Flood Study for Orphan School Creek, Green Valley Creek and Clear Paddock Creek

FINAL REPORT

- 24 October 2008

In association with

FAIRFIELD CONSULTING SERVICES
A Division of Fairfield City Council

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1. Introduction

1.1 Background

Fairfield City Council (FCC) commissioned Sinclair Knight Merz (SKM) to undertake a flood study for Orphan School Creek, Clear Paddock Creek and Green Valley Creek (the “Three Tributaries” of Prospect Creek) that is consistent with the requirements of the NSW Government’s *Floodplain Development Manual* (NSW Government, 2005) and State Government Policy. The NSW Department of Environment and Climate Change (DECC) and FCC jointly funded this project. SKM would like to acknowledge the invaluable contribution of both FCC and DECC to this project.

This study was jointly undertaken by SKM and Fairfield Consulting Services (FCS), a business unit of FCC.

Fairfield Local Government Area (LGA) covers an area of around 102.5km^2. Within the LGA there are typically old watercourses and tributaries that have been piped over the years. Unfortunately, most of the flow paths are in urban areas with direct impact and potential for damage to properties and hazard to residents.

There are two major catchments in the Fairfield Local Government Area (LGA) - the Georges River Catchment and the Hawkesbury Nepean Catchment. Each of these larger regional catchments contains sub-catchments and a variety of rivers, creeks, lakes and wetlands.

The eastern section of Fairfield City is part of the Prospect Creek sub-catchment that flows into the Georges River (which eventually flows into Botany Bay). This is the largest catchment in the Fairfield LGA, covering an area of 98km^2. The waterways in the Prospect Creek sub-catchment are a mix of natural creeks, concrete lined channels and enclosed pipe drainage systems.

1.2 Study Area

The study area is comprised of three highly urbanised sub-catchments of Prospect Creek, including Orphan School Creek and its tributaries, Green Valley Creek and Clear Paddock Creek. These creeks comprise a drainage system running generally through the middle of Fairfield LGA. Refer to **Figure 1-1** for an illustration of the study area.

Orphan School Creek covers a distance of approximately 12km and has a total catchment area of 34.3km^2, including Clear Paddock Creek and Green Valley Creek sub-catchments. The creek passes under a road bridge and railway viaduct at Canley Vale and joins Prospect Creek approximately 500m upstream of the railway bridge at Carramar Station. The upper and lower reaches of Orphan School Creek are natural waterways, while a section of the middle reach, between Smithfield Road and King Road, is a concrete-lined channel.

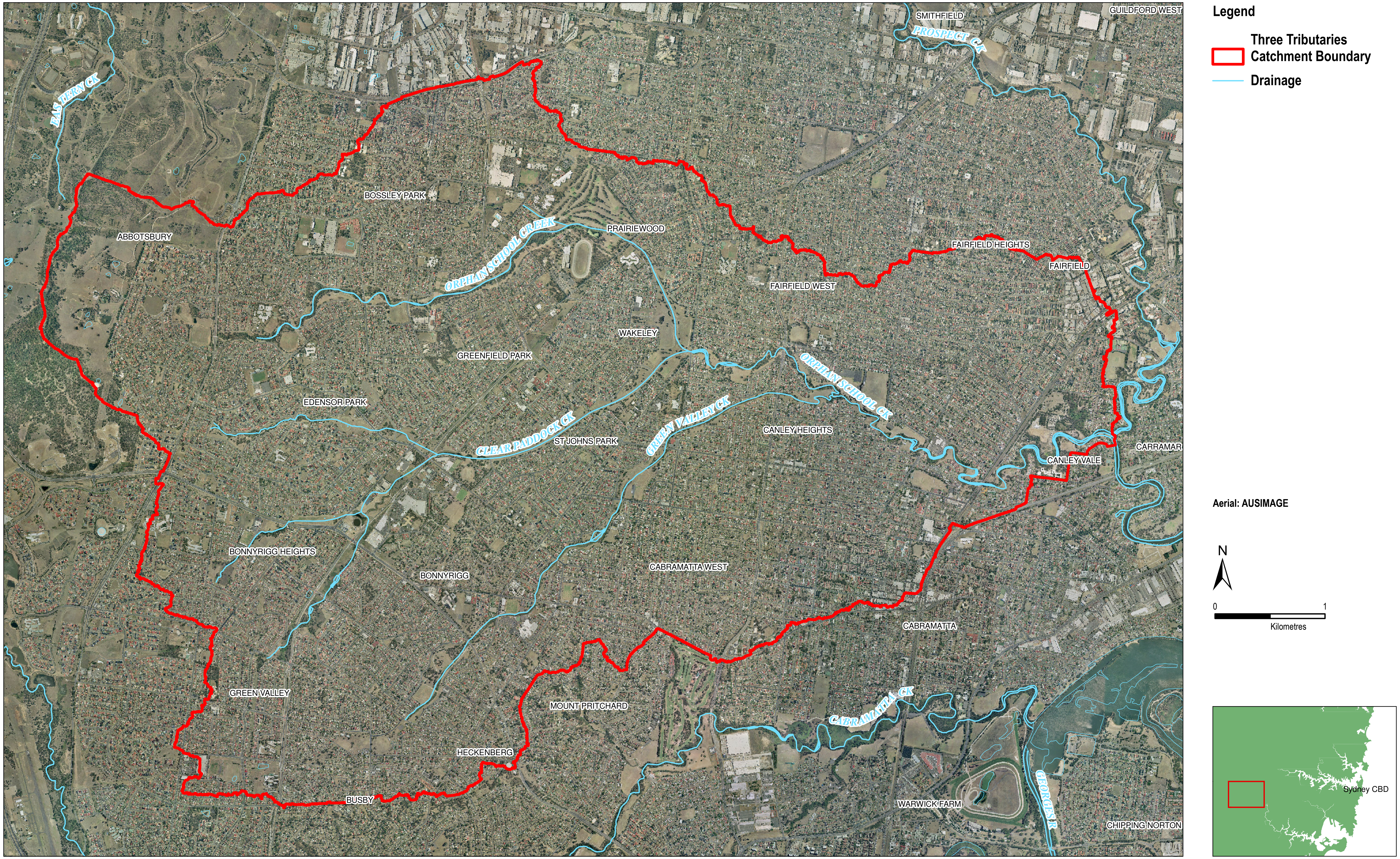

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Figure 1-1 Study Area Location

Flood Study for Orphan School Creek, Clear Paddock Creek and Green Valley Creek

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Clear Paddock Creek is approximately 5km long with a catchment area of 8.8km^2. At the upstream end of Clear Paddock Creek (in the Edensor Park area) are three smaller, predominantly natural waterways known as Edensor, Wilson and Henty Creeks, which flow into the main channel of Clear Paddock Creek at a naturalised section of the creek, named “Restoring the Waters”. The creek is then concrete lined from Brisbane Road to the confluence with Orphan School Creek.

Green Valley Creek is piped upstream of North Liverpool Road, whilst downstream it flows in a vegetated waterway for approximately 7km to its confluence with Orphan School Creek. It has a catchment area of 7.4km^2.

The floodplain for this Study is considered as all land that is potentially at risk from flooding up to the Probable Maximum Flood (PMF) as defined in the *Floodplain Development Manual* (NSW Government, 2005). Hence all flood events up to and including the PMF are required to be assessed as a part of this Flood Study.

For the purposes of this study, the study area is limited to the area upstream of the Canley Vale – Fairfield Railway line. The area downstream was covered in the previous *Prospect Creek Floodplain Management Plan, Flood Study Review* (Bewsher Consulting, 2006).

1.3 History of Flooding in the Catchments

Incidence of past events in Orphan School Creek form a part of the larger Prospect Creek catchment. Major flooding occurred along Prospect Creek and Orphan School Creek in August 1986, April-May 1988 and February 2001. These floods caused serious financial losses and hardship to a large number of families and businesses in the area. The 1986 flood caused a total damage of approximately $4.8 million on Prospect Creek alone (Willing & Partners, 1990). The 1986 and 1988 floods produced strong community pressure for measures to control flooding in the area. Previous to this, the last known major flood in Fairfield was in 1956 (Willing & Partners, 1990).

1.4 Purpose of This Study

FCC has undertaken a number of flood studies over the last few years including:

- Cabramatta Creek Flood Study
- Prospect Creek Flood Study
- Georges River (FCC section) Flood Study.

These studies provide accurate flood levels in waterways that are invaluable in planning development on and close to the floodplain. However, there are many other areas in Fairfield that are potentially flood prone but have not been studied or mapped, including areas in the current study area. Those areas in the study area which have been previously assessed were done so between 10 and 20 years ago using different modelling techniques and to varying levels of detail. Hence, the present understanding of flooding conditions in the current study area is not one that is fully integrated.

This current study therefore aims to determine the flooding conditions, including flood levels, flow rates and flood risk, in the study area in an integrated manner, in line with the previous studies recently undertaken for Prospect Creek, Cabramatta Creek and the Georges River. Subsequently, FCC intends to use the latest flood information from this study to update the Section 149 Certificates for the properties within the study area.

As per the floodplain management framework set out in the *Floodplain Development Manual 2005*, this Flood Study is part of a process that subsequently involves the undertaking of a Floodplain Risk Management Study and development of a Floodplain Risk Management Plan. Hence the findings of this Flood Study will be used in the subsequent studies in the process.

2. Available Data

2.1 Previous Studies

A number of previous studies are relevant to the study area, including the following:

- Bewsher Consulting (1997a) *Lower Clear Paddock Creek Flood Study* Prepared for Fairfield City Council.
- Bewsher Consulting (1997b) *Upper Clear Paddock Creek Flood Study* Prepared for Fairfield City Council
- Bewsher Consulting (2006) *Prospect Creek Floodplain Management Plan, Flood Study Review* Prepared for Fairfield City Council
- Dalland & Lucas (1991) *Orphan School Creek King Road to Railway Parade and Green Valley Creek Chisholm Park to Orphan School Creek Flood Profiles* Prepared for Fairfield City Council
- Fairfield City Council *Revision of Dalland & Lucas 1996 Study* (September 2000)
- L.J. Wiles, Fairfield City Council (January 1982) *Green Valley Creek Drainage Study*.
- Snowy Mountains Engineering Corporation (1985) *Fairfield Flood Mitigation Study. Volume 1 – Main Report* Prepared for Fairfield City Council.

Several other flood studies have been undertaken in the study area in the past, but have been superseded by more recent studies. These include:

- Dalland & Lucas (1996) *Orphan School Creek Sackville Street to Railway Parade Canley Vale* Prepared for Fairfield City Council: superseded by FCC's in-house revision of this study (Fairfield City Council, 2000)
- D. J. Dwyer and Associates (1978) *Drainage Study Green Valley Creek* Prepared for Fairfield Municipal Council: this study is considered to be too old and hence not representative of the current catchment.

2.2 Topographic Survey

2.2.1 Airborne Laser Survey

Airborne Laser Survey (ALS), conducted in January 2003 was used to generate a Digital Terrain Model (DTM) for the entire Fairfield LGA. The DTM was subsequently used in a number of projects undertaken for FCC, including this current study.

The ALS data used had been filtered to reduce the density of points and to remove non-ground points such as buildings, bridges and over/underpasses. A validation process was carried out on this data at the outset of this study, by generating 0.5m contours over the area and ground-truthing

100 random points over the data area. Building polygons were generated from the filtered data, allowing buildings to be digitised and represented in GIS.

2.2.2 Ground Survey

Ground survey was undertaken to provide more accurate information than the ALS could provide for cross sections along the waterways. This is because the ALS is not accurate in waterway areas and in areas where there is dense vegetation.

Approximately 194 cross sections were taken along Orphan School Creek alone, and a further 86 cross sections on Green Valley Creek and 55 cross sections on Edensor Creek. Survey data was already available for Clear Paddock Creek and its tributaries (other than Edensor Creek). This data was checked for accuracy and determined it was still suitable for use in this study.

Further ground survey was taken of all crossings including bridges, culverts and pipes with an approximate total of 35 crossings throughout the model.

Site visits were undertaken by members of the study team to record observations on the characteristics of the creeks for input into the hydraulic model. The creek characteristics recorded included the presence and type of creek and bank vegetation, pools and riffles and estimation of Manning's n.

2.3 Works As Executed Drawings

The NSW Roads and Traffic Authority (RTA) recently completed the construction of the bus transitway network which crosses a number of sections in Orphan School Creek and Clear Paddock Creek. The Works as Executed (WAE) drawings prepared by the RTA were readily available and were used to create cross-sections at the transitway crossings over these creeks. The drawings were also used to compare ALS data and road levels were adjusted where necessary.

Basin C, on Clear Paddock Creek in Bonnyrigg, is a major component of FCC's trunk drainage system in the study area, providing water quality improvement and flood mitigation in addition to public amenity. The Basin is one of FCC's major catchment management projects in recent years. Basin C was constructed in 2004, hence ALS data collected in 2003 was not available for the completed Basin. WAE plans were therefore used to define the topography of Basin C.

2.4 AUSIMAGE™ Aerial Photography

AUSIMAGE™ Aerial photography was used extensively in this study, mainly for data validation and presentation of results in the preparation of flood inundation and risk maps. The aerial photography that was used was flown for FCC by SKM in January 2005. This photography is at a resolution of 0.15m.

2.5 GIS Data

Various layers of GIS data were made available for this study from FCC, and through SKM's previous work within Fairfield LGA. Most notably including:

- FCC digital Cadastre and Local Environment Plan (LEP);
- Building Polygon Layer;
- Flow Accumulation Grids;
- Flow Accumulation Network.

2.6 Rainfall Data

Historic rainfall data was obtained from the Bureau of Meteorology (BOM) and Sydney Water for use in model calibration. The rainfall gauging stations in the study area include:

- Fairfield City Farm (BOM Station No. 067114)
- Fairfield STP (Sydney Water Station No. 567077).

Design rainfall Intensity-Frequency-Duration (IFD) data was obtained from BOM by FCC specifically for hydrologic analyses and hydraulic design in the Fairfield LGA (BOM, 1987).

2.7 Historical Flood Data

2.7.1 Stream Gauging Data

Searches of the various databases revealed that only one stream gauge is located in the study area with data suitable for the purposes of this study. The gauge is a Department of Water and Energy (DWE) commissioned gauge located on lower Orphan School Creek near Sackville Street, Canley Vale (Station No.213014). The gauge is a telemetered gauging station providing instantaneous stage and flow readings at 10 minute intervals, amongst other data formats. The gauge has been in operation since March 1987.

2.7.2 2001 Flood Event High Water Marks

Flood marks were surveyed and recorded by Council staff during the 30-31 January 2001 floods to provide further information on flood levels during historical floods. Observations and flood high water marks were reported by FCC's Catchment Management Branch shortly after the flood event, refer to **Appendix A**.

2.8 Existing Numerical Models

Various data was extracted from a number of existing numerical models and used in flood modelling in this current study:

- *Prospect Creek Flood Study* XP-RAFTS and TUFLOW models (Bewsher Consulting, 2006). XP-RAFTS hydrologic loss model adopted and catchment imperviousness used for comparison in this current study. Detention basin stage-storage relationships and outlet dimensions adopted in this current XP-RAFTS model. TUFLOW water levels extracted and adopted for downstream water level boundary condition in current study.
- *Lower Clear Paddock Creek Flood Study* HEC-RAS model (Bewsher Consulting, 1997a). Cross sections at "Restoring the Waters" and the concrete channel downstream reviewed and adopted in the TUFLOW model for this study.
- *Upper Clear Paddock Creek Flood Study* HEC-RAS models (Bewsher Consulting, 1997b). Cross sections on Henty Creek and Wilson Creek reviewed and adopted in the TUFLOW model for this study.

3. Hydrologic Modelling

3.1 Development of the Hydrologic Model

Hydrologic modelling was required to estimate rainfall-runoff from the study catchment for the selected flood events. The aims of the hydrological modelling were to:

- Assemble a detailed catchment rainfall/runoff model for the Three Tributaries catchments based on the hydrologic model developed for Prospect Creek.
- Estimate flood hydrographs for the 20, 50 and 100 year ARI and PMP design storms under existing conditions for use in subsequent hydraulic modelling, for storm durations between 25 minutes and 36 hours.

The hydrologic model of the Prospect Creek catchment for the *Prospect Creek Floodplain Management Plan, Flood Study Review* (Bewsher Consulting, 2006) was developed using XP-RAFTS. XP-RAFTS is a non-linear rainfall-runoff flood routing model developed by XP Software. It is a well-proven model, recommended by *Australian Rainfall & Runoff* (Institute of Engineers, 2003). Hence, XP-RAFTS was used to develop a detailed hydrologic model for the study catchment.

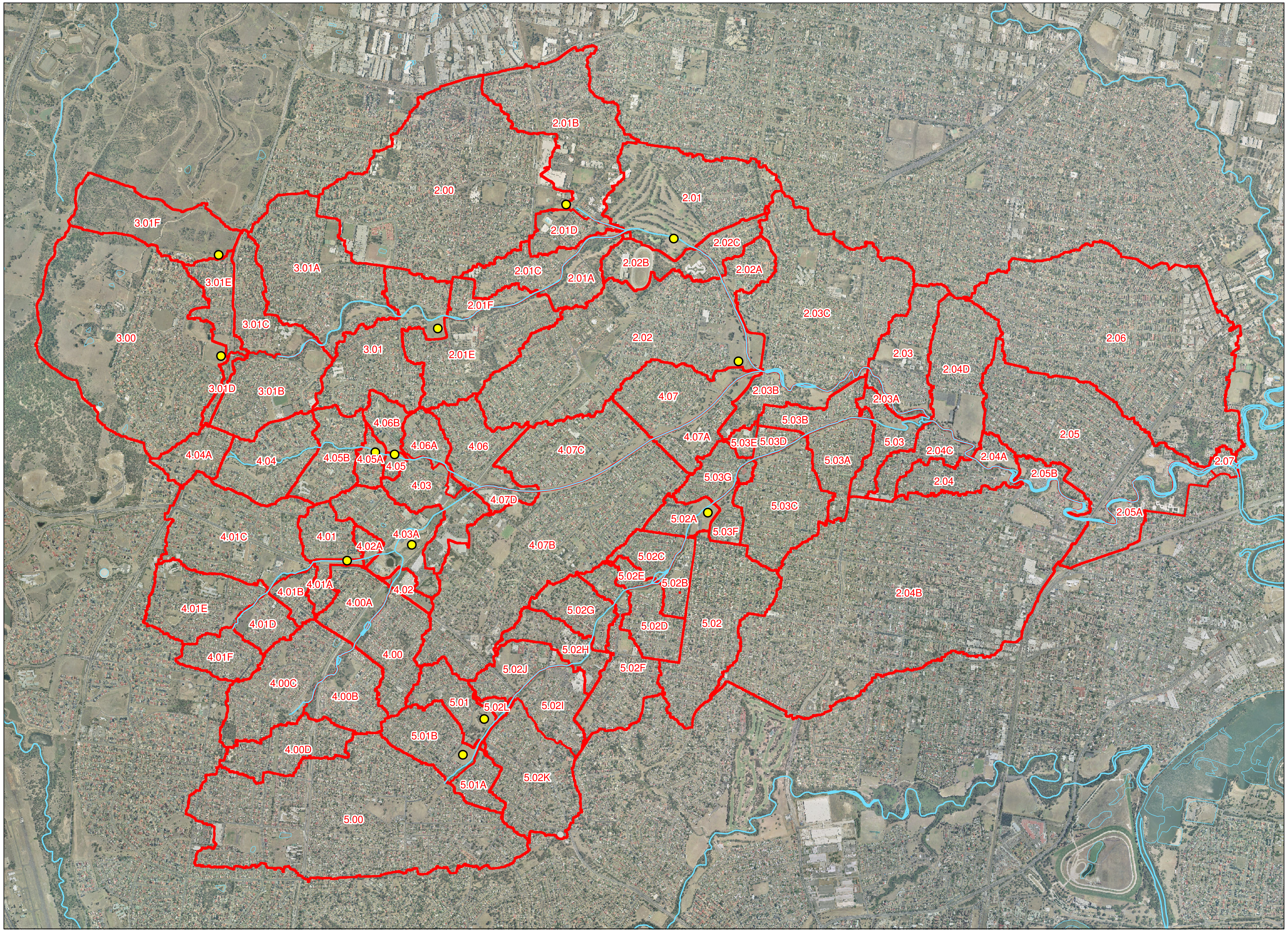
3.2 Model Configuration

3.2.1 Sub-Catchments

The XP-RAFTS model developed for the *Prospect Creek Floodplain Management Plan, Flood Study Review* (Bewsher Consulting, 2006) represented the Three Tributaries catchment using a total of 22 individual sub-catchments. For the purposes of this study the overall catchment was further discretised using the ALS data in GIS, resulting in a total of 88 individual sub-catchments. The rationale used to delineate the sub-catchments for this study involved sub-dividing the Prospect Creek XP-RAFTS model sub-catchments into smaller areas, taking into consideration (in order of priority):

- Catchment topography, including major overland flow paths;
- Existing detention basins; and
- Where possible, configuring the sub-catchments in order to avoid the need route the hydrographs in the XP-RAFTS model, thus reducing the number of variables in the model.
- Sub-areas straddling a creek were further sub-divided using the creek as a boundary. Catchment response on either side of the creek could therefore be analysed separately.

The final adopted sub-catchment layout is shown in **Figure 3-1**. Sub-catchment data is given in **Appendix C**.



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Drainage

Sub-Catchments

XP-RAFTS Detention Basins

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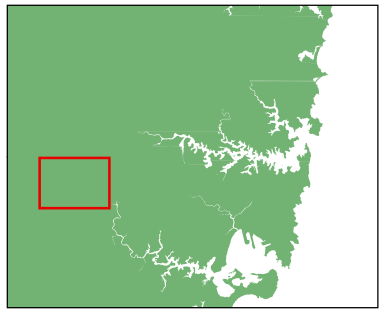

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Figure 3-1 XP-RAFTS Sub-Catchments

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Flood Study for Orphan School Creek, Clear Paddock Creek and Green Valley Creek

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3.2.2 Impervious fractions

Sub-catchment imperviousness was derived in GIS using SKM's Building Polygon Layer data for the area and then adjusted as necessary in order to maintain consistency with the previous Prospect Creek XP-RAFTS model, given that the sub-catchment imperviousness in the previous study had been accepted and adopted by FCC. The split catchment option was used in the XP-RAFTS model.

3.2.3 Vectored Slope

The vectored slope for each sub-catchment was determined in GIS from the ALS data. The range of sub-catchment slopes are summarised below:

- **Table 3-1 Vectored slope ranges for sub-catchments**

Slope Range	Number of Sub-Catchments
0% - 0.5%	6
0.5% - 1%	20
1% - 1.5%	17
1.5% - 2%	19
2% - 2.5%	10
2.5% - 3%	4
3% - 3.5%	7
3.5% - 4%	3
4% - 4.5%	2
TOTAL	**88**

3.2.4 Sub-Catchment Roughness

A uniform surface roughness (Manning's n) was adopted for the pervious (n = 0.025) and impervious (n = 0.02) portions of each sub-catchment, except for the top of the Orphan School Creek catchment where the land use is mostly rural and a Manning's n of 0.05 was adopted.

3.2.5 Detention Basins

There were 12 detention basins modelled in the Three Tributaries catchments as part of the Prospect Creek XP-RAFTS model. Hydraulic data (including stage-storage relationships and outlet design data) for the majority of the detention basins included in the model was derived from the *Prospect Creek Floodplain Management Plan, Flood Study Review* XP-RAFTS model (Bewsher Consulting, 2006). Where appropriate, this data was updated to reflect subsequent works undertaken by FCC. An additional basin was added at Comin Place, Abbotsbury, as it was omitted from the Prospect Creek model. In total, there are 13 detention basins in the Three Tributaries XP-RAFTS model. The basin locations are shown in **Figure 3-1**.

3.2.6 Routing Method and Hydrograph Lag Times

A routing method or lag times were not specified in the XP-RAFTS model, as the flows were not routed in the hydrologic model. Instead, the local hydrographs were used as the flow inputs into the hydraulic (TUFLOW) model and routed hydraulically.

3.3 Model Calibration

Calibration of the XP-RAFTS model itself was not undertaken since the hydrographs in the XP-RAFTS model were not routed hydrologically. A joint calibration of the XP-RAFTS and TUFLOW models was undertaken, refer to **Section 4.7**.

3.4 Design Input

3.4.1 Rainfall Intensity – Frequency – Duration Data

The Three Tributaries XP-RAFTS model made use of the Fairfield specific IFD data adopted by FCC. Adoption of these standard values was considered desirable for consistency with other studies that have been undertaken for FCC. The IFD data is shown in **Appendix B**.

Estimates of the Probable Maximum Precipitation (PMP) for the Three Tributaries catchments up to 6 hours duration were prepared using the procedures given in *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short Duration Method* (BOM, 2003). The PMP depths adopted for the various storm durations are tabulated **Table 3-2**.

Table 3-2 Probable Maximum Precipitation Depths for Various Storm Durations

Storm Duration	PMP Depth (mm)
30min	200
1hr	300
1.5hr	340
2hr	380
3hr	420
6hr	540

3.4.2 Rainfall Temporal Pattern

Temporal patterns for the synthetic design storms were derived from Book 2 of *Australian Rainfall and Runoff* (Institute of Engineers, 2003). Rainfall intensities for the Fairfield area were taken from BOM (1987). Adoption of these standard values was considered desirable for consistency with other local studies that have been undertaken.

3.4.3 Areal Reduction Factor

Areal Reduction Factors (ARFs) are applied to point rainfall estimates derived from Book VI of *Australian Rainfall and Runoff* (Institute of Engineers, 2003) to account for the variability of rainfall over the catchment. As catchment areas increase, a greater reduction is usually required.

Conceptually the application of areal reduction factors can be a problem. For storm durations less than 18 hours, *Australian Rainfall and Runoff* recommends calculating areal reduction factors using a relationship developed by Grayson et al, 1996 (refer page 65, Institute of Engineers, 2003). This relationship is a function only of catchment area and storm duration, that is, it is not dependent on ARI.

This suggests that a unique ARF should be calculated at each sub-catchment outlet or other location based on the upstream area of the catchment discharging runoff to the location. The consequence of this approach would be that peak flows at each location within a catchment would have to be individually calculated at each location using unique ARFs. This approach poses a significant problem when inputting local hydrographs into a hydraulic model for flood routing and flood level estimation purposes i.e. it will not achieve continuity.

Australian Rainfall and Runoff also notes that point rainfall may be taken to represent the total rainfall over small areas (up to $4km^2$), implying that no areal reduction factor is required for small catchment areas or where short duration floods are critical.

A basic, consistent approach to estimating areal reduction factors that can be applied over all catchments within the Fairfield LGA was derived in the recent *Prospect Creek Floodplain Management Plan, Flood Study Review* (Bewsher Consulting, 2006), and has been used in this study. This approach has adopted a value of 0.9 for all catchments where the critical duration is 1 hour or more, and no areal reduction factor applied where the critical duration is less than 1 hour.

3.4.4 Embedded Design Storms

Embedded storms are derived by embedding design storm bursts within observed storms. This tends to mask the effects of shorter duration floods in smaller catchment areas. Effectively, shorter duration events become very similar to the longer events. It was therefore decided not to use an embedded storm approach.

3.4.5 Rainfall Losses

In maintaining a simple, independent of storm duration approach taken from the updated Prospect Creek model, an initial/continuing loss rate model was adopted for the Three Tributaries. The loss rates in **Table 3-3**, which were also adopted in the calibrated XP-RAFTS model of Prospect Creek, were used in the current model for all events.

- **Table 3-3 Adopted rainfall losses**

	Initial Loss (mm)	Continuing Loss (mm/hr)
Pervious Areas	15	1.5
Impervious Areas	1.5	0

4. Hydraulic Modelling

4.1 Development of Hydraulic Model

A hydraulic model of the Three Tributaries was developed in the hydrodynamic modelling package TUFLOW (WBM Oceanics Australia, 2007). The TUFLOW model is a DOS-based program with a GIS-based interface and is useful for simulating depth-averaged 2D (Dimensional) and 1D free-surface flows. It has capability of dynamically linking 1D networks with 2D model domains and has the ability to model 1D culvert and bridge structures within the 1D and 2D domains.

The model was set up as a 1D stream network nested in a 2D domain to accurately represent the in-channel hydraulics and any 2D flow patterns on the floodplain. The model was run using TUFLOW version 2007-07-AF.

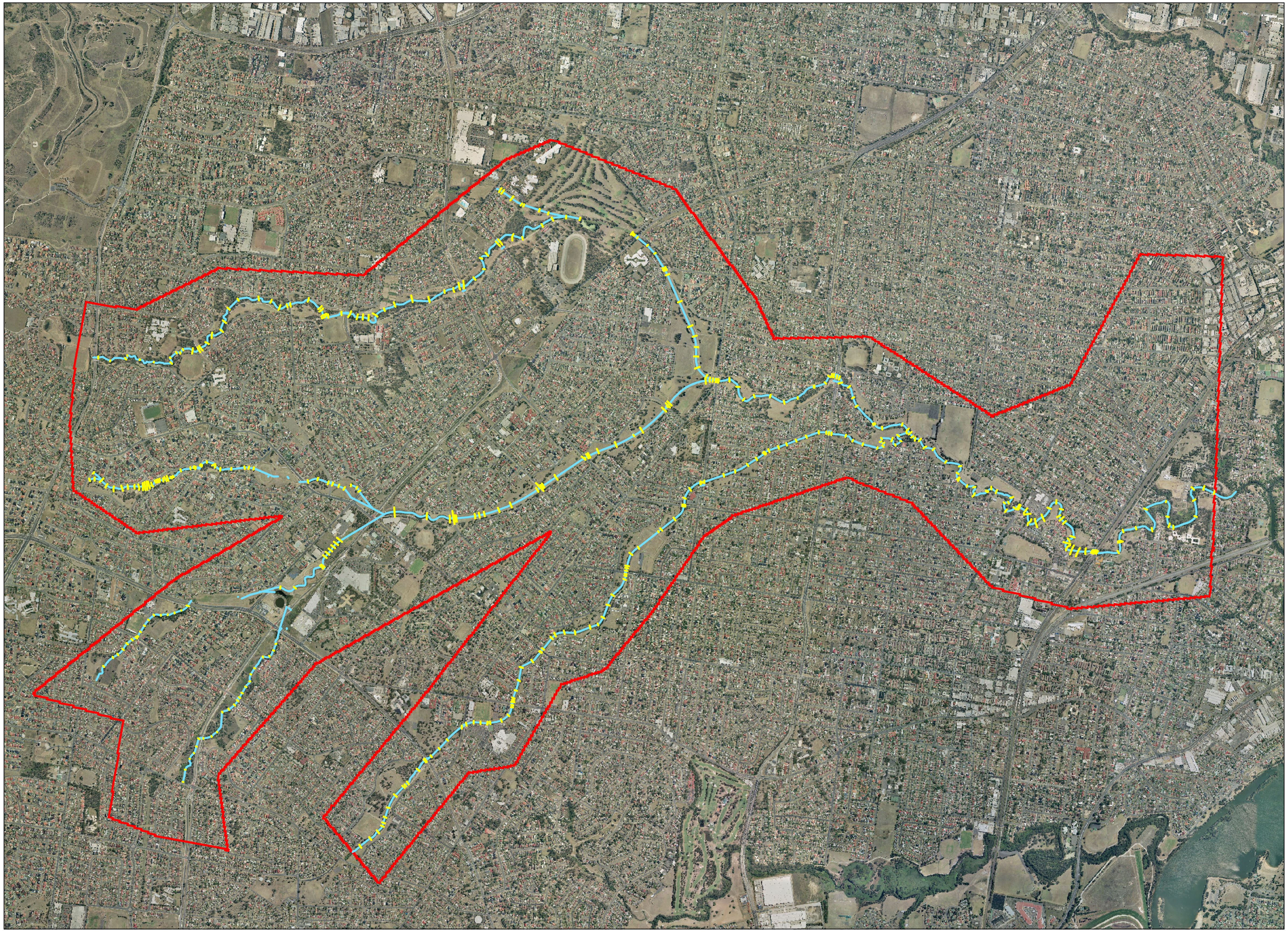
4.2 1D Domain Setup

The stream reaches were digitised based on the DEM and aerial photography. The stream reaches include open channel (natural profiles and concrete-lined), hydraulic structures (culverts and bridges) and associated overflows when the structures are overtopped (modelled as weirs). The streams and tributary channels represented in the model include:

- **Orphan School Creek**
  - Main Branch from Cowpasture Road to 250m upstream of Prospect Creek junction;
  - Prairiewood Branch downstream of Prairie Vale Road;
- **Green Valley Creek**
  - Main Branch downstream of North Liverpool Road;
- **Clear Paddock Creek**
  - Main (Southern) Branch downstream of North Liverpool Road;
  - Bonnyrigg Heights Branch downstream of Bonnyrigg Park;
  - Edensor Park Branch downstream of Kalang Road.

The in-channel geometry was defined using survey data collected by FCC in July – August 2004. The survey data included channel cross section transects and levels and dimensions of hydraulic structures. The modelling of hydraulic structures is discussed further in **Section 4.5**.

Figure 4-1 shows the model stream reaches and the model cross section locations. Also shown is the 2D model domain boundary, refer to **Section 4.3**. In general the cross sections inside the 2D domain are confined to inside the creek channel as the overbank terrain is defined by the 2D cells. Outside the 2D domain, the cross sections define both the in-channel and floodplain geometry.



Legend

TUFLOW 1D model cross sections

TUFLOW 1D stream network

TUFLOW 2D model domain

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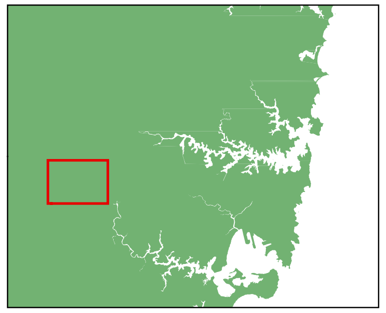

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Figure 4-1 TUFLOW Model Domains

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Flood Study for Orphan School Creek, Clear Paddock Creek and Green Valley Creek

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4.3 2D Domain Setup

The 2D domain was set up to allow representation of flow patterns and flood storage in the floodplain. The 2D domain consists of a grid of cells with a 10m spacing containing elevation and roughness data. The extent of the 2D domain is shown in **Figure 4-1**. In general, the 2D domain encompasses the combined floodplain of the Three Tributaries to elevations above the PMF level, with upstream and downstream boundaries corresponding to the 1D network extent.

4.3.1 Detention Basins

Detention basins in the TUFLOW model were represented as 2D objects in the floodplain and are a mixture of online and offline basins. Basin topography was typically derived from the DTM, with the crest of the basin walls being more accurately defined using surveyed break lines. Outlet structures were typically represented using 1D bridge, culvert and weir objects with their levels and dimensions defined from survey data.

Basin C on Clear Paddock Creek in Bonnyrigg is a major detention basin in the Three Tributaries catchment and was constructed in 2004, prior to the ALS data collection. A DTM was developed for Basin C using design levels to replace the old topography in the existing conditions runs. The basin was represented as a 1D/2D object, with the low-flow channel modelled as a 1D channel. The basin was omitted for the 2001 calibration run. **Photograph 1** shows the basin outlet.

- **Photograph 1 Basin C concrete V-notch wall outlet, looking upstream**

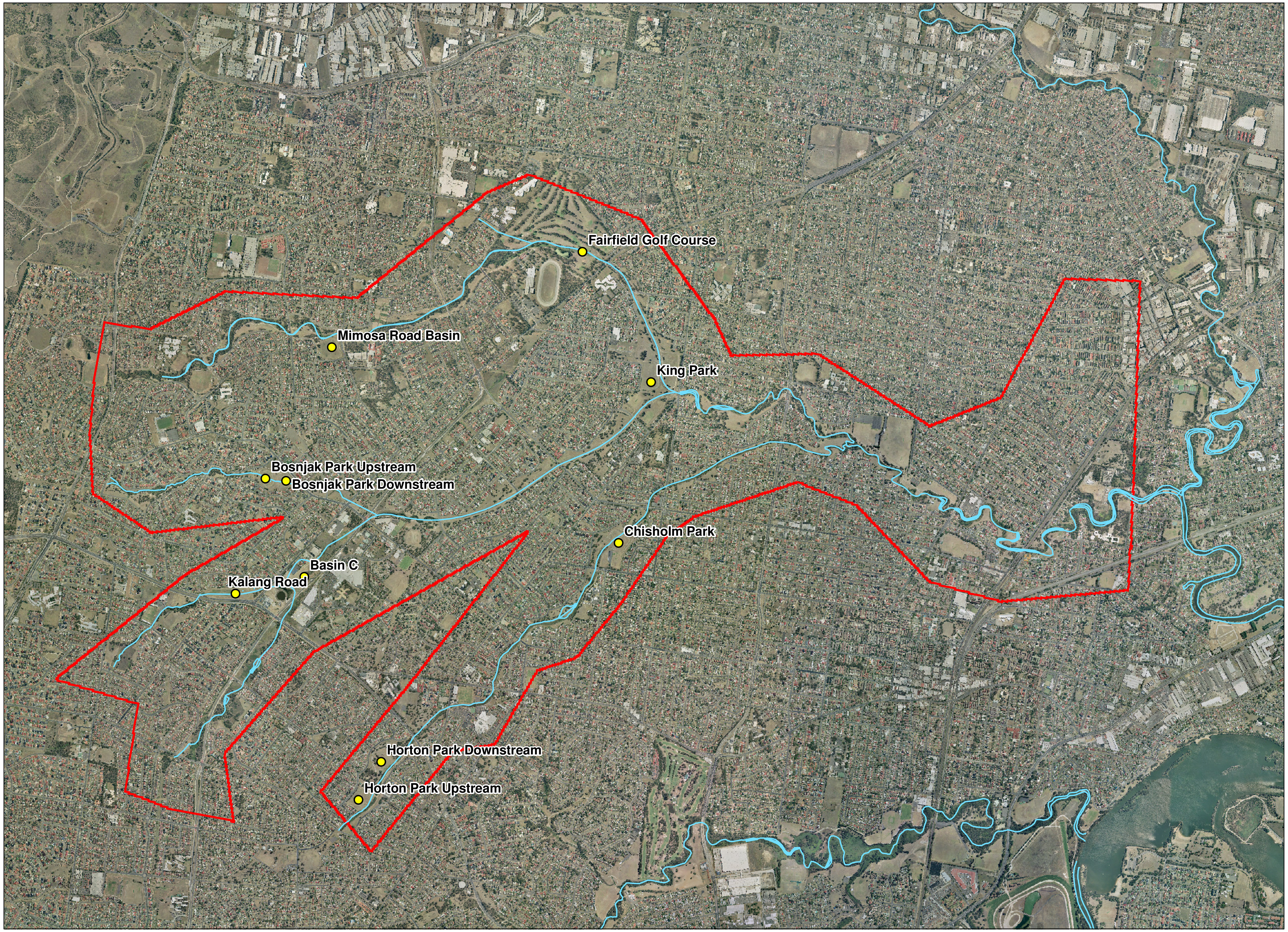
Table 4-1 Detention Basins represented in TUFLOW

Basin Name	Max WL (m AHD) Volume (m^3)	Inlet Structure	Outlet Structure	Comments
Orphan School Creek				
Mimosa Road	38.44 60,800	None (creek overflow)	2.45m dia RCP. No formal high flow outlet	Sports field in basin
Fairfield Golf Course	~27.6 139,700	None (creek overflow)	4.2m x 1.15m RCBC + ogee weir structure (crest at 25.52m AHD)	Low flows initially enter pond/wetland. Formed grass-lined channel conveys overflows from pond as well as flow bypassing pond. Receives flows from Orphan School Creek main branch and Prairiewood branch
King Park	~20.2 476,100	None (creek overflow)	Rectangular bridge structure 8.1m x 4m incl. low flow channel. No formal high flow outlet.	Located on confluence of Orphan School Creek and Clear Paddock Creek. Several smaller basins would merge to form a larger basin storage in larger flood events.
Green Valley Creek				
Horton Park Upstream	40.83 8,600	None (creek overflow)	3 x 2.5m x 2.2m RCBC. No formal high flow outlet.	
Horton Park Downstream	39.02 12,900	None (creek overflow)	3 x 2.5m x 2.2m RCBC. No formal high flow outlet.	
Chisholm Park	23.56 29,100	High level overflows from creek channel. Low flows are bypassed under the basin.	Approx. 10m x 4.4m conduit, mitred flush to basin embankment, leading to 2 x 3.7m x 2.73m RCBC under embankment. No formal high flow outlet.	The basin is built on a section of Green Valley Creek that has been filled to provide sporting fields. A set of 3 x 1.5m dia RCP is located under the basin and fields, and bypasses low flows from upstream to downstream of the basin.

Table 4-1 Summary of TUFLOW model detention basin data (cont')

Basin Name	Max WL (m AHD) Volume (m^3)*	Inlet Structure	Outlet Structure	Comments
Clear Paddock Creek				
Kalang Road	42.9 20,100	3 x 1.8m x 1m RCBC from upstream of Elizabeth Drive	2m x 4m grated sump connected to 2 x 1.35m dia RCP. High flow outlet is a lowered section of the earth embankment (unlined).	
Basin C	39.0 62,600	▪ 2 x 1.8m dia RCP from upstream of Elizabeth Drive draining into water quality pond (low flow inlet); ▪ 8 x 3.3m x 0.75m RCBC under Transitway, draining into water quality pond (high flow inlet); ▪ 1.65m dia RCP from Kalang Road Downstream basin draining into water quality pond (low flow inlet); ▪ 2 x 1.35m dia RCP from downstream of Kalang Road Basin bypassing water quality pond (high flow inlet).	▪ Concrete wall on northeast end of basin with V-notch and additional openings regulate flow up to 100 year ARI event; ▪ High flow bypass occurs over a 200m long weir crest (weir level 39m AHD) along northern flank of basin.	Basin C includes water quality improvement features (water quality pond, low-flow bioswale) in addition to an ornamental pond, contained within the overall basin formation. The low-flow bioswale was modelled as a 1D object within the 2D basin. The notched concrete wall outlet includes a footpath over the notch, modelled as a bridge object.
Bosnjak Park Upstream	42.65 13,000	High level overflows from creek channel. Low flows are bypassed under the basin.	▪ 2m x 4m grated sump connected to 2 x 1.2m dia RCP. No formal high flow outlet.	The basin is built on a section of Clear Paddock Creek that has been filled to provide sporting fields. A set of 2 x 0.9m dia RCP is located under the basin and fields for low flow bypass.
Bosnjak Park Downstream	39.8 11,700	2 x 1.2m dia RCP from Bosnjak Park Upstream	▪ Headwall with 2 x 1.2m dia RCP. No formal high flow outlet.	

* Maximum water level estimated from ALS measurement of basin embankment level. Basin volume estimated in GIS by SKM, January 2008, based on maximum water level.



Legend

- Detention Basins
- Drainage
- TUFLOW Hydraulic Model Domain

Aerial: AUSIMAGE

N

0 1 Kilometres

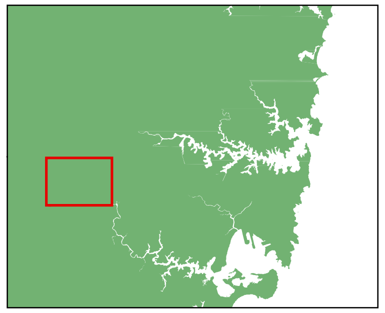


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Figure 4-2 Locality of Detention Basins in TUFLOW Model

Flood Study for Orphan School Creek, Clear Paddock Creek and Green Valley Creek

GDA 1994 MGA Zone 56

January 22, 2008

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4.4 Model Hydraulic Roughness

4.4.1 1D Domain

The roughness of the 1D model reaches was estimated based on knowledge of the channel type and observations of in-channel condition. The Manning's n was varied across the channel cross section according to changes in the channel surface roughness. Typical Manning's n values used are summarised in **Table 4-2**.

- **Table 4-2 Reach roughness,1D model reaches**

Channel	Manning's n	Description
Concrete channels and concrete aprons at bridge/culvert approaches	0.015	Middle reaches of Orphan School Creek and Clear Paddock Creek, upstream of King Road
Concrete culverts	0.015	
Turf lined formed channels	0.035	Overland flow paths in Fairfield Golf Course, on Orphan School Creek
Reedy natural channel	0.04 – 0.05	Sections of Green Valley Creek and Orphan School Creek. Roughness depends on density of weeds and other vegetation mixed in with the reeds.
Low-flow channels in detention basin	0.035 – 0.045	Basin C on Clear Paddock Creek, Bonnyrigg.
Restored creek reaches ('Restoring the Waters')	0.045 – 0.07	Effective roughness of n = 0.045 adopted for clear mid-channel areas which includes pool and riffle sections. Roughness of n = 0.07 adopted for banks, assuming fully-established landscape vegetation.
Heavily vegetated sections of natural channel	0.05 – 0.15	Roughness varies across the channel cross section. Lower values of range adopted for open water sections of channel. Mid-values adopted for weedy mid-channel sections and moderately vegetated bank sections. Higher values adopted for heavily vegetated bank sections (e.g. lower reaches of Orphan School Creek, lower reaches of Green Valley Creek)

4.4.2 2D Domain

The 2D model cells were assigned roughness values, based on landuse in the study area. A catchment materials plan was derived based on cadastral and LEP data in GIS, and aerial photography.

The cell roughness was assigned by reading the catchment materials data into the model and by making reference to the roughness values shown in **Table 4-3**. The high Manning's n values assigned to Commercial/Industrial/High Density Residential and Residential landuse areas takes into account the obstructions imposed by fences, walls and other structures.

▪ **Table 4-3 Catchment Materials and Roughness Values, 2D domain**

Landuse / Catchment Material	Manning's n
Roads and Carparks	0.02
Commercial/Industrial/High Density Residential	0.20
Open Space, with Trees	0.05
Open Space, Grassed only	0.035
Railway Corridor	0.04
Residential	0.15

4.5 Hydraulic Structures

4.5.1 Bridges and Culverts

Survey data for bridges and culverts was collected mainly during the channel cross section survey. Data on the invert and obvert levels, pier widths, footpath levels and railing heights was collected for the upstream and downstream ends of each structure and input into the model.

Bridges and culverts were typically modelled as a 1D reach object with a parallel 1D weir object representing the overflow path over the bridge deck during high flows. The weir geometry was defined as either a simple weir (weir level and length only) or with a cross section derived from the DEM.

Hand railings on the road and foot bridges were assumed to be fully blocked if the spacing between bars was less than 150mm. Other hand railings with greater than 150mm bar spacing were assumed unblocked, refer to **Photograph 2 (a)** and **(b)** for examples. For blocked hand railings, the 1D weir level was set at the top of the railing. The weir level for unblocked hand railings was set at the footpath level. In the locations where a traffic guard rail is located adjacent to an unblocked rail, the weir level was set to the top of the traffic guard rail.

4.5.2 Bypass Channels

A number of high flow bypass channels and culverts are present in the study area. The bypass channels were typically modelled as 2D features, and the bypass culverts as 1D network objects linking parts of the 2D domain on either side of an embankment. **Photograph 3** shows an example of a high flow bypass culvert, at Moonlight Road on Orphan School Creek.

- **Photograph 2 Bridge railing examples: (a) Sweethaven Road bridge, Orphan School Creek (left) modelled as an unblocked railing; (b) Brisbane Road bridge, Clear Paddock Creek (right) modelled as a blocked railing**

- **Photograph 3 Upstream face of high flow bypass culvert, Moonlight Road crossing, Orphan School Creek**

4.6 Boundary Conditions

4.6.1 Model Inflows

Model inflow hydrographs were extracted from the XP-RAFTS model and input into the TUFLOW model. The XP-RAFTS local catchment or total flow hydrographs were applied to the 1D domain as point inflows. Total flow hydrographs were applied typically at the upstream ends of creek branches, while local catchment hydrographs were applied for catchments located along the creeks.

Inputting the local catchment hydrographs along the creeks allowed the modelled flows to be hydraulically routed in the TUFLOW model. This approach was considered preferable to hydrological routing in the XP-RAFTS model.

4.6.2 Downstream Boundaries and Simulation Times

A stage hydrograph boundary condition was adopted at the downstream boundary of the TUFLOW model, in the 1D domain at a location 250m upstream from the confluence of Orphan School Creek and Prospect Creek. The stage hydrographs for various flood events were extracted from the 1D results of the TUFLOW modelling for Prospect Creek, previously undertaken by Bewsher Consulting (2006). The concurrent flood event ARI's adopted for the Prospect Creek boundary stage hydrographs for each Three Tributaries flood event ARI are summarised in **Table 4-4**.

- **Table 4-4 Adopted Concurrent Boundary Conditions**

Storm over Three Tributaries catchment	Flooding in Prospect Creek
20 year ARI	20 year ARI
50 year ARI	50 year ARI
100 year ARI	100 year ARI
PMF	100 year ARI
2001 event*	2001 event

* Model calibration event

Flood levels in the far downstream reaches of the Three Tributaries system are influenced by the flood peaks from:

- The flood wave propagating down the Three Tributaries system;
- Backwater caused by the Prospect Creek flood; and
- Backwater caused by the Georges River flood.

A sufficiently long simulation time was selected to ensure that the flood peaks caused by each of the above three sources were simulated in the model to capture the overall maximum flood levels in the downstream reaches of the model. The required simulation time for all event ARI's was selected from a review of the preliminary flood level results from the current Three Tributaries model and the flood levels from the Prospect Creek TUFLOW model for the 100 year ARI flood event, the latter of which is shown in **Figure 4-3** as water level hydrographs. These water level hydrographs were adopted for the downstream boundary conditions of the current TUFLOW model for the 100 year ARI event for various storm durations. The hydrographs reflect the water levels resulting from the Prospect Creek and Georges River flood peaks only, and do not include the flood peak from the Three Tributaries.

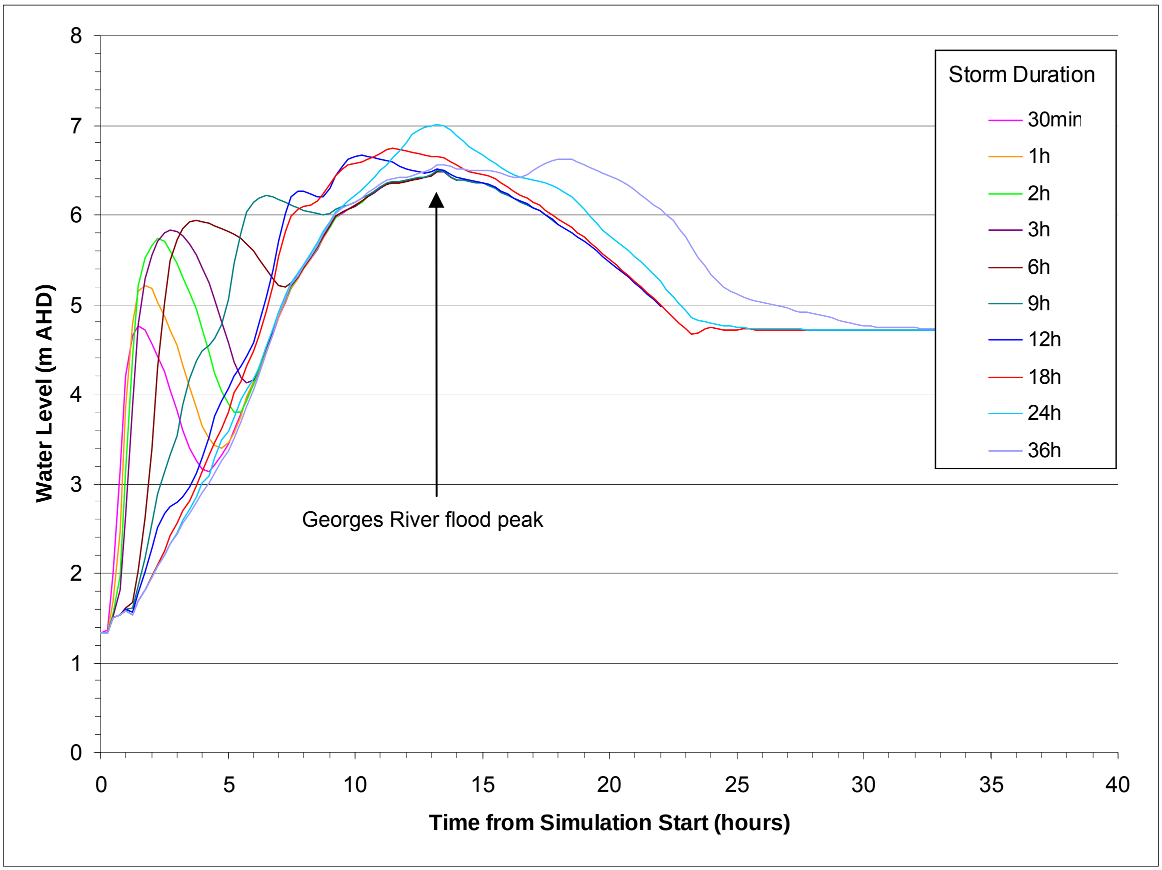
Generally, the maximum water levels in the downstream reach are caused by the Georges River flood peak. For the 12, 18 and 36 hour Prospect Creek events, the Prospect Creek flood dominates as it appears to be enhanced by backwater from the Georges River. For the 24 hour Prospect Creek event, the peaks of the Prospect Creek and Georges River floods appear to coincide.

The time to peak in the Prospect Creek water level hydrographs (shown in **Figure 4-3**), the preliminary Three Tributaries model and the selected simulation times for the various event durations for all ARI's are summarised below in **Table 4-5**. The selected simulation duration is longer than the time to peak in both the preliminary Three Tributaries TUFLOW model in addition to the Prospect Creek TUFLOW model.

- **Table 4-5 TUFLOW model simulation duration for various event durations**

Event Duration	Time to Peak (hours)		Selected Simulation Duration for Current Model (hours)
	Preliminary Three Tributaries model	Prospect Creek model	
25min	1.50	13.25	14
30min	1.50	13.25	14
1hr	1.75	13.25	14
1.5hr	2.00	13.25	14
2hr	2.25	13.25	14
3hr	2.75	13.25	14
6hr	3.75	13.25	14
9hr	6.50	13.25	14
12hr	10.25	10.25	11
18hr	11.50	11.50	12.5
24hr	13.25	13.25	14
36hr	18.25	18.25	19.5

▪ **Figure 4-3 100 year ARI water level hydrographs at downstream boundary of Three Tributaries TUFLOW model**



* Extracted from Prospect Creek TUFLOW model node LP21.1 (Bewsher Consulting, 2006). Does no include flood peak from Three Tributaries

SKM

4.7 Model Calibration

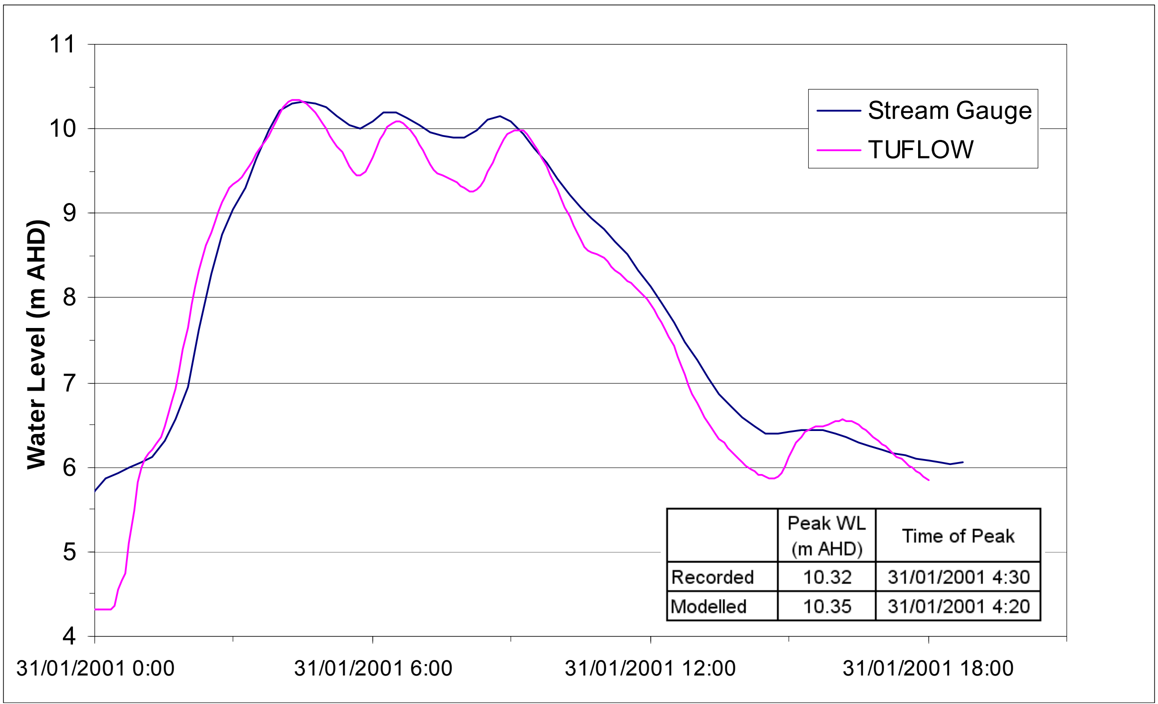
The TUFLOW model was calibrated using a number of observed high water marks recorded following the January 2001 flood event, and to water level data recorded at the DWE stream gauge on Orphan School Creek, upstream of Sackville Street (Station no. 213014). The model calibration is discussed below.

4.7.1 Calibration to Stream Gauge Water Level Data

The DWE stream gauge is located approximately 370m upstream along the main channel of the Sackville Street bridge. The gauge is on a relatively straight reach of Orphan School Creek, although the reaches upstream and downstream of the gauge are meandering. The reach that the gauge is on has dense, weedy vegetation inside the channel banks. The overbank areas are open, grassed areas.

The modelled stage hydrograph was plotted with the recorded stage hydrograph for comparison, refer to **Figure 4-4**.

- **Figure 4-4 Recorded and modelled stage hydrograph for 2001 flood event**



	Peak WL (m AHD)	Time of Peak
Recorded	10.32	31/01/2001 4:30
Modelled	10.35	31/01/2001 4:20

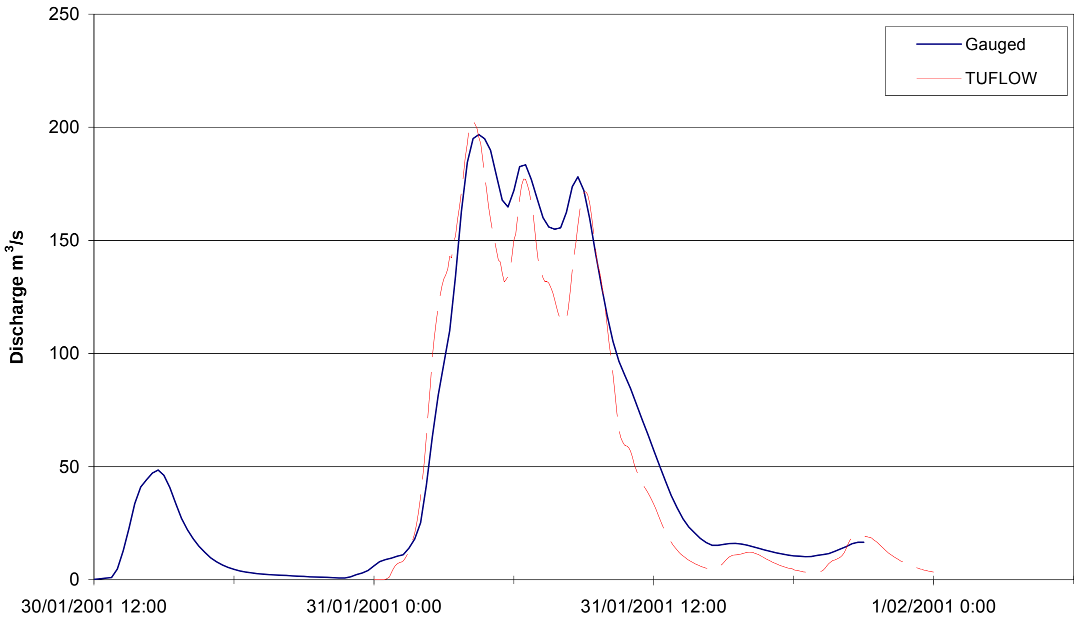
The TUFLOW model produced a peak flood level 30mm higher than the recorded flood level at the Sackville Street stream gauge, suggesting a good combined calibration of the XP-RAFTS and TUFLOW models. Typically calibration to within 100mm of the recorded peak water levels would be considered satisfactory. As mentioned previously, the XP-RAFTS model was not calibrated separately, and the flows were routed hydraulically in TUFLOW.

The TUFLOW model was able to reproduce the two minor peaks during the 2001 flood event. There is some minor deviation from the recorded water levels on the rising and falling limbs of the flood. This could be due to the inflows derived from the XP-RAFTS model, specifically there might be a quicker response to rainfall and conversion to runoff in the model (losses might be underestimated), and losses are not converted to runoff following the main flood wave (baseflow not modelled). For the purposes of this study these deviations are not considered a concern as the peak flows and flood levels are the main focus of the assessment.

4.7.2 Comparison of Flows

Routed discharges in the TUFLOW model are generally comparable to the gauged flows. **Figure 4-5** indicates that peak flows in the TUFLOW model and flows on the rising limb of the main flood wave of the 2001 event are similar to the gauged flows. There is some discrepancy in the flows during the interval between peaks in the hydrograph and also on the falling limb. The results reflect the findings of the comparison between the stage hydrographs in **Figure 4-4**. The TUFLOW flow hydrograph below is derived from flow results from the 1D and 2D domains at the Sackville Street gauge. Note that the TUFLOW model started at 31/01/2001 0:00, 15 hours after the start of the gauge record in the plot below.

▪ **Figure 4-5 Recorded and modelled flow hydrographs for 2001 flood event**



4.7.3 Calibration to Observed High Water Marks

High water marks were recorded and surveyed by Council staff at numerous locations on all three creeks of the Three Tributaries system. The high water marks in the form of debris marks were typically observed at locations upstream and downstream of bridge crossings. The observed and modelled peak water levels at the high water mark locations are presented and compared in **Table 4-6**. The observed flood levels were received from FCC in an email on 27th June 2007 and match those tabulated in Attachment A in **Appendix A**, with the exception of Canley Vale Road, St Johns Park, on Clear Paddock Creek, as the reported flood level in **Appendix A** was found to be incorrect after a review of the Council Officer's survey log.

Table 4-6 2001 flood event observed and modelled peak water levels

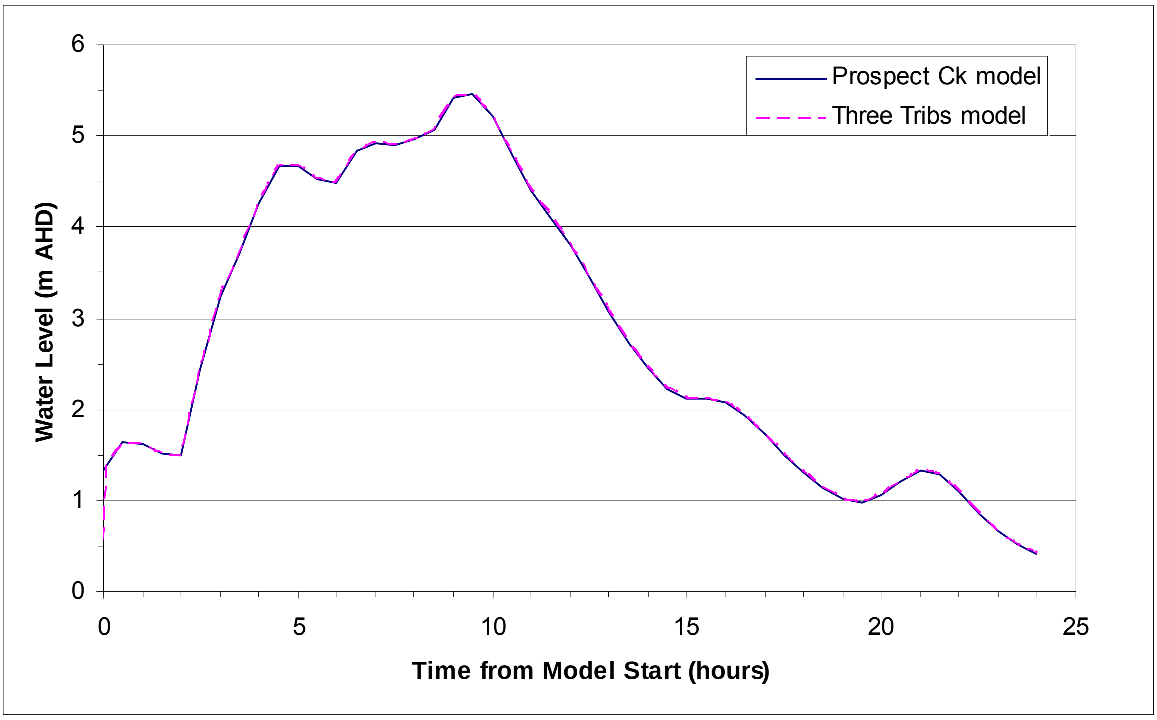
Location		High Water Level (m AHD)		Comment
		Observed	Modelled	
Orphan School Creek				
Railway Pde, Canley Vale	U/S	7.52	7.57	
	D/S	-	-	
Sackville Street, Canley Vale	U/S	10.32	10.12	Discarded – observed HWM is the same level as peak recorded water level at the DWE gauge approx. 300m upstream. A flat flood surface gradient is not considered realistic. Higher confidence is placed on the gauge data over the HWMs as the debris lines may be affected by wave action.
	D/S	10.3	9.95	Discarded – see note for U/S HWM.
Cumberland Hwy, Canley Heights	U/S	14.15	14.22	
	D/S	13.5	13.60	
King Road, Wakeley	U/S	18.17	18.20	
	D/S	17.61	17.63	
Smithfield Road, Prairiewood (in basin)	U/S	26.09	26.74	The minimum water level that could be reasonably achieved given the outlet configuration of the basin was 26.78m AHD. Debris line may have been washed down by local runoff. In any case this is a conservative result, and there appear to be no nearby developments that are sensitive to, or would be adversely affected by, this calibration result.
Green Valley Creek				
Avoca Road, Wakeley	U/S	18.51	18.49	
	D/S	18.71	-	Discarded – higher than peak water level upstream of the bridge.
Canley Vale Road, Wakeley	U/S	20.05	20.02	
	D/S	19.94	19.80	
Edensor Rd, Cabramatta West	U/S	28.93	28.94	
	D/S	28.91	28.84	
Clear Paddock Creek				
Kembla Street, Wakeley	U/S	18.8	18.81	
	D/S	18.51	18.59	
Canley Vale Road, St Johns Park	U/S	22.63	22.59	
	D/S	22.27	22.23	
Brisbane Road, St Johns Park	U/S	28.89	27.96	Discarded – suspected survey error. This HWM is located on a uniform concrete channel and the depth of flow derived from the observed water level 28.89m AHD) is not consistent with other locations along this concrete channel (1m higher than expected). Blockage at this crossing is highly unlikely – open span bridge, no piers.
	D/S	28.45	27.91	Discarded – see note for U/S HWM.

The modelled water levels in **Table 4-6** are generally within 100mm of the recorded high water levels, indicating a satisfactory model calibration. The model could not be calibrated to several of the high water marks, and it was suspected that the deviations may be attributed to survey error or misleading debris marks that may have been affected by wave action washing the debris higher, or by local runoff washing the debris down after the flood peak had passed. In addition, it should also be noted that the location and degree of any blockages that occurred during the 2001 flood event are not known. Refer to the comments in the table for details.

4.7.4 Comparison of Water Levels in Downstream Reaches of Orphan School Creek

As previously mentioned, the current Three Tributaries TUFLOW model utilised the modelled time series flood level results from the previous Prospect Creek model as the downstream boundary condition. Comparison of the two models indicates approximately a 1km overlap of the model domains. The water level hydrographs at the downstream and upstream ends of the overlapping area were compared as a part of the model validation.

- **Figure 4-6 Modelled 2001 event stage hydrographs, near Prospect Creek confluence**



- **Figure 4-7 Modelled 2001 event stage hydrographs, downstream of railway bridge**

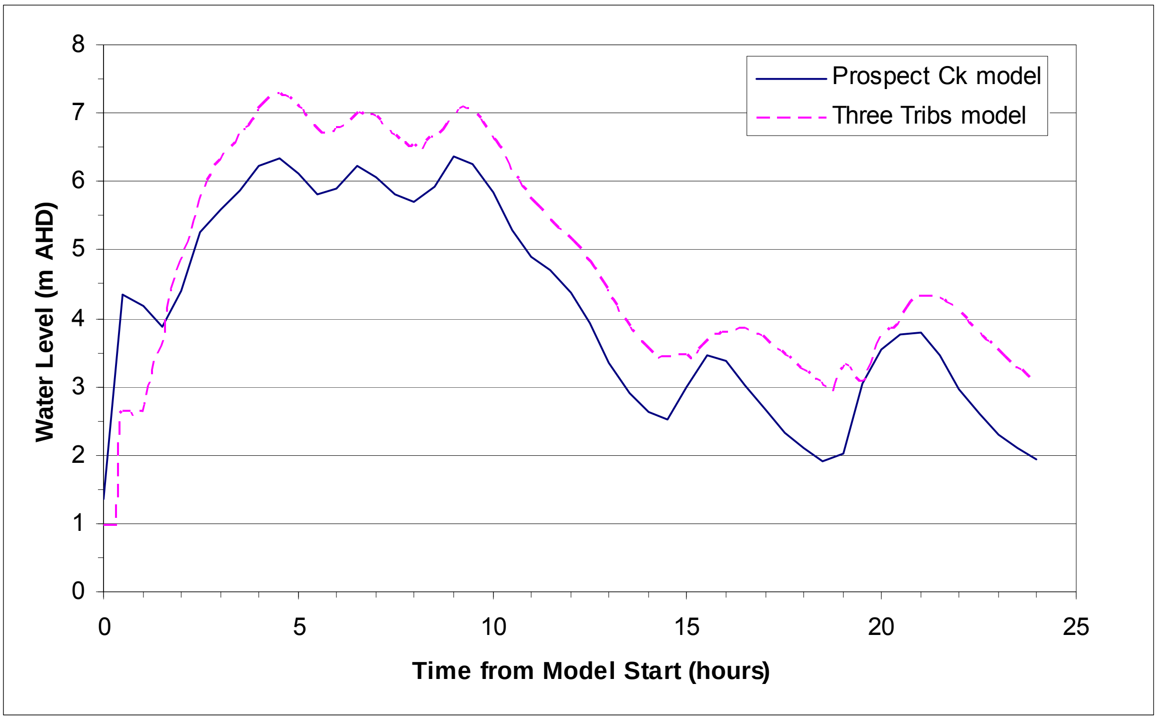


Figure 4-6 indicates an exact match in the stage hydrographs at the downstream boundary of the Three Tributaries model since this is the location where the Prospect Creek water level time series was applied. **Figure 4-7** indicates that water levels immediately downstream of the railway bridge in the Three Tributaries model are approximately 0.9m higher than in the Prospect Creek model. This is due to the greater level of model detail in this reach in the Three Tributaries model when compared to the Prospect Creek model. Specifically, channel bend and form losses and changes in channel bathymetry were modelled in more detail in the Three Tributaries model, and in less detail in the Prospect Creek model. While this lower detail would have suited the purposes of the Prospect Creek model, where the flood behaviour in the tributaries would have been of secondary focus, greater confidence may be placed in the Three Tributaries model results since the model was calibrated in this reach.

4.7.5 Other Historic Flood Events

Although the model could be calibrated against the 1986 and 1988 events, given the changes to the catchment land use since 1986, it was considered that the calibration would provide no additional confidence in the model results for the existing land use.

5. Flood Modelling Results

5.1 Design Events

The calibrated Three Tributaries TUFLOW model was run for a range of flood events including the 20, 50 and 100 year ARI flood events and PMF event. The 20, 50 and 100 year ARI flood events were run for a range of storm event durations including the 25 and 30 minute events and the 1, 1.5, 2, 3, 6, 9, 12, 18, 24 and 36 hour storm events. The PMF was run for the 30 minute and 1, 1.5, 2, 3 and 6 hour duration events. Maximum flood levels at selected locations are tabulated for each ARI flood event in **Table D-1**. Maximum discharges at selected locations are tabulated for the 20 and 100 year ARI and PMF flood events in **Table D-2**, and are summarised for key locations in the catchment in **Table 5-1**.

- **Table 5-1 Peak Flow and Critical Storm Duration at Key Locations[1]**

Location	20 year ARI event		50 year ARI event		100 year ARI event		PMF Event	
	Peak Flow (m^3/s)	Critical Storm Duration	Peak Flow (m^3/s)	Critical Storm Duration	Peak Flow (m^3/s)	Critical Storm Duration	Peak Flow (m^3/s)	Critical Storm Duration
Orphan School Creek								
OSC Railway Pde	229	9 hr	255	9 hr	281	9 hr	1983	2 hr
OSC D/S GVC Confluence	214	9 hr	242	9 hr	267	9 hr	2039	2 hr
OSC Cumberland Hwy[2]	227	9 hr	255	9 hr	277	9 hr	-	-
Cumberland Hwy[2]	-	-	-	-	-	-	2306	2 hr
OSC D/S CPC Confluence	127	9 hr	143	9 hr	154	9 hr	1452	2 hr
OSC_Smithfield Rd	57	9 hr	63	9 hr	71	9 hr	771	2 hr
OSC U/S Mimosa Rd Basin	37	30 min	45	2 hr	53	2 hr	356	2 hr
Clear Paddock Creek								
CPC Kembla St	55	12 hr	61	12 hr	67	12 hr	695	2 hr
CPC Edensor Rd	35	6 hr	45	6 hr	67	2 hr	1199	2 hr
Edensor Ck D/S Bosnjak Park	6	12 hr	7	90 min	8	2 hr	167	2 hr
Edensor Ck U/S Bosnjak Park	14	2 hr	16	2 hr	18	2 hr	127	2 hr
CPC D/S Basin C	27	6 hr	36	2 hr	70	6 hr	505	2 hr
CPC U/S Basin C	37	2 hr	44	2 hr	53	2 hr	499	2 hr
Wilson Ck Kalang Rd	4	2 hr	8	2 hr	12	2 hr	247	2 hr
Wilson Ck Elizabeth Dr	20	2 hr	22	2 hr	29	2 hr	238	2 hr
Henty Ck Elizabeth Dr	21	2 hr	27	2 hr	29	25 min	373	2 hr
Henty Ck Tway	6	25 min	6	2 hr	7	2 hr	29	2 hr
Green Valley Creek								
GVC Cumberland Hwy[2]	67	2 hr	80	2 hr	91	2 hr	-	-
GVC Avoca Rd	60	2 hr	71	2 hr	80	2 hr	511	2 hr
GVC Canley Vale Rd	58	2 hr	68	2 hr	78	2 hr	479	2 hr
GVC Edensor Rd	46	60 min	52	60 min	57	60 min	412	2 hr
GVC Cabramatta Rd	41	2 hr	46	30 min	51	2 hr	396	2 hr
GVC Elizabeth Dr	36	2 hr	41	30 min	45	2 hr	414	2 hr

1 Extracted from **Table D-1** in **Appendix D**.

5.2 Flood Levels and Depths

5.2.1 Flood Mapping

Flood mapping is shown upstream of Railway Parade and Canley Vale – Fairfield Railway line for the 20 and 100 year ARI and PMF events. Flooding downstream of the Railway line is not shown as the flood mapping from the *Prospect Creek Floodplain Management Plan, Flood Study Review* (Bewsher Consulting, 2006) is valid downstream of this location. The analysis of the flood behaviour in subsequent sections is also based on flooding upstream of Railway Parade.

5.2.2 Discussion of Flood Behaviour

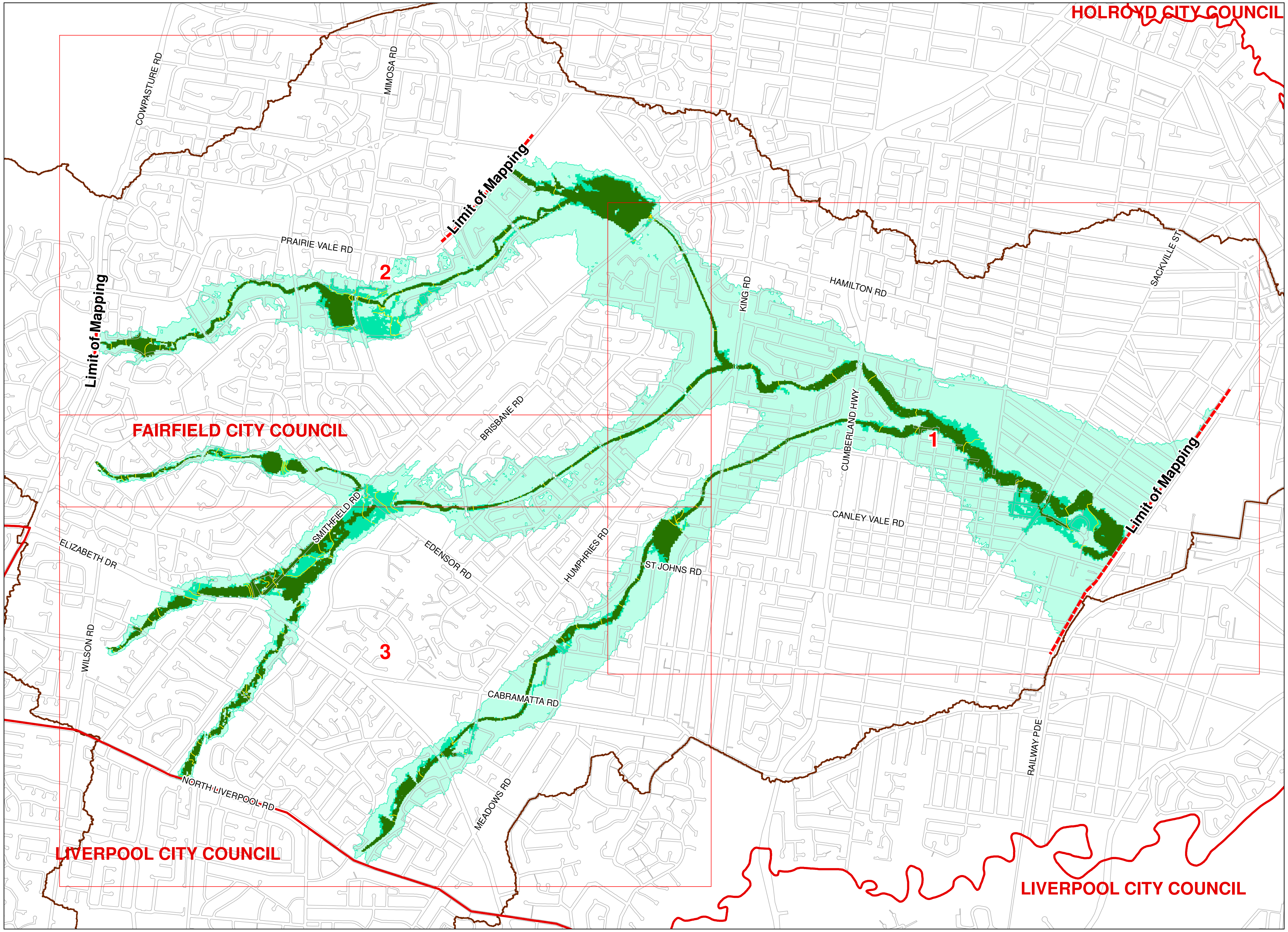
5.2.2.1 20 year ARI Event

Flooding is generally confined within the channel or is just above bank in the 20 year ARI event in upstream of the Cumberland Highway (Orphan School Creek and Green Valley Creek). Downstream of the Cumberland Highway bridges, flooding on the floodplain tends to be more widespread, with the extent of flooding increasing in the downstream direction.

There is a minor degree of flood interaction and backwater at the Orphan School Creek/Green Valley Creek confluence. There is little interaction at the Orphan School Creek/Clear Paddock Creek confluence, due to the efficient bifurcation of the concrete-lined channels and high capacity of King Road crossing.

Flows break out of bank at the following locations in the 20 year ARI event:

- Orphan School Creek – breakout occurs on right bank at Sackville Street, Freeman Avenue acting as a flowpath.
- Clear Paddock Creek – flows overtop the downstream basin wall of Kalang Road Basin and flow down Smithfield Road.



Legend

- 100 year ARI Flood 1m Contour
- LGA Boundary
- Three Tributaries Catchment Boundary
- Map Frame Index
- 20 year ARI Flood Extent
- 100 year ARI Flood Extent
- PMF Extent

Roads: LPI_NSW_Road_corridor
LGA Boundary: LPI_NSW_LGA_2007

N

0 1
Kilometres

NOTE:
The extent of flood inundation shown is approximate only. Mapping does not include local stormwater flooding.

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Figure 5-1 Flood Inundation Map Index

Flood Study for Orphan School Creek, Clear Paddock Creek and Green Valley Creek

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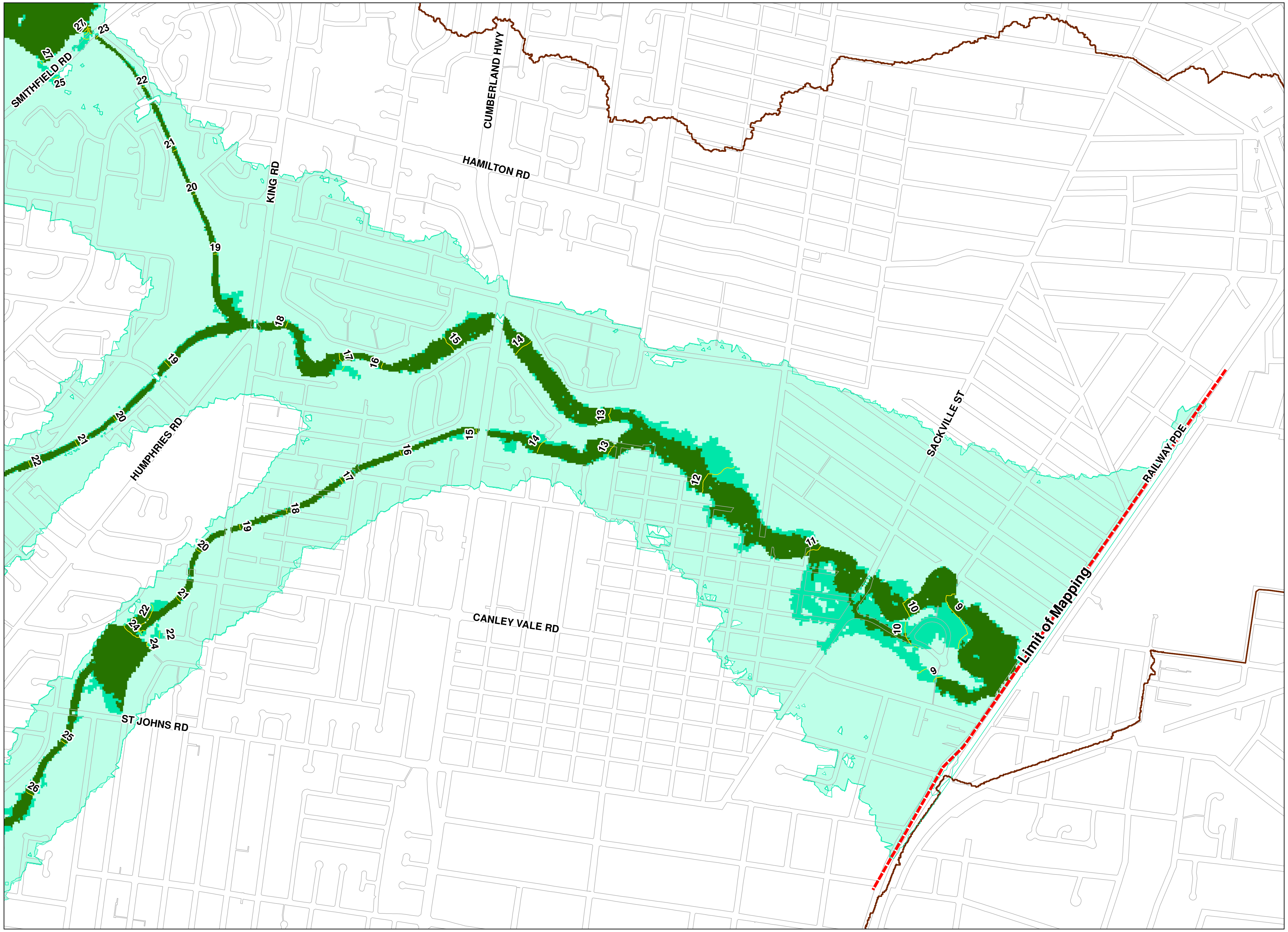

Legend

- 100 year ARI Flood 1m Contour (m AHD)
- Three Tributaries Catchment Boundary
- 20 year ARI Flood Extent
- 100 year ARI Flood Extent
- PMF Extent

Roads: LPI_NSW_Road_corridor

N

0 500
Metres

A3 1:14,000

NOTE:
The extent of flood inundation shown is approximate only. Mapping does not include local stormwater flooding.

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Figure 5-2 Flood Inundation Map - Sheet 1

Flood Study for Orphan School Creek, Clear Paddock Creek and Green Valley Creek

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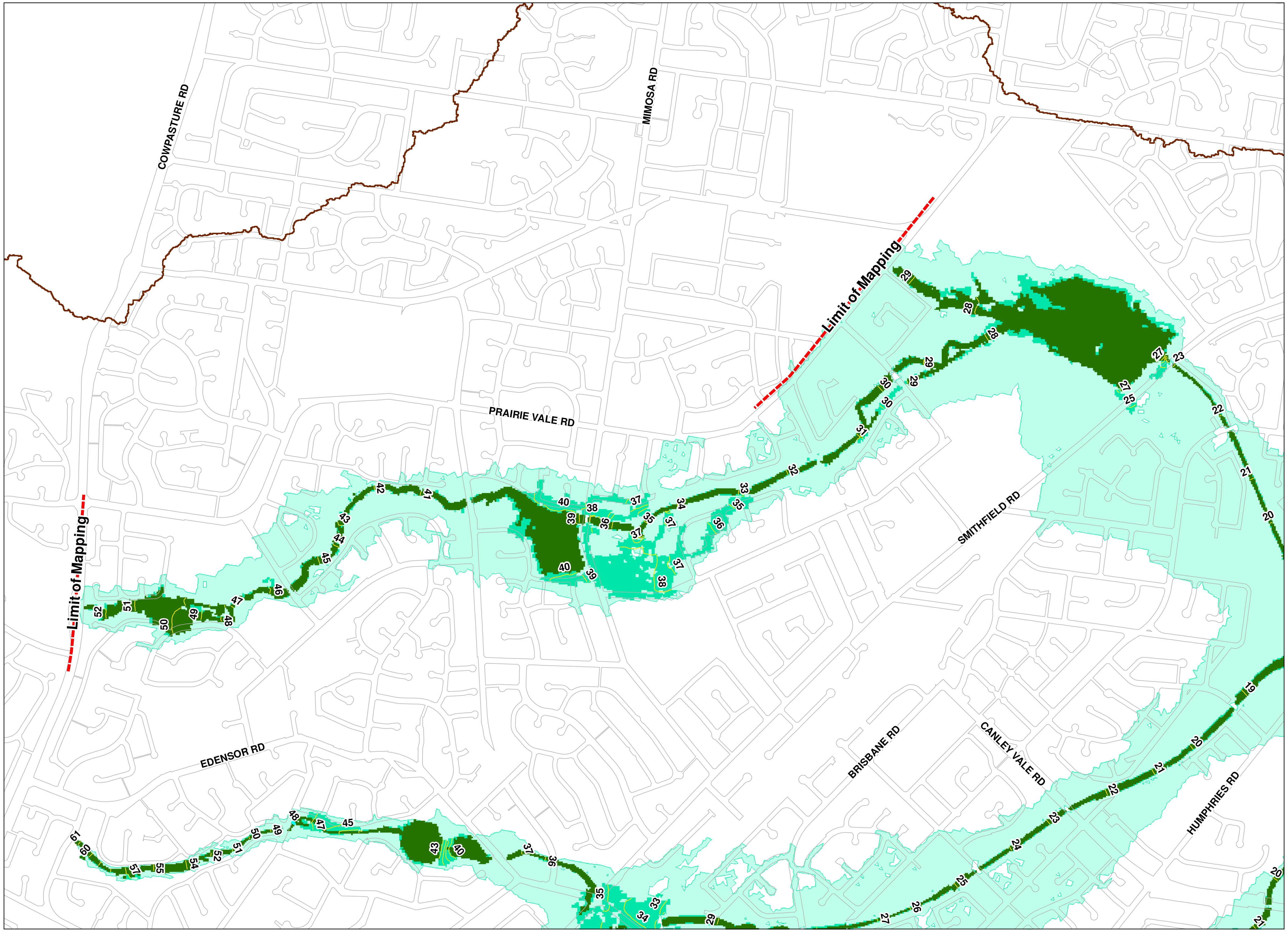

Legend

- 19 — 100 year ARI Flood 1m Contour (m AHD)
- Three Tributaries Catchment Boundary
- 20 year ARI Flood Extent
- 100 year ARI Flood Extent
- PMF Extent

Roads: LPI_NSW_Road_corridor

N

0 500

Metres

A3 1:14,000

NOTE:
The extent of flood inundation shown is approximate only. Mapping does not include local stormwater flooding.

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Figure 5-3 Flood Inundation Map - Sheet 2

Flood Study for Orphan School Creek, Clear Paddock Creek and Green Valley Creek

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May 5, 2008
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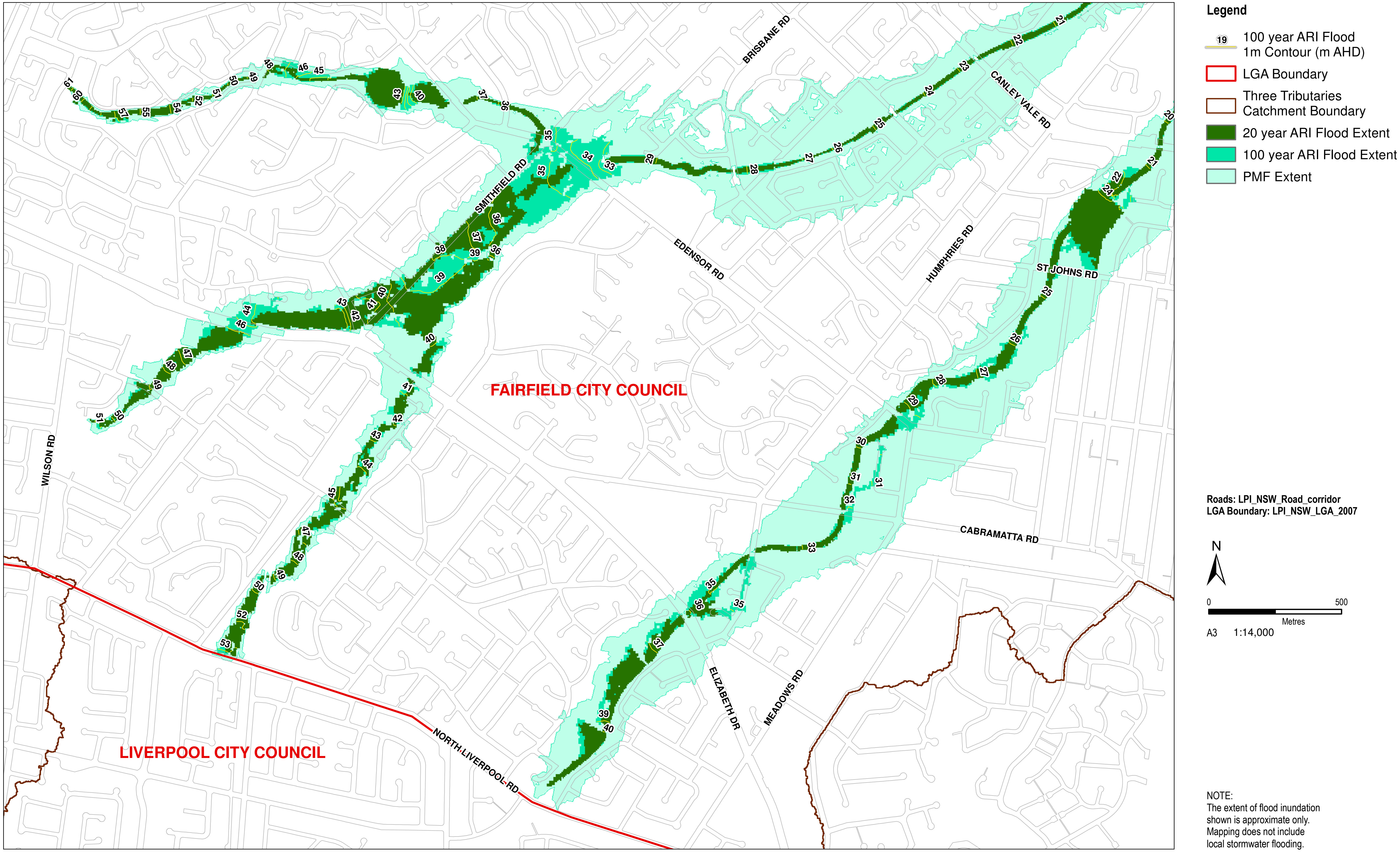

NOTE:
The extent of flood inundation shown is approximate only. Mapping does not include local stormwater flooding.

SINCLAIR KNIGHT MERZ SKM

FAIRFIELD CONSULTING SERVICES A Division of Fairfield City Council

Figure 5-4 Flood Inundation Map - Sheet 3

Flood Study for Orphan School Creek, Clear Paddock Creek and Green Valley Creek

GDA_1994_MGA_Zone_56

January 22, 2008

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All detention basins modelled in the TUFLOW model are activated in the 20 year ARI event to varying degrees, with exception of the King Road Basin. The high flow floodway at Moonlight Road and the high flow bypass culvert at Cumberland Highway on Orphan School Creek are activated in the 20 year ARI event.

Road crossings at Smithfield Road, Brown Road and Simpson Road on Clear Paddock Creek are ovetopped by flows in the 20 year ARI event.

5.2.2.2 100 year ARI Event

Flooding in the middle to upper reaches of the system is generally confined to the channel and a narrow strip of the floodplain on either side of the creek, and may affect a number of properties adjacent to the creek. Flows become increasingly constrained and breaking out at a number of locations, including:

- Orphan School Creek – the southern wall of Mimosa Road Basin is overtopped with flows breaking out and rejoining the main channel up to 600m downstream.
- Clear Paddock Creek – flows are overtopping the downstream basin wall of Kalang Road Basin and flowing down Smithfield Road. Inundation is more widespread than 20 year ARI and may be also constrained by the Edensor Road culvert capacity. Sections of the Bus Transitway at the Edensor Road junction are flood affected.
- Clear Paddock Creek – Bosnjak Upper Basin wall is overtopped but is contained by Bosnjak Lower Basin (not overtopping Edensor Road).
- Green Valley Creek – minor breakout at Edensor Road.
- Green Valley Creek – Chisholm Park Basin beginning to overtop downstream basin wall.
- Orphan School Creek – Sackville Street and Railway Parade constraining flows and causing increasing magnitude of breakouts in 100 year ARI event.

The extent of flooding in the vicinity of the Orphan School Creek/Green Valley Creek confluence is not significantly greater than in the 20 year ARI event, although there is increased risk of flooding to properties in the vicinity. There is little interaction at the Orphan School Creek/Clear Paddock Creek confluence in the 100 year ARI event. At this location, King Road Detention Basin becomes slightly affected by higher flood levels, however the basin appears to have little effect on attenuating 100 year ARI peak flows.

While higher flood levels are causing increased flooding on the floodplain in the 50 year ARI event, flows are still contained in-channel in parts of each creek, including the concrete lined reaches of Orphan School Creek and Clear Paddock Creek, the naturalised section of creek (“Restoring the Waters”) on Clear Paddock Creek, and Green Valley Creek between Canley Vale Road and Cumberland Highway and between Humphries Road and Cabramatta Road.

Road crossings at Brown Road, Simpson Road and Elizabeth Drive on Clear Paddock Creek (Wilson Creek branch) are inundated in the 100 year ARI event. As mentioned previously, Mimosa Road is also inundated due to the flow breaking out of the detention basin upstream. Smithfield Road is also flood affected due to Kalang Road Basin. Sackville Street bridge itself is not inundated, however flows do break out on both banks upstream of the bridge and outflank the bridge, inundating the road on either side of the bridge. The Canley Vale – Fairfield Railway line is not inundated in the 100 year ARI event.

5.2.2.3 PMF Event

Flood inundation during the PMF is widespread, with flood extent widths ranging from:

- 100 – 300m in the far upper reaches of the creeks;
- 300 – 500m in the middle to lower reaches of Clear Paddock and Green Valley Creeks (downstream of Basin C and Cabramatta Road, respectively);
- 500 – 600m in the middle reaches of Orphan School Creek (Fairfield Golf Course to Green Valley Creek confluence); and
- Up to 1.4km in the lower reaches of Orphan School Creek (upstream of Railway Parade).

Flow patterns in each creek are highly influenced by flows in the adjacent creeks at and upstream of creek junctions. Low lying areas located between the creeks upstream of the confluences are inundated in the PMF, particularly in the vicinity of the Orphan School Creek and Green Valley Creek confluence.

All road crossings and numerous other roads on the floodplain, in addition to the Canley Vale – Fairfield Railway line, are affected by the PMF.

5.3 Validation of Results

The current TUFLOW modelling was compared to the results from the following previous studies:

- Bewsher Consulting (1997a) *Lower Clear Paddock Creek Flood Study* Prepared for Fairfield City Council.
- Bewsher Consulting (1997b) *Upper Clear Paddock Creek Flood Study* Prepared for Fairfield City Council
- Dalland & Lucas (1991) *Orphan School Creek King Road to Railway Parade and Green Valley Creek Chisholm Park to Orphan School Creek Flood Profiles* Prepared for Fairfield City Council
- Fairfield City Council *Revision of Dalland & Lucas 1996 Study* (September 2000)
- L.J. Wiles, Fairfield City Council (January 1982) *Green Valley Creek Drainage Study*.
- Snowy Mountains Engineering Corporation (1985) *Fairfield Flood Mitigation Study. Volume 1 – Main Report* Prepared for Fairfield City Council.

Figure 5-5 shows the spatial coverage of the previous flood studies.

The peak 100 year ARI flood levels for the current study and the previous studies were plotted as long section profiles for comparison in **Figure 5-6** to **Figure 5-11**. The differences in the flood level profiles are discussed in the sections below.

Modelling undertaken as a part of the previous studies was undertaken using a number of different hydraulic modelling packages, including HEC-RAS and HEC-2. Both models were used to model steady state flood profiles using peak flows estimated by the hydrologic modelling package utilised in the previous studies. In this study, design runoff hydrographs simulated by XP-RAFTS were routed through the unsteady TUFLOW model.