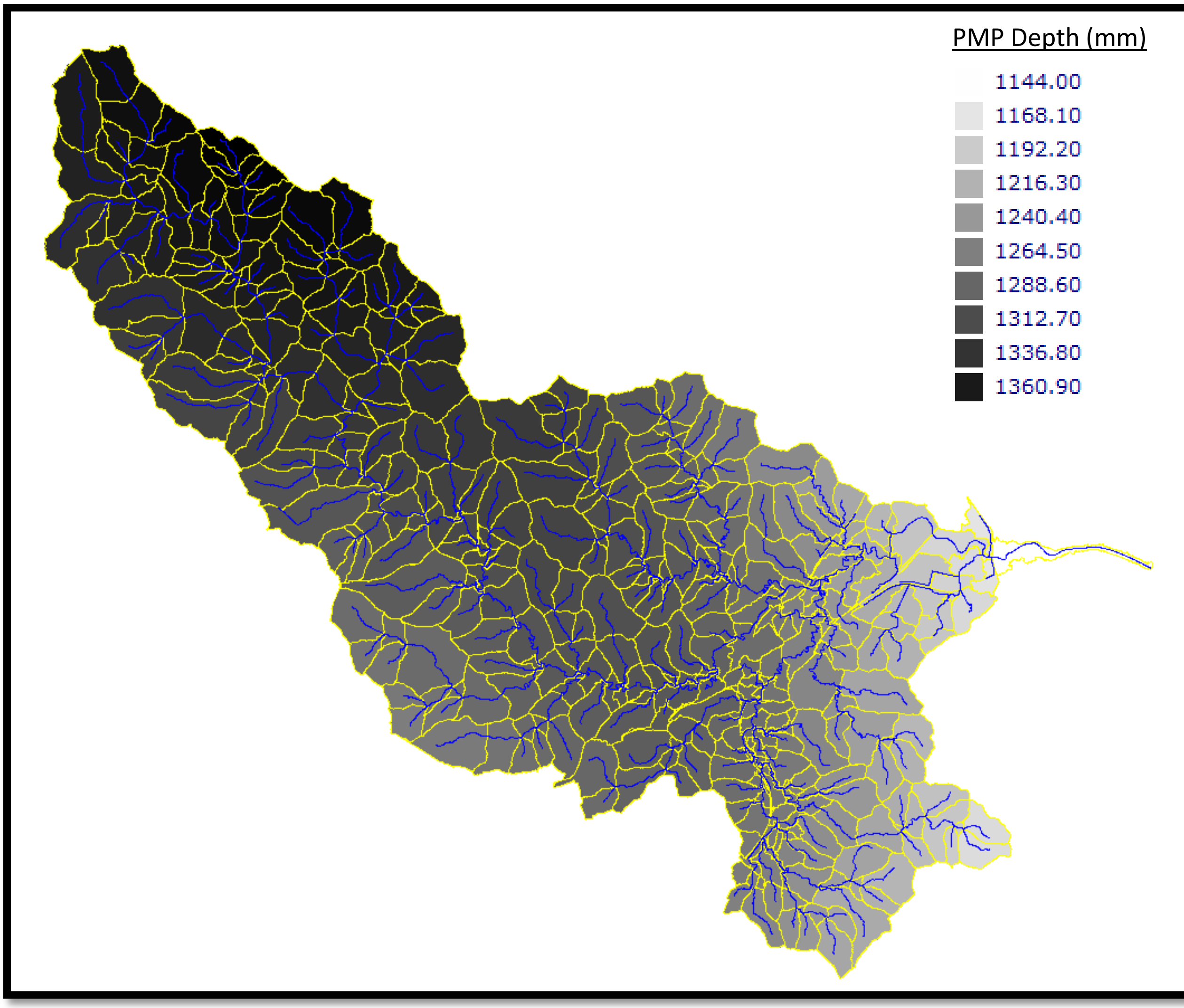
GSAM SPATIAL DISTRIBUTION – 24 Hour



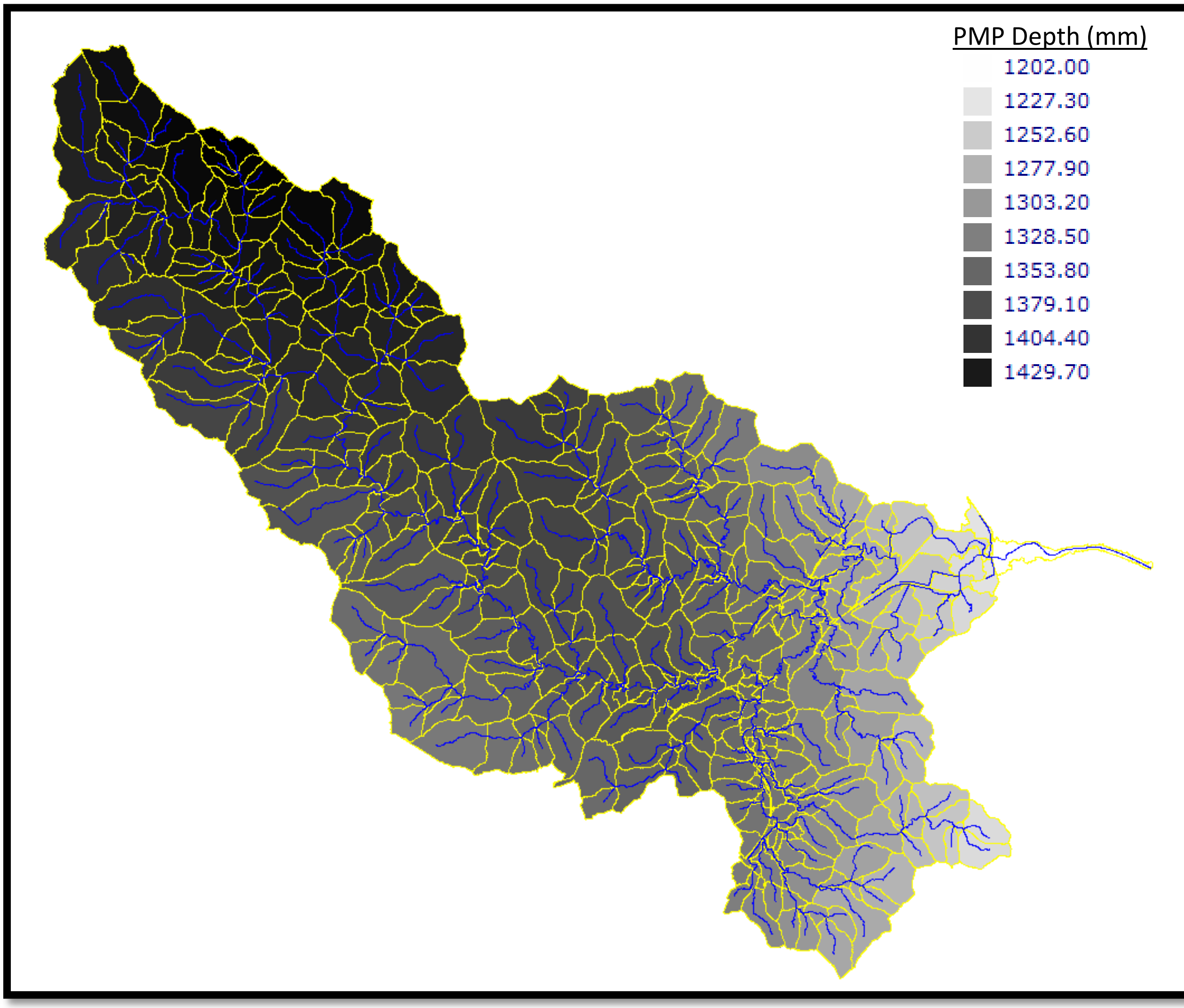
GSAM SPATIAL DISTRIBUTION – 36 Hour



GSAM SPATIAL DISTRIBUTION – 48 Hour



GSAM SPATIAL DISTRIBUTION – 72 Hour



GTSMR CALCULATION SHEET

LOCATION INFORMATION			
Catchment:	Ourimbah Creek	Catchment Area:	160.23 km^2
State:	New South Wales	GTSMR zone(s):	Coastal Transition (GTSMR & GSAM Coastal)

CATCHMENT FACTORS					
Topographical Adjustment Factor			**TAF =**	1.54	(1.0 – 2.0)
Decay Amplitude Factor			**DAF =**	0.80	(0.7 – 1.0)
Annual Moisture Adjustment Factor			**MAF_a =**	$EPW_{catchment}$ / 120.00	
Extreme Precipitable Water	($EPW_{catchment}$) =	74.19	**MAF_a =**	0.62	(0.4 – 1.1)
Winter Moisture Adjustment Factor (where applicable)			**MAF_w =**	$EPW_{catchment\_winter}$ / 82.30	
Winter EPW	($EPW_{catchment\_winter}$) =	N/A	**MAF_w =**	N/A	(0.4 – 1.1)

PMP VALUES (mm) - Annual

Duration (hours)	Initial Depth (D_a)	PMP Estimate $=D_a \times TAF \times DAF \times MAF_a$	Preliminary PMP Estimate (nearest 10 mm)	Final PMP Estimate (from envelope)
24	1316.72	1006	1010	1010
36	1604.45	1226	1230	1230
48	1873.34	1431	1430	1430
72	2347.85	1793	1793	1793
96	2634.31	2012	2010	2010
120	2765.06	2112	2110	2110

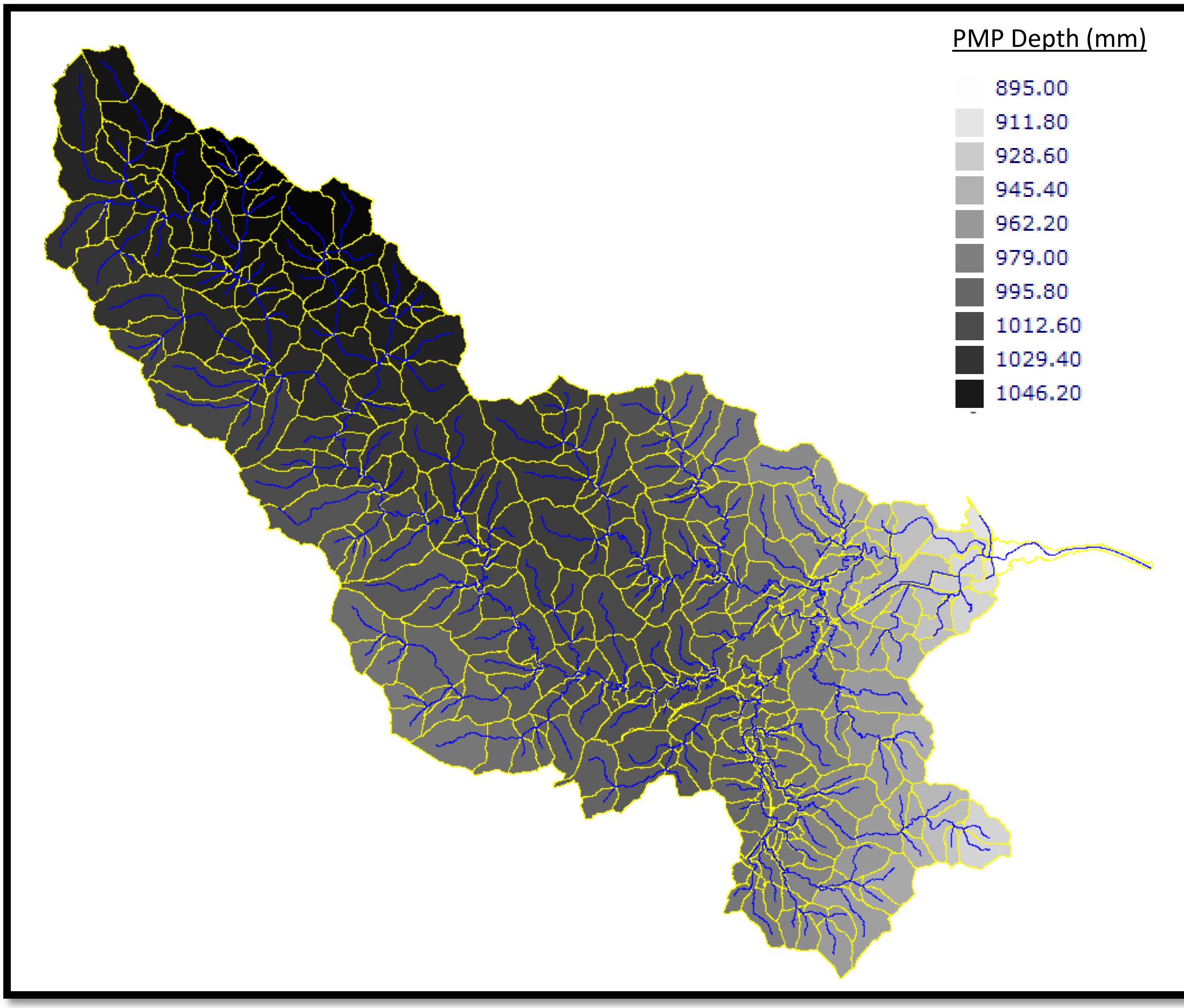
PMP VALUES (mm) – Winter (where applicable)

Duration (hours)	Initial Depth (D_w)	PMP Estimate $=D_w \times TAF \times DAF \times MAF_w$	Preliminary PMP Estimate (nearest 10 mm)	Final PMP Estimate (from envelope)
24	NOT APPLICABLE			
36				
48				
72				
96				
120				

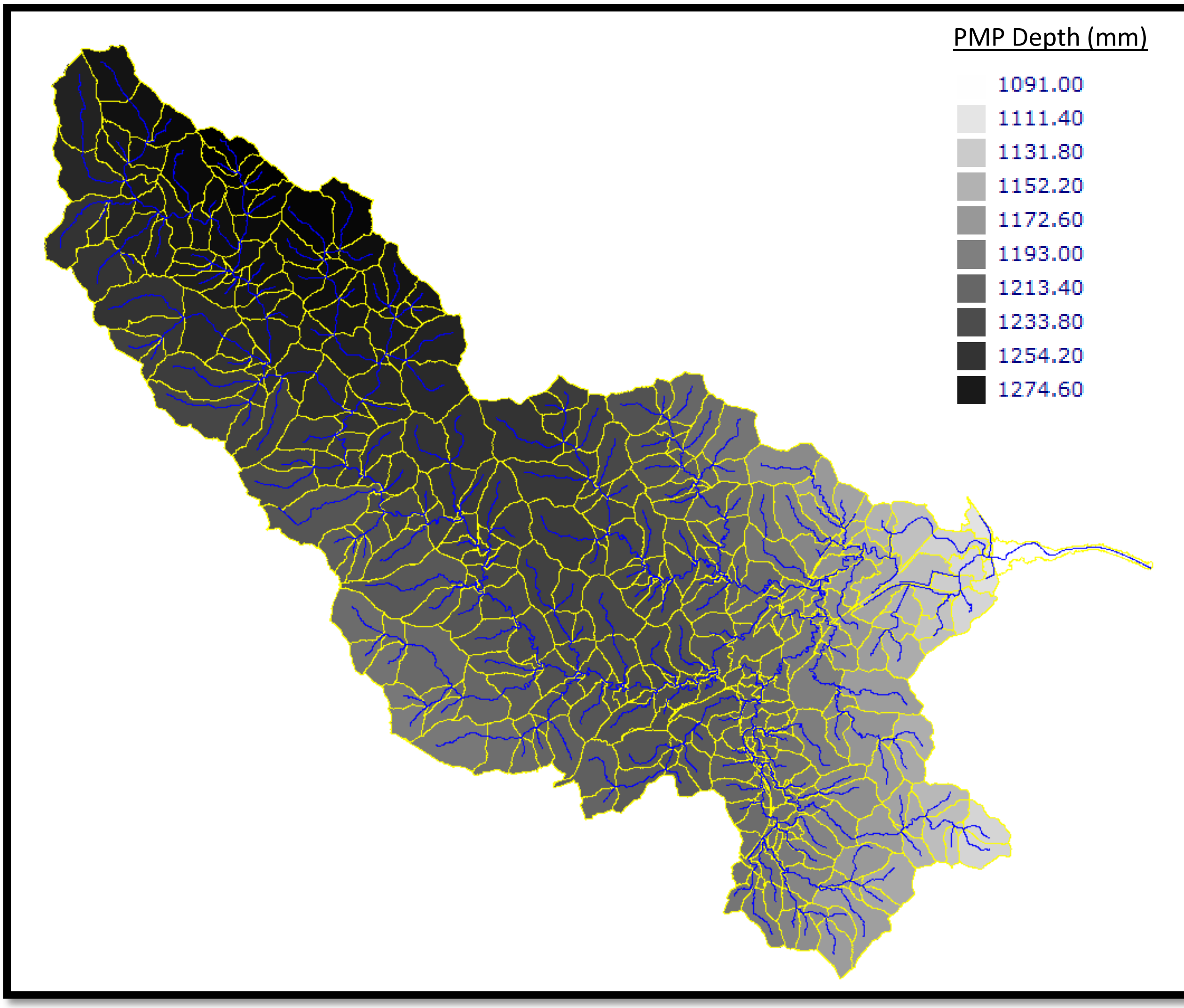
Prepared By	D.Tetley	Date	13-01-2013
Checked By	D. Fedczyna	Date	18-01-2013

Catchment Simulation Solutions

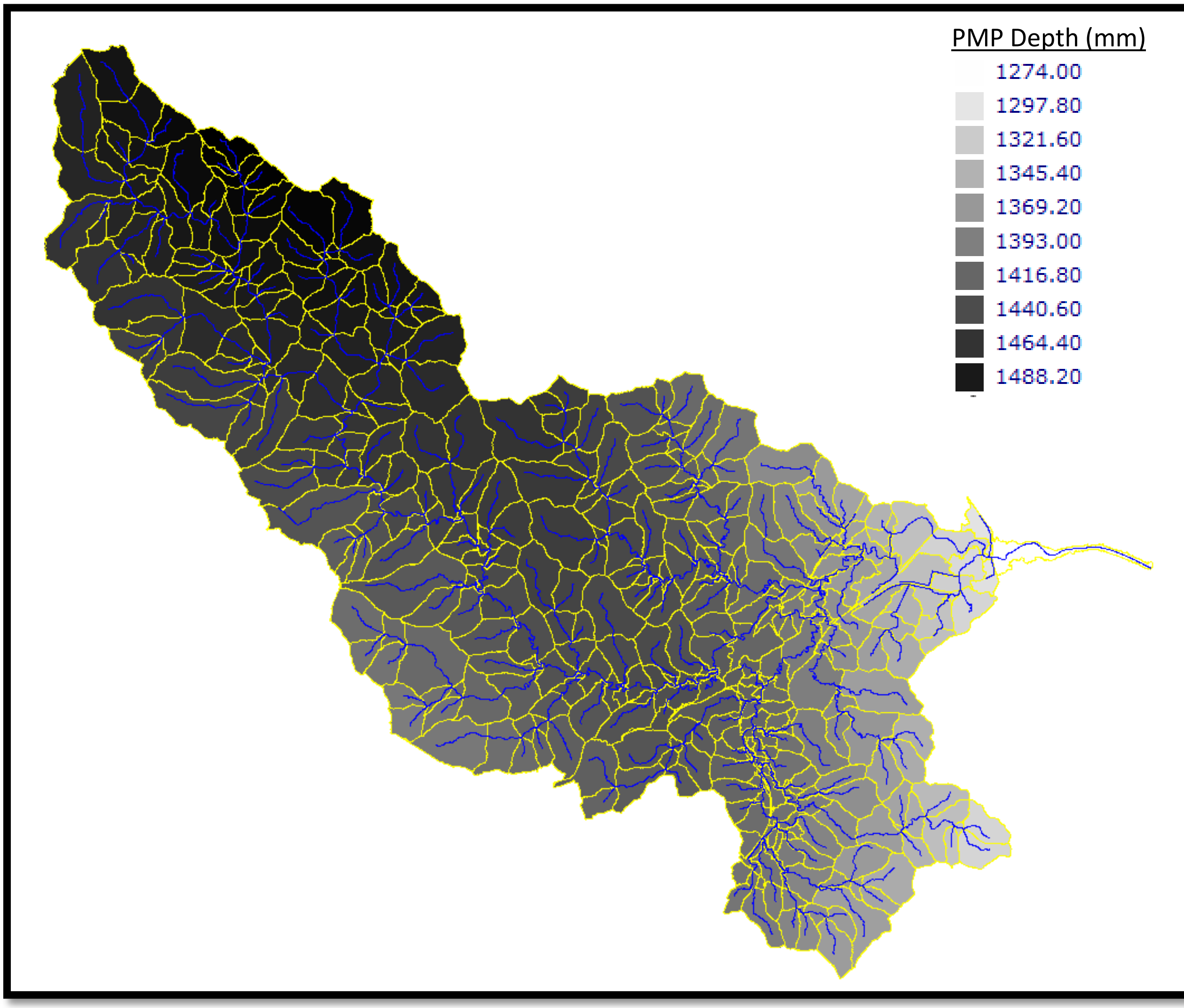
GTSMR SPATIAL DISTRIBUTION – 24 Hour



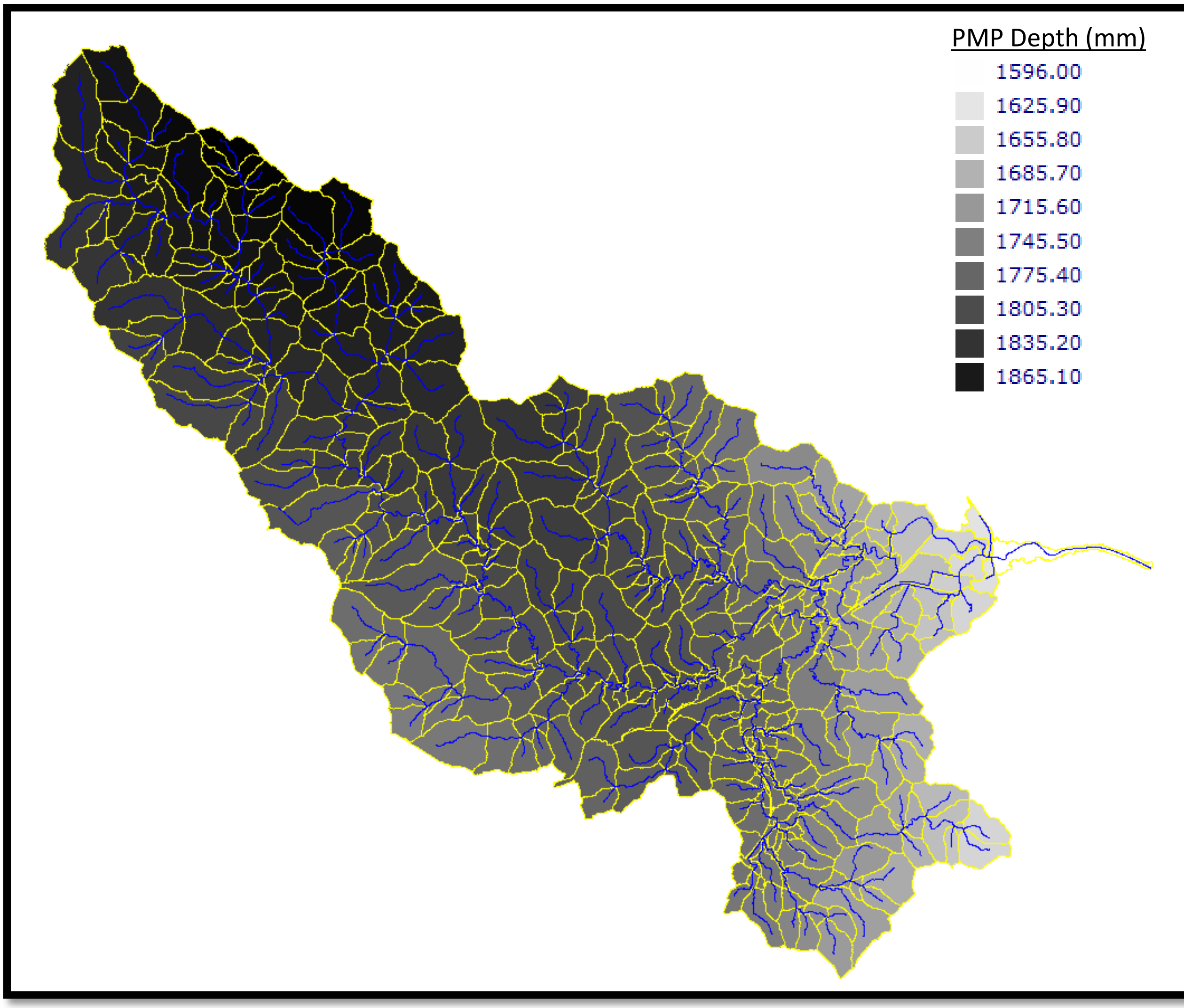
GTSMR SPATIAL DISTRIBUTION – 36 Hour



GTSMR SPATIAL DISTRIBUTION – 48 Hour



GTSMR SPATIAL DISTRIBUTION – 72 Hour



FINAL PMP ESTIMATES

Overview

The following table presents the final PMP estimates for the Ourimbah Creek catchment. They were developed based on the GSDM approach for storm durations up to and including the 6 hour event. For storms durations between 24 and 96 hours, the GTSMR and GSAM approaches were both investigated and the highest overall depth from both calculation approaches was adopted. The 12 hour PMP depth was interpolated based upon the final 6 hour and 24 hour PMP storm depths.

PMP VALUES (mm)

Duration (hours)	GSDM PMP Estimate	GSAM PMP Estimate	GTSMR PMP Estimate	Final PMP Estimate
0.25	110	-	-	110
0.5	160	-	-	160
0.75	210	-	-	210
1	250	-	-	250
1.5	330	-	-	330
2	370	-	-	370
2.5	430	-	-	430
3	460	-	-	460
4	520	-	-	520
5	560	-	-	560
6	600	-	-	600
12		-	-	790
24	-	1100	1010	1100
36	-	1230	1230	1230
48	-	1300	1430	1430
72	-	1360	1793	1793
96	-	1420	2010	2010

Prepared By D.Tetley Date 13-01-2013

Checked By D. Fedczyna Date 18-01-2013

Appendix F

XP-RAFTS Model Results For Design Flood Simulations

PEAK DESIGN FLOOD DISCHARGES - 20% AEP

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	3.41	5.43	5.70	7.19	**7.83**	6.68	6.26	4.36
1.02	6.17	9.63	10.8	**13.0**	12.9	12.6	12.0	8.51
1.03	9.7	14.7	16.2	**19.4**	19.3	18.7	17.7	12.6
1.04	13.1	18.8	20.0	24.5	**25.6**	23.9	22.8	16.2
1.05	22.2	32.2	34.4	42.3	**45.2**	42.3	40.6	29.1
1.06	29.7	41.3	43.5	53.5	**59.1**	54.4	52.5	37.7
1.07	37.5	52.1	54.6	67.2	**73.7**	66.8	63.9	45.7
1.08	42.4	58.2	61.7	75.6	**80.5**	74.1	70.3	50.5
1.09	47.9	66.3	70.5	86.0	**90.3**	83.7	79.0	56.8
1.10	49.9	70.5	74.8	91.3	**95.4**	89.0	83.6	60.1
1.11	59.9	87.4	92.0	112	**116**	108	101	73.0
1.12	61.5	91.3	96.6	117	**120**	114	107	77.2
1.13	62.0	92.6	98.3	119	**122**	116	109	78.7
1.14	63.1	95.1	101	123	**124**	120	112	81.2
1.15	63.7	96.9	104	126	**127**	123	115	83.5
1.16	66.0	99.6	109	**132**	130	128	120	87.4
1.17	77.2	121	134	**162**	156	158	148	108
1.18	84.5	135	152	**182**	174	178	168	123
1.19	82.9	129	152	**183**	173	180	172	127
1.20	82.7	129	153	**186**	175	182	174	128
1.21	115	182	221	**269**	248	257	244	180
1.22	115	180	221	**270**	251	258	246	181
1.23	115	180	222	**274**	260	260	250	183
1.24	115	180	222	**275**	263	261	251	183
1.25	115	180	226	**283**	269	268	258	189
1.26	115	178	226	**285**	275	270	261	191
1.27	115	178	226	**286**	276	270	262	192
1.28	114	177	226	**286**	278	271	263	193
1.29	114	177	227	**291**	287	275	268	196
1.30	114	177	227	**291**	288	276	268	196
1.31	116	178	232	**295**	291	279	275	201
1.32	112	172	229	**291**	285	276	273	201
1.33	112	172	229	**292**	288	280	275	203
1.34	111	170	229	**292**	288	281	276	203
1.35	110	167	228	**291**	287	283	277	204
1.36	110	167	228	294	294	**297**	283	210
1.37	110	166	228	296	300	**310**	288	216
1.38	108	163	226	295	299	**310**	290	216
1.39	108	161	226	295	300	**312**	291	218
1.40	106	159	224	293	297	**311**	290	218
1.41	106	158	224	293	297	**311**	290	219
1.42	105	157	223	292	297	**312**	290	219
1.43	105	156	222	291	297	**312**	291	220
1.44	105	156	222	291	297	**312**	291	221
1.45	104	154	221	291	297	**312**	291	221
1.46	104	154	221	291	297	**313**	292	222
1.47	103	153	220	290	296	**312**	292	222
1.48	103	153	220	280	284	**293**	281	222
1.49	103	154	223	288	308	331	**336**	247

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.50	103	153	223	288	308	331	**336**	247
1.51	110	180	252	338	394	404	**471**	289
1.52	110	180	253	340	395	405	**473**	291
1.53	109	180	253	339	395	405	**473**	291
1.54	110	180	253	340	396	405	**475**	292
1.55	111	182	257	349	402	414	**485**	297
1.56	110	182	257	349	402	415	**486**	297
1.57	109	180	256	349	403	416	**486**	298
1.58	108	178	256	349	403	415	**486**	297
1.59	109	180	259	357	411	427	**499**	305
1.60	98.4	172	247	346	410	421	**492**	301
2.01	2.42	3.45	3.54	4.49	**4.71**	3.83	3.40	2.35
3.01	2.78	3.21	2.75	**3.48**	3.36	2.34	1.85	1.28
4.01	4.10	5.83	6.97	8.21	**9.43**	8.95	9.07	6.56
4.02	7.89	12.2	13.3	16.3	**18.2**	16.9	16.5	11.9
5.01	2.50	3.90	4.77	5.63	6.37	6.41	**6.53**	4.77
5.02	6.52	8.51	8.40	10.3	**12.3**	10.6	10.4	7.44
6.01	1.28	1.71	1.74	2.05	**2.21**	1.68	1.39	0.96
7.01	3.71	5.85	6.17	7.79	**8.36**	7.12	6.65	4.62
7.02	7.73	10.9	11.4	14.0	**14.8**	12.6	11.4	7.95
8.01	1.12	1.43	1.41	1.65	**1.72**	1.32	1.07	0.74
9.01	3.36	4.48	4.44	5.30	**5.47**	4.26	3.54	2.43
10.01	5.59	7.89	8.11	10.1	**10.3**	8.40	7.21	4.96
11.01	2.30	2.81	2.59	3.04	**3.07**	2.28	1.81	1.25
12.01	3.88	5.02	4.84	5.54	**5.81**	4.29	3.44	2.37
12.02	7.82	9.89	9.41	11.0	**11.1**	8.51	6.95	4.78
12.03	11.8	15.3	14.7	**17.4**	17.1	13.5	11.2	7.69
12.04	17.0	22.2	21.6	**26.0**	24.7	20.2	17.0	11.7
13.01	2.16	2.47	2.13	**2.67**	2.60	1.83	1.45	0.99
14.01	2.38	3.01	2.92	3.40	**3.49**	2.68	2.17	1.49
15.01	2.89	3.76	3.66	4.34	**4.46**	3.45	2.83	1.94
16.01	1.59	1.99	1.84	2.16	**2.19**	1.61	1.28	0.88
16.02	4.14	5.10	4.88	5.69	**5.84**	4.38	3.55	2.43
16.03	6.87	8.39	7.98	9.36	**9.56**	7.15	5.78	3.97
17.01	1.90	2.44	2.36	2.74	**2.80**	2.15	1.74	1.19
18.01	2.58	3.21	2.96	3.46	**3.52**	2.62	2.10	1.44
19.01	2.14	2.67	2.53	2.93	**2.98**	2.25	1.81	1.24
20.01	3.00	3.85	3.72	4.34	**4.46**	3.39	2.75	1.89
21.01	2.07	2.42	2.17	**2.63**	2.60	1.87	1.49	1.02
22.01	2.51	3.18	3.03	3.51	**3.60**	2.73	2.21	1.51
23.01	6.42	9.54	9.90	12.5	**12.9**	10.8	9.76	6.73
23.02	17.6	25.6	26.6	**33.0**	32.8	28.2	25.2	17.5
23.03	19.1	27.8	29.2	**36.0**	35.9	31.0	27.8	19.3
23.04	20.2	29.6	31.1	**38.3**	38.3	33.3	29.9	20.8
24.01	2.41	3.24	3.26	4.02	**4.09**	3.26	2.77	1.91
24.02	6.67	9.13	9.18	**11.3**	11.1	9.18	7.91	5.45
25.01	1.31	1.80	1.82	2.27	**2.33**	1.87	1.59	1.09
26.01	2.24	2.60	2.27	**2.79**	2.75	1.97	1.56	1.07
27.01	6.48	9.14	9.32	11.6	**11.9**	9.61	8.26	5.69
27.02	11.4	15.3	15.2	18.3	**19.3**	15.2	12.8	8.80
27.03	17.1	23.1	23.7	29.4	**30.5**	24.8	21.5	14.8

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
28.01	3.67	4.73	4.57	5.29	**5.47**	4.09	3.29	2.26
29.01	5.61	8.31	8.67	10.9	**11.2**	9.46	8.52	5.88
30.01	4.59	6.78	7.11	8.91	**9.08**	7.59	6.75	4.65
31.01	6.11	8.10	8.00	9.50	**9.80**	7.63	6.28	4.31
31.02	9.27	12.3	12.3	15.0	**15.2**	12.0	10.1	6.96
31.03	14.1	19.3	19.8	24.4	**24.6**	20.1	17.4	11.9
31.04	17.6	24.1	24.7	30.5	**30.7**	25.3	21.9	15.1
31.05	21.5	29.8	30.6	**37.6**	37.5	31.5	27.6	19.1
31.06	25.6	35.3	36.5	**44.6**	44.2	37.7	33.1	22.9
31.07	29.3	41.2	42.9	**52.2**	50.7	45.0	39.8	28.1
31.08	44.5	64.0	72.3	**85.5**	80.4	77.9	71.6	51.6
31.09	44.4	64.3	73.0	**86.9**	81.6	79.1	72.8	53.2
32.01	2.93	3.97	4.00	4.96	**5.06**	4.02	3.42	2.35
33.01	4.81	7.08	7.42	9.29	**9.49**	7.96	7.08	4.88
34.01	2.54	3.63	3.75	4.74	**4.79**	3.98	3.56	2.45
35.01	2.16	3.00	3.08	3.83	**3.84**	3.17	2.79	1.92
36.01	2.01	2.51	2.37	2.75	**2.80**	2.10	1.69	1.16
37.01	2.65	3.35	3.15	3.67	**3.74**	2.82	2.26	1.55
38.01	2.61	3.83	3.98	5.06	**5.21**	4.39	3.99	2.75
38.02	5.30	7.17	7.43	9.32	**9.62**	7.91	6.94	4.79
38.03	12.2	16.3	16.4	19.9	**20.4**	16.9	14.8	10.2
38.04	21.6	30.2	31.7	39.1	**40.2**	34.5	31.0	21.6
39.01	2.36	3.08	3.08	3.72	**3.77**	3.00	2.51	1.72
40.01	1.69	2.29	2.29	2.77	**2.81**	2.26	1.89	1.30
40.02	4.39	5.54	5.29	6.20	**6.36**	4.97	4.12	2.83
41.01	1.50	1.79	1.60	**1.95**	1.94	1.38	1.10	0.75
42.01	4.70	7.34	7.90	9.75	**10.3**	9.09	8.50	5.90
42.02	9.39	14.4	15.3	19.1	**20.0**	17.3	15.9	11.1
43.01	4.12	6.25	6.57	8.31	**8.56**	7.25	6.56	4.53
44.01	2.35	3.01	2.95	3.47	**3.55**	2.76	2.27	1.56
45.01	3.56	5.15	5.30	6.61	**6.68**	5.50	4.80	3.30
46.01	4.31	6.55	6.90	8.77	**9.17**	7.60	6.84	4.73
46.02	8.55	12.1	12.5	15.5	**15.8**	13.3	11.8	8.16
47.01	2.84	3.63	3.52	4.13	**4.23**	3.24	2.64	1.81
48.01	2.66	3.82	3.95	5.01	**5.12**	4.21	3.76	2.59
49.01	7.63	8.12	9.61	11.1	**13.1**	11.5	11.4	8.08
50.01	2.30	3.21	3.30	4.12	**4.13**	3.41	3.00	2.07
51.01	2.28	**2.70**	2.14	2.55	2.36	1.56	1.23	0.85
51.02	6.69	7.83	6.43	**8.40**	7.87	5.57	4.41	3.04
51.03	9.66	12.1	11.0	**13.4**	13.0	10.3	8.69	6.01
52.01	3.69	4.37	3.92	**4.86**	4.78	3.36	2.67	1.84
53.01	2.82	3.21	2.68	**3.43**	3.26	2.24	1.77	1.22
54.01	1.71	2.24	2.19	2.54	**2.62**	2.03	1.65	1.13
55.01	2.83	4.49	5.09	6.06	**6.52**	5.94	5.74	4.02
56.01	4.61	7.06	7.46	9.34	**9.70**	8.37	7.64	5.28
56.02	8.37	13.7	15.1	18.4	**18.9**	18.0	16.9	12.2
56.03	9.33	15.2	17.2	20.9	**21.4**	20.7	19.6	14.1
57.01	3.15	4.98	5.33	6.57	**6.97**	6.18	5.84	4.06
58.01	2.28	3.06	3.10	3.82	**3.84**	3.10	2.65	1.82
59.01	1.13	1.60	1.69	2.15	**2.24**	1.82	1.61	1.11
60.01	2.56	3.89	4.23	5.23	**5.54**	4.89	4.61	3.21

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.02	4.78	7.10	8.14	**10.0**	9.36	9.35	8.68	6.41
61.01	2.42	3.58	3.73	4.70	**4.86**	4.16	3.82	2.64
62.01	1.14	1.60	1.69	2.15	**2.20**	1.83	1.62	1.12
63.01	3.64	6.41	7.79	9.18	9.92	10.4	**10.5**	7.64
63.02	5.97	9.91	11.6	13.7	**15.0**	14.8	14.7	10.7
64.01	2.24	3.37	3.66	4.47	**4.75**	4.19	3.97	2.76
65.01	2.12	3.16	3.35	4.13	**4.38**	3.81	3.57	2.48
66.01	2.04	3.20	3.69	4.30	**4.71**	4.36	4.31	3.05
67.01	2.62	4.19	4.92	5.76	**6.25**	5.83	5.76	4.07
67.02	5.82	7.48	8.01	10.1	**11.6**	10.0	9.51	6.68
67.03	14.6	19.5	20.2	24.8	**27.3**	24.3	22.5	15.9
67.04	19.9	27.3	27.2	33.7	**35.0**	31.3	29.2	20.6
67.05	24.3	33.2	33.6	41.6	**43.4**	39.2	36.4	25.9
67.06	24.5	34.4	35.8	43.9	**45.5**	42.7	39.7	28.7
67.07	25.4	35.6	38.3	46.8	**47.3**	45.6	42.7	30.8
68.01	1.42	2.15	2.19	2.76	**2.86**	2.41	2.16	1.49
69.01	4.45	5.26	4.74	**5.84**	5.79	4.09	3.24	2.24
70.01	2.69	3.59	3.64	4.33	**4.61**	3.55	2.95	2.04
70.02	6.80	8.89	8.39	9.55	**10.1**	7.70	6.27	4.34
71.01	2.59	3.19	3.05	3.46	**3.66**	2.67	2.14	1.48
72.01	2.60	3.23	3.01	3.50	**3.58**	2.65	2.12	1.46
73.01	1.62	2.53	2.76	3.29	**3.54**	3.17	3.04	2.13
74.01	4.91	7.50	7.84	9.96	**10.6**	8.75	7.82	5.43
74.02	7.06	10.9	11.6	14.5	**15.1**	13.1	12.1	8.42
74.03	9.66	13.9	14.9	18.6	**18.8**	16.6	15.2	10.7
74.04	11.3	15.7	16.9	20.9	**21.4**	18.9	17.2	12.1
74.05	14.8	21.1	22.7	28.0	**28.6**	25.7	23.5	16.6
74.06	14.3	20.4	23.1	**28.3**	27.1	26.0	24.2	17.4
74.07	14.3	20.4	23.1	**28.3**	27.1	26.0	24.2	17.5
75.01	2.15	2.76	2.74	3.21	**3.32**	2.58	2.11	1.45
76.01	1.57	2.07	2.01	2.32	**2.40**	1.85	1.51	1.03
77.01	2.54	3.84	4.13	5.18	**5.60**	4.77	4.48	3.12
78.01	2.27	3.70	4.42	5.25	**5.67**	5.60	5.64	4.04
78.02	5.66	8.47	9.32	11.5	**12.4**	11.5	11.0	7.90
78.03	7.80	11.5	12.6	15.6	**16.1**	15.4	14.5	10.5
79.01	2.15	3.16	3.29	4.11	**4.25**	3.67	3.38	2.34
80.01	1.57	2.08	2.04	2.37	**2.45**	1.90	1.56	1.07
81.01	1.71	2.83	3.30	3.86	**4.20**	4.10	4.11	2.95
82.01	2.74	4.58	5.46	6.44	**6.97**	6.87	6.89	4.96
82.02	3.85	6.41	7.80	9.27	9.70	**10.2**	9.79	7.33
83.01	1.96	3.05	3.53	4.07	**4.62**	4.16	4.14	2.94
83.02	2.29	3.57	3.96	4.65	**5.29**	4.76	4.68	3.33
84.01	1.66	2.73	3.15	3.67	**3.95**	3.79	3.77	2.69
84.02	1.62	2.66	3.14	3.76	3.73	**3.91**	3.78	2.78
85.01	1.99	2.07	1.80	2.04	**2.22**	1.62	1.30	0.91
85.02	2.25	2.64	2.93	3.50	3.10	**3.65**	3.51	2.60
86.01	3.02	**3.03**	1.95	2.05	2.37	1.83	1.58	1.11
87.01	1.38	2.37	2.84	3.34	3.64	3.83	**3.86**	2.84
87.02	1.54	2.58	3.05	3.58	3.96	4.09	**4.11**	3.02
88.01	1.02	1.67	2.05	2.38	**2.60**	2.50	2.49	1.78
89.01	4.09	6.94	8.28	9.71	**10.5**	10.1	10.0	7.14

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
89.02	9.68	14.3	15.0	18.6	**20.0**	17.9	16.9	11.9
89.03	13.9	20.5	21.5	26.6	**28.1**	24.9	23.1	16.3
89.04	17.8	26.6	28.5	35.2	**36.4**	33.1	30.8	21.8
89.05	21.0	31.4	33.9	41.7	**42.7**	39.1	36.4	25.9
89.06	23.4	34.9	38.5	**47.4**	47.2	44.4	41.1	29.5
89.07	27.8	41.8	47.6	**58.4**	57.4	57.4	54.1	39.3
89.08	29.0	43.5	50.3	**61.7**	59.8	60.9	57.2	41.9
89.09	29.2	43.9	51.5	**63.4**	60.8	62.7	59.0	43.3
89.10	29.4	44.3	52.0	**64.3**	61.5	63.6	59.9	44.0
89.11	29.4	44.3	52.5	**65.4**	62.1	64.7	61.0	44.9
89.12	29.6	44.8	54.2	**68.3**	64.4	67.4	64.0	47.3
89.13	29.7	44.7	55.2	**70.2**	65.8	69.4	66.1	49.1
89.14	29.6	44.8	55.4	**70.6**	66.4	69.9	66.7	49.5
89.15	35.8	52.9	66.9	90.6	90.6	**98.6**	97.6	69.3
89.16	36.0	53.3	68.4	92.6	92.7	**100**	99.3	70.6
89.17	35.7	52.9	68.9	93.9	94.2	**102**	101	71.7
90.01	1.57	2.09	2.05	2.37	**2.45**	1.90	1.56	1.07
90.02	5.17	7.25	7.28	8.77	**8.82**	7.31	6.31	4.34
91.01	1.77	2.52	2.58	3.18	**3.20**	2.66	2.34	1.61
92.01	2.86	4.16	4.28	5.41	**5.51**	4.58	4.08	2.81
93.01	3.77	6.00	6.63	8.08	**8.66**	7.71	7.33	5.11
94.01	2.94	4.44	4.58	5.79	**5.97**	5.11	4.63	3.20
95.01	2.33	3.05	3.03	3.65	**3.70**	2.94	2.45	1.68
96.01	3.18	5.50	6.51	7.76	8.41	8.39	**8.44**	6.09
96.02	5.09	7.62	8.57	10.4	**11.4**	10.9	10.8	7.76
97.01	1.67	2.28	2.30	2.80	**2.83**	2.30	1.94	1.33
98.01	2.37	3.52	3.69	4.63	**4.81**	4.14	3.83	2.65
99.01	1.29	1.73	1.76	2.18	**2.23**	1.78	1.50	1.03
100.01	0.85	1.31	1.37	1.71	**1.82**	1.57	1.45	1.00
101.01	1.15	1.62	1.72	2.19	**2.26**	1.86	1.65	1.14
102.01	1.28	2.00	2.16	2.62	**2.80**	2.51	2.39	1.67
103.01	1.63	2.46	2.52	3.13	**3.22**	2.77	2.54	1.75
104.01	0.68	1.05	1.08	1.38	**1.47**	1.23	1.11	0.77
105.01	3.18	4.94	5.15	6.45	**6.74**	5.86	5.41	3.75
105.02	5.09	6.77	7.09	8.86	**9.53**	7.92	7.09	4.91
105.03	8.45	11.6	12.2	15.2	**15.8**	13.7	12.4	8.64
105.04	8.03	12.5	14.1	**16.8**	16.0	15.8	14.9	10.7
105.05	8.74	13.5	15.7	**19.8**	18.1	19.1	17.3	13.6
105.06	9.36	14.4	17.5	**22.8**	20.1	22.6	20.7	16.3
105.07	11.1	17.5	22.3	29.7	26.6	**30.9**	29.2	22.8
105.08	11.3	17.9	23.0	31.0	28.5	**32.5**	31.0	24.1
105.09	13.3	20.0	25.9	35.3	31.7	**36.4**	34.8	26.9
105.10	11.7	19.7	25.1	34.8	32.9	**36.5**	35.4	26.6
105.11	11.8	19.8	25.1	35.2	33.9	**37.0**	35.9	26.8
106.01	1.77	2.18	2.03	2.38	**2.41**	1.77	1.41	0.97
107.01	2.63	3.92	4.12	5.21	**5.42**	4.67	4.30	2.98
108.01	2.43	3.25	3.28	4.05	**4.08**	3.28	2.80	1.92
109.01	2.27	3.36	3.55	4.43	**4.62**	4.02	3.75	2.60
110.01	2.21	3.19	3.29	4.14	**4.21**	3.58	3.25	2.24
111.01	2.20	3.66	4.44	5.24	5.70	5.87	**5.93**	4.32
111.02	4.66	6.68	7.17	8.86	**9.70**	9.25	9.00	6.51

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
112.01	1.89	2.50	2.48	2.97	**3.03**	2.41	2.01	1.38
113.01	1.26	1.87	1.95	2.43	**2.51**	2.15	1.95	1.34
114.01	1.65	2.31	2.34	2.88	**2.90**	2.38	2.05	1.41
115.01	1.70	2.31	2.33	2.83	**2.87**	2.31	1.95	1.34
116.01	1.39	1.84	1.78	2.10	**2.17**	1.67	1.36	0.94
117.01	1.47	2.40	2.74	3.22	**3.53**	3.27	3.24	2.30
118.01	0.95	1.31	1.35	1.68	**1.71**	1.38	1.18	0.81
119.01	1.82	2.80	3.08	3.66	**3.99**	3.53	3.40	2.38
119.02	3.56	5.53	6.05	7.16	**7.92**	7.09	6.86	4.84
119.03	5.91	9.24	10.1	12.2	**12.8**	12.2	11.7	8.44
119.04	8.53	13.3	14.8	17.8	**18.0**	17.6	16.7	12.1
119.05	9.55	14.9	16.6	19.9	**20.2**	19.9	19.0	13.8
119.06	12.1	18.9	21.3	25.6	25.6	**25.8**	24.4	17.9
119.07	13.0	20.6	23.5	28.3	28.1	**28.9**	27.4	20.3
119.08	11.8	19.2	22.9	27.7	26.8	**28.3**	27.1	20.1
119.09	12.7	21.0	25.5	32.1	31.0	**32.7**	31.5	23.7
119.10	12.8	21.4	26.3	33.2	31.9	**34.1**	33.0	24.9
119.11	20.5	35.5	45.7	63.0	71.1	69.8	**71.9**	52.8
119.12	20.5	35.6	46.0	64.2	**73.3**	70.7	73.1	53.6
119.13	20.5	35.6	46.0	64.9	**74.8**	71.3	74.0	54.1
119.14	20.5	35.6	46.0	65.0	**75.0**	71.4	74.1	54.1
119.15	23.1	39.8	52.6	73.9	84.2	81.4	**84.4**	61.6
119.16	23.1	39.7	52.7	74.2	84.9	81.8	**85.0**	61.9
119.17	32.2	52.3	71.5	93.3	104	107	**111**	80.8
119.18	32.3	52.5	71.7	93.9	106	108	**112**	81.4
119.19	32.2	52.5	71.6	93.9	106	108	**112**	81.4
119.20	31.6	51.8	71.4	93.9	105	108	**112**	81.2
119.21	31.1	51.5	71.5	94.4	106	109	**113**	81.5
119.22	31.1	51.5	71.6	94.7	106	109	**113**	81.9
119.23	35.7	61.6	81.2	111	127	131	**137**	97.5
120.01	1.52	2.49	2.80	3.29	**3.57**	3.30	3.24	2.29
121.01	1.17	1.56	1.59	1.97	**2.05**	1.61	1.35	0.93
122.01	2.14	3.18	3.35	4.18	**4.44**	3.80	3.55	2.46
123.01	1.41	2.14	2.19	2.76	**2.89**	2.43	2.18	1.51
124.01	1.65	2.36	2.38	2.94	**2.99**	2.45	2.11	1.46
125.01	1.41	2.40	2.84	3.34	3.67	3.77	**3.80**	2.77
125.02	2.93	4.63	5.19	6.16	**6.84**	6.50	6.43	4.66
126.01	1.49	2.12	2.21	2.78	**2.99**	2.50	2.26	1.57
127.01	1.22	1.47	1.52	1.86	**2.00**	1.55	1.31	0.91
127.02	1.08	1.53	1.75	**2.10**	1.93	1.78	1.63	1.15
128.01	4.32	4.46	3.31	4.13	5.02	5.34	**5.53**	4.12
128.02	7.66	12.2	14.4	17.2	18.0	**19.5**	19.0	14.2
128.03	10.3	16.5	20.9	26.4	24.4	**27.9**	27.3	21.2
128.04	10.4	16.6	21.3	27.0	25.9	**28.8**	28.5	22.1
128.05	10.8	17.3	23.2	30.7	31.6	32.5	**32.9**	25.3
128.06	10.8	17.4	23.4	31.8	**34.8**	33.8	34.6	26.1
128.07	12.3	17.7	23.8	33.1	**38.0**	35.3	36.5	27.3
128.08	13.1	17.7	23.8	33.5	**39.3**	35.9	37.2	27.6
128.09	13.6	17.6	23.9	33.9	**40.3**	36.3	37.8	28.0
128.10	14.5	18.9	24.1	34.6	**42.1**	37.2	38.9	28.6
128.11	14.5	19.0	24.1	34.6	**42.1**	37.3	38.9	28.6

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.12	14.8	19.7	24.2	34.9	**42.8**	37.6	39.4	28.8
129.01	2.00	3.18	3.72	4.32	**4.85**	4.48	4.49	3.19
129.02	3.76	5.44	5.77	7.18	**7.83**	7.08	6.80	4.84
129.03	5.57	8.54	9.51	11.4	**12.4**	11.8	11.5	8.39
130.01	1.42	2.04	2.04	2.56	**2.67**	2.14	1.82	1.26
131.01	3.34	3.43	3.18	3.65	**4.46**	3.97	4.06	2.94
132.01	2.11	3.17	3.45	4.17	**4.56**	3.95	3.77	2.63
132.02	3.54	5.31	5.81	7.07	**7.30**	6.67	6.26	4.43
132.03	4.74	6.98	7.67	9.32	**9.56**	8.79	8.24	5.84
132.04	5.50	8.18	9.34	**11.4**	10.9	10.8	10.0	7.59
132.05	5.51	8.20	9.37	**11.5**	11.1	10.8	10.1	7.70
133.01	1.01	1.51	1.60	2.05	**2.18**	1.80	1.62	1.12
134.01	1.31	1.93	1.99	2.52	**2.66**	2.16	1.89	1.31
135.01	1.38	2.03	2.07	2.61	**2.74**	2.23	1.93	1.33
136.01	2.88	**2.88**	2.18	2.44	2.79	2.06	1.70	1.19
136.02	2.78	**2.86**	1.98	1.61	1.95	2.16	1.93	1.58
137.01	1.84	1.89	2.26	2.59	**3.07**	3.00	3.06	2.25
137.02	5.30	5.21	3.84	4.80	**5.90**	5.00	4.92	3.56
137.03	0.00	3.13	3.65	4.22	4.27	**4.86**	4.85	3.70
137.04	4.25	4.39	4.52	5.24	5.67	5.90	**6.00**	4.50
137.05	5.12	5.78	5.41	6.19	6.38	7.10	**7.18**	5.38
138.01	1.70	1.66	1.36	1.76	**1.96**	1.58	1.40	0.98
139.01	**2.59**	2.53	1.63	1.53	1.69	1.24	1.03	0.73
140.01	**3.39**	3.20	2.21	2.16	2.07	1.43	1.15	0.81
141.01	**3.03**	2.97	2.01	2.48	2.84	2.24	1.99	1.39
141.02	6.25	**6.63**	4.54	4.59	5.37	4.17	3.64	2.57
141.03	7.65	**7.84**	5.42	5.36	6.29	4.87	4.23	2.99
141.04	6.51	**7.03**	5.44	6.06	6.91	5.53	4.93	3.48
142.01	**1.30**	1.25	0.84	0.78	0.75	0.51	0.41	0.29
143.01	0.17	0.26	0.27	0.33	**0.36**	0.31	0.29	0.20
144.01	3.62	3.67	2.59	3.14	**3.78**	3.22	3.11	2.22
144.02	3.08	3.38	2.99	3.61	**4.24**	3.80	3.70	2.67
145.01	0.90	1.17	1.18	1.52	**1.64**	1.36	1.23	0.85
146.01	1.58	1.62	1.73	2.01	**2.46**	2.26	2.32	1.68
147.01	1.54	**1.63**	1.03	0.96	1.24	1.02	0.98	0.71
148.01	**5.56**	5.32	3.52	3.67	4.26	3.27	2.81	1.98
148.02	3.70	3.44	3.06	3.56	**3.89**	3.19	2.90	2.04
149.01	**2.57**	2.46	1.79	2.01	2.17	1.58	1.28	0.90
149.02	2.65	**2.87**	1.90	2.18	2.31	1.71	1.38	0.97
150.01	1.69	2.94	3.55	4.24	4.64	5.13	**5.22**	3.84
150.02	1.84	3.19	3.96	4.76	4.94	**5.70**	5.65	4.26
150.03	2.52	4.46	5.35	6.40	6.76	**7.72**	7.57	5.75
150.04	2.51	4.46	5.36	6.43	6.77	**7.73**	7.58	5.76
150.05	3.53	5.07	7.29	9.50	9.48	**10.9**	10.7	7.74
151.01	1.61	1.59	1.24	1.62	**1.84**	1.52	1.39	0.97
152.01	**3.62**	3.58	2.28	2.34	3.03	2.55	2.50	1.80
152.02	2.80	2.77	2.29	2.79	**3.38**	2.96	2.93	2.12
152.03	1.49	1.92	2.25	2.82	3.07	**3.08**	3.05	2.19
152.04	2.26	2.33	2.33	3.24	**3.80**	3.40	3.43	2.34
153.01	5.10	5.16	4.85	5.90	**6.91**	5.88	5.64	3.98
153.02	4.89	7.63	8.82	10.5	10.6	**10.9**	10.6	7.79

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
153.03	5.92	9.13	10.5	12.5	12.8	**13.2**	13.0	9.54
153.04	8.28	12.6	14.7	17.3	17.7	**18.3**	18.1	13.2
153.05	10.6	15.9	18.4	21.7	22.2	**22.7**	22.2	16.2
153.06	11.6	17.7	21.4	25.6	24.8	**26.7**	25.7	19.2
153.07	11.6	17.7	21.4	25.8	24.9	**26.8**	25.8	19.3
153.08	12.6	19.0	22.9	27.7	26.8	**28.7**	27.7	20.6
154.01	1.68	2.40	2.40	2.98	**3.06**	2.48	2.13	1.47
155.01	1.92	1.92	1.81	2.34	**2.56**	2.04	1.80	1.26
156.01	2.22	3.50	4.09	4.79	**5.31**	4.89	4.86	3.44
157.01	1.86	2.80	2.87	3.61	**3.81**	3.17	2.87	1.99
158.01	1.02	1.49	1.58	2.02	**2.10**	1.73	1.55	1.07
159.01	1.37	1.69	1.74	2.08	**2.26**	1.72	1.43	0.99
159.02	1.57	2.03	2.07	2.54	**2.57**	2.08	1.79	1.25
160.01	1.11	**1.13**	0.73	0.80	1.00	0.83	0.80	0.57
160.02	**3.16**	2.98	2.16	2.05	2.50	1.95	1.75	1.25
160.03	**3.94**	3.94	3.23	3.01	3.54	2.73	2.43	1.75
160.04	3.87	**4.14**	3.25	3.03	3.55	2.75	2.45	1.76
161.01	1.90	1.84	1.26	9.93	12.4	**19.0**	10.7	0.59
161.02	1.58	1.70	1.72	9.75	12.2	**18.9**	10.6	1.02
161.03	2.40	3.43	3.65	9.22	11.9	**18.8**	10.5	2.59
162.01	0.68	0.93	0.93	1.17	**1.19**	0.96	0.81	0.56
163.01	2.02	2.93	3.01	3.78	**3.91**	3.26	2.94	2.03
163.02	4.15	6.00	6.39	7.89	**8.28**	7.17	6.64	4.64
163.03	6.68	10.2	12.0	14.5	14.1	**15.1**	14.1	10.7
163.04	7.88	11.6	14.2	17.4	16.6	**17.8**	17.0	12.7
163.05	9.39	14.6	18.5	23.3	23.7	25.2	**25.5**	18.8
163.06	9.35	14.5	18.5	23.5	24.1	25.3	**25.6**	18.9
163.07	9.34	14.5	18.8	24.7	25.8	26.2	**26.8**	19.7
163.08	9.16	14.1	18.7	24.6	25.4	26.1	**26.8**	19.7
164.01	2.03	3.03	3.25	3.95	**4.23**	3.69	3.49	2.43
165.01	1.69	2.70	3.07	3.55	**4.01**	3.58	3.55	2.51
166.01	1.22	1.84	2.00	2.50	**2.69**	2.33	2.16	1.51
167.01	2.18	2.31	2.69	3.81	4.98	4.91	**5.47**	3.84
168.01	1.19	1.73	1.82	2.32	**2.42**	2.00	1.77	1.23
169.01	2.08	3.12	3.40	4.11	**4.38**	3.89	3.70	2.58
169.02	2.86	4.41	5.00	5.88	6.83	6.74	**7.33**	5.18
169.03	2.90	4.47	5.10	6.08	6.79	6.93	**7.41**	5.23
170.01	1.89	1.91	1.77	2.11	**2.54**	2.17	2.10	1.48
170.02	1.60	2.33	2.73	3.21	**3.57**	3.46	3.43	2.50
170.03	2.07	3.32	4.11	5.15	5.00	**5.94**	5.73	4.41
171.01	2.14	3.63	4.46	5.32	5.74	6.28	**6.36**	4.70
171.02	2.62	4.51	5.77	7.28	7.41	8.57	**8.69**	6.46
171.03	3.96	6.88	8.84	11.0	10.9	**13.0**	13.0	9.75
171.04	4.12	7.32	9.46	11.9	12.1	14.4	**14.4**	10.8
171.05	5.76	9.55	13.0	16.6	17.2	19.8	**20.2**	15.0
171.06	5.77	9.54	13.1	16.7	17.3	19.9	**20.3**	15.0
172.01	1.50	1.62	1.92	2.21	**2.63**	2.36	2.37	1.69
173.01	2.05	2.05	1.64	1.92	**2.45**	2.29	2.37	1.73
174.01	1.31	1.29	1.06	1.28	**1.43**	1.09	0.91	0.64
175.01	1.00	1.74	2.31	2.94	3.43	3.74	**3.84**	2.91
175.02	1.65	2.93	3.83	4.82	5.10	5.78	**5.89**	4.41

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
176.01	1.06	1.32	1.57	1.87	2.19	2.17	**2.22**	1.61
177.01	1.28	1.43	1.65	2.01	2.36	2.47	**2.52**	1.87
178.01	1.36	1.86	1.82	2.22	**2.30**	1.81	1.51	1.04
178.02	2.50	3.34	3.35	4.10	**4.26**	3.35	2.80	1.93
179.01	2.23	2.29	2.60	3.04	3.60	3.62	**3.68**	2.73
179.02	4.03	5.33	6.42	7.41	**8.57**	8.11	8.21	5.96
179.03	3.70	5.92	7.53	8.88	9.31	**10.2**	10.0	7.51
179.04	3.23	6.42	7.98	9.95	9.83	11.3	**11.5**	8.64
179.05	3.43	6.75	8.48	11.2	12.5	12.6	**13.1**	9.50
179.06	3.79	7.44	9.53	12.9	15.0	14.8	**15.5**	11.1
179.07	14.9	16.1	13.2	13.3	16.9	**17.3**	17.1	12.5
180.01	1.38	1.83	2.24	2.58	**2.95**	2.69	2.69	1.92
181.01	5.60	**5.83**	3.57	2.73	3.15	2.45	2.27	1.65
182.01	0.97	1.37	1.41	1.76	**1.82**	1.46	1.25	0.86
182.02	1.54	2.44	2.64	3.26	3.28	**3.44**	3.41	2.47
183.01	1.29	1.38	1.03	1.54	2.08	1.95	**2.34**	1.53
184.01	13.7	**14.1**	9.24	6.46	6.51	4.69	4.18	3.08
185.01	8.05	**8.47**	5.24	3.75	3.67	2.54	2.08	1.51
186.01	**3.35**	3.30	2.05	1.66	1.84	1.36	1.14	0.81
186.02	**4.38**	4.21	3.25	2.60	2.77	2.02	1.71	1.23

PEAK DESIGN FLOOD DISCHARGES - 10% AEP

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	4.50	6.96	7.07	8.88	**9.25**	7.81	7.25	5.10
1.02	8.00	12.4	13.3	**15.6**	15.3	14.6	13.9	9.94
1.03	12.6	18.7	19.8	**23.3**	23.0	21.6	20.6	14.8
1.04	16.9	23.7	24.4	29.7	**30.3**	27.7	26.5	18.9
1.05	28.8	40.7	42.1	51.4	**53.4**	49.2	47.2	34.0
1.06	38.3	52.2	53.5	65.0	**70.0**	63.4	61.1	44.2
1.07	48.5	65.5	67.4	81.7	**87.2**	78.0	74.4	53.6
1.08	55.0	73.7	75.9	91.7	**95.1**	86.5	81.8	59.2
1.09	62.3	84.4	86.5	104	**107**	97.7	92.1	66.7
1.10	65.6	89.8	92.0	111	**113**	104	97.4	70.7
1.11	80.4	112	113	136	**137**	127	118	85.8
1.12	82.9	117	119	143	**143**	133	125	90.7
1.13	83.6	119	121	**145**	144	135	127	92.5
1.14	85.4	122	124	**149**	148	140	131	95.5
1.15	86.2	124	127	**153**	150	144	135	98.3
1.16	89.2	130	134	**160**	154	150	141	103
1.17	106	158	165	**197**	186	184	174	128
1.18	116	177	187	**222**	207	208	197	145
1.19	113	175	188	**224**	206	212	203	150
1.20	114	176	190	**227**	208	214	205	152
1.21	163	252	272	**330**	293	300	287	213
1.22	163	252	273	**332**	296	301	289	214
1.23	163	252	274	**338**	307	305	294	217
1.24	162	252	274	**339**	310	306	295	218
1.25	163	256	281	**347**	318	317	306	226
1.26	162	255	281	**351**	325	319	310	229
1.27	162	255	281	**351**	326	320	310	229
1.28	162	255	280	**353**	329	321	312	232
1.29	162	255	282	**361**	344	327	319	236
1.30	162	255	282	**361**	345	327	320	237
1.31	162	260	284	**366**	348	332	325	244
1.32	158	256	281	**362**	341	329	323	243
1.33	158	256	281	**364**	346	334	327	245
1.34	157	254	280	**364**	347	335	328	246
1.35	156	253	279	**364**	347	337	329	247
1.36	155	253	280	**369**	358	352	337	254
1.37	155	253	280	**374**	370	366	345	260
1.38	153	249	278	**372**	368	365	346	262
1.39	152	248	277	**373**	369	368	348	264
1.40	150	246	275	**370**	366	367	347	264
1.41	150	246	275	**370**	366	368	348	265
1.42	149	244	274	**369**	366	368	348	266
1.43	148	244	273	369	366	**369**	349	267
1.44	148	244	273	369	366	**370**	349	268
1.45	147	242	272	369	367	**370**	351	269
1.46	147	241	272	369	367	**371**	351	271
1.47	146	240	271	368	366	**371**	351	271
1.48	146	240	269	327	325	**329**	317	269
1.49	147	243	272	343	365	376	**393**	297

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.50	146	243	272	343	365	376	**393**	297
1.51	155	260	319	425	492	498	**559**	362
1.52	155	261	320	428	494	502	**563**	365
1.53	154	260	320	427	494	502	**563**	365
1.54	154	261	321	429	495	504	**565**	366
1.55	157	264	326	440	503	516	**580**	373
1.56	157	264	326	440	504	517	**581**	374
1.57	155	263	325	441	505	518	**583**	375
1.58	154	262	324	440	505	517	**583**	375
1.59	156	266	330	451	515	533	**599**	387
1.60	142	252	316	439	513	527	**593**	382
2.01	2.98	4.35	4.32	5.38	**5.52**	4.45	3.92	2.75
3.01	3.54	**4.11**	3.36	4.11	3.85	2.68	2.14	1.49
4.01	4.92	7.60	8.73	10.0	**11.1**	10.4	10.6	7.68
4.02	10.4	15.5	16.3	20.0	**21.3**	19.8	19.2	13.9
5.01	3.00	5.14	5.96	6.91	7.61	7.49	**7.64**	5.60
5.02	8.28	10.5	10.2	12.4	**14.4**	12.5	12.1	8.73
6.01	1.63	2.22	2.14	2.41	**2.54**	1.95	1.60	1.12
7.01	5.05	7.53	7.69	9.55	**9.79**	8.36	7.70	5.40
7.02	10.2	13.8	13.9	16.9	**17.3**	14.7	13.2	9.29
8.01	1.43	1.82	1.72	1.96	**2.00**	1.52	1.24	0.86
9.01	4.39	5.72	5.51	6.25	**6.32**	4.96	4.09	2.84
10.01	7.39	9.80	9.85	12.0	**12.0**	9.71	8.34	5.80
11.01	2.90	3.47	3.07	**3.60**	3.53	2.62	2.10	1.46
12.01	5.18	6.21	5.78	6.59	**6.68**	4.94	3.97	2.77
12.02	10.2	12.3	11.2	**13.1**	12.8	9.81	8.03	5.59
12.03	15.3	19.0	17.7	**20.6**	19.7	15.5	12.9	8.99
12.04	22.0	27.7	26.1	**30.7**	28.5	23.3	19.6	13.7
13.01	2.72	**3.17**	2.59	3.14	2.98	2.10	1.67	1.16
14.01	3.01	3.82	3.53	4.01	**4.03**	3.08	2.51	1.74
15.01	3.71	4.79	4.53	5.12	**5.21**	3.99	3.27	2.27
16.01	2.04	2.42	2.17	**2.55**	2.51	1.85	1.48	1.03
16.02	5.27	6.27	5.80	**6.75**	6.70	5.05	4.10	2.85
16.03	8.75	10.4	9.50	**11.1**	11.0	8.23	6.68	4.64
17.01	2.43	3.06	2.83	**3.23**	3.22	2.48	2.01	1.40
18.01	3.29	3.93	3.54	**4.12**	4.06	3.01	2.42	1.68
19.01	2.68	3.31	3.01	**3.45**	3.43	2.59	2.09	1.45
20.01	3.88	4.88	4.54	5.14	**5.20**	3.91	3.18	2.21
21.01	2.59	3.03	2.56	**3.10**	2.98	2.15	1.72	1.19
22.01	3.19	3.98	3.65	**4.17**	4.16	3.14	2.55	1.77
23.01	8.60	12.1	12.3	**15.2**	15.1	12.6	11.3	7.88
23.02	23.2	32.2	32.7	**39.4**	38.2	32.9	29.3	20.4
23.03	25.3	35.3	35.8	**43.0**	41.8	36.2	32.2	22.6
23.04	26.8	37.6	38.2	**46.0**	44.6	38.8	34.7	24.4
24.01	3.05	4.09	3.98	4.71	**4.77**	3.78	3.21	2.23
24.02	8.56	11.4	11.3	**13.3**	13.0	10.6	9.15	6.37
25.01	1.68	2.28	2.23	2.65	**2.69**	2.16	1.83	1.28
26.01	2.82	3.28	2.72	**3.31**	3.15	2.25	1.80	1.25
27.01	8.58	11.3	11.3	13.7	**13.9**	11.1	9.55	6.65
27.02	15.0	19.2	18.6	21.6	**22.3**	17.5	14.8	10.3
27.03	22.5	29.3	28.9	34.9	**35.6**	28.7	24.8	17.3

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
28.01	4.86	5.90	5.51	6.28	**6.30**	4.72	3.81	2.65
29.01	7.50	10.6	10.7	**13.3**	13.2	11.0	9.87	6.88
30.01	6.17	8.65	8.77	**10.7**	10.6	8.83	7.82	5.44
31.01	8.03	10.2	9.76	11.2	**11.3**	8.82	7.27	5.05
31.02	12.1	15.8	15.2	**17.6**	17.6	14.0	11.7	8.15
31.03	18.7	24.6	24.4	**28.9**	28.6	23.4	20.1	13.98
31.04	23.1	30.6	30.4	**36.2**	35.7	29.4	25.4	17.7
31.05	28.0	37.8	37.6	**44.8**	43.7	36.6	32.0	22.3
31.06	33.3	44.8	44.6	**53.2**	51.5	43.7	38.4	26.8
31.07	38.0	52.2	52.6	**62.6**	59.3	52.3	46.3	32.8
31.08	59.0	82.3	86.2	**107**	94.7	89.3	83.4	60.8
31.09	59.0	82.7	87.1	**109**	95.7	90.7	84.9	63.2
32.01	3.79	5.10	4.96	5.81	**5.85**	4.68	3.95	2.75
33.01	6.44	9.05	9.14	**11.2**	11.1	9.23	8.20	5.71
34.01	3.24	4.63	4.63	**5.68**	5.61	4.66	4.12	2.87
35.01	2.74	3.75	3.75	**4.57**	4.51	3.69	3.23	2.24
36.01	2.54	3.10	2.81	**3.24**	3.21	2.42	1.95	1.35
37.01	3.39	4.14	3.78	**4.35**	4.32	3.24	2.62	1.82
38.01	3.36	4.94	4.98	**6.11**	6.06	5.15	4.62	3.22
38.02	6.75	9.10	9.13	11.1	**11.2**	9.21	8.04	5.60
38.03	15.5	20.5	20.1	23.8	**23.8**	19.7	17.2	12.0
38.04	28.2	38.3	39.0	**47.0**	46.9	40.2	36.0	25.3
39.01	2.97	3.94	3.77	4.37	**4.39**	3.47	2.90	2.02
40.01	2.17	2.85	2.77	3.24	**3.24**	2.61	2.19	1.52
40.02	5.60	6.79	6.29	7.34	**7.38**	5.73	4.77	3.31
41.01	1.90	2.24	1.89	**2.31**	2.22	1.59	1.27	0.88
42.01	6.34	9.44	9.73	12.0	**12.1**	10.6	9.86	6.91
42.02	12.7	18.4	18.9	23.1	**23.4**	20.2	18.4	12.9
43.01	5.63	8.04	8.22	**10.0**	9.96	8.44	7.59	5.30
44.01	2.95	3.82	3.59	4.09	**4.11**	3.19	2.62	1.82
45.01	4.75	6.43	6.49	**7.88**	7.84	6.39	5.55	3.86
46.01	5.85	8.46	8.59	10.5	**10.6**	8.86	7.91	5.53
46.02	11.3	15.3	15.4	**18.4**	18.3	15.5	13.6	9.54
47.01	3.63	4.62	4.30	4.88	**4.93**	3.74	3.05	2.12
48.01	3.42	4.89	4.89	**5.99**	5.96	4.94	4.35	3.03
49.01	8.98	10.7	11.6	13.8	**15.5**	13.5	13.2	9.44
50.01	2.91	4.02	4.02	**4.92**	4.86	3.97	3.48	2.42
51.01	2.87	**3.55**	2.75	2.91	2.69	1.79	1.43	0.99
51.02	8.64	**10.4**	8.12	9.81	9.06	6.38	5.09	3.55
51.03	12.6	15.4	13.3	**15.8**	14.9	11.9	10.0	7.03
52.01	4.79	5.56	4.68	**5.82**	5.52	3.86	3.08	2.15
53.01	3.58	**4.22**	3.39	4.02	3.73	2.57	2.05	1.42
54.01	2.18	2.78	2.63	3.00	**3.01**	2.33	1.91	1.33
55.01	3.70	5.81	6.16	7.44	**7.74**	6.94	6.67	4.71
56.01	6.23	9.07	9.25	**11.4**	11.3	9.73	8.85	6.18
56.02	11.4	17.4	18.5	22.4	**22.8**	21.0	19.7	14.4
56.03	12.7	19.7	21.2	25.6	**25.9**	24.1	22.9	16.6
57.01	4.19	6.36	6.58	8.14	**8.29**	7.24	6.77	4.75
58.01	2.88	3.83	3.77	**4.48**	4.48	3.59	3.06	2.13
59.01	1.46	2.06	2.09	2.55	**2.57**	2.13	1.86	1.30
60.01	3.28	5.09	5.21	6.39	**6.50**	5.72	5.35	3.75

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.02	6.14	9.43	10.1	**12.2**	11.1	11.0	10.2	7.55
61.01	3.08	4.57	4.64	**5.74**	5.70	4.88	4.43	3.09
62.01	1.48	2.06	2.11	**2.56**	2.54	2.13	1.88	1.31
63.01	4.98	8.32	9.63	11.3	11.9	12.1	**12.3**	8.97
63.02	7.96	12.7	14.3	16.7	**17.9**	17.3	17.2	12.5
64.01	2.86	4.33	4.47	5.53	**5.61**	4.94	4.61	3.23
65.01	2.70	4.02	4.12	5.19	**5.23**	4.46	4.14	2.90
66.01	2.58	4.04	4.49	5.31	**5.64**	5.13	5.04	3.57
67.01	3.35	5.45	5.97	7.02	**7.42**	6.83	6.70	4.77
67.02	7.32	9.58	9.92	12.3	**13.6**	11.7	11.0	7.82
67.03	19.1	24.7	24.7	29.8	**31.9**	28.2	26.1	18.6
67.04	26.5	34.7	33.1	40.5	**41.3**	36.5	33.9	24.1
67.05	32.0	42.5	41.0	50.1	**51.3**	45.7	42.3	30.3
67.06	32.3	44.2	43.8	53.0	**53.7**	49.8	46.3	33.7
67.07	33.4	46.5	46.9	**56.5**	55.8	53.0	49.7	36.2
68.01	1.85	2.70	2.68	3.31	**3.32**	2.78	2.50	1.74
69.01	5.77	6.63	5.60	**6.97**	6.64	4.69	3.75	2.61
70.01	3.40	4.65	4.49	5.07	**5.34**	4.10	3.40	2.38
70.02	8.58	10.7	10.0	11.3	**11.7**	8.87	7.24	5.06
71.01	3.26	3.93	3.58	**4.20**	**4.20**	3.06	2.46	1.73
72.01	3.32	3.97	3.58	**4.15**	4.13	3.04	2.45	1.70
73.01	2.14	3.16	3.34	4.03	**4.18**	3.69	3.53	2.49
74.01	6.50	9.63	9.67	12.0	**12.3**	10.1	9.04	6.33
74.02	9.36	13.8	14.3	17.5	**17.6**	15.3	14.0	9.84
74.03	12.7	18.0	18.5	**22.4**	22.1	19.4	17.7	12.5
74.04	14.6	20.4	20.9	**25.3**	25.1	22.0	20.0	14.1
74.05	19.1	27.1	28.0	**34.1**	33.5	29.9	27.4	19.4
74.06	18.7	27.1	28.4	**34.5**	31.8	30.4	28.2	20.4
74.07	18.7	27.1	28.5	**34.5**	31.8	30.5	28.2	20.5
75.01	2.70	3.52	3.32	3.77	**3.84**	2.96	2.43	1.70
76.01	2.01	2.55	2.42	2.74	**2.75**	2.13	1.74	1.21
77.01	3.22	5.01	5.09	6.34	**6.52**	5.60	5.21	3.65
78.01	2.89	4.83	5.51	6.40	**6.76**	6.55	6.57	4.75
78.02	7.19	10.9	11.6	14.1	**14.7**	13.4	12.9	9.27
78.03	9.56	14.7	15.6	18.8	**19.4**	17.9	16.8	12.3
79.01	2.74	4.01	4.09	**5.10**	5.06	4.29	3.91	2.73
80.01	2.01	2.58	2.46	2.79	**2.81**	2.19	1.80	1.25
81.01	2.24	3.57	4.07	4.71	**5.06**	4.78	4.81	3.46
82.01	3.54	5.96	6.77	7.86	**8.35**	8.04	8.05	5.81
82.02	4.99	8.38	9.63	11.3	11.6	**11.9**	11.5	8.62
83.01	2.46	3.86	4.28	4.98	**5.53**	4.89	4.83	3.44
83.02	2.99	4.45	4.79	5.77	**6.27**	5.61	5.45	3.89
84.01	2.19	3.43	3.85	4.46	**4.73**	4.43	4.40	3.15
84.02	2.14	3.40	3.89	**4.59**	4.46	4.58	4.43	3.27
85.01	2.31	**2.57**	2.14	2.50	2.56	1.85	1.50	1.06
85.02	2.58	3.42	3.58	4.18	3.58	**4.24**	4.09	3.05
86.01	3.48	**3.80**	2.31	2.42	2.73	2.11	1.81	1.29
87.01	1.81	3.01	3.48	4.07	4.37	4.47	**4.54**	3.33
87.02	2.01	3.27	3.74	4.38	4.75	4.78	**4.82**	3.55
88.01	1.35	2.22	2.49	2.87	**3.06**	2.91	2.90	2.09
89.01	5.64	9.04	10.2	11.8	**12.5**	11.8	11.7	8.37

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
89.02	13.0	18.2	18.6	22.5	**23.5**	20.9	19.6	13.9
89.03	18.4	26.0	26.6	32.2	**33.0**	29.1	26.8	19.1
89.04	23.7	34.1	35.3	42.6	**43.0**	38.7	35.9	25.6
89.05	28.0	40.3	41.9	**50.4**	50.3	45.7	42.5	30.3
89.06	31.4	45.7	47.7	**57.2**	55.2	51.6	48.0	34.6
89.07	37.7	55.0	59.2	**69.9**	66.3	66.7	63.1	46.3
89.08	39.0	57.8	62.7	**73.8**	69.1	70.8	66.9	49.4
89.09	39.3	58.9	64.4	**76.0**	70.6	73.0	69.1	51.2
89.10	39.6	59.4	65.2	**77.1**	71.4	74.1	70.2	52.1
89.11	39.6	59.8	66.1	**78.5**	72.2	75.6	71.6	53.2
89.12	39.7	61.6	68.8	**82.2**	74.8	79.1	75.2	56.2
89.13	39.3	62.4	70.4	**84.6**	76.8	81.7	78.0	58.5
89.14	39.2	62.5	70.7	**85.2**	77.3	82.3	78.7	59.0
89.15	46.5	69.3	89.3	111	109	**118**	117	86.6
89.16	46.9	70.3	90.8	114	111	**120**	119	88.8
89.17	46.4	70.7	91.7	115	113	**122**	121	90.3
90.01	2.02	2.59	2.47	2.80	**2.81**	2.19	1.80	1.25
90.02	6.75	8.96	8.84	**10.5**	10.2	8.45	7.30	5.08
91.01	2.28	3.11	3.12	**3.79**	3.72	3.08	2.70	1.88
92.01	3.73	5.28	5.32	**6.49**	6.42	5.35	4.72	3.29
93.01	5.18	7.77	8.12	9.90	**10.1**	9.02	8.50	5.98
94.01	3.87	5.65	5.73	**7.05**	7.00	5.94	5.36	3.74
95.01	2.93	3.88	3.71	4.29	**4.31**	3.40	2.84	1.97
96.01	4.22	7.09	8.18	9.48	**9.97**	9.81	9.86	7.15
96.02	6.67	9.84	10.6	12.8	**13.5**	12.8	12.6	9.12
97.01	2.16	2.83	2.79	**3.29**	3.28	2.65	2.25	1.56
98.01	3.02	4.50	4.58	**5.68**	5.66	4.87	4.44	3.11
99.01	1.65	2.23	2.16	2.55	**2.56**	2.07	1.74	1.21
100.01	1.15	1.67	1.71	2.13	**2.16**	1.83	1.68	1.18
101.01	1.49	2.10	2.13	2.60	**2.60**	2.17	1.90	1.33
102.01	1.67	2.52	2.63	3.18	**3.27**	2.92	2.77	1.95
103.01	2.14	3.05	3.10	**3.80**	3.77	3.22	2.93	2.05
104.01	0.90	1.34	1.32	1.66	**1.71**	1.43	1.29	0.90
105.01	4.22	6.28	6.43	7.95	**7.97**	6.84	6.27	4.39
105.02	6.56	8.65	8.70	10.7	**11.2**	9.22	8.22	5.74
105.03	10.9	14.8	15.1	18.4	**18.5**	15.9	14.4	10.1
105.04	10.7	16.2	17.0	**20.7**	19.0	18.4	17.3	12.6
105.05	11.5	18.2	19.9	**24.4**	21.6	22.8	20.7	16.2
105.06	12.3	20.3	23.0	**28.1**	24.3	26.8	25.1	19.3
105.07	14.7	25.7	30.3	36.6	32.5	**36.7**	35.3	27.0
105.08	14.9	26.5	31.5	38.2	34.8	**38.8**	37.5	28.6
105.09	16.6	29.8	35.5	43.5	38.7	**43.6**	42.1	32.0
105.10	15.5	28.1	34.4	43.3	40.1	**43.9**	42.8	32.2
105.11	15.5	28.1	34.5	43.8	41.7	**44.4**	43.5	32.6
106.01	2.27	2.69	2.38	**2.81**	2.76	2.03	1.63	1.13
107.01	3.39	5.10	5.16	**6.33**	6.33	5.46	4.99	3.48
108.01	3.07	4.11	4.01	4.75	**4.78**	3.81	3.23	2.25
109.01	2.89	4.30	4.39	5.46	**5.48**	4.72	4.35	3.04
110.01	2.81	4.04	4.08	**5.06**	5.00	4.18	3.76	2.62
111.01	2.79	4.75	5.53	6.46	6.83	6.87	**6.95**	5.09
111.02	6.00	8.49	8.91	10.8	**11.5**	10.8	10.5	7.68

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
112.01	2.40	3.14	3.02	3.50	**3.51**	2.78	2.32	1.61
113.01	1.64	2.37	2.40	**2.93**	2.91	2.50	2.25	1.57
114.01	2.13	2.82	2.83	**3.40**	3.36	2.75	2.37	1.65
115.01	2.19	2.87	2.81	**3.31**	3.31	2.67	2.26	1.57
116.01	1.79	2.30	2.18	2.47	**2.49**	1.93	1.58	1.10
117.01	1.95	3.05	3.34	3.90	**4.17**	3.81	3.77	2.69
118.01	1.25	1.66	1.65	1.97	**2.01**	1.60	1.36	0.95
119.01	2.35	3.52	3.71	4.53	**4.73**	4.13	3.95	2.78
119.02	4.66	6.84	7.31	8.81	**9.37**	8.30	7.98	5.67
119.03	7.75	11.6	12.4	14.9	**15.1**	14.3	13.6	9.88
119.04	11.2	16.8	18.0	**21.6**	21.2	20.6	19.6	14.2
119.05	12.5	18.8	20.3	**24.3**	23.8	23.2	22.2	16.1
119.06	15.7	24.2	26.1	**31.1**	30.1	30.1	28.5	21.0
119.07	16.9	26.6	28.9	**34.4**	33.1	33.7	32.1	23.8
119.08	15.6	25.4	28.2	**33.7**	31.5	33.2	31.8	23.7
119.09	16.7	28.2	31.8	**39.0**	36.1	38.4	37.1	28.3
119.10	16.9	28.8	32.9	**40.5**	37.4	40.2	38.9	29.7
119.11	27.7	47.3	58.1	76.5	83.5	83.8	**86.0**	64.2
119.12	27.8	47.5	58.6	78.0	86.0	85.1	**87.5**	65.5
119.13	27.7	47.6	58.6	79.1	88.0	85.8	**88.5**	66.2
119.14	27.7	47.6	58.7	79.1	88.2	85.9	**88.6**	66.3
119.15	31.2	54.0	67.2	90.0	99.0	98.3	**101**	76.0
119.16	31.1	54.1	67.4	90.5	99.9	98.8	**102**	76.4
119.17	42.4	73.2	88.1	114	122	129	**133**	100
119.18	42.5	73.3	88.4	115	123	131	**134**	101
119.19	42.5	73.3	88.4	115	123	131	**134**	101
119.20	41.8	73.1	88.2	115	123	130	**134**	101
119.21	41.2	73.3	88.6	116	124	131	**135**	101
119.22	41.2	73.4	88.8	116	125	132	**139**	102
119.23	51.3	82.2	104	137	150	159	**166**	121
120.01	2.06	3.11	3.41	3.99	**4.22**	3.85	3.77	2.68
121.01	1.51	2.01	1.98	2.31	**2.35**	1.87	1.56	1.09
122.01	2.72	4.06	4.14	5.21	**5.27**	4.45	4.11	2.88
123.01	1.83	2.69	2.68	3.31	**3.35**	2.81	2.53	1.77
124.01	2.14	2.87	2.88	**3.48**	3.47	2.83	2.44	1.70
125.01	1.84	3.05	3.48	4.09	4.39	4.39	**4.45**	3.25
125.02	3.81	5.85	6.30	7.50	**8.06**	7.62	7.51	5.46
126.01	1.79	2.70	2.70	3.34	**3.46**	2.89	2.61	1.83
127.01	1.44	1.89	1.88	2.18	**2.33**	1.79	1.51	1.06
127.02	1.44	2.07	2.13	**2.49**	2.26	2.07	1.89	1.34
128.01	4.96	5.43	4.09	4.99	6.07	6.29	**6.51**	4.91
128.02	10.1	15.6	17.7	21.1	21.5	**23.0**	22.4	16.9
128.03	13.2	22.3	26.3	30.8	28.2	**32.7**	32.4	25.1
128.04	13.3	22.6	26.5	32.5	30.4	34.3	**34.4**	26.2
128.05	14.0	24.3	29.1	36.7	36.9	38.9	**39.7**	29.8
128.06	14.0	24.5	29.4	38.1	40.8	40.4	**41.7**	30.9
128.07	14.4	24.9	30.0	39.8	**44.6**	42.3	44.1	32.3
128.08	15.6	24.9	30.0	40.2	**46.1**	42.9	44.9	32.8
128.09	16.2	24.9	30.2	40.7	**47.4**	43.5	45.7	33.3
128.10	17.4	25.2	30.5	41.6	**49.5**	44.6	47.1	34.3
128.11	17.4	25.2	30.5	41.6	**49.6**	44.6	47.2	34.3

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.12	17.7	25.2	30.6	42.0	**50.5**	45.1	47.7	34.7
129.01	2.5	4.1	4.6	5.3	**5.8**	5.3	5.2	3.7
129.02	4.87	6.85	7.10	8.82	**9.26**	8.32	7.94	5.67
129.03	7.27	10.7	11.6	14.0	**14.7**	13.9	13.5	9.82
130.01	1.84	2.53	2.49	3.00	**3.07**	2.47	2.10	1.47
131.01	3.84	4.26	3.89	4.44	**5.26**	4.67	4.73	3.43
132.01	2.66	4.04	4.15	5.26	**5.44**	4.64	4.37	3.07
132.02	4.57	6.77	7.10	**8.70**	8.66	7.79	7.28	5.17
132.03	6.11	8.87	9.35	**11.4**	11.3	10.3	9.58	6.82
132.04	7.15	10.6	11.5	**13.8**	12.9	12.6	11.9	8.90
132.05	7.16	10.6	11.5	**13.8**	13.1	12.7	12.0	9.02
133.01	1.33	1.98	1.99	2.46	**2.53**	2.10	1.87	1.31
134.01	1.69	2.43	2.43	2.98	**3.06**	2.50	2.18	1.52
135.01	1.78	2.54	2.51	3.09	**3.16**	2.57	2.23	1.56
136.01	3.30	**3.67**	2.65	2.94	3.19	2.37	1.95	1.38
136.02	3.13	**3.34**	2.24	2.42	2.50	2.65	2.54	1.85
137.01	2.14	2.40	2.75	3.15	**3.63**	3.49	3.57	2.64
137.02	6.15	6.80	4.57	5.77	**6.88**	5.82	5.71	4.16
137.03	2.90	4.00	4.44	5.03	5.03	**5.65**	5.65	4.37
137.04	4.68	5.13	5.46	6.25	6.66	6.86	**6.97**	5.33
137.05	5.57	6.65	6.56	7.42	7.52	8.27	**8.38**	6.46
138.01	1.99	2.19	1.67	2.12	**2.28**	1.83	1.61	1.14
139.01	2.95	**3.26**	1.89	1.81	1.93	1.42	1.18	0.84
140.01	3.88	**4.27**	2.63	2.49	2.35	1.62	1.31	0.94
141.01	3.49	**3.83**	2.41	2.96	3.28	2.60	2.29	1.62
141.02	**7.16**	7.15	5.31	5.42	6.20	4.81	4.19	2.98
141.03	8.77	**9.24**	6.39	6.33	7.24	5.61	4.86	3.46
141.04	7.54	**8.39**	6.36	7.20	7.98	6.40	5.67	4.04
142.01	1.48	**1.63**	0.98	0.90	0.85	0.58	0.47	0.34
143.01	0.21	0.32	0.33	0.41	**0.43**	0.36	0.34	0.24
144.01	4.16	**4.55**	3.11	3.78	4.39	3.74	3.60	2.58
144.02	3.58	3.96	3.61	4.36	**4.95**	4.41	4.29	3.11
145.01	1.09	1.48	1.46	1.85	**1.92**	1.58	1.42	0.99
146.01	1.86	2.05	2.17	2.47	**2.89**	2.63	2.69	1.96
147.01	1.76	**1.89**	1.18	1.15	1.43	1.19	1.14	0.82
148.01	6.30	**6.98**	4.11	4.29	4.86	3.75	3.23	2.29
148.02	4.27	**4.91**	3.61	4.21	4.50	3.69	3.34	2.37
149.01	2.94	**3.26**	2.16	2.40	2.49	1.80	1.47	1.04
149.02	3.05	**3.47**	2.31	2.58	2.64	1.96	1.59	1.12
150.01	2.23	3.72	4.44	5.20	5.72	5.98	**6.10**	4.54
150.02	2.43	4.02	4.93	5.85	6.03	**6.72**	6.63	5.07
150.03	3.44	5.72	6.65	7.83	8.17	**9.14**	8.97	6.84
150.04	3.44	5.71	6.66	7.87	8.17	**9.17**	9.00	6.86
150.05	4.27	8.06	9.60	11.6	10.8	**13.1**	12.8	9.93
151.01	1.88	2.07	1.52	1.95	**2.14**	1.76	1.60	1.13
152.01	4.16	**4.54**	2.68	2.91	3.54	3.00	2.90	2.10
152.02	3.20	3.61	2.75	3.42	**3.98**	3.49	3.40	2.47
152.03	1.84	2.66	2.81	3.49	3.57	**3.61**	3.57	2.66
152.04	2.59	2.86	3.08	4.03	**4.39**	4.08	4.02	3.19
153.01	5.91	6.61	5.82	7.24	**8.05**	6.86	6.53	4.64
153.02	6.26	9.80	10.9	12.8	**12.8**	12.7	12.3	9.15

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
153.03	7.54	11.5	12.9	15.4	**15.7**	15.3	15.2	11.2
153.04	10.5	15.9	17.9	21.5	**21.5**	21.3	21.2	15.5
153.05	13.6	20.0	22.4	**27.0**	26.9	26.4	25.9	19.0
153.06	14.7	23.0	26.2	**31.8**	30.1	31.4	30.1	22.7
153.07	14.7	23.0	26.3	**31.9**	30.1	31.5	30.2	22.8
153.08	16.0	24.7	28.2	**34.4**	32.3	33.7	32.5	24.3
154.01	2.18	2.90	2.91	3.51	**3.54**	2.87	2.46	1.72
155.01	2.23	2.47	2.22	2.76	**2.95**	2.38	2.08	1.46
156.01	2.82	4.52	5.02	5.88	**6.27**	5.74	5.65	4.02
157.01	2.39	3.50	3.52	4.36	**4.44**	3.68	3.32	2.32
158.01	1.34	1.94	1.96	2.41	**2.44**	2.02	1.79	1.25
159.01	1.61	2.19	2.16	2.44	**2.60**	1.99	1.65	1.16
159.02	1.91	2.51	2.53	**2.99**	2.99	2.41	2.07	1.45
160.01	1.26	**1.37**	0.84	0.96	1.16	0.97	0.92	0.66
160.02	3.58	**3.73**	2.50	2.43	2.88	2.25	2.01	1.45
160.03	4.48	**4.55**	3.74	3.61	4.09	3.14	2.79	2.02
160.04	4.43	**4.66**	3.78	3.63	4.10	3.17	2.82	2.03
161.01	2.20	2.43	2.47	41.2	40.3	**42.5**	34.5	2.60
161.02	1.92	2.25	2.15	41.0	40.2	**42.4**	34.4	2.60
161.03	3.14	4.29	4.41	40.7	40.0	**42.6**	34.5	3.02
162.01	0.89	1.17	1.15	1.37	**1.38**	1.11	0.94	0.65
163.01	2.55	3.67	3.70	**4.59**	4.58	3.80	3.40	2.38
163.02	5.29	7.64	7.86	9.71	**9.76**	8.41	7.72	5.43
163.03	8.66	13.2	14.7	17.6	16.6	**17.7**	16.7	12.6
163.04	10.3	15.6	17.6	**21.2**	19.5	21.0	20.0	15.2
163.05	12.1	19.8	23.0	28.3	28.0	30.2	**30.4**	22.6
163.06	12.0	19.8	23.0	28.4	28.5	30.2	**30.6**	22.7
163.07	11.9	20.0	23.6	30.0	30.4	31.5	**32.1**	23.9
163.08	11.6	19.8	23.5	29.9	30.1	31.4	**32.2**	23.9
164.01	2.57	3.83	3.95	4.96	**5.02**	4.32	4.05	2.84
165.01	2.22	3.39	3.71	4.35	**4.74**	4.20	4.12	2.93
166.01	1.60	2.40	2.47	3.04	**3.13**	2.69	2.51	1.76
167.01	2.52	2.78	3.38	4.61	5.95	6.04	**6.50**	4.80
168.01	1.55	2.22	2.26	2.76	**2.79**	2.32	2.05	1.43
169.01	2.63	3.97	4.13	5.15	**5.24**	4.58	4.30	3.02
169.02	3.66	5.60	6.13	7.37	8.23	7.99	**8.66**	6.20
169.03	3.74	5.72	6.27	7.55	8.15	8.20	**8.76**	6.27
170.01	2.20	2.43	2.14	2.62	**2.95**	2.55	2.43	1.73
170.02	2.09	2.99	3.37	3.93	**4.20**	4.06	4.01	2.92
170.03	2.74	4.27	5.18	6.26	6.08	**7.04**	6.80	5.27
171.01	2.71	4.69	5.62	6.53	6.93	7.34	**7.47**	5.54
171.02	3.33	5.91	7.34	8.95	8.75	**10.3**	10.3	7.87
171.03	4.70	9.09	11.2	13.5	13.3	**15.5**	15.4	11.7
171.04	5.28	9.66	12.0	14.7	14.4	17.1	**17.1**	13.0
171.05	7.00	13.3	16.5	20.4	20.1	23.8	**23.9**	17.9
171.06	7.00	13.4	16.6	20.6	20.4	23.9	**24.1**	18.0
172.01	1.76	2.10	2.35	2.68	**3.07**	2.74	2.75	1.98
173.01	2.37	2.62	2.05	2.38	**2.92**	2.66	2.75	2.03
174.01	1.54	**1.70**	1.30	1.48	1.64	1.25	1.05	0.74
175.01	1.31	2.33	2.86	3.57	4.03	4.49	**4.60**	3.49
175.02	2.21	3.90	4.76	5.75	5.94	6.89	**6.98**	5.19

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	**2 hr**	**3 hr**	**6 hr**	**12 hr**	**24 hr**	**48 hr**	**72 hr**
176.01	1.27	1.71	1.99	2.32	**2.62**	2.53	2.58	1.90
177.01	1.51	1.76	2.10	2.45	2.82	2.88	**2.94**	2.21
178.01	1.76	2.34	2.26	2.60	**2.65**	2.10	1.74	1.21
178.02	3.22	4.28	4.18	4.81	**4.92**	3.88	3.23	2.25
179.01	2.57	2.84	3.21	3.68	4.28	4.21	**4.31**	3.20
179.02	4.80	6.99	7.80	8.98	**10.1**	9.46	9.57	6.97
179.03	4.87	7.98	9.21	10.8	11.1	**12.0**	11.8	8.91
179.04	4.85	8.16	9.84	11.8	11.7	13.3	**13.5**	10.4
179.05	5.08	8.65	10.6	13.5	14.8	14.9	**15.5**	11.5
179.06	5.49	9.66	11.9	15.7	17.9	17.6	**18.4**	13.6
179.07	17.5	17.6	15.2	16.4	20.0	20.0	**20.7**	15.2
180.01	1.61	2.44	2.72	3.09	**3.46**	3.12	3.12	2.24
181.01	6.33	**6.85**	4.06	3.17	3.60	2.82	2.61	1.91
182.01	1.28	1.71	1.72	2.08	**2.14**	1.69	1.45	1.01
182.02	2.02	3.08	3.33	4.00	**4.12**	4.06	3.96	2.92
183.01	1.48	1.60	1.28	1.91	2.51	2.43	**2.76**	1.94
184.01	15.5	**16.6**	10.4	7.33	7.41	5.38	4.79	3.55
185.01	9.13	**10.3**	5.92	4.28	4.14	2.88	2.37	1.72
186.01	3.81	**4.14**	2.34	1.97	2.09	1.55	1.31	0.94
186.02	**4.90**	4.81	3.73	3.00	3.15	2.31	1.96	1.41

PEAK DESIGN FLOOD DISCHARGES - 5% AEP

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	6.16	9.04	9.05	11.0	**11.0**	9.37	8.59	6.09
1.02	10.9	15.8	16.6	**19.6**	18.7	17.5	16.6	11.9
1.03	17.1	24.0	24.5	**29.5**	28.2	25.9	24.5	17.6
1.04	22.4	30.3	30.5	**37.3**	37.2	33.3	31.5	22.6
1.05	38.6	52.5	53.1	64.2	**65.1**	59.1	56.2	40.7
1.06	51.0	66.9	68.1	82.0	**85.3**	76.3	72.9	52.9
1.07	64.9	83.8	85.5	103	**106**	93.9	88.7	64.2
1.08	73.5	94.5	96.1	115	**115**	104	97.5	71.0
1.09	83.7	109	109	**130**	129	117	110	80.0
1.10	88.5	116	116	**138**	136	125	116	84.8
1.11	109	146	143	**169**	167	152	141	103
1.12	113	153	150	**177**	173	160	149	109
1.13	114	155	152	**180**	175	162	152	111
1.14	116	159	157	**186**	179	167	157	115
1.15	117	162	161	**191**	183	172	161	118
1.16	122	169	169	**200**	187	180	168	124
1.17	144	208	209	**246**	226	221	209	154
1.18	159	232	237	**278**	253	250	237	175
1.19	156	230	238	**279**	250	254	243	182
1.20	157	231	241	**283**	251	256	246	185
1.21	227	334	349	**410**	354	362	345	259
1.22	226	334	350	**413**	358	364	348	261
1.23	226	334	352	**420**	370	369	354	266
1.24	225	334	353	**422**	375	370	356	268
1.25	226	337	359	**433**	383	380	367	279
1.26	225	337	361	**438**	392	383	371	284
1.27	225	337	361	**438**	394	383	372	285
1.28	224	336	362	**441**	399	386	375	288
1.29	225	338	365	**453**	418	394	385	295
1.30	224	337	365	**453**	419	395	386	295
1.31	228	339	369	**460**	423	402	393	303
1.32	223	333	365	**455**	414	398	392	302
1.33	223	334	365	**459**	422	404	397	305
1.34	221	332	364	**460**	423	404	398	306
1.35	219	330	363	**460**	424	406	400	308
1.36	219	331	365	**470**	442	423	412	316
1.37	218	331	366	**478**	460	439	424	324
1.38	214	326	365	**474**	456	441	427	327
1.39	213	325	364	**475**	458	445	429	329
1.40	210	321	362	**473**	455	444	428	328
1.41	210	321	361	**473**	456	446	430	330
1.42	208	319	360	**472**	456	447	431	331
1.43	208	319	360	**472**	457	448	432	332
1.44	208	319	360	**472**	457	449	432	333
1.45	206	317	359	**472**	457	450	435	335
1.46	206	316	359	**472**	458	452	436	338
1.47	205	315	358	**471**	457	452	436	338
1.48	205	295	320	**388**	380	377	368	309
1.49	206	299	328	417	441	435	**454**	345

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.50	205	298	327	417	441	436	**454**	345
1.51	217	352	423	555	633	623	**683**	445
1.52	217	353	424	555	635	628	**688**	448
1.53	215	352	424	555	635	628	**688**	448
1.54	215	353	425	554	636	631	**692**	449
1.55	216	358	432	570	648	646	**711**	460
1.56	216	358	432	570	649	647	**712**	461
1.57	214	357	432	572	651	649	**715**	462
1.58	213	356	431	572	651	650	**715**	463
1.59	216	361	439	585	662	670	**735**	478
1.60	200	343	422	574	661	664	**730**	474
2.01	3.98	5.47	5.52	6.49	**6.60**	5.33	4.64	3.28
3.01	4.67	**5.60**	4.37	4.92	4.53	3.15	2.53	1.78
4.01	6.21	9.89	11.0	12.5	**13.6**	12.5	12.6	9.20
4.02	14.3	20.3	20.6	24.7	**25.8**	23.8	23.0	16.7
5.01	4.07	6.69	7.66	8.72	**9.41**	8.99	9.14	6.72
5.02	10.9	13.2	12.9	15.2	**17.5**	15.1	14.4	10.5
6.01	2.24	2.78	2.66	2.91	**2.99**	2.30	1.90	1.34
7.01	6.86	9.75	9.82	**11.9**	11.7	9.97	9.12	6.45
7.02	13.8	17.9	17.7	**20.8**	20.7	17.6	15.7	11.1
8.01	1.93	2.29	2.12	**2.39**	2.35	1.80	1.47	1.03
9.01	5.92	7.33	6.82	**7.60**	7.55	5.86	4.84	3.40
10.01	9.91	12.9	12.5	**14.4**	14.4	11.6	9.87	6.94
11.01	3.79	4.38	3.77	**4.41**	4.19	3.08	2.48	1.74
12.01	6.86	7.86	6.95	**8.15**	7.91	5.82	4.70	3.31
12.02	13.4	15.6	13.8	**15.9**	15.1	11.6	9.51	6.69
12.03	20.3	24.1	21.8	**24.9**	23.1	18.4	15.3	10.8
12.04	29.1	35.3	32.5	**37.1**	33.4	27.6	23.2	16.3
13.01	3.51	**4.12**	3.35	3.77	3.50	2.47	1.98	1.39
14.01	3.94	4.76	4.35	**4.90**	4.82	3.64	2.97	2.09
15.01	4.97	6.04	5.60	**6.24**	6.15	4.73	3.88	2.72
16.01	2.71	**3.11**	2.66	3.09	2.95	2.18	1.76	1.23
16.02	6.95	7.96	7.06	**8.24**	7.89	5.96	4.85	3.41
16.03	11.5	13.3	11.6	**13.6**	12.9	9.71	7.91	5.56
17.01	3.21	3.83	3.49	**3.90**	3.82	2.92	2.38	1.67
18.01	4.33	5.03	4.34	**5.08**	4.84	3.55	2.87	2.02
19.01	3.53	4.12	3.69	**4.20**	4.07	3.05	2.48	1.74
20.01	5.22	6.11	5.53	**6.28**	6.13	4.63	3.77	2.65
21.01	3.36	**3.88**	3.23	3.74	3.51	2.53	2.03	1.43
22.01	4.24	4.98	4.47	**5.11**	4.98	3.71	3.02	2.12
23.01	11.5	15.6	15.5	**18.6**	18.1	15.1	13.4	9.43
23.02	31.4	41.8	41.4	**48.4**	46.0	39.1	34.7	24.5
23.03	34.2	45.8	45.3	**53.1**	50.0	43.1	38.3	27.0
23.04	36.3	48.7	48.4	**56.9**	53.7	46.3	41.2	29.2
24.01	4.04	5.28	5.13	5.68	**5.70**	4.51	3.79	2.67
24.02	11.5	14.6	14.2	**16.1**	15.5	12.7	10.8	7.62
25.01	2.28	2.89	2.82	**3.21**	3.18	2.56	2.17	1.53
26.01	3.66	**4.26**	3.49	3.99	3.72	2.65	2.13	1.49
27.01	11.4	14.9	14.5	16.5	**16.6**	13.3	11.3	7.95
27.02	20.0	24.8	23.4	26.2	**26.5**	20.8	17.5	12.3
27.03	30.1	38.2	36.8	42.2	**42.4**	34.3	29.4	20.7

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
28.01	6.51	7.51	6.63	**7.68**	7.47	5.57	4.51	3.17
29.01	10.1	13.6	13.5	**16.3**	15.8	13.2	11.7	8.23
30.01	8.41	11.0	11.0	**13.1**	12.7	10.5	9.26	6.52
31.01	10.7	13.2	12.2	**13.6**	13.5	10.4	8.60	6.04
31.02	16.4	20.3	19.1	**21.4**	21.0	16.6	13.9	9.75
31.03	25.3	31.8	30.6	**35.0**	34.4	27.8	23.8	16.7
31.04	31.1	39.3	38.1	**43.9**	42.6	34.9	30.1	21.1
31.05	37.8	48.5	47.3	**54.8**	52.4	43.6	37.9	26.7
31.06	44.6	57.8	56.2	**65.2**	61.8	52.1	45.6	32.1
31.07	51.0	67.2	66.0	**76.9**	71.2	62.3	55.2	39.3
31.08	79.4	111.6	112.6	**133.0**	114.6	108.5	99.6	73.3
31.09	79.4	112.2	114.3	**135.3**	115.7	110.8	101.5	76.5
32.01	5.11	6.55	6.28	**7.04**	6.99	5.57	4.68	3.29
33.01	8.74	11.5	11.4	**13.7**	13.4	11.0	9.71	6.83
34.01	4.36	5.78	5.86	**6.91**	6.73	5.58	4.88	3.43
35.01	3.65	4.81	4.76	**5.51**	5.43	4.42	3.82	2.69
36.01	3.33	3.88	3.45	**3.93**	3.80	2.85	2.31	1.62
37.01	4.50	5.23	4.63	**5.34**	5.17	3.83	3.10	2.18
38.01	4.54	6.23	6.29	**7.55**	7.31	6.13	5.48	3.86
38.02	9.01	11.7	11.6	13.4	**13.5**	11.0	9.53	6.71
38.03	20.7	26.1	25.3	**29.2**	28.4	23.4	20.3	14.3
38.04	38.0	49.3	49.1	**58.0**	56.6	48.0	42.7	30.2
39.01	3.93	5.03	4.78	**5.29**	5.28	4.12	3.43	2.41
40.01	2.90	3.69	3.50	**3.93**	3.87	3.08	2.59	1.82
40.02	7.46	8.75	7.75	**8.99**	8.75	6.76	5.64	3.96
41.01	2.53	**2.92**	2.41	2.78	2.61	1.87	1.50	1.06
42.01	8.75	12.3	12.4	**15.1**	14.7	12.7	11.7	8.27
42.02	17.4	23.7	24.0	**28.8**	28.3	24.2	21.9	15.5
43.01	7.67	10.3	10.3	**12.4**	12.0	10.1	9.00	6.34
44.01	3.89	4.81	4.48	**4.97**	4.93	3.77	3.11	2.18
45.01	6.42	8.35	8.19	**9.49**	9.36	7.63	6.58	4.63
46.01	7.94	10.7	10.7	**12.9**	12.8	10.6	9.38	6.61
46.02	15.2	19.7	19.3	**22.5**	22.0	18.4	16.2	11.4
47.01	4.86	5.79	5.29	**5.96**	5.84	4.43	3.61	2.54
48.01	4.58	6.10	6.16	**7.29**	7.15	5.89	5.16	3.63
49.01	10.9	13.9	14.4	17.6	**18.6**	16.3	15.7	11.3
50.01	3.89	5.16	5.12	**5.92**	5.82	4.77	4.12	2.90
51.01	3.76	**4.59**	3.60	3.41	3.13	2.10	1.69	1.19
51.02	11.4	**13.5**	10.8	11.6	10.7	7.50	6.02	4.24
51.03	16.7	**20.0**	16.8	19.1	17.8	14.0	11.9	8.40
52.01	6.35	**7.45**	5.91	6.96	6.47	4.53	3.64	2.57
53.01	4.72	**5.74**	4.44	4.78	4.39	3.02	2.42	1.70
54.01	2.91	3.56	3.26	**3.63**	3.57	2.76	2.26	1.59
55.01	5.19	7.55	7.83	**9.44**	9.38	8.38	7.93	5.64
56.01	8.57	11.7	11.7	**14.2**	13.8	11.6	10.5	7.41
56.02	15.9	22.7	23.6	**28.1**	27.5	25.4	23.7	17.3
56.03	18.0	25.7	26.9	**31.9**	31.2	29.2	27.4	19.9
57.01	5.78	8.32	8.42	**10.2**	9.94	8.69	8.04	5.69
58.01	3.83	5.01	4.84	**5.41**	5.39	4.29	3.63	2.55
59.01	2.01	2.60	2.60	**3.09**	3.05	2.52	2.20	1.56
60.01	4.50	6.49	6.66	**8.13**	7.93	6.86	6.35	4.50

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.02	8.33	12.3	12.9	**15.4**	13.5	13.2	12.2	9.07
61.01	4.19	5.85	5.94	**7.11**	6.88	5.83	5.26	3.71
62.01	2.03	2.62	2.62	**3.12**	3.01	2.53	2.23	1.57
63.01	6.81	10.9	12.4	14.2	**14.7**	14.5	14.7	10.8
63.02	10.9	16.4	18.1	20.9	**22.0**	20.8	20.6	15.1
64.01	3.88	5.64	5.77	**6.95**	6.78	5.91	5.47	3.87
65.01	3.67	5.26	5.34	**6.42**	6.27	5.37	4.92	3.47
66.01	3.51	5.35	5.63	6.70	**6.83**	6.16	5.98	4.27
67.01	4.62	6.98	7.47	8.91	**9.06**	8.25	7.98	5.71
67.02	9.60	12.1	12.6	15.5	**16.4**	14.1	13.1	9.36
67.03	25.5	31.3	31.2	37.0	**38.4**	33.7	31.1	22.3
67.04	35.6	45.3	41.5	**50.0**	49.8	43.7	40.3	28.9
67.05	42.9	54.9	51.4	61.9	**62.1**	54.7	50.4	36.3
67.06	43.5	56.6	55.0	**65.8**	65.0	59.6	55.3	40.4
67.07	45.1	59.6	58.9	**70.4**	67.8	63.6	59.4	43.5
68.01	2.51	3.38	3.38	**4.07**	3.98	3.31	2.95	2.08
69.01	7.56	**8.91**	7.09	8.41	7.83	5.51	4.43	3.12
70.01	4.51	5.88	5.67	6.12	**6.35**	4.85	4.02	2.84
70.02	11.3	13.4	12.3	**14.1**	13.8	10.5	8.55	6.04
71.01	4.21	4.84	4.38	**5.19**	4.96	3.60	2.91	2.06
72.01	4.37	5.06	4.38	**5.13**	4.91	3.59	2.90	2.04
73.01	2.86	4.14	4.20	**5.22**	5.13	4.45	4.19	2.98
74.01	8.88	12.2	12.1	14.7	**14.8**	12.1	10.7	7.56
74.02	12.8	17.8	18.2	**21.8**	21.2	18.3	16.6	11.8
74.03	17.3	23.1	23.4	**27.7**	26.7	23.1	21.0	14.9
74.04	19.9	26.3	26.5	**31.4**	30.4	26.2	23.8	16.9
74.05	25.9	35.2	35.7	**42.4**	40.5	35.7	32.6	23.3
74.06	25.4	35.3	36.1	**42.9**	38.7	36.4	33.6	24.6
74.07	25.4	35.3	36.2	**42.9**	38.7	36.5	33.7	24.7
75.01	3.55	4.44	4.14	4.56	**4.57**	3.50	2.88	2.03
76.01	2.68	3.25	2.97	**3.32**	3.25	2.52	2.06	1.45
77.01	4.39	6.42	6.54	**7.97**	7.89	6.70	6.16	4.37
78.01	3.94	6.27	7.00	8.06	**8.33**	7.88	7.85	5.69
78.02	9.84	14.1	14.7	17.7	**17.9**	16.2	15.4	11.1
78.03	13.7	18.9	19.7	23.2	**23.3**	21.7	20.2	14.8
79.01	3.71	5.18	5.24	**6.27**	6.07	5.17	4.65	3.27
80.01	2.68	3.29	3.03	**3.38**	3.32	2.59	2.13	1.50
81.01	3.00	4.67	5.14	5.96	**6.20**	5.77	5.74	4.14
82.01	4.91	7.70	8.57	9.90	**10.1**	9.66	9.60	6.96
82.02	6.93	10.9	12.2	**14.3**	14.1	14.3	13.9	10.4
83.01	3.32	5.10	5.33	6.44	**6.69**	5.92	5.75	4.11
83.02	4.02	5.88	6.03	7.34	**7.57**	6.76	6.48	4.65
84.01	2.93	4.43	4.80	5.67	**5.82**	5.34	5.26	3.77
84.02	2.89	4.48	4.92	**5.85**	5.49	5.54	5.33	3.96
85.01	2.83	**3.14**	2.58	3.09	3.00	2.17	1.76	1.25
85.02	3.01	4.25	4.34	**5.19**	4.30	5.03	4.87	3.67
86.01	4.10	**4.50**	2.83	2.90	3.25	2.49	2.13	1.52
87.01	2.48	3.90	4.51	5.22	**5.50**	5.35	5.45	4.00
87.02	2.74	4.20	4.83	5.58	**5.93**	5.73	5.79	4.27
88.01	1.90	2.84	3.13	3.57	**3.71**	3.47	3.46	2.50
89.01	7.80	11.7	12.7	14.9	**15.2**	14.2	13.9	10.0

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
89.02	17.5	23.3	23.5	28.3	**28.4**	25.1	23.3	16.7
89.03	25.1	33.2	33.6	**40.1**	39.9	34.8	31.9	22.8
89.04	32.4	43.9	44.5	**53.2**	52.0	46.3	42.8	30.7
89.05	38.0	52.0	52.8	**63.0**	60.9	54.8	50.7	36.4
89.06	42.8	59.0	60.2	**71.5**	67.1	61.9	57.3	41.6
89.07	49.7	70.7	73.6	**90.6**	83.6	81.3	76.2	56.0
89.08	51.8	74.3	77.9	**95.7**	87.2	86.4	81.0	59.8
89.09	52.4	76.0	80.2	**98.7**	89.3	89.3	83.9	62.1
89.10	52.8	76.8	81.3	**100.2**	90.3	90.8	85.2	63.3
89.11	52.7	77.5	82.7	**101.9**	91.3	92.9	87.1	65.0
89.12	53.6	80.2	86.5	**107.0**	94.2	97.6	92.0	68.9
89.13	53.8	81.7	88.9	**110.3**	96.5	101.1	95.7	72.0
89.14	53.9	81.9	89.4	**111.1**	97.1	102.0	96.6	73.0
89.15	59.4	101.3	113.7	136.8	129.4	**142.8**	141.4	107.3
89.16	60.2	102.6	115.8	140.2	132.2	**145.8**	144.5	109.7
89.17	60.0	103.2	117.4	143.0	134.7	**148.5**	147.4	111.9
90.01	2.69	3.31	3.04	**3.39**	3.33	2.59	2.13	1.50
90.02	9.04	11.5	11.1	**12.7**	12.2	10.0	8.65	6.08
91.01	3.05	3.97	3.92	**4.61**	4.49	3.68	3.20	2.25
92.01	5.10	6.66	6.71	**7.94**	7.75	6.38	5.60	3.94
93.01	7.09	10.1	10.3	**12.5**	12.3	10.8	10.1	7.16
94.01	5.32	7.24	7.28	**8.73**	8.49	7.10	6.36	4.48
95.01	3.88	4.95	4.69	5.19	**5.19**	4.04	3.36	2.36
96.01	5.85	9.29	10.3	11.9	**12.2**	11.8	11.8	8.57
96.02	9.14	12.9	13.3	16.0	**16.5**	15.4	15.0	10.9
97.01	2.87	3.68	3.52	**3.98**	3.91	3.14	2.66	1.87
98.01	4.11	5.79	5.89	**7.06**	6.83	5.82	5.27	3.72
99.01	2.25	2.83	2.73	**3.08**	3.03	2.44	2.06	1.45
100.01	1.54	2.19	2.20	**2.61**	2.56	2.20	1.99	1.41
101.01	2.06	2.65	2.66	**3.17**	3.09	2.57	2.26	1.59
102.01	2.31	3.23	3.32	**4.04**	3.96	3.49	3.29	2.34
103.01	2.86	3.92	3.91	**4.75**	4.57	3.85	3.48	2.45
104.01	1.19	1.70	1.69	2.07	**2.07**	1.71	1.52	1.08
105.01	5.81	8.17	8.21	**9.86**	9.57	8.20	7.44	5.25
105.02	8.87	11.2	11.0	13.1	**13.4**	11.0	9.75	6.88
105.03	14.7	19.0	19.1	**22.7**	22.4	19.0	17.1	12.1
105.04	14.5	20.9	21.9	**25.8**	23.0	22.3	20.7	15.3
105.05	16.2	23.9	25.9	**30.3**	26.2	27.5	25.4	19.6
105.06	17.6	27.3	30.0	**34.8**	29.7	32.4	30.7	23.5
105.07	21.6	34.9	39.3	**45.4**	40.1	44.4	43.0	32.8
105.08	22.0	36.2	41.0	**47.5**	42.9	47.0	45.7	34.8
105.09	24.6	40.8	46.1	**54.2**	47.7	52.9	51.2	39.2
105.10	23.0	39.3	45.1	**54.4**	49.0	53.8	52.7	39.8
105.11	23.1	39.4	45.2	**55.2**	51.0	54.5	53.5	40.3
106.01	2.99	**3.42**	2.94	3.41	3.25	2.39	1.93	1.35
107.01	4.61	6.47	6.57	**7.95**	7.68	6.53	5.91	4.17
108.01	4.08	5.31	5.15	**5.73**	5.70	4.54	3.83	2.69
109.01	3.90	5.57	5.67	**6.80**	6.60	5.67	5.17	3.65
110.01	3.77	5.14	5.19	**6.18**	6.00	5.04	4.46	3.14
111.01	3.82	6.21	7.09	8.14	**8.45**	8.25	8.32	6.09
111.02	8.08	11.0	11.3	13.6	**14.1**	13.1	12.6	9.21

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
112.01	3.20	4.04	3.82	**4.24**	4.18	3.29	2.75	1.93
113.01	2.25	3.00	3.02	**3.63**	3.49	2.97	2.67	1.88
114.01	2.84	3.66	3.55	**4.11**	4.02	3.27	2.81	1.97
115.01	2.92	3.74	3.56	**4.01**	3.95	3.16	2.67	1.88
116.01	2.41	2.92	2.67	**2.99**	2.94	2.28	1.87	1.31
117.01	2.64	3.86	4.17	4.98	**5.14**	4.59	4.49	3.22
118.01	1.69	2.19	2.12	2.38	**2.38**	1.91	1.61	1.13
119.01	3.17	4.67	4.74	**5.81**	5.78	5.01	4.70	3.33
119.02	6.18	8.99	9.19	11.3	**11.5**	10.0	9.51	6.78
119.03	10.5	15.0	15.7	**18.9**	18.5	17.2	16.4	11.8
119.04	15.2	21.7	22.8	**27.3**	26.0	24.7	23.4	17.0
119.05	17.0	24.5	25.7	**30.6**	29.1	27.9	26.5	19.3
119.06	21.6	31.3	33.1	**39.2**	36.9	36.1	34.2	25.2
119.07	23.3	34.3	36.6	**43.3**	40.5	40.4	38.6	28.5
119.08	21.9	33.1	35.9	**42.5**	38.3	39.9	38.2	28.6
119.09	23.8	36.8	41.0	**49.2**	43.8	46.7	44.7	34.5
119.10	24.0	37.7	42.4	**51.1**	45.3	48.8	47.0	36.2
119.11	38.4	62.7	76.6	99.0	101	104	**105**	80.8
119.12	38.5	63.1	77.4	101	104	106	**107**	82.6
119.13	38.4	63.1	77.6	102	107	107	**108**	83.6
119.14	38.4	63.1	77.6	102	107	107	**108**	83.6
119.15	43.0	71.8	88.9	116	120	123	**124**	95.6
119.16	43.0	72.0	89.2	117	121	123	**125**	96.3
119.17	57.4	93.9	116	147	146	161	**162**	125
119.18	57.5	94.3	117	148	148	163	**164**	126
119.19	57.5	94.3	117	148	148	163	**164**	126
119.20	57.2	94.1	116	149	149	162	**164**	125
119.21	57.2	94.6	117	150	150	163	**165**	126
119.22	57.3	94.7	117	150	174	173	**195**	127
119.23	67.0	113	138	179	199	201	**229**	153
120.01	2.74	4.03	4.24	5.14	**5.21**	4.64	4.49	3.21
121.01	2.06	2.56	2.48	**2.79**	2.78	2.21	1.85	1.30
122.01	3.69	5.29	5.34	**6.44**	6.33	5.38	4.88	3.45
123.01	2.49	3.38	3.38	**4.09**	4.01	3.34	2.99	2.11
124.01	2.85	3.69	3.60	**4.19**	4.15	3.36	2.89	2.03
125.01	2.51	3.94	4.52	5.20	**5.51**	5.26	5.35	3.91
125.02	5.24	7.49	7.98	9.59	**9.85**	9.20	9.00	6.55
126.01	2.44	3.39	3.39	**4.14**	4.13	3.43	3.08	2.18
127.01	1.86	2.46	2.40	2.61	**2.75**	2.13	1.78	1.26
127.02	1.98	2.69	2.66	**3.09**	2.72	2.45	2.24	1.60
128.01	5.92	6.50	5.37	6.28	7.58	7.57	**7.85**	5.97
128.02	13.7	20.4	22.7	26.8	26.5	**27.7**	26.9	20.5
128.03	18.2	27.3	33.5	**41.0**	35.3	40.4	38.4	30.8
128.04	18.4	28.1	34.6	**42.8**	37.4	42.4	40.9	31.9
128.05	19.2	30.5	37.8	**49.0**	45.7	48.2	47.4	36.6
128.06	19.3	30.7	38.2	**51.7**	50.6	50.1	49.9	38.2
128.07	19.5	31.2	39.0	54.3	**55.2**	52.5	52.8	40.6
128.08	20.0	31.2	39.1	55.1	**57.2**	53.3	53.9	41.3
128.09	20.8	31.3	39.3	55.9	**58.7**	54.1	54.9	42.5
128.10	22.4	31.6	39.7	57.3	**61.3**	55.5	56.7	44.0
128.11	22.4	31.6	39.7	57.3	**61.4**	55.6	56.8	44.0

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.12	23.0	31.6	39.9	57.9	**62.5**	56.1	57.6	44.6
129.01	3.44	5.33	5.70	6.72	**7.04**	6.33	6.23	4.48
129.02	6.56	8.90	9.18	11.0	**11.2**	9.97	9.44	6.78
129.03	9.88	13.9	14.7	17.6	**17.9**	16.7	16.1	11.8
130.01	2.48	3.21	3.16	3.61	**3.64**	2.92	2.49	1.75
131.01	4.66	5.15	4.91	5.76	**6.49**	5.69	5.66	4.10
132.01	3.61	5.35	5.42	**6.57**	6.52	5.61	5.20	3.68
132.02	6.15	8.77	9.10	**10.8**	10.4	9.34	8.68	6.18
132.03	8.28	11.6	12.0	**14.1**	13.5	12.3	11.4	8.15
132.04	9.43	13.7	14.7	**17.6**	15.4	15.3	14.1	10.8
132.05	9.44	13.7	14.7	**17.7**	15.5	15.4	14.2	11.0
133.01	1.82	2.52	2.51	**3.00**	3.00	2.50	2.22	1.57
134.01	2.31	3.03	3.02	3.62	**3.63**	2.96	2.58	1.82
135.01	2.42	3.15	3.16	3.73	**3.76**	3.04	2.63	1.86
136.01	4.00	**4.42**	3.23	3.67	3.74	2.79	2.30	1.63
136.02	3.63	**3.91**	2.60	3.18	3.29	3.23	3.17	2.23
137.01	2.57	3.07	3.50	3.95	**4.41**	4.16	4.27	3.16
137.02	7.31	8.12	5.79	7.13	**8.29**	6.99	6.79	4.96
137.03	3.65	4.99	5.51	6.28	6.14	7.02	**7.17**	5.24
137.04	5.33	6.36	6.72	7.63	7.94	8.49	**8.74**	6.39
137.05	6.73	7.87	8.11	9.06	8.97	10.2	**10.4**	7.76
138.01	2.36	2.62	2.15	2.58	**2.75**	2.18	1.90	1.35
139.01	3.47	**3.79**	2.30	2.23	2.26	1.66	1.38	0.99
140.01	4.59	**5.08**	3.24	2.93	2.74	1.89	1.54	1.11
141.01	4.13	**4.55**	3.08	3.57	3.86	3.08	2.70	1.92
141.02	8.38	**8.69**	6.48	6.50	7.30	5.69	4.92	3.53
141.03	10.4	**11.2**	7.81	7.78	8.54	6.63	5.71	4.09
141.04	9.03	**10.2**	7.84	8.72	9.44	7.59	6.68	4.78
142.01	1.77	**1.94**	1.19	1.07	0.99	0.68	0.55	0.40
143.01	0.28	0.43	0.42	0.53	**0.53**	0.44	0.40	0.28
144.01	4.95	**5.47**	3.82	4.76	5.26	4.46	4.26	3.07
144.02	4.37	4.91	4.50	5.45	**5.93**	5.25	5.09	3.70
145.01	1.32	1.87	1.86	2.28	**2.33**	1.89	1.68	1.19
146.01	2.22	2.47	2.73	3.06	**3.47**	3.14	3.21	2.35
147.01	2.09	**2.26**	1.41	1.46	1.72	1.43	1.35	0.98
148.01	7.41	**8.22**	5.03	5.15	5.72	4.42	3.80	2.71
148.02	5.16	**5.77**	4.41	5.12	5.38	4.38	3.94	2.83
149.01	3.51	**3.90**	2.69	2.98	2.93	2.11	1.73	1.23
149.02	3.71	**4.19**	2.90	3.18	3.11	2.29	1.87	1.33
150.01	2.97	4.92	5.69	6.60	7.03	7.17	**7.34**	5.47
150.02	3.27	5.41	6.37	7.41	7.45	**8.11**	8.01	6.16
150.03	4.74	7.46	8.49	9.91	10.1	**10.9**	10.9	8.32
150.04	4.73	7.46	8.52	9.96	10.1	**11.0**	10.9	8.35
150.05	6.90	10.8	12.3	14.6	13.4	**15.9**	15.7	12.2
151.01	2.21	2.47	1.95	2.45	**2.59**	2.10	1.90	1.35
152.01	4.89	**5.38**	3.26	3.59	4.21	3.55	3.43	2.50
152.02	3.88	4.43	3.47	4.24	**4.79**	4.15	4.03	2.95
152.03	2.71	3.41	3.62	**4.35**	4.31	4.33	4.26	3.20
152.04	3.08	3.68	3.98	5.00	5.06	**5.10**	4.95	3.95
153.01	7.05	7.87	7.33	9.18	**9.74**	8.22	7.74	5.53
153.02	8.17	12.8	13.6	**16.0**	15.7	15.3	14.8	11.0

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
153.03	9.60	15.4	16.5	**19.4**	19.2	18.6	18.2	13.4
153.04	13.7	21.3	23.1	**27.0**	26.4	25.8	25.3	18.6
153.05	17.9	27.0	28.8	**34.1**	33.0	32.0	31.0	22.8
153.06	19.9	31.0	33.9	**40.1**	36.7	38.2	36.1	27.4
153.07	19.9	31.0	34.0	**40.2**	36.7	38.4	36.3	27.6
153.08	21.6	33.5	36.5	**43.3**	39.2	40.9	39.0	29.5
154.01	2.89	3.76	3.67	**4.23**	4.23	3.40	2.91	2.05
155.01	2.68	2.99	2.83	3.34	**3.47**	2.81	2.46	1.74
156.01	3.84	5.84	6.26	7.40	**7.65**	6.89	6.72	4.82
157.01	3.19	4.47	4.43	**5.40**	5.37	4.41	3.93	2.78
158.01	1.84	2.46	2.46	**2.93**	2.88	2.40	2.12	1.50
159.01	2.19	2.77	2.69	2.93	**3.06**	2.36	1.95	1.38
159.02	2.56	3.19	3.14	**3.58**	3.56	2.87	2.44	1.73
160.01	1.47	**1.63**	1.01	1.22	1.39	1.16	1.09	0.79
160.02	4.20	**4.31**	3.02	2.99	3.41	2.66	2.38	1.71
160.03	5.29	**5.61**	4.48	4.38	4.82	3.71	3.29	2.38
160.04	5.25	**5.67**	4.52	4.40	4.84	3.74	3.31	2.40
161.01	2.57	19.9	37.0	**82.4**	76.6	74.8	68.5	29.6
161.02	2.41	19.6	36.8	**82.2**	76.6	74.9	68.5	29.8
161.03	4.13	19.2	36.3	**82.0**	76.5	75.3	68.9	30.6
162.01	1.18	1.52	1.46	**1.65**	1.65	1.32	1.11	0.78
163.01	3.43	4.68	4.68	**5.62**	5.57	4.55	4.03	2.84
163.02	7.10	9.92	10.1	**12.1**	11.8	10.1	9.17	6.50
163.03	11.7	17.4	18.7	**22.2**	20.4	21.3	20.1	15.3
163.04	13.4	20.5	22.6	**26.7**	23.9	25.6	24.2	18.4
163.05	16.7	26.0	29.4	35.5	34.1	**36.9**	36.9	27.7
163.06	16.6	25.9	29.4	35.7	34.4	37.1	**37.1**	27.8
163.07	16.7	26.4	30.5	37.6	36.7	38.8	**39.2**	29.4
163.08	16.3	26.1	30.3	37.5	36.3	38.7	**39.3**	29.5
164.01	3.49	5.06	5.15	**6.20**	6.07	5.24	4.81	3.40
165.01	2.95	4.43	4.59	5.66	**5.84**	5.10	4.91	3.51
166.01	2.22	3.07	3.11	**3.81**	3.75	3.21	2.97	2.11
167.01	3.02	3.51	4.45	5.86	7.13	7.59	**8.03**	6.06
168.01	2.14	2.81	2.80	**3.37**	3.32	2.75	2.42	1.71
169.01	3.59	5.23	5.35	**6.45**	6.30	5.52	5.12	3.62
169.02	4.97	7.44	7.65	9.25	10.1	9.78	**10.6**	7.64
169.03	5.06	7.52	7.91	9.41	10.0	10.0	**10.7**	7.73
170.01	2.62	2.91	2.66	3.26	**3.51**	3.02	2.88	2.06
170.02	2.68	3.94	4.25	4.94	**5.11**	4.85	4.78	3.49
170.03	3.64	5.75	6.68	7.83	7.43	**8.46**	8.23	6.38
171.01	3.71	6.15	7.17	8.30	8.64	8.82	**8.97**	6.66
171.02	4.62	7.81	9.48	11.2	10.9	**12.6**	12.4	9.64
171.03	7.15	12.2	14.4	17.0	16.7	**18.9**	18.7	14.3
171.04	7.55	13.0	15.6	18.5	18.1	**20.8**	20.7	15.9
171.05	10.1	17.8	21.5	25.8	25.2	29.1	**29.1**	22.3
171.06	10.1	17.9	21.6	26.1	25.3	29.3	**29.4**	22.5
172.01	2.13	2.71	2.93	3.37	**3.68**	3.28	3.26	2.36
173.01	2.77	3.09	2.65	2.96	**3.52**	3.17	3.27	2.43
174.01	1.82	**2.03**	1.64	1.78	1.93	1.48	1.24	0.88
175.01	1.80	3.03	3.70	4.47	4.84	5.50	**5.63**	4.31
175.02	3.04	5.12	6.14	7.26	7.22	8.44	**8.54**	6.49

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
176.01	1.52	2.26	2.56	2.89	**3.16**	3.02	3.08	2.27
177.01	1.81	2.34	2.69	3.06	3.42	3.44	**3.52**	2.66
178.01	2.38	2.97	2.82	**3.15**	3.12	2.47	2.06	1.45
178.02	4.34	5.46	5.22	5.80	**5.81**	4.58	3.82	2.69
179.01	3.08	3.55	4.09	4.70	**5.28**	5.03	5.20	3.84
179.02	6.15	8.94	9.81	11.4	**12.3**	11.4	11.5	8.36
179.03	6.70	10.3	11.6	13.5	13.5	**14.3**	14.2	10.8
179.04	6.62	10.3	12.1	14.5	14.2	16.0	**16.3**	12.5
179.05	6.98	11.1	13.2	16.8	17.9	18.0	**18.8**	14.0
179.06	7.74	12.5	15.0	19.8	21.6	21.5	**22.6**	16.7
179.07	20.5	20.4	17.9	21.4	25.6	24.4	**25.9**	18.7
180.01	2.13	3.10	3.37	3.91	**4.18**	3.74	3.71	2.68
181.01	7.35	**7.96**	4.75	3.76	4.26	3.34	3.08	2.26
182.01	1.74	2.26	2.21	2.49	**2.52**	2.02	1.71	1.21
182.02	2.75	4.06	4.24	4.95	**4.99**	4.87	4.73	3.52
183.01	1.78	1.92	1.70	2.41	3.02	3.04	**3.37**	2.49
184.01	18.0	**19.4**	12.02	8.55	8.65	6.31	5.62	4.17
185.01	10.6	**11.9**	6.85	5.03	4.79	3.35	2.76	2.01
186.01	4.48	**4.89**	2.76	2.36	2.46	1.81	1.53	1.10
186.02	5.63	**5.86**	4.40	3.59	3.68	2.70	2.29	1.66

PEAK DESIGN FLOOD DISCHARGES - 2% AEP

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	8.55	11.4	11.2	**13.0**	12.6	10.5	9.54	6.83
1.02	14.6	20.4	20.6	**23.2**	21.7	19.7	18.4	13.3
1.03	22.9	31.1	30.6	**35.3**	32.9	29.2	27.3	19.8
1.04	29.5	39.1	38.2	**44.6**	43.1	37.6	35.1	25.4
1.05	51.5	67.6	66.1	**76.9**	75.6	66.8	62.7	45.7
1.06	67.8	85.9	84.5	98.1	**98.8**	86.3	81.3	59.4
1.07	86.6	107	106	122	**122**	106	98.9	72.1
1.08	98.3	121	119	**136**	134	117	109	79.8
1.09	112	139	135	**154**	150	132	123	89.9
1.10	119	148	143	**163**	158	140	130	95.4
1.11	148	184	176	**200**	193	171	158	116
1.12	154	193	184	**210**	201	180	167	123
1.13	155	196	187	**213**	203	183	170	125
1.14	158	202	193	**220**	209	189	175	129
1.15	161	207	199	**226**	212	194	180	133
1.16	166	216	209	**237**	218	203	189	140
1.17	200	266	259	**292**	264	250	234	173
1.18	220	298	293	**330**	294	281	265	197
1.19	216	295	295	**333**	292	287	273	205
1.20	217	297	300	**338**	294	291	277	209
1.21	315	431	434	**491**	413	407	387	293
1.22	313	431	437	**495**	417	410	391	297
1.23	313	432	441	**505**	430	416	399	303
1.24	312	431	442	**508**	435	418	401	305
1.25	316	438	453	**522**	445	429	413	318
1.26	314	437	455	**530**	456	435	419	325
1.27	314	437	455	**531**	458	436	420	326
1.28	313	437	457	**536**	464	439	424	329
1.29	313	440	463	**551**	488	450	437	340
1.30	313	440	463	**552**	490	451	438	340
1.31	312	445	473	**560**	494	459	447	350
1.32	306	438	468	**555**	485	456	446	349
1.33	306	438	470	**562**	496	463	452	354
1.34	303	436	469	**564**	498	466	455	355
1.35	300	434	468	**566**	500	469	458	358
1.36	300	435	472	**586**	530	489	476	371
1.37	300	436	474	**603**	558	508	493	383
1.38	294	432	470	**601**	557	510	497	383
1.39	293	431	470	**603**	561	515	500	386
1.40	289	427	467	**600**	558	514	500	386
1.41	288	426	467	**600**	559	518	502	388
1.42	286	424	465	**600**	560	519	503	388
1.43	285	423	465	**600**	561	521	505	390
1.44	285	423	465	**600**	561	522	505	391
1.45	283	421	465	**601**	563	526	510	393
1.46	282	421	464	**601**	564	528	513	396
1.47	281	419	463	**600**	562	528	513	397
1.48	274	357	384	**466**	443	423	414	344
1.49	277	365	398	516	**534**	495	510	390

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.50	277	365	398	516	**534**	495	511	391
1.51	298	475	561	739	**797**	758	793	545
1.52	299	477	564	740	**800**	763	799	549
1.53	298	476	563	739	**800**	764	799	549
1.54	299	477	565	739	801	768	**803**	551
1.55	303	486	576	743	813	786	**826**	564
1.56	303	486	577	743	814	787	**828**	565
1.57	301	485	577	740	816	790	**832**	567
1.58	299	484	576	738	816	791	**833**	568
1.59	304	492	587	747	830	815	**857**	586
1.60	284	472	571	736	828	810	**853**	583
2.01	5.52	6.97	6.75	7.46	**7.47**	5.95	5.15	3.68
3.01	5.95	**6.95**	5.43	5.48	5.03	3.48	2.81	2.00
4.01	8.72	12.9	13.8	15.2	**15.9**	14.1	14.1	10.3
4.02	19.6	25.9	25.5	29.7	**30.0**	26.7	25.6	18.7
5.01	5.79	8.92	9.66	10.5	**11.0**	10.2	10.2	7.55
5.02	14.3	16.5	15.6	18.1	**20.0**	16.9	16.1	11.8
6.01	2.94	**3.44**	3.15	3.34	3.33	2.55	2.10	1.50
7.01	9.45	12.4	12.1	**14.0**	13.5	11.2	10.1	7.25
7.02	18.6	22.5	21.6	**24.4**	23.6	19.6	17.5	12.5
8.01	2.55	**2.86**	2.50	2.73	2.62	1.99	1.63	1.16
9.01	7.86	**9.04**	8.15	8.75	8.47	6.51	5.37	3.82
10.01	13.4	16.3	15.3	**16.6**	16.2	12.9	10.9	7.80
11.01	5.03	**5.58**	4.49	5.04	4.68	3.41	2.76	1.96
12.01	8.99	**9.84**	8.29	9.34	8.82	6.43	5.21	3.72
12.02	17.6	**19.5**	16.4	18.3	17.0	12.8	10.5	7.51
12.03	26.7	**30.3**	26.0	28.7	26.0	20.4	17.0	12.1
12.04	38.6	**44.8**	38.9	42.7	37.9	30.7	25.8	18.4
13.01	4.57	**5.27**	4.09	4.22	3.88	2.73	2.20	1.56
14.01	5.35	**5.90**	5.13	5.64	5.38	4.04	3.30	2.34
15.01	6.59	**7.46**	6.57	7.18	6.89	5.25	4.30	3.06
16.01	3.48	**3.87**	3.19	3.51	3.28	2.41	1.95	1.38
16.02	8.99	**10.0**	8.38	9.46	8.80	6.59	5.39	3.83
16.03	14.9	**16.7**	13.7	15.5	14.4	10.8	8.78	6.24
17.01	4.22	**4.74**	4.13	4.50	4.28	3.23	2.64	1.88
18.01	5.71	**6.33**	5.11	5.76	5.38	3.93	3.18	2.27
19.01	4.68	**5.17**	4.36	4.86	4.56	3.38	2.75	1.95
20.01	6.82	**7.58**	6.50	7.22	6.85	5.14	4.18	2.97
21.01	4.39	**4.97**	3.93	4.22	3.90	2.79	2.26	1.60
22.01	5.63	**6.20**	5.25	5.86	5.54	4.12	3.35	2.38
23.01	15.7	19.5	19.1	**21.5**	20.8	16.9	14.9	10.6
23.02	42.7	53.1	50.8	**56.6**	52.7	43.7	38.5	27.5
23.03	46.4	58.1	55.6	**62.0**	57.1	48.1	42.5	30.4
23.04	49.5	61.8	59.5	**66.5**	61.4	51.7	45.8	32.7
24.01	5.56	**6.64**	6.14	6.54	6.41	5.04	4.21	3.00
24.02	15.5	18.3	17.0	**18.5**	17.5	14.1	12.0	8.56
25.01	3.04	3.65	3.42	**3.67**	3.58	2.84	2.41	1.72
26.01	4.77	**5.43**	4.25	4.49	4.13	2.93	2.36	1.68
27.01	15.4	18.8	17.7	**19.0**	18.7	14.8	12.5	8.93
27.02	26.6	**30.7**	28.1	30.4	29.8	23.1	19.4	13.8
27.03	40.2	47.8	44.8	**48.8**	48.0	38.1	32.6	23.3

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
28.01	8.53	**9.38**	7.90	8.82	8.35	6.16	5.00	3.56
29.01	13.8	17.0	16.6	**18.8**	18.0	14.7	13.0	9.25
30.01	11.4	14.0	13.5	**15.1**	14.5	11.8	10.3	7.32
31.01	14.2	**16.2**	14.5	15.6	15.1	11.6	9.5	6.79
31.02	21.8	**25.2**	22.8	24.7	23.7	18.5	15.4	11.0
31.03	33.8	40.0	37.1	**40.4**	38.9	31.0	26.4	18.8
31.04	41.8	49.7	46.3	**50.7**	48.1	38.8	33.4	23.8
31.05	50.9	61.4	57.6	**63.5**	59.4	48.6	42.1	30.0
31.06	60.3	73.1	68.4	**75.9**	70.0	58.1	50.6	36.1
31.07	68.9	85.3	80.6	**89.8**	81.2	69.6	61.5	44.2
31.08	111	143	139	**157**	132	119	111	82.7
31.09	111	145	142	**160**	133	122	114	86.4
32.01	6.85	**8.24**	7.54	8.12	7.91	6.19	5.19	3.70
33.01	11.9	14.6	14.1	**15.8**	15.1	12.3	10.8	7.68
34.01	6.08	7.46	7.13	**7.97**	7.69	6.22	5.42	3.86
35.01	5.00	6.14	5.82	**6.34**	6.15	4.96	4.24	3.02
36.01	4.37	**4.86**	4.08	4.53	4.25	3.15	2.56	1.82
37.01	5.92	**6.55**	5.42	6.11	5.74	4.24	3.44	2.45
38.01	6.36	7.89	7.69	**8.76**	8.40	6.86	6.08	4.33
38.02	12.4	14.9	14.1	**15.5**	15.3	12.2	10.6	7.54
38.03	28.1	32.9	30.6	**33.9**	32.0	26.1	22.6	16.1
38.04	51.5	62.9	60.3	**67.8**	64.6	53.7	47.5	34.0
39.01	5.38	**6.26**	5.71	6.10	5.90	4.59	3.81	2.71
40.01	3.82	**4.63**	4.25	4.51	4.37	3.43	2.88	2.05
40.02	9.65	**10.9**	9.27	10.4	9.80	7.51	6.26	4.45
41.01	3.22	**3.63**	2.94	3.11	2.89	2.07	1.67	1.19
42.01	12.0	15.7	15.4	**17.9**	16.9	14.3	13.0	9.29
42.02	23.7	30.1	29.6	**33.9**	32.4	27.1	24.4	17.41
43.01	10.4	13.0	12.7	**14.4**	13.7	11.3	10.0	7.12
44.01	5.29	**5.94**	5.29	5.74	5.51	4.19	3.45	2.45
45.01	8.69	10.6	9.98	**10.9**	10.6	8.51	7.30	5.20
46.01	10.8	13.5	13.1	**15.0**	14.6	11.8	10.4	7.43
46.02	20.4	24.9	23.6	**26.3**	25.0	20.5	18.0	12.8
47.01	6.43	**7.18**	6.19	6.84	6.52	4.92	4.01	2.85
48.01	6.39	7.87	7.51	**8.40**	8.18	6.58	5.72	4.08
49.01	12.7	17.9	17.9	21.4	**21.6**	18.3	17.5	12.6
50.01	5.35	6.56	6.22	**6.81**	6.60	5.32	4.57	3.25
51.01	4.71	**5.69**	4.46	3.75	3.45	2.32	1.87	1.33
51.02	14.6	**16.9**	13.4	13.0	11.8	8.28	6.68	4.76
51.03	21.6	**24.8**	20.5	21.8	19.9	15.6	13.2	9.44
52.01	8.18	**9.38**	7.34	7.77	7.16	5.00	4.04	2.88
53.01	6.05	**7.07**	5.56	5.30	4.86	3.33	2.68	1.91
54.01	3.81	**4.37**	3.87	4.16	4.00	3.05	2.51	1.78
55.01	7.21	9.80	9.69	**11.3**	10.8	9.41	8.82	6.34
56.01	11.7	14.8	14.4	**16.6**	15.7	13.0	11.7	8.32
56.02	21.8	29.3	29.2	**33.5**	32.1	28.6	26.5	19.5
56.03	24.7	33.1	33.3	**37.9**	36.3	32.8	30.7	22.4
57.01	8.06	10.6	10.4	**12.1**	11.4	9.74	8.94	6.39
58.01	5.22	**6.27**	5.83	6.23	6.06	4.79	4.02	2.86
59.01	2.68	3.28	3.15	**3.57**	3.44	2.80	2.45	1.74
60.01	6.38	8.42	8.29	**9.59**	9.11	7.71	7.06	5.05

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.02	11.8	16.0	16.1	**18.3**	15.7	14.9	13.6	10.2
61.01	5.87	7.43	7.26	**8.31**	7.92	6.53	5.84	4.16
62.01	2.72	3.31	3.19	**3.60**	3.42	2.81	2.47	1.76
63.01	9.45	14.4	15.7	17.2	**17.4**	16.4	16.4	12.1
63.02	15.1	21.7	22.6	25.6	**25.9**	23.6	23.0	16.9
64.01	5.47	7.26	7.16	**8.29**	7.87	6.64	6.08	4.35
65.01	5.16	6.72	6.60	**7.58**	7.22	6.02	5.46	3.90
66.01	4.99	6.97	7.01	**8.20**	8.00	6.95	6.66	4.80
67.01	6.60	9.24	9.26	**10.8**	10.5	9.26	8.88	6.41
67.02	12.6	15.7	15.7	18.4	**18.8**	15.8	14.6	10.5
67.03	34.0	39.6	38.4	**44.0**	43.8	37.8	34.6	25.0
67.04	47.5	56.8	50.6	**58.9**	57.5	49.1	44.9	32.4
67.05	57.5	69.2	62.8	**72.9**	71.6	61.4	56.1	40.7
67.06	58.3	71.6	67.6	**78.0**	75.4	67.0	61.7	45.4
67.07	60.6	75.6	72.7	**83.5**	78.9	71.5	66.4	48.9
68.01	3.38	4.23	4.13	**4.72**	4.54	3.70	3.28	2.34
69.01	9.80	**11.1**	8.85	9.39	8.68	6.08	4.91	3.50
70.01	6.21	**7.26**	6.69	7.12	7.09	5.39	4.45	3.18
70.02	15.1	**16.5**	14.4	16.3	15.4	11.6	9.48	6.77
71.01	5.63	**6.18**	5.15	5.94	5.53	3.97	3.22	2.30
72.01	5.75	**6.37**	5.16	5.84	5.46	3.97	3.21	2.29
73.01	3.90	5.36	5.32	**6.18**	5.91	5.03	4.66	3.34
74.01	12.1	15.2	14.8	**17.0**	16.8	13.5	11.9	8.49
74.02	17.5	22.9	22.5	**25.5**	24.3	20.5	18.4	13.2
74.03	23.4	29.5	28.8	**32.6**	30.6	25.9	23.3	16.7
74.04	27.1	33.5	32.6	**36.9**	34.9	29.4	26.4	19.0
74.05	35.7	45.0	44.0	**49.9**	46.5	40.0	36.3	26.1
74.06	34.9	45.2	44.6	**50.7**	44.4	41.0	37.6	27.7
74.07	35.0	45.2	44.7	**50.8**	44.4	41.1	37.6	27.8
75.01	4.75	**5.46**	4.91	5.27	5.14	3.88	3.19	2.28
76.01	3.48	**4.00**	3.53	3.80	3.64	2.79	2.29	1.63
77.01	6.21	8.26	8.09	**9.39**	9.10	7.52	6.85	4.90
78.01	5.60	8.26	8.73	**9.74**	9.73	8.91	8.76	6.40
78.02	13.7	18.3	18.3	**21.1**	20.6	18.2	17.2	12.5
78.03	18.5	24.2	24.3	**27.8**	27.0	24.2	22.5	16.6
79.01	5.18	6.58	6.43	**7.33**	6.96	5.77	5.16	3.68
80.01	3.48	**4.06**	3.62	3.87	3.72	2.87	2.36	1.68
81.01	4.11	6.11	6.42	7.20	**7.28**	6.51	6.40	4.66
82.01	6.95	10.1	10.7	**12.0**	11.9	10.9	10.7	7.83
82.02	9.71	14.4	15.3	**17.3**	16.7	16.1	15.6	11.7
83.01	4.62	6.61	6.63	**7.81**	7.78	6.66	6.39	4.62
83.02	5.50	7.55	7.52	**8.88**	8.82	7.59	7.21	5.22
84.01	4.01	5.85	6.00	**6.87**	6.80	6.03	5.85	4.24
84.02	3.99	5.92	6.21	**7.04**	6.48	6.27	5.97	4.47
85.01	3.30	**3.79**	3.04	3.49	3.31	2.40	1.95	1.40
85.02	3.94	5.52	5.61	**6.14**	4.98	5.65	5.45	4.11
86.01	4.59	**5.04**	3.25	3.41	3.63	2.76	2.36	1.70
87.01	3.40	5.26	5.75	6.30	**6.48**	6.06	6.10	4.51
87.02	3.77	5.60	6.14	6.73	**7.01**	6.49	6.49	4.81
88.01	2.60	3.68	3.87	4.32	**4.35**	3.91	3.85	2.81
89.01	10.8	15.3	15.8	**18.0**	17.8	16.0	15.5	11.3

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
89.02	23.6	29.6	29.1	**33.5**	32.8	28.2	26.0	18.7
89.03	33.8	42.4	41.4	**47.1**	45.8	39.1	35.6	25.7
89.04	43.9	56.2	55.0	**62.7**	59.8	52.0	47.6	34.5
89.05	51.9	66.8	65.4	**74.5**	70.5	61.5	56.4	40.9
89.06	58.6	75.9	74.5	**84.5**	77.7	69.5	63.9	46.7
89.07	67.8	95.1	94.8	**108**	97.5	91.8	85.3	63.1
89.08	70.7	100	101	**114**	102	97.5	90.9	67.4
89.09	71.8	103	104	**118**	105	101	94.2	70.0
89.10	72.3	104	105	**120**	106	103	95.7	71.5
89.11	72.7	106	107	**122**	107	105	97.9	73.6
89.12	74.4	110	113	**128**	111	111	104	78.3
89.13	75.1	112	117	**133**	114	115	108	81.8
89.14	75.2	113	118	**134**	114	116	109	83.0
89.15	87.9	131	143	**169**	153	165	161	122
89.16	88.9	133	146	**174**	157	168	165	125
89.17	88.9	134	148	**177**	160	172	169	128
90.01	3.50	**4.07**	3.63	3.88	3.73	2.87	2.36	1.68
90.02	12.0	14.5	13.5	**14.7**	13.8	11.2	9.60	6.83
91.01	4.09	5.13	4.85	**5.29**	5.15	4.11	3.56	2.53
92.01	6.94	8.55	8.17	**9.12**	8.80	7.14	6.21	4.42
93.01	9.80	13.1	12.9	**14.9**	14.2	12.1	11.2	8.04
94.01	7.29	9.11	8.87	**10.1**	9.65	7.97	7.06	5.03
95.01	5.30	**6.15**	5.60	5.99	5.79	4.49	3.72	2.65
96.01	8.24	12.1	13.0	14.4	**14.4**	13.3	13.2	9.64
96.02	12.5	16.5	16.7	**19.4**	19.3	17.5	16.8	12.3
97.01	3.79	**4.64**	4.29	4.57	4.43	3.50	2.95	2.10
98.01	5.75	7.38	7.21	**8.28**	7.88	6.52	5.85	4.18
99.01	2.98	**3.56**	3.30	3.53	3.41	2.71	2.28	1.63
100.01	2.14	2.74	2.69	**3.08**	2.91	2.45	2.21	1.58
101.01	2.74	3.34	3.22	**3.65**	3.50	2.86	2.50	1.78
102.01	3.14	4.20	4.16	**4.88**	4.60	3.93	3.66	2.62
103.01	3.85	4.95	4.84	**5.52**	5.28	4.32	3.86	2.76
104.01	1.65	2.13	2.08	**2.39**	2.36	1.91	1.69	1.21
105.01	8.04	10.3	10.1	**11.6**	11.0	9.16	8.26	5.90
105.02	11.8	14.1	13.4	**15.2**	15.2	12.3	10.8	7.73
105.03	19.9	24.2	23.4	**26.6**	25.6	21.3	19.0	13.6
105.04	20.4	26.9	26.9	**30.6**	26.6	25.1	23.3	17.3
105.05	23.0	30.9	32.0	**36.2**	30.2	31.1	28.7	22.2
105.06	25.4	35.3	37.2	**42.9**	34.5	36.8	34.7	26.7
105.07	31.0	45.8	49.4	**56.4**	47.7	50.5	48.6	37.3
105.08	31.7	47.7	51.8	**59.1**	51.1	53.5	51.6	39.6
105.09	35.6	53.8	58.7	**67.3**	56.8	60.3	58.0	44.4
105.10	34.2	52.0	57.9	**68.0**	58.7	62.0	60.2	45.6
105.11	34.2	52.1	58.0	**69.4**	61.1	62.7	61.2	46.2
106.01	3.86	**4.31**	3.52	3.87	3.61	2.64	2.14	1.52
107.01	6.49	8.26	8.07	**9.27**	8.81	7.31	6.57	4.68
108.01	5.62	**6.68**	6.18	6.61	6.42	5.08	4.25	3.02
109.01	5.48	7.12	6.98	**8.04**	7.61	6.35	5.74	4.10
110.01	5.23	6.50	6.35	**7.16**	6.84	5.62	4.96	3.53
111.01	5.45	8.30	8.95	9.84	**9.93**	9.33	9.30	6.86
111.02	11.0	14.2	14.1	16.3	**16.4**	14.7	14.1	10.4

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
112.01	4.25	**5.04**	4.59	4.87	4.73	3.66	3.05	2.17
113.01	3.03	3.80	3.70	**4.24**	3.99	3.31	2.96	2.11
114.01	3.77	4.68	4.38	**4.72**	4.57	3.64	3.12	2.22
115.01	3.85	**4.70**	4.33	4.61	4.47	3.52	2.96	2.11
116.01	3.13	**3.57**	3.17	3.42	3.28	2.53	2.07	1.47
117.01	3.59	5.12	5.18	**6.07**	5.99	5.22	5.01	3.62
118.01	2.29	2.73	2.54	**2.74**	2.66	2.12	1.79	1.27
119.01	4.36	6.03	5.95	**6.91**	6.65	5.62	5.23	3.74
119.02	8.41	11.7	11.6	**13.5**	13.2	11.3	10.6	7.62
119.03	14.2	19.5	19.7	**22.5**	21.5	19.4	18.3	13.3
119.04	20.7	28.3	28.6	**32.5**	30.3	27.8	26.2	19.2
119.05	23.3	31.8	32.2	**36.5**	33.9	31.4	29.7	21.7
119.06	29.5	40.6	41.4	**46.8**	43.2	40.7	38.3	28.3
119.07	31.9	44.6	46.0	**51.8**	47.6	45.6	43.3	32.1
119.08	30.2	43.4	45.3	**51.1**	45.1	45.2	43.0	32.3
119.09	33.1	48.5	52.2	**59.5**	51.2	53.3	50.6	39.2
119.10	33.6	49.9	54.3	**61.9**	53.2	55.7	53.2	41.2
119.11	52.8	86.2	102	**124**	118	122	121	93.7
119.12	53.0	86.7	103	**126**	122	125	124	95.9
119.13	53.0	86.8	104	**128**	125	126	126	97.1
119.14	52.9	86.8	104	**128**	126	126	126	97.3
119.15	59.6	98.6	118	**145**	140	144	144	111
119.16	59.6	98.8	119	**146**	142	145	145	112
119.17	80.4	128	154	182	171	187	**188**	144
119.18	80.7	128	154	184	173	189	**190**	145
119.19	80.6	128	154	184	173	189	**190**	145
119.20	80.1	128	154	185	174	189	**190**	145
119.21	80.0	129	155	186	177	190	**192**	146
119.22	80.1	129	155	211	242	231	**244**	147
119.23	94.9	154	185	240	270	264	**283**	178
120.01	3.74	5.27	5.29	**6.19**	6.04	5.25	5.01	3.61
121.01	2.72	**3.24**	2.98	3.19	3.11	2.45	2.05	1.46
122.01	5.17	6.72	6.58	**7.56**	7.26	6.01	5.42	3.87
123.01	3.36	4.25	4.14	**4.75**	4.59	3.74	3.32	2.37
124.01	3.77	4.72	4.46	**4.82**	4.71	3.74	3.21	2.29
125.01	3.46	5.29	5.73	6.28	**6.46**	5.96	5.97	4.39
125.02	7.15	9.86	10.0	**11.5**	11.5	10.4	10.0	7.37
126.01	3.29	4.29	4.16	**4.83**	4.71	3.83	3.42	2.45
127.01	2.51	3.04	2.85	3.00	**3.06**	2.37	1.97	1.41
127.02	2.67	3.44	3.21	**3.64**	3.08	2.74	2.48	1.79
128.01	6.68	7.29	6.99	7.71	**9.07**	8.63	8.86	6.74
128.02	18.6	26.8	28.7	**32.3**	31.4	31.4	30.2	23.2
128.03	23.5	39.7	44.3	**50.0**	42.3	46.1	44.6	34.9
128.04	24.1	40.5	45.7	**52.3**	44.5	48.7	47.7	37.0
128.05	25.5	44.0	50.4	**60.1**	53.8	55.5	55.1	42.7
128.06	25.6	44.4	51.2	**63.6**	60.2	57.9	58.0	44.7
128.07	25.9	45.2	52.5	**67.3**	65.7	60.8	61.6	47.7
128.08	26.0	45.3	52.7	**68.8**	67.9	61.8	62.8	48.6
128.09	26.5	45.4	53.1	**69.9**	69.5	62.9	64.2	49.9
128.10	28.8	45.9	53.8	72.0	**72.8**	65.3	67.3	51.6
128.11	28.8	45.9	53.8	72.1	**72.9**	65.3	67.4	51.7

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.12	29.7	46.1	54.1	72.9	**74.2**	66.5	68.7	52.5
129.01	4.84	6.92	7.10	8.24	**8.25**	7.13	6.94	5.03
129.02	8.86	11.4	11.3	**13.2**	12.9	11.2	10.5	7.62
129.03	13.3	18.1	18.4	**21.2**	20.9	18.8	18.0	13.2
130.01	3.29	4.04	3.84	**4.14**	4.11	3.24	2.76	1.97
131.01	5.30	5.82	6.13	7.02	**7.49**	6.43	6.30	4.60
132.01	5.10	6.81	6.72	**7.80**	7.52	6.28	5.77	4.13
132.02	8.55	11.2	11.2	**12.6**	11.9	10.4	9.64	6.94
132.03	11.4	14.9	14.7	**16.5**	15.4	13.8	12.7	9.15
132.04	13.1	18.1	18.5	**20.9**	17.8	17.3	16.0	12.2
132.05	13.1	18.1	18.6	**21.0**	17.9	17.4	16.2	12.4
133.01	2.48	3.14	3.03	**3.49**	3.40	2.78	2.46	1.76
134.01	3.10	3.83	3.72	**4.15**	4.10	3.29	2.86	2.04
135.01	3.25	4.02	3.89	**4.28**	4.24	3.38	2.92	2.09
136.01	4.59	**5.02**	3.80	4.23	4.14	3.08	2.54	1.83
136.02	4.05	**4.35**	3.15	4.04	4.04	3.73	3.69	2.72
137.01	2.99	4.03	4.41	4.78	**5.23**	4.71	4.78	3.55
137.02	8.31	9.19	7.04	8.51	**9.54**	7.90	7.58	5.56
137.03	4.67	6.48	7.17	7.92	7.91	8.02	**8.11**	5.90
137.04	6.47	7.97	8.69	9.73	**10.3**	9.78	9.87	7.18
137.05	8.15	9.46	10.1	11.4	11.5	11.7	**11.9**	8.72
138.01	2.66	2.96	2.68	2.96	**3.07**	2.43	2.11	1.52
139.01	3.88	**4.21**	2.63	2.55	2.50	1.84	1.52	1.10
140.01	5.21	**5.73**	3.72	3.25	3.01	2.08	1.70	1.23
141.01	4.70	**5.15**	3.69	4.13	4.33	3.42	2.99	2.15
141.02	9.49	**9.82**	7.42	7.65	8.17	6.30	5.44	3.94
141.03	11.8	**12.7**	8.99	9.14	9.55	7.34	6.32	4.57
141.04	10.5	**12.0**	9.25	10.1	10.6	8.41	7.39	5.34
142.01	1.96	**2.16**	1.39	1.18	1.09	0.75	0.61	0.44
143.01	0.40	0.54	0.54	**0.62**	0.61	0.50	0.45	0.32
144.01	5.63	**6.17**	4.72	5.75	6.06	5.01	4.74	3.44
144.02	5.27	5.94	5.52	6.58	**6.87**	5.91	5.65	4.14
145.01	1.80	2.34	2.31	**2.62**	2.62	2.11	1.86	1.33
146.01	2.52	3.13	3.42	3.69	**4.03**	3.54	3.57	2.64
147.01	2.35	**2.50**	1.59	1.74	1.95	1.60	1.50	1.10
148.01	8.31	**9.13**	5.80	6.01	6.40	4.89	4.20	3.03
148.02	5.89	**6.81**	5.41	5.93	6.08	4.88	4.37	3.16
149.01	4.04	**4.43**	3.13	3.41	3.24	2.33	1.91	1.38
149.02	4.26	**4.81**	3.39	3.66	3.45	2.53	2.06	1.49
150.01	4.08	6.55	7.32	8.09	**8.48**	8.13	8.24	6.16
150.02	4.50	7.23	8.18	9.06	8.98	**9.21**	9.06	6.96
150.03	6.57	9.83	10.8	12.1	12.2	**12.4**	12.3	9.39
150.04	6.57	9.87	10.9	12.2	12.2	**12.5**	12.3	9.43
150.05	9.42	14.1	15.8	17.7	16.3	**18.3**	17.8	13.9
151.01	2.52	2.79	2.42	2.84	**2.93**	2.35	2.10	1.51
152.01	5.45	**5.98**	3.71	4.26	4.80	3.97	3.81	2.80
152.02	4.51	4.97	4.29	5.02	**5.32**	4.66	4.48	3.30
152.03	3.53	4.27	4.52	**5.21**	5.00	4.90	4.77	3.61
152.04	3.74	4.60	5.07	**6.03**	5.72	5.91	5.67	4.53
153.01	8.07	9.37	9.19	10.93	**11.1**	9.26	8.59	6.20
153.02	11.8	16.5	16.8	**19.1**	18.6	17.3	16.7	12.4

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
153.03	14.1	20.0	20.5	**23.3**	22.6	21.1	20.4	15.1
153.04	19.5	27.7	28.7	**32.4**	31.3	29.3	28.4	20.9
153.05	25.3	35.3	36.1	**40.9**	38.8	36.2	34.8	25.7
153.06	28.4	40.8	42.6	**48.1**	43.6	43.3	40.6	31.0
153.07	28.4	40.8	42.7	**48.3**	43.6	43.6	40.8	31.2
153.08	30.7	44.0	46.0	**52.2**	46.5	46.7	43.8	33.4
154.01	3.81	4.79	4.52	**4.85**	4.79	3.78	3.23	2.30
155.01	3.11	3.48	3.40	3.86	**3.91**	3.12	2.72	1.95
156.01	5.47	7.73	7.79	**9.06**	8.95	7.79	7.49	5.41
157.01	4.33	5.60	5.47	**6.22**	6.12	4.94	4.36	3.11
158.01	2.50	3.07	2.97	**3.39**	3.27	2.68	2.35	1.68
159.01	2.90	**3.46**	3.20	3.38	3.40	2.61	2.16	1.55
159.02	3.40	4.01	3.80	**4.10**	3.99	3.18	2.70	1.93
160.01	1.67	**1.81**	1.20	1.46	1.59	1.30	1.21	0.88
160.02	4.72	**4.79**	3.48	3.51	3.83	2.97	2.63	1.91
160.03	6.07	**6.62**	5.15	5.05	5.39	4.13	3.64	2.66
160.04	6.04	**6.63**	5.19	5.08	5.42	4.16	3.67	2.68
161.01	6.29	61.7	79.3	**134**	119	106	99.5	53.1
161.02	5.86	61.2	79.1	**134**	119	106	99.6	53.3
161.03	5.39	60.8	78.8	**133**	119	106	100	54.3
162.01	1.58	**1.91**	1.79	1.91	1.87	1.47	1.24	0.88
163.01	4.70	5.90	5.75	**6.46**	6.30	5.12	4.47	3.19
163.02	9.81	12.6	12.4	**14.2**	13.5	11.4	10.2	7.30
163.03	15.9	22.7	23.4	**26.3**	24.3	24.1	22.7	17.2
163.04	18.7	27.0	28.4	**31.9**	28.5	29.1	27.2	20.9
163.05	23.1	34.2	37.5	**43.2**	40.1	42.8	41.8	31.5
163.06	23.0	34.1	37.5	**43.5**	40.2	43.0	42.0	31.7
163.07	23.1	34.9	39.1	**46.0**	42.9	45.4	44.6	34.0
163.08	22.8	34.6	38.9	**45.9**	42.7	45.3	44.7	34.0
164.01	4.89	6.46	6.36	**7.33**	6.98	5.85	5.34	3.82
165.01	4.04	5.78	5.76	**6.80**	6.73	5.75	5.46	3.94
166.01	2.98	3.95	3.86	**4.51**	4.30	3.60	3.30	2.36
167.01	3.50	4.86	5.98	7.43	8.56	8.96	**9.22**	7.03
168.01	2.85	3.52	3.40	**3.89**	3.76	3.06	2.69	1.92
169.01	5.08	6.72	6.65	**7.69**	7.29	6.19	5.69	4.07
169.02	7.03	9.53	9.49	11.1	**12.2**	11.3	11.9	8.80
169.03	7.08	9.68	9.80	11.3	12.1	11.7	**12.1**	8.91
170.01	2.99	3.32	3.29	3.92	**4.02**	3.38	3.19	2.31
170.02	3.49	5.08	5.33	**5.99**	5.96	5.46	5.33	3.92
170.03	4.91	7.56	8.49	9.49	8.94	**9.60**	9.31	7.21
171.01	5.31	8.29	9.14	10.1	**10.2**	9.99	10.1	7.50
171.02	6.56	10.5	12.2	13.7	13.2	**14.5**	14.1	11.0
171.03	10.2	16.4	18.5	20.5	19.8	**21.5**	21.1	16.3
171.04	10.8	17.7	20.1	22.5	21.8	**23.8**	23.5	18.0
171.05	14.7	24.1	27.8	31.6	30.2	**33.4**	33.0	25.5
171.06	14.7	24.2	27.9	31.9	30.3	**33.6**	33.3	25.7
172.01	2.51	3.45	3.63	4.11	**4.26**	3.70	3.64	2.65
173.01	3.13	3.45	3.33	3.58	**4.08**	3.58	3.66	2.73
174.01	2.08	**2.30**	1.97	2.10	2.16	1.64	1.37	0.98
175.01	2.49	4.06	4.87	5.53	5.74	6.31	**6.39**	4.95
175.02	4.21	6.79	7.99	8.99	8.88	**9.70**	9.68	7.45

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
176.01	1.94	2.92	3.21	3.47	**3.70**	3.41	3.44	2.55
177.01	2.10	3.02	3.41	3.72	**4.05**	3.90	3.96	2.99
178.01	3.11	**3.69**	3.39	3.61	3.51	2.74	2.29	1.63
178.02	5.72	**6.80**	6.25	6.65	6.49	5.08	4.24	3.02
179.01	3.57	4.77	5.27	5.72	**6.31**	5.69	5.82	4.32
179.02	8.31	11.7	12.3	14.0	**14.5**	12.9	12.8	9.40
179.03	9.12	13.6	14.8	**16.5**	16.2	16.2	16.0	12.1
179.04	8.90	13.4	16.5	18.6	17.6	19.1	**19.1**	14.3
179.05	9.49	14.6	18.0	21.9	21.7	21.7	**22.1**	16.1
179.06	10.6	16.4	20.5	25.7	26.5	25.9	**26.6**	19.4
179.07	23.7	23.1	20.9	28.4	**31.9**	29.4	30.6	21.9
180.01	2.86	4.01	4.16	4.83	**4.88**	4.23	4.14	3.01
181.01	8.15	**8.79**	5.31	4.29	4.83	3.73	3.41	2.52
182.01	2.35	2.82	2.65	**2.87**	2.82	2.24	1.90	1.35
182.02	3.75	5.23	5.24	**5.83**	5.77	5.51	5.30	3.97
183.01	2.01	2.17	2.32	3.05	3.71	3.65	**3.89**	2.89
184.01	19.9	**21.5**	13.2	9.45	9.64	7.00	6.22	4.63
185.01	11.7	**13.0**	7.53	5.56	5.25	3.68	3.04	2.23
186.01	4.97	**5.40**	3.11	2.71	2.73	2.00	1.69	1.23
186.02	6.30	**6.64**	4.91	4.07	4.08	2.98	2.52	1.84

PEAK DESIGN FLOOD DISCHARGES - 1% AEP

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	10.4	13.4	13.1	**15.0**	14.5	11.9	10.8	7.78
1.02	18.2	24.3	24.1	**27.0**	24.7	22.4	20.9	15.2
1.03	28.5	36.7	36.0	**41.1**	37.8	33.3	31.0	22.5
1.04	36.5	46.1	45.0	**51.7**	49.4	42.8	39.8	28.9
1.05	63.2	79.7	78.1	**89.3**	86.7	76.0	71.2	52.0
1.06	82.7	101	100	**114**	113	98.4	92.4	67.7
1.07	105	127	124	**142**	140	121	112	82.1
1.08	119	143	139	**158**	153	134	124	90.8
1.09	136	164	158	**178**	171	151	139	102
1.10	144	174	168	**189**	181	160	148	109
1.11	178	217	205	**231**	221	195	179	132
1.12	185	228	215	**243**	230	205	190	140
1.13	187	232	219	**247**	233	208	193	142
1.14	191	239	226	**255**	238	215	199	147
1.15	194	244	232	**262**	244	221	205	152
1.16	201	255	244	**275**	250	231	215	160
1.17	243	314	303	**338**	302	284	266	198
1.18	268	352	343	**383**	337	321	302	225
1.19	263	350	346	**388**	334	329	311	235
1.20	264	352	352	**394**	337	334	316	239
1.21	382	512	511	**571**	473	470	441	337
1.22	381	512	514	**576**	477	475	445	341
1.23	380	514	521	**588**	489	482	455	349
1.24	379	514	523	**592**	496	485	458	352
1.25	380	522	533	**609**	506	497	473	367
1.26	378	522	538	**618**	518	506	480	376
1.27	378	522	538	**620**	520	506	481	376
1.28	377	522	540	**625**	528	511	486	381
1.29	378	526	549	**643**	556	524	502	395
1.30	378	526	549	**644**	558	525	503	396
1.31	377	529	556	**653**	562	534	516	407
1.32	369	521	551	**648**	554	531	516	406
1.33	369	522	553	**658**	567	539	524	412
1.34	366	519	552	**660**	571	541	527	414
1.35	363	517	552	**663**	575	545	531	417
1.36	363	519	557	**688**	610	569	555	434
1.37	363	520	561	**711**	647	590	577	449
1.38	357	514	559	**708**	645	591	581	452
1.39	355	513	559	**711**	651	597	585	455
1.40	351	508	556	**708**	648	596	585	455
1.41	350	508	555	**709**	649	600	587	457
1.42	347	505	554	**709**	651	601	589	458
1.43	347	505	554	**709**	652	604	591	459
1.44	347	505	554	**710**	652	605	591	460
1.45	343	503	555	**711**	654	609	598	465
1.46	342	502	554	**711**	655	613	600	468
1.47	341	500	553	**709**	654	614	601	469
1.48	310	406	438	**531**	498	474	467	387
1.49	314	417	455	594	**610**	572	582	445
1.50	313	416	455	594	**610**	572	582	446
1.51	364	589	672	880	**941**	907	925	649

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.52	365	591	675	881	**944**	913	931	653
1.53	365	591	675	880	**944**	914	932	654
1.54	365	592	677	881	**946**	918	937	656
1.55	371	604	693	889	961	944	**965**	672
1.56	371	604	693	888	962	945	**967**	673
1.57	369	603	695	886	964	948	**972**	676
1.58	368	601	694	884	963	950	**973**	678
1.59	374	612	709	890	978	978	**1000**	698
1.60	353	588	691	872	975	970	**998**	697
2.01	6.69	8.22	7.93	**8.51**	8.51	6.75	5.82	4.18
3.01	7.14	**8.24**	6.55	6.15	5.66	3.91	3.17	2.28
4.01	10.6	15.3	16.0	18.0	**18.3**	16.1	16.0	11.8
4.02	23.7	30.6	30.1	**34.6**	34.3	30.5	29.1	21.3
5.01	7.14	10.5	11.3	12.3	**12.7**	11.6	11.6	8.61
5.02	17.1	19.2	18.5	21.1	**22.9**	19.3	18.2	13.4
6.01	3.51	**4.03**	3.62	3.85	3.76	2.87	2.37	1.71
7.01	11.4	14.5	14.1	**16.1**	15.4	12.7	11.5	8.25
7.02	22.3	26.6	25.3	**28.0**	26.9	22.3	19.8	14.2
8.01	3.03	**3.36**	2.89	3.11	2.95	2.25	1.84	1.32
9.01	9.39	**10.6**	9.31	10.0	9.58	7.36	6.08	4.35
10.01	16.1	**19.3**	17.9	18.9	18.5	14.6	12.4	8.88
11.01	6.00	**6.69**	5.40	5.71	5.30	3.84	3.12	2.23
12.01	10.5	**11.8**	9.64	10.6	9.92	7.24	5.89	4.23
12.02	20.9	**23.4**	19.1	20.8	19.2	14.5	11.9	8.5
12.03	32.0	**36.1**	30.2	32.7	29.6	23.1	19.2	13.8
12.04	46.4	**53.2**	45.4	48.7	43.4	34.8	29.2	20.9
13.01	5.47	**6.31**	4.98	4.78	4.38	3.07	2.49	1.78
14.01	6.39	**7.00**	5.88	6.46	6.09	4.56	3.73	2.67
15.01	7.99	**8.76**	7.57	8.25	7.83	5.92	4.86	3.48
16.01	4.17	**4.62**	3.78	3.99	3.70	2.71	2.20	1.58
16.02	10.9	**12.2**	9.83	10.8	10.0	7.44	6.09	4.36
16.03	18.0	**20.1**	16.3	17.7	16.3	12.1	9.93	7.11
17.01	5.13	**5.56**	4.75	5.19	4.88	3.65	2.99	2.14
18.01	6.82	**7.58**	6.15	6.54	6.08	4.43	3.60	2.58
19.01	5.63	**6.18**	5.08	5.54	5.19	3.81	3.11	2.23
20.01	8.22	**9.00**	7.53	8.27	7.77	5.79	4.73	3.39
21.01	5.27	**5.98**	4.75	4.81	4.41	3.15	2.55	1.83
22.01	6.75	**7.42**	6.09	6.69	6.26	4.65	3.79	2.71
23.01	19.1	23.3	22.3	**24.5**	23.5	19.3	16.8	12.1
23.02	51.8	62.8	59.3	**64.8**	59.8	49.8	43.6	31.3
23.03	56.5	68.8	65.1	**71.3**	65.1	54.6	48.2	34.6
23.04	60.2	73.2	69.5	**76.5**	70.1	58.8	51.9	37.3
24.01	6.68	**7.80**	7.11	7.49	7.29	5.70	4.76	3.41
24.02	18.7	**21.7**	19.8	21.2	19.9	16.0	13.6	9.75
25.01	3.64	**4.36**	4.00	4.19	4.07	3.22	2.72	1.95
26.01	5.69	**6.54**	5.17	5.11	4.68	3.30	2.67	1.91
27.01	18.6	**22.3**	20.7	21.7	21.4	16.8	14.2	10.2
27.02	31.9	**36.1**	32.5	34.9	33.8	26.1	22.0	15.7
27.03	48.3	**56.6**	52.2	56.0	54.7	43.3	36.9	26.5
28.01	10.1	**11.2**	9.2	10.0	9.40	6.95	5.66	4.05
29.01	16.7	20.5	19.5	**21.4**	20.7	16.8	14.7	10.5
30.01	13.6	16.7	15.8	**17.2**	16.5	13.4	11.6	8.34
31.01	17.0	**19.0**	16.7	17.9	17.1	13.1	10.8	7.73

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
31.02	26.3	**29.6**	26.4	28.3	26.9	20.9	17.4	12.5
31.03	40.7	**47.3**	43.2	46.3	44.2	35.2	29.9	21.4
31.04	50.4	**58.8**	53.9	58.0	54.7	44.1	37.8	27.0
31.05	61.7	72.4	67.1	**72.7**	67.5	55.2	47.7	34.2
31.06	72.9	86.2	79.8	**87.1**	79.6	65.8	57.3	41.1
31.07	83.7	101	94.0	**103**	93.1	79.1	69.7	50.3
31.08	135	170	163	**181**	150	139	125	94.5
31.09	135	172	167	**185**	152	143	127	98.6
32.01	8.34	**9.64**	8.77	9.28	8.96	7.02	5.88	4.21
33.01	14.3	17.4	16.5	**18.0**	17.3	14.0	12.2	8.74
34.01	7.34	8.88	8.41	**9.09**	8.76	7.08	6.13	4.39
35.01	6.08	7.23	6.82	**7.25**	7.00	5.62	4.80	3.44
36.01	5.29	**5.78**	4.77	5.19	4.84	3.55	2.90	2.07
37.01	7.11	**7.86**	6.42	6.96	6.49	4.79	3.89	2.79
38.01	7.72	9.39	9.03	**9.98**	9.53	7.83	6.88	4.94
38.02	15.0	17.6	16.5	**17.7**	17.4	13.9	12.0	8.58
38.03	33.9	38.8	35.6	**38.9**	36.5	29.6	25.6	18.3
38.04	62.2	74.5	70.5	**78.0**	73.7	61.1	53.8	38.7
39.01	6.45	**7.33**	6.56	6.97	6.71	5.20	4.31	3.09
40.01	4.66	**5.40**	4.93	5.16	5.00	3.89	3.26	2.33
40.02	11.6	**12.9**	10.7	12.0	11.1	8.50	7.09	5.07
41.01	3.86	**4.35**	3.50	3.52	3.25	2.33	1.89	1.35
42.01	14.5	18.6	18.1	**20.6**	19.4	16.3	14.7	10.6
42.02	28.5	35.6	34.6	**39.0**	37.1	30.9	27.6	19.8
43.01	12.5	15.4	14.8	**16.4**	15.6	12.8	11.3	8.11
44.01	6.34	**6.99**	6.05	6.56	6.24	4.75	3.90	2.79
45.01	10.4	**12.6**	11.7	12.5	12.0	9.65	8.26	5.92
46.01	12.9	16.1	15.4	**17.0**	16.6	13.5	11.8	8.45
46.02	24.6	29.5	27.6	**30.0**	28.6	23.4	20.3	14.6
47.01	7.75	**8.49**	7.16	7.87	7.40	5.55	4.54	3.25
48.01	7.75	9.37	8.86	**9.58**	9.28	7.49	6.48	4.64
49.01	15.2	21.6	21.2	**24.9**	24.8	21.0	19.8	14.4
50.01	6.51	7.76	7.31	**7.80**	7.54	6.03	5.17	3.71
51.01	5.60	**6.72**	5.34	4.21	3.87	2.61	2.11	1.52
51.02	17.2	**20.3**	16.2	14.6	13.3	9.32	7.55	5.42
51.03	25.6	**29.3**	24.1	24.8	22.6	17.6	15.0	10.7
52.01	9.59	**11.2**	8.88	8.77	8.07	5.63	4.56	3.28
53.01	7.20	**8.36**	6.64	5.95	5.47	3.75	3.04	2.18
54.01	4.64	**5.09**	4.46	4.80	4.55	3.45	2.84	2.03
55.01	8.87	11.7	11.5	**13.3**	12.5	10.7	10.0	7.22
56.01	14.0	17.4	16.9	**19.0**	17.9	14.8	13.2	9.48
56.02	26.4	34.8	34.3	**38.8**	36.7	32.6	30.2	22.2
56.03	29.7	39.1	39.0	**44.1**	41.6	37.3	34.9	25.6
57.01	9.79	12.5	12.3	**14.0**	13.2	11.1	10.1	7.28
58.01	6.33	**7.36**	6.75	7.12	6.88	5.43	4.55	3.26
59.01	3.20	3.93	3.70	**4.06**	3.92	3.18	2.77	1.99
60.01	7.81	9.92	9.72	**11.1**	10.4	8.78	8.00	5.75
60.02	14.5	19.1	19.0	**21.2**	18.1	16.9	15.5	11.6
61.01	7.13	8.73	8.51	**9.49**	9.02	7.44	6.61	4.74
62.01	3.24	3.95	3.73	**4.11**	3.90	3.19	2.80	2.00
63.01	11.5	17.1	18.4	20.3	**20.3**	18.8	18.7	13.8
63.02	18.6	25.8	26.3	**30.3**	30.0	26.9	26.2	19.3
64.01	6.72	8.50	8.41	**9.55**	8.99	7.58	6.89	4.95

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
65.01	6.26	7.84	7.70	**8.72**	8.31	6.86	6.19	4.44
66.01	6.13	8.30	8.30	**9.57**	9.17	7.97	7.55	5.47
67.01	8.17	11.0	10.9	**12.7**	12.1	10.6	10.1	7.30
67.02	15.1	18.4	18.5	21.4	**21.5**	18.0	16.6	12.0
67.03	40.7	47.4	45.1	**51.3**	50.1	42.9	39.3	28.5
67.04	56.8	67.3	59.1	**67.8**	66.0	55.8	50.9	36.9
67.05	69.1	81.9	73.2	**84.3**	81.9	69.9	63.7	46.4
67.06	70.4	85.0	78.9	**90.4**	86.4	76.3	70.1	51.8
67.07	73.2	89.5	84.9	**96.9**	90.5	81.5	75.5	55.8
68.01	4.10	5.11	4.90	**5.37**	5.23	4.22	3.71	2.66
69.01	11.6	**13.4**	10.5	10.6	9.75	6.85	5.55	3.98
70.01	7.47	**8.49**	7.64	8.26	8.03	6.09	5.03	3.62
70.02	18.0	**19.7**	16.6	18.7	17.5	13.1	10.7	7.70
71.01	6.68	**7.47**	6.01	6.70	6.23	4.47	3.64	2.62
72.01	6.87	**7.61**	6.19	6.63	6.16	4.47	3.64	2.61
73.01	4.91	6.34	6.27	**7.17**	6.77	5.73	5.29	3.81
74.01	14.5	18.2	17.5	**19.3**	19.1	15.4	13.4	9.65
74.02	21.3	27.1	26.4	**29.5**	27.6	23.3	20.9	15.0
74.03	28.5	34.9	33.8	**37.5**	34.9	29.5	26.4	19.0
74.04	32.9	39.6	38.2	**42.5**	39.8	33.5	29.9	21.6
74.05	43.3	53.2	51.6	**57.6**	53.1	45.5	41.1	29.7
74.06	42.4	53.7	52.4	**58.6**	50.9	46.5	42.7	31.6
74.07	42.4	53.7	52.5	**58.7**	51.0	46.7	42.8	31.7
75.01	5.79	**6.34**	5.60	6.05	5.81	4.39	3.61	2.59
76.01	4.23	**4.66**	4.07	4.35	4.13	3.15	2.59	1.85
77.01	7.56	9.68	9.46	**10.8**	10.3	8.61	7.75	5.58
78.01	6.94	9.70	10.2	**11.4**	11.2	10.2	9.97	7.29
78.02	16.7	21.3	21.4	**24.5**	23.6	20.8	19.5	14.2
78.03	22.2	28.5	28.5	**32.2**	30.9	27.6	25.6	18.9
79.01	6.29	7.66	7.52	**8.39**	8.00	6.57	5.84	4.19
80.01	4.24	**4.72**	4.16	4.43	4.23	3.24	2.67	1.91
81.01	5.26	7.30	7.49	**8.58**	8.43	7.44	7.27	5.30
82.01	8.63	12.1	12.4	**14.1**	13.8	12.4	12.2	8.92
82.02	12.0	17.2	18.0	**20.4**	19.3	18.4	17.8	13.3
83.01	5.75	7.88	7.85	**9.18**	8.99	7.63	7.25	5.26
83.02	6.76	8.98	8.93	**10.4**	10.13	8.70	8.18	5.94
84.01	5.13	6.98	7.02	**8.17**	7.86	6.89	6.64	4.83
84.02	5.06	7.04	7.28	**8.26**	7.42	7.14	6.80	5.11
85.01	3.87	**4.47**	3.68	3.96	3.72	2.70	2.20	1.59
85.02	4.83	6.71	6.64	**7.12**	5.82	6.40	6.19	4.68
86.01	5.27	**5.77**	3.74	3.98	4.08	3.13	2.66	1.93
87.01	4.21	6.32	6.78	7.38	**7.48**	6.93	6.94	5.14
87.02	4.67	6.71	7.21	7.91	**8.10**	7.41	7.39	5.49
88.01	3.11	4.40	4.49	**5.20**	5.06	4.47	4.38	3.20
89.01	13.1	18.5	18.4	**21.3**	20.6	18.3	17.6	12.8
89.02	28.7	34.8	34.0	**38.9**	37.8	32.1	29.5	21.3
89.03	41.1	50.1	48.3	**54.5**	52.3	44.6	40.4	29.2
89.04	53.3	66.4	64.4	**72.7**	68.8	59.3	54.1	39.3
89.05	63.2	79.0	76.6	**86.3**	80.9	70.1	64.1	46.6
89.06	71.5	89.0	87.2	**97.2**	87.9	79.2	72.7	53.3
89.07	87.3	112	111	**125**	111	105	97.2	72.5
89.08	91.1	118	118	**132**	116	111	104	77.4
89.09	92.8	121	122	**136**	119	115	107	80.5

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
89.10	93.6	123	124	**138**	120	118	109	82.4
89.11	94.0	124	126	**141**	122	121	112	85.0
89.12	96.5	130	133	**148**	126	127	118	90.6
89.13	97.7	133	138	**153**	129	132	124	94.8
89.14	97.8	133	139	**154**	130	133	125	96.1
89.15	110	159	174	**202**	179	191	187	143
89.16	112	162	178	**207**	182	196	191	147
89.17	112	163	182	**211**	186	199	196	151
90.01	4.26	**4.73**	4.17	4.45	4.24	3.24	2.67	1.92
90.02	14.7	**16.9**	15.7	16.8	15.7	12.7	10.9	7.78
91.01	5.02	6.02	5.69	**6.04**	5.82	4.69	4.03	2.88
92.01	8.45	10.15	9.59	**10.4**	10.0	8.14	7.03	5.04
93.01	11.8	15.4	15.1	**17.4**	16.2	13.9	12.7	9.16
94.01	8.88	10.7	10.4	**11.6**	11.0	9.04	7.99	5.73
95.01	6.36	**7.19**	6.43	6.85	6.57	5.10	4.21	3.02
96.01	10.1	14.4	15.1	**16.9**	16.6	15.2	15.0	11.0
96.02	15.2	19.6	19.6	**22.7**	22.1	19.9	19.1	14.0
97.01	4.64	**5.43**	5.00	5.22	5.08	3.97	3.34	2.39
98.01	7.03	8.61	8.44	**9.47**	8.98	7.43	6.63	4.76
99.01	3.58	**4.22**	3.85	4.03	3.88	3.07	2.58	1.85
100.01	2.57	3.21	3.13	**3.54**	3.31	2.78	2.51	1.80
101.01	3.27	4.01	3.78	**4.16**	3.99	3.24	2.83	2.03
102.01	3.82	5.06	4.96	**5.65**	5.33	4.49	4.15	2.99
103.01	4.77	5.82	5.68	**6.29**	6.00	4.95	4.37	3.14
104.01	2.03	2.50	2.45	**2.72**	2.67	2.18	1.91	1.37
105.01	9.74	12.1	11.8	**13.3**	12.5	10.4	9.36	6.72
105.02	14.2	16.5	15.7	**17.5**	17.3	14.0	12.3	8.80
105.03	24.1	28.6	27.4	**30.6**	29.2	24.2	21.6	15.5
105.04	24.8	31.9	31.7	**35.5**	30.7	28.5	26.5	19.8
105.05	27.8	37.1	38.0	**42.0**	35.1	35.4	32.9	25.3
105.06	31.0	43.1	45.2	**49.1**	41.7	42.0	39.6	30.6
105.07	38.0	56.2	59.8	**65.0**	55.5	57.6	55.5	42.6
105.08	39.0	58.8	62.8	**68.4**	59.0	61.0	59.0	45.3
105.09	43.9	66.1	70.9	**78.0**	64.9	69.1	66.2	51.4
105.10	42.5	64.2	70.3	**79.4**	67.7	71.2	69.2	53.7
105.11	42.5	64.2	70.6	**81.2**	70.9	72.3	70.7	54.4
106.01	4.64	**5.15**	4.18	4.41	4.09	2.98	2.42	1.73
107.01	7.91	9.68	9.43	**10.6**	10.0	8.34	7.43	5.33
108.01	6.75	**7.88**	7.16	7.57	7.32	5.74	4.81	3.44
109.01	6.71	8.28	8.16	**9.20**	8.71	7.23	6.50	4.66
110.01	6.37	7.70	7.43	**8.18**	7.85	6.39	5.61	4.02
111.01	6.70	9.77	10.5	**11.5**	11.4	10.7	10.6	7.81
111.02	13.5	16.7	16.5	**18.9**	18.8	16.8	16.0	11.8
112.01	5.19	**5.84**	5.28	5.59	5.37	4.15	3.45	2.47
113.01	3.65	4.50	4.35	**4.84**	4.58	3.77	3.36	2.41
114.01	4.62	**5.50**	5.14	5.39	5.24	4.14	3.53	2.53
115.01	4.70	**5.49**	5.05	5.27	5.13	3.99	3.35	2.40
116.01	3.78	**4.18**	3.66	3.91	3.72	2.85	2.34	1.68
117.01	4.48	6.15	6.12	**7.13**	6.87	5.94	5.68	4.12
118.01	2.71	**3.21**	2.94	3.12	3.01	2.39	2.02	1.45
119.01	5.45	7.11	7.01	**8.05**	7.63	6.41	5.91	4.26
119.02	10.5	13.8	13.7	**15.8**	15.2	12.9	12.0	8.67
119.03	17.5	23.0	23.1	**26.2**	24.5	22.1	20.8	15.2

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
119.04	25.5	33.6	33.5	**37.7**	34.6	31.7	29.7	21.8
119.05	28.5	37.6	37.7	**42.3**	38.6	35.8	33.7	24.7
119.06	36.1	48.4	48.6	**54.4**	49.4	46.3	43.6	32.3
119.07	39.0	53.4	54.0	**60.2**	54.4	51.9	49.3	36.5
119.08	37.1	51.9	53.2	**59.6**	51.7	51.5	49.2	37.0
119.09	40.8	58.3	61.9	**69.5**	58.5	61.2	58.2	45.1
119.10	41.4	60.6	64.5	**73.0**	60.8	64.0	61.2	47.4
119.11	67.1	106	123	**148**	135	142	141	110
119.12	67.4	106	125	**151**	140	145	144	113
119.13	67.4	106	126	**153**	144	146	146	114
119.14	67.3	106	126	**153**	144	147	147	114
119.15	75.8	121	143	**173**	160	167	167	130
119.16	75.9	121	144	**174**	162	168	169	131
119.17	99.2	156	185	216	194	217	**217**	168
119.18	99.6	157	186	219	198	219	**220**	170
119.19	99.5	157	186	219	198	219	**220**	170
119.20	99.0	157	186	220	199	219	**220**	170
119.21	99.3	157	187	**222**	202	221	222	171
119.22	99.4	158	194	273	**302**	294	301	183
119.23	118	192	227	301	335	336	**346**	215
120.01	4.69	6.31	6.26	**7.28**	6.93	5.99	5.68	4.11
121.01	3.25	**3.82**	3.47	3.64	3.53	2.77	2.32	1.67
122.01	6.27	7.82	7.68	**8.68**	8.34	6.84	6.13	4.41
123.01	4.07	5.09	4.89	**5.41**	5.27	4.26	3.76	2.70
124.01	4.64	**5.59**	5.25	5.49	5.40	4.26	3.63	2.60
125.01	4.29	6.33	6.73	7.37	**7.46**	6.82	6.80	5.01
125.02	8.74	11.8	11.8	**13.5**	13.3	11.8	11.4	8.40
126.01	3.99	5.04	4.90	**5.50**	5.41	4.36	3.87	2.78
127.01	2.98	**3.57**	3.29	3.44	3.45	2.67	2.23	1.60
127.02	3.18	4.06	3.76	**4.16**	3.50	3.10	2.81	2.03
128.01	7.61	8.36	8.34	9.03	**10.5**	9.82	10.1	7.72
128.02	22.9	32.0	33.7	**37.9**	36.3	35.9	34.5	26.5
128.03	31.6	48.1	52.4	**59.2**	50.4	52.8	51.1	40.0
128.04	32.1	49.3	54.4	**61.9**	52.7	55.9	54.7	42.6
128.05	34.8	53.6	60.1	**70.9**	63.0	63.5	63.0	49.3
128.06	35.1	54.1	61.2	**74.8**	70.4	66.2	66.5	51.8
128.07	35.5	55.2	63.1	**79.2**	76.4	70.2	70.9	55.6
128.08	35.5	55.3	63.3	**80.9**	79.0	71.4	72.6	57.0
128.09	35.6	55.5	64.0	**82.4**	80.7	73.3	75.1	58.8
128.10	35.9	56.2	65.1	**85.1**	84.3	76.5	78.8	61.3
128.11	35.9	56.2	65.1	**85.2**	84.5	76.6	78.9	61.3
128.12	36.0	56.4	65.4	**86.2**	86.0	78.0	80.4	62.4
129.01	6.00	8.27	8.31	**9.67**	9.46	8.20	7.87	5.72
129.02	10.9	13.4	13.4	**15.3**	14.8	12.8	11.9	8.67
129.03	16.4	21.5	21.6	**24.8**	24.1	21.5	20.4	15.1
130.01	3.97	**4.85**	4.52	4.72	4.67	3.68	3.12	2.24
131.01	6.12	6.96	7.12	8.30	**8.59**	7.33	7.14	5.23
132.01	6.21	8.02	7.89	**9.01**	8.66	7.17	6.53	4.70
132.02	10.3	13.0	12.9	**14.8**	13.7	11.9	10.9	7.90
132.03	13.8	17.2	16.9	**19.5**	18.0	15.6	14.4	10.4
132.04	16.3	21.2	21.5	**24.2**	20.4	19.7	18.2	13.9
132.05	16.2	21.2	21.6	**24.4**	20.5	19.8	18.4	14.2
133.01	2.95	3.65	3.53	**3.98**	3.86	3.15	2.78	2.00

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
134.01	3.70	4.61	4.40	**4.73**	4.67	3.73	3.23	2.32
135.01	3.90	4.84	4.59	**4.87**	4.84	3.84	3.30	2.37
136.01	5.30	**5.82**	4.44	4.84	4.66	3.47	2.86	2.07
136.02	4.56	**4.88**	3.75	4.87	4.66	4.30	4.28	3.14
137.01	3.41	4.82	5.21	5.70	**6.09**	5.37	5.47	4.04
137.02	9.52	10.5	8.30	10.0	**10.9**	9.04	8.62	6.32
137.03	5.46	7.99	8.58	9.54	**9.62**	9.26	9.33	6.95
137.04	7.49	9.97	10.3	11.8	**12.3**	11.4	11.3	8.42
137.05	9.32	11.7	12.3	13.7	**13.9**	13.6	13.6	10.2
138.01	3.10	3.41	3.11	3.37	**3.46**	2.74	2.38	1.72
139.01	4.39	**4.81**	3.03	2.91	2.81	2.07	1.71	1.25
140.01	5.90	**6.52**	4.32	3.65	3.38	2.34	1.91	1.39
141.01	5.32	**5.88**	4.31	4.70	4.91	3.86	3.38	2.44
141.02	10.8	**11.2**	8.57	8.89	9.22	7.11	6.14	4.46
141.03	13.5	**14.5**	10.4	10.6	10.8	8.29	7.12	5.17
141.04	12.3	**14.0**	10.8	11.7	11.9	9.51	8.33	6.05
142.01	2.23	**2.45**	1.62	1.31	1.22	0.84	0.68	0.50
143.01	0.52	0.64	0.63	**0.71**	0.69	0.57	0.51	0.36
144.01	6.39	**7.05**	5.58	6.73	6.99	5.73	5.37	3.91
144.02	6.18	7.02	6.51	7.72	**7.88**	6.75	6.41	4.70
145.01	2.23	2.73	2.69	**2.99**	2.96	2.40	2.10	1.51
146.01	2.95	3.72	3.98	4.40	**4.62**	4.05	4.06	3.00
147.01	2.64	**2.82**	1.84	2.02	2.22	1.81	1.70	1.24
148.01	9.46	**10.4**	6.76	6.99	7.26	5.53	4.73	3.43
148.02	6.83	**7.95**	6.31	6.77	6.89	5.54	4.93	3.59
149.01	4.62	**5.09**	3.69	3.85	3.63	2.63	2.15	1.56
149.02	4.89	**5.51**	4.02	4.14	3.86	2.84	2.33	1.69
150.01	5.23	7.87	8.68	9.48	**9.74**	9.27	9.39	7.03
150.02	5.71	8.66	9.63	**10.6**	10.4	10.5	10.4	7.97
150.03	8.03	11.7	12.8	**14.2**	14.0	14.2	14.0	10.7
150.04	8.03	11.7	12.8	**14.3**	14.1	14.3	14.1	10.8
150.05	11.5	17.1	18.7	20.5	19.0	**20.8**	20.5	16.0
151.01	2.91	3.22	2.87	3.25	**3.31**	2.67	2.38	1.72
152.01	6.21	**6.78**	4.26	5.00	5.46	4.51	4.31	3.17
152.02	5.14	5.71	5.01	5.77	**6.03**	5.23	5.08	3.75
152.03	4.27	5.05	5.29	**6.06**	5.67	5.57	5.41	4.18
152.04	4.50	5.69	6.01	**6.97**	6.31	6.75	6.55	5.24
153.01	9.34	11.0	10.8	**12.7**	12.7	10.5	9.73	7.05
153.02	14.5	19.5	19.7	**22.3**	21.4	19.8	19.0	14.2
153.03	17.5	23.6	24.0	**27.1**	26.0	24.1	23.3	17.3
153.04	24.2	33.0	33.5	**37.7**	36.1	33.4	32.3	23.9
153.05	31.2	42.1	42.4	**47.7**	44.7	41.4	39.6	29.3
153.06	35.2	49.0	50.1	**56.2**	50.0	49.4	46.5	35.4
153.07	35.2	49.1	50.3	**56.4**	50.0	49.7	46.8	35.7
153.08	37.9	53.0	54.3	**60.9**	53.3	53.4	50.3	38.3
154.01	4.68	**5.66**	5.32	5.54	5.50	4.30	3.65	2.62
155.01	3.57	4.13	4.01	4.39	**4.44**	3.52	3.07	2.22
156.01	6.71	9.12	9.15	**10.61**	10.20	8.90	8.49	6.16
157.01	5.36	6.61	6.44	**7.08**	6.96	5.64	4.93	3.54
158.01	2.97	3.64	3.47	**3.86**	3.71	3.03	2.66	1.91
159.01	3.45	**4.03**	3.68	3.90	3.84	2.95	2.44	1.76
159.02	4.03	**4.73**	4.41	4.66	4.51	3.59	3.04	2.20
160.01	1.90	**2.06**	1.42	1.69	1.79	1.48	1.37	1.00

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
160.02	5.31	**5.42**	4.04	4.04	4.33	3.37	2.97	2.17
160.03	6.83	**7.61**	5.92	5.81	6.08	4.67	4.11	3.01
160.04	6.80	**7.64**	5.97	5.84	6.12	4.70	4.14	3.03
161.01	30.3	93.9	115	**178**	155	140	135	81.9
161.02	29.9	93.7	115	**178**	155	140	135	82.2
161.03	29.3	93.3	115	**177**	156	141	136	83.3
162.01	1.94	**2.25**	2.08	2.19	2.12	1.67	1.40	1.00
163.01	5.76	7.00	6.76	**7.37**	7.18	5.81	5.06	3.63
163.02	12.1	14.8	14.6	**16.3**	15.4	12.9	11.5	8.31
163.03	19.6	26.5	27.3	**30.7**	27.9	27.4	26.0	19.7
163.04	23.2	32.1	33.2	**37.2**	32.9	33.2	31.2	24.0
163.05	28.5	40.6	44.0	**50.2**	47.0	49.2	48.2	36.7
163.06	28.4	40.6	44.1	**50.6**	47.4	49.4	48.5	37.0
163.07	28.7	41.3	45.7	**53.9**	50.6	51.7	51.2	39.8
163.08	28.2	41.0	45.5	**53.7**	50.0	51.7	51.4	39.9
164.01	5.99	7.57	7.45	**8.45**	8.03	6.67	6.05	4.35
165.01	5.11	6.86	6.83	**7.98**	7.72	6.56	6.19	4.48
166.01	3.61	4.68	4.53	**5.21**	4.96	4.11	3.74	2.69
167.01	4.02	5.92	7.18	8.81	9.72	10.4	**10.6**	8.30
168.01	3.42	4.21	4.01	**4.43**	4.29	3.47	3.04	2.19
169.01	6.19	7.93	7.82	**8.89**	8.39	7.06	6.44	4.63
169.02	8.60	11.3	11.2	13.0	**14.3**	13.0	13.7	10.2
169.03	8.68	11.4	11.5	13.2	**14.2**	13.4	13.9	10.4
170.01	3.43	3.94	3.87	4.57	**4.58**	3.84	3.61	2.63
170.02	4.20	6.03	6.18	**6.99**	6.80	6.22	6.05	4.46
170.03	5.98	9.11	9.90	**11.1**	10.3	11.0	10.7	8.25
171.01	6.50	9.82	10.8	11.8	**11.8**	11.4	11.5	8.57
171.02	8.08	12.5	14.4	16.0	15.3	**16.7**	16.3	12.7
171.03	12.6	19.3	21.7	23.9	22.8	**24.7**	24.2	18.7
171.04	13.5	20.9	23.6	26.2	25.2	**27.4**	27.0	20.8
171.05	18.6	28.4	32.8	36.9	35.1	**38.6**	38.1	29.5
171.06	18.6	28.6	33.0	37.4	35.3	**38.9**	38.4	29.8
172.01	2.90	4.09	4.20	4.87	**4.90**	4.23	4.12	3.02
173.01	3.62	3.94	3.90	4.21	**4.67**	4.09	4.16	3.10
174.01	2.42	**2.68**	2.28	2.45	2.45	1.85	1.55	1.12
175.01	2.97	4.97	5.80	6.48	6.69	7.25	**7.36**	5.71
175.02	5.19	8.19	9.49	10.5	10.4	**11.1**	11.1	8.62
176.01	2.39	3.46	3.76	4.06	**4.24**	3.87	3.91	2.91
177.01	2.49	3.60	4.02	4.40	**4.68**	4.43	4.52	3.41
178.01	3.76	**4.35**	3.93	4.12	3.98	3.10	2.58	1.85
178.02	6.86	**8.01**	7.24	7.58	7.35	5.74	4.79	3.44
179.01	4.11	5.75	6.17	6.70	**7.23**	6.49	6.62	4.93
179.02	9.98	14.2	14.3	16.6	**16.7**	14.8	14.5	10.7
179.03	10.9	16.3	17.3	**19.4**	18.7	18.5	18.2	13.8
179.04	10.5	17.1	19.3	21.8	20.4	**22.0**	21.9	16.4
179.05	11.3	18.6	21.3	**25.7**	24.7	25.1	25.4	18.7
179.06	12.6	20.9	24.4	30.3	30.2	30.1	**30.8**	22.8
179.07	26.8	26.0	24.9	34.3	**36.7**	33.9	35.4	25.8
180.01	3.44	4.86	4.84	**5.74**	5.68	4.86	4.70	3.42
181.01	9.15	**9.88**	5.97	4.89	5.45	4.24	3.86	2.84
182.01	2.78	**3.34**	3.08	3.27	3.19	2.54	2.15	1.54
182.02	4.53	6.12	6.05	**6.76**	6.57	6.27	6.04	4.53
183.01	2.28	2.48	2.74	3.57	4.30	4.28	**4.53**	3.40

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
184.01	22.2	**24.0**	14.7	10.6	10.8	7.89	7.00	5.22
185.01	13.1	**14.4**	8.45	6.24	5.86	4.11	3.40	2.51
186.01	5.57	**6.07**	3.53	3.09	3.06	2.26	1.90	1.39
186.02	7.08	**7.55**	5.55	4.62	4.58	3.35	2.83	2.08

PEAK DESIGN FLOOD DISCHARGES - 0.5% AEP

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	**2 hr**	**3 hr**	**6 hr**	**12 hr**	**24 hr**	**48 hr**	**72 hr**
1.01	17.7	**20.4**	19.3	18.5	17.5	14.6	13.1	9.8
1.02	32.1	**37.1**	35.1	35.4	30.1	27.3	25.5	19.0
1.03	49.0	**56.3**	52.4	52.6	46.2	40.7	37.8	28.3
1.04	61.7	**69.9**	66.0	66.7	60.3	52.4	48.5	36.3
1.05	107	**120**	115	117	106	93.2	87.0	65.4
1.06	138	**152**	145	150	138	121	113	85.1
1.07	176	**191**	181	185	171	148	137	103
1.08	200	**217**	201	206	188	164	151	114
1.09	229	**250**	227	233	210	185	171	129
1.10	242	**266**	241	247	222	196	181	137
1.11	300	**330**	296	303	270	239	220	167
1.12	313	**347**	313	319	282	251	233	176
1.13	318	**352**	319	325	286	256	237	180
1.14	326	**363**	330	335	294	264	245	186
1.15	332	**373**	339	344	301	271	252	192
1.16	344	**388**	356	360	309	284	264	202
1.17	418	**480**	443	443	376	349	327	250
1.18	466	**540**	502	502	421	394	371	284
1.19	459	**540**	509	513	422	407	385	299
1.20	461	**545**	518	523	426	414	393	305
1.21	667	**789**	749	747	596	584	551	431
1.22	665	**792**	757	755	600	591	558	439
1.23	666	**799**	772	772	613	604	572	454
1.24	665	**801**	777	778	620	609	577	459
1.25	672	**816**	800	802	634	629	598	480
1.26	668	**818**	809	815	646	641	612	495
1.27	668	**818**	810	817	650	642	614	496
1.28	666	817	813	**825**	658	647	621	504
1.29	671	826	833	**851**	691	667	644	528
1.30	670	826	833	**853**	695	669	646	529
1.31	674	838	848	**870**	702	682	661	543
1.32	660	826	839	**866**	694	680	662	543
1.33	660	829	846	**882**	715	692	675	554
1.34	656	826	846	**887**	721	696	681	559
1.35	650	824	847	**893**	729	702	689	565
1.36	652	829	860	**937**	788	737	728	597
1.37	653	833	873	**978**	848	767	764	626
1.38	643	823	867	**975**	846	770	768	628
1.39	641	823	868	**983**	857	777	776	635
1.40	633	816	864	**979**	852	776	776	635
1.41	633	816	864	**981**	855	782	779	638
1.42	628	813	864	**984**	857	784	783	641
1.43	627	813	864	**986**	860	787	786	643
1.44	627	813	864	**986**	860	788	786	644
1.45	623	811	864	**990**	863	796	795	650
1.46	622	810	863	**991**	865	802	799	654
1.47	619	807	862	**990**	865	804	800	655
1.48	477	590	623	**700**	625	589	586	499
1.49	490	612	667	**819**	788	739	759	619
1.50	490	612	666	**818**	788	740	759	619
1.51	681	942	1046	**1295**	1269	1223	1251	968
1.52	684	947	1052	**1298**	1274	1232	1259	974
1.53	683	946	1052	**1298**	1274	1233	1260	975
1.54	685	948	1056	**1300**	1278	1239	1267	979

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.55	700	971	1085	**1315**	1301	1270	1297	1002
1.56	700	971	1086	**1315**	1302	1273	1300	1004
1.57	699	973	1090	**1316**	1304	1278	1306	1009
1.58	697	971	1089	**1314**	1303	1280	1307	1012
1.59	710	991	1115	1329	1326	1317	**1341**	1037
1.60	678	964	1095	1313	1318	1311	**1338**	1038
2.01	11.3	**12.2**	11.0	10.5	10.2	8.14	7.03	5.22
3.01	10.8	**11.7**	9.51	7.16	6.62	4.66	3.85	2.86
4.01	19.2	23.9	23.5	**25.0**	22.8	20.1	19.6	14.8
4.02	40.8	46.3	44.8	**46.6**	42.4	37.6	35.6	26.8
5.01	13.0	16.4	16.3	**17.6**	15.9	14.4	14.3	10.8
5.02	28.1	**30.9**	26.5	28.4	28.0	23.8	22.3	16.9
6.01	5.71	**6.19**	5.31	4.72	4.44	3.42	2.86	2.13
7.01	19.7	**22.2**	20.8	19.9	18.7	15.6	13.9	10.4
7.02	37.4	**40.2**	35.9	35.2	32.4	27.1	24.1	17.9
8.01	4.89	**5.20**	4.39	3.75	3.50	2.70	2.25	1.67
9.01	15.4	**16.3**	13.8	12.2	11.4	8.85	7.40	5.50
10.01	26.8	**28.0**	24.6	23.2	22.1	17.7	15.1	11.2
11.01	9.51	**10.14**	8.56	6.75	6.25	4.59	3.80	2.82
12.01	17.1	**18.2**	15.5	12.6	11.7	8.63	7.14	5.30
12.02	33.7	**35.7**	30.1	24.8	22.8	17.4	14.5	10.8
12.03	52.0	**55.0**	46.6	39.1	35.5	27.7	23.3	17.3
12.04	76.0	**80.4**	68.2	58.3	52.2	41.9	35.5	26.4
13.01	8.41	**9.00**	7.39	5.59	5.18	3.67	3.03	2.25
14.01	10.3	**10.9**	9.25	7.75	7.23	5.47	4.54	3.37
15.01	12.9	**13.7**	11.6	9.91	9.28	7.12	5.93	4.40
16.01	6.65	**7.09**	5.99	4.75	4.39	3.24	2.68	1.99
16.02	17.6	**19.0**	16.0	12.9	11.7	8.93	7.42	5.51
16.03	29.0	**31.3**	26.1	21.0	19.2	14.6	12.1	8.99
17.01	8.26	**8.77**	7.42	6.20	5.78	4.38	3.64	2.70
18.01	10.8	**11.5**	9.74	7.77	7.20	5.31	4.39	3.26
19.01	9.04	**9.55**	8.14	6.58	6.12	4.57	3.79	2.81
20.01	13.2	**14.0**	11.9	9.85	9.19	6.94	5.76	4.28
21.01	8.22	**8.83**	7.33	5.65	5.23	3.76	3.11	2.31
22.01	10.8	**11.4**	9.71	7.99	7.43	5.57	4.62	3.43
23.01	32.0	**35.1**	31.9	30.1	28.3	23.4	20.5	15.2
23.02	87.8	**94.3**	84.1	79.7	72.5	60.5	53.2	39.5
23.03	96.3	**104**	92.5	87.9	78.7	66.4	58.7	43.7
23.04	102.4	**111**	98.9	94.4	84.8	71.6	63.3	47.1
24.01	11.1	**11.6**	9.94	9.17	8.72	6.86	5.79	4.30
24.02	31.0	**32.8**	28.1	26.1	23.9	19.3	16.6	12.3
25.01	6.06	**6.37**	5.49	5.16	4.90	3.89	3.31	2.46
26.01	8.83	**9.46**	7.83	5.96	5.51	3.94	3.25	2.42
27.01	30.8	**32.2**	28.3	26.5	25.3	20.3	17.2	12.8
27.02	51.6	**55.1**	47.0	42.9	40.0	31.5	26.7	19.8
27.03	79.7	**84.2**	72.4	69.1	65.2	52.4	45.0	33.4
28.01	16.3	**17.2**	14.7	12.0	11.1	8.31	6.88	5.11
29.01	28.1	**30.7**	27.8	26.3	24.8	20.5	17.9	13.3
30.01	23.2	**24.8**	22.3	21.1	20.0	16.3	14.2	10.5
31.01	27.6	**29.2**	24.8	21.8	20.5	15.7	13.2	9.8
31.02	42.8	**45.3**	38.6	34.4	32.1	25.2	21.2	15.8
31.03	67.3	**70.8**	61.1	57.0	53.2	42.6	36.4	27.1
31.04	83.3	**87.8**	76.1	71.4	65.8	53.5	46.0	34.2
31.05	103	**109**	95.1	89.4	81.3	66.9	58.1	43.2
31.06	122	**131**	114	107	96.6	80.0	69.8	51.9
31.07	140	**154**	135	128	112	96.1	85.2	63.6

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
31.08	225	**256**	235	226	185	171	156	120
31.09	226	**261**	241	231	187	176	160	125
32.01	13.7	**14.4**	12.3	11.3	10.7	8.5	7.2	5.3
33.01	24.2	**25.9**	23.3	22.1	20.9	17.1	14.9	11.0
34.01	12.4	**13.2**	11.8	11.2	10.5	8.60	7.47	5.55
35.01	10.2	**10.7**	9.42	8.91	8.46	6.81	5.85	4.35
36.01	8.49	**8.99**	7.63	6.15	5.72	4.26	3.53	2.62
37.01	11.4	**12.0**	10.2	8.29	7.69	5.72	4.74	3.52
38.01	13.1	**14.2**	13.0	12.3	11.5	9.52	8.39	6.24
38.02	25.0	**26.4**	22.8	22.1	20.9	16.9	14.6	10.8
38.03	55.9	**59.9**	51.2	48.2	44.0	35.9	31.2	23.2
38.04	105	**112**	100	97.3	89.0	74.3	65.7	48.9
39.01	10.6	**11.2**	9.51	8.52	8.04	6.26	5.25	3.90
40.01	7.72	**8.15**	6.94	6.31	5.96	4.71	3.97	2.95
40.02	18.7	**20.1**	16.9	14.4	13.2	10.3	8.63	6.41
41.01	6.04	**6.46**	5.41	4.15	3.83	2.78	2.30	1.71
42.01	25.0	**28.1**	26.4	25.5	23.6	20.0	18.0	13.4
42.02	49.3	**54.2**	50.2	48.4	44.9	37.7	33.7	25.1
43.01	21.4	**23.3**	21.3	20.2	19.0	15.6	13.8	10.3
44.01	10.3	**10.9**	9.25	7.96	7.43	5.70	4.75	3.53
45.01	17.6	**18.4**	16.2	15.3	14.5	11.7	10.1	7.48
46.01	22.2	**24.2**	22.1	20.9	20.0	16.3	14.3	10.6
46.02	41.5	**44.0**	38.8	37.3	34.6	28.3	24.7	18.4
47.01	12.4	**13.2**	11.2	9.39	8.77	6.65	5.52	4.10
48.01	13.0	**13.9**	12.5	11.7	11.1	9.08	7.88	5.86
49.01	26.7	32.0	31.0	**32.3**	30.0	25.6	24.1	18.0
50.01	10.9	**11.5**	10.1	9.57	9.06	7.33	6.30	4.68
51.01	8.26	**8.69**	6.76	4.87	4.51	3.11	2.57	1.91
51.02	26.2	**28.2**	22.7	16.9	15.6	11.1	9.15	6.80
51.03	40.2	**42.0**	35.2	30.0	26.8	21.2	18.2	13.5
52.01	15.0	**16.3**	13.4	10.2	9.41	6.68	5.52	4.10
53.01	10.8	**11.5**	9.29	6.92	6.39	4.47	3.69	2.74
54.01	7.52	**8.01**	6.76	5.79	5.42	4.15	3.46	2.57
55.01	15.4	**17.7**	16.9	16.9	15.3	13.2	12.2	9.12
56.01	24.1	**26.6**	24.5	23.3	21.8	18.1	16.1	12.0
56.02	46.3	**53.1**	50.2	50.1	45.3	40.1	37.2	28.1
56.03	52.3	**60.4**	57.1	57.5	51.4	46.0	42.9	32.4
57.01	16.8	**19.2**	18.0	17.5	16.0	13.6	12.4	9.20
58.01	10.5	**11.0**	9.45	8.73	8.29	6.55	5.54	4.12
59.01	5.45	**5.83**	5.28	4.96	4.74	3.85	3.36	2.50
60.01	13.4	**15.1**	14.2	13.8	12.7	10.7	9.76	7.27
60.02	23.5	**27.9**	26.9	26.1	22.0	20.8	19.2	14.7
61.01	12.1	**13.4**	12.3	11.7	10.9	9.08	8.06	5.99
62.01	5.52	**5.91**	5.34	5.04	4.75	3.89	3.41	2.53
63.01	21.5	26.7	26.5	**28.3**	25.2	23.3	23.0	17.5
63.02	33.7	39.8	39.0	**41.2**	37.1	33.4	32.2	24.4
64.01	11.5	**13.1**	12.3	11.9	10.9	9.26	8.41	6.26
65.01	10.7	**12.0**	11.2	10.8	10.0	8.41	7.54	5.61
66.01	10.8	12.5	12.2	**12.6**	11.3	9.80	9.23	6.90
67.01	14.4	16.7	16.2	**16.7**	15.0	13.1	12.3	9.22
67.02	25.3	**28.1**	27.2	27.4	26.2	22.1	20.2	15.1
67.03	67.2	**73.5**	64.5	67.0	61.7	52.5	48.0	35.9
67.04	93.4	**101**	86.7	88.1	80.4	68.3	62.1	46.4
67.05	114	**123**	107	110	99.5	85.4	77.9	58.4
67.06	117	**129**	115	119	106	93.5	86.1	65.3
67.07	123	**136**	123	127	112	100	92.8	70.4

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
68.01	6.95	**7.64**	6.97	6.58	6.29	5.16	4.51	3.35
69.01	18.1	**19.5**	16.1	12.4	11.4	8.14	6.73	5.00
70.01	12.1	**13.0**	11.2	10.1	9.50	7.26	6.07	4.51
70.02	28.9	**31.8**	27.0	22.2	20.6	15.6	12.9	9.62
71.01	10.6	**11.8**	9.94	7.86	7.29	5.30	4.38	3.26
72.01	10.9	**11.6**	9.85	7.85	7.28	5.34	4.42	3.28
73.01	8.45	**9.63**	9.18	9.01	8.36	7.03	6.44	4.80
74.01	24.8	**27.2**	25.0	23.6	23.0	18.6	16.2	12.1
74.02	36.9	**40.8**	37.9	36.5	33.4	28.3	25.3	18.8
74.03	48.5	**52.4**	48.1	46.7	42.3	35.9	32.1	23.9
74.04	55.5	**59.8**	54.3	53.1	48.4	40.7	36.4	27.1
74.05	74.0	**80.7**	74.0	72.5	65.0	55.5	50.1	37.4
74.06	72.8	**81.5**	75.6	74.6	62.3	57.0	52.3	39.8
74.07	72.8	**81.7**	75.8	74.8	62.4	57.2	52.4	39.9
75.01	9.35	**9.97**	8.54	7.34	6.89	5.28	4.38	3.26
76.01	6.85	**7.30**	6.19	5.29	4.95	3.78	3.15	2.34
77.01	12.9	**14.7**	13.9	13.3	12.5	10.5	9.42	7.01
78.01	12.6	15.4	15.1	**15.9**	14.0	12.6	12.2	9.21
78.02	29.1	**33.2**	31.6	32.2	29.4	25.7	23.9	18.0
78.03	40.4	**45.2**	42.7	42.9	38.9	34.0	31.6	23.9
79.01	10.7	**11.9**	10.9	10.3	9.66	8.05	7.12	5.29
80.01	6.91	**7.35**	6.23	5.41	5.08	3.90	3.26	2.42
81.01	9.38	11.3	11.1	**11.7**	10.4	9.22	8.90	6.69
82.01	15.4	18.9	18.5	**19.5**	17.2	15.4	14.9	11.3
82.02	21.3	26.8	26.7	**27.8**	24.1	22.8	22.0	16.9
83.01	10.1	11.9	11.5	**11.9**	10.9	9.39	8.82	6.60
83.02	11.7	**13.5**	13.1	13.5	12.3	10.7	9.96	7.46
84.01	9.08	10.7	10.5	**10.9**	9.71	8.53	8.13	6.09
84.02	9.03	10.9	10.7	**11.0**	9.30	8.82	8.37	6.46
85.01	6.05	**6.91**	5.77	4.63	4.32	3.17	2.63	1.95
85.02	7.96	**9.89**	9.28	9.23	7.36	7.77	7.52	5.82
86.01	6.87	**7.53**	5.41	4.95	4.74	3.67	3.14	2.34
87.01	7.74	9.83	9.76	**10.5**	9.42	8.61	8.54	6.49
87.02	8.46	10.6	10.5	**11.2**	10.2	9.23	9.09	6.92
88.01	5.71	6.87	6.72	**7.05**	6.30	5.57	5.37	4.04
89.01	23.7	28.2	27.5	**28.6**	25.3	22.6	21.6	16.2
89.02	48.7	**52.9**	49.1	49.6	46.1	39.4	36.1	27.0
89.03	70.1	**75.8**	69.4	69.2	63.9	54.5	49.4	37.0
89.04	92.1	**101**	93.1	92.8	84.1	72.6	66.3	49.6
89.05	110	**120**	111	110	98.8	86.0	78.5	58.8
89.06	124	**138**	126	126	110	96.8	89.1	67.3
89.07	152	**173**	162	164	139	128	120	91.9
89.08	159	**183**	172	174	146	136	128	98.3
89.09	164	**189**	178	180	150	142	132	102
89.10	165	**192**	181	183	152	145	135	105
89.11	167	**195**	185	187	154	148	138	108
89.12	172	**205**	196	197	160	157	147	116
89.13	177	**212**	204	206	165	163	154	122
89.14	177	**213**	206	208	166	165	155	123
89.15	199	258	267	**283**	231	243	236	191
89.16	202	263	273	**289**	235	249	242	196
89.17	201	268	279	**297**	241	254	249	201
90.01	6.94	**7.39**	6.26	5.42	5.09	3.90	3.26	2.42
90.02	24.4	**25.8**	22.2	20.6	18.9	15.4	13.2	9.83
91.01	8.46	**8.87**	7.86	7.42	7.03	5.70	4.91	3.64
92.01	14.1	**15.1**	13.5	12.8	12.1	9.86	8.57	6.37

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
93.01	20.8	**23.4**	22.3	21.8	20.1	17.0	15.5	11.6
94.01	15.0	**16.5**	15.0	14.2	13.4	11.0	9.74	7.24
95.01	10.4	**11.0**	9.37	8.36	7.87	6.12	5.13	3.81
96.01	18.4	22.6	22.3	**23.5**	21.0	18.9	18.4	13.9
96.02	26.3	30.0	29.2	**30.7**	27.7	24.7	23.5	17.7
97.01	7.71	**8.10**	6.95	6.40	6.05	4.81	4.07	3.02
98.01	12.0	**13.3**	12.3	11.7	10.9	9.07	8.08	6.01
99.01	5.94	**6.26**	5.37	4.96	4.68	3.71	3.15	2.34
100.01	4.35	**4.91**	4.58	4.36	4.02	3.39	3.05	2.27
101.01	5.58	**5.98**	5.40	5.09	4.84	3.94	3.44	2.56
102.01	6.67	**7.66**	7.23	7.09	6.51	5.54	5.07	3.78
103.01	8.13	**8.91**	8.20	7.75	7.29	6.03	5.33	3.96
104.01	3.34	**3.78**	3.52	3.32	3.18	2.62	2.31	1.72
105.01	16.6	**18.6**	17.2	16.4	15.3	12.8	11.4	8.49
105.02	23.5	**25.2**	22.3	22.0	20.9	17.0	15.0	11.1
105.03	40.3	**43.3**	39.2	38.3	35.4	29.6	26.3	19.6
105.04	42.4	**47.3**	46.2	45.7	37.9	35.1	32.6	25.0
105.05	48.1	**56.6**	55.5	55.0	44.3	43.7	41.1	32.1
105.06	54.5	**66.3**	64.9	65.1	51.6	52.2	49.5	38.9
105.07	69.1	**87.9**	86.6	87.9	71.5	71.5	69.2	54.1
105.08	72.0	92.4	91.2	**92.8**	76.2	75.8	73.6	57.6
105.09	81.5	104	104	**106**	85.1	86.5	82.8	66.2
105.10	79.1	103	105	**109**	87.6	90.2	87.2	70.3
105.11	79.1	103	106	**112**	92.0	91.8	89.4	71.8
106.01	7.37	**7.91**	6.63	5.24	4.86	3.56	2.95	2.19
107.01	13.4	**14.9**	13.7	13.1	12.2	10.2	9.07	6.74
108.01	11.2	**11.7**	10.1	9.25	8.75	6.93	5.86	4.35
109.01	11.4	**12.8**	11.9	11.4	10.5	8.84	7.92	5.90
110.01	10.7	**11.7**	10.6	10.1	9.46	7.80	6.83	5.08
111.01	12.2	15.4	15.2	**16.3**	14.4	13.2	13.0	9.89
111.02	23.0	25.5	24.2	**25.6**	23.3	20.9	19.7	15.0
112.01	8.52	**8.98**	7.64	6.81	6.40	5.02	4.20	3.12
113.01	6.24	**6.86**	6.27	5.95	5.58	4.63	4.09	3.04
114.01	7.75	**8.11**	7.03	6.61	6.25	5.05	4.30	3.19
115.01	7.82	**8.21**	7.03	6.45	6.10	4.84	4.08	3.03
116.01	6.11	**6.52**	5.53	4.76	4.44	3.42	2.86	2.12
117.01	7.95	9.35	9.07	**9.37**	8.54	7.34	6.93	5.19
118.01	4.50	**4.69**	4.06	3.79	3.59	2.89	2.46	1.83
119.01	9.39	**10.7**	10.2	10.1	9.33	7.89	7.20	5.36
119.02	18.2	**20.9**	20.1	20.2	18.7	15.9	14.6	10.9
119.03	30.5	**35.3**	33.8	34.2	30.4	27.1	25.4	19.1
119.04	44.5	**51.3**	48.8	49.5	42.9	38.9	36.5	27.5
119.05	49.8	**57.9**	54.9	55.8	48.1	43.9	41.4	31.2
119.06	63.3	**74.3**	70.7	71.9	61.5	56.9	53.7	40.8
119.07	68.8	**81.8**	78.3	79.9	68.0	63.7	60.6	46.0
119.08	66.1	**80.0**	77.7	79.3	65.1	63.6	60.8	47.0
119.09	73.1	92.0	91.4	**93.2**	74.4	76.4	72.6	57.9
119.10	76.7	96.8	96.3	**98.2**	78.0	80.0	76.3	60.8
119.11	126	176	193	**206**	168	183	180	147
119.12	126	177	196	**210**	172	187	184	151
119.13	126	178	198	**213**	177	189	187	154
119.14	126	178	198	**213**	178	189	187	154
119.15	142	202	224	**240**	198	215	213	174
119.16	143	202	225	**242**	200	216	215	176
119.17	174	256	283	**302**	250	277	275	223
119.18	175	257	285	**305**	253	280	279	226

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
119.19	175	257	285	**306**	254	280	279	226
119.20	174	256	285	**307**	256	280	279	226
119.21	176	257	287	**311**	260	283	282	228
119.22	191	318	365	**451**	443	434	444	318
119.23	215	355	411	480	483	485	**494**	357
120.01	8.25	**9.51**	9.24	9.46	8.62	7.39	6.93	5.18
121.01	5.38	**5.66**	4.82	4.44	4.21	3.34	2.82	2.10
122.01	10.7	**12.0**	11.2	10.7	10.1	8.38	7.46	5.55
123.01	6.90	**7.66**	7.01	6.63	6.35	5.21	4.56	3.39
124.01	7.79	**8.14**	7.16	6.73	6.43	5.18	4.41	3.28
125.01	7.85	9.86	9.76	**10.4**	9.36	8.46	8.35	6.32
125.02	15.4	17.9	17.4	**18.2**	16.5	14.7	14.0	10.6
126.01	6.80	**7.67**	7.11	6.71	6.51	5.32	4.68	3.48
127.01	4.87	**5.25**	4.48	4.28	4.07	3.18	2.68	1.99
127.02	5.43	**6.04**	5.34	5.01	4.21	3.70	3.36	2.50
128.01	10.2	11.6	12.4	13.0	**13.1**	12.1	12.5	9.72
128.02	40.2	49.5	49.4	**52.2**	45.5	44.2	42.7	33.5
128.03	59.5	76.8	78.0	**79.9**	63.9	66.6	63.7	51.2
128.04	60.1	78.7	81.1	**83.9**	67.1	70.9	68.3	55.1
128.05	65.2	85.7	91.4	**96.4**	78.5	81.2	79.1	64.9
128.06	65.8	87.1	95.0	**102**	87.6	85.5	83.8	70.3
128.07	67.0	89.7	99.7	**108**	95.0	91.8	91.4	76.7
128.08	67.0	90.0	101	**111**	98.1	93.9	94.1	78.7
128.09	67.2	90.7	102	**113**	100.2	96.6	97.1	80.8
128.10	68.0	92.2	105	**116**	105	101	102	84.4
128.11	68.0	92.2	105	**117**	105	101	102	84.5
128.12	68.2	92.6	106	**118**	107	103	104	86.0
129.01	10.6	12.7	12.3	**12.9**	11.6	10.1	9.60	7.20
129.02	18.4	**20.4**	19.4	19.8	18.2	15.7	14.5	10.9
129.03	28.3	32.6	31.8	**33.0**	29.6	26.4	24.9	18.9
130.01	6.64	**6.96**	6.13	5.86	5.62	4.43	3.77	2.80
131.01	8.69	10.7	10.4	**11.2**	10.5	9.06	8.66	6.51
132.01	10.6	**12.1**	11.5	11.2	10.4	8.77	7.93	5.91
132.02	18.1	**20.3**	19.1	18.8	16.7	14.5	13.2	9.91
132.03	24.0	**26.7**	25.0	24.7	21.9	19.1	17.4	13.1
132.04	27.2	**31.7**	31.0	30.9	25.2	24.4	22.4	17.6
132.05	27.1	**31.9**	31.3	31.2	25.2	24.7	22.6	17.9
133.01	5.04	**5.56**	5.17	4.85	4.66	3.81	3.37	2.50
134.01	6.30	**6.77**	6.11	5.84	5.65	4.51	3.90	2.90
135.01	6.59	**7.04**	6.31	6.03	5.82	4.63	3.99	2.97
136.01	7.62	**8.30**	6.86	5.78	5.44	4.07	3.40	2.53
136.02	5.19	5.54	5.54	**6.35**	6.19	5.38	5.31	4.08
137.01	5.85	7.47	7.44	**8.16**	7.54	6.68	6.67	5.07
137.02	13.5	**14.5**	12.4	13.3	13.2	11.0	10.4	7.85
137.03	10.2	12.9	12.8	**13.9**	12.8	11.5	11.3	8.65
137.04	13.0	15.7	15.6	**16.9**	16.0	14.2	13.7	10.4
137.05	14.1	18.1	18.1	**19.5**	17.9	16.9	16.5	12.6
138.01	4.45	**4.91**	4.36	4.20	4.08	3.27	2.86	2.12
139.01	5.63	**6.11**	4.25	3.46	3.25	2.40	2.00	1.49
140.01	7.92	**8.44**	5.71	4.14	3.86	2.68	2.22	1.65
141.01	7.32	**7.92**	6.06	5.99	5.80	4.59	4.02	2.99
141.02	14.2	**15.3**	12.2	11.2	10.7	8.35	7.23	5.38
141.03	18.0	**19.4**	14.8	13.2	12.5	9.73	8.38	6.23
141.04	17.4	**19.8**	16.0	14.9	14.2	11.2	9.85	7.33
142.01	2.95	**3.13**	2.08	1.48	1.38	0.96	0.79	0.59
143.01	0.86	**0.98**	0.91	0.87	0.83	0.69	0.61	0.46

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
144.01	8.68	**9.44**	8.38	8.62	8.39	6.97	6.46	4.83
144.02	9.15	**10.3**	9.80	10.2	9.61	8.17	7.71	5.78
145.01	3.63	**4.15**	3.87	3.63	3.53	2.88	2.54	1.89
146.01	4.49	5.84	5.76	**6.23**	5.80	5.04	4.96	3.75
147.01	3.32	**3.55**	2.56	2.64	2.66	2.18	2.02	1.52
148.01	12.3	**13.4**	9.75	8.91	8.50	6.52	5.59	4.16
148.02	9.39	**11.0**	8.99	8.66	8.17	6.58	5.84	4.36
149.01	6.61	**7.13**	5.59	4.47	4.18	3.07	2.54	1.89
149.02	7.22	**7.83**	6.03	4.82	4.46	3.32	2.75	2.05
150.01	9.40	12.2	12.6	**13.5**	12.3	11.5	11.6	8.89
150.02	10.3	13.6	14.1	**15.0**	13.0	13.0	12.8	10.1
150.03	14.4	18.2	18.7	**20.0**	17.5	17.4	17.3	13.5
150.04	14.4	18.2	18.8	**20.1**	17.6	17.6	17.4	13.6
150.05	19.6	26.8	27.3	**28.7**	24.1	25.7	25.2	20.1
151.01	4.12	**4.51**	4.14	3.98	3.92	3.19	2.85	2.12
152.01	7.86	**8.63**	6.18	6.65	6.59	5.47	5.18	3.89
152.02	7.26	**8.37**	7.30	7.72	7.30	6.34	6.09	4.61
152.03	6.70	7.80	7.75	**8.27**	6.88	6.87	6.58	5.27
152.04	7.07	8.87	8.88	**9.47**	7.72	8.35	8.01	6.57
153.01	13.8	**16.4**	16.0	16.0	15.4	12.8	11.7	8.76
153.02	25.4	29.6	28.7	**29.7**	26.7	24.4	23.4	17.8
153.03	31.3	36.2	35.1	**36.3**	32.2	29.7	28.5	21.7
153.04	43.5	50.7	49.2	**50.9**	45.0	41.1	39.6	30.1
153.05	55.4	**63.8**	61.5	63.3	56.1	50.9	48.5	36.9
153.06	62.8	**75.4**	73.1	74.6	63.2	60.6	57.4	44.7
153.07	62.8	**75.6**	73.5	74.9	63.4	61.1	57.7	45.1
153.08	67.3	**80.9**	79.0	80.7	67.4	65.8	61.9	48.6
154.01	7.86	**8.19**	7.22	6.81	6.53	5.21	4.43	3.29
155.01	5.55	**6.15**	5.68	5.47	5.29	4.23	3.69	2.74
156.01	11.9	14.0	13.6	**14.0**	12.6	11.0	10.4	7.77
157.01	9.10	**9.99**	9.19	8.67	8.41	6.82	5.97	4.44
158.01	5.07	**5.47**	5.02	4.72	4.49	3.68	3.23	2.40
159.01	5.65	**6.17**	5.26	4.80	4.53	3.50	2.94	2.18
159.02	6.67	**7.04**	6.07	5.65	5.31	4.27	3.64	2.70
160.01	2.48	**2.71**	2.11	2.18	2.15	1.78	1.64	1.23
160.02	6.80	**7.16**	5.72	5.18	5.07	3.96	3.51	2.62
160.03	8.92	**10.1**	8.15	7.27	7.08	5.47	4.82	3.60
160.04	9.07	**10.2**	8.25	7.32	7.12	5.50	4.86	3.63
161.01	142	217	239	**290**	240	216	215	156
161.02	141	217	239	**290**	240	217	215	157
161.03	141	216	238	**290**	240	219	216	158
162.01	3.14	**3.29**	2.86	2.66	2.51	2.01	1.70	1.27
163.01	9.73	**10.5**	9.57	9.04	8.69	7.05	6.15	4.57
163.02	20.6	**22.7**	21.0	20.2	18.7	15.7	14.1	10.5
163.03	34.1	**40.7**	39.7	40.7	35.3	33.7	32.2	24.9
163.04	41.0	49.5	48.6	**49.6**	41.5	40.9	38.6	30.4
163.05	50.6	63.0	66.4	**70.0**	60.1	62.9	61.4	48.9
163.06	50.5	63.1	66.8	**70.5**	60.2	63.4	61.8	49.4
163.07	51.4	66.2	71.3	**75.3**	63.0	68.1	66.4	53.3
163.08	50.6	65.7	71.1	**75.3**	62.9	67.9	66.6	53.4
164.01	10.2	**11.5**	10.8	10.4	9.74	8.19	7.37	5.48
165.01	8.9	**10.3**	10.0	10.3	9.48	8.08	7.53	5.62
166.01	6.22	**7.08**	6.66	6.41	6.04	5.05	4.54	3.38
167.01	6.45	9.79	11.3	12.5	12.4	13.4	**13.7**	11.1
168.01	5.82	**6.29**	5.74	5.40	5.21	4.22	3.69	2.74
169.01	10.6	**12.1**	11.4	11.1	10.2	8.64	7.86	5.85

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
169.02	14.7	17.1	16.5	17.9	**18.6**	16.7	17.2	13.4
169.03	15.0	17.5	17.1	18.2	**18.6**	17.2	17.5	13.7
170.01	5.08	5.87	5.80	**5.90**	5.60	4.68	4.37	3.27
170.02	7.40	9.16	9.06	**9.40**	8.32	7.62	7.35	5.56
170.03	10.6	14.2	14.8	**15.4**	13.1	13.4	13.2	10.4
171.01	11.9	15.5	15.6	**16.7**	15.0	14.2	14.2	10.8
171.02	14.7	20.4	21.4	**22.7**	20.0	20.9	20.5	16.5
171.03	22.4	30.3	31.9	**33.7**	29.4	30.7	30.3	24.1
171.04	24.1	33.0	35.0	**37.0**	32.6	34.1	33.7	26.8
171.05	33.2	45.9	49.2	**52.4**	45.7	48.5	47.9	38.3
171.06	33.3	46.1	49.6	**53.0**	45.8	49.0	48.4	38.8
172.01	5.23	6.38	6.24	**6.59**	6.10	5.25	5.03	3.77
173.01	4.96	5.60	5.53	**6.13**	5.82	5.09	5.08	3.87
174.01	3.57	**3.89**	3.34	3.02	2.87	2.19	1.85	1.37
175.01	5.59	7.98	8.81	**9.28**	8.87	9.12	9.24	7.36
175.02	9.54	13.1	14.2	**15.0**	13.5	14.1	14.0	11.1
176.01	4.13	5.45	5.41	**5.87**	5.38	4.79	4.81	3.66
177.01	4.18	5.73	5.91	**6.33**	5.99	5.47	5.59	4.30
178.01	6.17	**6.55**	5.58	5.06	4.77	3.73	3.14	2.34
178.02	11.3	**11.9**	10.1	9.28	8.75	6.88	5.80	4.31
179.01	6.77	8.88	8.85	**9.70**	9.08	8.07	8.10	6.18
179.02	17.9	21.7	21.2	**22.6**	20.7	18.4	17.8	13.4
179.03	19.8	25.3	25.3	**26.7**	23.3	22.7	22.4	17.4
179.04	19.2	25.8	27.3	**29.5**	26.2	27.4	27.2	21.7
179.05	20.8	28.8	31.6	**35.1**	31.3	31.9	32.0	25.9
179.06	23.4	32.8	36.8	**41.7**	38.0	38.9	39.2	31.7
179.07	31.4	33.6	38.1	48.4	**48.4**	43.6	44.8	35.4
180.01	6.17	7.48	7.25	**7.62**	6.96	6.01	5.73	4.29
181.01	10.8	**11.6**	7.32	6.33	6.30	4.95	4.51	3.39
182.01	4.63	**4.81**	4.25	3.97	3.80	3.05	2.60	1.94
182.02	7.76	**9.24**	8.82	9.10	8.07	7.75	7.47	5.73
183.01	3.10	3.56	4.32	5.16	5.62	5.72	**5.91**	4.76
184.01	25.0	**27.1**	16.8	12.5	12.3	9.04	8.02	6.05
185.01	15.1	**16.4**	9.84	7.05	6.55	4.62	3.83	2.85
186.01	6.70	**7.27**	4.54	3.72	3.50	2.60	2.20	1.63
186.02	8.39	**9.22**	6.93	5.52	5.20	3.84	3.25	2.42

PEAK DESIGN FLOOD DISCHARGES - PMF

Subcatchment ID	0.5 hr	1 hr	1.5 hr	2 hr	2.5 hr	3 hr	4 hr	5 hr	6 hr
1.01	29.5	50.2	**56.0**	52.1	54.2	48.9	42.4	37.2	33.2
1.02	50.9	82.1	99.0	96.5	**100**	90.7	81.7	71.0	64.2
1.03	75.7	127	**148**	143	148	133	121	105	95.1
1.04	105	165	**189**	180	188	168	154	134	122
1.05	182	291	331	320	**333**	299	273	240	217
1.06	244	376	426	411	**429**	386	353	310	281
1.07	313	475	**530**	505	526	473	431	378	343
1.08	359	539	**593**	563	586	528	477	418	381
1.09	410	617	**674**	639	664	598	538	473	430
1.10	434	656	**718**	682	708	637	572	504	458
1.11	544	820	**886**	837	867	780	696	617	559
1.12	566	864	**936**	886	917	824	736	653	591
1.13	572	879	**953**	904	935	841	750	666	603
1.14	588	909	**987**	936	967	869	777	689	623
1.15	599	933	**1018**	966	998	897	802	712	643
1.16	627	980	**1076**	1022	1057	950	849	754	682
1.17	762	1220	**1349**	1280	1318	1182	1056	939	846
1.18	848	1391	**1551**	1470	1510	1353	1210	1075	968
1.19	850	1417	**1611**	1545	1597	1434	1282	1143	1029
1.20	857	1436	1640	1580	**1642**	1475	1320	1177	1061
1.21	1264	2117	**2408**	2314	2397	2150	1910	1702	1537
1.22	1266	2126	2433	2350	**2445**	2196	1953	1741	1575
1.23	1270	2142	2469	2409	**2532**	2280	2033	1816	1644
1.24	1271	2147	2486	2435	**2570**	2316	2068	1849	1674
1.25	1240	2195	2562	2532	**2688**	2427	2171	1944	1760
1.26	1117	2197	2579	2574	**2759**	2499	2247	2015	1825
1.27	1090	2197	2581	2577	**2768**	2509	2260	2028	1837
1.28	922	2205	2599	2608	**2816**	2557	2310	2076	1882
1.29	816	2233	2653	2693	**2956**	2693	2455	2212	2010
1.30	762	2234	2654	2697	**2964**	2702	2466	2223	2020
1.31	524	2259	2708	2772	**3053**	2783	2543	2296	2088
1.32	509	2236	2697	2765	**3053**	2785	2554	2309	2103
1.33	516	2247	2719	2799	**3113**	2850	2635	2395	2185
1.34	427	2249	2733	2825	**3154**	2892	2682	2443	2231
1.35	249	2249	2746	2849	**3197**	2936	2738	2499	2287
1.36	367	2270	2789	2919	**3347**	3111	2975	2752	2530
1.37	661	2284	2822	2980	**3499**	3288	3215	3003	2771
1.38	638	2289	2842	3009	**3535**	3321	3251	3038	2805
1.39	676	2289	2849	3022	**3566**	3358	3313	3106	2876
1.40	655	2275	2840	3016	**3562**	3354	3314	3111	2883
1.41	639	2275	2841	3018	**3568**	3362	3332	3133	2907
1.42	402	2267	2840	3022	**3584**	3380	3358	3160	2935
1.43	344	2267	2841	3024	**3589**	3386	3371	3176	2953
1.44	336	2267	2841	3024	**3589**	3387	3372	3180	2958
1.45	22.3	2242	2844	3037	**3617**	3416	3409	3219	2997
1.46	31.7	2218	2845	3039	**3623**	3423	3420	3236	3020
1.47	35.7	2146	2841	3038	**3623**	3423	3423	3240	3026
1.48	35.9	1376	1811	1928	**2279**	2160	2160	2051	1922
1.49	572	1749	2273	2450	2756	2663	**2864**	2779	2637
1.50	550	1749	2273	2450	2756	2663	**2864**	2780	2639
1.51	805	2993	3993	4372	5027	4773	**5100**	4941	4681
1.52	750	3009	4017	4401	5068	4794	**5128**	4973	4716
1.53	592	3007	4017	4402	5070	4795	**5129**	4976	4720
1.54	525	3018	4033	4421	5095	4806	**5145**	4997	4743
1.55	438	3098	4139	4538	5237	4906	**5240**	5102	4853
1.56	378	3101	4145	4546	**5248**	4916	5247	5110	4862
1.57	12.4	3113	4166	4570	**5279**	4946	5265	5130	4886
1.58	35.4	3107	4162	4569	**5281**	4951	5266	5132	4892
1.59	111	3182	4265	4680	**5409**	5071	5357	5228	4999
1.60	49.9	2820	4166	4609	**5369**	5050	5320	5194	4974
2.01	19.8	30.7	**31.6**	29.5	30.2	26.9	23.3	20.1	17.8
3.01	22.0	**22.6**	20.8	18.4	17.4	15.4	13.1	11.5	10.4
4.01	29.8	56.0	69.1	70.4	**73.7**	67.1	61.0	54.4	48.6
4.02	67.5	115	131	129	**135**	121	110	97.8	87.7
5.01	19.9	38.5	48.5	49.4	**52.6**	47.7	43.4	39.4	35.4
5.02	53.2	73.2	80.5	78.0	**82.3**	74.5	68.6	61.1	54.8
6.01	10.8	**14.4**	14.1	13.1	12.7	11.3	9.57	8.22	7.33
7.01	32.5	55.0	**60.6**	56.3	58.2	52.4	45.1	39.9	35.5

Subcatchment ID	0.5 hr	1 hr	1.5 hr	2 hr	2.5 hr	3 hr	4 hr	5 hr	6 hr
7.02	67.8	101	**106**	98.4	101	90.1	78.6	69.3	61.8
8.01	10.2	**12.2**	11.9	10.9	10.2	9.31	7.85	6.82	6.08
9.01	31.7	**39.6**	38.5	35.7	33.0	30.6	25.9	22.5	20.0
10.01	49.6	71.5	**71.8**	66.3	64.1	58.4	50.8	43.8	38.8
11.01	20.5	**22.1**	21.3	18.8	17.5	15.8	13.4	11.7	10.5
12.01	34.4	**39.5**	38.6	33.8	31.9	29.0	24.4	21.3	19.1
12.02	68.5	**78.8**	76.6	68.3	64.4	59.0	49.8	43.2	38.6
12.03	105	**126**	123	110	104	95.2	80.7	70.1	62.6
12.04	152	**190**	185	168	157	145	123	107	95.4
13.01	17.49	**17.8**	16.7	14.8	13.6	12.3	10.5	9.23	8.33
14.01	21.8	**25.1**	24.6	22.1	20.7	18.9	15.9	13.9	12.4
15.01	26.8	**32.2**	31.3	28.7	26.7	24.6	20.7	18.0	16.1
16.01	14.3	**15.6**	15.0	13.3	12.4	11.2	9.46	8.28	7.42
16.02	37.4	**41.8**	40.8	36.0	34.0	30.9	26.0	22.7	20.3
16.03	62.0	**68.6**	66.5	58.9	55.4	50.4	42.4	37.0	33.2
17.01	17.5	**20.2**	19.8	17.7	16.6	15.1	12.8	11.1	9.93
18.01	23.2	**25.3**	24.5	21.7	20.2	18.3	15.5	13.5	12.1
19.01	19.3	**21.4**	21.0	18.5	17.4	15.8	13.3	11.6	10.4
20.01	27.7	**32.0**	31.3	28.0	26.3	24.0	20.2	17.6	15.7
21.01	17.8	**18.5**	17.6	15.6	14.4	13.0	11.0	9.70	8.72
22.01	24.3	**27.2**	26.6	23.5	22.3	20.2	17.0	14.9	13.3
23.01	60.3	92.3	**96.7**	90.2	87.6	81.4	70.4	61.7	54.5
23.02	167	247	**255**	236	227	211	183	160	142
23.03	183	271	**282**	261	250	232	202	177	157
23.04	195	292	**303**	281	270	251	218	191	169
24.01	22.6	**29.8**	29.5	27.4	25.6	23.6	20.2	17.5	15.5
24.02	61.9	**83.5**	83.1	76.6	72.6	66.9	57.8	50.1	44.3
25.01	12.2	**16.8**	16.7	15.5	14.6	13.4	11.6	10.0	8.87
26.01	19.5	**19.7**	18.6	16.6	15.2	13.8	11.7	10.3	9.29
27.01	62.3	87.1	**87.3**	81.2	77.5	70.6	61.2	53.1	47.0
27.02	112	**142**	140	130	122	113	96.5	83.9	74.2
27.03	166	224	**225**	209	201	184	160	139	123
28.01	37.5	**41.9**	41.1	35.9	34.1	30.8	25.9	22.8	20.4
29.01	53.6	81.7	**85.4**	79.7	77.5	72.0	62.1	54.5	48.2
30.01	48.6	71.6	**73.2**	67.6	66.5	60.8	52.5	46.1	40.7
31.01	56.9	**70.6**	68.5	63.5	58.8	54.4	46.0	40.0	35.6
31.02	88.5	**113**	110	102	94.7	87.8	74.8	64.9	57.7
31.03	135	**182**	182	168	160	147	127	111	97.8
31.04	166	227	**228**	210	201	184	160	139	123
31.05	205	285	**289**	266	255	234	204	178	157
31.06	246	342	**349**	323	308	285	247	216	191
31.07	287	407	**423**	392	376	348	302	265	235
31.08	489	733	**784**	735	712	661	575	510	453
31.09	493	743	**805**	760	740	687	599	532	473
32.01	28.6	**38.0**	37.5	34.7	32.6	29.9	25.6	22.2	19.7
33.01	46.1	68.8	**70.9**	66.0	64.1	59.3	51.3	44.8	39.6
34.01	23.9	35.0	**35.9**	33.3	32.4	29.8	25.9	22.5	19.9
35.01	20.8	28.9	**29.2**	27.0	26.1	23.8	20.7	18.0	15.9
36.01	19.7	**21.6**	21.1	18.5	17.5	15.8	13.3	11.7	10.5
37.01	26.3	**28.9**	28.3	24.8	23.5	21.2	17.9	15.7	14.1
38.01	26.9	41.0	**42.6**	39.6	38.9	35.8	30.8	27.2	24.0
38.02	54.8	75.2	**75.9**	70.2	68.3	62.2	54.0	47.4	41.8
38.03	123	162	**164**	151	145	133	115	101	89.3
38.04	229	326	**339**	313	304	281	244	216	191
39.01	23.9	**29.9**	29.2	27.0	25.2	23.3	19.7	17.2	15.2
40.01	17.4	**22.3**	21.9	20.3	19.0	17.5	14.8	12.9	11.5
40.02	43.3	**49.6**	48.7	43.9	41.7	38.1	32.3	28.1	25.0
41.01	14.3	**14.7**	14.0	12.4	11.5	10.3	8.74	7.74	6.96
42.01	54.8	86.2	**93.4**	87.3	84.3	79.4	68.4	61.3	54.5
42.02	105	161	**172**	161	156	146	126	112	99.5
43.01	44.3	66.8	**70.0**	65.1	63.8	58.9	50.8	44.8	39.5
44.01	24.3	**28.4**	27.8	25.2	23.7	21.6	18.1	15.9	14.2
45.01	37.8	52.7	**53.2**	49.2	47.7	43.2	37.5	32.7	28.9
46.01	46.1	69.6	**72.6**	67.6	66.6	61.2	52.8	46.5	41.0
46.02	88.5	124	**128**	118	114	105	91.2	80.4	71.0
47.01	28.5	**32.8**	32.3	28.7	27.2	24.7	20.7	18.2	16.3
48.01	32.2	45.0	**45.2**	42.2	40.5	36.7	32.0	28.1	25.0
49.01	55.4	93.7	**111**	106	105	98.6	88.4	78.2	70.6
50.01	28.7	**38.4**	38.0	35.3	33.3	30.2	26.3	23.1	20.6

Subcatchment ID	0.5 hr	1 hr	1.5 hr	2 hr	2.5 hr	3 hr	4 hr	5 hr	6 hr
51.01	**20.9**	19.3	17.4	15.0	13.8	12.6	10.9	9.8	8.9
51.02	**65.4**	64.1	58.8	51.8	47.4	42.8	36.7	32.8	29.9
51.03	106	**113**	108	97.4	91.7	84.0	72.4	63.9	56.8
52.01	36.3	**36.6**	34.2	30.4	28.0	25.2	21.5	19.1	17.2
53.01	**30.0**	28.4	25.9	22.5	20.5	18.6	16.1	14.4	13.2
54.01	21.0	**23.3**	22.7	20.3	18.9	17.1	14.5	12.8	11.6
55.01	37.0	59.4	**65.8**	61.8	59.5	56.3	49.3	44.4	39.9
56.01	60.4	88.5	**91.7**	85.7	82.6	76.3	66.4	58.9	52.5
56.02	113	176	**193**	184	176	166	147	132	120
56.03	130	203	**222**	212	204	191	169	152	138
57.01	41.8	63.7	**68.6**	64.3	61.5	57.9	50.1	45.1	40.3
58.01	28.3	**35.3**	34.3	31.9	29.4	27.1	23.2	20.4	18.3
59.01	14.4	19.8	**19.9**	18.5	17.7	16.0	14.0	12.3	11.0
60.01	32.8	50.6	**54.2**	50.9	48.7	45.8	39.8	35.6	31.8
60.02	68.8	104	**112**	108	102	95.6	84.5	75.9	67.8
61.01	37.7	51.4	**51.65**	48.7	46.1	42.6	37.6	33.2	29.6
62.01	18.7	**23.9**	23.5	22.3	20.5	18.9	16.6	14.6	13.1
63.01	48.1	87.0	106	**107**	104	99.1	90.0	82.0	73.6
63.02	78.0	133	**155**	153	148	140	127	114	104
64.01	28.3	43.9	**46.8**	43.9	42.2	39.6	34.2	30.7	27.4
65.01	27.4	41.3	**43.0**	40.5	38.9	36.1	31.3	28.0	24.9
66.01	29.5	47.5	**52.7**	50.4	48.0	45.7	40.7	36.5	32.8
67.01	30.0	51.7	**59.6**	56.9	55.8	52.1	46.7	41.6	37.6
67.02	63.4	89.7	**99.6**	93.9	91.3	87.2	76.7	68.8	61.8
67.03	169	229	**245**	233	227	212	186	168	152
67.04	238	303	**319**	301	291	273	239	216	195
67.05	289	380	**401**	378	366	343	302	273	246
67.06	298	406	**437**	416	403	379	336	303	275
67.07	316	440	**474**	452	438	411	365	329	298
68.01	15.6	23.1	**23.8**	22.1	21.7	19.9	17.2	15.1	13.4
69.01	**48.4**	48.0	44.4	39.6	36.1	32.6	27.9	24.9	22.6
70.01	28.4	**35.4**	35.0	32.2	30.0	27.5	23.2	20.3	18.1
70.02	73.1	**80.9**	79.8	71.1	66.8	60.6	51.2	45.0	40.3
71.01	27.8	**29.6**	28.4	25.1	23.2	20.8	17.7	15.7	14.1
72.01	30.0	**31.3**	29.7	26.4	24.3	21.8	18.6	16.5	15.0
73.01	23.2	35.2	**37.8**	35.7	33.8	32.0	27.8	25.1	22.4
74.01	58.9	86.6	**89.1**	83.5	81.5	74.8	64.7	57.1	50.7
74.02	86.9	133	**139**	130	125	116	101	90.1	80.2
74.03	120	172	**178**	166	160	148	129	115	102
74.04	141	196	**202**	189	181	168	146	131	116
74.05	187	268	**280**	261	251	232	203	181	162
74.06	186	273	**291**	275	264	246	215	194	173
74.07	186	274	**292**	276	265	247	216	194	174
75.01	25.9	**29.3**	28.6	25.8	24.0	21.7	18.4	16.3	14.6
76.01	19.2	**21.3**	20.7	18.5	17.2	15.6	13.2	11.7	10.5
77.01	32.2	49.1	**52.5**	49.4	47.6	44.4	38.5	34.4	30.7
78.01	38.1	61.7	**71.0**	69.9	66.0	62.4	57.6	51.2	46.7
78.02	96.4	139	**149**	143	134	128	115	104	93.6
78.03	139	194	**204**	196	184	174	155	141	126
79.01	37.8	**49.7**	49.6	46.9	44.0	40.7	36.0	31.9	28.3
80.01	28.9	**29.2**	28.2	25.5	23.1	21.2	18.3	16.3	14.6
81.01	25.1	42.1	**48.3**	47.3	45.2	42.6	39.0	34.6	31.6
82.01	55.1	86.6	**99.2**	96.8	91.4	87.0	79.6	71.5	64.2
82.02	78.5	124	**144**	143	135	129	117	106	95.0
83.01	25.6	42.2	**47.5**	45.1	43.6	41.5	36.8	32.9	29.7
83.02	32.3	49.1	**54.6**	51.8	49.8	47.6	42.1	37.7	34.1
84.01	28.5	45.3	**50.3**	48.6	45.9	43.9	39.5	35.4	31.9
84.02	29.0	46.3	**52.1**	51.0	48.0	45.7	41.2	37.2	33.5
85.01	17.1	**18.5**	17.8	15.7	14.5	13.1	11.1	9.82	8.85
85.02	21.5	31.1	36.2	**36.3**	35.0	33.1	29.9	27.7	25.1
86.01	14.9	18.5	**18.7**	17.9	16.8	15.2	13.2	11.6	10.3
87.01	21.9	37.7	44.7	**45.6**	43.2	41.5	38.3	34.6	31.1
87.02	23.9	40.3	47.6	**48.3**	45.8	44.0	40.4	36.6	32.9
88.01	13.4	23.0	**26.8**	26.1	25.3	23.6	21.5	19.1	17.5
89.01	54.4	93.8	**109**	105	106	95.3	86.7	76.9	70.3
89.02	126	178	**190**	180	180	163	144	130	117
89.03	180	254	**266**	250	250	225	197	178	161
89.04	233	338	**359**	337	337	303	265	240	216
89.05	277	404	**427**	401	400	360	315	285	257

Subcatchment ID	0.5 hr	1 hr	1.5 hr	2 hr	2.5 hr	3 hr	4 hr	5 hr	6 hr
89.06	318	464	**491**	463	461	414	363	327	295
89.07	409	611	**664**	638	633	574	510	461	417
89.08	428	645	**706**	680	676	612	545	493	445
89.09	439	667	**735**	710	706	639	570	516	466
89.10	444	677	**749**	726	723	655	584	529	478
89.11	451	695	**772**	750	747	677	605	548	495
89.12	474	735	**823**	803	802	727	650	588	533
89.13	489	763	**858**	840	840	762	681	617	559
89.14	491	767	**866**	849	851	771	690	625	566
89.15	565	973	1188	1206	**1256**	1138	1037	945	859
89.16	574	989	1213	1235	**1291**	1171	1067	973	886
89.17	581	1003	1235	1262	**1325**	1203	1100	1004	915
90.01	19.4	**21.8**	21.2	19.1	18.2	16.1	13.7	12.1	10.9
90.02	65.8	**82.3**	80.5	74.6	71.7	64.0	55.3	48.5	43.4
91.01	22.4	**29.7**	29.4	27.4	26.5	23.5	20.5	18.0	16.0
92.01	36.9	50.5	**50.5**	47.0	46.1	40.8	35.7	31.3	28.0
93.01	50.7	79.3	**86.1**	80.6	80.8	73.0	63.1	57.0	51.0
94.01	38.5	54.8	**56.0**	52.2	52.0	46.2	40.4	35.6	31.7
95.01	28.5	**33.6**	32.5	29.9	28.5	25.3	21.5	18.9	17.0
96.01	53.9	90.4	**104**	104	102	93.3	86.1	76.8	70.0
96.02	85.3	122	**136**	133	130	119	110	98.2	89.5
97.01	26.6	**30.6**	29.2	27.6	25.6	23.1	19.9	17.6	15.8
98.01	32.1	46.4	**47.7**	44.8	44.4	39.7	34.6	30.7	27.4
99.01	20.8	**23.7**	22.7	21.4	19.8	17.9	15.4	13.6	12.2
100.01	14.9	20.5	**20.6**	19.6	18.9	17.1	15.1	13.4	11.9
101.01	19.1	**24.4**	24.0	22.8	21.3	19.3	17.0	14.9	13.3
102.01	21.6	30.9	**32.6**	31.1	30.1	27.5	24.2	21.7	19.3
103.01	21.0	29.9	**30.6**	28.6	28.5	25.3	22.1	19.5	17.4
104.01	9.05	13.0	**13.4**	12.6	12.6	11.2	9.74	8.61	7.67
105.01	39.6	58.9	**62.1**	58.2	58.5	52.2	45.3	40.3	35.8
105.02	58.4	78.1	**80.1**	74.7	75.5	67.2	58.5	51.9	46.0
105.03	94.4	132	**138**	128	130	116	100	89.2	79.2
105.04	111	166	**177**	166	166	148	129	115	103
105.05	128	196	**217**	207	208	186	164	146	130
105.06	146	230	**260**	250	252	226	199	178	159
105.07	176	293	**343**	334	339	304	270	242	217
105.08	182	309	**364**	355	361	323	287	258	232
105.09	204	352	416	408	**417**	374	332	299	270
105.10	200	352	421	419	**438**	394	359	326	295
105.11	199	354	426	428	**453**	409	376	341	309
106.01	17.3	**18.5**	17.8	15.7	15.0	13.2	11.1	9.86	8.83
107.01	27.2	42.7	**45.4**	42.3	43.2	38.6	33.1	29.4	26.0
108.01	30.2	**37.5**	36.3	33.8	32.2	28.7	24.5	21.5	19.3
109.01	24.0	37.5	**40.3**	37.5	38.3	34.1	29.3	26.2	23.1
110.01	27.7	39.5	**39.8**	36.8	36.7	32.5	28.3	25.0	22.3
111.01	22.7	42.9	52.7	53.1	**55.4**	50.2	45.3	41.3	36.6
111.02	50.9	73.9	84.7	82.3	**85.8**	77.0	69.7	62.8	56.8
112.01	19.8	**24.3**	23.7	21.9	21.2	18.9	15.9	13.9	12.4
113.01	16.2	23.2	**23.6**	21.9	21.9	19.5	16.9	15.0	13.3
114.01	21.0	**26.7**	26.2	24.4	23.3	20.9	18.0	15.7	14.1
115.01	19.7	**24.6**	24.1	22.3	21.4	19.1	16.2	14.2	12.7
116.01	17.1	**19.2**	18.7	16.8	16.0	14.1	12.0	10.6	9.54
117.01	19.6	32.1	**36.5**	34.7	34.8	31.6	28.3	25.3	22.9
118.01	12.3	**15.5**	15.1	14.1	13.4	12.0	10.3	9.02	8.08
119.01	15.2	26.7	**30.0**	28.0	29.0	26.4	23.1	20.3	18.2
119.02	30.1	52.3	**59.4**	56.1	58.0	52.6	46.8	40.9	36.9
119.03	50.2	88.1	**100**	96.2	99.5	89.8	80.0	70.2	63.7
119.04	74.6	130	**147**	141	146	131	116	103	92.8
119.05	84.3	148	**167**	161	165	149	132	116	105
119.06	107	189	**216**	209	216	194	173	153	138
119.07	116	206	241	234	**242**	219	194	173	156
119.08	111	202	239	234	**245**	221	197	176	158
119.09	125	229	278	281	**299**	271	243	217	197
119.10	127	237	291	295	**315**	286	257	230	208
119.11	216	421	564	623	**716**	662	617	561	512
119.12	218	424	571	636	**733**	678	635	577	528
119.13	218	425	573	641	**745**	691	649	590	540
119.14	217	425	574	642	**746**	692	650	592	542
119.15	237	483	661	737	**853**	790	741	675	618

Subcatchment ID	0.5 hr	1 hr	1.5 hr	2 hr	2.5 hr	3 hr	4 hr	5 hr	6 hr
119.16	234	485	665	742	**861**	799	749	684	626
119.17	362	687	913	992	**1129**	1043	970	889	815
119.18	366	693	920	1001	**1144**	1058	987	908	833
119.19	366	693	920	1001	**1145**	1059	988	909	834
119.20	364	691	921	1002	**1148**	1064	997	919	844
119.21	300	695	928	1012	**1161**	1077	1013	935	861
119.22	260	1131	1581	1764	**2091**	1995	2088	2003	1884
119.23	268	1250	1735	1935	**2278**	2134	2244	2166	2045
120.01	13.0	23.7	**27.5**	26.3	27.3	24.5	22.1	19.2	17.4
121.01	9.99	**13.8**	13.6	12.6	12.3	11.0	9.41	8.07	7.18
122.01	18.8	30.6	**33.3**	31.0	31.9	28.6	24.6	21.8	19.3
123.01	13.2	20.5	**21.4**	20.1	20.4	18.2	15.7	13.8	12.2
124.01	14.3	20.9	**20.9**	19.3	19.2	17.0	14.8	12.7	11.3
125.01	13.2	25.0	30.9	31.5	**32.7**	29.7	26.9	24.4	21.8
125.02	28.1	48.5	56.2	54.9	**56.8**	51.2	46.4	41.4	37.2
126.01	13.4	21.1	**22.4**	21.1	21.5	19.2	16.5	14.5	12.8
127.01	10.9	**14.8**	14.7	13.8	13.3	11.8	10.0	8.76	7.77
127.02	11.7	17.2	**17.8**	16.6	16.4	14.7	12.5	11.0	9.74
128.01	17.3	26.2	35.0	37.8	**44.1**	40.4	36.9	33.6	31.5
128.02	69.4	123	150	153	**164**	149	135	122	111
128.03	99.7	202	245	247	**263**	237	213	191	173
128.04	99.8	208	256	262	**281**	255	231	208	188
128.05	108	222	275	287	**323**	297	276	250	228
128.06	109	225	280	295	**343**	318	300	273	249
128.07	111	230	290	311	**368**	343	326	297	271
128.08	110	231	292	314	**376**	351	336	307	280
128.09	106	232	295	320	**386**	361	346	316	289
128.10	108	236	300	330	**402**	376	362	332	303
128.11	107	235	300	330	**402**	376	363	332	304
128.12	110	237	302	334	**408**	383	369	339	310
129.01	17.1	31.4	37.5	36.6	**38.0**	34.1	30.9	27.0	24.5
129.02	33.2	52.6	**58.5**	55.7	57.5	52.1	46.8	40.9	37.2
129.03	50.5	84.9	98.3	96.2	**99.3**	89.5	81.0	71.5	64.8
130.01	12.3	18.0	**18.0**	16.7	16.5	14.6	12.7	10.9	9.69
131.01	16.5	27.1	33.1	33.5	**34.6**	31.4	28.7	25.5	22.9
132.01	17.6	30.3	**33.9**	31.4	32.6	29.5	25.6	22.6	20.2
132.02	31.1	51.9	**57.4**	53.7	55.1	49.6	43.1	38.2	34.2
132.03	41.9	69.4	**76.2**	71.2	72.7	65.4	57.1	50.6	45.4
132.04	44.5	87.7	**98.9**	94.6	97.4	86.5	76.6	67.3	60.3
132.05	44.6	87.7	**99.5**	95.8	99.0	87.9	77.8	68.5	61.4
133.01	9.12	14.4	**15.3**	14.3	14.6	13.1	11.3	9.85	8.73
134.01	12.0	18.0	**18.4**	17.2	17.4	15.5	13.4	11.7	10.3
135.01	12.9	19.1	**19.4**	18.1	18.1	16.0	13.9	12.1	10.7
136.01	14.6	17.9	**18.3**	16.7	15.9	14.2	12.0	10.4	9.23
136.02	11.0	14.7	17.4	17.5	**20.0**	18.8	18.3	17.3	15.8
137.01	10.5	18.8	23.8	24.6	**25.8**	23.5	21.5	19.5	17.5
137.02	24.6	34.0	40.1	39.2	**40.7**	37.0	34.2	30.6	27.2
137.03	23.1	38.7	**44.8**	43.5	42.3	40.9	37.8	33.8	30.0
137.04	31.2	49.2	**55.3**	52.7	54.5	49.2	45.3	40.5	36.1
137.05	33.8	59.5	**66.5**	64.3	66.1	60.0	54.8	49.2	44.1
138.01	8.54	12.7	**13.2**	12.6	12.8	11.5	9.88	8.65	7.64
139.01	9.25	10.6	**10.8**	10.0	9.47	8.49	7.18	6.23	5.52
140.01	14.2	**15.2**	13.9	12.1	11.3	10.0	8.46	7.67	6.98
141.01	12.6	17.7	**18.4**	17.6	18.1	16.2	13.9	12.2	10.8
141.02	26.8	33.1	**34.0**	32.6	32.7	29.3	25.1	22.0	19.5
141.03	33.0	39.1	**40.1**	38.3	38.1	34.1	29.3	25.7	22.7
141.04	35.9	44.8	**46.1**	43.5	44.4	39.9	34.3	30.3	26.8
142.01	5.02	**5.27**	4.75	4.14	3.83	3.42	2.90	2.66	2.41
143.01	1.71	2.69	**2.94**	2.75	2.82	2.52	2.17	1.93	1.71
144.01	15.5	22.4	**27.0**	25.8	26.7	24.5	21.9	19.1	17.3
144.02	18.1	27.5	31.2	30.7	**31.6**	28.8	26.2	23.1	20.8
145.01	7.77	12.0	**12.7**	11.9	12.2	10.9	9.36	8.26	7.29
146.01	9.27	16.1	20.1	20.4	**21.2**	19.3	17.5	15.8	14.0
147.01	5.96	7.36	8.73	8.40	**8.82**	8.07	7.32	6.48	5.79
148.01	23.0	29.4	**30.2**	28.7	28.0	24.9	21.4	18.7	16.5
148.02	22.4	29.0	**29.8**	28.2	28.3	25.3	21.7	19.2	17.0
149.01	14.9	**16.7**	16.4	14.5	13.7	12.2	10.3	9.04	8.10
149.02	16.4	**17.9**	17.7	15.6	14.7	13.1	11.1	9.73	8.71
150.01	17.5	32.8	43.3	44.7	**48.0**	43.2	39.2	36.3	32.8

Subcatchment ID	0.5 hr	1 hr	1.5 hr	2 hr	2.5 hr	3 hr	4 hr	5 hr	6 hr
150.02	19.2	35.7	47.7	49.8	**53.8**	48.9	43.8	40.5	36.6
150.03	27.8	47.3	63.3	65.5	**71.6**	65.0	58.1	53.6	49.1
150.04	27.8	47.4	63.5	65.8	**72.0**	65.5	58.5	54.0	49.5
150.05	41.8	70.1	92.7	96.8	**106**	97.6	87.5	80.6	73.8
151.01	8.39	12.6	**13.9**	13.1	13.6	12.2	10.4	9.27	8.21
152.01	13.8	18.1	22.0	21.5	**22.5**	20.3	18.6	16.6	14.8
152.02	16.5	22.3	25.9	25.2	**26.3**	23.8	21.8	19.5	17.4
152.03	15.2	22.6	26.9	27.2	**28.9**	26.4	24.0	21.8	19.7
152.04	16.5	24.5	29.6	31.3	**34.7**	32.2	29.1	26.7	24.5
153.01	35.3	54.9	**62.5**	58.9	59.9	54.4	47.7	42.7	38.4
153.02	61.0	99.0	**111**	108	109	98.2	89.5	80.8	73.5
153.03	76.3	122	**137**	132	133	120	109	98.6	89.4
153.04	105	172	**193**	186	188	169	153	138	125
153.05	135	217	**242**	232	233	210	189	169	155
153.06	154	250	**286**	278	282	254	229	206	188
153.07	154	250	**287**	280	284	256	231	208	189
153.08	166	269	**309**	302	306	277	249	225	205
154.01	19.6	**26.0**	25.8	24.0	23.0	20.6	17.7	15.5	13.8
155.01	13.9	20.2	**20.6**	19.5	19.3	17.1	14.8	13.1	11.6
156.01	27.9	47.3	**53.6**	51.2	51.6	46.7	41.9	37.3	33.8
157.01	22.9	32.8	**33.5**	31.4	31.5	28.0	24.3	21.4	19.1
158.01	13.3	18.6	**18.8**	17.5	17.4	15.4	13.4	11.8	10.6
159.01	15.7	**19.0**	18.8	17.2	16.3	14.5	12.3	10.8	9.73
159.02	18.4	**23.1**	22.6	20.9	19.9	17.8	15.3	13.4	12.0
160.01	5.39	7.29	**8.39**	7.97	8.20	7.50	6.69	5.94	5.37
160.02	15.8	17.5	**17.7**	17.0	17.3	15.8	14.1	12.6	11.5
160.03	23.5	**25.1**	24.8	23.7	23.8	21.7	19.4	17.3	15.8
160.04	23.8	**25.3**	25.0	23.8	24.0	21.9	19.6	17.4	15.9
161.01	10.6	752	1031	1109	**1343**	1263	1263	1191	1106
161.02	14.9	742	1030	1109	**1343**	1263	1264	1192	1107
161.03	25.3	719	1030	1109	**1344**	1264	1266	1196	1113
162.01	7.01	**9.36**	9.29	8.58	8.13	7.45	6.37	5.55	4.92
163.01	18.7	28.0	**29.1**	27.2	26.5	24.5	21.3	18.6	16.4
163.02	38.7	60.2	**64.8**	60.5	58.5	55.1	47.7	42.2	37.5
163.03	62.6	106	**126**	123	123	116	105	93.7	85.1
163.04	77.0	130	**155**	153	152	144	130	116	106
163.05	95.2	168	203	217	**224**	217	200	184	168
163.06	95.0	168	204	218	**226**	219	203	186	171
163.07	101	178	219	237	**246**	240	222	204	187
163.08	100	177	219	237	**247**	241	223	205	188
164.01	18.8	30.4	**33.5**	31.3	30.1	28.8	24.8	22.1	19.6
165.01	15.7	27.3	**31.7**	30.4	29.9	28.2	25.3	22.2	20.0
166.01	12.6	20.4	**22.4**	20.9	20.5	19.2	16.4	14.7	13.0
167.01	12.4	22.1	31.1	36.6	41.4	**42.2**	42.0	39.1	36.2
168.01	12.2	18.4	**19.0**	17.6	17.3	15.8	13.7	12.0	10.6
169.01	21.6	34.8	**38.5**	35.7	34.8	33.0	28.3	25.4	22.6
169.02	30.3	50.5	58.8	58.1	**59.0**	57.3	53.3	50.0	46.5
169.03	30.9	51.5	60.4	59.6	**60.4**	58.6	54.6	51.2	47.5
170.01	10.5	16.9	**20.1**	18.8	18.9	17.9	15.8	14.0	12.6
170.02	14.8	26.2	**31.7**	31.1	30.8	28.9	26.0	23.3	20.9
170.03	20.5	37.6	49.2	51.1	**52.6**	50.5	45.8	41.6	38.0
171.01	22.1	42.3	54.0	55.4	**56.5**	53.2	48.0	44.6	40.1
171.02	27.4	53.1	70.8	75.4	**79.0**	76.5	69.9	64.4	58.7
171.03	41.9	80.2	107	112	**117**	113	102	93.7	86.1
171.04	45.5	87.4	118	124	**129**	125	114	104	95.6
171.05	63.6	122	164	175	**184**	179	164	150	138
171.06	63.7	123	166	177	**187**	181	166	153	141
172.01	10.3	17.9	**21.8**	21.3	21.1	19.8	18.0	15.9	14.4
173.01	9.41	14.6	18.6	19.5	**19.5**	18.6	17.0	15.6	14.0
174.01	6.95	9.42	**9.44**	8.91	8.34	7.62	6.53	5.65	5.01
175.01	10.2	20.1	28.0	30.7	**33.2**	32.9	30.2	28.2	25.8
175.02	17.7	34.9	46.5	49.9	**53.2**	51.7	47.4	43.6	40.4
176.01	8.09	15.0	18.9	19.3	**19.3**	18.4	16.6	15.2	13.6
177.01	7.95	14.5	19.1	20.1	**20.8**	19.6	18.0	16.6	15.1
178.01	12.7	**16.5**	16.2	15.0	14.0	12.9	11.0	9.52	8.45
178.02	23.2	**30.4**	29.9	27.7	25.8	23.9	20.3	17.6	15.6
179.01	12.4	22.1	28.1	29.2	**29.7**	28.0	25.6	23.7	21.3
179.02	32.7	57.5	**68.6**	68.6	67.0	64.3	58.5	52.6	46.8
179.03	35.4	64.4	81.5	82.5	**83.5**	79.6	72.3	65.4	59.5

Subcatchment ID									
	0.5 hr	1 hr	1.5 hr	2 hr	2.5 hr	3 hr	4 hr	5 hr	6 hr
179.04	30.3	71.2	93.0	97.0	**100.0**	97.5	89.8	82.5	75.5
179.05	32.5	78.2	105	112	**118**	118	110	102	93.4
179.06	23.5	87.0	118	128	138	**139**	134	125	115
179.07	78.5	89.0	121	132	145	155	**155**	150	140
180.01	11.4	20.4	**24.3**	23.7	23.3	21.9	19.9	17.5	15.8
181.01	**20.5**	17.8	18.2	17.7	17.9	17.4	15.8	14.0	12.4
182.01	9.29	13.0	**13.0**	12.1	11.5	10.5	9.09	7.87	6.97
182.02	14.2	23.2	**27.6**	27.4	27.4	26.0	23.7	21.5	19.5
183.01	5.29	7.81	11.0	13.1	15.2	16.1	**16.5**	16.0	15.0
184.01	**51.3**	42.1	37.9	33.4	31.9	30.1	27.0	24.2	21.7
185.01	**28.1**	23.3	20.8	18.3	17.0	15.4	13.1	11.5	10.4
186.01	**10.5**	10.2	10.4	9.88	9.46	8.66	7.37	6.36	5.64
186.02	**16.5**	15.6	14.9	13.8	13.5	12.6	10.9	9.43	8.37

Appendix G

Probabilistic Rational Method Results

PROBABILISTIC RATIONAL METHOD
PEAK DESIGN FLOOD DISCHARGES - 1% AEP

C10 = 0.4
Ffy = 1.39
Cy = 0.55

Subcatchment ID	Contributing Catchment Area (Ha)	Tc (min)	Design Intensity (mm/hr)	PRM Discharge (m^3/s)	XP-RAFTS Discharge (m^3/s)
1.01	98.7	45	77.5	13.7	15.0
1.02	192.6	64	63.5	23.3	27.0
1.03	286	71	60.1	32.0	41.1
1.04	367	92	51.3	39.0	51.7
1.05	661.7	102	48.3	62.4	89.3
1.06	861.4	111	45.9	76.9	114.2
1.07	1045.8	113	45.3	89.7	141.7
1.08	1158.1	120	43.8	97.3	157.6
1.09	1306.4	122	43.3	107.1	177.9
1.10	1388.6	132	41.2	112.4	188.9
1.11	1687.5	136	40.6	131.2	231.3
1.12	1784.4	137	40.4	137.1	243.2
1.13	1819.7	139	40.1	139.3	247.3
1.14	1882.1	140	39.9	143.1	255.1
1.15	1943.3	142	39.6	146.7	262.0
1.16	2051.1	156	37.4	153.2	274.6
1.17	2538.1	163	36.3	181.4	338.4
1.18	2888.3	166	36	201.0	382.6
1.19	3063.7	167	35.8	210.6	387.5
1.20	3158.6	193	32.9	215.8	394.0
1.21	4456.9	194	32.7	283.7	570.9
1.22	4565.9	198	32.3	289.1	576.1
1.23	4781.4	199	32.2	299.9	587.9
1.24	4867.8	200	32.1	304.2	591.8
1.25	5112.2	205	31.6	316.3	608.6
1.26	5302.2	207	31.5	325.6	618.1
1.27	5339.2	208	31.3	327.4	619.8
1.28	5467.1	213	30.9	333.6	624.6
1.29	5824.7	214	30.8	350.8	642.7
1.30	5856.2	216	30.6	352.3	644.0
1.31	6022	217	30.6	360.2	653.4
1.32	6085.3	221	30.2	363.3	648.3
1.33	6333.4	221	30.2	375.0	657.7
1.34	6463.8	223	30	381.1	660.2
1.35	6615.3	233	29.2	388.2	663.0
1.36	7376.7	237	29	423.3	688.0
1.37	8062.4	243	28.5	454.2	711.2
1.38	8149.9	245	28.4	458.2	707.9
1.39	8329.4	245	28.4	466.2	711.3
1.40	8358.6	246	28.3	467.5	707.9
1.41	8452	247	28.2	471.6	708.6
1.42	8526.1	248	28.2	474.9	709.2
1.43	8590.7	248	28.2	477.7	709.5
1.44	8614.7	249	28.1	478.8	709.6
1.45	8739	250	28	484.3	711.1

Subcatchment ID	Contributing Catchment Area (Ha)	Tc (min)	Design Intensity (mm/hr)	PRM Discharge (m^3/s)	XP-RAFTS Discharge (m^3/s)
1.46	8847.3	250	28	489.1	711.2
1.47	8882.2	251	28	490.6	709.3
1.48	8888.7	273	26.6	490.9	531.5
1.49	11119.5	273	26.6	586.5	610.1
1.50	11129.8	302	25	586.9	610.1
1.51	14427.7	303	25	721.5	940.7
1.52	14580.3	303	25	727.5	943.8
1.53	14611.1	304	24.9	728.8	943.8
1.54	14718.6	307	24.7	733.0	945.8
1.55	15157.9	308	24.7	750.4	965.2
1.56	15205.8	308	24.7	752.3	967.0
1.57	15335.3	309	24.7	757.3	971.9
1.58	15400.5	313	24.5	759.9	973.2
1.59	15916.1	313	24.4	780.1	1000.1
1.60	16022.8	314	24.4	784.2	997.8
2.01	52.9	36	88.3	8.3	8.5
3.01	28.9	28	100	5.1	8.2
4.01	149.7	53	70.9	19.1	18.3
4.02	271.4	67	62.1	30.7	34.6
5.01	109.8	51	72.8	14.9	12.7
5.02	170.8	56	68.8	21.2	22.9
6.01	21.5	25	106.1	4.0	4.0
7.01	105	49	74	14.4	16.1
7.02	181.3	57	67.9	22.2	28.0
8.01	16.9	23	111.3	3.3	3.4
9.01	55.6	36	87.4	8.6	10.6
10.01	113.2	48	75.2	15.2	19.3
11.01	28.6	28	100.2	5.0	6.7
12.01	53.7	41	81.8	8.4	11.8
12.02	108.9	52	71.5	14.8	23.4
12.03	175.5	62	65.1	21.7	36.1
12.04	266.9	66	62.4	30.3	53.2
13.01	22.8	26	104.9	4.2	6.3
14.01	34.1	30	96.7	5.8	7.0
15.01	44.5	56	68.4	7.2	8.8
16.01	20.2	25	107.5	3.8	4.6
16.02	55.8	44	79.2	8.6	12.2
16.03	90.9	44	78.8	12.8	20.1
17.01	27.3	34	90.3	4.8	5.6
18.01	33	37	87.3	5.7	7.6
19.01	28.5	28	100.3	5.0	6.2
20.01	43.3	33	92.1	7.0	9.0
21.01	23.4	26	104.4	4.3	6.0
22.01	34.7	31	96.3	5.9	7.4
23.01	154.2	67	61.8	19.5	24.5
23.02	399.9	75	57.8	41.8	64.8
23.03	442	82	55	45.2	71.3
23.04	476.6	83	54.8	48.0	76.5
24.01	43.5	39	83.7	7.1	7.8
24.02	124.4	50	73.7	16.4	21.7
25.01	24.9	33	92	4.5	4.4
26.01	24.5	27	103.4	4.4	6.5

Subcatchment ID	Contributing Catchment Area (Ha)	Tc (min)	Design Intensity (mm/hr)	PRM Discharge (m^3/s)	XP-RAFTS Discharge (m^3/s)
27.01	129.6	57	67.9	17.0	22.3
27.02	200.8	72	59.3	24.1	36.1
27.03	338	72	59.2	36.5	56.6
28.01	51.7	36	88.7	8.1	11.2
29.01	134.6	51	72.4	17.5	21.4
30.01	106.7	47	76.2	14.5	17.2
31.01	98.9	54	70.5	13.7	19.0
31.02	159.7	67	62.1	20.1	29.6
31.03	274	72	59.5	30.9	47.3
31.04	346	76	57.3	37.2	58.8
31.05	437.1	82	55.1	44.8	72.7
31.06	525.5	88	52.8	51.9	87.1
31.07	643.5	115	44.9	61.0	103.2
31.08	1213.1	119	44	100.9	181.2
31.09	1267.5	120	43.9	104.5	184.9
32.01	53.8	36	88	8.4	9.6
33.01	111.8	48	75.4	15.1	18.0
34.01	56.2	37	87.2	8.7	9.1
35.01	44	73	58.9	7.1	7.2
36.01	26.5	28	101.7	4.7	5.8
37.01	35.6	31	95.8	6.0	7.9
38.01	63.1	46	76.8	9.5	10.0
38.02	109.8	56	68.4	14.9	17.7
38.03	234.4	63	64.2	27.3	38.9
38.04	494.9	84	54.3	49.5	78.0
39.01	39.5	32	93.8	6.5	7.3
40.01	29.8	34	90.5	5.2	5.4
40.02	64.9	39	84.6	9.8	12.9
41.01	17.3	23	110.8	3.3	4.3
42.01	135.3	64	63.9	17.6	20.6
42.02	253.7	83	54.5	29.1	39.0
43.01	103.8	46	76.6	14.2	16.4
44.01	35.7	31	95.8	6.0	7.0
45.01	75.7	41	81.9	11.0	12.6
46.01	107.5	53	70.8	14.6	17.0
46.02	186.2	58	67.5	22.7	30.0
47.01	41.5	33	92.8	6.8	8.5
48.01	59.3	37	86.3	9.1	9.6
49.01	182	57	67.8	22.3	24.9
50.01	47.4	34	90.4	7.6	7.8
51.01	19.3	24	108.4	3.7	6.7
51.02	68.7	45	77.8	10.2	20.3
51.03	136.7	51	72.2	17.7	29.3
52.01	41.5	38	85.8	6.8	11.2
53.01	27.7	28	100.8	4.9	8.4
54.01	26	27	102.2	4.7	5.1
55.01	92.3	44	78.5	12.9	13.3
56.01	121.2	61	65.4	16.1	19.0
56.02	284.8	71	59.6	31.9	38.8
56.03	328.4	72	59.5	35.7	44.1
57.01	93.1	44	78.4	13.0	14.0
58.01	41.7	33	92.8	6.8	7.4

Subcatchment ID	Contributing Catchment Area (Ha)	Tc (min)	Design Intensity (mm/hr)	PRM Discharge (m^3/s)	XP-RAFTS Discharge (m^3/s)
59.01	25.3	27	102.7	4.6	4.1
60.01	73.5	51	72.5	10.8	11.1
60.02	148.9	53	70.9	19.0	21.2
61.01	60.6	38	85.8	9.2	9.5
62.01	25.6	27	102.5	4.6	4.1
63.01	177	64	63.8	21.8	20.3
63.02	247.3	64	63.4	28.5	30.3
64.01	63.4	38	85.1	9.6	9.5
65.01	56.8	37	87	8.8	8.7
66.01	69.8	40	83.3	10.3	9.6
67.01	93.4	50	73.3	13.1	12.7
67.02	152.8	60	66.2	19.4	21.5
67.03	363.8	82	55.2	38.7	51.3
67.04	469.7	84	54.1	47.5	67.8
67.05	590.9	90	52.2	57.0	84.3
67.06	661	96	50.1	62.3	90.4
67.07	715.1	96	50	66.3	96.9
68.01	33.9	30	96.8	5.8	5.4
69.01	50.5	53	70.7	8.0	13.4
70.01	45.6	42	81.3	7.3	8.5
70.02	97.3	45	77.7	13.5	19.7
71.01	32.9	30	97.4	5.6	7.5
72.01	33.2	30	97.2	5.7	7.6
73.01	48.6	35	89.9	7.7	7.2
74.01	122.2	49	74	16.2	19.3
74.02	190.7	62	64.8	23.1	29.5
74.03	242	66	62.4	28.0	37.5
74.04	274.4	73	58.9	30.9	42.5
74.05	378.3	76	57.7	40.0	57.6
74.06	402.8	77	56.9	42.0	58.6
74.07	404.5	78	56.8	42.2	58.7
75.01	33	30	97.4	5.7	6.3
76.01	23.7	26	104.1	4.3	4.7
77.01	71	40	83.1	10.5	10.8
78.01	93.3	53	71.1	13.1	11.4
78.02	182.2	60	66	22.3	24.5
78.03	242	64	63.7	28.0	32.2
79.01	53.6	36	88.1	8.4	8.4
80.01	24.5	27	103.4	4.4	4.7
81.01	67.7	39	83.9	10.1	8.6
82.01	114.1	48	75.1	15.3	14.1
82.02	170.7	56	68.8	21.2	20.4
83.01	66.8	39	84.1	10.0	9.2
83.02	75.5	41	82	11.0	10.4
84.01	61.7	38	85.6	9.4	8.2
84.02	65.5	39	84.5	9.8	8.3
85.01	19.7	25	108.1	3.7	4.5
85.02	59.1	37	86.3	9.0	7.1
86.01	23.6	26	104.1	4.3	5.8
87.01	65.7	39	84.4	9.9	7.5
87.02	70.1	40	83.3	10.4	8.1
88.01	40.8	32	93.2	6.7	5.2

Subcatchment ID	Contributing Catchment Area (Ha)	Tc (min)	Design Intensity (mm/hr)	PRM Discharge (m^3/s)	XP-RAFTS Discharge (m^3/s)
89.01	164.2	66	62.5	20.5	21.3
89.02	273.1	72	59.2	30.8	38.9
89.03	374.2	84	54.4	39.6	54.5
89.04	502.3	89	52.5	50.1	72.7
89.05	595.7	92	51.4	57.4	86.3
89.06	681.7	103	47.9	63.8	97.2
89.07	932.4	109	46.4	81.9	125.1
89.08	997.5	110	46.1	86.4	131.8
89.09	1040.9	112	45.6	89.4	136.0
89.10	1065.4	113	45.4	91.0	138.1
89.11	1101.4	115	44.9	93.5	140.7
89.12	1184.2	118	44.2	99.0	148.1
89.13	1247.2	120	43.9	103.2	153.1
89.14	1265	144	39.2	104.4	154.3
89.15	2062.3	145	39	153.8	202.0
89.16	2131	146	38.8	157.9	206.6
89.17	2214.2	148	38.6	162.8	211.5
90.01	24.5	27	103.4	4.4	4.7
90.02	99.5	46	77.3	13.8	16.9
91.01	36.9	38	85.6	6.2	6.0
92.01	64.4	39	84.8	9.7	10.4
93.01	117.1	48	74.6	15.7	17.4
94.01	73.3	84	54.1	10.8	11.6
95.01	38.6	32	94.3	6.4	7.2
96.01	140.7	56	68.7	18.1	16.9
96.02	179.6	57	68	22.1	22.7
97.01	30.6	29	98.9	5.3	5.4
98.01	60.8	38	85.8	9.3	9.5
99.01	23.7	26	104.1	4.3	4.2
100.01	23	26	104.7	4.2	3.5
101.01	25.9	27	102.2	4.6	4.2
102.01	38.2	32	94.5	6.4	5.6
103.01	40.1	32	93.5	6.6	6.3
104.01	17.4	23	110.7	3.4	2.7
105.01	85.9	47	75.9	12.2	13.3
105.02	112.6	57	67.9	15.2	17.5
105.03	198.2	64	63.7	23.9	30.6
105.04	253.2	70	60.2	29.0	35.5
105.05	324.8	75	57.8	35.4	42.0
105.06	393.9	87	53.1	41.3	49.1
105.07	548.5	89	52.4	53.7	65.0
105.08	584	91	51.7	56.5	68.4
105.09	674.5	96	50.1	63.3	78.0
105.10	754.2	98	49.4	69.2	79.4
105.11	795.3	100	48.8	72.2	81.2
106.01	22.2	26	105.5	4.1	5.1
107.01	68.2	39	83.7	10.2	10.6
108.01	44	33	91.8	7.1	7.9
109.01	59.7	37	86.1	9.1	9.2
110.01	51.4	35	88.9	8.1	8.2
111.01	100.1	51	72.8	13.8	11.5
111.02	151.6	53	70.6	19.3	18.9

Subcatchment ID	Contributing Catchment Area (Ha)	Tc (min)	Design Intensity (mm/hr)	PRM Discharge (m^3/s)	XP-RAFTS Discharge (m^3/s)
112.01	31.6	29	98.2	5.5	5.8
113.01	30.8	29	98.7	5.3	4.8
114.01	32.3	30	97.8	5.6	5.5
115.01	30.7	29	98.8	5.3	5.5
116.01	21.5	25	107	4.0	4.2
117.01	52.5	36	88.5	8.2	7.1
118.01	18.5	24	109.3	3.5	3.2
119.01	54.3	47	76.2	8.5	8.0
119.02	110.6	51	72.8	15.0	15.8
119.03	193.6	65	63.3	23.4	26.2
119.04	278.9	70	60.2	31.3	37.7
119.05	315.7	73	58.7	34.6	42.3
119.06	412.7	78	56.6	42.8	54.4
119.07	466.1	82	55.1	47.2	60.2
119.08	486.3	90	52.1	48.8	59.6
119.09	600.2	92	51.5	57.7	69.5
119.10	632.8	92	51.4	60.2	73.0
119.11	1630.4	133	41.1	127.6	148.0
119.12	1676.9	134	41	130.5	150.8
119.13	1716	134	40.9	132.9	152.7
119.14	1720.6	140	39.8	133.2	152.9
119.15	1944	141	39.7	146.8	172.8
119.16	1970.2	154	37.6	148.4	174.1
119.17	2471.7	155	37.5	177.6	217.4
119.18	2526.1	156	37.4	180.7	219.9
119.19	2529.6	156	37.4	180.9	220.1
119.20	2565.6	156	37.3	183.0	220.4
119.21	2624.2	159	36.9	186.3	222.5
119.22	2687.6	172	35.2	189.8	302.4
119.23	3297.5	172	35.2	223.3	346.1
120.01	52.4	36	88.5	8.2	7.3
121.01	21.2	25	106.4	3.9	3.8
122.01	56.1	37	87.2	8.7	8.7
123.01	34.3	30	96.6	5.8	5.4
124.01	33.1	30	97.2	5.7	5.6
125.01	64	45	77.3	9.6	7.5
125.02	107.1	47	76.1	14.6	13.5
126.01	35.2	38	84.9	6.0	5.5
127.01	20.2	25	107.6	3.8	3.6
127.02	25.3	27	102.7	4.6	4.2
128.01	99.2	45	77.4	13.7	10.5
128.02	341.1	86	53.6	36.8	37.9
128.03	529.2	86	53.5	52.2	59.2
128.04	584.8	96	50	56.5	61.9
128.05	717.7	100	48.8	66.5	70.9
128.06	792.7	103	48	72.0	74.8
128.07	867.2	104	47.8	77.3	79.248
128.08	899.2	106	47.2	79.6	80.904
128.09	926.6	108	46.7	81.5	82.42
128.10	973.1	108	46.6	84.7	85.082
128.11	975.7	109	46.4	84.9	85.213
128.12	994.4	132	41.4	86.2	86.239

Subcatchment ID	Contributing Catchment Area (Ha)	Tc (min)	Design Intensity (mm/hr)	PRM Discharge (m^3/s)	XP-RAFTS Discharge (m^3/s)
129.01	72.8	46	77	10.7	9.668
129.02	110.3	57	68.3	14.9	15.308
129.03	191.1	68	61.2	23.2	24.818
130.01	28.4	28	100.4	5.0	4.848
131.01	65.9	39	84.3	9.9	8.59
132.01	59.8	43	79.9	9.1	9.009
132.02	100.3	50	73	13.8	14.775
132.03	132.2	55	69.6	17.3	19.523
132.04	178.4	57	68.2	21.9	24.171
132.05	181.9	57	67.8	22.3	24.351
133.01	25.3	27	102.7	4.6	3.981
134.01	29.4	29	99.7	5.1	4.728
135.01	30	29	99.2	5.2	4.874
136.01	25.6	27	102.5	4.6	5.821
136.02	53.1	36	88.3	8.3	4.881
137.01	51.4	40	82.6	8.1	6.086
137.02	79.4	42	81.3	11.5	10.934
137.03	87.8	43	79.4	12.4	9.615
137.04	106.4	47	76.2	14.5	12.323
137.05	128.9	50	73.1	16.9	13.855
138.01	21.5	25	106.1	4.0	3.459
139.01	15.1	22	113.8	3.0	4.809
140.01	16.7	23	111.6	3.3	6.515
141.01	30.2	29	99.1	5.3	5.876
141.02	54.4	36	88	8.5	11.236
141.03	63.1	38	85.1	9.5	14.502
141.04	74.2	41	82.3	10.9	14.003
142.01	6	16	135.7	1.4	2.45
143.01	4.6	14	142.2	1.1	0.7076
144.01	48.9	35	89.8	7.8	7.054
144.02	58.5	37	86.5	9.0	7.878
145.01	19.1	24	108.6	3.6	2.988
146.01	38	32	94.6	6.3	4.619
147.01	15.3	22	113.4	3.0	2.822
148.01	42.1	33	92.6	6.9	10.373
148.02	44.3	33	91.6	7.2	7.953
149.01	19.1	24	108.6	3.6	5.089
149.02	20.7	25	106.9	3.9	5.514
150.01	90.2	44	78.9	12.7	9.743
150.02	102.5	49	73.7	14.1	10.617
150.03	137.7	52	72.1	17.8	14.239
150.04	138.7	60	66	17.9	14.301
150.05	206.5	134	40.9	24.7	20.811
151.01	21.5	25	106.1	4.0	3.307
152.01	39.4	32	93.9	6.5	6.78
152.02	46.7	34	90.7	7.5	6.03
152.03	54.2	36	87.9	8.4	6.062
152.04	67.6	39	83.9	10.1	6.974
153.01	88.7	49	74	12.5	12.682
153.02	181.3	60	65.8	22.2	22.309
153.03	220.9	69	60.8	26.0	27.087
153.04	305.2	73	58.7	33.7	37.724

Subcatchment ID	Contributing Catchment Area (Ha)	Tc (min)	Design Intensity (mm/hr)	PRM Discharge (m^3/s)	XP-RAFTS Discharge (m^3/s)
153.05	375	77	57	39.7	47.661
153.06	455	81	55.4	46.3	56.167
153.07	458.8	83	54.5	46.6	56.399
153.08	497.1	84	54.3	49.7	60.871
154.01	33.3	30	97.2	5.7	5.664
155.01	27.8	28	100.8	4.9	4.436
156.01	78.6	42	81.3	11.4	10.613
157.01	44.9	34	91.4	7.3	7.079
158.01	24.3	27	103.6	4.4	3.862
159.01	22.1	26	105.6	4.1	4.034
159.02	27.4	28	101.1	4.9	4.725
160.01	12.4	21	118.2	2.5	2.058
160.02	26.5	28	101.7	4.7	5.417
160.03	36.4	31	95.4	6.1	7.608
160.04	36.7	31	95.2	6.2	7.643
161.01	12.3	21	118.3	2.5	177.74
161.02	22	31	96.3	4.1	177.66
161.03	57.3	37	86.8	8.8	177.33
162.01	12.8	21	117.4	2.6	2.247
163.01	46.2	34	90.8	7.4	7.369
163.02	105.9	55	69.5	14.5	16.322
163.03	253.2	68	61.3	29.0	30.675
163.04	309.7	79	56	34.1	37.241
163.05	528.4	86	53.5	52.1	50.219
163.06	536.6	88	52.7	52.8	50.645
163.07	586.2	89	52.3	56.6	53.866
163.08	592.3	90	52.2	57.1	53.707
164.01	55.5	46	76.9	8.6	8.451
165.01	56.9	37	87	8.8	7.983
166.01	34.2	30	96.6	5.8	5.211
167.01	120.9	70	60.3	16.1	10.635
168.01	27.8	28	100.8	4.9	4.426
169.01	59.2	37	86.3	9.1	8.892
169.02	143.3	52	71.5	18.4	14.29
169.03	147.4	53	71	18.8	14.211
170.01	33.1	30	97.3	5.7	4.584
170.02	56.3	37	87.2	8.7	6.994
170.03	106.3	47	76.2	14.5	11.09
171.01	110	47	75.7	14.9	11.831
171.02	170.5	60	65.8	21.2	16.71
171.03	248.5	66	62.6	28.6	24.705
171.04	277.9	77	57.1	31.3	27.356
171.05	404	78	56.8	42.1	38.568
171.06	411.7	78	56.6	42.7	38.854
172.01	38.2	32	94.5	6.4	4.897
173.01	39.2	32	94	6.5	4.668
174.01	13.9	22	115.6	2.8	2.679
175.01	75.9	48	75.2	11.1	7.356
175.02	116.9	48	74.7	15.6	11.141
176.01	37.1	31	95.1	6.2	4.242
177.01	43.7	33	91.9	7.1	4.68
178.01	23.6	26	104.1	4.3	4.35

Subcatchment ID	Contributing Catchment Area (Ha)	Tc (min)	Design Intensity (mm/hr)	PRM Discharge (m^3/s)	XP-RAFTS Discharge (m^3/s)
178.02	43.6	33	91.9	7.1	8.013
179.01	62.7	47	76.2	9.5	7.229
179.02	136.1	51	72.3	17.7	16.686
179.03	176.6	61	65.7	21.8	19.438
179.04	242.6	64	63.7	28.0	21.953
179.05	304.8	74	58.3	33.6	25.689
179.06	387.1	81	55.5	40.7	30.79
179.07	484.3	83	54.6	48.6	36.725
180.01	43.5	33	92	7.1	5.735
181.01	34.3	30	96.6	5.8	9.881
182.01	19.6	25	108.1	3.7	3.34
182.02	58.3	37	86.6	9.0	6.755
183.01	55.7	37	87.4	8.6	4.525
184.01	61.3	42	81	9.3	23.956
185.01	28.8	28	100.1	5.1	14.443
186.01	16.5	23	111.8	3.2	6.066
186.02	24.5	27	103.4	4.4	7.553

Appendix H

Tuggerah Lake Design Stage Hydrographs

Catchment Simulation Solutions

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1 INTRODUCTION

The prevailing water levels within Tuggerah Lake greatly influence flood behaviour along the lower reaches of Ourimbah Creek. Accordingly, it is important to define a reliable water level in Tuggerah Lake to ensure flood behaviour is reliably defined during each of the design flood simulations.

The following document outlines the approach that was adopted for estimating design stage hydrographs for Tuggerah Lake as part of the Ourimbah Creek Flood Study.

2 BACKGROUND

2.1 Data Review

A review of available information was completed to identify data that could be used to assist in defining the relationship between Ourimbah Creek and Tuggerah Lake flooding and to ultimately help develop suitable design stage hydrographs for Tuggerah Lake. The outcomes of this review determined that:

- Tuggerah Lake is not influenced by the tide. Normal (i.e., non-flood) water levels within the lake typically vary between 0.2 and 0.3 mAHD (WMAwater, 2010). Accordingly, it should not be necessary to make an allowance for tidal impacts.
- Peak design Tuggerah Lake levels are documented in several reports. The most recent design levels are documented in the “Tuggerah Lake Flood Study” (Lawson and Treloar, 1994), which are summarised in **Table I1**:

Table I1 Summary of peak design flood levels for Tuggerah Lake taken from “Tuggerah Lakes Flood Study”

Location	Peak Lake Water Level (mAHD)				
	50% AEP	20% AEP	5% AEP	1% AEP	Maximum Probable Flood
Tuggerah Lake	0.91	1.36	1.80	2.23	2.70

- The “Lower Ourimbah Creek Flood Study” (1986) investigated the relative timing/coincidence of peak flood levels within Tuggerah Lake and Ourimbah Creek. The outcomes of this investigation determined that peak outflows from Ourimbah Creek do not coincide with peak water levels within Tuggerah Lake. Accordingly, this report suggests adopting the Tuggerah Lake levels documented in **Table I2** at the time of peak Ourimbah Creek outflow into Tuggerah Lake. It should be noted that this assessment was based upon a simple volumetric analysis and did not involve any sort of dynamic hydraulic analysis:

Table I2 Summary of peak design flood levels for Tuggerah Lake at time of Ourimbah Creek flood peak taken from "Lower Ourimbah Creek Flood Study"

Location	Peak Lake Water Level (mAHD)		
	5% AEP	2% AEP	1% AEP
Tuggerah Lake	0.6	0.7	0.9

2.2 Historic Flooding Information

A review of stream and lake gauging stations was completed to investigate past incidences of flooding along the lower reaches of Ourimbah Creek and Tuggerah Lake. This review was based upon stage data for the following gauges:

- Long Jetty Gauge (September 1991-> Present) - Located on Tuggerah Lake opposite the Ourimbah Creek entrance. It was assumed that this gauge would provide a reliable description of the variation in Tuggerah Lake stage during floods.
- Lees Bridge Gauge (May 1993-> Present) – This gauge is located approximately 3.5km upstream from Tuggerah Lake at the Wyong Road crossing of Ourimbah Creek. It was assumed that this gauge would provide a reasonable description of the variation in stage along the lower reaches of Ourimbah Creek during floods.

Stage hydrographs were extracted for both gauges for the June 2007 and June 2011 floods and are presented in **Figures I2** and **I3**. No recorded stage hydrograph was available for the Lees Bridge gauge for the 1992 event. Therefore, the 1992 discharge hydrograph was extracted from the XP-RAFTS model and is shown in **Figure I1**.

The historic analysis indicates that the peak Ourimbah Creek stage and peak Tuggerah Lake stage do not coincide. This tends to confirm the findings documented in the "Lower Ourimbah Creek Flood Study" (1986). More specifically, Ourimbah Creek peaks between 16 hours (1992 event) and 42 hours (2011 event) before Tuggerah Lake.

Figures I1 to **I3** also show that the Tuggerah Lake stage hydrographs comprise a broad, single peaked hydrograph, despite the Ourimbah Creek hydrograph being comparatively "peaky".

The hydrographs also suggest that the Tuggerah Lake stage at the time of peak Ourimbah Creek outflow is approximately 75% of the overall peak Tuggerah Lake stage. This is somewhat different to the design Tuggerah Lake water elevations documented in the "Lower Ourimbah Creek Flood Study", which suggests that the Tuggerah Lake stage at the time of peak Ourimbah Creek outflow is 30-40% of the peak design Tuggerah Lake stage. However, as discussed, this previous assessment was based on volumetric analysis only and did not consider recorded floods as part of the analysis.

It is also suggested that a static tailwater elevation for Tuggerah Lake may not be appropriate for the design flood simulations. A static tailwater has the potential to either:

- Overestimate the degree of flooding along the lower reaches of Ourimbah Creek (if peak Ourimbah Creek outflows are assumed to occur at the same time as peak Tuggerah Lake design water levels), or;

- Underestimate the degree of flooding along the lower reaches of Ourimbah Creek (if a non-peak Tuggerah Lake water level is adopted, as recommended in the "Lower Ourimbah Creek Flood Study" (1986))

3 Adopted Approach

The review of available information indicates that the design stage hydrographs for Tuggerah Lake should take account of the following factors:

- The peak Ourimbah Creek outflow will occur before the peak Tuggerah Lake stage;
- The Tuggerah Lake stage comprises a broad, single peaked stage hydrograph. The recession limb of the hydrograph is typically much "flatter" relative to the accession limb;
- The shape of the Tuggerah Lake hydrograph will be influenced by the rainfall distribution across the catchment. For example, the Tuggerah Lake stage hydrograph following a 2 hour rainfall burst will peak before an equivalent 2 day rainfall event.

The following approach was employed to develop synthetic stage hydrographs for Tuggerah Lake based upon consideration of the above factors:

<u>User-Defined Inputs:</u>

- Design outflow hydrographs for Ourimbah Creek (i.e., generated by XP-RAFTS model)
- Maximum Tuggerah Lake Design Stage (as defined in **Table I1**)
- Difference in time between peak Ourimbah Creek outflow and peak Tuggerah lake stage (20 hours adopted – slightly higher than the 1992 and 2007 lag, but lower than the 2011 lag. A lag value at the lower end of this historic range was adopted as it will provide a more conservative flood estimate across the lower sections of the catchment)
- Normal (i.e., non-flood) Tuggerah Lake stage (0.3mAHD adopted).

It was noted that peak Tuggerah Lake stages were not available for all required AEPs (refer **Table I1**). Therefore, it was necessary to interpolate Tuggerah Lake stages for the 10%, 2% and 0.5% AEP events. This was completed by plotting the known Tuggerah Lake design stages against AEP on a log-log graph to provide a roughly linear relationship between AEP and peak stage, as shown in **Plate I1**. Note that a nominal AEP of 0.00001% was adopted for the PMF.

The peak stages for the other AEPs could then be read directly off the chart, as shown in **Plate I2**, to provide the final interpolated peak stage values:

- 10% AEP Peak Stage = 1.60 mAHD
- 2% AEP = 2.05 mAHD
- 0.5% AEP = 2.30 mAHD

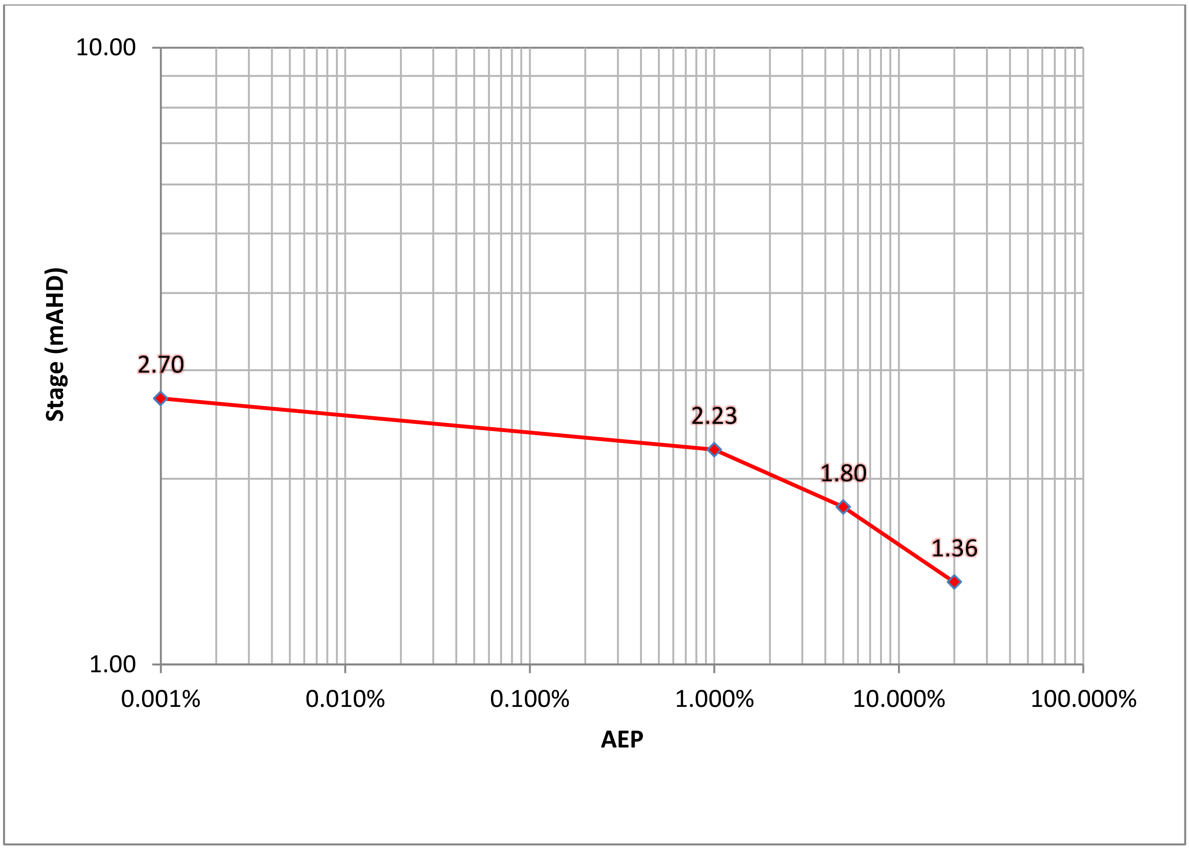


Plate I1 Peak Tuggerah Lake Design Stage versus Annual Exceedance Probability (%)

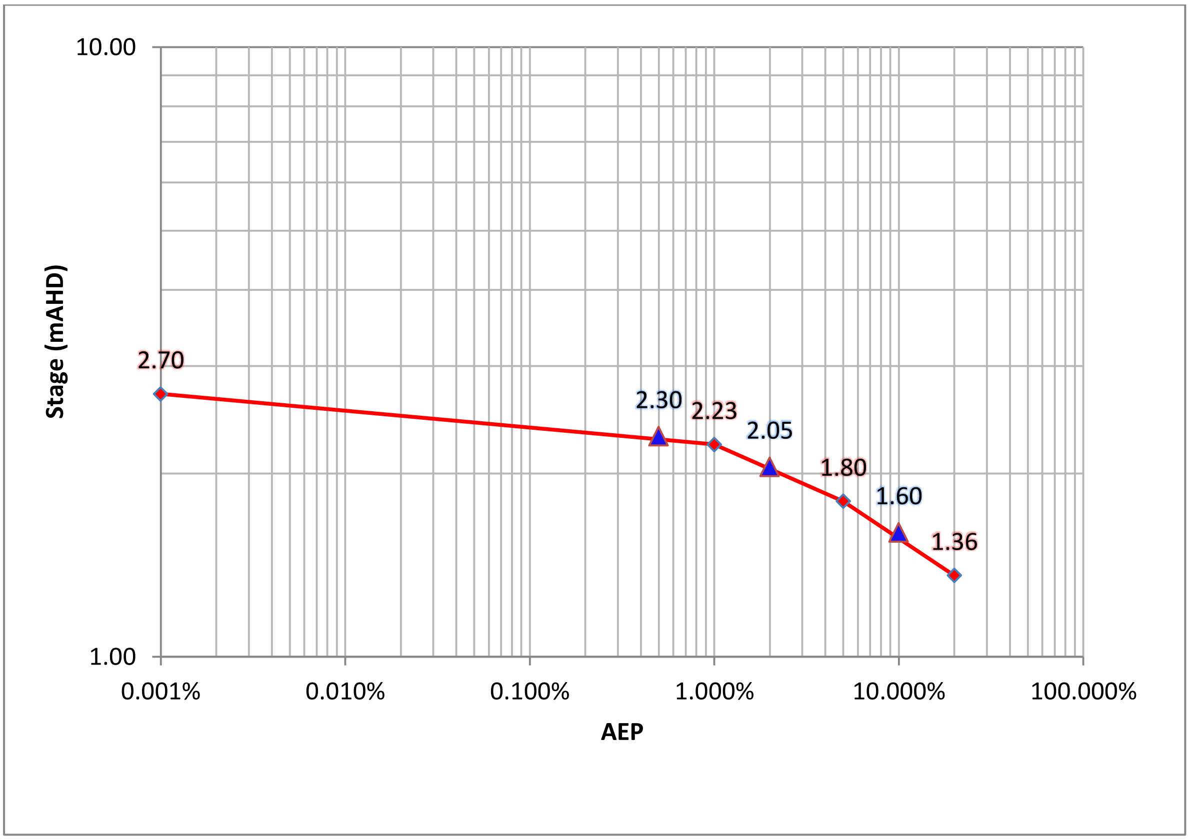


Plate I2 Peak Tuggerah Lake Design Stage versus Annual Exceedance Probability (%) incorporating interpolated design lake levels (blue)

Once the inputs were defined, the Tuggerah Lake stage hydrograph was constructed as follows:

1. The Tuggerah Lake stage would increase from the "normal" lake water level at the start of the nominated design flood to the time of peak Ourimbah Creek outflow (defined based upon Ourimbah Creek outflow hydrograph from XP-RAFTS). The stage at this point was set at 75% of the ultimate peak design Tuggerah Lake. This value is based on observed ratios of Tuggerah Lake stage at peak Ourimbah Creek outflow to overall Tuggerah Lake peak stage during the 1992 (78%), 2007 (76%) and 2011 (76%) floods. This value should ensure a conservative Tuggerah Lake stage is adopted at the time of peak Ourimbah Creek outflow, but still allow for the fact that the peak outflow and Tuggerah Lake stage do not coincide. So for a 1% AEP event, the Tuggerah Lake stage at this time would be set to 1.67mAHD (75% x 2.23mAHD)

2. The stage continues to rise to the peak design Tuggerah Lake stage (i.e., 2.23mAHD for a 1% AEP event). The time that this occurs is based on the time of peak Ourimbah Creek outflow plus a "lag" of 20 hours based on observed lags for the 1992, 2007 and 2011 floods.

3. The stage hydrograph now decreases back to the "normal" lake water level. The lake stage is assumed to return to "normal" 4 times after the time of peak lake stage. So if the peak lake stage occurs after 30 hours, the stage will return to normal after 120 hours. Accordingly, the recession limb of the hydrograph is "flatter" relative to the rising limb of the hydrograph. This is based on visual assessment of the historic stage hydrographs (refer **Figures I1** to **I3**).

The above approach was employed to develop Tuggerah Lake design stage hydrographs for the 20%, 10%, 5%, 2%, 1% and 0.5% AEP events as well as the Probable Maximum Flood (PMF) for a range of storm durations, which are presented in **Figures I4** to **I10**. The design outflow hydrographs (from XP-RAFTS) for Ourimbah Creek are also included. Note that the outflow hydrographs are provided in m^3/s, while the Tuggerah Lake stage is provided relative to mAHD.

Employing the above approach ensures that a fully dynamic Tuggerah Lake stage hydrograph is provided that accounts for the fact that Ourimbah Creek and Tuggerah Lake peak stages typically do not coincide. However, it still allows peak Tuggerah Lake design levels to be represented (after the peak Ourimbah Creek inflow) to ensure the potential for inundation along the lower reaches of Ourimbah Creek from catchment runoff and elevated lake levels is represented in a realistic manner.

The suggested approach also accounts for the fact that the hydrograph shape will typically be unique to each storm duration (i.e., the stage hydrograph for a short duration design storm will be "peakier" than a longer design storm duration).

4 Assumptions and Limitations

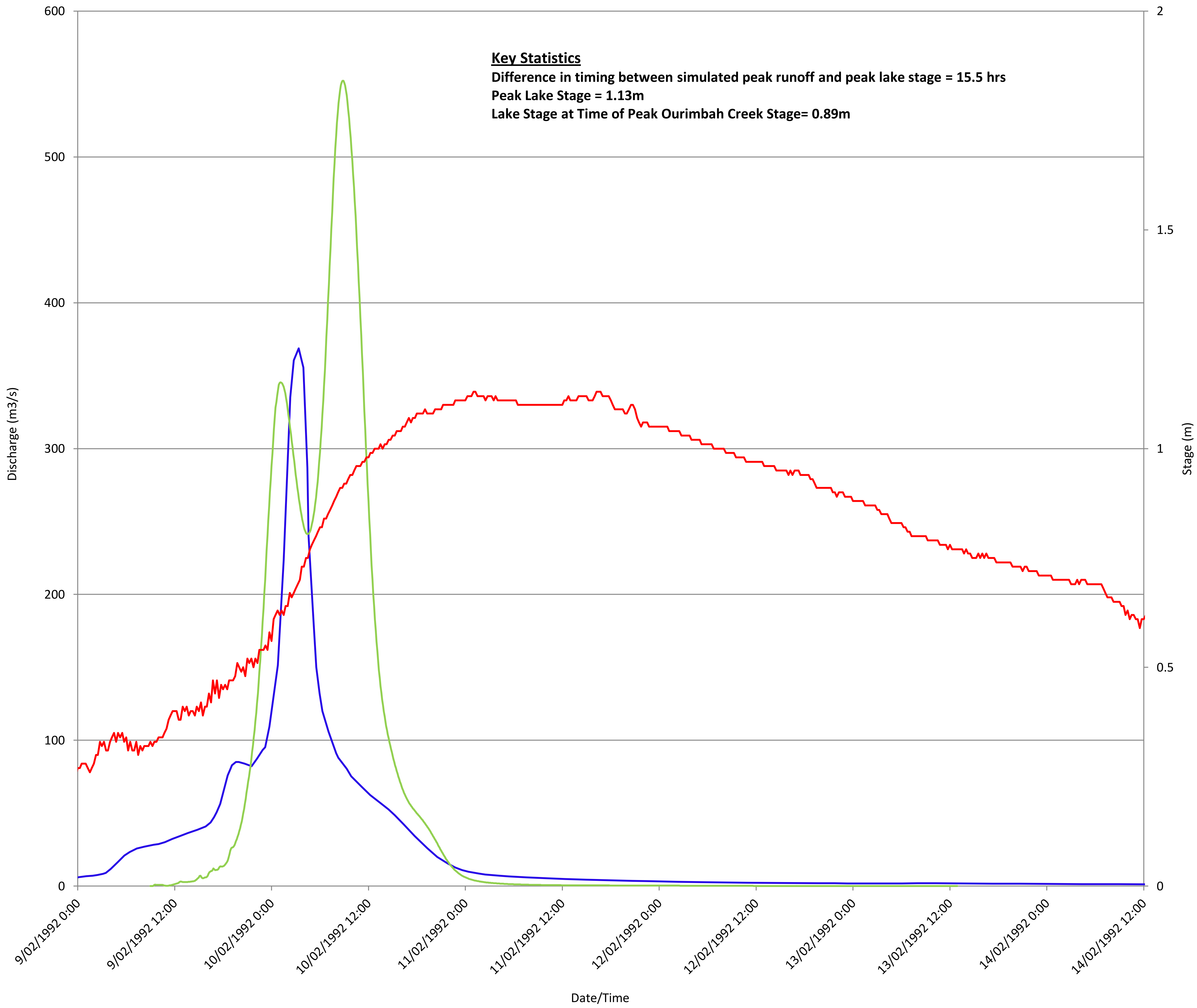
The above approach makes several assumptions with regard to how rainfall is distributed across the Ourimbah and Tuggerah Lakes catchments, the duration of the storms and how Ourimbah Creek and Tuggerah Lake interact.

- It was assumed that a constant AEP event is occurring simultaneously over the Ourimbah Creek and overall Tuggerah Lake catchment. It is considered that this a reasonable assumption based on a review of approximate AEPs for historic Tuggerah Lake stages and Ourimbah Creek peak discharges, as shown in **Table I3**

Table I3 Comparison between approximate AEPs for historic Ourimbah Creek and Tuggerah Lake floods

Event	Ourimbah Creek		Tuggerah Lake	
	Peak Discharge	AEP	Peak Stage	AEP
1992	550	2-1%	1.13	50-20%
2007	300	~5%	1.63	20-5%
2011	120	50-20%	1.10	50-20%

- It was also assumed that a constant storm duration was occurring simultaneously over the Ourimbah Creek and overall Tuggerah Lake catchment. For example, a design 12 hour storm was falling over both the Ourimbah Creek and Tuggerah Lake catchments. Although there is likely to be some variation in rainfall across both catchments during any rainfall event, it was difficult to identify any patterns based on a review of historic rainfall information. Therefore, a simplified "uniform" rainfall distribution was assumed to be applicable across both catchments.
- A 'static' peak Tuggerah Lake stage was adopted for all storm durations. That is, the peak stage did not vary with storm duration. The critical storm duration for the Tuggerah Lake catchment is 48 hours. Accordingly, the peak stages documented in **Table I1** are strictly only applicable for the 48 hour storm (i.e., design stages during other storm durations are likely to be lower than those documented in **Table I1**). However, with the exception of the 1% AEP event, no information is available in the "Tuggerah Lake Flood Study" (Lawson and Treloar, 1994) documenting peak design stages for alternate storm durations. As a result, the peak design stages listed in **Table I1** were applied to all storm durations.



Gosford City Council
Wyong Shire Council
Central Coast

LEGEND:

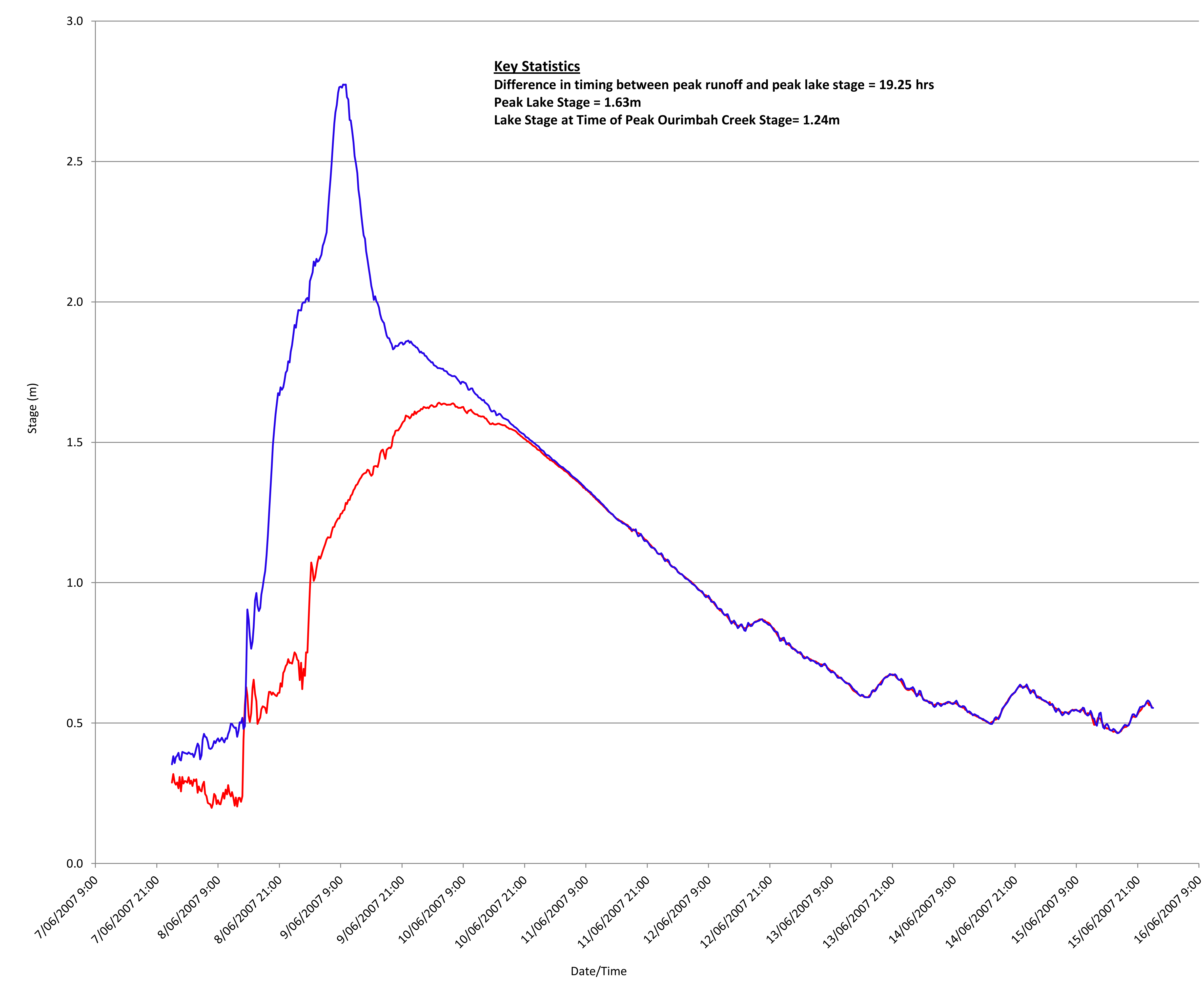
- Ourimbah Creek Upstream of Weir Discharge Hydrograph
- Ourimbah Creek Simulated 1992 Outflow (XP-RAFTS)
- Tuggerah Lake Stage Hydrograph

Notes:

Figure I1: Comparison Between Tuggerah Lake Stage and Simulated Ourimbah Creek Outflow During 1992 Event

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Tuggerah Lake Historic Tailwater.xlsxxlsx



GOSFORD CITY COUNCIL
Wyong Shire Council
CENTRAL COAST

LEGEND:

Tuggerah Lake Stage

Lees Bridge Stage

Notes:

Figure I2: Comparison Between Tuggerah Lake Stage and Ourimbah Creek Stage During 2007 Event

Prepared By:
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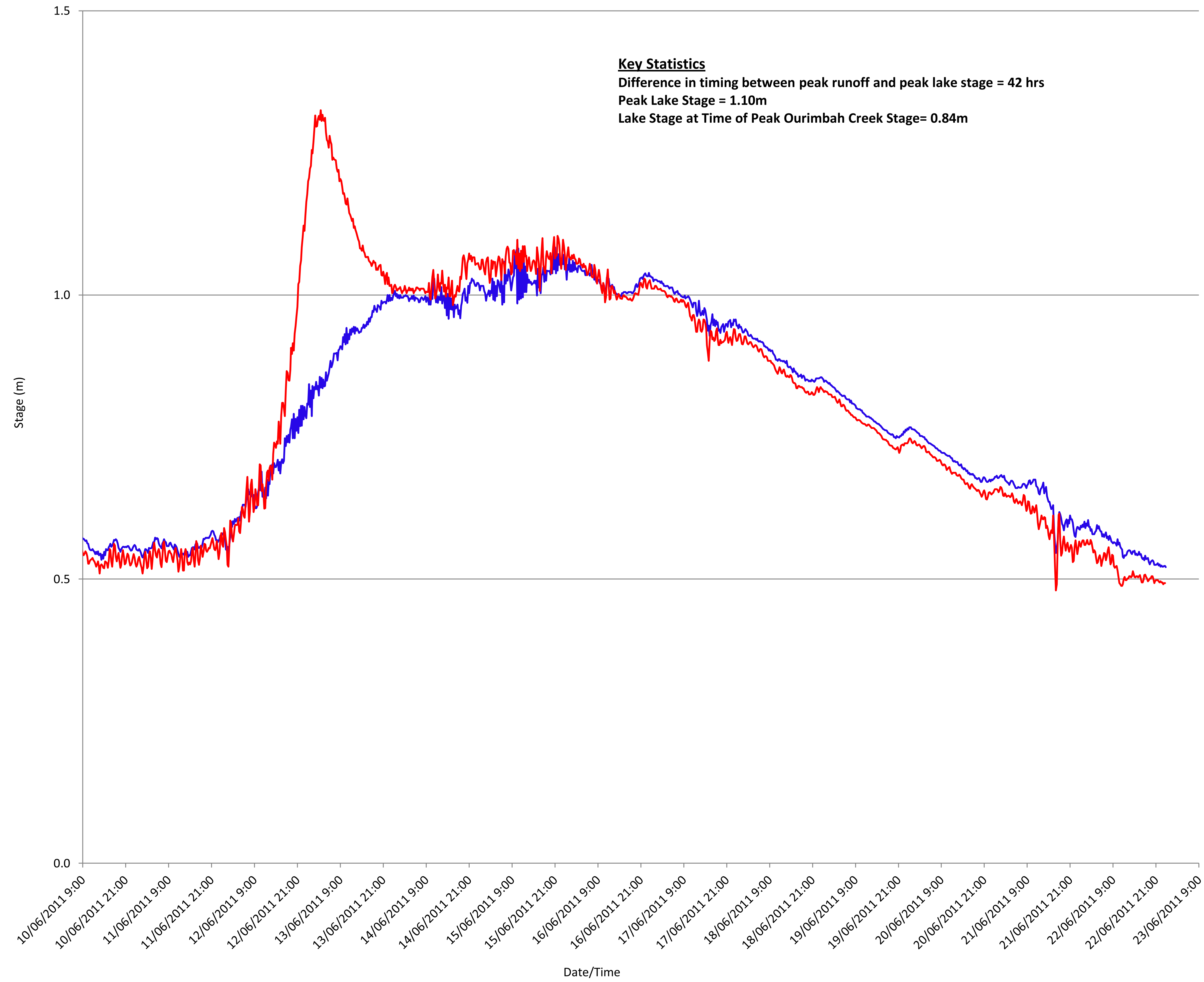
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Tuggerah Lake Historic Tailwater.xlsxxlsx



GOSFORD CITY COUNCIL

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CENTRAL COAST

LEGEND:

- Tuggerah Lake Stage
- Lees Bridge Stage

Notes:

Figure I3:
Comparison Between Tuggerah Lake Stage and Ourimbah Creek Stage During 2011 Event

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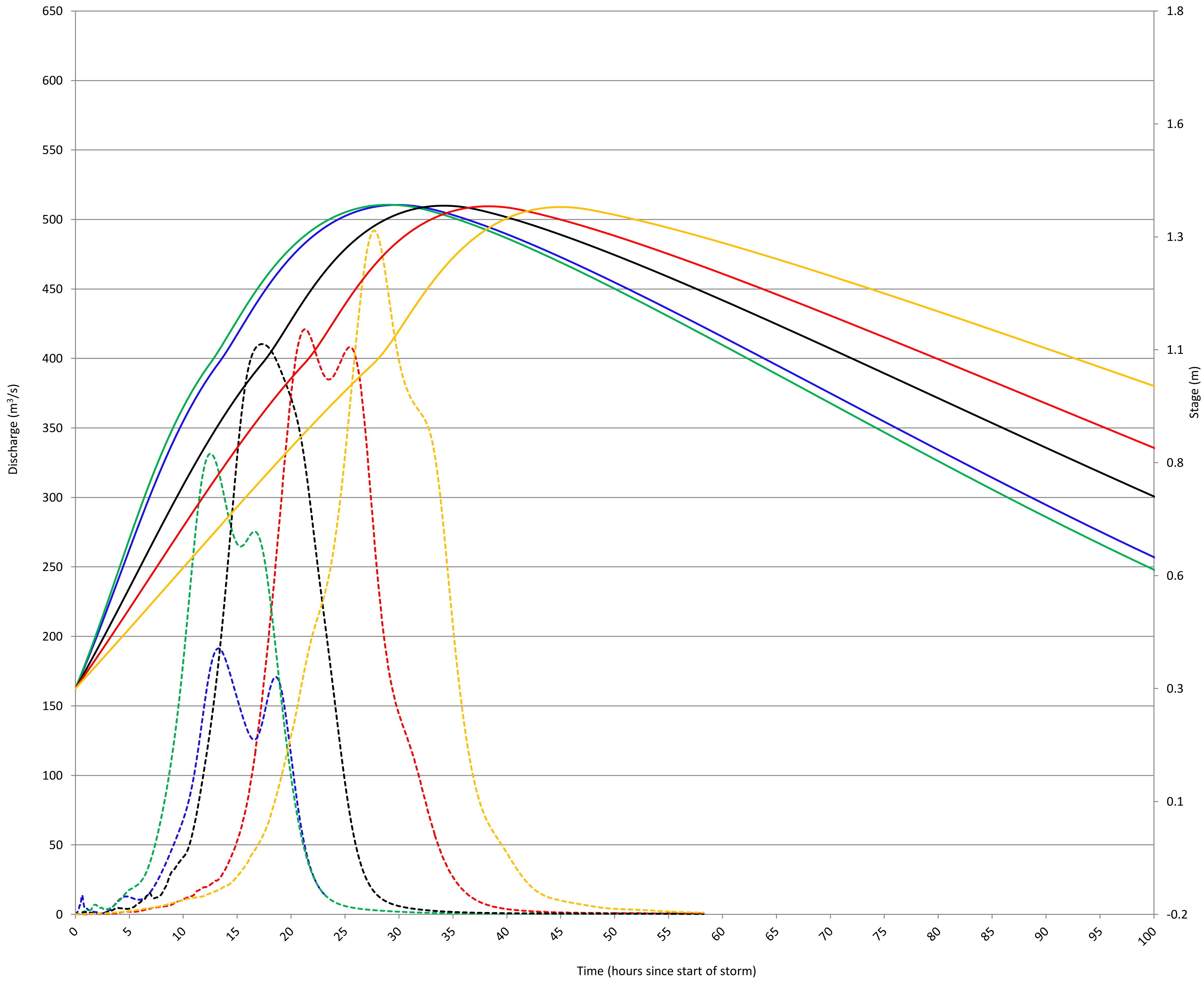
Sydney, NSW, 2000

File Name: Tuggerah Lake Historic Tailwater.xlsxxlsx



CENTRAL COAST

LEGEND:

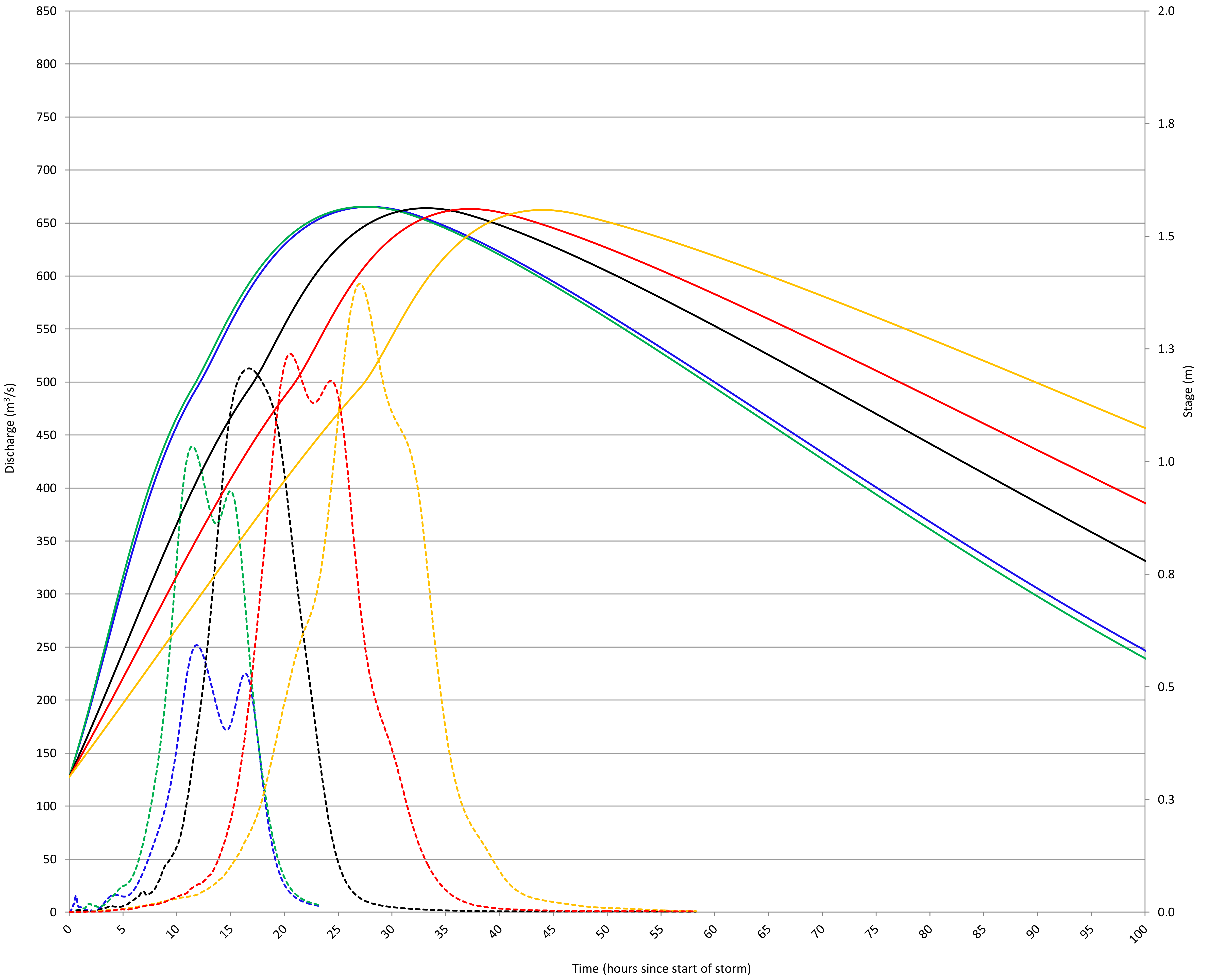
- 24hr discharge hydrograph at Chittaway Point
- 2hr discharge hydrograph at Chittaway Point
- 6hr discharge hydrograph at Chittaway Point
- 12hr discharge hydrograph at Chittaway Point
- 48hr discharge hydrograph at Chittaway Point
- 2hr stage hydrograph for Tuggerah Lake
- 6hr stage hydrograph for Tuggerah Lake
- 12hr stage hydrograph for Tuggerah Lake
- 24hr stage hydrograph for Tuggerah Lake
- 48hr stage hydrograph for Tuggerah Lake

Notes:

Figure I4: Tuggerah Lake 20% AEP Synthetic Stage Hydrographs

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Tuggerah Lake Design Tailwater.xlsx



Notes:

Figure I5: Tuggerah Lake 10% AEP Synthetic Stage Hydrographs

Prepared By:
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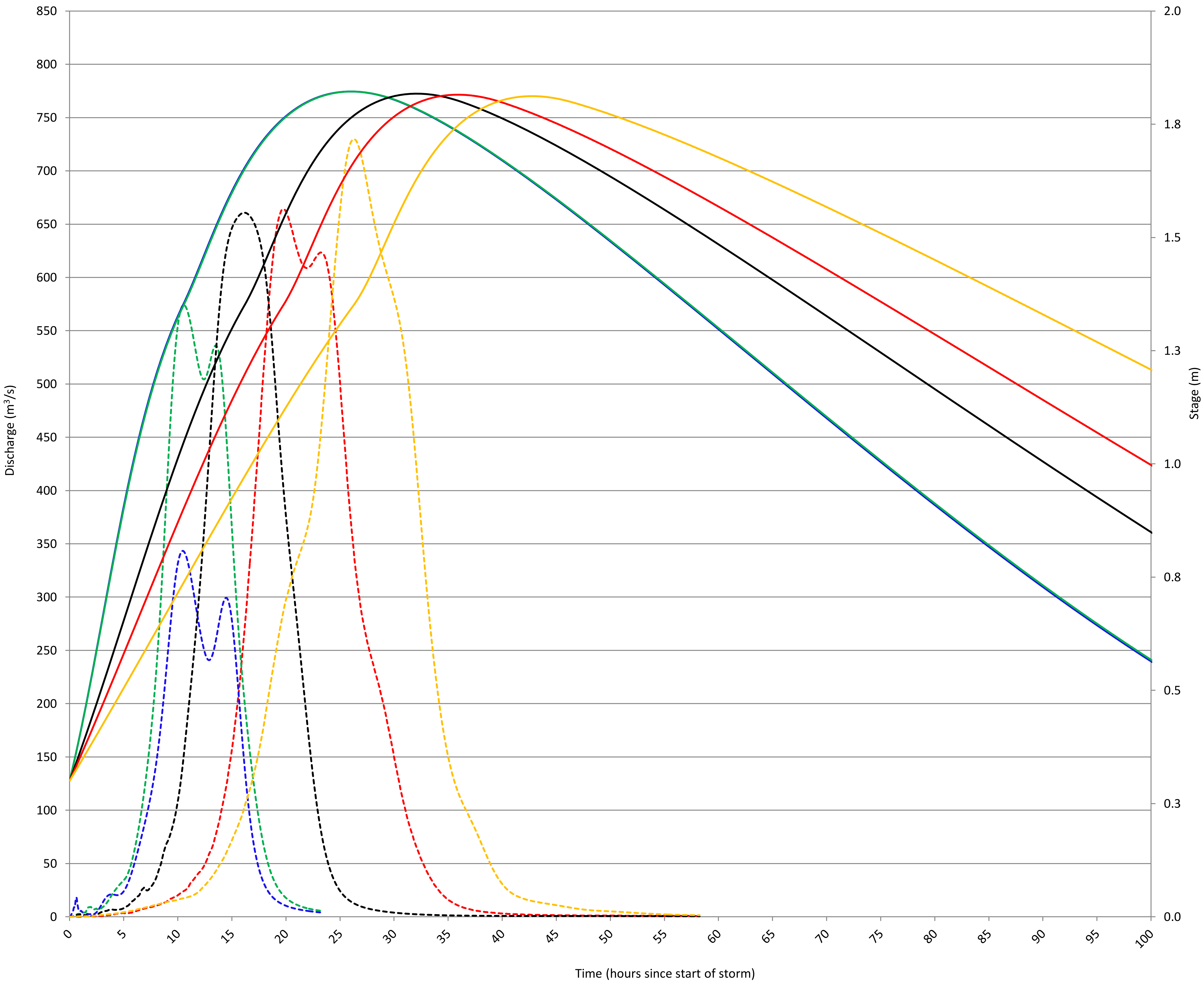
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Tuggerah Lake Design Tailwater.xlsx



GOSFORD CITY COUNCIL
Wyong Shire Council
CENTRAL COAST

LEGEND:

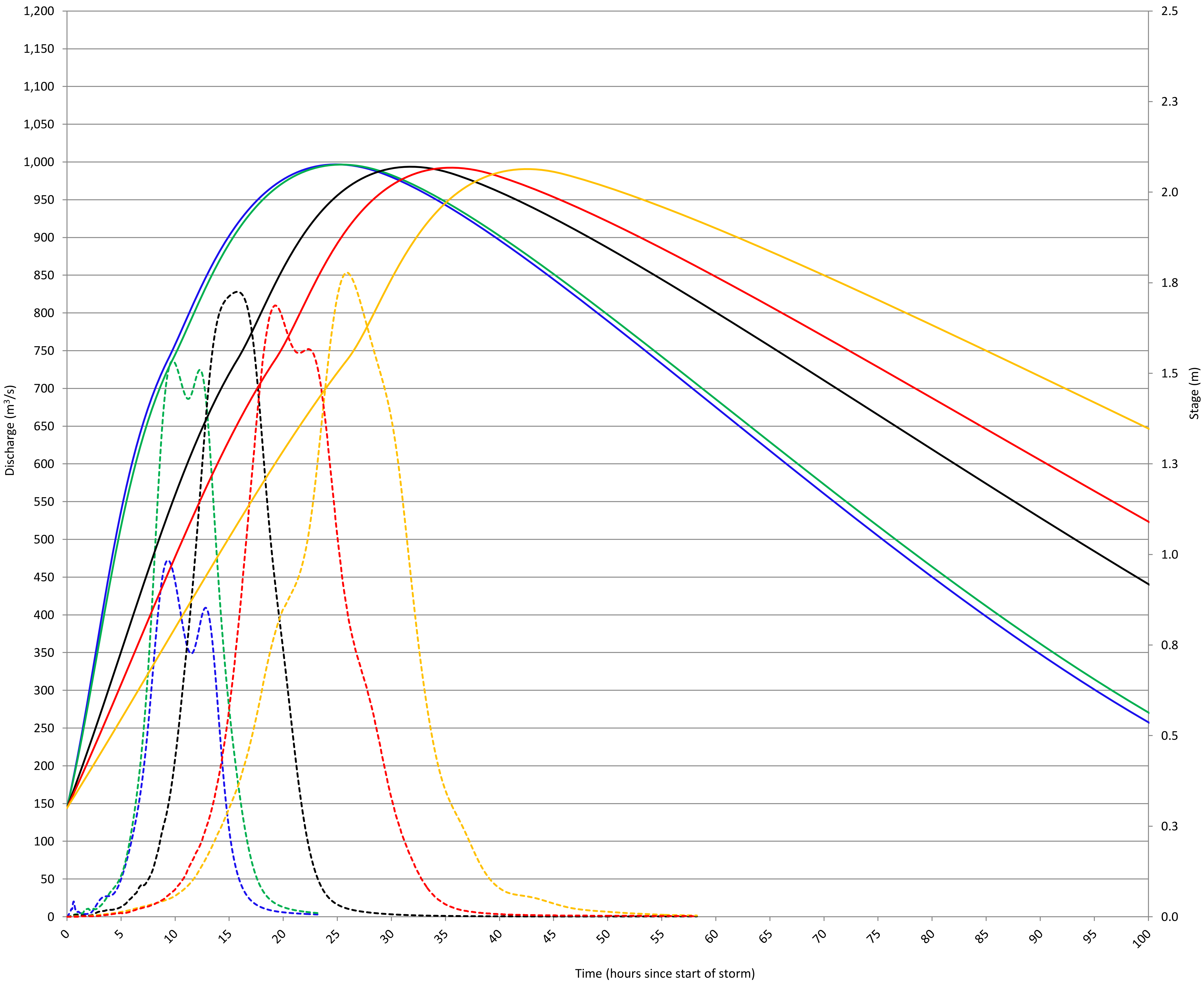
- 24hr discharge hydrograph at Chittaway Point
- 2hr discharge hydrograph at Chittaway Point
- 6hr discharge hydrograph at Chittaway Point
- 12hr discharge hydrograph at Chittaway Point
- 48hr discharge hydrograph at Chittaway Point
- 2hr stage hydrograph for Tuggerah Lake
- 6hr stage hydrograph for Tuggerah Lake
- 12hr stage hydrograph for Tuggerah Lake
- 24hr stage hydrograph for Tuggerah Lake
- 48hr stage hydrograph for Tuggerah Lake

Notes:

Figure I6: Tuggerah Lake 5% AEP Synthetic Stage Hydrographs

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Tuggerah Lake Design Tailwater.xlsx



GOSFORD CITY COUNCIL

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CENTRAL COAST

LEGEND:

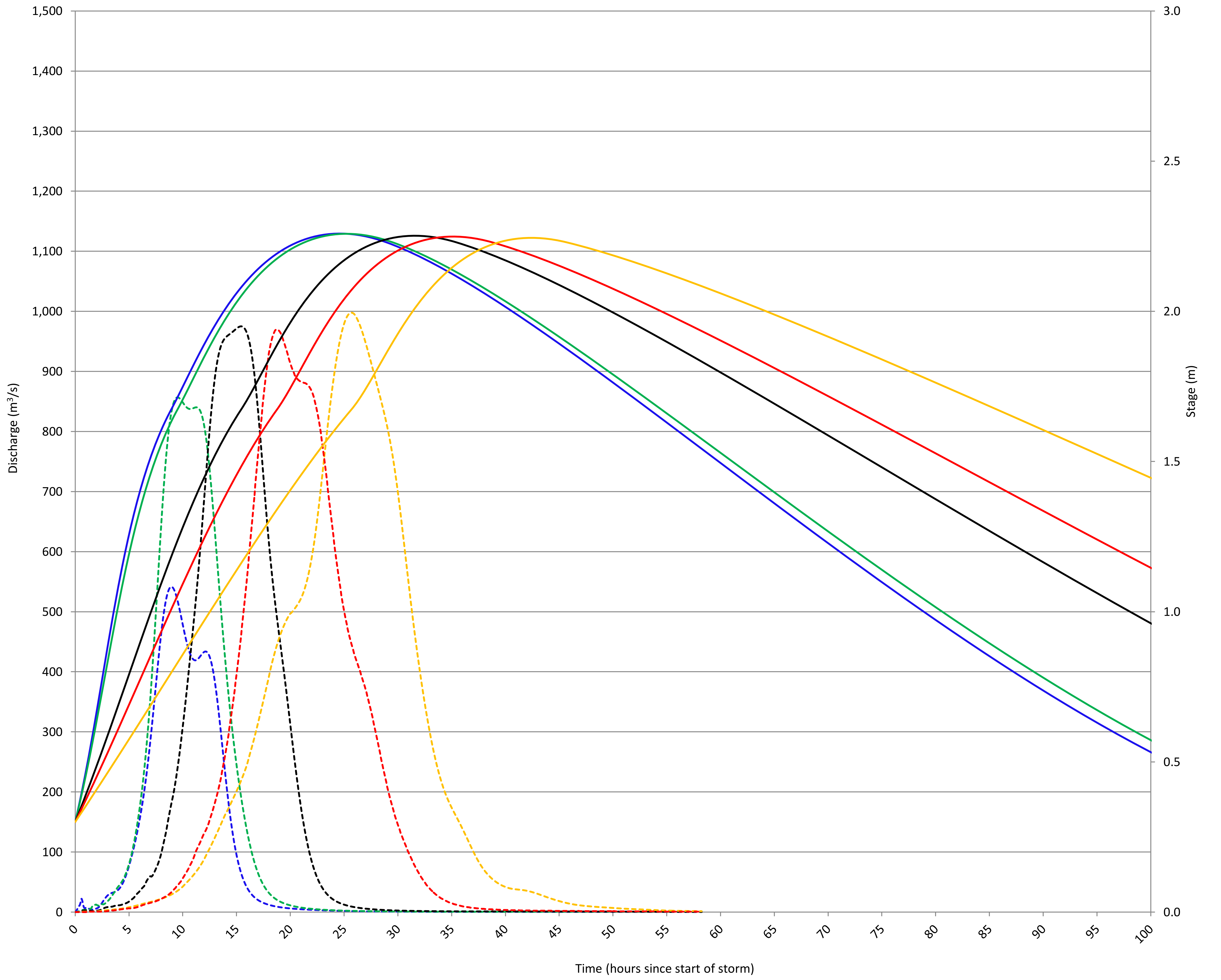
- 2hr discharge hydrograph at Chittaway Point
- 6hr discharge hydrograph at Chittaway Point
- 12hr discharge hydrograph at Chittaway Point
- 48hr discharge hydrograph at Chittaway Point
- 24hr discharge hydrograph at Chittaway Point
- 2hr stage hydrograph for Tuggerah Lake
- 6hr stage hydrograph for Tuggerah Lake
- 12hr stage hydrograph for Tuggerah Lake
- 24hr stage hydrograph for Tuggerah Lake
- 48hr stage hydrograph for Tuggerah Lake

Notes:

Figure I7: Tuggerah Lake 2% AEP Synthetic Stage Hydrographs

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Tuggerah Lake Design Tailwater.xlsx

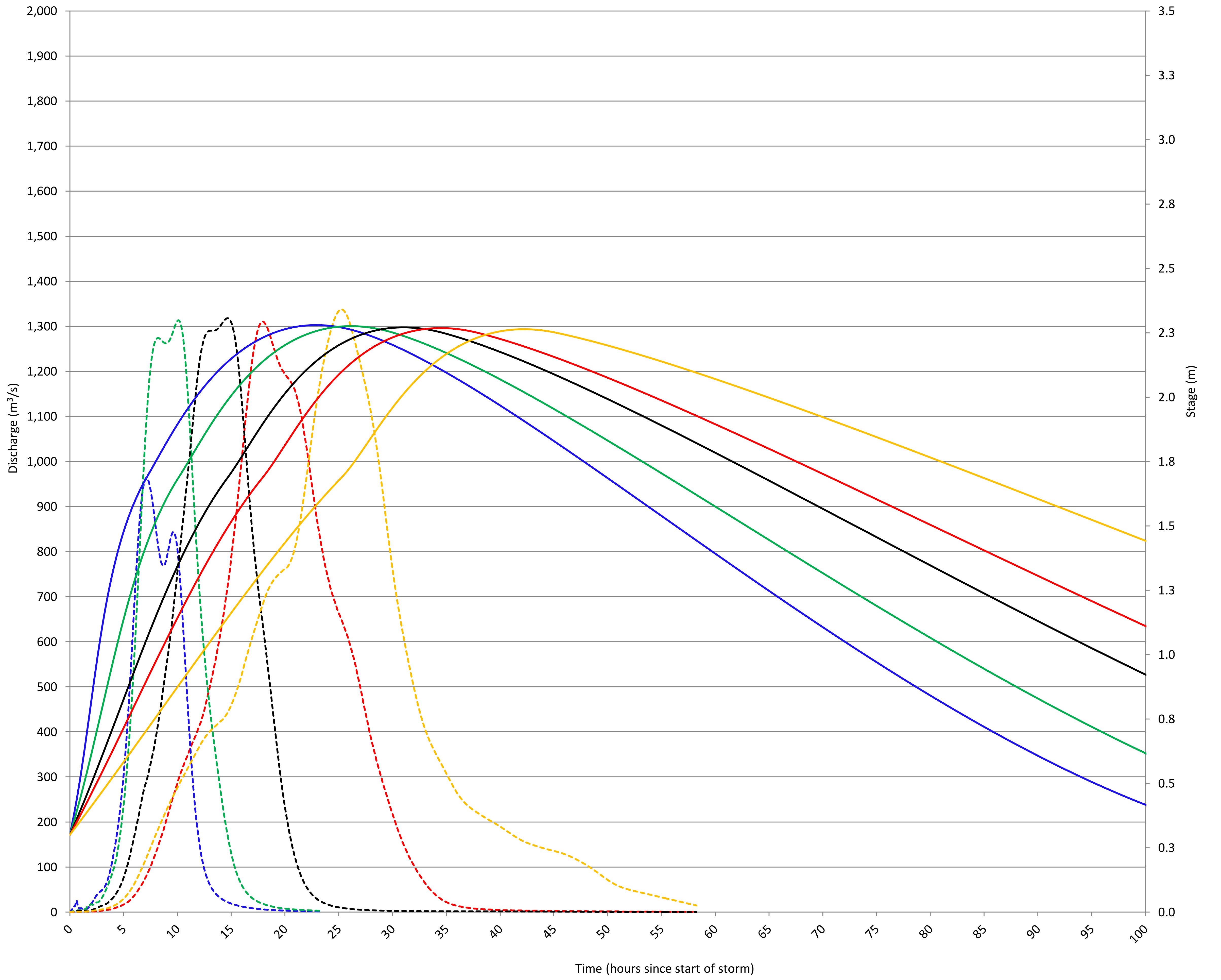


Notes:

Figure I8: Tuggerah Lake 1% AEP Synthetic Stage Hydrographs

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Tuggerah Lake Design Tailwater.xlsx



Wyong Shire Council

GOSFORD CITY COUNCIL

CENTRAL COAST

LEGEND:

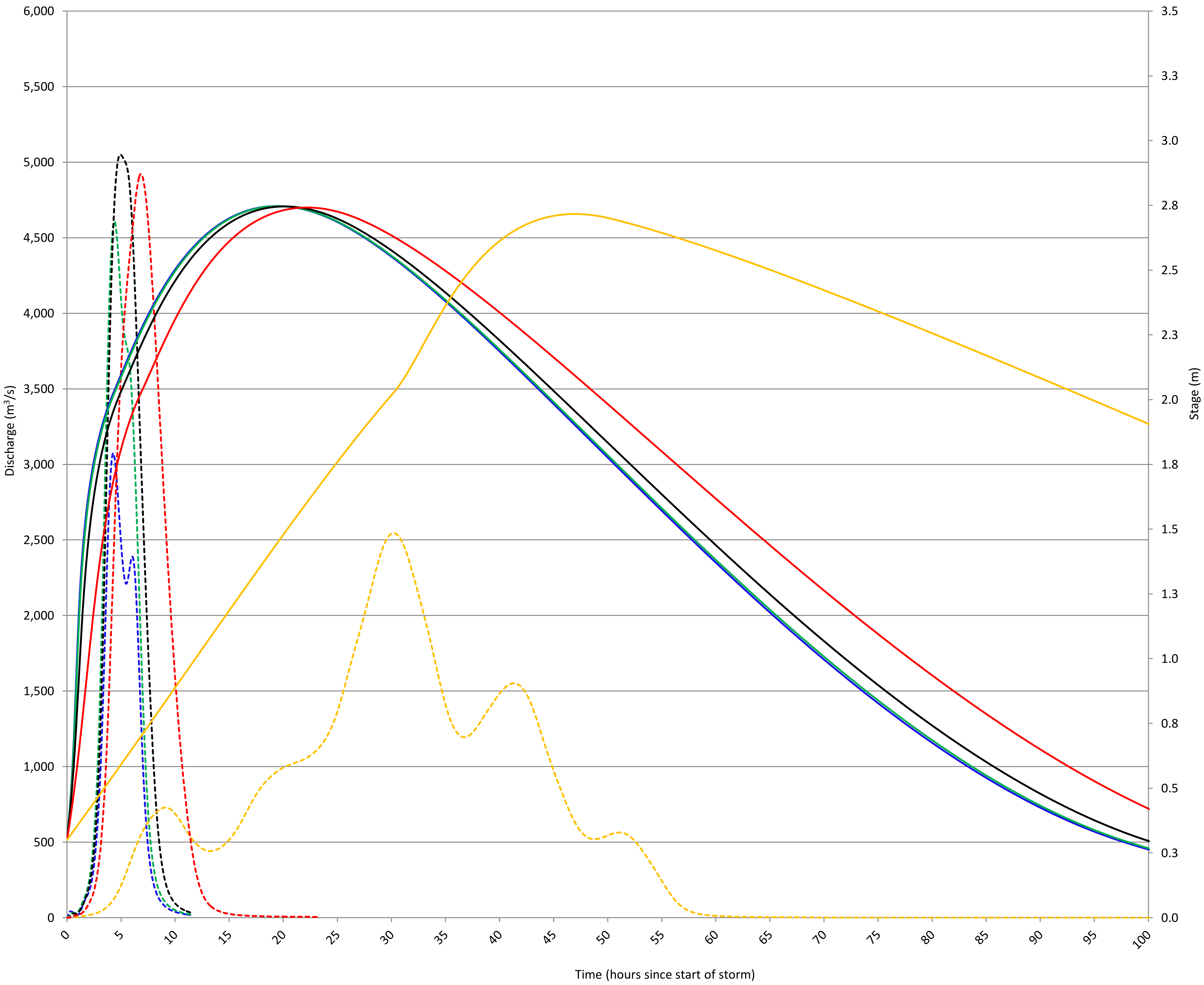
- 24hr discharge hydrograph at Chittaway Point
- 2hr discharge hydrograph at Chittaway Point
- 6hr discharge hydrograph at Chittaway Point
- 12hr discharge hydrograph at Chittaway Point
- 48hr discharge hydrograph at Chittaway Point
- 2hr stage hydrograph for Tuggerah Lake
- 6hr stage hydrograph for Tuggerah Lake
- 12hr stage hydrograph for Tuggerah Lake
- 24hr stage hydrograph for Tuggerah Lake
- 48hr stage hydrograph for Tuggerah Lake

Notes:

Figure I9: Tuggerah Lake 0.5% AEP Synthetic Stage Hydrographs

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Tuggerah Lake Design Tailwater.xlsx



LEGEND:

- 1hr discharge hydrograph at Chittaway Point
- 2hr discharge hydrograph at Chittaway Point
- 3hr discharge hydrograph at Chittaway Point
- 48hr discharge hydrograph at Chittaway Point
- 6hr discharge hydrograph at Chittaway Point
- 1hr stage hydrograph for Tuggerah Lake
- 2hr stage hydrograph for Tuggerah Lake
- 3hr stage hydrograph for Tuggerah Lake
- 6hr stage hydrograph for Tuggerah Lake
- 48hr stage hydrograph for Tuggerah Lake

Notes:

Figure I10: Tuggerah Lake PMF Synthetic Stage Hydrographs

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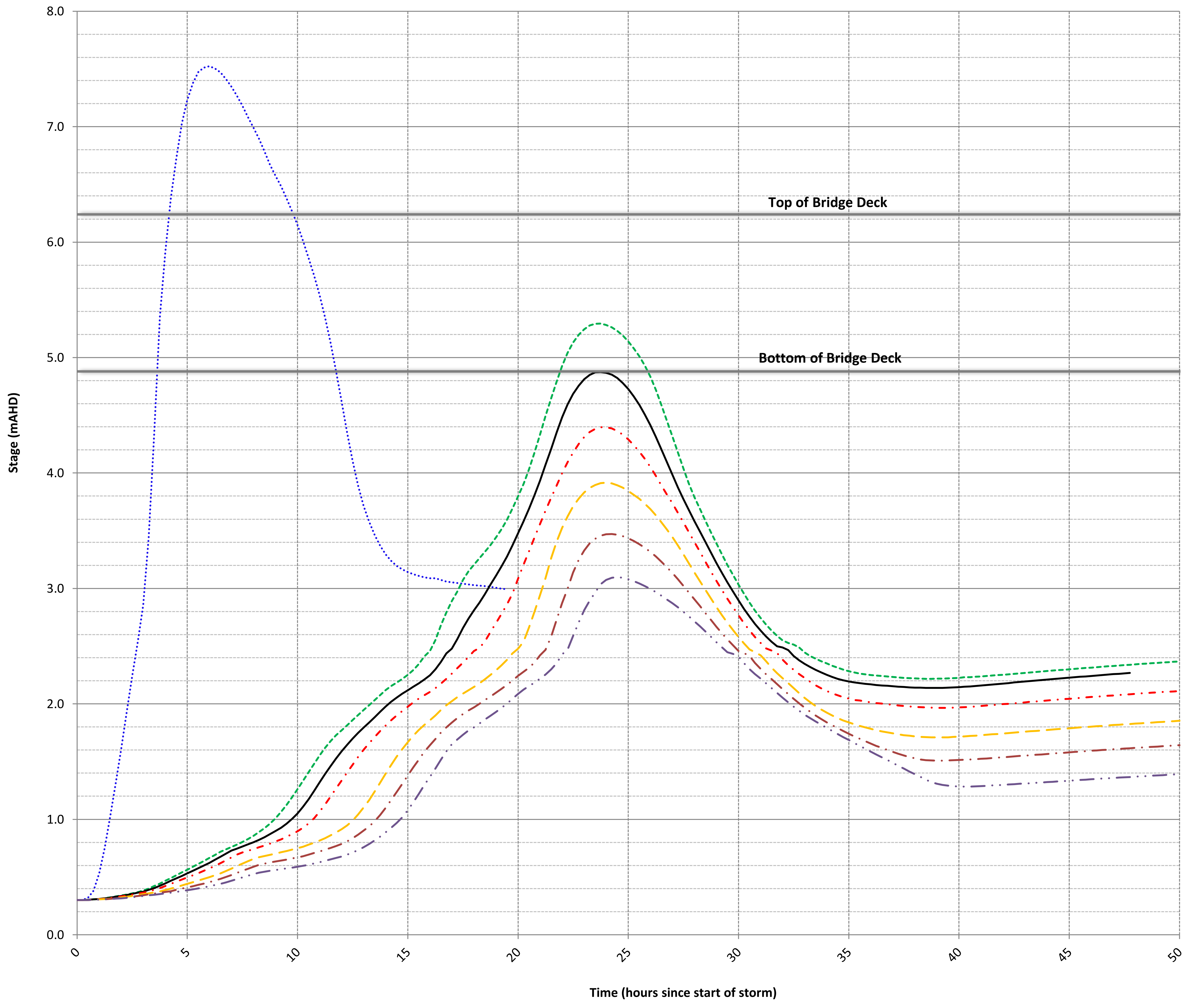
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Tuggerah Lake Design Tailwater.xlsx

APPENDIX I

DESIGN STAGE HYROGRAPHS



LEGEND:

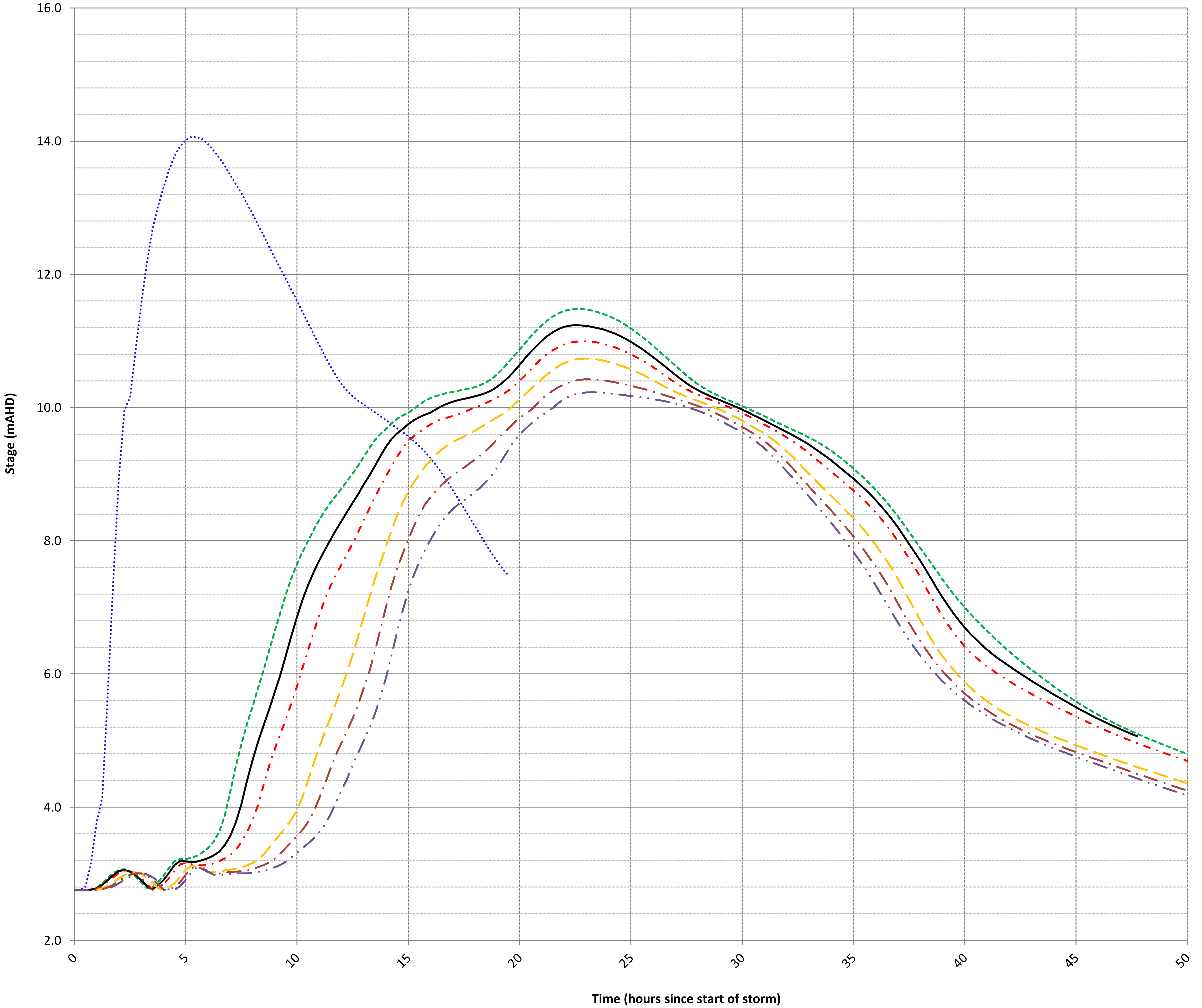
- PMF stage hydrograph
- 0.5% AEP stage hydrograph
- 1% AEP stage hydrograph
- 2% AEP stage hydrograph
- 5% AEP stage hydrograph
- 10% AEP stage hydrograph
- 20% AEP stage hydrograph

Notes:
Only design stage hydrographs for the critical storm duration (i.e., the storm duration that generated the highest peak stage) are shown for each AEP

Figure J1: Design Stage Hydrographs for Wyong Road Crossing of Ourimbah Creek (Lees Bridge)

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Design Stage Hydrographs.xlsx



LEGEND:

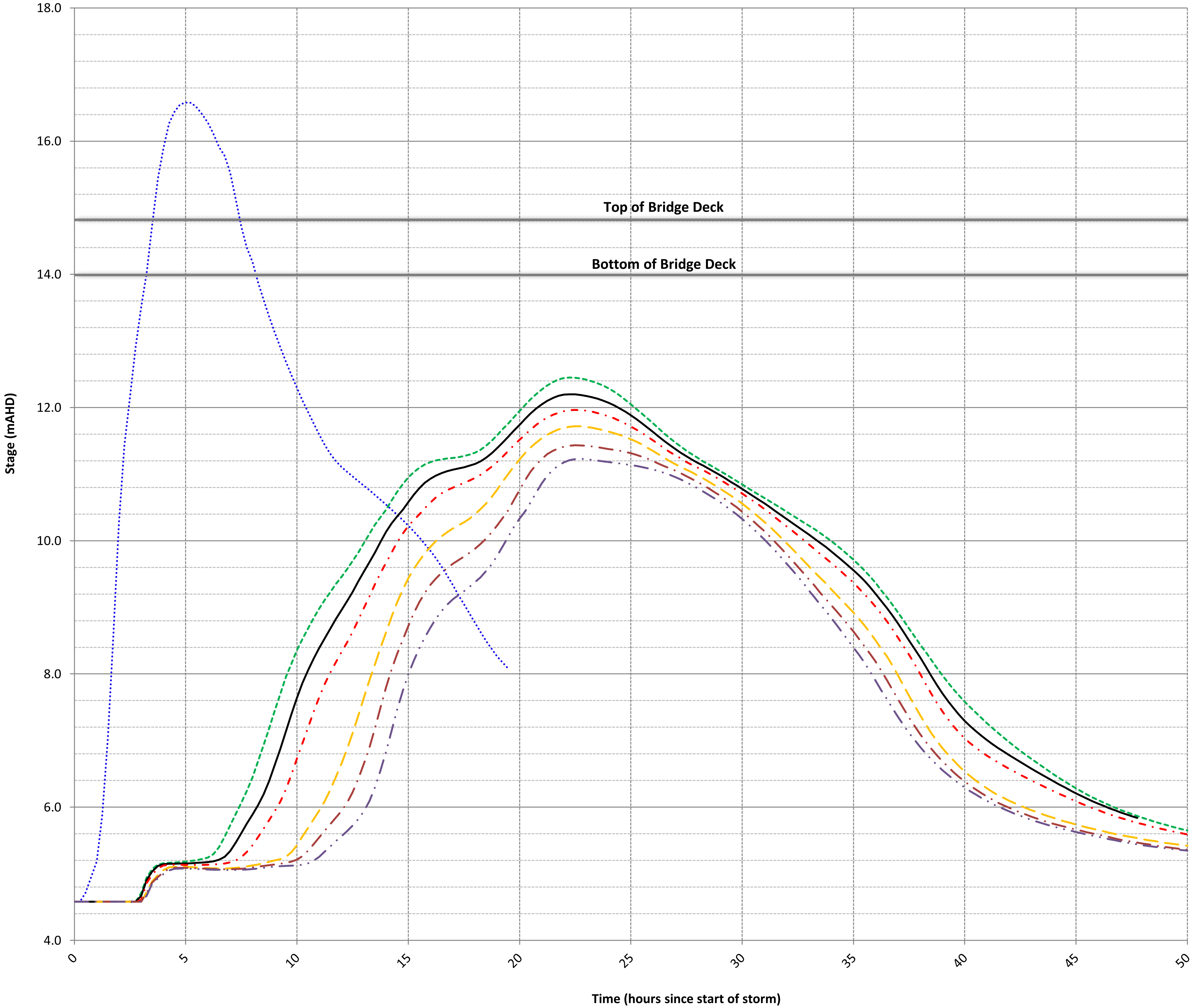
- PMF stage hydrograph
- 0.5% AEP stage hydrograph
- 1% AEP stage hydrograph
- 2% AEP stage hydrograph
- 5% AEP stage hydrograph
- 10% AEP stage hydrograph
- 20% AEP stage hydrograph

Notes:
Only design stage hydrographs for the critical storm duration (i.e., the storm duration that generated the highest peak stage) are shown for each AEP

Figure J2: Design Stage Hydrographs at Gauge 211015 (Ourimbah Creek)

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Design Stage Hydrographs.xlsx



LEGEND:

- PMF stage hydrograph
- 0.5% AEP stage hydrograph
- 1% AEP stage hydrograph
- 2% AEP stage hydrograph
- 5% AEP stage hydrograph
- 10% AEP stage hydrograph
- 20% AEP stage hydrograph

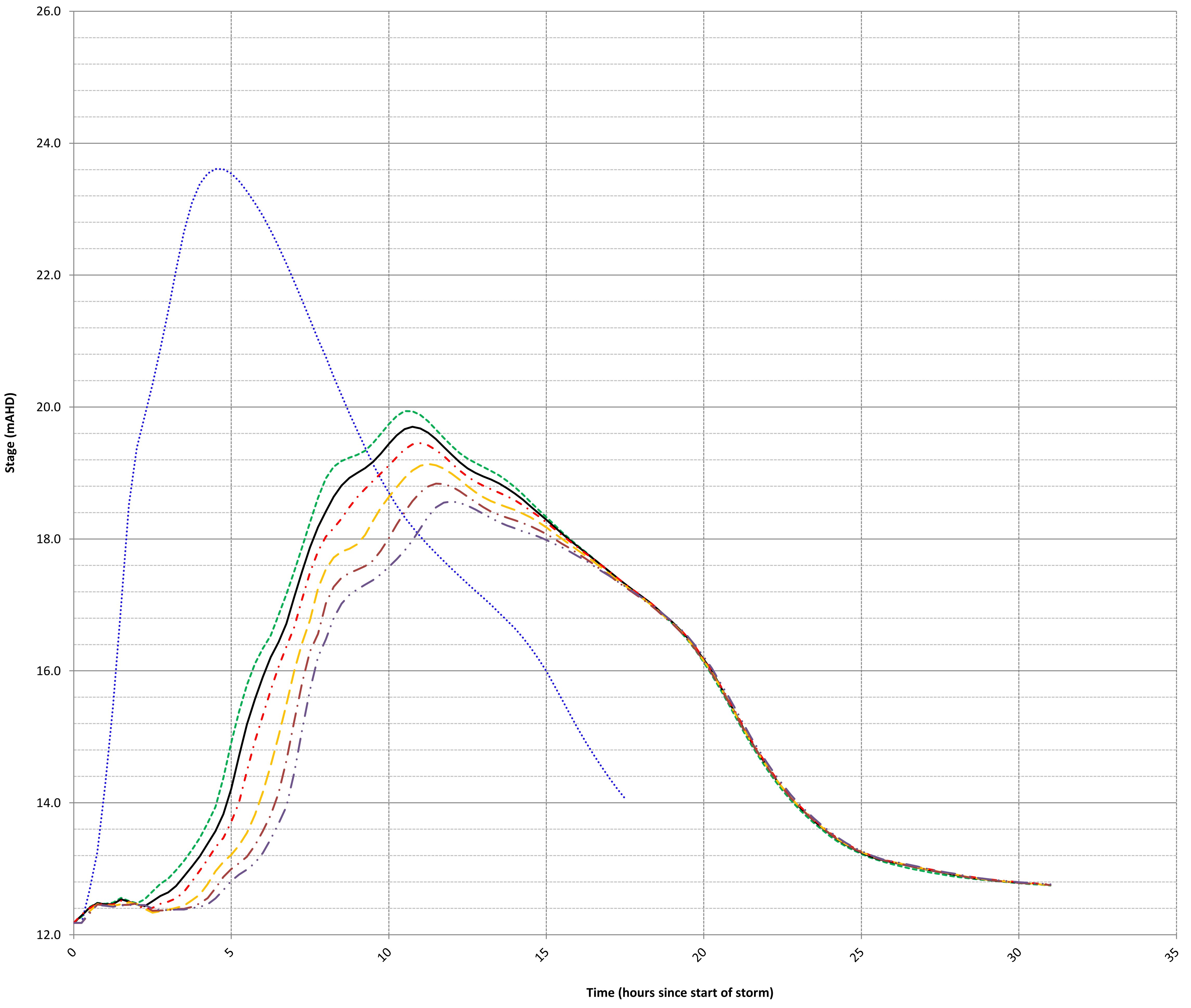
Notes:

Only design stage hydrographs for the critical storm duration (i.e., the storm duration that generated the highest peak stage) are shown for each AEP

Figure J3: Design Stage Hydrographs for Ourimbah Creek Upstream of Pacific Highway

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Design Stage Hydrographs.xlsx



Wyong Shire Council

CENTRAL COAST

LEGEND:

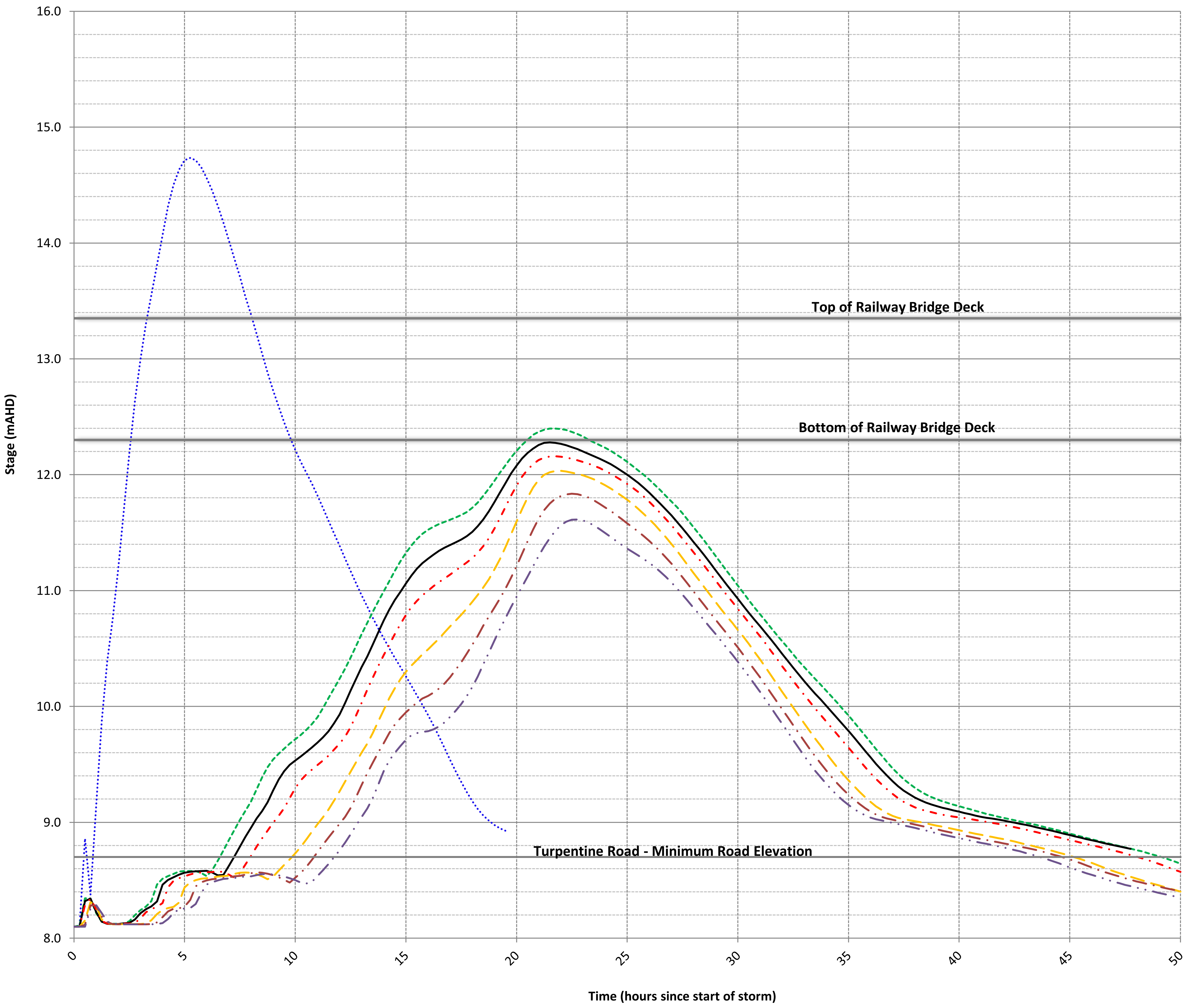
- PMF stage hydrograph
- 0.5% AEP stage hydrograph
- 1% AEP stage hydrograph
- 2% AEP stage hydrograph
- 5% AEP stage hydrograph
- 10% AEP stage hydrograph
- 20% AEP stage hydrograph

Notes:
Only design stage hydrographs for the critical storm duration (i.e., the storm duration that generated the highest peak stage) are shown for each AEP

Figure J4: Design Stage Hydrographs for Gauge 211013 (Ourimbah Creek)

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Design Stage Hydrographs.xlsx



LEGEND:

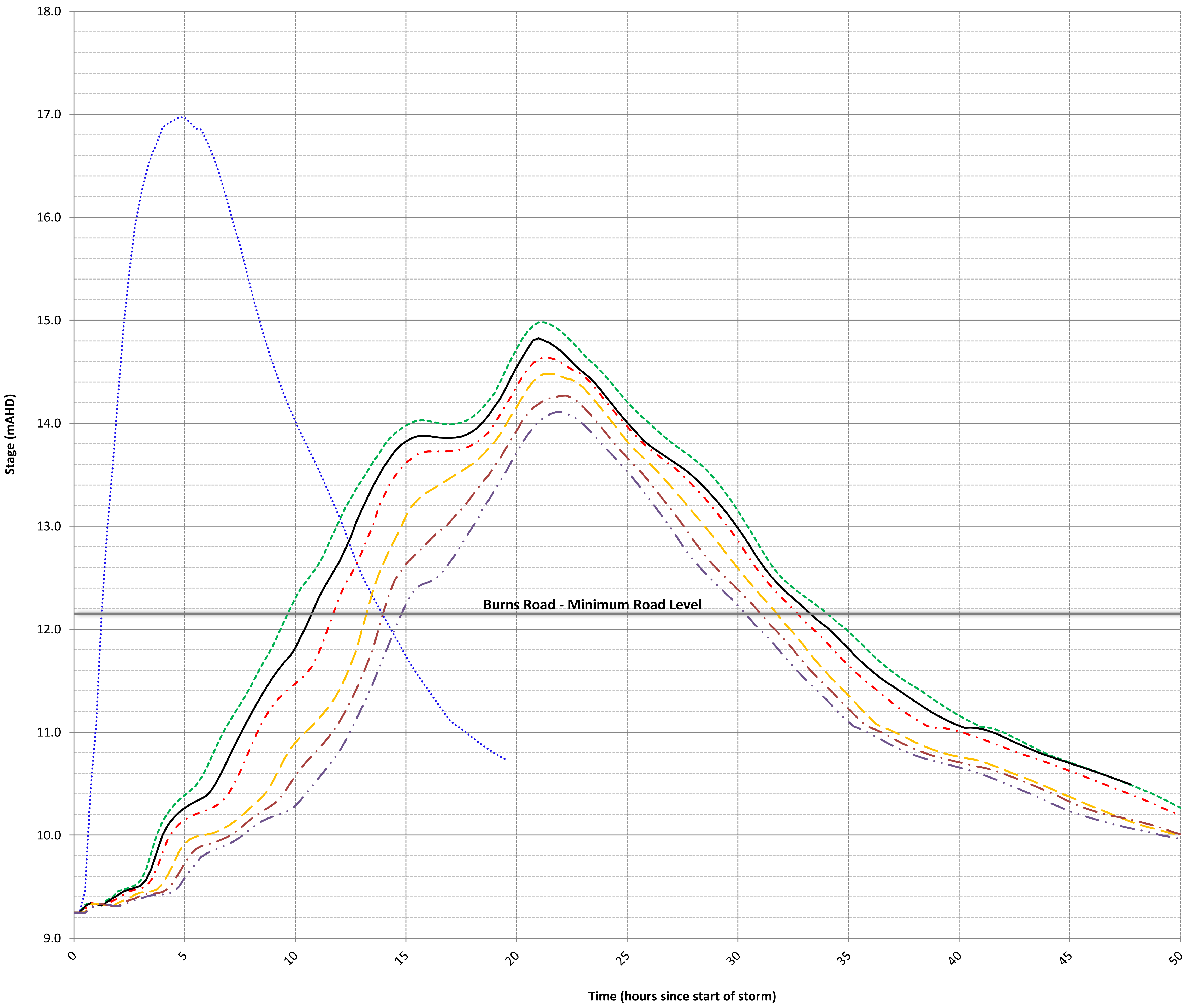
- PMF stage hydrograph
- 0.5% AEP stage hydrograph
- 1% AEP stage hydrograph
- 2% AEP stage hydrograph
- 5% AEP stage hydrograph
- 10% AEP stage hydrograph
- 20% AEP stage hydrograph

Notes:
Only design stage hydrographs for the critical storm duration (i.e., the storm duration that generated the highest peak stage) are shown for each AEP

Figure J5: Design Stage Hydrographs for Turpentine Road Railway Underpass (Chittaway Creek)

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Design Stage Hydrographs.xlsx



CENTRAL COAST

LEGEND:

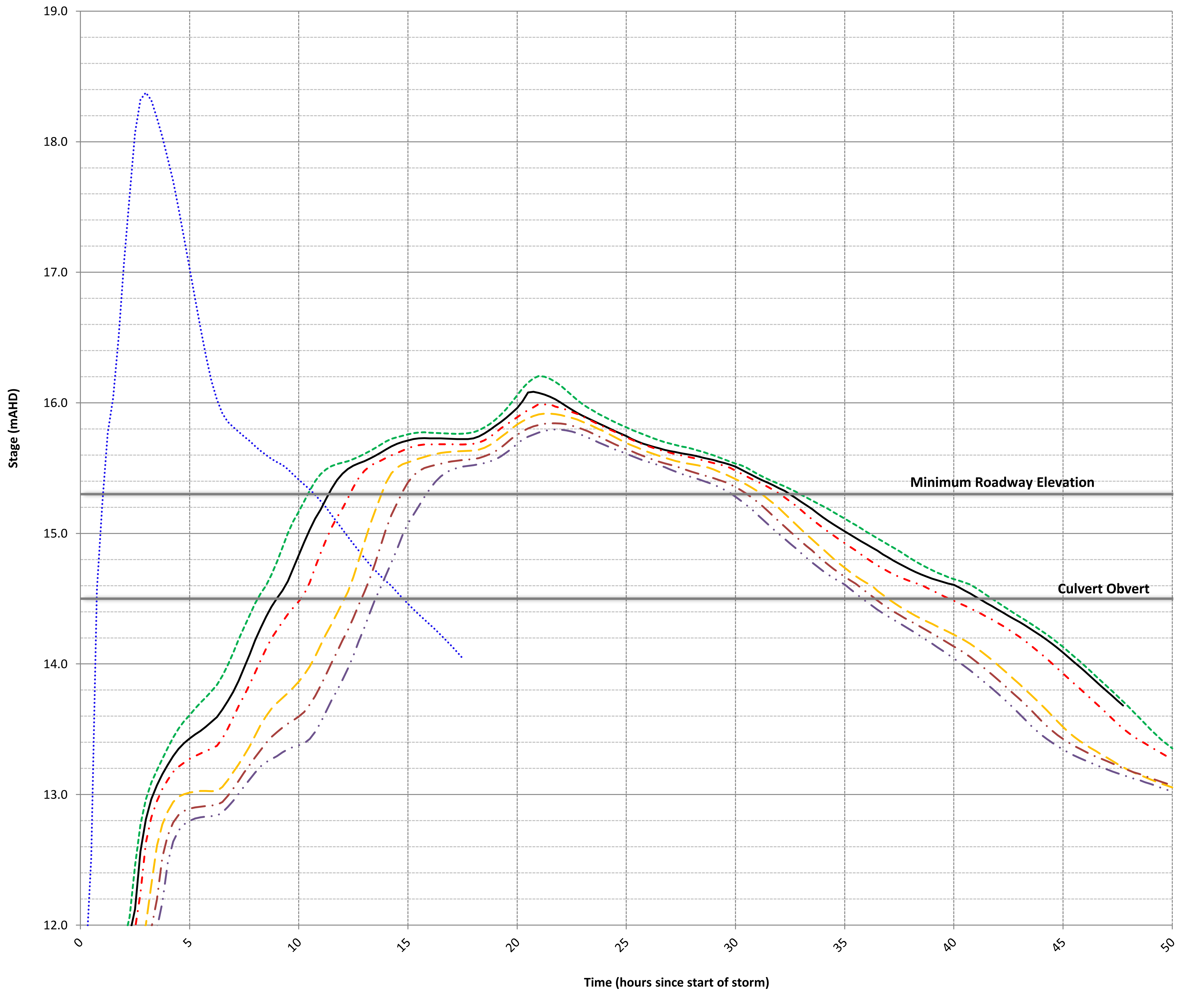
- PMF stage hydrograph
- 0.5% AEP stage hydrograph
- 1% AEP stage hydrograph
- 2% AEP stage hydrograph
- 5% AEP stage hydrograph
- 10% AEP stage hydrograph
- 20% AEP stage hydrograph

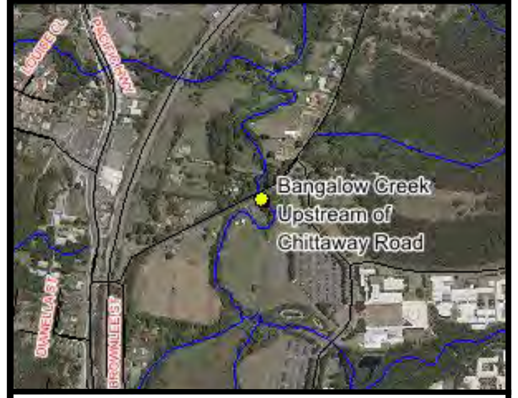
Notes:
Only design stage hydrographs for the critical storm duration (i.e., the storm duration that generated the highest peak stage) are shown for each AEP

Figure J6: Design Stage Hydrographs for Burns Road Crossing of Bangalow Creek

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Design Stage Hydrographs.xlsx





LEGEND:

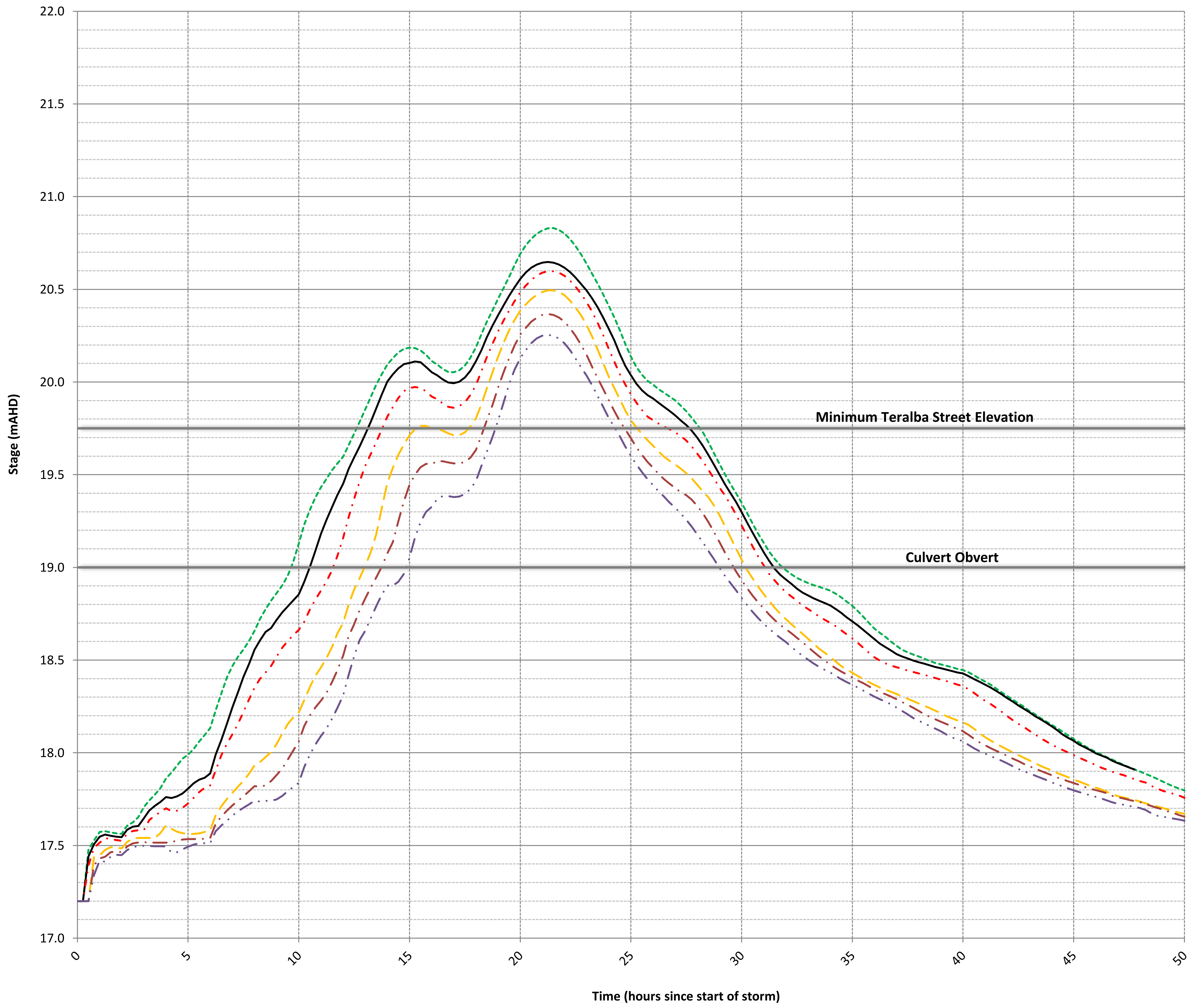
- PMF stage hydrograph
- 0.5% AEP stage hydrograph
- 1% AEP stage hydrograph
- 2% AEP stage hydrograph
- 5% AEP stage hydrograph
- 10% AEP stage hydrograph
- 20% AEP stage hydrograph

Notes:
Only design stage hydrographs for the critical storm duration (i.e., the storm duration that generated the highest peak stage) are shown for each AEP

Figure J7: Design Stage Hydrographs for Chittaway Road Crossing of Bangalow Creek

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Design Stage Hydrographs.xlsx



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Wyong Shire Council

CENTRAL COAST

LEGEND:

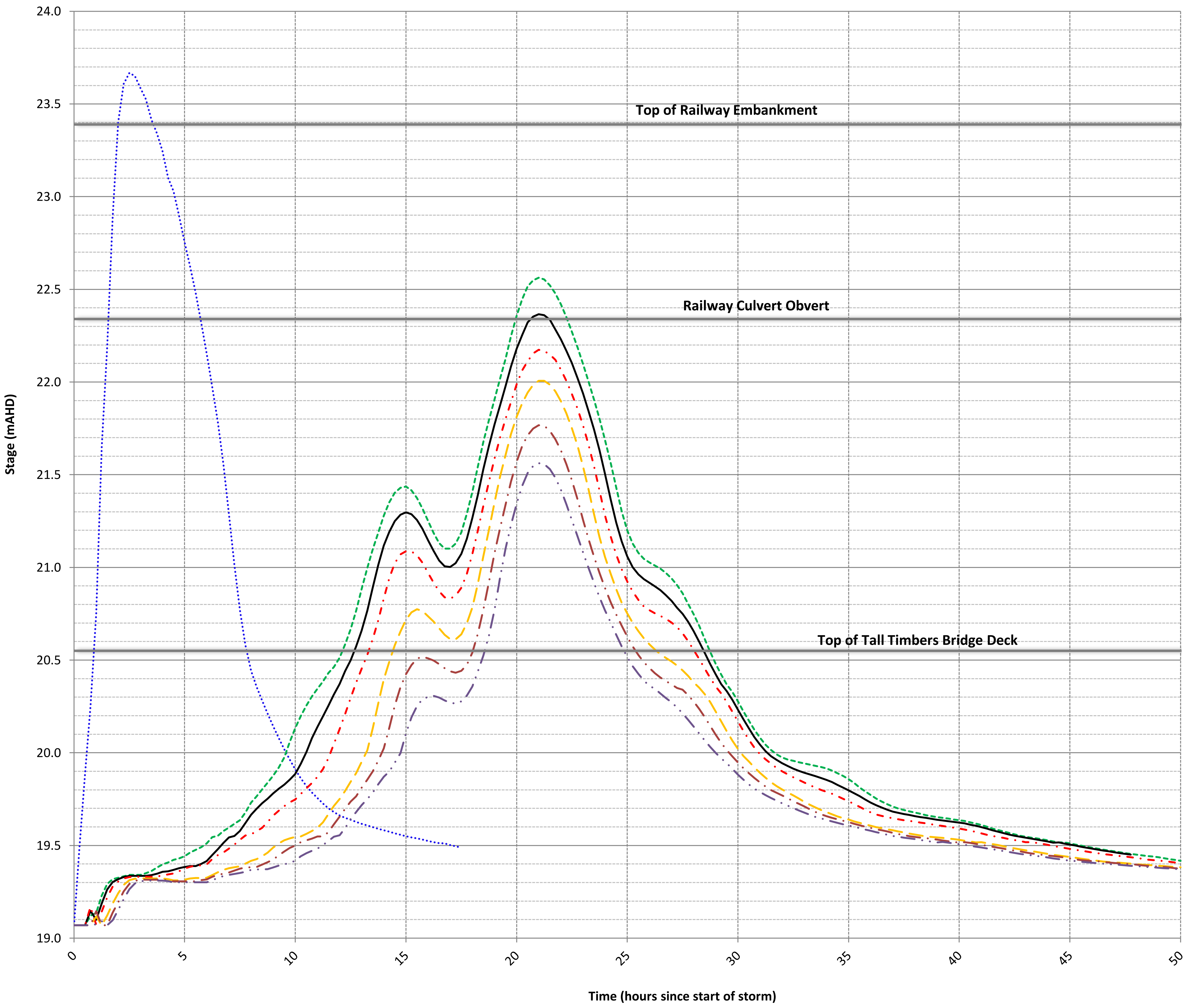
- PMF stage hydrograph
- 0.5% AEP stage hydrograph
- 1% AEP stage hydrograph
- 2% AEP stage hydrograph
- 5% AEP stage hydrograph
- 10% AEP stage hydrograph
- 20% AEP stage hydrograph

Notes:
Only design stage hydrographs for the critical storm duration (i.e., the storm duration that generated the highest peak stage) are shown for each AEP

Figure J8: Design Stage Hydrographs for Cut Rock Creek at Teralba Street

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter Street
Sydney, NSW, 2000

File Name: Design Stage Hydrographs.xlsx



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Wyong Shire Council

CENTRAL COAST

LEGEND:

- PMF stage hydrograph
- 0.5% AEP stage hydrograph
- 1% AEP stage hydrograph
- 2% AEP stage hydrograph
- 5% AEP stage hydrograph
- 10% AEP stage hydrograph
- 20% AEP stage hydrograph
- Tall Timber Bridge

Notes:

Only design stage hydrographs for the critical storm duration (i.e., the storm duration that generated the highest peak stage) are shown for each AEP

Figure J9: Design Stage Hydrographs for Cut Rock Creek Upstream of Railway (Tall Timbers)

Prepared By:

Catchment Simulation Solutions

Suite 302, 5 Hunter Street

Sydney, NSW, 2000

File Name: Design Stage Hydrographs.xlsx

Appendix J

Hydraulic Category Verification

HYDRAULIC CATEGORY VERIFICATION

Floodway

The floodway hydraulic category was verified by the application of floodway blockages in the form of ‘walls’ that provided 100% blockage across ~50-75% of the active floodway width. The TUFLOW hydraulic model was run with these ‘walls’ and flood level differences computed to quantify the impact of the blockage of the floodway.

The depth and velocity results for the floodway blockage scenario for selected blockage ‘walls’ are shown in **Plate L1** and **Plate L3** and indicate an increase in depth upstream of the ‘walls’ and velocity vectors indicate a change in flow direction and magnitude. Flood level Difference results are shown in **Plate L2** and **Plate L4** and indicate a typical flood level increase in the range of 22-27cm in the vicinity of the floodway blockage ‘walls’, with a maximum increase of 30cm. Understandably, flood level decreased are experienced immediately downstream of the ‘walls’ but are relatively small in magnitude and do not propagate a significant distance downstream.

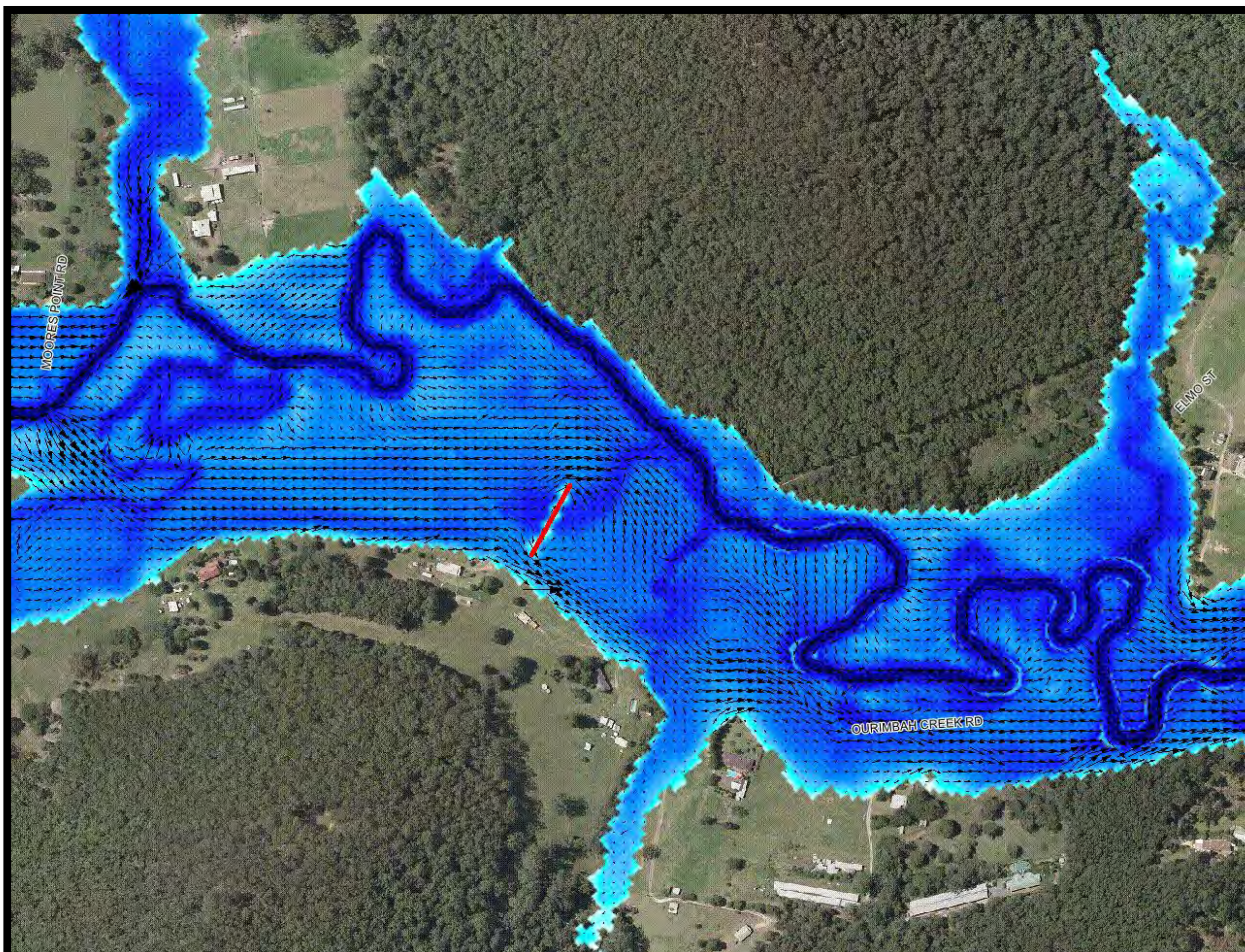

Plate L1 – Depths and Velocities in the vicinity of a floodway blockage ‘wall’ (black line) located about 550m downstream of the Moores point Road crossing of Ourimbah Creek.

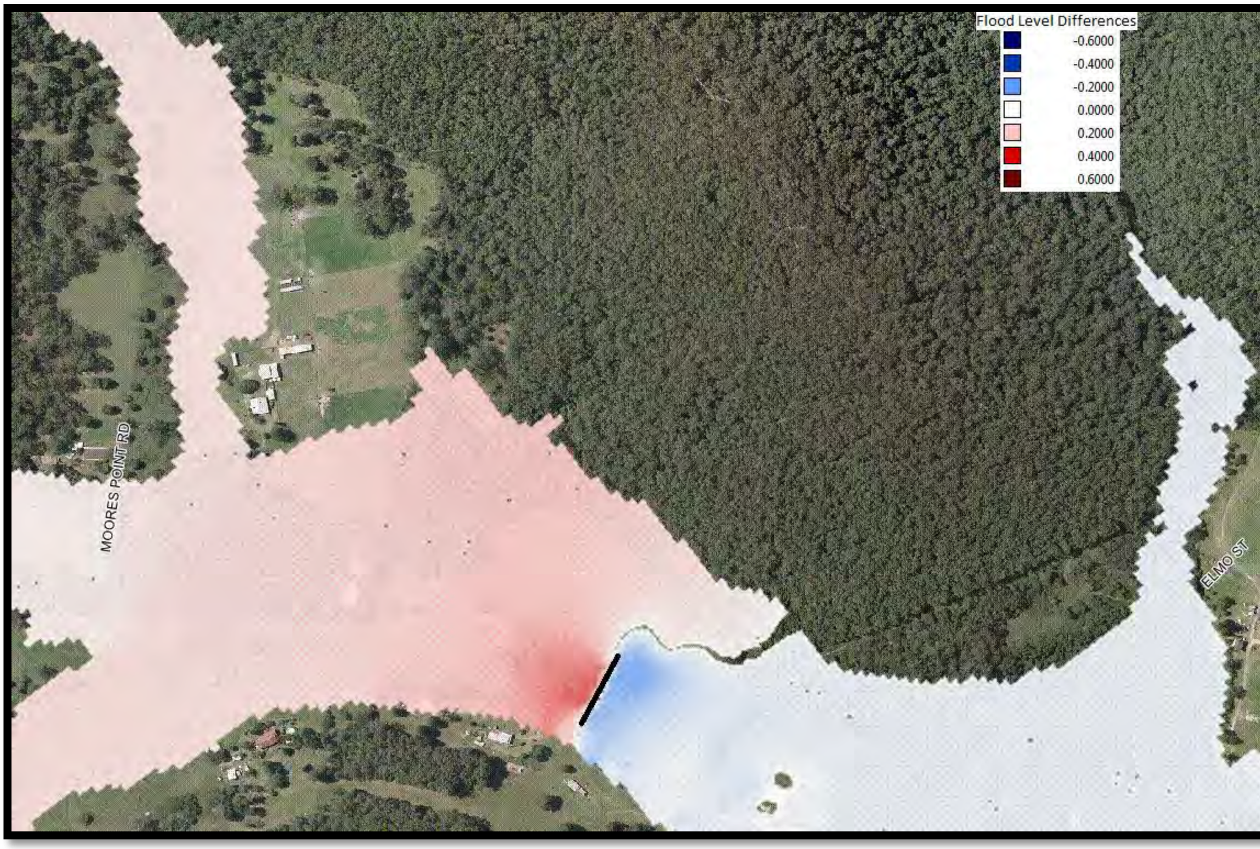

Plate L2 – Flood Level Differences in the vicinity of a floodway blockage 'wall' (black line) located about 550m downstream of the Moores point Road crossing of Ourimbah Creek.

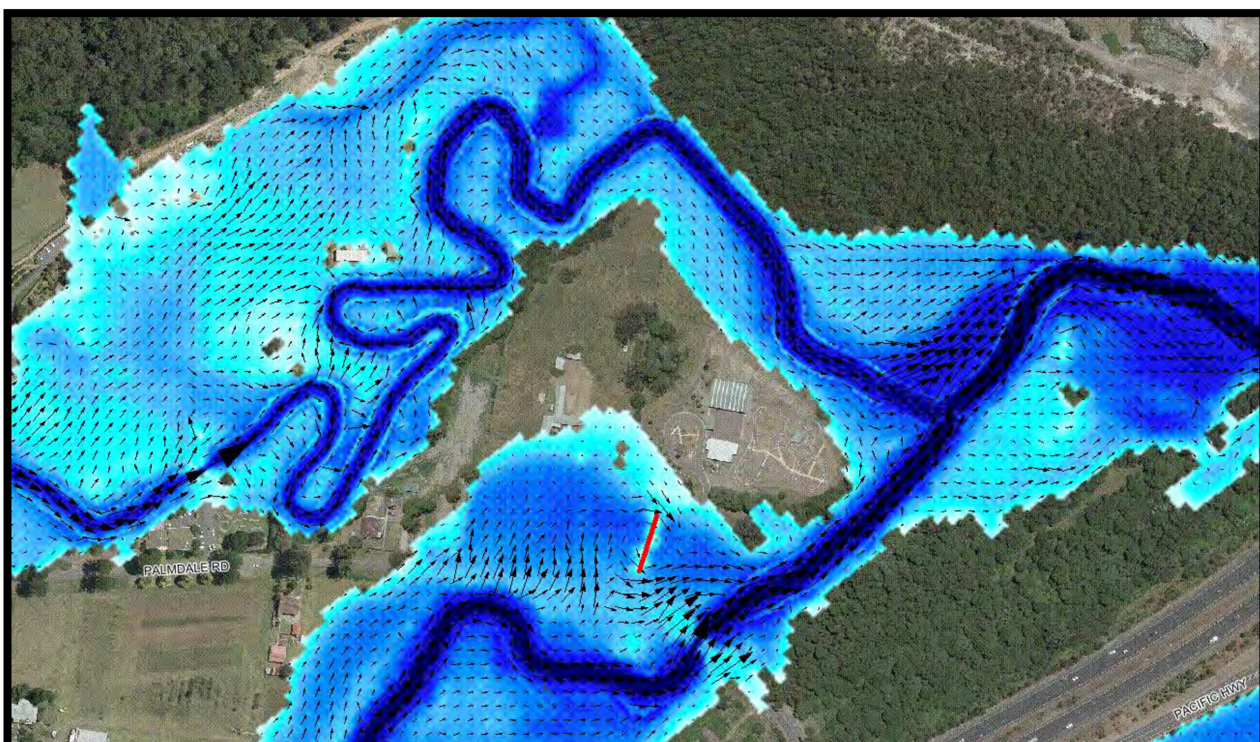

Plate L3 – Depths and Velocities in the vicinity of a floodway blockage 'wall' (red line) located just downstream of the Palmdale Road crossing of the Ourimbah Creek/Kangy Angy Creek floodway.

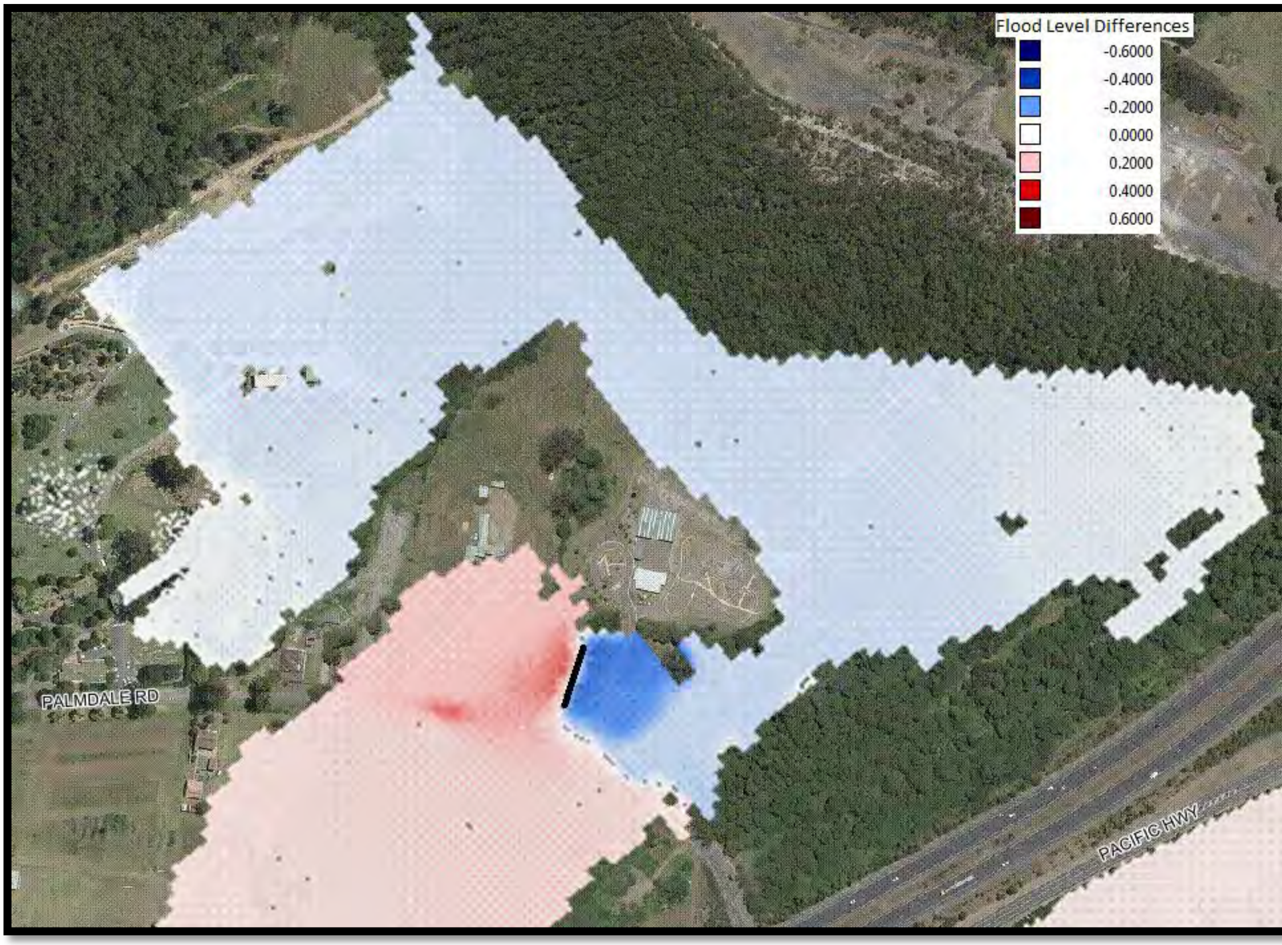

Plate L4 – Flood Level Differences in the vicinity of a floodway blockage 'wall' (black line) located just downstream of the Palmdale Road crossing of the Ourimbah Creek/Kangy Angy Creek floodway.

Flood Storage

The flood storage hydraulic category was verified by the application of a significant increase in 'Mannings' roughness of areas deemed to be flood storage. This had the effect of slowing the spread of water into the flood storage areas and reducing the storage available in these areas. The TUFLOW hydraulic model was run with these modified storage areas and flood level differences computed to quantify the impact of the reduced conveyance and storage in areas deemed to be flood storage.

Results are shown in **Plate L5** and **Plate L6** and indicate a typical flood level increase in the range of 6-17cm in the main conveyance path (as shown in **Plate L5**) and localised increases of up to 22cm in areas with large concentrated areas of flood storage (such as that shown in **Plate L6**).

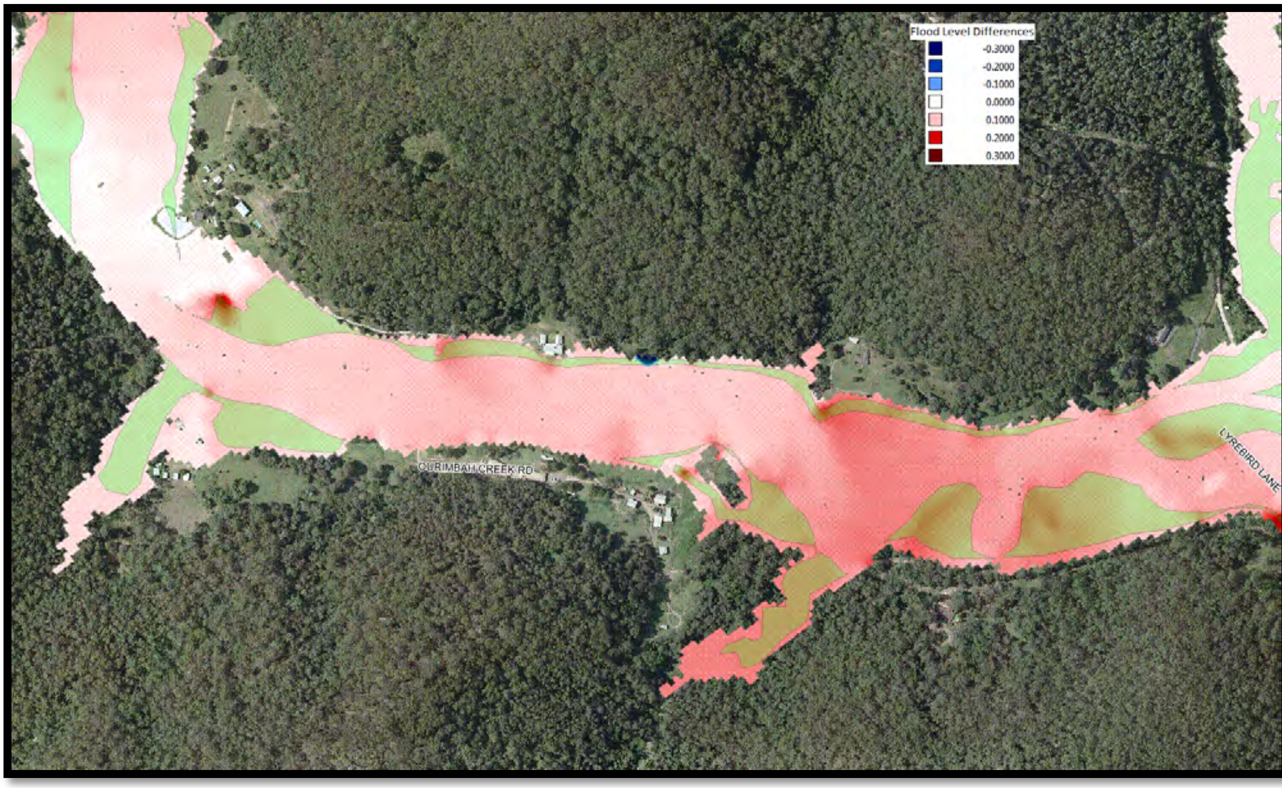

Plate L5 - Flood Level Differences caused by reduced flood storage capacity (green polygons) on Ourimbah Creek (approximately 2km upstream from Lyrebird Lane).

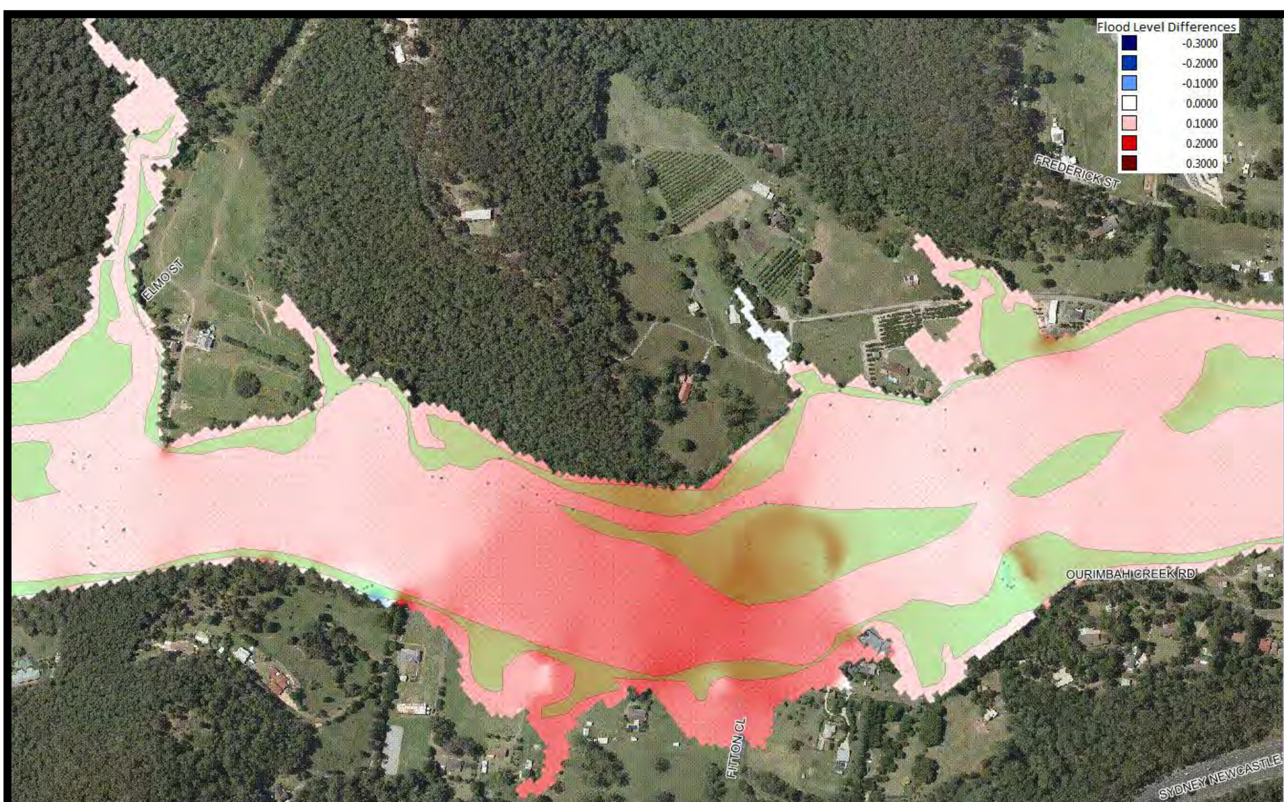

Plate L6 – Flood Level Differences in the vicinity of in the vicinity of Elmo and Fitton Close crossings of Ourimbah Creek.

Flood Fringe

Flood Fringe was verified by the complete filling of the areas designated as flood fringe, causing water to move into the flood storage and floodway areas. The TUFLOW hydraulic model was run with these fill areas and differences computed to quantify the impact of the complete filling of the fringe areas of the 1% AEP flood.

Results are shown in Plate L7 and indicate typical flood level increases of between 5-8cm, with some isolated areas with increases of up to 12cm.

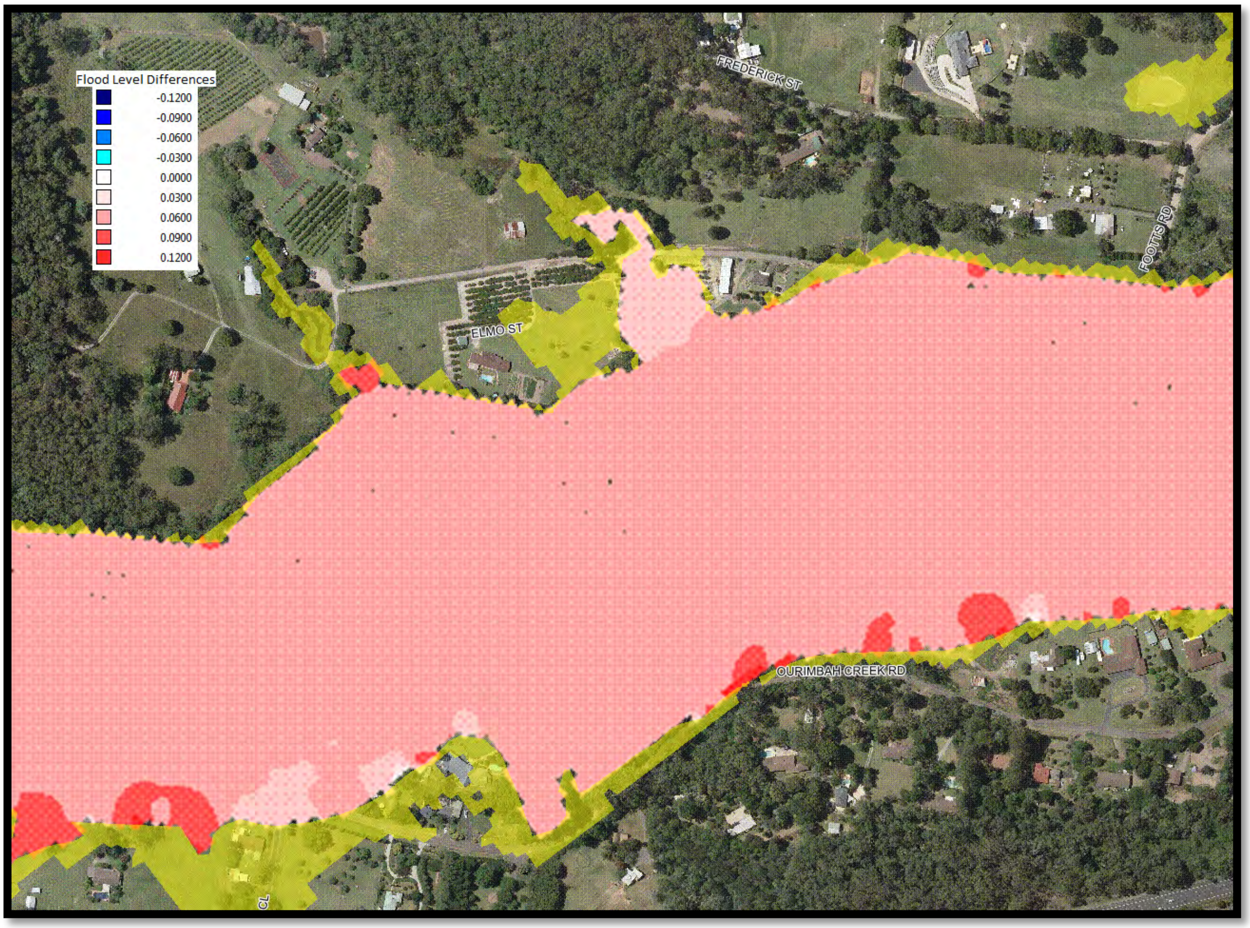

Plate L7 – Flood Level Differences caused by the complete filling of flood fringe designated areas (yellow polygons) along Ourimbah Creek in the vicinity of Elmo and Foots Rd.

Appendix K

XP-RAFTS Model Results for Climate Change Assessment

CLIMATE CHANGE ASSESSMENT SUMMARY - 1% AEP

Subcatchment ID	Peak Discharge (m^3/s)			
	Existing	10% Increase in Rainfall	20% Increase in Rainfall	30% Increase in Rainfall
1.01	15.0	16.9	18.8	20.6
1.02	27.0	31.0	34.9	38.8
1.03	41.1	46.6	52.1	57.7
1.04	51.7	58.7	65.8	73.0
1.05	89.3	102	115	127
1.06	114	130	146	162
1.07	142	161	181	200
1.08	158	179	201	222
1.09	178	202	227	252
1.10	189	215	241	267
1.11	231	263	295	327
1.12	243	277	311	345
1.13	247	281	316	351
1.14	255	291	326	362
1.15	262	298	335	373
1.16	275	313	351	390
1.17	338	386	433	482
1.18	383	436	491	546
1.19	388	443	499	555
1.20	394	451	508	565
1.21	571	651	731	811
1.22	576	658	739	819
1.23	588	671	754	837
1.24	592	676	760	843
1.25	609	696	782	868
1.26	618	706	794	881
1.27	620	708	796	883
1.28	625	714	802	892
1.29	643	737	827	920
1.30	644	738	828	922
1.31	653	750	844	939
1.32	648	745	838	933
1.33	658	756	852	950
1.34	660	760	856	955
1.35	663	764	860	960
1.36	688	796	899	1007
1.37	711	827	934	1049
1.38	708	823	930	1044
1.39	711	827	936	1052
1.40	708	824	932	1047
1.41	709	825	933	1049
1.42	709	826	935	1053
1.43	709	826	936	1054
1.44	710	826	936	1055
1.45	711	826	938	1057
1.46	711	826	939	1057
1.47	709	825	938	1056
1.48	531	601	669	739
1.49	610	689	770	860
1.50	610	689	770	860
1.51	941	1088	1235	1385
1.52	944	1092	1240	1390
1.53	944	1091	1239	1390
1.54	946	1094	1242	1394
1.55	965	1114	1263	1417
1.56	967	1115	1264	1419
1.57	972	1117	1265	1420
1.58	973	1116	1263	1417

Subcatchment ID	Peak Discharge (m^3/s)			
	Existing	10% Increase in Rainfall	20% Increase in Rainfall	30% Increase in Rainfall
1.59	1000	1134	1284	1440
1.60	998	1129	1280	1433
2.01	8.51	9.69	11.0	12.4
3.01	8.24	9.58	11.0	12.4
4.01	18.3	21.0	23.8	26.5
4.02	34.6	39.7	45.0	49.9
5.01	12.7	14.5	16.3	18.4
5.02	22.9	25.8	28.7	31.6
6.01	4.03	4.59	5.17	5.84
7.01	16.1	18.1	20.1	22.1
7.02	28.0	31.6	35.2	39.5
8.01	3.36	3.86	4.45	5.06
9.01	10.6	12.2	13.9	15.8
10.01	19.3	22.3	25.2	28.2
11.01	6.69	7.91	9.04	10.3
12.01	11.8	13.8	16.1	18.2
12.02	23.4	27.3	31.5	35.9
12.03	36.1	42.2	48.4	55.0
12.04	53.2	62.0	70.9	80.4
13.01	6.31	7.33	8.35	9.49
14.01	7.00	8.25	9.40	10.7
15.01	8.76	10.2	11.7	13.3
16.01	4.62	5.50	6.35	7.20
16.02	12.2	14.5	16.6	18.9
16.03	20.1	23.9	27.5	31.3
17.01	5.56	6.59	7.55	8.65
18.01	7.58	8.92	10.3	11.7
19.01	6.18	7.30	8.36	9.59
20.01	9.00	10.6	12.1	13.8
21.01	5.98	7.04	8.02	9.10
22.01	7.42	8.73	9.94	11.4
23.01	24.5	27.5	31.1	35.1
23.02	64.8	72.9	83.0	93.5
23.03	71.3	80.3	90.8	102
23.04	76.5	86.1	96.6	109
24.01	7.80	8.97	10.1	11.4
24.02	21.7	25.2	28.6	32.2
25.01	4.36	5.02	5.64	6.34
26.01	6.54	7.64	8.68	9.86
27.01	22.3	25.6	29.1	32.5
27.02	36.1	41.1	47.0	53.1
27.03	56.6	64.8	73.3	82.3
28.01	11.2	13.1	15.1	17.2
29.01	21.4	24.1	27.0	30.6
30.01	17.2	19.5	22.2	24.9
31.01	19.0	21.9	25.2	28.3
31.02	29.6	34.1	39.0	44.0
31.03	47.3	54.6	62.1	69.5
31.04	58.8	67.9	77.3	86.7
31.05	72.7	84.1	95.8	108
31.06	87.1	100	114	128
31.07	103	117	133	151
31.08	181	205	228	252
31.09	185	209	232	256
32.01	9.64	11.1	12.6	14.1
33.01	18.0	20.4	23.2	26.0
34.01	9.09	10.3	11.7	13.4
35.01	7.25	8.48	9.58	10.8
36.01	5.78	6.87	7.88	9.05
37.01	7.86	9.22	10.6	12.1

Subcatchment ID	Peak Discharge (m^3/s)			
	Existing	10% Increase in Rainfall	20% Increase in Rainfall	30% Increase in Rainfall
38.01	9.98	11.2	12.5	14.3
38.02	17.7	20.4	23.0	26.0
38.03	38.9	44.9	51.0	58.3
38.04	78.0	87.9	98.4	110.5
39.01	7.33	8.45	9.56	10.9
40.01	5.40	6.20	7.04	7.90
40.02	12.9	15.3	17.6	19.9
41.01	4.35	5.17	5.92	6.65
42.01	20.6	23.2	25.8	28.3
42.02	39.0	43.9	48.8	53.8
43.01	16.4	18.4	20.8	23.3
44.01	6.99	8.16	9.29	10.7
45.01	12.6	14.5	16.5	18.6
46.01	17.0	19.1	21.6	24.2
46.02	30.0	34.0	38.9	43.5
47.01	8.49	9.94	11.4	13.0
48.01	9.58	10.9	12.4	14.0
49.01	24.9	28.4	31.9	35.5
50.01	7.80	9.08	10.3	11.6
51.01	6.72	7.76	8.81	9.78
51.02	20.3	23.6	27.2	30.3
51.03	29.3	34.2	38.9	43.4
52.01	11.2	12.9	14.8	16.8
53.01	8.36	9.76	11.1	12.6
54.01	5.09	5.95	6.86	7.79
55.01	13.3	15.1	16.9	18.7
56.01	19.0	21.3	23.6	26.2
56.02	38.8	44.1	49.4	54.7
56.03	44.1	50.1	56.1	62.3
57.01	14.0	15.8	17.6	19.4
58.01	7.36	8.53	9.60	10.8
59.01	4.06	4.59	5.28	5.86
60.01	11.1	12.5	13.9	15.3
60.02	21.2	23.7	25.7	29.3
61.01	9.49	10.65	11.8	13.4
62.01	4.11	4.64	5.31	5.89
63.01	20.3	23.3	26.2	29.4
63.02	30.3	34.7	39.1	43.7
64.01	9.55	10.8	12.0	13.2
65.01	8.72	9.81	10.88	12.0
66.01	9.57	11.0	12.4	13.7
67.01	12.7	14.6	16.4	18.3
67.02	21.5	24.3	27.2	30.1
67.03	51.3	58.3	65.4	72.5
67.04	67.8	78.0	89.0	99.9
67.05	84.3	95.5	108.1	122.1
67.06	90.4	102.7	115.0	127.7
67.07	96.9	110.2	123.4	137.0
68.01	5.37	6.02	6.76	7.70
69.01	13.4	15.5	17.7	20.2
70.01	8.49	9.72	10.9	12.3
70.02	19.7	23.3	26.6	30.5
71.01	7.47	8.82	10.0	11.4
72.01	7.61	9.02	10.4	11.8
73.01	7.17	8.16	9.08	9.99
74.01	19.3	21.7	24.3	27.3
74.02	29.5	33.3	37.0	40.7
74.03	37.5	42.4	47.2	52.0
74.04	42.5	48.0	53.4	58.8
74.05	57.6	65.2	72.7	80.3

Subcatchment ID	Peak Discharge (m^3/s)			
	Existing	10% Increase in Rainfall	20% Increase in Rainfall	30% Increase in Rainfall
74.06	58.6	66.4	74.3	82.3
74.07	58.7	66.6	74.5	82.5
75.01	6.34	7.41	8.46	9.68
76.01	4.66	5.44	6.27	7.13
77.01	10.8	12.2	13.5	14.8
78.01	11.4	13.3	15.0	16.9
78.02	24.5	28.0	31.4	34.9
78.03	32.2	36.9	41.8	46.3
79.01	8.39	9.41	10.5	11.7
80.01	4.72	5.48	6.29	7.15
81.01	8.58	9.86	11.2	12.5
82.01	14.1	16.2	18.5	20.8
82.02	20.4	23.3	26.4	29.6
83.01	9.18	10.5	11.8	13.1
83.02	10.4	11.8	13.2	14.7
84.01	8.17	9.35	10.5	11.8
84.02	8.26	9.45	10.6	11.7
85.01	4.47	5.16	5.89	6.73
85.02	7.12	8.07	9.05	10.0
86.01	5.77	6.48	7.21	7.91
87.01	7.48	8.55	9.67	10.9
87.02	8.10	9.24	10.5	11.7
88.01	5.20	5.96	6.77	7.59
89.01	21.3	24.4	27.6	30.8
89.02	38.9	43.9	49.0	54.1
89.03	54.5	61.4	68.4	75.6
89.04	72.7	82.3	91.8	102
89.05	86.3	97.9	109	121
89.06	97.2	111	124	138
89.07	125	143	160	177
89.08	132	151	169	188
89.09	136	156	175	195
89.10	138	158	178	198
89.11	141	161	182	202
89.12	148	170	192	213
89.13	153	177	200	222
89.14	154	178	202	224
89.15	202	233	263	301
89.16	207	238	269	308
89.17	211	244	276	315
90.01	4.73	5.50	6.32	7.19
90.02	16.9	19.7	22.5	25.3
91.01	6.04	7.00	8.00	8.94
92.01	10.4	11.9	13.5	15.2
93.01	17.4	19.7	22.0	24.2
94.01	11.6	13.0	14.5	16.3
95.01	7.19	8.32	9.40	10.7
96.01	16.9	19.6	22.2	24.8
96.02	22.7	26.0	29.4	32.7
97.01	5.43	6.24	7.08	7.95
98.01	9.47	10.6	11.8	13.2
99.01	4.22	4.85	5.46	6.15
100.01	3.54	3.98	4.42	4.85
101.01	4.16	4.70	5.38	5.98
102.01	5.65	6.39	7.14	7.88
103.01	6.29	7.07	7.88	8.89
104.01	2.72	3.05	3.38	3.75
105.01	13.3	14.9	16.6	18.3
105.02	17.5	19.6	21.8	24.5
105.03	30.6	34.5	38.4	42.7

Subcatchment ID	Peak Discharge (m^3/s)			
	Existing	10% Increase in Rainfall	20% Increase in Rainfall	30% Increase in Rainfall
105.04	35.5	40.6	45.4	49.6
105.05	42.0	48.2	54.1	59.6
105.06	49.1	56.1	63.3	70.2
105.07	65.0	74.5	84.5	94.3
105.08	68.4	78.4	89.0	99.5
105.09	78.0	89.5	101	114
105.10	79.4	91.5	104	116
105.11	81.2	93.6	106	119
106.01	5.15	6.11	7.03	8.05
107.01	10.6	11.9	13.2	14.7
108.01	7.88	9.05	10.2	11.5
109.01	9.20	10.3	11.5	12.6
110.01	8.18	9.18	10.3	11.7
111.01	11.5	13.3	15.1	17.0
111.02	18.9	21.7	24.4	27.2
112.01	5.84	6.77	7.68	8.73
113.01	4.84	5.43	6.04	6.83
114.01	5.50	6.36	7.23	8.10
115.01	5.49	6.31	7.16	8.03
116.01	4.18	4.85	5.58	6.37
117.01	7.13	8.21	9.23	10.2
118.01	3.21	3.69	4.20	4.67
119.01	8.05	9.10	10.1	11.2
119.02	15.8	18.0	20.1	22.2
119.03	26.2	29.9	33.5	37.1
119.04	37.7	43.1	48.3	53.7
119.05	42.3	48.4	54.4	60.4
119.06	54.4	62.3	70.1	77.8
119.07	60.2	68.9	77.6	86.2
119.08	59.6	68.2	76.8	85.4
119.09	69.5	79.6	89.8	100
119.10	73.0	83.8	94.7	105
119.11	148	171	195	218
119.12	151	174	198	222
119.13	153	176	201	225
119.14	153	177	201	225
119.15	173	199	227	254
119.16	174	201	228	256
119.17	217	249	282	318
119.18	220	252	286	322
119.19	220	252	286	322
119.20	220	253	288	324
119.21	222	256	291	328
119.22	302	368	430	494
119.23	346	405	472	541
120.01	7.28	8.36	9.36	10.4
121.01	3.82	4.38	4.96	5.50
122.01	8.68	9.75	10.8	11.9
123.01	5.41	6.07	6.75	7.69
124.01	5.59	6.46	7.34	8.22
125.01	7.46	8.56	9.73	10.9
125.02	13.5	15.6	17.5	19.4
126.01	5.50	6.16	6.83	7.67
127.01	3.57	4.07	4.58	5.11
127.02	4.16	4.66	5.23	5.82
128.01	10.5	11.8	13.2	14.6
128.02	37.9	43.6	49.3	55.1
128.03	59.2	67.8	76.7	85.1
128.04	61.9	70.8	80.3	89.3
128.05	70.9	81.3	92.1	102

Subcatchment ID	Peak Discharge (m^3/s)			
	Existing	10% Increase in Rainfall	20% Increase in Rainfall	30% Increase in Rainfall
128.06	74.8	85.8	97.3	109
128.07	79.2	90.9	103	115
128.08	80.9	92.6	105	117
128.09	82.4	94.4	107	120
128.10	85.1	97.5	111	123
128.11	85.2	97.7	111	124
128.12	86.2	98.8	112	125
129.01	9.67	11.1	12.5	14.0
129.02	15.3	17.4	19.5	21.6
129.03	24.8	28.4	32.0	35.6
130.01	4.85	5.59	6.28	7.07
131.01	8.59	9.73	10.8	12.1
132.01	9.01	10.2	11.3	12.4
132.02	14.8	16.8	18.8	20.8
132.03	19.5	22.2	24.8	27.4
132.04	24.2	27.4	30.5	33.4
132.05	24.4	27.6	30.8	33.7
133.01	3.98	4.46	4.95	5.58
134.01	4.73	5.41	6.14	6.88
135.01	4.87	5.64	6.39	7.18
136.01	5.82	6.60	7.43	8.28
136.02	4.88	5.56	6.32	7.23
137.01	6.09	6.84	7.64	8.53
137.02	10.9	12.2	13.6	14.9
137.03	9.62	11.3	13.0	14.8
137.04	12.3	14.3	16.4	18.4
137.05	13.9	16.1	18.4	20.9
138.01	3.46	3.86	4.34	4.79
139.01	4.81	5.42	6.00	6.62
140.01	6.52	7.29	8.09	8.90
141.01	5.88	6.62	7.38	8.11
141.02	11.2	12.7	14.4	16.0
141.03	14.5	16.4	18.4	20.3
141.04	14.0	16.0	18.2	20.3
142.01	2.45	2.75	3.08	3.39
143.01	0.71	0.80	0.89	0.97
144.01	7.05	7.92	8.82	9.69
144.02	7.88	8.92	9.96	11.1
145.01	2.99	3.35	3.71	4.13
146.01	4.62	5.24	5.92	6.60
147.01	2.82	3.14	3.47	3.83
148.01	10.4	11.6	12.9	14.2
148.02	7.95	9.08	9.95	11.2
149.01	5.09	5.75	6.44	7.14
149.02	5.51	6.25	7.03	7.80
150.01	9.74	11.0	12.3	13.8
150.02	10.6	12.2	13.8	15.5
150.03	14.2	16.4	18.5	20.8
150.04	14.3	16.4	18.6	20.9
150.05	20.8	23.7	26.9	30.4
151.01	3.31	3.68	4.07	4.48
152.01	6.78	7.58	8.43	9.23
152.02	6.03	6.86	7.61	8.50
152.03	6.06	6.95	7.87	8.88
152.04	6.97	8.00	9.04	10.2
153.01	12.7	14.4	16.1	17.8
153.02	22.3	25.5	28.7	31.7
153.03	27.1	30.9	34.7	38.0
153.04	37.7	43.3	49.0	53.8
153.05	47.7	54.5	61.4	67.4

Subcatchment ID	Peak Discharge (m^3/s)			
	Existing	10% Increase in Rainfall	20% Increase in Rainfall	30% Increase in Rainfall
153.06	56.2	64.3	72.4	79.5
153.07	56.4	64.6	72.7	79.9
153.08	60.9	69.7	78.2	85.9
154.01	5.66	6.53	7.41	8.29
155.01	4.44	4.96	5.53	6.21
156.01	10.6	12.2	13.8	15.3
157.01	7.08	7.95	8.92	10.0
158.01	3.86	4.33	4.90	5.52
159.01	4.03	4.60	5.19	5.72
159.02	4.73	5.46	6.21	6.95
160.01	2.06	2.31	2.57	2.86
160.02	5.42	6.11	6.77	7.48
160.03	7.61	8.65	9.75	10.8
160.04	7.64	8.72	9.83	11.0
161.01	178	224	269	316
161.02	178	224	269	316
161.03	177	224	269	316
162.01	2.25	2.59	2.94	3.30
163.01	7.37	8.29	9.40	10.6
163.02	16.3	18.4	20.4	22.5
163.03	30.7	35.1	39.3	43.7
163.04	37.2	42.7	47.9	53.2
163.05	50.2	56.9	65.9	73.4
163.06	50.6	57.4	66.4	74.0
163.07	53.9	61.2	70.8	79.0
163.08	53.7	61.0	70.6	78.9
164.01	8.45	9.52	10.6	11.6
165.01	7.98	9.11	10.2	11.3
166.01	5.21	5.86	6.50	7.15
167.01	10.6	12.0	13.5	14.8
168.01	4.43	4.96	5.67	6.30
169.01	8.89	10.0	11.2	12.3
169.02	14.3	16.2	18.2	20.3
169.03	14.2	16.2	18.2	20.3
170.01	4.58	5.24	5.90	6.51
170.02	6.99	8.02	9.06	10.1
170.03	11.1	12.7	14.4	16.1
171.01	11.8	13.6	15.4	17.3
171.02	16.7	18.8	21.0	23.5
171.03	24.7	27.7	31.1	34.9
171.04	27.4	30.8	34.2	38.3
171.05	38.6	43.5	48.3	54.1
171.06	38.9	43.9	48.8	54.7
172.01	4.90	5.68	6.40	7.12
173.01	4.67	5.28	5.93	6.59
174.01	2.68	3.03	3.39	3.80
175.01	7.36	8.29	9.17	10.1
175.02	11.1	12.6	14.0	15.4
176.01	4.24	4.82	5.46	6.12
177.01	4.68	5.35	6.03	6.65
178.01	4.35	4.99	5.61	6.37
178.02	8.01	9.18	10.3	11.6
179.01	7.23	8.18	9.19	10.1
179.02	16.7	19.0	21.6	24.2
179.03	19.4	22.3	25.2	28.3
179.04	22.0	24.8	27.9	31.9
179.05	25.7	29.3	33.1	37.7
179.06	30.8	34.9	39.4	44.4
179.07	36.7	42.3	48.1	53.8
180.01	5.74	6.56	7.42	8.30

Subcatchment ID	Peak Discharge (m^3/s)			
	Existing	10% Increase in Rainfall	20% Increase in Rainfall	30% Increase in Rainfall
181.01	9.88	10.9	12.0	13.0
182.01	3.34	3.85	4.38	4.87
182.02	6.76	7.71	8.67	9.70
183.01	4.53	5.16	5.77	6.38
184.01	24.0	26.6	29.3	32.0
185.01	14.4	15.9	17.4	18.9
186.01	6.07	6.75	7.48	8.16
186.02	7.55	8.47	9.41	10.39

PEAK DESIGN FLOOD DISCHARGES - Climate Change - 10% Increase in Rainfall

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	12.3	15.5	15.0	**16.9**	16.2	13.4	12.0	8.65
1.02	21.7	28.4	27.8	**31.0**	27.7	25.0	23.3	16.9
1.03	34.1	42.6	41.4	**46.6**	42.6	37.2	34.5	25.1
1.04	43.5	53.6	52.1	**58.7**	55.6	47.9	44.3	32.2
1.05	75.0	92.4	90.3	**102**	97.7	85.1	79.3	57.9
1.06	97.8	117	115	**130**	127	110	103	75.3
1.07	124	147	143	**161**	157	135	125	91.4
1.08	141	166	160	**179**	173	149	138	101
1.09	161	190	181	**202**	192	168	155	114
1.10	170	202	193	**215**	204	179	164	121
1.11	211	252	236	**263**	248	218	200	147
1.12	219	265	248	**277**	258	229	211	156
1.13	222	270	252	**281**	262	233	215	159
1.14	227	277	260	**291**	269	241	222	164
1.15	231	284	267	**298**	275	248	229	169
1.16	239	296	281	**313**	282	259	239	178
1.17	287	365	349	**386**	342	318	297	221
1.18	317	410	395	**436**	381	359	337	251
1.19	312	408	400	**443**	380	368	348	260
1.20	313	412	407	**451**	383	375	354	264
1.21	456	597	590	**651**	536	527	496	373
1.22	453	598	595	**658**	539	532	502	378
1.23	453	602	604	**671**	553	543	513	389
1.24	452	602	607	**676**	559	546	517	392
1.25	455	612	623	**696**	571	562	534	410
1.26	453	612	628	**706**	582	571	544	420
1.27	452	612	628	**708**	585	572	546	421
1.28	451	611	630	**714**	593	577	553	427
1.29	453	617	641	**737**	624	593	571	444
1.30	453	617	641	**738**	627	594	573	445
1.31	452	622	650	**750**	632	605	585	456
1.32	442	612	644	**745**	624	602	585	455
1.33	442	614	647	**756**	641	611	596	463
1.34	439	611	646	**760**	645	614	600	466
1.35	435	609	646	**764**	650	618	605	470
1.36	435	612	652	**796**	697	645	636	490
1.37	435	614	658	**827**	743	669	664	509
1.38	428	608	655	**823**	739	670	667	511
1.39	426	606	655	**827**	748	676	673	516
1.40	421	601	651	**824**	744	675	673	515
1.41	420	601	651	**825**	746	679	675	517
1.42	417	598	650	**826**	748	681	678	520
1.43	417	597	649	**826**	749	684	680	521
1.44	416	597	649	**826**	749	685	680	522
1.45	413	595	651	**826**	751	691	687	528
1.46	412	595	650	**826**	752	696	690	531
1.47	410	593	649	**825**	752	696	690	531
1.48	352	461	495	**601**	557	524	520	425
1.49	357	476	518	687	**689**	636	652	497
1.50	357	476	518	687	**689**	636	652	497
1.51	439	684	789	1055	**1088**	1029	1054	747
1.52	440	687	793	1057	**1092**	1037	1060	752
1.53	440	687	793	1056	**1091**	1037	1061	752
1.54	440	689	795	1057	**1094**	1042	1066	755
1.55	448	704	821	1066	**1114**	1067	1093	774
1.56	448	705	821	1066	**1115**	1069	1095	775
1.57	447	705	823	1064	**1117**	1074	1100	779
1.58	445	704	822	1061	**1116**	1076	1102	781
1.59	453	717	841	1071	**1134**	1108	1131	803
1.60	430	694	821	1048	1128	1100	**1129**	803
2.01	7.91	**9.69**	9.16	9.55	9.54	7.53	6.45	4.65
3.01	8.40	**9.58**	7.80	6.83	6.28	4.34	3.52	2.53
4.01	12.8	17.8	18.3	**21.0**	20.7	18.1	17.8	13.1
4.02	28.3	35.4	34.9	**39.7**	38.7	34.2	32.4	23.7
5.01	8.63	12.3	13.0	14.3	**14.5**	13.0	13.0	9.59
5.02	20.1	22.4	21.1	24.2	**25.8**	21.6	20.3	14.9
6.01	4.10	**4.59**	4.10	4.37	4.19	3.19	2.63	1.90
7.01	13.6	16.7	16.3	**18.1**	17.3	14.3	12.7	9.18
7.02	26.5	30.6	29.1	**31.6**	30.1	24.9	22.0	15.8
8.01	3.53	**3.86**	3.29	3.50	3.29	2.50	2.05	1.47
9.01	11.1	**12.2**	10.6	11.3	10.7	8.19	6.74	4.85
10.01	19.0	**22.3**	20.5	21.3	20.8	16.3	13.7	9.89
11.01	7.00	**7.91**	6.36	6.38	5.90	4.26	3.46	2.49
12.01	12.5	**13.8**	11.3	11.9	11.0	8.03	6.54	4.70

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
12.02	24.6	**27.3**	22.4	23.3	21.5	16.12	13.23	9.52
12.03	37.7	**42.2**	35.0	36.7	33.2	25.6	21.3	15.3
12.04	54.7	**62.0**	52.3	54.7	48.7	38.6	32.4	23.3
13.01	6.36	**7.33**	5.89	5.32	4.89	3.40	2.76	1.98
14.01	7.47	**8.25**	6.79	7.26	6.80	5.08	4.14	2.98
15.01	9.32	**10.2**	8.60	9.26	8.72	6.58	5.40	3.88
16.01	4.88	**5.50**	4.42	4.48	4.14	3.01	2.45	1.76
16.02	12.7	**14.5**	11.6	12.1	11.1	8.27	6.76	4.86
16.03	21.1	**23.9**	19.3	19.8	18.1	13.5	11.0	7.92
17.01	6.00	**6.59**	5.43	5.82	5.44	4.06	3.32	2.38
18.01	7.98	**8.92**	7.21	7.33	6.78	4.92	4.00	2.87
19.01	6.55	**7.30**	5.96	6.19	5.77	4.23	3.45	2.48
20.01	9.62	**10.6**	8.74	9.26	8.65	6.43	5.25	3.77
21.01	6.12	**7.04**	5.63	5.35	4.94	3.49	2.83	2.04
22.01	7.89	**8.73**	7.14	7.50	6.99	5.16	4.21	3.02
23.01	22.7	27.0	25.6	**27.5**	26.3	21.5	18.7	13.4
23.02	61.5	72.6	67.9	**72.9**	67.1	55.6	48.4	34.9
23.03	67.2	79.5	74.5	**80.3**	73.0	61.0	53.5	38.5
23.04	71.6	84.5	79.5	**86.1**	78.6	65.6	57.7	41.5
24.01	7.88	**8.97**	8.07	8.44	8.19	6.34	5.28	3.80
24.02	22.0	**25.2**	22.6	23.9	22.3	17.8	15.1	10.9
25.01	4.27	**5.02**	4.57	4.72	4.57	3.59	3.02	2.18
26.01	6.63	**7.64**	6.11	5.66	5.22	3.65	2.97	2.13
27.01	22.0	**25.6**	23.5	24.5	23.7	18.7	15.7	11.3
27.02	37.7	**41.1**	36.6	39.3	37.6	29.1	24.4	17.5
27.03	57.2	**64.8**	59.3	63.0	61.0	48.2	41.0	29.5
28.01	11.9	**13.1**	10.7	11.2	10.5	7.70	6.28	4.51
29.01	19.8	23.7	22.5	**24.1**	23.0	18.8	16.3	11.7
30.01	16.2	**19.5**	18.3	19.3	18.5	15.0	12.9	9.29
31.01	20.2	**21.9**	18.9	20.3	19.2	14.6	12.0	8.61
31.02	30.9	**34.1**	29.8	31.9	30.1	23.2	19.4	13.9
31.03	47.9	**54.6**	49.2	52.2	49.6	39.2	33.2	23.9
31.04	59.4	**67.9**	61.6	65.4	61.4	49.2	41.9	30.1
31.05	72.8	**84.1**	76.6	81.9	75.5	61.5	52.9	38.1
31.06	86.3	**100**	91.2	98.2	89.5	73.5	63.6	45.8
31.07	98.7	**117**	108	116	104	88.3	77.6	56.0
31.08	160	197	188	**205**	169	156	141	105
31.09	161	200	192	**209**	171	160	145	110
32.01	9.75	**11.1**	9.94	10.4	10.0	7.82	6.52	4.69
33.01	16.9	**20.4**	19.2	20.2	19.4	15.7	13.5	9.74
34.01	8.67	**10.3**	9.68	10.21	9.80	7.92	6.81	4.89
35.01	7.17	**8.48**	7.81	8.17	7.89	6.27	5.33	3.83
36.01	6.17	**6.87**	5.59	5.79	5.39	3.95	3.22	2.31
37.01	8.30	**9.22**	7.52	7.80	7.25	5.31	4.32	3.10
38.01	9.10	11.0	10.4	**11.2**	10.7	8.73	7.64	5.50
38.02	17.6	**20.4**	18.9	20.0	19.5	15.5	13.3	9.56
38.03	39.8	**44.9**	40.5	43.8	41.0	33.0	28.4	20.4
38.04	73.7	86.2	81.1	**87.9**	82.7	68.2	59.8	43.1
39.01	7.60	**8.45**	7.41	7.87	7.51	5.78	4.79	3.44
40.01	5.48	**6.20**	5.55	5.83	5.58	4.34	3.61	2.60
40.02	13.6	**15.3**	12.4	13.4	12.4	9.47	7.86	5.65
41.01	4.48	**5.17**	4.09	3.93	3.62	2.58	2.09	1.50
42.01	17.3	21.3	20.9	**23.2**	21.8	18.2	16.4	11.8
42.02	34.1	41.4	40.1	**43.9**	41.6	34.5	30.7	22.1
43.01	14.9	17.9	17.1	**18.4**	17.6	14.4	12.6	9.04
44.01	7.43	**8.16**	6.89	7.41	6.97	5.28	4.33	3.11
45.01	12.4	**14.5**	13.5	14.0	13.5	10.8	9.17	6.59
46.01	15.5	18.7	17.9	**19.1**	18.6	15.0	13.1	9.41
46.02	29.3	**34.0**	31.6	33.8	32.2	26.1	22.6	16.3
47.01	9.07	**9.94**	8.25	8.83	8.28	6.16	5.03	3.62
48.01	9.10	**10.9**	10.2	10.8	10.4	8.37	7.19	5.17
49.01	18.3	24.9	24.6	**28.4**	27.7	23.5	22.0	16.0
50.01	7.67	**9.08**	8.38	8.77	8.47	6.74	5.74	4.13
51.01	6.45	**7.76**	6.11	4.66	4.29	2.89	2.35	1.69
51.02	20.0	**23.6**	19.0	16.2	14.8	10.3	8.38	6.04
51.03	29.9	**34.2**	27.9	27.8	25.1	19.6	16.6	12.0
52.01	11.4	**12.9**	10.5	9.73	8.97	6.23	5.06	3.65
53.01	8.40	**9.76**	7.89	6.60	6.07	4.15	3.37	2.42
54.01	5.42	**5.95**	5.02	5.41	5.12	3.83	3.15	2.26
55.01	10.5	13.6	13.3	**15.1**	14.1	12.0	11.1	8.04
56.01	16.7	20.3	19.5	**21.3**	20.3	16.6	14.7	10.6
56.02	31.6	40.1	39.6	**44.1**	41.3	36.5	33.7	24.7
56.03	35.4	45.7	45.1	**50.1**	47.0	41.9	38.9	28.5
57.01	11.6	14.5	14.1	**15.8**	14.8	12.4	11.3	8.11
58.01	7.45	**8.53**	7.68	8.04	7.73	6.04	5.05	3.63
59.01	3.77	**4.59**	4.31	4.56	4.40	3.55	3.07	2.21

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.01	9.23	11.5	11.2	**12.5**	11.7	9.82	8.89	6.41
60.02	17.3	22.0	21.8	**23.7**	20.3	19.0	17.3	13.0
61.01	8.46	10.2	9.79	**10.6**	10.1	8.33	7.34	5.28
62.01	3.82	**4.64**	4.34	4.61	4.40	3.57	3.10	2.23
63.01	14.0	20.0	21.1	**23.3**	22.8	21.0	20.9	15.4
63.02	22.3	30.4	30.5	**34.7**	33.8	30.3	29.2	21.5
64.01	8.03	9.92	9.64	**10.8**	10.1	8.47	7.65	5.52
65.01	7.43	9.07	8.85	**9.81**	9.30	7.70	6.87	4.95
66.01	7.29	9.71	9.59	**11.0**	10.3	8.92	8.40	6.09
67.01	9.63	12.9	12.7	**14.6**	13.7	11.9	11.2	8.14
67.02	17.7	21.4	21.4	**24.3**	24.3	20.1	18.4	13.3
67.03	47.9	55.5	51.9	**58.3**	57.1	47.9	43.7	31.8
67.04	66.7	**78.0**	67.6	76.6	74.2	62.5	56.6	41.1
67.05	81.4	94.9	84.2	**95.5**	92.0	78.2	70.9	51.6
67.06	83.0	98.8	90.5	**103**	97.6	85.4	78.2	57.7
67.07	86.6	104.1	97.5	**110**	102	91.2	84.2	62.2
68.01	4.83	5.94	5.66	**6.02**	5.85	4.72	4.12	2.97
69.01	13.6	**15.5**	12.5	11.8	10.8	7.58	6.16	4.43
70.01	8.78	**9.72**	8.65	9.39	8.98	6.76	5.58	4.02
70.02	21.0	**23.3**	19.0	21.0	19.5	14.5	11.9	8.57
71.01	7.78	**8.82**	7.21	7.48	6.93	4.96	4.04	2.91
72.01	8.05	**9.02**	7.27	7.42	6.87	4.96	4.03	2.90
73.01	5.78	7.38	7.22	**8.16**	7.65	6.42	5.87	4.24
74.01	17.2	21.2	20.4	**21.7**	21.4	17.1	14.9	10.7
74.02	25.5	31.4	30.5	**33.3**	31.0	26.0	23.2	16.7
74.03	33.8	40.5	38.9	**42.4**	39.2	33.0	29.3	21.2
74.04	39.0	45.9	43.9	**48.0**	44.8	37.4	33.3	24.0
74.05	51.4	61.8	59.3	**65.2**	59.8	50.9	45.7	33.1
74.06	50.5	62.5	60.2	**66.4**	57.1	52.1	47.6	35.2
74.07	50.5	62.6	60.4	**66.6**	57.1	52.3	47.7	35.3
75.01	6.77	**7.41**	6.34	6.83	6.49	4.89	4.01	2.88
76.01	4.94	**5.44**	4.59	4.95	4.64	3.50	2.87	2.06
77.01	8.97	11.2	10.9	**12.2**	11.6	9.59	8.61	6.21
78.01	8.40	11.5	11.6	**13.3**	12.7	11.4	11.1	8.12
78.02	19.9	25.1	24.7	**28.0**	26.8	23.3	21.7	15.9
78.03	26.4	33.4	32.8	**36.9**	35.0	30.9	28.6	21.1
79.01	7.46	9.04	8.66	**9.41**	8.96	7.36	6.49	4.67
80.01	4.97	**5.48**	4.70	5.05	4.75	3.60	2.97	2.13
81.01	6.19	8.59	8.58	**9.86**	9.48	8.37	8.09	5.91
82.01	10.2	14.2	14.3	**16.2**	15.5	14.0	13.6	9.94
82.02	14.2	20.1	20.9	**23.3**	21.7	20.6	19.9	14.85
83.01	6.79	9.24	9.10	**10.5**	10.1	8.59	8.05	5.85
83.02	7.96	10.5	10.3	**11.8**	11.4	9.78	9.09	6.61
84.01	6.02	8.23	8.16	**9.35**	8.88	7.75	7.39	5.38
84.02	5.99	8.28	8.41	**9.45**	8.42	8.00	7.58	5.70
85.01	4.40	**5.16**	4.23	4.42	4.13	2.99	2.44	1.77
85.02	5.66	7.85	7.61	**8.07**	6.60	7.14	6.74	5.21
86.01	5.90	**6.48**	4.26	4.49	4.53	3.46	2.94	2.14
87.01	5.11	7.35	7.76	8.54	**8.55**	7.77	7.74	5.73
87.02	5.62	7.83	8.25	9.20	**9.24**	8.33	8.24	6.11
88.01	3.73	5.17	5.19	**5.96**	5.73	5.05	4.89	3.56
89.01	15.8	21.5	21.4	**24.4**	23.1	20.6	19.7	14.3
89.02	34.0	40.5	39.4	**43.9**	42.4	36.0	32.8	23.8
89.03	48.7	58.3	55.8	**61.4**	58.9	49.9	44.9	32.6
89.04	63.5	77.0	74.4	**82.3**	77.5	66.4	60.2	43.7
89.05	75.4	91.8	88.5	**97.9**	90.9	78.6	71.3	51.9
89.06	85.0	104	99.7	**111**	100.0	88.4	81.1	59.3
89.07	104	131	128	**143**	126	117	108	80.9
89.08	108	138	135	**151**	132	124	116	86.4
89.09	111	142	140	**156**	135	129	120	90.0
89.10	112	144	142	**158**	137	131	122	92.1
89.11	112	147	145	**161**	139	135	125	95.0
89.12	116	153	152	**170**	144	142	133	101
89.13	117	157	158	**177**	147	147	139	106
89.14	117	158	159	**178**	148	149	140	108
89.15	129	189	205	**233**	204	215	211	162
89.16	131	192	210	**238**	208	220	216	166
89.17	131	194	213	**244**	213	225	221	171
90.01	5.00	**5.50**	4.71	5.06	4.76	3.61	2.97	2.13
90.02	17.3	**19.7**	17.8	18.9	17.6	14.2	12.1	8.67
91.01	5.87	**7.00**	6.49	6.80	6.53	5.24	4.47	3.21
92.01	9.91	**11.9**	11.1	11.7	11.2	9.06	7.80	5.61
93.01	14.3	17.9	17.5	**19.7**	18.4	15.5	14.1	10.2
94.01	10.4	12.6	12.0	**13.0**	12.4	10.1	8.87	6.38
95.01	7.50	**8.32**	7.27	7.72	7.37	5.66	4.68	3.36
96.01	12.1	16.9	17.3	**19.6**	18.8	17.0	16.7	12.2

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
96.02	18.1	22.8	22.7	**26.0**	25.1	22.3	21.3	15.6
97.01	5.44	**6.24**	5.65	5.90	5.66	4.43	3.71	2.66
98.01	8.33	10.1	9.71	**10.6**	10.1	8.32	7.36	5.30
99.01	4.19	**4.85**	4.38	4.54	4.36	3.42	2.87	2.06
100.01	3.04	3.69	3.58	**3.98**	3.72	3.10	2.78	2.00
101.01	3.86	**4.70**	4.41	4.67	4.49	3.62	3.14	2.26
102.01	4.58	5.83	5.70	**6.39**	5.98	5.06	4.61	3.33
103.01	5.61	6.82	6.52	**7.07**	6.74	5.53	4.86	3.50
104.01	2.40	2.90	2.79	**3.05**	2.97	2.42	2.12	1.53
105.01	11.5	14.0	13.6	**14.9**	14.1	11.7	10.4	7.48
105.02	16.7	19.2	18.2	**19.6**	19.5	15.6	13.6	9.80
105.03	28.4	33.2	31.6	**34.5**	32.8	27.1	24.0	17.3
105.04	29.3	37.4	36.6	**40.6**	34.4	32.0	29.5	22.0
105.05	33.0	43.6	43.9	**48.2**	39.8	39.7	37.0	28.2
105.06	37.4	50.3	51.4	**56.1**	46.2	47.5	44.4	34.2
105.07	46.2	65.8	68.3	**74.5**	63.8	65.0	62.3	47.6
105.08	47.6	69.0	71.9	**78.4**	68.0	68.8	66.2	50.6
105.09	53.7	77.7	81.5	**89.5**	75.6	77.5	74.5	57.8
105.10	51.5	76.0	81.4	**91.5**	77.7	80.2	77.9	60.5
105.11	51.5	76.1	81.8	**93.6**	81.5	81.4	79.6	61.5
106.01	5.44	**6.11**	4.93	4.97	4.57	3.30	2.69	1.93
107.01	9.29	11.3	10.9	**11.9**	11.3	9.30	8.26	5.94
108.01	7.96	**9.05**	8.15	8.53	8.22	6.39	5.34	3.83
109.01	7.98	9.68	9.37	**10.3**	9.76	8.11	7.22	5.20
110.01	7.54	9.09	8.59	**9.18**	8.79	7.15	6.23	4.48
111.01	8.16	11.4	12.0	**13.3**	13.0	11.9	11.8	8.71
111.02	16.11	19.5	19.0	**21.7**	21.2	18.9	17.9	13.2
112.01	6.08	**6.77**	5.94	6.30	6.00	4.63	3.83	2.75
113.01	4.32	5.28	5.05	**5.43**	5.20	4.23	3.73	2.68
114.01	5.42	**6.36**	5.83	6.07	5.84	4.63	3.92	2.81
115.01	5.52	**6.31**	5.69	5.94	5.71	4.45	3.72	2.68
116.01	4.39	**4.85**	4.15	4.42	4.16	3.16	2.60	1.87
117.01	5.35	7.18	7.09	**8.21**	7.77	6.66	6.31	4.58
118.01	3.18	**3.69**	3.37	3.50	3.36	2.67	2.24	1.61
119.01	6.40	8.24	8.04	**9.10**	8.65	7.19	6.57	4.74
119.02	12.4	16.0	15.8	**18.0**	17.2	14.5	13.3	9.66
119.03	20.7	26.8	26.6	**29.9**	27.6	24.7	23.1	16.9
119.04	30.3	39.1	38.5	**43.1**	39.0	35.5	33.1	24.3
119.05	33.8	43.7	43.2	**48.4**	43.7	40.0	37.6	27.5
119.06	42.7	56.3	55.6	**62.3**	55.7	51.8	48.6	36.0
119.07	46.2	62.2	61.8	**68.9**	61.6	58.1	55.0	40.7
119.08	44.1	60.5	61.2	**68.2**	58.8	57.7	54.9	41.3
119.09	48.5	68.5	71.5	**79.6**	66.6	69.0	65.2	50.7
119.10	49.5	71.9	75.0	**83.8**	69.5	72.1	68.5	53.2
119.11	81.0	128	147	**171**	151	162	160	124
119.12	81.3	129	149	**174**	156	165	164	128
119.13	81.3	129	150	**176**	160	167	166	130
119.14	81.3	129	150	**177**	161	167	166	130
119.15	91.6	146	170	**199**	179	190	189	148
119.16	91.7	146	171	**201**	181	192	191	149
119.17	118.5	186	218	**249**	219	247	245	191
119.18	119.0	187	219	**252**	223	249	248	192
119.19	119.0	187	219	**252**	224	249	248	192
119.20	118.4	186	218	**253**	226	249	249	192
119.21	118.8	187	220	**256**	230	251	251	194
119.22	118.9	200	249	349	**368**	352	361	227
119.23	143.0	226	283	369	401	394	**405**	261
120.01	5.55	7.39	7.28	**8.36**	7.86	6.71	6.31	4.57
121.01	3.80	**4.38**	3.94	4.09	3.94	3.08	2.58	1.85
122.01	7.45	9.09	8.83	**9.75**	9.34	7.67	6.81	4.91
123.01	4.80	5.92	5.67	**6.07**	5.91	4.77	4.17	3.01
124.01	5.45	**6.46**	5.96	6.19	6.01	4.76	4.03	2.90
125.01	5.19	7.34	7.67	**8.56**	8.51	7.64	7.57	5.58
125.02	10.4	13.7	13.6	**15.6**	15.1	13.3	12.7	9.36
126.01	4.72	5.91	5.71	**6.16**	6.08	4.89	4.29	3.10
127.01	3.49	**4.07**	3.74	3.90	3.84	2.97	2.47	1.78
127.02	3.79	4.65	4.32	**4.66**	3.93	3.45	3.11	2.25
128.01	8.52	9.39	9.69	10.4	**11.8**	11.0	11.3	8.62
128.02	27.2	37.3	38.7	**43.6**	41.2	40.1	38.6	29.6
128.03	38.2	58.2	61.6	**67.8**	57.3	59.5	57.4	44.6
128.04	38.8	59.5	63.9	**70.8**	59.9	63.2	61.4	47.8
128.05	42.0	64.9	70.9	**81.3**	70.8	71.8	70.8	55.1
128.06	42.3	65.6	72.5	**85.8**	79.3	75.3	74.8	58.3
128.07	42.9	67.1	75.2	**90.9**	85.9	80.2	80.5	63.3
128.08	42.9	67.2	75.7	**92.6**	88.9	82.0	82.9	64.9
128.09	43.0	67.5	76.7	**94.4**	90.7	84.5	85.6	66.8

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.10	43.4	68.4	78.2	**97.5**	94.7	88.1	89.8	69.7
128.11	43.4	68.4	78.2	**97.7**	95.0	88.2	89.9	69.8
128.12	43.6	68.7	78.8	**98.8**	96.7	89.7	91.7	71.1
129.01	7.11	9.69	9.62	**11.1**	10.6	9.18	8.75	6.37
129.02	12.7	15.6	15.4	**17.4**	16.7	14.3	13.3	9.65
129.03	19.3	25.0	24.9	**28.4**	27.1	24.1	22.7	16.8
130.01	4.65	**5.59**	5.17	5.30	5.25	4.09	3.46	2.49
131.01	6.87	8.15	8.12	9.59	**9.73**	8.24	7.94	5.82
132.01	7.35	9.29	9.04	**10.2**	9.68	8.04	7.25	5.23
132.02	12.2	15.5	15.1	**16.8**	15.5	13.1	12.1	8.79
132.03	16.2	20.6	20.0	**22.2**	20.3	17.3	16.0	11.6
132.04	19.3	25.0	24.9	**27.4**	22.9	22.0	20.3	15.5
132.05	19.2	25.0	25.1	**27.6**	22.9	22.2	20.5	15.8
133.01	3.48	4.26	4.12	**4.46**	4.33	3.51	3.08	2.22
134.01	4.36	**5.41**	5.09	5.30	5.26	4.16	3.58	2.58
135.01	4.58	**5.64**	5.30	5.47	5.45	4.28	3.66	2.64
136.01	5.97	**6.60**	5.07	5.45	5.19	3.84	3.17	2.30
136.02	5.06	5.39	4.35	**5.56**	5.43	4.85	4.82	3.55
137.01	3.93	5.62	5.97	6.57	**6.84**	6.04	6.08	4.50
137.02	10.8	11.9	9.69	11.4	**12.2**	10.1	9.57	7.03
137.03	6.56	9.50	10.0	11.1	**11.3**	10.5	10.4	7.75
137.04	8.75	11.9	12.1	13.9	**14.3**	13.0	12.6	9.39
137.05	10.6	13.8	14.4	16.0	**16.1**	15.4	15.3	11.4
138.01	3.50	**3.86**	3.55	3.76	3.85	3.05	2.64	1.91
139.01	4.92	**5.42**	3.46	3.28	3.13	2.29	1.90	1.38
140.01	6.64	**7.29**	4.98	4.04	3.74	2.58	2.11	1.54
141.01	6.03	**6.62**	4.97	5.25	5.48	4.28	3.74	2.71
141.02	12.1	**12.7**	9.8	10.0	10.2	7.89	6.79	4.94
141.03	15.2	**16.4**	11.9	11.9	12.0	9.20	7.88	5.73
141.04	14.0	**16.0**	12.3	13.3	13.5	10.5	9.22	6.71
142.01	2.50	**2.75**	1.84	1.45	1.34	0.92	0.76	0.55
143.01	0.59	0.74	0.71	**0.80**	0.77	0.63	0.56	0.40
144.01	7.20	**7.92**	6.52	7.65	7.81	6.46	5.97	4.34
144.02	7.14	8.03	7.65	8.85	**8.92**	7.57	7.14	5.22
145.01	2.60	3.18	3.08	**3.35**	3.30	2.67	2.33	1.68
146.01	3.34	4.33	4.52	5.15	**5.24**	4.56	4.53	3.34
147.01	2.92	**3.14**	2.11	2.31	2.49	2.02	1.88	1.38
148.01	10.6	**11.6**	7.63	8.03	8.13	6.14	5.24	3.80
148.02	7.79	**9.08**	7.28	7.63	7.73	6.17	5.46	3.98
149.01	5.26	**5.75**	4.37	4.28	4.02	2.91	2.38	1.73
149.02	5.58	**6.25**	4.75	4.61	4.28	3.15	2.58	1.87
150.01	6.14	9.27	10.0	10.9	**11.0**	10.4	10.5	7.84
150.02	6.75	10.2	11.1	**12.2**	11.7	11.8	11.6	8.90
150.03	9.62	13.8	14.7	**16.4**	15.8	15.9	15.7	12.0
150.04	9.63	13.8	14.8	**16.4**	15.9	16.0	15.7	12.1
150.05	13.5	20.3	21.3	**23.7**	21.7	23.3	22.8	17.9
151.01	3.29	3.61	3.27	3.65	**3.68**	2.97	2.63	1.91
152.01	6.92	**7.58**	4.82	5.74	6.12	5.05	4.79	3.52
152.02	5.81	6.63	5.69	6.60	**6.86**	5.84	5.62	4.16
152.03	4.98	5.92	6.04	**6.95**	6.36	6.26	6.02	4.70
152.04	5.24	6.79	6.86	**8.00**	7.13	7.61	7.23	5.89
153.01	10.6	12.8	12.5	**14.4**	14.2	11.8	10.8	7.84
153.02	17.3	22.7	22.6	**25.5**	24.3	22.1	21.2	15.8
153.03	20.8	27.6	27.6	**30.9**	29.5	27.1	26.0	19.3
153.04	29.0	38.8	38.5	**43.3**	40.9	37.5	36.0	26.6
153.05	37.2	49.1	48.7	**54.5**	50.5	46.4	44.1	32.7
153.06	41.9	57.2	57.8	**64.3**	56.6	55.3	52.0	39.6
153.07	41.9	57.4	58.1	**64.6**	56.7	55.6	52.3	39.9
153.08	45.8	61.4	62.6	**69.7**	60.5	59.9	56.1	42.9
154.01	5.51	**6.53**	6.03	6.24	6.11	4.80	4.05	2.92
155.01	4.10	4.80	4.66	4.91	**4.96**	3.93	3.41	2.46
156.01	8.11	10.7	10.6	**12.2**	11.5	9.96	9.44	6.86
157.01	6.27	7.76	7.42	**7.95**	7.82	6.28	5.47	3.94
158.01	3.50	4.24	4.05	**4.33**	4.17	3.38	2.95	2.13
159.01	4.04	**4.60**	4.16	4.43	4.28	3.27	2.71	1.95
159.02	4.71	**5.46**	5.03	5.25	5.02	3.99	3.37	2.44
160.01	2.12	**2.31**	1.64	1.93	2.01	1.65	1.52	1.11
160.02	5.91	**6.11**	4.61	4.59	4.83	3.73	3.29	2.40
160.03	7.72	**8.65**	6.74	6.57	6.78	5.18	4.55	3.33
160.04	7.72	**8.72**	6.83	6.61	6.82	5.22	4.58	3.36
161.01	58.0	131	153	**224**	195	173	171	107
161.02	57.4	131	153	**224**	195	173	171	107
161.03	56.9	130	153	**224**	195	175	172	108
162.01	2.28	**2.59**	2.34	2.46	2.36	1.85	1.55	1.12
163.01	6.74	8.27	7.81	**8.29**	8.08	6.49	5.62	4.04
163.02	14.2	17.4	16.8	**18.4**	17.3	14.4	12.8	9.25

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
163.03	23.2	31.0	31.6	**35.1**	31.8	30.6	29.0	22.0
163.04	27.7	37.8	38.4	**42.7**	37.4	37.2	34.8	26.8
163.05	34.1	47.7	51.1	**56.9**	53.4	56.2	54.6	41.2
163.06	33.9	47.7	51.4	**57.4**	53.4	56.5	55.0	41.5
163.07	34.3	49.2	54.3	**61.2**	55.5	60.4	58.9	45.0
163.08	33.8	48.9	54.1	**61.0**	55.5	60.4	59.0	45.0
164.01	7.05	8.75	8.54	**9.52**	9.02	7.48	6.72	4.84
165.01	6.01	8.07	7.94	**9.11**	8.75	7.35	6.88	4.99
166.01	4.26	5.37	5.23	**5.86**	5.61	4.61	4.15	2.99
167.01	4.61	6.98	8.52	10.1	10.9	11.8	**12.0**	9.42
168.01	4.01	4.95	4.67	**4.96**	4.83	3.88	3.38	2.43
169.01	7.38	9.20	8.97	**10.0**	9.40	7.91	7.16	5.16
169.02	10.2	13.1	12.9	14.9	**16.2**	14.7	15.4	11.5
169.03	10.3	13.3	13.3	15.1	**16.2**	15.1	15.6	11.7
170.01	3.91	4.58	4.47	**5.24**	5.16	4.30	4.02	2.92
170.02	5.04	6.94	7.10	**8.02**	7.63	6.96	6.73	4.96
170.03	7.19	10.6	11.4	**12.7**	11.7	12.2	12.0	9.22
171.01	7.90	11.6	12.5	**13.6**	13.5	12.8	12.8	9.55
171.02	9.79	14.8	16.7	18.5	17.5	**18.8**	18.3	14.3
171.03	15.3	22.6	24.9	27.5	25.9	**27.7**	27.2	21.0
171.04	16.2	24.4	27.2	30.1	28.7	**30.8**	30.3	23.4
171.05	22.4	33.2	38.1	42.4	39.9	**43.5**	42.8	33.2
171.06	22.4	33.4	38.4	42.9	40.0	**43.9**	43.2	33.5
172.01	3.47	4.82	4.79	**5.68**	5.58	4.76	4.59	3.36
173.01	4.08	4.44	4.46	4.91	**5.28**	4.60	4.64	3.45
174.01	2.76	**3.03**	2.57	2.81	2.74	2.06	1.71	1.24
175.01	3.58	5.84	6.74	7.46	7.67	8.17	**8.29**	6.41
175.02	6.19	9.62	11.0	12.1	11.8	**12.6**	12.5	9.69
176.01	2.80	4.03	4.31	4.69	**4.82**	4.33	4.37	3.24
177.01	2.85	4.24	4.68	5.06	**5.35**	4.96	5.07	3.80
178.01	4.37	**4.99**	4.44	4.64	4.46	3.45	2.87	2.06
178.02	8.02	**9.18**	8.21	8.52	8.21	6.39	5.31	3.83
179.01	4.71	6.69	7.14	7.76	**8.18**	7.28	7.38	5.49
179.02	12.0	16.6	16.4	**19.0**	18.8	16.7	16.2	11.9
179.03	13.1	19.3	20.0	**22.3**	21.0	20.7	20.4	15.5
179.04	12.4	20.0	22.4	**24.8**	23.4	24.7	24.6	19.0
179.05	13.4	21.8	25.0	**29.3**	27.9	28.4	28.7	22.1
179.06	15.0	24.6	28.7	34.7	33.4	34.3	**34.9**	26.9
179.07	29.6	29.4	29.4	40.2	**42.3**	38.7	40.1	30.2
180.01	4.12	5.72	5.67	**6.56**	6.38	5.50	5.24	3.81
181.01	10.2	**10.9**	6.66	5.52	6.04	4.70	4.27	3.15
182.01	3.26	**3.85**	3.54	3.66	3.56	2.82	2.38	1.71
182.02	5.38	7.04	6.99	**7.71**	7.35	7.02	6.75	5.05
183.01	2.58	2.80	3.19	4.07	4.89	4.92	**5.16**	3.90
184.01	24.6	**26.6**	16.3	11.8	12.0	8.75	7.73	5.77
185.01	14.6	**15.9**	9.38	6.92	6.46	4.53	3.75	2.76
186.01	6.19	**6.75**	3.95	3.47	3.39	2.50	2.10	1.53
186.02	7.85	**8.47**	6.20	5.20	5.07	3.71	3.13	2.29

PEAK DESIGN FLOOD DISCHARGES - Climate Change - 20% Increase in Rainfall

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	14.3	17.5	17.0	**18.8**	18.0	14.8	13.2	9.53
1.02	25.3	32.4	31.4	**34.9**	30.8	27.6	25.6	18.6
1.03	39.7	48.3	46.8	**52.1**	47.3	41.2	38.0	27.6
1.04	50.5	60.8	58.8	**65.8**	61.7	53.0	48.7	35.4
1.05	86.9	105	102	**115**	109	94.2	87.3	63.8
1.06	113	133	130	**146**	141	122	113	83.0
1.07	144	167	162	**181**	175	150	138	101
1.08	163	189	181	**201**	192	166	152	112
1.09	186	217	205	**227**	215	186	171	126
1.1	197	231	218	**241**	227	198	181	134
1.11	244	288	266	**295**	277	241	220	162
1.12	254	303	279	**311**	288	254	233	172
1.13	258	308	284	**316**	292	258	237	175
1.14	264	317	294	**326**	300	266	245	181
1.15	268	325	302	**335**	307	274	252	187
1.16	278	339	318	**351**	315	286	264	197
1.17	336	419	395	**433**	383	352	327	243
1.18	371	471	448	**491**	428	397	371	277
1.19	364	469	453	**499**	427	408	385	290
1.2	365	474	461	**508**	430	416	392	296
1.21	532	685	669	**731**	601	586	549	417
1.22	530	687	675	**739**	605	592	556	423
1.23	530	691	687	**754**	617	604	568	436
1.24	528	692	690	**760**	623	609	573	441
1.25	532	704	710	**782**	637	628	593	461
1.26	530	704	717	**794**	648	639	605	474
1.27	530	704	717	**796**	652	640	607	475
1.28	529	704	720	**802**	660	644	614	482
1.29	530	712	738	**827**	692	663	635	503
1.3	530	713	738	**828**	695	664	637	504
1.31	530	720	750	**844**	702	676	651	517
1.32	517	709	743	**838**	692	673	652	516
1.33	518	711	747	**852**	713	684	664	525
1.34	513	709	747	**856**	718	687	669	529
1.35	509	706	747	**860**	725	692	675	533
1.36	510	710	756	**899**	782	722	710	559
1.37	510	714	766	**934**	838	748	742	582
1.38	501	706	760	**930**	835	750	746	584
1.39	500	705	761	**936**	845	757	753	589
1.4	493	699	756	**932**	840	756	752	588
1.41	493	699	756	**933**	842	760	755	591
1.42	489	696	756	**935**	844	761	758	593
1.43	488	696	756	**936**	846	765	761	595
1.44	488	696	756	**936**	846	766	761	596
1.45	484	694	757	**938**	848	773	769	602
1.46	483	693	757	**939**	849	778	773	605
1.47	480	690	755	**938**	849	779	773	605
1.48	394	520	559	**669**	615	574	570	469
1.49	402	536	593	769	**770**	708	730	565
1.5	402	536	592	769	**770**	709	730	565
1.51	540	789	911	1202	**1235**	1170	1199	870
1.52	542	793	916	1205	**1240**	1178	1207	875
1.53	541	792	916	1204	**1239**	1179	1208	876
1.54	542	794	919	1205	**1242**	1184	1213	879
1.55	552	818	942	1215	**1263**	1213	1242	901
1.56	552	818	943	1215	**1264**	1215	1244	903
1.57	549	819	946	1213	**1265**	1220	1250	907
1.58	547	817	945	1211	**1263**	1221	1251	910
1.59	556	834	966	1222	**1284**	1257	1283	933
1.6	528	808	947	1198	1275	1249	**1280**	934
2.01	9.17	**11.0**	10.3	10.6	10.5	8.31	7.09	5.12
3.01	9.53	**11.0**	8.95	7.52	6.92	4.76	3.87	2.79
4.01	15.0	20.6	20.6	**23.8**	23.2	20.2	19.7	14.4
4.02	32.8	40.6	39.7	**45.0**	43.3	37.9	35.7	26.2
5.01	10.0	14.0	14.6	**16.3**	16.1	14.4	14.3	10.6
5.02	23.2	25.4	23.8	27.1	**28.7**	24.0	22.4	16.5
6.01	4.75	**5.17**	4.58	4.89	4.64	3.50	2.89	2.09
7.01	15.7	19.2	18.5	**20.1**	19.3	15.8	14.0	10.1
7.02	30.4	35.0	32.8	**35.2**	33.4	27.5	24.1	17.4
8.01	4.07	**4.45**	3.69	3.89	3.63	2.74	2.25	1.62
9.01	12.8	**13.9**	11.9	12.6	11.8	9.00	7.41	5.34
10.01	22.0	**25.2**	22.9	23.7	22.9	18.0	15.1	10.9
11.01	8.07	**9.04**	7.31	7.05	6.51	4.68	3.80	2.74
12.01	14.3	**16.1**	13.0	13.2	12.2	8.81	7.18	5.18

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
12.02	28.3	**31.5**	25.7	25.8	23.7	17.7	14.5	10.5
12.03	43.4	**48.4**	39.9	40.7	36.8	28.2	23.4	16.9
12.04	63.3	**70.9**	59.3	60.5	54.1	42.6	35.6	25.7
13.01	7.33	**8.35**	6.73	5.85	5.38	3.73	3.03	2.19
14.01	8.60	**9.40**	7.76	8.07	7.52	5.57	4.55	3.28
15.01	10.7	**11.7**	9.74	10.3	9.63	7.24	5.93	4.28
16.01	5.65	**6.35**	5.09	4.98	4.58	3.30	2.69	1.94
16.02	14.7	**16.6**	13.4	13.5	12.2	9.10	7.43	5.36
16.03	24.4	**27.5**	22.3	22.0	20.0	14.8	12.1	8.73
17.01	6.89	**7.55**	6.22	6.45	6.01	4.46	3.64	2.63
18.01	9.15	**10.3**	8.32	8.12	7.49	5.40	4.40	3.17
19.01	7.55	**8.36**	6.80	6.86	6.36	4.66	3.79	2.73
20.01	11.0	**12.1**	9.97	10.2	9.55	7.07	5.77	4.16
21.01	7.03	**8.02**	6.43	5.90	5.43	3.83	3.11	2.24
22.01	9.05	**9.94**	8.20	8.32	7.73	5.67	4.62	3.33
23.01	25.9	**31.1**	29.1	30.6	29.1	23.7	20.5	14.8
23.02	71.1	**83.0**	76.7	81.0	74.7	61.3	53.3	38.4
23.03	77.6	**90.8**	84.0	89.3	81.0	67.4	58.8	42.5
23.04	82.6	**96.6**	89.6	95.8	87.3	72.6	63.4	45.8
24.01	9.12	**10.1**	8.96	9.40	9.03	6.98	5.81	4.19
24.02	25.5	**28.6**	25.4	26.7	24.7	19.6	16.6	12.0
25.01	5.02	**5.64**	5.12	5.26	5.09	3.96	3.32	2.40
26.01	7.65	**8.68**	7.03	6.24	5.74	4.01	3.26	2.35
27.01	25.1	**29.1**	26.3	27.2	26.2	20.7	17.3	12.5
27.02	42.8	**47.0**	40.9	43.8	41.4	32.1	26.8	19.3
27.03	65.4	**73.3**	66.5	70.0	67.3	53.2	45.1	32.5
28.01	13.5	**15.1**	12.3	12.5	11.6	8.47	6.90	4.97
29.01	22.8	**27.0**	25.5	26.7	25.5	20.8	17.9	12.9
30.01	18.8	**22.2**	20.7	21.5	20.7	16.5	14.2	10.2
31.01	22.9	**25.2**	21.2	22.5	21.2	16.0	13.2	9.5
31.02	35.4	**39.0**	33.4	35.5	33.3	25.6	21.3	15.3
31.03	55.4	**62.1**	55.2	58.1	54.9	43.2	36.5	26.3
31.04	68.5	**77.3**	69.1	72.7	67.9	54.3	46.1	33.2
31.05	84.4	**95.8**	86.1	91.1	83.9	67.9	58.2	42.0
31.06	100	**114**	103	109	99.5	81.2	69.9	50.4
31.07	114	**133**	121	129	115	97.4	85.3	61.8
31.08	186	223	212	**228**	188	172	156	116
31.09	186	226	217	**232**	190	178	160	122
32.01	11.3	**12.6**	11.1	11.6	11.1	8.61	7.17	5.17
33.01	19.7	**23.2**	21.6	22.5	21.5	17.3	14.9	10.7
34.01	10.0	**11.7**	10.9	11.3	10.9	8.73	7.48	5.39
35.01	8.35	**9.58**	8.76	9.08	8.71	6.92	5.86	4.22
36.01	7.11	**7.88**	6.40	6.42	5.95	4.34	3.53	2.55
37.01	9.52	**10.6**	8.65	8.62	8.01	5.83	4.75	3.42
38.01	10.5	**12.5**	11.8	12.4	11.9	9.65	8.40	6.06
38.02	20.4	**23.0**	21.2	22.3	21.6	17.1	14.6	10.5
38.03	46.0	**51.0**	45.3	48.8	45.4	36.4	31.2	22.5
38.04	85.5	**98.4**	91.3	97.8	91.5	75.3	65.8	47.5
39.01	8.78	**9.56**	8.27	8.77	8.33	6.37	5.26	3.79
40.01	6.38	**7.04**	6.17	6.49	6.17	4.79	3.97	2.86
40.02	15.7	**17.6**	14.3	14.9	13.7	10.4	8.64	6.23
41.01	5.20	**5.92**	4.73	4.35	3.99	2.83	2.30	1.66
42.01	20.3	24.3	23.6	**25.8**	24.1	20.2	18.0	13.0
42.02	39.7	47.6	45.4	**48.8**	46.1	38.2	33.7	24.4
43.01	17.2	**20.8**	19.5	20.5	19.6	15.9	13.8	9.96
44.01	8.58	**9.29**	7.74	8.25	7.72	5.80	4.76	3.43
45.01	14.2	**16.5**	15.1	15.6	15.0	11.9	10.1	7.27
46.01	17.8	**21.6**	20.4	21.3	20.7	16.6	14.4	10.4
46.02	33.8	**38.9**	35.7	37.8	35.8	28.8	24.8	17.9
47.01	10.4	**11.4**	9.43	9.77	9.11	6.77	5.53	3.99
48.01	10.5	**12.4**	11.5	12.0	11.5	9.22	7.90	5.70
49.01	21.5	28.5	27.9	**31.9**	30.8	26.0	24.2	17.6
50.01	8.91	**10.3**	9.39	9.75	9.35	7.45	6.31	4.55
51.01	7.36	**8.81**	6.83	5.11	4.71	3.17	2.58	1.86
51.02	22.9	**27.2**	21.6	17.8	16.2	11.3	9.20	6.65
51.03	34.3	**38.9**	31.8	30.7	27.6	21.6	18.2	13.2
52.01	13.0	**14.8**	12.2	10.7	9.85	6.84	5.56	4.02
53.01	9.51	**11.1**	8.99	7.25	6.67	4.56	3.70	2.67
54.01	6.29	**6.86**	5.66	6.00	5.63	4.22	3.46	2.50
55.01	12.3	15.4	15.1	**16.9**	15.6	13.3	12.2	8.86
56.01	19.5	23.3	22.1	**23.6**	22.4	18.4	16.1	11.6
56.02	36.9	46.0	44.9	**49.4**	46.1	40.4	37.1	27.3
56.03	41.6	52.4	51.1	**56.1**	52.4	46.4	42.9	31.5
57.01	13.5	16.4	16.0	**17.6**	16.4	13.7	12.4	8.94
58.01	8.64	**9.60**	8.54	8.95	8.55	6.66	5.55	4.00
59.01	4.37	**5.28**	4.92	5.06	4.91	3.92	3.37	2.44

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.01	10.7	12.9	12.6	**13.9**	13.1	10.9	9.78	7.06
60.02	20.2	24.9	24.2	**25.7**	22.3	21.0	19.1	14.3
61.01	9.80	11.7	11.0	**11.8**	11.2	9.20	8.07	5.82
62.01	4.44	**5.31**	4.97	5.12	4.91	3.95	3.41	2.46
63.01	16.4	22.9	23.7	**26.2**	25.4	23.3	23.0	17.0
63.02	26.2	34.7	34.5	**39.1**	37.6	33.5	32.2	23.7
64.01	9.30	11.1	10.9	**12.0**	11.2	9.36	8.42	6.08
65.01	8.68	10.3	9.98	**10.9**	10.3	8.51	7.55	5.46
66.01	8.64	11.1	10.9	**12.4**	11.5	9.88	9.24	6.71
67.01	11.3	14.6	14.4	**16.4**	15.2	13.2	12.3	8.97
67.02	20.6	24.4	24.2	**27.2**	26.9	22.3	20.3	14.7
67.03	55.6	63.4	58.7	**65.4**	63.3	53.1	48.1	35.0
67.04	77.2	**89.0**	76.1	85.7	82.6	69.1	62.3	45.3
67.05	94.0	**108**	94.8	107	102	86.4	78.1	56.9
67.06	96.5	112	102	**115.04**	109	94.4	86.2	63.6
67.07	101	118	110	**123**	114	101	92.9	68.6
68.01	5.68	**6.76**	6.42	6.69	6.49	5.25	4.53	3.27
69.01	15.7	**17.7**	14.6	13.0	11.9	8.32	6.77	4.88
70.01	10.1	**10.9**	9.65	10.4	9.89	7.44	6.13	4.43
70.02	24.2	**26.6**	22.0	23.2	21.5	15.9	13.1	9.43
71.01	9.04	**10.0**	8.38	8.26	7.63	5.44	4.43	3.21
72.01	9.22	**10.4**	8.36	8.22	7.58	5.45	4.43	3.20
73.01	6.74	8.36	8.16	**9.08**	8.56	7.11	6.46	4.67
74.01	20.0	**24.3**	23.1	24.1	23.7	18.9	16.4	11.8
74.02	29.8	35.9	34.5	**37.0**	34.4	28.7	25.5	18.4
74.03	39.3	46.2	43.9	**47.2**	43.6	36.4	32.3	23.4
74.04	45.2	52.4	49.5	**53.4**	49.9	41.4	36.6	26.5
74.05	59.7	70.6	67.0	**72.7**	66.9	56.3	50.3	36.5
74.06	58.7	71.3	68.0	**74.3**	63.6	57.6	52.4	38.8
74.07	58.7	71.4	68.2	**74.5**	63.7	57.9	52.5	38.9
75.01	7.83	**8.46**	7.11	7.62	7.17	5.38	4.40	3.18
76.01	5.74	**6.27**	5.17	5.49	5.16	3.85	3.16	2.27
77.01	10.4	12.6	12.2	**13.5**	12.9	10.6	9.46	6.84
78.01	9.77	13.2	13.2	**15.0**	14.2	12.6	12.2	8.95
78.02	23.3	28.5	28.1	**31.4**	29.9	25.9	23.9	17.5
78.03	31.8	39.2	37.3	**41.8**	39.7	34.3	31.5	23.2
79.01	8.70	10.3	9.79	**10.5**	9.93	8.16	7.13	5.14
80.01	5.77	**6.29**	5.24	5.60	5.27	3.97	3.26	2.35
81.01	7.32	9.83	9.75	**11.2**	10.5	9.27	8.91	6.51
82.01	12.0	16.2	16.2	**18.5**	17.4	15.5	15.0	11.0
82.02	16.7	23.0	23.7	**26.4**	24.3	22.8	21.9	16.4
83.01	8.09	10.5	10.3	**11.8**	11.2	9.50	8.87	6.45
83.02	9.44	11.9	11.7	**13.2**	12.6	10.8	10.0	7.28
84.01	7.10	9.39	9.27	**10.5**	9.87	8.59	8.14	5.93
84.02	7.04	9.47	9.53	**10.6**	9.40	8.86	8.36	6.29
85.01	5.04	**5.89**	4.85	4.87	4.54	3.28	2.68	1.94
85.02	6.67	8.84	8.56	**9.05**	7.47	7.89	7.60	5.75
86.01	6.55	**7.21**	4.79	5.01	4.98	3.81	3.23	2.35
87.01	6.03	8.40	8.76	**9.67**	9.49	8.62	8.54	6.31
87.02	6.65	9.07	9.33	**10.5**	10.3	9.25	9.10	6.74
88.01	4.40	5.95	5.93	**6.77**	6.40	5.60	5.38	3.93
89.01	18.5	24.6	24.3	**27.6**	25.7	22.7	21.6	15.8
89.02	39.3	46.4	44.3	**49.0**	47.2	39.8	36.1	26.2
89.03	56.5	66.7	63.0	**68.4**	65.5	55.0	49.5	35.9
89.04	73.6	88.2	84.2	**91.8**	86.1	73.4	66.3	48.2
89.05	87.5	105	100	**109**	101	86.9	78.5	57.2
89.06	97.3	120	114	**124**	112	97.7	89.0	65.4
89.07	120	150	145	**160**	141	129	119.4	89.3
89.08	124	158	154	**169**	148	137	127	95.4
89.09	127	164	159	**175**	152	142	132	99.4
89.1	128	166	162	**178**	154	145	134	102
89.11	129	169	165	**182**	156	149	138	105
89.12	132	177	174	**192**	161	157	146	112
89.13	134	183	181	**200**	167	163	153	118
89.14	134	184	182	**202**	168	165	154	119
89.15	152	219	235	**263**	230	241	233	183
89.16	154	223	240	**269**	234	247	239	188
89.17	154	226	245	**276**	240	252	245	192
90.01	5.80	**6.32**	5.25	5.61	5.28	3.97	3.26	2.35
90.02	20.0	**22.5**	20.0	21.1	19.6	15.6	13.3	9.56
91.01	6.87	**8.00**	7.29	7.57	7.26	5.78	4.91	3.54
92.01	11.4	**13.5**	12.5	13.0	12.5	10.0	8.58	6.18
93.01	16.4	20.3	19.8	**22.0**	20.6	17.2	15.6	11.2
94.01	12.1	**14.5**	13.7	14.4	13.8	11.2	9.76	7.03
95.01	8.67	**9.40**	8.11	8.61	8.17	6.23	5.14	3.71
96.01	14.2	19.6	19.6	**22.2**	21.2	18.9	18.4	13.5

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
96.02	21.2	25.8	25.7	**29.4**	28.1	24.8	23.5	17.2
97.01	6.34	**7.08**	6.28	6.56	6.26	4.90	4.07	2.94
98.01	9.67	11.5	11.0	**11.8**	11.2	9.19	8.09	5.84
99.01	4.92	**5.46**	4.90	5.08	4.85	3.77	3.15	2.27
100.01	3.47	4.24	4.05	**4.42**	4.14	3.43	3.06	2.21
101.01	4.48	**5.38**	5.03	5.18	5.01	4.01	3.45	2.49
102.01	5.39	6.61	6.45	**7.14**	6.66	5.60	5.08	3.67
103.01	6.53	**7.88**	7.42	7.86	7.51	6.11	5.34	3.85
104.01	2.73	3.33	3.17	**3.38**	3.28	2.67	2.33	1.68
105.01	13.4	16.1	15.4	**16.6**	15.7	12.9	11.4	8.25
105.02	19.3	21.7	20.4	**21.8**	21.6	17.2	15.0	10.8
105.03	32.9	37.7	35.6	**38.4**	36.4	29.9	26.3	19.0
105.04	34.1	42.3	41.3	**45.4**	38.5	35.4	32.6	24.3
105.05	38.4	49.6	49.6	**54.1**	44.7	43.9	41.0	31.2
105.06	43.4	57.6	57.9	**63.3**	51.7	52.4	49.3	37.7
105.07	54.3	75.6	77.2	**84.5**	71.7	71.7	69.0	52.6
105.08	56.1	79.4	81.2	**89.0**	76.4	76.0	73.3	55.9
105.09	63.3	89.7	92.3	**101**	85.1	86.6	82.4	64.1
105.1	61.4	87.7	92.8	**104**	87.1	89.7	86.2	67.6
105.11	61.3	87.9	93.3	**106**	91.4	91.1	88.2	68.8
106.01	6.26	**7.03**	5.68	5.47	5.07	3.63	2.95	2.13
107.01	10.8	12.9	12.3	**13.2**	12.5	10.3	9.08	6.55
108.01	9.19	**10.2**	9.05	9.49	9.06	7.05	5.86	4.23
109.01	9.26	11.0	10.6	**11.5**	10.8	8.95	7.93	5.73
110.01	8.77	**10.3**	9.70	10.2	9.74	7.92	6.84	4.93
111.01	9.51	13.1	13.5	**15.1**	14.5	13.3	13.0	9.60
111.02	18.7	22.1	21.5	**24.4**	23.6	21.0	19.7	14.5
112.01	7.06	**7.68**	6.62	7.01	6.64	5.11	4.21	3.03
113.01	5.08	**6.04**	5.72	6.03	5.74	4.69	4.10	2.96
114.01	6.31	**7.23**	6.52	6.76	6.47	5.13	4.30	3.10
115.01	6.44	**7.16**	6.32	6.62	6.31	4.92	4.09	2.95
116.01	5.13	**5.58**	4.64	4.94	4.62	3.48	2.86	2.06
117.01	6.31	8.24	8.15	**9.23**	8.72	7.40	6.95	5.05
118.01	3.65	**4.20**	3.79	3.88	3.72	2.94	2.46	1.78
119.01	7.54	9.35	9.08	**10.1**	9.56	7.98	7.22	5.23
119.02	14.6	18.3	17.9	**20.1**	19.1	16.1	14.7	10.6
119.03	24.4	30.7	30.3	**33.5**	30.9	27.4	25.5	18.6
119.04	35.5	44.7	43.7	**48.3**	43.7	39.3	36.5	26.8
119.05	39.7	50.3	49.1	**54.4**	48.9	44.2	41.4	30.4
119.06	50.4	64.4	63.3	**70.1**	62.5	57.3	53.7	39.7
119.07	54.5	71.1	70.3	**77.6**	69.0	64.2	60.7	44.9
119.08	52.2	69.4	69.5	**76.8**	65.6	63.9	60.7	45.7
119.09	57.5	79.1	81.5	**89.8**	74.6	76.6	72.3	56.1
119.1	59.9	83.1	85.7	**94.7**	78.2	80.2	76.0	59.0
119.11	98.4	149	170	**195**	167	182	178	142
119.12	98.8	150	172	**198**	172	186	183	146
119.13	98.8	150	173	**201**	177	188	186	148
119.14	98.8	150	174	**201**	177	189	186	149
119.15	111	170	197	**227**	197	214	211	168
119.16	111	171	198	**228**	199	216	213	170
119.17	139	217	250	**282**	247	277	274	216
119.18	139	217	252	**286**	251	279	277	218
119.19	139	217	252	**286**	251	280	277	218
119.2	139	217	251	**288**	253	279	278	218
119.21	139	218	253	**291**	257	281	280	220
119.22	140	249	305	412	**430**	413	424	279
119.23	175	280	344	433	468	462	**472**	316
120.01	6.54	8.43	8.32	**9.36**	8.79	7.45	6.95	5.04
121.01	4.42	**4.96**	4.41	4.56	4.37	3.40	2.83	2.04
122.01	8.70	10.4	9.99	**10.8**	10.3	8.51	7.48	5.41
123.01	5.64	**6.75**	6.44	6.73	6.55	5.30	4.59	3.31
124.01	6.34	**7.34**	6.67	6.88	6.66	5.27	4.42	3.19
125.01	6.11	8.46	8.68	**9.73**	9.45	8.49	8.36	6.15
125.02	12.3	15.7	15.6	**17.5**	16.8	14.8	14.0	10.3
126.01	5.55	6.75	6.49	**6.83**	6.73	5.42	4.72	3.41
127.01	4.02	**4.58**	4.18	4.37	4.24	3.26	2.71	1.96
127.02	4.40	**5.23**	4.84	5.17	4.37	3.80	3.42	2.48
128.01	9.56	10.5	11.1	11.9	**13.2**	12.2	12.5	9.52
128.02	32.0	42.8	43.9	**49.3**	45.9	44.5	42.7	32.7
128.03	47.0	66.6	69.9	**76.7**	64.2	67.0	63.7	49.9
128.04	47.6	68.2	72.7	**80.3**	67.3	71.1	68.3	53.6
128.05	51.6	74.3	81.0	**92.1**	78.6	81.2	78.7	62.9
128.06	52.0	75.3	83.0	**97.3**	87.9	85.3	83.3	67.5
128.07	53.0	77.1	86.6	**103**	95.4	91.4	90.7	73.9
128.08	53.0	77.3	87.3	**105**	98.6	93.4	93.4	75.7
128.09	53.1	77.7	88.6	**107**	101	96.1	96.4	77.9

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.1	53.7	78.8	90.6	**111**	105	100	101	81.2
128.11	53.7	78.8	90.6	**111**	105	100	101	81.3
128.12	53.8	79.1	91.3	**112**	107	102	103	82.8
129.01	8.49	11.1	10.9	**12.5**	11.8	10.2	9.63	7.02
129.02	15.0	17.8	17.3	**19.5**	18.6	15.9	14.6	10.6
129.03	22.8	28.5	28.3	**32.0**	30.2	26.7	25.1	18.5
130.01	5.51	**6.28**	5.78	5.91	5.82	4.52	3.80	2.74
131.01	7.75	9.37	9.29	**10.8**	10.8	9.18	8.73	6.40
132.01	8.62	10.5	10.2	**11.3**	10.7	8.89	7.97	5.76
132.02	14.4	17.8	17.2	**18.8**	17.2	14.7	13.3	9.68
132.03	19.3	23.4	22.6	**24.8**	22.6	19.4	17.5	12.8
132.04	22.3	28.4	28.1	**30.5**	25.6	24.6	22.4	17.2
132.05	22.2	28.4	28.3	**30.8**	25.6	24.9	22.7	17.6
133.01	4.01	4.94	4.71	**4.95**	4.82	3.88	3.39	2.45
134.01	5.11	**6.14**	5.77	5.88	5.86	4.60	3.93	2.84
135.01	5.41	**6.39**	5.97	6.08	6.02	4.73	4.02	2.91
136.01	6.74	**7.43**	5.76	6.06	5.72	4.22	3.48	2.53
136.02	5.54	5.92	4.99	6.24	**6.32**	5.41	5.34	3.96
137.01	4.48	6.45	6.74	7.54	**7.64**	6.70	6.70	4.96
137.02	12.1	13.3	11.0	12.9	**13.6**	11.2	10.5	7.74
137.03	7.93	11.2	11.4	12.9	**13.0**	11.7	11.5	8.54
137.04	10.5	13.8	13.9	16.0	**16.4**	14.4	13.9	10.4
137.05	12.0	16.0	16.5	**18.4**	18.3	17.2	16.8	12.6
138.01	3.93	**4.34**	4.01	4.17	4.25	3.35	2.90	2.10
139.01	5.48	**6.00**	3.88	3.64	3.45	2.51	2.08	1.52
140.01	7.35	**8.09**	5.59	4.42	4.10	2.82	2.31	1.69
141.01	6.70	**7.38**	5.65	5.84	6.07	4.73	4.10	2.98
141.02	13.5	**14.4**	11.0	11.2	11.3	8.68	7.44	5.42
141.03	16.9	**18.4**	13.4	13.3	13.2	10.1	8.63	6.29
141.04	15.7	**18.2**	14.0	14.9	14.9	11.6	10.1	7.37
142.01	2.76	**3.08**	2.06	1.59	1.47	1.01	0.83	0.61
143.01	0.70	0.84	0.81	**0.89**	0.86	0.70	0.62	0.45
144.01	8.00	**8.82**	7.41	8.58	8.66	7.11	6.56	4.78
144.02	8.02	9.08	8.76	**9.96**	9.92	8.35	7.84	5.74
145.01	2.98	3.65	3.49	**3.71**	3.65	2.94	2.56	1.85
146.01	3.75	5.00	5.08	5.89	**5.92**	5.08	4.99	3.68
147.01	3.24	**3.47**	2.35	2.60	2.76	2.24	2.06	1.52
148.01	11.7	**12.9**	8.60	9.04	8.94	6.77	5.74	4.18
148.02	8.80	**9.95**	8.22	8.65	8.55	6.81	5.99	4.38
149.01	5.86	**6.44**	4.94	4.72	4.41	3.18	2.61	1.90
149.02	6.23	**7.03**	5.37	5.08	4.70	3.45	2.82	2.06
150.01	7.24	10.6	11.4	12.3	**12.3**	11.5	11.6	8.66
150.02	7.95	11.7	12.6	**13.8**	13.0	13.0	12.8	9.83
150.03	11.2	15.8	16.7	**18.5**	17.6	17.5	17.3	13.3
150.04	11.3	15.8	16.7	**18.6**	17.7	17.6	17.4	13.3
150.05	15.9	23.2	24.4	**26.9**	24.3	25.9	25.4	19.8
151.01	3.65	4.04	3.72	4.05	**4.07**	3.27	2.89	2.10
152.01	7.63	**8.43**	5.42	6.52	6.82	5.59	5.27	3.87
152.02	6.52	7.42	6.44	7.47	**7.61**	6.47	6.19	4.58
152.03	5.73	6.78	6.88	**7.87**	7.05	6.99	6.66	5.21
152.04	6.05	7.81	7.91	**9.04**	7.84	8.50	8.11	6.53
153.01	11.9	14.5	14.1	**16.1**	15.9	13.0	11.9	8.63
153.02	20.1	25.8	25.7	**28.7**	27.2	24.6	23.5	17.4
153.03	24.4	31.8	31.2	**34.7**	32.8	30.0	28.7	21.3
153.04	34.1	44.5	43.7	**49.0**	45.8	41.5	39.8	29.4
153.05	43.7	55.9	54.8	**61.4**	57.1	51.4	48.7	36.1
153.06	49.7	65.3	65.3	**72.4**	64.2	61.2	57.6	43.7
153.07	49.7	65.5	65.6	**72.7**	64.4	61.6	57.9	44.1
153.08	53.3	70.5	70.6	**78.2**	68.4	66.5	62.1	47.5
154.01	6.40	**7.41**	6.74	6.93	6.76	5.32	4.45	3.21
155.01	4.61	**5.53**	5.32	5.44	5.51	4.33	3.74	2.71
156.01	9.45	12.2	12.1	**13.8**	12.9	11.0	10.4	7.56
157.01	7.33	**8.92**	8.44	8.83	8.71	6.94	6.01	4.34
158.01	4.04	**4.90**	4.62	4.81	4.64	3.74	3.24	2.34
159.01	4.68	**5.19**	4.65	4.95	4.74	3.59	2.97	2.15
159.02	5.45	**6.21**	5.65	5.84	5.55	4.39	3.70	2.68
160.01	2.36	**2.57**	1.84	2.17	2.23	1.82	1.67	1.22
160.02	6.57	**6.77**	5.16	5.13	5.33	4.11	3.61	2.64
160.03	8.63	**9.75**	7.60	7.31	7.47	5.70	4.99	3.66
160.04	8.64	**9.83**	7.70	7.36	7.51	5.74	5.02	3.68
161.01	86.2	170	196	**269**	234	206	204	137
161.02	85.8	170	196	**269**	234	207	204	137
161.03	85.3	169	196	**269**	234	209	205	138
162.01	2.60	**2.94**	2.61	2.73	2.60	2.05	1.71	1.23
163.01	7.90	**9.40**	8.80	9.21	8.97	7.17	6.17	4.46
163.02	16.7	19.9	18.9	**20.4**	19.3	16.0	14.1	10.2

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
163.03	27.1	35.7	35.8	**39.3**	35.5	33.9	32.2	24.3
163.04	32.3	43.3	43.6	**47.9**	41.8	41.2	38.6	29.6
163.05	39.1	55.0	57.5	**65.9**	59.3	62.6	60.9	47.2
163.06	38.9	55.0	57.8	**66.4**	59.4	63.0	61.3	47.6
163.07	39.1	57.2	61.4	**70.8**	62.0	67.6	65.7	51.4
163.08	38.5	56.8	61.2	**70.6**	61.8	67.5	65.9	51.4
164.01	8.29	9.93	9.63	**10.6**	10.0	8.30	7.38	5.33
165.01	7.03	9.19	9.01	**10.2**	9.70	8.18	7.56	5.49
166.01	5.03	6.13	5.93	**6.50**	6.21	5.13	4.56	3.30
167.01	5.17	8.21	9.78	11.5	12.1	13.2	**13.5**	10.5
168.01	4.67	**5.67**	5.34	5.50	5.40	4.29	3.71	2.68
169.01	8.63	10.4	10.1	**11.2**	10.4	8.74	7.87	5.69
169.02	11.9	15.0	14.7	17.0	**18.2**	16.4	17.0	12.9
169.03	12.0	15.2	15.1	17.2	**18.2**	16.9	17.3	13.1
170.01	4.39	5.26	5.10	**5.90**	5.78	4.77	4.42	3.22
170.02	5.87	7.93	8.02	**9.06**	8.48	7.71	7.41	5.46
170.03	8.34	12.2	13.1	**14.4**	13.1	13.5	13.3	10.2
171.01	9.25	13.3	14.1	**15.4**	15.1	14.1	14.1	10.5
171.02	11.5	17.1	19.1	**21.0**	19.7	20.9	20.3	15.9
171.03	17.6	25.8	28.3	**31.1**	29.2	30.7	30.2	23.4
171.04	18.8	28.0	31.0	**34.2**	32.3	34.1	33.6	26.0
171.05	25.9	38.8	43.5	48.3	45.1	**48.3**	47.6	37.1
171.06	26.0	39.0	43.9	**48.8**	45.2	**48.8**	48.1	37.4
172.01	4.02	5.64	5.56	**6.40**	6.23	5.31	5.06	3.70
173.01	4.55	4.99	5.04	5.69	**5.93**	5.13	5.12	3.80
174.01	3.07	**3.39**	2.85	3.10	3.01	2.26	1.88	1.37
175.01	4.19	6.79	7.75	8.47	8.70	9.06	**9.17**	7.11
175.02	7.23	11.2	12.6	13.8	13.3	**14.0**	13.9	10.8
176.01	3.24	4.64	4.86	**5.46**	5.44	4.80	4.82	3.57
177.01	3.29	4.94	5.36	5.74	**6.03**	5.49	5.60	4.20
178.01	5.17	**5.61**	4.96	5.20	4.96	3.80	3.15	2.27
178.02	9.41	**10.3**	9.17	9.55	9.11	7.03	5.83	4.21
179.01	5.34	7.65	8.10	8.92	**9.19**	8.09	8.14	6.05
179.02	14.1	19.0	18.8	**21.6**	21.1	18.5	17.9	13.1
179.03	15.4	22.2	22.7	**25.2**	23.6	22.9	22.6	17.0
179.04	15.5	22.9	25.1	**27.9**	26.0	27.5	27.2	21.1
179.05	16.7	25.1	28.4	**33.1**	30.9	31.7	31.8	24.8
179.06	18.6	28.4	32.7	**39.4**	37.3	38.4	38.9	30.2
179.07	32.7	32.6	33.6	46.0	**48.1**	43.2	44.6	33.9
180.01	4.88	6.57	6.49	**7.42**	7.11	6.07	5.76	4.20
181.01	11.2	**12.0**	7.34	6.19	6.64	5.16	4.68	3.45
182.01	3.75	**4.38**	3.99	4.07	3.94	3.11	2.62	1.89
182.02	6.19	7.94	7.92	**8.67**	8.16	7.79	7.47	5.58
183.01	2.87	3.16	3.66	4.60	5.48	5.55	**5.77**	4.43
184.01	27.0	**29.3**	17.8	12.9	13.1	9.58	8.47	6.32
185.01	16.1	**17.4**	10.3	7.58	7.07	4.95	4.09	3.02
186.01	6.79	**7.48**	4.39	3.86	3.72	2.74	2.30	1.68
186.02	8.66	**9.41**	6.88	5.75	5.57	4.06	3.42	2.51

PEAK DESIGN FLOOD DISCHARGES - Climate Change - 30% Increase in Rainfall

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	16.2	20.0	19.3	**20.6**	19.9	16.2	14.4	10.4
1.02	28.9	36.7	35.3	**38.8**	33.9	30.2	27.9	20.3
1.03	44.9	54.7	52.3	**57.7**	52.2	45.3	41.4	30.2
1.04	57.1	68.8	66.1	**73.0**	68.0	58.2	53.2	38.7
1.05	98.6	119	115	**127**	120	103	95.4	69.7
1.06	128	150	146	**162**	156	134	124	90.7
1.07	163	188	181	**200**	193	164	150	110
1.08	186	213	203	**222**	211	182	166	122
1.09	212	245	229	**252**	237	204	187	137
1.10	225	261	243	**267**	251	217	198	146
1.11	279	325	297	**327**	305	264	241	177
1.12	290	342	313	**345**	318	278	255	188
1.13	294	347	318	**351**	323	283	260	191
1.14	302	359	329	**362**	331	292	268	198
1.15	307	368	338	**373**	339	300	276	204
1.16	318	384	356	**390**	348	314	289	215
1.17	386	475	443	**482**	424	387	358	266
1.18	427	535	503	**546**	473	436	406	303
1.19	421	533	509	**555**	473	449	422	317
1.20	422	538	519	**565**	478	458	430	325
1.21	611	777	749	**811**	663	645	602	458
1.22	609	780	757	**819**	667	653	610	466
1.23	610	786	771	**837**	679	667	624	482
1.24	608	787	775	**843**	685	672	629	488
1.25	613	802	798	**868**	700	694	652	510
1.26	611	802	806	**881**	713	708	665	525
1.27	611	802	806	**883**	718	709	667	526
1.28	607	801	809	**892**	727	716	675	534
1.29	611	810	826	**920**	764	739	700	558
1.30	610	810	827	**922**	767	741	702	559
1.31	611	820	841	**939**	777	757	719	574
1.32	598	808	833	**933**	766	752	720	573
1.33	598	810	839	**950**	790	764	734	583
1.34	593	807	839	**955**	797	768	740	589
1.35	589	804	839	**960**	802	773	747	594
1.36	590	809	850	**1007**	870	807	787	624
1.37	590	812	861	**1049**	937	836	824	651
1.38	580	803	855	**1044**	932	837	828	653
1.39	578	802	856	**1052**	944	845	836	659
1.40	571	796	851	**1047**	938	843	836	658
1.41	571	795	851	**1049**	942	848	839	661
1.42	566	792	851	**1053**	943	851	844	664
1.43	565	792	851	**1054**	946	854	846	666
1.44	565	792	851	**1055**	946	855	847	667
1.45	561	790	850	**1057**	947	863	856	673
1.46	560	789	850	**1057**	949	869	860	676
1.47	556	786	848	**1056**	948	870	861	676
1.48	440	578	615	**739**	675	629	623	512
1.49	448	598	653	**860**	851	788	808	619
1.50	448	598	653	**860**	851	789	808	620
1.51	602	911	1037	1373	**1385**	1320	1346	977
1.52	605	915	1043	1376	**1390**	1329	1355	983
1.53	604	914	1042	1375	**1390**	1330	1355	984
1.54	605	917	1046	1377	**1394**	1336	1362	987
1.55	618	939	1074	1392	**1417**	1370	1394	1008
1.56	618	939	1075	1392	**1419**	1372	1397	1009
1.57	617	940	1079	1391	**1420**	1378	1403	1014
1.58	614	938	1078	1388	**1417**	1379	1404	1017
1.59	626	957	1103	1403	**1440**	1418	1439	1042
1.60	599	930	1081	1379	1427	1410	**1433**	1044
2.01	10.4	**12.4**	11.5	11.7	11.5	9.10	7.72	5.59
3.01	10.6	**12.4**	10.1	8.19	7.55	5.18	4.21	3.05
4.01	17.1	23.3	23.2	**26.5**	25.5	22.3	21.5	15.8
4.02	37.5	45.9	44.8	**49.9**	47.6	41.6	39.0	28.6
5.01	11.5	15.9	16.3	**18.4**	17.8	15.8	15.6	11.6
5.02	26.2	29.3	26.7	30.1	**31.6**	26.3	24.4	18.0
6.01	5.40	**5.84**	5.07	5.41	5.09	3.82	3.15	2.28
7.01	18.0	21.9	20.9	**22.1**	21.3	17.3	15.3	11.1
7.02	34.6	**39.5**	36.5	38.9	36.7	30.1	26.3	19.1
8.01	4.61	**5.06**	4.16	4.28	3.99	2.99	2.45	1.77
9.01	14.5	**15.8**	13.2	13.8	13.0	9.8	8.08	5.84
10.01	25.0	**28.2**	25.3	26.0	25.0	19.7	16.5	11.9
11.01	9.03	**10.3**	8.34	7.73	7.12	5.10	4.15	3.00
12.01	16.2	**18.2**	14.7	14.4	13.3	9.60	7.82	5.66

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
12.02	32.0	**35.9**	29.2	28.3	25.9	19.3	15.8	11.5
12.03	49.1	**55.0**	45.2	44.7	40.4	30.8	25.5	18.4
12.04	71.6	**80.4**	66.8	66.5	59.4	46.6	38.8	28.0
13.01	8.22	**9.49**	7.67	6.39	5.87	4.07	3.31	2.39
14.01	9.65	**10.7**	8.82	8.84	8.25	6.07	4.96	3.58
15.01	12.1	**13.3**	11.0	11.3	10.5	7.90	6.47	4.67
16.01	6.35	**7.20**	5.82	5.44	5.03	3.60	2.93	2.12
16.02	16.6	**18.9**	15.3	14.8	13.4	9.92	8.11	5.85
16.03	27.5	**31.3**	25.4	24.0	21.9	16.2	13.2	9.54
17.01	7.78	**8.65**	7.08	7.08	6.58	4.87	3.97	2.87
18.01	10.3	**11.7**	9.46	8.87	8.21	5.88	4.79	3.46
19.01	8.54	**9.59**	7.78	7.53	6.97	5.08	4.13	2.99
20.01	12.4	**13.8**	11.3	11.2	10.5	7.70	6.29	4.55
21.01	7.96	**9.10**	7.36	6.45	5.93	4.17	3.39	2.45
22.01	10.2	**11.4**	9.32	9.11	8.45	6.18	5.04	3.64
23.01	29.6	**35.1**	32.5	33.6	32.0	26.0	22.4	16.2
23.02	81.1	**93.5**	85.3	89.1	82.2	67.1	58.1	42.0
23.03	88.8	**102**	93.5	98.3	89.1	73.8	64.2	46.4
23.04	94.4	**109**	99.8	106	96.1	79.5	69.2	50.0
24.01	10.3	**11.4**	9.94	10.3	9.89	7.63	6.33	4.57
24.02	28.8	**32.2**	28.1	29.4	27.1	21.5	18.1	13.1
25.01	5.71	**6.34**	5.63	5.81	5.57	4.33	3.62	2.62
26.01	8.59	**9.86**	7.99	6.81	6.26	4.37	3.55	2.57
27.01	28.7	**32.5**	29.0	29.8	28.7	22.5	18.9	13.6
27.02	48.7	**53.1**	45.2	48.4	45.3	35.0	29.2	21.1
27.03	74.6	**82.3**	73.5	77.1	73.8	58.1	49.1	35.5
28.01	15.5	**17.2**	14.0	13.7	12.7	9.22	7.52	5.43
29.01	26.0	**30.6**	28.3	29.4	28.0	22.7	19.5	14.1
30.01	21.5	**24.9**	22.9	23.6	22.6	18.1	15.5	11.2
31.01	26.1	**28.3**	23.7	24.7	23.2	17.5	14.4	10.4
31.02	40.2	**44.0**	37.1	39.0	36.4	27.9	23.2	16.7
31.03	62.8	**69.5**	61.0	64.0	60.1	47.3	39.8	28.7
31.04	77.6	**86.7**	76.6	80.1	74.4	59.4	50.2	36.3
31.05	95.7	**108**	95.7	100	92.1	74.3	63.4	45.9
31.06	114	**128**	114	120	109	88.8	76.3	55.1
31.07	129	**151**	134	143	125	107	93.1	67.5
31.08	208	**252**	235	250	205	190	170	127
31.09	209	**256**	240	255	207	196	175	133
32.01	12.8	**14.1**	12.3	12.8	12.1	9.40	7.82	5.65
33.01	22.3	**26.0**	23.9	24.7	23.6	19.0	16.2	11.7
34.01	11.3	**13.4**	12.2	12.5	11.9	9.55	8.16	5.90
35.01	9.44	**10.8**	9.73	10.0	9.56	7.57	6.39	4.61
36.01	8.04	**9.05**	7.30	7.04	6.51	4.73	3.85	2.78
37.01	10.72	**12.1**	9.81	9.44	8.73	6.35	5.18	3.74
38.01	11.9	**14.3**	13.3	13.7	13.1	10.6	9.16	6.62
38.02	23.0	**26.0**	23.6	24.6	23.7	18.7	15.9	11.5
38.03	51.9	**58.3**	50.5	54.0	49.8	39.8	34.0	24.6
38.04	97.3	**111**	102	108	100	82.4	71.8	51.9
39.01	9.90	**10.9**	9.20	9.65	9.10	6.95	5.73	4.14
40.01	7.27	**7.90**	6.85	7.15	6.77	5.23	4.33	3.13
40.02	17.8	**19.9**	16.3	16.4	15.0	11.4	9.42	6.81
41.01	5.88	**6.65**	5.44	4.77	4.37	3.08	2.51	1.81
42.01	23.0	27.4	26.3	**28.3**	26.5	22.1	19.6	14.2
42.02	45.4	53.4	50.6	**53.8**	50.5	41.8	36.8	26.6
43.01	19.8	**23.3**	21.8	22.5	21.5	17.4	15.1	10.9
44.01	9.63	**10.7**	8.81	9.05	8.45	6.33	5.18	3.75
45.01	16.2	**18.6**	16.8	17.2	16.4	13.0	11.0	7.94
46.01	20.5	**24.2**	22.7	23.4	22.7	18.2	15.7	11.3
46.02	38.6	**43.5**	39.6	41.6	39.2	31.5	27.1	19.6
47.01	11.7	**13.0**	10.7	10.7	9.97	7.38	6.03	4.36
48.01	11.9	**14.0**	12.9	13.2	12.7	10.1	8.61	6.23
49.01	24.5	31.9	31.2	**35.5**	33.9	28.5	26.4	19.2
50.01	10.1	**11.6**	10.4	10.7	10.3	8.16	6.88	4.97
51.01	8.20	**9.78**	7.55	5.55	5.13	3.45	2.81	2.03
51.02	25.8	**30.3**	24.3	19.4	17.7	12.3	10.0	7.26
51.03	38.7	**43.4**	35.6	33.7	30.6	23.6	19.9	14.4
52.01	14.7	**16.8**	13.8	11.7	10.7	7.44	6.06	4.39
53.01	10.7	**12.6**	10.0	7.90	7.28	4.96	4.03	2.92
54.01	7.09	**7.79**	6.44	6.59	6.17	4.61	3.77	2.73
55.01	14.0	17.4	16.9	**18.7**	17.3	14.6	13.4	9.69
56.01	22.2	**26.2**	24.7	26.0	24.6	20.2	17.6	12.7
56.02	42.2	51.9	50.3	**54.7**	50.9	44.4	40.6	29.8
56.03	47.6	59.1	57.3	**62.3**	57.7	50.8	46.9	34.4
57.01	15.3	18.6	17.9	**19.4**	18.2	15.1	13.5	9.77
58.01	9.77	**10.8**	9.46	9.85	9.36	7.28	6.05	4.37
59.01	5.04	**5.86**	5.47	5.56	5.43	4.30	3.68	2.66

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.01	12.1	14.8	14.2	**15.3**	14.4	11.9	10.7	7.72
60.02	22.5	27.5	27.0	**29.3**	23.6	22.8	21.0	15.6
61.01	11.1	**13.4**	12.5	13.0	12.4	10.1	8.80	6.36
62.01	5.12	**5.89**	5.50	5.64	5.40	4.33	3.72	2.69
63.01	19.1	25.9	26.5	**29.4**	28.0	25.6	25.2	18.6
63.02	30.3	39.1	38.7	**43.7**	41.5	36.8	35.2	25.9
64.01	10.6	12.8	12.2	**13.2**	12.4	10.3	9.18	6.65
65.01	9.82	11.8	11.2	**12.0**	11.3	9.33	8.24	5.96
66.01	9.83	12.6	12.3	**13.7**	12.7	10.8	10.1	7.33
67.01	12.9	16.6	16.3	**18.3**	16.8	14.5	13.5	9.80
67.02	23.3	27.7	27.2	**30.1**	29.6	24.4	22.1	16.1
67.03	62.9	71.5	65.6	**72.5**	69.5	58.2	52.5	38.2
67.04	87.6	**99.9**	84.9	95.2	91.1	75.9	68.0	49.4
67.05	107	**122**	106	119	112	94.7	85.3	62.2
67.06	109	127	114	**128**	120	104	94.3	69.5
67.07	115	134	123	**137**	126	111	102	75.0
68.01	6.48	**7.70**	7.14	7.37	7.14	5.74	4.94	3.57
69.01	17.7	**20.2**	16.4	14.2	13.0	9.06	7.37	5.34
70.01	11.3	**12.3**	10.7	11.4	10.8	8.11	6.68	4.84
70.02	27.1	**30.5**	25.4	25.4	23.5	17.4	14.2	10.3
71.01	10.2	**11.4**	9.65	9.04	8.34	5.92	4.83	3.50
72.01	10.3	**11.8**	9.50	8.97	8.30	5.93	4.83	3.49
73.01	7.79	9.38	9.14	**9.99**	9.39	7.83	7.04	5.10
74.01	22.8	**27.3**	25.7	26.5	26.0	20.8	17.8	12.9
74.02	34.0	40.5	38.5	**40.7**	37.9	31.5	27.8	20.1
74.03	44.8	**52.0**	48.9	51.9	48.0	39.9	35.2	25.5
74.04	51.4	58.8	55.2	**58.8**	55.0	45.3	39.9	28.9
74.05	68.1	79.5	74.9	**80.3**	73.9	61.7	54.9	39.8
74.06	66.9	80.3	76.1	**82.3**	70.6	62.9	57.3	42.4
74.07	66.9	80.4	76.3	**82.5**	70.6	63.1	57.5	42.6
75.01	8.82	**9.68**	8.03	8.41	7.86	5.86	4.80	3.47
76.01	6.49	**7.13**	5.89	6.02	5.62	4.20	3.44	2.49
77.01	11.8	14.5	13.9	**14.8**	14.3	11.6	10.3	7.47
78.01	11.2	15.0	14.9	**16.9**	15.7	13.9	13.4	9.78
78.02	26.5	32.5	31.6	**34.9**	33.0	28.4	26.2	19.1
78.03	36.4	44.9	42.9	**46.3**	43.3	37.7	34.5	25.4
79.01	9.8	**11.7**	11.0	11.5	10.9	8.92	7.77	5.62
80.01	6.55	**7.15**	5.94	6.15	5.75	4.33	3.56	2.57
81.01	8.52	11.1	11.0	**12.5**	11.6	10.2	9.73	7.11
82.01	13.8	18.5	18.3	**20.8**	19.3	17.1	16.4	12.0
82.02	19.1	26.2	26.6	**29.6**	26.9	25.1	24.0	17.9
83.01	9.25	11.9	11.6	**13.1**	12.3	10.4	9.67	7.04
83.02	10.8	13.3	13.1	**14.7**	13.9	11.9	10.9	7.96
84.01	8.28	10.6	10.5	**11.8**	10.9	9.44	8.89	6.48
84.02	8.18	10.7	10.7	**11.7**	10.3	9.74	9.14	6.87
85.01	5.70	**6.73**	5.48	5.34	4.95	3.57	2.91	2.12
85.02	7.43	10.0	9.51	**10.0**	8.34	8.62	8.35	6.28
86.01	7.21	**7.91**	5.43	5.53	5.44	4.15	3.51	2.56
87.01	6.94	9.55	9.76	**10.9**	10.5	9.48	9.33	6.90
87.02	7.62	10.3	10.4	**11.7**	11.3	10.2	9.95	7.36
88.01	5.17	6.73	6.66	**7.59**	7.08	6.15	5.87	4.29
89.01	21.5	27.7	27.3	**30.8**	28.3	24.9	23.6	17.2
89.02	45.2	52.1	49.4	**54.1**	52.0	43.6	39.4	28.6
89.03	64.9	74.9	70.2	**75.6**	72.2	60.3	53.9	39.3
89.04	84.7	99.2	93.9	**102**	95.0	80.5	72.4	52.7
89.05	101	118	112	**121**	112	95.2	85.7	62.5
89.06	114	135	127	**138**	124	107	97.3	71.5
89.07	139	170	163	**177**	156	142	131	97.6
89.08	145	179	172	**188**	164	151	139	104
89.09	149	185	179	**195**	169	157	145	109
89.10	151	188	182	**198**	171	160	147	111
89.11	152	192	186	**202**	173	164	151	115
89.12	157	200	196	**213**	179	173	160	123
89.13	161	207	204	**222**	186	180	168	129
89.14	162	209	206	**224**	187	182	169	131
89.15	180	250	265	**301**	255	266	256	201
89.16	183	255	271	**308**	260	273	263	207
89.17	183	259	277	**315**	266	278	270	212
90.01	6.58	**7.19**	5.97	6.17	5.76	4.33	3.56	2.57
90.02	22.8	**25.3**	22.2	23.3	21.5	17.1	14.5	10.4
91.01	7.85	**8.94**	8.14	8.33	8.01	6.33	5.36	3.87
92.01	13.0	**15.2**	14.0	14.3	13.7	10.9	9.35	6.76
93.01	18.9	22.8	22.2	**24.2**	22.5	18.9	17.0	12.3
94.01	13.7	**16.3**	15.3	15.9	15.1	12.3	10.6	7.69
95.01	9.76	**10.7**	9.03	9.47	8.93	6.80	5.60	4.05
96.01	16.3	22.1	22.0	**24.8**	23.3	20.8	20.1	14.8

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
96.02	24.0	29.4	29.1	**32.7**	31.0	27.2	25.6	18.8
97.01	7.24	**7.95**	6.96	7.23	6.87	5.34	4.44	3.21
98.01	11.0	**13.2**	12.4	13.0	12.3	10.1	8.83	6.38
99.01	5.60	**6.15**	5.38	5.60	5.33	4.13	3.44	2.48
100.01	4.01	4.82	4.59	**4.85**	4.58	3.76	3.34	2.41
101.01	5.17	**5.98**	5.58	5.70	5.51	4.39	3.77	2.72
102.01	6.13	7.41	7.19	**7.88**	7.36	6.14	5.54	4.01
103.01	7.50	**8.89**	8.34	8.65	8.31	6.70	5.82	4.21
104.01	3.11	**3.75**	3.55	3.71	3.60	2.92	2.54	1.84
105.01	15.2	**18.3**	17.3	18.3	17.3	14.2	12.5	9.02
105.02	21.9	**24.5**	22.8	24.2	23.7	18.9	16.3	11.8
105.03	37.1	**42.7**	39.8	42.4	40.0	32.8	28.7	20.8
105.04	38.7	46.5	46.3	**49.6**	42.1	38.8	35.6	26.6
105.05	43.7	55.1	55.8	**59.6**	49.4	48.2	45.0	34.1
105.06	49.2	64.7	65.2	**70.2**	57.6	57.5	54.1	41.3
105.07	61.9	85.7	86.9	**94.3**	79.8	78.7	75.6	57.5
105.08	64.2	90.0	91.4	**99.5**	85.2	83.4	80.4	61.2
105.09	72.6	102	104	**114**	94.9	95.4	90.5	70.2
105.10	70.6	100	105	**116**	97.0	99.0	94.9	74.3
105.11	70.7	100	106	**119**	102	101	97.0	75.7
106.01	7.04	**8.05**	6.46	5.99	5.53	3.95	3.22	2.33
107.01	12.2	**14.7**	13.9	14.6	13.8	11.3	9.90	7.16
108.01	10.4	**11.5**	10.0	10.4	9.92	7.70	6.39	4.62
109.01	10.5	12.6	11.9	**12.6**	11.9	9.81	8.65	6.26
110.01	9.93	**11.7**	10.9	11.2	10.7	8.65	7.46	5.39
111.01	10.9	15.0	15.1	**17.0**	16.1	14.6	14.2	10.5
111.02	21.2	25.0	24.2	**27.2**	26.0	23.0	21.5	15.9
112.01	8.00	**8.73**	7.38	7.75	7.29	5.57	4.59	3.31
113.01	5.77	**6.83**	6.39	6.64	6.31	5.16	4.47	3.23
114.01	7.21	**8.10**	7.23	7.45	7.12	5.60	4.69	3.39
115.01	7.34	**8.03**	7.01	7.29	6.93	5.37	4.46	3.22
116.01	5.82	**6.37**	5.24	5.43	5.09	3.80	3.12	2.25
117.01	7.27	9.35	9.12	**10.2**	9.56	8.16	7.58	5.52
118.01	4.17	**4.67**	4.18	4.27	4.09	3.20	2.69	1.94
119.01	8.65	10.4	10.2	**11.2**	10.5	8.76	7.88	5.71
119.02	16.8	20.5	20.1	**22.2**	21.0	17.7	16.0	11.6
119.03	28.0	34.6	33.8	**37.1**	34.1	30.0	27.8	20.3
119.04	40.6	50.4	48.9	**53.7**	48.1	43.1	39.9	29.3
119.05	45.4	56.9	55.0	**60.4**	53.9	48.6	45.2	33.2
119.06	57.7	72.8	70.7	**77.8**	69.0	63.0	58.7	43.4
119.07	62.5	79.9	78.5	**86.2**	76.2	70.5	66.4	49.0
119.08	60.0	78.5	77.8	**85.4**	72.6	70.2	66.4	50.0
119.09	66.1	89.9	91.4	**100**	82.8	84.5	79.4	61.6
119.10	69.3	94.6	96.3	**105**	86.9	88.6	83.5	64.8
119.11	114	171	193	**218**	182	202	198	157
119.12	115	173	197	**222**	187	207	203	162
119.13	115	173	198	**225**	193	210	206	165
119.14	115	173	198	**225**	193	210	206	165
119.15	129	196	225	**254**	214	238	234	187
119.16	129	197	226	**256**	217	240	237	188
119.17	160	250	285	**318**	275	307	303	239
119.18	160	251	286	**322**	279	310	307	241
119.19	160	251	286	**322**	279	310	307	241
119.20	160	250	286	**324**	281	310	307	241
119.21	161	251	288	**328**	285	312	310	244
119.22	162	305	362	487	**494**	479	488	326
119.23	195	341	407	515	536	534	**541**	367
120.01	7.57	9.54	9.30	**10.4**	9.65	8.21	7.58	5.51
121.01	5.07	**5.50**	4.87	5.05	4.82	3.71	3.09	2.23
122.01	9.83	11.9	11.3	**11.9**	11.4	9.29	8.16	5.91
123.01	6.43	**7.69**	7.17	7.42	7.20	5.80	5.00	3.62
124.01	7.24	**8.22**	7.40	7.58	7.32	5.75	4.82	3.49
125.01	7.07	9.62	9.67	**10.9**	10.4	9.33	9.13	6.72
125.02	14.1	17.7	17.4	**19.4**	18.4	16.2	15.3	11.3
126.01	6.29	**7.67**	7.25	7.52	7.40	5.93	5.14	3.72
127.01	4.59	**5.11**	4.60	4.84	4.65	3.55	2.95	2.14
127.02	5.07	**5.82**	5.37	5.69	4.82	4.15	3.72	2.70
128.01	10.6	11.6	12.5	13.3	**14.6**	13.3	13.7	10.4
128.02	36.7	48.4	49.4	**55.1**	50.9	48.7	46.9	35.8
128.03	54.1	75.5	78.4	**85.1**	71.3	73.6	70.5	54.7
128.04	54.7	77.7	81.8	**89.3**	74.6	78.3	75.5	58.9
128.05	59.4	84.4	91.6	**102**	86.3	89.8	87.2	69.5
128.06	59.9	85.6	94.6	**109**	95.9	94.7	92.6	75.5
128.07	61.0	88.0	99.2	**115**	104	102	101	82.4
128.08	61.0	88.2	100	**117**	108	104	104	84.6
128.09	61.2	88.8	102	**120**	110	107	108	86.9

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.10	61.9	90.1	104	**123**	115	112	113	90.6
128.11	61.9	90.1	104	**124**	115	112	113	90.8
128.12	62.1	90.5	105	**125**	117	114	115	92.4
129.01	9.6	12.6	12.4	**14**	13.1	11.2	10.5	7.67
129.02	17.0	20.1	19.4	**22**	20.6	17.4	15.9	11.6
129.03	26.0	32.2	31.8	**36**	33.4	29.3	27.4	20.2
130.01	6.28	**7.07**	6.35	6.55	6.37	4.95	4.14	3.00
131.01	8.63	10.7	10.4	**12.1**	11.9	10.1	9.54	6.99
132.01	9.78	11.9	11.4	**12.4**	11.8	9.74	8.69	6.30
132.02	16.5	20.1	19.3	**20.8**	18.9	16.1	14.6	10.6
132.03	22.0	26.4	25.3	**27.4**	24.9	21.2	19.2	13.9
132.04	25.2	31.5	31.2	**33.4**	28.3	27.0	24.7	18.8
132.05	25.1	31.6	31.5	**33.7**	28.3	27.4	25.0	19.2
133.01	4.60	**5.58**	5.28	5.43	5.33	4.25	3.69	2.68
134.01	5.83	**6.88**	6.39	6.48	6.41	5.04	4.29	3.11
135.01	6.15	**7.18**	6.60	6.70	6.61	5.19	4.38	3.17
136.01	7.52	**8.28**	6.47	6.67	6.27	4.60	3.79	2.76
136.02	6.04	6.48	5.64	6.90	**7.23**	5.96	5.85	4.45
137.01	5.27	7.25	7.50	**8.53**	8.47	7.39	7.32	5.42
137.02	13.5	14.7	12.4	14.3	**14.9**	12.3	11.5	8.46
137.03	9.38	12.9	12.8	**14.8**	14.8	13.0	12.6	9.35
137.04	12.2	15.9	15.8	18.2	**18.4**	16.0	15.2	11.3
137.05	13.6	18.2	18.6	**20.9**	20.4	19.0	18.4	13.8
138.01	4.39	**4.79**	4.50	4.57	4.66	3.66	3.16	2.29
139.01	5.98	**6.62**	4.29	4.00	3.77	2.73	2.26	1.65
140.01	8.10	**8.90**	6.16	4.80	4.45	3.06	2.51	1.84
141.01	7.39	**8.11**	6.32	6.54	6.67	5.17	4.47	3.25
141.02	14.9	**16.0**	12.3	12.4	12.4	9.47	8.10	5.91
141.03	18.7	**20.3**	15.0	14.7	14.4	11.0	9.39	6.85
141.04	17.5	**20.3**	15.7	16.5	16.3	12.7	11.0	8.03
142.01	3.09	**3.39**	2.29	1.73	1.60	1.10	0.90	0.66
143.01	0.78	0.96	0.92	**0.97**	0.94	0.77	0.67	0.49
144.01	8.85	**9.69**	8.27	9.54	9.54	7.80	7.14	5.21
144.02	8.95	10.14	9.80	**11.1**	10.93	9.16	8.55	6.26
145.01	3.39	**4.13**	3.92	4.07	4.00	3.21	2.79	2.02
146.01	4.19	5.74	5.69	**6.60**	6.52	5.63	5.47	4.02
147.01	3.54	**3.83**	2.58	2.90	3.05	2.46	2.25	1.65
148.01	13.0	**14.2**	9.55	9.98	9.78	7.41	6.25	4.55
148.02	9.52	**11.2**	9.11	9.54	9.39	7.46	6.52	4.77
149.01	6.52	**7.14**	5.49	5.15	4.81	3.46	2.84	2.07
149.02	6.99	**7.80**	5.99	5.55	5.12	3.75	3.07	2.24
150.01	8.49	12.0	12.8	**13.8**	13.7	12.6	12.7	9.46
150.02	9.31	13.2	14.2	**15.5**	14.4	14.3	14.1	10.7
150.03	13.0	17.9	18.8	**20.8**	19.5	19.3	19.0	14.5
150.04	13.0	17.9	18.8	**20.9**	19.5	19.4	19.1	14.6
150.05	18.6	26.5	27.6	**30.4**	27.1	28.5	27.9	21.7
151.01	4.09	**4.48**	4.17	4.45	4.46	3.57	3.15	2.29
152.01	8.41	**9.23**	6.16	7.25	7.56	6.15	5.75	4.23
152.02	7.28	8.50	7.33	8.44	**8.50**	7.16	6.76	5.00
152.03	6.50	7.69	7.83	**8.88**	7.91	7.76	7.29	5.71
152.04	6.90	8.85	9.01	**10.2**	8.57	9.43	8.92	7.14
153.01	13.1	16.3	15.8	**17.8**	17.4	14.3	12.9	9.42
153.02	23.1	29.0	28.8	**31.7**	30.0	27.0	25.6	19.1
153.03	28.4	35.7	35.1	**38.0**	35.9	32.9	31.3	23.2
153.04	39.6	50.2	49.3	**53.8**	50.3	45.5	43.4	32.1
153.05	50.6	62.9	61.7	**67.4**	62.8	56.4	53.3	39.4
153.06	57.1	73.9	73.5	**79.5**	70.9	67.3	63.2	47.8
153.07	57.1	74.0	74.0	**79.9**	71.0	67.8	63.5	48.2
153.08	61.4	79.6	79.4	**85.9**	74.8	73.1	68.1	52.0
154.01	7.34	**8.29**	7.45	7.64	7.43	5.80	4.85	3.51
155.01	5.15	**6.21**	5.94	6.00	6.08	4.74	4.07	2.96
156.01	10.8	13.9	13.6	**15.3**	14.2	12.1	11.3	8.26
157.01	8.42	**10.0**	9.46	9.71	9.54	7.61	6.55	4.74
158.01	4.64	**5.52**	5.17	5.28	5.13	4.10	3.54	2.56
159.01	5.31	**5.72**	5.13	5.49	5.20	3.92	3.24	2.35
159.02	6.21	**6.95**	6.23	6.45	6.09	4.80	4.03	2.93
160.01	2.58	**2.86**	2.09	2.41	2.46	1.99	1.82	1.33
160.02	7.18	**7.48**	5.71	5.69	5.84	4.48	3.93	2.88
160.03	9.52	**10.8**	8.42	8.06	8.17	6.21	5.42	3.98
160.04	9.59	**11.0**	8.53	8.12	8.21	6.26	5.46	4.01
161.01	117	209	233	**316**	273	243	239	165
161.02	116	208	233	**316**	273	244	239	165
161.03	115	208	233	**316**	274	246	240	167
162.01	2.96	**3.30**	2.90	2.99	2.84	2.23	1.86	1.34
163.01	8.97	**10.6**	9.85	10.12	9.82	7.86	6.73	4.87
163.02	19.0	**22.5**	21.3	22.5	21.2	17.5	15.4	11.1

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
163.03	31.2	40.4	39.9	**43.7**	39.2	37.2	35.3	26.5
163.04	37.4	48.9	48.8	**53.2**	46.3	45.3	42.4	32.4
163.05	45.8	61.4	66.5	**73.4**	65.5	69.4	66.9	51.6
163.06	45.6	61.4	66.9	**74.0**	65.9	69.9	67.4	52.1
163.07	46.3	64.2	71.3	**79.0**	69.0	74.9	72.4	56.2
163.08	45.6	63.7	71.0	**78.9**	68.5	74.6	72.6	56.2
164.01	9.42	11.3	10.8	**11.6**	11.0	9.07	8.05	5.83
165.01	8.18	10.4	10.1	**11.3**	10.7	8.97	8.25	6.00
166.01	5.75	6.88	6.65	**7.15**	6.84	5.62	4.98	3.60
167.01	5.85	9.28	11.1	12.8	13.3	14.6	**14.8**	11.7
168.01	5.38	**6.30**	5.93	6.06	5.91	4.71	4.05	2.93
169.01	9.76	11.8	11.4	**12.3**	11.5	9.58	8.58	6.21
169.02	13.5	17.0	16.6	18.9	**20.3**	18.2	18.7	14.2
169.03	13.6	17.3	17.0	19.2	**20.3**	18.7	19.0	14.5
170.01	4.90	5.89	5.74	**6.51**	6.40	5.25	4.82	3.51
170.02	6.72	8.92	9.04	**10.1**	9.33	8.48	8.09	5.96
170.03	9.57	13.8	14.7	**16.1**	14.6	14.9	14.5	11.2
171.01	10.5	15.1	15.8	**17.3**	16.7	15.6	15.5	11.5
171.02	13.0	19.7	21.4	**23.5**	21.9	22.9	22.4	17.5
171.03	19.9	29.5	31.8	**34.9**	32.4	33.7	33.1	25.6
171.04	21.4	32.2	35.0	**38.3**	35.9	37.4	36.9	28.6
171.05	29.6	44.5	49.1	**54.1**	50.1	53.3	52.4	40.7
171.06	29.7	44.7	49.5	**54.7**	50.2	53.7	52.8	41.2
172.01	4.70	6.32	6.25	**7.12**	6.87	5.84	5.54	4.04
173.01	5.07	5.53	5.61	6.39	**6.59**	5.67	5.61	4.15
174.01	3.44	**3.80**	3.14	3.41	3.27	2.47	2.05	1.49
175.01	4.96	7.72	8.73	9.47	9.60	9.95	**10.1**	7.81
175.02	8.49	12.7	14.2	**15.4**	14.8	15.4	15.3	11.8
176.01	3.74	5.27	5.42	**6.12**	6.02	5.32	5.29	3.90
177.01	3.79	5.63	5.99	6.43	**6.65**	6.03	6.13	4.59
178.01	5.86	**6.37**	5.46	5.73	5.44	4.15	3.44	2.48
178.02	10.7	**11.6**	10.1	10.5	10.0	7.67	6.36	4.60
179.01	6.13	8.55	8.98	10.0	**10.1**	8.95	8.90	6.61
179.02	16.3	21.4	21.1	**24.2**	23.3	20.4	19.5	14.4
179.03	18.0	24.9	25.4	**28.3**	26.1	25.1	24.7	18.6
179.04	17.9	25.9	28.4	**31.9**	28.7	30.3	29.9	23.2
179.05	19.4	28.6	32.3	**37.7**	34.0	35.1	35.1	27.5
179.06	21.6	32.4	37.3	**44.4**	41.4	42.4	42.7	33.5
179.07	35.8	36.0	38.4	51.9	**53.8**	47.6	49.0	37.5
180.01	5.66	7.37	7.29	**8.30**	7.86	6.67	6.28	4.58
181.01	12.3	**13.0**	8.04	6.84	7.25	5.63	5.09	3.76
182.01	4.29	**4.87**	4.40	4.48	4.33	3.39	2.85	2.06
182.02	7.06	9.01	8.87	**9.70**	8.97	8.56	8.20	6.11
183.01	3.19	3.45	4.21	5.21	6.00	6.15	**6.38**	4.97
184.01	29.4	**32.0**	19.4	14.1	14.2	10.4	9.19	6.87
185.01	17.5	**18.9**	11.2	8.24	7.67	5.37	4.44	3.28
186.01	7.45	**8.16**	4.86	4.24	4.05	2.98	2.49	1.83
186.02	9.46	**10.4**	7.58	6.31	6.07	4.42	3.72	2.73

APPENDIX L

TUFLOW MODEL RESULTS FOR CLIMATE CHANGE ASSESSMENT

SENSITIVITY ASSESSMENT SUMMARY - 1% AEP

Tributary and Location	Peak 1% AEP Water Elevation (mAHD)					
	'Base' Case	10% Rainfall Increase	20% Rainfall Increase	30% Rainfall Increase	Sea Level Rise of 0.4m	Sea Level Rise of 0.9m
Ourimbah-Platypus Creek Rd	34.59	34.81	35.00	35.18	34.59	34.59
Ourimbah-Lyrebird Lane	29.80	29.97	30.12	30.28	29.80	29.80
Ourimbah-Moores Point Road	21.60	21.78	21.96	22.13	21.60	21.60
Ourimbah-Footes Road	16.98	17.22	17.47	17.70	16.97	16.98
Ourimbah-Palmdale Road	14.12	14.32	14.52	14.71	14.11	14.12
Ourimbah-Sydney-Newcastle Freeway	12.38	12.63	12.84	13.09	12.38	12.38
Ourimbah-Pacific Highway	12.23	12.44	12.66	12.87	12.22	12.22
Ourimbah-Main Northern Railway	7.80	8.24	8.60	8.92	7.79	7.80
Ourimbah-Wyong Road	4.49	4.75	4.97	5.15	4.49	4.50
Ourimbah-Tuggerah Lake	2.29	2.30	2.30	2.30	2.68	3.22
Kangy Angy-Prestons Road	11.53	11.73	11.92	12.12	11.53	11.53
Kangy Angy-Sydney-Newcastle Freeway	11.11	11.37	11.62	11.88	11.11	11.11
Kangy Angy-Pacific Highway	11.01	11.25	11.48	11.70	11.01	11.01
Windy Drop Down-Sydney-Newcastle Freeway	11.59	11.83	12.07	12.32	11.59	11.59
Chittaway-Berrys Lane	19.62	19.70	19.86	19.94	19.62	19.62
Chittaway-Orange Road	15.60	15.71	15.82	15.90	15.60	15.60
Chittaway-Old Chittaway Road	13.38	13.45	13.51	13.56	13.38	13.38
Chittaway-Enterprise Drive	12.29	12.40	12.51	12.63	12.29	12.29
Chittaway-Main Northern Railway	12.28	12.38	12.49	12.60	12.28	12.28
Bangalow Floodrunner-Sydney-Newcastle Freeway	13.62	13.92	14.18	14.42	13.62	13.62
Bangalow Floodrunner-Pacific Highway	13.28	13.54	13.76	13.95	13.28	13.28
Bangalow Floodrunner-Bridge Street	12.41	12.50	12.60	12.72	12.41	12.41
Dog Trap-Dog Trap Road	19.91	19.96	20.02	20.07	19.91	19.91
Dog Trap-Pacific Highway	17.86	17.89	17.93	17.99	17.86	17.86
Dog Trap-Main Northern Railway	16.36	16.67	16.83	16.97	16.36	16.36
Cut Rock-Detention Basin	24.47	24.49	24.51	24.53	24.47	24.47
Cut Rock-Tuggerah Street	23.86	23.89	23.93	23.97	23.86	23.86
Cut Rock-Cox Street (Tall Timbers)	22.47	22.58	22.72	22.85	22.47	22.47
Cut Rock-Main Northern Railway (upstream)	22.38	22.49	22.65	22.78	22.38	22.38
Cut Rock-Pacific Highway (upstream)	21.99	22.03	22.18	22.28	21.99	21.99
Cut Rock-Teralba Street	20.72	20.78	20.89	20.97	20.72	20.72
Cut Rock-Pacific Highway (downstream)	20.36	20.45	20.59	20.69	20.36	20.36
Cut Rock-Main Northern Railway (downstream)	20.25	20.34	20.48	20.57	20.25	20.25
Bangalow-Pryor Road	25.56	25.70	25.80	25.84	25.56	25.56
Bangalow-Coachwood Drive	24.11	24.19	24.27	24.34	24.11	24.11
Bangalow-Baileys Road	21.57	21.67	21.77	21.86	21.57	21.57
Bangalow-Shirley Street	16.57	16.64	16.73	16.84	16.57	16.57
Bangalow-Chittaway Road	16.07	16.16	16.27	16.40	16.07	16.07
Bangalow-Main Northern Railway	15.02	15.18	15.33	15.50	15.02	15.02
Bangalow-Burns Road	14.81	14.95	15.09	15.25	14.81	14.81

Appendix M

XP-RAFTS Model Results for Sensitivity Analyses

SMENT SUMMARY - 1% AEP

Peak Discharge (m^3/s)				
Existing	10mm/hr Pervious 0mm/hr Impervious **Initial Loss**	30mm/hr Pervious 3mm/hr Impervious **Initial Loss**	2.5mm/hr Pervious 0mm/hr Impervious **Continuing Loss**	5mm/hr Pervious 2.5mm/hr Impervious **Continuing Loss**
15.0	15.4	14.5	15.4	14.7
27.0	28.7	25.1	27.9	26.4
41.1	43.0	37.9	42.3	40.1
51.7	54.2	49.4	53.2	50.6
89.3	94.4	86.7	92.0	87.3
114	121	113	118	112
142	149	140	146	138
158	165	153	162	154
178	187	171	183	174
189	200	181	195	185
231	249	221	238	226
243	261	230	250	238
247	265	233	255	242
255	273	238	263	249
262	279	244	270	256
275	290	256	283	268
338	357	315	348	330
383	401	356	394	374
388	407	360	400	378
394	414	366	407	384
571	597	532	589	557
576	603	536	595	562
588	615	547	608	573
592	619	551	612	576
609	637	566	630	593
618	646	575	639	602
620	648	577	641	604
625	653	581	646	608
643	673	599	666	625
644	674	600	667	626
653	684	609	677	635
648	679	604	672	630
658	689	612	682	639
660	692	615	685	641
663	695	617	689	643
688	722	639	717	666
711	749	660	743	687
708	745	658	740	684
711	749	660	744	687
708	746	657	740	683
709	746	657	741	684
709	747	658	742	684
709	748	658	743	685
710	748	658	743	685
711	750	660	745	686
711	751	660	745	686
709	749	658	744	684
531	555	501	552	517
610	626	609	648	586
610	626	609	648	586
941	942	939	1005	894
944	945	942	1008	897
944	945	942	1008	897
946	947	944	1010	899
965	965	965	1034	912
967	967	967	1036	914
972	972	972	1042	918

973	973	973	1043	919
1000	1000	1000	1071	944
998	998	998	1069	941
8.51	9.5	8.51	8.76	8.33
8.24	9.5	7.14	8.36	8.14
18.3	19.6	18.3	19.0	17.7
34.6	36.9	34.3	35.7	33.8
12.7	13.4	12.7	13.3	12.3
22.9	22.9	22.9	23.7	22.3
4.03	4.45	3.76	4.10	3.96
16.1	16.5	15.4	16.6	15.8
28.0	30.1	26.9	28.8	27.5
3.36	3.86	2.98	3.42	3.31
10.6	12.1	9.58	10.8	10.4
19.3	21.7	18.5	19.8	19.0
6.69	7.91	5.57	6.80	6.60
11.8	14.0	10.2	12.0	11.6
23.4	27.5	20.1	23.8	23.1
36.1	42.2	31.5	36.7	35.6
53.2	61.6	47.0	54.3	52.5
6.31	7.24	5.02	6.41	6.24
7.00	8.28	6.18	7.14	6.91
8.76	10.2	7.85	8.93	8.63
4.62	5.53	3.88	4.70	4.56
12.2	14.5	10.4	12.4	12.0
20.1	24.1	17.1	20.5	19.9
5.56	6.61	4.94	5.66	5.49
7.58	9.00	6.35	7.71	7.49
6.18	7.37	5.33	6.31	6.09
9.00	10.6	7.90	9.18	8.88
5.98	6.94	4.78	6.08	5.90
7.42	8.79	6.40	7.56	7.32
24.5	26.8	23.6	25.2	24.0
64.8	71.5	61.6	66.5	63.5
71.3	78.2	67.6	73.2	69.9
76.5	83.4	72.5	78.6	74.9
7.80	8.75	7.29	7.98	7.67
21.7	24.7	20.3	22.1	21.3
4.36	4.84	4.07	4.45	4.29
6.54	7.52	5.22	6.65	6.46
22.3	25.0	21.4	22.7	21.9
36.1	41.1	33.8	36.8	35.5
56.6	63.6	54.7	57.8	55.7
11.2	13.3	9.6	11.4	11.1
21.4	23.4	20.7	22.0	21.0
17.2	19.2	16.5	17.7	16.8
19.0	22.0	17.1	19.4	18.7
29.6	34.0	27.0	30.2	29.2
47.3	53.6	44.2	48.3	46.6
58.8	66.9	55.4	60.0	57.8
72.7	82.9	69.3	74.7	71.3
87.1	98.8	82.7	89.5	85.5
103	116	97.7	106	101.2
181	195	170	187	177
185	197	174	191	181
9.64	10.9	8.96	9.84	9.49
18.0	20.0	17.3	18.5	17.6
9.09	10.1	8.76	9.33	8.91
7.25	8.28	7.00	7.45	7.12
5.78	6.92	5.01	5.91	5.70
7.86	9.3	6.69	8.00	7.76
9.98	10.8	9.58	10.3	9.79
17.7	19.9	17.4	18.2	17.4

38.9	44.6	36.9	39.9	38.2
78.0	85.0	73.8	80.2	76.4
7.33	8.34	6.71	7.49	7.21
5.40	6.08	5.00	5.51	5.31
12.9	15.3	11.3	13.2	12.8
4.35	5.11	3.52	4.41	4.30
20.6	21.2	19.4	21.2	20.2
39.0	41.0	37.1	40.1	38.2
16.4	17.7	15.7	16.9	16.1
6.99	8.19	6.27	7.14	6.88
12.6	14.2	12.0	12.9	12.4
17.0	18.5	16.6	17.5	16.7
30.0	33.4	28.6	30.8	29.4
8.49	10.0	7.50	8.66	8.37
9.58	10.7	9.28	9.84	9.39
24.9	26.3	24.8	25.7	24.3
7.80	8.87	7.54	8.02	7.65
6.72	7.40	5.49	6.82	6.66
20.3	23.2	16.2	20.5	20.1
29.3	33.5	24.3	29.8	28.9
11.2	12.9	8.89	11.4	11.1
8.36	9.56	6.78	8.49	8.27
5.09	5.98	4.57	5.19	5.02
13.3	13.9	12.5	13.7	13.0
19.0	20.3	18.1	19.5	18.6
38.8	40.5	36.7	40.0	38.0
44.1	46.1	41.6	45.5	43.1
14.0	14.5	13.2	14.4	13.7
7.36	8.31	6.88	7.54	7.23
4.06	4.52	3.92	4.17	3.98
11.1	11.4	10.4	11.4	10.8
21.2	21.9	19.8	21.7	20.7
9.49	10.1	9.07	9.75	9.30
4.11	4.56	3.95	4.22	4.03
20.3	21.7	20.2	21.2	19.7
30.3	32.4	30.0	31.3	29.5
9.55	9.8	8.99	9.84	9.34
8.72	9.0	8.31	8.97	8.54
9.57	10.1	9.17	9.87	9.36
12.7	13.5	12.1	13.1	12.40
21.5	22.4	21.5	22.3	20.9
51.3	55.6	50.1	52.8	50.1
67.8	77.4	66.1	69.7	66.4
84.3	94	81.9	86.7	82.5
90.4	98	86.4	93.1	88.4
96.9	103	90.5	100	94.7
5.37	5.81	5.23	5.51	5.26
13.4	15.5	10.6	13.6	13.2
8.49	9.5	8.03	8.66	8.35
19.7	23.7	17.7	20.0	19.4
7.47	8.9	6.52	7.58	7.36
7.61	9.07	6.41	7.74	7.52
7.17	7.44	6.77	7.39	7.01
19.3	21.0	19.1	19.9	18.9
29.5	31.0	27.8	30.3	28.8
37.5	39.9	35.4	38.5	36.6
42.5	45.2	40.0	43.7	41.6
57.6	60.9	54.1	59.2	56.3
58.6	61.5	54.8	60.4	57.3
58.7	61.6	54.9	60.5	57.4
6.34	7.40	5.81	6.47	6.24
4.66	5.47	4.16	4.75	4.59
10.8	11.1	10.3	11.1	10.5

11.4	12.4	11.2	11.8	11.1
24.5	25.8	23.6	25.3	23.9
32.2	33.9	30.9	33.3	31.4
8.39	8.94	8.04	8.62	8.23
4.72	5.49	4.24	4.81	4.65
8.58	9.20	8.43	8.85	8.39
14.1	15.2	13.8	14.6	13.7
20.4	21.7	19.2	21.1	19.9
9.18	9.68	8.99	9.45	8.97
10.4	10.9	10.1	10.7	10.13
8.17	8.70	7.85	8.43	7.96
8.26	8.77	7.55	8.54	8.04
4.47	5.20	3.81	4.50	4.41
7.12	7.65	6.66	7.33	6.91
5.77	6.18	5.39	5.78	5.70
7.48	8.02	7.47	7.85	7.23
8.10	8.66	8.09	8.49	7.84
5.20	5.58	5.06	5.37	5.06
21.3	22.8	20.6	22.0	20.9
38.9	40.5	37.8	40.0	38.1
54.5	57.4	52.3	56.0	53.4
72.7	75.7	68.8	74.9	71.2
86.3	90	80.9	88.9	84.5
97.2	102	90.8	100	95.2
125	132	116	129	122
132	139	122	136	129
136	144	126	140	133
138	146	128	143	135
141	149	131	145	137
148	157	138	153	145
153	163	142	158	149
154	164	143	160	151
202	214	191	210	196
207	219	196	214	201
211	225	199	220	204
4.73	5.52	4.26	4.83	4.67
16.9	19.4	16.0	17.3	16.7
6.04	6.86	5.82	6.20	5.93
10.4	11.6	10.0	10.7	10.2
17.4	18.0	16.2	17.9	17.0
11.6	12.5	11.1	11.9	11.3
7.19	8.21	6.57	7.36	7.08
16.9	18.3	16.6	17.5	16.5
22.7	24.2	22.1	23.4	22.2
5.43	6.10	5.08	5.54	5.35
9.47	10.0	9.02	9.74	9.28
4.22	4.69	3.88	4.31	4.16
3.54	3.63	3.33	3.64	3.47
4.16	4.62	4.00	4.27	4.08
5.65	5.85	5.33	5.81	5.53
6.29	6.73	6.02	6.46	6.17
2.72	2.87	2.67	2.79	2.66
13.3	13.9	12.6	13.7	13.1
17.5	18.8	17.3	17.9	17.1
30.6	32.6	29.2	31.5	30.0
35.5	37.2	33.1	36.7	34.7
42.0	44.2	39.2	43.5	41.1
49.1	51.8	45.8	50.9	48.0
65.0	68.8	60.4	67.4	63.5
68.4	72.4	63.4	70.9	66.7
78.0	82.6	72.2	80.9	76.0
79.4	84.3	73.4	82.6	77.2
81.2	86.2	75.1	84.6	78.9

5.15	6.14	4.64	5.23	5.09
10.6	11.1	10.1	10.9	10.4
7.88	8.84	7.32	8.06	7.75
9.20	9.5	8.73	9.46	9.02
8.18	8.94	7.87	8.40	8.02
11.5	12.4	11.4	12.0	11.2
18.9	20.2	18.8	19.6	18.5
5.84	6.67	5.37	5.96	5.75
4.84	5.22	4.65	4.98	4.75
5.50	6.19	5.24	5.62	5.42
5.49	6.17	5.13	5.60	5.41
4.18	4.84	3.78	4.25	4.12
7.13	7.56	6.87	7.36	6.94
3.21	3.61	3.01	3.28	3.16
8.05	8.34	7.63	8.29	7.87
15.8	16.5	15.2	16.3	15.4
26.2	27.6	24.5	27.1	25.6
37.7	39.7	35.0	39.0	36.8
42.3	44.6	39.3	43.7	41.3
54.4	57.4	50.5	56.3	53.1
60.2	63.6	55.9	62.3	58.7
59.6	63.0	55.2	61.7	58.0
69.5	73.5	64.4	72.0	67.6
73.0	77.3	67.4	75.7	70.6
148	158	142	154	142
151	161	145	157	145
153	163	146	159	147
153	163	147	159	147
173	184	167	180	166
174	185	169	181	167
217	230	217	228	208
220	233	220	231	210
220	233	220	231	210
220	234	220	231	211
222	236	222	233	213
302	303	302	330	282
346	346	346	376	320
7.28	7.69	6.93	7.52	7.10
3.82	4.26	3.53	3.90	3.76
8.68	9.0	8.34	8.92	8.50
5.41	5.80	5.27	5.55	5.30
5.59	6.29	5.40	5.70	5.50
7.46	8.06	7.45	7.82	7.21
13.5	14.5	13.3	14.0	13.2
5.50	5.82	5.41	5.64	5.39
3.57	3.95	3.45	3.64	3.50
4.16	4.52	3.93	4.26	4.07
10.5	10.6	10.4	11.0	10.11
37.9	40.7	36.2	39.2	36.8
59.2	62.8	54.9	61.4	57.6
61.9	65.5	57.4	64.1	60.0
70.9	75.0	65.9	73.6	68.5
74.8	79.2	70.2	77.7	72.1
79.2	83.8	76.3	82.4	76.3
80.9	85.4	78.9	84.1	77.8
82.4	87.1	80.5	85.7	79.2
85.1	89.8	84.2	88.5	81.7
85.2	90.0	84.4	88.7	81.8
86.2	91.0	85.9	89.8	82.8
9.67	10.3	9.46	10.0	9.44
15.3	16.1	14.8	15.7	15.0
24.8	26.4	24.1	25.6	24.2
4.85	5.39	4.67	4.95	4.76

8.59	8.94	8.59	8.91	8.31
9.01	9.3	8.66	9.26	8.81
14.8	15.4	13.8	15.2	14.4
19.5	20.3	18.2	20.1	19.1
24.2	25.2	22.6	24.9	23.6
24.4	25.4	22.7	25.1	23.7
3.98	4.22	3.86	4.09	3.89
4.73	5.28	4.67	4.85	4.63
4.87	5.48	4.84	5.00	4.77
5.82	6.53	5.30	5.84	5.76
4.88	5.09	4.83	5.03	4.82
6.09	6.23	6.08	6.32	5.88
10.9	11.7	10.9	11.3	10.6
9.62	13.6	9.53	12.5	12.14
12.3	12.9	12.2	13.0	11.6
13.9	14.9	13.7	14.6	13.1
3.46	3.82	3.46	3.54	3.38
4.81	5.11	4.55	4.82	4.75
6.52	7.04	6.03	6.53	6.44
5.88	6.39	5.43	5.89	5.81
11.2	12.3	10.8	11.3	11.1
14.5	15.8	13.5	14.5	14.3
14.0	15.6	12.6	14.1	13.8
2.45	2.67	2.31	2.46	2.42
0.71	0.73	0.69	0.73	0.69
7.05	7.65	6.99	7.19	6.98
7.88	8.21	7.88	8.15	7.61
2.99	3.16	2.96	3.06	2.92
4.62	4.80	4.62	4.81	4.47
2.82	2.96	2.71	2.83	2.79
10.4	11.1	9.76	10.4	10.3
7.95	8.77	7.22	7.99	7.83
5.09	5.65	4.62	5.11	5.03
5.51	6.22	4.91	5.54	5.46
9.74	10.1	9.71	10.2	9.41
10.6	11.4	10.5	11.0	10.3
14.2	15.3	14.2	14.7	13.8
14.3	15.4	14.3	14.8	13.9
20.8	22.0	20.8	21.6	20.1
3.31	3.56	3.31	3.39	3.22
6.78	7.19	6.41	6.80	6.71
6.03	6.44	6.03	6.21	5.84
6.06	6.47	5.66	6.23	5.86
6.97	7.42	6.75	7.19	6.72
12.7	13.2	12.7	13.1	12.4
22.3	23.6	21.4	23.0	21.7
27.1	28.6	25.9	27.9	26.4
37.7	40.2	36.0	38.9	36.7
47.7	50.4	44.6	49.2	46.5
56.2	59.3	51.9	58.0	54.6
56.4	59.6	52.1	58.2	54.8
60.9	64.2	56.5	62.8	59.4
5.66	6.34	5.50	5.77	5.57
4.44	4.73	4.44	4.55	4.33
10.6	11.3	10.2	11.0	10.4
7.08	7.67	6.96	7.26	6.93
3.86	4.20	3.71	3.96	3.78
4.03	4.45	3.84	4.11	3.96
4.73	5.33	4.51	4.81	4.63
2.06	2.18	1.94	2.06	2.03
5.42	5.81	5.31	5.43	5.34
7.61	8.32	7.10	7.65	7.49
7.64	8.36	7.13	7.68	7.52

178	194	157	191	168
178	194	157	191	168
177	193	157	191	167
2.25	2.54	2.12	2.30	2.22
7.37	8.12	7.18	7.56	7.22
16.3	17.2	15.4	16.8	16.0
30.7	32.4	28.2	31.7	29.9
37.2	39.4	34.3	38.5	36.2
50.2	53.0	48.6	52.2	48.7
50.6	53.5	48.8	52.5	49.1
53.9	56.8	51.2	56.0	52.1
53.7	56.7	51.4	56.0	51.9
8.45	8.68	8.03	8.69	8.29
7.98	8.40	7.72	8.23	7.78
5.21	5.34	4.96	5.35	5.10
10.6	10.6	10.6	11.2	10.21
4.43	4.86	4.29	4.54	4.34
8.89	9.2	8.39	9.15	8.71
14.3	14.5	14.1	15.0	13.7
14.2	14.5	14.0	15.0	13.6
4.58	4.82	4.58	4.73	4.45
6.99	7.44	6.80	7.21	6.80
11.1	11.8	10.9	11.5	10.7
11.8	12.7	11.8	12.4	11.5
16.7	17.2	16.7	17.5	16.1
24.7	25.6	24.7	25.8	23.8
27.4	28.1	27.3	28.6	26.3
38.6	39.6	38.5	40.4	37.1
38.9	40.0	38.8	40.7	37.4
4.90	5.26	4.90	5.09	4.74
4.67	4.67	4.66	4.85	4.51
2.68	3.01	2.45	2.69	2.65
7.36	7.36	7.36	7.71	7.10
11.1	11.3	11.1	11.7	10.7
4.24	4.42	4.24	4.43	4.10
4.68	4.69	4.66	4.91	4.50
4.35	4.84	3.98	4.44	4.29
8.01	8.92	7.35	8.17	7.88
7.23	7.32	7.22	7.54	6.98
16.7	17.7	16.7	17.4	16.1
19.4	20.8	18.6	20.0	18.9
22.0	23.1	21.9	22.9	21.0
25.7	27.2	25.4	26.7	24.7
30.8	32.0	30.8	32.5	29.3
36.7	36.9	36.5	38.4	34.7
5.74	6.09	5.68	5.91	5.60
9.88	10.1	9.64	9.89	9.77
3.34	3.76	3.19	3.41	3.28
6.76	7.12	6.56	6.98	6.58
4.53	4.53	4.53	4.81	4.31
24.0	24.2	23.8	24.0	23.7
14.4	14.7	14.3	14.4	14.3
6.07	6.30	5.91	6.07	6.00
7.55	7.87	7.28	7.55	7.43

PEAK DESIGN FLOOD DISCHARGES - Sensitivity - 10mm/hr Pervious and 0mm/hr Impervious Initial Losses

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	12.5	15.1	14.7	**15.4**	14.5	11.9	10.8	7.78
1.02	22.3	27.9	26.8	**28.7**	24.7	22.4	20.9	15.2
1.03	34.9	41.8	39.9	**43.0**	37.8	33.3	31.0	22.5
1.04	44.3	52.6	50.6	**54.2**	49.4	42.8	39.8	28.9
1.05	76.3	90.5	87.6	**94.4**	86.7	76.0	71.2	52.0
1.06	100	114	111	**121**	113	98.4	92.4	67.7
1.07	127	144	138	**149**	140	121	112	82.1
1.08	144	163	155	**165**	153	134	124	90.8
1.09	164	**187**	175	187	171	151	139	102
1.10	174	**200**	186	198	181	160	148	109
1.11	215	**249**	227	243	221	195	179	132
1.12	224	**261**	240	255	230	205	190	140
1.13	227	**265**	244	260	233	208	193	142
1.14	232	**273**	252	268	238	215	199	147
1.15	235	**279**	259	275	244	221	205	152
1.16	244	**290**	272	288	250	231	215	160
1.17	293	**357**	337	354	302	284	266	198
1.18	324	**401**	382	401	337	321	302	225
1.19	318	399	386	**407**	334	329	311	235
1.20	320	403	392	**414**	337	334	316	239
1.21	467	585	569	**597**	473	470	441	337
1.22	465	586	573	**603**	477	475	445	341
1.23	464	589	582	**615**	489	482	455	349
1.24	463	589	584	**619**	496	485	458	352
1.25	466	599	600	**637**	506	497	473	367
1.26	464	599	605	**646**	518	506	480	376
1.27	464	599	605	**648**	520	506	481	376
1.28	463	598	607	**653**	528	511	486	381
1.29	464	604	617	**673**	556	524	502	395
1.30	463	604	618	**674**	558	525	503	396
1.31	463	608	626	**684**	562	534	516	407
1.32	453	598	620	**679**	554	531	516	406
1.33	452	600	623	**689**	568	539	524	412
1.34	449	597	622	**692**	571	541	527	414
1.35	445	595	621	**695**	575	545	531	417
1.36	445	598	628	**722**	611	569	555	434
1.37	445	600	634	**749**	647	590	577	449
1.38	438	594	630	**745**	645	591	581	452
1.39	437	593	630	**749**	651	597	585	455
1.40	431	587	626	**746**	648	596	585	455
1.41	431	587	626	**746**	649	600	587	457
1.42	427	584	625	**747**	652	601	589	458
1.43	427	584	625	**748**	653	604	591	459
1.44	427	583	625	**748**	653	605	591	460
1.45	423	582	626	**750**	654	609	598	465
1.46	422	581	625	**751**	655	613	600	468
1.47	420	579	623	**749**	654	614	601	469
1.48	358	453	480	**555**	498	474	467	387
1.49	363	467	509	**626**	611	572	582	445
1.50	363	467	509	**626**	611	573	582	446
1.51	453	667	764	**942**	942	908	925	649
1.52	455	670	768	944	**945**	914	931	653
1.53	454	670	767	943	**945**	914	932	654
1.54	455	672	770	943	**947**	919	937	656
1.55	464	687	794	952	962	944	**965**	672
1.56	464	687	795	951	963	946	**967**	673
1.57	462	687	796	949	965	949	**972**	676
1.58	460	686	795	948	965	950	**973**	678
1.59	468	699	812	955	980	979	**1000**	698
1.60	445	676	793	937	977	971	**998**	697
2.01	8.12	**9.5**	8.83	8.69	8.51	6.75	5.82	4.18
3.01	8.39	**9.5**	7.80	6.15	5.66	3.91	3.17	2.28
4.01	13.1	17.5	17.4	**19.6**	18.3	16.1	16.0	11.8
4.02	28.9	34.7	33.9	**36.9**	34.3	30.5	29.1	21.3
5.01	8.9	11.9	12.3	**13.4**	12.7	11.6	11.6	8.6
5.02	20.5	22.6	20.3	22.4	**22.9**	19.3	18.2	13.4
6.01	4.19	**4.45**	3.95	3.96	3.76	2.87	2.37	1.71
7.01	13.8	16.5	15.9	**16.5**	15.4	12.7	11.5	8.25
7.02	26.9	**30.1**	28.0	28.9	26.9	22.3	19.8	14.2
8.01	3.62	**3.86**	3.25	3.15	2.95	2.25	1.84	1.32
9.01	11.2	**12.1**	10.2	10.2	9.58	7.36	6.07	4.35
10.01	19.5	**21.7**	19.6	19.3	18.5	14.6	12.4	8.88
11.01	7.12	**7.91**	6.48	5.73	5.30	3.84	3.12	2.23
12.01	12.6	**14.0**	11.5	10.7	9.92	7.24	5.89	4.23

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
12.02	25.0	**27.5**	22.7	21.0	19.2	14.5	11.9	8.55
12.03	38.4	**42.2**	35.1	33.0	29.6	23.1	19.2	13.8
12.04	55.8	**61.6**	51.7	49.1	43.4	34.8	29.2	20.9
13.01	6.45	**7.24**	5.94	4.79	4.38	3.07	2.49	1.78
14.01	7.59	**8.28**	6.85	6.52	6.09	4.56	3.73	2.67
15.01	9.4	**10.2**	8.58	8.36	7.83	5.92	4.86	3.48
16.01	5.01	**5.53**	4.49	4.01	3.70	2.71	2.20	1.58
16.02	13.1	**14.5**	11.9	10.9	9.95	7.44	6.09	4.36
16.03	21.6	**24.1**	19.7	17.8	16.3	12.1	9.93	7.11
17.01	6.10	**6.61**	5.47	5.23	4.88	3.65	2.99	2.14
18.01	8.09	**9.00**	7.36	6.57	6.08	4.43	3.60	2.58
19.01	6.70	**7.37**	6.04	5.57	5.19	3.81	3.11	2.22
20.01	9.7	**10.6**	8.83	8.34	7.77	5.79	4.73	3.39
21.01	6.26	**6.94**	5.71	4.82	4.41	3.15	2.55	1.83
22.01	8.02	**8.79**	7.23	6.73	6.26	4.65	3.79	2.71
23.01	23.1	**26.8**	25.0	25.1	23.5	19.3	16.8	12.1
23.02	63.1	**71.5**	65.5	66.3	59.8	49.8	43.6	31.3
23.03	68.9	**78.2**	71.7	73.1	65.1	54.6	48.2	34.6
23.04	73.4	**83.4**	76.6	78.5	70.1	58.8	51.9	37.3
24.01	8.11	**8.75**	7.70	7.64	7.29	5.70	4.76	3.41
24.02	22.5	**24.7**	21.8	21.7	19.9	16.0	13.6	9.75
25.01	4.41	**4.84**	4.36	4.27	4.07	3.22	2.72	1.95
26.01	6.75	**7.52**	6.18	5.11	4.68	3.30	2.67	1.91
27.01	22.6	**25.0**	22.4	22.2	21.4	16.8	14.2	10.2
27.02	38.3	**41.1**	35.2	35.9	33.8	26.1	22.0	15.7
27.03	58.5	**63.6**	57.0	57.5	54.7	43.3	36.9	26.5
28.01	12.0	**13.3**	10.9	10.1	9.40	6.95	5.66	4.05
29.01	20.3	**23.4**	21.9	21.9	20.7	16.8	14.7	10.5
30.01	16.6	**19.2**	17.7	17.6	16.5	13.4	11.6	8.34
31.01	20.5	**22.0**	18.5	18.3	17.1	13.1	10.8	7.73
31.02	31.5	**34.0**	28.8	28.9	26.9	20.9	17.4	12.5
31.03	49.0	**53.6**	47.2	47.4	44.2	35.2	29.9	21.4
31.04	60.7	**66.9**	59.2	59.4	54.7	44.1	37.8	27.0
31.05	74.5	**82.9**	73.8	74.4	67.5	55.2	47.7	34.2
31.06	88	**99**	87.8	89.2	79.6	65.8	57.3	41.1
31.07	101	**116**	104	106	93.1	79.1	69.7	50.3
31.08	164	**195**	182	187	150	139	125	94.5
31.09	165	**197**	186	191	152	143	127	98.6
32.01	9.9	**10.9**	9.5	9.46	8.96	7.02	5.88	4.21
33.01	17.3	**20.0**	18.5	18.4	17.3	14.0	12.2	8.74
34.01	8.9	**10.1**	9.33	9.28	8.76	7.08	6.13	4.39
35.01	7.37	**8.28**	7.47	7.41	7.00	5.62	4.80	3.44
36.01	6.30	**6.92**	5.68	5.21	4.84	3.55	2.90	2.07
37.01	8.42	**9.3**	7.65	6.99	6.49	4.78	3.89	2.79
38.01	9.3	**10.8**	10.1	10.2	9.53	7.83	6.88	4.93
38.02	18.1	**19.9**	18.1	18.2	17.4	13.9	12.0	8.58
38.03	40.8	**44.6**	39.0	40.0	36.5	29.6	25.6	18.3
38.04	75.6	**85.0**	78.2	80.3	73.7	61.1	53.8	38.7
39.01	7.78	**8.34**	7.14	7.10	6.70	5.20	4.31	3.09
40.01	5.67	**6.08**	5.29	5.27	5.00	3.89	3.26	2.33
40.02	14.0	**15.3**	12.6	12.2	11.1	8.50	7.08	5.07
41.01	4.62	**5.11**	4.15	3.53	3.25	2.33	1.89	1.35
42.01	17.7	21.1	20.3	**21.2**	19.4	16.2	14.7	10.6
42.02	34.9	**41.0**	38.9	40.1	37.1	30.9	27.6	19.8
43.01	15.2	**17.7**	16.6	16.8	15.6	12.8	11.3	8.11
44.01	7.57	**8.19**	6.83	6.67	6.24	4.75	3.90	2.79
45.01	12.5	**14.2**	12.9	12.7	12.0	9.65	8.26	5.92
46.01	15.7	**18.5**	17.4	17.4	16.6	13.5	11.8	8.45
46.02	29.9	**33.4**	30.4	30.8	28.6	23.4	20.3	14.6
47.01	9.2	**10.0**	8.33	7.95	7.40	5.55	4.54	3.25
48.01	9.3	**10.7**	9.9	9.78	9.27	7.49	6.48	4.64
49.01	18.8	24.4	23.9	**26.3**	24.8	21.0	19.8	14.4
50.01	7.88	**8.87**	8.06	7.97	7.54	6.03	5.17	3.71
51.01	6.44	**7.40**	5.78	4.21	3.87	2.61	2.11	1.52
51.02	20.2	**23.2**	18.8	14.6	13.3	9.32	7.55	5.42
51.03	30.3	**33.5**	27.7	25.2	22.6	17.6	14.9	10.7
52.01	11.5	**12.9**	10.7	8.78	8.07	5.63	4.56	3.28
53.01	8.38	**9.56**	7.75	5.95	5.47	3.75	3.04	2.18
54.01	5.56	**5.98**	4.97	4.87	4.55	3.45	2.84	2.03
55.01	10.7	13.2	12.9	**13.9**	12.5	10.7	10.0	7.22
56.01	17.1	**20.3**	19.0	19.4	17.9	14.8	13.2	9.47
56.02	32.4	39.5	38.3	**40.5**	36.7	32.6	30.2	22.2
56.03	36.4	45.1	43.6	**46.1**	41.6	37.3	34.9	25.6
57.01	11.8	14.1	13.7	**14.5**	13.2	11.1	10.1	7.28
58.01	7.67	**8.31**	7.31	7.27	6.88	5.42	4.55	3.26
59.01	3.86	**4.52**	4.19	4.14	3.92	3.18	2.77	1.99

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.01	9.4	11.1	10.8	**11.4**	10.4	8.78	8.00	5.75
60.02	17.9	21.7	21.1	**21.9**	18.1	16.9	15.5	11.6
61.01	8.7	**10.1**	9.5	9.69	9.02	7.44	6.61	4.74
62.01	3.92	**4.56**	4.22	4.19	3.90	3.19	2.79	2.00
63.01	14.4	19.6	20.1	**21.7**	20.3	18.8	18.7	13.8
63.02	23.1	29.7	29.6	**32.4**	30.0	26.9	26.2	19.3
64.01	8.23	9.6	9.3	**9.84**	8.99	7.57	6.89	4.95
65.01	7.63	**9.0**	8.55	8.93	8.31	6.86	6.19	4.44
66.01	7.59	9.5	9.3	**10.1**	9.17	7.97	7.55	5.47
67.01	9.9	12.6	12.3	**13.5**	12.1	10.6	10.1	7.30
67.02	18.2	20.9	20.6	**22.4**	21.5	18.0	16.6	12.0
67.03	48.9	**55.6**	50.0	54.1	50.1	42.9	39.3	28.5
67.04	68.2	**77.4**	66.3	71.3	66.0	55.8	50.9	36.9
67.05	83.2	**94**	82.1	88.8	81.9	69.9	63.7	46.4
67.06	85.0	**98**	87.8	95.3	86.4	76.3	70.1	51.8
67.07	88.9	**103**	94	102	90.5	81.5	75.5	55.8
68.01	4.99	**5.81**	5.49	5.48	5.23	4.22	3.71	2.66
69.01	13.9	**15.5**	12.8	10.6	9.75	6.85	5.55	3.98
70.01	8.9	**9.5**	8.31	8.48	8.03	6.09	5.03	3.62
70.02	21.4	**23.7**	19.8	18.9	17.5	13.1	10.7	7.70
71.01	8.01	**8.9**	7.52	6.72	6.23	4.47	3.64	2.62
72.01	8.14	**9.07**	7.41	6.66	6.16	4.47	3.63	2.60
73.01	5.97	7.13	6.93	**7.44**	6.77	5.73	5.29	3.81
74.01	17.6	**21.0**	19.8	19.7	19.1	15.4	13.4	9.65
74.02	26.2	**31.0**	29.5	30.4	27.6	23.3	20.9	15.0
74.03	34.8	**39.9**	37.5	38.7	34.9	29.5	26.4	19.0
74.04	40.0	**45.2**	42.3	43.9	39.8	33.5	29.9	21.6
74.05	52.8	**60.9**	57.2	59.6	53.1	45.5	41.1	29.7
74.06	51.8	**61.5**	58.2	61.0	50.9	46.5	42.7	31.6
74.07	51.8	**61.6**	58.4	61.1	51.0	46.7	42.8	31.7
75.01	6.90	**7.40**	6.20	6.17	5.81	4.39	3.61	2.59
76.01	5.09	**5.47**	4.53	4.43	4.13	3.14	2.59	1.85
77.01	9.2	10.9	10.5	**11.1**	10.3	8.61	7.75	5.58
78.01	8.7	11.3	11.2	**12.4**	11.2	10.2	9.97	7.29
78.02	20.5	24.6	23.8	**25.8**	23.6	20.8	19.5	14.2
78.03	27.3	32.7	31.6	**33.9**	30.9	27.6	25.6	18.9
79.01	7.66	**8.94**	8.41	8.57	8.00	6.57	5.84	4.19
80.01	5.12	**5.49**	4.56	4.52	4.23	3.24	2.67	1.91
81.01	6.48	8.40	8.32	**9.20**	8.43	7.44	7.27	5.30
82.01	10.5	13.9	13.8	**15.2**	13.8	12.4	12.2	8.92
82.02	14.6	19.7	20.1	**21.7**	19.3	18.4	17.8	13.3
83.01	7.08	9.03	8.82	**9.68**	8.99	7.63	7.25	5.26
83.02	8.27	10.2	10.0	**10.9**	10.1	8.70	8.18	5.94
84.01	6.29	8.02	7.91	**8.70**	7.85	6.89	6.64	4.83
84.02	6.26	8.07	8.09	**8.77**	7.42	7.14	6.80	5.11
85.01	4.57	**5.20**	4.37	3.98	3.72	2.70	2.20	1.59
85.02	5.88	**7.65**	7.30	7.44	5.83	6.40	6.19	4.68
86.01	5.65	**6.18**	4.22	4.18	4.07	3.13	2.66	1.93
87.01	5.33	7.09	7.38	**8.02**	7.49	6.93	6.94	5.14
87.02	5.85	7.64	7.85	**8.66**	8.10	7.41	7.39	5.49
88.01	3.83	5.11	5.04	**5.58**	5.06	4.47	4.38	3.20
89.01	16.3	21.0	20.8	**22.8**	20.6	18.3	17.6	12.8
89.02	34.8	40.0	38.0	**40.5**	37.8	32.1	29.5	21.3
89.03	50.0	**57.4**	53.9	56.5	52.3	44.6	40.4	29.2
89.04	65.1	75.7	71.8	**75.7**	68.8	59.3	54.1	39.3
89.05	77.2	**90**	85.4	90.0	80.9	70.1	64.1	46.5
89.06	87	**102**	96	102	87.9	79.2	72.7	53.2
89.07	107	129	124	**132**	111	105	97.2	72.5
89.08	112	136	130	**139**	116	111	104	77.4
89.09	114	140	135	**144**	119	115	107	80.5
89.10	115	142	137	**146**	120	118	109	82.4
89.11	116	144	140	**149**	122	121	112	85.0
89.12	119	150	147	**157**	126	127	118	90.6
89.13	121	154	152	**163**	129	132	124	94.8
89.14	121	155	153	**164**	130	133	125	96.1
89.15	133	185	197	**214**	179	191	187	143
89.16	135	189	201	**219**	183	196	191	147
89.17	135	191	204	**225**	186	199	196	151
90.01	5.14	**5.52**	4.58	4.53	4.24	3.24	2.67	1.91
90.02	17.8	**19.4**	17.1	17.2	15.7	12.7	10.9	7.78
91.01	6.08	**6.86**	6.23	6.17	5.82	4.69	4.03	2.88
92.01	10.1	**11.6**	10.7	10.6	10.0	8.13	7.03	5.04
93.01	14.4	17.3	16.9	**18.0**	16.2	13.9	12.7	9.16
94.01	10.6	**12.5**	11.7	11.8	11.0	9.04	7.99	5.73
95.01	7.67	**8.21**	7.00	6.97	6.57	5.10	4.21	3.02
96.01	12.5	16.6	16.6	**18.3**	16.6	15.2	15.0	11.0

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
96.02	18.6	22.3	22.0	**24.2**	22.1	19.9	19.1	14.0
97.01	5.65	**6.10**	5.37	5.34	5.08	3.97	3.34	2.39
98.01	8.55	**10.0**	9.4	9.67	8.98	7.43	6.63	4.76
99.01	4.32	**4.69**	4.18	4.11	3.88	3.07	2.58	1.85
100.01	3.10	3.62	3.45	**3.63**	3.31	2.78	2.51	1.80
101.01	3.95	**4.62**	4.28	4.24	3.99	3.24	2.83	2.03
102.01	4.73	5.64	5.51	**5.85**	5.33	4.49	4.15	2.99
103.01	5.80	**6.73**	6.34	6.42	6.00	4.95	4.37	3.14
104.01	2.43	**2.87**	2.73	2.78	2.67	2.18	1.91	1.37
105.01	11.7	**13.9**	13.2	13.6	12.5	10.4	9.36	6.72
105.02	17.0	**18.8**	17.5	18.0	17.3	14.0	12.3	8.80
105.03	29.0	**32.6**	30.5	31.6	29.2	24.2	21.6	15.5
105.04	30.1	36.6	35.3	**37.2**	30.7	28.5	26.5	19.8
105.05	33.8	42.6	42.2	**44.2**	35.1	35.4	32.9	25.3
105.06	38.3	49.2	49.3	**51.8**	41.7	42.0	39.6	30.6
105.07	47.5	64.3	65.5	**68.8**	55.5	57.6	55.5	42.6
105.08	49.0	67.3	68.8	**72.4**	59.0	61.0	59.0	45.3
105.09	55.4	75.8	78.0	**82.6**	64.9	69.1	66.2	51.4
105.10	53.3	74.2	77.9	**84.3**	67.7	71.2	69.2	53.7
105.11	53.3	74.3	78.3	**86.2**	71.0	72.3	70.7	54.4
106.01	5.54	**6.14**	5.02	4.43	4.09	2.98	2.42	1.73
107.01	9.5	**11.1**	10.6	10.8	10.0	8.34	7.43	5.33
108.01	8.18	**8.84**	7.77	7.72	7.32	5.74	4.81	3.44
109.01	8.19	**9.5**	9.08	9.41	8.71	7.23	6.50	4.66
110.01	7.73	**8.94**	8.32	8.35	7.85	6.39	5.61	4.02
111.01	8.5	11.2	11.4	**12.4**	11.4	10.7	10.6	7.81
111.02	16.6	19.2	18.3	**20.2**	18.8	16.8	16.0	11.8
112.01	6.23	**6.67**	5.67	5.69	5.37	4.15	3.45	2.47
113.01	4.45	**5.22**	4.92	4.94	4.58	3.77	3.36	2.41
114.01	5.62	**6.19**	5.57	5.51	5.24	4.14	3.53	2.53
115.01	5.73	**6.17**	5.40	5.39	5.13	3.99	3.35	2.40
116.01	4.50	**4.84**	4.04	3.97	3.72	2.85	2.34	1.68
117.01	5.55	7.02	6.90	**7.56**	6.87	5.94	5.68	4.12
118.01	3.24	**3.61**	3.23	3.17	3.01	2.39	2.02	1.45
119.01	6.64	7.98	7.73	**8.34**	7.63	6.41	5.91	4.26
119.02	12.8	15.6	15.2	**16.5**	15.2	12.9	12.0	8.67
119.03	21.5	26.2	25.7	**27.6**	24.5	22.1	20.8	15.2
119.04	31.4	38.2	37.1	**39.7**	34.6	31.7	29.7	21.8
119.05	35.0	42.9	41.6	**44.6**	38.6	35.8	33.7	24.7
119.06	44.4	55.0	53.6	**57.4**	49.4	46.3	43.6	32.3
119.07	48.0	60.6	59.5	**63.6**	54.4	51.9	49.3	36.5
119.08	45.9	59.2	58.9	**63.0**	51.8	51.5	49.2	37.0
119.09	50.5	67.0	68.7	**73.5**	58.6	61.3	58.2	45.1
119.10	51.9	70.2	71.7	**77.3**	60.8	64.0	61.2	47.4
119.11	84	124	140	**158**	136	142	141	110
119.12	85	125	142	**161**	140	145	144	113
119.13	85	125	143	**163**	144	146	146	114
119.14	85	125	143	**163**	144	147	147	114
119.15	95	142	162	**184**	160	167	167	130
119.16	95	142	163	**185**	162	168	169	131
119.17	121	180	207	**230**	194	217	217	168
119.18	121	181	208	**233**	198	219	220	170
119.19	121	181	208	**233**	198	219	220	170
119.20	121	180	207	**234**	200	219	220	170
119.21	121	181	209	**236**	203	221	222	171
119.22	121	192	233	300	**303**	294	301	183
119.23	147	217	266	329	336	336	**346**	215
120.01	5.74	7.19	7.04	**7.69**	6.93	5.99	5.68	4.11
121.01	3.92	**4.26**	3.77	3.70	3.53	2.77	2.32	1.66
122.01	7.63	**9.0**	8.58	8.87	8.34	6.84	6.13	4.41
123.01	4.95	**5.80**	5.51	5.51	5.27	4.26	3.76	2.70
124.01	5.65	**6.29**	5.70	5.61	5.40	4.26	3.63	2.60
125.01	5.41	7.14	7.32	**8.06**	7.46	6.82	6.80	5.01
125.02	10.9	13.3	13.2	**14.5**	13.3	11.8	11.4	8.40
126.01	4.86	**5.82**	5.59	5.60	5.41	4.36	3.87	2.78
127.01	3.56	**3.95**	3.56	3.58	3.45	2.67	2.23	1.60
127.02	3.91	**4.52**	4.14	4.25	3.50	3.10	2.81	2.03
128.01	8.33	9.07	9.3	9.8	**10.6**	9.82	10.1	7.71
128.02	28.3	36.4	37.2	**40.7**	36.3	35.9	34.5	26.5
128.03	40.0	56.8	59.1	**62.8**	50.4	52.8	51.1	40.0
128.04	40.5	57.9	61.2	**65.5**	52.8	55.9	54.7	42.6
128.05	43.8	63.2	68.0	**75.0**	63.0	63.5	63.0	49.3
128.06	44.1	63.9	69.5	**79.2**	70.4	66.2	66.5	51.8
128.07	44.9	65.3	72.1	**83.8**	76.5	70.2	70.9	55.6
128.08	44.9	65.5	72.5	**85.4**	79.1	71.4	72.6	57.0
128.09	45.0	65.8	73.5	**87.1**	80.7	73.3	75.1	58.8

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.10	45.5	66.7	74.9	**89.8**	84.4	76.6	78.8	61.3
128.11	45.5	66.7	74.9	**90.0**	84.6	76.7	78.9	61.3
128.12	45.6	66.9	75.4	**91.0**	86.1	78.0	80.4	62.4
129.01	7.42	9.5	9.3	**10.3**	9.46	8.20	7.87	5.72
129.02	13.2	15.4	14.8	**16.1**	14.8	12.8	11.9	8.67
129.03	20.1	24.3	24.1	**26.4**	24.1	21.5	20.4	15.1
130.01	4.83	**5.39**	4.93	4.81	4.67	3.68	3.12	2.24
131.01	6.91	7.96	7.86	**8.94**	8.59	7.33	7.14	5.23
132.01	7.57	9.0	8.70	**9.28**	8.66	7.17	6.53	4.70
132.02	12.5	15.3	14.7	**15.4**	13.7	11.9	10.9	7.90
132.03	16.7	20.2	19.3	**20.3**	18.0	15.6	14.4	10.4
132.04	19.8	24.5	24.0	**25.2**	20.4	19.7	18.2	13.9
132.05	19.7	24.5	24.2	**25.4**	20.5	19.8	18.4	14.2
133.01	3.53	**4.22**	4.01	4.06	3.86	3.15	2.78	2.00
134.01	4.49	**5.28**	4.92	4.82	4.67	3.73	3.23	2.32
135.01	4.74	**5.48**	5.10	4.96	4.83	3.84	3.30	2.37
136.01	6.00	**6.53**	5.15	4.94	4.66	3.47	2.86	2.07
136.02	4.61	4.94	4.14	**5.09**	4.69	4.30	4.28	3.14
137.01	3.95	5.46	5.67	**6.23**	6.09	5.37	5.47	4.04
137.02	10.7	**11.7**	9.4	10.6	10.9	9.04	8.62	6.32
137.03	12.24	**13.6**	10.7	11.9	12.16	10.09	9.55	7.00
137.04	8.8	11.5	11.5	**12.9**	12.4	11.4	11.3	8.42
137.05	10.4	13.2	13.6	**14.9**	13.9	13.6	13.6	10.2
138.01	3.48	**3.82**	3.45	3.43	3.46	2.74	2.38	1.72
139.01	4.69	**5.11**	3.39	2.99	2.81	2.07	1.71	1.25
140.01	6.44	**7.04**	4.86	3.65	3.38	2.34	1.91	1.39
141.01	5.86	**6.39**	4.81	4.87	4.91	3.86	3.38	2.44
141.02	11.6	**12.3**	9.6	9.38	9.22	7.10	6.14	4.45
141.03	14.6	**15.8**	11.7	11.1	10.8	8.29	7.12	5.17
141.04	13.6	**15.6**	12.3	12.3	11.9	9.51	8.33	6.05
142.01	2.43	**2.67**	1.77	1.31	1.22	0.84	0.68	0.50
143.01	0.62	**0.73**	0.70	0.73	0.69	0.57	0.51	0.36
144.01	7.03	**7.65**	6.30	7.05	6.99	5.73	5.37	3.91
144.02	7.12	7.92	7.47	**8.21**	7.88	6.75	6.41	4.70
145.01	2.62	**3.16**	3.01	3.05	2.96	2.40	2.10	1.51
146.01	3.36	4.20	4.29	**4.80**	4.62	4.05	4.06	3.00
147.01	2.78	**2.96**	2.03	2.14	2.22	1.81	1.70	1.24
148.01	10.2	**11.1**	7.51	7.44	7.25	5.53	4.73	3.43
148.02	7.62	**8.77**	6.98	7.11	6.90	5.54	4.93	3.59
149.01	5.19	**5.65**	4.38	3.88	3.63	2.63	2.15	1.56
149.02	5.59	**6.22**	4.76	4.18	3.86	2.84	2.33	1.69
150.01	6.41	9.0	9.6	**10.1**	9.75	9.27	9.38	7.03
150.02	7.06	9.9	10.6	**11.4**	10.4	10.5	10.4	7.97
150.03	10.0	13.5	14.1	**15.3**	14.0	14.2	14.0	10.7
150.04	10.0	13.5	14.1	**15.4**	14.1	14.3	14.1	10.8
150.05	13.8	19.6	20.5	**22.0**	19.0	20.8	20.5	16.0
151.01	3.25	**3.56**	3.21	3.33	3.31	2.67	2.38	1.72
152.01	6.58	**7.19**	4.72	5.32	5.46	4.51	4.31	3.17
152.02	5.68	**6.44**	5.53	6.13	6.03	5.23	5.08	3.75
152.03	4.96	5.81	5.82	**6.47**	5.67	5.57	5.41	4.18
152.04	5.23	6.57	6.65	**7.42**	6.31	6.75	6.55	5.24
153.01	10.6	12.4	12.0	**13.2**	12.7	10.5	9.73	7.05
153.02	17.9	22.1	21.8	**23.6**	21.5	19.8	19.0	14.2
153.03	21.7	27.2	26.6	**28.6**	26.0	24.1	23.3	17.3
153.04	30.2	38.1	37.2	**40.2**	36.1	33.4	32.3	23.9
153.05	38.8	48.1	47.0	**50.4**	44.7	41.4	39.6	29.3
153.06	43.7	56.1	55.7	**59.3**	50.0	49.4	46.5	35.4
153.07	43.7	56.3	55.9	**59.6**	50.0	49.7	46.8	35.7
153.08	47.0	60.3	60.2	**64.2**	53.4	53.4	50.3	38.3
154.01	5.73	**6.34**	5.75	5.65	5.50	4.30	3.65	2.62
155.01	4.12	**4.73**	4.52	4.46	4.44	3.52	3.07	2.21
156.01	8.38	10.5	10.3	**11.3**	10.2	8.90	8.49	6.16
157.01	6.48	**7.67**	7.21	7.23	6.96	5.63	4.93	3.54
158.01	3.56	**4.20**	3.93	3.94	3.71	3.03	2.66	1.91
159.01	4.12	**4.45**	3.99	4.03	3.84	2.95	2.44	1.76
159.02	4.85	**5.33**	4.83	4.77	4.51	3.59	3.04	2.20
160.01	2.02	**2.18**	1.60	1.78	1.79	1.48	1.37	1.00
160.02	5.65	**5.81**	4.50	4.26	4.33	3.37	2.97	2.17
160.03	7.34	**8.32**	6.54	6.07	6.08	4.67	4.11	3.01
160.04	7.37	**8.36**	6.62	6.11	6.12	4.70	4.14	3.03
161.01	61.9	126	143	**194**	156	140	135	81.9
161.02	61.4	125	143	**194**	156	140	135	82.2
161.03	60.7	125	143	**193**	156	141	136	83.3
162.01	2.31	**2.54**	2.24	2.23	2.12	1.66	1.40	1.00
163.01	6.94	**8.12**	7.53	7.53	7.18	5.81	5.06	3.63
163.02	14.7	**17.2**	16.2	16.8	15.4	12.9	11.5	8.3

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
163.03	24.1	30.5	30.3	**32.4**	28.0	27.4	26.0	19.7
163.04	28.7	37.0	36.8	**39.4**	32.9	33.2	31.2	24.0
163.05	35.4	46.9	48.8	**53.0**	47.3	49.2	48.2	36.7
163.06	35.2	46.9	49.2	**53.5**	47.7	49.4	48.5	37.0
163.07	35.6	48.3	51.9	**56.8**	50.9	51.7	51.2	39.8
163.08	35.0	48.0	51.7	**56.7**	50.3	51.7	51.4	39.9
164.01	7.28	8.63	8.26	**8.68**	8.03	6.67	6.05	4.35
165.01	6.22	7.83	7.65	**8.40**	7.72	6.55	6.19	4.48
166.01	4.41	5.31	5.10	**5.34**	4.95	4.10	3.74	2.69
167.01	4.61	6.83	8.14	9.38	9.74	10.37	**10.6**	8.30
168.01	4.13	**4.86**	4.54	4.51	4.29	3.47	3.04	2.18
169.01	7.57	9.0	8.63	**9.17**	8.39	7.06	6.44	4.63
169.02	10.4	12.8	12.5	13.9	**14.5**	13.0	13.7	10.2
169.03	10.6	13.0	12.8	14.1	**14.5**	13.4	13.9	10.4
170.01	3.91	4.44	4.30	**4.82**	4.58	3.84	3.61	2.63
170.02	5.23	6.74	6.80	**7.44**	6.80	6.22	6.05	4.46
170.03	7.44	10.4	11.0	**11.8**	10.3	11.0	10.7	8.25
171.01	8.21	11.3	11.9	**12.7**	11.8	11.4	11.5	8.57
171.02	10.2	14.5	15.9	**17.2**	15.4	16.7	16.3	12.7
171.03	15.8	22.1	23.8	**25.6**	22.9	24.7	24.2	18.7
171.04	16.8	23.8	26.0	**28.1**	25.3	27.4	27.0	20.8
171.05	23.1	32.8	36.5	**39.6**	35.2	38.6	38.1	29.5
171.06	23.1	32.9	36.8	**40.0**	35.5	38.9	38.4	29.8
172.01	3.55	4.73	4.66	**5.26**	4.90	4.23	4.12	3.02
173.01	3.95	4.33	4.24	4.64	**4.67**	4.09	4.16	3.10
174.01	2.76	**3.01**	2.44	2.56	2.45	1.85	1.55	1.12
175.01	3.69	5.70	6.45	6.94	6.77	7.25	**7.36**	5.71
175.02	6.38	9.4	10.5	**11.3**	10.4	11.1	11.1	8.62
176.01	2.85	3.93	4.09	**4.42**	4.24	3.87	3.91	2.91
177.01	2.89	4.14	4.47	**4.69**	4.69	4.43	4.52	3.41
178.01	4.53	**4.84**	4.25	4.19	3.98	3.10	2.58	1.85
178.02	8.28	**8.92**	7.86	7.71	7.35	5.74	4.79	3.44
179.01	4.74	6.50	6.80	**7.32**	7.23	6.49	6.62	4.93
179.02	12.4	16.3	16.0	**17.7**	16.7	14.8	14.5	10.7
179.03	13.6	18.9	19.3	**20.8**	18.7	18.5	18.2	13.8
179.04	12.7	19.5	21.2	**23.1**	20.5	22.0	21.9	16.4
179.05	13.8	21.3	23.6	**27.2**	24.8	25.1	25.4	18.7
179.06	15.5	24.0	27.2	**32.0**	30.4	30.1	30.8	22.8
179.07	27.5	27.1	27.8	36.8	**36.9**	34.0	35.4	25.8
180.01	4.26	5.62	5.52	**6.09**	5.68	4.86	4.70	3.42
181.01	9.43	**10.1**	6.22	5.19	5.45	4.24	3.86	2.84
182.01	3.32	**3.76**	3.40	3.33	3.19	2.54	2.15	1.54
182.02	5.52	6.86	6.75	**7.12**	6.57	6.27	6.04	4.53
183.01	2.52	2.73	3.06	3.76	4.34	4.30	**4.53**	3.40
184.01	22.4	**24.2**	14.9	10.8	10.8	7.89	7.00	5.22
185.01	13.3	**14.7**	8.64	6.30	5.86	4.11	3.40	2.51
186.01	5.79	**6.30**	3.77	3.20	3.06	2.26	1.90	1.39
186.02	7.27	**7.87**	5.85	4.79	4.58	3.35	2.83	2.07

PEAK DESIGN FLOOD DISCHARGES - Sensitivity - 30mm/hr Pervious and 3mm/hr Impervious Initial Losses

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	10.4	11.7	11.6	14.2	**14.5**	11.9	10.8	7.78
1.02	18.2	20.9	21.6	**25.1**	24.7	22.4	20.9	15.2
1.03	28.5	31.6	32.0	**37.9**	37.8	33.3	31.0	22.5
1.04	36.5	39.4	39.9	47.9	**49.4**	42.8	39.8	28.9
1.05	63.2	68.2	68.9	82.6	**86.7**	76.0	71.2	52.0
1.06	82.7	87.2	87.5	105	**113**	98.4	92.4	67.7
1.07	105	109	110	132	**140**	121	112	82.1
1.08	119	123	123	147	**153**	134	124	90.8
1.09	136	140	140	166	**171**	151	139	102
1.1	144	149	149	176	**181**	160	148	109
1.11	178	185	183	216	**221**	195	179	132
1.12	185	194	193	226	**230**	205	190	140
1.13	187	198	196	230	**233**	208	193	142
1.14	191	204	202	237	**238**	215	199	147
1.15	194	209	207	244	**244**	221	205	152
1.16	201	218	218	**256**	250	231	215	160
1.17	243	270	270	**315**	302	284	266	198
1.18	268	303	306	**356**	337	321	302	225
1.19	263	300	309	**360**	334	329	311	235
1.2	264	303	314	**366**	337	334	316	239
1.21	382	439	455	**532**	473	470	441	337
1.22	381	439	457	**536**	477	475	445	341
1.23	380	440	462	**547**	489	482	455	349
1.24	379	440	463	**551**	495	485	458	352
1.25	380	446	474	**566**	506	497	473	367
1.26	378	446	477	**575**	517	506	480	376
1.27	378	446	477	**577**	520	506	481	376
1.28	377	446	479	**581**	528	511	486	381
1.29	378	449	485	**599**	556	524	502	395
1.3	378	449	485	**600**	558	525	503	396
1.31	377	456	491	**609**	562	534	516	407
1.32	369	448	486	**604**	554	531	516	406
1.33	369	449	488	**612**	567	539	524	412
1.34	366	447	488	**615**	570	541	527	414
1.35	363	445	487	**617**	574	545	531	417
1.36	363	446	491	**639**	610	568	555	434
1.37	363	447	494	**660**	646	589	577	449
1.38	357	442	491	**658**	644	591	581	452
1.39	355	442	491	**660**	650	597	585	455
1.4	351	438	488	**657**	647	596	585	455
1.41	350	437	488	**657**	648	600	587	457
1.42	347	435	487	**658**	651	601	589	458
1.43	347	434	486	**658**	651	603	591	459
1.44	347	434	486	**658**	652	605	591	460
1.45	343	432	486	**660**	653	609	598	465
1.46	342	431	486	**660**	654	613	600	468
1.47	341	430	484	**658**	653	614	601	468
1.48	310	364	396	**501**	498	474	467	387
1.49	314	372	411	564	**609**	571	582	445
1.5	313	371	411	564	**609**	571	582	446
1.51	364	489	595	823	**939**	906	925	649
1.52	365	491	598	825	**942**	912	931	653
1.53	365	491	597	824	**942**	913	932	653
1.54	365	491	599	824	**944**	917	937	656
1.55	371	501	612	829	959	942	**965**	672
1.56	371	501	612	829	959	944	**967**	673
1.57	369	500	612	827	961	947	**972**	676
1.58	368	499	611	825	961	948	**973**	678
1.59	374	507	623	831	975	976	**1000**	698
1.6	353	487	606	810	971	968	**998**	697
2.01	6.69	7.04	6.93	8.21	**8.51**	6.75	5.82	4.18
3.01	**7.14**	6.61	5.16	6.12	5.66	3.91	3.17	2.28
4.01	10.6	13.3	14.6	16.2	**18.3**	16.1	16.0	11.8
4.02	23.7	26.0	26.6	31.9	**34.3**	30.5	29.1	21.3
5.01	7.14	9.15	10.2	11.4	**12.7**	11.6	11.6	8.61
5.02	17.1	16.8	16.2	19.6	**22.9**	19.3	18.2	13.4
6.01	3.51	3.52	3.30	3.64	**3.76**	2.87	2.37	1.71
7.01	11.4	12.6	12.5	15.2	**15.4**	12.7	11.5	8.25
7.02	22.3	22.6	22.3	26.5	**26.9**	22.3	19.8	14.2
8.01	2.41	2.89	2.63	**2.98**	2.95	2.25	1.84	1.32
9.01	7.56	9.14	8.50	9.57	**9.58**	7.36	6.08	4.35
10.01	12.8	16.3	15.7	18.2	**18.5**	14.6	12.4	8.88
11.01	4.84	5.40	4.64	**5.57**	5.30	3.84	3.12	2.23
12.01	8.67	9.75	8.61	**10.2**	9.92	7.24	5.89	4.23

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
12.02	16.9	19.3	17.1	**20.1**	19.2	14.5	11.9	8.55
12.03	25.7	30.0	27.0	**31.5**	29.6	23.1	19.2	13.8
12.04	36.9	44.4	40.2	**47.0**	43.4	34.8	29.2	20.9
13.01	4.38	**5.02**	3.97	4.74	4.38	3.07	2.49	1.78
14.01	5.11	5.94	5.43	**6.18**	6.09	4.56	3.73	2.67
15.01	6.34	7.58	6.94	**7.85**	7.83	5.92	4.86	3.48
16.01	3.37	3.80	3.26	**3.88**	3.70	2.71	2.20	1.58
16.02	8.72	9.89	8.82	**10.4**	9.95	7.44	6.09	4.36
16.03	14.5	16.3	14.4	**17.1**	16.3	12.1	9.93	7.11
17.01	4.07	4.81	4.34	**4.94**	4.88	3.65	2.99	2.14
18.01	5.50	6.16	5.33	**6.35**	6.08	4.43	3.60	2.58
19.01	4.49	5.14	4.57	**5.33**	5.19	3.81	3.11	2.23
20.01	6.57	7.62	6.86	**7.90**	7.77	5.79	4.73	3.39
21.01	4.23	**4.78**	3.87	4.72	4.41	3.15	2.55	1.83
22.01	5.41	6.18	5.55	**6.40**	6.26	4.65	3.79	2.71
23.01	15.1	20.1	19.8	**23.6**	23.5	19.3	16.8	12.1
23.02	40.7	53.8	52.5	**61.6**	59.8	49.8	43.6	31.3
23.03	44.3	58.9	57.6	**67.6**	65.1	54.6	48.2	34.6
23.04	47.1	62.7	61.6	**72.5**	70.1	58.8	51.9	37.3
24.01	5.34	6.69	6.38	7.17	**7.29**	5.70	4.76	3.41
24.02	14.9	18.5	17.8	**20.3**	19.9	16.0	13.6	9.75
25.01	2.88	3.69	3.51	4.04	**4.07**	3.22	2.72	1.95
26.01	4.58	**5.22**	4.14	5.04	4.68	3.30	2.67	1.91
27.01	14.8	18.9	18.1	20.9	**21.4**	16.8	14.2	10.2
27.02	25.5	31.2	29.2	33.2	**33.8**	26.1	22.0	15.7
27.03	38.6	48.2	46.2	53.5	**54.7**	43.3	36.9	26.5
28.01	8.22	9.30	8.24	**9.65**	9.40	6.95	5.66	4.05
29.01	13.2	17.5	17.3	20.7	**20.7**	16.8	14.7	10.5
30.01	10.9	14.1	13.9	**16.5**	16.5	13.4	11.6	8.34
31.01	13.6	16.5	15.2	**17.1**	17.1	13.1	10.8	7.73
31.02	20.9	25.5	23.8	**27.0**	26.9	20.9	17.4	12.5
31.03	32.4	40.3	38.4	44.2	**44.2**	35.2	29.9	21.4
31.04	40.1	50.0	48.0	**55.4**	54.7	44.1	37.8	27.0
31.05	48.8	61.9	59.8	**69.3**	67.5	55.2	47.7	34.2
31.06	57.7	73.7	71.1	**82.7**	79.6	65.8	57.3	41.1
31.07	65.8	86.1	83.9	**97.7**	93.1	79.1	69.7	50.3
31.08	105	145	145	**170**	150	139	125	94.5
31.09	105	146	148	**174**	152	143	127	98.6
32.01	6.61	8.30	7.86	8.87	**8.96**	7.02	5.88	4.21
33.01	11.4	14.7	14.5	**17.3**	17.3	14.0	12.2	8.74
34.01	5.86	7.48	7.44	8.74	**8.76**	7.08	6.13	4.39
35.01	4.85	6.16	6.02	6.96	**7.00**	5.62	4.80	3.44
36.01	4.22	4.83	4.27	**5.01**	4.84	3.55	2.90	2.07
37.01	5.70	6.47	5.72	**6.69**	6.49	4.79	3.89	2.79
38.01	6.11	8.12	8.09	**9.58**	9.53	7.83	6.88	4.94
38.02	11.9	15.0	14.7	17.0	**17.4**	13.9	12.0	8.58
38.03	27.0	33.3	32.1	**36.9**	36.5	29.6	25.6	18.3
38.04	49.4	63.4	62.6	**73.8**	73.7	61.1	53.8	38.7
39.01	5.15	6.33	5.96	6.67	**6.71**	5.20	4.31	3.09
40.01	3.70	4.69	4.39	4.95	**5.00**	3.89	3.26	2.33
40.02	9.35	10.8	9.71	**11.3**	11.1	8.50	7.09	5.07
41.01	3.13	**3.52**	2.86	3.46	3.25	2.33	1.89	1.35
42.01	11.4	15.9	15.9	**19.4**	19.4	16.3	14.7	10.6
42.02	22.6	30.7	30.6	36.9	**37.1**	30.9	27.6	19.8
43.01	10.0	13.3	13.1	**15.7**	15.6	12.8	11.3	8.11
44.01	5.08	6.04	5.58	**6.27**	6.24	4.75	3.90	2.79
45.01	8.39	10.5	10.3	12.0	**12.0**	9.65	8.26	5.92
46.01	10.4	13.9	13.7	16.4	**16.6**	13.5	11.8	8.45
46.02	19.6	25.1	24.4	**28.6**	28.6	23.4	20.3	14.6
47.01	6.18	7.23	6.56	**7.50**	7.40	5.55	4.54	3.25
48.01	6.15	7.88	7.85	9.22	**9.28**	7.49	6.48	4.64
49.01	12.6	18.1	18.9	22.9	**24.8**	21.0	19.8	14.4
50.01	5.20	6.56	6.44	7.48	**7.54**	6.03	5.17	3.71
51.01	4.53	**5.49**	4.16	4.20	3.87	2.61	2.11	1.52
51.02	13.8	**16.2**	12.5	14.5	13.3	9.32	7.55	5.42
51.03	20.7	**24.3**	20.2	24.0	22.6	17.6	15.0	10.7
52.01	7.82	**8.89**	7.03	8.69	8.07	5.63	4.56	3.28
53.01	5.81	**6.78**	5.23	5.93	5.47	3.75	3.04	2.18
54.01	3.68	4.45	4.06	**4.57**	4.55	3.45	2.84	2.03
55.01	6.83	9.98	10.1	12.1	**12.5**	10.7	10.0	7.22
56.01	11.1	15.1	15.0	**18.1**	17.9	14.8	13.2	9.48
56.02	20.7	29.7	30.5	36.1	**36.7**	32.6	30.2	22.2
56.03	23.5	33.7	34.9	41.0	**41.6**	37.3	34.9	25.6
57.01	7.65	10.8	10.8	13.1	**13.2**	11.1	10.1	7.28
58.01	5.07	6.32	6.03	6.82	**6.88**	5.43	4.55	3.26
59.01	2.57	3.36	3.29	3.91	**3.92**	3.18	2.77	1.99

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.01	6.08	8.57	8.60	10.3	**10.4**	8.78	8.00	5.75
60.02	11.2	16.3	16.8	**19.8**	18.1	16.9	15.5	11.6
61.01	5.65	7.63	7.60	**9.07**	9.02	7.44	6.61	4.74
62.01	2.59	3.38	3.33	**3.95**	3.90	3.19	2.80	2.00
63.01	9.03	14.6	16.4	18.6	**20.2**	18.8	18.7	13.8
63.02	14.5	21.9	23.9	27.5	**30.0**	26.9	26.2	19.3
64.01	5.29	7.42	7.42	8.96	**8.99**	7.58	6.89	4.95
65.01	4.94	6.87	6.83	8.28	**8.31**	6.86	6.19	4.44
66.01	4.73	7.11	7.37	8.72	**9.17**	7.97	7.55	5.47
67.01	6.25	9.35	9.82	11.5	**12.1**	10.6	10.1	7.30
67.02	12.2	16.1	16.5	19.9	**21.5**	18.0	16.6	12.0
67.03	32.3	40.0	40.0	47.2	**50.1**	42.9	39.3	28.5
67.04	45.5	56.1	53.1	63.6	**66.1**	55.8	50.9	36.9
67.05	55.1	68.7	65.9	78.6	**81.9**	69.9	63.7	46.4
67.06	55.8	71.8	70.7	83.8	**86.4**	76.3	70.1	51.8
67.07	58.0	76.3	75.9	89.8	**90.5**	81.5	75.5	55.8
68.01	3.21	4.40	4.32	5.19	**5.23**	4.22	3.71	2.66
69.01	9.34	**10.6**	8.50	10.5	9.75	6.85	5.55	3.98
70.01	5.91	7.41	7.04	7.72	**8.03**	6.09	5.03	3.62
70.02	14.5	16.6	15.3	**17.7**	17.5	13.1	10.7	7.70
71.01	5.42	6.02	5.40	**6.52**	6.23	4.47	3.64	2.62
72.01	5.55	6.20	5.38	**6.41**	6.16	4.47	3.64	2.61
73.01	3.69	5.51	5.49	6.64	**6.77**	5.73	5.29	3.81
74.01	11.6	15.7	15.4	18.6	**19.1**	15.4	13.4	9.65
74.02	16.8	23.2	23.3	**27.8**	27.6	23.3	20.9	15.0
74.03	22.4	29.8	29.8	**35.4**	34.9	29.5	26.4	19.0
74.04	25.9	33.9	33.8	**40.0**	39.8	33.5	29.9	21.6
74.05	34.1	45.6	45.6	**54.1**	53.1	45.5	41.1	29.7
74.06	33.4	45.8	46.4	**54.8**	50.9	46.5	42.7	31.6
74.07	33.4	45.8	46.5	**54.9**	51.0	46.7	42.8	31.7
75.01	4.59	5.60	5.19	5.76	**5.81**	4.39	3.61	2.59
76.01	3.36	4.08	3.70	**4.16**	4.13	3.15	2.59	1.85
77.01	5.94	8.43	8.43	10.15	**10.3**	8.61	7.75	5.58
78.01	5.38	8.50	9.26	10.5	**11.2**	10.2	9.97	7.29
78.02	13.2	18.7	19.1	22.7	**23.6**	20.8	19.5	14.2
78.03	17.6	24.6	25.4	29.9	**30.9**	27.6	25.6	18.9
79.01	5.01	6.76	6.71	**8.04**	8.00	6.57	5.84	4.19
80.01	3.38	4.14	3.77	**4.24**	4.23	3.24	2.67	1.91
81.01	3.93	6.33	6.82	7.71	**8.43**	7.44	7.27	5.30
82.01	6.57	10.4	11.4	12.8	**13.8**	12.4	12.2	8.92
82.02	9.15	14.7	16.3	18.6	**19.2**	18.4	17.8	13.3
83.01	4.43	6.70	7.01	8.34	**8.99**	7.63	7.25	5.26
83.02	5.28	7.69	7.89	9.52	**10.1**	8.70	8.18	5.94
84.01	3.81	5.99	6.35	7.32	**7.85**	6.89	6.64	4.83
84.02	3.78	6.08	6.53	**7.55**	7.42	7.14	6.80	5.11
85.01	3.19	3.68	3.20	**3.81**	3.72	2.70	2.20	1.59
85.02	3.75	5.67	5.88	**6.66**	5.80	6.40	6.19	4.68
86.01	4.92	**5.39**	3.33	3.63	4.08	3.13	2.66	1.93
87.01	3.17	5.43	6.06	6.82	**7.47**	6.93	6.94	5.14
87.02	3.53	5.78	6.48	7.28	**8.09**	7.41	7.39	5.49
88.01	2.46	3.79	4.10	4.65	**5.06**	4.47	4.38	3.20
89.01	13.1	15.6	16.8	19.4	**20.6**	18.3	17.6	12.8
89.02	28.7	30.2	30.1	36.3	**37.8**	32.1	29.5	21.3
89.03	41.1	43.0	42.9	51.1	**52.3**	44.6	40.4	29.2
89.04	53.3	57.0	57.0	68.0	**68.8**	59.3	54.1	39.3
89.05	63.2	67.7	67.9	80.6	**80.9**	70.1	64.1	46.6
89.06	71.5	76.8	77.5	**90.8**	87.9	79.2	72.7	53.3
89.07	87.3	96.3	98.9	**116**	111	105	97.2	72.5
89.08	91.1	102	105	**122**	116	111	104	77.4
89.09	92.8	105	109	**126**	119	115	107	80.5
89.1	93.6	106	110	**128**	120	118	109	82.4
89.11	94.0	107	113	**131**	122	121	112	85.0
89.12	96.5	111	118	**138**	126	127	118	90.6
89.13	97.7	114	123	**142**	129	132	124	94.8
89.14	97.8	115	123	**143**	130	133	125	96.1
89.15	110	133	154	186	178	**191**	187	143
89.16	112	136	157	190	182	**196**	191	147
89.17	112	137	160	194	185	**199**	196	151
90.01	**4.26**	4.15	3.78	4.25	4.24	3.24	2.67	1.92
90.02	14.7	14.7	14.0	**16.0**	15.7	12.7	10.9	7.78
91.01	5.02	5.13	4.99	5.80	**5.82**	4.69	4.03	2.88
92.01	8.45	8.57	8.52	**10.0**	10.0	8.14	7.03	5.04
93.01	11.8	13.2	13.3	16.1	**16.2**	13.9	12.7	9.16
94.01	8.88	9.36	9.30	**11.1**	11.0	9.04	7.99	5.73
95.01	6.36	6.23	5.85	6.54	**6.57**	5.10	4.21	3.02
96.01	10.1	12.4	13.7	15.4	**16.6**	15.2	15.0	11.0

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
96.02	15.2	16.8	17.6	20.7	**22.1**	19.9	19.1	14.0
97.01	4.64	4.70	4.41	5.01	**5.08**	3.97	3.34	2.39
98.01	7.03	7.56	7.54	**9.02**	8.98	7.43	6.63	4.76
99.01	3.58	3.60	3.40	**3.88**	3.88	3.07	2.58	1.85
100.01	2.57	2.80	2.76	**3.33**	3.31	2.78	2.51	1.80
101.01	3.27	3.43	3.37	**4.00**	3.99	3.24	2.83	2.03
102.01	3.82	4.30	4.30	5.27	**5.33**	4.49	4.15	2.99
103.01	4.77	5.13	5.05	**6.02**	6.00	4.95	4.37	3.14
104.01	2.03	2.20	2.18	2.61	**2.67**	2.18	1.91	1.37
105.01	9.74	10.5	10.5	**12.6**	12.5	10.4	9.36	6.72
105.02	14.2	14.1	14.0	16.6	**17.3**	14.0	12.3	8.80
105.03	24.1	24.4	24.4	28.9	**29.2**	24.2	21.6	15.5
105.04	24.8	27.3	28.3	**33.1**	30.7	28.5	26.5	19.8
105.05	27.8	31.4	33.8	**39.2**	35.1	35.4	32.9	25.3
105.06	31.0	35.9	39.5	**45.8**	41.7	42.0	39.6	30.6
105.07	38.0	46.6	52.7	**60.4**	55.5	57.6	55.5	42.6
105.08	39.0	48.6	55.3	**63.4**	59.0	61.0	59.0	45.3
105.09	43.9	54.9	62.4	**72.2**	64.9	69.1	66.2	51.4
105.1	42.5	53.0	61.6	**73.4**	67.7	71.2	69.2	53.7
105.11	42.5	53.1	61.7	**75.1**	70.9	72.3	70.7	54.4
106.01	**4.64**	4.21	3.60	4.29	4.09	2.98	2.42	1.73
107.01	7.91	8.44	8.45	**10.1**	10.0	8.34	7.43	5.33
108.01	6.75	6.73	6.41	7.24	**7.32**	5.74	4.81	3.44
109.01	6.71	7.28	7.27	**8.73**	8.71	7.23	6.50	4.66
110.01	6.37	6.69	6.63	**7.87**	7.85	6.39	5.61	4.02
111.01	6.70	8.50	9.43	10.6	**11.4**	10.7	10.6	7.81
111.02	13.5	14.4	14.7	17.5	**18.8**	16.8	16.0	11.8
112.01	5.19	5.13	4.78	5.33	**5.37**	4.15	3.45	2.47
113.01	3.65	3.90	3.85	**4.65**	4.58	3.77	3.36	2.41
114.01	4.62	4.70	4.49	5.17	**5.24**	4.14	3.53	2.53
115.01	4.70	4.76	4.47	5.05	**5.13**	3.99	3.35	2.40
116.01	**3.78**	3.66	3.33	3.74	3.72	2.85	2.34	1.68
117.01	4.48	5.27	5.48	6.45	**6.87**	5.94	5.68	4.12
118.01	2.71	2.74	2.60	2.99	**3.01**	2.39	2.02	1.45
119.01	5.45	6.12	6.11	7.45	**7.63**	6.41	5.91	4.26
119.02	10.5	11.9	12.0	14.5	**15.2**	12.9	12.0	8.67
119.03	17.5	20.1	20.6	24.3	**24.5**	22.1	20.8	15.2
119.04	25.5	28.9	29.9	**35.0**	34.6	31.7	29.7	21.8
119.05	28.5	32.6	33.7	**39.3**	38.6	35.8	33.7	24.7
119.06	36.1	41.7	43.4	**50.5**	49.4	46.3	43.6	32.3
119.07	39.0	45.8	48.1	**55.9**	54.4	51.9	49.3	36.5
119.08	37.1	44.5	47.5	**55.2**	51.7	51.5	49.2	37.0
119.09	40.8	49.7	54.9	**64.4**	58.5	61.2	58.2	45.1
119.1	41.4	51.2	57.1	**67.4**	60.7	63.9	61.2	47.4
119.11	67.1	89.0	108	137	135	**142**	141	110
119.12	67.4	89.6	109	139	139	**145**	144	113
119.13	67.4	89.7	110	141	143	146	**146**	114
119.14	67.3	89.7	110	141	144	146	**147**	114
119.15	75.8	102	126	160	160	167	**167**	130
119.16	75.9	102	126	161	162	168	**169**	131
119.17	99.2	132	164	200	194	217	**217**	168
119.18	99.6	133	164	202	197	219	**220**	170
119.19	99.5	133	164	203	198	219	**220**	170
119.2	99.0	132	164	203	198	219	**220**	170
119.21	99.3	133	165	205	201	221	**222**	171
119.22	99.4	133	165	247	**302**	293	301	183
119.23	118	160	196	270	333	335	**346**	215
120.01	4.69	5.44	5.56	6.60	**6.93**	5.99	5.68	4.11
121.01	3.25	3.25	3.08	3.50	**3.53**	2.77	2.32	1.67
122.01	6.27	6.89	6.84	8.27	**8.34**	6.84	6.13	4.41
123.01	4.07	4.41	4.33	5.22	**5.27**	4.26	3.76	2.70
124.01	4.64	4.75	4.55	5.28	**5.40**	4.26	3.63	2.60
125.01	4.29	5.47	6.05	6.79	**7.45**	6.82	6.80	5.01
125.02	8.74	10.1	10.6	12.4	**13.3**	11.8	11.4	8.40
126.01	3.99	4.43	4.35	5.29	**5.41**	4.36	3.87	2.78
127.01	2.98	3.08	2.95	3.29	**3.45**	2.67	2.23	1.60
127.02	3.18	3.46	3.35	**3.93**	3.50	3.10	2.81	2.03
128.01	7.61	7.75	7.39	8.40	**10.4**	9.82	10.11	7.72
128.02	22.9	27.5	30.3	34.7	**36.2**	35.9	34.5	26.5
128.03	31.6	40.8	46.6	**54.9**	50.3	52.8	51.1	40.0
128.04	32.1	41.9	48.3	**57.4**	52.6	55.9	54.7	42.6
128.05	34.8	45.5	53.2	**65.9**	62.8	63.4	63.0	49.3
128.06	35.1	45.9	54.0	69.9	**70.2**	66.1	66.5	51.8
128.07	35.5	46.7	55.5	74.1	**76.3**	70.1	70.9	55.6
128.08	35.5	46.8	55.6	75.7	**78.9**	71.4	72.6	57.0
128.09	35.6	47.0	56.1	77.2	**80.5**	73.2	75.1	58.8

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.1	35.9	47.5	56.9	79.7	**84.2**	76.5	78.8	61.3
128.11	35.9	47.5	56.9	79.8	**84.4**	76.5	78.9	61.3
128.12	36.0	47.7	57.2	80.8	**85.9**	77.9	80.4	62.3
129.01	6.00	7.07	7.53	8.76	**9.46**	8.20	7.87	5.72
129.02	10.9	11.7	11.8	14.2	**14.8**	12.8	11.9	8.67
129.03	16.4	18.5	19.3	22.8	**24.1**	21.5	20.4	15.1
130.01	3.97	4.10	3.95	4.55	**4.67**	3.68	3.12	2.24
131.01	6.12	6.10	6.54	7.44	**8.59**	7.33	7.14	5.23
132.01	6.21	6.97	6.92	8.48	**8.66**	7.17	6.53	4.70
132.02	10.3	11.4	11.6	**13.8**	13.7	11.9	10.9	7.9
132.03	13.8	15.1	15.2	**18.2**	18.0	15.6	14.4	10.4
132.04	16.3	18.5	19.3	**22.6**	20.4	19.7	18.2	13.9
132.05	16.2	18.5	19.4	**22.7**	20.5	19.8	18.4	14.2
133.01	2.95	3.23	3.16	3.81	**3.86**	3.15	2.78	2.00
134.01	3.70	3.91	3.82	4.57	**4.67**	3.73	3.23	2.32
135.01	3.90	4.05	3.97	4.71	**4.84**	3.84	3.30	2.37
136.01	**5.30**	5.23	4.03	4.53	4.66	3.47	2.86	2.07
136.02	4.56	**4.83**	3.35	4.51	4.64	4.29	4.28	3.14
137.01	3.41	4.14	4.64	5.19	**6.08**	5.37	5.47	4.04
137.02	9.52	9.46	7.47	9.17	**10.9**	9.04	8.62	6.32
137.03	0.00	6.76	7.64	8.64	**9.53**	9.25	9.33	6.95
137.04	7.49	8.34	9.31	10.6	**12.2**	11.4	11.3	8.42
137.05	9.32	9.93	10.9	12.4	**13.7**	13.6	13.6	10.2
138.01	3.10	3.03	2.73	3.24	**3.46**	2.74	2.38	1.72
139.01	4.39	**4.55**	2.75	2.74	2.81	2.07	1.71	1.25
140.01	5.90	**6.03**	3.79	3.62	3.38	2.34	1.91	1.39
141.01	5.32	**5.43**	3.77	4.52	4.91	3.86	3.38	2.44
141.02	**10.8**	10.5	7.68	8.17	9.22	7.11	6.14	4.46
141.03	13.5	**13.5**	9.22	9.70	10.8	8.29	7.12	5.17
141.04	12.3	**12.6**	9.6	11.0	11.9	9.51	8.33	6.05
142.01	2.23	**2.31**	1.41	1.31	1.22	0.84	0.68	0.50
143.01	0.52	0.57	0.56	0.67	**0.69**	0.57	0.51	0.36
144.01	6.39	6.50	5.05	6.17	**6.99**	5.73	5.37	3.91
144.02	6.18	6.07	5.91	7.06	**7.88**	6.75	6.41	4.70
145.01	2.23	2.41	2.39	2.86	**2.96**	2.40	2.10	1.51
146.01	2.95	3.23	3.60	3.95	**4.62**	4.05	4.06	3.00
147.01	2.64	**2.71**	1.68	1.86	2.22	1.81	1.70	1.24
148.01	9.46	**9.76**	5.96	6.49	7.26	5.53	4.73	3.43
148.02	6.83	**7.22**	5.56	6.50	6.89	5.54	4.93	3.59
149.01	**4.62**	4.57	3.15	3.70	3.63	2.63	2.15	1.56
149.02	4.89	**4.91**	3.37	3.97	3.86	2.84	2.33	1.69
150.01	5.23	6.73	7.74	8.67	**9.71**	9.27	9.39	7.03
150.02	5.71	7.44	8.65	9.73	10.4	**10.5**	10.4	7.97
150.03	8.03	10.1	11.5	13.0	14.0	**14.2**	14.0	10.7
150.04	8.03	10.2	11.5	13.0	14.0	**14.3**	14.1	10.8
150.05	11.5	14.7	16.7	19.0	18.9	**20.8**	20.5	16.0
151.01	2.91	2.89	2.53	3.08	**3.31**	2.67	2.38	1.72
152.01	6.21	**6.41**	3.89	4.54	5.46	4.51	4.31	3.17
152.02	5.14	5.17	4.53	5.29	**6.03**	5.23	5.08	3.75
152.03	4.27	4.34	4.76	5.55	**5.66**	5.57	5.41	4.18
152.04	4.50	4.74	5.35	6.45	6.30	**6.75**	6.55	5.24
153.01	9.34	9.56	9.51	11.7	**12.7**	10.5	9.73	7.05
153.02	14.5	16.8	17.6	20.5	**21.4**	19.8	19.0	14.2
153.03	17.5	20.6	21.5	25.0	**25.9**	24.1	23.3	17.3
153.04	24.2	28.5	30.2	34.9	**36.0**	33.4	32.3	23.9
153.05	31.2	35.9	37.9	44.1	**44.6**	41.4	39.6	29.3
153.06	35.2	41.5	44.7	**51.9**	49.9	49.4	46.5	35.4
153.07	35.2	41.6	44.9	**52.1**	49.9	49.7	46.8	35.7
153.08	37.9	44.9	48.3	**56.5**	53.3	53.4	50.3	38.3
154.01	4.68	4.83	4.62	5.33	**5.50**	4.30	3.65	2.62
155.01	3.57	3.60	3.50	4.24	**4.44**	3.52	3.07	2.22
156.01	6.71	7.88	8.24	9.62	**10.2**	8.90	8.49	6.16
157.01	5.36	5.80	5.70	6.81	**6.96**	5.64	4.93	3.54
158.01	2.97	3.17	3.11	3.71	**3.71**	3.03	2.66	1.91
159.01	3.45	3.51	3.33	3.67	**3.84**	2.95	2.44	1.76
159.02	4.03	4.01	3.92	4.48	**4.51**	3.59	3.04	2.20
160.01	1.90	**1.94**	1.27	1.57	1.79	1.48	1.37	1.00
160.02	**5.31**	5.19	3.64	3.73	4.33	3.37	2.97	2.17
160.03	6.83	**7.10**	5.39	5.41	6.08	4.67	4.11	3.01
160.04	6.80	**7.13**	5.43	5.45	6.12	4.70	4.14	3.03
161.01	30.3	65.9	87.7	**157**	155	140	135	81.9
161.02	29.9	65.5	87.5	**157**	155	140	135	82.2
161.03	29.3	65.1	87.3	**157**	155	141	136	83.3
162.01	1.54	1.92	1.84	2.09	**2.12**	1.67	1.40	1.00
163.01	4.55	6.07	5.97	7.10	**7.18**	5.81	5.06	3.63
163.02	9.40	13.0	12.9	**15.4**	15.4	12.9	11.5	8.31

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
163.03	15.1	23.3	24.5	**28.2**	27.9	27.4	26.0	19.7
163.04	17.7	27.6	29.8	**34.3**	32.8	33.2	31.2	24.0
163.05	21.9	34.4	39.5	46.2	46.7	**48.6**	48.2	36.7
163.06	21.8	34.3	39.6	46.6	47.1	**48.8**	48.5	37.0
163.07	21.9	35.0	41.3	49.5	50.3	51.0	**51.2**	39.8
163.08	21.6	34.7	41.1	49.5	49.6	50.9	**51.4**	39.9
164.01	4.67	6.60	6.56	7.97	**8.03**	6.67	6.05	4.35
165.01	3.83	5.90	6.04	7.24	**7.72**	6.56	6.19	4.48
166.01	2.82	4.01	3.99	4.90	**4.96**	4.11	3.74	2.69
167.01	3.51	4.99	6.37	8.11	9.68	10.3	**10.6**	8.30
168.01	2.72	3.63	3.56	4.26	**4.29**	3.47	3.04	2.19
169.01	4.83	6.88	6.85	8.33	**8.39**	7.06	6.44	4.63
169.02	6.71	9.69	9.95	11.9	**14.1**	12.9	13.7	10.2
169.03	6.74	9.86	10.28	12.1	**14.0**	13.4	13.9	10.4
170.01	3.05	3.38	3.47	4.17	**4.58**	3.84	3.61	2.63
170.02	3.35	5.20	5.57	6.38	**6.80**	6.22	6.05	4.46
170.03	4.71	7.69	8.90	10.2	10.2	**10.9**	10.7	8.25
171.01	5.04	8.46	9.65	10.9	**11.8**	11.4	11.5	8.57
171.02	6.22	10.8	12.9	14.8	15.2	**16.7**	16.3	12.7
171.03	9.60	16.7	19.5	22.1	22.7	**24.7**	24.2	18.7
171.04	10.2	18.2	21.3	24.2	25.0	**27.3**	27.0	20.8
171.05	14.0	24.7	29.4	33.9	34.8	**38.5**	38.1	29.5
171.06	14.0	24.7	29.5	34.3	35.0	**38.8**	38.4	29.8
172.01	2.48	3.58	3.84	4.34	**4.90**	4.23	4.12	3.02
173.01	3.29	3.61	3.51	3.84	**4.66**	4.09	4.16	3.10
174.01	2.14	2.36	2.05	2.24	**2.45**	1.85	1.55	1.12
175.01	2.38	4.18	5.15	6.02	6.58	7.25	**7.36**	5.71
175.02	4.01	6.96	8.45	9.74	10.3	**11.1**	11.1	8.62
176.01	1.86	2.97	3.37	3.74	**4.24**	3.87	3.91	2.91
177.01	2.15	3.07	3.60	4.00	**4.66**	4.43	4.52	3.41
178.01	2.98	3.75	3.51	3.95	**3.98**	3.10	2.58	1.85
178.02	5.48	6.90	6.49	7.28	**7.35**	5.74	4.79	3.44
179.01	3.57	4.89	5.58	6.16	**7.22**	6.49	6.62	4.93
179.02	7.92	12.0	13.1	14.9	**16.7**	14.8	14.5	10.7
179.03	8.65	13.9	15.6	17.7	**18.6**	18.5	18.2	13.8
179.04	8.65	15.0	17.5	20.3	20.3	**21.9**	21.9	16.4
179.05	9.19	16.2	19.2	23.9	24.5	25.1	**25.4**	18.7
179.06	10.2	18.1	21.8	28.1	30.0	30.0	**30.8**	22.8
179.07	26.0	25.3	22.2	31.2	**36.5**	33.9	35.4	25.7
180.01	2.71	4.15	4.45	5.14	**5.68**	4.86	4.70	3.42
181.01	9.00	**9.64**	5.69	4.64	5.45	4.24	3.86	2.84
182.01	2.25	2.83	2.72	3.14	**3.19**	2.54	2.15	1.54
182.02	3.59	5.30	5.50	6.31	**6.56**	6.27	6.04	4.53
183.01	2.13	2.32	2.42	3.35	4.25	4.23	**4.53**	3.40
184.01	22.0	**23.8**	14.5	10.4	10.8	7.89	7.00	5.22
185.01	13.0	**14.3**	8.28	6.12	5.86	4.11	3.40	2.51
186.01	5.43	**5.91**	3.29	2.91	3.06	2.26	1.90	1.39
186.02	6.94	**7.28**	5.32	4.41	4.58	3.35	2.83	2.08

PEAK DESIGN FLOOD DISCHARGES - Sensitivity - 2.5mm/hr Pervious and 0mm/hr Impervious Continuing Losses

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	10.6	13.8	13.4	**15.4**	15.0	12.4	11.2	8.16
1.02	18.7	24.9	24.8	**27.9**	25.6	23.2	21.7	15.9
1.03	29.2	37.6	36.9	**42.3**	39.2	34.5	32.2	23.6
1.04	37.5	47.1	46.2	**53.2**	51.2	44.4	41.3	30.3
1.05	64.7	81.6	80.2	**92.0**	89.9	78.9	73.9	54.6
1.06	84.5	103	102	**118**	117	102	95.8	71.0
1.07	107	130	128	**146**	145	125	117	86.2
1.08	122	146	143	**162**	159	139	129	95.4
1.09	139	167	162	**183**	177	156	145	108
1.10	147	178	172	**195**	188	166	153	114
1.11	182	222	211	**238**	229	202	186	139
1.12	189	233	221	**250**	238	213	197	147
1.13	192	237	225	**255**	242	217	201	150
1.14	196	244	232	**263**	247	223	207	155
1.15	199	250	239	**270**	253	230	213	160
1.16	206	261	251	**283**	260	240	223	168
1.17	249	322	311	**348**	315	296	277	208
1.18	274	361	352	**394**	351	333	314	237
1.19	270	360	357	**400**	350	343	324	248
1.20	270	363	363	**407**	353	349	330	253
1.21	391	526	526	**589**	496	491	463	355
1.22	390	526	530	**595**	499	496	468	360
1.23	389	529	537	**608**	513	505	478	370
1.24	387	529	539	**612**	519	508	481	373
1.25	390	537	553	**630**	530	523	497	389
1.26	388	537	558	**639**	541	532	507	398
1.27	388	537	558	**641**	544	533	508	399
1.28	387	537	560	**646**	552	539	514	405
1.29	388	542	570	**666**	581	554	531	420
1.30	387	542	570	**667**	584	555	532	421
1.31	387	545	578	**677**	589	565	546	432
1.32	379	537	572	**672**	581	562	546	432
1.33	378	538	575	**682**	596	571	555	439
1.34	376	536	574	**685**	600	574	559	442
1.35	372	534	574	**689**	605	578	564	446
1.36	372	536	580	**717**	646	605	592	466
1.37	372	538	585	**743**	688	628	617	484
1.38	366	531	582	**740**	685	630	621	486
1.39	365	530	582	**744**	693	636	626	491
1.40	360	525	579	**740**	689	635	626	490
1.41	360	525	579	**741**	691	640	628	492
1.42	357	523	578	**742**	693	641	631	494
1.43	356	522	578	**743**	695	644	633	496
1.44	356	522	578	**743**	695	645	633	496
1.45	352	520	578	**745**	697	651	640	502
1.46	352	519	578	**745**	698	655	642	505
1.47	350	517	577	**744**	695	656	643	506
1.48	316	416	452	**552**	523	500	492	410
1.49	320	427	473	626	**648**	605	625	480
1.50	319	427	473	626	**648**	605	625	480
1.51	371	610	704	942	**1005**	969	996	717
1.52	372	612	707	944	**1008**	976	1003	722
1.53	372	612	707	943	**1008**	977	1003	723
1.54	372	613	709	943	**1010**	982	1008	726
1.55	378	625	726	953	1030	1007	**1034**	744
1.56	378	625	727	952	1031	1009	**1036**	745
1.57	376	625	728	950	1033	1013	**1042**	749
1.58	375	623	727	948	1033	1015	**1043**	751
1.59	381	634	743	955	1049	1045	**1071**	772
1.60	361	611	725	935	1045	1038	**1069**	772
2.01	6.84	8.41	8.12	8.74	**8.76**	6.97	6.02	4.38
3.01	7.25	**8.36**	6.66	6.27	5.78	4.03	3.28	2.39
4.01	10.9	15.7	16.5	18.6	**19.0**	16.8	16.6	12.3
4.02	24.3	31.4	31.0	**35.7**	35.6	31.7	30.2	22.4
5.01	7.3	10.8	11.7	12.8	**13.3**	12.1	12.1	9.0
5.02	17.5	19.6	18.9	21.8	**23.7**	20.0	18.9	14.1
6.01	3.58	**4.10**	3.70	3.95	3.85	2.95	2.45	1.78
7.01	11.7	14.9	14.5	**16.6**	15.9	13.2	11.9	8.7
7.02	22.7	27.2	26.0	**28.8**	27.8	23.1	20.5	14.9
8.01	3.09	**3.42**	2.96	3.18	3.02	2.32	1.91	1.39
9.01	9.58	**10.8**	9.52	10.3	9.84	7.59	6.30	4.58
10.01	16.4	**19.8**	18.3	19.4	19.0	15.1	12.8	9.33
11.01	6.11	**6.80**	5.51	5.83	5.42	3.96	3.23	2.35
12.01	10.7	**12.0**	9.8	10.9	10.1	7.45	6.10	4.43

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
12.02	21.3	**23.8**	19.6	21.3	19.7	14.9	12.4	8.98
12.03	32.7	**36.7**	30.9	33.5	30.4	23.8	19.9	14.5
12.04	47.4	**54.3**	46.5	49.9	44.7	35.8	30.3	22.0
13.01	5.56	**6.41**	5.09	4.89	4.48	3.16	2.58	1.87
14.01	6.51	**7.14**	6.01	6.62	6.24	4.71	3.87	2.81
15.01	8.14	**8.93**	7.75	8.45	8.04	6.11	5.05	3.66
16.01	4.25	**4.70**	3.86	4.08	3.79	2.79	2.28	1.66
16.02	11.1	**12.4**	10.0	11.1	10.2	7.68	6.32	4.59
16.03	18.3	**20.5**	16.7	18.1	16.7	12.5	10.3	7.48
17.01	5.22	**5.66**	4.85	5.31	5.01	3.76	3.10	2.25
18.01	6.94	**7.71**	6.29	6.69	6.23	4.57	3.74	2.71
19.01	5.73	**6.31**	5.19	5.66	5.30	3.93	3.22	2.34
20.01	8.37	**9.18**	7.70	8.47	7.98	5.97	4.91	3.56
21.01	5.36	**6.08**	4.84	4.92	4.52	3.24	2.65	1.92
22.01	6.87	**7.56**	6.23	6.85	6.42	4.80	3.93	2.85
23.01	19.7	23.8	22.9	**25.2**	24.2	20.0	17.5	12.7
23.02	53.1	64.2	60.8	**66.5**	61.7	51.6	45.3	32.9
23.03	57.9	70.4	66.8	**73.2**	67.1	56.6	50.0	36.4
23.04	61.7	74.9	71.4	**78.6**	72.3	60.9	53.9	39.2
24.01	6.82	**7.98**	7.28	7.69	7.50	5.88	4.94	3.59
24.02	19.1	**22.1**	20.3	21.8	20.5	16.5	14.1	10.2
25.01	3.72	**4.45**	4.10	4.31	4.18	3.32	2.82	2.05
26.01	5.79	**6.65**	5.28	5.20	4.79	3.40	2.77	2.01
27.01	19.0	**22.7**	21.2	22.3	21.9	17.3	14.7	10.7
27.02	32.6	**36.8**	33.3	35.8	34.7	27.0	22.8	16.5
27.03	49.4	**57.8**	53.5	57.5	56.2	44.7	38.3	27.8
28.01	10.2	**11.4**	9.38	10.3	9.63	7.16	5.87	4.26
29.01	17.1	20.9	20.1	**22.0**	21.3	17.4	15.2	11.1
30.01	14.0	17.1	16.2	**17.7**	17.0	13.9	12.1	8.77
31.01	17.4	**19.4**	17.1	18.4	17.6	13.5	11.2	8.13
31.02	26.8	**30.2**	27.0	29.0	27.6	21.6	18.1	13.1
31.03	41.6	**48.3**	44.2	47.5	45.5	36.4	31.0	22.5
31.04	51.6	**60.0**	55.3	59.6	56.3	45.6	39.2	28.5
31.05	63.2	74.1	68.8	**74.7**	69.5	57.1	49.5	36.0
31.06	74.6	88.2	81.9	**89.5**	82.2	68.2	59.4	43.2
31.07	85.7	103	96.4	**106**	96.1	81.9	72.4	52.9
31.08	138	175	168	**187**	156	145	132	99
31.09	138	177	172	**191**	157	149	135	103
32.01	8.51	**9.84**	8.98	9.52	9.20	7.26	6.10	4.43
33.01	14.6	17.9	16.9	**18.5**	17.8	14.5	12.7	9.20
34.01	7.54	9.10	8.62	**9.33**	9.02	7.33	6.36	4.62
35.01	6.23	7.39	6.99	**7.45**	7.22	5.81	4.98	3.62
36.01	5.39	**5.91**	4.88	5.30	4.96	3.66	3.00	2.18
37.01	7.24	**8.00**	6.56	7.12	6.65	4.93	4.04	2.93
38.01	7.94	9.61	9.26	**10.3**	9.83	8.12	7.14	5.19
38.02	15.4	18.0	16.9	**18.2**	17.9	14.4	12.4	9.03
38.03	34.7	39.6	36.5	**39.9**	37.6	30.6	26.5	19.3
38.04	63.7	76.3	72.5	**80.2**	76.1	63.3	55.9	40.7
39.01	6.59	**7.49**	6.71	7.16	6.89	5.37	4.47	3.25
40.01	4.77	**5.51**	5.05	5.30	5.15	4.02	3.38	2.45
40.02	11.8	**13.2**	11.0	12.2	11.4	8.78	7.35	5.34
41.01	3.93	**4.41**	3.57	3.60	3.33	2.40	1.96	1.42
42.01	14.9	19.1	18.6	**21.2**	20.1	16.9	15.3	11.1
42.02	29.2	36.5	35.6	**40.1**	38.3	32.0	28.6	20.9
43.01	12.8	15.8	15.2	**16.9**	16.1	13.3	11.7	8.5
44.01	6.48	**7.14**	6.19	6.74	6.40	4.90	4.04	2.94
45.01	10.6	**12.9**	12.0	12.8	12.4	10.0	8.57	6.23
46.01	13.3	16.5	15.8	**17.5**	17.1	13.9	12.2	8.87
46.02	25.2	30.1	28.3	**30.8**	29.4	24.2	21.1	15.3
47.01	7.90	**8.66**	7.32	8.07	7.59	5.72	4.71	3.42
48.01	7.95	9.58	9.07	**9.84**	9.55	7.75	6.72	4.88
49.01	15.6	22.2	21.9	**25.7**	25.6	21.8	20.5	15.1
50.01	6.66	7.97	7.50	**8.02**	7.78	6.25	5.37	3.90
51.01	5.68	**6.82**	5.42	4.28	3.95	2.68	2.19	1.59
51.02	17.4	**20.5**	16.5	14.9	13.6	9.58	7.82	5.69
51.03	26.1	**29.8**	24.6	25.4	23.2	18.2	15.5	11.3
52.01	9.73	**11.4**	9.06	8.93	8.23	5.79	4.72	3.43
53.01	7.30	**8.49**	6.75	6.06	5.59	3.86	3.15	2.29
54.01	4.74	**5.19**	4.56	4.93	4.67	3.56	2.94	2.14
55.01	9.09	12.0	11.8	**13.7**	12.9	11.1	10.4	7.59
56.01	14.4	17.8	17.4	**19.5**	18.6	15.4	13.7	10.0
56.02	27.1	35.7	35.3	**40.0**	38.1	33.8	31.4	23.4
56.03	30.5	40.1	40.2	**45.5**	43.2	38.8	36.3	26.9
57.01	10.0	12.9	12.6	**14.4**	13.6	11.5	10.5	7.66
58.01	6.46	**7.54**	6.91	7.32	7.09	5.61	4.72	3.43
59.01	3.27	4.02	3.80	**4.17**	4.04	3.28	2.87	2.09

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.01	8.05	10.2	10.0	**11.4**	10.7	9.10	8.30	6.05
60.02	14.9	19.6	19.5	**21.7**	18.8	17.6	16.2	12.2
61.01	7.32	8.95	8.74	**9.75**	9.31	7.72	6.86	4.99
62.01	3.33	4.04	3.84	**4.22**	4.02	3.31	2.90	2.11
63.01	11.9	17.7	19.0	21.0	**21.2**	19.6	19.5	14.5
63.02	19.1	26.5	27.2	**31.3**	31.2	28.1	27.3	20.3
64.01	6.91	8.73	8.65	**9.84**	9.30	7.87	7.15	5.21
65.01	6.43	8.04	7.92	**8.97**	8.58	7.12	6.42	4.67
66.01	6.29	8.52	8.53	**9.87**	9.51	8.29	7.84	5.75
67.01	8.38	11.3	11.2	**13.1**	12.6	11.0	10.5	7.68
67.02	15.4	19.0	19.1	22.1	**22.3**	18.6	17.2	12.6
67.03	41.5	48.3	46.4	**52.8**	52.3	44.5	40.8	30.0
67.04	58.0	68.5	60.7	**69.7**	68.3	57.9	52.8	38.7
67.05	70.6	83.4	75.3	**86.7**	84.7	72.5	66.2	48.7
67.06	71.9	86.7	81.1	**93.1**	89.7	79.2	72.9	54.4
67.07	74.9	91.5	87.3	**99.8**	94.0	84.6	78.5	58.7
68.01	4.21	5.24	5.03	**5.51**	5.40	4.37	3.84	2.80
69.01	11.7	**13.6**	10.7	10.8	10.0	7.04	5.75	4.18
70.01	7.62	**8.66**	7.80	8.47	8.23	6.27	5.20	3.78
70.02	18.4	**20.0**	17.0	19.1	17.9	13.4	11.1	8.06
71.01	6.79	**7.58**	6.14	6.83	6.36	4.59	3.76	2.74
72.01	6.99	**7.74**	6.33	6.78	6.31	4.61	3.77	2.74
73.01	5.06	6.53	6.45	**7.39**	7.02	5.94	5.48	4.00
74.01	14.9	18.6	18.0	**19.9**	19.6	15.9	13.9	10.1
74.02	21.9	27.7	27.1	**30.3**	28.5	24.1	21.6	15.8
74.03	29.2	35.7	34.6	**38.5**	35.9	30.6	27.4	20.0
74.04	33.7	40.5	39.2	**43.7**	41.1	34.7	31.0	22.6
74.05	44.3	54.5	52.9	**59.2**	54.8	47.2	42.6	31.2
74.06	43.4	55.0	53.8	**60.4**	52.8	48.3	44.3	33.2
74.07	43.4	55.1	53.9	**60.5**	52.9	48.5	44.4	33.3
75.01	5.91	**6.47**	5.73	6.21	5.96	4.53	3.74	2.72
76.01	4.31	**4.75**	4.16	4.48	4.24	3.25	2.68	1.95
77.01	7.78	9.9	9.71	**11.1**	10.7	8.89	8.03	5.86
78.01	7.14	10.0	10.5	**11.8**	11.7	10.6	10.4	7.67
78.02	17.2	21.9	22.0	**25.3**	24.6	21.6	20.3	15.0
78.03	22.8	29.2	29.3	**33.3**	32.2	28.7	26.7	19.9
79.01	6.46	7.85	7.72	**8.62**	8.28	6.81	6.06	4.41
80.01	4.33	**4.81**	4.26	4.56	4.34	3.35	2.77	2.01
81.01	5.39	7.52	7.74	**8.85**	8.78	7.76	7.55	5.58
82.01	8.84	12.4	12.9	**14.6**	14.3	13.0	12.7	9.38
82.02	12.3	17.8	18.7	**21.1**	20.1	19.2	18.5	14.0
83.01	5.91	8.09	8.09	**9.45**	9.30	7.94	7.52	5.52
83.02	6.93	9.22	9.21	**10.7**	10.5	9.04	8.48	6.23
84.01	5.26	7.20	7.25	**8.43**	8.19	7.18	6.90	5.08
84.02	5.20	7.26	7.53	**8.54**	7.76	7.43	7.06	5.38
85.01	3.89	**4.50**	3.72	4.03	3.79	2.76	2.27	1.65
85.02	4.92	6.83	6.80	**7.33**	6.08	6.61	6.41	4.89
86.01	5.27	**5.78**	3.78	4.04	4.15	3.19	2.73	1.99
87.01	4.34	6.53	7.02	7.68	**7.85**	7.23	7.22	5.41
87.02	4.81	6.93	7.46	8.24	**8.49**	7.73	7.69	5.77
88.01	3.20	4.54	4.63	**5.37**	5.30	4.66	4.55	3.36
89.01	13.5	19.1	19.0	**22.0**	21.4	19.1	18.3	13.5
89.02	29.4	35.7	35.0	**40.0**	39.2	33.4	30.6	22.5
89.03	42.2	51.4	49.7	**56.0**	54.2	46.3	41.9	30.8
89.04	54.7	68.0	66.3	**74.9**	71.3	61.6	56.2	41.3
89.05	64.8	81.0	78.8	**88.9**	83.8	72.9	66.6	49.0
89.06	73.3	91.3	89.0	**100**	91.1	82.3	75.6	56.0
89.07	89.5	115	114	**129**	115	109	101	76.4
89.08	93.3	121	121	**136**	121	116	108	81.6
89.09	95.2	125	125	**140**	124	120	112	84.9
89.10	96.0	126	127	**143**	125	122	114	86.9
89.11	96.4	128	129	**145**	127	126	117	89.7
89.12	99.0	133	136	**153**	131	132	124	95.7
89.13	100	137	141	**158**	134	137	129	100
89.14	100	137	142	**160**	135	139	131	102
89.15	109	166	183	**210**	188	201	196	153
89.16	111	169	187	**214**	192	205	201	157
89.17	111	171	190	**220**	196	210	205	161
90.01	4.35	**4.83**	4.27	4.57	4.35	3.35	2.77	2.01
90.02	15.0	**17.3**	16.1	17.2	16.1	13.1	11.3	8.19
91.01	5.15	6.15	5.83	**6.20**	6.00	4.86	4.18	3.03
92.01	8.65	10.4	9.84	**10.7**	10.3	8.40	7.29	5.30
93.01	12.2	15.9	15.6	**17.9**	16.9	14.4	13.2	9.64
94.01	9.10	11.0	10.7	**11.9**	11.3	9.36	8.29	6.03
95.01	6.49	**7.36**	6.57	7.03	6.75	5.25	4.37	3.17
96.01	10.3	14.9	15.6	**17.5**	17.3	15.8	15.6	11.6

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
96.02	15.6	20.1	20.2	**23.4**	23.1	20.7	19.8	14.8
97.01	4.74	**5.54**	5.12	5.36	5.22	4.10	3.46	2.52
98.01	7.21	8.84	8.68	**9.74**	9.26	7.71	6.88	5.00
99.01	3.66	**4.31**	3.94	4.14	3.99	3.17	2.68	1.95
100.01	2.63	3.30	3.21	**3.64**	3.42	2.88	2.60	1.89
101.01	3.36	4.10	3.89	**4.27**	4.11	3.36	2.94	2.14
102.01	3.93	5.19	5.11	**5.81**	5.50	4.67	4.31	3.14
103.01	4.91	5.96	5.83	**6.46**	6.19	5.14	4.54	3.30
104.01	2.09	2.55	2.50	**2.79**	2.74	2.25	1.97	1.44
105.01	10.0	12.4	12.1	**13.7**	13.0	10.8	9.72	7.07
105.02	14.5	16.9	16.1	**17.9**	17.9	14.5	12.7	9.26
105.03	24.7	29.3	28.2	**31.5**	30.2	25.1	22.4	16.3
105.04	25.4	32.8	32.6	**36.7**	31.6	29.7	27.5	20.8
105.05	28.5	38.2	39.2	**43.5**	36.4	37.0	34.3	26.7
105.06	31.8	44.5	46.1	**50.9**	42.7	43.8	41.3	32.3
105.07	39.2	58.1	61.2	**67.4**	58.6	60.1	57.8	44.9
105.08	40.3	60.8	64.4	**70.9**	62.5	63.6	61.5	47.8
105.09	44.6	68.3	72.8	**80.9**	68.3	71.8	69.2	54.5
105.10	43.4	66.5	72.6	**82.6**	71.0	74.5	72.5	57.1
105.11	43.5	66.5	72.9	**84.6**	74.5	75.7	74.1	58.1
106.01	4.73	**5.23**	4.27	4.52	4.19	3.07	2.51	1.82
107.01	8.14	9.9	9.69	**10.9**	10.3	8.63	7.71	5.61
108.01	6.91	**8.06**	7.33	7.78	7.53	5.92	4.99	3.62
109.01	6.90	8.50	8.38	**9.46**	8.99	7.51	6.74	4.91
110.01	6.54	7.89	7.63	**8.40**	8.12	6.62	5.82	4.23
111.01	6.91	10.1	10.8	**12.0**	12.0	11.1	11.0	8.23
111.02	13.8	17.1	17.0	**19.6**	19.6	17.5	16.7	12.5
112.01	5.30	**5.96**	5.40	5.74	5.51	4.29	3.58	2.60
113.01	3.74	4.62	4.48	**4.98**	4.74	3.91	3.48	2.53
114.01	4.73	**5.62**	5.26	5.54	5.37	4.29	3.66	2.66
115.01	4.82	**5.60**	5.16	5.41	5.26	4.13	3.48	2.53
116.01	3.85	**4.25**	3.75	4.00	3.82	2.94	2.43	1.77
117.01	4.61	6.31	6.30	**7.36**	7.14	6.17	5.89	4.33
118.01	2.77	**3.28**	3.01	3.20	3.09	2.47	2.09	1.52
119.01	5.59	7.29	7.20	**8.29**	7.92	6.66	6.13	4.47
119.02	10.8	14.2	14.1	**16.3**	15.8	13.4	12.4	9.11
119.03	18.0	23.6	23.8	**27.1**	25.4	22.9	21.6	15.9
119.04	26.1	34.5	34.5	**39.0**	36.0	32.9	30.9	23.0
119.05	29.2	38.6	38.8	**43.7**	40.2	37.2	35.0	26.0
119.06	37.0	49.6	50.0	**56.3**	51.4	48.2	45.3	34.0
119.07	40.0	54.8	55.7	**62.3**	56.7	53.9	51.3	38.4
119.08	38.1	53.3	54.9	**61.7**	54.0	53.7	51.2	39.0
119.09	41.9	60.1	64.0	**72.0**	61.3	64.0	60.8	47.8
119.10	42.6	62.5	66.9	**75.7**	63.7	66.9	63.8	50.2
119.11	68.9	110	129	**154**	141	149	148	116
119.12	69.1	111	131	**157**	145	153	152	119
119.13	69.1	111	132	**159**	149	154	154	121
119.14	69.1	111	132	**159**	150	154	154	121
119.15	77.8	126	150	**180**	167	176	175	138
119.16	77.9	126	151	**181**	169	177	177	139
119.17	102	162	193	224	203	**228**	228	178
119.18	102	162	194	227	207	231	**231**	180
119.19	102	162	194	227	208	231	**231**	180
119.20	102	162	194	228	210	231	**231**	180
119.21	102	163	195	231	213	232	**233**	182
119.22	102	163	208	299	329	324	**330**	213
119.23	120	198	238	318	361	365	**376**	246
120.01	4.84	6.47	6.46	**7.52**	7.21	6.23	5.89	4.32
121.01	3.31	**3.90**	3.55	3.73	3.62	2.86	2.41	1.75
122.01	6.44	8.02	7.89	**8.92**	8.63	7.10	6.36	4.63
123.01	4.17	5.21	5.02	**5.55**	5.45	4.41	3.89	2.83
124.01	4.75	**5.70**	5.36	5.64	5.53	4.40	3.76	2.73
125.01	4.42	6.54	6.96	7.67	**7.82**	7.10	7.07	5.27
125.02	8.98	12.1	12.1	**14.0**	13.8	12.3	11.8	8.83
126.01	4.09	5.16	5.03	**5.64**	5.58	4.51	4.00	2.91
127.01	3.03	**3.64**	3.35	3.52	3.52	2.74	2.30	1.67
127.02	3.24	4.14	3.84	**4.26**	3.60	3.19	2.89	2.11
128.01	7.63	8.37	8.64	9.40	**11.0**	10.2	10.5	8.11
128.02	23.5	32.9	34.8	**39.2**	37.9	37.3	35.9	27.9
128.03	32.4	51.0	55.0	**61.4**	53.0	55.1	53.4	41.9
128.04	32.9	52.1	57.0	**64.1**	55.4	58.5	57.1	44.9
128.05	35.6	56.8	63.1	**73.6**	65.9	66.4	65.8	51.8
128.06	35.9	57.4	64.4	**77.7**	73.5	69.4	69.6	54.5
128.07	36.4	58.6	66.6	**82.4**	79.7	73.9	74.4	58.9
128.08	36.4	58.7	66.8	**84.1**	82.5	75.3	76.6	60.4
128.09	36.4	59.0	67.6	**85.7**	84.2	77.5	79.2	62.3

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.10	36.8	59.7	68.8	**88.5**	87.9	80.9	83.0	65.0
128.11	36.8	59.7	68.8	**88.7**	88.1	81.0	83.2	65.1
128.12	36.8	59.9	69.2	**89.8**	89.7	82.5	84.8	66.1
129.01	6.16	8.49	8.56	**10.0**	9.81	8.55	8.16	6.01
129.02	11.1	13.7	13.8	**15.7**	15.4	13.3	12.4	9.10
129.03	16.8	22.0	22.3	**25.6**	25.0	22.3	21.2	15.8
130.01	4.06	**4.95**	4.63	4.84	4.80	3.79	3.23	2.35
131.01	6.14	7.12	7.34	8.56	**8.91**	7.62	7.39	5.47
132.01	6.37	8.22	8.11	**9.26**	8.94	7.43	6.76	4.93
132.02	10.6	13.6	13.5	**15.2**	14.2	12.3	11.3	8.28
132.03	14.1	18.1	17.8	**20.1**	18.6	16.1	14.9	10.9
132.04	16.7	22.0	22.4	**24.9**	21.2	20.4	18.9	14.6
132.05	16.6	22.0	22.5	**25.1**	21.2	20.6	19.1	14.8
133.01	3.01	3.73	3.61	**4.09**	3.97	3.25	2.88	2.09
134.01	3.79	4.72	4.51	**4.85**	4.81	3.85	3.34	2.43
135.01	3.99	4.95	4.70	**5.00**	4.97	3.96	3.41	2.49
136.01	5.32	**5.84**	4.48	4.93	4.75	3.55	2.94	2.15
136.02	4.56	4.88	3.85	**5.03**	4.87	4.49	4.46	3.33
137.01	3.42	4.99	5.39	5.88	**6.32**	5.62	5.66	4.24
137.02	9.54	10.6	8.52	10.3	**11.3**	9.38	8.90	6.60
137.03	10.92	12.35	9.67	11.57	**12.5**	10.47	9.85	7.30
137.04	7.57	10.2	10.6	12.2	**13.0**	11.9	11.7	8.79
137.05	9.39	12.0	12.6	14.2	**14.6**	14.2	14.1	10.7
138.01	3.11	3.42	3.17	3.45	**3.54**	2.82	2.46	1.79
139.01	4.39	**4.82**	3.04	2.96	2.85	2.10	1.75	1.28
140.01	5.91	**6.53**	4.34	3.68	3.42	2.37	1.94	1.43
141.01	5.33	**5.89**	4.39	4.80	5.02	3.96	3.47	2.54
141.02	10.8	**11.3**	8.61	9.04	9.38	7.26	6.28	4.60
141.03	13.5	**14.5**	10.5	10.7	11.0	8.47	7.29	5.34
141.04	12.3	**14.1**	10.9	11.9	12.2	9.73	8.54	6.26
142.01	2.23	**2.46**	1.63	1.32	1.23	0.85	0.70	0.51
143.01	0.53	0.66	0.64	**0.73**	0.71	0.59	0.52	0.38
144.01	6.41	7.08	5.76	6.90	**7.19**	5.93	5.54	4.07
144.02	6.21	7.08	6.73	7.92	**8.15**	6.98	6.61	4.89
145.01	2.28	2.79	2.75	**3.06**	3.04	2.47	2.17	1.58
146.01	2.96	3.84	4.11	4.54	**4.81**	4.22	4.21	3.15
147.01	2.65	**2.83**	1.85	2.06	2.28	1.86	1.74	1.29
148.01	9.47	**10.4**	6.80	7.16	7.40	5.66	4.85	3.55
148.02	6.85	**7.99**	6.43	6.90	7.05	5.68	5.06	3.72
149.01	4.63	**5.11**	3.72	3.91	3.69	2.68	2.21	1.61
149.02	4.90	**5.54**	4.06	4.21	3.92	2.90	2.39	1.75
150.01	5.35	8.18	8.99	9.83	**10.2**	9.67	9.76	7.40
150.02	5.86	9.00	10.0	**11.0**	10.9	10.9	10.8	8.39
150.03	8.24	12.1	13.2	14.7	14.7	**14.7**	14.6	11.3
150.04	8.24	12.1	13.3	14.8	14.7	**14.8**	14.6	11.4
150.05	11.7	17.7	19.2	21.3	19.9	**21.6**	21.2	16.8
151.01	2.92	3.22	2.92	3.33	**3.39**	2.75	2.45	1.79
152.01	6.22	**6.80**	4.30	5.12	5.62	4.66	4.44	3.30
152.02	5.16	5.76	5.11	5.91	**6.21**	5.40	5.22	3.90
152.03	4.32	5.13	5.42	**6.23**	5.88	5.78	5.59	4.39
152.04	4.55	5.80	6.17	**7.19**	6.52	7.00	6.73	5.50
153.01	9.37	11.3	11.1	13.0	**13.1**	10.9	10.1	7.37
153.02	14.8	20.1	20.2	**23.0**	22.3	20.5	19.8	14.9
153.03	17.9	24.2	24.7	**27.9**	27.0	25.1	24.2	18.2
153.04	24.8	33.9	34.5	**38.9**	37.6	34.8	33.5	25.1
153.05	32.0	43.1	43.6	**49.2**	46.4	43.0	41.1	30.8
153.06	36.1	50.3	51.6	**58.0**	52.1	51.3	48.3	37.2
153.07	36.1	50.4	51.9	**58.2**	52.2	51.6	48.6	37.5
153.08	38.9	54.0	56.1	**62.8**	55.6	55.5	52.2	40.3
154.01	4.79	**5.77**	5.44	5.68	5.63	4.44	3.78	2.75
155.01	3.58	4.21	4.09	4.49	**4.55**	3.63	3.17	2.31
156.01	6.91	9.36	9.43	**11.0**	10.6	9.25	8.82	6.47
157.01	5.49	6.75	6.60	**7.26**	7.17	5.82	5.10	3.71
158.01	3.04	3.72	3.55	**3.96**	3.82	3.13	2.75	2.00
159.01	3.51	**4.11**	3.76	3.99	3.93	3.02	2.52	1.84
159.02	4.10	**4.81**	4.51	4.76	4.61	3.69	3.13	2.29
160.01	1.90	**2.06**	1.45	1.74	1.84	1.52	1.41	1.04
160.02	5.32	**5.43**	4.06	4.11	4.41	3.44	3.04	2.24
160.03	6.83	**7.65**	5.95	5.89	6.20	4.77	4.20	3.10
160.04	6.81	**7.68**	6.01	5.93	6.23	4.80	4.23	3.12
161.01	33.9	101	125	**191**	172	157	152	97
161.02	33.5	101	124	**191**	172	157	152	97
161.03	32.9	100	124	**191**	172	158	153	98
162.01	1.98	**2.30**	2.12	2.24	2.17	1.72	1.45	1.05
163.01	5.89	7.15	6.93	**7.56**	7.40	6.01	5.25	3.81
163.02	12.4	15.2	15.0	**16.8**	15.9	13.4	12.0	8.73

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
163.03	20.1	27.3	28.0	**31.7**	29.2	28.4	27.0	20.7
163.04	23.8	33.0	34.1	**38.5**	34.4	34.5	32.4	25.2
163.05	29.2	41.9	45.3	51.6	48.6	**52.2**	50.4	39.2
163.06	29.1	41.9	45.5	52.0	48.8	**52.5**	50.7	39.5
163.07	29.4	42.7	48.0	55.4	51.4	**56.0**	53.7	42.7
163.08	29.0	42.3	47.8	55.3	51.1	**56.0**	53.8	42.8
164.01	6.14	7.77	7.65	**8.69**	8.32	6.92	6.27	4.57
165.01	5.26	7.07	7.03	**8.23**	8.01	6.81	6.41	4.70
166.01	3.70	4.79	4.67	**5.35**	5.14	4.26	3.87	2.82
167.01	4.03	6.15	7.53	9.22	10.2	11.0	**11.2**	8.91
168.01	3.50	4.31	4.12	**4.54**	4.42	3.59	3.15	2.29
169.01	6.36	8.14	8.05	**9.15**	8.67	7.32	6.69	4.87
169.02	8.8	11.6	11.5	13.4	**15.0**	13.7	14.3	10.9
169.03	8.9	11.7	11.8	13.6	**15.0**	14.1	14.6	11.1
170.01	3.44	4.03	3.97	4.70	**4.73**	3.97	3.74	2.75
170.02	4.28	6.21	6.36	**7.21**	7.04	6.45	6.26	4.66
170.03	6.12	9.38	10.3	**11.5**	10.8	11.4	11.1	8.67
171.01	6.68	10.1	11.2	12.3	**12.4**	11.9	11.9	9.02
171.02	8.31	12.9	14.9	16.7	16.2	**17.5**	17.0	13.5
171.03	12.9	20.0	22.5	24.8	24.0	**25.8**	25.3	19.8
171.04	13.9	21.5	24.5	27.2	26.5	**28.6**	28.2	22.0
171.05	19.1	29.4	34.1	38.4	37.0	**40.4**	39.9	31.3
171.06	19.2	29.5	34.3	38.9	37.2	**40.7**	40.3	31.6
172.01	2.96	4.20	4.32	5.05	**5.09**	4.40	4.27	3.16
173.01	3.63	3.95	4.02	4.36	**4.85**	4.26	4.31	3.25
174.01	2.43	**2.69**	2.33	2.51	2.50	1.90	1.59	1.16
175.01	3.05	5.19	6.05	6.78	7.12	7.61	**7.71**	6.04
175.02	5.31	8.52	9.85	11.0	10.9	**11.7**	11.6	9.13
176.01	2.45	3.57	3.88	4.21	**4.43**	4.03	4.06	3.06
177.01	2.49	3.71	4.16	4.56	**4.91**	4.61	4.71	3.59
178.01	3.84	**4.44**	4.02	4.22	4.09	3.20	2.68	1.95
178.02	7.00	**8.17**	7.40	7.77	7.54	5.91	4.95	3.60
179.01	4.13	5.94	6.40	6.93	**7.54**	6.76	6.87	5.17
179.02	10.2	14.6	14.8	17.1	**17.4**	15.4	15.1	11.2
179.03	11.2	16.8	17.8	**20.0**	19.5	19.2	18.9	14.5
179.04	10.7	17.6	19.9	22.6	21.4	**22.9**	22.8	17.9
179.05	11.5	19.1	22.1	**26.7**	25.8	26.4	26.6	20.8
179.06	12.9	21.5	25.3	31.5	31.6	31.7	**32.5**	25.3
179.07	26.8	26.1	25.9	35.8	**38.4**	35.7	37.3	28.4
180.01	3.52	5.00	4.99	**5.91**	5.89	5.07	4.88	3.59
181.01	9.16	**9.89**	5.98	4.94	5.54	4.32	3.93	2.92
182.01	2.84	**3.41**	3.15	3.35	3.27	2.62	2.22	1.62
182.02	4.64	6.31	6.23	**6.98**	6.82	6.53	6.29	4.77
183.01	2.28	2.48	2.86	3.76	4.54	4.58	**4.81**	3.71
184.01	22.2	**24.0**	14.7	10.7	11.0	8.00	7.08	5.31
185.01	13.1	**14.4**	8.46	6.27	5.89	4.13	3.42	2.53
186.01	5.57	**6.07**	3.54	3.13	3.10	2.29	1.93	1.42
186.02	7.08	**7.55**	5.56	4.67	4.62	3.40	2.87	2.11

PEAK DESIGN FLOOD DISCHARGES - Sensitivity - 5mm/hr Pervious and 2.5mm/hr Impervious Continuing Losses

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
1.01	10.1	13.2	12.8	**14.7**	14.1	11.6	10.5	7.47
1.02	17.7	23.8	23.5	**26.4**	24.0	21.7	20.3	14.6
1.03	27.6	35.9	35.2	**40.1**	36.7	32.3	30.1	21.6
1.04	35.4	45.2	44.0	**50.6**	48.0	41.6	38.6	27.8
1.05	61.5	78.1	76.4	**87.3**	84.2	73.8	69.1	50.0
1.06	80.7	99.1	97.4	**112**	110	95.4	89.7	65.0
1.07	103	124	122	**138**	136	117	109	78.9
1.08	116	141	136	**154**	149	130	120	87.3
1.09	133	161	154	**174**	167	146	135	98.5
1.10	141	171	164	**185**	176	155	143	105
1.11	175	213	201	**226**	215	189	174	127
1.12	181	224	211	**238**	224	199	184	134
1.13	184	228	214	**242**	227	202	188	137
1.14	188	234	221	**249**	232	209	194	142
1.15	190	240	227	**256**	237	215	199	146
1.16	197	250	239	**268**	242	224	208	154
1.17	238	308	297	**330**	294	276	258	190
1.18	262	345	336	**374**	327	311	293	216
1.19	258	342	339	**378**	326	318	302	226
1.20	258	345	344	**384**	328	324	307	230
1.21	374	501	499	**557**	462	456	429	323
1.22	373	501	503	**562**	465	460	433	327
1.23	372	503	509	**573**	477	467	442	334
1.24	371	503	510	**576**	483	469	445	337
1.25	372	510	522	**593**	493	481	459	350
1.26	370	510	525	**602**	504	489	466	358
1.27	370	510	526	**604**	507	490	467	359
1.28	369	510	529	**608**	514	494	472	363
1.29	370	514	537	**625**	541	506	486	375
1.30	370	513	537	**626**	543	507	487	376
1.31	370	516	544	**635**	547	517	498	386
1.32	361	508	538	**630**	538	513	498	385
1.33	361	509	541	**639**	551	521	505	390
1.34	358	506	540	**641**	553	522	508	392
1.35	355	504	539	**643**	556	525	512	394
1.36	356	506	545	**666**	589	547	533	408
1.37	355	507	549	**687**	622	566	553	421
1.38	348	501	546	**684**	621	567	556	423
1.39	347	500	546	**687**	626	572	560	426
1.40	343	495	543	**683**	623	571	560	425
1.41	342	495	542	**684**	624	575	561	427
1.42	339	492	541	**684**	626	576	564	428
1.43	339	492	541	**685**	626	578	565	429
1.44	339	492	541	**685**	627	579	565	430
1.45	335	489	541	**686**	628	584	571	433
1.46	334	489	541	**686**	628	587	573	436
1.47	333	487	539	**684**	627	587	574	437
1.48	305	398	429	**517**	482	458	450	368
1.49	309	408	446	585	**586**	544	556	418
1.50	308	408	446	585	**586**	544	556	418
1.51	356	568	649	856	**894**	854	874	599
1.52	357	571	652	857	**897**	860	880	603
1.53	356	570	652	856	**897**	860	880	603
1.54	357	571	653	857	**899**	864	885	606
1.55	362	583	669	864	912	888	**912**	620
1.56	362	583	669	863	913	890	**914**	621
1.57	361	582	670	861	914	893	**918**	624
1.58	359	580	669	859	914	893	**919**	625
1.59	365	591	683	865	928	920	**944**	643
1.60	345	568	665	848	925	912	**941**	641
2.01	6.54	8.07	7.77	**8.33**	8.31	6.56	5.65	4.01
3.01	7.06	**8.14**	6.47	6.06	5.57	3.83	3.08	2.19
4.01	10.4	14.9	15.6	17.5	**17.7**	15.6	15.5	11.3
4.02	23.3	30.0	29.4	**33.8**	33.3	29.5	28.2	20.5
5.01	6.97	10.2	11.0	12.0	**12.3**	11.2	11.3	8.28
5.02	16.9	18.9	18.1	20.6	**22.3**	18.7	17.7	12.9
6.01	3.45	**3.96**	3.55	3.77	3.68	2.80	2.30	1.64
7.01	11.1	14.2	13.8	**15.8**	15.0	12.4	11.2	7.93
7.02	21.9	26.1	24.8	**27.5**	26.3	21.7	19.2	13.7
8.01	2.99	**3.31**	2.84	3.05	2.90	2.20	1.80	1.27
9.01	9.26	**10.4**	9.16	9.84	9.40	7.20	5.92	4.19
10.01	15.8	**19.0**	17.6	18.6	18.1	14.2	12.1	8.54
11.01	5.93	**6.60**	5.32	5.62	5.22	3.75	3.04	2.15
12.01	10.4	**11.6**	9.5	10.4	9.74	7.08	5.73	4.06

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
12.02	20.7	**23.1**	18.8	20.5	18.9	14.2	11.6	8.22
12.03	31.6	**35.6**	29.7	32.1	29.0	22.5	18.7	13.2
12.04	45.7	**52.5**	44.7	47.8	42.5	34.0	28.4	20.1
13.01	5.41	**6.24**	4.91	4.71	4.31	3.00	2.42	1.72
14.01	6.30	**6.91**	5.78	6.34	5.98	4.46	3.63	2.57
15.01	7.87	**8.63**	7.45	8.11	7.68	5.79	4.74	3.35
16.01	4.12	**4.56**	3.72	3.92	3.64	2.65	2.14	1.52
16.02	10.7	**12.0**	9.68	10.7	9.78	7.28	5.93	4.20
16.03	17.7	**19.9**	16.1	17.4	16.0	11.9	9.67	6.85
17.01	5.06	**5.49**	4.67	5.11	4.79	3.57	2.91	2.06
18.01	6.73	**7.49**	6.05	6.43	5.98	4.34	3.51	2.48
19.01	5.55	**6.09**	5.00	5.45	5.10	3.73	3.03	2.14
20.01	8.12	**8.88**	7.40	8.15	7.63	5.67	4.61	3.26
21.01	5.20	**5.90**	4.68	4.73	4.34	3.08	2.48	1.76
22.01	6.66	**7.32**	5.98	6.57	6.15	4.55	3.69	2.61
23.01	18.8	22.9	21.9	**24.0**	23.0	18.8	16.4	11.6
23.02	50.9	61.7	58.2	**63.5**	58.5	48.5	42.5	30.1
23.03	55.4	67.7	63.8	**69.9**	63.6	53.2	46.9	33.3
23.04	59.1	72.0	68.1	**74.9**	68.2	57.3	50.5	35.9
24.01	6.57	**7.67**	6.99	7.35	7.14	5.56	4.63	3.28
24.02	18.4	**21.3**	19.4	20.8	19.5	15.6	13.2	9.38
25.01	3.58	**4.29**	3.93	4.11	3.99	3.14	2.65	1.88
26.01	5.62	**6.46**	5.10	5.03	4.60	3.23	2.60	1.84
27.01	18.3	**21.9**	20.3	21.3	20.9	16.4	13.8	9.78
27.02	31.4	**35.5**	31.9	34.3	33.1	25.5	21.4	15.1
27.03	47.5	**55.7**	51.2	54.9	53.6	42.2	35.9	25.5
28.01	9.94	**11.1**	9.02	9.86	9.24	6.79	5.51	3.90
29.01	16.4	20.1	19.1	**21.0**	20.2	16.4	14.3	10.14
30.01	13.4	16.5	15.5	**16.8**	16.1	13.1	11.3	8.03
31.01	16.8	**18.7**	16.4	17.6	16.8	12.8	10.5	7.45
31.02	25.9	**29.2**	25.9	27.8	26.4	20.4	17.0	12.0
31.03	40.0	**46.6**	42.4	45.4	43.3	34.4	29.1	20.6
31.04	49.6	**57.8**	53.0	56.9	53.5	43.1	36.8	26.1
31.05	60.7	**71.3**	65.9	71.3	66.1	53.9	46.4	32.9
31.06	71.7	84.9	78.4	**85.5**	77.9	64.3	55.8	39.6
31.07	82.3	99.1	92.3	**101.2**	90.9	77.1	67.9	48.5
31.08	132	167	160	**177**	147	135	123	90.9
31.09	133	169	164	**181**	149	139	125	94.9
32.01	8.21	**9.49**	8.62	9.11	8.78	6.86	5.72	4.05
33.01	14.0	17.2	16.2	**17.6**	16.9	13.7	11.9	8.42
34.01	7.21	8.74	8.27	**8.91**	8.58	6.90	5.97	4.23
35.01	5.97	**7.12**	6.70	7.11	6.85	5.48	4.68	3.31
36.01	5.22	**5.70**	4.69	5.11	4.75	3.48	2.82	2.00
37.01	7.02	**7.76**	6.32	6.84	6.37	4.68	3.79	2.68
38.01	7.57	9.22	8.86	**9.79**	9.31	7.62	6.70	4.75
38.02	14.7	17.3	16.2	**17.4**	17.0	13.6	11.7	8.27
38.03	33.4	**38.2**	35.0	38.1	35.8	28.9	24.9	17.7
38.04	61.1	73.3	69.2	**76.4**	72.1	59.5	52.4	37.3
39.01	6.35	**7.21**	6.45	6.85	6.58	5.10	4.20	2.97
40.01	4.58	**5.31**	4.85	5.07	4.90	3.80	3.17	2.25
40.02	11.5	**12.8**	10.6	11.7	10.9	8.30	6.90	4.89
41.01	3.81	**4.30**	3.45	3.47	3.20	2.28	1.84	1.30
42.01	14.2	18.3	17.7	**20.2**	18.9	15.8	14.3	10.19
42.02	27.9	35.0	33.9	**38.2**	36.2	30.1	26.8	19.1
43.01	12.2	15.2	14.5	**16.1**	15.3	12.5	11.0	7.82
44.01	6.25	**6.88**	5.95	6.44	6.13	4.64	3.80	2.69
45.01	10.2	**12.4**	11.5	12.2	11.8	9.41	8.04	5.70
46.01	12.7	15.8	15.1	**16.7**	16.2	13.1	11.4	8.13
46.02	24.2	29.0	27.1	**29.4**	27.9	22.8	19.8	14.1
47.01	7.64	**8.37**	7.04	7.72	7.27	5.43	4.42	3.13
48.01	7.60	9.22	8.70	**9.39**	9.08	7.30	6.30	4.47
49.01	14.8	21.1	20.7	**24.3**	24.2	20.3	19.2	13.8
50.01	6.39	7.61	7.18	**7.65**	7.38	5.89	5.04	3.57
51.01	5.55	**6.66**	5.28	4.15	3.81	2.55	2.06	1.46
51.02	17.0	**20.1**	15.9	14.4	13.1	9.11	7.34	5.21
51.03	25.2	**28.9**	23.7	24.4	22.1	17.2	14.5	10.33
52.01	9.47	**11.1**	8.73	8.63	7.93	5.50	4.43	3.14
53.01	7.12	**8.27**	6.56	5.86	5.39	3.66	2.95	2.10
54.01	4.57	**5.02**	4.38	4.70	4.46	3.38	2.76	1.96
55.01	8.71	11.4	11.2	**13.0**	12.1	10.4	9.74	6.95
56.01	13.7	17.1	16.5	**18.6**	17.5	14.5	12.9	9.13
56.02	25.9	34.1	33.6	**38.0**	35.7	31.6	29.3	21.4
56.03	29.2	38.3	38.2	**43.1**	40.5	36.3	33.9	24.6
57.01	9.61	12.3	12.0	**13.7**	12.8	10.8	9.86	7.01
58.01	6.23	**7.23**	6.63	6.99	6.75	5.30	4.43	3.14
59.01	3.14	3.86	3.63	**3.98**	3.83	3.10	2.69	1.91

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
60.01	7.64	9.73	9.53	**10.8**	10.13	8.55	7.78	5.54
60.02	14.3	18.7	18.6	**20.7**	17.6	16.5	15.1	11.2
61.01	7.00	8.57	8.35	**9.30**	8.82	7.25	6.43	4.57
62.01	3.18	3.89	3.65	**4.03**	3.81	3.11	2.72	1.93
63.01	11.3	16.7	17.9	**19.7**	19.5	18.2	18.2	13.3
63.02	18.2	25.2	25.7	**29.5**	29.1	26.1	25.4	18.6
64.01	6.58	8.35	8.24	**9.34**	8.78	7.37	6.71	4.77
65.01	6.14	7.69	7.55	**8.54**	8.10	6.68	6.02	4.28
66.01	6.00	8.14	8.13	**9.36**	8.93	7.73	7.35	5.26
67.01	7.98	10.7	10.7	**12.4**	11.7	10.27	9.81	7.03
67.02	14.9	18.0	18.1	20.9	**20.9**	17.5	16.1	11.5
67.03	40.1	46.7	44.1	**50.1**	48.8	41.7	38.2	27.4
67.04	55.9	66.3	57.8	**66.4**	64.3	54.3	49.5	35.5
67.05	67.9	80.6	71.7	**82.5**	79.8	68.0	61.9	44.6
67.06	69.1	83.5	77.2	**88.4**	84.0	74.1	68.1	49.8
67.07	72.1	87.9	83.1	**94.7**	88.0	79.1	73.3	53.6
68.01	4.03	5.02	4.80	**5.26**	5.10	4.10	3.61	2.56
69.01	11.4	**13.2**	10.3	10.4	9.59	6.69	5.40	3.83
70.01	7.34	**8.35**	7.49	8.08	7.86	5.94	4.88	3.47
70.02	17.8	**19.4**	16.3	18.3	17.1	12.7	10.4	7.38
71.01	6.58	**7.36**	5.91	6.58	6.12	4.36	3.53	2.51
72.01	6.78	**7.52**	6.09	6.52	6.06	4.37	3.54	2.51
73.01	4.81	6.22	6.14	**7.01**	6.59	5.57	5.15	3.66
74.01	14.1	17.9	17.1	**18.9**	18.6	14.9	13.0	9.27
74.02	20.9	26.5	25.8	**28.8**	27.0	22.7	20.3	14.4
74.03	27.9	34.3	33.0	**36.6**	34.0	28.7	25.7	18.3
74.04	32.2	38.9	37.4	**41.6**	38.8	32.6	29.1	20.7
74.05	42.5	52.2	50.5	**56.3**	51.8	44.3	40.0	28.6
74.06	41.6	52.6	51.2	**57.3**	49.5	45.2	41.5	30.4
74.07	41.6	52.7	51.3	**57.4**	49.6	45.3	41.6	30.5
75.01	5.71	**6.24**	5.51	5.94	5.70	4.29	3.51	2.49
76.01	4.17	**4.59**	4.00	4.27	4.06	3.07	2.52	1.78
77.01	7.39	9.48	9.26	**10.5**	10.09	8.36	7.54	5.36
78.01	6.79	9.50	9.92	**11.1**	10.8	9.87	9.68	7.02
78.02	16.4	20.9	21.0	**23.9**	23.0	20.2	19.0	13.7
78.03	22.2	28.0	27.9	**31.4**	30.0	26.8	24.9	18.2
79.01	6.17	7.53	7.37	**8.23**	7.80	6.40	5.69	4.04
80.01	4.18	**4.65**	4.09	4.35	4.15	3.17	2.60	1.84
81.01	5.16	7.13	7.30	**8.39**	8.16	7.21	7.07	5.11
82.01	8.46	11.8	12.1	**13.7**	13.4	12.1	11.9	8.59
82.02	11.7	16.8	17.6	**19.9**	18.6	17.8	17.3	12.8
83.01	5.62	7.71	7.66	**8.97**	8.72	7.39	7.04	5.05
83.02	6.62	8.78	8.72	**10.13**	9.87	8.42	7.94	5.71
84.01	5.01	6.82	6.86	**7.96**	7.61	6.68	6.46	4.65
84.02	4.95	6.87	7.11	**8.04**	7.17	6.94	6.60	4.91
85.01	3.83	**4.41**	3.63	3.88	3.64	2.62	2.13	1.52
85.02	4.71	6.48	6.46	**6.91**	5.52	6.18	5.98	4.47
86.01	5.21	**5.70**	3.68	3.88	3.97	3.03	2.56	1.83
87.01	4.12	6.17	6.60	7.19	**7.23**	6.71	6.74	4.95
87.02	4.56	6.55	7.02	7.71	**7.84**	7.18	7.18	5.28
88.01	3.05	4.29	4.38	**5.06**	4.89	4.33	4.26	3.08
89.01	12.8	18.1	18.0	**20.9**	20.0	17.7	17.2	12.4
89.02	28.2	34.2	33.4	**38.1**	36.8	31.2	28.7	20.6
89.03	40.4	49.3	47.4	**53.4**	51.0	43.4	39.3	28.2
89.04	52.5	65.2	63.1	**71.2**	67.0	57.7	52.6	37.8
89.05	62.2	77.6	75.1	**84.5**	78.9	68.2	62.3	44.8
89.06	70.4	88.3	85.4	**95.2**	85.6	77.1	70.6	51.3
89.07	85.9	111	109	**122**	108	101.7	94.4	69.3
89.08	89.6	117	115	**129**	113	108	100.5	74.1
89.09	91.3	120	119	**133**	116	112	104	77.0
89.10	92.1	122	121	**135**	117	114	106	78.6
89.11	92.4	123	124	**137**	118	117	108	81.0
89.12	94.8	129	130	**145**	122	123	115	86.2
89.13	95.9	132	135	**149**	125	128	120	90.1
89.14	96.0	133	136	**151**	126	129	121	91.3
89.15	109	154	169	**196**	172	184	180	136
89.16	110	157	173	**201**	176	188	185	139
89.17	110	159	176	**204**	179	192	189	142
90.01	4.20	**4.67**	4.10	4.36	4.16	3.17	2.60	1.84
90.02	14.4	**16.7**	15.4	16.4	15.4	12.4	10.6	7.50
91.01	4.93	**5.93**	5.59	5.92	5.70	4.57	3.92	2.78
92.01	8.29	9.99	9.42	**10.2**	9.79	7.93	6.85	4.85
93.01	11.6	15.1	14.8	**17.0**	15.8	13.5	12.4	8.82
94.01	8.72	10.6	10.2	**11.3**	10.7	8.82	7.78	5.52
95.01	6.27	**7.08**	6.32	6.72	6.45	4.98	4.10	2.91
96.01	9.9	14.0	14.7	**16.5**	16.1	14.7	14.5	10.6

Subcatchment ID	Peak Discharge (m³/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
96.02	15.0	19.2	19.2	**22.2**	21.5	19.3	18.5	13.5
97.01	4.56	**5.35**	4.91	5.12	4.97	3.87	3.25	2.30
98.01	6.89	8.43	8.28	**9.28**	8.77	7.24	6.45	4.58
99.01	3.53	**4.16**	3.78	3.96	3.80	3.00	2.52	1.78
100.01	2.52	3.16	3.07	**3.47**	3.23	2.70	2.44	1.73
101.01	3.21	3.94	3.70	**4.08**	3.90	3.16	2.75	1.96
102.01	3.74	4.96	4.84	**5.53**	5.20	4.37	4.04	2.88
103.01	4.68	5.71	5.57	**6.17**	5.86	4.81	4.26	3.02
104.01	1.98	2.46	2.40	**2.66**	2.61	2.12	1.85	1.32
105.01	9.57	11.8	11.5	**13.1**	12.2	10.16	9.11	6.47
105.02	14.0	16.3	15.4	**17.1**	16.9	13.6	11.9	8.48
105.03	23.7	28.1	26.9	**30.0**	28.5	23.6	21.0	14.9
105.04	24.3	31.2	31.0	**34.7**	29.8	27.7	25.7	19.0
105.05	27.3	36.3	37.1	**41.1**	34.0	34.3	31.9	24.4
105.06	30.4	42.3	44.1	**48.0**	40.3	40.5	38.5	29.4
105.07	37.3	55.0	58.3	**63.5**	53.6	55.6	53.8	41.0
105.08	38.2	57.5	61.2	**66.7**	56.9	58.9	57.2	43.6
105.09	43.0	64.7	69.1	**76.0**	63.0	66.5	64.3	49.2
105.10	41.6	62.7	68.4	**77.2**	65.6	68.5	66.9	51.1
105.11	41.7	62.7	68.7	**78.9**	68.5	69.5	68.2	51.8
106.01	4.58	**5.09**	4.12	4.34	4.02	2.92	2.36	1.67
107.01	7.75	9.50	9.25	**10.4**	9.79	8.13	7.24	5.14
108.01	6.64	**7.75**	7.04	7.42	7.17	5.61	4.68	3.32
109.01	6.57	8.14	8.00	**9.02**	8.52	7.05	6.33	4.50
110.01	6.25	7.57	7.29	**8.02**	7.66	6.23	5.46	3.87
111.01	6.56	9.55	10.22	**11.2**	11.1	10.3	10.3	7.52
111.02	13.2	16.4	16.2	**18.5**	18.3	16.3	15.6	11.4
112.01	5.12	**5.75**	5.20	5.49	5.28	4.06	3.36	2.38
113.01	3.58	4.42	4.26	**4.75**	4.47	3.67	3.27	2.32
114.01	4.54	**5.42**	5.06	5.28	5.14	4.04	3.43	2.43
115.01	4.63	**5.41**	4.96	5.17	5.02	3.90	3.26	2.31
116.01	3.72	**4.12**	3.60	3.83	3.65	2.78	2.28	1.62
117.01	4.37	6.03	5.98	**6.94**	6.67	5.77	5.52	3.96
118.01	2.67	**3.16**	2.89	3.06	2.95	2.34	1.97	1.39
119.01	5.34	6.97	6.86	**7.87**	7.43	6.23	5.75	4.10
119.02	10.3	13.5	13.4	**15.4**	14.8	12.6	11.7	8.35
119.03	17.2	22.6	22.6	**25.6**	23.8	21.5	20.2	14.6
119.04	25.0	32.9	32.8	**36.8**	33.7	30.8	28.9	21.0
119.05	28.0	36.9	36.9	**41.3**	37.6	34.8	32.8	23.8
119.06	35.4	47.4	47.5	**53.1**	48.0	45.0	42.3	31.1
119.07	38.3	52.2	52.8	**58.7**	52.8	50.4	47.9	35.1
119.08	36.4	50.7	51.9	**58.0**	50.0	49.9	47.6	35.5
119.09	40.0	56.9	60.3	**67.6**	56.6	59.1	56.2	43.2
119.10	40.6	59.1	62.6	**70.6**	58.7	61.8	59.0	45.3
119.11	65.5	102	119	**142**	130	135	135	103.4
119.12	65.7	103	120	**145**	134	138	138	106
119.13	65.8	103	121	**147**	137	139	140	107
119.14	65.7	103	121	**147**	138	140	140	107
119.15	74.0	117	138	**166**	153	159	159	122
119.16	74.1	118	139	**167**	155	160	161	123
119.17	96.7	151	178	207	186	207	**208**	158
119.18	97.0	151	179	210	189	209	**210**	160
119.19	97.0	151	179	**210**	189	209	210	160
119.20	96.5	151	178	**211**	190	209	210	160
119.21	96.7	152	179	**213**	193	210	212	161
119.22	96.8	152	184	258	**282**	271	279	162
119.23	115	185	216	285	313	310	**320**	196
120.01	4.58	6.18	6.13	**7.10**	6.74	5.82	5.52	3.95
121.01	3.19	**3.76**	3.40	3.57	3.45	2.71	2.26	1.60
122.01	6.15	7.67	7.52	**8.50**	8.13	6.66	5.96	4.24
123.01	3.99	4.99	4.79	**5.30**	5.14	4.14	3.65	2.60
124.01	4.55	**5.50**	5.15	5.38	5.29	4.15	3.53	2.50
125.01	4.19	6.19	6.55	7.18	**7.21**	6.60	6.60	4.82
125.02	8.55	11.5	11.5	**13.2**	12.8	11.5	11.1	8.08
126.01	3.90	4.94	4.79	**5.39**	5.26	4.24	3.75	2.67
127.01	2.92	**3.50**	3.22	3.37	3.37	2.60	2.16	1.53
127.02	3.11	3.97	3.68	**4.07**	3.40	3.01	2.71	1.94
128.01	7.53	8.26	8.07	8.75	**10.11**	9.47	9.76	7.37
128.02	22.4	31.2	32.8	**36.8**	35.0	34.6	33.3	25.4
128.03	30.9	46.8	51.2	**57.6**	47.9	50.9	49.3	38.3
128.04	31.3	47.9	53.0	**60.0**	50.1	53.7	52.6	40.6
128.05	34.0	52.2	58.6	**68.5**	60.1	60.9	60.4	46.7
128.06	34.2	52.7	59.6	**72.1**	67.1	63.3	63.5	48.9
128.07	34.7	53.7	61.4	**76.3**	73.0	66.6	67.5	52.2
128.08	34.7	53.8	61.6	**77.8**	75.3	67.7	68.8	53.2
128.09	34.7	54.0	62.2	**79.2**	76.9	69.4	71.0	54.9

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
128.10	35.0	54.6	63.2	**81.7**	80.4	72.3	74.6	57.1
128.11	35.0	54.6	63.2	**81.8**	80.6	72.3	74.7	57.2
128.12	35.1	54.8	63.5	**82.8**	82.0	73.6	76.1	58.1
129.01	5.87	8.09	8.11	**9.44**	9.21	7.94	7.65	5.50
129.02	10.7	13.1	13.1	**15.0**	14.4	12.4	11.6	8.33
129.03	16.1	21.0	21.1	**24.2**	23.3	20.8	19.8	14.5
130.01	3.90	**4.76**	4.44	4.62	4.57	3.58	3.03	2.15
131.01	6.06	6.80	6.92	8.03	**8.31**	7.09	6.92	5.01
132.01	6.08	7.86	7.72	**8.81**	8.42	6.96	6.35	4.52
132.02	10.2	12.7	12.8	**14.4**	13.3	11.5	10.6	7.59
132.03	13.6	16.8	16.7	**19.1**	17.5	15.2	14.0	10.00
132.04	16.0	20.8	21.2	**23.6**	19.8	19.1	17.6	13.4
132.05	16.0	20.8	21.3	**23.7**	19.9	19.2	17.8	13.6
133.01	2.88	3.58	3.46	**3.89**	3.77	3.06	2.70	1.92
134.01	3.63	4.53	4.30	**4.63**	4.56	3.63	3.13	2.23
135.01	3.82	4.75	4.50	**4.77**	4.72	3.74	3.21	2.28
136.01	5.24	**5.76**	4.37	4.73	4.55	3.37	2.76	1.97
136.02	4.49	**4.82**	3.62	4.65	4.42	4.05	4.03	2.90
137.01	3.37	4.68	5.06	5.52	**5.88**	5.19	5.30	3.88
137.02	9.41	10.4	8.07	9.74	**10.6**	8.72	8.33	6.05
137.03	10.76	**12.14**	9.26	10.94	11.80	9.74	9.23	6.69
137.04	7.32	9.62	9.93	11.3	**11.6**	10.8	10.8	7.98
137.05	9.09	11.2	11.8	**13.1**	13.0	13.0	13.0	9.64
138.01	3.07	3.37	3.04	3.29	**3.38**	2.66	2.31	1.64
139.01	4.34	**4.75**	2.97	2.84	2.74	2.00	1.64	1.18
140.01	5.83	**6.44**	4.24	3.56	3.29	2.26	1.83	1.31
141.01	5.26	**5.81**	4.21	4.58	4.77	3.74	3.26	2.33
141.02	10.6	**11.1**	8.41	8.64	8.97	6.86	5.90	4.22
141.03	13.3	**14.3**	10.2	10.3	10.5	8.01	6.85	4.90
141.04	12.1	**13.8**	10.5	11.3	11.6	9.19	8.03	5.74
142.01	2.20	**2.42**	1.59	1.28	1.18	0.81	0.65	0.47
143.01	0.50	0.63	0.61	**0.69**	0.67	0.55	0.49	0.35
144.01	6.32	**6.98**	5.41	6.55	6.77	5.53	5.19	3.73
144.02	6.07	6.89	6.31	7.49	**7.61**	6.50	6.19	4.48
145.01	2.18	2.69	2.63	**2.92**	2.89	2.33	2.04	1.45
146.01	2.92	3.62	3.86	4.28	**4.47**	3.91	3.93	2.88
147.01	2.61	**2.79**	1.80	1.95	2.15	1.75	1.63	1.18
148.01	9.36	**10.3**	6.64	6.81	7.06	5.35	4.56	3.26
148.02	6.72	**7.83**	6.14	6.58	6.69	5.35	4.74	3.40
149.01	4.57	**5.03**	3.63	3.77	3.55	2.55	2.07	1.48
149.02	4.84	**5.46**	3.96	4.05	3.77	2.76	2.24	1.60
150.01	5.09	7.65	8.47	9.21	**9.41**	8.98	9.10	6.76
150.02	5.58	8.40	9.36	**10.3**	10.00	10.16	10.03	7.64
150.03	7.86	11.4	12.4	**13.8**	13.5	13.7	13.6	10.28
150.04	7.86	11.4	12.4	**13.9**	13.6	13.7	13.6	10.34
150.05	11.2	16.4	18.0	19.8	18.1	**20.1**	19.7	15.2
151.01	2.88	3.18	2.80	3.17	**3.22**	2.59	2.30	1.64
152.01	6.14	**6.71**	4.18	4.84	5.29	4.35	4.16	3.02
152.02	5.07	5.62	4.88	5.59	**5.84**	5.11	4.90	3.57
152.03	4.16	4.91	5.11	**5.86**	5.46	5.39	5.20	3.95
152.04	4.39	5.38	5.79	**6.72**	6.09	6.52	6.24	4.95
153.01	9.24	10.7	10.5	**12.4**	12.3	10.20	9.43	6.75
153.02	14.2	19.1	19.2	**21.7**	20.7	19.1	18.4	13.6
153.03	17.1	22.9	23.4	**26.4**	25.1	23.4	22.5	16.6
153.04	23.7	32.2	32.7	**36.7**	34.9	32.4	31.3	22.9
153.05	30.5	41.1	41.3	**46.5**	43.2	40.1	38.4	28.1
153.06	34.5	47.7	48.8	**54.6**	48.2	47.8	45.0	33.9
153.07	34.5	47.8	49.0	**54.8**	48.3	48.1	45.1	34.1
153.08	37.1	51.4	52.8	**59.4**	51.4	51.6	48.5	36.5
154.01	4.59	**5.57**	5.22	5.42	5.37	4.19	3.55	2.52
155.01	3.52	4.04	3.92	4.29	**4.33**	3.42	2.98	2.12
156.01	6.57	8.94	8.95	**10.4**	9.92	8.64	8.26	5.93
157.01	5.26	6.49	6.31	**6.93**	6.79	5.50	4.79	3.40
158.01	2.91	3.57	3.40	**3.78**	3.63	2.95	2.59	1.84
159.01	3.39	**3.96**	3.60	3.82	3.76	2.87	2.37	1.68
159.02	3.94	**4.63**	4.31	4.55	4.40	3.49	2.94	2.10
160.01	1.87	**2.03**	1.37	1.65	1.74	1.43	1.33	0.95
160.02	5.24	**5.34**	3.96	3.94	4.21	3.25	2.86	2.06
160.03	6.71	**7.49**	5.79	5.65	5.90	4.50	3.94	2.84
160.04	6.68	**7.52**	5.84	5.68	5.93	4.53	3.97	2.86
161.01	27.1	88.6	110	**168**	145	129	124	69.1
161.02	26.7	88.4	110	**168**	145	129	124	69.3
161.03	26.1	88.0	109	**167**	145	130	125	70.4
162.01	1.91	**2.22**	2.05	2.14	2.09	1.62	1.36	0.96
163.01	5.65	6.88	6.63	**7.22**	7.01	5.66	4.92	3.49
163.02	11.9	14.5	14.3	**16.0**	15.0	12.6	11.2	7.99

Subcatchment ID	Peak Discharge (m^3/s)							
	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr
163.03	19.3	26.0	26.6	**29.9**	27.0	26.5	25.2	18.9
163.04	22.8	31.4	32.4	**36.2**	31.6	32.1	30.1	23.0
163.05	28.0	39.5	42.9	**48.7**	45.2	46.7	46.0	34.8
163.06	27.9	39.5	42.9	**49.1**	45.6	46.9	46.3	35.0
163.07	28.1	40.1	44.5	**52.1**	48.6	48.9	49.2	37.6
163.08	27.7	39.8	44.3	**51.9**	48.0	48.8	49.3	37.6
164.01	5.87	7.43	7.29	**8.29**	7.82	6.49	5.88	4.18
165.01	4.98	6.72	6.68	**7.78**	7.49	6.36	6.01	4.30
166.01	3.53	4.58	4.43	**5.10**	4.82	3.99	3.63	2.59
167.01	3.98	5.73	6.92	8.49	9.39	9.91	**10.21**	7.82
168.01	3.34	4.14	3.92	**4.34**	4.19	3.38	2.96	2.10
169.01	6.08	7.78	7.66	**8.71**	8.19	6.87	6.27	4.46
169.02	8.43	11.1	11.0	12.7	**13.7**	12.5	13.2	9.76
169.03	8.52	11.2	11.2	12.9	**13.6**	12.9	13.4	9.88
170.01	3.40	3.84	3.77	**4.45**	4.45	3.72	3.50	2.52
170.02	4.11	5.87	6.01	**6.80**	6.58	6.02	5.85	4.27
170.03	5.86	8.83	9.60	**10.7**	9.84	10.6	10.29	7.88
171.01	6.36	9.59	10.5	**11.5**	11.4	11.0	11.1	8.24
171.02	7.92	12.2	13.9	15.6	14.6	**16.1**	15.6	12.2
171.03	12.3	18.8	21.0	23.2	22.0	**23.8**	23.3	17.9
171.04	13.2	20.3	22.9	25.3	24.1	**26.3**	26.0	19.8
171.05	18.2	27.7	31.8	35.7	33.4	**37.1**	36.7	28.1
171.06	18.2	27.8	31.9	36.1	33.6	**37.4**	37.0	28.3
172.01	2.85	4.00	4.09	4.74	**4.74**	4.09	4.00	2.89
173.01	3.58	3.91	3.78	4.09	**4.51**	3.93	4.02	2.97
174.01	2.39	**2.65**	2.23	2.39	2.39	1.80	1.50	1.07
175.01	2.90	4.81	5.62	6.26	6.40	7.00	**7.10**	5.45
175.02	5.09	7.95	9.20	10.19	9.90	**10.7**	10.7	8.22
176.01	2.34	3.37	3.66	3.93	**4.10**	3.75	3.79	2.79
177.01	2.46	3.50	3.91	4.24	**4.50**	4.29	4.38	3.27
178.01	3.70	**4.29**	3.86	4.04	3.90	3.03	2.51	1.78
178.02	6.74	**7.88**	7.10	7.43	7.20	5.60	4.65	3.30
179.01	4.06	5.59	5.99	6.50	**6.98**	6.28	6.41	4.73
179.02	9.75	13.9	13.9	**16.1**	16.1	14.3	14.1	10.28
179.03	10.7	15.9	16.8	**18.9**	17.9	17.8	17.6	13.3
179.04	10.3	16.7	18.7	**21.0**	19.3	20.9	21.0	15.5
179.05	11.1	18.1	20.5	**24.7**	23.6	23.9	24.3	17.6
179.06	12.4	20.3	23.5	29.0	28.9	28.5	**29.3**	21.2
179.07	26.2	25.4	23.9	32.4	**34.7**	31.8	33.4	23.6
180.01	3.36	4.75	4.71	**5.60**	5.49	4.70	4.56	3.29
181.01	9.03	**9.77**	5.85	4.76	5.28	4.06	3.69	2.68
182.01	2.73	**3.28**	3.03	3.20	3.12	2.47	2.09	1.48
182.02	4.45	5.98	5.92	**6.58**	6.37	6.07	5.86	4.34
183.01	2.25	2.45	2.63	3.41	4.11	4.05	**4.31**	3.18
184.01	21.9	**23.7**	14.4	10.3	10.5	7.52	6.65	4.87
185.01	12.9	**14.3**	8.29	6.06	5.68	3.93	3.22	2.33
186.01	5.50	**6.00**	3.46	3.01	2.98	2.17	1.82	1.30
186.02	6.96	**7.43**	5.43	4.49	4.44	3.21	2.70	1.94

Appendix N

TUFLOW Model Results for Sensitivity Analyses

SENSITIVITY ANALYSIS SUMMARY - 1% AEP

Tributary and Location	Peak 1% AEP Water Elevation (mAHD)				
	'Base' Case	0% Blockage	100% Blockage	Mannings 'n' Increase of 20%	Mannings 'n' Decrease of 20%
Ourimbah-Platypus Creek Rd	34.59	34.59	34.59	35.18	34.39
Ourimbah-Lyrebird Lane	29.80	29.80	29.80	30.24	29.56
Ourimbah-Moores Point Road	21.60	21.60	21.61	21.87	21.36
Ourimbah-Footes Road	16.98	16.98	17.33	17.11	16.85
Ourimbah-Palmdale Road	14.12	14.10	16.14	14.29	13.96
Ourimbah-Sydney-Newcastle Freeway	12.38	12.25	16.82	12.53	12.16
Ourimbah-Pacific Highway	12.23	12.09	15.57	12.40	11.99
Ourimbah-Main Northern Railway	7.80	6.89	10.52	7.92	7.65
Ourimbah-Wyong Road	4.49	4.11	4.89	4.54	4.44
Ourimbah-Tuggerah Lake	2.29	2.29	2.30	2.52	2.13
Kangy Angy-Prestons Road	11.53	11.53	11.68	11.74	11.33
Kangy Angy-Sydney-Newcastle Freeway	11.11	11.06	11.55	11.35	10.98
Kangy Angy-Pacific Highway	11.01	10.95	11.45	11.12	10.81
Windy Drop Down-Sydney-Newcastle Freeway	11.59	11.58	11.90	11.76	11.40
Chittaway-Berrys Lane	19.62	19.62	19.62	19.85	19.60
Chittaway-Orange Road	15.60	15.60	15.60	15.77	15.46
Chittaway-Old Chittaway Road	13.38	13.38	13.71	13.40	13.15
Chittaway-Enterprise Drive	12.29	12.29	13.95	12.30	12.04
Chittaway-Main Northern Railway	12.28	12.27	13.92	12.34	12.09
Bangalow Floodrunner-Sydney-Newcastle Freeway	13.62	13.61	15.68	13.66	13.52
Bangalow Floodrunner-Pacific Highway	13.28	13.26	15.01	13.30	13.24
Bangalow Floodrunner-Bridge Street	12.41	12.41	12.83	12.57	12.18
Dog Trap-Dog Trap Road	19.91	19.92	19.90	20.03	19.68
Dog Trap-Pacific Highway	17.86	16.99	18.08	17.93	17.73
Dog Trap-Main Northern Railway	16.36	16.36	16.37	16.75	16.11
Cut Rock-Detention Basin	24.47	24.47	24.47	24.69	24.34
Cut Rock-Tuggerah Street	23.86	23.85	24.30	23.87	23.66
Cut Rock-Cox Street (Tall Timbers)	22.47	22.38	23.34	22.68	22.31
Cut Rock-Main Northern Railway (upstream)	22.38	22.26	23.33	22.55	22.34
Cut Rock-Pacific Highway (upstream)	21.99	21.94	23.25	22.14	21.93
Cut Rock-Teralba Street	20.72	20.73	20.29	20.79	20.57
Cut Rock-Pacific Highway (downstream)	20.36	20.38	19.81	20.52	20.22
Cut Rock-Main Northern Railway (downstream)	20.25	20.27	19.74	20.43	20.24
Bangalow-Pryor Road	25.56	25.53	25.54	25.75	25.35
Bangalow-Coachwood Drive	24.11	24.10	24.10	24.20	24.02
Bangalow-Baileys Road	21.57	21.57	21.57	21.75	21.43
Bangalow-Shirley Street	16.57	16.53	17.28	16.75	16.35
Bangalow-Chittaway Road	16.07	16.04	16.13	16.30	15.95
Bangalow-Main Northern Railway	15.02	15.01	15.07	15.15	14.95
Bangalow-Burns Road	14.81	14.80	14.86	14.83	14.74

Appendix O

Tall Timbers Estate
Hydraulic Assessment

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1 INTRODUCTION

During the preparation of the Ourimbah Creek catchment Flood Study, Tall Timbers Estate at Lisarow was isolated by floodwaters on several occasions. Therefore, Gosford City Council requested additional investigations be completed to quantify the potential hydraulic benefits of:

- Removal of boulders/rocks within the Cut Rock Creek channel, downstream of the Pacific Highway; and,
- Reshaping of the Cut Rock Creek channel adjoining the southern end of Tall Timbers Estate.

Accordingly, additional hydraulic model simulations where completed to determine the impact that these channel modification works may have on existing flood levels in the vicinity of Tall Timbers Estate. A summary of the additional hydraulic model simulations that were completed and the results of the simulations are summarised below.

2 HYDRAULIC MODELLING

2.1 Model Modifications

The TUFLOW hydraulic model that was developed to quantify existing flood behaviour as part of the Ourimbah Creek Catchment Flood Study was updated to incorporate the potential channel modification works. This included the following hydraulic model modifications:

- Removal of rocks/boulders from the Cut Rock Creek channel downstream of the Pacific Highway. This was represented in the hydraulic model by reducing the Manning's 'n' roughness coefficient assigned to this channel segment from 0.1 to 0.035.
- Reshaping of the Cut Rock Creek channel at the southern end of Tall Timbers Estate. This was represented in the TUFLOW model by updating the cross-section assigned to this 1D channel segment from 'existing' conditions to 'design' conditions, as defined in the original subdivision plans (refer highlighted section in **Plate 1**).

2.2 Model Results

The updated model was used to simulate flood behaviour, with the channel modifications in place, for the 20% and 1% AEP floods. Peak flood levels were extracted from the results of the modelling and were compared against peak design flood levels for 'existing' conditions. This allowed flood level difference mapping to be prepared for each design flood.

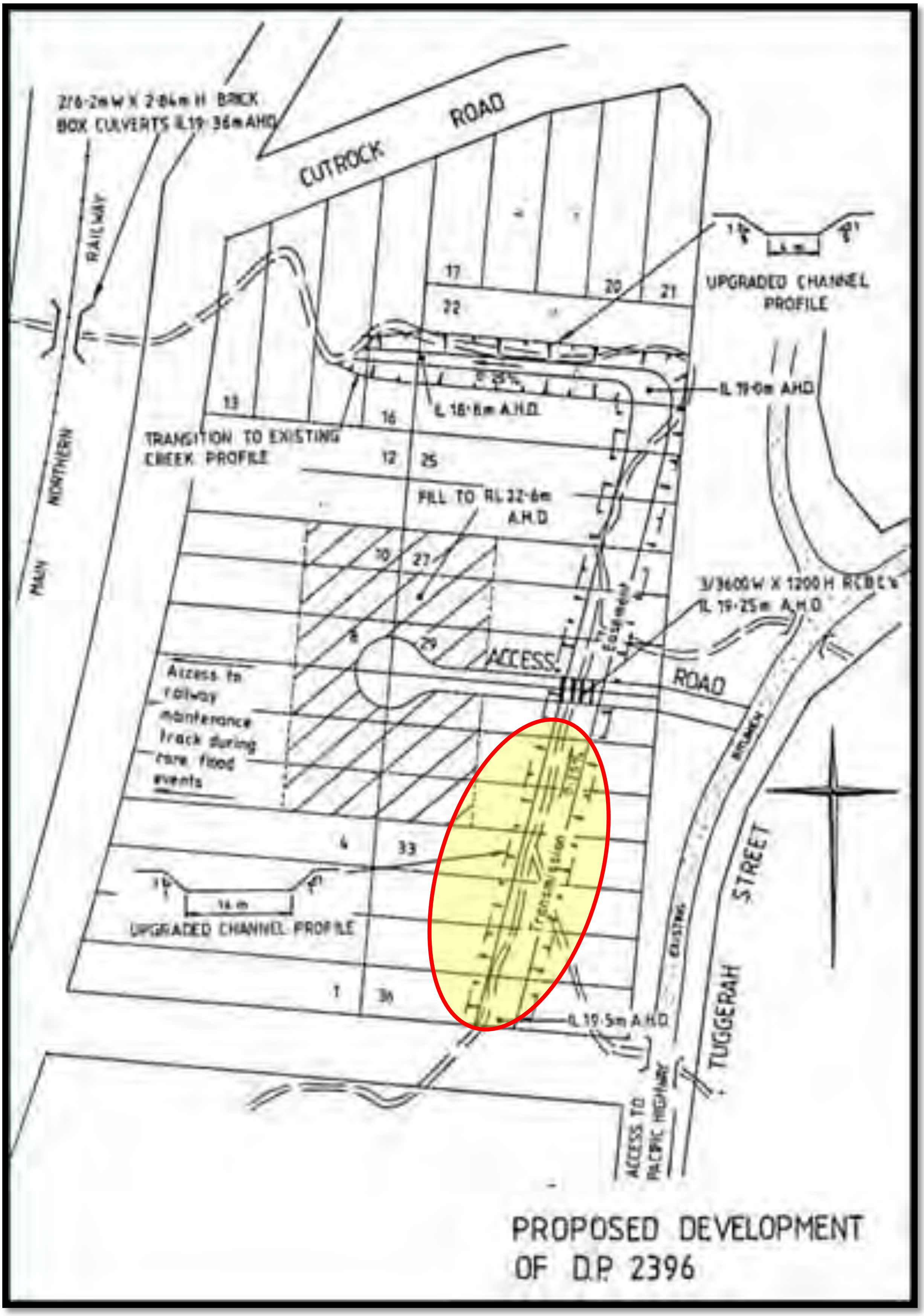


Plate 1 Original Cut Rock Creek Channel Design in vicinity of Tall Timbers Estate

The flood level difference mapping is presented in **Figures O1** and **O2** for the 20% and 1% AEP floods respectively. The flood level difference mapping shows the location and magnitude of changes in peak water levels associated with the channel modifications works. Decreases in flood levels relative to existing conditions are shown as different shades of blue and increases in flood levels relative to existing conditions are shown as different shades of red.

Figures O1 and **O2** show that the channel modification works are predicted to alter peak design flood levels in the vicinity of Tall Timbers Estate. The most significant decrease in design flood levels is predicted to occur immediately downstream of the Pacific Highway at the location of the rock/boulder removal. The magnitude of the maximum decrease in flood level is predicted to be 0.32 metres during the 1% AEP flood and 0.3 metres during the 20% AEP flood.

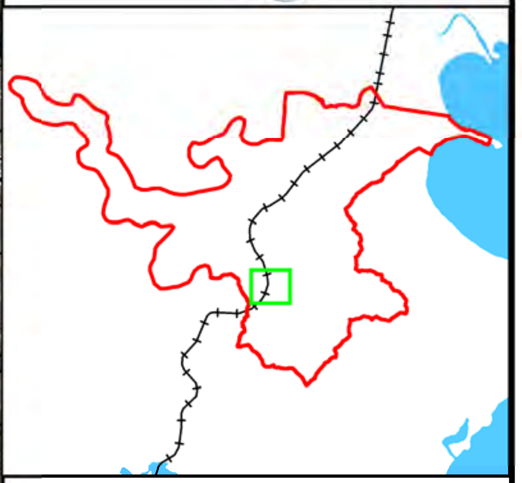
Reductions in design flood levels are also predicted to extend upstream of the Pacific Highway / railway and across Tall Timbers Estate. However, the highway and railway culverts serve as hydraulic controls during large floods which “dampen” the flood level reductions across Tall Timbers Estate. The magnitude of the reduction in 1% AEP flood level across Tall Timbers Estate is predicted to vary between 0.06 metres and 0.10 metres. During the 20% AEP flood, peak flood levels are predicted to decrease by between 0.07 and 0.15 metres.

The channel reshaping at the southern end of Tall Timbers Estate is predicted to have only a small impact on peak flood levels across Tall Timbers Estate. This is primarily associated with the fact that during large floods, the majority of the flood flows are conveyed across the floodplain. Therefore, minor channel modifications are unlikely to have a significant impact on the overall conveyance capacity through this area. This differs significantly from the Cut Rock Channel downstream of the Pacific Highway where the railway and highway culverts direct and concentrate the majority of the flow to the main creek channel.

There are predicted to be some small increases in design flood levels in the vicinity of Teralba Street associated with the channel modification work. However, the magnitude of the increase is predicted to be less than 0.05 metres during both the 1% and 20% AEP floods.

Overall, there appears to be some hydraulic benefits associated with the removal of the rocks/boulders located downstream of the Pacific Highway. This assessment only considered the 20% and 1% AEP floods. The flood level reduction benefits associated with the boulder removal are likely to be more significant across Tall Timbers Estate during relatively frequent floods where the water depth is less than the height of the boulders. Conversely, there appears to be minimal benefits associated with channel reshaping near the southern end of Tall Timbers Estate during the design events considered as part of this investigation.

Gosford City Council — Wyong Shire Council — CENTRAL COAST



LEGEND

TUFLOW Model Extent

Change in Peak Flood Level (mAHD)

- -0.25 to -0.30
- -0.20 to -0.25
- -0.15 to -0.20
- -0.10 to -0.15
- -0.05 to -0.10
- 0.00 to -0.05
- 0.00 to 0.05
- 0.05 to 0.10
- 0.10 to 0.15
- 0.15 to 0.20
- 0.20 to 0.25
- 0.25 to 0.30

Notes:
Aerial Photograph Date: 2010

N E S W

Scale 1:3,000 (at A3) (m)
0 100 200

Figure O1:
20% AEP Cut Rock Creek Channel Modification Flood Level Differences

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Catchment Simulation Solutions
Suite 302, 5 Hunter St
Sydney, NSW 2000

File Name: Figure O1 20% Flood Level Diff Cut Rock Assessment.wor

Gosford City Council | Wyong Shire Council | CENTRAL COAST

LEGEND

TUFLOW Model Extent

Change in Peak Flood Level (mAHD)

- -0.25 to -0.30
- -0.20 to -0.25
- -0.15 to -0.20
- -0.10 to -0.15
- -0.05 to -0.10
- 0.00 to -0.05
- 0.00 to 0.05
- 0.05 to 0.10
- 0.10 to 0.15
- 0.15 to 0.20
- 0.20 to 0.25
- 0.25 to 0.30

Notes:
Aerial Photograph Date: 2010

N W E S

Scale 1:3,000 (at A3)
0 100 200 (m)

Figure O2: 1% AEP Cut Rock Creek Channel Modification Flood Level Differences

Prepared By:
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File Name: Figure O2 1% Flood Level Diff Cut Rock Assessment.wor

APPENDIX P

PACIFIC HIGHWAY UPGRADE
HYDRAULIC ASSESSMENT

Catchment Simulation Solutions

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1 INTRODUCTION

The NSW Roads and Maritime Services (RMS) are currently preparing design plans for the proposed upgrade of the Pacific Highway between Lisarow and Ourimbah. The upgrade will include widening of the existing highway to provide two northbound and two southbound travel lanes and construction of new bridges to span Cut Rock Creek at Lisarow and Ourimbah.

Due to the potential for the proposed upgrade to impact on existing flood behaviour along Cut Rock Creek, Wyong Shire Council requested additional hydraulic investigations be completed. Accordingly, additional hydraulic model simulations where completed to determine the impact that the highway upgrade may have on existing flood levels during a range of design floods. A summary of the additional hydraulic model simulations that were completed and the results of the simulations are summarised below.

2 HYDRAULIC MODELLING

2.1 Model Modifications

The TUFLOW hydraulic model that was developed to quantify existing flood behaviour as part of the Ourimbah Creek Catchment Flood Study was updated to incorporate the proposed highway upgrade. This included the following hydraulic model modifications:

- Modification of the existing ground surface terrain on the western side of the current highway embankment to include the new Pacific Highway roadway embankment. The "post-development" terrain representation was defined using a design terrain model provided by the RMS on 7th March 2013. The terrain representation for both existing and post-development conditions is shown in **Plate 1**.
- Inclusion of a new single span, northbound bridge downstream of the existing Main Northern Railway and Pacific Highway culverts at Lisarow. The bridge details were based on plans provided by the RMS titled "Northbound Bridge Over Cut Rock Creek at 8.5km North of Gosford". The existing boulders located within the Cut Rock Creek channel at the location of the proposed bridge were also removed. This was represented by reducing the Manning's 'n' assigned to this channel segment from 0.1 to 0.035.
- Inclusion of two new bridges over Cut Rock Creek near Ourimbah to replace the current bridge. The bridge details were based upon design plans provided by the RMS titled "Twin Bridges Over Cut Rock Creek at 9.4km North of Gosford".

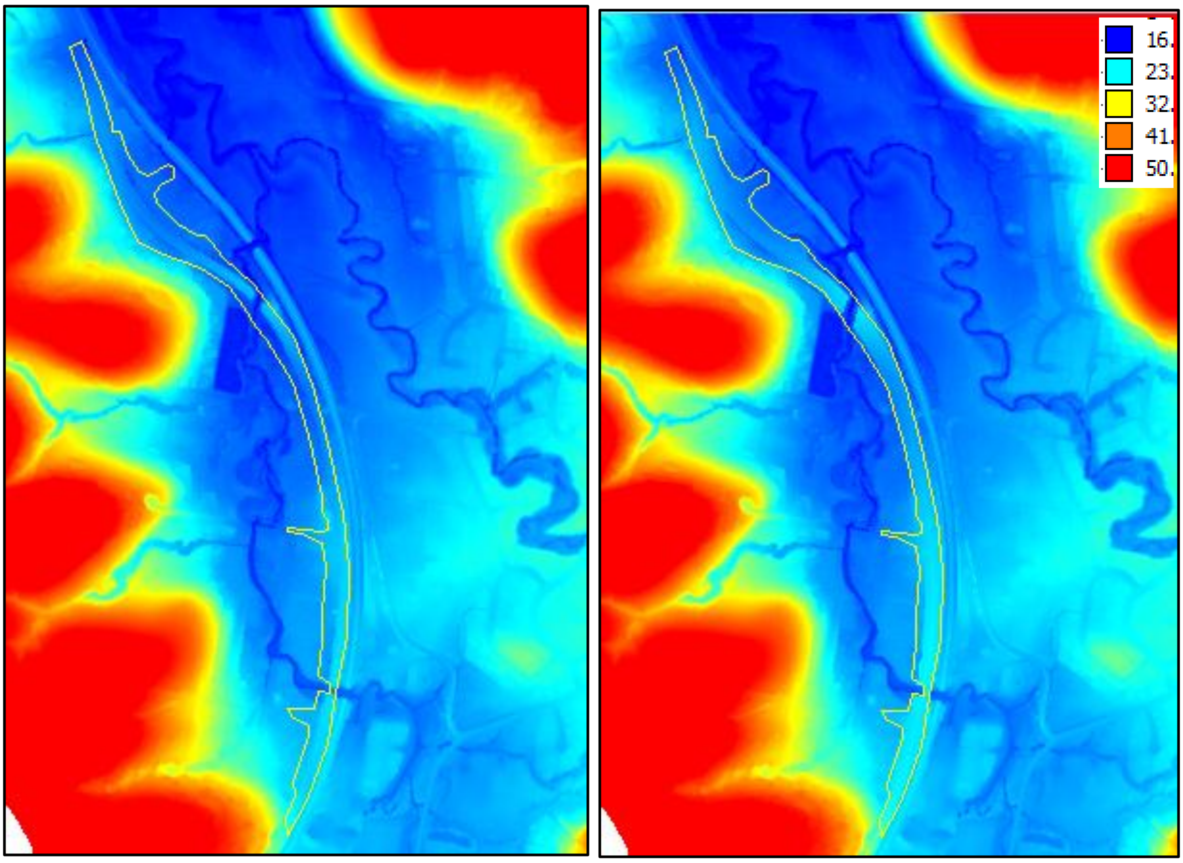


Plate 1 Terrain representation in TUFLOW model for existing (left image) and post-development (right image) conditions

2.2 Model Results

The updated model was used to simulate flood behaviour with the upgraded Pacific Highway in place for the 20% and 1% AEP floods as well as the Probable Maximum Flood (PMF). Peak floodwater depths and velocities were extracted from the results of the modelling and are presented in **Figures P1** to **P3** for the 20% AEP, 1% AEP and PMF respectively.

Peak flood levels were also extracted from the results of the modelling and were compared against peak design flood levels for 'existing' conditions. This allowed flood level difference mapping to be prepared for each design flood.

The flood level difference mapping is presented in **Figures P4** to **P6** for the 20% AEP, 1% AEP and PMF respectively. The flood level difference mapping shows the location and magnitude of changes in peak water level associated with the highway upgrade. Decreases in flood levels relative to existing conditions are shown as different shades of blue and increases in flood levels relative to existing conditions are shown as different shades of red.

Figure P4 shows that the highway upgrade is predicted to produce small changes in peak 20% AEP flood levels. The maximum decrease in flood level is predicted to be around 0.3 m and occurs immediately downstream of the new Pacific Highway crossing of Cut Rock Creek at Lisarow. This decrease in flood level is primarily associated with the removal of rocks/boulders along this section of the Cut Rock Creek channel. Flood level decreases are also predicted to extend upstream of the Main Northern Railway and across Tall Timbers

Estate where flood level decreases are predicted to vary between 0.04 metres (near the southern end of Tall Timbers Estate) and 0.13 metres (immediately upstream of the railway). Some small increases in peak 20% AEP flood levels are predicted in the vicinity of Teralba Street, however, the magnitude of the decreases is only predicted to be around 0.01 metres.

Figure P5 shows that peak flood levels during the 1% AEP flood are also predicted to decrease along Cut Rock Creek in the vicinity of the new bridge at Lisarow as well as across Tall Timbers Estate. The maximum decrease in 1% AEP flood level at the new bridge location is predicted to be about 0.25 metres and across Tall Timbers Estate the decreases are predicted to vary between 0.04 and 0.07 metres.

Some small increases in peak 1% AEP flood level are predicted around Teralba Street (0.01 m) and more substantial increases are predicted towards the north of the study area near Ourimbah. The maximum increase at this location is predicted to be around 0.06 metres and is associated with the new roadway embankment encroaching within a flood storage area located between the Pacific Highway and railway line.

Figure P6 indicates that some more substantial flood levels differences are predicted to occur during the PMF. In particular, a maximum increase in peak PMF flood level of around 0.7 metres is predicted to occur immediately upstream of the new roadway embankment near the Cut Rock Creek crossing at Lisarow. This increase in flood level is associated with the additional height of the new roadway embankment which impedes the path of water that currently overtops the Pacific Highway and railway embankment during the PMF. It should be noted that these maximum increases are localised and appear to be fully contained to the roadway and railway reserves. Nevertheless, increases in PMF flood levels are predicted to extend across Tall Timbers Estate and upstream as far as Fagans Road. The magnitude of the flood level increase across Tall Timbers Estate is predicted to be around 0.2 metres.

Although the new roadway embankment is predicted to increase peak flood levels upstream of the highway, there is predicted to be a commensurate decrease in PMF flood levels downstream of the highway. This is associated with the “sheltering” effect provided by the elevated embankment. The maximum decrease in flood level is predicted to be 0.6 metres at this location. The elevated embankment is also predicted to reduce flood levels in the vicinity of Teralba Street by around 0.3 metres.

Flood level decreases of around 0.3 metres are predicted to extend downstream from Teralba Street to the Pacific Highway crossing of Cut Rock Creek near Ourimbah. Downstream of the railway line near Ourimbah, some increases in PMF flood levels are predicted. This is associated with the additional water that is diverted along the “flood runner” located west of the railway embankment that was previously conveyed across the Pacific Highway during the PMF. The magnitude of the increase at this location is around 0.07 metres.

2.3 Summary

2.3.1 Tall Timbers Estate

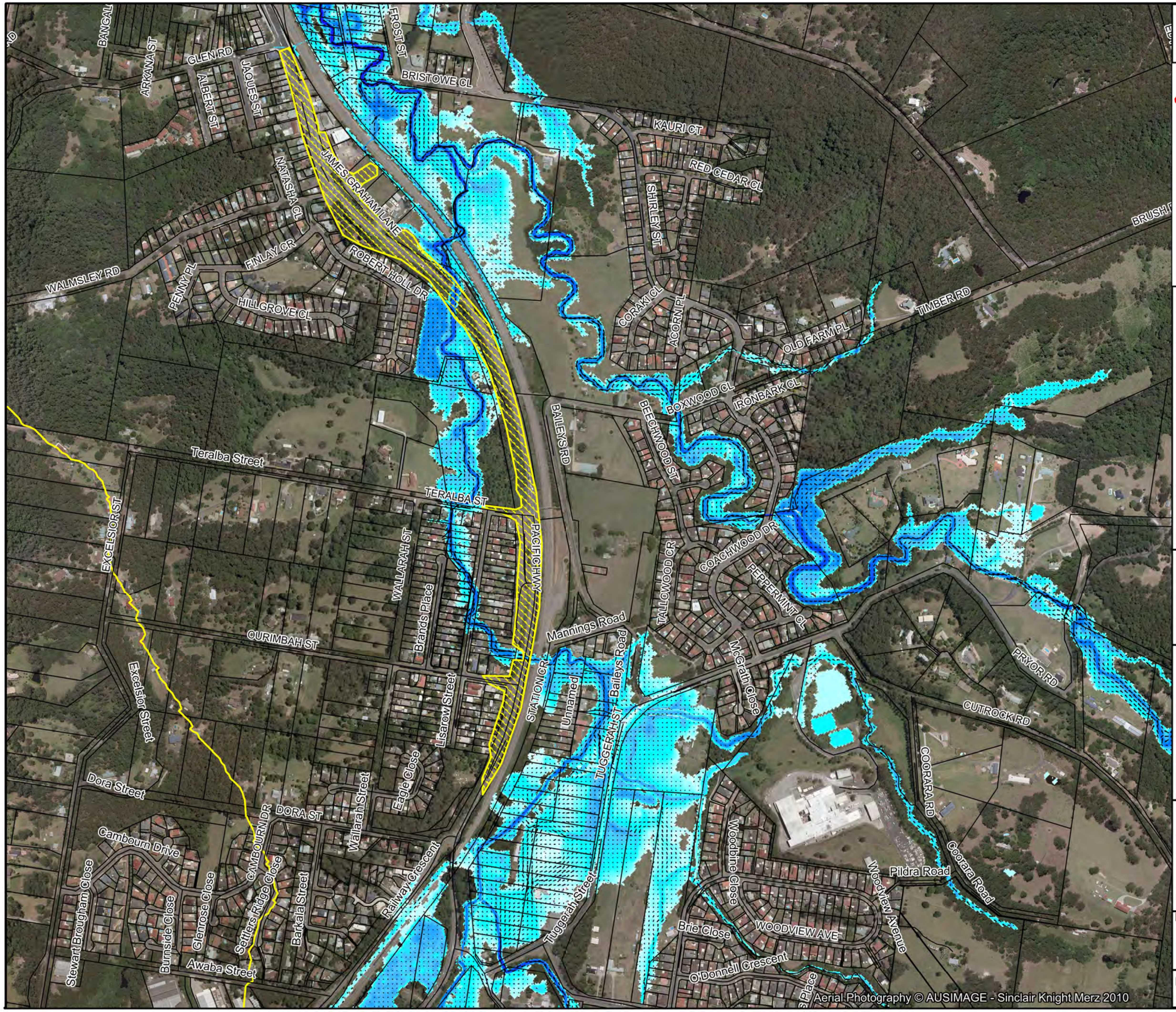
The proposed upgrade of the Pacific Highway is predicted to cause some changes to peak design flood levels. Decreases in flood levels are predicted across Tall Timbers Estate during events up to and including the 1% AEP flood, although the magnitude of the decreases is typically less than 0.1 metres. During the PMF, the new roadway embankment is predicted to reduce the amount of water being conveyed across the Pacific Highway. This is predicted to increase peak PMF flood levels by around 0.2 metres across Tall Timbers Estate.

2.3.2 Teralba Street

In the vicinity of Teralba Street, the Pacific Highway upgrade is predicted to produce small increases in design flood levels during events up to and including the 1% AEP flood (i.e., less than 0.02 metres). During the PMF, the new roadway embankment is predicted to afford protection from floodwaters that would currently overtop the highway. This is predicted to reduce PMF flood levels around Teralba Street by at least 0.3 metres.

2.3.3 Ourimbah

The Pacific Highway upgrade is predicted to produce some small changes in flood levels across the southern section of Ourimbah village. However, the magnitude of the changes is typically equal to or less than 0.1 metres for all events between the 20% AEP flood and PMF.



CENTRAL COAST

LEGEND

TUFLOW Model Extent

Pacific Highway Upgrade Works

Depths (m)	Velocity Vectors
0.0 - 0.1	0.5 m/s
0.1 - 0.5	1 m/s
0.5 - 1.0	2 m/s
1.0 - 2.0	4 m/s
2.0 - 3.0	
3.0 - 4.0	
4.0 - 5.0	
5.0 - 6.0	
> 6.0	

Notes:
Aerial Photograph Date: 2010

N
W E
S

Scale 1:8,000 (at A3) (m)
0 250 500

Figure P1: 20% AEP Floodwater Depths and Velocities with Pacific Highway Upgrade

Prepared By:
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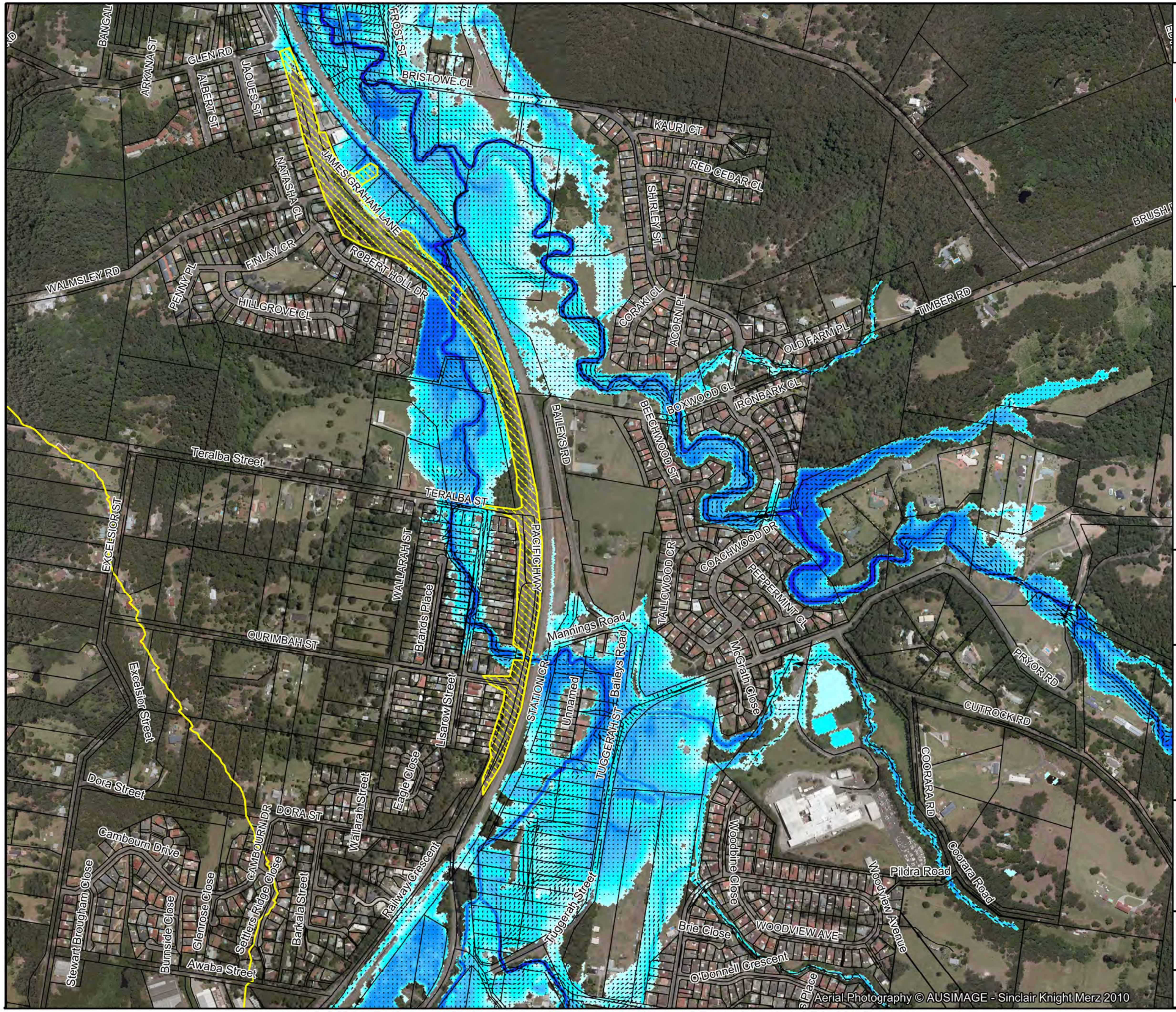
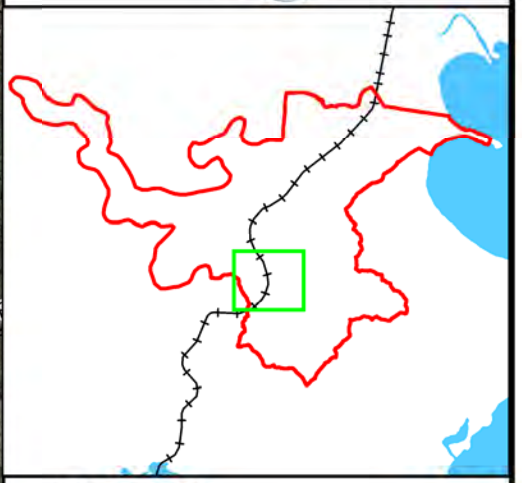
Sydney, NSW 2000

File Name: Figure P1 20% AEP D and V with Pacific Hwy.wor



Wyong Shire Council
CENTRAL COAST



LEGEND

TUFLOW Model Extent

Pacific Highway Upgrade Works

Depths (m)	Velocity Vectors
0.0 - 0.1	0.5 m/s
0.1 - 0.5	1 m/s
0.5 - 1.0	2 m/s
1.0 - 2.0	4 m/s
2.0 - 3.0	
3.0 - 4.0	
4.0 - 5.0	
5.0 - 6.0	
> 6.0	

Notes:
Aerial Photograph Date: 2010

N
W E
S

Scale 1:8,000 (at A3) (m)
0 250 500

Figure P2:
1% AEP Floodwater Depths and Velocities with Pacific Highway Upgrade

Prepared By:
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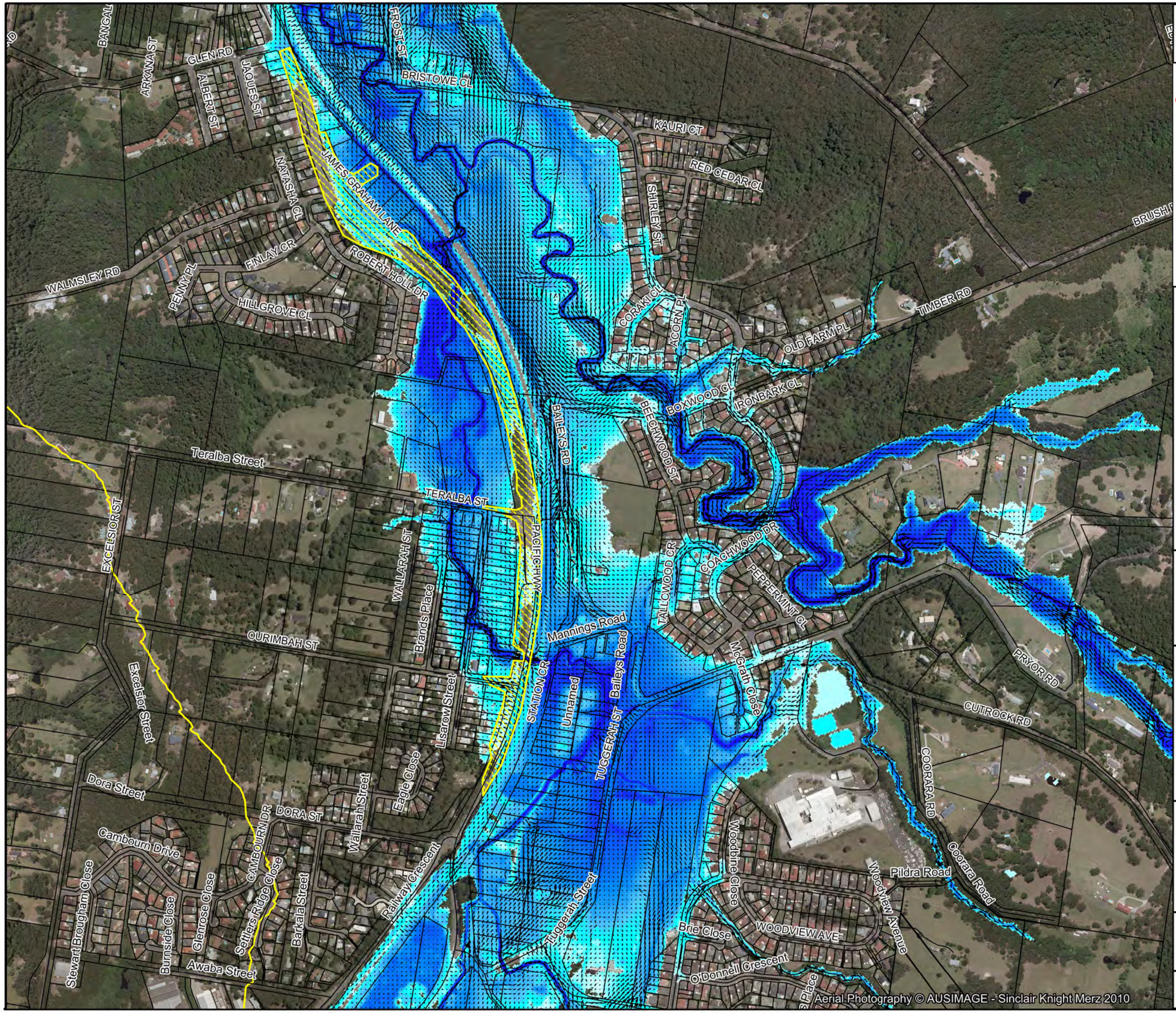
Sydney, NSW 2000

File Name: Figure P2 1% AEP D and V with Pacific Hwy.wor



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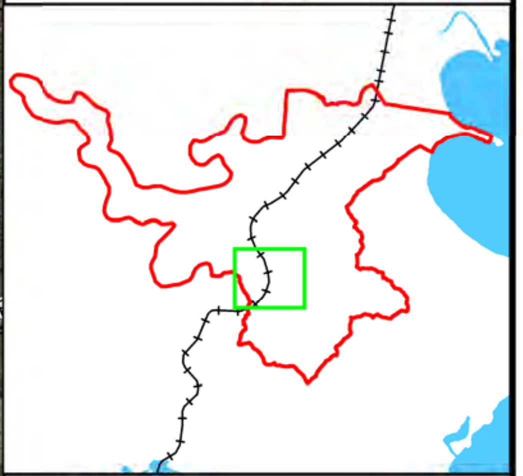

LEGEND

TUFLOW Model Extent

Pacific Highway Upgrade Works

Depths (m)	Velocity Vectors
0.0 - 0.1	0.5 m/s
0.1 - 0.5	1 m/s
0.5 - 1.0	2 m/s
1.0 - 2.0	4 m/s
2.0 - 3.0	
3.0 - 4.0	
4.0 - 5.0	
5.0 - 6.0	
> 6.0	

Notes:
Aerial Photograph Date: 2010

N W E S

Scale 1:8,000 (at A3)

0 250 500 (m)

Figure P3: PMF Floodwater Depths and Velocities with Pacific Highway Upgrade

Prepared By:
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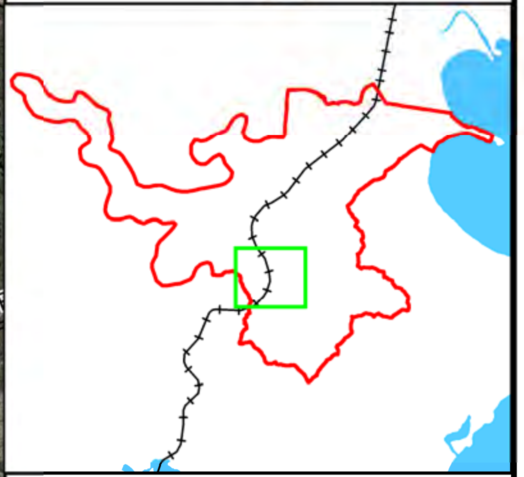
File Name: Figure P3 PMF D and V with Pacific Hwy.wor

Gosford City Council | Wyong Shire Council
CENTRAL COAST



LEGEND

TUFLOW Model Extent

Pacific Highway Upgrade Works

Change in Peak Flood Level (mAHD)

- -0.50 to -0.40
- -0.40 to -0.30
- -0.30 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.30
- 0.30 to 0.40
- 0.40 to 0.50

Notes:
Aerial Photograph Date: 2010

N W E S

Scale 1:8,000 (at A3) (m)
0 250 500

Figure P4: 20% AEP Flood Level Differences with Pacific Highway Upgrade

Prepared By:
Catchment Simulation Solutions
Suite 302, 5 Hunter St
Sydney, NSW 2000

File Name: Figure P4 20% Flood Level Diff with Pacific Hwy.wor

Gosford City Council
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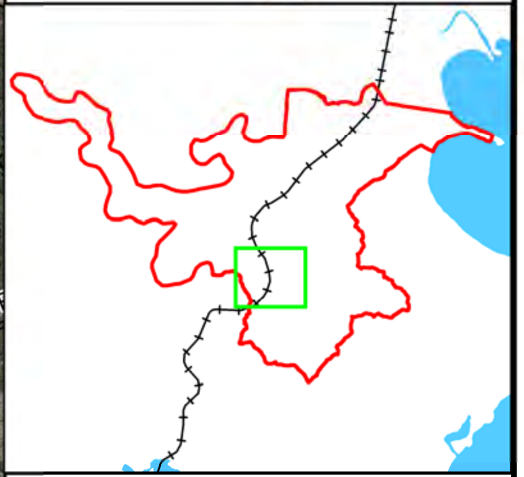
CENTRAL COAST



LEGEND

TUFLOW Model Extent

Pacific Highway Upgrade Works

Change in Peak Flood Level (mAHD)

- -0.50 to -0.40
- -0.40 to -0.30
- -0.30 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.30
- 0.30 to 0.40
- 0.40 to 0.50

Notes:

Aerial Photograph Date: 2010

N W E S

Scale 1:8,000 (at A3)

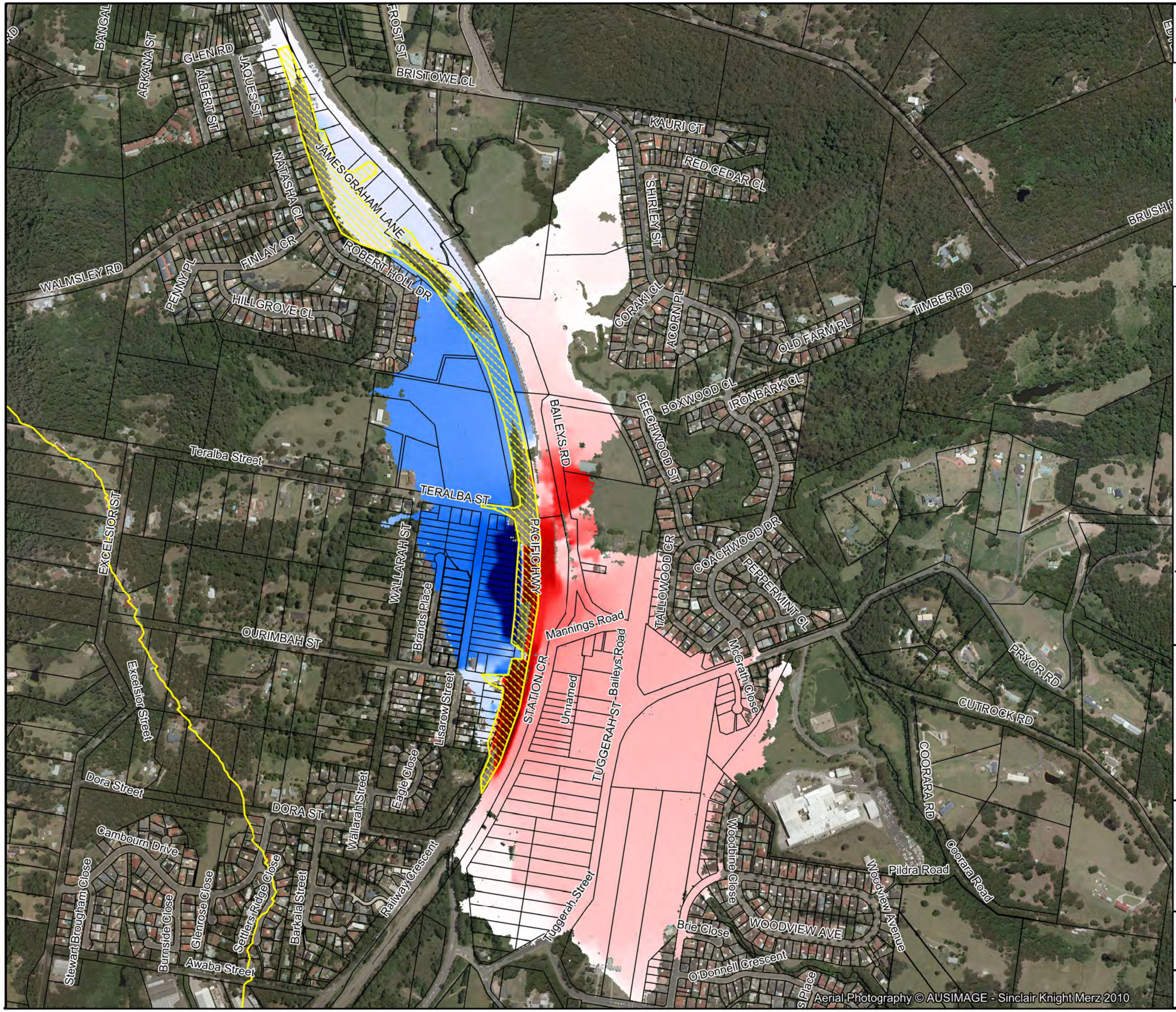
(m) 0 250 500

Figure P5: 1% AEP Flood Level Differences with Pacific Highway Upgrade

Prepared By:

Catchment Simulation Solutions
Suite 302, 5 Hunter St
Sydney, NSW 2000

File Name: Figure P5 1% AEP Flood Level Diff with Pacific Hwy.wor



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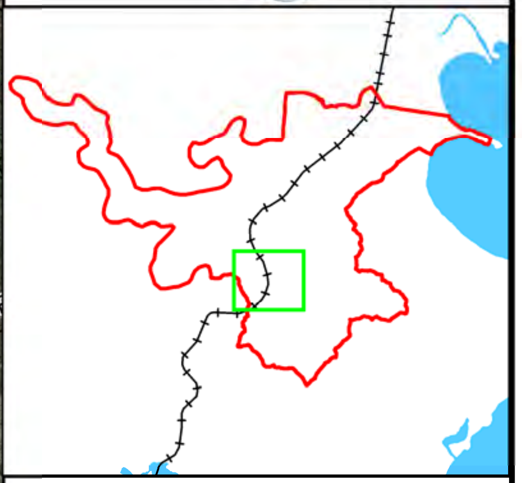
CENTRAL COAST



LEGEND

TUFLOW Model Extent

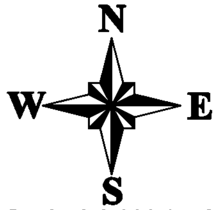
Pacific Highway Upgrade Works

Change in Peak Flood Level (mAHD)

- -0.50 to -0.40
- -0.40 to -0.30
- -0.30 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.30
- 0.30 to 0.40
- 0.40 to 0.50

Notes:

Aerial Photograph Date: 2010



Scale 1:8,000 (at A3)

(m)

0 250 500

Figure P6:
PMF
Flood Level Differences with Pacific Highway Upgrade

Prepared By:
Catchment Simulation Solutions
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Sydney, NSW 2000

File Name: Figure P6 PMF Flood Level Diff with Pacific Hwy.wor