Oxley Creek Flood Study
Volume 1 of 2

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Volume 1 of 2

Prepared by Aurecon Australia Pty Ltd
Prepared for Brisbane City Council

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Executive summary

Oxley Creek extends from its confluence with the Brisbane River at Graceville some 50 km through Brisbane City and Logan City upstream to its headwaters near Flinders Peak in Beaudesert Shire. The creek headwaters rise to an elevation of approximately 170 m near Flinders Peak. The Oxley Creek catchment covers an area of approximately 257 km^2. The Oxley Creek catchment is shown in Figure 3-1 in the Calibration Report (Report A).

The catchment is long and narrow in shape with a low stream gradient and wide floodplains in the lower reaches. The lower reaches, as far upstream as the Beatty Road crossing, are tidally influenced and these reaches can also be affected by backwater from Brisbane River flood events. The channel gradient increases upstream of Beatty Road and flood width extents are reduced.

Major tributaries of Oxley Creek include:

- Blunder Creek
- Sheep Station Gully
- Stable Swamp Creek
- Moolabin Creek and
- Rocky Waterholes Creek

Blunder Creek drains the Forest Lake, Doolandella, Inala and Durack areas before it meets Oxley Creek upstream of Ipswich Road. Blunder Creek contains a number of tributaries which run through the residential areas of Inala and Doolandella.

Sheep Station Gully drains the Calamvale area and its confluence with Oxley Creek lies upstream of Brookbent Road.

Stable Swamp Creek runs through Rocklea and joins Oxley Creek in its lower reaches between Ipswich Road and Sherwood Road.

Moolabin and Rocky Waterholes Creeks drain the Salisbury, Moorooka and Yeerongpilly areas before they discharge to Oxley Creek downstream of Sherwood Road.

Historically, there have been significant mitigation and sand extraction works carried out along the length of Oxley Creek and in some parts of Blunder Creek. These works have had considerable impacts on the creek configurations and have contributed to the highly mobile nature of the channels, with loops, meanders, anabranches and oxbows being created along the length of the creeks.

Project objectives

The primary objectives of this project were to:

- Undertake RAFTS hydrologic modelling of the catchment
- Develop a TUFLOW hydraulic model of the creek system
- Calibrate both models to historical events
- Undertake design flood estimation
- Utilise the calibrated RAFTS model to undertake design event hydrologic modelling
- Incorporate the design discharge hydrographs into the calibrated hydraulic model to compute the design event flood levels, velocities, for the range of specified scenarios agreed with Council. This includes incorporating revegetation of the Minimum Riparian Corridor (MRC) and Waterway Corridor
- Undertake modelling of extreme flood events
- Assess the potential for higher rainfall intensities associated with climate change to increase flood levels

Project elements

The Oxley Creek Flood Study was carried out in two stages. These stages form separate reports within this document which constitutes Volume 1 of the flood study:

- Report A – Calibration Report
- Report B – Design Events Report

Report A: Calibration Report

A RAFTS hydrologic model and a TUFLOW hydraulic model were developed for the study area. The hydrologic model simulates the catchment rainfall-runoff and, based on the catchment characteristics, predicts volumes of water flowing through the waterways. The hydraulic model simulates the movement of this flood water through the waterways and predicts flood levels, discharges and velocities. The hydraulic model takes into account the effects of downstream tailwater conditions, hydraulic structures and the state of the floodplain.

Calibration is the process of simulating historical rainfall events using recorded rainfall data with the hydrologic and hydraulic models with the aim of confirming that the models can replicate recorded flood information. Model calibration is achieved when the models predict the behaviour for the historical event to within specified tolerances. During the calibration process, various hydraulic and hydraulic model parameters can be refined (within realistic ranges) until acceptable model predictions are achieved.

The hydrologic model was calibrated to the May 1996 and April 1990 events. It was then verified to the May 2009 event. Given the changes to the floodplain that have occurred over time, the hydraulic model was calibrated to the May 1996 event and verified against the May 2009 event.

This process of model calibration is documented in Report A along with summaries of the model predictions.

Report B: Design Events Report

The calibrated hydrologic and hydraulic models were then used to simulate a range of design flood events, including the 1, 2, 5, 10, 20, 50 and 100 year ARI design events. These events were modelled recognising Brisbane City Council's (BCC) Waterway Corridor and Riparian Corridor. Key model predictions are presented in Report B as summarised below:

- Peak discharge predictions at major road crossings are summarised in Table 9
- Appendix G provides a detailed tabulation of peak water level and velocity predictions
- Appendix H contains Hydraulic Structure Reference Sheets (HSRS) for existing crossings

A range of extreme events have also been modelled including the 200, 500 and 2000 year ARI events and the Probable Maximum Flood (PMF) event.

An assessment of the potential impacts of Climate Change was undertaken. In order to understand the potential for higher rainfall intensities to increase flood levels two climate change scenarios were assessed.

Flood mapping

GIS based flood mapping was completed for the geo-referenced hydraulic model outputs. This included:

- Water surface levels (m AHD)
- Flood depth (m)

The flood mapping was completed for the following scenarios and is provided in Volume 2 of the Oxley Creek Flood Study:

- 2, 5, 10, 20, 50, 100, 200, 500 and 2000 year ARI flood extent mapping – Scenario 1 (Existing Conditions)
- 2, 5, 10, 20, 50, 100, 200 and 500 year ARI water surface level mapping – Scenario 3 (Ultimate Conditions)
- 2, 5, 10, 20, 50 and 100 year ARI water depth mapping – Scenario 3 (Ultimate Conditions)

At the request of Council, the Scenario 3 mapping was completed such that the flood levels constrained within the Waterway Corridor were extrapolated outwards until they intercepted existing ground levels.

Note also that for the mapping presented in Volume 2 of the flood study the designated nomenclature for event magnitude has been nominated as being Annual Exceedance Probability (AEP) as opposed to ARI. This was done in accordance with Council's mapping guidelines. Refer to Section 10 of Report B (Design Events Report) for further discussion on this topic.

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1 Introduction

1.1 The Oxley Creek catchment

The Oxley Creek catchment has an area of approximately 258 km^2. The creek headwaters rise near Flinders Peak in the western Logan City region to an elevation of approximately 170 m AHD. The creek then flows through approximately 50 km of Logan City and Brisbane City areas to its confluence with the Brisbane River at Graceville. Major tributaries of Oxley Creek include Blunder, Sheep Station, Stable Swamp and Moolabin Creeks.

Historically, there have been significant mitigation and sand extraction works carried out within the Brisbane City region along the lower half of Oxley Creek and in some parts of Blunder Creek.

1.2 Study objectives and scope of work

1.2.1 Project objectives

The primary objectives of this project are to:

- Undertake hydrologic modelling of the catchment
- Develop a hydraulic model of the creek system, and
- Calibrate both models to historical events

1.2.2 Project scope

The following tasks were undertaken to achieve the project objectives outlined above:

- Develop a RAFTS hydrologic model of the catchment, representing a refinement of previous hydrologic studies for Oxley Creek
- Calibrate the RAFTS model to the May 1996 and April 1990 historical flood events
- Verify the RAFTS model to the May 2009 historical flood event
- Develop a TUFLOW hydraulic model of the creek system
- Calibrate the TUFLOW model to the May 1996 event and verify the model to the May 2009 event

1.3 Modelling history and study background

A number of flood studies have been carried out on the lower half of the Oxley Creek catchment since the late 1990s, including:

- The *Blunder Creek Catchment Master Drainage Plan* (Kinhill Engineers, 1997) which identified trunk drainage requirements and stormwater management strategies to plan for urban development in the Blunder Creek catchment, whilst minimising the impact of this development on the creek and waterway environment and hydrologic regimes. This study included RAFTS hydrologic and MIKE 11 hydraulic modelling of the Blunder Creek catchment
- The *Oxley Creek Flood Study Final Draft Report* (Connell Wagner, 1999) which incorporated RAFTS hydrologic modelling of the catchment and MIKE 11 hydraulic analysis of the Brisbane City portion of Oxley and Blunder Creeks. The models were calibrated and then used to set design event flood levels and assess the impacts of Waterway Corridors and Riparian Corridors
- The *Oxley Creek Flood Study Draft Final Report* (Connell Wagner, 2008) which was an update of the 1999 study to incorporate changes in computing power and software capabilities and included MIKE FLOOD hydraulic analysis to replace the previous MIKE 11 analysis
- The *Integrated Water Cycle Management Plan – Hydrologic and Hydraulic Assessment* was undertaken in 2009 by MRG Water Consulting. This study looked at proposed development in the "Oxley Wedge" and its likely impacts on flooding. It utilised the RAFTS and MIKE FLOOD models from the 2008 study and included some upgrades to these models
- The *Paradise Road Upgrade Feasibility Study* was undertaken by AECOM in 2010. This study looked at the feasibility of providing a higher level of immunity to Paradise Road and also included some upgrades to the 2008 models
- The *Oxley Creek Model Review* (Aurecon, 2012) was carried out to review the Oxley Creek models and Draft Final Report and identify upgrades/modifications required to bring these in line with current standards

The Oxley Creek Model Review process identified that, at the time that the RAFTS and MIKE FLOOD models were developed, they were consistent with industry best practice and utilised the most advanced software available; however recent advances in both software and hardware capabilities mean that a number of the model features are no longer consistent with industry best practice. A number of upgrades to the models were recommended as summarised below:

- Upgrade of the RAFTS model to provide better definition across the catchment and to reflect current catchment development conditions
- Development of a new TUFLOW hydraulic model to represent current catchment development conditions and incorporate recent advances in hydraulic modelling practice

The study presented in this report was undertaken to address the above recommendations. Logan City Council and the area of the catchment which falls within their boundaries are included in this study as it is desirable to have a consistent modelling platform and approach across the entire catchment. This study includes a single RAFTS model covering the entire catchment and development of two separate TUFLOW hydraulic models, one for each Council.

1.4 Scope of this report

This report details the setup, calibration and verification of the single RAFTS model which covers both the Logan and Brisbane City parts of the catchment. It also details the setup, calibration and verification of the TUFLOW model of the Logan City Council part of the catchment. It summarises the data used in the model set up and calibration and presents the calibration and verification results.

2 Calibration and verification events

Significant historical events that have occurred in the catchment were evaluated to select the historical events most suitable for model calibration and verification purposes. Selection of specific events for calibration and verification was then based upon event size (flood heights and total event rainfall) and duration, as well as data availability and completeness.

Table 1 shows the eleven highest ranking flood events, in terms of magnitude of the event across the wide Oxley Creek catchment, recorded over the last 40 years. A summary of the available data coverage for each event is also given. It should be noted that in terms of observed maximum flood level at the Beatty Road gauge, the 2009 event ranks slightly higher than the 1996 event.

Table 1 | Highest ranked storms

Ranking	Approx Total Rainfall Depth (mm)	Event	Available Data Coverage			
			Number of Stations			
			Pluviograph	Daily Rainfall	Streamflow Gauges	Maximum Height Gauges
1	700	January 1974 [b]	3	10	3 [a]	0
2	500	May 1996	7	9	3	25
3	240	May 2009	9	NA	4	21
4	170	April 1990	7	12	4	22
5	150	October 2010	15	7	8	26
6	150	June 1983	3	15	3	5
7		May 1980 [b]	4	21	1	6
8	170	March 1992	10	14	4	18
9	130	July 1988	3	15	3	5
10		March 1974 [b]	2	19	0	5
11		February 1972 [b]	3	17	0	5

[a] – Only part of the record available
[b] – These events occurred prior to the flood mitigation works along the creek

Based upon the magnitude of discharges, rainfalls and flood levels, and the availability of data the following events were selected for calibration and verification. It was decided that:

Calibration should be against the following two events, with emphasis on the May 1996 event:

- May 1996 (Rank 2)
- April 1990 (Rank 4)

Verification should be against the following event:

- May 2009 (Rank 3)

Available data coverage for the calibration and verification events was considered to be adequate (refer Table 1).

Whilst the January 1974 event is the largest event on record, it was not selected as a calibration or verification event due to the lack of available data. Much of the data for this event was affected by Brisbane River flooding which occurred at the same time as the Oxley Creek event. Also, there have been significant changes to the creek and catchment since this time.

It should also be noted that the May 2009 and October 2010 events were reported to be similar in magnitude. As a result, using both events for verification was found not likely to provide any additional benefits. The May 2009 event was selected as the modelling of this event had already been progressed by Council.

The following Sections 2.1 to 2.3 present a summary of the selected calibration and verification events and their available data. Section 3 of this report presents the available data in more detail.

2.1 May 1996 event

The May 1996 flood produced the highest flood levels over the majority of the Study Area since completion of creek mitigation works in the early 1980s. The flood resulted in extensive damage to much of the creek. Of significance was:

- The loss of Brookbent Road bridge right bank approach abutments, and an associated 30 m lateral shift and 2 m lowering of the main creek channel over a 300 m length
- Scours of over 2 m through several sand pits on both Oxley and Blunder Creeks
- Over 2 m scouring at Johnston Road on Oxley Creek
- Over 1.5 m deposition in sand pits on both creeks, and
- Large debris loads at some bridge locations, including Brookbent Road

With Brisbane City Council's network of flood recording, a good maximum flood height record was obtained for this flood within the Brisbane area, with 25 heights along the creeks obtained (compared with 22 for the 1990 flood, and 18 for the 1992 floods). This is the only event for which several MHG (Maximum Height Gauge) records are available in the downstream reaches. Within the Local City region, flood heights are available at the New Beith stream gauge only.

Recorded flood levels in Oxley Creek for the 1996 flood were in the order of 300 mm higher than the 1990 flood (the third highest since the early 1980s) over the majority of the creeks' length.

It is also noteworthy that this event produced a small flood in the Brisbane River, generating the highest tailwaters since the 1974 flood. Peak discharge in Oxley Creek (approximately 440 m^3/s) occurred at approximately 6:00 pm on 3 May 1996. Peak water levels in the River (approximately 2.8 m AHD) did not occur until approximately 12:00 am on 5 May 1996 (approximately 30 hours later). Recorded tidal information at 10 minute intervals was available for the Brisbane River at the Port Office Gauge.

2.2 April 1990 event

The April 1990 event is the fourth largest event on record after the 1974, 1996 and 2009 events. There is a relatively good coverage of MHG data for Blunder Creek. Several MHG records are available for the reaches of Oxley Creek between the Logan Motorway and Ipswich Road, with little data available downstream of Ipswich Road. New Beith, Beatty Road and King Avenue Gauge records are available for this event.

Recorded tidal information at 10 minute intervals is available for the Brisbane River at the Port Office Gauge.

2.3 May 2009 event

The storm event of May 2009 was the third most significant storm in the Oxley Creek catchment where sufficient rain fell to produce a measurable storm discharge. The Oxley-Blunder catchment experienced an approximately 5 year ARI rainfall in the upper catchment and resulted in minor flooding in the creeks. Blunder Creek at King Avenue recorded a level of approximately 8 m AHD representing a rise of 3.7 m; Oxley Creek at Acacia Ridge Speedway recorded a slow rise of 5.6 m reaching approximately 6.9 m AHD; and Oxley Creek at Corinda rose approximately 3 m on the top of high tide to reach a level of 4.0 m AHD. At New Beith Road flood levels peaked at approximately 54.4 m AHD, a rise of almost 4 m that occurred in less than 24 hours.

Approximately 5 year ARI flood levels were experienced in the lower reach of Oxley Creek flooding low lying areas in the vicinity of Ipswich Road and forcing the closure of some roads including Blunder Road. This event was selected as a verification event given its magnitude and its recentness.

Fifteen maximum height gauge readings were recorded along Oxley Creek during the May 2009 event. There were also six MHG records captured along Blunder Creek.

Recorded tidal information is available for the Oxley Mouth Gauge (OXA588), which is representative of the downstream tailwater conditions.

3 Study data

3.1 Aerial photography

Aerial photographs have been utilised as the basis for setting initial land use parameters for both the RAFTS and TUFLOW models, particularly with regard to Manning's 'n, PerN and catchment percentage impervious areas. Aerial photographs with dates closest to those of each of the calibration and verification events were adopted respectively for the purposes of setting initial land use parameters. The following photographs were provided by BCC and LCC for use in this study:

Aerial photographs for BCC model area:

- 1995
- 1997
- 2009
- 2011

Aerial photographs for LCC model area:

- 2008
- 2011

3.2 Hydrographic data

3.2.1 Rainfall data

Several pluviograph stations are located in and around the Oxley Creek catchment. Available daily rainfall data for respective rainfall events is summarised in Table 2, including the period of record for each gauge. Table 3 details the pluviograph stations in and around the Oxley Creek catchment. Each table indicates the coverage of each daily rainfall and pluviograph gauge for the calibration and verification events. The locations of each of the daily rainfall and pluviograph stations are shown in Figure 3-1.

3.2.2 Streamflow data

Streamflow data is available for four stream gauges within the study area. The streamflow gauge locations are shown on Figure 3-1. Table 4 provides the details of these gauging stations and the available coverage for the calibration and verification events. Additional streamflow gauges, shown in Table 5, are located within the catchment but data from these stations was either unavailable or unreliable.

3.2.3 Rating curves

Rating curves for the streamflow gauging stations were obtained from the previous RAFTS models from the 1999 and 2008 Oxley Creek Flood Studies at the four gauging stations identified in Figure 3-1. The historic rating curve for the Beatty Road gauging station was rated to a maximum stage of RL 5.44 m AHD and extrapolated to a stage of RL 7.0 m AHD.

New Beith gauge

The New Beith gauge has been in operation since 1976. Recorded stage hydrographs are available at this station for all calibration and verification events.

Although the maximum discharge in the rating curve data provided for this gauge is 370 m^3/s, the maximum gauged discharge is only 11.1 m^3/s. During previous studies this rating was checked using Manning's equation which indicated that the current curve is satisfactory.

Beatty Road gauge

The Beatty Road gauge was destroyed during the January 1974 flood event. Prior to this event, it was located immediately upstream of Beatty Road. When reconstructed, it was relocated to the present site on the downstream side of Beatty Road.

Available records show that the creek has been well gauged at this location up to a discharge of 147 m^3/s. During previous studies it was recognised that this rating curve may be influenced by backwater effects from the Brisbane River, especially when high tailwater levels occur.

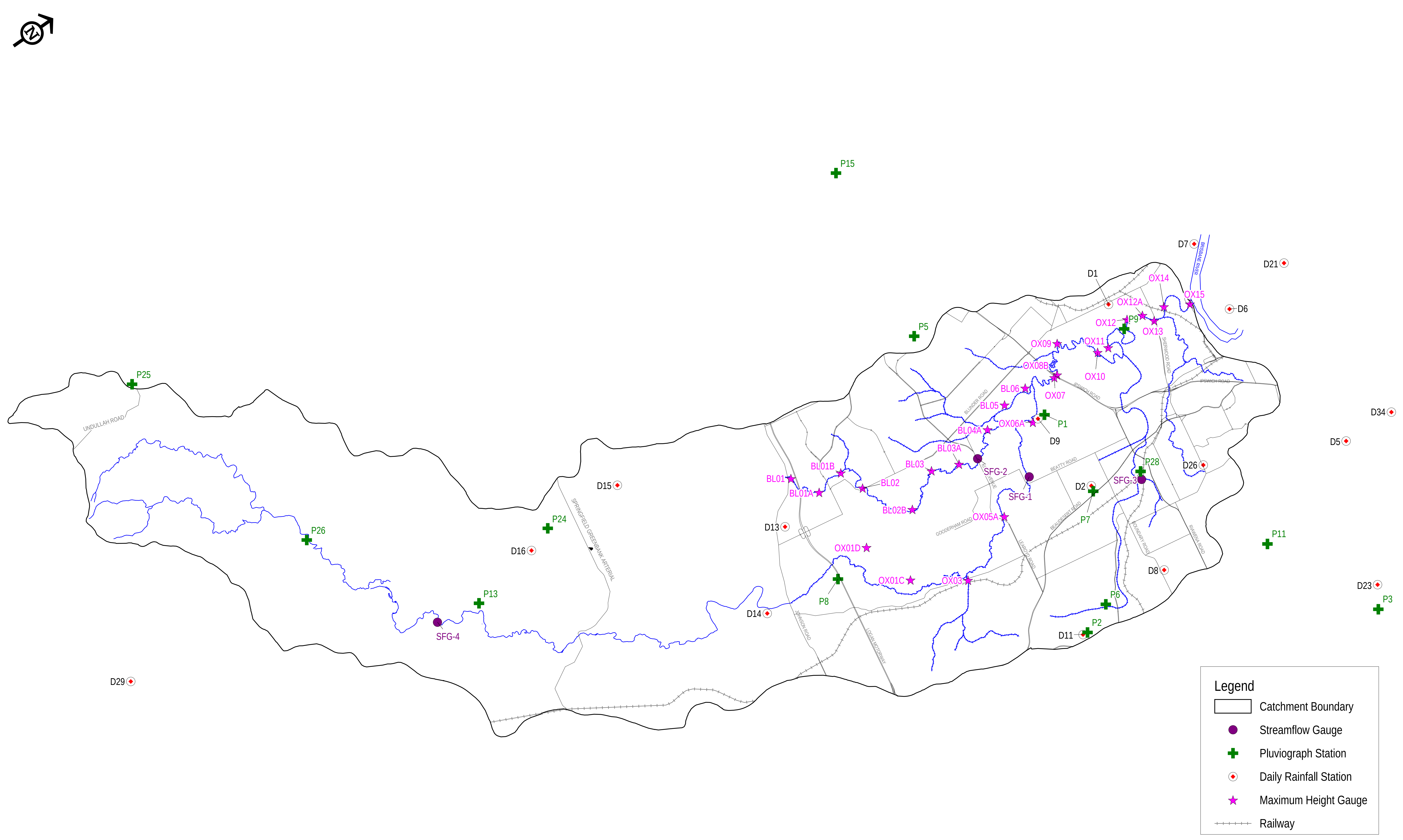
King Avenue gauge

The King Avenue gauge was previously located on the upstream face of the King Avenue Bridge across Blunder Creek, and was operational since 1973. The gauge is now downstream of the crossing. There is some uncertainty attached to the stream gauge recording for the 1996 event.

This gauge has been rated up to 70 m^3/s, which corresponds to a stage of 7.98 m AHD. The available rating curve extends up to a discharge of 93 m^3/s at 8.52 m AHD. At this elevation the creek would break out of its channel and begin to flow across King Avenue.

Musgrave Road gauge

The Musgrave Road Gauge was installed in 1971. The extensive flood mitigation work undertaken in the lower parts of Oxley Creek and Stable Swamp Creek in 1982/83 altered the rating curve at this location. It is also noted that the rating curve at this location is influenced by water levels in Oxley Creek.



Disclaimers and Notes:	Logo:	Client:	Project:	Scale:	Figure Title:	Figure No.
1. Creek alignment approximate only. 2. Gauge locations as provided by BoM, DNRM & BCC.	BRISBANE CITY	BRISBANE CITY COUNCIL	OXLEY CREEK FLOOD STUDY	0 2,500 5,000 Scale 1:100,000 (A3)	FIGURE 3-1 CATCHMENT MAP	Figure 3-1
						Revision. 2
						Date. 29/05/2013

Table 2 | Daily rainfall stations in and around Oxley Creek catchment

Figure 3-1 Reference	Station Number	Location	Period of Record	Catchment Position	Calibration Events		Verification Event
					Apr 1990	May 1996	May 2009
D1	040 463	Oxley	1971-Present	Inside	F	P	P
D2	040 211	Archerfield Airport	1929-Present	Inside	F	F	F
D3	040 220	Coorparoo	1898-1992	Outside	P		
D4	040 383	Greenslopes Repatriation	1965-Present	Outside	P		P
D5	040 368	Holland Park	1965-1990	Outside	F	F	
D6	040 450	Long Pocket Laboratory CSIRO	1968-Present	Outside	F	F	F
D7	040 243	Sherwood (Graceville)	1898-1987	Outside			
D8	040 244	Sunnybank Bowling Club	1888-Present	Inside		F	F
D9	040 530	Inala BCC	1974-Present	Inside	F		
D11	040 527	Acacia Ridge BCC	1974-1991	Inside	F		
D13	040 512	Brisbane (Browns Plains)	1973-Present	Inside	P	F	
D14	040 623	Greenbank Army Camp	1974-Present	Inside	F		
D15	040 659	Greenbank Lot 6 Army Camp	1975-Present	Inside	P	F	P
D16	040 312	Greenbank (New Beith Comp)	1961-Present	Inside	F	P	P
D18	040 454	Jimboomba (Glenlogan Field)	1971-1989	Outside			
D21	040 245	Toowong	1889-Present	Outside	F	F	P
D23	040 274	Mt Gravatt Bowling Club	1955-Present	Outside	F	F	
D26	040 240	Salisbury Composite	1899-1992	Inside	F		
D29	040 411	Woodhill (Undullah)	1967-1993	Outside	F	F	

Note: F – Full Record Available, P – Partial Record Available, NA – not available

Table 3 | Pluviograph stations in and around the Oxley Creek catchment

Figure 3-1 Reference	Council Reference Number	Name	Source	Period of Record	Catchment Position	Calibration Events		Verification Event
						Apr 1990	May 1996	May 2009
P1	INALA RFS	Inala Sewage Treatment Works, Bowhill Road, Durack	BCC	Feb 1989-Present	Inside		F	F
P2		84 Benhiam Street, Calamvale (Private Property)	BCC	Oct 1974-Nov 1991	Inside			
P3		Mt Gravatt Gauge - Wecker Road, Mansfield	BCC	Jan 1974-Sept 1989	Outside			
P5	BLR 116	Blunder Creek at Richlands Reservoir	BCC	Feb 1989-Present	Outside	F		F
P6	OXR 114	Oxley Creek Telecom Exchange, Beaudesert Road, Calamvale	BCC	Feb 1991-Present	Inside	F		F
P7	OXR 126	Oxley Creek, D/S Beatty Road, Acacia Ridge	BCC	Jun 1989-Present	Inside	F	F	F
P8	OXR 108	Oxley Creek at Johnson Road, Forestdale	BCC	May 1989-Present	Inside		F	F
P9	OXR 020	Oxley Creek at Corinda High School	BCC	May 1991-Present	Inside			F
P11	BMR 138	Griffith University, Mt Gravatt	BCC	Feb 1989-Present	Outside	F	F	F
P13		New Beith	CBM	From 1976	Inside	F	F	F
P15		Wacol	CBM	Pre 1980	Outside			
P24	OXR 104	Thompson Road	CBM	1989-Present	Inside	F	F	F
P25	OXR 106	The Gap between Ipswich and Beaudesert Highways	CBM	1989-Present	Outside	F	F	F
P26	OXR 102	Elmark	CBM	1989-Present	Inside		F	
P28	SSR 130	Coopers Plains	BCC	Mar 1994-May 2003	Inside		F	

Note: BCC – Brisbane City Council, CBM – Commonwealth Bureau of Meteorology, F – Full record available

Table 4 | Streamflow Gauge

Figure 3-1 Reference	Gauge ID	Station	Source	Period of Operation	Calibration Events		Verification Event
					Apr 1990	May 1996	May 2009
SFG-1	OXE 125	Beatty Road, Oxley Creek	DNRW BCC	Pre 1982 1982-Present	F	F	F
SFG-2	BLA 121	King Avenue, Blunder Creek	DNRW BCC	Pre 1982 1982-Present	F	F	F
SFG-3	SSE 129	Musgrave Road, Stable Swamp Creek	DNRW BCC	Pre 1982 1982-Present	M	F	M
SFG-4	OXE 727	New Beith, Oxley Creek	DNRW	1976-Present	F	F	F
SFG-5	OXA 588	Oxley Mouth, Oxley Creek	BCC	1999-Present	NA	NA	F

Note: F – Full record available, P – Only part record available, M – Recorder malfunction, NA – Not available, DNRW – Department of Natural Resources and Water, BCC – Brisbane City Council

Table 5 | Streamflow gauges not used

Station	Source	Reason for non-use
Brisbane Golf Club (MLA 143)	BCC	Station closed 1993 due to unreliable data
Rocky Water Holes (R_A849)	BCC	Outside model boundary
Stable Swamp Ck (SSA 847)	BCC	One gauge considered sufficient on Stable Swamp Creek
Corinda High (OXA 023)	BCC	Difficult to generate rating curve and tidally influenced
Forest Lake (BLA 805)	BCC	Opened in November 2011 Lake levels only

Note: BCC – Brisbane City Council

Table 6 | Historic rating curve details

Location	Creek	Maximum Gauged Height (m AHD)	Maximum Gauged Discharge (m^3/s)	Rating Curve Range	
				Stage (m AHD)	Discharge (m^3/s)
New Beith	Oxley	51.53	11.1	48.85-55.05	0-370
Beatty Road Upstream (Pre 1974) Downstream (Post 1974)	Oxley	6.22	105	1.3-5.55	1-164
King Avenue	Blunder	7.98	70	4.26-8.52	0-93
Musgrave Road	Stable Swamp	7.63 [a]	Unknown	4.23-6.97 [a]	0-20[a]

[a] – Pre-flood Mitigation Conditions

4 RAFTS model setup and calibration

4.1 RAFTS model setup

The Oxley Creek RAFTS model schematisation is shown Figure 4-1. The model consists of 249 subcatchments which were delineated with the intent to keep the average catchment size in the order of 100 Ha. Generally, the subcatchment definitions in the upper reaches of the Blunder Creek tributaries are consistent with those in the Blunder Creek Catchment Master Drainage Plan (BCCMDP). The adopted catchment parameters are shown in Appendix B.

4.1.1 Catchment slope

Catchment slopes have been calculated from the topography by identifying indicative flow paths and associated equal area slopes.

4.1.2 PerN and percentage impervious

Per 'N' and fraction impervious discretisation have been derived to be consistent with the BCC CityPlan class groups. The land classification from the CityPlan associates generic land use types with all the cadastral parcels. The same land use spatial delineation was applied in the RAFTS model. Where RAFTS sub-catchments contained more than one type of land use, weighted averages of the PerN and fraction imperviousness were applied for the sub-catchment characteristics.

The PerN and fraction imperviousness selected to describe the catchment characteristics are consistent with industry standards, including Table 4.05.1 of the Queensland Urban Drainage Manual and the RAFTS User Manual. Residential areas are considered to be best represented by the lower density urban residential factors. Five percent imperviousness has been included to model the sub-catchments with predominantly pervious areas in order to represent the paved roadways. The adopted land parameters in the RAFTS model for the generic land use types are shown below in Table 7.

Table 7 | Catchment parameters by land use

Land Use Type	% Impervious	Per N
Special Purpose Centres	15	0.050
Community Use Areas	40	0.050
Industrial Areas	90	0.020
Emerging Communities	20	0.060
Residential Areas	45	0.030
Multi-Purpose Centres	90	0.020
Green Space Areas	5	0.075

Within the BCC domain of the Oxley Creek catchment, the future land-use was discretised based on the BCC CityPlan. The actual land-use (ie from aerial photography taken in 2011) was also cross-checked against the CityPlan zoning. Where an area was identified to have undergone development but was zoned to be greenfield, the area of development was incorporated. This discretisation representing the future catchment development is suitable for the prediction of the design events.

The land use extent was modified in the modelling of the calibration and verification events to replicate the actual state of development at the time. The review of the land use extents was undertaken through comparison of current and historical aerial photographs. For the 2009 event, the model parameters have been set with reference to the supplied 2011 aerial photograph for both BCC and LCC. Within the BCC domain values for the 1990 and 1996 were set uniformly using the 1995 and 1997 aerial photographs supplied by BCC as the basis. Due to lack of available imagery the LCC domain used the same discretisation as that obtained from the 2011 aerial photography (it was not observed to differ appreciably from the 2008 photography). This was not deemed to be an issue due to the fact that the majority of the catchment would have been in a forested state at that time.

Land use maps are included in Appendix C. These show the discretisation of the land-use as applied to the hydrologic model sub-catchments for the 2009 and 1990/1996 events.

4.1.3 Channel routing and link lags

Generally, routing of the main watercourses is undertaken in the RAFTS routing module, with channel attributes adapted from the 2008 model. The channel links in the model includes lagged links and routing links.

For the channel routed links, representative cross-sections were input to enable the model to calculate the parameters required for the Muskingum-Cunge routing. Cross-sections were input to the model in the simplified RAFTS format, which defines the cross-section as a compound trapezoid. In the current study, as was found in the previous 2008 study, the channel routing typically underestimates the storage attenuation along the channel reaches, particularly in the lower reaches. For this reason, high Manning's "n" values (0.12 to 0.15) and small hydraulic gradients (0.004 to 0.0002 m/m) have been utilised to improve the fit of the recorded and predicted hydrographs.

Link lags have been used for the purposes of routing smaller tributaries. A number of various lag times representative of stream velocities were trialled in the calibration process. It was found that adopting a general velocity of 0.3 m/s to compute lag times from link lengths gave the best results with respect to calibration gauge data.

The choice of the routed links' roughness and the lag links' timing was confirmed by the hydrograph peak routing in the hydraulic model.

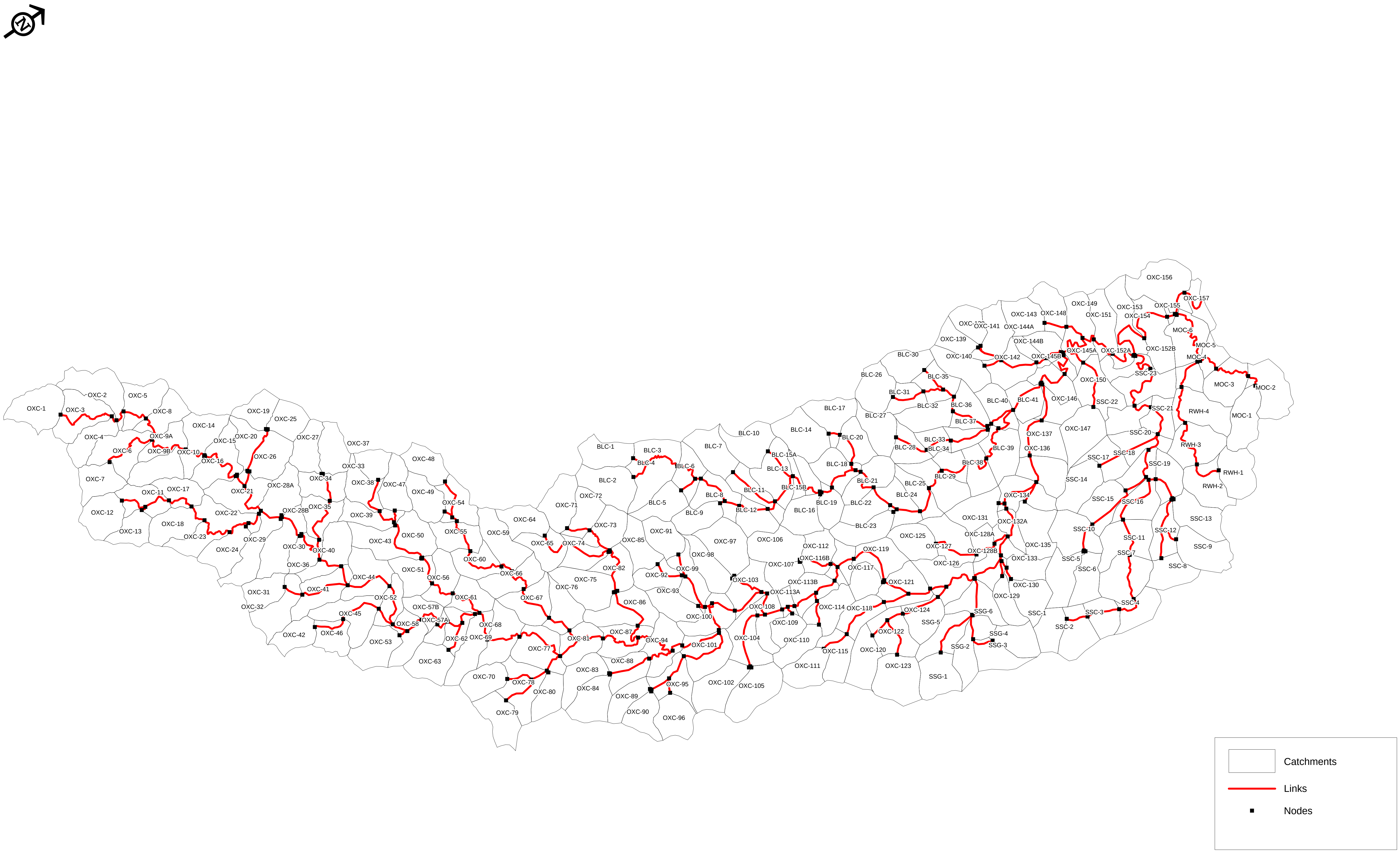
4.2 Calibration rainfall data

Recorded data for each of the calibration and verification events was represented in the RAFTS model using a standard HYDSYS database format. This enabled the full rainfall period for each of the events to be modelled using a fast and reliable method.

The available data coverage for the selected calibration and verification events was detailed in Section 3.1. Table 8 summarises the total and maximum 24 hour rainfall totals for each event at each pluviograph station for which data is available. The duration (start and finish date) of each event is also shown in Table 8. The locations of the different pluviograph stations are shown in Figure 3-1.

Table 9 summarises the four and fourteen day rainfall totals preceding each calibration event and for the 2009 verification event at all daily gauges in and around the Oxley Creek catchment. The antecedent rainfalls shown in Table 9 were used as a guide to estimate initial rainfall losses.

Only pluviograph information was used in the RAFTS modelling. It was not considered necessary to supplement pluviograph data with daily rainfall data as the pluviograph data coverage for each historical event was acceptable. The coverage of the pluviograph stations is given in Table 3 with the gauge locations shown on Figure 3-1. Rainfall from these stations was distributed across the sub catchments using Theissen Polygons.



Disclaimers and Notes:

1. Creek alignment approximate only.
2. Gauge locations as provided by BoM, DNRM & BCC.

Logo:

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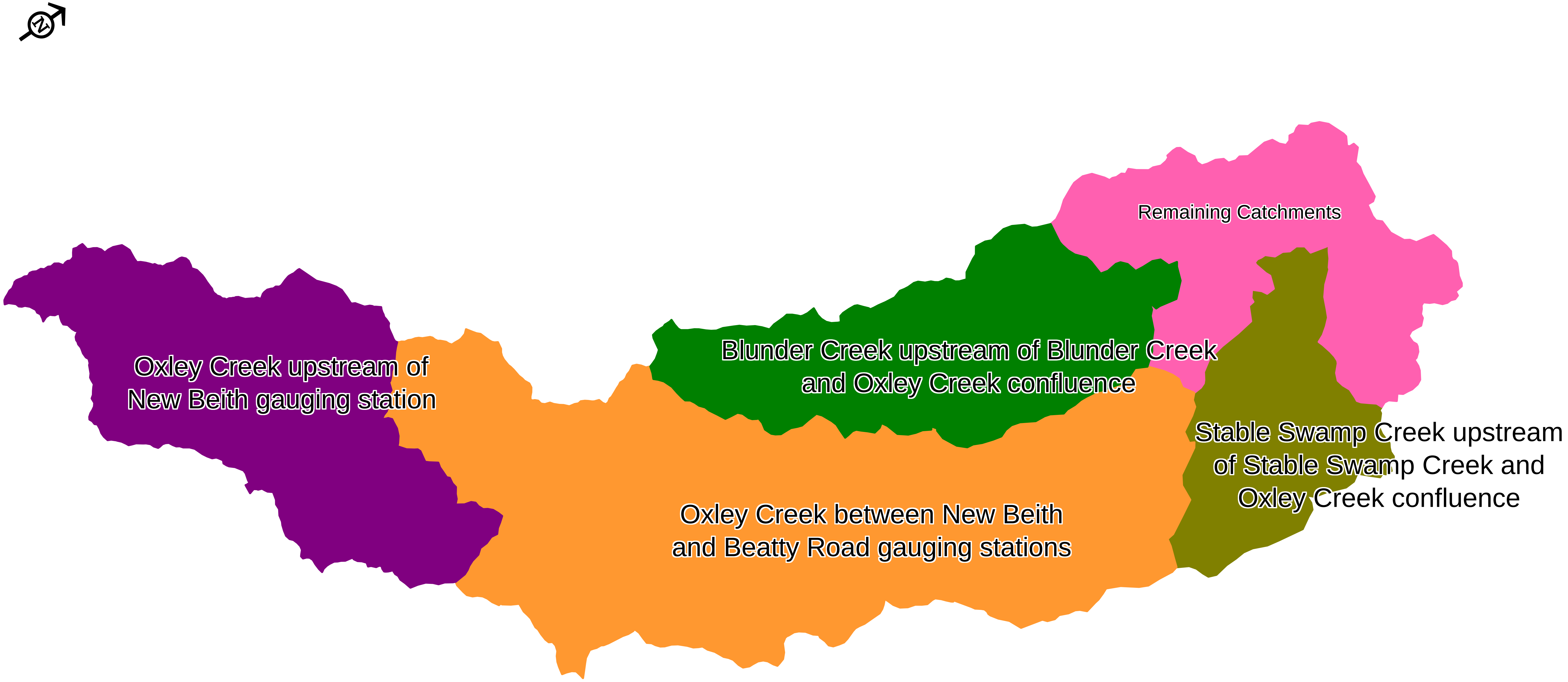
Figure Title: FIGURE 4-1 RAFTS MODEL LAYOUT

Figure No. Figure 4-1

Revision. 2

Date. 29/05/2013



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	BRISBANE CITY	BRISBANE CITY COUNCIL	OXLEY CREEK FLOOD STUDY	0 2,500 5,000 Scale 1:100,000 (A3)	FIGURE 4-2 OXLEY CREEK STREAM GAUGE CATCHMENT AREAS	Figure 4-2
						Revision. 2
						Date. 29/05/2013

Table 8 | Rainfall during calibration and verification events

Pluviograph Station Name	Calibration Events				Verification Events	
	5-9 April 1990		1-7 May 1996		20-22 May 2009	
	Event Total (mm)	Max 24h (mm)	Event Total (mm)	Max 24h (mm)	Event Total (mm)	Max 24h (mm)
P1	-	-	521	120	255	174
P2	-	-	-	-	-	-
P3	-	-	-	-	-	-
P5	153	89	-	-	271	192
P6	163	105	-	-	-	-
P7	144	71	513	118	263	-
P8	-	-	520	141	223	146
P9	-	-	-	-	220	147
P11	159	68	-	-	-	-
P13	205	164	478	115	262	174
P15	-	-	-	-	-	-
P24	217	153	518	132	246	171
P25	171	138	448	115	223	-
P26	-	-	-	-	-	-
P28	-	-	575	129	234	145

Table 9 | 4 day and 14 day rainfall preceding calibration and verification events

Pluviograph Station Name	Calibration Events				Verification Events	
	5-9 April 1990		1-7 May 1996		20-22 May 2009	
	14 day total (mm)	4 day total (mm)	14 day total (mm)	4 day total (mm)	14 day total (mm)	4 day total (mm)
D1	128.4	6	53.8	32.6	0.6	0
D2	132	11.4	44	25	0	0
D3	106.8	5.4	-	-	-	-
D4	112.8	6.8	-	-	2.3	0
D5	129	10	69.6	47	-	-
D6	107.8	3.8	51.4	24.8	0.8	0
D7	-	-	-	-	-	-
D8	149.4	7.8	68.6	45.6	0	0
D9	130.8	6.5	-	-	-	-
D11	158	9.2	-	-	-	-
D13	143	7.8	55.6	27.2	-	-
D14	129.8	7	-	-	-	-
D15	128	7.4	50	23.2	8.8	0
D16	137	5.8	50.8	27	3.4	0
D18	-	-	-	-	-	-
D21	122	8.4	54	28.2	1	0
D23	139.4	14.6	70.5	42.6	-	-
D26	79	6	-	-	-	-
D29	150.2	19.8	46.4	23.2	-	-

4.3 RAFTS calibration data summary

Records of gauge height (and thus discharge where associated with rating curves) data were available at four gauging stations for all calibration and verification events.

New Beith and Beatty Road gauges have operated satisfactorily during all events since their installation. King Avenue gauge has operated satisfactorily for all events, except the May 1996 event. This recorder malfunctioned during the May 1996 event and the recorded data is not considered reliable.

The reliability of the Musgrave Road data is uncertain. Problems such as timing errors and silt blockages were documented during the April 1990 event. Furthermore, the readings at this station are affected by backwater from Oxley Creek.

4.4 Adopted RAFTS calibration parameters

The RAFTS model was calibrated by adjusting the following parameters to achieve agreement between recorded and predicted discharges:

- Rainfall losses initially to fix runoff volumes
- Manning's n values in the routing links
- Lag time based on flow velocities in the lagged links, and
- Catchment storage, through the storage delay time multiplier

In order to recognise the variability of the catchment responses depending on the location, the calibration adopted different loss parameters for the sub-catchments during the calibration process. The extent of the zones of influence is shown in Figure 4-2.

The initial step of the calibration was to fix the rainfall losses so that the model predicts the same volume of runoff that was recorded at the gauging stations. There is consistency in the predicted rainfall losses upstream of the three stream gauges monitoring the upstream mostly undeveloped catchments. Stable Swamp Creek catchment being significantly more developed shows limited rainfall losses and storage due to its significant impervious areas and drainage network. A summary of the rainfall losses applied for the pervious areas in the calibration and verification events is shown in Table 10. For the impervious areas, initial and continuous losses were assumed to be negligible.

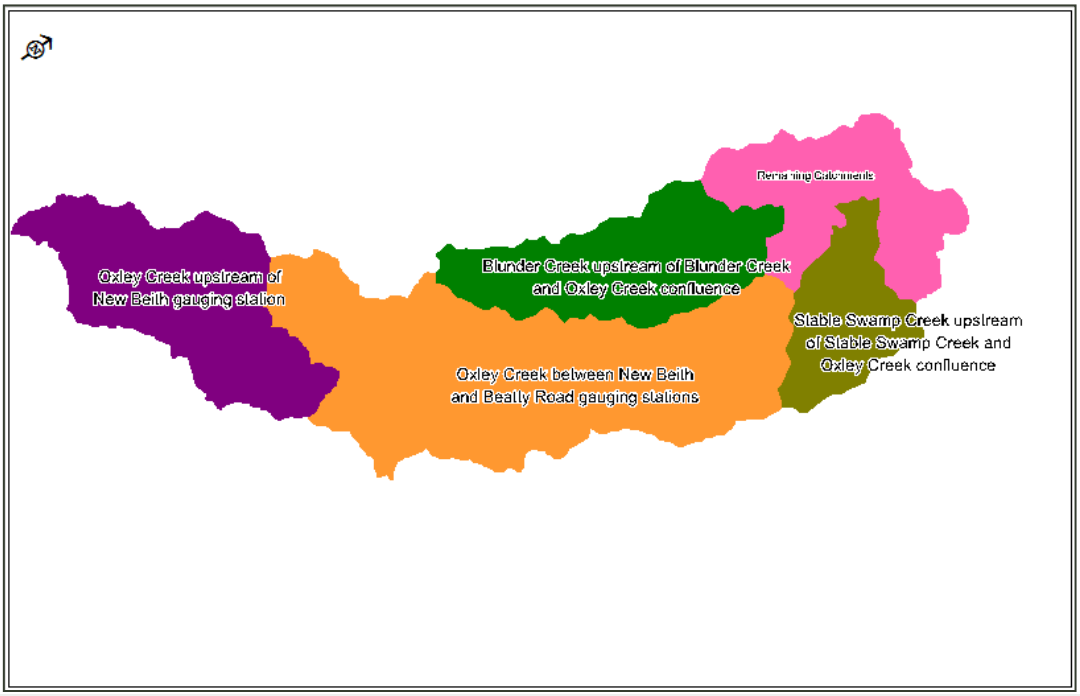

Figure 4-2 | Oxley Creek stream gauge catchment areas

Table 10 | Adopted initial and continuing losses

Catchment Area	Adopted Initial/Continuing Loss (mm)		
	Calibration Events		Verification Event
	April 1990	May 1996	May 2009
Oxley Creek upstream of New Beith gauging station	0/0	108/0.5	50/0
Oxley Creek between New Beith and Beatty Road gauging stations	0/0	150/0	15/0
Upstream of Stable Swamp Creek and Oxley Creek confluence	10/0	0/0	0/0
Blunder Creek upstream of Blunder Creek and Oxley Creek confluence	0/0	150/0	70/0
Remainder of catchment	0/0	0/0	0/0

The Manning's n and the lag time in the routing and lagged links were finalised based on the results of the hydraulic model, ensuring that the RAFTS routing achieved similar routing rates down the catchments as the more precise hydraulic modelling predicts. Manning's "n" values of 0.12 to 0.15 and small hydraulic gradients (0.004 to 0.0002 m/m) and link lags based on a general velocity of 0.3 m/s achieved the best results with respect to calibration gauge data and hydraulic modelling predictions. Note however that RAFTS calculates the lag time to the nearest time step (in this case fifteen minutes) and hence is relatively insensitive to the channel velocity assumptions.

In relation to the Bx factor, a global multiplier of 2.1 was applied to the RAFTS model. This was found to provide a good calibration with the recorded data and was agreed upon with Council.

4.5 RAFTS calibration and verification results

The RAFTS calibration and verification models aimed at the achieving the following tolerances:

- Volume: +20% to -10%
- Peak flow rates at each significant peak: +25% to -15%
- Good timing of peaks/troughs

4.5.1 May 1996 event

For the May 1996 event, the RAFTS model predictions are within the targeted tolerances for the main Oxley Creek catchment (New Beith and Beatty Road). However, the tributary catchments of Blunder Creek and Stable Swamp Creek are predicted to deliver less flow than was recorded.

At Blunder Creek (King Avenue) and Stable Swamp Creek (Musgrave Road) the predictions show a significant deficit of 21% to 25% of runoff volumes compared to the records at the stream gauges. The low peak flow predictions are directly related to the lack of runoff. Considering the degree of discrepancy between the recorded volumes and the modelled volumes with no losses, it is expected that the rainfall records at the gauges are not fully representative to the actual rainfall that fell over the sub-catchments and/or the rating curves overestimate the discharges for the recorded water levels. This is an issue that is common to the other large events analysed as part of the calibration and verification of the RAFTS model.

Whilst generally lower than the recorded hydrographs, the predicted results from RAFTS show a good correlation in timing. It is noted that the predictions at New Beith show an excellent fit with the records, demonstrating that the modelling of the storage of the individual sub-catchments in the upper parts of the Oxley Creek catchment is adequate.

A summary of the model performances in terms of peak flow and runoff volume predictions is presented in Table 11 while the hydrographs are shown in Appendix E.

Table 11 | RAFTS model result summary for 1996 event

Location	Peak Discharge (m^3/s)		Error	Runoff Volume (1,000,000 m^3)		Error
	Gauge	Rafts	%	Gauge	Rafts	%
Beatty Rd	341	327	-4.1	48.67	46.80	-3.8
King Ave	119	75	-37.0	12.59	9.88	-21.5
New Beith Rd	115	125	8.7	12.59	13.97	11.0
Musgrave Rd	127	97	-23.6	12.23	9.13	-25.4

4.5.2 April 1990 event

For the April 1990 event, the RAFTS model predictions are within the targeted tolerances for the main Oxley Creek catchment at New Beith. Beatty Road shows a good volumetric correlation although its peak discharge is slightly higher than the preferred threshold (25% greater than that of the gauge).

Discrepancies are evident at Stable Swamp Creek (Musgrave Road) where the RAFTS model appears to behave too responsively to the rainfall received during this event- this generates a ‘peaky’ hydrograph that over predicts peak discharge significantly despite the flood volume correlating well.

At Blunder Creek the peak discharge shows good agreement although the RAFTS model under predicts the run-off volume significantly (20%).

It is possible that errors inherent to the rating curves could be a cause of these observed discrepancies. Also, at other gauges problems were documented during this event including timing errors and silt blockages.

Overall, the predicted results from RAFTS show a good correlation in timing at all four gauges. A summary of the model performances in terms of peak flow and runoff volume predictions is presented in Table 12 while the hydrographs are shown in Appendix E.

Table 12 | RAFTS model result summary for 1990 event

Location	Peak Discharge (m^3/s)		Error	Runoff Volume (1,000,000 m^3)		Error
	Gauge	Rafts	%	Gauge	Rafts	%
Beatty Rd	325	407	25.2	31.06	29.24	-5.9
King Ave	69	63	-8.7	6.35	5.08	-20.1
New Beith Rd	161	169	5.0	9.47	9.13	-3.6
Musgrave Rd	39	53	35.9	2.94	2.78	-5.3

4.5.3 May 2009 event

For the May 2009 event, the RAFTS model consistently under predicts the peak discharge by as much as 32% at all but the King Avenue gauge. Volumetrically the predictions correlate better, with only Musgrave Road outside of the preferred threshold (a 23% under prediction). The modelling of Stable Swamp Creek sub-catchments has been undertaken assuming zero initial and continuous rainfall losses, yet the predictions show a significant deficit of 23% of runoff volumes compared to the records at the stream gauges. The low peak flow predictions are directly related to the lack of runoff. Similar to what was reported for the 1996 event, it is expected that the rainfall records at the Musgrave Road gauge are not fully representative of the actual rainfall that fell over the sub-catchments.

Whilst generally lower than the recorded hydrographs, the predicted results from RAFTS show a very good correlation in timing. A summary of the model performances in terms of peak flow and runoff volume predictions is presented in Table 13 while the hydrographs are shown in Appendix E.

Table 13 | RAFTS model result summary for 2009 event

Location	Peak Discharge (m^3/s)		Error	Runoff Volume (1,000,000 m^3)		Error
	Gauge	Rafts	%	Gauge	Rafts	%
Beatty Rd	355	292	-17.7	28.20	29.68	5.3
King Ave	72	70	-2.8	5.67	5.14	-9.4
New Beith Rd	212	144	-32.1	6.81	7.99	17.3
Musgrave Rd	89	73	-18.0	6.18	4.74	-23.3

4.6 RAFTS calibration conclusions

It is acknowledged that the calibration of the Oxley Creek RAFTS model is not straightforward due to a number of factors including the sparseness of the rain-gauge data, the lack of stream gauge data (particularly in the upper catchment), the uncertainty in rating curves, the variation in losses that is likely across the catchment, etc. Taking this into account the results of the calibration are deemed satisfactory and provide a good basis from which to model the design events.

5 TUFLOW model setup and calibration

5.1 TUFLOW model key features

The characteristics of the Oxley Creek floodplain mean a two-dimensional modelling approach is suitable. These characteristics include:

- Several sand mining areas
- The confluence with Blunder Creek, and
- The lower floodplain from the Ipswich Motorway to Sherwood Road

During large events, these areas are characterised by flow breaking out from the meandering channel to discharge across the floodplain. TUFLOW provides the capability to model both low-flow and high-flow scenarios using a 1D/2D approach and has therefore been adopted for use in the hydraulic assessment. The model layout is presented in Figure 5-1 and some of its key features are:

- The reaches of creek shown in Figure 5-1 are represented by 1D channels. These are dynamically linked to the 2D domain using 'HX' lines to allow for the movement of water between both domains
- In the other areas the channel is defined using purely 2D techniques
- Where the channel is narrow with limited capacity in comparison to the floodplain flow it is represented using z-lines, a standard tool in TUFLOW. This tool creates a continuous flowpath along the length of the z-line by lowering grid cells to an elevation which is interpolated between specified elevations at the ends of the line and allows for the channel to be carved into the 2D domain. This approach applies to the upper reaches of Blunder Creek
- In the lower reaches of Oxley Creek between points A and D (as shown on Figure 5-1) a DEM of the channel was generated using the available cross-sectional data. This was then stamped onto the topographic DEM for the wider floodplain, thereby accurately representing the overall conveyance within the model's 2D domain. This was undertaken as a result of the severe meandering nature of the creek in this area, which was observed to cause problems when being modelled as a coupled 1D-2D channel

Note that all cross-sections were defined using data provided by BCC.

5.2 TUFLOW 2D domain setup

5.2.1 Model extents

The 2D domain model stretches from 2.2 km south of the Logan Motorway at its upstream extent, to the Brisbane River at its downstream extent. In the west, the model boundary runs through Forest Lake. In the east the model boundary runs through Coopers Plains, Acacia Ridge and Algester.

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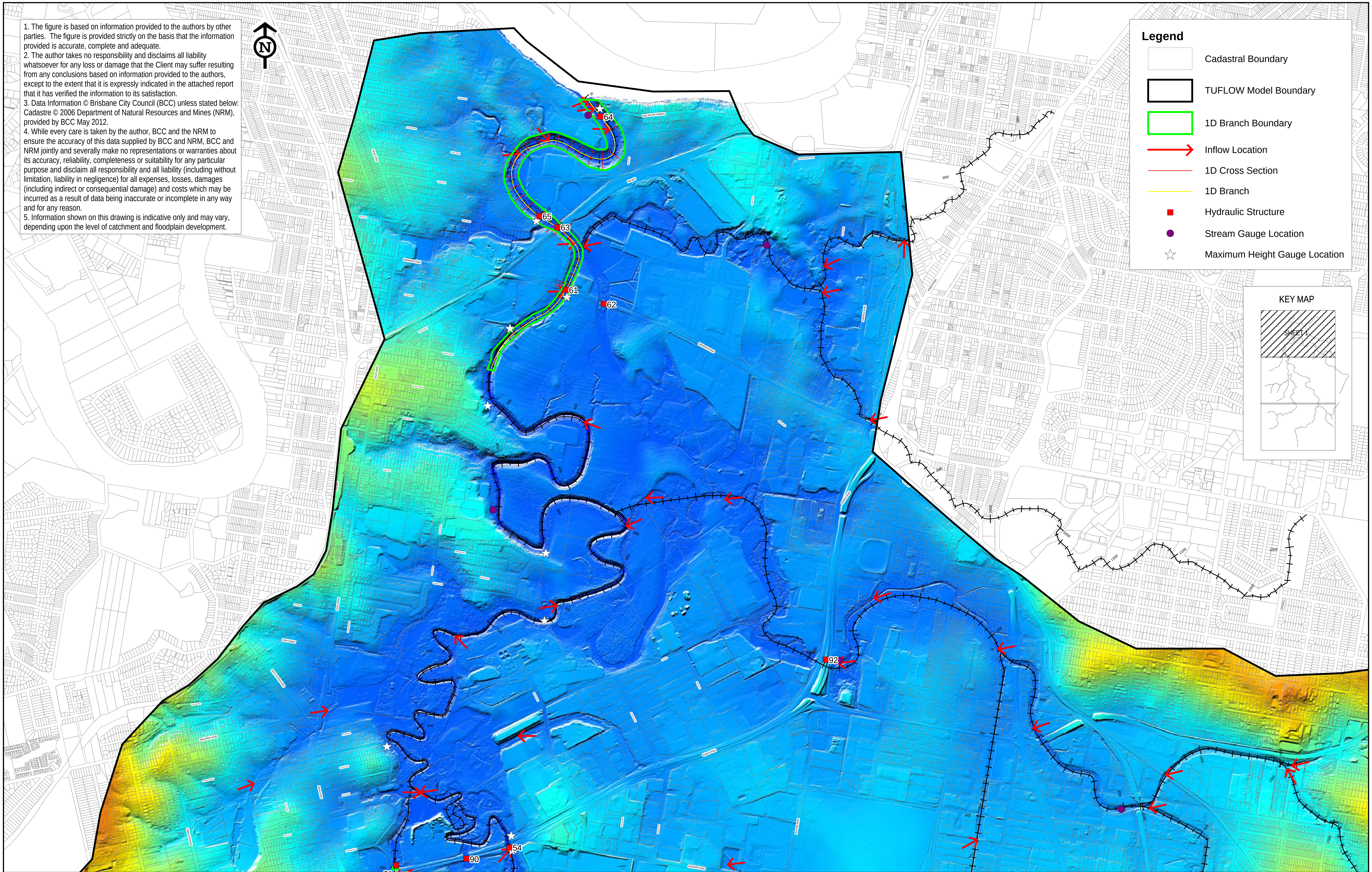

Legend

- Cadastral Boundary
- TUFLOW Model Boundary
- 1D Branch Boundary
- Inflow Location
- 1D Cross Section
- 1D Branch
- Hydraulic Structure
- Stream Gauge Location
- Maximum Height Gauge Location

Disclaimers and Notes:	Logo:	Client:	Project:	Scale:	Figure Title:	Figure No.
See above	BRISBANE CITY	BRISBANE CITY COUNCIL	OXLEY CREEK FLOOD STUDY	0 500 1,000 (m) Scale 1:20,000 (A3)	FIGURE 5-1 TUFLOW MODEL LAYOUT SHEET 1 OF 3	Figure 5-1-1
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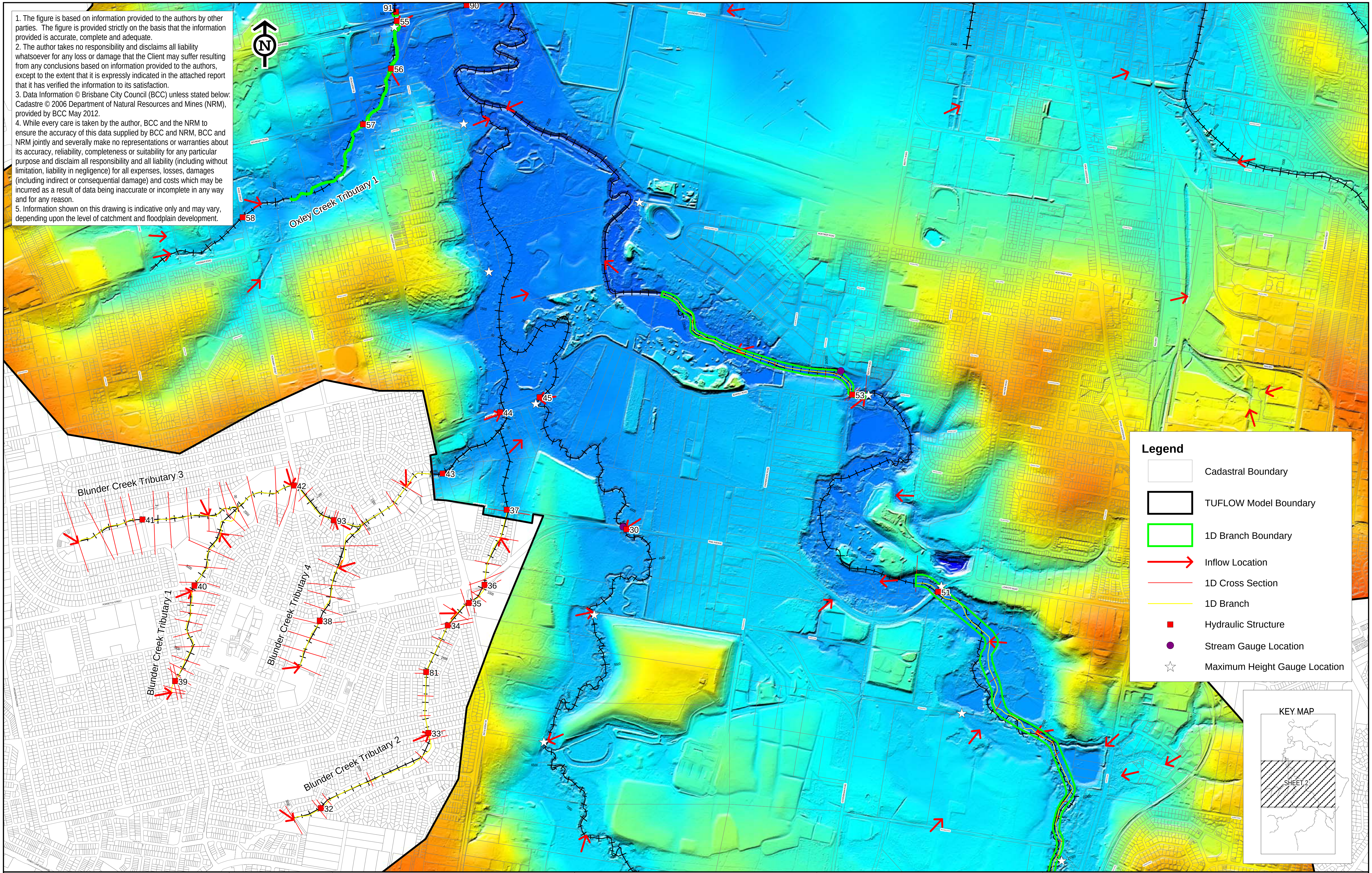
						Date: 30/05/2013



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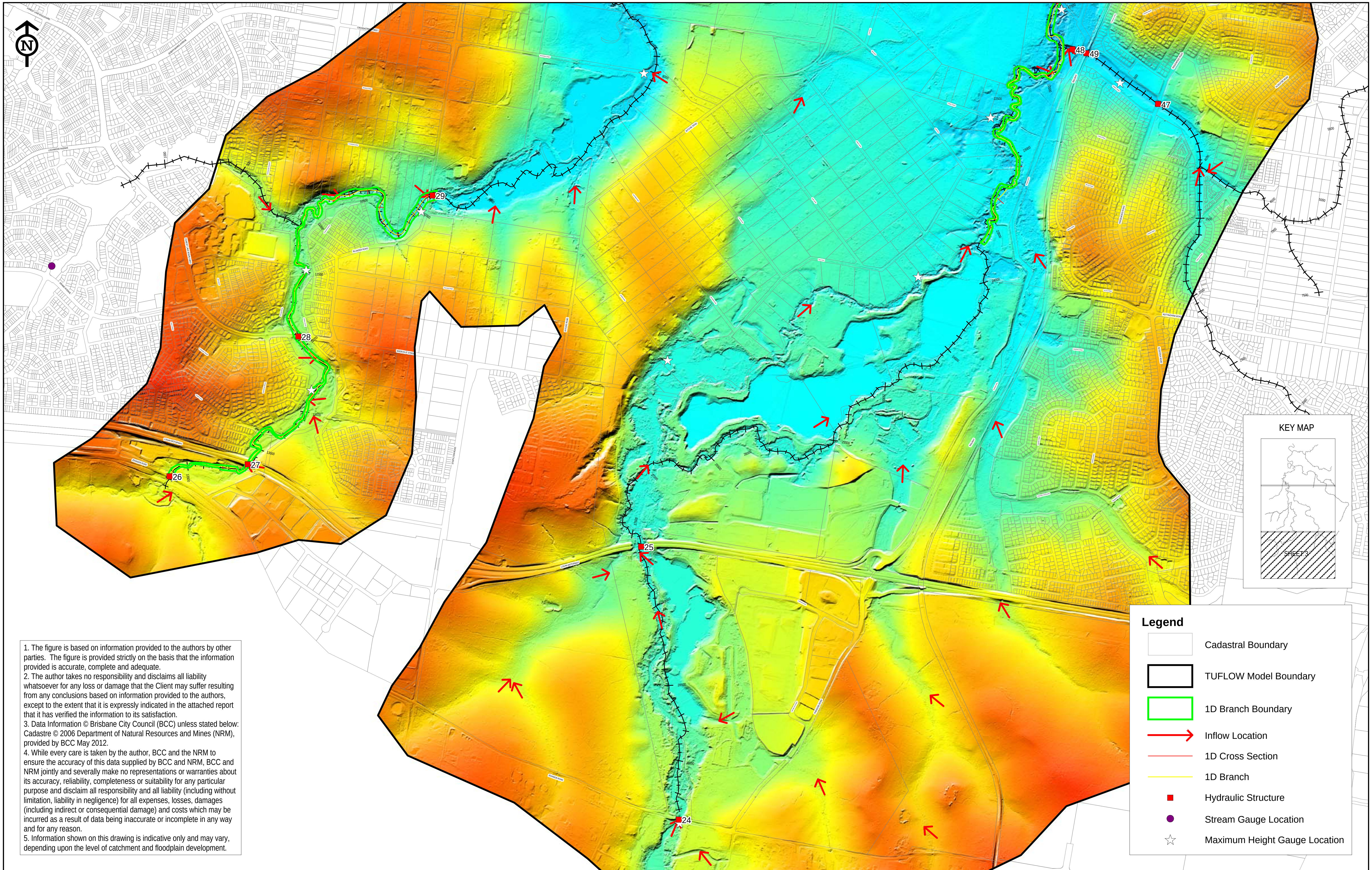

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						Revision. 2
						Date. 30/05/2013

5.2.2 Topography

The base topography was created using supplied ALS data. A 7.5 m grid digital elevation model was extracted over the following extents (MGA Zone 56):

- South-west corner – 494000, 6939000
- North-east corner – 506000, 6957000

The base topography did not contain any detail below the water surface. This bathymetric information was extracted from the cross-section survey data which was provided by BCC. At each location, the cross-section was truncated to represent only the channel (ie overbanks were removed). Those channels were modelled as 1D branches in the 2D domain. Hence, the truncated cross-sections were used to define the channel profile of the 1D branches.

The creek cross-section data is an amalgamation of numerous surveys undertaken over the previous 40 years. The bulk of the data came from two surveys (mid-1990s and mid-late 1970s) with some from 1972. As such, the data is not considered representative of the current state of the creek, nor any previous creek states. In some areas, where the available creek cross-section data was not representative, the ALS 2009 data was used if it was considered to give a better representation of the creek.

Two areas where relatively new creek cross-sectional information was available were:

- Oxley Creek adjacent to Paradise Road (circa 2010)
- Oxley Creek from the railway to the mouth (circa 2005)

Accurate bathymetric information was not available for the sand mine lake areas and the topography within these lakes was set to the standing water level (and a low roughness value was applied).

The base topography also covers a significant portion of Stable Swamp and Rocky Waterholes Creeks. It should be noted that these areas are included for their storage capacity and are not accurate representations of the tributaries themselves.

5.2.3 Assumptions

This section of the report outlines a number of key assumptions regarding the model set-up:

- The sand mine areas were assumed to be full to standing water level and the storage/ conveyance below this level has not been represented
- The cross-sectional data is assumed to be representative of current conditions even though it is acknowledged that the cross-sections may have been modified by natural/unnatural processes in the interim period since the survey was completed
- The tailwater conditions at the Brisbane River are assumed to remain static over the duration of the Oxley Creek flood event

5.2.4 Structures

The hydraulic structures within this study were modelled as either 1D structure or 2D structures, depending on the applicable modelling domain. 2D structures are detailed in Table 14.

Table 14 | Structures represented in 2D domain

Creek/channel	Figure Reference	Structure Location	Comments
Oxley Creek	24	Johnson Road	3 span bridge
	25	Logan Motorway	5 span bridge
	90	Ipswich Motorway Overflow	3 span bridge
	54	Ipswich Motorway	2 x 3 span bridges
	47	Ridgewood Road	5/3670x1840 Box Culverts
	48	Paradise Road	6/3000x3000 Box Culverts
	49	Rail Upstream of Paradise Road	3 span bridge
	62	Sherwood Road Overflow	15/3600x2700 Box culverts

5.2.5 Roughness

The Manning's n values shown in Table 15 were adopted throughout the 2D domain. Aerial photographs were used to define land type zones.

Table 15 | Adopted roughness values

Land Type	Typical Manning's n
High density residential/industrial	0.15
Low density residential/parkland with dense trees	0.08
Rural residential/parkland with medium density trees	0.07
Parkland with few trees	0.05
Grassed parkland	0.04
Channel rough	0.05
Channel smooth	0.035
Sand mines	0.02
Roads	0.02
Golf course	0.04
High density forest	0.12
Medium density forest	0.075
Quarry	0.07

5.2.6 Boundaries

The 2D local inflows throughout the TUFLOW model were taken from the RAFTS model and applied at the appropriate locations. The inflow locations are shown on Figure 5-1. A 2D time varying water level boundary was also specified at the Brisbane River to allow flow to exit the model from the 2D domain.

5.3 TUFLOW 1D domain setup

5.3.1 Branch extents

The extent of the 1D branches is shown in Figure 5-1. The 1D branches were digitised using TUFLOW's '1d_nwk' layer properties and attributes.

5.3.2 Topography

- All cross-section data used for the above branches (except Oxley Creek – Vied Road to Learoyd Road) were sourced from the previous MIKE11/MIKEFLOOD models
- Cross sections between Vied Road to Learoyd Road were sourced from the survey data which was captured during the Paradise Road Upgrade Feasibility Study (circa 2010)

5.3.3 Structures

The hydraulic structures represented in the 1D domain are detailed in Table 16. The structure locations are presented in Figure 5-1.

Table 16 | Structures represented in 1D domain

Creek/Channel	Figure Reference	Structure Location	Structure Description
Oxley Creek	65	Water main	
	64	Graceville Avenue	4 span bridge
	61	Sherwood Road	3 span bridge
	63	Railway bridge	5 span & 3 span bridges
	51	Learoyd Road	3 span bridge
	53	Beatty Road	3 span bridge
	28	Forest Lake Boulevard	3 span bridge
	29	Blunder Road	2 span bridge
	26	Johnson Road	5/3600x2400 RCBC
	27	Logan Motorway	5/3600x3600 RCBC
	45	Bowhill Road	5/2350x1500 RCBC
Blunder Creek Tributary	32	Wallaroo Way	6/1800x1200 RCBC
	33	Lorikeet Street	4/1500 RCP
	81	Pigeon Street	4/1500 RCP
	34	Rosella Street	4/1650 RCP
	35	Blunder Road	5/3000x1500 RCBC
	36	Inala Avenue	5/3000x1500 RCBC
	37	King Avenue	1/600 RCP
	44	Bowhill Road	5/1500 RCP
	39	Clipper Street	5/1200 RCP
	40	Inala Avenue	5/1200 RCP
	41	Eucalypt Street	3/1500 RCP
	42	Serviceton Avenue	6/1500 RCP

Creek/Channel	Figure Reference	Structure Location	Structure Description
	38	Inala Avenue	3/1050 RCP + 1/1200 RCP
	43	Blunder Road	2 span bridge + 4/3600x1800 RCBC
Oxley Creek Tributary	58	Rudd Street	4/1500 RCP
	57	Blunder Road	6/3050x1870 RCBC
	56	Blunder Road Exit	4/3550x1490 RCBC
	55	Ipswich Motorway	8/2400x2150 RCBC
	91	Ipswich Road	8/2100x2100 RCBC
Stable Swamp Creek	92	Ipswich Motorway	3/7250 steel pipes

5.3.4 Roughness

Manning's n roughness values were based on the previous MIKE11 model. Some modifications were made in discussion with BCC to improve calibration results.

5.3.5 Boundaries

The inflow locations are shown on Figure 5-1. 1D boundaries were established upstream of Blunder Road and King Avenue along the Blunder Creek Tributaries which are outside the 2D domain.

A 1d time-varying water level boundary was provided at the Brisbane River to allow flow to exit the model.

5.4 Calibration procedure

Section 2 describes the calibration and verification events and the available data for each event. The May 1996 event was the largest recent event to occur in the Oxley Creek system. This event was considered the most appropriate event with which to calibrate the TUFLOW model.

The absence of reliable topographic data for events prior to 1996 and the TUFLOW model run times meant that calibration of the model to more than one event was not practical or justified. This is particularly relevant to the sand mines whose topography would have changed over the years due to industrial processes and flood events.

However, the May 2009 event was also used to verify the model.

The 1996 calibration model simulates from 12 pm on 2 May 1996 to 12 pm 4 May 1996 (ie 48 hours). The 2009 verification model simulates from 12 am on 20 May 2009 to 12 am on 22 May 2009 (ie 48 hours). Model calculation timesteps of 2.5 seconds and 1 second were adopted for 2D and 1D domain respectively.

Calibration of the TUFLOW model was undertaken through refinement of the following parameters:

- Manning’s roughness (values defined in Table 15 are the final adopted values) and
- 1D channel geometry (adjust/add/remove cross section data)

5.5 Calibration/verification results

The peak water levels and calibration results are presented in Figure 5-2. The following sections discuss the model calibration in further detail.

The TUFLOW model extents include the King Avenue gauge on Blunder Creek, the Beatty Road gauge on Oxley Creek and the Musgrave Road gauge on Stable Swamp Creek.

Figure 5-3 to Figure 5-6 present the calibration at Beatty Road and King Avenue respectively. The Stable Swamp Creek gauge was included in the calibration process, however is not reported in detail here as the Stable Swamp Creek channel is only represented in 2D in the domain and lacks the discretisation precision of the two other gauge locations. The discharges are also compared to the RAFTS model results at these locations.

5.5.1 1996 calibration to streamflow gauge records

This section of the report presents the results of the calibration at the King Avenue and Beatty Road stream gauges for the 1996 calibration.

5.5.1.1 1996 Beatty Road gauge

Figure 5-3 and Figure 5-4 show that a good calibration is achieved at this gauge, in terms of discharge, timing and water level. The TUFLOW prediction is observed to be 0.07 m greater than the recorded level, which is still within the allowable tolerance of 0.15 m.

Table 17 presents a summary of peak water levels and discharges.

Table 17 | 1996 peak water level and discharges at Beatty Road gauge

	Peak water level (m AHD)	Peak discharge (m^3/s)
Recorded stream gauge data	6.78	341
RAFTS predicted results	6.76	327
TUFLOW predicted results	6.85	328

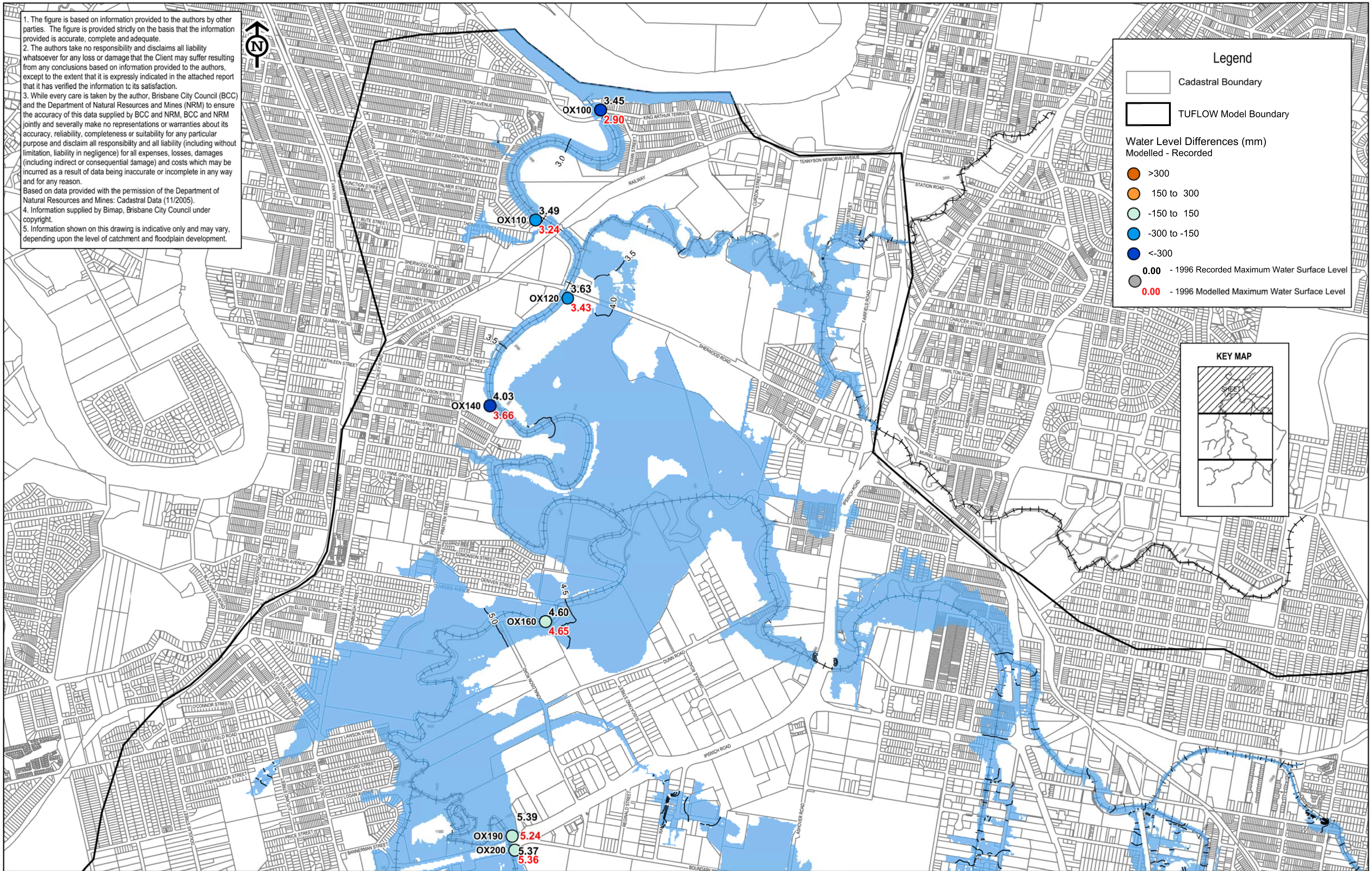
5.5.1.2 1996 King Avenue gauge

Figure 5-5 and Figure 5-6 show the calibration results for both water level and discharge respectively. From Figure 5-6 it is apparent that while the RAFTS and TUFLOW discharge hydrographs compare well, they are both significantly less than the rated hydrograph. The fact that a reasonable correlation was achieved (0.17 m) between the predicted and recorded water levels would suggest that the current rating curve may be overestimating the discharge. The timing at the peak water level is observed to be fair.

Table 18 presents a summary of peak water levels and discharges

Table 18 | 1996 peak water level and discharges at King Avenue gauge

	Peak water level (m AHD)	Peak discharge (m^3/s)
Recorded stream gauge data	8.58	119
RAFTS predicted results	8.27	75
TUFLOW predicted results	8.41	72



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See above	BRISBANE CITY	BRISBANE CITY COUNCIL	OXLEY CREEK FLOOD STUDY	0 500 1,000 (m) Scale 1:20,000 (A3)	FIGURE 5-2 SHEET 1 of 3 1996 EVENT PEAK WATER LEVELS	Figure 5-2-1 Revision: 3 Date: 19/07/2013

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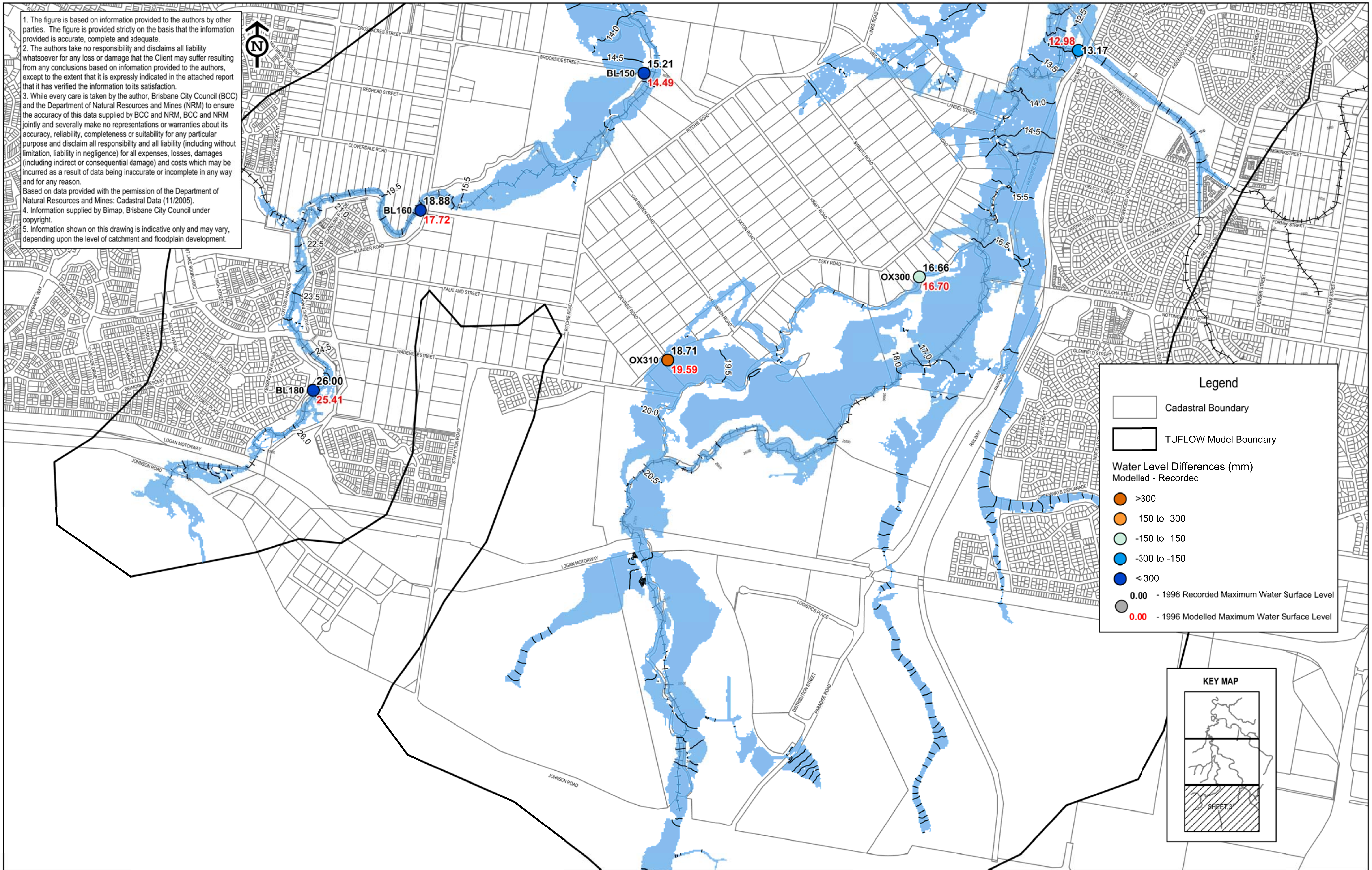

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See above	BRISBANE CITY	BRISBANE CITY COUNCIL	OXLEY CREEK FLOOD STUDY	0 500 1,000 (m) Scale 1:20,000 (A3)	FIGURE 5-2 SHEET 3 of 3 1996 EVENT PEAK WATER LEVELS	Figure 5-2-3 Revision: 3 Date: 19/07/2013

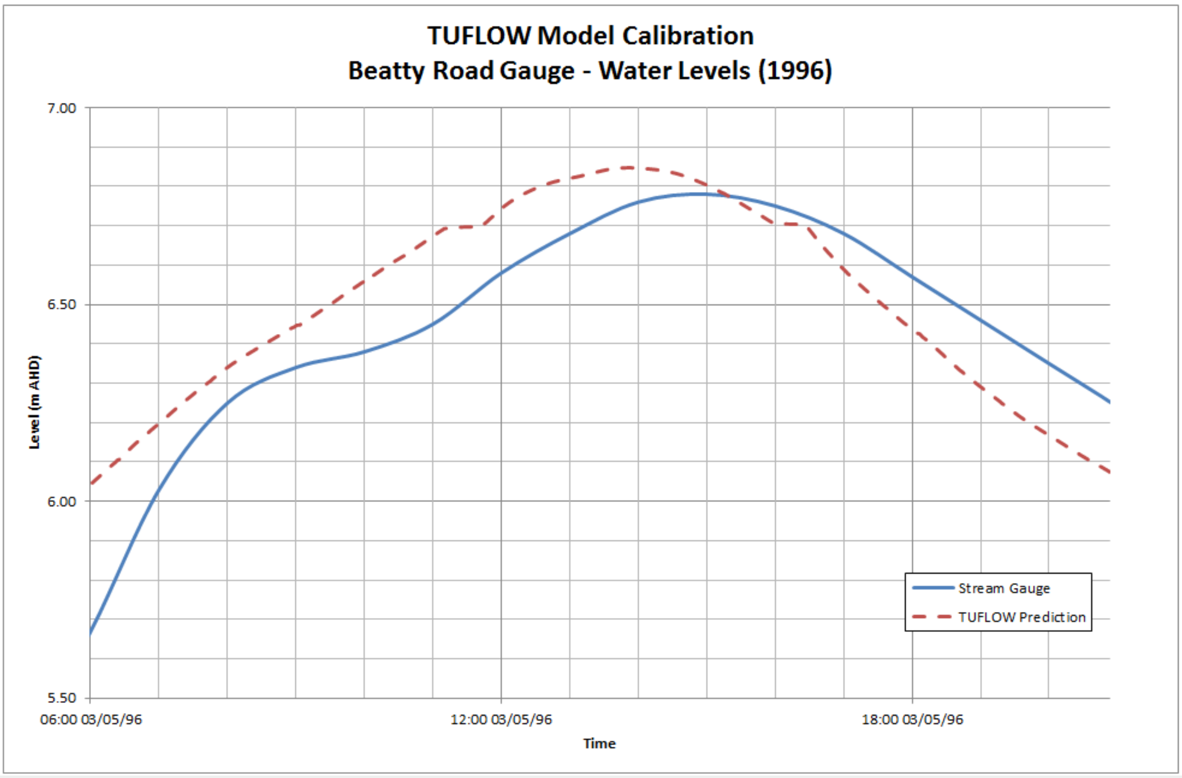

Figure 5-3 | Beatty Road gauge water level calibration (May 1996 event)

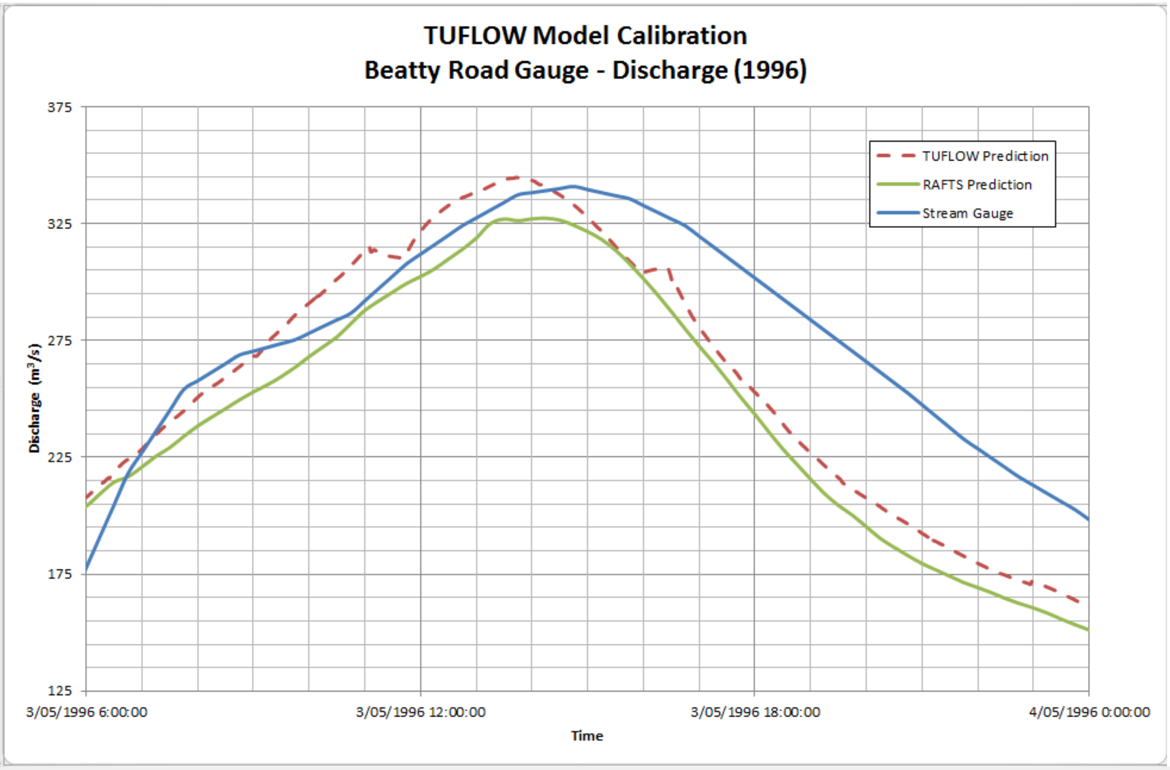

Figure 5-4 | Beatty Road gauge discharge calibration (May 1996 event)

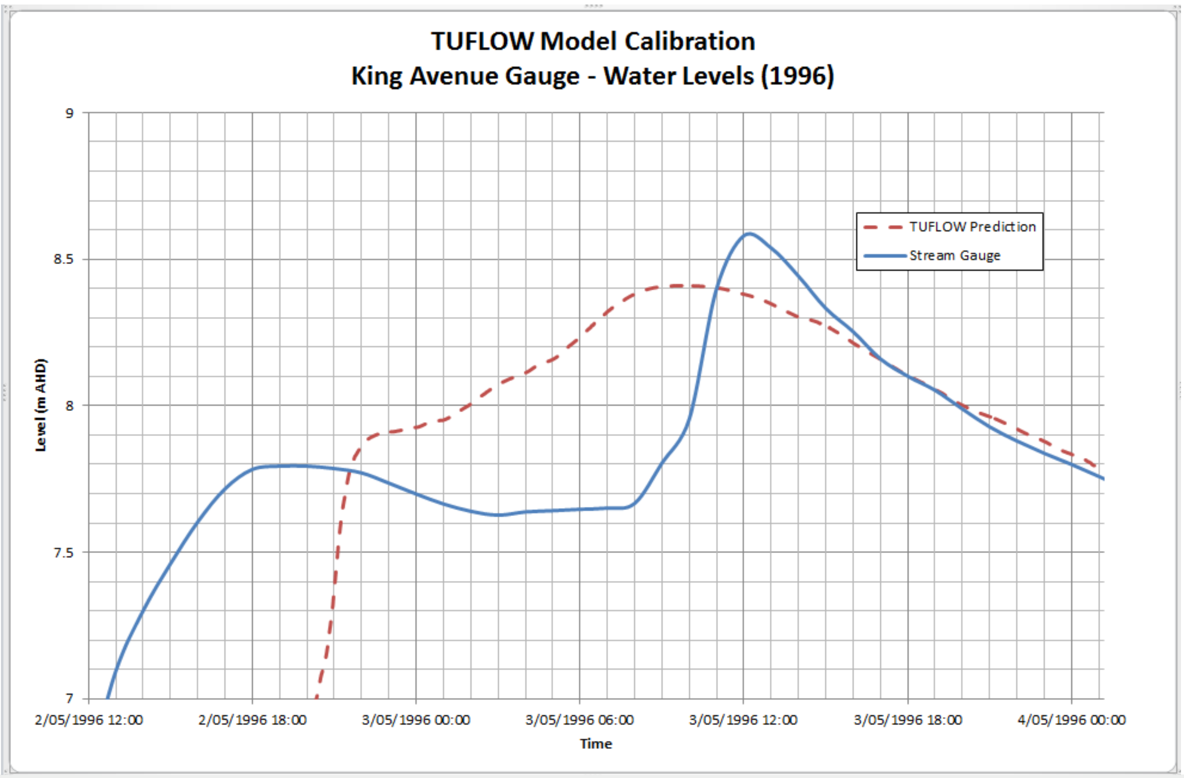

Figure 5-5 | King Avenue gauge water level calibration (May 1996 event)

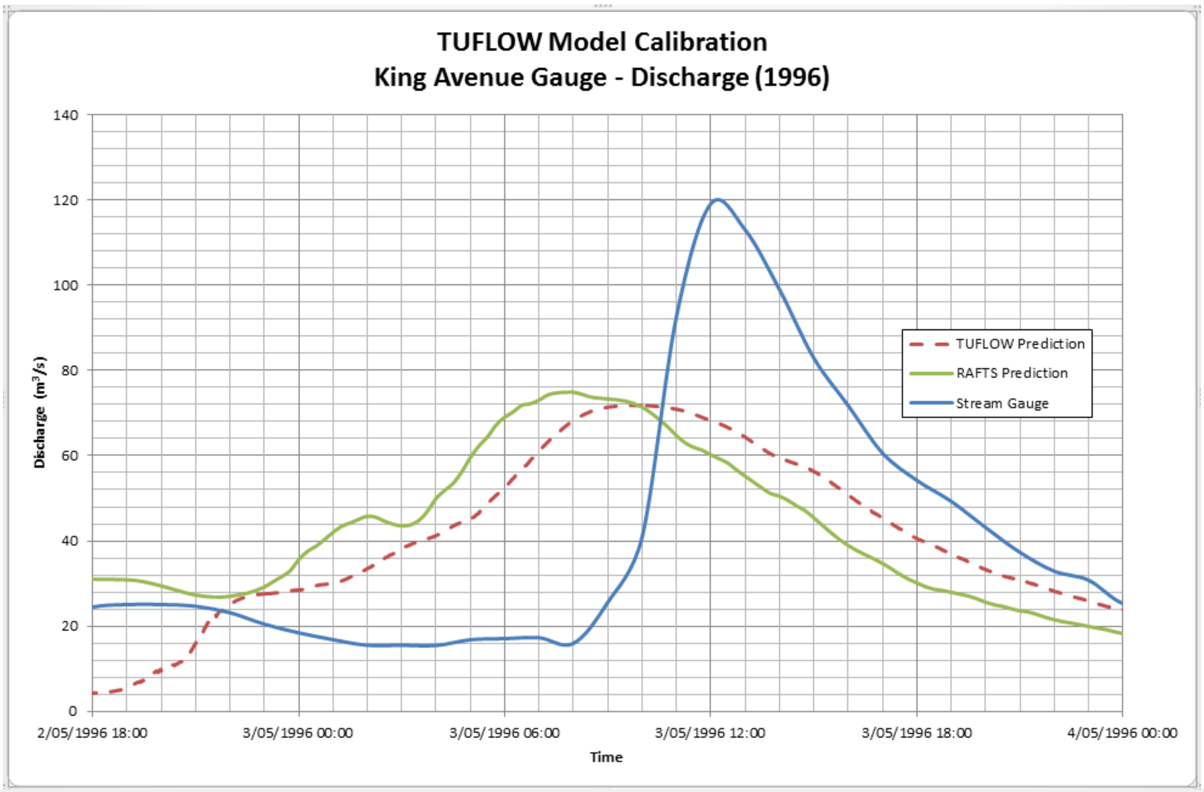

Figure 5-6 | King Avenue gauge discharge calibration (May 1996 event)

5.5.2 1996 calibration to maximum height gauges

Table 19 presents a summary of the peak water levels calculated at the Maximum Height Gauges and a comparison to the recorded data. A calibration tolerance of 0.3 m has been adopted.

Table 19 | 1996 calibration results at maximum height gauges

Gauge Location	Gauge ID	Recorded Peak Water Level (m AHD)	Calculated Peak Water Level (m AHD)	Difference (mm)
Oxley Creek				
Devries Road	OX310	18.71	19.59	880
Kraft Road	OX300	16.66	16.70	36
Paradise Road	OX270	13.17	12.98	-187
Watson Road	OX240	8.23	8.76	530
Colebard Street	OX220	6.05	5.97	-79
Ipswich Road (US)	OX200	5.37	5.36	-7
Ipswich Road (DS)	OX190	5.39	5.24	-150
Kendall Street	OX170	>4.52	5.02	-
Cliveden Avenue	OX160	4.60	4.65	50
Archer Parade	OX150	>4.32	4.14	-
Erinvale Street	OX140	4.03	3.66	-370
Kennard Street	OX130	>3.69	3.16	-
Sherwood Road	OX120	3.63	3.43	-200
Thomas Street	OX110	3.49	3.24	-250
King Arthur Terrace*	OX100	3.45	2.90	-550
Blunder Creek				
Blunder Road	BL180	26.00	25.41	-590
Blunder Road	BL170	>23.39	22.98	-
Blunder Road	BL160	18.88	17.72	-1160
Brookside Street	BL150	15.21	14.49	-720
Un-named Road	BL140	12.70	12.48	-220
Sherbrooke Road	BL130	10.16	10.12	-40
Bowhill Road	BL120	6.16	6.04	-120
Kippax Street	BL110	5.83	5.63	-197
Riviera Court	BL100	>5.46	5.31	-

* Recorded value represents Brisbane River level

5.5.2.1 Calibration in the upper reaches of Oxley Creek (upstream of Ipswich Road)

At Devries Road (OX310) the model over-predicts the peak flood level by 0.9 m. This is close to a sand-mine area and it is likely that differences in topographic conditions between the model and conditions on the ground at the time of the event contribute to this.

Both the Kraft Road and Paradise Road (OX300 and OX270) correlate well, as does Colebard Street (OX220). However Watson Road (OX240) is over predicted by 0.5 m which is again upstream of a sand-mine area.

5.5.2.2 Calibration in the middle reaches of Oxley Creek (Ipswich Road to Kendall Road)

A good match between recorded and predicted flood levels is achieved at the gauges upstream and downstream of Ipswich Road (OX200 and OX190 respectively). It is noted that the recorded levels show a marginally higher flood level downstream of the bridge which is unusual. However, the model predictions are in close agreement to both levels although they do show a head loss of just over 0.1 m at the bridge.

5.5.2.3 Calibration in the lower reaches of Oxley Creek (downstream of Kendall Road)

With the exception of the Erinvale Street gauge (OX140) which is just outside the tolerance threshold of 0.3 m, all other predictions at operational gauges correlate well.

5.5.2.4 Calibration in Blunder Creek

At Cliveden Avenue (BL160), a significant discrepancy is observed during the 1996 event with TUFLOW underpredicting the peak flood level as compared to that recorded. However it should be noted that this gauge is in close proximity to a sand-mine and it is likely that differences in topographic conditions between the model and conditions on the ground at the time of the event contribute to this discrepancy. In addition to the proximity to the sand mine which is unlikely to be represented accurately using ALS 2009, another potential reason why the simulated results are substantially lower than the gauge is that the TUFLOW model utilises the new bridge details, which is considerably larger than the old bridge (ie generates less headloss than the old structure).

Blunder Road (BL180) and Brookside St (BL150) show a discrepancy of approximately 0.6 m and 0.7 m respectively, but all gauges in the lower reaches of Blunder Creek show a good correlation with the margins being less than the 0.3 m threshold.

5.5.3 1996 flood level comparison

The 1996 model outputs were compared to the design event results to estimate the ARI of the 1996 event. The results are as follows for Oxley Creek:

- Johnson Road – just greater than a 2 year ARI
- Beatty Road – between a 2 and 5 year ARI
- Ipswich Road – almost a 10 year ARI

The results are as follows for Blunder Creek:

- King Avenue – between a 2 and 5 year ARI

5.5.4 2009 verification to streamflow gauge records

This section of the report presents the results of the calibration at the King Avenue and Beatty Road stream gauges for the 2009 verification. The peak water levels and calibration results are presented in Figure 5-7.

5.5.4.1 2009 Beatty Road gauge

Figure 5-8 and Figure 5-9 show that a reasonable calibration is achieved at this gauge, in terms of the peak discharge and water level prediction. The TUFLOW prediction is observed to be 0.19 m below the recorded level, which just outside the allowable tolerance of 0.15 m. In assessing the timing it is clear that the TUFLOW model is peaking approximately six hours ahead of the gauge readings. This may be related to the spatial and temporal variations in the recorded rainfall (ie not being accurately represented due to the sparseness of the gauges), storage at sand mines, and the vegetative condition of the creek.

Table 20 presents a summary of peak water levels and discharges.

Table 20 | 2009 peak water level and discharges at Beatty Road gauge

	Peak water level (m AHD)	Peak discharge (m^3/s)
Recorded stream gauge data	6.87	357
RAFTS predicted results	6.55	292
TUFLOW predicted results	6.68	309

5.5.4.2 2009 King Avenue gauge

Figure 5-10 and Figure 5-11 show the calibration results for both water level and discharge respectively at the King Avenue gauge.

A good agreement is seen in the hydrograph comparison, although the RAFTS and TUFLOW do have a double peak which is not evident in the gauged reading. Timing and hydrograph volume appears reasonable with TUFLOW predicting a flood level 0.26 m higher than that recorded. This is outside of the preferred tolerance range of 0.15 m.

Table 21 presents a summary of peak water levels and discharges.

Table 21 | 2009 peak water level and discharges at King Avenue Gauge

	Peak water level (m AHD)	Peak discharge (m^3/s)
Recorded stream gauge data	8.09	72
RAFTS predicted results	7.99	70
TUFLOW predicted results	8.35	65

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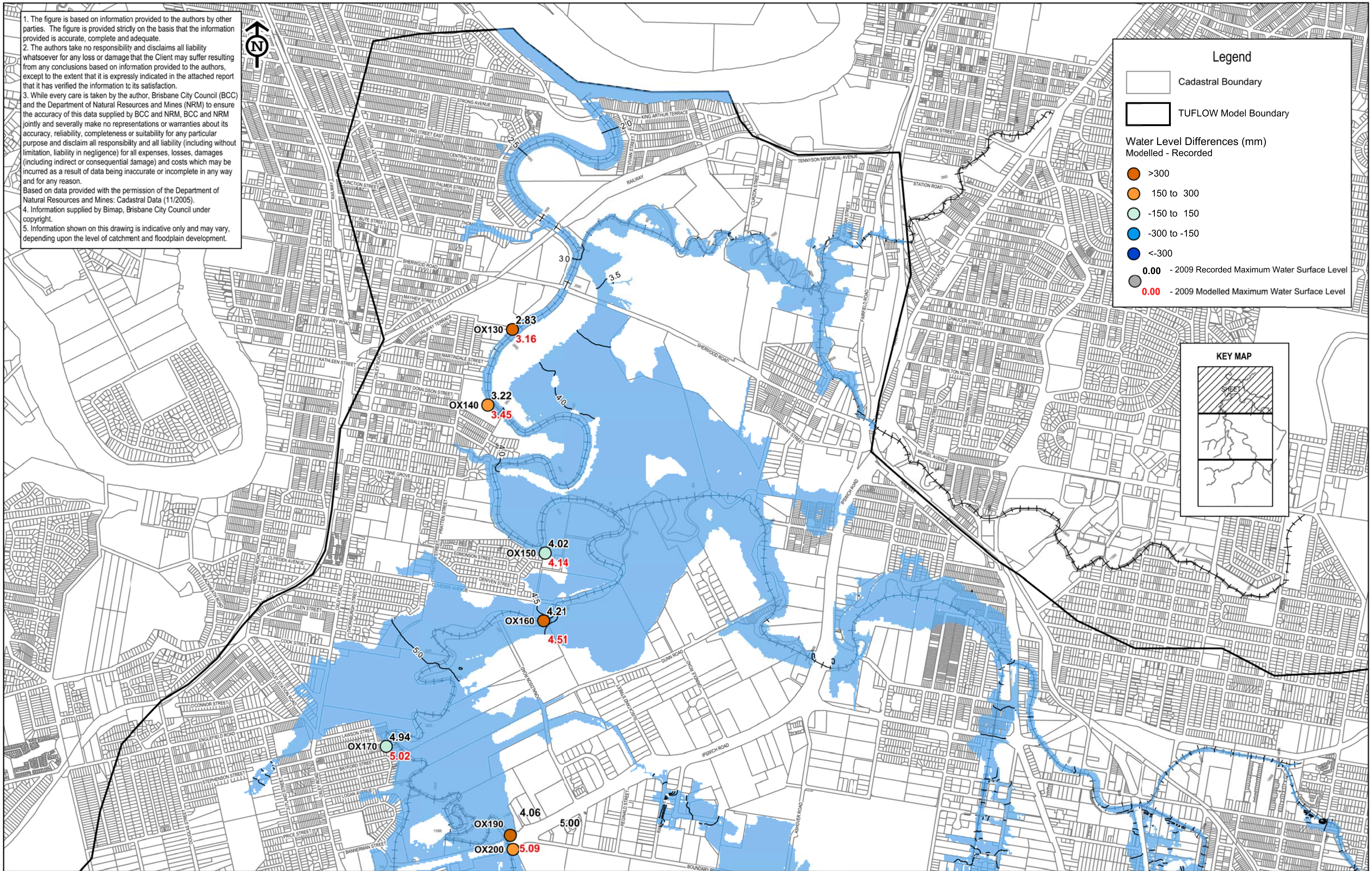

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See above	BRISBANE CITY	BRISBANE CITY COUNCIL	OXLEY CREEK FLOOD STUDY	0 500 1,000 (m) Scale 1:20,000 (A3)	FIGURE 5-7 SHEET 1 of 3 2009 EVENT PEAK WATER LEVELS	Figure 5-7-1 Revision: 3 Date: 19/07/13

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Legend

Cadastral Boundary

TUFLOW Model Boundary

Water Level Differences (mm)
Modelled - Recorded

- >300
- 150 to 300
- -150 to 150
- -300 to -150
- <-300

0.00 - 2009 Recorded Maximum Water Surface Level
0.00 - 2009 Modelled Maximum Water Surface Level

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See above	BRISBANE CITY	BRISBANE CITY COUNCIL	OXLEY CREEK FLOOD STUDY	0 500 1,000 (m) Scale 1:20,000 (A3)	FIGURE 5-7 SHEET 2 of 3 2009 EVENT PEAK WATER LEVELS	Figure 5-7-2
						Revision. 3
						Date. 19/07/13

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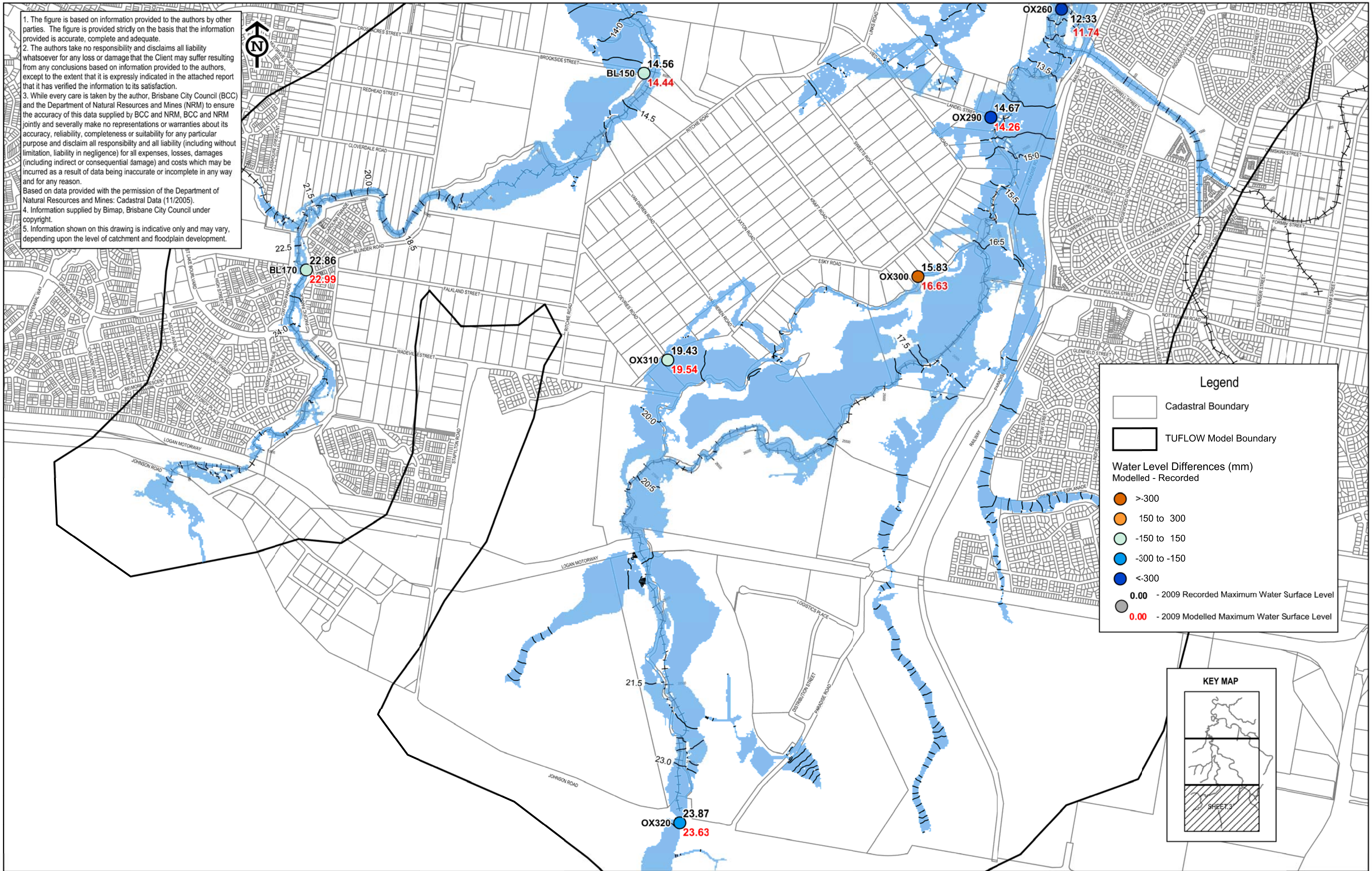

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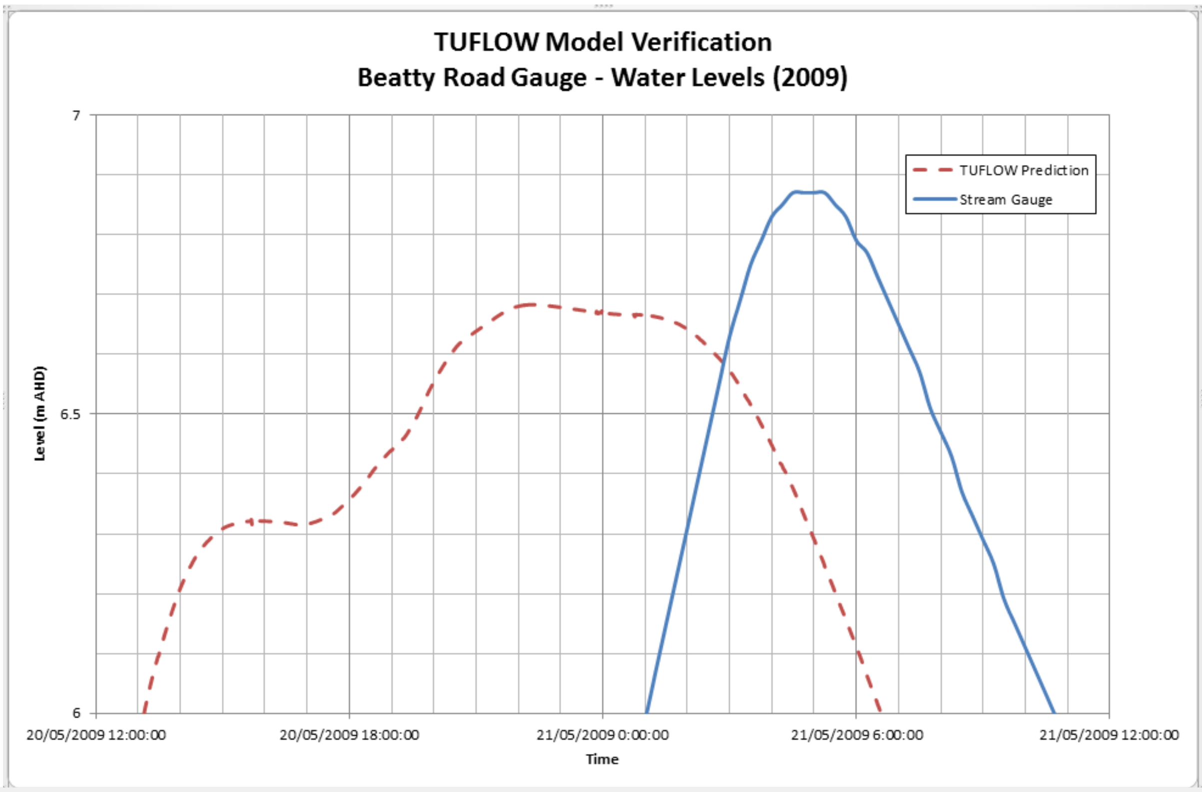

Figure 5-8 | Beatty Road gauge water level verification (May 2009 event)

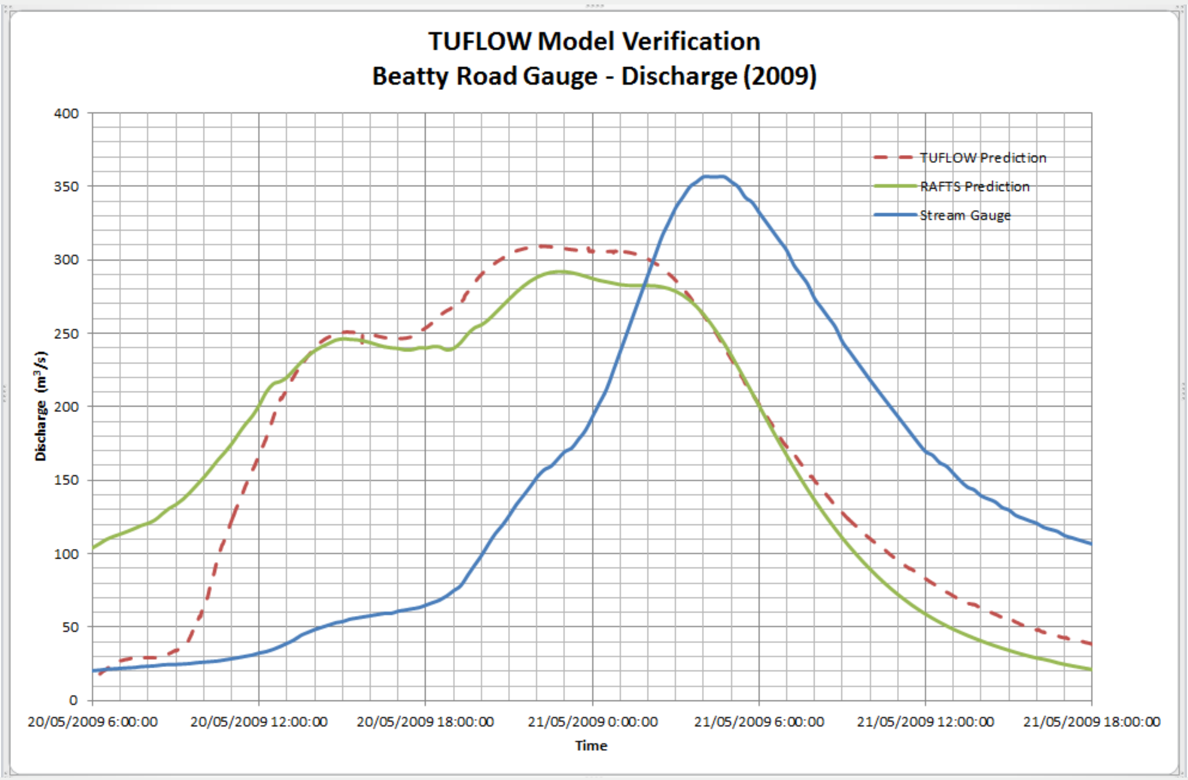

Figure 5-9 | Beatty Road gauge discharge verification (May 2009 event)

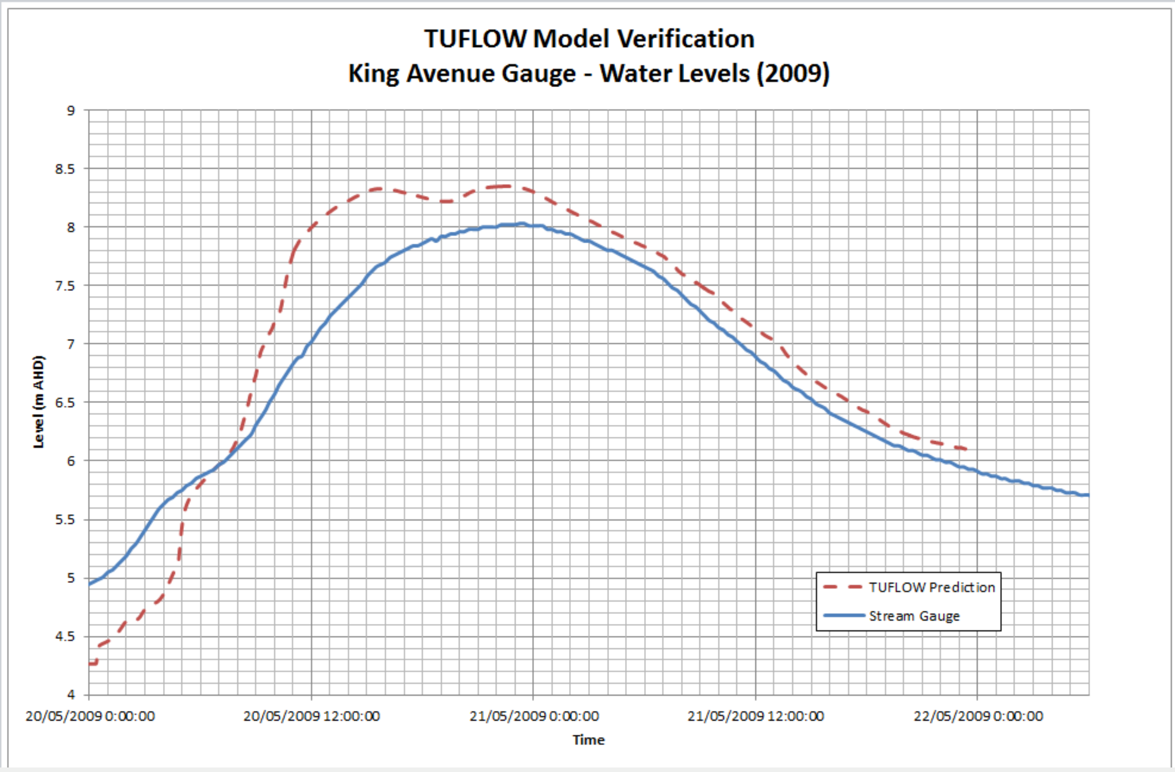

Figure 5-10 | King Avenue gauge water level verification (May 2009 event)

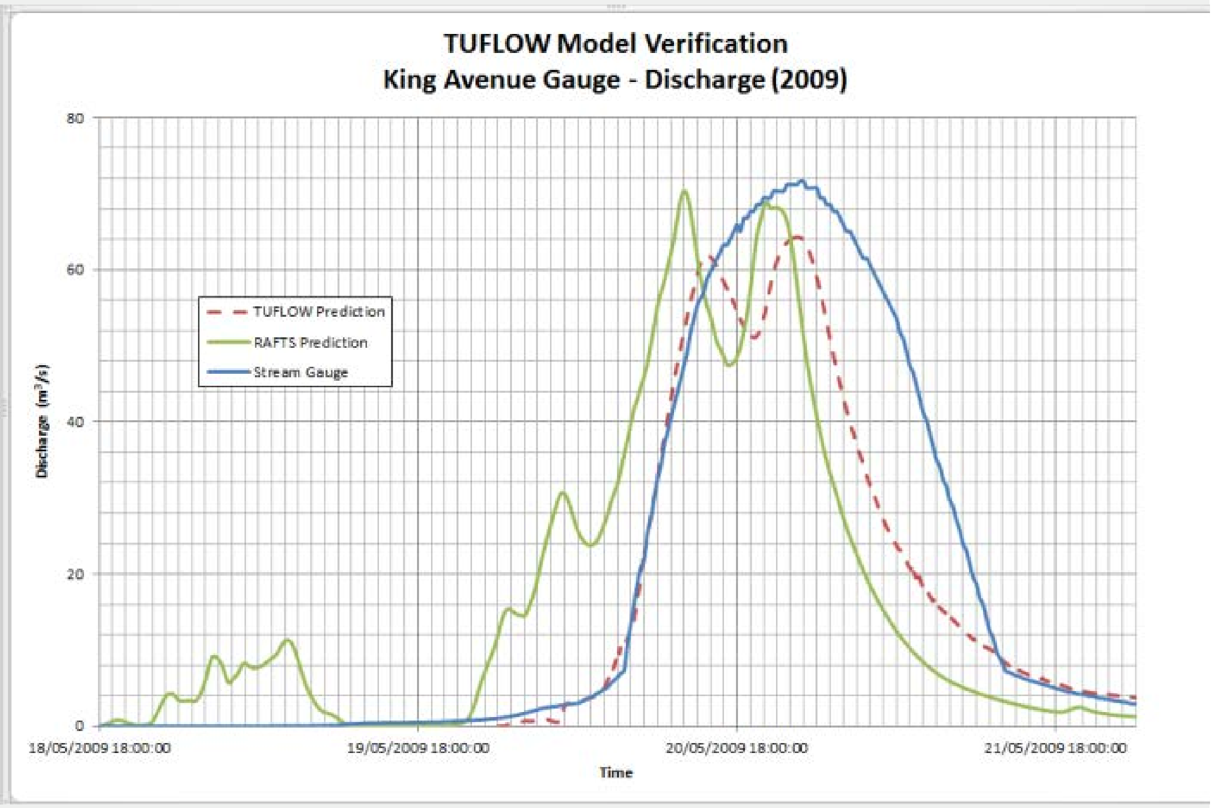

Figure 5-11 | King Avenue gauge discharge verification (May 2009 event)

5.5.5 2009 verification to maximum height gauges

Table 22 presents a summary of the peak water levels calculated at the Maximum Height Gauges and a comparison to the recorded data. A calibration tolerance of 0.3 m has been adopted.

Table 22 | Verification results at maximum height gauges

Gauge Location	Gauge ID	Recorded Peak Water Level (m AHD)	Calculated Peak Water Level (m AHD)	Difference (mm)
Oxley Creek				
#N/A	OX320	23.87	23.63	-240
Devries Road	OX310	19.43	19.54	114
Kraft Road	OX300	15.83	16.63	801
#N/A	OX290	14.67	14.26	-410
#N/A	OX260	12.33	11.74	-590
#N/A	OX250	9.70	10.20	500
#N/A	OX230	7.65	7.03	-623
Colebard Street	OX220	5.81	5.89	80
Ipswich Road (US)	OX200	5.00	5.19	192
Ipswich Road (DS)	OX190	4.06**	5.09	-
Kendall Street	OX170	4.94	5.02	81
Cliveden Avenue	OX160	4.21	4.51	300
Archer Parade	OX150	4.02	4.14	120
Erinvale Street	OX140	3.22	3.45	230
Kennard Street	OX130	2.83	3.16	330
Blunder Creek				
Blunder Road	BL170	22.86	22.99	130
Brookside Street	BL150	14.56	14.44	-122
Sherbrooke Road	BL130	9.89	10.07	180
Bowhill Road	BL120	5.77	6.05	280
Kippax Street	BL110	5.32	5.49	170
Riviera Court	BL100	5.09	5.31	220

**Suspected malfunction

5.5.5.1 Verification in the upper reaches of Oxley Creek (upstream of Ipswich Road)

At gauge OX320 the model underpredicts the flood levels by 0.2 m, while a 0.8 m over prediction at Kraft Road (OX300) is also observed. At Devries Road (OX310) the model compares well with the recorded data.

Between gauges OX290 and OX230 the predicted water levels are outside of the allowable threshold of 0.3 m, varying by between -0.6 m and +0.5 m. This reach contains sand-mines and due to potential changes in the terrain owing to flood events or industrial processes, these changes may not be represented in the base topographic data. This could contribute to the discrepancies that are present in the results.

5.5.5.2 Verification in the middle reaches of Oxley Creek (Ipswich Road to Kendall Road)

While the gauge downstream of Ipswich Road (OX190) malfunctioned the other model predictions in this reach of Oxley Creek show a good comparison with recorded water levels, with all differences being less than the allowable threshold.

5.5.5.3 Verification in the lower reaches of Oxley Creek (downstream of Kendall Road)

With the exception of the Kennard Street gauge (OX130) which is just outside the tolerance threshold of 0.3 m, all other predictions at operational gauges correlate well.

5.5.5.4 Verification in Blunder Creek

All gauges on Blunder Creek show a good correlation with the differences being less than the 0.3 m threshold.

5.5.6 2009 flood level comparison

The 1996 model outputs were compared to the design event results to estimate the ARI of the 1996 event. The results are as follows for Oxley Creek:

- Johnson Road – just greater than a 2 year ARI
- Beatty Road – between a 2 and 5 year ARI
- Ipswich Road – just greater than a 5 year ARI

The results are as follows for Blunder Creek:

- King Avenue – between a 2 and 5 year ARI

5.6 Consistency between RAFTS and TUFLOW models

Further to the consistency checks between the RAFTS and TUFLOW models at the Beatty Road and King Avenue gauges, consistency checks were carried out at the following locations for both the 1996 and 2009 events:

- Oxley Creek – Upstream of Sheepstation Gully confluence – RAFTS Sub-catchment OXC-126
- Oxley Creek – Downstream of Oxtrib1 confluence – RAFTS Sub-catchment OXC-149
- Oxley Creek – Upstream of Sherwood Road – RAFTS Sub-catchment OXC-154
- Blunder Creek – Between Forest Lake Boulevard and Blunder Road – RAFTS Sub-catchments BLC-21
- Blunder Creek Tributaries – Upstream of Blunder Creek confluence – RAFTS Sub-catchment BLC-40

5.6.1 1996 calibration event

Table 23 shows a comparison of peak discharges predicted by the RAFTS and TUFLOW models at the locations specified above for the 1996 calibration event.

Figure 5-12 to Figure 5-16 present a comparison of discharge hydrographs predicted by the RAFTS and TUFLOW models at the above locations for the 1996 calibration event.

Table 23 | Peak discharge predictions at key locations (RAFTS and TUFLOW models) for 1996 event

Location	RAFTS peak discharge (m^3/s)	TUFLOW Peak discharge (m^3/s)
Oxley Creek – Upstream of Sheepstation Gully confluence RAFTS sub-catchment OXC-126	301	286
Oxley Creek – Downstream of Oxtrib1 confluence RAFTS sub-catchment OXC-149	457	423
Oxley Creek – Upstream of Sherwood Road RAFTS sub-catchment OXC-154	497	457
Blunder Creek – Between Forest Lake Boulevard and Blunder Road RAFTS sub-catchment BLC-21	57	53
Blunder Creek Tributaries – Upstream of Blunder Creek confluences RAFTS sub-catchment BLC-36&37	66	42

The results show an acceptable level of hydrologic and hydraulic consistency has been achieved for the calibration event with respect to the predicted peak discharges. The shapes of hydrographs predicted by RAFTS and TUFLOW models are consistent. There is a discrepancy observed on Blunder Creek (BLC36&37) with TUFLOW under predicting the discharge by approximately 30%. The slight difference in hydrograph shape (and the lag) at the downstream end of Oxley Creek (ie RAFTS Node OXC-154 and 149) is due to the influence of the downstream boundary condition and the water break-out through the Sherwood Road (overflow) culverts. The hydrologic model cannot account for such downstream influences.

5.6.2 2009 verification event

Table 24 shows a comparison of peak discharges predicted by the RAFTS and TUFLOW models at the locations specified above for the 2009 verification event.

Figure 5-17 to Figure 5-21 present a comparison of discharge hydrographs predicted by the RAFTS and TUFLOW models at the above locations for the 2009 verification event.

Table 24 | Peak discharge predictions at key locations (RAFTS and TUFLOW models) for 1996 event

Location	RAFTS peak discharge (m^3/s)	TUFLOW Peak discharge (m^3/s)
Oxley Creek – Upstream of Sheepstation Gully confluence RAFTS sub-catchment OXC-126	274	261
Oxley Creek – Downstream of Oxtrib1 confluence RAFTS sub-catchment OXC-149	379	379
Oxley Creek – Upstream of Sherwood Road RAFTS sub-catchment OXC-154	426	402
Blunder Creek – Between Forest Lake Boulevard and Blunder Road RAFTS sub-catchment BLC-21	64	55
Blunder Creek Tributaries – Upstream of Blunder Creek confluences RAFTS sub-catchment BLC-36&37	52	56

The results show a good level of hydrologic and hydraulic consistency has been achieved for the verification event with respect to the predicted peak discharges. The shapes of hydrographs predicted by RAFTS and TUFLOW models are also very consistent. Note that the slight difference in hydrograph shape (and the lag) at the downstream end of Oxley Creek (ie RAFTS Node OXC-154 and 149) is due to the influence of the downstream boundary condition and the water break-out through the Sherwood Road (overflow) culverts. The hydrologic model cannot account for such downstream influences.

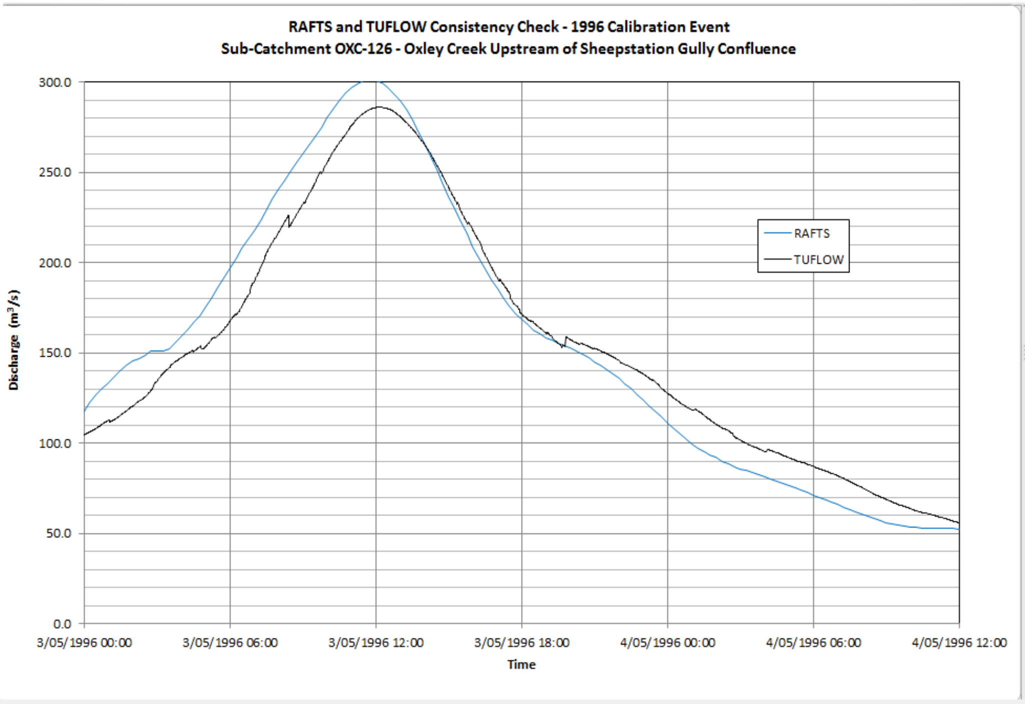

Figure 5-12 | 1996 RAFTS and TUFLOW consistency check – sub-catchment OXC-126

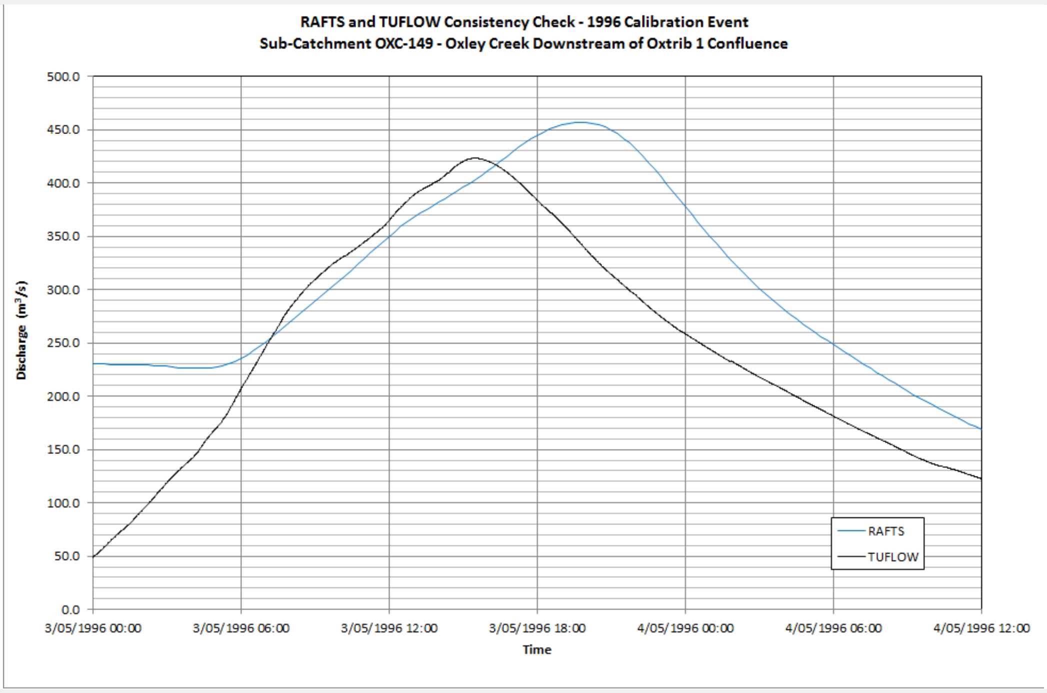

Figure 5-13 | 1996 RAFTS and TUFLOW consistency check – sub-catchment OXC-149

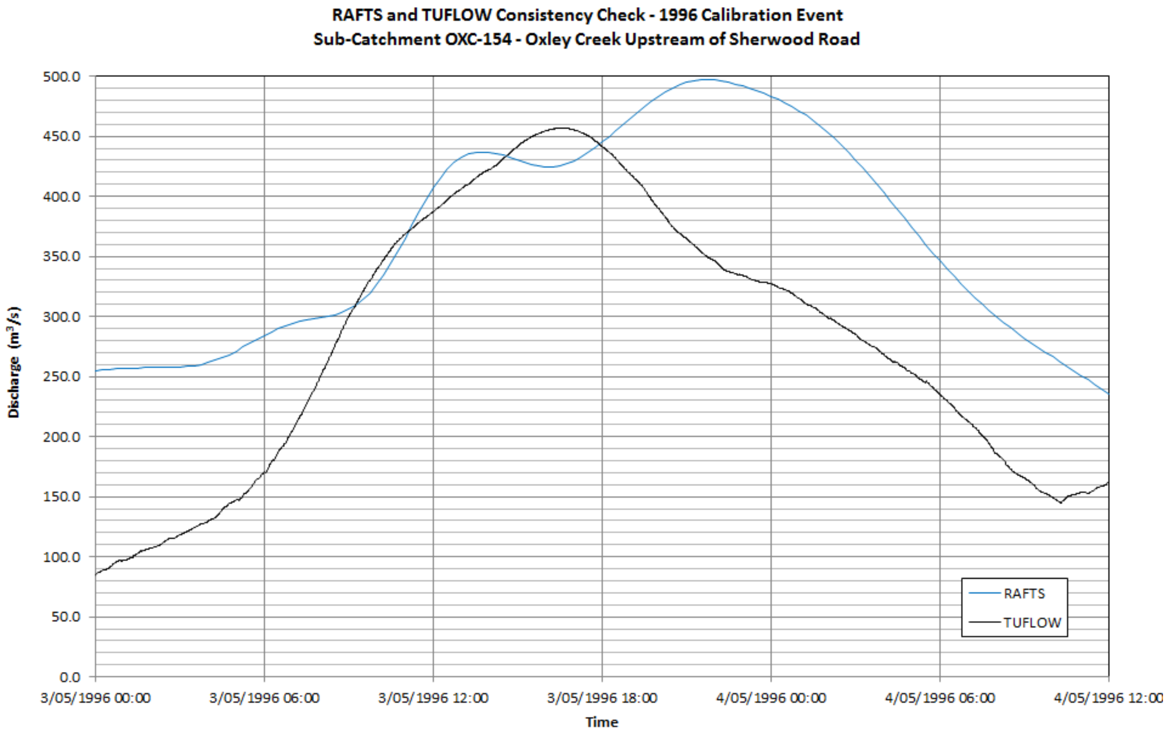

Figure 5-14 | 1996 RAFTS and TUFLOW consistency check – sub-catchment OXC-154

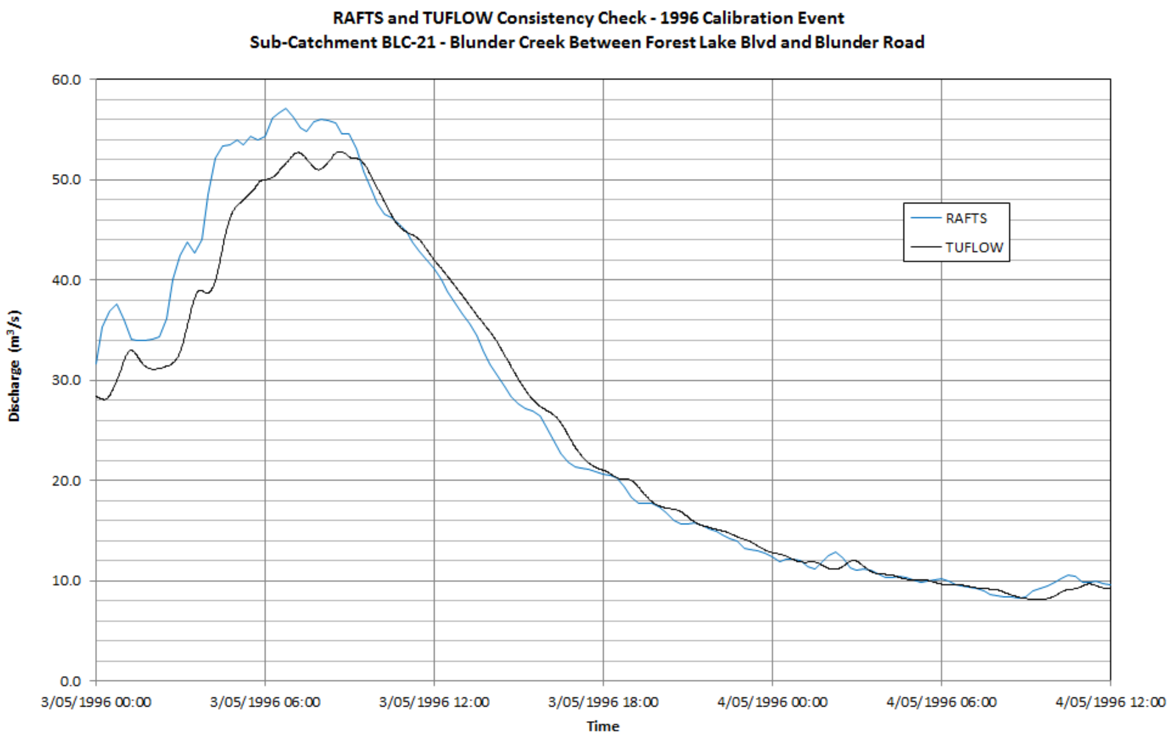

Figure 5-15 | 1996 RAFTS and TUFLOW consistency check – sub-catchments BLC-21

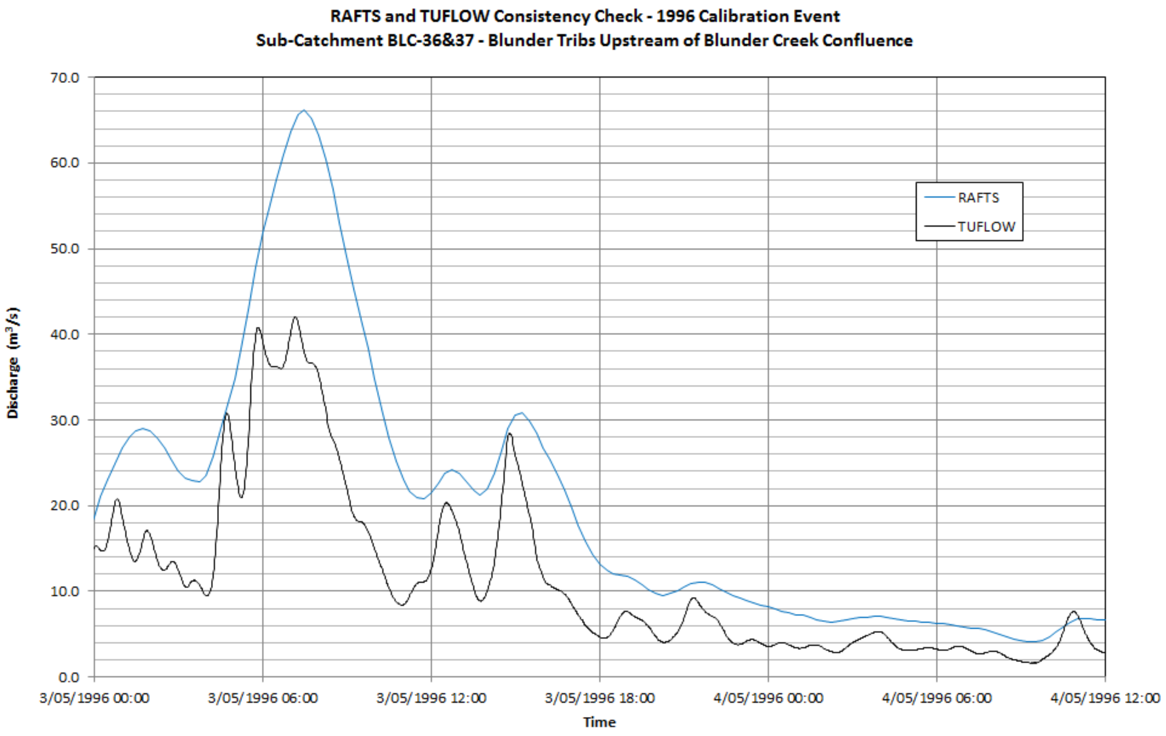

Figure 5-16 | 1996 RAFTS and TUFLOW consistency check – sub-catchments BLC-36&37

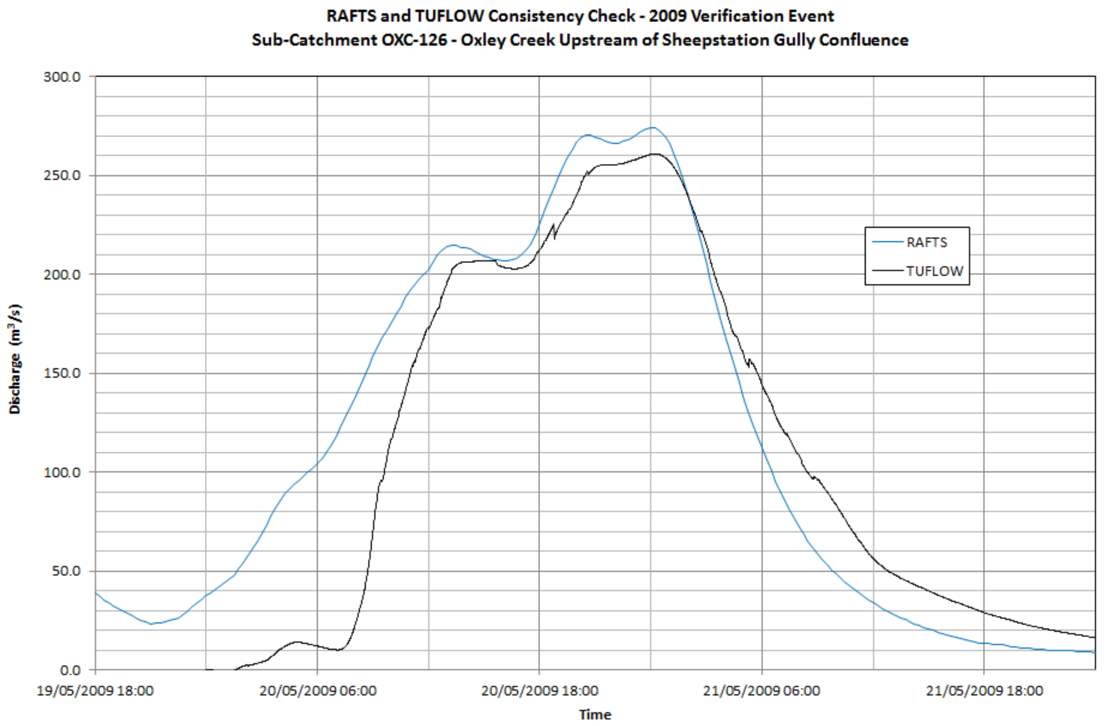

Figure 5-17 | 2009 RAFTS and TUFLOW consistency check – sub-catchment OXC-126

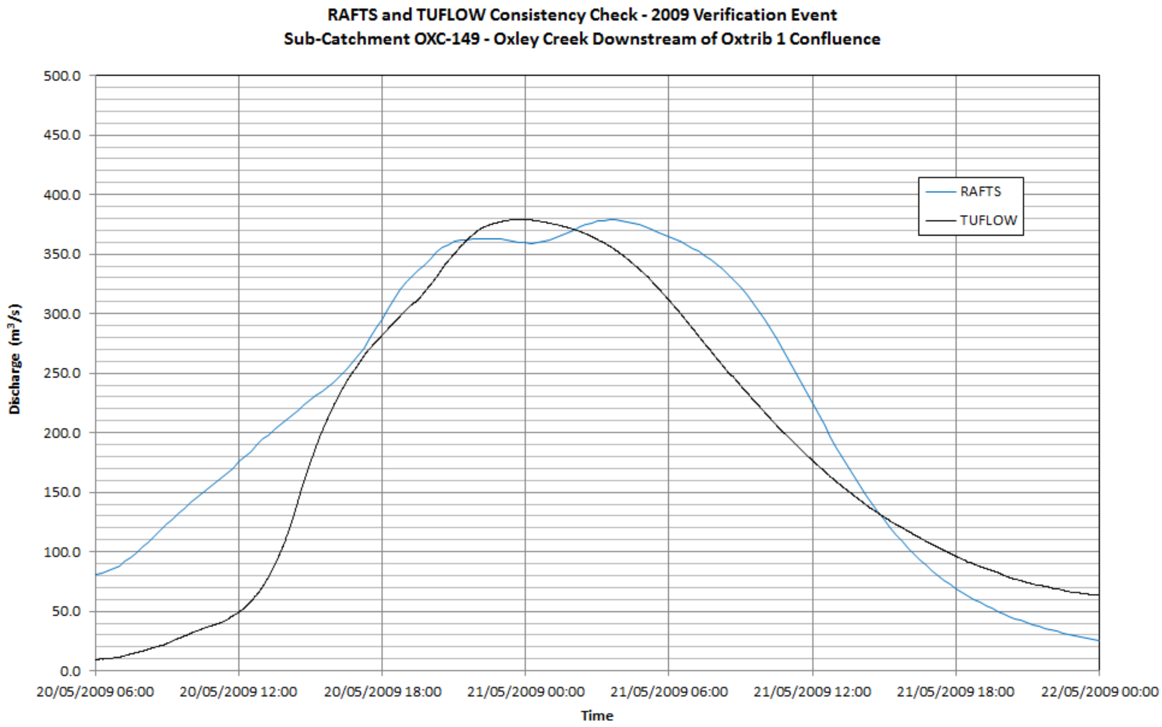

Figure 5-18 | 2009 RAFTS and TUFLOW consistency check – sub-catchment OXC-149

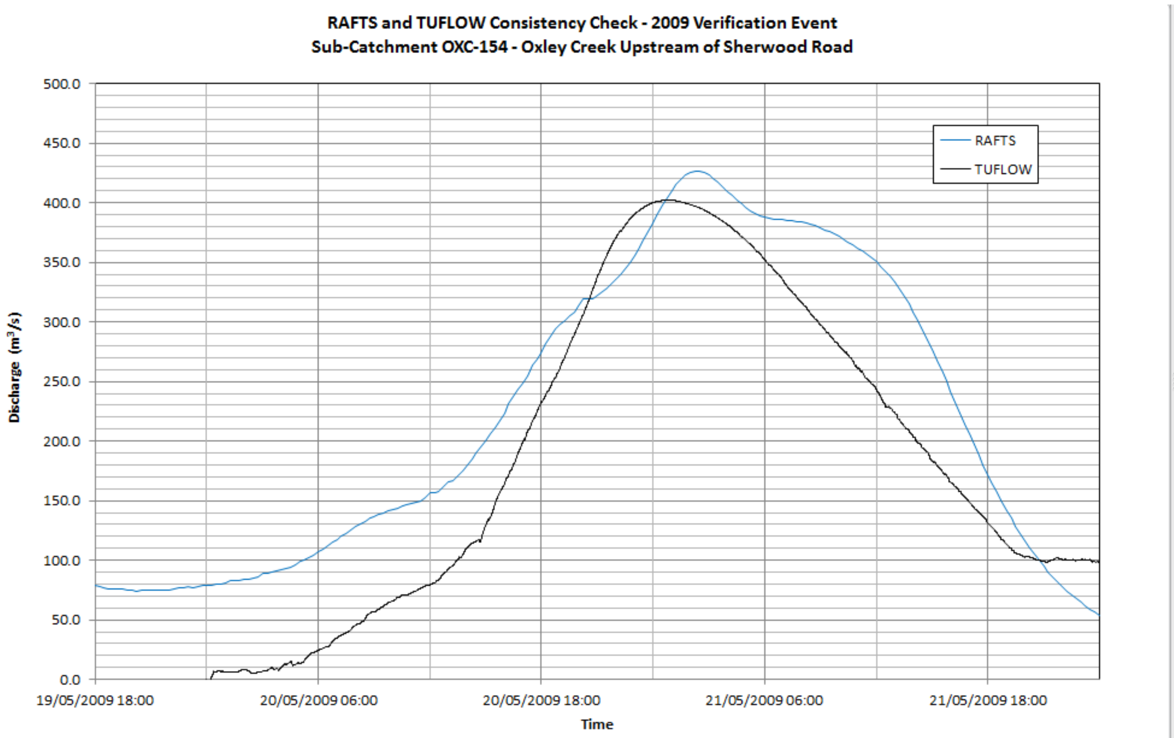

Figure 5-19 | 2009 RAFTS and TUFLOW consistency check – sub-catchment OXC-154

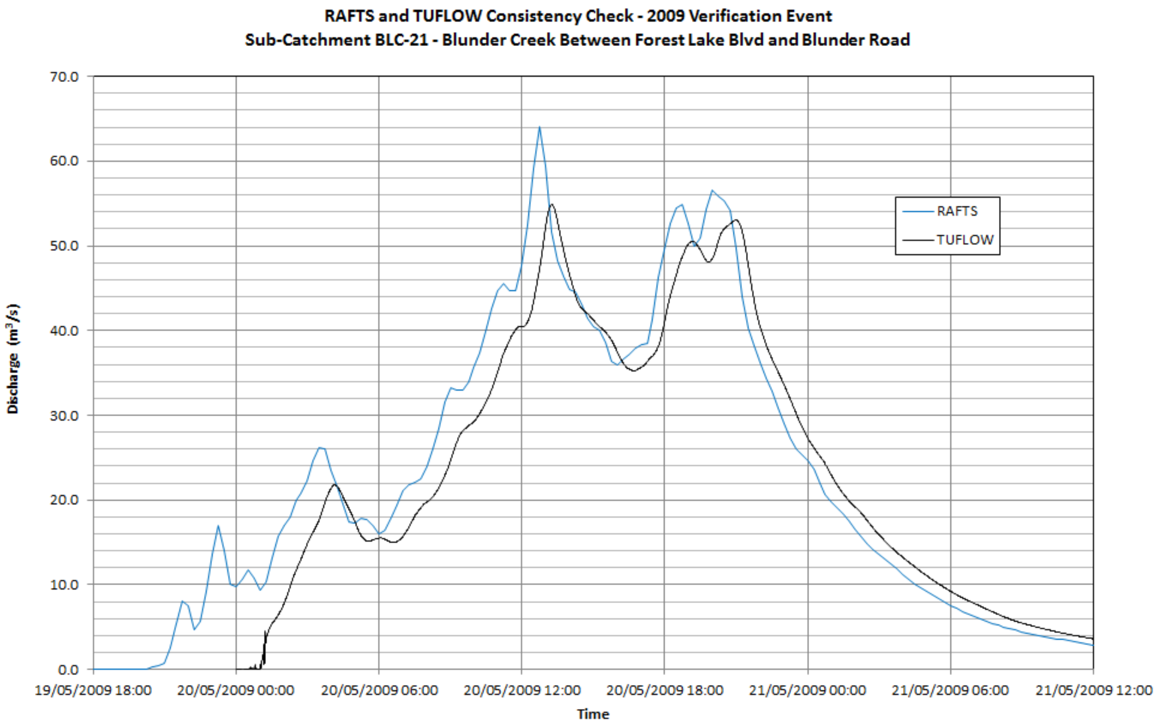

Figure 5-20 | 2009 RAFTS and TUFLOW consistency check – sub-catchments BLC-21

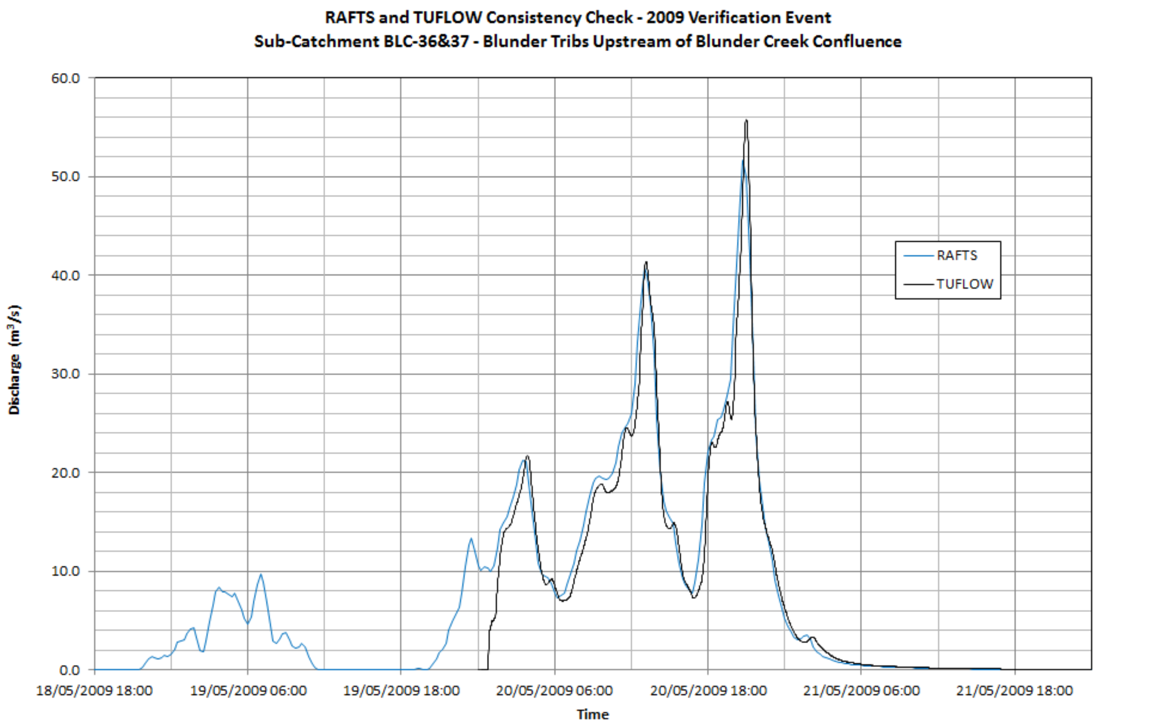

Figure 5-21 | 2009 RAFTS and TUFLOW consistency check – sub-catchments BLC-36&37

6 Conclusions

6.1 Study findings

Hydrologic and hydraulic models of the Oxley Creek system have been developed using the RAFTS and TUFLOW modelling softwares respectively. The RAFTS model covers the entire Oxley Creek catchment while two hydraulically discrete TUFLOW models have been developed for the BCC and LCC reaches of Oxley Creek. This report discusses the joint calibration of the RAFTS model with the BCC TUFLOW model of the creek system.

The RAFTS calibration was carried out based on two historical events (1990 and 1996). The RAFTS model was then verified against the 2009 event.

Calibration data for the three aforementioned events was provided at the outset of the project. This data included:

- Daily rainfall station recordings
- Pluviograph station data
- Recorded streamflow gauge data and
- Maximum height gauge recordings (although no MHG recordings were available in the LCC domain)

The BCC TUFLOW model was calibrated to the 1996 event only. Calibration was undertaken using the information listed above and by fine tuning the Manning's roughness parameters.

A good correlation between the predicted and gauged peak discharges for the 1996 event was observed for the RAFTS calibration. Good agreement was also apparent in terms of hydrograph timing and flood volume. Calibration and verification of the TUFLOW model was undertaken for the Beatty Road and King Avenue gauges. For the 1996 calibration event the discrepancies were 0.11 m and 0.18 m respectively. For the 2009 verification event the discrepancies were 0.16 m and 0.31 m respectively. A target tolerance of 0.15 m was set at the outset of the exercise. Generally speaking the timing and volumetric comparison between recorded and predicted data was reasonable for the 1996 event. Some discrepancies were observed during the 2009 event at Beatty Road and King Avenue which may be related to the spatial and temporal variations in the recorded rainfall (ie not being accurately represented due to the sparseness of the gauges), storage at sand mines, and the vegetative condition of the creek.

Flood levels were also compared at 24 and 21 MHG's for the 1996 and 2009 event respectively. A good correlation was observed across both events with the vast majority of readings being within the 0.3 m target tolerance that had been specified. In the areas where it significantly exceeded this threshold it is expected that changing topography due to natural and industrial process at sand-mines was a contributory factor.

It is acknowledged that the calibration of the Oxley Creek RAFTS model is not straightforward due to a number of factors including the sparseness of the rain-gauge data, the uncertainty in rating curves, the variation in losses that is likely across the catchment, etc. Taking this into account the results of the calibration are deemed satisfactory and provide a good basis from which to model the design events.

A good consistency is also achieved between the RAFTS and BCC TUFLOW model throughout the system. This comparison was undertaken at five locations for both the 1996 and 2009 events.

6.2 Limitations

It is important to note the following when reading this report:

- The RAFTS calibration accuracy is directly related to the accuracy of the calibration data
- The BCC TUFLOW model has been calibrated to the 1996 historical event. Calibration of the model is based upon the data documented in this report. The calibration accuracy is directly related to the accuracy of the calibration data provided. The same applies to the 2009 verification event
- ALS data has been used to represent the topography above standing water level. Whilst spot checks of this data have shown reasonable agreement with other available information, detailed verification of the information has not been undertaken
- Bathymetric survey data for certain submerged areas (eg the sand mines) was not available for use in developing the TUFLOW model

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Report B

Design Events Report

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1 Introduction

This report follows on from the Hydrology and Hydraulic Calibration and Verification Report (Rev 2, May 2013) that was prepared for Brisbane City Council (BCC). It documents the assessment of design event flooding in the BCC domain of the Oxley Creek catchment based on the calibrated models.

1.1 Study objectives and scope of work

1.1.1 Project objectives

The primary objectives of this project were to:

- Undertake design flood estimation
- Utilise the calibrated RAFTS model to undertake design event hydrologic modelling
- Incorporate the design discharge hydrographs into the calibrated hydraulic model to compute the design event flood levels, velocities, for the range of specified scenarios agreed with Council. This includes incorporating revegetation of the Minimum Riparian Corridor (MRC) and Waterway Corridor
- Undertake modelling of extreme flood events
- Assess the potential for higher rainfall intensities associated with climate change to increase flood levels

1.1.2 Project scope

The following tasks were identified as being critical to achieve the project objectives outlined above:

- Simulate design rainfall events within the calibrated RAFTS model
- Use the TUFLOW model to assess peak water levels under a range of design events (1, 2, 5, 10, 20, 50, 100 year Average Recurrence Interval (ARI))
- Modifying the TUFLOW model to account for the MRC
- Modifying the TUFLOW model to account for the Waterway Corridor
- Using the TUFLOW model to assess peak water levels for a range of extreme design events (200, 500 and 2000 year ARI events, and the Probable Maximum Flood (PMF))
- Use the TUFLOW model to assess changes in peak water levels for two climate change scenarios
- Prepare flood mapping of the TUFLOW model outputs to accompany the design event report

1.2 Scope of this report

This report details the design event, extreme event and climate change flooding assessment. It presents the changes made to the RAFTS and TUFLOW models in representing these events and presents the outcomes of the assessments.

2 Study data

2.1 Design storms

Design storms were developed for the Oxley Creek catchment in line with the recommendations outlined in Australian Rainfall and Runoff (AR&R). In advance of this a flood frequency analysis was first carried out using 101 years of historical rainfall data for the Brisbane CBD. This was used to assess the design rainfall events and set appropriate loss rates within the RAFTS model. The findings of the flood frequency analysis are presented and discussed in Section 3.1.

2.2 Other model data

In addition the project also utilised the following information:

- Aerial photography of the model area
- Cadastral information within the model area
- Other model setup information as discussed in the Hydrology and Hydraulic Calibration and Verification Report (Rev 2, May 2013) eg topographic data, cross-sectional data, etc
- Waterway Corridor layouts provided by Council

3 Hydrologic modelling

3.1 Frequency analysis

3.1.1 Background

The period of record for stream gauges within the Oxley Creek catchment is generally of the order of 35 to 40 years as most of the gauges were commissioned in the early 1970s. Given the relatively short period of record for these stream gauges and the unreliability of the gauges during a number of major flood events, the historical data is not well suited to flood frequency analysis. On this basis, the calibrated RAFTS model was used to generate a synthetic historical series of annual peak discharges for flood frequency analysis.

This analysis assumed Brisbane CBD rainfall was representative of historical rainfall in the Oxley Creek catchment as a whole. The Brisbane CBD rainfall was adopted as a full record of rainfall events, as pluviograph information within the Oxley Creek catchment was not available.

Brisbane City Council provided 101 years (1911 to 2011) of continuous rainfall records at the Brisbane CBD in RAFTS format, with the maximum 30 minute, 1, 2, 3, 6, 9, 12, 24, 48 and 72 hour burst computed for each year. These storms were run through the existing state RAFTS model and the annual maximum flows at the following locations along Oxley Creek were tabulated at the following locations.

- Johnson Road – Oxley Creek
- Beatty Road – Oxley Creek
- King Avenue – Blunder Creek
- Ipswich Road – Oxley Creek

Rainfall losses adopted for the flood frequency analysis were zero initial and zero continuing loss for all of the years modelled. Adoption of a zero initial loss recognises the fact that as the series of storms contain the worst burst of rainfall for a given duration, there is no consideration given to the antecedent rainfall. Therefore it is not appropriate to include an initial loss. The zero continuing loss was established during the calibration phase of the study.

3.1.2 IFD factoring

The CBD rainfall data was not factored to account for its location relative to the Oxley Creek catchment. Over the course of the flood frequency analysis, Brisbane City Council and Logan City Council elected to adopt this approach. Other approaches were tested but the use of unfactored CBD rainfall data was deemed the most appropriate.

3.1.3 FFA distribution

In line with current AR&R guidelines the Log-Pearson III distribution was used in undertaking the flood frequency analysis. This was observed to provide a good fit for the data (refer to the plots provided in Appendix F).

3.1.4 Results

Table 1 below shows the results of the flood frequency analysis.

Table 1 | RAFTS peak discharges from Flood Frequency Analysis

Return Period (years)	Probability of Exceedence (%)	Rafts Peak Flow (m^3/s)			
		Johnson Road Oxley Creek	Beatty Road Oxley Creek	Ipswich Road Oxley Creek	King Avenue Blunder Creek
100	1	663	715	887	183
50	2	589	638	786	162
20	5	492	535	653	135
10	10	417	456	552	115
5	20	341	374	448	95
2	50	228	251	296	66

Table 2 below shows the results that were obtained by running the standard AR&R storms through the RAFTS model (these have been termed the 'unfactored' storms). Note that this analysis was based on zero initial and zero continuing losses.

Table 2 | RAFTS peak discharges from unfactored AR&R storms

Return Period (years)	Probability of Exceedence (%)	Rafts Peak Flow (m^3/s)			
		Johnson Road Oxley Creek	Beatty Road Oxley Creek	Ipswich Road Oxley Creek	King Avenue Blunder Creek
100	1	623	677	818	158
50	2	548	594	715	137
20	5	471	511	613	113
10	10	394	431	515	97
5	20	333	363	429	84
2	50	239	259	299	66

It is evident that the results presented in Table 2, with the exception of the 2 year ARI event, are lower than those presented in Table 1.

In discussions with Council it was decided that the AR&R design rainfall intensities would be scaled up using a suitable factor that gives the best comparison between both sets of discharge results. Accordingly a scaling factor was applied to all but the 2 year ARI design rainfall intensities.

The factor that was applied to the 100, 50, 20, 10, 5 and 2 year ARI design rainfall intensities is shown in Table 3. The corresponding discharge data based on the scaled rainfall intensities is shown in Table 4.

Table 3 | Design rainfall intensity scaling factors

Return Period (years)	Probability of Exceedence (%)	Rainfall intensity scaling factor
100	1	1.07
50	2	1.08
20	5	1.06
10	10	1.06
5	20	1.03
2	50	1.00

Table 4 | RAFTS peak discharges from factored AR&R storms

Return Period (years)	Probability of Exceedence (%)	Rainfall intensity scaling factor	Rafts Peak Flow (m^3/s) and % difference Existing Catchment			
			Oxley Creek	Oxley Creek	Oxley Creek	Blunder Creek
			Johnson Road Oxley Creek	Beatty Road Oxley Creek	Ipswich Road Oxley Creek	King Avenue
100	1	1.07	671 (1%)	727 (2%)	875 (-1%)	176 (-4%)
50	2	1.08	596 (1%)	643 (1%)	772 (-2%)	154 (-5%)
20	5	1.06	501 (2%)	537 (0%)	642 (-2%)	123 (-9%)
10	10	1.06	418 (0%)	460 (1%)	549 (1%)	104 (-9%)
5	20	1.03	342 (0%)	374 (0%)	444 (-1%)	88 (-7%)
2	50	1.00	239 (5%)	259 (3%)	299 (1%)	66 (0%)

Note: Figures in (%) represent the percentage difference in flow compared to the flood frequency analysis results in Table 1

From the results it is clear that a very good comparison is achieved throughout Oxley Creek with peak discharges only differing by approximately 1% to 2% from the flood frequency analysis results. However, on Blunder Creek the scaled rainfall intensity approach results in peak discharges which are still less than that predicted by the flood frequency analysis. The 100 and 50 year ARI events are in the order of 5% less, while the 20 and 10 year ARI events are up to 9% less.

The calibration and verification event peak flows, along with their respective return periods are shown in Table 5. These return periods were derived by locating each historical event, using the peak flow, upon the line of best fit obtained from the flood frequency analysis.

Table 5 | Estimated return periods for historical flood events

Historical event	Johnson Road Oxley Creek		Beatty Road Oxley Creek		King Avenue Blunder Creek		Ipswich Road Oxley Creek	
	Flow (m^3/s)	ARI (years)	Flow (m^3/s)	ARI (years)	Flow (m^3/s)	ARI (years)	Flow (m^3/s)	ARI (years)
April 1990	376	7	407	8	63	2	468	6
May 1996	265	3	327	4	75	3	421	5
May 2009	259	3	292	3	70	2	375	3

3.2 Design events

3.2.1 Catchment development conditions

The design events were modelled using ultimate catchment development conditions. These conditions assume that the state of development within the catchment is in its ultimate condition. This affects the adopted percentage impervious values for each sub-catchment.

Within the BCC domain of the Oxley Creek catchment, the future land-use was discretised based on the BCC CityPlan. The actual land-use (ie from aerial photography taken in 2011) was also cross-checked against the CityPlan zoning. Where an area was identified to have undergone development but was zoned to be greenfield, the area of development was incorporated. This discretisation representing the future catchment development is suitable for the prediction of the design events.

Within the LCC domain of the Oxley Creek catchment the sub-catchment parameterisation has generally been set with reference to the supplied 2011 aerial imagery, which is generally consistent with LCC land-use planning. In terms of the catchment conditions, this portion of the catchment is predominantly a mixture of forested terrain and residential development. At New Beith and Greenbank extensive residential development has taken place over the past two decades. However this area is bounded by densely forested terrain to the north (Greenbank Military Camp) and south (Spring Mountain Forest Park), both of which are unlikely to see any major change in terms of development.

Appendix B presents the percentage impervious values for each RAFTS model sub-catchment.

3.2.2 Synthetic design storms

Referring to Section 3.1.4 the AR&R design storms were used in establishing the design discharge hydrographs, noting that the rainfall intensities were factored as per the information presented in Table 3.

Table 6 and Table 7 below outline the standard intensities and the factored intensities for comparative purposes.

The results of the FFA also enabled the design event rainfall losses to be set. Accordingly, both the initial and continuing losses were set to zero.

Table 6 | Unfactored IFD data

Raw AR&R IFD Data from BOM							
Duration (hrs)	1 Year	2 years	5 years	10 years	20 years	50 years	100 years
0.333	65.1	84.1	107.5	121.7	140.7	166.1	185.9
0.5	53.1	68.6	88.2	100.0	115.9	137.2	153.8
0.75	42.2	54.7	70.6	80.2	93.2	110.5	124.0
1	35.4	45.9	59.3	67.6	78.5	93.3	104.8
1.5	27.0	35.1	45.6	52.0	60.5	72.0	80.9
2	22.1	28.7	37.3	42.6	49.6	59.1	66.5
3	16.4	21.3	27.8	31.8	37.1	44.3	49.9
4.5	12.1	15.8	20.6	23.6	27.6	32.9	37.1
6	9.8	12.7	16.7	19.1	22.3	26.7	30.1
9	7.3	9.5	12.5	14.3	16.7	20.0	22.6
12	6.0	7.8	10.2	11.7	13.7	16.4	18.5
18s	4.6	6.0	7.9	9.0	10.5	12.6	14.2

Raw AR&R IFD Data from BOM							
Duration (hrs)	1 Year	2 years	5 years	10 years	20 years	50 years	100 years
24	3.8	5.0	6.6	7.5	8.8	10.5	11.9
48	2.5	3.2	4.2	4.8	5.7	6.8	7.6
72	1.8	2.4	3.1	3.6	4.2	5.0	5.6

Table 7 | Factored IFD data

Factored AR&R IFD Data							
Factor Applied	1.00	1.00	1.03	1.06	1.06	1.08	1.07
Duration (hrs)	1 Year	2 years	5 years	10 years	20 years	50 years	100 years
0.333	65.1	84.1	110.8	129.0	149.2	179.4	198.9
0.5	53.1	68.6	90.8	106.0	122.9	148.2	164.6
0.75	42.2	54.7	72.7	85.0	98.8	119.3	132.7
1	35.4	45.9	61.1	71.6	83.3	100.7	112.1
1.5	27.0	35.1	46.9	55.1	64.1	77.7	86.6
2	22.1	28.7	38.4	45.2	52.6	63.8	71.2
3	16.4	21.3	28.7	33.7	39.3	47.8	53.4
4.5	12.1	15.8	21.2	25.0	29.2	35.5	39.7
6	9.8	12.7	17.2	20.3	23.7	28.8	32.2
9	7.3	9.5	12.9	15.2	17.7	21.6	24.1
12	6.0	7.8	10.5	12.4	14.6	17.7	19.8
18	4.6	6.0	8.1	9.5	11.2	13.6	15.2
24	3.8	5.0	6.8	8.0	9.3	11.4	12.7
48	2.5	3.2	4.4	5.1	6.0	7.3	8.1
72	1.8	2.4	3.2	3.8	4.4	5.4	6.0

4 Hydraulic modelling

4.1 Modelled scenarios

The TUFLOW model was used to assess the 1, 2, 5, 10, 20, 50 and 100 year ARI events. For both the 2 year and 100 year ARI events the entire set of event durations were modelled (ie 1 hour to 72 hour).

The runs are described in the following sections, including details of how the model was modified.

4.1.1 Scenario 1: Existing conditions

Scenario1 is based on the current creek conditions. No modifications were made to the TUFLOW model developed as part of the calibration phase. Refer to Section 5 of the Hydrology and Hydraulic Calibration and Verification Report for further details.

4.1.2 Scenario 2: Minimum Riparian Corridor incorporated

The Minimum Riparian Corridor (MRC) was defined using a ‘Materials’ layer within the TUFLOW model. This involved defining a 15 m wide corridor from the edge of the channel after which a review of soil conditions and existing vegetation was undertaken. Based on this review an appropriate Manning’s n was set for specific sections of the channel. Two material types (either “High Density Forest n = 0.12 or Medium Density Forest n = 0.075) were adopted to match in with the densest nearby vegetation types.

It should be noted that in some areas a 15 m width is not available for vegetation. In these areas the Riparian Corridor has been set to the maximum possible width.

4.1.3 Scenario 3: Ultimate Conditions - Waterway Corridor incorporated

This scenario incorporated the Waterway Corridor (WC) boundary such that the WC acted to glass-wall the flow on either side of the channel. This essentially limits the lateral spread of the flow and represents full development and filling to above 100 year ARI flood levels up to the corridor boundary. This is a simple but also conservatively unrealistic assumption used to develop design levels. It does not necessarily reflect allowable development assumptions under City Plan.

The MRC roughness layer was also included in Scenario 3.

4.2 Tailwater conditions

The TUFLOW model utilised a fixed water level (HT) boundary at its downstream extent (ie the Brisbane River). BCC provided a rating curve for the Brisbane River at the Oxley Creek mouth, against which the predicted flow on Oxley Creek for a given design event (taken from the hydrologic model) was compared. Where this comparison yielded a water level in excess of the Mean High Water Springs (MHWS) tide level, this value was set as a fixed tailwater level. Where it was less than MHWS, MHWS was used (ie 1.22 mAHD).

Table 8 below outlines the tailwater levels used for the range of design events

Table 8 | Adopted tailwater elevations for design events

Return Period (years)	Tailwater Level (m AHD)
1	1.22
2	1.22
5	1.22
10	1.22
20	1.22
50	1.24
100	1.30

4.3 Model results and mapping

GIS based flood mapping was completed for the geo-referenced hydraulic model outputs. This included:

- Water surface levels (m AHD)
- Flood depth (m)

The flood mapping was completed for the following scenarios and is provided in Volume 2 of the Oxley Creek Flood Study:

- 2, 5, 10, 20, 50 and 100 year ARI flood extent mapping – Scenario 1 (Existing Conditions)
- 2, 5, 10, 20, 50 and 100 year ARI water surface level mapping – Scenario 3 (Ultimate Conditions)
- 2, 5, 10, 20, 50 and 100 year ARI water depth mapping – Scenario 3 (Ultimate Conditions)

At the request of Council, the Scenario 3 mapping was completed such that the flood levels constrained within the Waterway Corridor were extrapolated outwards until they intercepted existing ground levels. A summary of this approach is described below.

Associated tabulated peak water level and velocity results for locations throughout the model are also provided in Appendix G.

4.3.1 Flood mapping approach

At the request of Council, the Scenario 3 mapping was completed such that the flood levels constrained within the Waterway Corridor were extrapolated outwards until they reached existing ground levels.

In terms of extrapolating or‘stretching’ the flood surface grids two methods were initially trialed using the WaterRIDE and 12D softwares. However in both cases the results were not satisfactory.

The chosen method for 'stretching' the flood surface grids involved the use of the GIS package, MapInfo. It involved the manual digitisation of a large number of multi-vertex lines which would run from the edge of the flood surface to beyond the possible 'stretched' flood extent. The lines were then modified such that the vertices were transformed into points, with the elevation of water-surface level at the edge-point being attributed to all other points on the same original line. A DEM was then created using this point data, which was merged with the original flood surface grid and trimmed against the point at which it intercepted the natural topography.

The results obtained through this approach to the mapping were excellent and gave a high degree of accuracy. Note also that in looking at some of the extreme Scenario 1 inundation extents it is possible to gain a good understanding of the extent of inundation that could be expected upon 'stretching' the flood grids.

Accordingly, while this approach does require a significant investment of time at its front-end (ie in initially digitising the lines and generating points, etc), and also requires a reasonable knowledge of how the flood mechanisms occur/interact, it ultimately provides the user with a high degree of control over how the extrapolation process will behave. This is particularly important at channel bends, confluences and on smaller tributaries. It also allows the extent of backwater flooding to be easily and accurately predicted.

Overall the 'stretching' of the Ultimate/Scenario 3 flood surface grids was successful and no significantly erroneous locations were observed following examination and review of the final outputs, notwithstanding the fact that the 'stretched' flood surface is an artificially generated profile which cannot fully replicate the exact hydraulic behaviour that may occur outside of the Waterway Corridor.

4.4 Discharge predictions

Discharges predicted by the TUFLOW model were extracted at crossing locations. These discharges are presented in Table 9. Table 9 presents the total flow at that location and includes discharge through all culverts/bridges and associated bypass flow.

Table 9 | TUFLOW Peak Discharges at Major Crossing Locations for Scenario 1

Creek/ Channel	Structure Location	Peak Discharge (m^3/s)						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
Oxley Creek	Logan Motorway	688	611	514	429	352	245	179
	Learoyd Road	733	645	541	454	369	253	180
	Beatty Road	729	644	541	450	364	252	178
	Ipswich Road[1]	815	718	578	479	389	273	196
	Sherwood Road[2]	823	715	560	454	371	250	172
	Railway Bridge	834	726	574	466	379	253	173
	Pamphlett Bridge	836	728	575	466	379	253	173
Blunder Creek	Logan Motorway	93	81	63	52	43	30	21
	Forest Lake Boulevard	78	70	57	48	41	31	23
	Blunder Road	150	132	108	90	75	54	48
	King Avenue	167	143	113	94	78	53	38
	Bowhill Road	216	179	150	124	103	74	60
Oxtrib1	Rudd Street	42	38	32	27	23	16	12
	Blunder Road	89	79	66	55	52	40	29
	Ipswich Road[1]	See Ipswich Road on Oxley Creek						
Btrib1	Clipper Street	43	39	30	26	22	16	12
	Inala Avenue	62	58	46	39	33	24	18
	Rosemary Street	111	99	79	65	52	43	32
	Blunder Road	147	130	104	85	70	56	42
	Bowhill Road[3]	See Bowhill Road on Blunder Creek						
Btrib2	Wallaroo Way	35	31	27	23	20	15	11
	Lorikeet Street	50	45	37	31	26	19	15
	Pigeon Street	50	44	37	31	26	19	15
	Rosella Street	50	44	37	31	25	19	15
	Blunder Road	63	57	47	39	31	24	19
	Inala Avenue	63	57	47	39	31	24	19
	King Avenue	68	61	50	41	33	25	20
Btrib3	Eucalypt Street	28	25	22	18	16	12	9
Btrib4	Inala Avenue	12	11	9	8	7	5	4

[1] *Ipswich Road discharges are total flow through Oxley Creek, Oxley Overflow and Oxtrib1 crossings*
[2] *Sherwood Road discharges are total flow through the Oxley Creek and Oxley Overflow crossings*
[3] *Bowhill Road discharges are total flow through the Blunder Creek and Btrib1 crossings*

4.5 Depth-velocity predictions

Peak depth-velocity digital flood maps for the various design events were produced as part of this study. Whilst not presented as part of the flood mapping included in this report, this data is available in electronic form. This data shows the depth-velocity product that occurs at the time of peak depth within the TUFLOW model.

4.6 Critical durations

A full range of event durations (1, 1.5, 2, 3, 4.5, 6, 9, 12, 18, 24, 48, 72 hours) were simulated within the TUFLOW model for the 2 year ARI and 100 year ARI events. The results were evaluated to determine the six most critical events across the catchment. The critical durations were established as being the 1, 3, 6, 9, 12 and 18 hour storms and were modelled for the 1, 2, 5, 10, 20 and 50 year ARI events. Table 10 summarises the critical duration at crossing locations for both of these AR&R design event magnitudes.

Table 10 | Critical Durations at Crossing Locations

Location		Critical Duration (hours)	
MIKE 11 Branch	Crossing	2 Year ARI	100 Year ARI
Oxley Creek	Logan Motorway	12	12
	Learoyd Road	12	12
	Beatty Road	12	12
	Ipswich Road	18	18
	Sherwood Road	18	18
	Railway Road	18	18
	Pamphlet Bridge	18	18
Blunder Creek	Logan Motorway	9	6
	Forest Lake Boulevard	9	6
	Blunder Road	1*	1*
	King Avenue	9	3
	Bowhill Road	12	18
Oxtrib1	Rudd Street	1	1
	Blunder Road	18	18
	Loop Road	18	18
	Ipswich Road	18	18
	Service Road	18	18
Btrib1	Clipper Street	1	1
	Inala Avenue	1	1
	Rosemary Street	1	1
	Blunder Road	1	1
	Bowhill Road	1	1
Btrib2	Wallaroo Way	1	1
	Lorikeet Street	1	1
	Pigeon Street	1	1
	Rosella Street	1	1

Location		Critical Duration (hours)	
MIKE 11 Branch	Crossing	2 Year ARI	100 Year ARI
	Blunder Street	1	1
	Inala Avenue	1	1
	King Avenue	1	1
Btrib3	Eucalypt Street	1	1
Btrib4	Inala Avenue	1	1

* At Blunder Road on Blunder Creek, the critical duration is 1 hour for both the 2 year and 100 year ARI events. This is a result of the close proximity of the fully urbanised Forest Lake catchment, for which the shorter duration event produces a higher flow.

4.7 Immunity for structures

Existing flood immunities were calculated for each crossing by comparing peak flood levels upstream of the crossing and the minimum overtopping levels. The predicted structure immunities are presented in Table 11.

Hydraulic Structure Reference Sheets (HSRS's) were also produced which outline the hydraulic characteristics of each structure. These are provided in Appendix H.

Table 11 | Existing Immunity for Structures

Creek/Channel	Structure Location	Existing Immunity
Oxley Creek	Logan Motorway	100 year ARI
	Learoyd Road	100 year ARI
	Beatty Road	5 year ARI
	Ipswich Road	10 year ARI
	Sherwood Road	20 year ARI
	Railway Road	100 year ARI
	Pamphlet Bridge	100 year ARI
Blunder Creek	Logan Motorway	100 year ARI
	Forest Lake Boulevard	100 year ARI
	Blunder Road	100 year ARI
	King Avenue	5 year ARI
	Bowhill Road	<1 year ARI
Oxtrib1	Rudd Street	2 year ARI
	Blunder Road	1 year ARI
	Loop Road	<1 year ARI
	Ipswich Road	10 year ARI
	Service Road	<1 year ARI
Btrib1	Clipper Street	5 year ARI
	Inala Avenue	<1 year ARI
	Rosemary Street	2 year ARI
	Blunder Road	<1 year ARI
	Bowhill Road	<1 year ARI

Creek/Channel	Structure Location	Existing Immunity
Btrib2	Wallaroo Way	100 year ARI
	Lorikeet Street	2 year ARI
	Pigeon Street	2 year ARI
	Rosella Street	2 year ARI
	Blunder Road	100 year ARI
	Inala Avenue	100 year ARI
	King Avenue	<1 year ARI
Btrib3	Eucalypt Street	5 year ARI
Btrib4	Inala Avenue	1 year ARI

4.8 Consistency between RAFTS and TUFLOW models

Consistency checks between the RAFTS and TUFLOW models were carried out at the same locations as for the calibration event and verification events.

Table 12 and Table 13 show a comparison of peak discharges predicted by the RAFTS and TUFLOW models at five locations for the 2 year and 100 year ARI design events respectively.

Table 12 | Peak Discharges Predictions at Key Locations (2 year ARI)

Location	Peak Discharge Prediction (2 year ARI) (m^3/s)	
	RAFTS	TUFLOW
OXC-126 – Oxley Creek Upstream of Sheepstation Gully Confluence	255	236
OXC-149 – Oxley Creek Downstream of Oxtrib 1 Confluence	287	252
OXC-154 – Oxley Creek Upstream of Sherwood Road	290	249
BLC-21 – Blunder Creek Between Forest Lake Blvd and Blunder Road	79	51
BLC-36&37 – Blunder Tribs Upstream of Blunder Creek Confluence	62	79

Table 13 | Peak Discharges Predictions at Key Locations (100 year ARI)

Location	Peak Discharge Prediction (100 year ARI) (m^3/s)	
	RAFTS	TUFLOW
OXC-126 – Oxley Creek Upstream of Sheepstation Gully Confluence	712	656
OXC-149 – Oxley Creek Downstream of Oxtrib 1 Confluence	815	784
OXC-154 – Oxley Creek Upstream of Sherwood Road	871	828
BLC-21 – Blunder Creek Between Forest Lake Blvd and Blunder Road	174	141
BLC-36&37 – Blunder Tribs Upstream of Blunder Creek Confluence	166	214

Figure 4-1 to Figure 4-3 show comparisons between the RAFTS and TUFLOW discharges on Oxley Creek. For the 100 year ARI event it is evident that the RAFTS hydrographs lag that of the TUFLOW model slightly. The lag is observed to increase as the flood wave propagates downstream. This is most likely due to the increased accuracy with which TUFLOW routes the flood wave as it propagates downstream, taking into account the topography/bathymetry of the creek and floodplain storage.

Similar behaviour is also visible in the 2 year ARI event. Peak discharges correlate well across both the 2 year and 100 year ARI events.

Figure 4-4 and Figure 4-5 show a hydrograph comparison on Blunder Creek. The timing is observed to improve as the flood propagates downstream with correlation between peak discharges considered to be fair. The difference between the hydrographs is primarily due to routing differences between both models. RAFTS uses a generic storage-discharge relationship approach which does not take into account the detailed channel characteristics or floodplain storage, with catchments connected using basic lag (time-offset) links. TUFLOW physically represents the actual creek topography and can thus provide a more accurate representation of the runoff routing and storage attenuation that occurs within each creek segment. In addition permanent storage within the TUFLOW model (ie areas that fill and do not drain) would impact on this comparison. A number of checks have been carried out (eg Location 4 where the volume in RAFTS over 28 hours is 2.4 GL and in TUFLOW 2.3 GL) and a reasonable match has been achieved.

It should be noted that the TUFLOW model results are truncated due to run time and the actual tail of the hydrograph would generally extend for longer than the RAFTS hydrograph providing additional volume.

As for the calibration event, the results show that an acceptable level of hydrologic and hydraulic consistency has been achieved with respect to peak discharges and flood levels.

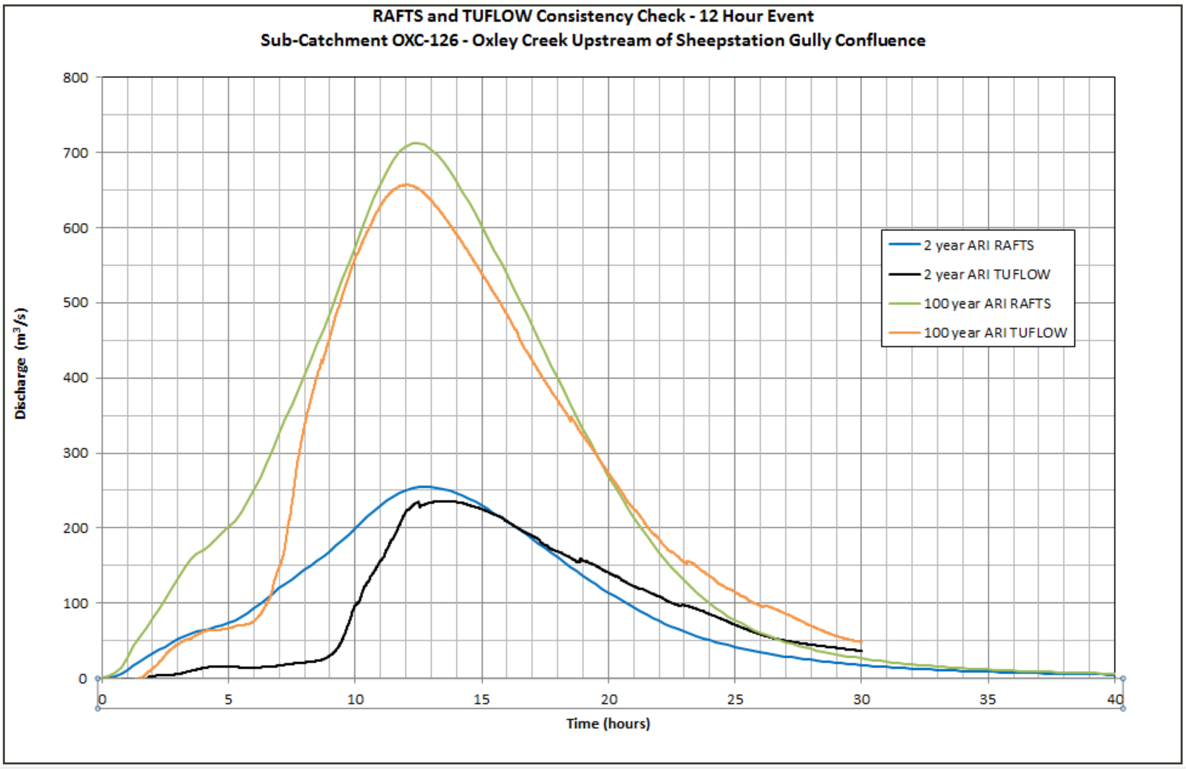

Figure 4-1 | Consistency check: Location 1

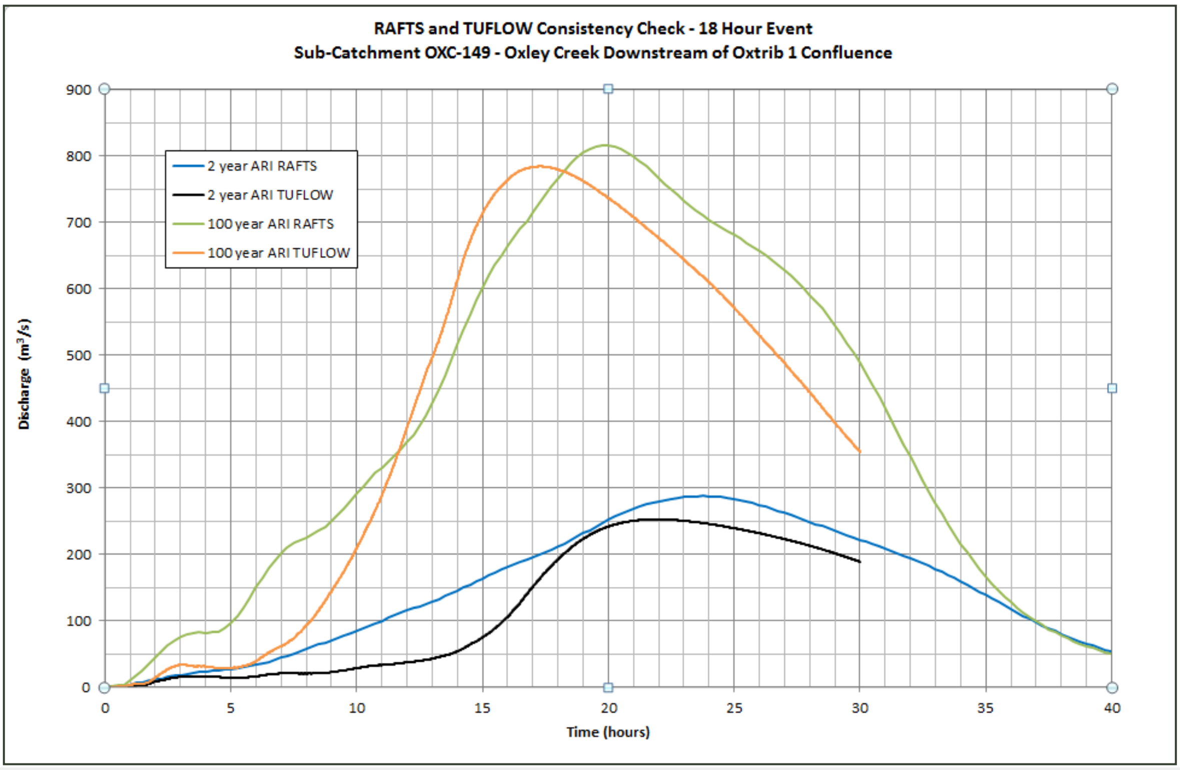

Figure 4-2 | Consistency check: Location 2

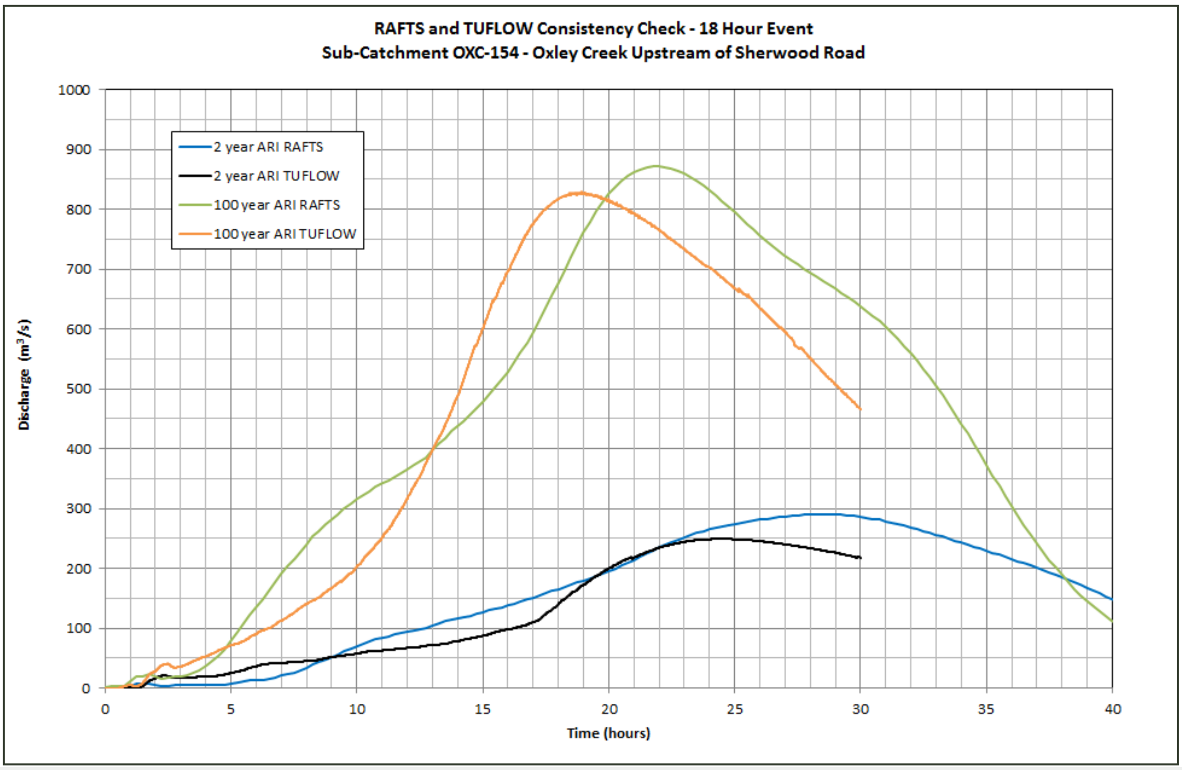

Figure 4-3 | Consistency check: Location 3

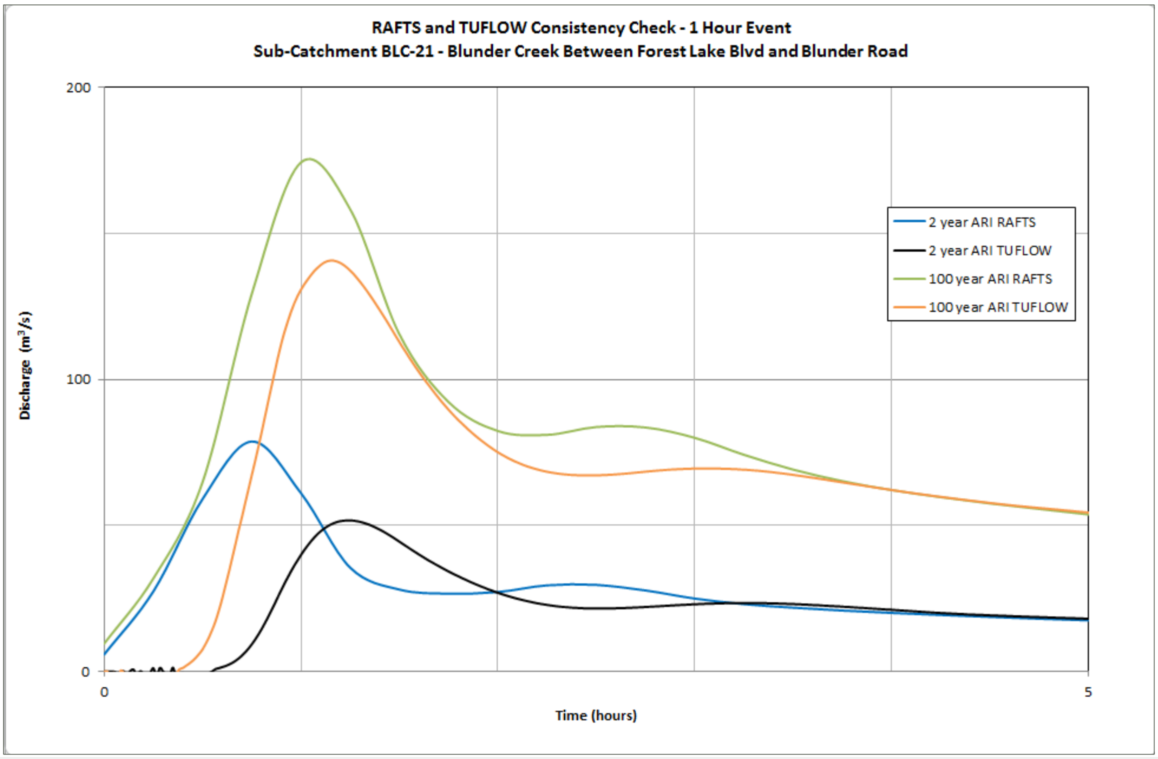

Figure 4-4 | Consistency check: Location 4

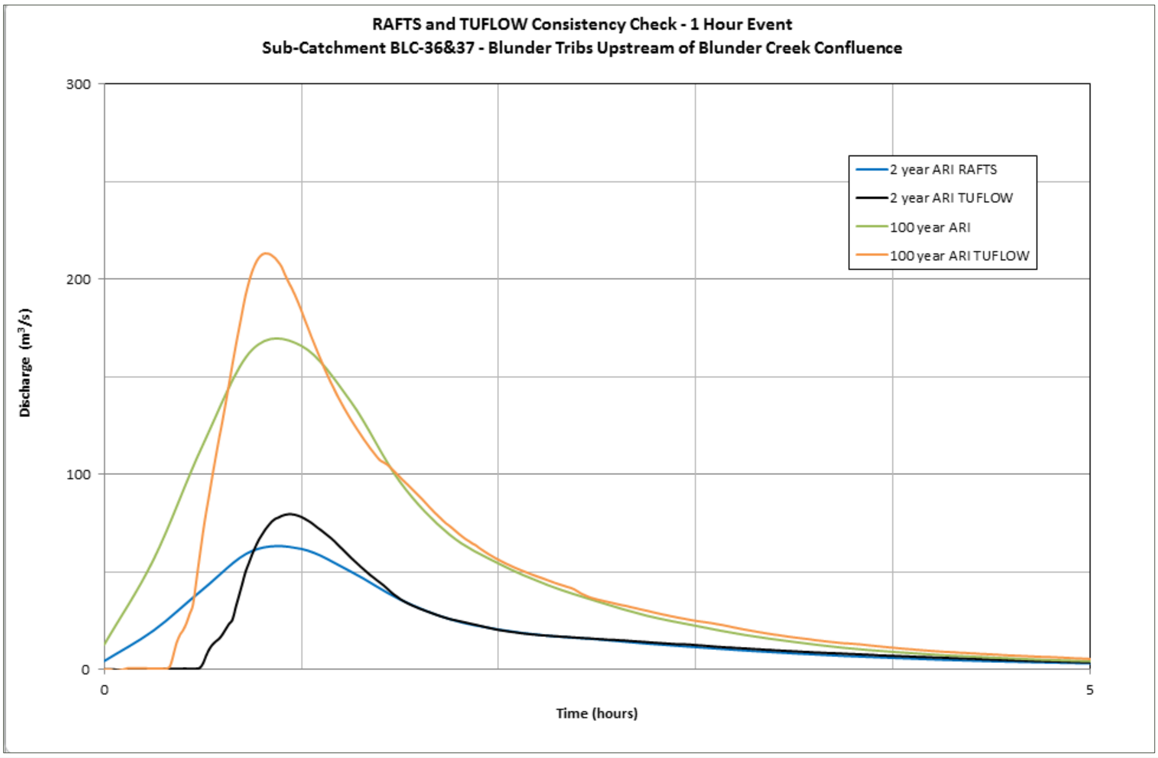

Figure 4-5 | Consistency check: Location 5

5 Hydraulic assessment of crossings

5.1 Hydraulic structure reference sheets

Hydraulic Structure Reference Sheets (HSRS) for all crossings within the TUFLOW model area were prepared. These sheets can be found in Appendix H. The HSRS provide data for each hydraulic structure along the alignment of Oxley and Blunder Creeks and their associated tributaries. Data included on the HSRS includes:

- Structure description
- Structure location (UDB map reference)
- Summary of hydraulic performance and
- Design and construction history

Hydraulic description of each of the structures includes:

- Weir and structure discharge
- Peak water surface elevation
- Afflux
- Flow area and
- Velocity

Weir and structure discharges were extrapolated from hydraulic model result files. It is important to note that some approximations were required to extract this information for structures within the TUFLOW model domain. The following approximations were required for those structures:

- "Total discharge" was taken to be the discharge across the entire floodplain immediately upstream from the crossing
- "Structure discharge" was taken as the total discharge through the model cells used to represent the culvert or bridge structure
- "Weir discharge" was then calculated to be the difference between the "total discharge" and "structure discharge"
- "Upstream water level" was extracted from a model cell immediately upstream from the culvert or bridge structure
- "Downstream water level" was extracted from a model cell immediately downstream from the culvert of bridge structure
- "Afflux" was taken to be the difference between the "upstream water level" and "downstream water level"

5.2 Bridge structures check

HEC-RAS models of all bridge structures included in the TUFLOW model have been developed to cross-check the performance of the TUFLOW model in predicting head loss across each structure. The outcomes of this analysis are presented in Appendix J. Overall a reasonable correlation was achieved.

6 Emergency planning information

This section presents information regarding emergency planning in times of a flood event in Oxley Creek.

6.1 Road closures

Tabulated data has been compiled for roads that either cross or are in close proximity to Oxley Creek. The data provided includes:

- The road name
- The suburb
- The length of the inundated stretch of road
- The length of the inundated stretch of road that is covered by more than 0.25 m or floodwater
- The low-point of the road (ie the first point to get cut)
- The approximate maximum depth at the low-point

Note that this constitutes a high level assessment only. Data pertaining to the 1, 2, 5, 10, 20, 50, and 100 year ARI events is presented in the following tables.

Table 14 | 1 year ARI emergency planning information

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
Oxley Creek	Logan Motorway	Larapinta	None	None	Approximately 60m East of Bridge	0.0
	Learoyd Road	Acacia Ridge	None	None	Approximately 170m South-West of Bridge	0.0
	Beatty Road	Acacia Ridge	None	None	North-East approach	0.0
	Ipswich Road	Rocklea	None	None	In-between overflow and main crossing	0.0
	Sherwood Road	Rocklea	None	None	East of over-flow culvert	0.0
	Railway Bridge	Sherwood	None	None	Approximately 90m NE of Bridge	0.0
	Pamphlett Bridge	Graceville	None	None	Continuing West of Bridge	0.0

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
Blunder Creek	Logan Motorway	Forest Lake	None	None	At crossing	0.0
	Forest Lake Boulevard	Forest Lake	None	None	50m West of Bridge	0.0
	Blunder Road	Doolandella	None	None	112m West of Bridge	0.0
	King Avenue	Willawong	None	None	App. 100m East of Bridge	0.0
	Bowhill Road	Willawong	440m	375m	Eastern culvert crossing	0.5
Oxtrib1	Rudd Street	Oxley	None	None	At crossing	0.0
	Blunder Road	Oxley	None	None	App. 65 m North of crossing	0.0
	Ipswich Road	Durack	None	None	At crossing	0.0
Btrib1	Clipper Street	Inala	None	None	At crossing	0.0
	Inala Avenue	Inala	25m	None	At crossing	0.2
	Rosemary Street	Inala	None	None	At crossing	0.0
	Blunder Road	Durack	105m	95m	15m South of crossing	0.9
	Bowhill Road	See Bowhill Road on Blunder Creek				
Btrib2	Wallaroo Way	Doolandella	None	None	At crossing	0.0
	Lorikeet Street	Inala	None	None	App. 17m East of Crossing	0.0
	Pigeon Street	Inala	None	None	App. 5m West of Crossing	0.0
	Rosella Street	Inala	None	None	At crossing	0.0
	Blunder Road	Durack	None	None	App. 30m North of Crossing	0.0
	Inala Avenue	Durack	None	None	App. 10m West of Crossing	0.0
	King Avenue	Durack	115m	95m	At crossing	0.7
Btrib3	Eucalypt Street	Inala	None	None	At crossing	0.0
Btrib4	Inala Avenue	Inala	None	None	At crossing	0.0

Table 15 | 2 year ARI emergency planning information

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
Oxley Creek	Logan Motorway	Larapinta	None	None	Approximately 60m East of Bridge	0.0
	Learoyd Road	Acacia Ridge	None	None	Approximately 170m South-West of Bridge	0.0
	Beatty Road	Acacia Ridge	None	None	North-East approach	0.0
	Ipswich Road	Rocklea	None	None	In-between overflow and main crossing	0.0
	Sherwood Road	Rocklea	None	None	East of over-flow culvert	0.0
	Railway Bridge	Sherwood	None	None	Approximately 90m NE of Bridge	0.0
	Pamphlett Bridge	Graceville	None	None	Continuing West of Bridge	0.0
Blunder Creek	Logan Motorway	Forest Lake	None	None	At crossing	0.0
	Forest Lake Boulevard	Forest Lake	None	None	50m West of Bridge	0.0
	Blunder Road	Doolandell a	None	None	112m West of Bridge	0.0
	King Avenue	Willawong	None	None	App. 100m East of Bridge	0.0
	Bowhill Road	Willawong	710m	400m	Eastern culvert crossing	0.5
Oxtrib1	Rudd Street	Oxley	None	None	At crossing	0.0
	Blunder Road	Oxley	200m	None	App. 65 m North of crossing	0.1
	Ipswich Road	Durack	None	None	At crossing	0
Btrib1	Clipper Street	Inala	None	None	At crossing	0.0
	Inala Avenue	Inala	40m	15m	At crossing	0.4
	Rosemary Street	Inala	None	None	At crossing	0
	Blunder Road	Durack	100m	100m	15m South of crossing	1.1
	Bowhill Road	See Bowhill Road on Blunder Creek				
Btrib2	Wallaroo Way	Doolandella	None	None	At crossing	0
	Lorikeet Street	Inala	None	None	App. 17m East of Crossing	0
	Pigeon Street	Inala	None	None	App. 5m West of Crossing	0
	Rosella Street	Inala	None	None	At crossing	0
	Blunder Road	Durack	None	None	App. 30m North of Crossing	0
	Inala Avenue	Durack	None	None	App. 10m West of Crossing	0
	King Avenue	Durack	120m	100m	At crossing	0.8

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
Btrib3	Eucalypt Street	Inala	None	None	At crossing	0
Btrib4	Inala Avenue	Inala	15m	None	At crossing	<0.1

Table 16 | 5 year ARI emergency planning information

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
Oxley Creek	Logan Motorway	Larapinta	None	None	Approximately 60m East of Bridge	0.0
	Learoyd Road	Acacia Ridge	None	None	Approximately 170m South-West of Bridge	0.0
	Beatty Road	Acacia Ridge	None	None	North-East approach	0.0
	Ipswich Road	Rocklea	None	None	In-between overflow and main crossing	0.0
	Sherwood Road	Rocklea	None	None	East of over-flow culvert	0.0
	Railway Bridge	Sherwood	None	None	Approximately 90m NE of Bridge	0.0
	Pamphlett Bridge	Graceville	None	None	Continuing West of Bridge	0.0
Blunder Creek	Logan Motorway	Forest Lake	None	None	At crossing	0.0
	Forest Lake Boulevard	Forest Lake	None	None	50m West of Bridge	0.0
	Blunder Road	Doolandella	None	None	112m West of Bridge	0.0
	King Avenue	Willawong	None	None	App. 100m East of Bridge	0.0
	Bowhill Road	Willawong	725m	405m	Eastern culvert crossing	0.5
Oxtrib1	Rudd Street	Oxley	5m	None	At crossing	0.1
	Blunder Road	Oxley	290m	215m	App. 65 m North of crossing	0.6
	Ipswich Road	Durack	None	None	At crossing	0
Btrib1	Clipper Street	Inala	None	None	At crossing	0.0
	Inala Avenue	Inala	50m	30m	At crossing	0.6
	Rosemary Street	Inala	75m	55m	At crossing	0.5
	Blunder Road	Durack	120m	105m	15m South of crossing	1.3
	Bowhill Road	See Bowhill Road on Blunder Creek				
Btrib2	Wallaroo Way	Doolandella	None	None	At crossing	0
	Lorikeet Street	Inala	30m	5m	App. 17m East of Crossing	0.3
	Pigeon Street	Inala	40m	None	App. 5m West of Crossing	0.2
	Rosella Street	Inala	75m	None	At crossing	0.2
	Blunder Road	Durack	None	None	App. 30m North of Crossing	0
	Inala Avenue	Durack	None	None	App. 10m West of Crossing	0

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
	King Avenue	Durack	125m	105m	At crossing	0.9
Btrib3	Eucalypt Street	Inala	None	None	At crossing	0
Btrib4	Inala Avenue	Inala	20m	None	At crossing	0.1

Table 17 | 10 year ARI emergency planning information

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
Oxley Creek	Logan Motorway	Larapinta	None	None	Approximately 60m East of Bridge	0.0
	Learoyd Road	Acacia Ridge	None	None	Approximately 170m South-West of Bridge	0.0
	Beatty Road	Acacia Ridge	130m	40m	North-East approach	0.5
	Ipswich Road	Rocklea	None	None	In-between overflow and main crossing	0.0
	Sherwood Road	Rocklea	None	None	East of over-flow culvert	0.0
	Railway Bridge	Sherwood	None	None	Approximately 90m NE of Bridge	0.0
	Pamphlett Bridge	Graceville	None	None	Continuing West of Bridge	0.0
Blunder Creek	Logan Motorway	Forest Lake	None	None	At crossing	0.0
	Forest Lake Boulevard	Forest Lake	None	None	50m West of Bridge	0.0
	Blunder Road	Doolandella	None	None	112m West of Bridge	0.0
	King Avenue	Willawong	250m	20m	App. 100m East of Bridge	0.3
	Bowhill Road	Willawong	745m	705m	Eastern culvert crossing	0.7
Oxtrib1	Rudd Street	Oxley	30m	None	At crossing	0.1
	Blunder Road	Oxley	335m	305m	App. 65 m North of crossing	0.9
	Ipswich Road	Durack	None	None	At crossing	0
Btrib1	Clipper Street	Inala	25m	None	At crossing	0.2
	Inala Avenue	Inala	55m	40m	At crossing	0.6
	Rosemary Street	Inala	90m	70m	At crossing	0.8
	Blunder Road	Durack	120m	110m	15m South of crossing	1.4
	Bowhill Road	See Bowhill Road on Blunder Creek				
Btrib2	Wallaroo Way	Doolandella	None	None	At crossing	0
	Lorikeet Street	Inala	60m	25m	App. 17m East of Crossing	0.4
	Pigeon Street	Inala	45m	40m	App. 5m West of Crossing	0.4
	Rosella Street	Inala	115m	15m	At crossing	0.3
	Blunder Road	Durack	None	None	App. 30m North of Crossing	0

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
	Inala Avenue	Durack	None	None	App. 10m West of Crossing	0
	King Avenue	Durack	125m	115m	At crossing	0.9
Btrib3	Eucalypt Street	Inala	15m	None	At crossing	<0.1
Btrib4	Inala Avenue	Inala	25m	None	At crossing	0.2

Table 18 | 20 year ARI emergency planning information

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
Oxley Creek	Logan Motorway	Larapinta	None	None	Approximately 60m East of Bridge	0.0
	Learoyd Road	Acacia Ridge	None	None	Approximately 170m South-West of Bridge	0.0
	Beatty Road	Acacia Ridge	160m	135m	North-East approach	0.8
	Ipswich Road	Rocklea	835m	100m	In-between overflow and main crossing	0.3
	Sherwood Road	Rocklea	None	None	East of over-flow culvert	0.0
	Railway Bridge	Sherwood	None	None	Approximately 90m NE of Bridge	0.0
	Pamphlett Bridge	Graceville	None	None	Continuing West of Bridge	0.0
Blunder Creek	Logan Motorway	Forest Lake	None	None	At crossing	0.0
	Forest Lake Boulevard	Forest Lake	None	None	50m West of Bridge	0.0
	Blunder Road	Doolandella	None	None	112m West of Bridge	0.0
	King Avenue	Willawong	295m	55m	App. 100m East of Bridge	0.4
	Bowhill Road	Willawong	770m	730m	Eastern culvert crossing	0.8
Oxtrib1	Rudd Street	Oxley	65m	None	At crossing	0.2
	Blunder Road	Oxley	365m	335m	App. 65 m North of crossing	1.3
	Ipswich Road	See Ipswich Road on Oxley Creek				
Btrib1	Clipper Street	Inala	30m	20m	At crossing	0.4
	Inala Avenue	Inala	60m	50m	At crossing	0.7
	Rosemary Street	Inala	100m	85m	At crossing	0.9
	Blunder Road	Durack	125m	115m	15m South of crossing	1.5
	Bowhill Road	See Bowhill Road on Blunder Creek				
Btrib2	Wallaroo Way	Doolandella	None	None	At crossing	0
	Lorikeet Street	Inala	65m	30m	App. 17m East of Crossing	0.5
	Pigeon Street	Inala	50m	40m	App. 5m West of Crossing	0.5
	Rosella Street	Inala	130m	80m	At crossing	0.4
	Blunder Road	Durack	None	None	App. 30m North of Crossing	0

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
	Inala Avenue	Durack	None	None	App. 10m West of Crossing	0
	King Avenue	Durack	135m	120m	At crossing	1
Btrib3	Eucalypt Street	Inala	25m	None	At crossing	0.1
Btrib4	Inala Avenue	Inala	30m	None	At crossing	0.2

Table 19 | 50 year ARI emergency planning information

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
Oxley Creek	Logan Motorway	Larapinta	None	None	Approximately 60m East of Bridge	0.0
	Learoyd Road	Acacia Ridge	None	None	Approximately 170m South-West of Bridge	0.0
	Beatty Road	Acacia Ridge	195m	175m	North-East approach	1.1
	Ipswich Road	Rocklea	900m	850m	In-between overflow and main crossing	0.6
	Sherwood Road	Rocklea	245m	190m	East of over-flow culvert	0.3
	Railway Bridge	Sherwood	None	None	Approximately 90m NE of Bridge	0.0
	Pamphlett Bridge	Graceville	None	None	Continuing West of Bridge	0.0
Blunder Creek	Logan Motorway	Forest Lake	None	None	At crossing	0.0
	Forest Lake Boulevard	Forest Lake	None	None	50m West of Bridge	0.0
	Blunder Road	Doolandella	None	None	112m West of Bridge	0.0
	King Avenue	Willawong	360m	80m	App. 100m East of Bridge	0.5
	Bowhill Road	Willawong	800m	780m	Eastern culvert crossing	1.1
Oxtrib1	Rudd Street	Oxley	70m	None	At crossing	0.2
	Blunder Road	Oxley	395m	360m	App. 65 m North of crossing	1.6
	Ipswich Road	See Ipswich Road on Oxley Creek				
Btrib1	Clipper Street	Inala	60m	50m	At crossing	1.1
	Inala Avenue	Inala	65m	50m	At crossing	0.8
	Rosemary Street	Inala	110m	95m	At crossing	1.1
	Blunder Road	Durack	130m	125m	15m South of crossing	1.7
	Bowhill Road	See Bowhill Road on Blunder Creek				
Btrib2	Wallaroo Way	Doolandella	None	None	At crossing	0
	Lorikeet Street	Inala	75m	55m	App. 17m East of Crossing	0.6
	Pigeon Street	Inala	55m	50m	App. 5m West of Crossing	0.6
	Rosella Street	Inala	140m	110m	At crossing	0.5
	Blunder Road	Durack	None	None	App. 30m North of Crossing	0

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
	Inala Avenue	Durack	None	None	App. 10m West of Crossing	0
	King Avenue	Durack	135m	120m	At crossing	1.1
Btrib3	Eucalypt Street	Inala	35m	None	At crossing	0.2
Btrib4	Inala Avenue	Inala	35m	<5m	At crossing	0.3

Table 20 | 100 year ARI emergency planning information

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
Oxley Creek	Logan Motorway	Larapinta	None	None	Approximately 60m East of Bridge	0.0
	Learoyd Road	Acacia Ridge	None	None	Approximately 170m South-West of Bridge	0.0
	Beatty Road	Acacia Ridge	195m	170m	North-East approach	1.4
	Ipswich Road	Rocklea	920m	915m	In-between overflow and main crossing	0.8
	Sherwood Road	Rocklea	370m	200m	East of over-flow culvert	0.5
	Railway Bridge	Sherwood	None	None	Approximately 60m East of Bridge	0.0
	Pamphlett Bridge	Graceville	None	None	Approximately 170m South-West of Bridge	0.0
Blunder Creek	Logan Motorway	Forest Lake	205m	190m	North-East approach	1.4
	Forest Lake Boulevard	Forest Lake	920m	915m	In-between overflow and main crossing	0.8
	Blunder Road	Doolandella	370m	200m	East of over-flow culvert	0.5
	King Avenue	Willawong	None	None	Approximately 90m NE of Bridge	0.0
	Bowhill Road	Willawong	None	None	Continuing West of Bridge	0.0
Oxtrib1	Rudd Street	Oxley	None	None	At crossing	0.0
	Blunder Road	Oxley	None	None	50m West of Bridge	0.0
	Ipswich Road	See Ipswich Road on Oxley Creek				
Btrib1	Clipper Street	Inala	60m	50m	At crossing	1.1
	Inala Avenue	Inala	65m	50m	At crossing	0.8
	Rosemary Street	Inala	110m	95m	At crossing	1.2
	Blunder Road	Durack	130m	125m	15m South of crossing	1.7
	Bowhill Road	See Bowhill Road on Blunder Creek				
Btrib2	Wallaroo Way	Doolandella	None	None	At crossing	0
	Lorikeet Street	Inala	80m	65m	App. 17m East of Crossing	0.7
	Pigeon Street	Inala	55m	50m	App. 5m West of Crossing	0.7
	Rosella Street	Inala	150m	115m	At crossing	0.6
	Blunder Road	Durack	None	None	App. 30m North of Crossing	0

Creek	Road Name	Suburb	Inundation Width	Closed width >0.25m depth	Low Point	Max Depth at Low Point (m)
	Inala Avenue	Durack	None	None	App. 10m West of Crossing	0
	King Avenue	Durack	140m	125m	At crossing	1.1
Btrib3	Eucalypt Street	Inala	35m	15m	At crossing	0.3
Btrib4	Inala Avenue	Inala	35m	<5m	At crossing	0.3

6.2 Isolated areas

Areas that are isolated during events have also been identified and are documented in Table 21. The data provided includes:

- The suburb
- Area which is isolated during each event
- Closed access routes
- Lowest level access route
- Highest level access route

Table 21 | Isolated areas

Suburb	Area Isolated	Return Period	Access Roads cut	Lowest level access route	Highest level access route
Rocklea	Water Treatment Plant	2 years	Donaldson Road	Donaldson Road	Donaldson Road
Oxley	Metalcorp, Onesteel Recycying and ABC Spare Parts	1 year	Ipswich Road	Ipswich Road	Ipswich Road
Oxley	Harvey Norman	1 year	Blunder Road Exit	Blunder Road Exit	Blunder Road Exit
Willawong	Property 400 Bowhill Road	1 year	Bowhill Road	Bowhill Road	Bowhill Road
Oxley	Commercial Properties on Alban Street, Factory Road and Boundary Road	10 years	Alban Street and Blunder Road	Alban Street and Blunder Road	Alban Street and Blunder Road
Rocklea	Rocklea Showgrounds and Brisbane Tractor Sales	100 years	Corner of Ipswich Road and Goburra Street and Pegg Road	Ipswich Road	Pegg Road
Sherwood	Parklands at Sherwood	50 years	Egmont Street	Egmont Street	Egmont Street

Suburb	Area Isolated	Return Period	Access Roads cut	Lowest level access route	Highest level access route
Rocklea	Commercial and residential properties between Oxley Creek and Ipswich Rd on Sherwood Rd	>100 year but 50 year allows only a single evacuation route.	None	Muriel Avenue	Abercrombie Street
Rocklea	Commercial Properties on Franklin Street	2 years	Franklin Street	Franklin Street	Franklin Street
Corinda	Residential Properties on Deniven Street and Cliveden Avenue	50 years	Penaton Street	Cliveden Avenue	Edmondson Street
Rocklea	Entire Commercial Area between Oxley Creek, Stable Swamp Creek and Ipswich Motorway	100 years	Ipswich Motorway onramp on Suscatand Street	Suscatand Street	Suscatand Street
Rocklea	Commercial Area bound by Oxley Creek, Suscatand Street and Ipswich Motorway	20 years	Ipswich Motorway onramp on Suscatand Street	Suscatand Street	Suscatand Street
Oxley	Numerous Properties on near corner of Cliveden Avenue and Wilpowell Street	100 years	Wilpowell Street	Cliveden Avenue	Thornburgh Street
Willawong	Transpacific and Queensland Gaelic Football and Hurling Association	20 years	Bowhill Road	Bowhill Road to the west	Bowhill Road to the east
Willawong	Additional Properties east of Queensland Gaelic Football and Hurling Association	50 years	Bowhill Road	Bowhill Road to the west	Bowhill Road to the east

7 Extreme event analysis

This section of the report provides details regarding the extreme event analysis that was completed as part of the project. This incorporates the 200, 500 and 2000 year ARI events, and the Probable Maximum Flood (PMF) and contains the following sections:

- Extreme event hydrology
- Hydraulic model set-up
- Discussion of results

7.1 Extreme event hydrology

7.1.1 200, 500 and 2000 year ARI design rainfall intensities

In line with current practices the CRC-Forge method was used to obtain average rainfall intensities for the 200, 500 and 2000 year ARI design events. These were then compared with the factored 100 year ARI event rainfall intensities derived using the Australian Rainfall & Runoff guidelines and the flood frequency analysis (refer to Section 3.1). It was found that the factored 100 year ARI rainfall intensities were approximately equal to the 200 year ARI CRC-Forge intensities. In discussion with Council it was concluded that an adjustment must be made to the 200yr ARI CRC-Forge intensities to account for the increase in the original AR&R IFD data. No factoring for the 500 or 2000 year ARI CRC-Forge rainfall intensities was required or applied.

Table 22 shows the comparison of the factored AR&R 100 year ARI average rainfall intensities with the CRC-Forge method average rainfall intensities. It is evident that the 200 year ARI CRC-Forge intensity is approximately equal to the factored 100 year ARI AR&R intensity.

Table 22 | Factored AR&R IFD data compared with Raw CRC-Forge data

Duration (min)	Factored IFD data	Raw CRC-Forge average rainfall intensities (mm/hour)			
	Average Recurrence Interval (years)				
	100	100	200	500	2000
30	164.6	145.4	164.9	193.3	242.9
60	112.1	101.2	114.8	134.6	169.1
180	53.4	46.6	52.8	61.9	77.8
360	32.2	28.3	32.1	37.6	47.2
720	19.8	17.2	19.5	22.9	28.7
1080	15.2	13.4	15.2	17.8	22.4
1440	12.7	11.2	12.7	14.9	18.7

Duration (min)	Factored IFD data	Raw CRC-Forge average rainfall intensities (mm/hour)		
	Average Recurrence Interval (years)				
	100	100	200	500	2000
2880	8.1	7.5	8.7	10.5	13.7
4320	6.0	5.8	6.7	8.1	10.7

The agreed adjustment to the 200 year ARI rainfall intensities is described by the following equation:

$$200 \text{ year ARI intensity } (Y) = (500Y_{\text{CRC-Forge}} - 100Y_{\text{Factored AR\&R}}) \times \{(200Y_{\text{CRC-Forge}} - 100Y_{\text{CRC-Forge}}) / (500Y_{\text{CRC-Forge}} - 100Y_{\text{CRC-Forge}})\} + 100Y_{\text{Factored AR\&R}}$$

Table 23 presents the final extreme event design rainfalls used in the RAFTS model. The factored 100 year ARI design rainfall intensities are also provided for comparative purposes.

Table 23 | Adopted average rainfall intensities

	Factored IFD data	Adopted Average Rainfall Intensities (mm/hour)		
	Average Recurrence Interval (years)			
Duration (min)	100	200	500	2000
30	164.6	176.3	193.3	242.9
60	112.1	121.3	134.6	169.1
180	53.4	56.8	61.9	77.8
360	32.2	34.4	37.6	47.2
720	19.8	21.1	22.9	28.7
1080	15.2	16.3	17.8	22.4
1440	12.7	13.6	14.9	18.7
2880	8.1	9.1	10.4	13.7
4320	6.0	6.8	8.1	10.7

For the 200 year and 500 year ARI design events, a 100 year ARI temporal pattern was used. For the 2000 year ARI design event the Probable Maximum Precipitation (PMP) Generalised Short Duration Method (GSDM) temporal pattern was used for durations up to and including six hours. For durations longer than six hours the PMP Generalised Tropical Storm Method Revised (GTSMR) temporal pattern was used.

The following six storm durations were simulated in accordance with the procedures adopted for the design event modelling: 1, 3, 6, 9, 12, and 18 hours. (Note that the critical storm durations for the PMF event were different and are discussed in the following section).

7.1.2 Probable maximum precipitation (PMP) hydrology

The PMP GSDM and GTSMR were both used to assess all standard PMP storm durations ranging from 15 minutes to 120 hours. All of the resulting design storms were simulated in the RAFTS model. Results were then compared across the catchment to establish the six most critical storms for hydraulic modelling purposes. Note also that for the GSDM four storm locations were trialled (for which all of the standard event durations was simulated).

7.1.2.1 Generalised short duration method

The PMP GSDM was used to derive average rainfall intensities for storm durations between 1 hour and 6 hours (this amounts to eight durations in total: 1, 1.5, 2, 2.5, 3, 4, 5 and 6 hours). This method requires super-imposing a series of ellipses over the catchment using GIS techniques. These ellipses represent the spatial variation in rainfall intensity, with the highest intensities attributed to the central ellipse and decreasing in an outward direction. Four locations throughout the catchment were chosen in which to undertake the GSDM as shown in Figure 7-1.

A review of the hydrologic model outputs for all permutations of storm location and duration was undertaken. In total this amounted to 32 different storm events all of which were run through the RAFTS model.

Based on this review the following storm locations/durations were selected for use in the hydraulic modelling:

- Location 4: 3, 4, 5, and 6 hour (critical on Oxley Creek)
- Location 2: 6 hour (critical on Blunder Creek)
- Location 1: 2 hour (critical on Stable Swamp Creek)

Table 24 presents tabulated discharge data at a range of RAFTS nodes for all four ellipse locations. The critical storm duration is also provided.

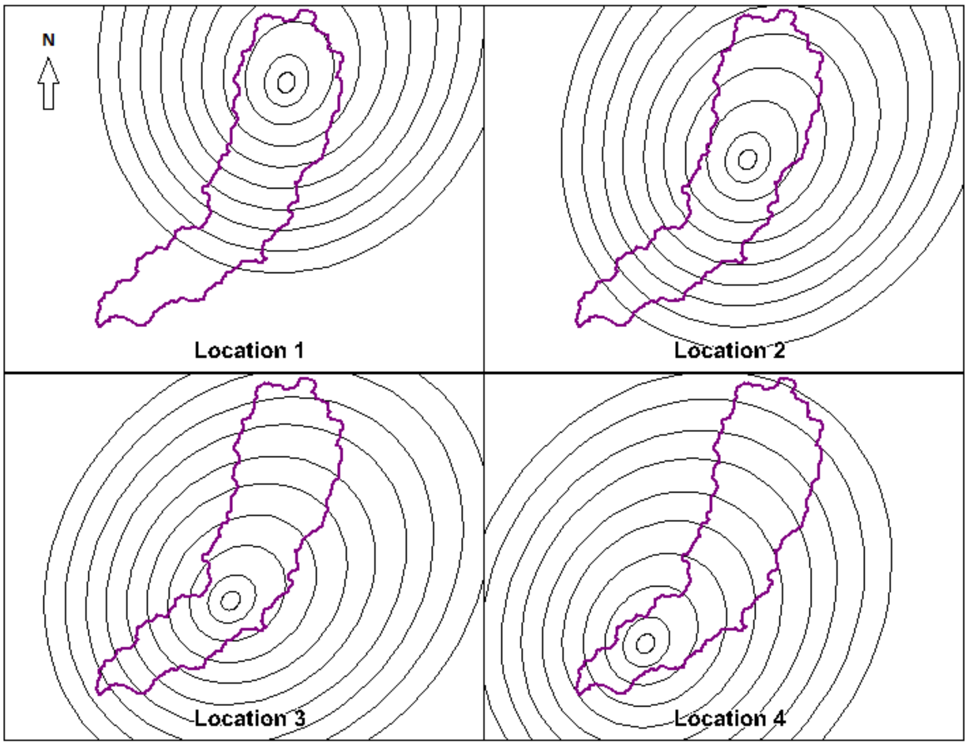

Figure 7-1 | Locations used for the PMP generalised short duration method hydrologic assessment

The average hourly rainfall intensities for each of the ellipses at Locations 1, 2, 3 and 4 are shown in Table 25 to Table 28.

Table 24 | Critical durations and maximum discharges for the four PMP GSDM locations extracted from RAFTS

Location	Node	Generalised short duration method									
		Domain	Creek	Location 1		Location 2		Location 3		Location 4	
				Critical Duration (hrs)	Discharge (m^3/s)	Critical Duration (hrs)	Discharge (m^3/s)	Critical Duration (hrs)	Discharge (m^3/s)	Critical Duration (hrs)	Discharge (m^3/s)
Ripley Road	OXC-6	LCC	Oxley	-	0	-	0	3	391	3	426
Tully Road near Spring Valley Road	OXC-36	LCC	Oxley	-	0	4	787	4	1141	4	1572
New Beith Road near Argyle Road	OXC-69	LCC	Oxley	4	270	4	1416	5	1820	5	2413
Driving Range near Goodna Road	OXC-94	LCC	Oxley	4	1143	6	2089	6	2871	5	3238
Adise Road off Paradise Road	OXC-D121	BCC	Oxley	6	1575	6	2507	6	3304	6	3572
Logan Ave off Oxley Road	OXC144-145	BCC	Oxley	6	2428	6	3327	6	4014	6	4179
Long St East and Stickland Terrace	OXC-156	BCC	Oxley	6	2802	6	3353	6	3948	6	4079
Greenbank Military Camp	BLC-6	LCC	Blunder	4	171	6	192	5	212	6	190
Gibbston Place	BLC-18	BCC	Blunder	5	538	6	686	5	582	6	536
Forest Place Durack Retirement Village	BLC-40	BCC	Blunder	6	822	6	976	6	767	6	705
Colvin Street	SSC-20	BCC	Stable Swamp	2	1192	3	1012	3	949	3	905

Table 25 | Average rainfall intensities for Location 1

Ellipse	Average Rainfall Intensity (mm/hr)										
	0.25hr	0.5hr	0.75hr	1hr	1.5hr	2hr	2.5hr	3hr	4hr	5hr	6hr
A (centre)	780	560	480	410	360	310	280	250	220	190	170
B	670	490	420	370	310	280	240	220	190	170	150
C	570	410	350	320	270	240	210	190	160	140	130
D	500	360	310	280	250	210	190	170	150	130	110
E	470	340	290	270	230	200	180	160	140	120	110
F	460	330	280	260	230	200	180	160	140	120	100
G	440	330	280	250	220	190	170	160	130	110	100
H	430	320	270	250	220	190	170	150	130	110	100
I	420	310	270	240	210	180	170	150	130	110	100
J (outside)	420	310	260	240	210	180	160	150	130	110	100

Table 26 | Average rainfall intensities for Location 2

Ellipse	Average Rainfall Intensity (mm/hr)										
	0.25hr	0.5hr	0.75hr	1hr	1.5hr	2hr	2.5hr	3hr	4hr	5hr	6hr
A (centre)	780	560	480	410	360	310	280	250	220	190	170
B	670	490	420	370	310	280	240	220	190	170	150
C	570	410	350	320	270	240	210	190	160	140	130
D	490	360	300	280	240	210	190	170	140	120	110
E	450	330	280	260	220	190	170	160	130	110	100
F	420	310	260	240	210	180	170	150	130	110	100
G	410	300	260	240	210	180	160	150	130	110	100
H	410	300	260	230	210	180	160	150	130	110	90
I	400	300	250	230	200	180	160	140	120	100	90
J (outside)	390	290	250	230	200	170	160	140	120	100	90

Table 27 | Average rainfall intensities for Location 3

Ellipse	Average Rainfall Intensity (mm/hr)										
	0.25hr	0.5hr	0.75hr	1hr	1.5hr	2hr	2.5hr	3hr	4hr	5hr	6hr
A (centre)	780	560	480	410	360	310	280	250	220	190	170
B	670	490	420	370	310	280	240	220	190	170	150
C	580	420	350	320	280	240	220	190	160	140	130
D	510	370	310	290	250	210	190	170	150	130	110
E	470	340	290	270	230	200	180	160	140	120	110
F	440	320	270	250	220	190	170	150	130	110	100
G	410	310	260	240	210	180	160	150	130	110	100
H	400	290	250	230	200	170	160	140	120	100	90
I	390	290	250	230	200	170	160	140	120	100	90
J (outside)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 28 | Average rainfall intensities for Location 4

Ellipse	Average Rainfall Intensity (mm/hr)										
	0.25hr	0.5hr	0.75hr	1hr	1.5hr	2hr	2.5hr	3hr	4hr	5hr	6hr
A (centre)	780	560	480	410	360	310	280	250	220	190	170
B	670	490	420	370	310	280	240	220	190	170	150
C	590	430	360	330	280	240	220	200	170	150	130
D	530	380	320	300	260	220	200	180	150	130	120
E	490	360	300	280	240	210	190	170	140	120	110
F	460	340	290	260	230	200	180	160	140	120	100
G	440	320	270	250	220	190	170	160	130	110	100
H	420	310	260	240	210	180	170	150	130	110	100
I	400	300	250	230	200	180	160	150	120	100	90
J (outside)	390	290	250	230	200	170	160	140	120	100	90

7.1.2.2 Generalised tropical storm method revised

The PMP Generalised Tropical Storm Method Revised was used to derive hydrologic conditions for storm durations ranging from 24 to 120 hours. Both the winter and summer scenarios were assessed. It was found that the summer scenario resulted in greater total rainfall depths and so this data was used to determine the final values. As is standard practice, the PMP estimates for both the GSDM and GTSMR were graphed and adjusted slightly so the transition between both datasets follows a smooth curve. This also enabled a 12 hour rainfall intensity to be interpolated. Table 29 provides the constant values adopted for the derivation of PMP GTSMR rainfall depths. Table 30 indicates the consequential initial rainfall depths, preliminary PMP estimates, rounded estimates and Final PMP rainfall depths as per the guidelines. Table 31 shows the critical duration and discharge at various locations throughout the catchment determined by the GTSMR. Note that for the 12 hour storm, this was trialled with both the GSDM temporal pattern and the 24 hour GTSMR temporal pattern to establish which generated the highest discharges. In all cases it was observed to be the 24 hour GTSMR pattern.

Table 29 | PMP GTSMR constants

Constant	Value
Catchment Area (ha)	258.2
Moisture Adjustment Factor	0.72
Decay Amplitude Factor	0.97
Topographic Adjustment Factor	1.02

Table 30 | Generalised tropical storm method revised results

Duration (hours)	Initial Depth (mm)	PMP Estimate (mm)	Preliminary PMP Estimate (nearest 10mm)	Final PMP Estimate (nearest 10mm)
12	-	-	-	710
24	1305	928	930	930
36	1579	1123	1120	1130
48	1834	1305	1300	1310
72	2286	1626	1630	1630
96	2568	1827	1830	1830
120	2696	1918	1920	1920

Table 31 | Critical durations and maximum discharges for the four PMP GTSMR locations extracted from RAFTS

Location	Node			Generalised Tropical Storm Method Revised	
		Model Domain	Creek	Critical Duration (hrs)	Discharge (m^3/s)
Ripley Road	OXC-6	LCC	Oxley	12 (24hr Temporal Pattern)	252
Tully Road near Spring Valley Road	OXC-36	LCC	Oxley	12 (24hr Temporal Pattern)	857
New Beith Road near Argyle Road	OXC-69	LCC	Oxley	12 (24hr Temporal Pattern)	1358
Driving Range near Goodna Road	OXC-94	LCC	Oxley	12 (24hr Temporal Pattern)	1964
Adise Road off Paradise Road	OXC-D121	BCC	Oxley	12 (24hr Temporal Pattern)	2405
Logan Avenue off Oxley Road	OXC144-145	BCC	Oxley	12 (24hr Temporal Pattern)	3247
Long Street East and Stickland Terrace	OXC-156	BCC	Oxley	12 (24hr Temporal Pattern)	3379
Greenbank Military Camp	BLC-6	LCC	Blunder	12 (24hr Temporal Pattern)	138
Gibbston Place	BLC-18	BCC	Blunder	12 (24hr Temporal Pattern)	434
Forest Place Durack Retirement Village	BLC-40	BCC	Blunder	12 (24hr Temporal Pattern)	694
Colvin Street	SSC-20	BCC	Stable Swamp	12 (24hr Temporal Pattern)	585

Note that for all the discharges presented in Table 31 the GSDM discharges (refer to Table 24) are critical.

7.2 Extreme event hydraulic model set-up and scenarios

7.2.1 200 and 500 year ARI events

The 200 and 500 year ARI events were simulated for Scenario 1 and Scenario 3 (ie Waterway Corridor (WC) and Minimum Riparian Corridor (MRC) incorporated). The WC assumed that the boundary was filled to a level of 0.3 m above the 100 year ARI flood level. This artificial filling was achieved using GIS techniques to interrogate the 100 year ARI flood extents which had been 'glass-walled' to the Waterway Corridor boundary extent. The MRC was also incorporated. Section 4.1 discusses these scenarios in more detail. The mass balance error was less than 0.5% indicating a healthy and robust model.

The Brisbane River tailwater conditions adopted for use in the 200 and 500 year ARI events are outlined below. These were extracted from a rating curve on the Brisbane River at the mouth of Oxley Creek which was provided by Council. This rating curve assumed the only flow in Brisbane River was from the Oxley Creek Catchment.

- 200 year ARI: 1.34 m AHD
- 500 year ARI: 1.42 m AHD

7.2.2 2000 year ARI and PMF events

Due to the magnitude of the discharges associated with the 2000 year ARI and PMF events the model was run as a purely 2D simulation (as agreed with Council). A z-line was used to approximate the main channel where the waterway would have originally been represented as a 1D branch. Due to the high magnitude of the discharge the majority of the flow is located on the floodplain area and as a result the conveyance of the main channel is not as critical when compared to the design events. Structures were also removed from the model with gaps in embankments provided to allow the water pass through.

The 2000 year ARI and PMF events were run for Scenario 1 only (ie current creek conditions with ultimate hydrology flows). The model was observed to run smoothly with a mass balance error in the region of 0.2%.

The Brisbane River tailwater conditions adopted for use in the 2000 year ARI and PMF events are outlined below. These were extracted from a rating curve on the Brisbane River at the mouth of Oxley Creek which was provided by Council. This rating curve assumed the only flow in Brisbane River was from the Oxley Creek Catchment.

- 2000 year ARI: 1.7 m AHD
- PMF: 4.9 m AHD

7.3 Results discussion

A plot of the flood profiles is presented in Figure 7-2 to aid in the discussion in the following sections. GIS based flood mapping for the extreme events was completed and is presented in Volume 2 of the Oxley Creek Flood Study.

The flood mapping was completed for the following scenarios and is provided in Volume 2 of the Oxley Creek Flood Study:

- 200, 500 and 2000 year ARI flood extent mapping – Scenario 1 (Existing Conditions)
- 200, and 500 year ARI water surface level mapping – Scenario 3 (Ultimate Conditions)

Associated tabulated peak water level and velocity results for locations throughout the model are also provided in the Appendix I.

Refer also to Section 4.3.1 where the 'stretching' of the Scenario 3 mapping is described. This was also applied to the 200 and 500 year ARI events, notwithstanding the locations where the constrained floodwater exceeded and overtopped the 300mm freeboard at the Waterway Corridor boundary.

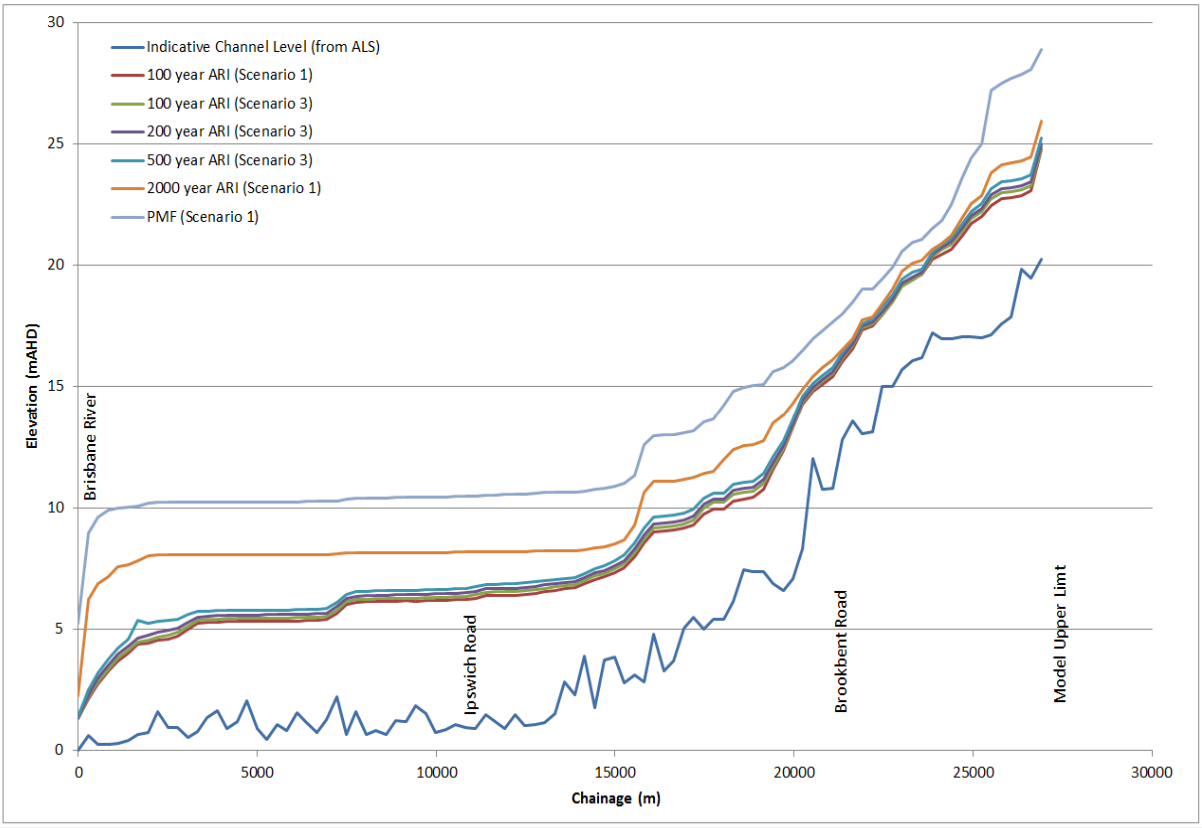

Figure 7-2 | Extreme event flood profiles on Oxley Creek

Tabulated discharge data at key locations is provided in Table 32. A review of the discharges associated with the various event magnitudes shows that in certain locations (particularly the downstream reaches of Oxley Creek) there may appear to be some inconsistencies in the results provided (most notably between the 200/500 year ARI results and those of the 2000 year ARI/PMF events). These have been reviewed and it is found that such anomalies are due to a number of factors including:

- Different tailwater conditions
- Different model set-up (combined 1D/2D as compared to fully 2D for the 200/500 year ARI events and the 2000 year ARI/PMF events respectively)

Of note is that the portion of channel below the rail-line is modelled as a 1D channel in the 200 and 500 year ARI events, whereas it is represented as a fully 2D channel for the 2000 year ARI and PMF events. As the flow occurs predominantly in the 1D channel during the 200 and 500 year ARI events the momentum changes experienced by the flow at the meanders and channel bends on Oxley Creek are not accounted for in comparison to the fully 2D 2000 year ARI and PMF events. Another possible contributing factor is the tailwater levels, particularly for the PMF event. This is partially why the 2000 year ARI discharges are only marginally greater than those of the 500 year ARI event downstream of Sherwood Road.

Also, as the rail-line acts as a constriction to the flow significant attenuation occurs upstream of the embankment particularly during the 2000 year ARI and PMF events (refer to Figure 7-2). Accordingly, the peak discharge in both these events is observed to reduce at Sherwood Road and further downstream.

At a number of the crossing locations on the smaller tributaries the ratios of the 2000 year ARI and PMF flows compared to those of the 200 and 500 year ARI events are not as great as may be expected (eg Wallaroo Way, Inala Avenue, etc). Note however that the 2000 year ARI and PMF model was set up using a purely 2D grid. The discretisation of the topography and the materials layer for these smaller tributaries does not match the level of detail within the combined 1D/2D model. This is likely to contribute to these apparent anomalies. Note also that in relation to the PMF event, for many of the tributaries the shortest PMF duration that was modelled out of the six total durations was the 120 minute GSDM storm, whereas the critical storm being compared against for the lesser events is the 60 minute storm.

Table 32 | Tabulated extreme event discharges

Creek/ Channel	Structure Location	Peak Discharge (m^3/s)			
		200 year ARI	500 year ARI	2000 year ARI	PMF
Oxley Creek	Logan Motorway	748	847	1155	3526
	King Avenue	785	877	1198	3595
	Beatty Road	786	876	1194	2918
	Ipswich Road[1]	881	977	1261	3628
	Sherwood Road[2]	925	1008	1085	2904
	Railway Bridge	944	1035	1078	2883
	Pamphlett Bridge	948	1038	1077	2880
Blunder Creek	Logan Motorway	102	114	155	464

Creek/ Channel	Structure Location	Peak Discharge (m^3/s)			
		200 year ARI	500 year ARI	2000 year ARI	PMF
	Forest Lake Boulevard	85	95	168	508
	Blunder Road	171	195	216	690
	King Avenue	192	216	270	861
	Bowhill Road[3]	232	282	342	1391
Oxtrib1	Rudd Street	45	50	55	83
	Blunder Road	100	111	114	228
	Ipswich Road[1]	See Ipswich Road on Oxley Creek			
Btrib1	Clipper Street	40	44	55	77
	Inala Avenue	66	74	81	123
	Rosemary Street	121	135	148	239
	Blunder Road	162	182	205	364
	Bowhill Road[3]	See Bowhill Road on Blunder Creek			
Btrib2	Wallaroo Way	37	41	45	71
	Lorikeet Street	55	61	68	120
	Pigeon Street	54	61	68	120
	Rosella Street	54	61	68	120
	Blunder Road	69	77	88	160
	Inala Avenue	69	77	88	160
	King Avenue	75	84	96	179
Btrib3	Eucalypt Street	31	34	37	61
Btrib4	Inala Avenue	13	14	15	25

[1] Peak discharge is inclusive of entire stretch of road including flows from Oxley Creek and Oxley Tributaries.
[2] Peak discharge is inclusive of entire stretch of Sherwood Road including the main bridge and overflow culvert.
[3] Peak discharge is inclusive of entire stretch of Bowhill Road including flows from Blunder Creek and Blunder Tributaries.

7.3.1 200 and 500 year ARI events

In relation to the main channel of Oxley Creek, the average increase in flood depth associated with the 200 and 500 year ARI events when compared to the 100 year ARI flood profile is:

- 200 year ARI event: +0.15 m (Scenario 3)
- 500 year ARI event: +0.35 m (Scenario 3)

The flood profiles for the 200 and 500 year ARI events are observed to follow a very similar trend with no significant areas of increased flood depth as compared to the 100 year ARI flood profile along Oxley Creek (refer to Figure 7-2). Similar behaviour is observed on Blunder Creek.

In relation to the flood extent associated with the 200 and 500 year ARI events, the approximate increase in the area of inundation when compared to that of the 100 year ARI event (15.3 km^2) is:

- 200 year ARI event: +17.5 km2 – 14%
- 500 year ARI event: +20.5 km2 – 34%

Figure 7-3 and Figure 7-4 present discharge hydrographs at key locations within the model domain for the 200 and 500 year ARI events respectively.

Tabulated results for the 200 and 500 year ARI events are provided in Appendix I. These are based on Scenario 3 topographic conditions.

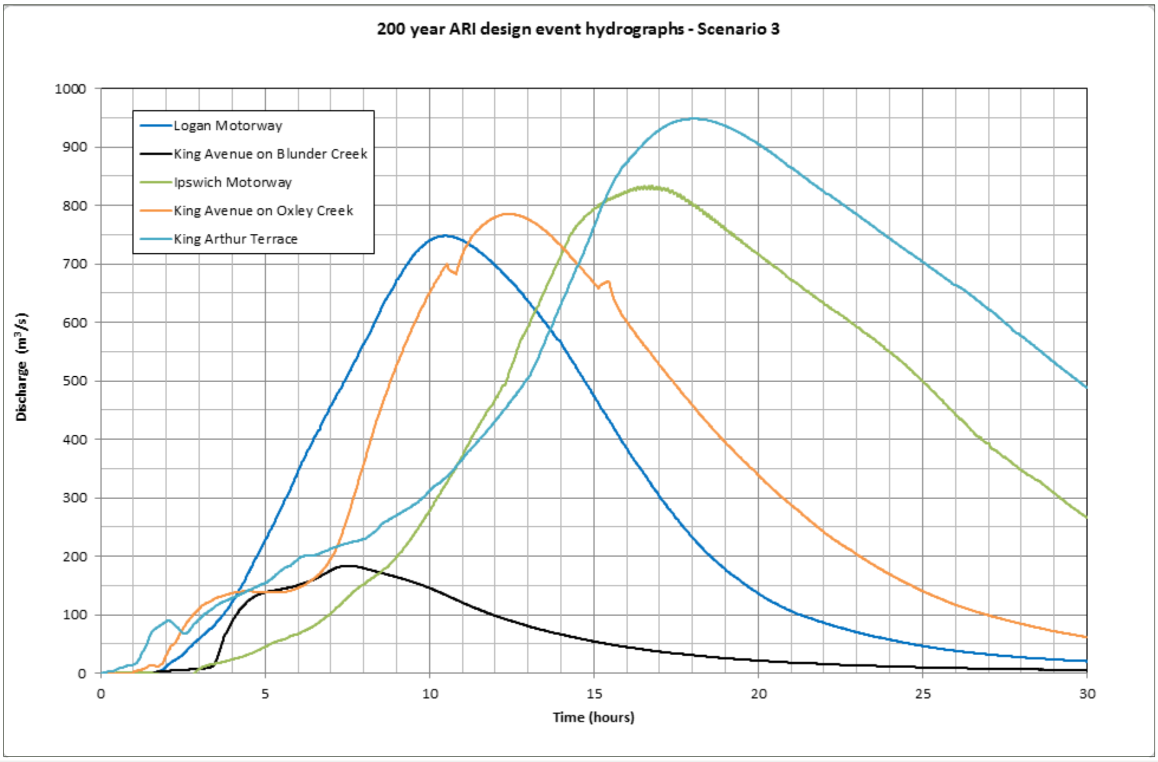

Figure 7-3 | 200 year ARI design event hydrographs (Scenario 3)

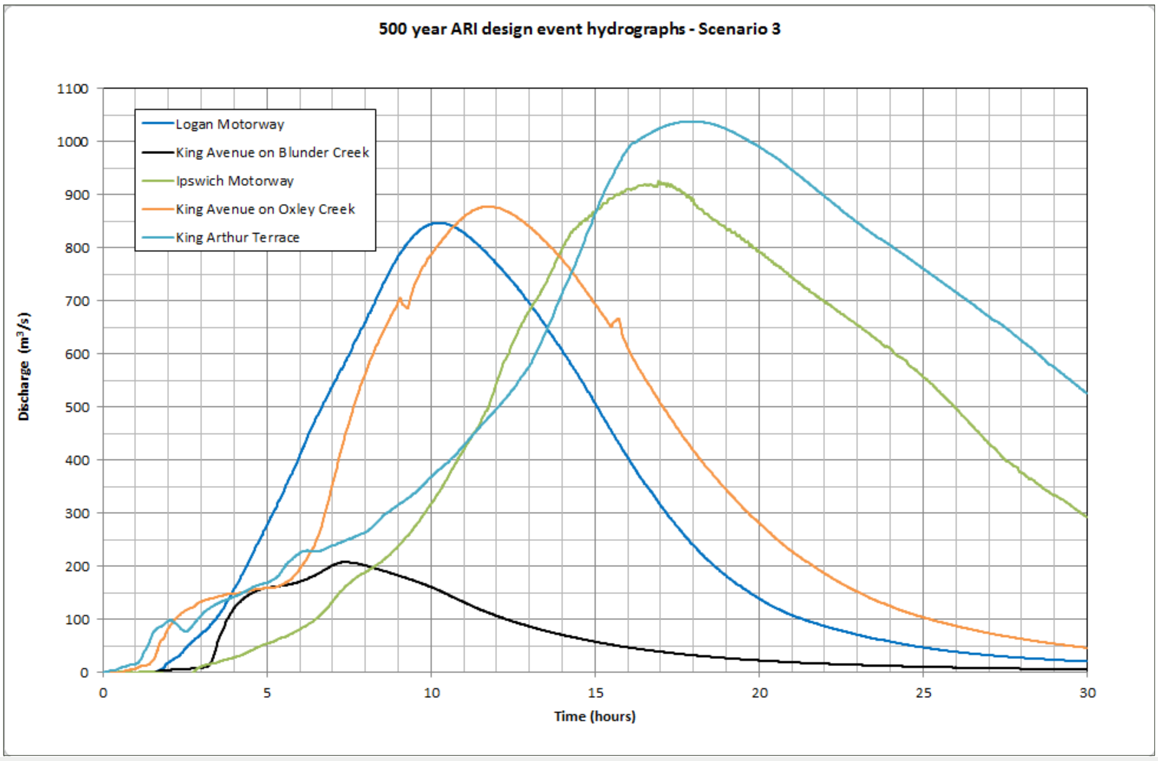

Figure 7-4 | 500 year ARI design event hydrographs (Scenario 3)

7.3.2 2000 year ARI and PMF events

The flood profiles for the 2000 year ARI and PMF events follow a similar trend upstream of Brookbent Road (refer to Figure 7-2). The average increase in flood depth associated with both events when compared to the 100 year ARI flood profile is:

- 2000 year ARI event: +0.60 m (Scenario 1)
- PMF event: +2.0 m (Scenario 1)

However it is observed that downstream of Brookbent Road significantly deeper flooding is predicted due to the reduction in bed slope and a flatter less efficient floodplain (refer to Figure 7-2). Depths are observed to increase by approximately 2.8 m and 5 m when compared to those of the 100 year ARI event upstream of the rail crossing on Oxley Creek.

In relation to the flood extent associated with the 2000 year ARI and PMF events, the approximate increase in the area of inundation when compared to that of the 100 year ARI event (15.3 km^2) is:

- 2000 year ARI event: +28.9 km^2 – 89%
- PMF event: +38.5 km^2 – 150%

Figure 7-5 and Figure 7-6 show discharge hydrographs at key locations within the model domain for the 2000 year ARI and PMF events respectively for both Oxley and Blunder Creek.

It is clear that during the PMF event the Oxley Creek hydrographs extracted from TUFLOW show some attenuation within the floodplain upstream of the rail-line. Having assessed the results of the six simulations it was found that the Location 4 5 hr GSDM storm generates the critical flood levels along the entirety of Oxley Creek.

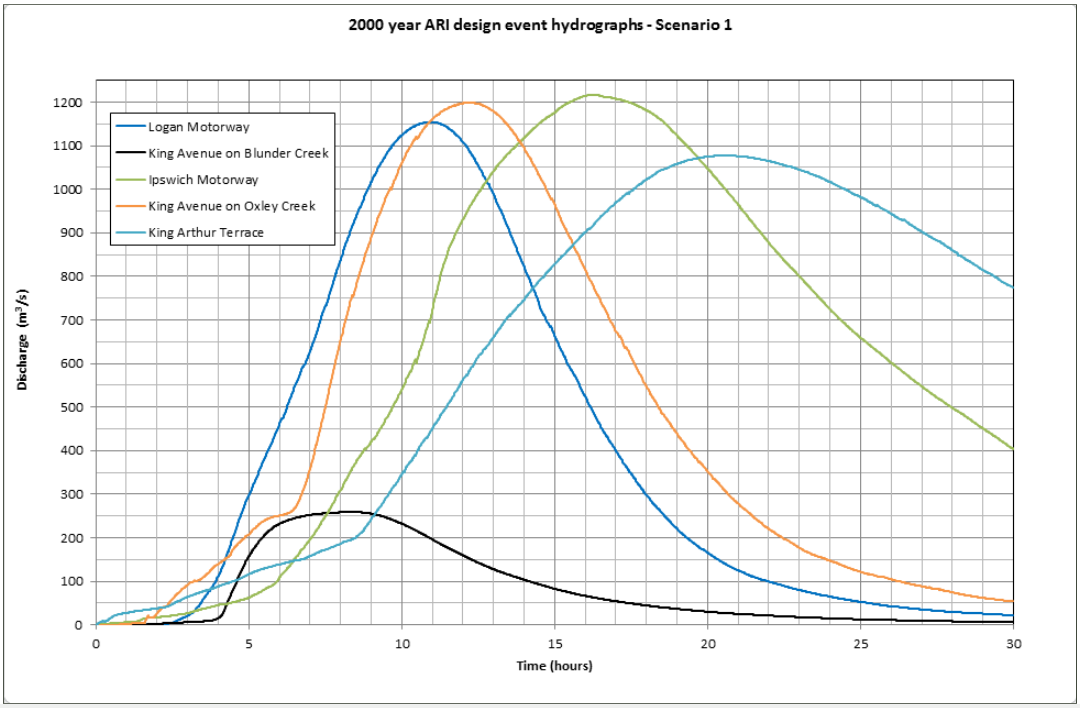

Figure 7-5 | 2000 year ARI design event hydrographs (Scenario 1)

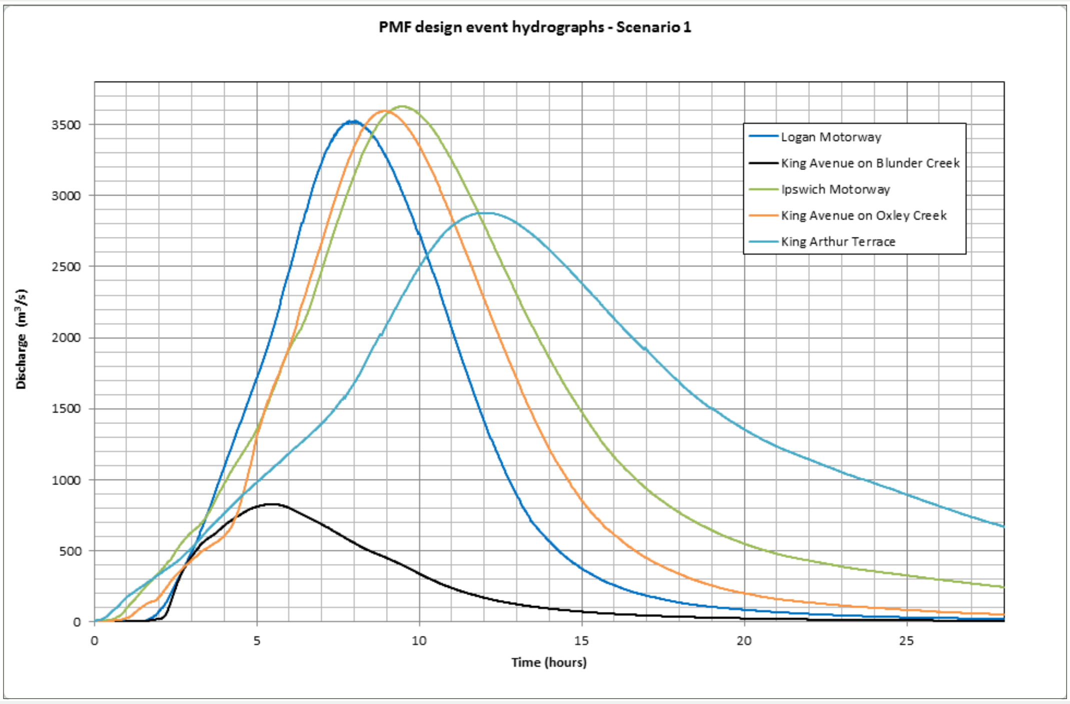

Figure 7-6 | PMF event hydrographs (Scenario 1)

Tabulated results for the 2000 year ARI and PMF events are provided Appendix I. These are based on Scenario 1 topographic conditions.

8 Climate change analysis

In order to understand the potential for higher rainfall intensities to increase flood levels two climate change scenarios were considered:

- 2050 case: +10% rainfall intensity increase (CC1)
- 2100 case: +20% rainfall intensity increase (CC2)

The following topics relating to the climate change analysis are discussed:

- Background and model set-up
- Discussion of results

The climate change values above are based upon the recommendations of the *"Increasing Queensland's resilience to inland flooding in a changing climate: Final report on the Inland Flooding Study"* (2010), and the Queensland Reconstruction Authority's *"Temporary State Planning Policy 2/11: Planning for stronger, more resilient floodplains: Part 2 – Measures to support floodplain management in future planning schemes"* (2012).

The climate change analysis was conducted for the 100, 200 and 500 year ARI events.

8.1 Background and modelling set-up

To assess the impact of climate change the design storm IFD information presented in the Design Event Report was increased by 10% (CC1) and 20% (CC2). Table 33 and Table 34 present the scaled IFD data for these two cases respectively.

The increased rainfall intensities were incorporated into the RAFTS model rainfall database and simulations were subsequently carried out. The RAFTS output was then extracted and used within the TUFLOW model. Typical mass balance errors in the model were in the region of 0.5%.

The following five simulations were undertaken as part of the climate change analysis assuming the Scenario 3 conditions (ie WC and MRC incorporation):

- 100 year CC1
- 100 year CC2
- 200 year CC1
- 200 year CC2
- 500 year CC2

Table 33 | 2050 Factored Climate Change AR&R IFD Data (+10%)

2050 Factored Climate Change AR&R IFD Data (+10%)			
Duration (hr)	100 Year	200 years	500 years
0.5	181.1	193.9	212.6
1	123.3	133.4	148.1
3	58.7	62.5	68.1
6	35.4	37.8	41.4
12	21.8	23.2	25.2
18	16.7	17.9	19.6
24	14.0	15.0	16.4
48	8.9	10.0	11.4
72	6.6	7.5	8.9

Table 34 | 2100 Factored Climate Change AR&R IFD Data (+20%)

2050 Factored Climate Change AR&R IFD Data (+10%)			
Duration (hr)	100 Year	200 years	500 years
0.5	197.5	211.6	232.0
1	134.5	145.6	161.5
3	64.1	68.2	74.3
6	38.6	41.3	45.1
12	23.8	25.3	27.5
18	18.2	19.6	21.4
24	15.2	16.3	17.9
48	9.7	10.9	12.5
72	7.2	8.2	9.7

The tailwater levels specified in the Brisbane River which would also account for climate change were specified by Council. These are summarised in Table 35.

Table 35 | Tailwater conditions for climate change analysis

Event	Brisbane River level from BCC rating curve (m AHD)	Additional water level increase (m)	Final tailwater level (m AHD)
100 year CC1	1.36	0.3	1.66
100 year CC2	1.44	0.8	2.24
200 year CC1	1.42	0.3	1.72
200 year CC2	1.51	0.7	2.21
500 year CC2	1.6	0.7	2.3

8.2 Climate change analysis: discussion of results

The approximate average increase in flood levels and discharge associated with each of the climate change scenario simulations when compared to the base/existing conditions (for a given return period) is outlined in Table 36.

Table 36 | Climate change scenario discharge and water level summary information along Oxley Creek

Scenario	Average increase	
	Water Level (m)	Discharge (%)
100 year CC1	0.25	12%
100 year CC2	0.45	23%
200 year CC1	0.25	12%
200 year CC2	0.45	23%
500 year CC2	0.45	22%

The flood profiles across all climate change scenarios are observed to follow the same trend with no areas of significantly increased flood depth above the average flood level increase outlined in Table 36.

In relation to Blunder Creek the water level increases were not as great but water levels for CC1 and CC2 were approximately 0.08 and 0.15 m greater than the base/existing case for all return periods. Table 37 to Table 39 contain tabulated data related to the 100, 200 and 500 year ARI events and the climate change scenarios.

Table 37 | Tabulated climate change data at key locations within the catchment for the 100 year ARI event

Location	Creek	Water Level (m AHD)			Discharge (m^3/s)		
		Existing	CC1	CC2	Existing	CC1	CC2
Logan Motorway	Oxley Creek	22.53	22.71	22.89	689	766	846
King Avenue	Oxley Creek	10.87	11.17	11.47	735	817	907
Beatty Road	Oxley Creek	9.23	9.49	9.75	735	819	909
Ipswich Motorway	Oxley Creek	6.49	6.68	6.86	641	725	816
Cliveden Avenue	Oxely Creek	5.45	5.64	5.83	810	902	993
Railway	Oxley Creek	4.41	4.70	5.01	878	970	1057
King Arthur Terrace	Oxley Creek	1.94	2.25	2.70	881	973	1061
King Avenue	Blunder Creek	9.10	9.18	9.25	175	198	220

Table 38 | Tabulated climate change data at key locations within the catchment for the 200 year ARI event

Location	Creek	Water Level (m AHD)			Discharge (m^3/s)		
		Existing	CC1	CC2	Existing	CC1	CC2
Logan Motorway	Oxley Creek	22.67	22.87	23.05	748	838	921
King Avenue	Oxley Creek	11.06	11.38	11.66	785	880	970
Beatty Road	Oxley Creek	9.39	9.67	9.93	786	882	972
Ipswich Motorway	Oxley Creek	6.62	6.82	7.00	694	781	877
Cliveden Avenue	Oxley Creek	5.58	5.78	5.98	867	967	1056
Railway	Oxley Creek	4.60	4.90	5.16	944	1041	1122
King Arthur Terrace	Oxley Creek	2.04	2.35	2.73	948	1044	1126
King Avenue	Blunder Creek	9.16	9.24	9.31	192	215	238

Table 39 | Tabulated climate change data at key locations within the catchment for the 500 year ARI event

Location	Creek	Water Level (m AHD)		Discharge (m^3/s)	
		Existing	CC2	Existing	CC2
Logan Motorway	Oxley Creek	22.89	23.28	847	1037
King Avenue	Oxley Creek	11.37	11.96	877	1076
Beatty Road	Oxley Creek	9.66	10.21	877	1076
Ipswich Motorway	Oxley Creek	6.81	7.17	769	955
Cliveden Avenue	Oxley Creek	5.76	6.19	955	1146
Railway	Oxley Creek	4.85	5.43	1035	1232
King Arthur Tce	Oxley Creek	2.18	2.87	1038	1236
King Avenue	Blunder Creek	9.24	9.37	216	264

9 Conclusions

The calibrated RAFTS and TUFLOW models described in the Calibration Report were used in the design event analyses. These analyses assumed ultimate catchment development conditions.

A Flood Frequency Analysis was carried out to establish discharge data against which to compare the RAFTS design discharges, and subsequently set appropriate design losses. This used 101 years of rain gauge records from Brisbane's CBD. Note that the rainfall data was not modified to account for the geographical separation between the CBD and the Oxley Creek catchment. The results of the comparison showed that the unmodified design event discharges came out to be less than those of the FFA for all but the 2 year ARI event. Accordingly, the design rainfall intensities were factored by between 1.03 and 1.08 such that a good correlation was achieved between both sets of discharges.

The design discharge hydrographs were then extracted from the RAFTS model and incorporated into the TUFLOW model.

The TUFLOW model was used to assess the 1, 2, 5, 10, 20, 50 and 100 year ARI events. For both the 2 year and 100 year ARI events the entire set of run durations were modelled (ie 1 hour to 72 hour). The results of this were then evaluated to determine the six most critical events across the catchment. These were established as being the 1, 3, 6, 9, 12 and 18 hour storms and were modelled for the 1, 5, 10, 20 and 50 year ARI events.

Three scenarios were modelled for the design event runs (ie 1 to 100 year ARI). Scenario1 was based on the current creek conditions – no modifications were made to the TUFLOW model developed as part of the calibration phase. Scenario 2 incorporated a Minimum Riparian Corridor (MRC). This involved defining a 15 m wide corridor from the edge of the channel after which a review of soil conditions and existing vegetation was undertaken. Based on this review an appropriate Manning's n was set for specific sections of the channel. Scenario 3 incorporated the Waterway Corridor thereby limiting the lateral spread of the flow (this represents full development and filling to above 100 year ARI to the waterway corridor boundary).

The TUFLOW outputs were then used to predict and map/tabulate the following for the modelled waterways:

- Water surface levels (m AHD)
- Flood depth (m)
- Depth-velocity product (m^2/s)
- Flood immunity and emergency management information

Hydraulic Structure Reference Sheets (HSRS) for all crossings within the TUFLOW model area were also prepared. The HSRS provide data for each hydraulic structure along the alignment of Oxley and Blunder Creeks and their associated tributaries. This includes data relating to the structure description, location, hydraulic performance and history.

In addition, hydrologic and hydraulic modelling was undertaken for four extreme events: the 200, 500 and 2000 year ARI events and the PMF. The details of this exercise are presented in Section 7. In relation to the main channel of Oxley Creek, the average increase in flood depth associated with the extreme events when compared to the 100 year ARI flood depth is outlined in the following bullet points:

- 200 year ARI: 0.15 m
- 500 year ARI: 0.35 m
- 2000 year ARI: 0.6 m
- PMF: 2.0 m

The effects of climate change were also evaluated in order to understand the potential for higher rainfall intensities to increase flood levels. Two scenarios were considered:

- 2050 case: +10% rainfall intensity increase
- 2100 case: +20% rainfall intensity increase

These scenarios are discussed in more detail in Section 8. For the 100 year ARI events an additional 10% rainfall can be seen to translate to an increase in peak discharge of approximately 12%, and an increase in water surface level of 0.25 m. For the 100 year ARI events an additional 20% rainfall can be seen to translate to an increase in peak discharge of approximately 23%, and an increase in water surface level of 0.45 m.

10 Volume 2: Flood mapping design event nomenclature

The flood mapping presented in Volume 2 adopts the latest approach to design flood terminology as detailed in the updated Australian Rainfall and Runoff (AR&R) – Book 1 (Draft). This was done in accordance with Council's prescribed mapping guidelines. Accordingly all design event flood maps are quoted in terms of Annual Exceedance Probability (AEP) using percentage probability (eg 1% AEP design event).

Table 2, an extract of Table 1.1.1 from Book 1, details the relationship between ARI and AEP for the range of design events included in the Oxley Creek Flood Study.

Table 40 | Extract from Table 1.1.1 AR&R preferred terminology

Events per year (EY)	AEP (%)	AEP (1 in x)	Average Recurrence Interval (ARI)
0.69	50.00	2	1.44
0.50	39.35	2.54	2.00
0.22	20.00	5	4.48
0.20	18.13	5.52	5.00
0.11	10.00	10	9.49
0.05	5.00	20	19.5
0.02	2.00	50	49.5
0.01	1.00	100	99.5
0.01	0.50	200	199.5
0.002	0.20	500	499.5
0.0005	0.05	2000	1999.5

As can be seen from Table 40, the difference between AEP and ARI is minimal for 10 year ARI event and above. This range of events reflects a focus on flooding, therefore use of the AEP terminology is acceptable.

However for the 2 and 5 year ARI events the corresponding AEP percentages are 39.35% and 18.13%. This range of events reflects a focus on stormwater drainage and in such circumstances, annualised exceedence probabilities is misleading and confusing. Furthermore, a recurrence interval approach is also misleading where a strong seasonality is experienced. Typically, South-East Queensland experiences a wet summer rainfall and a dry winter rainfall regime. Consequently, events more frequent than 50% AEP should be expressed as X Exceedances per Year (EY).

For the Oxley Creek flood study mapping the 2 and 5 year ARI events are labelled as the 50% and 20% AEP events respectively. This is a conservative approach with the 50% AEP actually only equating to 1.44 year ARI but the 2 year ARI event having been modelled resulting in higher peak water level results for the 50% AEP event.

It is believed that this is an acceptable approach for the flood mapping and the intended use of the resulting peak water level estimates for these events.

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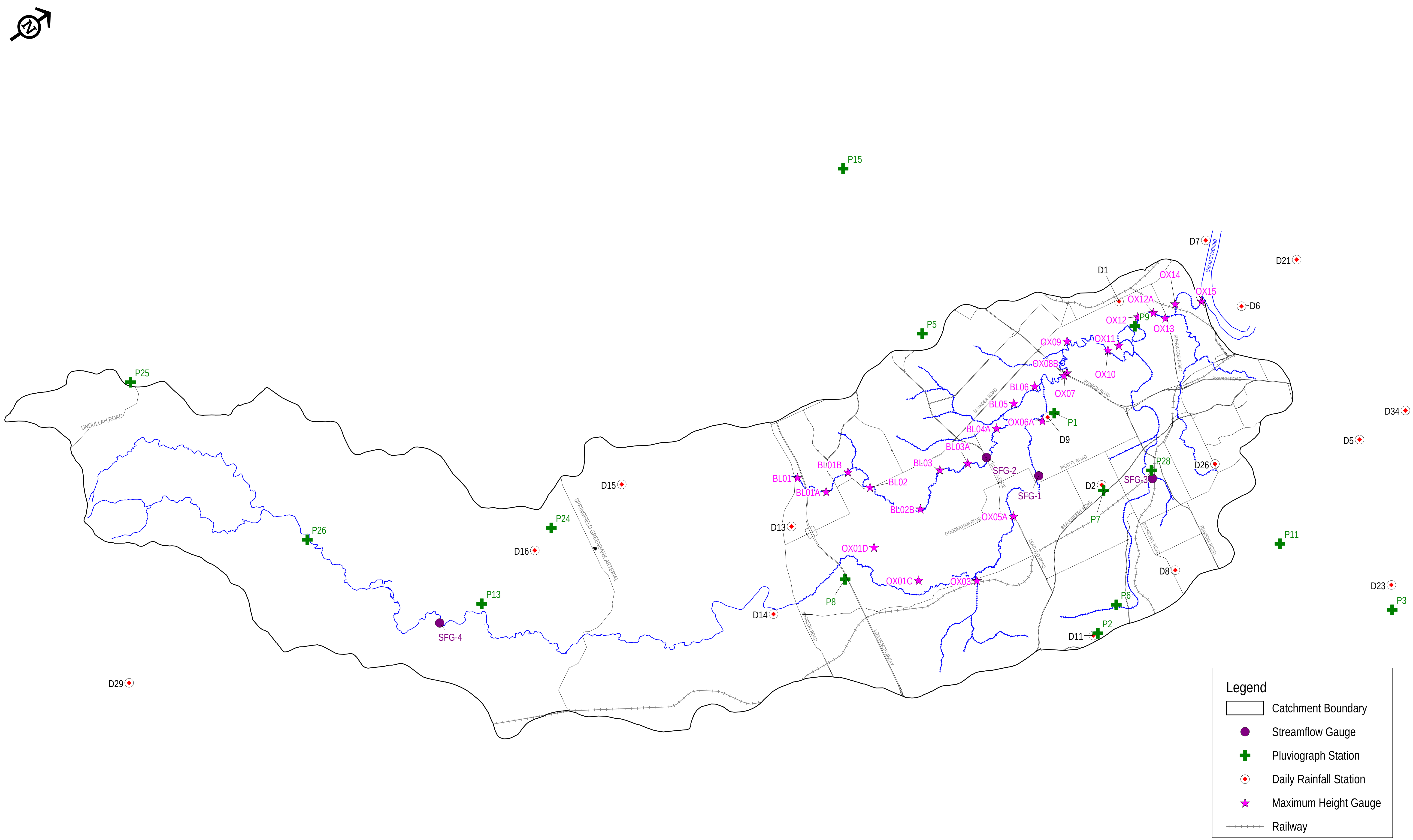
Appendix A
OCFS Catchment Information Map



Disclaimers and Notes:

1. Creek alignment approximate only.
2. Gauge locations as provided by BoM, DNRM & BCC.

Logo:

Client: BRISBANE CITY COUNCIL

Project: OXLEY CREEK FLOOD STUDY

Scale: 0 2,500 5,000

Scale 1:100,000 (A3)

Figure Title: FIGURE 3-1 CATCHMENT MAP

Figure No. Figure 3-1

Revision. 2

Date. 29/05/2013

Appendix B
Adopted RAFTS Model Parameters

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
BLC-1 (A)	14.70	100	1.53	0.015	14.70	100	1.53	0.015
BLC-1 (B)	94.25	0	1.53	0.065	94.25	0	1.53	0.065
BLC-10 (A)	6.28	100	2.31	0.015	6.71	100	2.31	0.015
BLC-10 (B)	119.35	0	2.31	0.075	118.92	0	2.31	0.074
BLC-11 (A)	4.83	100	1.06	0.015	5.02	100	1.06	0.015
BLC-11 (B)	91.70	0	1.06	0.075	91.50	0	1.06	0.074
BLC-12 (A)	4.48	100	1.83	0.015	4.48	100	1.83	0.015
BLC-12 (B)	85.11	0	1.83	0.075	85.11	0	1.83	0.075
BLC-13 (A)	7.22	100	1.57	0.015	15.12	100	1.57	0.015
BLC-13 (B)	137.15	0	1.57	0.075	129.25	0	1.57	0.071
BLC-14 (A)	15.91	100	1.54	0.015	90.96	100	1.54	0.015
BLC-14 (B)	139.10	0	1.54	0.071	64.05	0	1.54	0.027
BLC-15A (A)	2.33	100	2.82	0.015	24.77	100	2.82	0.015
BLC-15A (B)	44.27	0	2.82	0.075	21.84	0	2.82	0.031
BLC-15A-16 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
BLC-15A-16 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
BLC-15B (A)	1.51	100	1.2	0.015	25.44	100	1.2	0.015
BLC-15B (B)	28.74	0	1.2	0.074	4.81	0	1.2	0.022
BLC-16 (A)	5.08	100	2.07	0.015	70.60	100	2.07	0.015
BLC-16 (B)	96.43	0	2.07	0.074	30.91	0	2.07	0.03
BLC-17 (A)	49.41	100	1.27	0.015	63.07	100	1.27	0.015
BLC-17 (B)	66.58	0	1.27	0.041	52.92	0	1.27	0.031
BLC-18 (A)	14.98	100	1.42	0.015	55.11	100	1.42	0.015
BLC-18 (B)	93.49	0	1.42	0.068	53.35	0	1.42	0.034
BLC-19 (A)	10.31	100	1.78	0.015	27.83	100	1.78	0.015
BLC-19 (B)	61.43	0	1.78	0.066	43.91	0	1.78	0.044
BLC-2 (A)	7.55	100	1.24	0.015	7.55	100	1.24	0.015
BLC-2 (B)	143.35	0	1.24	0.075	143.35	0	1.24	0.075
BLC-20 (A)	19.15	100	2.02	0.015	43.52	100	2.02	0.015
BLC-20 (B)	77.03	0	2.02	0.061	52.66	0	2.02	0.037
BLC-21 (A)	27.99	100	2.98	0.015	30.72	100	2.98	0.015
BLC-21 (B)	87.91	0	2.98	0.057	85.18	0	2.98	0.055
BLC-22 (A)	13.64	100	1.85	0.015	16.36	100	1.85	0.015
BLC-22 (B)	65.87	0	1.85	0.064	63.14	0	1.85	0.06
BLC-23 (A)	17.69	100	1.75	0.015	37.16	100	1.75	0.015
BLC-23 (B)	86.86	0	1.75	0.064	67.38	0	1.75	0.047
BLC-24 (A)	11.34	100	1.05	0.015	11.34	100	1.05	0.015
BLC-24 (B)	85.15	0	1.05	0.069	85.15	0	1.05	0.069

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
BLC-25 (A)	12.27	100	2.05	0.015	16.59	100	2.05	0.015
BLC-25 (B)	73.74	0	2.05	0.067	69.41	0	2.05	0.061
BLC-26 (A)	64.33	100	2.7	0.015	64.33	100	2.7	0.015
BLC-26 (B)	54.09	0	2.7	0.029	54.09	0	2.7	0.029
BLC-27 (A)	37.67	100	3.02	0.015	57.27	100	3.02	0.015
BLC-27 (B)	70.01	0	3.02	0.047	50.41	0	3.02	0.031
BLC-28 (A)	35.74	100	1.85	0.015	35.80	100	1.85	0.015
BLC-28 (B)	47.19	0	1.85	0.039	47.13	0	1.85	0.039
BLC-29 (A)	21.31	100	0.93	0.015	24.97	100	0.93	0.015
BLC-29 (B)	109.92	0	0.93	0.066	106.26	0	0.93	0.063
BLC-3 (A)	4.67	100	0.85	0.015	4.67	100	0.85	0.015
BLC-3 (B)	88.69	0	0.85	0.075	88.69	0	0.85	0.075
BLC-3-4 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
BLC-3-4 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
BLC-30 (A)	45.36	100	3.57	0.015	45.36	100	3.57	0.015
BLC-30 (B)	53.29	0	3.57	0.038	53.29	0	3.57	0.038
BLC-31 (A)	39.22	100	2.19	0.015	39.22	100	2.19	0.015
BLC-31 (B)	30.90	0	2.19	0.03	30.90	0	2.19	0.03
BLC-32 (A)	56.20	100	1.88	0.015	56.20	100	1.88	0.015
BLC-32 (B)	48.71	0	1.88	0.031	48.71	0	1.88	0.031
BLC-33 (A)	32.18	100	1.47	0.015	32.18	100	1.47	0.015
BLC-33 (B)	23.47	0	1.47	0.026	23.47	0	1.47	0.026
BLC-34 (A)	12.87	100	1.01	0.015	12.87	100	1.01	0.015
BLC-34 (B)	48.29	0	1.01	0.06	48.29	0	1.01	0.06
BLC-35 (A)	47.25	100	1.19	0.015	47.25	100	1.19	0.015
BLC-35 (B)	47.48	0	1.19	0.035	47.48	0	1.19	0.035
BLC-36 (A)	50.16	100	1.37	0.015	50.16	100	1.37	0.015
BLC-36 (B)	54.33	0	1.37	0.035	54.33	0	1.37	0.035
BLC-37 (A)	25.13	100	1.2	0.015	25.13	100	1.2	0.015
BLC-37 (B)	32.38	0	1.2	0.04	32.38	0	1.2	0.04
BLC-38 (A)	17.48	100	1.09	0.015	17.48	100	1.09	0.015
BLC-38 (B)	74.56	0	1.09	0.063	74.56	0	1.09	0.063
BLC-39 (A)	35.49	100	0.14	0.015	35.49	100	0.14	0.015
BLC-39 (B)	93.15	0	0.14	0.057	93.15	0	0.14	0.057
BLC-4 (A)	5.46	100	1.3	0.015	5.46	100	1.3	0.015
BLC-4 (B)	103.68	0	1.3	0.075	103.68	0	1.3	0.075
BLC-40 (A)	32.79	100	2.01	0.015	32.79	100	2.01	0.015
BLC-40 (B)	64.55	0	2.01	0.049	64.55	0	2.01	0.049

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
BLC-41 (A)	14.67	100	1.11	0.015	14.67	100	1.11	0.015
BLC-41 (B)	78.78	0	1.11	0.064	78.78	0	1.11	0.064
BLC-5 (A)	5.00	100	1.76	0.015	5.00	100	1.76	0.015
BLC-5 (B)	94.94	0	1.76	0.075	94.94	0	1.76	0.075
BLC-6 (A)	4.49	100	1.18	0.015	4.49	100	1.18	0.015
BLC-6 (B)	85.24	0	1.18	0.075	85.24	0	1.18	0.075
BLC-7 (A)	6.31	100	1.92	0.015	6.31	100	1.92	0.015
BLC-7 (B)	119.90	0	1.92	0.075	119.90	0	1.92	0.075
BLC-8 (A)	5.39	100	1.12	0.015	5.39	100	1.12	0.015
BLC-8 (B)	102.39	0	1.12	0.075	102.39	0	1.12	0.075
BLC-9 (A)	4.49	100	2	0.015	4.49	100	2	0.015
BLC-9 (B)	85.23	0	2	0.075	85.23	0	2	0.075
BLC-D18 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
BLC-D18 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
BLC-D24 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
BLC-D24 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
BLC-D3 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
BLC-D3 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
BLC-D35 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
BLC-D35 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
BLC-D36 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
BLC-D36 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
BLC-D6 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
BLC-D6 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
BLC-D8 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
BLC-D8 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
BLC41-O146 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
BLC41-O146 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
MOC-1 (A)	62.02	100	2.21	0.015	62.02	100	2.21	0.015
MOC-1 (B)	65.52	0	2.21	0.034	65.52	0	2.21	0.034
MOC-2 (A)	69.08	100	1.55	0.015	69.08	100	1.55	0.015
MOC-2 (B)	80.15	0	1.55	0.037	80.15	0	1.55	0.037
MOC-3 (A)	82.64	100	2.32	0.015	82.64	100	2.32	0.015
MOC-3 (B)	42.21	0	2.32	0.025	42.21	0	2.32	0.025
MOC-4 (A)	32.18	100	0.6	0.015	32.18	100	0.6	0.015
MOC-4 (B)	21.27	0	0.6	0.033	21.27	0	0.6	0.033
MOC-4-5 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
MOC-4-5 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
MOC-5 (A)	22.38	100	0.71	0.015	22.38	100	0.71	0.015
MOC-5 (B)	35.01	0	0.71	0.051	35.01	0	0.71	0.051
MOC-6 (A)	78.75	100	0.25	0.015	78.75	100	0.25	0.015
MOC-6 (B)	54.55	0	0.25	0.038	54.55	0	0.25	0.038
OX152A152B (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OX152A152B (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-1 (A)	7.59	100	4.77	0.015	7.59	100	4.77	0.015
OXC-1 (B)	144.22	0	4.77	0.074	144.22	0	4.77	0.074
OXC-10 (A)	1.62	100	3.13	0.015	1.62	100	3.13	0.015
OXC-10 (B)	30.87	0	3.13	0.075	30.87	0	3.13	0.075
OXC-10-14 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-10-14 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-100 (A)	5.63	100	0.54	0.015	5.63	100	0.54	0.015
OXC-100 (B)	106.87	0	0.54	0.075	106.87	0	0.54	0.075
OXC-101 (A)	7.40	100	1.21	0.015	7.40	100	1.21	0.015
OXC-101 (B)	140.58	0	1.21	0.075	140.58	0	1.21	0.075
OXC-102 (A)	13.37	100	1.72	0.015	13.37	100	1.72	0.015
OXC-102 (B)	129.05	0	1.72	0.07	129.05	0	1.72	0.07
OXC-103 (A)	12.71	100	2.21	0.015	12.71	100	2.21	0.015
OXC-103 (B)	104.72	0	2.21	0.068	104.72	0	2.21	0.068
OXC-104 (A)	28.16	100	0.84	0.015	28.16	100	0.84	0.015
OXC-104 (B)	99.54	0	0.84	0.055	99.54	0	0.84	0.055
OXC-105 (A)	53.48	100	2.12	0.015	53.48	100	2.12	0.015
OXC-105 (B)	111.04	0	2.12	0.044	111.04	0	2.12	0.044
OXC-106 (A)	10.54	100	1.68	0.015	22.97	100	1.68	0.015
OXC-106 (B)	126.68	0	1.68	0.072	114.25	0	1.68	0.066
OXC-107 (A)	9.38	100	1.56	0.015	9.39	100	1.56	0.015
OXC-107 (B)	56.56	0	1.56	0.065	56.55	0	1.56	0.065
OXC-108 (A)	26.28	100	1.5	0.015	26.28	100	1.5	0.015
OXC-108 (B)	66.26	0	1.5	0.048	66.26	0	1.5	0.048
OXC-109 (A)	27.72	100	2.57	0.015	27.75	100	2.57	0.015
OXC-109 (B)	37.45	0	2.57	0.032	37.42	0	2.57	0.032
OXC-11 (A)	5.07	100	4.38	0.015	5.07	100	4.38	0.015
OXC-11 (B)	96.24	0	4.38	0.075	96.24	0	4.38	0.075
OXC-110 (A)	28.84	100	2.12	0.015	28.85	100	2.12	0.015
OXC-110 (B)	54.00	0	2.12	0.041	53.99	0	2.12	0.041
OXC-111 (A)	43.64	100	1.98	0.015	43.65	100	1.98	0.015
OXC-111 (B)	62.32	0	1.98	0.034	62.31	0	1.98	0.034

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-112 (A)	4.92	100	2.18	0.015	23.43	100	2.18	0.015
OXC-112 (B)	93.41	0	2.18	0.075	74.89	0	2.18	0.06
OXC-113A (A)	4.68	100	3.62	0.015	4.68	100	3.62	0.015
OXC-113A (B)	26.69	0	3.62	0.064	26.69	0	3.62	0.064
OXC-113B (A)	4.88	100	0.55	0.015	6.57	100	0.55	0.015
OXC-113B (B)	92.64	0	0.55	0.074	90.94	0	0.55	0.073
OXC-114 (A)	5.58	100	1.07	0.015	53.51	100	1.07	0.015
OXC-114 (B)	105.97	0	1.07	0.075	58.04	0	1.07	0.046
OXC-115 (A)	7.60	100	2.04	0.015	10.75	100	2.04	0.015
OXC-115 (B)	96.78	0	2.04	0.072	93.63	0	2.04	0.07
OXC-116A (A)	2.49	100	5.2	0.015	11.67	100	5.2	0.015
OXC-116A (B)	47.30	0	5.2	0.075	38.12	0	5.2	0.06
OXC-116B (A)	1.04	100	0.39	0.015	4.37	100	0.39	0.015
OXC-116B (B)	19.68	0	0.39	0.075	16.35	0	0.39	0.063
OXC-117 (A)	3.66	100	1.02	0.015	31.50	100	1.02	0.015
OXC-117 (B)	69.56	0	1.02	0.075	41.72	0	1.02	0.049
OXC-118 (A)	6.82	100	0.95	0.015	48.61	100	0.95	0.015
OXC-118 (B)	87.13	0	0.95	0.073	45.33	0	0.95	0.043
OXC-119 (A)	17.35	100	0.93	0.015	21.80	100	0.93	0.015
OXC-119 (B)	91.67	0	0.93	0.064	87.22	0	0.93	0.061
OXC-12 (A)	6.25	100	8.62	0.015	6.25	100	8.62	0.015
OXC-12 (B)	118.72	0	8.62	0.075	118.72	0	8.62	0.075
OXC-120 (A)	6.03	100	1.64	0.015	9.19	100	1.64	0.015
OXC-120 (B)	114.56	0	1.64	0.075	111.40	0	1.64	0.073
OXC-121 (A)	11.51	100	0.55	0.015	19.57	100	0.55	0.015
OXC-121 (B)	120.76	0	0.55	0.071	112.70	0	0.55	0.067
OXC-122 (A)	11.03	100	1.04	0.015	76.34	100	1.04	0.015
OXC-122 (B)	125.74	0	1.04	0.072	60.43	0	1.04	0.027
OXC-123 (A)	10.05	100	2.74	0.015	49.65	100	2.74	0.015
OXC-123 (B)	152.64	0	2.74	0.073	113.03	0	2.74	0.052
OXC-124 (A)	17.29	100	0.93	0.015	56.84	100	0.93	0.015
OXC-124 (B)	91.47	0	0.93	0.065	51.91	0	0.93	0.032
OXC-125 (A)	26.34	100	1.36	0.015	26.34	100	1.36	0.015
OXC-125 (B)	83.80	0	1.36	0.057	83.80	0	1.36	0.057
OXC-126 (A)	32.40	100	0.86	0.015	33.77	100	0.86	0.015
OXC-126 (B)	110.09	0	0.86	0.059	108.72	0	0.86	0.058
OXC-127 (A)	17.68	100	0.51	0.015	17.68	100	0.51	0.015
OXC-127 (B)	114.83	0	0.51	0.068	114.83	0	0.51	0.068

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-128A (A)	3.58	100	0.47	0.015	3.58	100	0.47	0.015
OXC-128A (B)	47.83	0	0.47	0.073	47.83	0	0.47	0.073
OXC-128B (A)	12.32	100	0.92	0.015	12.09	100	0.92	0.015
OXC-128B (B)	55.78	0	0.92	0.064	56.01	0	0.92	0.065
OXC-129 (A)	37.15	100	2.5	0.015	38.82	100	2.5	0.015
OXC-129 (B)	33.23	0	2.5	0.03	31.55	0	2.5	0.029
OXC-13 (A)	4.15	100	8.87	0.015	4.15	100	8.87	0.015
OXC-13 (B)	78.92	0	8.87	0.075	78.92	0	8.87	0.075
OXC-130 (A)	40.83	100	3.2	0.015	43.97	100	3.2	0.015
OXC-130 (B)	67.43	0	3.2	0.045	64.29	0	3.2	0.043
OXC-131 (A)	23.79	100	0.55	0.015	23.79	100	0.55	0.015
OXC-131 (B)	96.29	0	0.55	0.064	96.29	0	0.55	0.064
OXC-132A (A)	8.33	100	0.89	0.015	8.33	100	0.89	0.015
OXC-132A (B)	44.64	0	0.89	0.067	44.64	0	0.89	0.067
OXC-132B (A)	3.90	100	3.43	0.015	3.90	100	3.43	0.015
OXC-132B (B)	37.82	0	3.43	0.071	37.82	0	3.43	0.071
OXC-133 (A)	26.88	100	1.86	0.015	50.87	100	1.86	0.015
OXC-133 (B)	51.51	0	1.86	0.052	27.52	0	1.86	0.034
OXC-134 (A)	33.79	100	1.08	0.015	33.79	100	1.08	0.015
OXC-134 (B)	86.03	0	1.08	0.054	86.03	0	1.08	0.054
OXC-135 (A)	60.77	100	1.41	0.015	62.80	100	1.41	0.015
OXC-135 (B)	69.99	0	1.41	0.04	67.96	0	1.41	0.038
OXC-136 (A)	59.91	100	1.1	0.015	59.91	100	1.1	0.015
OXC-136 (B)	57.43	0	1.1	0.038	57.43	0	1.1	0.038
OXC-137 (A)	42.75	100	0.48	0.015	42.75	100	0.48	0.015
OXC-137 (B)	86.00	0	0.48	0.051	86.00	0	0.48	0.051
OXC-138 (A)	45.13	100	1.84	0.015	45.13	100	1.84	0.015
OXC-138 (B)	32.10	0	1.84	0.04	32.10	0	1.84	0.04
OXC-139 (A)	28.39	100	2.27	0.015	28.39	100	2.27	0.015
OXC-139 (B)	41.47	0	2.27	0.044	41.47	0	2.27	0.044
OXC-14 (A)	5.36	100	7.37	0.015	5.36	100	7.37	0.015
OXC-14 (B)	101.88	0	7.37	0.075	101.88	0	7.37	0.075
OXC-140 (A)	56.66	100	1.88	0.015	56.66	100	1.88	0.015
OXC-140 (B)	57.88	0	1.88	0.034	57.88	0	1.88	0.034
OXC-141 (A)	81.74	100	1.38	0.015	81.74	100	1.38	0.015
OXC-141 (B)	30.11	0	1.38	0.028	30.11	0	1.38	0.028
OXC-142 (A)	45.53	100	1.1	0.015	45.53	100	1.1	0.015
OXC-142 (B)	71.60	0	1.1	0.047	71.60	0	1.1	0.047

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-143 (A)	54.66	100	1.62	0.015	54.66	100	1.62	0.015
OXC-143 (B)	47.07	0	1.62	0.037	47.07	0	1.62	0.037
OXC-144A (A)	36.84	100	1.48	0.015	36.84	100	1.48	0.015
OXC-144A (B)	23.23	0	1.48	0.028	23.23	0	1.48	0.028
OXC-144B (A)	22.45	100	0.9	0.015	22.45	100	0.9	0.015
OXC-144B (B)	17.18	0	0.9	0.04	17.18	0	0.9	0.04
OXC-145A (A)	23.92	100	0.92	0.015	23.92	100	0.92	0.015
OXC-145A (B)	3.49	0	0.92	0.02	3.49	0	0.92	0.02
OXC-145B (A)	42.94	100	0.52	0.015	42.94	100	0.52	0.015
OXC-145B (B)	39.32	0	0.52	0.043	39.32	0	0.52	0.043
OXC-146 (A)	10.67	100	0.48	0.015	10.67	100	0.48	0.015
OXC-146 (B)	60.98	0	0.48	0.056	60.98	0	0.48	0.056
OXC-147 (A)	39.07	100	0.51	0.015	39.07	100	0.51	0.015
OXC-147 (B)	105.02	0	0.51	0.045	105.02	0	0.51	0.045
OXC-148 (A)	46.18	100	1.6	0.015	46.18	100	1.6	0.015
OXC-148 (B)	54.07	0	1.6	0.037	54.07	0	1.6	0.037
OXC-149 (A)	58.73	100	0.64	0.015	58.73	100	0.64	0.015
OXC-149 (B)	96.48	0	0.64	0.048	96.48	0	0.64	0.048
OXC-15 (A)	4.02	100	2.88	0.015	4.02	100	2.88	0.015
OXC-15 (B)	76.46	0	2.88	0.075	76.46	0	2.88	0.075
OXC-15-16 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-15-16 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-150 (A)	125.79	100	0.29	0.015	125.79	100	0.29	0.015
OXC-150 (B)	18.63	0	0.29	0.02	18.63	0	0.29	0.02
OXC-151 (A)	48.75	100	0.67	0.015	48.75	100	0.67	0.015
OXC-151 (B)	64.14	0	0.67	0.042	64.14	0	0.67	0.042
OXC-152A (A)	8.22	100	0.0015	0.015	8.22	100	0.0015	0.015
OXC-152A (B)	20.28	0	0.0015	0.058	20.28	0	0.0015	0.058
OXC-152B (A)	26.01	100	0.198	0.015	26.01	100	0.198	0.015
OXC-152B (B)	36.00	0	0.198	0.049	36.00	0	0.198	0.049
OXC-153 (A)	65.17	100	0.892	0.015	65.17	100	0.892	0.015
OXC-153 (B)	66.81	0	0.892	0.037	66.81	0	0.892	0.037
OXC-154 (A)	86.59	100	1.58	0.015	86.59	100	1.58	0.015
OXC-154 (B)	76.28	0	1.58	0.039	76.28	0	1.58	0.039
OXC-155 (A)	6.51	100	0.578	0.015	6.51	100	0.578	0.015
OXC-155 (B)	1.32	0	0.578	0.023	1.32	0	0.578	0.023
OXC-156 (A)	107.16	100	0.744	0.015	107.16	100	0.744	0.015
OXC-156 (B)	86.94	0	0.744	0.031	86.94	0	0.744	0.031

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-157 (A)	27.44	100	1.27	0.015	27.44	100	1.27	0.015
OXC-157 (B)	27.64	0	1.27	0.037	27.64	0	1.27	0.037
OXC-16 (A)	3.41	100	2.19	0.015	3.41	100	2.19	0.015
OXC-16 (B)	64.78	0	2.19	0.075	64.78	0	2.19	0.075
OXC-17 (A)	4.48	100	3.76	0.015	4.48	100	3.76	0.015
OXC-17 (B)	85.12	0	3.76	0.075	85.12	0	3.76	0.075
OXC-18 (A)	5.81	100	3.65	0.015	5.81	100	3.65	0.015
OXC-18 (B)	110.39	0	3.65	0.075	110.39	0	3.65	0.075
OXC-19 (A)	4.34	100	10.75	0.015	4.34	100	10.75	0.015
OXC-19 (B)	82.49	0	10.75	0.075	82.49	0	10.75	0.075
OXC-19-25 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-19-25 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-2 (A)	7.37	100	3.59	0.015	7.37	100	3.59	0.015
OXC-2 (B)	140.08	0	3.59	0.075	140.08	0	3.59	0.075
OXC-20 (A)	4.01	100	4.71	0.015	4.01	100	4.71	0.015
OXC-20 (B)	76.27	0	4.71	0.075	76.27	0	4.71	0.075
OXC-20-26 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-20-26 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-21 (A)	7.22	100	1.17	0.015	7.22	100	1.17	0.015
OXC-21 (B)	137.24	0	1.17	0.075	137.24	0	1.17	0.075
OXC-22 (A)	5.69	100	1.25	0.015	5.69	100	1.25	0.015
OXC-22 (B)	108.08	0	1.25	0.075	108.08	0	1.25	0.075
OXC-23 (A)	3.70	100	2.84	0.015	3.70	100	2.84	0.015
OXC-23 (B)	70.31	0	2.84	0.075	70.31	0	2.84	0.075
OXC-24 (A)	5.83	100	1.56	0.015	5.83	100	1.56	0.015
OXC-24 (B)	110.79	0	1.56	0.075	110.79	0	1.56	0.075
OXC-25 (A)	4.60	100	9.2	0.015	4.60	100	9.2	0.015
OXC-25 (B)	87.43	0	9.2	0.075	87.43	0	9.2	0.075
OXC-26 (A)	6.06	100	6.69	0.015	6.06	100	6.69	0.015
OXC-26 (B)	115.12	0	6.69	0.075	115.12	0	6.69	0.075
OXC-27 (A)	4.98	100	8.23	0.015	4.98	100	8.23	0.015
OXC-27 (B)	94.66	0	8.23	0.075	94.66	0	8.23	0.075
OXC-27-33 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-27-33 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-28A (A)	5.74	100	5.79	0.015	5.74	100	5.79	0.015
OXC-28A (B)	109.04	0	5.79	0.075	109.04	0	5.79	0.075
OXC-28A-29 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-28A-29 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-28B (A)	1.57	100	3.45	0.015	1.57	100	3.45	0.015
OXC-28B (B)	29.84	0	3.45	0.075	29.84	0	3.45	0.075
OXC-28B-30 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-28B-30 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-29 (A)	6.30	100	1.8	0.015	6.30	100	1.8	0.015
OXC-29 (B)	119.65	0	1.8	0.075	119.65	0	1.8	0.075
OXC-3 (A)	7.48	100	2.58	0.015	7.48	100	2.58	0.015
OXC-3 (B)	142.06	0	2.58	0.074	142.06	0	2.58	0.074
OXC-30 (A)	5.95	100	2.05	0.015	5.95	100	2.05	0.015
OXC-30 (B)	113.01	0	2.05	0.075	113.01	0	2.05	0.075
OXC-31 (A)	4.62	100	3.38	0.015	4.62	100	3.38	0.015
OXC-31 (B)	87.85	0	3.38	0.075	87.85	0	3.38	0.075
OXC-32 (A)	6.23	100	1.89	0.015	6.23	100	1.89	0.015
OXC-32 (B)	118.40	0	1.89	0.075	118.40	0	1.89	0.075
OXC-33 (A)	5.22	100	7.41	0.015	5.22	100	7.41	0.015
OXC-33 (B)	99.22	0	7.41	0.075	99.22	0	7.41	0.075
OXC-34 (A)	4.82	100	4.26	0.015	4.82	100	4.26	0.015
OXC-34 (B)	91.59	0	4.26	0.075	91.59	0	4.26	0.075
OXC-35 (A)	4.98	100	3.74	0.015	4.98	100	3.74	0.015
OXC-35 (B)	94.52	0	3.74	0.075	94.52	0	3.74	0.075
OXC-36 (A)	3.99	100	3.84	0.015	3.99	100	3.84	0.015
OXC-36 (B)	75.85	0	3.84	0.075	75.85	0	3.84	0.075
OXC-37 (A)	3.49	100	12.05	0.015	3.49	100	12.05	0.015
OXC-37 (B)	66.37	0	12.05	0.075	66.37	0	12.05	0.075
OXC-38 (A)	4.82	100	4.14	0.015	4.82	100	4.14	0.015
OXC-38 (B)	91.61	0	4.14	0.075	91.61	0	4.14	0.075
OXC-39 (A)	11.73	100	1.72	0.015	11.73	100	1.72	0.015
OXC-39 (B)	79.04	0	1.72	0.066	79.04	0	1.72	0.066
OXC-4 (A)	4.59	100	2.31	0.015	4.59	100	2.31	0.015
OXC-4 (B)	87.18	0	2.31	0.074	87.18	0	2.31	0.074
OXC-40 (A)	6.48	100	2.13	0.015	6.48	100	2.13	0.015
OXC-40 (B)	123.04	0	2.13	0.075	123.04	0	2.13	0.075
OXC-41 (A)	8.58	100	0.72	0.015	8.58	100	0.72	0.015
OXC-41 (B)	125.41	0	0.72	0.073	125.41	0	0.72	0.073
OXC-42 (A)	4.76	100	2.78	0.015	4.76	100	2.78	0.015
OXC-42 (B)	81.92	0	2.78	0.074	81.92	0	2.78	0.074
OXC-43 (A)	30.53	100	1.22	0.015	30.53	100	1.22	0.015
OXC-43 (B)	84.12	0	1.22	0.05	84.12	0	1.22	0.05

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-43-50 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-43-50 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-44 (A)	26.34	100	1.09	0.015	26.34	100	1.09	0.015
OXC-44 (B)	122.25	0	1.09	0.06	122.25	0	1.09	0.06
OXC-45 (A)	11.36	100	0.75	0.015	11.36	100	0.75	0.015
OXC-45 (B)	141.00	0	0.75	0.072	141.00	0	0.75	0.072
OXC-46 (A)	9.99	100	1.62	0.015	9.99	100	1.62	0.015
OXC-46 (B)	76.47	0	1.62	0.068	76.47	0	1.62	0.068
OXC-47 (A)	5.68	100	4.21	0.015	5.68	100	4.21	0.015
OXC-47 (B)	99.37	0	4.21	0.074	99.37	0	4.21	0.074
OXC-48 (A)	4.84	100	3.99	0.015	4.84	100	3.99	0.015
OXC-48 (B)	91.98	0	3.99	0.075	91.98	0	3.99	0.075
OXC-49 (A)	9.57	100	3.58	0.015	9.57	100	3.58	0.015
OXC-49 (B)	99.81	0	3.58	0.07	99.81	0	3.58	0.07
OXC-5 (A)	6.05	100	3.32	0.015	6.05	100	3.32	0.015
OXC-5 (B)	114.99	0	3.32	0.075	114.99	0	3.32	0.075
OXC-50 (A)	25.03	100	1.14	0.015	25.03	100	1.14	0.015
OXC-50 (B)	84.12	0	1.14	0.055	84.12	0	1.14	0.055
OXC-51 (A)	24.86	100	2.5	0.015	24.86	100	2.5	0.015
OXC-51 (B)	83.44	0	2.5	0.054	83.44	0	2.5	0.054
OXC-52 (A)	4.99	100	1.32	0.015	4.99	100	1.32	0.015
OXC-52 (B)	72.72	0	1.32	0.073	72.72	0	1.32	0.073
OXC-53 (A)	14.97	100	1.16	0.015	14.97	100	1.16	0.015
OXC-53 (B)	105.62	0	1.16	0.067	105.62	0	1.16	0.067
OXC-54 (A)	12.41	100	1.9	0.015	12.41	100	1.9	0.015
OXC-54 (B)	90.18	0	1.9	0.067	90.18	0	1.9	0.067
OXC-55 (A)	20.78	100	1.33	0.015	20.78	100	1.33	0.015
OXC-55 (B)	83.12	0	1.33	0.059	83.12	0	1.33	0.059
OXC-56 (A)	11.61	100	1.89	0.015	11.61	100	1.89	0.015
OXC-56 (B)	89.85	0	1.89	0.068	89.85	0	1.89	0.068
OXC-57A (A)	6.68	100	1.9	0.015	6.68	100	1.9	0.015
OXC-57A (B)	26.71	0	1.9	0.059	26.71	0	1.9	0.059
OXC-57B (A)	11.81	100	1.42	0.015	11.81	100	1.42	0.015
OXC-57B (B)	53.56	0	1.42	0.061	53.56	0	1.42	0.061
OXC-58 (A)	18.43	100	1.73	0.015	18.43	100	1.73	0.015
OXC-58 (B)	86.15	0	1.73	0.062	86.15	0	1.73	0.062
OXC-59 (A)	27.90	100	1.7	0.015	27.90	100	1.7	0.015
OXC-59 (B)	111.61	0	1.7	0.059	111.61	0	1.7	0.059

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-6 (A)	7.50	100	2.67	0.015	7.50	100	2.67	0.015
OXC-6 (B)	142.46	0	2.67	0.075	142.46	0	2.67	0.075
OXC-60 (A)	19.70	100	0.98	0.015	19.70	100	0.98	0.015
OXC-60 (B)	79.23	0	0.98	0.06	79.23	0	0.98	0.06
OXC-61 (A)	18.23	100	1.11	0.015	18.23	100	1.11	0.015
OXC-61 (B)	73.94	0	1.11	0.06	73.94	0	1.11	0.06
OXC-62 (A)	14.96	100	1.28	0.015	14.96	100	1.28	0.015
OXC-62 (B)	59.83	0	1.28	0.059	59.83	0	1.28	0.059
OXC-63 (A)	23.00	100	1.54	0.015	23.00	100	1.54	0.015
OXC-63 (B)	92.02	0	1.54	0.059	92.02	0	1.54	0.059
OXC-64 (A)	19.62	100	2.02	0.015	19.62	100	2.02	0.015
OXC-64 (B)	78.47	0	2.02	0.059	78.47	0	2.02	0.059
OXC-65 (A)	20.72	100	1.57	0.015	20.72	100	1.57	0.015
OXC-65 (B)	82.90	0	1.57	0.059	82.90	0	1.57	0.059
OXC-66 (A)	22.82	100	1.64	0.015	22.82	100	1.64	0.015
OXC-66 (B)	91.29	0	1.64	0.059	91.29	0	1.64	0.059
OXC-67 (A)	25.61	100	1.19	0.015	25.61	100	1.19	0.015
OXC-67 (B)	102.43	0	1.19	0.059	102.43	0	1.19	0.059
OXC-68 (A)	26.56	100	1.17	0.015	26.56	100	1.17	0.015
OXC-68 (B)	106.22	0	1.17	0.059	106.22	0	1.17	0.059
OXC-69 (A)	26.90	100	1.16	0.015	26.90	100	1.16	0.015
OXC-69 (B)	107.59	0	1.16	0.059	107.59	0	1.16	0.059
OXC-7 (A)	5.18	100	6.58	0.015	5.18	100	6.58	0.015
OXC-7 (B)	98.36	0	6.58	0.075	98.36	0	6.58	0.075
OXC-70 (A)	19.86	100	1.42	0.015	19.86	100	1.42	0.015
OXC-70 (B)	79.43	0	1.42	0.059	79.43	0	1.42	0.059
OXC-71 (A)	18.39	100	1.45	0.015	18.39	100	1.45	0.015
OXC-71 (B)	105.75	0	1.45	0.065	105.75	0	1.45	0.065
OXC-72 (A)	7.32	100	1.91	0.015	7.32	100	1.91	0.015
OXC-72 (B)	89.37	0	1.91	0.072	89.37	0	1.91	0.072
OXC-73 (A)	5.17	100	1.59	0.015	5.17	100	1.59	0.015
OXC-73 (B)	96.84	0	1.59	0.074	96.84	0	1.59	0.074
OXC-73-74 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-73-74 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-74 (A)	13.90	100	1.19	0.015	13.90	100	1.19	0.015
OXC-74 (B)	70.14	0	1.19	0.063	70.14	0	1.19	0.063
OXC-75 (A)	28.16	100	1.05	0.015	28.16	100	1.05	0.015
OXC-75 (B)	121.68	0	1.05	0.061	121.68	0	1.05	0.061

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-75-82 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-75-82 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-76 (A)	21.93	100	1.24	0.015	21.93	100	1.24	0.015
OXC-76 (B)	87.74	0	1.24	0.059	87.74	0	1.24	0.059
OXC-77 (A)	29.82	100	0.93	0.015	29.82	100	0.93	0.015
OXC-77 (B)	119.66	0	0.93	0.06	119.66	0	0.93	0.06
OXC-78 (A)	29.02	100	0.81	0.015	29.02	100	0.81	0.015
OXC-78 (B)	116.08	0	0.81	0.059	116.08	0	0.81	0.059
OXC-79 (A)	24.71	100	1.33	0.015	24.71	100	1.33	0.015
OXC-79 (B)	98.84	0	1.33	0.059	98.84	0	1.33	0.059
OXC-8 (A)	4.91	100	3.39	0.015	4.91	100	3.39	0.015
OXC-8 (B)	93.31	0	3.39	0.075	93.31	0	3.39	0.075
OXC-80 (A)	15.65	100	0.98	0.015	15.65	100	0.98	0.015
OXC-80 (B)	72.10	0	0.98	0.062	72.10	0	0.98	0.062
OXC-81 (A)	11.49	100	0.59	0.015	11.49	100	0.59	0.015
OXC-81 (B)	95.80	0	0.59	0.069	95.80	0	0.59	0.069
OXC-82 (A)	5.32	100	0.96	0.015	5.32	100	0.96	0.015
OXC-82 (B)	88.46	0	0.96	0.074	88.46	0	0.96	0.074
OXC-83 (A)	5.40	100	1.12	0.015	5.40	100	1.12	0.015
OXC-83 (B)	97.31	0	1.12	0.074	97.31	0	1.12	0.074
OXC-83-84 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-83-84 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-84 (A)	6.18	100	1.17	0.015	6.18	100	1.17	0.015
OXC-84 (B)	117.47	0	1.17	0.075	117.47	0	1.17	0.075
OXC-85 (A)	4.93	100	1.52	0.015	4.93	100	1.52	0.015
OXC-85 (B)	93.58	0	1.52	0.075	93.58	0	1.52	0.075
OXC-86 (A)	11.35	100	1.19	0.015	11.35	100	1.19	0.015
OXC-86 (B)	144.86	0	1.19	0.072	144.86	0	1.19	0.072
OXC-87 (A)	5.70	100	0.52	0.015	5.70	100	0.52	0.015
OXC-87 (B)	108.27	0	0.52	0.075	108.27	0	0.52	0.075
OXC-88 (A)	4.92	100	0.64	0.015	4.92	100	0.64	0.015
OXC-88 (B)	93.52	0	0.64	0.075	93.52	0	0.64	0.075
OXC-89 (A)	3.95	100	1.34	0.015	3.95	100	1.34	0.015
OXC-89 (B)	74.98	0	1.34	0.075	74.98	0	1.34	0.075
OXC-89-90 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-89-90 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-90 (A)	7.59	100	1.55	0.015	7.59	100	1.55	0.015
OXC-90 (B)	84.41	0	1.55	0.071	84.41	0	1.55	0.071

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-91 (A)	4.87	100	2.49	0.015	4.87	100	2.49	0.015
OXC-91 (B)	92.45	0	2.49	0.075	92.45	0	2.49	0.075
OXC-92 (A)	4.15	100	1.91	0.015	4.15	100	1.91	0.015
OXC-92 (B)	78.85	0	1.91	0.075	78.85	0	1.91	0.075
OXC-93 (A)	4.97	100	1.21	0.015	4.97	100	1.21	0.015
OXC-93 (B)	94.45	0	1.21	0.075	94.45	0	1.21	0.075
OXC-94 (A)	6.37	100	0.98	0.015	6.37	100	0.98	0.015
OXC-94 (B)	121.02	0	0.98	0.075	121.02	0	0.98	0.075
OXC-95 (A)	5.59	100	1.23	0.015	5.59	100	1.23	0.015
OXC-95 (B)	100.56	0	1.23	0.074	100.56	0	1.23	0.074
OXC-96 (A)	17.77	100	2.23	0.015	17.77	100	2.23	0.015
OXC-96 (B)	97.15	0	2.23	0.064	97.15	0	2.23	0.064
OXC-97 (A)	7.80	100	1.35	0.015	7.80	100	1.35	0.015
OXC-97 (B)	146.09	0	1.35	0.074	146.09	0	1.35	0.074
OXC-97-98 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-97-98 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-98 (A)	5.27	100	1.24	0.015	5.27	100	1.24	0.015
OXC-98 (B)	100.20	0	1.24	0.075	100.20	0	1.24	0.075
OXC-99 (A)	5.25	100	0.92	0.015	5.25	100	0.92	0.015
OXC-99 (B)	99.69	0	0.92	0.075	99.69	0	0.92	0.075
OXC-9A (A)	4.10	100	1.35	0.015	4.10	100	1.35	0.015
OXC-9A (B)	77.93	0	1.35	0.075	77.93	0	1.35	0.075
OXC-9A-9B (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-9A-9B (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-9B (A)	5.27	100	3.53	0.015	5.27	100	3.53	0.015
OXC-9B (B)	100.13	0	3.53	0.075	100.13	0	3.53	0.075
OXC-D100 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D100 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D101 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D101 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D103 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D103 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D108 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D108 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D11 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D11 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D113A (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D113A (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035

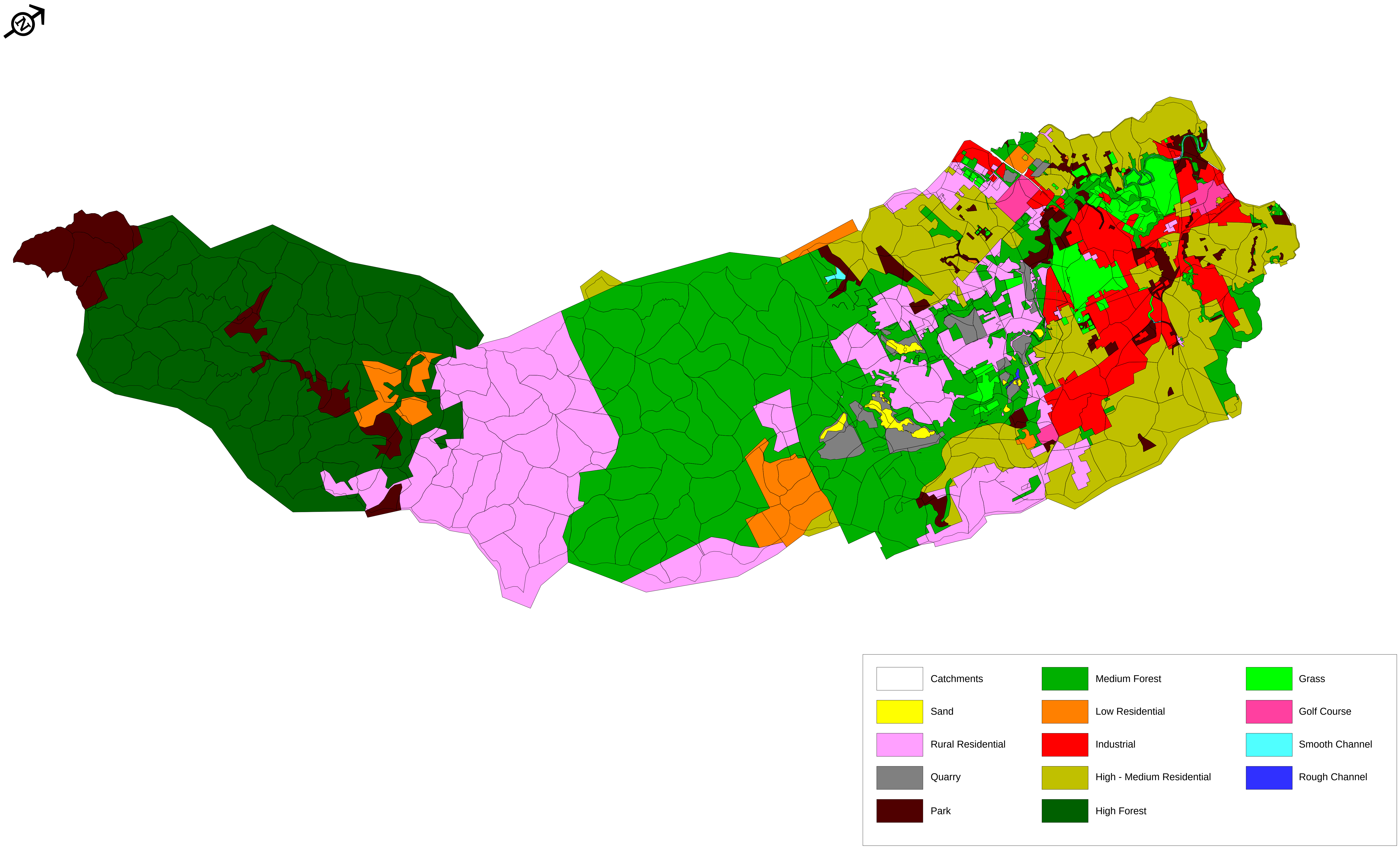
ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-D113B (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D113B (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D121 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D121 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D122 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D122 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D126 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D126 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D128B (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D128B (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D134 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D134 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D142 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D142 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D149A (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D149A (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D149B (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D149B (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D21 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D21 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D22 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D22 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D36 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D36 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D39 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D39 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D54 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D54 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D58 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D58 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D62 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D62 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D78 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D78 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D81 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D81 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D87 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D87 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
OXC-D94 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D94 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D95 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D95 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC-D99 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC-D99 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC102-105 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC102-105 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC106-107 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC106-107 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC117-119 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC117-119 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC126SSG6 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC126SSG6 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC144-145 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC144-145 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
OXC155MOC6 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
OXC155MOC6 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
RWH-1 (A)	46.39	100	3.26	0.015	46.39	100	3.26	0.015
RWH-1 (B)	80.85	0	3.26	0.051	80.85	0	3.26	0.051
RWH-2 (A)	51.12	100	2.8	0.015	51.12	100	2.8	0.015
RWH-2 (B)	80.10	0	2.8	0.04	80.10	0	2.8	0.04
RWH-3 (A)	111.13	100	2.36	0.015	111.13	100	2.36	0.015
RWH-3 (B)	39.76	0	2.36	0.024	39.76	0	2.36	0.024
RWH-4 (A)	93.19	100	1.2	0.015	93.19	100	1.2	0.015
RWH-4 (B)	58.84	0	1.2	0.028	58.84	0	1.2	0.028
SSC-1 (A)	45.88	100	2.22	0.015	45.88	100	2.22	0.015
SSC-1 (B)	40.25	0	2.22	0.029	40.25	0	2.22	0.029
SSC-10 (A)	97.39	100	1.29	0.015	97.39	100	1.29	0.015
SSC-10 (B)	43.26	0	1.29	0.028	43.26	0	1.29	0.028
SSC-11 (A)	103.04	100	1.82	0.015	103.04	100	1.82	0.015
SSC-11 (B)	51.79	0	1.82	0.027	51.79	0	1.82	0.027
SSC-12 (A)	46.60	100	0.85	0.015	46.60	100	0.85	0.015
SSC-12 (B)	56.06	0	0.85	0.037	56.06	0	0.85	0.037
SSC-12-13 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
SSC-12-13 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
SSC-13 (A)	48.58	100	2.27	0.015	48.58	100	2.27	0.015
SSC-13 (B)	80.42	0	2.27	0.038	80.42	0	2.27	0.038

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
SSC-14 (A)	71.63	100	1.41	0.015	71.63	100	1.41	0.015
SSC-14 (B)	51.49	0	1.41	0.033	51.49	0	1.41	0.033
SSC-15 (A)	79.52	100	1.3	0.015	79.52	100	1.3	0.015
SSC-15 (B)	34.68	0	1.3	0.029	34.68	0	1.3	0.029
SSC-16 (A)	80.99	100	1.11	0.015	80.99	100	1.11	0.015
SSC-16 (B)	24.81	0	1.11	0.025	24.81	0	1.11	0.025
SSC-17 (A)	57.89	100	0.88	0.015	57.89	100	0.88	0.015
SSC-17 (B)	35.81	0	0.88	0.03	35.81	0	0.88	0.03
SSC-18 (A)	66.62	100	0.47	0.015	66.62	100	0.47	0.015
SSC-18 (B)	11.55	0	0.47	0.021	11.55	0	0.47	0.021
SSC-19 (A)	59.72	100	3.3	0.015	59.72	100	3.3	0.015
SSC-19 (B)	31.89	0	3.3	0.025	31.89	0	3.3	0.025
SSC-2 (A)	60.10	100	2.43	0.015	60.10	100	2.43	0.015
SSC-2 (B)	60.26	0	2.43	0.032	60.26	0	2.43	0.032
SSC-20 (A)	64.27	100	0.43	0.015	64.27	100	0.43	0.015
SSC-20 (B)	33.74	0	0.43	0.028	33.74	0	0.43	0.028
SSC-21 (A)	42.43	100	0.78	0.015	42.43	100	0.78	0.015
SSC-21 (B)	39.36	0	0.78	0.039	39.36	0	0.78	0.039
SSC-22 (A)	57.88	100	1.05	0.015	57.88	100	1.05	0.015
SSC-22 (B)	24.40	0	1.05	0.027	24.40	0	1.05	0.027
SSC-23 (A)	96.75	100	0.17	0.015	96.75	100	0.17	0.015
SSC-23 (B)	33.06	0	0.17	0.028	33.06	0	0.17	0.028
SSC-3 (A)	43.63	100	3.07	0.015	43.63	100	3.07	0.015
SSC-3 (B)	43.53	0	3.07	0.032	43.53	0	3.07	0.032
SSC-4 (A)	48.56	100	2.65	0.015	48.56	100	2.65	0.015
SSC-4 (B)	48.69	0	2.65	0.034	48.69	0	2.65	0.034
SSC-5 (A)	92.01	100	1.76	0.015	92.01	100	1.76	0.015
SSC-5 (B)	24.61	0	1.76	0.023	24.61	0	1.76	0.023
SSC-5-6 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
SSC-5-6 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
SSC-6 (A)	69.52	100	1.74	0.015	69.52	100	1.74	0.015
SSC-6 (B)	27.62	0	1.74	0.027	27.62	0	1.74	0.027
SSC-7 (A)	77.73	100	1.75	0.015	77.73	100	1.75	0.015
SSC-7 (B)	79.94	0	1.75	0.034	79.94	0	1.75	0.034
SSC-8 (A)	48.64	100	2.7	0.015	48.64	100	2.7	0.015
SSC-8 (B)	52.01	0	2.7	0.033	52.01	0	2.7	0.033
SSC-9 (A)	60.22	100	2.14	0.015	60.22	100	2.14	0.015
SSC-9 (B)	82.81	0	2.14	0.035	82.81	0	2.14	0.035

ID	Area (ha)	%Imp	Slope%	PerN	Area (ha)	%Imp	Slope%	PerN
	1990 and 1996 events				2009 event/Design events			
SSC-D12 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
SSC-D12 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
SSC-D18 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
SSC-D18 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
SSG-1 (A)	31.59	100	1.78	0.015	61.29	100	1.78	0.015
SSG-1 (B)	93.51	0	1.78	0.057	63.82	0	1.78	0.034
SSG-2 (A)	41.35	100	1.64	0.015	41.66	100	1.64	0.015
SSG-2 (B)	79.22	0	1.64	0.05	78.91	0	1.64	0.049
SSG-2-5 (A)	0.00	100	0.0015	0.015	0.00	100	0.0015	0.015
SSG-2-5 (B)	0.00	0	0.0015	0.001	0.00	0	0.0015	0.035
SSG-3 (A)	33.55	100	2.36	0.015	38.99	100	2.36	0.015
SSG-3 (B)	58.97	0	2.36	0.049	53.53	0	2.36	0.042
SSG-4 (A)	35.13	100	2.99	0.015	41.44	100	2.99	0.015
SSG-4 (B)	64.67	0	2.99	0.049	58.36	0	2.99	0.041
SSG-5 (A)	49.38	100	1.01	0.015	51.10	100	1.01	0.015
SSG-5 (B)	59.43	0	1.01	0.036	57.70	0	1.01	0.034
SSG-6 (A)	53.01	100	1.68	0.015	53.01	100	1.68	0.015
SSG-6 (B)	56.26	0	1.68	0.035	56.26	0	1.68	0.035

Appendix C
Land Use Plans



Disclaimers and Notes:

Logo:

Client: BRISBANE CITY COUNCIL

Project: OXLEY CREEK FLOOD STUDY

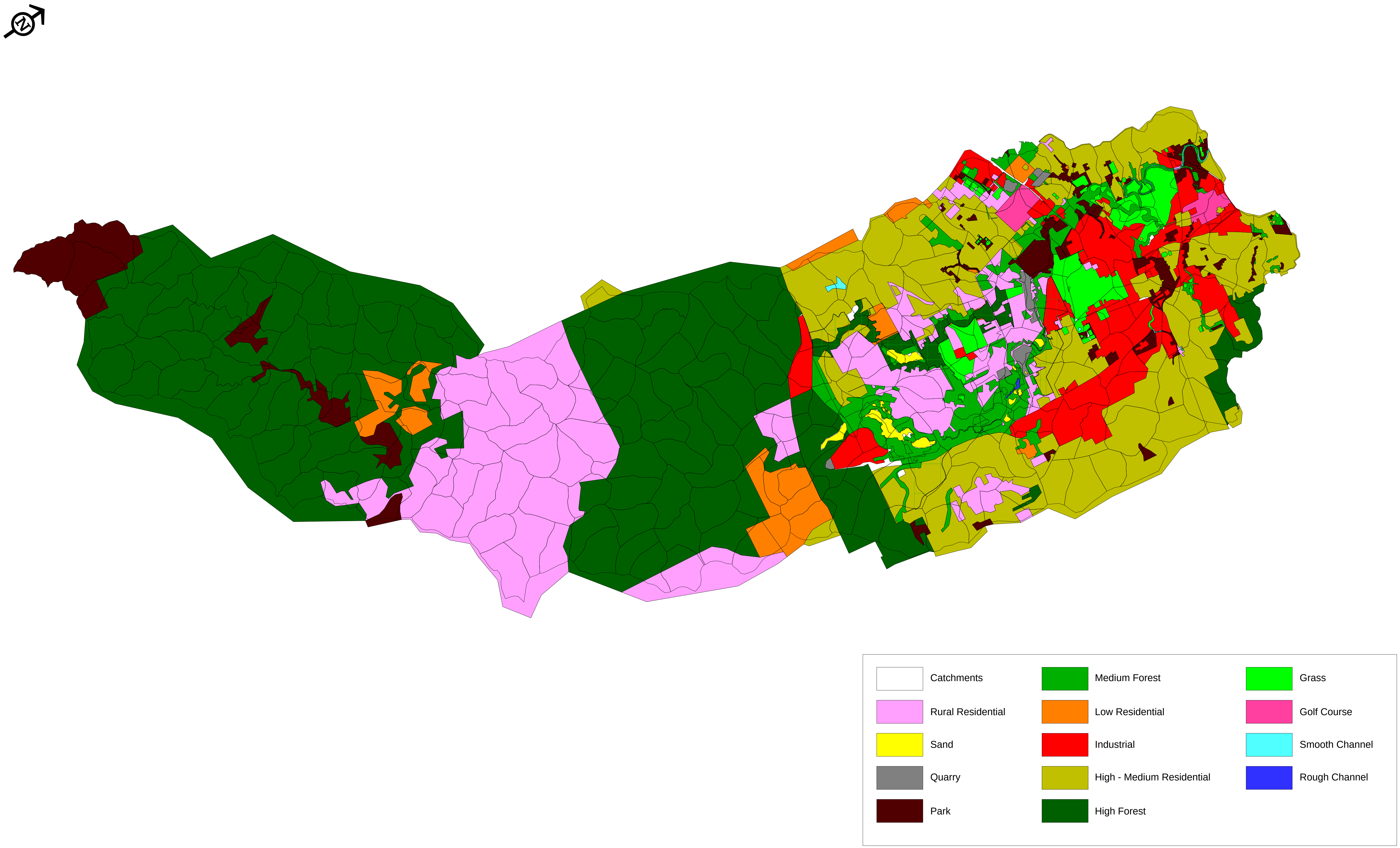
Scale: 0 2,500 5,000 Scale 1:100,000 (A3)

Figure Title: APPENDIX C1 1990 AND 1996 LAND USE MAP

Figure No. APPENDIX C1

Revision. 2

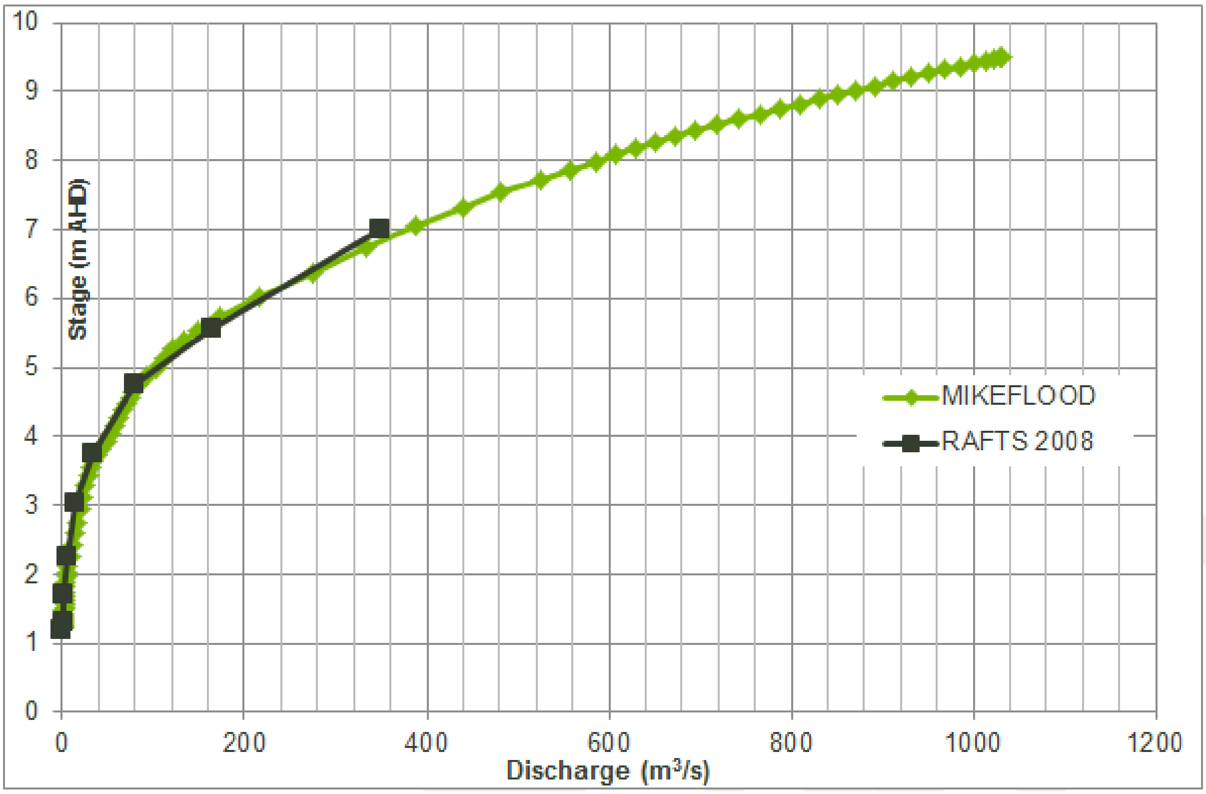
Date. 29/05/2013



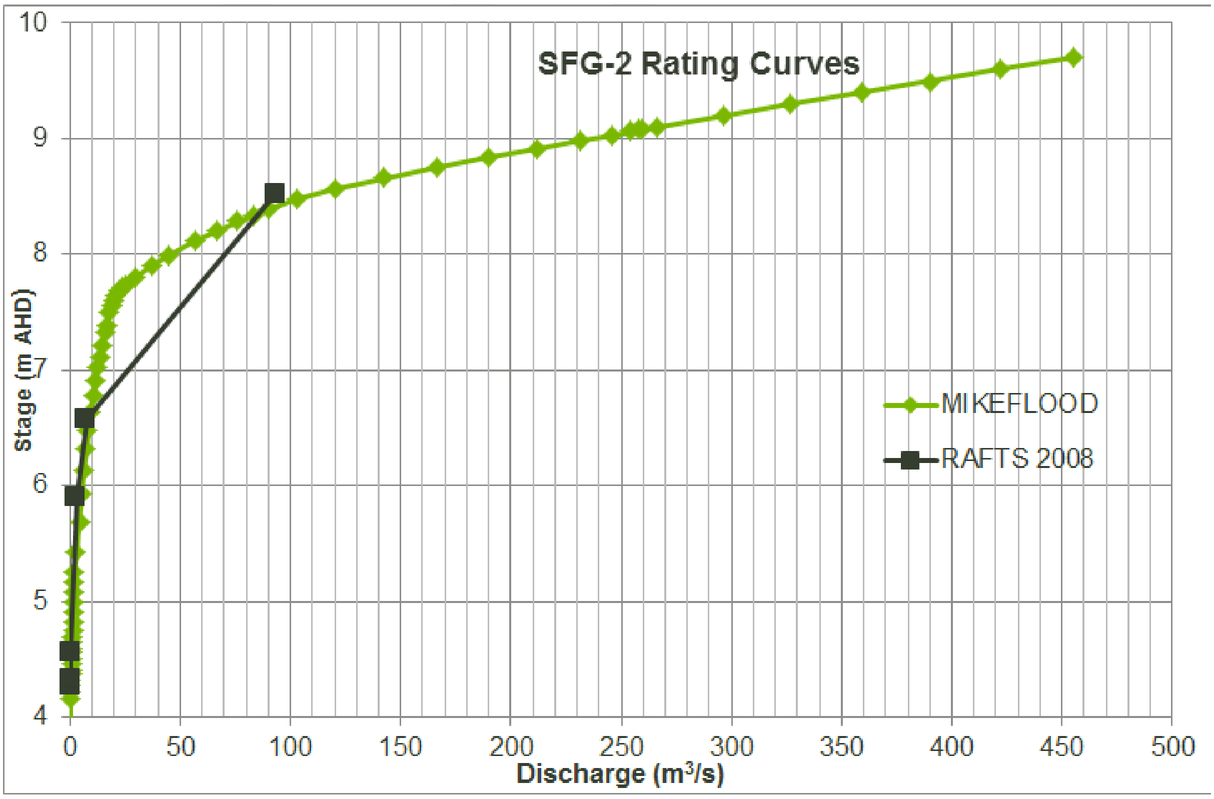
Disclaimers and Notes:	Logo:	Client:	Project:	Scale:	Figure Title:	Figure No.
	BRISBANE CITY	BRISBANE CITY COUNCIL	OXLEY CREEK FLOOD STUDY	0 2,500 5,000 Scale 1:100,000 (A3)	APPENDIX C2 2009 LAND USE MAP	APPENDIX C2 Revision. 2 Date. 29/05/2013

Appendix D
Rating Curves

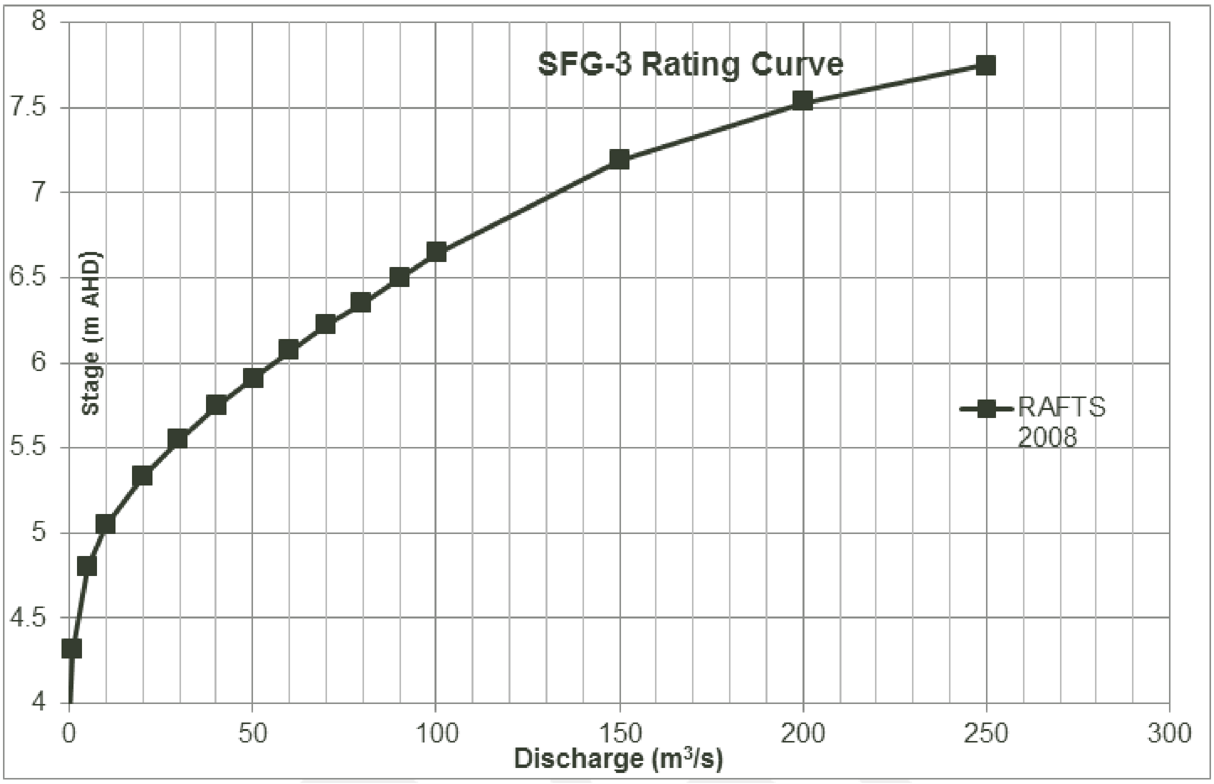
SFG-1 Beatty Road



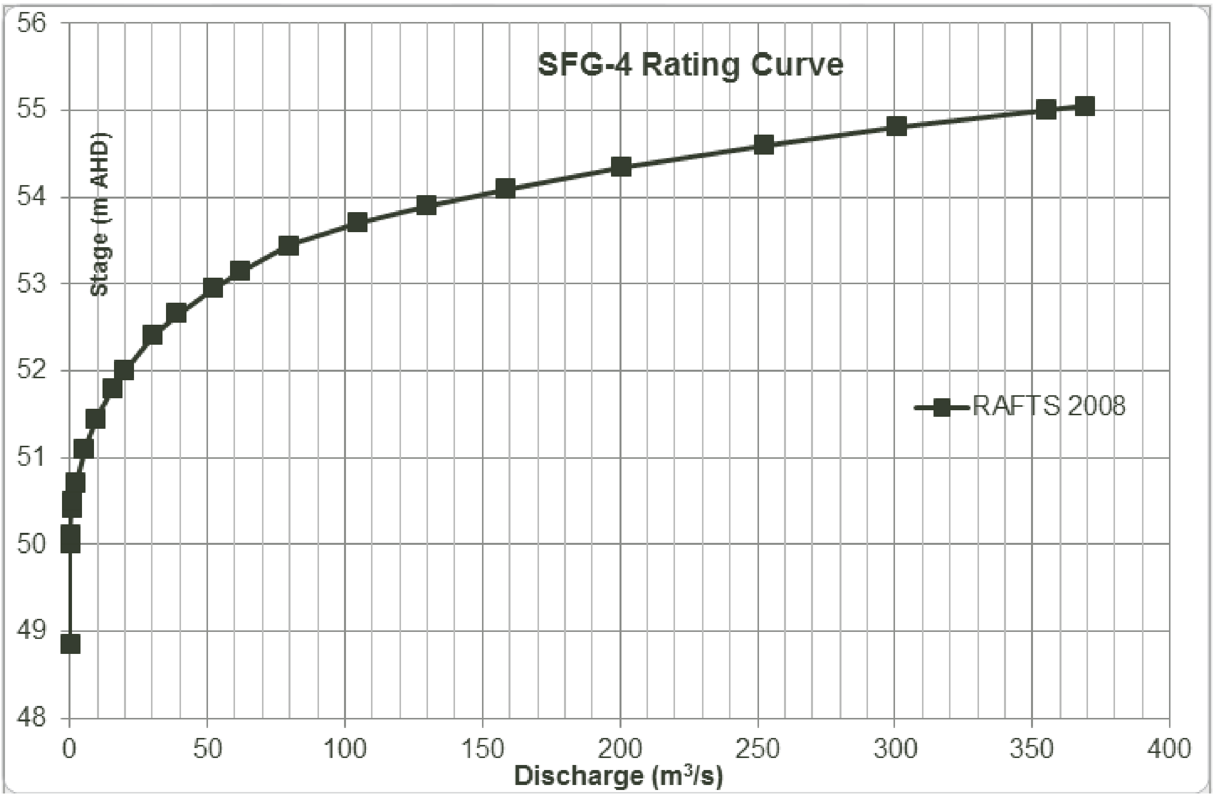
SFG-2 King Avenue



SFG-3 Musgrave Road

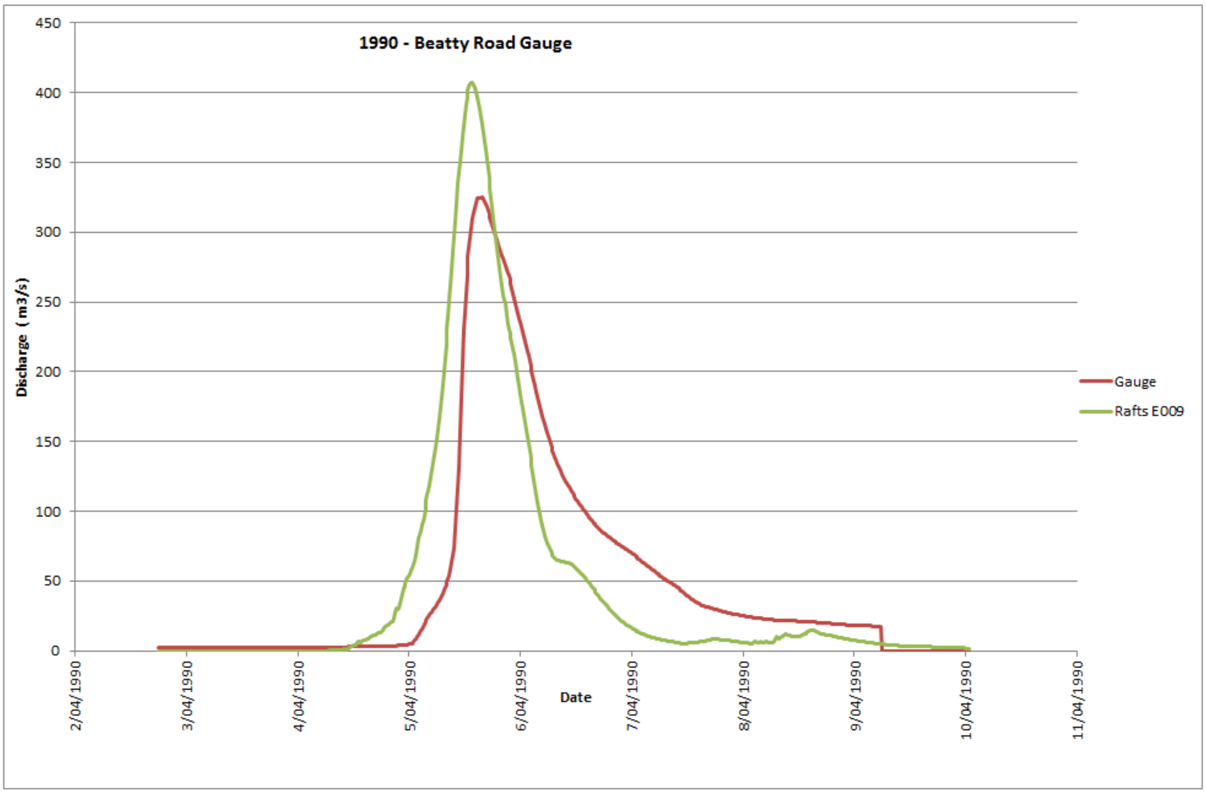


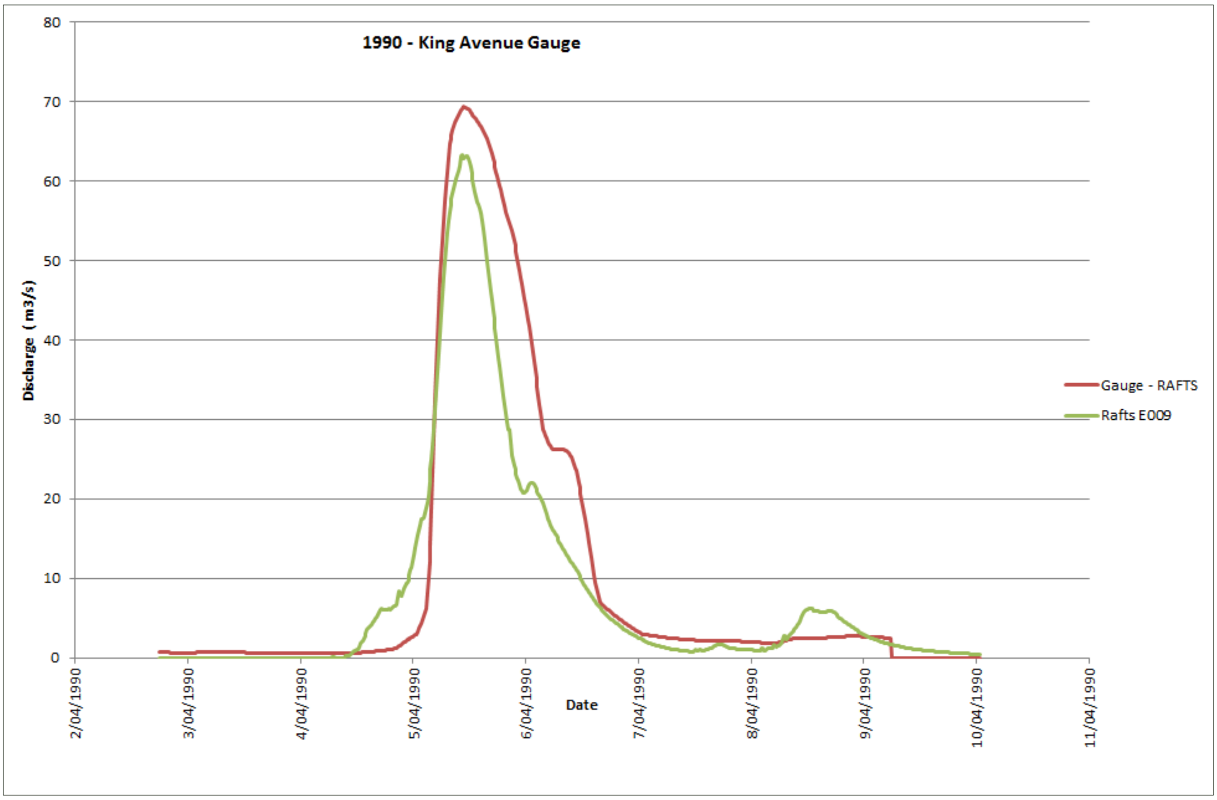
SFG-4 New Beith

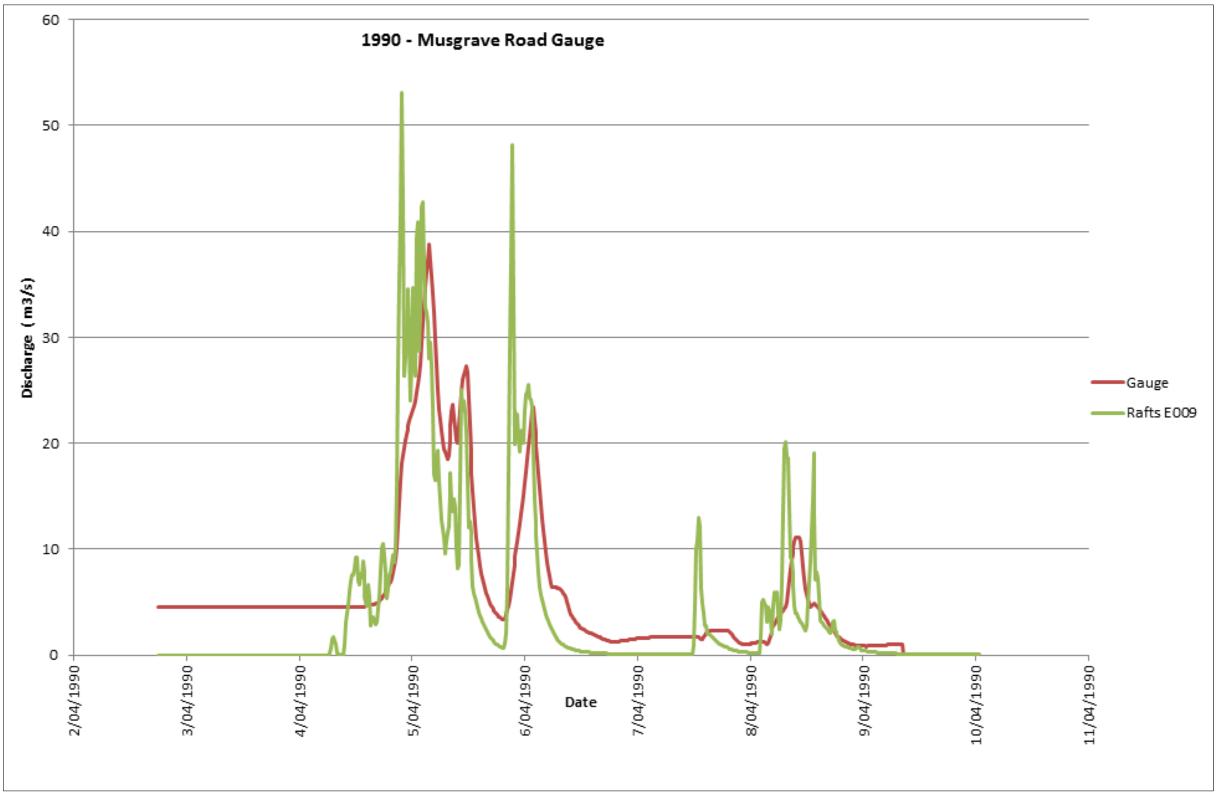


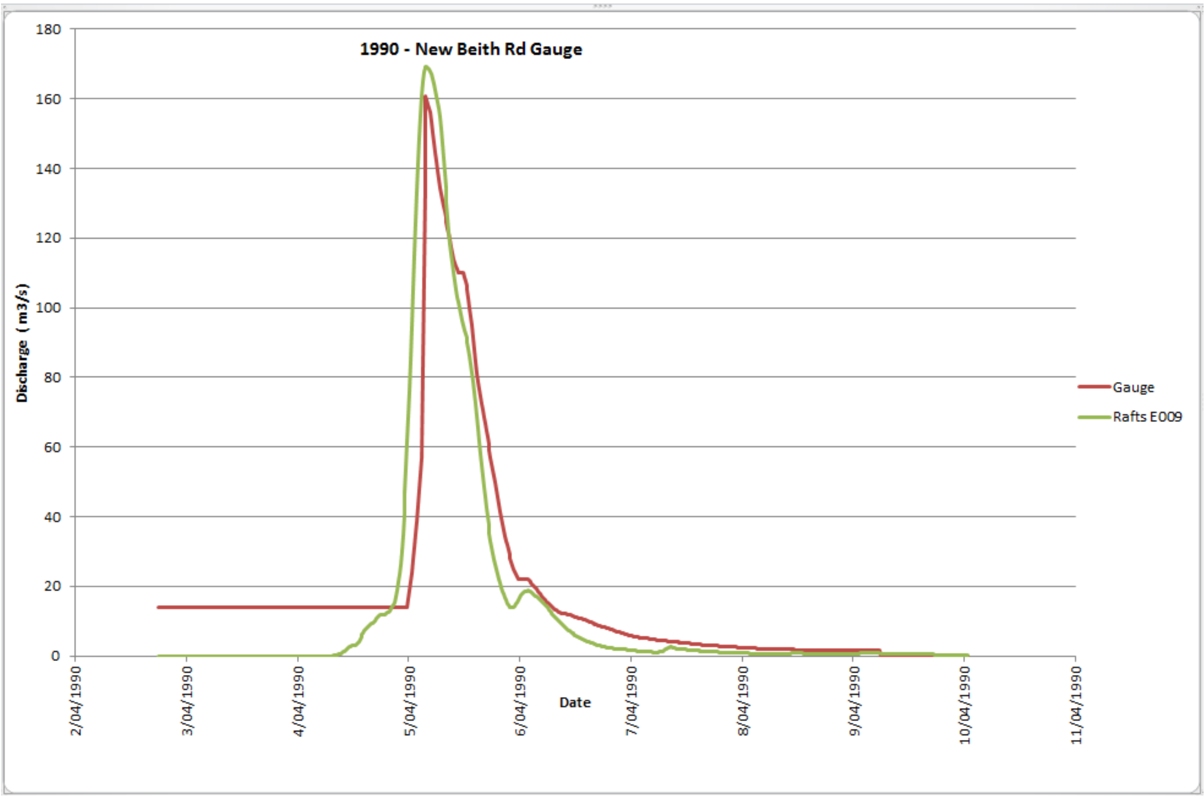
Appendix E

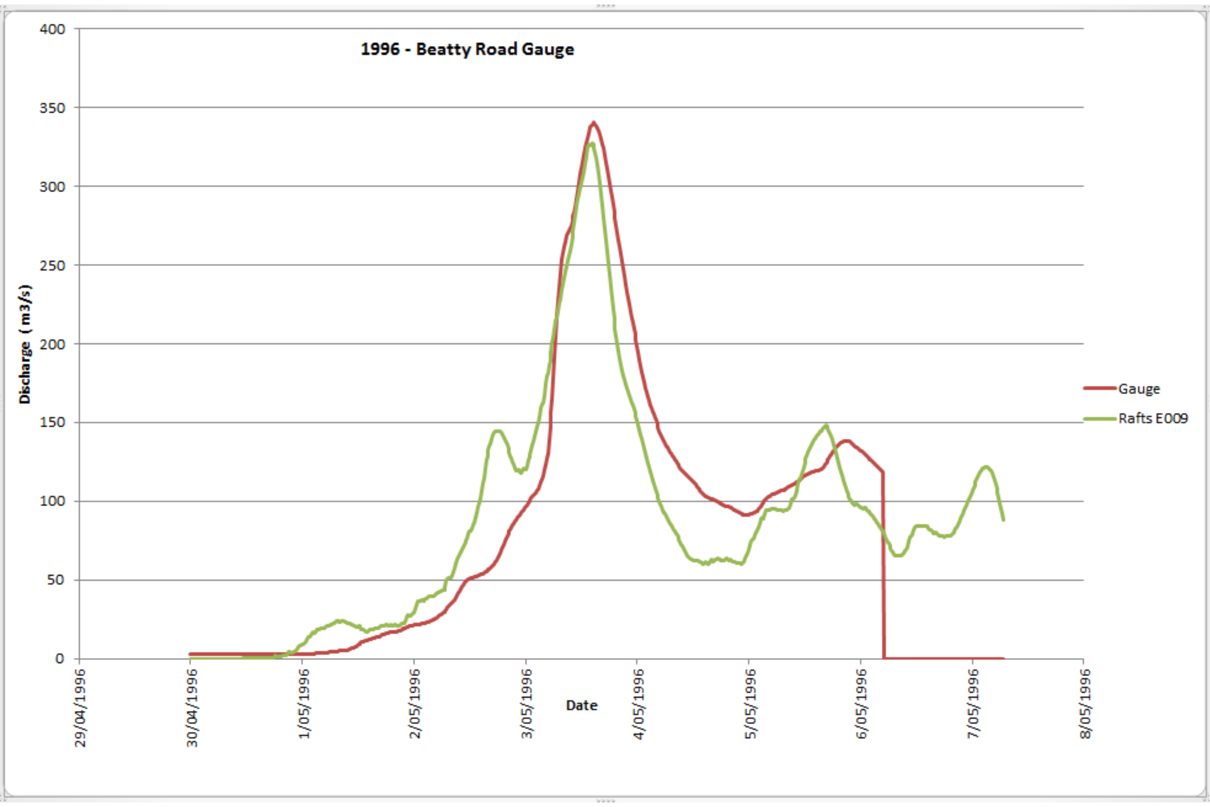
RAFTS Gauge Comparisons


1990 - Beatty Road Gauge
Discharge (m3/s)
450
400
350
300
250
200
150
100
50
0
Date
2/04/1990
3/04/1990
4/04/1990
5/04/1990
6/04/1990
7/04/1990
8/04/1990
9/04/1990
10/04/1990
11/04/1990
Gauge
Rafts E009

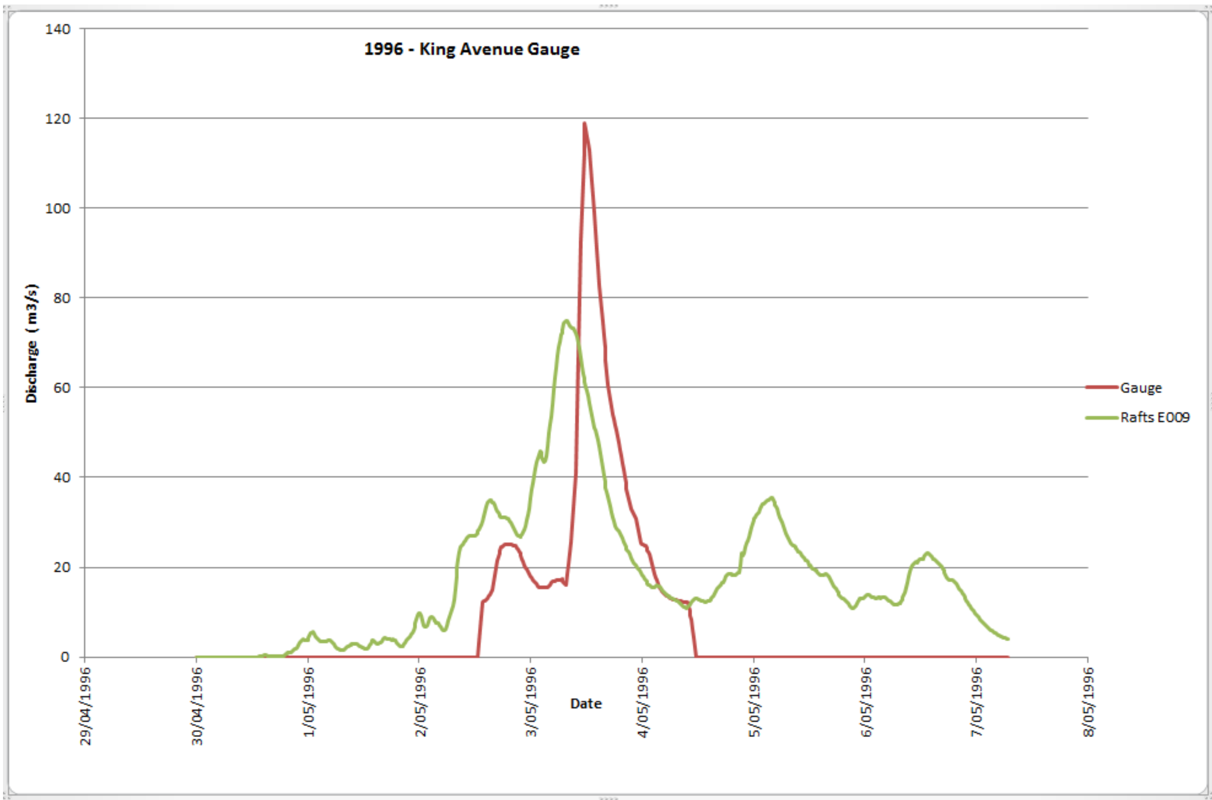

1990 - King Avenue Gauge
Discharge (m3/s)
80
70
60
50
40
30
20
10
0
Date
2/04/1990
3/04/1990
4/04/1990
5/04/1990
6/04/1990
7/04/1990
8/04/1990
9/04/1990
10/04/1990
11/04/1990
Gauge - RAFTS
Rafts E009


1990 - Musgrave Road Gauge
Discharge (m3/s)
60
50
40
30
20
10
0
Gauge
Rafts E009
Date
2/04/1990
3/04/1990
4/04/1990
5/04/1990
6/04/1990
7/04/1990
8/04/1990
9/04/1990
10/04/1990
11/04/1990

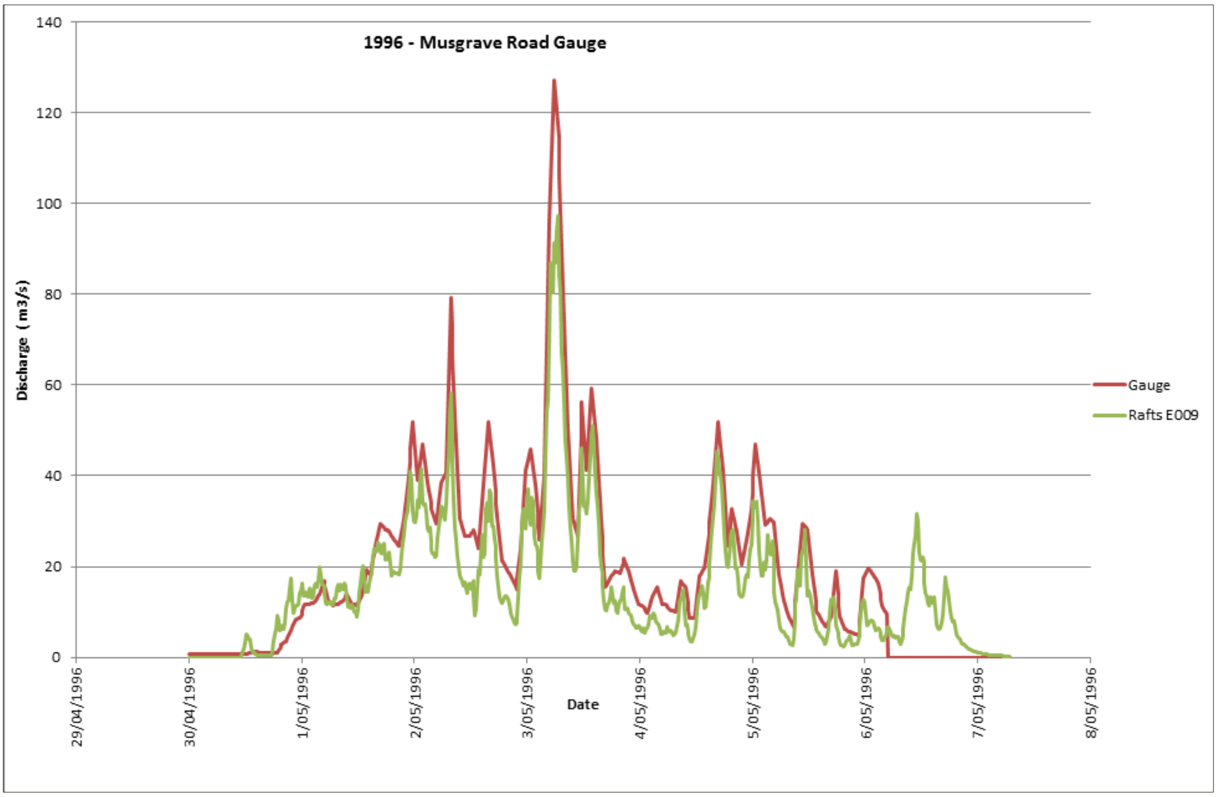

1990 - New Beith Rd Gauge
Discharge (m3/s)
180
160
140
120
100
80
60
40
20
0
Gauge
Rafts E009
Date
2/04/1990
3/04/1990
4/04/1990
5/04/1990
6/04/1990
7/04/1990
8/04/1990
9/04/1990
10/04/1990
11/04/1990

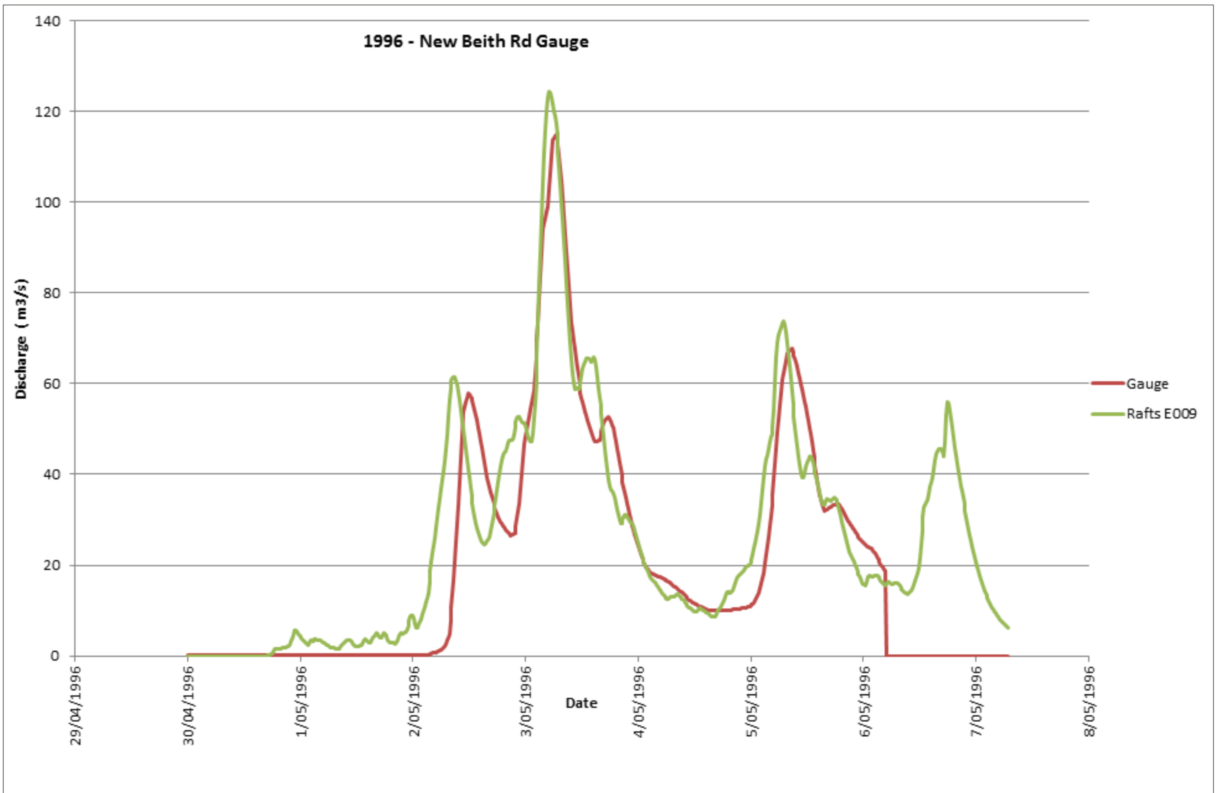


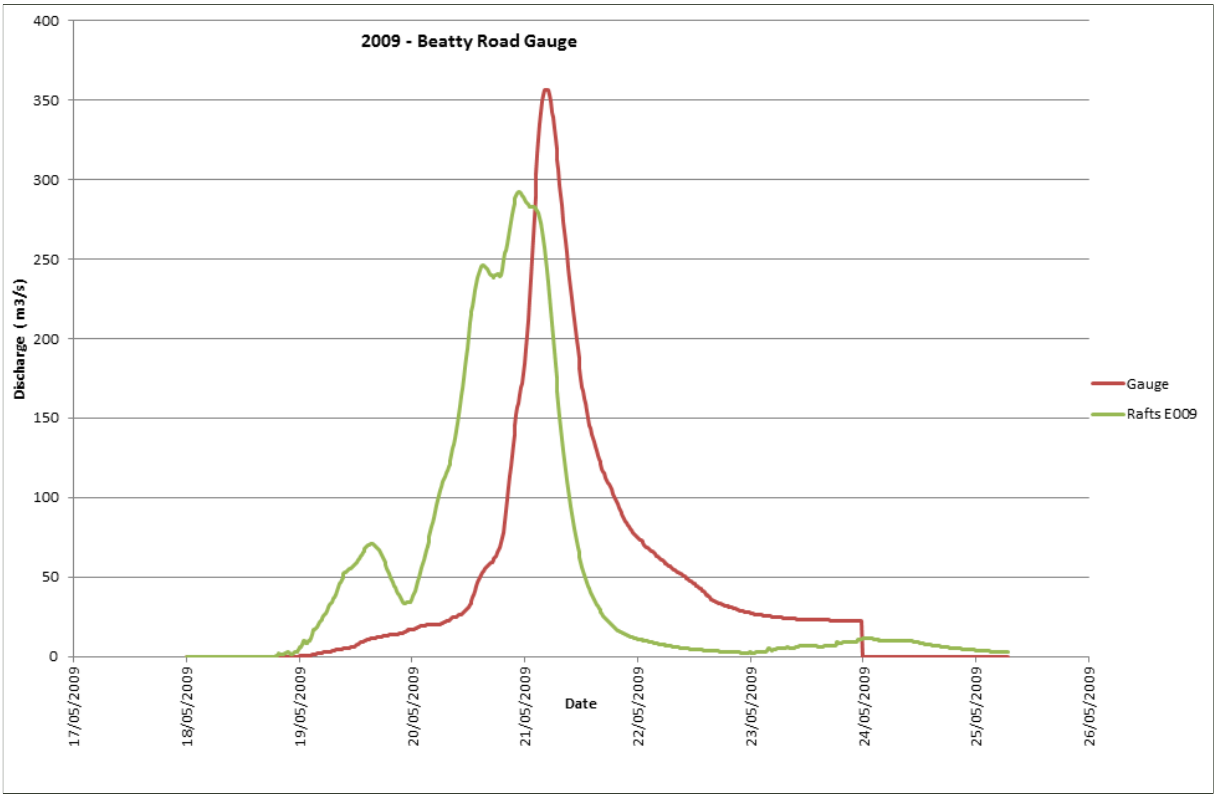
1996 - Beatty Road Gauge
Discharge (m3/s)
400
350
300
250
200
150
100
50
0
29/04/1996
30/04/1996
1/05/1996
2/05/1996
3/05/1996
4/05/1996
5/05/1996
6/05/1996
7/05/1996
8/05/1996
Date
Gauge
Rafts E009

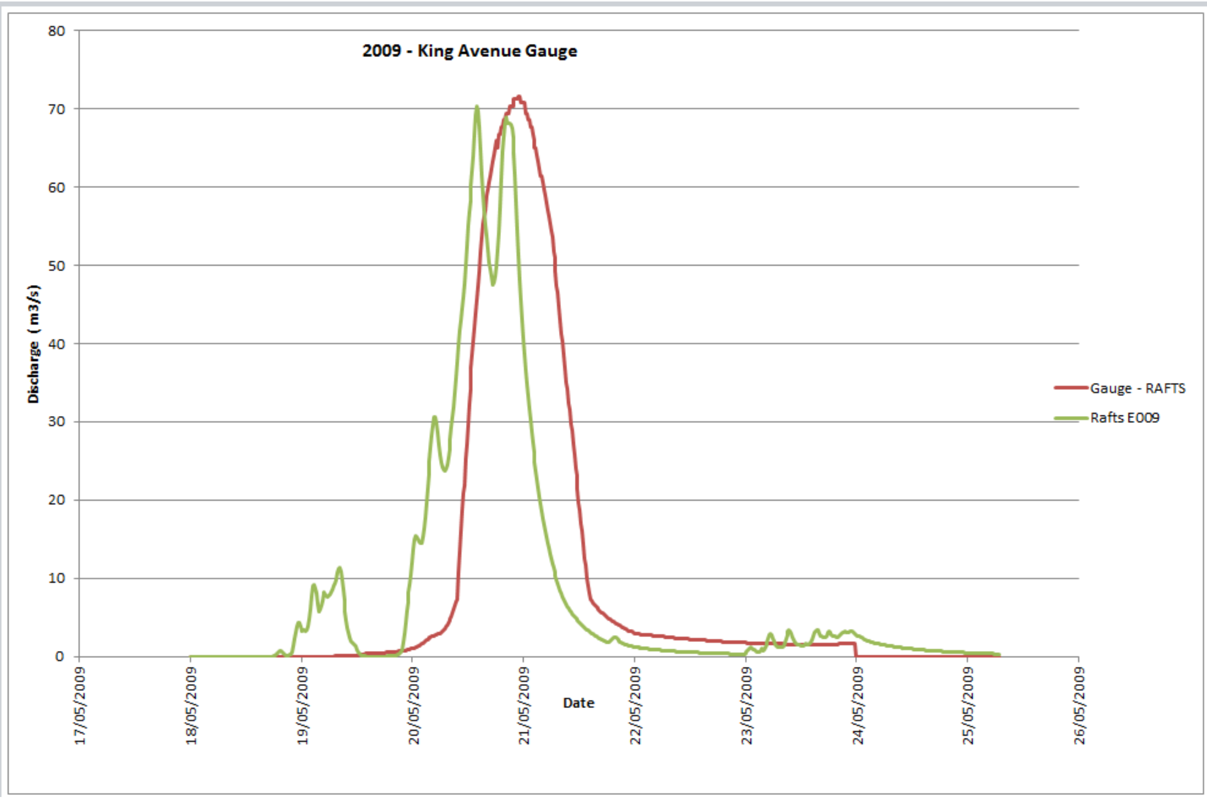


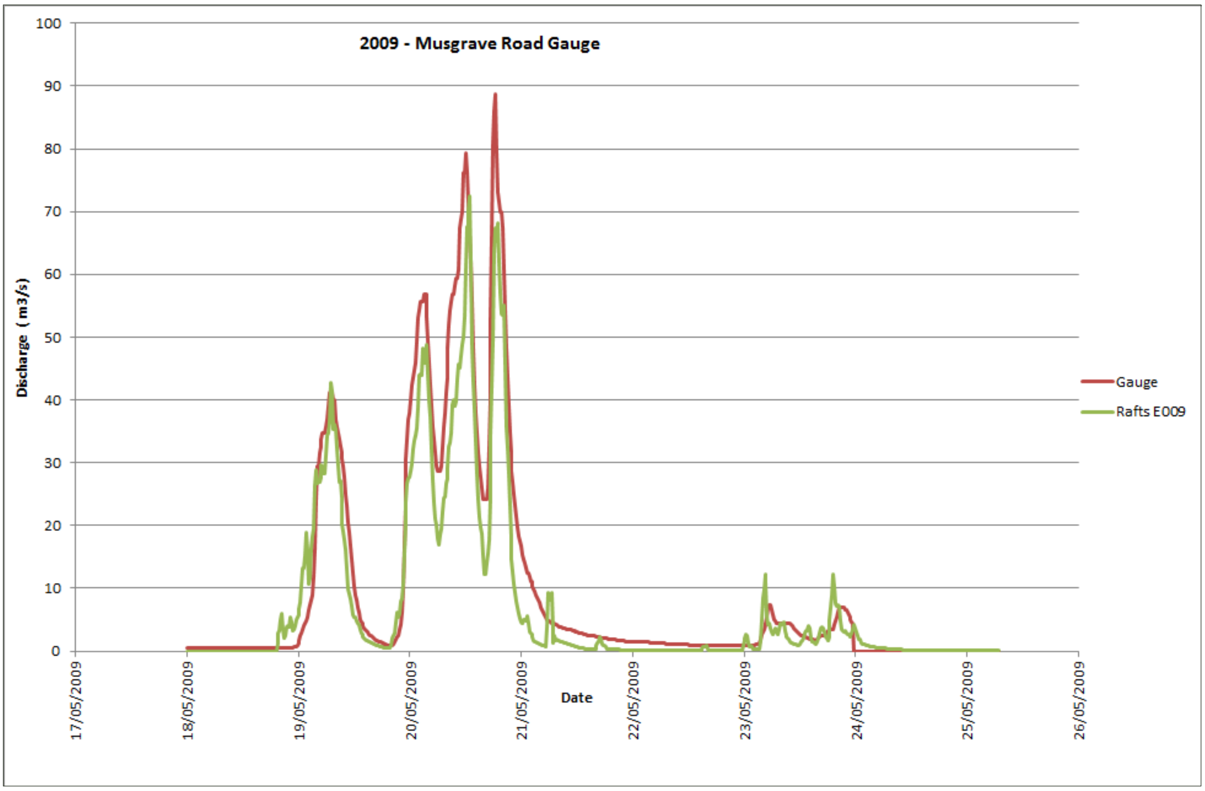
1996 - King Avenue Gauge
Discharge (m3/s)
140
120
100
80
60
40
20
0
29/04/1996
30/04/1996
1/05/1996
2/05/1996
3/05/1996
4/05/1996
5/05/1996
6/05/1996
7/05/1996
8/05/1996
Date
Gauge
Rafts E009


1996 - Musgrave Road Gauge
Discharge (m3/s)
0
20
40
60
80
100
120
140
29/04/1996
30/04/1996
1/05/1996
2/05/1996
3/05/1996
4/05/1996
5/05/1996
6/05/1996
7/05/1996
8/05/1996
Date
Gauge
Rafts E009

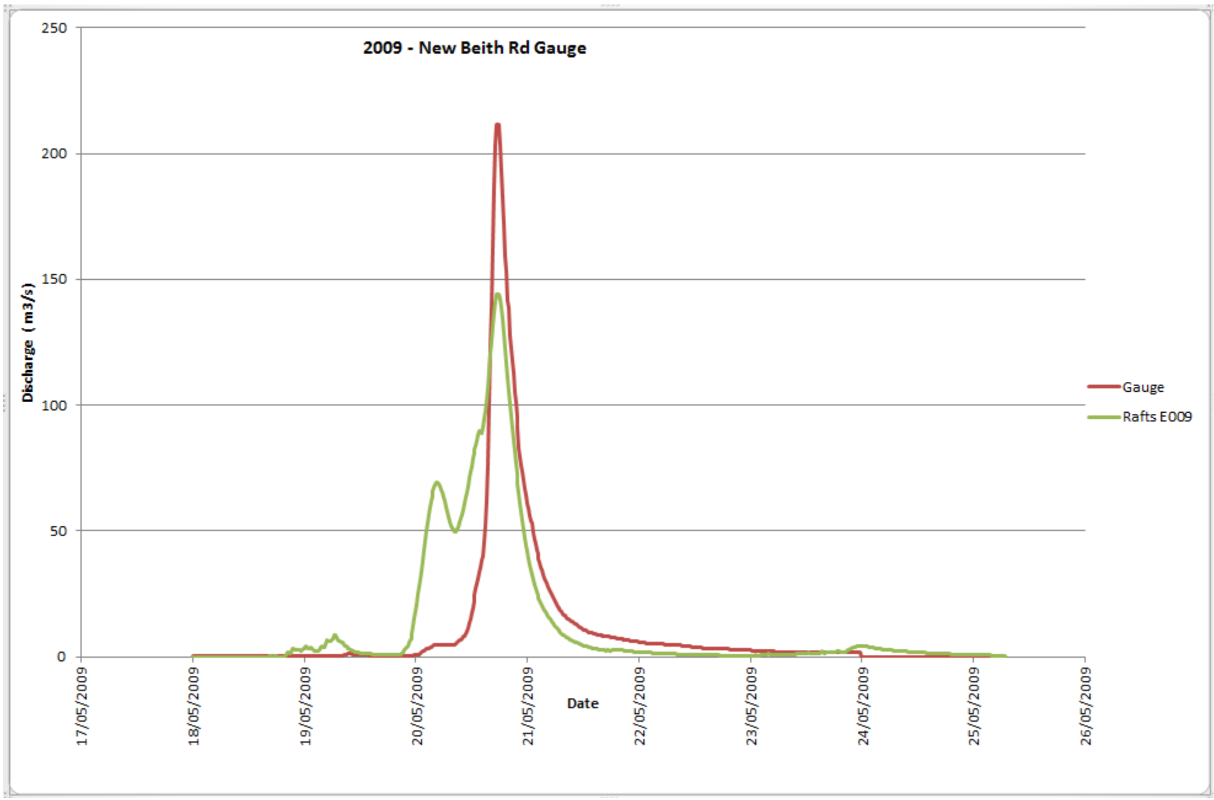

1996 - New Beith Rd Gauge
Discharge (m3/s)
0
20
40
60
80
100
120
140
29/04/1996
30/04/1996
1/05/1996
2/05/1996
3/05/1996
4/05/1996
5/05/1996
6/05/1996
7/05/1996
8/05/1996
Date
Gauge
Rafts E009


2009 - Beatty Road Gauge
Discharge (m3/s)
400
350
300
250
200
150
100
50
0
17/05/2009
18/05/2009
19/05/2009
20/05/2009
21/05/2009
22/05/2009
23/05/2009
24/05/2009
25/05/2009
26/05/2009
Date
Gauge
Rafts E009


2009 - King Avenue Gauge
Discharge (m3/s)
80
70
60
50
40
30
20
10
0
17/05/2009
18/05/2009
19/05/2009
20/05/2009
21/05/2009
22/05/2009
23/05/2009
24/05/2009
25/05/2009
26/05/2009
Date
Gauge - RAFTS
Rafts E009



2009 - Musgrave Road Gauge
Discharge (m3/s)
100
90
80
70
60
50
40
30
20
10
0
17/05/2009
18/05/2009
19/05/2009
20/05/2009
21/05/2009
22/05/2009
23/05/2009
24/05/2009
25/05/2009
26/05/2009
Date
Gauge
Rafts E009



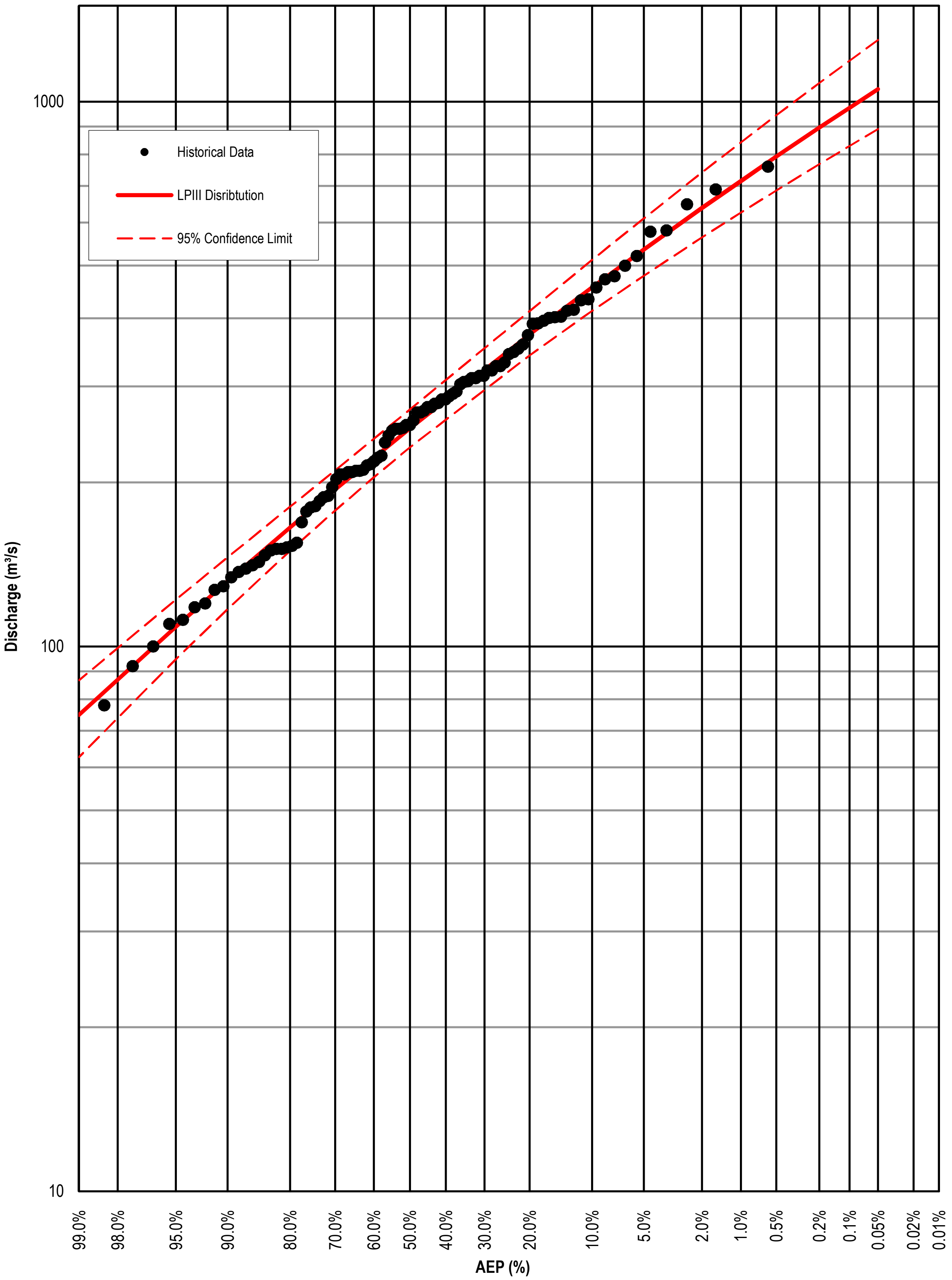
2009 - New Beith Rd Gauge
Discharge (m3/s)
250
200
150
100
50
0
17/05/2009
18/05/2009
19/05/2009
20/05/2009
21/05/2009
22/05/2009
23/05/2009
24/05/2009
25/05/2009
26/05/2009
Date
Gauge
Rafts E009

Appendix F
Flood Frequency Analysis

Client:	BCC			Date:	22/11/2012
Project/Job:	Oxley Creek Flood Study	Job No:	229985	Sheet No:	1
Subject:	**Flood Frequency Analysis** BEATTY RD			By:	BS/JS

Sample Period (Years)	101
Number of Samples Used, *N*	101
Plotting Position Parameter, α	0.4

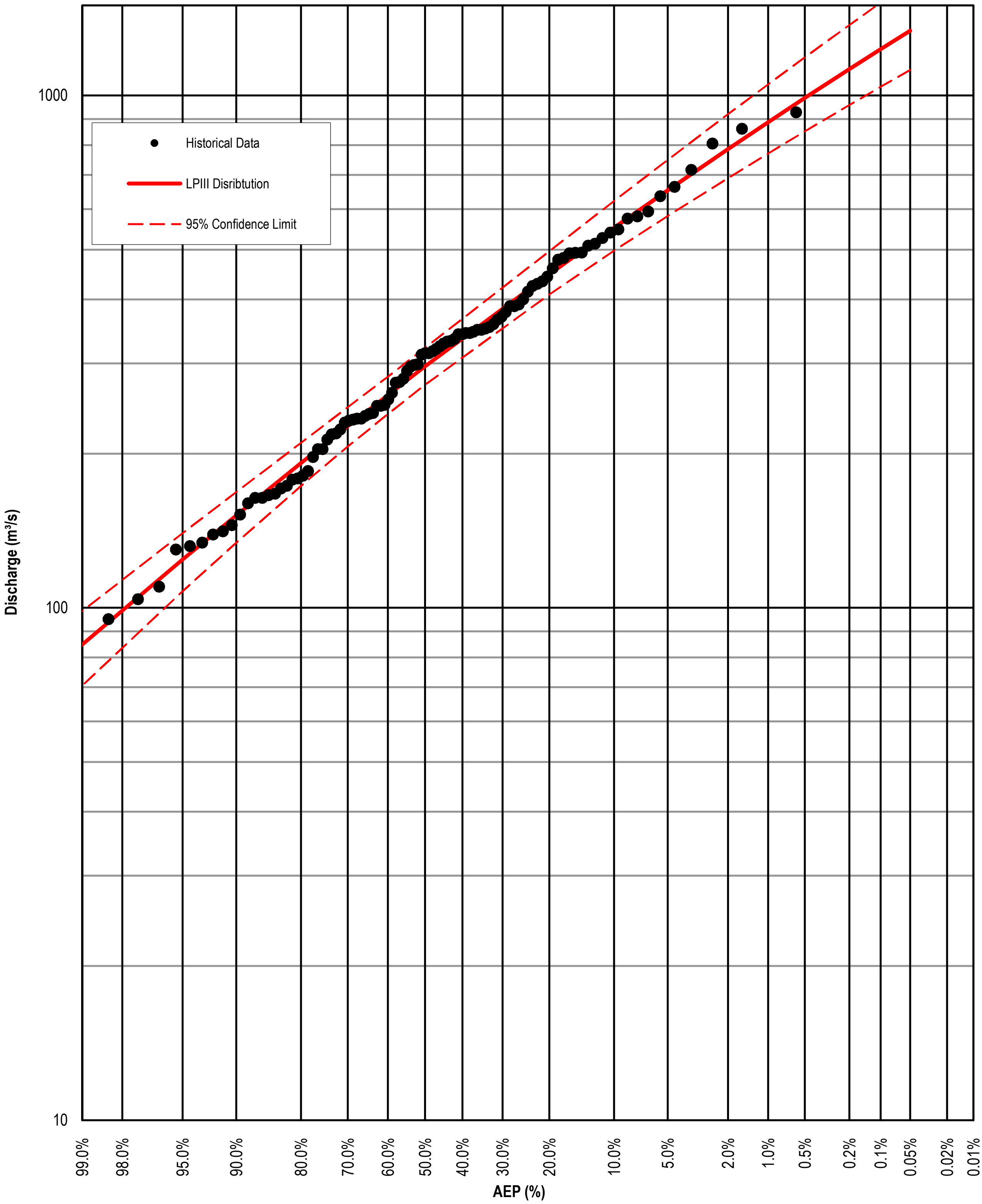
Adjusted Mean, *M*	2.393
Adjusted Std Deviation, *S*	0.211
Coefficient of Skewness, *g*	-0.188



Client:	BCC			Date:	22/11/2012
Project/Job:	Oxley Creek Flood Study	Job No:	229985	Sheet No:	1
Subject:	**Flood Frequency Analysis** IPSWICH ROAD			By:	BS/JS

Sample Period (Years)	101
Number of Samples Used, *N*	101
Plotting Position Parameter, α	0.4

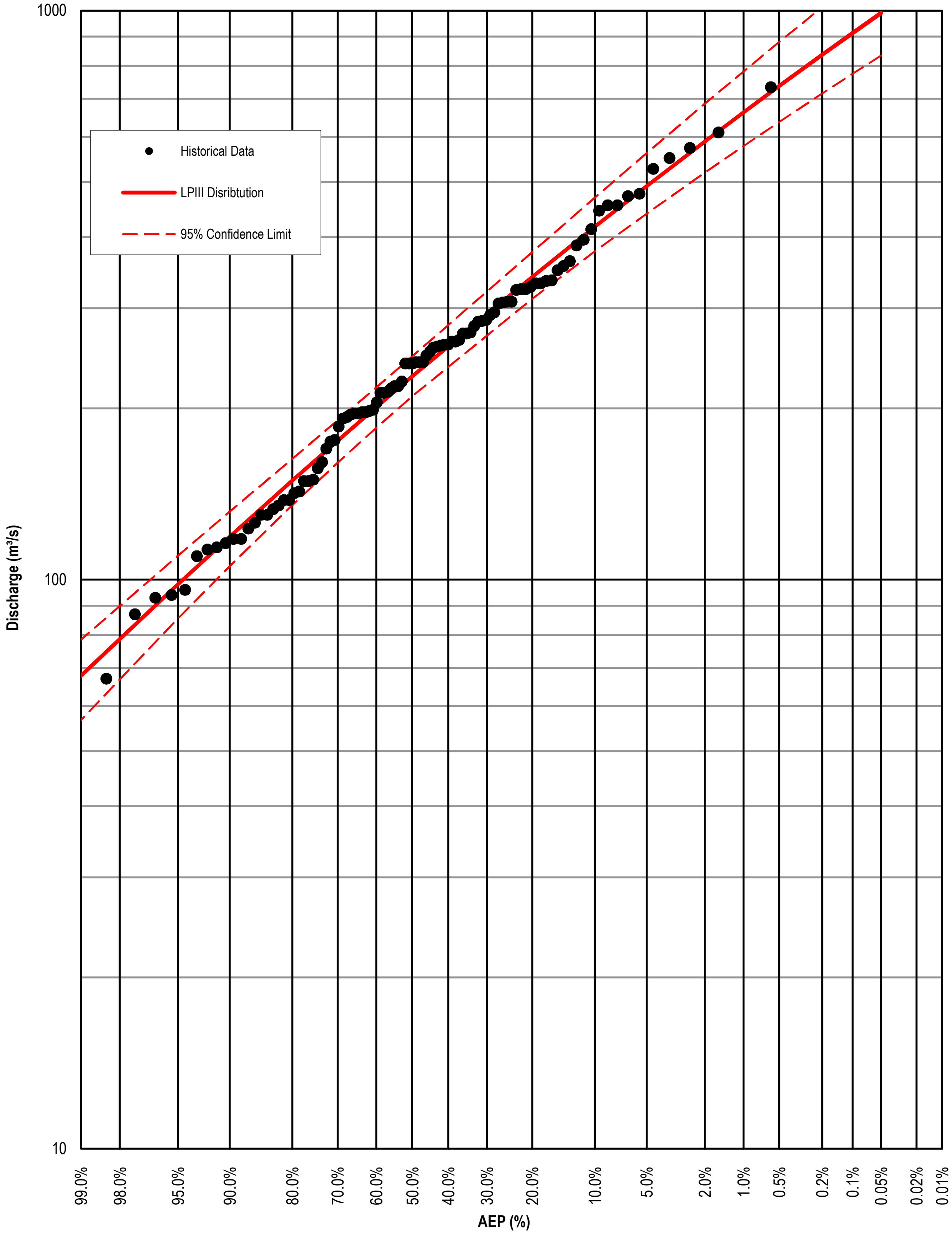
Adjusted Mean, *M*	2.465
Adjusted Std Deviation, *S*	0.219
Coefficient of Skewness, *g*	-0.168



Client:	BCC			Date:	22/11/2012
Project/Job:	Oxley Creek Flood Study	Job No:	229985	Sheet No:	1
Subject:	**Flood Frequency Analysis** JOHNSON RD			By:	BS/JS

Sample Period (Years)	101
Number of Samples Used, *N*	101
Plotting Position Parameter, α	0.4

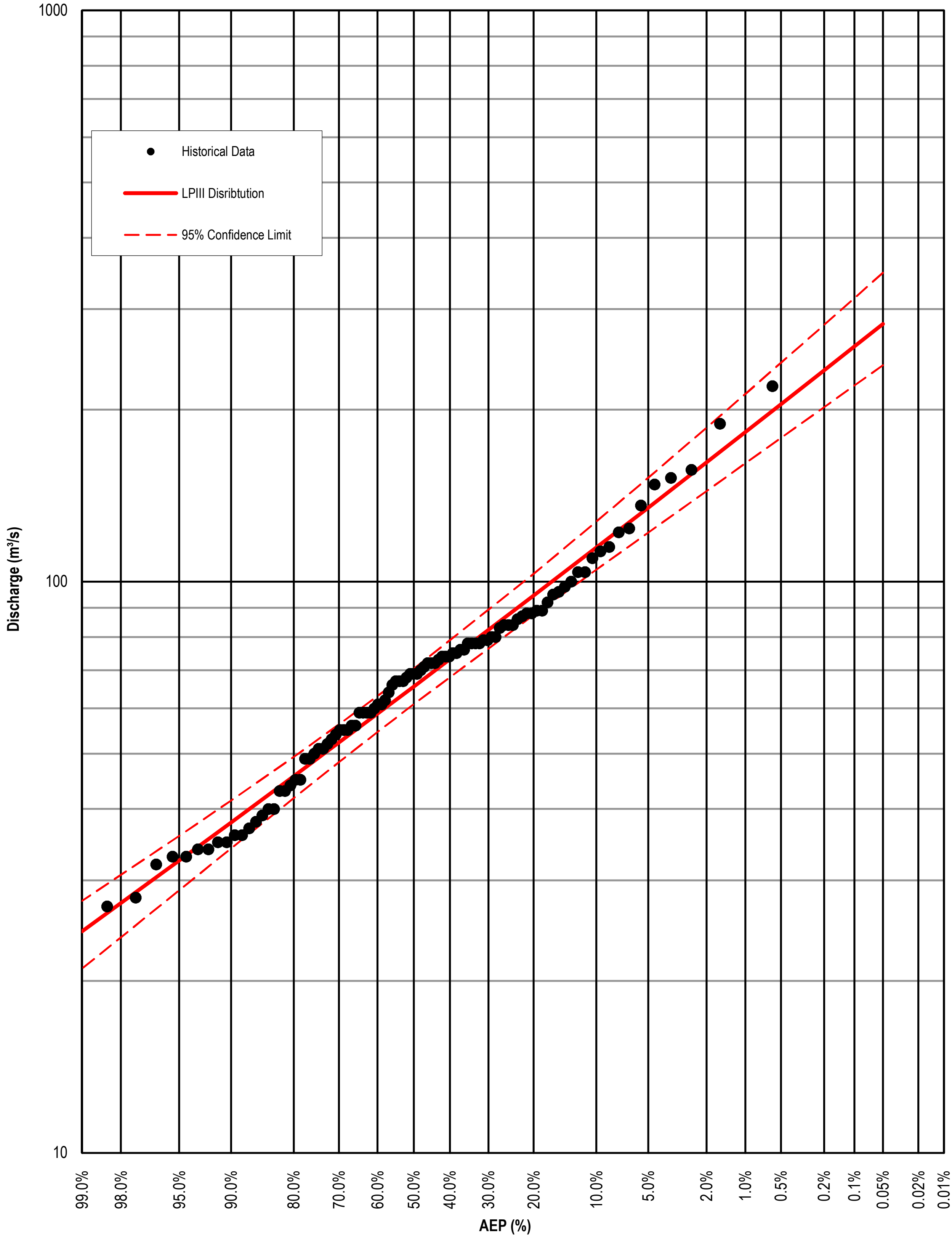
Adjusted Mean, *M*	2.352
Adjusted Std Deviation, *S*	0.213
Coefficient of Skewness, *g*	-0.162



Client:	BCC			Date:	22/11/2012
Project/Job:	Oxley Creek Flood Study	Job No:	229985	Sheet No:	1
Subject:	**Flood Frequency Analysis** KING AVE			By:	BS/JS

Sample Period (Years)	101
Number of Samples Used, *N*	101
Plotting Position Parameter, α	0.4

Adjusted Mean, *M*	1.818
Adjusted Std Deviation, *S*	0.188
Coefficient of Skewness, *g*	0.049



Appendix G

Tabulated Results up to 100 year ARI

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
Oxley Creek								
29282	OX1690	0.80	0.75	0.70	0.67	0.64	0.56	0.52
29176	OX1680	1.05	0.97	0.88	0.79	0.70	0.56	0.45
28371	OX1630	0.08	0.07	0.06	0.06	0.05	0.04	0.03
27626	OX1600	1.73	1.58	1.43	1.31	1.17	0.94	0.77
Logan Motorway Bridge and Culverts								
27610	OX1580	1.81	1.65	1.49	1.36	1.21	0.99	0.83
26626	OX1550	1.41	1.38	1.35	1.29	1.18	1.06	0.95
26255	OX1530	0.88	0.81	0.73	0.67	0.61	0.52	0.47
25226	OX1490	0.61	0.60	0.59	0.59	0.59	0.59	0.49
24701	OX1460	0.71	0.67	0.60	0.58	0.58	0.47	0.42
24428	OX1430	0.61	0.55	0.48	0.41	0.39	0.33	0.25
23710	OX1390	1.52	1.51	1.49	1.48	1.45	1.35	1.22
23444	OX1380	1.35	1.33	1.30	1.26	1.21	1.11	1.02
23321	OX1370	0.81	0.80	0.78	0.76	0.73	0.70	0.68
23027	OX1360	1.13	1.11	1.09	1.07	1.05	1.00	0.94
22825	OX1350	1.10	1.09	1.08	1.08	1.07	1.05	1.02
22554	OX1340	0.57	0.56	0.55	0.53	0.52	0.49	0.47
22417	OX1330	0.23	0.22	0.22	0.22	0.22	0.22	0.22
21958	OX1320	2.15	2.08	1.99	1.89	1.76	1.46	1.20
21704	OX1310	2.18	2.13	2.05	1.98	1.88	1.60	1.32
21457	OX1290	2.79	2.75	2.71	2.65	2.52	2.04	1.70
21406	OX1280	2.35	2.27	2.27	2.26	2.19	1.89	1.57
21374	OX1260	2.46	2.34	2.26	2.16	2.00	1.66	1.35
21194	OX1250	3.05	2.94	2.80	2.62	2.34	1.88	1.52
20908	OX1240	2.22	2.20	2.16	2.11	1.99	1.65	1.35
20754	OX1230	2.38	2.37	2.33	2.28	2.14	1.78	1.46
20576	OX1220	2.51	2.43	2.22	2.00	1.75	1.47	1.19
20280	OX1210	1.21	1.16	1.06	0.94	0.76	0.45	0.49
19562	OX1170	1.76	1.72	1.60	1.49	1.36	1.12	0.94

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
19341	OX1160	1.62	1.59	1.46	1.35	1.22	0.98	0.80
19183	OX1150	1.71	1.67	1.55	1.43	1.30	1.06	0.88
Oxley Creek								
Learoyd Road Bridge								
19139	OX1120	1.84	1.72	1.55	1.37	1.17	0.92	0.74
19015	OX1110	0.82	0.77	0.72	0.66	0.60	0.52	0.45
18855	OX1100	0.88	0.81	0.75	0.70	0.64	0.55	0.44
18696	OX1090	1.03	0.99	0.93	0.88	0.82	0.70	0.59
18535	OX1080	1.49	1.48	1.46	1.42	1.35	1.13	0.98
18233	OX1060	0.76	0.75	0.74	0.73	0.70	0.60	0.52
18200	OX1050	0.82	0.75	0.75	0.71	0.68	0.59	0.53
18018	OX1040	0.69	0.67	0.73	0.72	0.71	0.69	0.60
17818	OX1030	0.54	0.47	0.42	0.32	0.31	0.25	0.25
17382	OX1020	0.50	0.59	0.59	0.48	0.48	0.47	0.45
17023	OX1010	1.07	1.04	0.96	0.87	0.83	0.80	0.78
16821	OX1000	1.78	1.78	1.80	1.79	1.80	1.79	1.91
16800	OX930	1.45	1.45	1.45	1.44	1.38	1.32	1.14
Beatty Road Bridge								
16740	OX930	2.71	2.68	2.71	2.71	2.59	2.48	1.84
16570	OX970	2.41	2.26	2.03	1.80	1.55	1.19	0.94
16502	OX950	2.77	2.60	2.35	2.09	1.80	1.39	1.10
16190	OX945	2.36	2.22	2.01	1.79	1.55	1.20	0.97
15949	OX920	1.64	1.57	1.46	1.34	1.22	1.02	0.89
15588	OX910	0.76	0.72	0.67	0.61	0.54	0.45	0.37
15289	OX900	0.29	0.27	0.23	0.19	0.16	0.12	0.09
14778	OX890	0.83	0.77	0.67	0.58	0.49	0.36	0.26
14339	OX870	0.46	0.46	0.46	0.45	0.45	0.38	0.35
13829	OX860	0.56	0.55	0.56	0.55	0.54	0.51	0.47
13496	OX850	1.09	1.11	1.10	1.11	1.11	1.05	0.91
13243	OX840	0.65	0.66	0.70	0.73	0.73	0.76	0.74

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
12885	OX830	0.99	0.97	0.91	0.90	0.90	0.91	0.90
12429	OX820	0.52	0.52	0.52	0.52	0.51	0.52	0.53
12026	OX810	0.32	0.33	0.35	0.37	0.38	0.39	0.44
Oxley Creek								
11670	OX780	1.60	1.61	1.57	1.35	1.15	1.14	1.07
Ipswich Road Bridge								
11616	OX760	1.20	1.20	1.17	1.04	1.02	1.01	0.94
10720	OX740	0.40	0.38	0.36	0.33	0.30	0.24	0.22
9737	OX730	0.35	0.35	0.35	0.36	0.37	0.47	0.50
9626	OX720	0.53	0.52	0.50	0.48	0.48	0.51	0.62
9355	OX710	0.37	0.46	0.44	0.43	0.43	0.44	0.41
9078	OX700	0.27	0.26	0.17	0.15	0.13	0.15	0.22
8942	OX690	0.25	0.24	0.21	0.18	0.15	0.13	0.17
8295	OX680	0.35	0.38	0.40	0.40	0.40	0.39	0.44
8058	OX670	0.42	0.41	0.40	0.38	0.40	0.49	0.49
7730	OX660	0.48	0.48	0.47	0.46	0.51	0.59	0.59
7500	OX650	0.89	0.87	0.83	0.81	0.79	0.75	0.69
7355	OX640	1.30	1.27	1.21	1.16	1.11	0.98	0.83
7174	OX630	2.03	2.00	1.90	1.78	1.64	1.37	1.14
6998	OX620	0.95	0.94	0.99	1.01	1.01	1.02	1.00
6779	OX610	1.38	1.39	1.39	1.39	1.38	1.31	1.25
6230	OX600	0.65	0.72	0.83	0.85	0.84	0.84	0.82
5990	OX590	0.65	0.64	0.63	0.61	0.59	0.58	0.56
5650	OX580	0.72	0.72	0.70	0.73	0.72	0.73	0.72
5268	OX570	0.89	0.91	0.93	0.93	0.93	0.93	0.92
5191	OX550	0.92	0.94	0.95	0.95	0.95	0.94	0.91
5067	OX540	1.23	1.26	1.25	1.26	1.26	1.24	1.21
4928	OX530	1.10	1.12	1.15	1.16	1.15	1.15	1.14
4641	OX510	0.81	0.81	0.82	0.81	0.80	0.74	0.66
4534	OX500	0.62	0.62	0.63	0.62	0.62	0.60	0.57

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
4283	OX490	0.81	0.83	0.84	0.84	0.85	0.84	0.82
3578	OX480	0.81	0.82	0.82	0.82	0.81	0.79	0.78
3289	OX470	1.42	1.42	1.41	1.40	1.36	1.21	0.96
2946	OX460	1.75	1.72	1.70	1.55	1.48	1.31	1.12
2728	OX450	1.80	1.75	1.64	1.52	1.37	1.11	0.90
Oxley Creek								
2463	OX440	1.67	1.62	1.51	1.40	1.26	1.02	0.83
2388	OX430	1.44	1.39	1.26	1.14	1.03	0.83	0.68
2087	OX420	1.78	1.74	1.65	1.55	1.41	1.17	0.97
2057	OX420	1.99	1.95	1.85	1.75	1.60	1.34	1.12
Sherwood Road Bridge and Culverts								
2045	OX380	2.06	2.02	1.93	1.82	1.67	1.40	1.17
2015	OX370	0.09	0.08	0.05	0.05	0.05	0.00	0.00
1949	OX360	1.77	1.71	1.60	1.51	1.38	1.15	0.96
1865	OX350	1.79	1.72	1.58	1.46	1.32	1.06	0.84
1746	OX340	3.66	3.44	3.05	2.76	2.48	1.92	1.44
1626	OX330	3.84	3.59	3.14	2.78	2.43	1.84	1.36
Railway Bridge								
1618	OX310	3.87	3.57	3.03	2.62	2.25	1.66	1.22
1531	OX290	2.70	2.46	2.07	1.77	1.51	1.11	0.81
1479	OX290	2.57	2.35	1.98	1.70	1.46	1.07	0.78
Watermain Bridge								
1476	OX280	2.56	2.34	1.97	1.70	1.45	1.07	0.78
1388	OX260	2.44	2.23	1.88	1.62	1.39	1.02	0.74
1329	OX250	2.44	2.23	1.87	1.61	1.37	1.00	0.73
1245	OX240	2.48	2.26	1.89	1.62	1.37	0.99	0.72
1179	OX230	2.28	2.07	1.74	1.49	1.26	0.91	0.66
1102	OX210	2.47	2.25	1.88	1.61	1.36	0.98	0.70
1027	OX200	2.57	2.34	1.96	1.67	1.42	1.02	0.73
972	OX190	2.60	2.37	1.98	1.68	1.43	1.02	0.73

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
896	OX180	2.23	2.02	1.67	1.42	1.19	0.84	0.60
835	OX170	2.25	2.04	1.69	1.43	1.20	0.85	0.60
777	OX160	2.38	2.16	1.80	1.52	1.28	0.91	0.65
698	OX150	3.01	2.75	2.29	1.95	1.65	1.17	0.83
631	OX140	2.32	2.11	1.76	1.49	1.26	0.89	0.63
554	OX130	2.22	2.01	1.67	1.41	1.18	0.83	0.58
481	OX120	2.14	1.95	1.61	1.36	1.13	0.79	0.56
Oxley Creek								
406	OX110	2.21	2.00	1.63	1.36	1.13	0.78	0.54
290	OX90	2.42	2.18	1.79	1.49	1.23	0.84	0.59
156	OX60	1.15	1.03	0.83	0.69	0.56	0.38	0.26
Pamphlett Bridge								
143	OX40	1.00	0.90	0.71	0.58	0.48	0.32	0.22
117	OX30	3.24	2.90	2.31	1.89	1.54	1.03	0.71
18	OX10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blunder Creek								
13615	BL830	0.89	0.87	0.85	0.84	0.88	0.86	0.86
13485	BL820	1.29	1.24	1.17	1.11	1.04	0.89	0.75
13382	BL810	0.80	0.73	0.71	0.69	0.68	0.54	0.58
13283	BL800	0.79	0.75	0.67	0.59	0.53	0.42	0.34
13092	BL790	0.80	0.78	0.75	0.71	0.69	0.61	0.49
Logan Motorway Culverts								
13078	BL770	0.87	0.86	0.82	0.79	0.76	0.68	0.56
12910	BL760	0.62	0.59	0.56	0.54	0.52	0.47	0.38
12719	BL750	1.23	1.19	1.12	1.09	1.02	0.85	0.74
12555	BL740	0.52	0.49	0.45	0.42	0.38	0.27	0.20
12421	BL730	1.00	0.94	0.85	0.80	0.77	0.69	0.57
12276	BL710	1.04	0.96	0.84	0.76	0.69	0.53	0.35
12098	BL700	1.05	1.01	0.92	0.85	0.75	0.57	0.45
12000	BL690	0.92	0.85	0.74	0.66	0.58	0.46	0.37

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
Forest Lake Boulevarde Bridge								
11903	BL680	0.69	0.63	0.55	0.49	0.42	0.31	0.24
11717	BL670	0.97	0.90	0.79	0.71	0.63	0.47	0.33
11631	BL660	0.87	0.81	0.71	0.64	0.56	0.40	0.25
11484	BL640	0.76	0.71	0.63	0.58	0.53	0.44	0.34
11368	BL630	1.59	1.55	1.45	1.38	1.32	1.18	1.04
11273	BL620	1.13	1.09	1.03	0.97	0.92	0.79	0.67
11109	BL610	1.05	1.07	1.08	1.08	1.05	0.89	0.74
1906	BL600	0.84	0.83	0.80	0.81	0.80	0.77	0.70
Blunder Creek								
10781	BL590	1.41	1.34	1.19	1.07	0.95	0.79	0.65
10720	BL580	1.28	1.19	1.06	0.94	0.83	0.68	0.57
10606	BL570	0.91	0.85	0.76	0.68	0.60	0.49	0.41
10425	BL560	0.88	0.79	0.66	0.56	0.47	0.36	0.30
10329	BL550	1.16	1.07	0.96	0.85	0.75	0.60	0.49
10203	BL540	0.94	0.85	0.75	0.65	0.55	0.38	0.32
10038	BL530	1.54	1.41	1.21	1.09	0.97	0.81	0.67
9978	BL520	1.25	1.14	1.02	0.92	0.83	0.70	0.60
9909	BL510	1.14	1.03	0.90	0.84	0.87	0.85	0.59
Blunder Road Bridge								
9898	BL500	1.09	0.99	0.86	0.81	0.87	0.88	0.59
9852	BL480	2.04	1.89	1.71	1.60	2.07	2.34	2.44
9694	BL470	1.72	1.69	1.60	1.51	1.42	1.28	1.17
9531	BL460	0.86	0.82	0.76	0.71	0.66	0.61	0.54
9282	BL450	0.65	0.62	0.55	0.49	0.43	0.39	0.36
9180	BL440	0.57	0.53	0.46	0.39	0.33	0.27	0.25
9029	BL430	0.20	0.28	0.25	0.14	0.12	0.16	0.15
8706	BL420	1.22	1.16	1.07	0.98	0.91	0.78	0.67
8560	BL410	0.27	0.26	0.12	0.09	0.07	0.05	0.06
8417	BL400	0.70	0.69	0.67	0.65	0.62	0.58	0.56

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
8212	BL390	0.34	0.31	0.27	0.25	0.22	0.20	0.18
8052	BL380	0.54	0.52	0.51	0.49	0.48	0.47	0.45
8009	BL370	0.41	0.41	0.39	0.37	0.35	0.35	0.33
7904	BL360	1.42	1.42	1.42	1.41	1.41	1.41	1.37
7733	BL350	0.46	0.43	0.39	0.41	0.46	0.49	0.49
7552	BL340	0.90	0.88	0.87	0.86	0.84	0.82	0.78
7318	BL330	1.31	1.28	1.23	1.22	1.15	1.12	0.99
7116	BL320	0.65	0.62	0.57	0.58	0.58	0.57	0.56
6993	BL310	0.78	0.77	0.74	0.71	0.68	0.63	0.58
6844	BL300	0.61	0.60	0.59	0.59	0.61	0.63	0.63
6649	BL290	0.48	0.48	0.47	0.47	0.50	0.51	0.49
Blunder Creek								
6475	BL280	0.62	0.62	0.61	0.59	0.57	0.55	0.51
6306	BL260	0.67	0.62	0.53	0.44	0.39	0.31	0.28
6175	BL250	1.41	1.33	1.20	1.11	1.00	0.87	0.78
5841	BL240	0.80	0.76	0.70	0.64	0.58	0.48	0.41
5541	BL230	0.52	0.51	0.49	0.46	0.44	0.43	0.44
5438	BL220	1.07	1.05	1.02	0.98	1.00	0.88	0.78
5288	BL210	0.65	0.65	0.64	0.64	0.63	0.65	0.61
5098	BL200	0.70	0.66	0.57	0.45	0.41	0.35	0.31
4929	BL190	0.57	0.53	0.47	0.36	0.39	0.29	0.22
4617	BL180	0.67	0.66	0.58	0.56	0.56	0.52	0.50
4468	BL170	0.67	0.67	0.69	0.70	0.70	0.70	0.71
4370	BL160	0.59	0.60	0.59	0.56	0.56	0.29	0.25
4217	BL150	1.51	1.44	1.31	1.17	0.96	0.65	0.47
King Avenue Bridge								
4206	BL140	1.43	1.36	1.27	1.12	0.95	0.70	0.52
3944	BL120	0.53	0.50	0.46	0.43	0.40	0.35	0.32
3560	BL110	0.51	0.48	0.43	0.40	0.37	0.34	0.26
3134	BL100	0.46	0.44	0.40	0.37	0.34	0.29	0.24

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
2670	BL80	0.80	0.77	0.76	0.75	0.74	0.70	0.65
Bowhill Road Culverts								
2654	BL60	0.69	0.62	0.58	0.55	0.53	0.49	0.47
2423	BL50	0.39	0.34	0.27	0.25	0.24	0.28	0.27
1666	BL40	0.35	0.33	0.29	0.25	0.24	0.22	0.21
1415	BL30	0.89	0.84	0.77	0.72	0.66	0.60	0.53
1185	BL20	0.77	0.73	0.65	0.60	0.56	0.48	0.45
1144	BL10	0.73	0.69	0.64	0.52	0.49	0.42	0.49
657	OX850	0.50	0.56	0.45	0.48	0.53	0.39	0.38
202	OX840	2.26	2.25	2.24	2.21	2.17	2.12	2.07
Oxtrib1								
2625	OX2220	0.90	0.81	0.73	0.65	0.60	0.56	0.53
2494	OX2210	1.69	1.52	1.59	1.34	1.15	0.97	0.81
Oxtrib1								
2373	OX2200	1.32	1.23	1.03	0.98	0.84	0.61	0.47
2277	OX2180	2.06	1.94	1.89	1.80	1.85	1.77	1.74
2236	OX2180	0.75	0.69	0.67	0.51	0.45	0.45	0.65
Rudd Street Culverts								
2216	OX2170	1.40	1.34	1.29	1.15	1.08	0.86	0.90
1906	OX2160	2.03	1.95	1.85	1.69	1.55	1.26	0.98
1614	OX2150	2.91	2.79	2.61	2.42	2.25	1.96	1.73
1362	OX2140	0.98	0.94	0.90	0.86	0.81	0.67	0.56
1221	OX2130	0.94	0.97	1.02	0.99	0.96	0.83	0.68
Blunder Road Culverts								
1196	OX2110	0.44	0.36	0.28	0.21	0.12	0.05	0.07
1080	OX2100	2.42	2.36	2.32	2.29	2.14	1.82	1.39
966	OX2090	2.45	2.39	2.31	2.28	2.27	2.18	1.83
852	OX2080	1.24	1.19	1.12	1.07	1.04	1.07	0.94
Loop Road Culverts								
774	OX2060	0.39	0.37	0.19	0.19	0.18	0.17	0.14

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
684	OX2050	0.25	0.24	0.16	0.18	0.15	0.17	0.13
560	OX2050	0.45	0.36	0.19	0.13	0.12	0.11	0.04
Ipswich Road Culverts								
513	OX760	0.82	0.75	0.67	0.63	0.66	0.62	0.44
495	OX2009	1.11	1.08	1.01	0.97	0.92	0.77	0.62
Service Road Culverts								
481	OX2006	0.90	0.90	0.87	0.84	0.79	0.64	0.53
442	OX2000	0.66	0.66	0.66	0.64	0.62	0.58	0.52
Btrib1								
3768		6.68	6.65	6.65	4.66	4.45	4.13	3.86
3741		5.91	5.89	5.90	4.83	4.66	4.39	4.16
3711		5.14	5.13	5.15	4.99	4.86	4.64	4.46
Clipper Street Culverts								
3678		4.05	3.87	3.88	3.47	3.68	3.41	3.40
3659		3.76	3.66	3.68	2.68	2.73	2.54	2.49
Btrib1								
3612		3.44	3.44	3.45	2.01	1.91	1.75	1.63
3555		2.94	2.94	2.95	2.13	2.04	1.89	1.75
3462		1.85	1.85	1.86	1.53	1.47	1.35	1.38
3375		1.75	1.75	1.75	1.42	1.35	1.22	1.25
3303		1.90	1.90	1.90	1.57	1.50	1.38	1.33
3248		1.45	1.45	1.45	1.16	1.09	0.99	0.96
3187		1.81	1.81	1.81	1.55	1.48	1.37	1.28
3115		2.26	2.26	2.26	2.03	1.96	1.84	1.75
Inala Avenue Culverts								
3056		2.45	2.44	2.41	2.14	2.03	1.91	1.83
2946		2.47	2.46	2.43	2.19	2.10	2.00	1.92
2836		2.18	2.17	2.15	1.92	1.86	1.75	1.66
2718		2.05	2.04	2.01	1.81	1.73	1.61	1.50
2592		2.98	2.96	2.91	2.70	2.61	2.45	2.32

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
2526	BL1160	2.90	2.88	2.82	2.63	2.54	2.38	2.27
2412	BL1150	1.97	1.94	1.86	1.75	1.72	1.66	1.59
2258	BL1140	1.63	1.61	1.54	1.48	1.47	1.48	1.46
2152	BL1120	1.40	1.39	1.36	1.32	1.29	1.33	1.32
Rosemary Street Culverts								
2121	BL1110	4.88	4.74	4.51	4.15	3.86	3.61	3.29
2050	BL1100	5.01	4.86	4.61	4.27	3.99	3.75	3.44
1880	BL1090	6.93	6.39	5.58	4.91	4.35	3.62	3.17
1804	BL1087	5.91	5.69	5.34	4.91	4.54	4.22	3.93
1629	BL1080	6.42	6.20	5.86	5.44	5.11	4.79	4.47
1408	BL1070	5.64	5.46	5.22	4.94	4.81	4.62	4.38
1283	BL1060	4.71	4.56	4.36	4.14	4.06	3.91	3.73
1083	BL1050	5.06	4.90	4.66	4.38	4.17	3.95	3.71
1046	BL1040	1.76	1.59	1.25	0.99	0.66	0.51	0.15
Blunder Road Culverts								
1037	BL1020	2.35	2.27	2.11	1.87	1.67	1.56	1.45
932	BL1010	1.02	1.02	0.99	0.96	0.92	0.81	0.71
Btrib1								
681	BL1010	1.07	1.05	1.00	0.96	0.93	0.90	0.86
Bowhill Road Culverts								
Btrib2								
3002	BL2260	2.00	1.98	1.96	1.94	1.93	1.91	1.90
2835	BL2252	2.00	1.98	1.96	1.94	1.93	1.91	1.90
Wallaroo Way Culverts								
2816	BL2249	1.55	1.49	1.43	1.37	1.30	1.24	1.21
2765	BL2240	1.58	1.53	1.47	1.40	1.33	1.26	1.23
2481	BL2230	1.48	1.46	1.43	1.39	1.35	1.29	1.24
2142	BL2220	1.06	1.04	1.02	1.02	1.02	1.03	0.99
2025	BL2210	0.93	0.87	0.82	0.84	0.86	0.83	0.80
1994	BL2207	1.10	1.03	0.96	0.97	1.00	0.92	0.86

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
1980	BL2204	6.93	6.74	6.43	6.12	5.81	5.42	5.13
Lorikeet Street Culverts								
1879	BL2200	5.76	5.60	5.34	5.09	4.83	4.62	4.47
1761	BL2190	3.49	3.43	3.33	3.20	3.09	3.08	3.07
1626	BL2182	2.39	2.39	2.40	2.35	2.32	2.33	2.33
Pigeon Street Culverts								
1611	BL2179	5.91	5.70	5.36	5.03	4.67	4.49	4.33
1408	BL2170	5.64	5.46	5.22	4.94	4.81	4.62	4.38
1323	BL2160	2.75	2.74	2.66	2.59	2.57	2.47	2.45
Rosella Street Culverts								
1300	BL2140	2.64	2.62	2.60	2.78	2.65	2.49	2.37
1218	BL2130	2.73	2.71	2.68	2.77	2.69	2.61	2.55
1138	BL2120	2.82	2.80	2.77	2.75	2.73	2.72	2.73
Blunder Road Culverts								
1127	BL2100	4.96	4.97	5.65	5.35	5.35	5.57	5.61
1053	BL2090	3.47	3.43	3.74	3.59	3.55	3.64	3.65
1005	BL2080	1.99	1.90	1.84	1.84	1.75	1.72	1.69
Inala Avenue Culverts								
945	BL2060	2.54	2.70	2.67	2.64	2.59	2.52	2.40
Btrib2								
845	BL2050	2.20	2.23	2.17	2.09	2.00	1.91	1.80
674	BL2040	1.88	1.82	1.72	1.62	1.50	1.41	1.33
507	BL2030	1.92	1.87	1.77	1.69	1.60	1.53	1.46
492	BL2010	2.35	2.27	2.11	1.87	1.67	1.56	1.45
King Avenue Culverts								
364	BL2000	1.10	1.05	0.97	0.90	0.82	0.76	0.70
Btrib3								
1007		1.96	1.91	1.85	1.78	1.72	1.61	1.52
863		2.26	2.20	2.12	2.05	1.98	1.85	1.75
788		2.40	2.34	2.27	2.23	2.18	2.08	1.97

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
692		1.90	1.85	1.79	1.77	1.76	1.72	1.65
641		1.54	1.50	1.43	1.40	1.39	1.38	1.35
Eucalypt Street Culverts								
523		1.68	1.62	1.53	1.43	1.34	1.21	1.08
429		1.59	1.55	1.47	1.40	1.33	1.22	1.13
318		1.13	1.08	1.00	0.95	0.91	0.85	0.80
192		1.57	1.51	1.42	1.34	1.27	1.16	1.06
76		2.98	2.96	2.91	2.70	2.61	2.45	2.32
Btrib4								
961		1.16	1.10	1.03	0.98	0.95	0.88	0.83
868		1.31	1.26	1.20	1.14	1.09	1.00	0.93
780		1.38	1.34	1.28	1.23	1.17	1.08	1.02
683		1.30	1.26	1.21	1.16	1.12	1.05	0.99
Inala Avenue Culverts								
586		5.39	5.24	5.03	4.84	4.64	4.30	4.00
498		5.60	5.45	5.22	5.02	4.80	4.45	4.14
431		5.54	5.38	5.16	4.96	4.75	4.40	4.08
317		6.39	6.14	5.80	5.52	5.24	4.81	4.44
181		5.91	5.69	5.34	4.91	4.54	4.22	3.93

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
Oxley Creek								
29282	OX1690	25.00	24.75	24.42	24.11	23.80	23.28	22.87
29176	OX1680	24.88	24.64	24.32	24.02	23.72	23.22	22.83
28371	OX1630	23.03	22.76	22.41	22.09	21.75	21.21	20.81
27626	OX1600	22.53	22.31	22.00	21.70	21.38	20.86	20.44
Logan Motorway Bridge and Culverts								
27610	OX1580	22.51	22.29	21.98	21.69	21.37	20.86	20.44
26626	OX1550	21.64	21.45	21.19	20.93	20.67	20.21	19.86
26255	OX1530	20.79	20.65	20.45	20.24	20.01	19.62	19.31
25226	OX1490	19.74	19.66	19.52	19.39	19.26	19.01	18.84
24701	OX1460	19.07	18.87	18.54	18.21	17.96	17.60	17.25
24428	OX1430	18.03	17.86	17.59	17.36	17.15	16.76	16.45
23710	OX1390	17.31	17.19	17.04	16.89	16.72	16.40	16.13
23444	OX1380	16.77	16.64	16.47	16.31	16.14	15.85	15.63
23321	OX1370	16.52	16.38	16.20	16.04	15.86	15.58	15.37
23027	OX1360	15.98	15.83	15.65	15.49	15.31	15.02	14.79
22825	OX1350	15.53	15.37	15.17	14.98	14.77	14.43	14.16
22554	OX1340	15.21	15.04	14.82	14.61	14.38	14.00	13.69
22417	OX1330	15.04	14.87	14.64	14.43	14.18	13.75	13.34
21958	OX1320	14.76	14.58	14.36	14.14	13.89	13.40	12.91
21704	OX1310	13.93	13.73	13.47	13.21	12.88	12.29	11.74
21457	OX1290	13.30	13.08	12.79	12.48	12.09	11.41	10.81
21406	OX1280	13.17	12.95	12.64	12.32	11.91	11.20	10.59
21374	OX1260	13.09	12.86	12.54	12.20	11.78	11.03	10.41
21194	OX1250	12.52	12.26	11.92	11.59	11.17	10.44	9.85
20908	OX1240	11.91	11.61	11.25	10.89	10.49	9.83	9.28
20754	OX1230	11.69	11.35	10.97	10.60	10.18	9.52	8.99
20576	OX1220	11.38	11.02	10.64	10.26	9.84	9.16	8.64
20280	OX1210	10.96	10.53	10.17	9.81	9.43	8.82	8.36
19562	OX1170	10.81	10.36	10.00	9.65	9.27	8.68	8.24

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
19341	OX1160	10.75	10.29	9.93	9.58	9.21	8.63	8.21
19183	OX1150	10.70	10.24	9.88	9.54	9.17	8.60	8.19
Oxley Creek								
Learoyd Road Bridge								
19139	OX1120	10.44	10.19	9.84	9.50	9.14	8.58	8.16
19015	OX1110	10.36	10.11	9.76	9.43	9.08	8.53	8.13
18855	OX1100	10.23	9.99	9.65	9.33	8.98	8.45	8.06
18696	OX1090	10.10	9.86	9.52	9.20	8.85	8.32	7.94
18535	OX1080	9.79	9.54	9.19	8.86	8.50	8.01	7.68
18233	OX1060	9.58	9.31	8.93	8.56	8.13	7.56	7.22
18200	OX1050	9.56	9.28	8.91	8.53	8.08	7.47	7.13
18018	OX1040	9.52	9.24	8.86	8.47	8.01	7.36	7.00
17818	OX1030	9.42	9.14	8.76	8.37	7.91	7.24	6.89
17382	OX1020	9.40	9.12	8.74	8.34	7.86	7.14	6.78
17023	OX1010	9.37	9.09	8.71	8.31	7.81	6.97	6.50
16821	OX1000	9.27	8.99	8.61	8.21	7.69	6.76	6.18
16800	OX930	9.26	8.98	8.59	8.19	7.68	6.73	6.16
Beatty Road Bridge								
16740	OX930	9.14	8.86	8.46	8.05	7.56	6.67	6.10
16570	OX970	8.51	8.23	7.82	7.45	7.07	6.45	5.92
16502	OX950	8.39	8.12	7.72	7.37	7.00	6.40	5.88
16190	OX945	7.81	7.58	7.25	6.97	6.68	6.18	5.72
15949	OX920	7.60	7.37	7.06	6.80	6.53	6.06	5.62
15588	OX910	7.35	7.13	6.83	6.59	6.35	5.92	5.51
15289	OX900	7.25	7.04	6.76	6.53	6.31	5.89	5.49
14778	OX890	6.93	6.74	6.50	6.30	6.12	5.76	5.38
14339	OX870	6.81	6.63	6.38	6.18	6.01	5.68	5.32
13829	OX860	6.73	6.52	6.20	5.89	5.60	5.26	5.00
13496	OX850	6.66	6.44	6.10	5.78	5.42	4.99	4.76
13243	OX840	6.62	6.40	6.06	5.73	5.36	4.89	4.62

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
12885	OX830	6.57	6.35	6.01	5.69	5.31	4.80	4.48
12429	OX820	6.57	6.35	6.01	5.68	5.30	4.77	4.39
12026	OX810	6.55	6.34	5.99	5.66	5.27	4.73	4.35
Oxley Creek								
11670	OX780	6.44	6.21	5.81	5.49	5.15	4.63	4.24
Ipswich Road Bridge								
11616	OX760	6.37	6.12	5.70	5.40	5.09	4.60	4.20
10720	OX740	6.32	6.08	5.65	5.34	5.04	4.54	4.11
9737	OX730	6.30	6.06	5.63	5.32	5.02	4.52	4.09
9626	OX720	6.29	6.05	5.62	5.32	5.01	4.51	4.09
9355	OX710	6.28	6.04	5.61	5.30	5.00	4.51	4.08
9078	OX700	6.28	6.04	5.61	5.30	5.00	4.50	4.08
8942	OX690	6.28	6.03	5.61	5.30	5.00	4.50	4.08
8295	OX680	6.26	6.02	5.59	5.29	4.99	4.49	4.07
8058	OX670	6.24	6.00	5.57	5.27	4.97	4.48	4.06
7730	OX660	6.21	5.97	5.55	5.24	4.95	4.45	4.03
7500	OX650	6.12	5.88	5.46	5.15	4.86	4.38	3.97
7355	OX640	6.00	5.76	5.34	5.03	4.75	4.28	3.89
7174	OX630	5.74	5.50	5.08	4.78	4.52	4.09	3.75
6998	OX620	5.62	5.37	4.95	4.67	4.42	4.00	3.67
6779	OX610	5.50	5.24	4.79	4.48	4.21	3.78	3.43
6230	OX600	5.46	5.20	4.72	4.39	4.11	3.65	3.28
5990	OX590	5.46	5.19	4.71	4.38	4.09	3.63	3.25
5650	OX580	5.45	5.19	4.71	4.37	4.08	3.59	3.20
5268	OX570	5.45	5.19	4.70	4.36	4.05	3.53	3.10
5191	OX550	5.45	5.18	4.70	4.36	4.04	3.50	3.06
5067	OX540	5.45	5.18	4.70	4.35	4.02	3.43	2.98
4928	OX530	5.45	5.18	4.69	4.33	3.99	3.34	2.88
4641	OX510	5.44	5.17	4.66	4.27	3.89	3.20	2.74
4534	OX500	5.44	5.17	4.65	4.26	3.88	3.20	2.73

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
4283	OX490	5.43	5.15	4.61	4.21	3.83	3.11	2.64
3578	OX480	5.38	5.10	4.56	4.13	3.69	2.88	2.39
3289	OX470	5.31	5.01	4.42	3.96	3.52	2.75	2.28
2946	OX460	4.99	4.66	4.08	3.65	3.24	2.56	2.13
2728	OX450	4.78	4.44	3.86	3.42	3.03	2.41	1.99
Oxley Creek								
2463	OX440	4.70	4.35	3.76	3.32	2.93	2.32	1.92
2388	OX430	4.68	4.33	3.74	3.30	2.90	2.30	1.90
2087	OX420	4.61	4.25	3.66	3.22	2.82	2.23	1.84
2057	OX420	4.58	4.22	3.63	3.19	2.80	2.21	1.82
Sherwood Road Bridge and Culverts								
2045	OX380	4.57	4.21	3.62	3.18	2.79	2.20	1.81
2015	OX370	4.56	4.20	3.61	3.17	2.78	2.19	1.80
1949	OX360	4.55	4.19	3.60	3.16	2.77	2.18	1.79
1865	OX350	4.53	4.18	3.59	3.14	2.75	2.16	1.78
1746	OX340	4.48	4.13	3.54	3.10	2.71	2.13	1.75
1626	OX330	4.42	4.07	3.49	3.05	2.67	2.09	1.73
Railway Bridge								
1618	OX310	4.32	3.98	3.40	2.98	2.60	2.04	1.69
1531	OX290	4.28	3.94	3.37	2.95	2.58	2.03	1.68
1479	OX290	4.20	3.86	3.30	2.89	2.52	1.99	1.65
Watermain Bridge								
1476	OX280	4.19	3.86	3.30	2.88	2.52	1.99	1.65
1388	OX260	4.12	3.79	3.24	2.83	2.47	1.95	1.63
1329	OX250	4.05	3.72	3.18	2.78	2.43	1.92	1.61
1245	OX240	3.97	3.65	3.11	2.72	2.38	1.89	1.59
1179	OX230	3.90	3.58	3.05	2.66	2.33	1.85	1.57
1102	OX210	3.80	3.49	2.97	2.59	2.27	1.81	1.55
1027	OX200	3.70	3.39	2.89	2.53	2.21	1.78	1.52
972	OX190	3.63	3.32	2.83	2.47	2.17	1.75	1.51

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
896	OX180	3.51	3.22	2.74	2.40	2.11	1.71	1.49
835	OX170	3.42	3.13	2.67	2.34	2.06	1.68	1.47
777	OX160	3.34	3.06	2.61	2.29	2.02	1.66	1.46
698	OX150	3.21	2.93	2.51	2.20	1.95	1.62	1.43
631	OX140	3.08	2.82	2.41	2.12	1.89	1.58	1.41
554	OX130	2.93	2.68	2.29	2.02	1.81	1.53	1.38
481	OX120	2.79	2.54	2.17	1.93	1.73	1.49	1.36
Oxley Creek								
406	OX110	2.63	2.40	2.05	1.83	1.66	1.45	1.34
290	OX90	2.36	2.16	1.87	1.69	1.55	1.39	1.31
156	OX60	1.93	1.77	1.58	1.47	1.39	1.31	1.27
Pamphlett Bridge								
143	OX40	1.86	1.71	1.53	1.44	1.37	1.29	1.26
117	OX30	1.77	1.63	1.48	1.40	1.34	1.27	1.25
18	OX10	1.30	1.24	1.22	1.22	1.22	1.22	1.22
Blunder Creek								
13615	BL830	30.27	30.13	29.91	29.75	29.57	29.23	28.92
13485	BL820	29.78	29.64	29.41	29.24	29.08	28.77	28.43
13382	BL810	29.18	29.04	28.78	28.57	28.36	27.96	27.62
13283	BL800	28.51	28.33	28.03	27.81	27.58	27.16	26.80
13092	BL790	27.87	27.72	27.49	27.34	27.17	26.80	26.46
Logan Motorway Culverts								
13078	BL770	27.86	27.71	27.48	27.32	27.15	26.79	26.45
12910	BL760	27.64	27.49	27.25	27.10	26.93	26.57	26.28
12719	BL750	27.32	27.14	26.85	26.66	26.45	25.99	25.55
12555	BL740	26.95	26.77	26.47	26.26	26.06	25.66	25.23
12421	BL730	26.73	26.55	26.24	26.02	25.79	25.36	24.93
12276	BL710	26.22	26.06	25.79	25.58	25.36	24.91	24.50
12098	BL700	25.52	25.36	25.09	24.91	24.73	24.40	24.06
12000	BL690	25.33	25.17	24.91	24.72	24.54	24.22	23.89

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
Forest Lake Boulevarde Bridge								
11903	BL680	25.16	25.00	24.74	24.56	24.38	24.05	23.72
11717	BL670	24.78	24.61	24.33	24.12	23.91	23.55	23.23
11631	BL660	24.51	24.34	24.07	23.85	23.64	23.24	22.91
11484	BL640	24.03	23.88	23.63	23.44	23.24	22.81	22.45
11368	BL630	23.83	23.68	23.43	23.24	23.05	22.60	22.20
11273	BL620	23.47	23.32	23.09	22.90	22.72	22.33	21.96
11109	BL610	23.15	23.02	22.80	22.62	22.45	22.10	21.71
1906	BL600	22.80	22.64	22.36	22.08	21.79	21.34	20.94
Blunder Creek								
10781	BL590	22.32	22.13	21.83	21.53	21.24	20.79	20.43
10720	BL580	22.02	21.80	21.52	21.23	20.94	20.51	20.16
10606	BL570	21.40	21.21	20.94	20.66	20.37	19.94	19.59
10425	BL560	20.67	20.46	20.17	19.89	19.62	19.21	18.87
10329	BL550	20.37	20.17	19.88	19.62	19.35	18.96	18.64
10203	BL540	19.97	19.77	19.49	19.24	18.99	18.62	18.31
10038	BL530	19.18	19.00	18.75	18.53	18.32	18.00	17.75
9978	BL520	18.62	18.44	18.23	18.04	17.85	17.56	17.31
9909	BL510	18.17	18.02	17.83	17.64	17.51	17.38	17.17
Blunder Road Bridge								
9898	BL500	18.13	17.98	17.79	17.61	17.49	17.43	17.23
9852	BL480	18.06	17.93	17.74	17.55	17.40	17.18	17.19
9694	BL470	16.20	16.09	15.92	15.79	15.67	15.48	15.34
9531	BL460	15.97	15.89	15.75	15.65	15.54	15.37	15.26
9282	BL450	15.89	15.82	15.69	15.59	15.50	15.34	15.24
9180	BL440	15.89	15.82	15.69	15.59	15.50	15.34	15.24
9029	BL430	15.89	15.82	15.69	15.59	15.50	15.34	15.24
8706	BL420	15.71	15.65	15.52	15.43	15.35	15.22	15.14
8560	BL410	15.50	15.42	15.29	15.21	15.12	14.98	14.87
8417	BL400	15.42	15.33	15.18	15.07	14.96	14.78	14.67

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
8212	BL390	15.28	15.17	14.98	14.83	14.66	14.40	14.20
8052	BL380	15.20	15.10	14.92	14.77	14.61	14.34	14.14
8009	BL370	15.20	15.10	14.92	14.76	14.60	14.34	14.13
7904	BL360	15.07	14.97	14.80	14.65	14.50	14.24	14.04
7733	BL350	14.65	14.55	14.38	14.28	14.17	13.99	13.81
7552	BL340	14.52	14.42	14.26	14.16	14.06	13.89	13.73
7318	BL330	14.30	14.19	14.05	13.96	13.87	13.67	13.53
7116	BL320	14.01	13.90	13.74	13.65	13.55	13.38	13.25
6993	BL310	13.84	13.72	13.56	13.46	13.36	13.19	13.04
6844	BL300	13.71	13.57	13.37	13.25	13.14	12.99	12.84
6649	BL290	13.62	13.45	13.19	12.99	12.80	12.55	12.36
Blunder Creek								
6475	BL280	13.58	13.41	13.14	12.93	12.72	12.40	12.14
6306	BL260	13.44	13.27	13.00	12.80	12.59	12.28	12.01
6175	BL250	12.85	12.72	12.51	12.36	12.20	11.96	11.74
5841	BL240	11.69	11.58	11.42	11.30	11.18	11.01	10.85
5541	BL230	11.29	11.19	11.03	10.91	10.79	10.63	10.49
5438	BL220	11.08	10.97	10.81	10.69	10.54	10.38	10.25
5288	BL210	10.99	10.87	10.69	10.55	10.41	10.22	10.09
5098	BL200	10.71	10.61	10.45	10.32	10.19	9.98	9.80
4929	BL190	10.23	10.14	10.01	9.92	9.81	9.63	9.48
4617	BL180	9.53	9.44	9.30	9.18	9.07	8.94	8.85
4468	BL170	9.39	9.30	9.14	8.99	8.81	8.56	8.38
4370	BL160	9.36	9.26	9.09	8.94	8.74	8.46	8.24
4217	BL150	9.01	8.95	8.81	8.66	8.51	8.29	8.10
King Avenue Bridge								
4206	BL140	8.92	8.84	8.74	8.62	8.48	8.28	8.10
3944	BL120	8.15	8.05	7.90	7.79	7.68	7.53	7.42
3560	BL110	7.44	7.36	7.24	7.15	7.05	6.91	6.76
3134	BL100	6.96	6.83	6.73	6.66	6.60	6.48	6.35

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
2670	BL80	6.81	6.60	6.27	6.00	5.89	5.80	5.71
Bowhill Road Culverts								
2654	BL60	6.80	6.60	6.26	5.99	5.87	5.78	5.70
2423	BL50	6.78	6.57	6.22	5.90	5.58	5.22	5.10
1666	BL40	6.77	6.56	6.21	5.89	5.55	5.15	5.00
1415	BL30	6.75	6.54	6.20	5.88	5.52	5.05	4.78
1185	BL20	6.74	6.53	6.20	5.88	5.52	5.03	4.75
1144	BL10	6.74	6.53	6.20	5.88	5.52	5.03	4.75
657	OX850	6.71	6.50	6.17	5.85	5.50	5.01	4.73
202	OX840	6.61	6.39	6.06	5.74	5.38	4.90	4.64
Oxtrib1								
2625	OX2220	13.44	13.33	13.20	13.10	13.01	12.85	12.74
2494	OX2210	13.39	13.29	13.16	13.06	12.97	12.83	12.73
Oxtrib1								
2373	OX2200	11.13	11.13	11.08	11.04	10.99	10.88	10.80
2277	OX2180	10.28	10.23	10.18	10.13	10.03	9.92	9.72
2236	OX2180	9.78	9.74	9.66	9.58	9.47	8.89	8.60
Rudd Street Culverts								
2216	OX2170	9.09	9.03	8.93	8.86	8.76	8.48	8.38
1906	OX2160	7.33	7.27	7.19	7.10	7.02	6.87	6.74
1614	OX2150	6.56	6.42	6.38	6.32	6.27	6.18	6.06
1362	OX2140	6.56	6.32	6.00	5.68	5.29	4.75	4.45
1221	OX2130	6.58	6.34	6.02	5.70	5.30	4.75	4.31
Blunder Road Culverts								
1196	OX2110	6.60	6.36	6.03	5.69	5.30	4.75	4.31
1080	OX2100	6.69	6.42	6.07	5.73	5.33	4.76	4.31
966	OX2090	6.65	6.37	6.02	5.70	5.30	4.76	4.31
852	OX2080	6.63	6.35	6.01	5.69	5.30	4.75	4.31
Loop Road Culverts								
774	OX2060	6.59	6.36	6.01	5.70	5.31	4.77	4.32

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
684	OX2050	6.55	6.32	5.98	5.67	5.28	4.74	4.29
560	OX2050	6.52	6.30	5.97	5.66	5.28	4.74	4.29
Ipswich Road Culverts								
513	OX760	6.45	6.20	5.74	5.38	5.08	4.60	4.19
495	OX2009	6.45	6.20	5.74	5.38	5.08	4.59	4.19
Service Road Culverts								
481	OX2006	6.43	6.19	5.73	5.38	5.07	4.59	4.18
442	OX2000	6.42	6.17	5.72	5.37	5.07	4.58	4.17
Btrib1								
3768		32.05	32.04	32.04	31.63	31.57	31.52	31.52
3741		30.63	30.62	30.62	30.17	30.12	30.03	29.96
3711		31.35	31.35	31.35	30.09	29.60	29.16	28.85
Clipper Street Culverts								
3678		29.55	29.54	29.55	28.70	28.60	28.44	28.31
3659		29.39	29.39	29.39	28.53	28.43	28.28	28.19
Btrib1								
3612		28.68	28.68	28.68	27.87	27.79	27.64	27.52
3555		27.21	27.21	27.20	26.87	26.81	26.69	26.59
3462		26.50	26.50	26.51	26.14	26.06	25.91	25.80
3375		26.06	26.06	26.06	25.80	25.75	25.63	25.54
3303		24.83	24.82	24.84	24.54	24.47	24.33	24.21
3248		24.53	24.53	24.53	24.29	24.22	24.10	24.00
3187		24.06	24.06	24.06	23.78	23.69	23.53	23.44
3115		23.89	23.88	23.86	23.66	23.58	23.43	23.29
Inala Avenue Culverts								
3056		22.59	22.57	22.55	22.32	22.23	22.14	22.10
2946		21.09	21.09	21.07	20.90	20.84	20.76	20.72
2836		19.81	19.78	19.74	19.49	19.38	19.18	19.01
2718		19.05	19.03	18.99	18.81	18.73	18.60	18.50
2592		17.18	17.15	17.10	16.90	16.81	16.65	16.52

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
2526	BL1160	16.56	16.44	16.25	15.99	15.78	15.49	15.22
2412	BL1150	16.16	16.05	15.89	15.66	15.41	15.04	14.78
2258	BL1140	15.86	15.77	15.64	15.43	15.14	14.45	14.09
2152	BL1120	15.73	15.66	15.53	15.34	15.04	14.20	13.82
Rosemary Street Culverts								
2121	BL1110	13.81	13.69	13.51	13.29	13.12	12.97	12.80
2050	BL1100	13.69	13.56	13.38	13.16	12.98	12.84	12.67
1880	BL1090	13.64	13.50	13.28	13.04	12.85	12.70	12.53
1804	BL1087	11.74	11.62	11.44	11.23	11.06	10.92	10.75
1629	BL1080	11.06	10.98	10.85	10.69	10.58	10.47	10.35
1408	BL1070	10.34	10.23	10.05	9.87	9.73	9.58	9.42
1283	BL1060	10.12	10.01	9.83	9.62	9.47	9.30	9.11
1083	BL1050	9.80	9.74	9.64	9.49	9.38	9.25	9.05
1046	BL1040	9.79	9.78	9.65	9.52	9.42	9.29	9.09
Blunder Road Culverts								
1037	BL1020	10.08	10.05	9.98	9.91	9.85	9.79	9.74
932	BL1010	8.95	8.87	8.75	8.63	8.55	8.46	8.34
Btrib1								
681	BL1010	7.90	7.82	7.69	7.56	7.48	7.37	7.25
Bowhill Road Culverts								
Btrib2								
3002	BL2260	31.21	31.16	31.09	31.02	30.96	30.86	30.79
2835	BL2252	29.90	29.74	29.57	29.44	29.31	29.10	28.95
Wallaroo Way Culverts								
2816	BL2249	29.06	29.01	28.92	28.85	28.77	28.64	28.55
2765	BL2240	28.60	28.57	28.52	28.49	28.43	28.34	28.30
2481	BL2230	25.40	25.35	25.30	25.29	25.26	25.22	25.13
2142	BL2220	23.72	23.65	23.52	23.38	23.22	22.86	22.60
2025	BL2210	23.59	23.52	23.41	23.29	23.13	22.75	22.45
1994	BL2207	23.55	23.49	23.38	23.27	23.11	22.73	22.42

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
1980	BL2204	21.55	21.49	21.39	21.29	21.20	21.10	21.00
Lorikeet Street Culverts								
1879	BL2200	20.72	20.66	20.55	20.46	20.36	20.26	20.26
1761	BL2190	20.17	20.09	19.95	19.82	19.65	19.27	18.97
1626	BL2182	20.10	20.02	19.90	19.77	19.60	19.20	18.86
Pigeon Street Culverts								
1611	BL2179	18.43	18.37	18.27	18.17	18.06	17.93	17.85
1408	BL2170	10.34	10.23	10.05	9.87	9.73	9.58	9.42
1323	BL2160	17.67	17.62	17.52	17.41	17.20	16.70	16.50
Rosella Street Culverts								
1300	BL2140	16.39	16.34	16.26	16.19	16.23	16.14	16.07
1218	BL2130	15.74	15.53	15.30	15.08	14.70	14.59	14.51
1138	BL2120	15.62	15.38	15.13	14.90	14.68	14.51	14.38
Blunder Road Culverts								
1127	BL2100	14.39	14.31	14.15	14.00	13.86	13.74	13.66
1053	BL2090	14.26	14.11	13.89	13.68	13.48	13.30	13.17
1005	BL2080	14.01	13.82	13.58	13.35	13.13	12.96	12.83
Inala Avenue Culverts								
945	BL2060	13.35	13.26	13.10	12.93	12.76	12.59	12.45
Btrib2								
845	BL2050	12.58	12.50	12.38	12.27	12.15	12.04	11.95
674	BL2040	11.63	11.58	11.49	11.40	11.32	11.25	11.20
507	BL2030	11.43	11.36	11.21	11.08	10.95	10.84	10.74
492	BL2010	10.08	10.05	9.98	9.91	9.85	9.79	9.74
King Avenue Culverts								
364	BL2000	9.21	9.15	9.07	8.99	8.92	8.86	8.80
Btrib3								
1007		30.38	30.34	30.28	30.23	30.18	30.10	30.04
863		27.35	27.29	27.19	27.11	27.02	26.87	26.74
788		26.08	25.99	25.87	25.75	25.57	25.29	25.18

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) - Scenario 3						
		100 year ARI	50 year ARI	20 year ARI	10 year ARI	5 year ARI	2 year ARI	1 year ARI
692		24.64	24.55	24.42	24.24	24.03	23.78	23.60
641		24.37	24.31	24.20	24.00	23.72	23.30	23.04
Eucalypt Street Culverts								
523		21.51	21.43	21.32	21.20	21.09	20.95	20.81
429		20.75	20.68	20.59	20.50	20.42	20.33	20.24
318		20.05	20.02	19.97	19.88	19.77	19.60	19.45
192		19.91	19.89	19.86	19.79	19.68	19.52	19.37
76		17.18	17.15	17.10	16.90	16.81	16.65	16.52
Btrib4								
961		23.22	23.19	23.13	23.10	23.08	23.04	23.00
868		22.10	22.10	22.09	22.07	22.03	21.97	21.93
780		20.10	20.07	20.03	20.00	19.96	19.90	19.88
683		19.56	19.53	19.48	19.44	19.40	19.33	19.26
Inala Avenue Culverts								
586		17.96	17.94	17.91	17.89	17.87	17.83	17.79
498		16.06	16.03	16.00	15.97	15.95	15.90	15.86
431		14.94	14.92	14.89	14.87	14.84	14.80	14.77
317		14.33	14.26	14.14	14.04	13.95	13.86	13.79
181		11.74	11.62	11.44	11.23	11.06	10.92	10.75

Appendix H

Hydraulic Structure Reference Sheets

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Pamphlet Bridge King Arthur Terrace	UBD REF: Map 179 B15
AERIAL PHOTO No:	STRUCTURE ID: 64
BCC XS No: OXLEY_MO1 49140	AMTD(m):
STRUCTURE DESCRIPTION: 4 Span Bridge	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 4 span bridge @ 16.77m, 21.34m, 16.76m and 12.19m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: -3.32mAHD

UPSTREAM OBVERT LEVEL: 7.10mAHD

DOWNSTREAM INVERT LEVEL: -3.32mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 7.10mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, envelope of OX30, OX40, OX50, OX60, OX80, OX90.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of bridge, refer to Brisbane City Council drawings - W1683

WEIR WIDTH (m): 12 LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 8.1

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:
Steel handrails

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1964 PLAN NUMBER: W1683

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	836	1.9	80	-	165.8	-	5.0
50	-	728	1.74	70	-	158.0	-	4.6
20	-	575	1.57	50	-	150.3	-	3.9
10	-	466	1.47	50	-	145.3	-	3.2
5	-	379	1.4	40	-	141.8	-	2.7
2	-	253	1.31	30	-	137.7	-	1.8
1	-	173	1.27	20	-	136.2	-	1.3

Oxley Creek – upstream side of the bridge

Oxley Creek – downstream side of the bridge

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Water main d/s of railway bridges	UBD REF: Map 179 A18
AERIAL PHOTO No:	STRUCTURE ID: 65
BCC XS No: OXLEY_MO1 47810	AMTD(m):
STRUCTURE DESCRIPTION: Pipe Crossing	ROAD CLASSIFICATION: N/A (Major or minor road)

STRUCTURE SIZE: 1 Span @ 75m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: -2.96mAHD

DOWNSTREAM INVERT LEVEL: -2.96mAHD
For culverts give floor level.

UPSTREAM OBVERT LEVEL: 5.50mAHD

DOWNSTREAM OBVERT LEVEL: 5.50mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes OX280 FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher

For bridge details, refer to Brisbane City Council, Department of Water Supply & Sewerage drawing - 2/22-44.

WEIR WIDTH (m): 3m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 6.15mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1971 PLAN NUMBER: 2 / 22-44

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	834	4.11	31	-	252.7	-	3.3
50	-	726	3.77	28	-	242.1	-	3.0
20	-	574	3.29	25	-	212.7	-	2.7
10	-	466	2.88	22	-	194.0	-	2.4
5	-	379	2.53	20	-	172.2	-	2.2
2	-	253	2.00	16	-	148.7	-	1.7
1	-	173	1.66	13	-	133.2	-	1.3

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Railway Bridge	UBD REF: Map 179 A18
AERIAL PHOTO No:	STRUCTURE ID: 63
BCC XS No: OXLEY_MO1 47665	AMTD(m):
STRUCTURE DESCRIPTION: Railway Bridges (bridges modelled as one structure)	ROAD CLASSIFICATION: N/A (Major or minor road)

STRUCTURE SIZE: 5 Spans @ 8.2m, 18.6m, 18.6m, 18.6m, 6.4m & 3 Spans @ 25m each
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: -2.32mAHD

UPSTREAM OBVERT LEVEL: 5.80mAHD

DOWNSTREAM INVERT LEVEL: -2.32mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 5.80mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, envelope of OX330, OX320, OX311, OX310, OX301, OX300. FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of bridges refer to Brisbane City Council drawings – I-14-467B, I-17-467, I-17-467A

WEIR WIDTH (m): 14m
(In direction of flow, ie. distance from u/s face to d/s face)

LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -

Deck level = 8.0

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1986

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	834	4.27	70	-	238.3	-	3.5
50	-	726	3.93	66	-	227.0	-	3.2
20	-	574	3.43	63	-	205.1	-	2.8
10	-	466	3.00	56	-	186.3	-	2.5
5	-	379	2.64	50	-	172.2	-	2.2
2	-	253	2.08	39	-	140.5	-	1.8
1	-	173	1.72	32	-	133.2	-	1.3

Oxley Creek – Downstream Looking Upstream at Railway Crossing

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Sherwood Road	UBD REF: Map 179 A20
AERIAL PHOTO No:	STRUCTURE ID: 61
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Bridge	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 3 Spans, 18.28m all spans
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: -3.260mAHD

UPSTREAM OBVERT LEVEL: 5.20mAHD

DOWNSTREAM INVERT LEVEL: -3.260mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 5.20mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? YES. envelope of, OX390, OX400, OX420 FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

Two full width piers with rounded nose and tail. For section under the bridge and full detail, refer to Brisbane City Council drawing W4386

WEIR WIDTH (m):12m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 5.66mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1971 PLAN NUMBER: W4386

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	402	4.50	62	-	134.7	-	3.0
50	-	379	4.14	57	-	133.6	-	2.8
20	-	322	3.62	50	-	133.8	-	2.4
10	-	279	3.18	43	-	132.9	-	2.1
5	-	238	2.81	38	-	132.8	-	1.8
2	-	175	2.21	29	-	134.6	-	1.3
1	-	136	1.83	25	-	113.3	-	1.2

Oxley Creek – downstream side of the bridge

Oxley Creek – upstream side of the bridge

Oxley Creek – Downstream Looking Upstream at Sherwood Road

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Sherwood Road (Overflow)	UBD REF: Map 179 B20
AERIAL PHOTO No:	STRUCTURE ID: 62
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 15No./ 3600 x 2700 RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 1.720mAHD

UPSTREAM OBVERT LEVEL: 4.420mAHD

DOWNSTREAM INVERT LEVEL: 1.647mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 4.347mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 12m

LENGTH OF CULVERT BARREL AT OBVERT (m): 12m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? OX400, OX390, OX420 FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

Flared wingwalls @ 45 degrees to direction of flow. Box culverts slightly projected from vertical skewed headwall. No apparent rounding or bevels.

For full details, refer to Brisbane City Council drawings - W6677 / 1A

WEIR WIDTH (m): LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 4.80mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1985 PLAN NUMBER: W6677

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	96	323	5.07	380	70.7	150.5	1.4	2.1
50	24	313	4.76	353	20.8	155.5	1.3	2.0
20	-	239	4.28	203	-	142.4	-	1.7
10	-	176	3.94	163	-	126.1	-	1.4
5	-	133	3.66	141	-	111.5	-	1.2
2	-	74	3.18	94	-	82.4	-	0.9
1	-	36	2.75	58	-	60.0	-	0.6

Oxley Creek – upstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Ipswich Motorway	UBD REF: Map 198 R13
AERIAL PHOTO No:	STRUCTURE ID: 54
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Bridge	ROAD CLASSIFICATION: Major (Major or minor road)

STRUCTURE SIZE:: 3 Spans @ 12.91m, 13.01m, 12.81m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: -1.50mAHD

UPSTREAM OBVERT LEVEL: 5.20mAHD

DOWNSTREAM INVERT LEVEL: -1.50 mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 5.20mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of bridge refer to Kinhill Cameron McNamara Job # BC1104, drawings – 85155, 85175.

WEIR WIDTH (m): 52m
(In direction of flow, ie. distance from u/s face to d/s face)

LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -

Deck level = 5.75mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	278[a]	248	6.34	105	213.8[a]	162.1	1.3[a]	1.4
50	192[a]	246	6.13	125	160.0[a]	172.3	1.2[a]	1.3
20	40[a]	235	5.77	163	87.5[a]	160.0	0.8[a]	1.3
10	-	200	5.41	100	-	161.8	-	1.1
5	-	158	5.11	78	-	151.0	-	1.0
2	-	136	4.60	60	-	148.9	-	0.9
1	-	123	4.21	67	-	150.0	-	0.8

[a] Total weir flow over Ipswich Motorway Bridge and Overflow

Oxley Creek – Downstream Looking Upstream at Ipswich Road


Oxley Creek – Under Ipswich Road Looking Downstream

Oxley Creek – Downstream Looking Upstream at Ipswich Road

Oxley Creek – Downstream Looking Upstream at Ipswich Road

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Ipswich Motorway (Overflow)	UBD REF: Map 198 Q13
AERIAL PHOTO No:	STRUCTURE ID: 90
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Bridge	ROAD CLASSIFICATION: Major (Major or minor road)

STRUCTURE SIZE:: 3 Spans @ 13.85m, 14.00m, 13.85m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 1.1mAHD

UPSTREAM OBVERT LEVEL: 4.8mAHD

DOWNSTREAM INVERT LEVEL: 1.1 mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 4.8mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m): N/a
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of bridge refer to Kinhill Cameron McNamara Job # BC1104, drawings – 85192, 85210.

WEIR WIDTH (m): 52m
(In direction of flow, ie. distance from u/s face to d/s face)

LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -

Deck level = 5.78mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	278[a]	228	6.33	74	213.8[a]	261.1	1.3[a]	1.9
50	192[a]	228	6.12	93	160.0[a]	258.1	1.2[a]	1.9
20	40[a]	222	5.77	154	87.5[a]	242.2	0.8[a]	1.8
10	-	196	5.40	84	-	197.5	-	1.5
5	-	161	5.10	57	-	159.8	-	1.2
2	-	90	4.56	24	-	88.3	-	0.7
1	-	38	4.11	8	-	37.7	-	0.3

[a] Total weir flow over Ipswich Motorway Bridge and Overflow

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Beatty Road	UBD REF: Map 219 H3
AERIAL PHOTO No:	STRUCTURE ID: 53
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: 3 Span Bridge	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 3 spans @ 12.19m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 0.870mAHD

UPSTREAM OBVERT LEVEL: 7.00mAHD

DOWNSTREAM INVERT LEVEL: 0.870mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 6.80mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? YES. OX969 FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of bridge, refer to Brisbane City Council drawings - W3502

WEIR WIDTH (m): 14m LOWEST POINT OF WEIR (m AHD): 7.45 PIER WIDTH: -

(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 8.75mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE:1968 PLAN NUMBER: W3502

HAS THE STRUCTURE BEEN UPGRADED? Original structure's date of construction was 1929, and current structure was constructed in 1968.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	356	416	9.10	380	165.0	154.1	2.2	2.7
50	255	416	8.83	400	117.9	153.8	2.2	2.7
20	132	414	8.48	450	62.5	153.3	2.1	2.7
10	50	400	8.08	430	27.5	153.3	1.8	2.6
5	-	349	7.58	330	-	153.1	-	2.3
2	-	252	6.64	40	-	142.4	-	1.77
1	-	178	6.07	30	-	121.9	-	1.46


Oxley Creek – downstream side of the bridge

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Learoyd Road-King Avenue	UBD REF: Map 219 K7
AERIAL PHOTO No:	STRUCTURE ID: 51
BCC XS No: OXLEY_MO1 21169	AMTD(m):
STRUCTURE DESCRIPTION: 3 Span Bridge	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 3 spans @ 25.518m, 25.225m, 23.250m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 3.540mAHD

UPSTREAM OBVERT LEVEL: 10.286mAHD

DOWNSTREAM INVERT LEVEL: 3.540 mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 10.675mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, envelope of OX1140, OX1132 FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of bridge, refer to the Brisbane City Council drawings - W6263

WEIR WIDTH (m): 12m
(In direction of flow, ie. distance from u/s face to d/s face)

LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -

Deck level = 11.20mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1984 PLAN NUMBER: W6263

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	733	10.17	37	-	330.3	-	2.2
50	-	645	9.93	39	-	330.2	-	1.9
20	-	541	9.60	31	-	319.1	-	1.7
10	-	454	9.31	31	-	271.6	-	1.7
5	-	369	8.99	24	-	219.5	-	1.7
2	-	253	8.46	18	-	150.2	-	1.7
1	-	180	8.05	14	-	108.0	-	1.7

Oxley Creek – downstream side of the bridge

Oxley Creek – upstream side of the bridge

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Logan Motorway	UBD REF: Map 239 C7
AERIAL PHOTO No:	STRUCTURE ID: 25
BCC XS No: OXLEY_MO1 21693	AMTD(m):
STRUCTURE DESCRIPTION: Bridge	ROAD CLASSIFICATION: Major (Major or minor road)

STRUCTURE SIZE: : 5 Spans @ 19.885m, 20m, 20m, 20m, 20m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 15.06mAHD

DOWNSTREAM INVERT LEVEL: 15.06mAHD
For culverts give floor level.

UPSTREAM OBVERT LEVEL: 25.87mAHD

DOWNSTREAM OBVERT LEVEL: 26.38mAHD

For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details refer to the Logan Motorway Company Limited, Logan Motorway, Job # GT007 drawings.

WEIR WIDTH (m): 9m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 26.3mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE:1990 PLAN NUMBER: 030-8000-

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.
A duplicated bridge was constructed in 1995. For details refer to Logan Motorway Company, Logan Motorway Duplication, Job # 062-01 C187 BC5110, drawings – 5B101, 5B102

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	688	22.31	74	-	459.3	-	1.5
50	-	611	22.08	65	-	436.8	-	1.4
20	-	514	21.79	54	-	394.8	-	1.3
10	-	429	21.50	45	-	357.2	-	1.2
5	-	352	21.19	35	-	319.7	-	1.1
2	-	245	20.67	22	-	272.1	-	0.9
1	-	179	20.27	16	-	223.4	-	0.8

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek	DATE OF SURVEY: 10 July 1996
LOCATION Johnson Road	UBD REF: Map 239 D13
AERIAL PHOTO No:	STRUCTURE ID: 24
BCC XS No: OXLEY_MO1 21693	AMTD(m):
STRUCTURE DESCRIPTION: Bridge	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: : 3 Spans @ 15.85m, 16m, 15.85m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 19.00mAHD

DOWNSTREAM INVERT LEVEL: 19.00mAHD
For culverts give floor level.

UPSTREAM OBVERT LEVEL: 24.25mAHD

DOWNSTREAM OBVERT LEVEL: 24.25mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details refer to the Main Roads Department, Goodna-Springwood Road, Job# 70-200-14 140-U92-10.

WEIR WIDTH (m): N/A LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level = 25.7mAHD
LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: N/A PLAN NUMBER: 167477-167481

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.
A duplicated bridge was constructed in 1995. For details refer to Logan Motorway Company, Logan Motorway Duplication, Job # 062-01 C187 BC5110, drawings – 5B101, 5B102

ADDITIONAL COMMENTS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	50	619	26.24	1242	35.1	147.3	1.4	4.2
50	13	580	25.81	1088	13.7	139.1	0.9	4.2
20	-	500	25.06	649	-	131.4	-	3.8
10	-	417	24.66	544	-	120.0	-	3.5
5	-	342	24.23	412	-	110.7	-	3.1
2	-	239	23.59	289	-	90.2	-	2.7
1	-	174	23.12	223	-	74.5	-	2.3

Oxley Creek – upstream side of the bridge (left hand side)

Oxley Creek – upstream side of the bridge (right hand side)

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek Tributary 1	DATE OF SURVEY: 10 July 1996
LOCATION Ipswich Road	UBD REF: Map 198 N13
AERIAL PHOTO No:	STRUCTURE ID: 91
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 8No/2100x2100RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 0.555mAHD

UPSTREAM OBVERT LEVEL: 2.655mAHD

DOWNSTREAM INVERT LEVEL: 0.506mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 2.606mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 14m

LENGTH OF CULVERT BARREL AT OBVERT (m): 14m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): 14m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level = 3.50mAHD
LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	235	53	6.60	159.1	77.0	25.9	3.1	2.1
50	208	53	6.17	8.3	73.8	23.2	2.8	2.3
20	149	52	5.64[a]	-27.8[b]	56.6	24.4	2.6	2.1
10	106	51	5.29[a]	-20.7[b]	53.5	21.9	2.0	2.3
5	60	48	5.04[a]	-4.1[b]	50.0	21.9	1.2	2.2
2	56	50	4.58	2.3	46.3	23.2	1.2	2.2
1	51	48	4.18	13.6	44.6	22.5	1.1	2.1

[a] Maximum inundation occurs as a result of Oxley Creek flooding. There the downstream water surface elevation has been taken as the maximum.
[b] Maximum inundation occurs as a result of Oxley Creek flooding. Therefore maximum afflux will occur as a result of backflow.


Oxley Creek Tributary – upstream side of the culvert


Oxley Creek Tributary – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek Tributary 1	DATE OF SURVEY: 10 July 1996
LOCATION Ipswich Motorway	UBD REF: Map 198 N14
AERIAL PHOTO No:	STRUCTURE ID: 55
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Major (Major or minor road)

STRUCTURE SIZE: 8No/2400x2150RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 0.810mAHD

UPSTREAM OBVERT LEVEL: 2.96mAHD

DOWNSTREAM INVERT LEVEL: 0.620mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 2.77mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 53m

LENGTH OF CULVERT BARREL AT OBVERT (m): 53m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): 53m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level = 5.60mAHD
LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	150	109	6.38	18	113.0	41.3	1.3	2.6
50	115	109	6.17	90	90.1	41.3	1.3	2.6
20	38	107	5.86	244	36.9	41.3	1.0	2.5
10	-	91	5.51	236	-	41.3	-	2.2
5	-	73	5.19	157	-	41.3	-	1.8
2	-	61	4.68	98	-	41.3	-	1.5
1	-	46	4.23	55	-	41.3	-	1.1

Oxley Creek Tributary – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek Tributary 1	DATE OF SURVEY: 10 July 1996
LOCATION Blunder Road Exit	UBD REF: Map 198 N15
AERIAL PHOTO No:	STRUCTURE ID: 56
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 4No/3550x1490RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 1.14mAHD

UPSTREAM OBVERT LEVEL: 2.59mAHD

DOWNSTREAM INVERT LEVEL: 1.05mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 2.54mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 41m

LENGTH OF CULVERT BARREL AT OBVERT (m): 41m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? maximum envelope of OX2070, OX2079. FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details refer to Main Roads Department - Brisbane City, Cunningham Arterial Job # 140-U16-AB55 drawings.

WEIR WIDTH (m): 41m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 3.60mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	38	67	6.41	7	47.1	31.7	0.7	2.1
50	23	63	6.21	21	36.6	33.5	0.6	1.9
20	13	58	5.87	3	21.6	33.5	0.6	1.7
10	9	54	5.52	3	18.0	36.5	0.5	1.5
5	5	51	5.21	1	10.0	41.4	0.5	1.2
2	3	40	4.68	0	5.0	50.7	0.4	0.8
1	1	30	4.25	0	2.5	44.9	0.4	0.7

Oxley Creek Tributary – downstream side of the culvert (photo taken on the left culvert)

Oxley Creek Tributary – upstream side of the culvert (photo taken on the left culvert)

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek Tributary 1	DATE OF SURVEY: 10 July 1996
LOCATION Blunder Road	UBD REF: Map 198 N16
AERIAL PHOTO No:	STRUCTURE ID: 57
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 6No/3050x1870RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 1.92

UPSTREAM OBVERT LEVEL: 3.79

DOWNSTREAM INVERT LEVEL: 1.75
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 3.62
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 23m

LENGTH OF CULVERT BARREL AT OBVERT (m): 23m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? envelope of OX2110, OX2128, OX2120. FB no.
If yes give details ie. Plan number and/or survey book number.\
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

Wingwalls at 45 degrees to direction of flow. Slightly projected box culverts with vertical skewed headwall.

For full details, refer to Brisbane City Council drawing - W5903

WEIR WIDTH (m): 23m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 4.13mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE:1977 PLAN NUMBER: W5903

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	28	70	6.44	-1[a]	35.2	60.7	0.8	1.2
50	22	68	6.22	-10[a]	31.0	65.5	0.7	1.0
20	14	62	5.89	0[a]	28.0	65.7	0.5	0.9
10	7	55	5.52	0[a]	22.1	70.0	0.3	0.8
5	3	52	5.21	-1[a]	13.0	70.1	0.2	0.7
2	1	40	4.69	0[a]	7.6	47.1	0.1	0.8
1	-	29	4.25	1[a]	-	33.2	-	0.9

[a] Maximum inundation at this location occurs during flooding on Oxley Creek, not during local catchment flood events. Afflux and water level presented relate to an Oxley Creek flood event while discharge relates to the local catchment flood event.

Oxley Creek Tributary – upstream side of the culvert

Oxley Creek Tributary – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Oxley Creek Tributary 1	DATE OF SURVEY: 10 July 1996
LOCATION Rudd Street	UBD REF: Map 198 K18
AERIAL PHOTO No:	STRUCTURE ID: 58
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Pipe culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 4No/1500RCP
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 6.930mAHD UPSTREAM OBVERT LEVEL: 8.43mAHD

DOWNSTREAM INVERT LEVEL: 6.860mAHD
For culverts give floor level.
DOWNSTREAM OBVERT LEVEL: 8.36mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 14m

LENGTH OF CULVERT BARREL AT OBVERT (m): 14m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, maximum envelope of OX2180 and OX2185.. FB no.
If yes give details ie. Plan number and/or survey book number.\
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of culverts, refer to Brisbane City Council drawings - W2757 / 2

WEIR WIDTH (m): 14m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 9.39mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER: W2757 / 2

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	22	21	8.92	420	16.9	9.3	1.3	2.2
50	17	20	8.78	325	14.2	10.5	1.2	2.0
20	12	21	8.70	276	10.9	11.5	1.1	1.8
10	8	21	8.58	199	8.0	12.2	1.0	1.7
5	7	20	8.47	135	8.0	12.0	0.9	1.7
2	-	16	8.42	111	-	9.6	-	1.7
1	-	12	8.41	105	-	7.6	-	1.6

Oxley Creek Tributary – upstream side of the culvert

Oxley Creek Tributary – stand on the culvert looking downstream

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek	DATE OF SURVEY: 10 July 1996
LOCATION Bowhill Road	UBD REF: Map 219 A3
AERIAL PHOTO No:	STRUCTURE ID: 45
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 5No/2350x1500RCBC
For Culverts: Number of cells/pipes & sizes   For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 3.50mAHD

DOWNSTREAM INVERT LEVEL: 3.40mAHD
For culverts give floor level.

UPSTREAM OBVERT LEVEL: 5.00mAHD

DOWNSTREAM OBVERT LEVEL: 4.90mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 11m

LENGTH OF CULVERT BARREL AT OBVERT (m): 11m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, envelope of BL70, BL61, BL80, BL60. FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For full details of culverts, refer to Brisbane City Council drawings - W6723

WEIR WIDTH (m): 11.0m
(In direction of flow, ie. distance from u/s face to d/s face)

LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -

Deck level = 5.30mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1987 PLAN NUMBER: W6723

HAS THE STRUCTURE BEEN UPGRADED? Original structure was constructed in 1954 and modified in 1987.
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	205[a]	25	6.80	12	256.7	3.8	0.8	6.8
50	177[a]	24	6.62	18	220.7	3.6	0.8	6.6
20	133[a]	22	6.35	34	190.0	3.5	0.7	6.3
10	108[a]	22	6.19	64	154.1	3.6	0.7	6.1
5	90[a]	22	6.13	79	128.9	3.6	0.7	6.1
2	63[a]	27	6.05	82	105.4	4.5	0.6	6.0
1	47[a]	22	5.98	82	94.2	3.8	0.5	5.9

[a] – Weir flow is assumed to be the entire flow that is crossing Bowhill Road

Blunder Creek – downstream side of the culvert

Blunder Creek – stand on the culvert looking downstream

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek	DATE OF SURVEY: 10 July 1996
LOCATION King Avenue	UBD REF: Map 219 C6
AERIAL PHOTO No:	STRUCTURE ID: 30
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete Bridge	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 2 spans @ 11.7m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 4.10mAHD

UPSTREAM OBVERT LEVEL: 8.222

DOWNSTREAM INVERT LEVEL: 4.10mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 8.232
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): 11m LOWEST POINT OF WEIR (m AHD): 8.70mAHD PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 9.10mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS: BL 150 –
BL 141 - Hand rails

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1967 PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

Specify survey book No. 6364/5 Folio 32

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	43	123	9.33	588	86.3	102.9	0.5	1.2
50	26	117	9.24	567	53.0	106.1	0.5	1.1
20	8	105	9.09	504	19.8	95.7	0.4	1.1
10	1	93	8.95	427	4.1	84.6	0.3	1.1
5	-	78	8.70	262	-	78.3	0.1	1.0
2	-	53	8.28	78	-	76.0	-	0.7
1	-	38	8.04	23	-	75.4	-	0.5

Blunder Creek – stand on the bridge looking upstream

Blunder Creek – downstream side of the bridge

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek	DATE OF SURVEY: N/A
LOCATION Blunder Road	UBD REF: Map 218 P18
AERIAL PHOTO No:	STRUCTURE ID: 29
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Bridge	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 2 spans @ 25m
For Culverts: Number of cells/pipes & sizes   For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 15.80mAHD

UPSTREAM OBVERT LEVEL: 20.726 - 20.855

DOWNSTREAM INVERT LEVEL: 15.80mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 20.726 - 20.855
For bridges give bed level.

IS THERE A SURVEYED WEIR PROFILE? Yes, envelope of BL510, BL501, BL500, BL490   FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): 8m   LOWEST POINT OF WEIR (m AHD):   PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 20.90mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 2010-2011   PLAN NUMBER: CD 061405

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.
Yes- for details of bridge, refer to Brisbane City Council drawings – W4355 (bridge construction in 1972), W6640 (bridge widening in 1984), and CD 061405 (new bridge construction 2010 to 2011)

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	150	18.06	20	-	38.0	-	3.9
50	-	132	17.93	18	-	34.0	-	3.9
20	-	108	17.73	-358	-	27.6	-	3.9
10	-	90	17.56	-506	-	22.8	-	4.0
5	-	75	17.41	-307	-	19.0	-	4.0
2	-	54	17.14	-531	-	11.8	-	4.6
1	-	48	16.92	-829	-	10.4	-	3.9

Blunder Creek – downstream side of the bridge

Blunder Creek – upstream side of the bridge

Blunder Creek – upstream side of the bridge (left hand side)

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek	DATE OF SURVEY: 10 July 1996
LOCATION Forest Lake Boulevard	UBD REF: Map 238 L2
AERIAL PHOTO No:	STRUCTURE ID: 28
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Bridge	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 3 spans @ 17m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL:

UPSTREAM OBVERT LEVEL: 26.07 – 26.58

DOWNSTREAM INVERT LEVEL:
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 26.20 – 26.71
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of bridge, refer to Brisbane City Council job# WP737

WEIR WIDTH (m): LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 26.70 – 27.30mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1997 PLAN NUMBER: G96137S

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.
The bridge was upgraded (widened) in 1972. It was then replaced by 2 span dual-carriageway bridge in 2009. For bridge details refer to Brisbane City Council, City Design project # CD 061405

ADDITIONAL COMMENTS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	78	25.13	25	-	34.1	-	2.3
50	-	70	24.97	23	-	30.5	-	2.3
20	-	57	24.72	18	-	25.9	-	2.2
10	-	48	24.54	16	-	22.8	-	2.1
5	-	41	24.37	13	-	19.6	-	2.1
2	-	31	24.03	11	-	15.4	-	2.0
1	-	23	23.71	10	-	11.7	-	2.0

Blunder Creek – upstream side of the bridge (right hand side)

Blunder Creek – upstream side of the bridge (left hand side)

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek	DATE OF SURVEY: 10 July 1996
LOCATION Logan Motorway	UBD REF: Map 238 K5
AERIAL PHOTO No:	STRUCTURE ID: 27
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Major (Major or minor road)

STRUCTURE SIZE: : 5/ 3600 x 3600 RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD

UPSTREAM INVERT LEVEL: 24.05mAHD

UPSTREAM OBVERT LEVEL: 27.65mAHD

DOWNSTREAM INVERT LEVEL: 23.90mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 27.50mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 34m

LENGTH OF CULVERT BARREL AT OBVERT (m): 34m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Logan Motorway Job # ST 007 Plan Nos 020-1109 & 020-1110
FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

Flared wingwalls, slightly projected box culverts with a vertical skewed headwall. No apparent rounding or bevels.

For full details refer to the Logan Motorway Company Limited, Job # GT007, plan # 020-3030

WEIR WIDTH (m): 34m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 33.65mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1988 PLAN NUMBER: From above - 020-3030

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	93	27.88	55	-	64.8	-	1.4
50	-	81	27.73	31	-	64.8	-	1.3
20	-	63	27.50	13	-	52.5	-	1.2
10	-	52	27.34	9	-	44.0	-	1.2
5	-	43	27.15	7	-	37.1	-	1.2
2	-	30	26.76	6	-	27.2	-	1.1
1	-	21	26.41	5	-	20.5	-	1.0

Blunder Creek – downstream side of the culvert

Blunder Creek – upstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek	DATE OF SURVEY: 10 July 1996
LOCATION Johnson Road	UBD REF: Map 238 H5
AERIAL PHOTO No:	STRUCTURE ID: 26
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: : 5/ 3600 x 2400 RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD

UPSTREAM INVERT LEVEL: 28.10mAHD

UPSTREAM OBVERT LEVEL:

DOWNSTREAM INVERT LEVEL: 28.00mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL:
For bridges give bed level.

For Culverts

LENGTH OF CULVERT BARREL AT INVERT (m): 15m

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level =

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS: No drawings available at the time of modelling. Assume 5% culvert barrel slope.

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	93	30.61	242	-	38.9	-	2.4
50	-	81	30.43	195	-	36.2	-	2.2
20	-	63	30.15	136	-	28.6	-	2.2
10	-	52	29.95	104	-	23.6	-	2.2
5	-	43	29.73	82	-	19.5	-	2.2
2	-	30	29.34	67	-	13.8	-	2.2
1	-	21	29.00	72	-	10.0	-	2.1

Blunder Creek – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 1	DATE OF SURVEY: 10 July 1996
LOCATION Bowhill Road	UBD REF: Map 218 R3
AERIAL PHOTO No:	STRUCTURE ID: 44
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Pipe culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 5No/1500RCP
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 3.42mAHD

UPSTREAM OBVERT LEVEL: 4.92mAHD

DOWNSTREAM INVERT LEVEL: 3.38mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 4.88mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 15m

LENGTH OF CULVERT BARREL AT OBVERT (m): 15m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, envelope of BL70, BL61, BL80, BL60. FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of culverts, refer to Brisbane City Council drawings - W6724.

WEIR WIDTH (m): 15m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 5.60mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER: W6724

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	205[a]	15	6.76	2	256.7	11.0	0.8	1.4
50	177[a]	16	6.60	3	220.7	9.1	0.8	1.8
20	133[a]	15	6.26	34	190	10.2	0.7	1.5
10	108[a]	15	6.21	116	154.1	10.9	0.7	1.4
5	90[a]	15	6.16	116	128.9	8.6	0.7	1.8
2	63[a]	15	6.06	116	105.4	11.0	0.6	1.4
1	47[a]	15	5.99	115	94.2	8.6	0.5	1.8

[a] – Weir flow is assumed to be the entire flow that is crossing Bowhill Road

Blunder Creek Tributary – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 1	DATE OF SURVEY: N/A
LOCATION Blunder Road	UBD REF: Map 218 P4
AERIAL PHOTO No:	STRUCTURE ID: 43
BCC XS No: BTRIB1 11483	AMTD(m):
STRUCTURE DESCRIPTION: Bridge, Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 2 spans @ 7.63m & 4No/3600x1800RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 6.05mAHD

UPSTREAM OBVERT LEVEL: 7.85mAHD

DOWNSTREAM INVERT LEVEL: 5.70mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 7.86mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): N/a

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING:
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): 12 LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level = 8.40 and 9.04mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS: BL1030
BL1035 - Hand rails

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1964 for original bridge- 2001 for culverts

HAS THE STRUCTURE BEEN UPGRADED? An adjacent carriageway constructed in 2001
If yes, explain type and date of upgrade. Include plan number and location if applicable.
For details of the structures refer to:
- W2828 – Bridge construction in 1964
- W9643 – Road upgrade (duplication) and culvert construction in 2001

ADDITIONAL COMMENTS: Refer to Blunder Rd Survey, FB 8296/4, File M333-C (June 1994) DTM Survey, Includes Bridge Site

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	101	55	9.90	274	101.5	18.3	1.0	3.0
50	81	55	9.83	337	90.4	19.0	0.9	2.9
20	55	55	9.68	314	78.6	19.2	0.7	2.9
10	35	55	9.53	323	76.8	19.6	0.5	2.8
5	35	55	9.43	320	76.3	20.0	0.5	2.7
2	38	55	9.28	296	75.1	19.6	0.5	2.8
1	29	55	9.06	228	71.8	21.7	0.4	2.5


Blunder Creek Tributary – stand on the bridge looking upstream


Blunder Creek Tributary – upstream side of the bridge

Blunder Creek Tributary – downstream side of the bridge and upstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 1	DATE OF SURVEY:
LOCATION Serviceton Road (Rosemary Street)	UBD REF: Map 218 L5
AERIAL PHOTO No:	STRUCTURE ID: 42
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete pipe culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 6No/1500RCP
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 11.900mAHD

UPSTREAM OBVERT LEVEL: 13.400mAHD

DOWNSTREAM INVERT LEVEL: 11.000mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 13.000mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 29m

LENGTH OF CULVERT BARREL AT OBVERT (m): 29m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details, refer to Brisbane City Council Drawings - W4746

WEIR WIDTH (m): 24m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level = 14.88mAHD
LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS: BL1120
BL1129

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

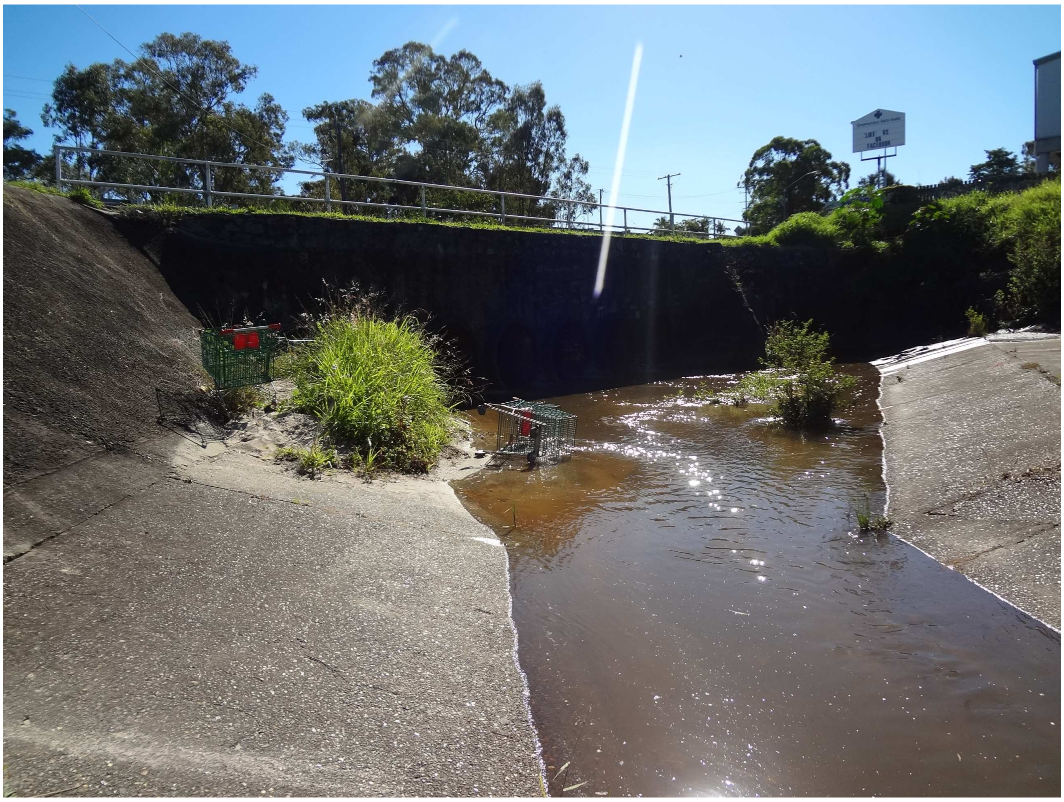
CONSTRUCTION DATE OF CURRENT STRUCTURE: 1974 PLAN NUMBER: W4746

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	55	56	15.72	1938	35.9	10.6	1.5	5.3
50	44	55	15.65	1978	29.8	10.6	1.5	5.2
20	25	54	15.50	2035	18.9	10.6	1.3	5.1
10	12	53	15.34	2037	10.2	10.6	1.1	5.0
5	2	51	15.09	1934	2.0	10.6	0.8	4.8
2	-	43	14.23	1218	-	10.6	-	4.0
1	-	32	13.84	994	-	10.6	-	3.1



Blunder Creek Tributary – downstream side of the culvert

Blunder Creek Tributary – upstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 3	DATE OF SURVEY:
LOCATION Eucalypt Street	UBD REF: Map 218 G6
AERIAL PHOTO No:	STRUCTURE ID: 41
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete pipe culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 3No/1500RCP
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 21.74mAHD

DOWNSTREAM INVERT LEVEL: 21.61mAHD
For culverts give floor level.

UPSTREAM OBVERT LEVEL:

DOWNSTREAM OBVERT LEVEL:
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 17.3m

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details, refer to

WEIR WIDTH (m): LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level
LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	7	21	23.37	360	6.9	5.3	1.0	4.0
50	5	21	23.28	360	5.1	5.3	0.9	3.9
20	2	20	23.19	350	2.5	5.3	0.7	3.7
10	<1	18	23.06	350	<1.0	5.3	0.1	3.5
5	-	16	22.84	340	-	4.7	-	3.3
2	-	12	22.49	300	-	4.9	-	2.4
1	-	9	22.28	290	-	4.1	-	2.2

Blunder Creek Tributary – upstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 4	DATE OF SURVEY:
LOCATION Inala Avenue	UBD REF: Map 218 M8
AERIAL PHOTO No:	STRUCTURE ID: 38
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete pipe culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 3No/1050RCP + 1No/1200RCP
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 18.5mAHD

UPSTREAM OBVERT LEVEL:

DOWNSTREAM INVERT LEVEL: 18.3mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL:
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 74.3m

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details, refer to

WEIR WIDTH (m): LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX*# (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	6	6	19.55	1591	5.8	3.1	1.1	1.8
50	5	5	19.52	1579	5.1	2.9	1.0	1.8
20	4	5	19.48	1564	4.2	3.1	1.0	1.6
10	3	5	19.44	1550	3.3	3.1	0.9	1.5
5	2	4	19.40	1536	2.6	2.9	0.8	1.5
2	1	4	19.32	1503	1.3	2.5	0.7	1.5
1	-	3	19.24	1449	-	2.7	-	1.3

Discrepancy between culvert outlet level and channel invert level leading to significant afflux.

Blunder Creek Tributary – downstream side of the culvert

Blunder Creek Tributary – upstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 1	DATE OF SURVEY:
LOCATION Inala Avenue	UBD REF: Map 218 J7
AERIAL PHOTO No:	STRUCTURE ID: 40
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete pipe culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 5No/1200RCP
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 21.5mAHD

DOWNSTREAM INVERT LEVEL: 21.45mAHD
For culverts give floor level.

UPSTREAM OBVERT LEVEL:

DOWNSTREAM OBVERT LEVEL:
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 37.1m

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details, refer to

WEIR WIDTH (m): LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level
LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	38	23	23.87	1203	24.0	5.6	1.6	4.1
50	37	20	23.86	1219	23.5	5.7	1.6	3.6
20	26	19	23.74	1211	17.8	5.7	1.5	3.4
10	20	19	23.66	1203	14.4	5.7	1.4	3.3
5	15	18	23.58	1194	11.6	5.7	1.3	3.2
2	8	16	23.42	1187	7.0	5.7	1.1	2.9
1	4	15	23.28	1157	3.8	5.7	0.9	2.6

Blunder Creek Tributary – downstream side of the culvert

Blunder Creek Tributary – upstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 1	DATE OF SURVEY:
LOCATION Clipper Street	UBD REF: Map 218 H9
AERIAL PHOTO No:	STRUCTURE ID: 39
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete pipe culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 5No/1200RCP
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 27.5mAHD

UPSTREAM OBVERT LEVEL:

DOWNSTREAM INVERT LEVEL: 27.4mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL:
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 18.3m

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details, refer to

WEIR WIDTH (m): LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	16	27	30.94	1595	9.1	5.3	1.8	5.0
50	13	26	30.94	1595	7.4	5.3	1.8	5.0
20	5	25	30.27	1435	4.6	5.7	1.1	4.5
10	1	24	30.09	1359	1.7	5.7	0.8	4.3
5	-	22	29.58	954	-	5.7	-	3.9
2	-	16	29.16	703	-	5.6	-	2.9
1	-	12	28.85	532	-	5.5	-	2.3

Blunder Creek Tributary – upstream side of the culvert

Blunder Creek Tributary – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 2	DATE OF SURVEY: 10 July 1996
LOCATION King Avenue	UBD REF: Map 218 R5
AERIAL PHOTO No:	STRUCTURE ID: 37
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete pipe culvert	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 1No/600RCP
For Culverts: Number of cells/pipes & sizes   For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 8.55
UPSTREAM OBVERT LEVEL: 9.15

DOWNSTREAM INVERT LEVEL: 8.43
For culverts give floor level.
DOWNSTREAM OBVERT LEVEL: 9.03
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 14m

LENGTH OF CULVERT BARREL AT OBVERT (m): 14m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, envelope of BL2020 and BL2030   FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): 14m   LOWEST POINT OF WEIR (m AHD):   PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 9.76mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	67	1	10.86	910	51.7	0.3	1.3	3.3
50	60	1	10.81	916	45.8	0.3	1.3	3.3
20	49	1	10.73	918	40.8	0.3	1.2	3.2
10	40	1	10.66	915	33.5	0.3	1.2	3.2
5	32	1	10.58	917	29.2	0.3	1.1	3.2
2	24	1	10.50	941	22.3	0.3	1.1	3.2
1	19	1	10.43	935	18.9	0.3	1.0	3.2

Blunder Creek Tributary – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 2	DATE OF SURVEY: 10 July 1996
LOCATION Inala Avenue	UBD REF: Map 218 Q7
AERIAL PHOTO No:	STRUCTURE ID: 36
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 5No/3000x1500RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 11.95

UPSTREAM OBVERT LEVEL:

DOWNSTREAM INVERT LEVEL: 11.55
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL:
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 50.4m

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, envelope of BL2075, BL2070. FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): 15m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 14.43mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 2005 PLAN NUMBER: W10684

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS: Refer to Brisbane City Council project# CD9800479 Blunder Road Durack Stage 3 Inala Avenue to Crossacres Street

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	63	13.95	493	-	13.5	-	4.6
50	-	57	13.77	399	-	16.4	-	3.5
20	-	47	13.56	328	-	14.5	-	3.3
10	-	39	13.37	300	-	12.8	-	3.1
5	-	31	13.17	270	-	11.0	-	2.8
2	-	24	12.97	283	-	9.2	-	2.6
1	-	19	12.83	281	-	7.9	-	2.4

Blunder Creek Tributary – upstream side of the culvert

Blunder Creek Tributary – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 2	DATE OF SURVEY: 10 July 1996
LOCATION Blunder Road	UBD REF: Map 218 Q8
AERIAL PHOTO No:	STRUCTURE ID: 35
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 5No/3000x1500RCBC

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD

UPSTREAM INVERT LEVEL: 13.50mAHD

UPSTREAM OBVERT LEVEL:

DOWNSTREAM INVERT LEVEL: 13.20mAHD

For culverts give floor level.

DOWNSTREAM OBVERT LEVEL:

For bridges give bed level.

For Culverts

LENGTH OF CULVERT BARREL AT INVERT (m): 45.6m

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING: Concrete - 0.013 (Manning's)

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, BL2110 FB no.

If yes give details ie. Plan number and/or survey book number.

Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): 10m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -

(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 15.72mAHD

LOWEST POINT LOCATION:

Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.

Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.

For bridges, details of piers and section under bridge including abutment details.

Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 2005 PLAN NUMBER: W10684

HAS THE STRUCTURE BEEN UPGRADED?

If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS: Refer to Brisbane City Council project# CD9800479 Blunder Road Durack Stage 3 Inala Avenue to Crossacres Street

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	63	15.52	1057	-	13.5	-	4.7
50	-	57	15.32	940	-	16.4	-	3.5
20	-	47	15.12	854	-	14.5	-	3.3
10	-	39	14.93	777	-	12.8	-	3.1
5	-	31	14.72	698	-	11.0	-	2.8
2	-	24	14.53	621	-	9.2	-	2.6
1	-	19	14.38	569	-	7.9	-	2.4

Blunder Creek Tributary – upstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 2	DATE OF SURVEY: 10 July 1996
LOCATION Rosella Street	UBD REF: Map 218 Q8
AERIAL PHOTO No:	STRUCTURE ID: 34
BCC XS No: BTRIB 11698	AMTD(m):
STRUCTURE DESCRIPTION: Concrete pipe culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 4No/1650RCP
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 14.972mAHD

UPSTREAM OBVERT LEVEL: 16.622mAHD

DOWNSTREAM INVERT LEVEL: 14.917mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 16.567mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 20m

LENGTH OF CULVERT BARREL AT OBVERT (m): 20m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, BL2150 FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of culverts, refer to Brisbane City Council drawings - W4787

WEIR WIDTH (m): 20m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 17.23mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED? Yes, The structure was upgraded from 4 culverts to 5 culverts in 1981, For details of original structure see drawings L-7-15 Section 8

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	18	31	17.65	1185	16.8	8.5	1.1	3.7
50	14	30	17.60	1204	13.6	8.5	1.0	3.6
20	8	29	17.51	1219	8.9	8.5	0.9	3.4
10	3	28	17.41	1235	4.7	8.5	0.7	3.2
5	<1	25	17.26	1194	<1.0	7.8	0.3	3.2
2	-	19	16.72	808	-	6.4	-	2.9
1	-	15	16.49	663	-	5.7	-	2.6

Blunder Creek Tributary – downstream side of the culvert

Blunder Creek Tributary – upstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 2	DATE OF SURVEY: 10 July 1996
LOCATION Pigeon Street	UBD REF: Map 218 P9
AERIAL PHOTO No:	STRUCTURE ID: 81
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete pipe culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 4No/1500RCP
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 17.297mAHD

UPSTREAM OBVERT LEVEL: 18.797mAHD

DOWNSTREAM INVERT LEVEL: 17.185mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 18.685mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 15m

LENGTH OF CULVERT BARREL AT OBVERT (m): 15m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Plan no. BL2180, BL2181
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of culverts, refer to Brisbane City Council drawings - W4787/1

WEIR WIDTH (m): 15m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level = 19.38mAHD
LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED? BCC Dept. of Works
Plan No. W4787/1
Originally constructed in 1963
Plan NO. L-7-15 Sect 8.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	20	30	20.07	1825	14.2	7.1	1.4	4.3
50	15	29	19.99	1806	11.6	7.1	1.3	4.1
20	9	28	19.87	1777	7.9	7.1	1.2	3.9
10	5	26	19.76	1745	4.6	7.1	1.0	3.7
5	1	25	19.62	1685	1.2	7.1	0.8	3.5
2	-	19	19.22	1394	-	5.8	-	3.3
1	-	15	18.83	1053	-	6.4	-	2.4

Blunder Creek Tributary – downstream side of the culvert

Blunder Creek Tributary – upstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 2	DATE OF SURVEY: 10 July 1996
LOCATION Lorikeet Street	UBD REF: Map 218 P11
AERIAL PHOTO No:	STRUCTURE ID: 33
BCC XS No: BTRIB2 11016	AMTD(m):
STRUCTURE DESCRIPTION: Concrete pipe culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 4No/1500RCP
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 20.85mAHD

UPSTREAM OBVERT LEVEL: 22.35mAHD

DOWNSTREAM INVERT LEVEL: 20.65mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 22.15mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 13m

LENGTH OF CULVERT BARREL AT OBVERT (m): 13m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, envelope of BL2205, BL2206 FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of culvert, refer to drawings L-7-15 Section 8, drawing numbers 1, 6 and 12 of set of 27.

WEIR WIDTH (m): 13m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 23.2mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1963 PLAN NUMBER: L-7-15 Section 8
Estate No. 171 - Inala Section 8

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	**DISCHARGE***		**WATER SURFACE ELEVATION*** (m AHD)	**MAX AFFLUX*** (mm)	**AREA***		**VELOCITY***	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	20	30	23.53	2003	15.9	7.1	1.3	4.2
50	16	29	23.46	1997	13.0	7.1	1.2	4.1
20	9	28	23.36	1980	8.7	7.1	1.1	3.9
10	5	27	23.25	1946	5.1	7.1	0.9	3.8
5	1	25	23.10	1868	1.4	7.1	0.7	3.5
2	-	19	22.71	1571	-	7.1	-	2.7
1	-	15	22.39	1319	-	6.4	-	2.4

Blunder Creek Tributary – upstream side of the culvert

Blunder Creek Tributary – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Blunder Creek Tributary 2	DATE OF SURVEY: 10 July 1996
LOCATION Wallaroo Way	UBD REF: Map 218 M12
AERIAL PHOTO No:	STRUCTURE ID: 32
BCC XS No: BTRIB2 10175	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: 6No/1800x1200RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 28.193mAHD

UPSTREAM OBVERT LEVEL: 29.393mAHD

DOWNSTREAM INVERT LEVEL: 27.977mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL: 29.177mAHD
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 20m

LENGTH OF CULVERT BARREL AT OBVERT (m): 20m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? Yes, envelope of BL2250, BL2249, BL2252. FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

For details of culverts, refer to Brisbane City Council drawings of Doolandella Park - Stage 7, drawing number - WP262

WEIR WIDTH (m): 20m LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 30.13mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: 1994 PLAN NUMBER: WP262

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

SUMMARY OF STRUCTURE CHARACTERISTICS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	35	29.93	840	-	7.8	-	4.5
50	-	31	29.75	718	-	7.8	-	4.0
20	-	27	29.58	637	-	9.0	-	3.0
10	-	23	29.44	577	-	8.1	-	2.9
5	-	20	29.31	517	-	7.2	-	2.7
2	-	15	29.11	423	-	5.9	-	2.4
1	-	11	28.96	349	-	4.9	-	2.2

Blunder Creek Tributary – upstream side of the culvert

Blunder Creek Tributary – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Sheepstation Creek	DATE OF SURVEY: 10 July 1996
LOCATION Paradise Road	UBD REF: Map 219 P15
AERIAL PHOTO No:	STRUCTURE ID: 48
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION: Minor (Major or minor road)

STRUCTURE SIZE: : 6/ 3000 x 3000 RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 9.17mAHD

UPSTREAM OBVERT LEVEL:

DOWNSTREAM INVERT LEVEL: 9.13mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL:
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 12.2m

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)

Deck level = 12.62mAHD

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS: Structure has been recently surveyed. Refer to Paradise Road Upgrade – Feasibility Study for detail.

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	- [a]	84	14.22	0 [b]	- [a]	56.0	- [a]	1.5
50	- [a]	79	14.04	0 [b]	- [a]	60.7	- [a]	1.3
20	- [a]	67	13.79	0 [b]	- [a]	55.9	- [a]	1.2
10	- [a]	58	13.55	0 [b]	- [a]	53.1	- [a]	1.1
5	- [a]	50	13.25	0 [b]	- [a]	49.9	- [a]	1.0
2	- [a]	37	12.68	0 [b]	- [a]	40.6	- [a]	0.9
1	- [a]	27	12.11	0 [b]	- [a]	34.1	- [a]	0.8

[a] Overtopping of Paradise Road occurs as a result of Oxley Creek Flooding, not discharge from Sheepstation Creek. Further analysis would be needed to determine flows and velocities occurring purely from Sheepstation Creek and to separate discharge overtopping Paradise Road from the West opposed to the East.
[b] Maximum water surface elevations occur as a result of Oxley Creek flooding. Therefore, afflux coinciding with peak water surface elevations does not occur as a result of structure hydraulics.

Sheepstation Creek – upstream side of the culvert

Sheepstation Creek – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Sheepstation Creek	DATE OF SURVEY: 10 July 1996
LOCATION Brisbane-Sydney Railway	UBD REF: Map 219 P15
AERIAL PHOTO No:	STRUCTURE ID: 49
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Bridge	ROAD CLASSIFICATION: (Major or minor road)

STRUCTURE SIZE: : 3 span bridge 10.76m, 10.08m, 10.76m
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: UPSTREAM OBVERT LEVEL:

DOWNSTREAM INVERT LEVEL: DOWNSTREAM OBVERT LEVEL:
For culverts give floor level. For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level = 12.62mAHD
LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS: Refer to drawing S7385.

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	93	14.20	9	-	66.8	-	1.4
50	-	84	14.02	7	-	59.6	-	1.4
20	-	69	13.78	6	-	57.2	-	1.2
10	-	59	13.54	4	-	53.6	-	1.1
5	-	50	13.25	2	-	50.1	-	1.0
2	-	37	12.68	0	-	40.6	-	0.9
1	-	27	12.12	0	-	34.1	-	0.8

Sheepstation Creek – upstream side of the bridge

Sheepstation Creek – downstream side of the bridge

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Sheepstation Creek	DATE OF SURVEY: 10 July 1996
LOCATION Ridgewood Road	UBD REF: Map 219 R16
AERIAL PHOTO No:	STRUCTURE ID: 47
BCC XS No:	AMTD(m):
STRUCTURE DESCRIPTION: Concrete box culverts	ROAD CLASSIFICATION:Minor (Major or minor road)

STRUCTURE SIZE: : 5No/ 3600 x 1800 RCBC
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: 11.55mAHD

UPSTREAM OBVERT LEVEL:

DOWNSTREAM INVERT LEVEL: 11.5mAHD
For culverts give floor level.

DOWNSTREAM OBVERT LEVEL:
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): LOWEST POINT OF WEIR (m AHD): PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level =

LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS: No drawings available at the time of modelling. Assume 5% culvert barrel slope.

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	14	76	15.20	322	23.6	45.9	0.6	1.7
50	9	71	15.04	300	17.3	45.6	0.5	1.6
20	3	63	14.77	258	7.6	49.2	0.4	1.3
10	1	55	14.55	219	2.7	45.8	0.3	1.2
5	-	48	14.33	173	-	43.6	-	1.1
2	-	35	13.99	122	-	43.8	-	0.8
1	-	27	13.71	72	-	38.6	-	0.7

Sheepstation Creek – upstream side of the culvert

Sheepstation Creek – downstream side of the culvert

HYDRAULIC STRUCTURE REFERENCE SHEET VERS 3.3

CREEK Stable Swamp Creek	DATE OF SURVEY: 10 July 1996
LOCATION Ipswich Motorway	UBD REF: Map 199 H9
AERIAL PHOTO No:	STRUCTURE ID: 92
BCC XS No: SS130	AMTD(m): 8047
STRUCTURE DESCRIPTION: Concrete pipe culverts	ROAD CLASSIFICATION:Major (Major or minor road)

STRUCTURE SIZE: : 3No/ 7250 Oval Armco culverts
For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lengths

All Levels to AHD
UPSTREAM INVERT LEVEL: -0.53mAHD
UPSTREAM OBVERT LEVEL:

DOWNSTREAM INVERT LEVEL: -0.56mAHD
For culverts give floor level.
DOWNSTREAM OBVERT LEVEL:
For bridges give bed level.

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): 107m

LENGTH OF CULVERT BARREL AT OBVERT (m): 107m
TYPE OF LINING: Concrete - 0.013 (Manning's)
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? FB no.
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m): 107m LOWEST POINT OF WEIR (m AHD): 5.79 PIER WIDTH: -
(In direction of flow, ie. distance from u/s face to d/s face)
Deck level =
LOWEST POINT LOCATION:
Facing u/s, give details of where and whether the lowest pt is on the structure or to the LHS/RHS of the structure

HEIGHT OF GUARD RAILS:

DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:

The following should also be provided.
Wingwall and Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, details of entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details.
Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE: PLAN NUMBER: MRD219229

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS:

ARI (years)	DISCHARGE*		WATER SURFACE ELEVATION* (m AHD)	MAX AFFLUX* (mm)	AREA*		VELOCITY*	
	Qweir (m^3/s)	Qstructure (m^3/s)			WEIR (m^2)	STRUCTURE (m^2)	WEIR (m/s)	STRUCTURE (m/s)
100	-	332	6.31	434	-	94.9	-	3.5
50	-	324	6.02	410	-	95.3	-	3.4
20	-	286	5.90	741	-	79.3	-	3.6
10	-	333	5.05	442	-	92.5	-	3.6
5	-	203	4.81	501	-	72.4	-	2.8
2	-	162	4.35	384	-	55.8	-	2.9
1	-	172	4.10	165	-	59.4	-	2.9

Appendix I

Tabulated Results – Extreme Events

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
Oxley Creek					
29282	OX1690	0.80	0.83	3.42	3.71
29176	OX1680	1.09	1.17	1.56	2.00
28371	OX1630	0.06	0.08	0.25	0.76
27626	OX1600	1.84	1.99	2.79	4.47
Logan Motorway Bridge and Culverts					
27610	OX1580	1.93	2.08	2.88	5.00
26626	OX1550	1.42	1.44	1.86	2.61
26255	OX1530	0.93	1.02	1.27	2.29
25226	OX1490	0.61	0.61	0.65	0.69
24701	OX1460	0.73	0.76	0.98	1.06
24428	OX1430	0.65	0.69	0.97	1.23
23710	OX1390	1.53	1.54	1.48	1.99
23444	OX1380	1.37	1.39	1.80	1.74
23321	OX1370	0.82	0.84	1.34	1.66
23027	OX1360	1.15	1.18	1.34	1.49
22825	OX1350	1.11	1.12	1.40	1.53
22554	OX1340	0.57	0.58	1.81	1.95
22417	OX1330	0.23	0.24	1.77	1.69
21958	OX1320	2.19	2.26	1.54	1.86
21704	OX1310	2.21	2.27	2.01	2.02
21457	OX1290	2.81	2.84	2.11	2.22
21406	OX1280	2.38	2.42	2.15	2.24
21374	OX1260	2.49	2.54	1.92	2.06
21194	OX1250	3.10	3.16	2.63	2.56
20908	OX1240	2.22	2.22	2.66	2.46
20754	OX1230	2.39	2.39	1.37	1.55
20576	OX1220	2.54	2.61	2.37	2.71
20280	OX1210	1.21	1.22	3.96	4.59

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
19562	OX1170	1.74	1.80	1.21	1.50
19341	OX1160	1.62	1.67	1.24	1.94
19183	OX1150	1.69	1.75	2.10	2.67
Oxley Creek					
Learoyd Road Bridge					
19139	OX1120	1.91	2.02	3.00	3.28
19015	OX1110	0.85	0.89	2.48	2.77
18855	OX1100	0.91	0.97	1.66	2.92
18696	OX1090	1.07	1.08	1.01	1.53
18535	OX1080	1.49	1.52	1.89	2.27
18233	OX1060	0.77	0.79	0.82	1.37
18200	OX1050	0.80	0.78	0.75	1.32
18018	OX1040	0.69	0.71	0.72	0.79
17818	OX1030	0.56	0.60	0.64	0.94
17382	OX1020	0.55	0.53	0.55	0.43
17023	OX1010	1.04	1.06	1.10	0.58
16821	OX1000	1.76	1.74	2.04	1.04
16800	OX930	1.46	1.45	1.24	1.08
Beatty Road Bridge					
16740	OX930	2.73	2.71	2.35	2.23
16570	OX970	2.50	2.65	2.78	3.24
16502	OX950	2.87	3.05	3.25	3.88
16190	OX945	2.45	2.60	3.16	3.91
15949	OX920	1.68	1.77	1.88	2.66
15588	OX910	0.79	0.84	0.87	1.08
15289	OX900	0.31	0.34	0.87	1.01
14778	OX890	0.86	0.92	1.16	1.15
14339	OX870	0.46	0.46	0.58	0.35
13829	OX860	0.56	0.55	1.03	0.73

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
13496	OX850	1.07	1.03	1.35	0.79
13243	OX840	0.62	0.62	0.39	0.92
12885	OX830	1.00	1.01	1.24	0.92
12429	OX820	0.52	0.51	0.66	0.66
12026	OX810	0.33	0.35	0.36	0.64
Oxley Creek					
11670	OX780	1.63	1.63	1.85	1.23
Ipswich Road Bridge					
11616	OX760	1.21	1.22	1.72	1.15
10720	OX740	0.42	0.45	0.54	1.02
9737	OX730	0.34	0.33	0.35	0.50
9626	OX720	0.52	0.53	0.39	0.57
9355	OX710	0.35	0.26	0.23	0.22
9078	OX700	0.28	0.29	0.37	0.61
8942	OX690	0.26	0.28	0.40	0.58
8295	OX680	0.34	0.31	0.25	0.37
8058	OX670	0.43	0.45	0.49	0.61
7730	OX660	0.47	0.48	0.50	0.62
7500	OX650	0.91	0.93	0.91	1.11
7355	OX640	1.31	1.33	1.07	1.24
7174	OX630	2.03	2.05	1.83	1.26
6998	OX620	0.95	0.96	0.90	0.99
6779	OX610	1.35	1.31	1.09	0.76
6230	OX600	0.59	0.55	0.49	0.69
5990	OX590	0.66	0.66	0.32	0.28
5650	OX580	0.72	0.72	0.47	0.29
5268	OX570	0.87	0.87	0.49	0.04
5191	OX550	0.90	0.87	0.53	0.06
5067	OX540	1.20	1.13	0.66	0.08

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
4928	OX530	1.08	1.03	0.64	0.06
4641	OX510	0.80	0.79	0.54	0.04
4534	OX500	0.61	0.60	0.49	0.04
4283	OX490	0.79	0.75	0.45	0.11
3578	OX480	0.80	0.80	0.53	0.34
3289	OX470	1.41	1.40	0.91	0.19
2946	OX460	1.75	1.75	0.94	0.32
2728	OX450	1.82	1.82	1.04	0.39
Oxley Creek					
2463	OX440	1.69	1.70	1.13	0.52
2388	OX430	1.46	1.48	1.22	0.59
2087	OX420	1.80	1.81	1.00	0.74
2057	OX420	1.99	2.00	1.06	0.84
Sherwood Road Bridge and Culverts					
2045	OX380	2.05	2.06	1.07	0.87
2015	OX370	0.09	0.08	0.76	0.73
1949	OX360	1.79	1.82	1.02	0.97
1865	OX350	1.82	1.87	1.04	0.97
1746	OX340	3.78	3.92	2.61	2.39
1626	OX330	3.99	4.18	2.89	3.02
Railway Bridge					
1618	OX310	4.04	4.26	2.89	3.15
1531	OX290	2.83	3.00	2.65	2.90
1479	OX290	2.69	2.86	2.63	2.75
Watermain Bridge					
1476	OX280	2.68	2.85	2.61	2.71
1388	OX260	2.56	2.71	2.40	2.50
1329	OX250	2.56	2.71	2.33	2.23
1245	OX240	2.61	2.77	2.28	2.03

AMTD (m)	Cross-Section ID	Peak Velocities (m/s) Scenario 3 200 year ARI	Peak Velocities (m/s) Scenario 3 500 year ARI	Peak Velocities (m/s) Scenario 1 2000 year ARI	Peak Velocities (m/s) Scenario 1 PMF
1179	OX230	2.39	2.53	1.78	1.56
1102	OX210	2.60	2.76	2.38	1.99
1027	OX200	2.69	2.86	2.49	2.10
972	OX190	2.73	2.90	2.78	2.41
896	OX180	2.35	2.50	2.80	2.58
835	OX170	2.37	2.53	2.85	2.72
777	OX160	2.51	2.67	3.15	3.03
698	OX150	3.16	3.36	3.01	2.98
631	OX140	2.44	2.59	2.87	2.93
554	OX130	2.33	2.48	2.95	3.08
481	OX120	2.25	2.40	2.91	3.00
Oxley Creek					
406	OX110	2.34	2.49	2.99	3.13
290	OX90	2.55	2.71	3.41	4.09
156	OX60	1.21	1.29	4.50	5.35
Pamphlett Bridge					
143	OX40	1.06	1.14	4.77	5.73
117	OX30	3.44	3.68	5.65	6.69
18	OX10	0.00	0.00	4.79	6.31
Blunder Creek					
13615	BL830	0.89	0.91	0.39	0.45
13485	BL820	1.32	1.36	0.79	0.82
13382	BL810	0.81	0.83	0.67	0.73
13283	BL800	0.81	0.84	0.64	0.68
13092	BL790	0.80	0.82	2.91	5.25
Logan Motorway Culverts					
13078	BL770	0.88	0.89	3.00	5.86
12910	BL760	0.64	0.67	0.71	0.75
12719	BL750	1.28	1.31	0.59	0.92

Peak Velocities

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
12555	BL740	0.54	0.57	0.84	1.04
12421	BL730	1.03	1.06	0.97	1.00
12276	BL710	1.08	1.13	1.41	1.43
12098	BL700	1.08	1.12	0.78	0.86
12000	BL690	0.96	1.02	1.51	1.63
Forest Lake Boulevarde Bridge					
11903	BL680	0.72	0.77	1.18	1.85
11717	BL670	1.01	1.09	1.01	1.23
11631	BL660	0.91	0.97	1.07	1.56
11484	BL640	0.78	0.82	0.74	1.13
11368	BL630	1.62	1.66	0.66	1.00
11273	BL620	1.16	1.19	2.11	1.74
11109	BL610	1.06	1.07	2.69	2.80
1906	BL600	0.86	0.88	0.67	0.86
Blunder Creek					
10781	BL590	1.46	1.53	1.19	1.30
10720	BL580	1.35	1.44	1.41	2.04
10606	BL570	0.97	1.08	1.24	1.68
10425	BL560	0.94	1.03	1.46	1.50
10329	BL550	1.22	1.31	1.16	1.50
10203	BL540	1.00	1.07	1.11	1.26
10038	BL530	1.63	1.75	1.58	2.01
9978	BL520	1.32	1.43	1.82	1.91
9909	BL510	0.83	0.90	2.06	2.61
Blunder Road Bridge					
9898	BL500	1.17	1.28	2.68	3.96
9852	BL480	2.14	2.26	1.43	2.47
9694	BL470	1.73	1.75	1.65	1.93
9531	BL460	0.88	0.92	0.99	1.77

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
9282	BL450	0.68	0.73	0.77	1.47
9180	BL440	0.60	0.65	0.66	1.39
9029	BL430	0.31	0.34	0.43	1.13
8706	BL420	1.25	1.29	1.27	1.38
8560	BL410	0.27	0.31	0.33	0.37
8417	BL400	0.71	0.73	0.75	0.81
8212	BL390	0.35	0.38	0.41	0.48
8052	BL380	0.56	0.59	0.46	0.49
8009	BL370	0.41	0.39	0.20	0.24
7904	BL360	1.42	1.41	1.38	1.40
7733	BL350	0.47	0.49	0.52	0.72
7552	BL340	0.91	0.98	0.93	1.01
7318	BL330	1.33	1.33	1.29	1.24
7116	BL320	0.67	0.69	0.71	0.90
6993	BL310	0.79	0.81	0.82	0.84
6844	BL300	0.62	0.62	0.62	0.72
6649	BL290	0.47	0.46	0.48	0.49
Blunder Creek					
6475	BL280	0.64	0.66	0.38	0.28
6306	BL260	0.70	0.75	0.83	1.38
6175	BL250	1.46	1.53	1.72	2.74
5841	BL240	0.84	0.87	0.83	1.13
5541	BL230	0.53	0.53	0.53	0.77
5438	BL220	1.08	1.10	1.07	1.15
5288	BL210	0.66	0.66	0.64	0.88
5098	BL200	0.74	0.80	0.89	1.52
4929	BL190	0.61	0.64	0.69	0.95
4617	BL180	0.69	0.70	0.69	0.84
4468	BL170	0.66	0.66	0.32	0.42

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
4370	BL160	0.60	0.59	0.60	0.61
4217	BL150	1.55	1.59	1.45	1.56
King Avenue Bridge					
4206	BL140	1.45	1.49	1.40	1.51
3944	BL120	0.54	0.57	0.60	0.81
3560	BL110	0.53	0.56	0.62	0.82
3134	BL100	0.55	0.57	0.69	0.67
2670	BL80	0.80	0.83	0.96	1.09
Bowhill Road Culverts					
2654	BL60	0.70	0.74	0.84	0.95
2423	BL50	0.40	0.43	0.45	0.58
1666	BL40	0.38	0.52	0.57	0.85
1415	BL30	0.91	0.96	1.24	1.03
1185	BL20	0.79	0.84	0.93	0.75
1144	BL10	0.77	0.82	0.90	0.67
657	OX850	0.59	0.62	0.62	0.57
202	OX840	2.29	2.31	2.45	1.21
Oxtrib1					
2625	OX2220	1.08	1.14	1.43	1.50
2494	OX2210	1.83	2.02	2.47	2.56
Oxtrib1					
2373	OX2200	1.46	1.59	1.71	1.73
2277	OX2180	2.02	2.07	2.25	2.37
2236	OX2180	0.81	0.91	1.56	1.68
Rudd Street Culverts					
2216	OX2170	1.47	1.52	3.29	3.45
1906	OX2160	2.09	2.16	2.73	3.13
1614	OX2150	3.04	3.17	1.66	1.58
1362	OX2140	0.99	1.01	1.22	0.71

Peak Velocities

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
1221	OX2130	0.91	0.87	1.35	0.78
Blunder Road Culverts					
1196	OX2110	0.51	0.58	1.21	0.88
1080	OX2100	2.55	2.66	1.25	0.47
966	OX2090	2.53	2.64	1.28	0.79
852	OX2080	1.30	1.37	0.99	0.94
Loop Road Culverts					
774	OX2060	0.42	0.59	0.80	0.61
684	OX2050	0.35	0.53	0.77	0.40
560	OX2050	0.48	0.58	1.22	0.81
Ipswich Road Culverts					
513	OX760	0.84	0.87	1.21	0.81
495	OX2009	1.08	1.10	1.40	0.87
Service Road Culverts					
481	OX2006	0.87	0.88	1.48	0.79
442	OX2000	0.64	0.64	0.87	0.78
Btrib1					
3768		6.26	6.28	6.43	6.53
3741		5.31	5.32	5.28	5.32
3711		5.31	5.32	5.28	5.32
Clipper Street Culverts					
3678		3.26	3.27	3.31	3.34
3659		2.67	2.68	2.72	2.75
Btrib1					
3612		2.82	2.83	2.85	2.95
3555		2.34	2.41	2.46	2.72
3462		1.09	1.15	1.19	1.43
3375		2.08	2.15	2.21	2.50
3303		1.62	1.68	1.82	1.85

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
3248		1.29	1.35	1.39	1.61
3187		2.25	2.34	2.40	2.67
3115		2.25	2.34	2.40	2.67
Inala Avenue Culverts					
3056		2.26	2.32	2.35	2.54
2946		2.26	2.30	2.25	2.44
2836		1.80	1.85	1.89	2.09
2718		2.35	2.37	2.37	2.52
2592		3.81	3.86	3.91	4.24
2526	BL1160	2.24	2.27	2.29	2.53
2412	BL1150	1.72	1.76	1.89	1.90
2258	BL1140	1.51	1.52	1.54	1.54
2152	BL1120	1.51	1.52	1.54	1.54
Rosemary Street Culverts					
2121	BL1110	4.81	5.03	5.32	6.06
2050	BL1100	5.00	5.19	5.21	6.26
1880	BL1090	4.05	4.20	4.73	5.93
1804	BL1087	5.20	5.41	5.45	6.43
1629	BL1080	6.57	6.80	6.75	7.89
1408	BL1070	4.43	4.60	4.75	5.31
1283	BL1060	4.86	5.04	5.99	7.41
1083	BL1050	4.86	5.04	5.99	7.41
1046	BL1040	1.89	9.90	10.03	10.56
Blunder Road Culverts					
1037	BL1020	2.27	10.13	10.29	10.66
932	BL1010	1.06	9.11	9.15	10.56
Btrib1					
681	BL1010	1.04	8.01	8.10	10.56
Bowhill Road Culverts					

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
Btrib2					
3002	BL2260	1.62	1.62	1.86	1.92
2835	BL2252	1.62	1.62	1.86	1.92
Wallaroo Way Culverts					
2816	BL2249	1.63	1.70	1.97	2.10
2765	BL2240	1.53	1.58	1.62	1.83
2481	BL2230	1.24	1.27	1.39	1.38
2142	BL2220	0.87	0.92	0.95	1.05
2025	BL2210	1.25	1.29	1.29	1.35
1994	BL2207	1.25	1.29	1.29	1.35
1980	BL2204	6.74	6.99	8.04	9.14
Lorikeet Street Culverts					
1879	BL2200	4.34	4.50	4.68	5.63
1761	BL2190	1.77	1.84	2.10	2.26
1626	BL2182	1.77	1.84	2.10	2.26
Pigeon Street Culverts					
1611	BL2179	6.16	6.39	6.65	8.21
1408	BL2170	4.43	4.60	4.75	5.31
1323	BL2160	1.45	1.49	1.59	1.67
Rosella Street Culverts					
1300	BL2140	3.22	3.22	3.21	3.36
1218	BL2130	2.86	2.88	1.87	2.95
1138	BL2120	2.86	2.88	1.87	2.95
Blunder Road Culverts					
1127	BL2100	3.58	3.75	3.93	4.93
1053	BL2090	2.32	2.33	2.33	2.36
1005	BL2080	2.32	2.33	2.33	2.36
Inala Avenue Culverts					
945	BL2060	1.97	2.04	2.18	2.44

Peak Velocities

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
Btrib2					
845	BL2050	1.66	1.74	1.69	1.95
674	BL2040	1.80	1.82	1.76	1.81
507	BL2030	1.80	1.82	1.76	1.81
492	BL2010	2.27	10.13	10.29	10.66
King Avenue Culverts					
364	BL2000	1.11	9.27	9.30	10.56
Btrib3					
1007		2.32	2.32	2.38	2.43
863		2.63	2.69	2.73	2.84
788		2.38	2.45	2.48	2.69
692		1.67	1.75	1.89	2.17
641		1.67	1.75	1.89	2.17
Eucalypt Street Culverts					
523		1.65	1.71	1.75	2.05
429		1.53	1.60	1.64	1.81
318		0.96	1.02	1.08	1.36
192		2.56	2.57	2.53	2.62
76		3.81	3.86	3.91	4.24
Btrib4					
961		1.21	1.26	1.28	1.50
868		1.35	1.38	1.37	1.50
780		1.17	1.21	1.33	1.40
683		1.17	1.21	1.33	1.40
Inala Avenue Culverts					
586		5.47	5.64	5.77	6.71
498		4.58	4.70	4.80	5.64
431		4.36	4.48	4.57	5.38
317		7.18	7.49	7.68	9.12

Peak Velocities

AMTD (m)	Cross-Section ID	Peak Velocities (m/s)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
181		5.20	5.41	5.45	6.43

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
Oxley Creek					
29282	OX1690	25.20	25.48	26.30	29.40
29176	OX1680	25.06	25.33	26.08	29.12
28371	OX1630	23.21	23.48	24.22	27.77
27626	OX1600	22.68	22.90	23.44	26.32
Logan Motorway Bridge and Culverts					
27610	OX1580	22.65	22.87	23.41	26.08
26626	OX1550	21.76	21.96	22.25	24.10
26255	OX1530	20.87	21.00	21.07	22.09
25226	OX1490	19.82	19.94	20.25	21.10
24701	OX1460	19.20	19.37	19.68	20.53
24428	OX1430	18.15	18.35	18.50	19.49
23710	OX1390	17.38	17.50	17.64	18.92
23444	OX1380	16.84	16.99	16.98	18.48
23321	OX1370	16.60	16.76	16.82	18.33
23027	OX1360	16.06	16.21	16.39	17.90
22825	OX1350	15.61	15.77	16.06	17.64
22554	OX1340	15.30	15.47	15.70	17.24
22417	OX1330	15.13	15.30	15.55	17.13
21958	OX1320	14.84	15.01	15.10	16.68
21704	OX1310	14.03	14.20	14.56	16.32
21457	OX1290	13.41	13.58	14.12	15.97
21406	OX1280	13.28	13.46	14.01	15.91
21374	OX1260	13.20	13.39	14.01	15.91
21194	OX1250	12.64	12.86	13.66	15.71
20908	OX1240	12.06	12.32	13.26	15.55
20754	OX1230	11.85	12.11	13.18	15.48
20576	OX1220	11.55	11.83	12.88	15.21
20280	OX1210	11.15	11.45	12.25	14.94

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
19562	OX1170	11.00	11.32	12.13	14.78
19341	OX1160	10.94	11.25	12.02	14.58
19183	OX1150	10.89	11.20	11.77	14.26
Oxley Creek					
Learoyd Road Bridge					
19139	OX1120	10.60	10.85	11.52	14.08
19015	OX1110	10.51	10.76	11.44	14.03
18855	OX1100	10.38	10.62	11.15	13.46
18696	OX1090	10.25	10.50	11.14	13.54
18535	OX1080	9.94	10.19	10.95	13.25
18233	OX1060	9.74	10.00	10.82	13.08
18200	OX1050	9.72	9.99	10.80	13.06
18018	OX1040	9.68	9.94	10.77	13.04
17818	OX1030	9.58	9.85	10.67	12.91
17382	OX1020	9.56	9.82	10.66	12.91
17023	OX1010	9.53	9.79	10.64	12.88
16821	OX1000	9.43	9.69	10.57	12.82
16800	OX930	9.42	9.68	10.56	12.81
Beatty Road Bridge					
16740	OX930	9.31	9.58	10.43	12.71
16570	OX970	8.68	8.96	9.86	12.15
16502	OX950	8.56	8.83	9.57	11.80
16190	OX945	7.95	8.17	8.51	10.88
15949	OX920	7.73	7.94	8.41	10.81
15588	OX910	7.48	7.67	8.17	10.70
15289	OX900	7.37	7.55	8.07	10.63
14778	OX890	7.04	7.21	7.84	10.50
14339	OX870	6.93	7.11	7.80	10.47
13829	OX860	6.86	7.04	7.78	10.46

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) Scenario 3 200 year ARI	Peak Water Level (m AHD) Scenario 3 500 year ARI	Peak Water Level (m AHD) Scenario 1 2000 year ARI	Peak Water Level (m AHD) Scenario 1 PMF
13496	OX850	6.79	6.98	7.75	10.43
13243	OX840	6.75	6.94	7.73	10.39
12885	OX830	6.70	6.89	7.71	10.35
12429	OX820	6.70	6.89	7.71	10.35
12026	OX810	6.68	6.87	7.70	10.34
Oxley Creek					
11670	OX780	6.57	6.75	7.66	10.27
Ipswich Road Bridge					
11616	OX760	6.50	6.68	7.65	10.27
10720	OX740	6.46	6.64	7.63	10.23
9737	OX730	6.43	6.61	7.62	10.21
9626	OX720	6.43	6.60	7.62	10.20
9355	OX710	6.41	6.59	7.61	10.19
9078	OX700	6.41	6.58	7.61	10.19
8942	OX690	6.41	6.58	7.61	10.19
8295	OX680	6.39	6.56	7.61	10.19
8058	OX670	6.37	6.54	7.60	10.17
7730	OX660	6.34	6.51	7.59	10.17
7500	OX650	6.24	6.41	7.55	10.11
7355	OX640	6.12	6.29	7.52	10.08
7174	OX630	5.87	6.04	7.46	10.03
6998	OX620	5.74	5.91	7.44	10.01
6779	OX610	5.63	5.81	7.42	10.00
6230	OX600	5.59	5.77	7.42	9.99
5990	OX590	5.59	5.76	7.42	9.99
5650	OX580	5.58	5.76	7.41	9.98
5268	OX570	5.58	5.76	7.41	9.98
5191	OX550	5.58	5.76	7.41	9.98
5067	OX540	5.58	5.76	7.41	9.98

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
4928	OX530	5.58	5.76	7.41	9.98
4641	OX510	5.58	5.75	7.41	9.98
4534	OX500	5.57	5.75	7.41	9.98
4283	OX490	5.56	5.74	7.41	9.98
3578	OX480	5.52	5.70	7.41	9.98
3289	OX470	5.45	5.65	7.40	9.97
2946	OX460	5.16	5.39	7.40	9.97
2728	OX450	4.97	5.21	7.40	9.97
Oxley Creek					
2463	OX440	4.89	5.14	7.39	9.97
2388	OX430	4.87	5.13	7.38	9.96
2087	OX420	4.80	5.06	7.34	9.93
2057	OX420	4.77	5.03	7.32	9.92
Sherwood Road Bridge and Culverts					
2045	OX380	4.76	5.02	7.32	9.91
2015	OX370	4.75	5.01	7.30	9.89
1949	OX360	4.74	5.00	7.29	9.88
1865	OX350	4.73	4.99	7.29	9.88
1746	OX340	4.68	4.93	7.01	9.82
1626	OX330	4.61	4.86	6.78	9.74
Railway Bridge					
1618	OX310	4.51	4.76	6.72	9.72
1531	OX290	4.47	4.72	6.73	9.72
1479	OX290	4.38	4.63	6.68	9.70
Watermain Bridge					
1476	OX280	4.38	4.62	6.68	9.70
1388	OX260	4.31	4.55	6.68	9.70
1329	OX250	4.23	4.47	6.66	9.70
1245	OX240	4.15	4.39	6.61	9.69

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
1179	OX230	4.08	4.31	6.59	9.68
1102	OX210	3.98	4.21	6.48	9.65
1027	OX200	3.87	4.10	6.40	9.64
972	OX190	3.79	4.02	6.27	9.59
896	OX180	3.68	3.89	6.15	9.52
835	OX170	3.58	3.79	6.05	9.51
777	OX160	3.50	3.70	5.89	9.47
698	OX150	3.36	3.56	5.73	9.37
631	OX140	3.23	3.42	5.61	9.21
554	OX130	3.08	3.27	5.55	8.94
481	OX120	2.93	3.11	5.46	8.87
Oxley Creek					
406	OX110	2.76	2.94	5.30	8.74
290	OX90	2.48	2.64	4.80	8.08
156	OX60	2.03	2.16	3.98	7.03
Pamphlett Bridge					
143	OX40	1.94	2.08	3.85	6.84
117	OX30	1.85	1.97	3.27	6.18
18	OX10	1.34	1.42	1.97	5.20
Blunder Creek					
13615	BL830	30.34	30.46	30.92	34.38
13485	BL820	29.85	29.96	30.66	34.34
13382	BL810	29.26	29.38	30.39	34.28
13283	BL800	28.63	28.78	30.21	34.23
13092	BL790	27.97	28.09	28.89	31.53
Logan Motorway Culverts					
13078	BL770	27.95	28.08	28.66	30.79
12910	BL760	27.74	27.87	28.37	30.08
12719	BL750	27.44	27.58	27.82	29.61

Peak Water Levels

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
12555	BL740	27.07	27.21	27.22	29.14
12421	BL730	26.84	26.99	26.95	28.96
12276	BL710	26.33	26.49	26.76	28.82
12098	BL700	25.63	25.80	26.40	28.47
12000	BL690	25.44	25.62	26.10	28.17
Forest Lake Boulevarde Bridge					
11903	BL680	25.28	25.46	25.70	27.63
11717	BL670	24.91	25.10	25.25	27.18
11631	BL660	24.64	24.81	24.98	26.85
11484	BL640	24.19	24.35	24.56	26.41
11368	BL630	23.98	24.14	24.34	26.16
11273	BL620	23.63	23.78	23.99	25.80
11109	BL610	23.29	23.45	23.53	25.42
1906	BL600	22.94	23.12	23.29	25.16
Blunder Creek					
10781	BL590	22.46	22.66	22.93	24.71
10720	BL580	22.17	22.37	22.70	24.37
10606	BL570	21.54	21.73	22.09	23.72
10425	BL560	20.83	21.05	21.38	23.09
10329	BL550	20.52	20.73	21.12	22.81
10203	BL540	20.12	20.32	20.74	22.58
10038	BL530	19.31	19.50	19.73	21.73
9978	BL520	18.73	18.89	19.47	21.43
9909	BL510	18.26	18.40	18.79	20.81
Blunder Road Bridge					
9898	BL500	18.22	18.36	18.51	20.26
9852	BL480	18.15	18.29	18.47	20.04
9694	BL470	16.28	16.37	16.41	17.81
9531	BL460	16.02	16.10	16.09	17.43

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
9282	BL450	15.94	16.00	15.96	17.23
9180	BL440	15.93	16.00	15.96	17.23
9029	BL430	15.93	16.00	15.96	17.23
8706	BL420	15.75	15.82	15.82	17.23
8560	BL410	15.54	15.62	15.71	17.21
8417	BL400	15.47	15.55	15.67	17.18
8212	BL390	15.34	15.45	15.60	17.15
8052	BL380	15.26	15.36	15.52	17.11
8009	BL370	15.26	15.36	15.51	17.10
7904	BL360	15.13	15.23	15.37	17.01
7733	BL350	14.72	14.83	14.97	16.85
7552	BL340	14.60	14.71	14.85	16.77
7318	BL330	14.39	14.50	14.66	16.67
7116	BL320	14.10	14.23	14.43	16.55
6993	BL310	13.94	14.09	14.31	16.48
6844	BL300	13.82	13.98	14.23	16.43
6649	BL290	13.74	13.91	14.17	16.39
Blunder Creek					
6475	BL280	13.71	13.88	14.15	16.36
6306	BL260	13.56	13.72	13.98	16.12
6175	BL250	12.95	13.07	13.23	14.89
5841	BL240	11.77	11.89	12.02	13.57
5541	BL230	11.37	11.48	11.66	13.22
5438	BL220	11.16	11.28	11.48	13.04
5288	BL210	11.07	11.19	11.40	12.90
5098	BL200	10.79	10.88	11.07	12.32
4929	BL190	10.29	10.38	10.52	11.48
4617	BL180	9.59	9.67	9.78	11.04
4468	BL170	9.45	9.54	9.61	11.01

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
4370	BL160	9.42	9.50	9.56	10.98
4217	BL150	9.06	9.13	9.23	10.93
King Avenue Bridge					
4206	BL140	8.96	9.03	9.19	10.93
3944	BL120	8.21	8.31	8.48	10.82
3560	BL110	7.49	7.56	7.86	10.65
3134	BL100	7.05	7.20	7.81	10.58
2670	BL80	6.93	7.11	7.80	10.56
Bowhill Road Culverts					
2654	BL60	6.93	7.11	7.80	10.56
2423	BL50	6.91	7.10	7.80	10.54
1666	BL40	6.90	7.08	7.79	10.52
1415	BL30	6.88	7.07	7.79	10.49
1185	BL20	6.87	7.06	7.78	10.48
1144	BL10	6.87	7.06	7.78	10.48
657	OX850	6.84	7.03	7.77	10.46
202	OX840	6.74	6.93	7.72	10.38
Oxtrib1					
2625	OX2220	13.12	13.20	12.96	13.34
2494	OX2210	12.99	13.05	12.64	12.93
Oxtrib1					
2373	OX2200	11.17	11.20	11.26	11.48
2277	OX2180	10.32	10.36	10.45	10.62
2236	OX2180	9.84	9.88	9.90	10.34
Rudd Street Culverts					
2216	OX2170	9.14	9.18	9.18	10.34
1906	OX2160	7.38	7.44	7.70	10.34
1614	OX2150	6.71	6.90	7.70	10.34
1362	OX2140	6.70	6.89	7.70	10.34

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD) Scenario 3 200 year ARI	Peak Water Level (m AHD) Scenario 3 500 year ARI	Peak Water Level (m AHD) Scenario 1 2000 year ARI	Peak Water Level (m AHD) Scenario 1 PMF
1221	OX2130	6.76	6.98	7.70	10.34
Blunder Road Culverts					
1196	OX2110	6.80	6.99	7.70	10.34
1080	OX2100	6.98	7.28	7.70	10.34
966	OX2090	6.93	7.21	7.70	10.34
852	OX2080	6.87	7.12	7.70	10.34
Loop Road Culverts					
774	OX2060	6.83	7.10	7.70	10.35
684	OX2050	6.76	7.03	7.69	10.34
560	OX2050	6.67	6.93	7.67	10.31
Ipswich Road Culverts					
513	OX760	6.61	6.86	7.67	10.30
495	OX2009	6.60	6.86	7.67	10.30
Service Road Culverts					
481	OX2006	6.59	6.82	7.67	10.30
442	OX2000	6.57	6.79	7.67	10.30
Btrib1					
3768		32.31	32.31	32.30	32.31
3741		30.66	30.73	30.78	31.09
3711		30.91	30.91	30.93	31.00
Clipper Street Culverts					
3678		29.32	29.32	29.34	29.60
3659		29.06	29.06	29.08	29.31
Btrib1					
3612		28.42	28.43	28.45	28.64
3555		27.10	27.16	27.21	27.45
3462		26.47	26.55	26.60	26.89
3375		26.14	26.20	26.24	26.51
3303		25.02	25.08	25.13	25.42

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
3248		24.60	24.67	24.72	24.99
3187		24.15	24.21	24.26	24.54
3115		23.91	23.97	24.02	24.29
Inala Avenue Culverts					
3056		22.69	22.75	22.80	23.05
2946		21.20	21.27	21.29	21.60
2836		20.01	20.09	20.16	20.49
2718		19.29	19.35	19.41	19.70
2592		17.49	17.57	17.63	17.92
2526	BL1160	16.71	16.83	16.94	17.50
2412	BL1150	16.23	16.33	16.42	16.91
2258	BL1140	15.91	15.99	16.07	16.48
2152	BL1120	15.77	15.85	15.91	16.28
Rosemary Street Culverts					
2121	BL1110	13.89	14.01	14.09	15.17
2050	BL1100	13.77	13.89	13.96	14.58
1880	BL1090	13.72	13.87	13.63	14.07
1804	BL1087	11.75	11.85	11.88	12.41
1629	BL1080	11.20	11.29	11.31	11.79
1408	BL1070	10.38	10.48	10.56	11.37
1283	BL1060	10.15	10.25	10.33	10.96
1083	BL1050	9.91	9.96	9.69	10.56
1046	BL1040	9.83	9.90	10.03	10.56
Blunder Road Culverts					
1037	BL1020	10.08	10.13	10.29	10.66
932	BL1010	9.02	9.11	9.15	10.56
Btrib1					
681	BL1010	7.93	8.01	8.10	10.56
Bowhill Road Culverts					

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
Btrib2					
3002	BL2260	31.46	31.51	31.71	31.83
2835	BL2252	30.09	30.30	30.40	30.74
Wallaroo Way Culverts					
2816	BL2249	29.13	29.20	29.25	29.56
2765	BL2240	28.67	28.72	28.76	28.97
2481	BL2230	25.67	25.70	25.79	25.89
2142	BL2220	23.81	23.89	23.98	24.44
2025	BL2210	23.62	23.69	23.77	24.21
1994	BL2207	23.58	23.65	23.72	24.17
1980	BL2204	21.58	21.64	21.71	22.18
Lorikeet Street Culverts					
1879	BL2200	20.66	20.73	20.81	21.26
1761	BL2190	20.24	20.33	20.42	21.01
1626	BL2182	20.13	20.22	20.31	20.90
Pigeon Street Culverts					
1611	BL2179	18.29	18.36	18.43	18.84
1408	BL2170	10.38	10.48	10.56	11.37
1323	BL2160	17.70	17.71	17.77	18.15
Rosella Street Culverts					
1300	BL2140	16.55	16.64	16.72	17.13
1218	BL2130	15.88	16.10	16.24	16.74
1138	BL2120	15.73	15.98	16.12	16.59
Blunder Road Culverts					
1127	BL2100	14.53	14.62	14.73	15.37
1053	BL2090	14.41	14.53	14.66	15.20
1005	BL2080	14.07	14.20	14.33	14.82
Inala Avenue Culverts					
945	BL2060	13.51	13.60	13.71	14.15

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
Btrib2					
845	BL2050	12.66	12.72	12.67	13.12
674	BL2040	11.57	11.61	11.58	12.19
507	BL2030	11.40	11.48	11.45	11.95
492	BL2010	10.08	10.13	10.29	10.66
King Avenue Culverts					
364	BL2000	9.22	9.27	9.30	10.56
Btrib3					
1007		30.89	30.97	31.00	31.14
863		27.56	27.62	27.66	27.96
788		26.15	26.24	26.31	26.78
692		24.81	24.91	24.97	25.43
641		24.41	24.48	24.52	24.83
Eucalypt Street Culverts					
523		21.60	21.69	21.75	22.20
429		20.90	20.99	21.05	21.46
318		20.13	20.18	20.21	20.52
192		19.90	19.90	19.87	19.94
76		17.49	17.57	17.63	17.92
Btrib4					
961		23.47	23.51	23.54	23.75
868		22.08	22.09	22.11	22.18
780		20.30	20.34	20.38	20.62
683		19.58	19.61	19.64	19.84
Inala Avenue Culverts					
586		17.98	18.00	18.02	18.13
498		15.96	15.98	16.00	16.13
431		14.95	14.97	14.98	15.12
317		14.43	14.49	14.54	14.81

Peak Water Levels

AMTD (m)	Cross-Section ID	Peak Water Level (m AHD)			
		Scenario 3		Scenario 1	
		200 year ARI	500 year ARI	2000 year ARI	PMF
181		11.75	11.85	11.88	12.41

Appendix J

HECRAS Bridge Modelling Comparison

Creek	Blunder Creek	Structure ID	28	
Location	Forest Lake Boulevard			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	30	20	24.91	25.08
50	30	20	24.75	24.94
20	20	10	24.47	24.70
10	20	10	24.26	24.54
5	10	10	24.04	24.38
2	10	10	23.67	24.07
1	20	10	23.34	23.74

Creek	Blunder Creek	Structure ID	30	
Location	King Avenue			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	290	250	8.85	9.10
50	190	241	8.62	9.02
20	160	174	8.38	8.84
10	70	117	8.14	8.69
5	50	76	7.98	8.54
2	30	34	7.67	8.27
1	20	21	7.41	8.09

Creek	Oxley Creek	Structure ID	53	
Location	Beatty Road			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	230	377	9.11	9.10
50	290	411	8.83	8.84
20	380	453	8.45	8.48
10	390	433	8.04	8.09
5	260	330	7.37	7.58
2	50	41	6.53	6.64
1	40	34	5.97	6.07

Creek	Oxley Creek	Structure ID	54 & 90			
Location	Ipswich Motorway & Ipswich Motorway Overflow					
	Head Loss (mm)			Upstream Water Surface Elevation (m AHD)		
ARI (years)	Hec-Ras	TUFLOW Main Bridge	TUFLOW Overflow	Hec-Ras	TUFLOW Main	TUFLOW Overflow
100	60	120	109	6.28	6.36	6.37
50	90	146	137	6.08	6.16	6.16
20	110	210	232	5.67	5.82	5.84
10	80	147	158	5.36	5.48	5.50
5	50	95	85	5.04	5.13	5.12
2	40	67	31	4.54	4.61	4.56
1	30	73	10	4.11	4.23	4.12

Creek	Oxley Creek	Structure ID	24	
Location	Johnson Road			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	860	905	25.71	26.00
50	930	714	25.57	25.56
20	290	314	24.59	24.79
10	240	250	24.3	24.43
5	200	192	23.97	24.06
2	160	142	23.44	23.46
1	130	111	23.02	23.03

Creek	Oxley Creek	Structure ID	61	
Location	Sherwood Road			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	40	42	4.44	4.47
50	30	40	4.11	4.12
20	20	37	3.62	3.59
10	20	35	3.16	3.16
5	20	32	2.80	2.80
2	10	28	2.22	2.21
1	10	25	1.83	1.83

Creek	Oxley Creek	Structure ID	51	
Location	King Avenue			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	150	143	10.28	10.26
50	130	128	10.02	10.00
20	100	131	9.68	9.68
10	90	116	9.36	9.36
5	60	103	9.01	9.01
2	40	77	8.46	8.47
1	30	53	8.05	8.06

Creek	Blunder Creek	Structure ID	29	
Location	Blunder Road			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	200	332	17.99	18.24
50	190	323	17.87	18.11
20	180	308	17.67	17.91
10	160	304	17.50	17.73
5	140	302	17.35	17.56
2	120	271	17.08	17.28
1	110	211	16.86	17.06

Creek	Oxley Creek	Structure ID	25	
Location	Logan Motorway			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	70	74	22.16	22.31
50	60	65	21.95	22.08
20	40	54	21.66	21.79
10	30	45	21.37	21.50
5	30	35	21.07	21.19
2	20	22	20.56	20.67
1	10	16	20.17	20.27

Creek	Oxley Creek	Structure ID	63	
Location	Railway Bridge			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	130	136	4.35	4.41
50	110	71	4.00	3.93
20	90	63	3.52	3.43
10	70	56	3.09	3.00
5	60	50	2.72	2.64
2	40	39	2.12	2.08
1	20	32	1.74	1.72

Creek	Sheepstation Creek	Structure ID 49		
Location	Brisbane-Sydney Railway			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	20	9	14.23	14.20
50	10	7	14.04	14.02
20	10	6	13.80	13.78
10	10	4	13.55	13.54
5	0	2	13.25	13.25
2	0	0	12.68	12.68
1	10	0	12.13	12.12

Creek	Oxley Creek	Structure ID 64		
Location	King-Arthur Terrace**			
	Head Loss (mm)		Upstream Water Surface Elevation (m AHD)	
ARI (years)	Hec-Ras	TUFLOW	Hec-Ras	TUFLOW
100	120	80	3.51	1.90
50	110	70	3.14	1.74
20	110	50	2.52	1.57
10	90	50	2.09	1.47
5	70	40	1.80	1.40
2	30	30	1.47	1.31
1	20	20	1.34	1.27

** Note: The Oxley Creek model has been created using a linked 1D/2D TUFLOW model, with the main channel represented as a one-dimensional channel linked to a two-dimensional floodplain. A limitation of the one-dimensional component of TUFLOW is that it cannot truly simulate super-critical flow. Note that this is the case for most (if not all) one-dimensional unsteady hydraulic models. Super-critical flow must be controlled from upstream, however the formulation of the one-dimensional St Venant equations used by numerical models assumes downstream (tailwater) control. They therefore reduce the influence of some parameters (eg convective momentum, inertia) as the Froude Number increases, which allows the solution to continue but means that the results may not be accurate. The tailwater level that has been adopted in the Brisbane River is lower than the critical level in Oxley Creek, so the flow would be expected to pass through critical conditions just upstream of the confluence, which would act as a control for flows upstream in Oxley Creek. Due to the limitations of the numerical solution discussed above, the software performs a backwater calculation commencing at the low Brisbane River level and consequently underestimates levels in the reach immediately upstream of the confluence- this explains the discrepancy in headwater levels at King Arthur Terrace. This condition is likely to persist upstream for several hundred metres of this lower reach before attaining accurate levels. However, of note is that the critical flood levels in this area are most likely dominated by Brisbane River flooding, which are not accounted for in the modelling and mapping carried out as part of this study

Appendix K
Peer Review Memorandum

Dedicated to a better Brisbane

MEMORANDUM

Brisbane City Council

To: Richard Yearsley
Project Manager, NEWS

Date: **22nd May 2014**

From: Scott Glover
Engineer, Flood Management

Re: **Peer Review of Oxley Creek Flood Study**

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Brisbane Infrastructure

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Purpose

This review has been undertaken to ensure the following:

- The flood study has been delivered in accordance with the Consultancy Brief.
- The flood study has been delivered in accordance with Council's procedures and methods.
- The flood study was undertaken in accordance with industry standard methodology.
- The outputs from the study are fit for BCC's purpose.
- Any limitations of the study are identified.

Background

This flood study was managed by City Project Office (CPO) and undertaken by Aurecon P/L on behalf of BCC Natural Environment, Water and Sustainability Branch (NEWS). The flood study commenced in May 2012 and the final deliverables were received in August 2013. At the request of the BCC Oversight Committee, this project was run jointly with Logan City Council (LCC), as the upper section of the Oxley Creek Catchment is within their jurisdiction. Each Council was only responsible for reviewing the work which related to their own Council area.

Peer Review Procedure

The review of this flood study was undertaken by CPO on behalf of NEWS. The review was undertaken on a project milestone basis with the major milestone review points being as follows:

1. Hydrologic Model - development, calibration and associated reporting (Hydrologic Calibration and Verification Memo).
2. Hydraulic Model - development, calibration and associated reporting (Calibration and Verification Report).
3. Design Hydrology and associated reporting (Design Hydrology Memo).
4. Extreme Events Hydrology and associated reporting (Extreme Events Memo).
5. Design and Extreme Events and associated reporting (Design Events Report).
6. Draft Final Report (including deliverables)

The budget for the review process was limited, which meant that the scope of review was required to be tailored to suit the budgetary requirements. In undertaking this review it has been assumed that the consultant (Aurecon) has applied best-practise Quality Assurance in producing the flood study and that the work has been prepared under suitably qualified RPEQ supervision as is required by State law.

1. Hydrologic Model – development and calibration results

This work entailed a review of the hydrologic XP-RAFTS model; preliminary hydrologic calibration results and the associated memorandum, which would later form part of the Calibration and Verification Report.

General comments on the XP-RAFTS hydrologic model are provided below.

Sub-catchment Representation

- The XP-RAFTS sub-catchment definition was in accordance with the project requirement of approximately 1 km^2 (249 sub-catchments for an area of 258 km^2).
- The XP-RAFTS sub-catchment delineation appropriately aligns with the topographical features within the catchment and appears reasonable.
- The XP-RAFTS sub-catchment parameters (area, impervious area %, PerN, slope, etc.) for the calibration and verification events appear reasonable for those sub-catchments reviewed, noting it was not possible to review all 249 sub-catchments. CPO questioned the large discrepancy in impervious area when compared with the old XP-RAFTS model of which Aurecon advised the values in the previous model were too low.
- The XP-RAFTS links utilised hydrologic routing for the main creeks and lagging for the minor tributaries. The routing link attributes were adopted from the old XP-RAFTS model with values adjusted to suit the calibration. The link lagging velocity was adopted to suit the calibration. This would appear sound practice.

Event Rainfall

- The Thiessen polygon method was used to distribute the event rainfall and appeared representative for those events checked.

Hydrologic Calibration Procedure

- The Consultancy Brief required the calibration / verification procedure to be undertaken using a similar methodology to the previous 2008 Oxley Creek Flood Study, which was undertaken by Aurecon. This methodology appears sound.
- The number of calibration / verification events was limited to three by BCC. The calibration consisted of two events (April 1990 & May 1996) and the verification of one event (May 2009). Ideally, there should be more events, however given the lack of recent large flooding events and the many changes in the creek, this was considered acceptable.
- The January 2013 event occurred late in the study, after the calibration / verification was essentially complete. It would be good practice to additionally verify the model with this event in the future.

Hydrologic Calibration and Verification Results

- The hydrologic model parameters adopted from the calibration / verification were a Continuing Loss (CL) of 0 mm/hr and Bx factor of 2.1, which appear to be within the normal range for such values. It should be noted, that many of the creeks in Brisbane have a calibrated continuing loss of 0 mm/hr.
- The hydrologic model was able to adequately represent the observed results at most locations but not all locations. This trend varied between the three events modelled. However, the calibration / verification results are considered acceptable on the basis that the calibration of the Oxley Creek XP-RAFTS model is not straightforward due to a number of factors including: (i) the sparseness of the rain-gauge data, (ii) the lack of stream gauge data (particularly in the upper catchment), (iii) the uncertainty in rating curves, (iv) the variation in losses that is likely across a catchment with a large disparity in landuse and (v) the relatively small sub-catchment sizing as required by the Brief.

2. Hydraulic Model – development and calibration results

This work entailed a review of the calibration and verification results; TUFLOW model and the Calibration and Verification Report.

TUFLOW Model Schematic

- The extent of the TUFLOW model was as required by the Consultants Brief and included Oxley Creek, Blunder Creek, Oxley Tributary #1, Blunder Tributaries #1 to #4 and the downstream sections of Moolabin Creek; Rocky Water Holes Creek; Stable Swamp Creek and Sheep Station Gully.
- The TUFLOW model representation of the main two creeks (Oxley and Blunder) initially primarily consisted of 1d-2d linkages. However, due to model instabilities a number of the 1d-2d sections were converted to fully 2d. These areas included (i) Oxley Creek from Archerfield Speedway to Corinda High School and (ii) a significant proportion of the downstream section of Blunder Creek. This resulted in some locations not having the minimum recommended 4 to 5 grid cells across the channel. However, CPO were advised by Aurecon that conveyance checks had been undertaken between the former 1d cross-sections and the 2d representation, to ensure good consistency was achieved by the 2d representation. Whilst it would have been preferable to have a consistent modelling approach throughout, this could not be avoided due to the instabilities between the 1d and 2d domains encountered by Aurecon.

TUFLOW Model Bathymetry and Roughness

- The TUFLOW model bathymetry utilised data provided by CPO which included the following: 2009 ALS; creek cross-section survey and hydraulic structure data.
- Sand mines / dams were represented using ALS 2009 as per the data supplied by CPO. This could be improved in future studies by undertaking survey of these areas.
- The TUFLOW model grid size of 7.5 m was implemented as per the Consultants Brief. No obvious interpolation errors or rapidly changing / erroneous bed levels were observed in the grid data.
- Major floodplain controls (motorway/railway embankments) have been reasonably represented by the 7.5 m grid. Terrain modifiers have been used to correct issues and define inverts / crests, as necessary.
- The inputting of the 1d cross-sectional data has not been checked and it was assumed that the cross-section profiles were as per the information provided by CPO. It should be noted that most of this cross-sectional data was old and best practice would have been to update this data with new survey for a study of this significance.
- The manning's roughness values adopted appear sensible and within the range of industry accepted values.

TUFLOW Model Structures

- Structures have generally been modelled as fully 1d (1d waterway / 1d weir); 1d-2d (1d waterway / 2d weir) and fully 2d (2d waterway / 2d weir) as appropriate.
- The set-up of structures was undertaken using the old MIKE11 model data and / or design drawings provided by CPO. The coding of the structures has not been checked as this is quite onerous and considered outside the scope of this review.
- The adequacy of the bridge loss coefficients used has not been checked, as the results of the structure head-loss comparisons against HEC-RAS (tabulated in the report) indicated a good correlation.

TUFLOW Model Running and Performance

- The model was not run as part of this checking process. The review relied on the digital data provided by the consultant.
- The 2d timestep of 2.5 seconds appears reasonable and within the half to quarter (of the grid size) range generally recommended.

- The 1d timestep of 1 second also appears reasonable.
- The total cumulative mass error is less than 1 % for all model runs checked.
- Flow and stage hydrographs have been spot checked with no major instabilities found.

TUFLOW Model Calibration and Verification

- The hydraulic model was calibrated using the one event (May 1996) and verified using one event (May 2009), as was requested by BCC.
- Similar to the XP-RAFTS model, the hydraulic model was able to adequately represent the observed results at most locations, but not all locations. For the May 1996, the prescribed calibration tolerance was able to be achieved at 12 out of 19 MHGs. For the May 2009, the prescribed verification tolerance was able to be achieved at 14 out of 20 MHGs. The report notes that a number of the locations at which the prescribed tolerance could not be achieved were in the vicinity of sand mines / dams, where the accuracy of the topographical data would be questionable.
- In general, the calibration and verification is considered reasonable and acceptable, noting the data limitations as identified in the hydrologic calibration review. Also, there are additional hydraulic model data limitations, being that both the 1996 and 2009 events used the 2009 ALS data; a mismatch of creek cross-sectional information from different eras dating back to 1972; sand mines / dams were represented purely with 2009 ALS data; and bridge / culvert crossings used up to date information (when for some crossings there might have been a different structure at the time of the historical event).

3. Design Hydrology

This work entailed a review of the design hydrology and Design Hydrology Memo, which would later form part of the Design Events Report.

- The design hydrology for the 1-yr ARI to 100-yr ARI was determined using AR&R (1987) methodology. Annual maximum and peak over threshold (POT) flood frequency techniques were deemed not suitable because of the limited number of years of stream gauge records. The methodology used is considered acceptable.
- In order to apply some consistencies between previous flood studies of Oxley Creek, which used Duration Independent Storm (DIS) methodology, CPO requested a rainfall based flood frequency methodology be used to check peak flow values. CPO requested Aurecon to scale the peak flow derived by AR&R (1987) to match the flood frequency methodology. This is not considered standard practice, however, the scale factors were very low (average of +5 %), thus having negligible effect on resultant flood levels. This work was undertaken satisfactorily and in accordance with CPO requirements

4. Extreme Event Hydrology

This work entailed a review of the extreme events hydrology and Extreme Events Memo, which would later form part of the Design Events Report.

- The design hydrology for the 200-yr ARI and 500-yr ARI used the AR&R (1987) 100-yr ARI temporal pattern as well as the CRC Forge IFD values, as per the Consultants Brief.
- The design hydrology for the 2000-yr ARI used the GTSM (up to 6hrs) and GSDM (9hrs and above) temporal patterns as well as the CRC Forge IFD values. This methodology appears appropriate and was agreed with CPO.
- The PMP utilised GSDM and GTSMR techniques. This methodology is sound and appears to have been applied correctly.

5. Design Event Modelling and Reporting

This work entailed a review of the design and extreme events hydraulic modelling and Design Event Report (including mapping products).

The TUFLOW modelling of design and extreme events was undertaken using Scenario 1, Scenario 2 and Scenario 3 model set-ups as per BCC requirements.

Design Event TUFLOW Modelling

1-yr to 100-yr ARI

- The 1-yr to 100-yr modelling was undertaken for Scenario 1, Scenario 2 and Scenario 3 as per BCC requirements.
- All durations have been modelled to ensure the peak values have been identified.
- The modelling utilised a fixed Brisbane River boundary condition as agreed with CPO.
- For the Scenario 3 modelling, grid elevations outside the waterway corridor were raised to a very high elevation. This is considered an appropriate methodology to model the waterway corridor.
- Critical duration results have been provided (as required) and appear sensible.
- Tabulated hydraulic structure immunity values have been checked against the TUFLOW results and appear correct.
- The total cumulative mass error is less than 1 % for all model runs checked.
- Flow and stage hydrographs have been spot checked with no major instabilities found.
- XP-RAFTS flow inputs to the TUFLOW model have not been checked as this is considered too onerous and outside the scope of the review process.
- The results appear sensible at the locations checked, given that as the ARI of the event increases, the flow value also increases.
- The consistency between XP-RAFTS and TUFLOW is not great at the locations identified in the report. Therefore, it is recommended that only flow and water level values from the TUFLOW model be used for design purposes. Further work on hydrology model is required if model is considered for use as a flood forecasting tool.

Extreme Event TUFLOW Modelling

200-yr and 500-yr ARI

- The 200-yr and 500-yr modelling was undertaken for Scenario 1 and Scenario 3 as per BCC requirements.
- All durations have been modelled to ensure the peak values have been identified.
- The 200-yr and 500-yr modelling utilised a fixed Brisbane River boundary condition as provided by CPO.
- The Scenario 3 modelling utilised filled floodplain conditions as per BCC requirements.
- The total cumulative mass error is less than 1 % for all model runs checked.
- Flow and stage hydrographs have been spot checked with no major instabilities found.
- XP-RAFTS flow inputs to the TUFLOW model have not been checked as this is considered too onerous and outside the scope of the review process.
- The results appear sensible at the locations checked, given that as the ARI of the event increases, the flow value also increases.

2000-yr ARI and PMF

- The 2000-yr and PMF modelling was undertaken for Scenario 1 only and utilised a fully 2d approach (with removed structures) within the 2d model domain. This approach was agreed with CPO.

- The 2000-yr and PMF modelling utilised a fixed Brisbane River boundary conditions as provided by CPO.
- Due to the extreme nature and hence inherent uncertainties of the events, the 2000-yr and PMF model inputs and results have not been checked in any detail by CPO.
- XP-RAFTS flow inputs to the TUFLOW model have not been checked as this is considered too onerous and outside the scope of the review process.
- The 2000-yr and PMF modelling results indicate significant attenuation downstream of the Ipswich Railway Corridor. CPO queried this and was advised by Aurecon that this phenomenon is real and not a modelling issue.

Flood Mapping

- Water level, depth and hazard mapping were provided as required in the Consultants Brief.
- Stretched flood level surfaces were not provided, as at the time of the study they were not required and a standardised approach to mapping deliverables had not been formulated.
- Mapping palettes were as agreed with CPO, as at the time of the study a standardised approach to mapping palettes had not been formulated.
- Mapping disclaimers were as agreed with CPO, as at the time of the study a standardised approach to mapping disclaimers had not been formulated.
- Mapping extents were truncated at the request of CPO to suit the study objectives. For example, if the flooding was not considered to originate from fluvial flooding of open waterways, then the flooding extents were truncated. This is consistent with the scope of the flood study.

6. Draft Final Report and Deliverables

This work entailed a review of the Draft Final Report, associated mapping products and final deliverables.

Report

- The content of the Draft Final Report reflects that requested in the Consultants Brief and was accepted by CPO.

Mapping Products

- The mapping products produced reflect that requested in the Consultants Brief and were accepted by CPO.

Deliverables

- The deliverables received reflect that requested in the Consultants Brief and were accepted by CPO.

Conclusion

From this review, it is concluded the Oxley Creek Flood Study has been undertaken to the requirements of BCC and in accordance with industry standard methods.

The Oxley Creek flood models have generally been developed using sound techniques and diligent application. These models are considered fit for the purposes of this study and general use by others with interest in the Oxley Creek Catchment.

Recommendations

The following are recommendations which should be considered:

- Due to the lack of large recent flooding events for calibration / verification, the January 2013 event should be additionally utilised as a verification event.

- Additional stream gauges, particularly in the upper LCC portion of the catchment would aid future model calibration and verification.
- Comprehensive creek cross-sectional survey should be undertaken for future studies as the current data is a mismatch from different eras.
- Only flow and water level values from the TUFLOW model should be used for design purposes.
- Survey undertaken at sand mines / dams to allow a more accurate model representation.

Regards

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