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Milestone Report 5: Detailed Model Results

Comprehensive Hydraulic Assessment

Brisbane River Catchment Flood Study

DRAFT FINAL

Prepared for the State of Queensland

October 2016

Comprehensive Hydraulic Assessment
as part of the
Brisbane River Catchment Flood Study

Milestone Report 5:
Detailed Model Results

Prepared for:	State of Queensland (acting through) Department of Infrastructure, Local Government and Planning Department of Natural Resources and Mines
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Synopsis: Milestone Report 5: Detailed Model Results including simulation of selected Monte Carlo AEP events to produce peak flood levels, velocities and other relevant mapped outputs for these events. Sensitivity testing of several scenarios including floodplain future condition, climate change, with/no dams and bed level change. Report prepared for the Comprehensive Hydraulic Assessment as part of the Brisbane River Catchment Flood Study.

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The on-going involvement and review by the Technical Working Group, consisting of the following organisations, are appreciated:

- Department of Infrastructure, Local Government and Planning (Client)
- Department of Natural Resources and Mines (Project Manager on behalf of Client)
- Department of Science, Information Technology and Innovation
- Department of Energy and Water Supply
- Seqwater
- Brisbane City Council
- Ipswich City Council
- Somerset Regional Council
- Lockyer Valley Regional Council
- Bureau of Meteorology
- Queensland Reconstruction Authority (post June 2016).

Executive Summary

The State of Queensland, acting through the Department of Infrastructure, Local Government and Planning (DILGP) (formerly Department of State Development, Infrastructure and Planning, DSDIP), and project managed through the Department of Natural Resources and Mines, is undertaking a Comprehensive Hydraulic Assessment (this assessment) to deliver a fully calibrated detailed hydraulic model that accurately defines the flood behaviour of the lower Brisbane River including major tributaries downstream of Wivenhoe Dam. This assessment is a component of a broader framework of the Brisbane River Catchment Floodplain Studies (BRCFS) currently being undertaken by the Queensland Government in response to the Queensland Floods Commission of Inquiry to provide a comprehensive plan to manage Brisbane River flood risk.

This Milestone Report 5: *Detailed Model Results* is the fifth[1] in a series of milestone reports to be delivered as part of the BRCFS Hydraulic Assessment. The purpose of this report is to provide details on:

- Detailed Model simulation of 60 selected Monte Carlo events to produce mapped output for the 11 AEP (Annual Exceedance Probability) events specified in the ITO;
- Detailed Model simulation of four general sensitivity assessments (the acronyms in brackets are how the scenarios are referenced in the modelling and report content):
  - Floodplain Future condition scenario (FF1);
  - Climate Change scenarios (CC1 to CC4);
  - Bed Level scenarios (BL1 and BL2); and
  - Calibration events No/With Dams scenarios (CND and CWD).

Minor modifications were made to the Detailed Model developed during model calibration as detailed in Milestone Report 3. These modifications include additional features and changes that form part of an agreed Base Case scenario to represent conditions as of 2015 including approved major infrastructure. A key update was the use of DNRM LiDAR data captured in 2014 to represent the out of bank terrain across the majority of Brisbane and Ipswich City Council areas. Other changes were the inclusion of the recent Riverwalk and the proposed development at Howard Smith Wharves. It should be noted that backflow prevention devices that may prevent this flooding are not included in the modelling to allow for a conservative, or ‘worst case’ scenario with regard to flood levels and extents. Additional assessments on these devices have been undertaken separately by BCC.

Key outputs from the modelling include:

- **Drawings** provided in the accompanying Drawing Addendum. These present peak flood levels, depths, velocities and hydraulic hazard for each of the 11 design flood AEPs.
- **Plots** in the accompanying Plot Addendum. The plots show design flood levels and flows for the duration of the model simulation. Long section plots and rating curves are also supplied in the plot addendum.

[1] The first report being BMT WBM (2014) - Milestone Report 1: Data Review and Modelling Methodology, BMT WBM for Department of State Development, Infrastructure and Planning, Draft Final - 29 October 2014. The second report being BMT WBM (2015a) - Milestone Report 2: Fast Model Development and Calibration, BMT WBM for Department of State Development, Infrastructure and Planning, Draft Final – April 2015, The third report being BMT WBM (2015b) – Milestone Report 3 – Detailed Model Development and Calibration, BMT WBM for Department of State Development, Infrastructure and Planning, Draft Final – August 2015. The fourth report being BMT WBM (2016) – Milestone Report 4 – Fast Model Results and Design Events Selection, BMT WBM for Department of State Development, Infrastructure and Planning, Draft Final – August 2016.

- **Tables** of Detailed Model AEP peak flood levels at the 28 reporting locations are provided in an accompanying Table Addendum, along with preliminary advice on structure blockage.

Table 1 provides a summary of resulting design flood levels at Lowood and Ipswich and Brisbane CBDs. The 2011 event levels are also included. It can be seen that the 1 in 100 AEP event was around 1m lower than the 2011 event at Lowood, 1m higher at Ipswich and very similar (0.08m higher) at Brisbane (City Gauge).

Table 1-1 Summary of Peak Design Riverine Flood Levels and Flows at Lowood and Ipswich and Brisbane CBDs

AEP 1 in …	Peak Design Flood Levels and Flows					
	Lowood (Pump Station)		Ipswich (David Trumpy Bridge)		Brisbane (City Gauge)	
	Peak Level (mAHD)	Peak Flow (m3/s)†	Peak Level (mAHD)	Peak Flow (m3/s)†	Peak Level (mAHD)	Peak Flow (m3/s)†
2*	n/a	n/a	1.9	n/a	1.6	n/a
5	31.0	1,000	11.8	1,300	1.7	2,300
10	33.7	1,800	14.8	1,900	1.8	3,200
20	36.3	2,800	16.1	2,300	2.2	4,800
50	40.9	5,500	18.7	3,200	3.2	6,900
100	45.3	9,800	20.1	3,800	4.5	9,200
200	47.3	13,000	21.8	4,800	5.8	11,000
500	48.6	15,800	23.4	5,600	7.3	13,200
2,000	51.0	20,400	25.7	6,900	9.9	17,200
10,000	54.5	29,300	29.0	9,300	14.7	25,700
100,000	63.0	52,600	36.1	13,500	23.7	56,000
2011 event[‡]	*46.3*	*10,900*	*19.2*	*2,300*	*4.5*	*8,900*

*1 in 2 AEP event results provided for tidal zone only i.e results at Lowood not included.

†Peak flood flows for the 1 in 2 AEP event simulations are not provided because the simulated peak flows are due to tidal influence rather than flood influence.

‡ Peak levels and flows shown for the 2011 event are modelled results.

The severity of overbank flooding varies widely within the study area depending on the location and size of the design flood. Observations at a few key locations within the study area are:

- In Brisbane CBD the onset of flooding occurs in the 1 in 10 AEP flood with floodwater backing up the stormwater network and affecting lower lying parts of Margaret Street. It should be noted that backflow prevention devices that may prevent this flooding are not included in the modelling. This is discussed in further detail in Section 3.3 and additional assessments on these devices have been undertaken separately by BCC. The extent of inundation increases with increasing flood rarity, but until the 1 in 2000 AEP event the hydraulic hazard (velocity times depth) remains low as depths and/or flow velocities are typically low for the ponded water. For the 1 in 2,000 AEP or greater, parts of the CBD become flow routes as water cuts across the river bend with a significant increase in the associated hydraulic hazard.

- Within Ipswich CBD, inundation starts to affect lower lying parts of the CBD from the 1 in 5 AEP flood but the hydraulic hazard remains relatively low until the 1 in 10,000 AEP event when the northern part of the CBD becomes an area of active flow. For the 1 in 100,000 AEP event there is a notable flow bypass through North Ipswich causing flow to short circuit the river meander in the CBD. This bypass flow has high hydraulic hazard values, however, this event has an extremely rare probability of occurrence.
- Modelling results for Fernvale, which experienced flooding from a bypass overland flow route in the 2011 flood event, show that this flow route becomes active for the 1 in 100 AEP event and is fully established with high associated hazard values for the 1 in 200 AEP flood and higher.

A range of sensitivity tests were carried out to estimate changes to flooding from a hypothetical future floodplain development case, consequences of Brisbane River bed level changes, the effect of major dams on historical events, and climate change. It is important to clarify that the sensitivity scenarios undertaken using the 60 selected design events represent the impacts on the flood modelling outputs only for those individual events. The sensitivity scenarios do not produce equivalent AEP peak flood levels for that scenario. Key findings from the sensitivity testing are as follows:

- The future floodplain assessment showed that increasing ground levels across the nominated floodplain area generally increased peak levels everywhere for the more extreme events and resulted in a mix of increases and decreases in peak flood level for the smaller events considered. The decreases were due to upstream constrictions in the floodplain throttling the flow resulting in lower peak levels downstream.
- Lowering the Brisbane River bed level within the tidal zone reduces flood levels, whilst raising the bed level increases flood levels. For a ±20% change in conveyance at the flood peak, the 1 in 100 AEP peak levels increased and decreased by around 1.0m and 0.7m respectively at Brisbane City Gauge under these two scenarios.
- The major dams (Wivenhoe, Somerset, Cressbrook, Perseverence, Manchester and Moogerah Dams) have a significant influence on peak flood levels. For example, if these dams were not present for the 2011 event, the peak level would have been around 2.1m and 2.8m higher in Brisbane and Ipswich CBDs respectively for the simulated conditions applied.
- Increases in rainfall and sea level rise will have a pronounced effect on design flood levels. The increases in peak flood levels at Brisbane and Ipswich CBDs under two climate scenarios are shown in Table 2.
- Of interest is that the magnitude of the changes for the sensitivity tests are strongly influenced by the effect of Wivenhoe Dam (and associated dam operation) and the changing dynamics of the floodplain for the more extreme events as new floodways and flood storages come into play at much higher flood levels, and major hydraulic controls shift and/or become drowned out. There is, therefore, not a direct correlation with flood magnitude, in that "the larger the flood, the greater the change" expectation does not necessarily apply.

Table 1-2 Change in Peak Flood Level under Climate Change Sensitivity Scenarios

	Increase in Peak Flood Level from Base Case (m)			
AEP	Brisbane (City Gauge)		Ipswich (David Trumpy Bridge)	
1 in …	CC2	CC4	CC2	CC4
5	0.3	0.8	1.0	1.8
20	0.5	1.1	0.8	1.5
100	1.2	2.5	0.9	2.4
10,000	1.7	3.0	1.1	2.0

CC2 = 10% increase in rainfall and 0.3m rise in sea level
CC4 = 20% increase in rainfall and 0.8m rise in sea level

The rating curve reconciliation discussion presented in MR3 has been included and extended in MR5 to include the results of the design flood simulations. The findings from MR3 on rating curves is consistent with the design flood events, and the addition of the design flood results from both the Fast and Detailed Models provides valuable further information on the accuracy of the rating curves under a wide range of flood magnitudes and shapes. In particular, the design floods provide valuable insight to the performance of the gauges under floods greater in size than historically recorded events.

Guidance is provided on the limitations of the modelling in terms of interpreting the flood information presented in this Milestone Report 5, and for appropriate future application of the Detailed Model. Of particular note is that the flood information provided is for Brisbane River riverine flooding downstream of Wivenhoe Dam, not for localised flooding.

Contents

List of Figures

List of Tables

List of Drawings

List of Plots in Plot Addendum

List of Tables in Table Addendum

List of Drawings in Digital Addendum

A digital addendum accompanies this report and contains pdf drawings of all specified map outputs including those not shown in the Drawing Addendum. A complete list of mapping supplied in the Digital Addendum is given in Appendix B.

List of Abbreviations

1D	One dimensional
2D	Two dimensional
3D	Three-dimensional
AEP	Annual Exceedance Probability
AFRL	Adopted Flood Regulation Line
AHD	Australian Height Datum
ALS	Aerial Laser Survey
AWRC	Australian Water Resources Council
B15	Base Case circa 2015
BCC	Brisbane City Council
BCC (CPO)	Brisbane City Council (City Projects Office)
BL1	Bed Level Scenario 1
BL2	Bed Level Scenario 2
BoM	Bureau of Meteorology
BRCFMS	Brisbane River Catchment Floodplain Management Study
BRCSFMP	Brisbane River Catchment Strategic Floodplain Management Plan
BRCFS	Brisbane River Catchment Flood Study
CC1	Climate Change Sensitivity Scenario 1
CC2	Climate Change Sensitivity Scenario 2
CC3	Climate Change Sensitivity Scenario 3
CC4	Climate Change Sensitivity Scenario 4
CBD	Central Business District
CMD	Coastal Management District
CND	Calibration event with No Dams
CPU	Central Processing Unit
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CWD	Calibration event With Dams
DCS	Data Collection Study
DEHP	Department of Environment and Heritage Protection
DEM	Digital Elevation Model - a fixed grid of elevations sampled from a DTM
DILGP	Department of Infrastructure, Local Government and Planning DILGP (formerly the Department of State Development, Infrastructure and Planning, DSDIP)
DM	Detailed Model
DMT	Disaster Management Tool
DNRM	Department of Natural Resources and Mines
DPI	Department of Primary Industries (former)

DTM	Digital Terrain Model – a triangulation of raw elevation data points
FCoI	Floods Commission of Inquiry (Qld)
FEWS	Flood Early Warning System
FF1	Floodplain Future Condition Scenario 1
FM	Fast Model
GIS	Geographic Information System
H&H	Hydrologic and Hydraulic
ICC	Ipswich City Council
IFD	Intensity Frequency Duration
ITO	Invitation to Offer, ie. The Hydraulic Assessment Brief (DILGP, 2014)
IPE	Independent Panel of Experts (for the current Study)
LiDAR	Light Detection and Ranging
LVRC	Lockyer Valley Regional Council
MC	Monte Carlo
PMF	Probable Maximum Flood (Nominally 1 in 100,000 AEP)
Q-CAS	Queensland Climate Change Adaptation Study
QC	Quality Control
SARA	State Assessment and Referral Agency
SEQ	South East Queensland
SPP	State Planning Policy
SRC	Somerset Regional Council
TWG	Technical Working Group
WSDOS	Wivenhoe and Somerset Dams Optimisation Study

1 Introduction

1.1 Context

1.1.1 Brisbane River Catchment Floodplain Studies

The State of Queensland, acting through the Department of Infrastructure, Local Government and Planning (DILGP) and the Department of Natural Resources and Mines (DNRM) as project manager, is undertaking a Comprehensive Hydraulic Assessment (this assessment) to deliver a fully calibrated hydraulic model that accurately defines the flood behaviour of the lower Brisbane River including major tributaries downstream of Wivenhoe Dam.

This assessment is a component of a broader framework of the Brisbane River Catchment Floodplain Studies (shown in Figure 1-1) currently being undertaken by the Queensland Government in response to Recommendation 2.2 of the Queensland Floods Commission of Inquiry[2] to provide a comprehensive plan to manage Brisbane River flood risk.

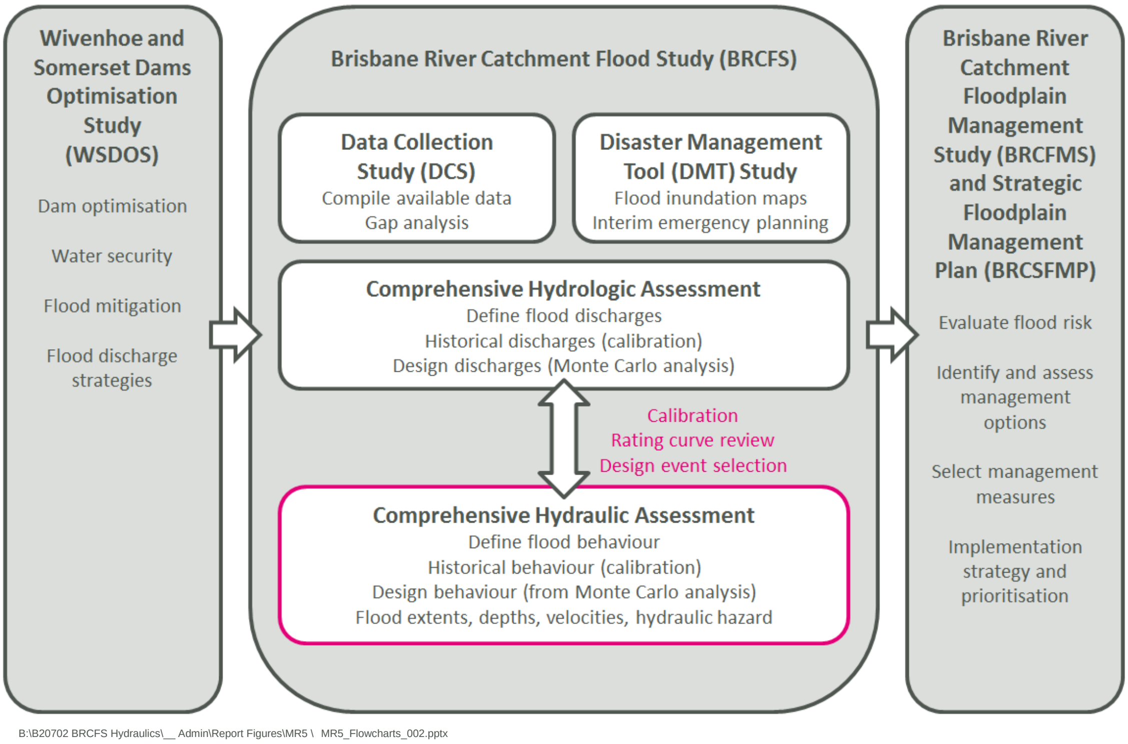

Figure 1-1 Brisbane River Catchment Floodplain Studies

Based on Recommendation 2.2[2], this suite of studies follows the traditional and effective flood risk management framework endorsed as current best practice in Australia[3], which incorporates the following steps:

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[2] Final Report, Queensland Floods Commission of Inquiry, March 2012.
[3] Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia, Australian Emergency Management Handbook 7, Australian Government Attorney-General's Department, 2013.

- A Flood Study: The **Brisbane River Catchment Flood Study (BRCFS)** is presently underway to define flood behaviour. The BRCFS comprises a Data Collection Study (DCS), Comprehensive Hydrologic Assessment and Comprehensive Hydraulic Assessment (see Section 1.1.2).
- A Floodplain Management Study: The **Brisbane River Catchment Floodplain Management Study (BRCFMS)** will subsequently evaluate flood risk based on the flood behaviour defined in the BRCFS and identify and assess a range of flood risk management options. Options that involve changes in hydrologic and/or hydraulic conditions will be assessed using the models developed for the BRCFS. A catchment-wide floodplain management strategy will be formulated.
- A Strategic Floodplain Management Plan: The **Brisbane River Catchment Strategic Floodplain Management Plan (BRCSFMP)** will select a range of flood risk management measures based on the catchment-wide floodplain management strategy in the BRCFMS to guide the current and future management of flood risk in different areas. Details of this work are currently being reviewed.

The **Wivenhoe and Somerset Dams Optimisation Study** (WSDOS) has also been carried out in response to the Queensland Floods Commission of Inquiry to investigate potential options to improve dam operations and flood mitigation, taking into consideration water supply security, dam safety and erosion.

1.1.2 Brisbane River Catchment Flood Study (BRCFS)

The Brisbane River Catchment Flood Study (BRCFS) comprises the following stages:

- **Data Collection Study (Aurecon *et al*, 2013):** The Data Collection Study (DCS) was completed by Aurecon in August 2013 and identified, compiled and reviewed readily available data and metadata, including a gap analysis.
- **Comprehensive Hydrologic Assessment (Aurecon *et al*, 2015c):** The Hydrologic Assessment commenced in 2013 and was finalised in June 2015. It defines flood flows for the Brisbane River catchment based on flood frequency analysis, design event analysis and hydrologic modelling using a Monte Carlo approach to cater for temporal and spatial variations in rainfall patterns, initial reservoir levels and other factors that affect catchment runoff. The Hydrologic Assessment also includes the configuration of a FEWS framework for data and simulation management.
- **Comprehensive Hydraulic Assessment:** The Hydraulic Assessment (this assessment) will define flood behaviour of the lower Brisbane River[4] on the basis of, and in conjunction with, the Hydrologic Assessment. Specifically, this assessment will identify flood extents, depths, velocities and hydraulic hazard, across the full extent of the floodplain, for a range of events up to and including the 1 in 100,000 AEP (Annual Exceedance Probability) which is known as

[4] For the purpose of the Hydraulic Assessment, the lower Brisbane River is defined as the reach downstream of Wivenhoe Dam to the mouth of the river. However it should be noted that the lower Brisbane has been defined differently in other studies, such as where the mid Brisbane is taken to be between Wivenhoe Dam and Mt Crosby Weir (e.g. Resilient Rivers Initiative and Mid Brisbane Irrigators), and the lower Brisbane as the areas downstream of Mt Crosby Weir (Healthy Waterways Report Card).

"Extreme Flood – notionally 1 in 100,000 AEP" for the purpose of this Study. The components of the Hydraulic Assessment are outlined in Section 1.1.3.

In addition to the above stages, the **Disaster Management Tool (DMT) Study** (BCC, 2014a) has been undertaken by Brisbane City Council (City Projects Office) (BCC (CPO)) for the BRCFS Steering Committee for the purposes of providing flood inundation maps for interim emergency planning. The DMT also provides significant and useful background for the development of the hydraulic models for this assessment.

1.1.3 BRCFS Hydraulic Assessment

Key elements of the Hydraulic Assessment include the development of an integrated suite of hydraulic models, rigorous and defendable calibration to historical events, determination of design events ensembles and modelling of a comprehensive range of design events to define flood behaviour.

The Hydraulic Assessment incorporates the following phases: data collation, site inspections, modelling, reporting and workshops (shown in Figure 1-2). Two models are developed and calibrated as part of the Hydraulic Assessment: the Fast Model and the Detailed Model. The development and calibration of the Fast and Detailed Models are detailed in Milestone Report 2 (BMT WBM, 2015a) and Milestone Report 3 (BMT WBM, 2015b) respectively. An overview of the Detailed Model is given in Section 1.1.4.

The Fast Model was developed to undertake the simulation of 11,340 Monte Carlo events. The results from these simulations were used to derive AEP peak flood levels based on the Fast Model at 28 reporting locations throughout the study area. A selection of 60 of these events were chosen that, in combination, reproduced the AEP levels, as detailed in Milestone Report 4 (BMT WBM, 2016). The 60 critical events were simulated through the Detailed Model to produce the final estimates of AEP flood levels throughout the Hydraulic Assessment study area as presented in this MR5 report.

1.1.4 Detailed Model

The Detailed Model is a 1D/2D hydraulic model that is designed to reproduce the hydraulic behaviour of the rivers, creeks and floodplains at a significantly higher resolution than the Fast Model. The Detailed Model, whilst substantially slower to simulate a flood event than the Fast Model[5], is designed for producing flood maps and 3D surfaces of flood depths, water levels, hazard, risk categories and other useful data for floodplain management planning initiatives. The model will also more accurately predict changes in flood levels and flow patterns due to past and proposed works, including flood mitigation measures and future developments.

The Detailed Model is calibrated to tidal conditions and the 2011 and 2013 flood events with verification to the 1996, 1999 and 1974 events. The Detailed Model development, calibration and verification is documented in Milestone Report 3 (BMT WBM, 2015b).

The functions of the Detailed Model are to:

[5] The indicative runtime for a 1 in 100 AEP flood event is 28 hours in the Detailed Model compared with a Fast Model time of around 8 minutes. (Run times based on a CPU core running at 4.0GHz.)

- Accurately reproduce the flood behaviour of the Brisbane River below Wivenhoe, Lockyer Creek and Bremer River at a sufficiently high resolution to produce mapping of flood levels, depths and hazard for whole-of-catchment (below Wivenhoe Dam) planning purposes as per the requirements specified in the Invitation to Offer (ITO), (DILGP, 2014).
- Provide a tool that can be used into the future to quantify the impacts or changes in flood levels, depths and hydraulic hazard due to:
  - Flood mitigation measures, urban developments, road and rail infrastructure, dredging and quarry operations, and other works that change the flood behaviour; and
  - Changes in climate, land-use, sedimentation and erosion, or other factors that may or may not influence the flood behaviour into the future so that planning instruments can accommodate these effects.

This report documents use of the Detailed Model to derive design flood level, depth, velocity and hydraulic hazard information.

1.2 This Report

1.2.1 Purpose and Scope

This Milestone Report 5: Detailed Model Results is the fifth[6] in a series of milestone reports to be delivered as part of the BRCFS Hydraulic Assessment. The purpose of this report is to provide detail on:

- Detailed Model simulation of 60 selected Monte Carlo events to produce mapped output for the 11 AEPs specified in the ITO;
- Detailed Model simulation of four general sensitivity scenarios (the acronym in brackets is how the scenarios are referenced in the modelling naming conventions and report content):
  - Floodplain Future Condition scenario (FF1);
  - Flooding under climate change scenarios (CC1 to CC4);
  - Changing Bed Levels (BL1 and BL2); and
  - Calibration events No/With Dams (CND and CWD).

The majority of the report consists of map output of model results and plots of model results (flows and levels) at key locations. Drawings (mapping) and plots are contained in two separate addenda that accompany this report. Discussion is also provided on rating curve analyses that builds upon that presented in Milestone Report 3 (BMT WBM, 2015b) along with guidance on future use and revision of the model.

[6] The first report being BMT WBM (2014) - Milestone Report 1: Data Review and Modelling Methodology, BMT WBM for Department of State Development, Infrastructure and Planning, Draft Final - 29 October 2014.
The second report being BMT WBM (2015a) - Milestone Report 2: Fast Model Development and Calibration, BMT WBM for Department of State Development, Infrastructure and Planning, Draft Final – April 2015.
The third report being BMT WBM (2015b) – Milestone Report 3: Detailed Model Development and Calibration, BMT WBM for Department of State Development, Infrastructure and Planning, Draft Final – August 2015.
The fourth being BMT WBM (2016) – Milestone Report 4: Fast Model Results and Design Events Selection, BMT WBM for Department of State Development, Infrastructure and Planning, Draft Final – in preparation.

This report was released as a Draft prior to the Workshop held on June 16, 2016, at which the findings outlined in this report were presented and discussed with the IPE and TWG members. Outcomes, key points and response to comments from the review and workshop have subsequently been incorporated into this Draft Final report. Appendix D contains IPE comments on the Draft Report and endorsement.

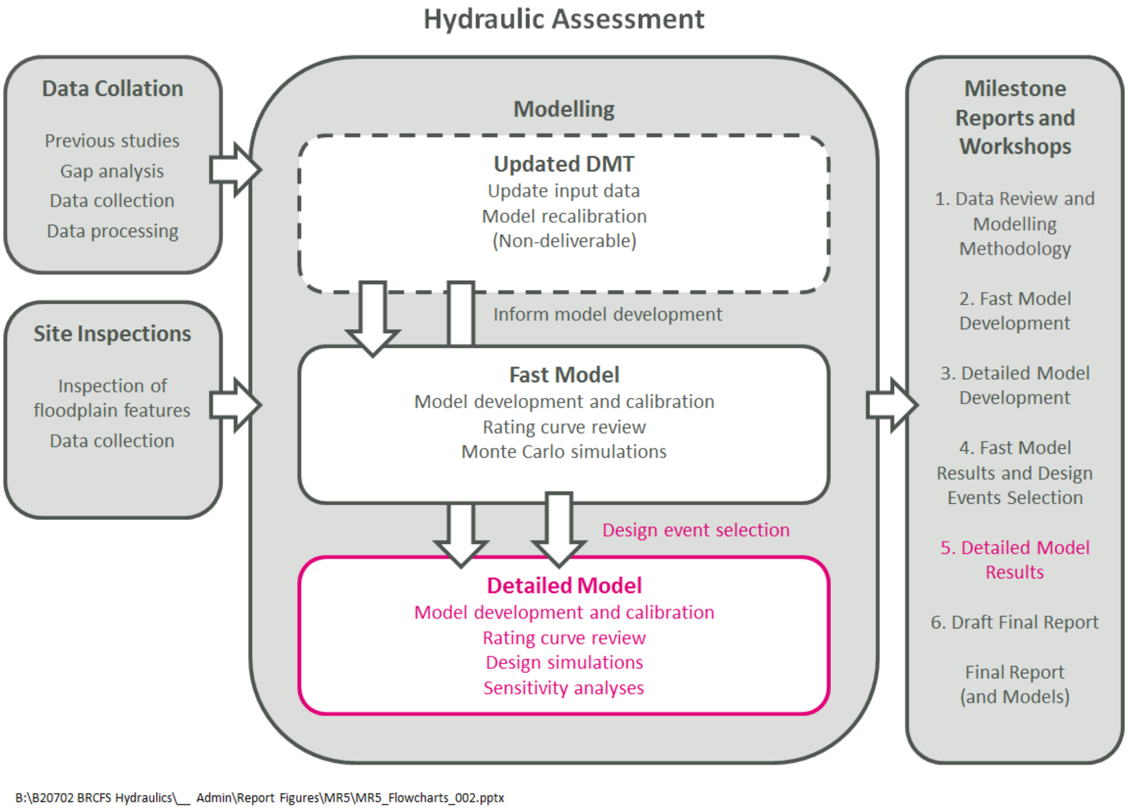


Figure 1-2 BRCFS Hydraulic Assessment

1.2.2 Invitation to Offer (the Brief)

This Milestone Report 5: Detailed Model Results, addresses the relevant components of the following tasks as outlined in the Invitation to Offer (ITO) (DILGP, 2014). Note that the scope of some of these tasks changed during the course of the project. The methodology described and used in this report reflects the final agreed approach and may therefore not necessarily reflect all aspects of the ITO, as reproduced below.

Interface #3: 2D model design runs

1. A subset will be drawn from the fast hydraulic model Monte Carlo simulation results of approximately 500 scenarios, for use in the detailed 2D hydraulic model as boundary conditions, including downstream ocean levels. This subset will consist of approximately 50 'events', covering a range of design probabilities, for different river reaches and for pre- and post-dam scenarios, and will be the final output of the Monte-Carlo analysis. Selection of the subset will form part of the Monte Carlo analysis and, as such, should be undertaken in line with the objectives of the previously completed analysis. Again, the selection of approximately 50 'events' would be made based on the interaction process (involving the IPE, TWG, the hydrology consultant and the hydraulics consultant) to be facilitated by the client. Approval from the client is required prior to the use of these 50 events in the detailed hydraulic modelling.

2. This subset of approximately 50 runs is to be run in the 2D hydraulic model as part of the hydraulic study.

3. The model results will be used to produce design flood levels and other final results. This would include analysis and interpretation of the approximate 50 detailed hydraulic model Monte-Carlo simulation results as part of the hydraulic study.

4. Feedback/input from the client through the proposed interaction process (involving the IPE, TWG and the hydrology consultant) will be required before the final results are produced."

3.9.5 Results of modelling – Estimates of AEP events

Design events are to be generated using the detailed hydraulic model for two Brisbane River catchment development scenarios:

1. *Existing Development: Existing (or currently-approved) land use and development within in the catchment, and the currently adopted method of flood operation of Wivenhoe and Somerset Dams (taking account of any changes made as a consequence of the Wivenhoe and Somerset Dam Optimisation Study).*
2. *No-dam scenario: Existing (or currently-approved) land use and development within in the catchment, but without any of the major storages, including Wivenhoe, Somerset, Cressbrook, Perseverance, Manchester and Moogerah Dams.*

These scenarios were modelled in the hydrology study.

The peak levels, peak total discharges and the flood mapping for each AEP is expected to be derived from a composite of a number of storm and tide level scenarios. The scenarios to be modelled, and the type of output required from the scenarios are summarised in ***Table 1****.*

Climate Change Sensitivity Analysis

Sensitivity analyses will be carried out to examine the impacts of climate change (both on storm rainfall characteristics and sea levels). Two scenarios are required for each variable: one with the mid-range climate change prediction, and the second using the high range prediction.

Bed Level Sensitivity Analysis

An analysis of sensitivity of design flood levels to changes in channel geometry is to be completed. In this analysis, the following should be considered:

- *Records of historical bed level changes (from cross sections, bathymetry surveys, hydrographic charts and other information);*
- *Channel geomorphology including sediment types and underlying geology;*
- *Records of past dredging activities;*
- *Bore logs where available from investigation and design of in-stream structures;*
- *Review of streampower results from the hydraulic model and comparisons using the reference reach approach and published literature guideline values relevant to Australian tropical streams.*
- *From this information likely upper and lower bounds of bed level changes will be proposed. These will be modelled, and summary results produced at the key locations above for the upper and lower bound changes.*

Floodplain Future Condition Sensitivity Analysis

An analysis of the sensitivity of flood levels to future conditions such as development which may include increase in ground levels in specific parts of the catchment is required. The areas and conditions (e.g. for floodplain filling) to be analysed will be specified by the client. A cost per scenario for this analysis should be provided by the Offeror.

Table 1 – Summary of Scenarios and Output Types*

Annual Exceedence Probability (AEP) %	Existing (Approved) Development Scenario	No-dams Scenario	Climate Change Sensitivity Analysis (2x2 scenarios)	Bed Level Sensitivity Analysis (2 scenarios)	Floodplain Future Condition Sensitivity Analysis (1 Scenario)
50%	DM (L, D, H, V)				
20%	DM (L, D, H, V)	RS	RS	RS	
10%	DM (L, D, H, V)				
5%	DM (L, D, H, V)	RS	RS	RS	RS
2%	DM (L, D, H, V)				
1%	DM, HC (L, D, H, V)	TS	DM (L, D, H, V)	RS	RS
0.5%	DM (L, D, H, V)				
0.2%	DM (L, D, H, V)				RS
0.05%	DM (L, D, H, V)				
0.01%	DM (L, D, H, V)	RS	RS	RS	RS
PMF	DM (L, D, H, V)				

* The scope of works was reviewed and fine tuned through discussions and workshops with the TWG/IPE and so the events and outputs sometimes differ to what is contained in this original table from the ITO. Differences from the ITO are described in the relevant section for each sensitivity scenario.

Key to Table: DM = Digital Mapping (+ full hydrographs at Key Locations)

HC = Hard Copy Mapping (+ full hydrographs at Key Locations)

TS= Full hydrographs (Water Level, and Total Q) at Key locations

RS = Summary of results (Peak Total Q, Peak Level) at Key Locations

L = Peak Water Level

D = Peak Depth

H = Hydraulic hazard (based on hydraulic principles only and is defined as the product of velocity and depth)

V = Peak Velocity

The key locations at which statistics of model output will be required, as specified in Table 1 are:

Wivenhoe Dam Tailwater

Lockyer Creek at Tarampa

Lockyer Creek at Lyons Bridge

Brisbane River at Lowood Pump Station

Brisbane River at Savages Crossing

Brisbane River upstream Mt Crosby Weir

Brisbane River downstream Mt Crosby Weir

Brisbane River at Toowong

Brisbane River at Port Office

Brisbane River at Hawthorne

Brisbane River at Gateway Bridge

Warrill Creek at Amberley

Bremer River at Walloon

Purga Creek at Loamside

Brisbane River at Moggill	Bremer River at Three Mile Bridge
Brisbane River at Jindalee	Bremer River at One Mile Bridge
Brisbane River at Tennyson	Bremer River at Hancocks Bridge
Brisbane River at Fairfield	Bremer River at David Trumpy Bridge
Bremer River at Bundamba Creek Confluence	Woogaroo Creek at Brisbane Road Alert
Bremer River at Warrego Highway	Oxley Creek at Rocklea
Bundamba Creek at Hanlon Street Alert	Oxley Creek at Beatty Road

The outputs and deliverables will need to be in a format and so as to be able to be incorporated into all four Councils' flood information systems. For the Brisbane City Council, outputs need to be compatible with WaterRIDE Flood Manager software package and Brisbane City Council's Corporate GIS platform (ArcGIS).

3.10.5.3 Detailed Hydraulic Modelling: Design Events

The Detailed Model will be used for simulation of the design flood events listed in Table 1. These design events will be determined from the hydrology modelling study, with further refinement and filtering of events to approximately 50 'events' using the Fast hydraulic model.

3.10.5.4 Detailed Model – Bed Level Sensitivity Analysis

An analysis of sensitivity of design flood levels to changes in channel geometry is to be completed. Two scenarios (likely upper and lower bounds of bed levels as described in Section 3.9.5 are to be completed. The outputs required are listed in Table 1.

3.10.5.5 Detailed Model - Climate Change Sensitivity Analysis

An analysis of sensitivity of design flood levels to potential changes in climate is to be completed. Two scenarios (for both storm rainfall and sea level) – medium range and high range climate change projections – as described in Section 3.9.5 are to be modelled. The output requirements are listed in Table 1.

3.10.5.6 Detailed Model – Floodplain Future Condition Sensitivity Analysis

An analysis of sensitivity of design flood levels to future conditions such as development and potential filling of selected parts of the floodplain is to be completed as described in Section 3.9.5. The output requirements are listed in Table 1.

2 Methodology

2.1 Introduction

The current stage of the study consists of two general components:

- Simulation of 60 Monte Carlo flood events through the Detailed Model and use of the results to derive Base Case[7] design flood outputs for 11 AEP design floods.
- Assessment of the sensitivity of the Base Case results to changes associated with future climates, future development, changes in bed level and the influence of key dams.

A total of 213 simulations were carried out using the Detailed Model comprising:

- 60 design runs for the 11 AEPs (Base Case)
- 21 floodplain future condition sensitivity scenarios
- 84 climate change sensitivity scenario runs
- 42 bed level sensitivity runs
- 6 calibration events No/With dams runs

Results are presented in a number of ways including:

- Maps showing peak design flood elevations, depths, velocities and hydraulic hazard
- Time series plots showing the change in flows/elevations with time
- Tabulated results of peak flood elevations at reporting locations.

The agreed Base Case for derivation of design flood information required some modifications to the Detailed Model from that documented in Milestone Report 3 (BMT WBM, 2015b). The remainder of this section describes the modelled events along with those modifications to the Detailed Model.

2.2 Design Flood Events

As specified in Table 1 in the ITO (DILGP, 2014), design floods for eleven (11) AEPs are to be determined using the Detailed Model. The AEPs are listed in Table 2-1 below and they include the 1 in 100,000 AEP flood, as this is the rarest flood that can be estimated in a consistent and defensible manner across all sites in the study area. This is referred to as the “Extreme Flood – notionally 1:100,000 AEP” for the purpose of this Study.

Each AEP is made up of a number of Monte Carlo events (individual model runs). This number varies between 4 and 7 events depending on the AEP under consideration. Each collection of events is termed an ‘AEP ensemble’ for any given AEP.

AEPs are referenced in the modelling and model results through the use of a five character identifier. This identifier is also provided in Table 2-1.

In total, a suite of 60 Monte Carlo events are used to represent the 11 AEP design floods.

[7] The Base Case is the Existing (Approved) Development Scenario as specified in the ITO and is current at the time of model simulation (2015)

Table 2-1 Design Flood AEPs

AEP Identifier	AEP (%)	AEP (1 in ..)	Number of Events in Ensemble
D0002	50%	2	7
D0005	20%	5	6
D0010	10%	10	5
D0020	5%	20	6
D0050	2%	50	6
D0100	1%	100	5
D0200	0.5%	200	7
D0500	0.2%	500	5
D2000	0.05%	2,000	5
DK010	0.01%	10,000	4
DK100	0.001%	100,000	4
			Total = 60

2.3 Model Naming Conventions

In order to manage the large number of simulations carried out, design model runs are labelled as follows.

BR_D_MC_aaa_bbbbb_ccc_dddd_vvv

Where:

- BR signifies Brisbane River
- D signifies Detailed Model
- MC signifies the event is a Monte Carlo event.
- aaa is the scenario represented by 3 characters (see Table 2-2).
- bbbbb is the AEP represented by 5 characters, eg. D0500 for the 1 in 500 AEP event (refer to Table 2-1).
- ccc is the event duration in hours There are nine durations ranging from 12 hours (012) to 168 hours (168).
- dddd is a unique Monte Carlo identifier assigned by the Hydrologic Assessment for each duration.
- vvv is the Detailed Model version number assigned for quality control purposes.

Table 2-2 lists the scenarios used by the Detailed Model for design simulations. This includes the Base Case (B15) scenario and sensitivity scenarios included in the assessment. Details on the Base Case and sensitivity assessments are provided in Section 3 and 4 respectively.

Table 2-2 Scenario Acronyms used in Study

aaa Acronym	Scenario
B15	**B**ase Case circa 20**15***
FF1	**F**loodplain **F**uture Condition (**1** variant)
CC1	**C**limate **C**hange **1**: 0.3m rise in sea level
CC2	**C**limate **C**hange **2**: 0.3m rise in sea level and 10% increase in rainfall
CC3	**C**limate **C**hange **3**: 0.8m rise in sea level
CC4	**C**limate **C**hange **4**: 0.8m rise in sea level and 20% increase in rainfall
BL1	**B**ed **L**evel **1**: Decrease in bed level (20% increase in conveyance)
BL2	**B**ed **L**evel **2**: Increase in bed level (20% decrease in conveyance)
CND	**C**alibration event with **N**o **D**ams
CWD	**C**alibration event **W**ith **D**ams

*The Base Case is dated 2015 as being the year in which the inclusions for the Base Case were agreed with the TWG.

The unique Monte Carlo identifier for each duration is a four digit number that ranges from 1 to 1260, representing the 1,260 events generated by the Hydrologic Assessment for each AEP. Combined with the nine durations, this gives a unique identifier for each of the 11,340 (9x1,260) Monte Carlo events. For example, 096_0774 is event number 774 for the 96 hour duration rainfall.

The version number is an internal quality control number used to assist during the model build process. The version number of the Detailed Model for the results within this report is 600 and is the same for all simulations presented.

Examples of the labelling system are presented below.

Example 1

BR_D_MC_B15_D0050_072_0653_600

This is a Base Case (B15) event that is part of the 1 in 50 AEP ensemble. It has a 72 hour duration with a Monte Carlo event identifier of 0653. The model version number is 600.

Example 2

BR_D_MC_CC3_DK010_036_1026_600

This is a climate change sensitivity scenario corresponding to the third climate scenario (CC3). The event is part of the 1 in 10,000 AEP ensemble (DK010). It has a 36 hour duration with a Monte Carlo identifier of 1026. The model version number is 600.

2.4 Reporting Locations

Reporting Locations are locations within the model domain, typically on the main rivers, where the model captures time series information on flows and levels. The locations were used to inform the Monte Carlo event selection process by determining ensembles of events that make up each required design flood AEP. The ITO specified the reporting locations and the statistics that are to be reported for each location. As documented in Milestone Report 4 (BMT WBM, 2016), the original reporting locations have been revised during the course of the project. In total, 28 reporting locations are specified. These are listed in Table 2-3 and are shown in Drawing 1.

Table 2-3 Reporting Locations

ID	Reporting Location	Description
RL_01	Lockyer Creek at Tarampa	At Rifle Range Road gauge
RL_02	Wivenhoe Dam Tailwater	At gauge
RL_03	Lockyer Creek at Lyons Bridge	At gauge
RL_04	Brisbane River at Lowood Pump Station	At gauge
RL_05	Brisbane River at Savages Crossing	At gauge
RL_06	Brisbane River Upstream Mt Crosby Weir	At gauge
RL_07	Brisbane River downstream Mt Crosby Weir	Downstream weir
RL_08	Brisbane River at Moggill	Moggill ferry (mid river)
RL_09	Brisbane River at Jindalee	Upstream Centenary Highway
RL_10	Brisbane River at Tennyson	Tennis Centre
RL_11	Brisbane River at Fairfield	Leyshon Park
RL_12	Brisbane River at Toowong	Regatta ferry terminal
RL_13	Port Office Gauge	At gauge (Edward Street)
RL_14	Brisbane City Gauge	At gauge (Kangaroo Point)
RL_15	Brisbane River at Hawthorne	Hawthorne ferry terminal
RL_16	Brisbane River at Gateway Bridge	Upstream Gateway Bridge (mid river)
RL_17	Warrill Creek at Amberley	At gauge
RL_18	Purga Creek at Loamside	At gauge
RL_19	Bremer River at Walloon	At gauge
RL_20	Bremer River at Three Mile Bridge	Mid river
RL_21	Bremer River at One Mille Bridge	Mid river
RL_22	Bremer River at David Trumpy Bridge	At gauge
RL_23	Bremer River at Hancock Bridge	At gauge
RL_24	Bremer River at Bundamba Confluence	Downstream confluence
RL_25	Bremer River at Warrego Highway	Upstream Warrego Highway (mid river)
RL_26	Bundamba Creek at Hanlon St Alert	At gauge
RL_27	Woogaroo Creek at Brisbane Road Alert	Downstream confluence
RL_28	Oxley Creek at Rocklea	Upstream Sherwood Road

2.5 Detailed Model Updates

Minor updates were made to the Detailed Model in order to establish the Base Case model used for design runs. Further details on the updates are provided in Section 3.

2.6 Model Quality Control

In total, 213 Detailed Model runs were undertaken for this stage of the study. This consisted of 60 Base Case runs and 153 Sensitivity Test runs. Due to the significant volume of model runs it was important to have procedures in place to ensure that quality was maintained throughout the modelling process. In additional to using a structured naming convention, checks needed to be undertaken on individual model simulations to ensure that the potential for errors in model set up or issues with model stability were identified and rectified. Appendix A provides details on the checks that were undertaken as part of the Quality Control (QC) process.

3 Base Case Scenario (B15)

3.1 Overview

The Base Case, referred to as B15 (**B**ase Case circa 20**15**), is simulated in the Detailed Model for the 11 AEP flood events in order to derive peak flood level, depth, velocity and hydraulic hazard output across the study area. The results are provided as tables of peak levels and flows, maps and plots of flows and levels over time at reporting locations. The output forms the key deliverable for the BRCFS and is the culmination of a significant investment in hydrologic and hydraulic catchment analysis and simulation.

The Detailed Model was developed, calibrated and verified as described in Milestone Report 3 (BMT WBM, 2015b). For determining design events, a number of changes were required to be made to the model. Some of these changes relate to physical features represented in the model whereas other changes were made to allow for simulation of events considerably larger than the largest calibration event. These changes are described in the following sections.

The impact of potential blockage of hydraulic structures was not included in the original scope of works in the ITO, but was raised by stakeholders at an earlier workshop. It was decided that "preliminary guidance from ARR and professional judgement" would be used to shortlist which structures may be subject to blockage for consideration in future assessments. The resulting information is provided in Addendum Table 11 which takes into consideration input from councils' engineers. Structure blockage is not considered in any of the simulations carried out for this report.

3.2 Terrain/Feature Updates

LiDAR

The Detailed Model developed in Milestone Report 3 (BMT WBM, 2015b) primarily used the DMT DEM to represent floodplain terrain. This was made up from a variety of sources with much of the coverage in Brisbane and Ipswich consisting of LiDAR captured in 2009. Since the completion of Milestone Report 3 (BMT WBM, 2015b), more recent LiDAR data was captured by DNRM across much of the Brisbane and Ipswich area has become available. This has been termed the '2014 LiDAR' and has been incorporated into the Detailed Model for design simulations. The 2014 LiDAR does not capture bathymetry data. Therefore, it has only been applied for out of bank (floodplain) areas and the representation of bathymetry remains unchanged from that used in the calibration events.

The extent of the 2014 LiDAR applicable to the model is shown in Drawing 2. Sensitivity testing of the updated LiDAR for the calibration events showed only minor differences in peak flood level (typically less than ±0.03m. Figure 3-1 plots a histogram of changes peak flood level between model simulations with and without the 2014 LiDAR (peak flood levels with 2014 LiDAR minus levels without 2014 LiDAR). The 1974 and 2011 events were used for the comparison as these were the largest calibration events. It can be seen that over 95% of peak levels are within ±0.10m regardless of whether the 2014 LiDAR is applied in the model. These changes would typically be less than 1% of the peak depth and it is concluded that use of the 2014 LiDAR will not compromise the model calibration.

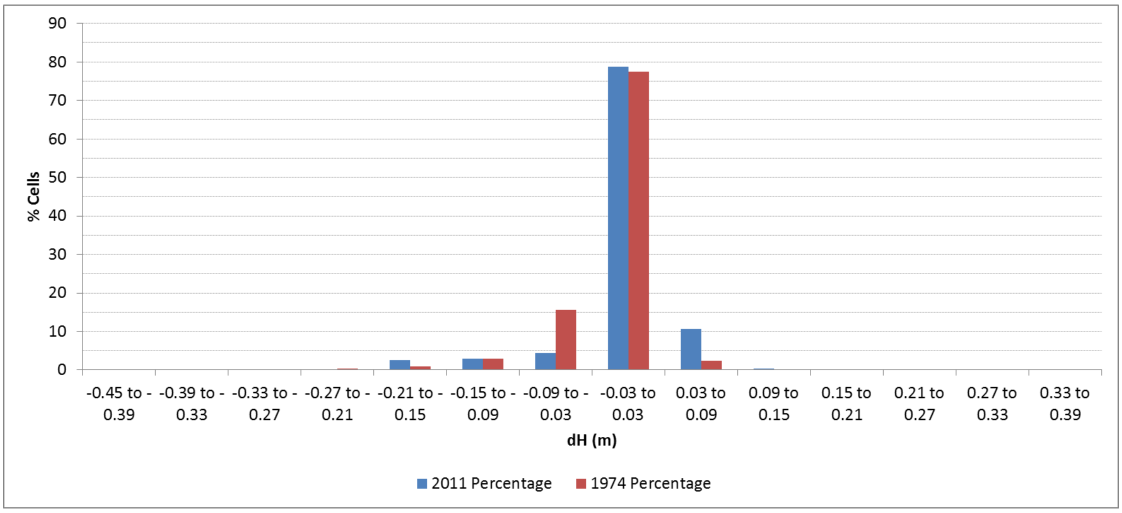


Figure 3-1 Change in Peak Flood Level With/Without 2014 Lidar

Fernvale Quarry

Seqwater provided more recent LiDAR data for the Fernvale Quarry. This LiDAR was captured in 2011 and supersedes the 2008 LiDAR in the DMT DEM across this location. The extent of the more recent LiDAR is also shown in Drawing 2 and has been applied in the Detailed Model for the design runs.

Features

The following new structures or approved developments were included in the model for the Base Case B15 scenario after discussions and agreement with the TWG:

- The Riverwalk is modelled as a layered flow constriction in a similar way to the majority of bridges represented in the model except that it extends along the river in a downstream direction rather than across it. Details such as the obvert level and deck levels were obtained from survey drawings supplied by Brisbane City Council. The deck blockage factor has been apportioned based on the model cell size and a small form loss is specified to represent the structure piers.
- The representation of the proposed Howard Smith Wharves development within the model is based on a conceptual design (Robert Bird Group) that was recently used by BMT WBM in modelling undertaken for BCC. The proposed development is represented using a combination of topographic modifications for proposed surfaces and a layered flow constriction to represent the deck of the structure that extends out into the river.
- Construction plans for the rebuilt Citycat, other ferry terminals and pontoons (rebuilt after the 2011 event) were reviewed. It was determined that these rebuilt structures would have a similar effect on flooding as for the structures present in 2011 and 2013, therefore, the influence of these rebuilt structures on flood behaviour would be essentially unchanged. The effect of these structures, which would be very minor and localised, is incorporated into the model calibration parameters and not explicitly added to the Base Case scenario.

3.3 Backflow Prevention Devices

Backflow prevention devices are fitted to stormwater pipes and trunk drainage systems to prevent riverine floodwater backing up into specific local areas for certain flood events. The devices provide protection for riverine flood events only, such as the Brisbane River flood in 2011. It is important to recognise that they do not provide protection for all floods for the following reasons:

- The device may fail - the device becomes blocked or unable to fully close for a number of reasons including power failure or accessibility issues.
- The river bank is breached – slumping or erosion at a weak point can occur.
- The river bank is overtopped - major riverine floods can still overtop river banks when flood levels in the river are high enough.

As it is not possible to eliminate all flood risk for the reasons outlined above, it was assumed (in consultation with the TWG) that **no** backflow prevention devices were fitted to the stormwater pipes or trunk drainage systems, for the design case modelling. It is important to note the following points in relation to this assumption:

- Conservative (worst case) modelled flood level and extent is produced in those local areas that are typically protected by the backflow prevention devices. For those events for which the devices would otherwise provide protection, the impact on peak flood levels and extent of inundation in the local areas can be significant.
- The inclusion/use (or otherwise) of backflow prevention devices will have no measurable effect on peak flood levels within the main Brisbane River. This is due to the flood storage available in those local areas (behind the backflow prevention devices) being insignificant in comparison to the overall flood storage available in the Brisbane River itself.

More detailed hydraulic assessment of backflow prevention devices has been undertaken by BCC

Table 3-1 AEP events for which River Bank overtopping occurs

Local Area	Riverbank Level* (m AHD)	Estimated City Gauge Trigger Level at which overtopping occurs* (m AHD)	Indicative AEP event at which overtopping commences
Chelmer (Leybourne St)	6.2 to 6.5	3.2 to 3.4	1 in 50
CBD	3.75	3.7	1 in 50 to 1 in 100
Chelmer (Rosebury Tce, Queenscroft St)	8.25	4.2	1 in 50 to 1 in 100
Newfarm (Oxlade Dve)	3.5	4.8	1 in 100 to 1 in 200
Milton (Little Cribb St)	6.2	5.0	1 in 100 to 1 in 200
Newfarm Park	3.75	5.3	1 in 100 to 1 in 200

* These levels provided by BCC on 18 July 2016.

3.4 Other Updates

The largest event simulated as part of the design suite of simulations is the 1 in 100,000 AEP event. This is significantly larger than any of the calibration events. Whilst the calibrated model was generally sufficient to model very large hypothetical events such as 8x1974 event, some improvements were made to extend the model domain on minor tributaries to allow for full propagation of backwater. For other local creeks, including those in the vicinity of Brisbane CBD, the model extends sufficiently far upstream into those tributaries to allow for full backwater propagation for up to the 1 in 100,000 AEP event.

As for the larger events modelled in Milestone Report 3 (BMT WBM, 2015b) (5x1974 and 8x1974), the larger design floods required that the modelled timestep be reduced to improve Courant stability conditions. Therefore, AEPs of 1 in 2 to 1 in 200 use a 12 second computational timestep whereas AEP's of 1 in 500 to 1 in 100,000 use a timestep of 6 seconds. Halving the timestep approximately doubles the model run time meaning that the larger events take significantly longer to run.

To ensure that timestep convergence is achieved, that is, the model results do not significantly change when the timestep is changed, a check was undertaken on the 1 in 100 AEP flood. The model was run for both the standard 12 second and reduced 6 second timesteps and the results compared. The results showed no significant differences with the majority of the modelled levels being within 0.03m (0.1% of peak depths) of each other. This quality control check is documented in Appendix A.

4 Sensitivity Test Scenarios

4.1 Introduction

Sensitivity testing was undertaken on roughness and form loss values as part of the calibration exercise documented in Milestone Report 3 (BMT WBM, 2015b). Sensitivity testing at the design stage is concerned with ascertaining the sensitivity of the design flood levels to potential changes in the catchment that may occur due to direct human influence, geomorphic or climatic processes for each of the selected events.

Sensitivity tests to be undertaken were specified in the ITO with the scope further refined in Workshop 4 Agenda Papers. In general, four categories of sensitivity test have been undertaken as follows:

- Floodplain Future Condition (FF1);
- Climate Change scenarios (CC1, CC2, CC3, CC4);
- Bed Level scenarios (BL1, BL2); and
- Calibration events No/With Dams scenarios (CND, CWD).

Details of each test, and required changes to the Detailed Model in order to implement those tests, are presented in the remainder of this section. The methodology presented was agreed through the workshop process (with the TWG and subsequently endorsed by IPE) and may not necessarily reflect what was originally intended and specified in the ITO (refer to Section 1.2.2). Results from the sensitivity testing are presented in Section 5.3.

It is important to clarify that the sensitivity scenarios undertaken using the 60 selected design events represent the impacts on the flood modelling outputs only for those individual events. The sensitivity scenarios do not produce equivalent AEP peak flood levels for that scenario.

For example, simulation of climate change using the events selected in the 1 in 100 AEP event ensemble, will not necessarily produce the 1 in 100 AEP climate change ensemble. This is because the hydrological impact due to climate change alters the hydrograph volumes, which may have a non-linear effect on the outflow hydrograph due to dam operations. The resulting flood levels are also dependent on hydrograph volume and timing in the mainstream waterway, tributaries and local inflows. For other physical change scenarios such as the floodplain future condition or bed level sensitivity scenarios, the storage-conveyance characteristics of the waterway and/or floodplains change, a different selection of flood events would be necessary to define the AEP ensemble for the scenario. The impacts on flood levels are also not uniform across all events for each AEP at each location.

To undertake a sensitivity scenario to define an equivalent AEP event ensemble would require: a) the scenario to be applied to all 11,340 Monte Carlo events using the Fast Model, b) repeating the Total Probability Theorem analysis of the resulting peak flood levels of the 11,340 events at each reporting location, and c) repeating the event selection process to produce new AEP sensitivity event ensembles. As this has not been undertaken, the resulting sensitivity scenario impacts presented and discussed in this study must be regarded as indicative only, and resulting peak flood levels not able to be aligned to an AEP.

4.2 Floodplain Future Condition (FF1)

An assessment has been undertaken to assess the sensitivity of flood levels to future conditions, such as development, which may include increases in ground levels in specific parts of the catchment. This sensitivity test simulates a hypothetical ultimate development catchment across the Brisbane City Council (BCC) and Ipswich City Council (ICC) local government areas. For BCC this is in accordance with the Brisbane City Plan, 2014 and assumes an increase in ground levels outside of the 'Flood Corridor'. The Flood Corridor supplied by BCC contained floodplains mapped to the outer extent of current Brisbane City Plan's Flood Planning Area 3 and Waterway Corridors together with road reserve, parklands and public land. This was supplied to BMT WBM by BCC on 11/08/2015. For ICC the 'Adopted Flood Regulation Line' (AFRL) was supplied as a polygon and everything outside of this polygon is assumed to be filled. Both BCC and ICC fill areas are shown in Drawing 3 and are implemented simultaneously in the model.

It is important to highlight the limitations of this approach as follows:

- The modelling methodology agreed and implemented for this scenario assumes that the areas outside of the 'Flood Corridor' have ground levels raised so that they are flood free for all AEP events. In reality, the level of filling will vary across the floodplain and be limited to the planning controls specified by councils (for example, residential properties are typically raised to the 1 in 100 AEP plus a freeboard, while industrial properties are generally raised to a lower level). The degree of ground level increases adopted for this sensitivity test can therefore be considered, in reality, as excessive. The magnitude of the impact of these assumptions on flood behaviour will be variable across the model and are only applicable to this filling scenario. Although these hypothetical results cannot be used directly in subsequent floodplain management studies, they are of value in providing one example of the consequences of wide-scale filling of the floodplain for the 1 in 100 AEP event, noting that other fill scenarios could have a very different impact as impacts are highly dependent on the location and extent of ground level increases. Future studies should carefully consider residual risk, and this may require limiting increases in ground levels to realistic maximums, thus allowing floodwater to access these areas in extreme events. This will enable a more realistic assessment of impacts on flood behaviour for events greater than the 1 in 100 AEP event to be made.
- As discussed in Section 4.1, this sensitivity scenario does not produce equivalent AEP peak flood levels. This is due to changes in the storage-conveyance characteristics of the floodplains due to the flooding filling that can potentially result in a different selection of flood events to define the AEP ensemble. Thus, the impacts presented and discussed in Section 5.3.1 must be regarded as indicative only, and resulting peak flood levels not truly representative of the AEP in the absence of repeating the Monte Carlo analysis using the adjusted floodplain topography adopted for this sensitivity test.

The floodplain future condition sensitivity test was undertaken for the 1 in 100, 200, 500 and 10,000 AEP events.

4.2.1 Model Implementation

Increasing the DEM ground levels of the BCC and ICC 'developed areas' was implemented in the model through the deactivating of these areas within the model domain. No changes to model boundary locations were required. In order to incorporate the ICC supplied AFRL into the Detailed Model, the AFRL was simplified through the removal of small 'dry islands' which were appearing as 'speckle' and very minor manual adjustments were made to the AFRL near the 1D/2D model interface. Overall these changes were very minor and would not affect the comparison with the Base Case.

4.3 Climate Change Sensitivity (CC1, CC2, CC3, CC4)

The climate change sensitivity tests examine the impacts of climate change (storm rainfall characteristics and sea level rise) on design flood levels. Both mid- and high- range climate predictions have been assessed. Background to the climate predictions and how these have been implemented in the model are provided in the following sections.

4.3.1 Aurecon Discussion Paper

The Aurecon discussion paper *Assessment of the Implications of Climate Change on Flood Estimation Report* was prepared as part of the BRCFS hydrological assessment (2015) and provides discussion on what the relevant climatic variables are, projected climatic changes for South-East Queensland, and a practical means of incorporating the predicted change into the BRCFS.

4.3.2 Statutory requirements and current policy in Queensland

Queensland's coastal mapping includes coastal hazards (erosion prone areas and storm tide inundation area) and the coastal management district (CMD). Both erosion prone areas and the CMD are statutory maps and are declared under the *Coastal Protection and Management Act 1995*.

The State Planning Policy (SPP) and the State Assessment and Referral Agency (SARA) rely on state-wide coastal mapping. Both the SPP and the SARA online mapping systems have updated the erosion prone areas and storm tide inundation areas mapping to re-instate long term climate change related sea level rise projections of 0.8 metres by 2100.

The Department of Environment and Heritage Protection (DEHP) has prepared revised mapping of the CMD, which now considers the impact of climate change sea level rise. The revised CMD dated 17 November 2015 came into effect on 3 February 2016 and is reflected in these mapping systems.

DEHP is also developing and implementing a Queensland Climate Change Adaptation Strategy (Q-CAS) to ensure that Queensland, its people, environment and economy are best positioned to adapt to current and future climate impacts.

The Queensland Government's inland flooding study report (Queensland Government, 2010) makes recommendations to help local governments factor in increased rainfall intensity as a result of climate change into flood studies. The report proposed a 5% increase in rainfall intensity per °C of global warming. This increase can be incorporated into annual exceedance probability (AEP) flood events to inform the location and design of new development, using scaled temperature increases over time (2 °C by 2050, 3 °C by 2070, and 4 °C by 2100).

4.3.3 ARR Guidelines (Interim)

The ARR website elaborates on the climate change research in Project 1 whose goals are to:

- Quantify possible changes and uncertainties in rainfall intensity-frequency-duration (IFD) curves due to anthropogenic climate change.
- Provide interim advice to practitioners on how these changes can be included into design and planning decisions.
- In order to address the first goal, there is an ongoing research involving BOM, CSIRO, and Engineers Australia to assess the impact of climate change on IFDs – focussed on the Greater Sydney Region and south-east Queensland in the first instance.

Engineers Australia has released a draft discussion paper (2014) on an Interim Guideline for considering climate change in rainfall and runoff. A key focus is to provide a structured approach that leads to a reasonable understanding of climate risk. The interim guideline is intended to be applied to the key system design event. It is proposed that a 5% increase in rainfall intensity (or equivalent depth) per degree centigrade of global warming be used until more detailed information becomes available.

4.3.4 Model Implementation

The climate change sensitivity analysis requires hydrologic boundary inputs (flows and tidal levels) to be modified. The BRCFS URBS hydrologic model is used to derive the modified flow inputs by applying revised model input parameters (i.e. increased design rainfall depth) as a result of predicted climate change. These inputs are generated for the 1 in 5, 20, 100 and 10,000 AEP floods using the 2050 and 2100 time horizons with increases in rainfall depths of 10% and 20% for each time horizon respectively.

Sea level rise is implemented for the 2050 and 2100 time horizons using increases of 0.3m and 0.8m respectively. The Moreton Bay tide/storm tide hydrograph for each of the events in the AEP ensembles has been adjusted upwards by these amounts for each respective scenario (BMT WBM 2006a).

Table 4-1 summarises the climate change parameters that have been adopted for sensitivity analysis:

Table 4-1 Parameters used in the BRCFS Climate Change Sensitivity

Parameter	2050	2100
Design rainfall depth	+10%	+20%
Average sea-level rise	+0.3m	+0.8m

The simulations required to undertake this sensitivity assessment are shown in the Table 4-2. Note that the ITO specifies that 2x2 climate change scenarios are to be undertaken for four AEP events (as indicated in Table 4-2). Scenarios CC1 and CC2 represent the 2050 time horizon with CC1 being sea level rise only and CC2 including both sea level rise and increases in rainfall. Likewise, CC3 and CC4 apply to the 2100 time horizon with CC3 including only sea level rise and CC4 including sea level rise and increases in rainfall.

The number of events in each AEP ensemble is also shown in Table 4-2, which, in combination with the four scenarios for each AEP, gives a total of 84 model runs.

Table 4-2 Simulations Required for Climate Change Sensitivity Assessment

AEP Event (from ITO)	# Events in AEP Ensemble	Scenarios								# Model Runs
		2050				2100				
		Scenario CC1		Scenario CC2		Scenario CC3		Scenario CC4		
		SLR*	Rain^	SLR*	Rain^	SLR*	Rain^	SLR*	Rain^	
20%	6	+0.3m	-	+0.3m	+10%	+0.8m	-	+0.8m	+20%	24
5%	6	+0.3m	-	+0.3m	+10%	+0.8m	-	+0.8m	+20%	24
1%	5	+0.3m	-	+0.3m	+10%	+0.8m	-	+0.8m	+20%	20
0.01%	4	+0.3m	-	+0.3m	+10%	+0.8m	-	+0.8m	+20%	16
									Total	**84**

* Sea Level Rise (average)

^ Increase in Design Rainfall Depth

4.4 Bed Level Sensitivity (BL1, BL2)

The Queensland Floods Commission of Inquiry (QFCoI) recommended development of a suitable model that is "able to deal with the movement of sediment and changes in river beds during floods". The hydraulic models developed for the BRCFS (Fast and Detailed models) are not sediment transport models. Developing a sediment transport model requires substantially more data than currently available. In lieu of a sediment transport model, the Detailed Model can be used to gain an understanding of the sensitivity of modelled peak flood levels due to potential changes in channel geometry caused by sediment movement. A methodology has been developed for this purpose in consultation with the TPG and IPE. The methodology draws upon the following relevant studies:

- Bed Level Sensitivity Analysis (BLSA), Brisbane City Council, (2014)
- Side Scan Sonar Records of the Brisbane River and the Interpretation of Ancient Sea Levels, Sargent, Gerald E.G. University of Queensland (1978)
- Pre- and Post- 2011 bed level difference plots (provided by BCC).

The ITO requires that sensitivity analyses be undertaken with respect to two scenarios (likely upper and lower bounds) of adjusted bed levels. Sensitivity analysis is to be undertaken for the 1 in 5, 20, 100 and 10,000 AEP floods.

The adopted methodology for undertaking this assessment is to relate a change in bed level to a desired change in channel conveyance. This is undertaken by increasing or decreasing the depth, y, by $f_{\Delta K}^{\frac{3}{5}}$ where $f_{\Delta K}$ is the change in conveyance as a factor (for example, for a 10% increase in conveyance, $f_{\Delta K} = 1.1$), as the depth is proportional to conveyance according to the relationship $K \propto y^{\frac{5}{3}}$ assuming that Manning's n is unchanged and side friction is negligible or not relevant. For example, to increase conveyance by 10% in a cell with a 20m depth of water will require a lowering of bed level by 1.18m. Similarly, for a reduction in conveyance of 10% where the depth of water is 20m will require an increase in bed level of 1.23m. The Technical Working Group agreed that a ±20% conveyance change was appropriate for the upper and lower bounds of the assessment.

The changes to bed level are to be applied to the tidal reach of the Brisbane River from Karana Downs at the upstream end to the downstream end of the model at Moreton Bay. Table 4-3 indicates the magnitude of the bed level adjustment at Moggill based on the adopted methodology.

Table 4-3 Thalweg Bed Level Change at Moggill for 20% Conveyance

AEP Event	Approx Peak Flood Depth (m)	Depth Change (m) ±20% K
20%	13.5	±1.6
5%	19.1	±2.2
1%	27.1	±3.1
0.01%	37.9	±4.4

There are a number of solid rock outcrops within the lower Brisbane River. It is not proposed to adjust bed levels at known locations of such outcrops. Minor rock outcrops that extend less than 15m into the river (half a model cell size) are ignored. In total, seven rock outcrops have been identified where no bed level adjustment will occur. This configuration was agreed with the TWG and is shown in Drawing 3 along with the length of river that is to be modified.

4.4.1 Model Implementation

As shown in Drawing 3, the length of Brisbane River subject to bed level adjustment in the Detailed Model extends for approximately 85km from Karana Downs to the Estuary. Following application of the methodology described above, the change in bed material modelled for the 1 in 100 AEP event along this length of river is as follows:

- Increase in conveyance (decrease in bed level) result in approximately 38 million cubic metres of bed material removed. This equates approximately to an average 2m decrease in bed level.
- Decrease in conveyance (increase in bed level) results in approximately 41 million cubic metres of bed material added. This equates approximately to an average 2m increase in bed level.

The methodology adopted to change bed levels in the BLSA Study by BCC (2014) is different from that developed and applied in the current study, meaning direct comparison is not possible. However, the approximate average changes to bed level noted here can be roughly compared to bed level adjustments of -4m, -2m and +2m applied in the BCC BLSA study (BCC, 2014). It is important to note that the BCC (2014) bed level adjustments were applied uniformly over a smaller area from Victoria Bridge to the Brisbane Bar and did not change across event magnitudes.

Bed level modification is carried out automatically by TUFLOW using the following inputs:

- A peak water surface grid for each respective AEP;
- A target conveyance factor eg 0.8 for a 20% decrease in conveyance and 1.2 for a 20% increase; and
- A polygon to be read by the model covering the area in which the bed modification is to occur.

The modification is applied after all other terrain inputs are made in the model. The Base Case AEP ensemble peak water surface for each respective AEP is used. Checks were undertaken to ensure that the bed level was being adjusted as expected and that no adjustment was occurring at the specified rock outcrops. An example of the adjustment at Moggill is shown in Figure 4-1 for the increases and decreases in conveyance.

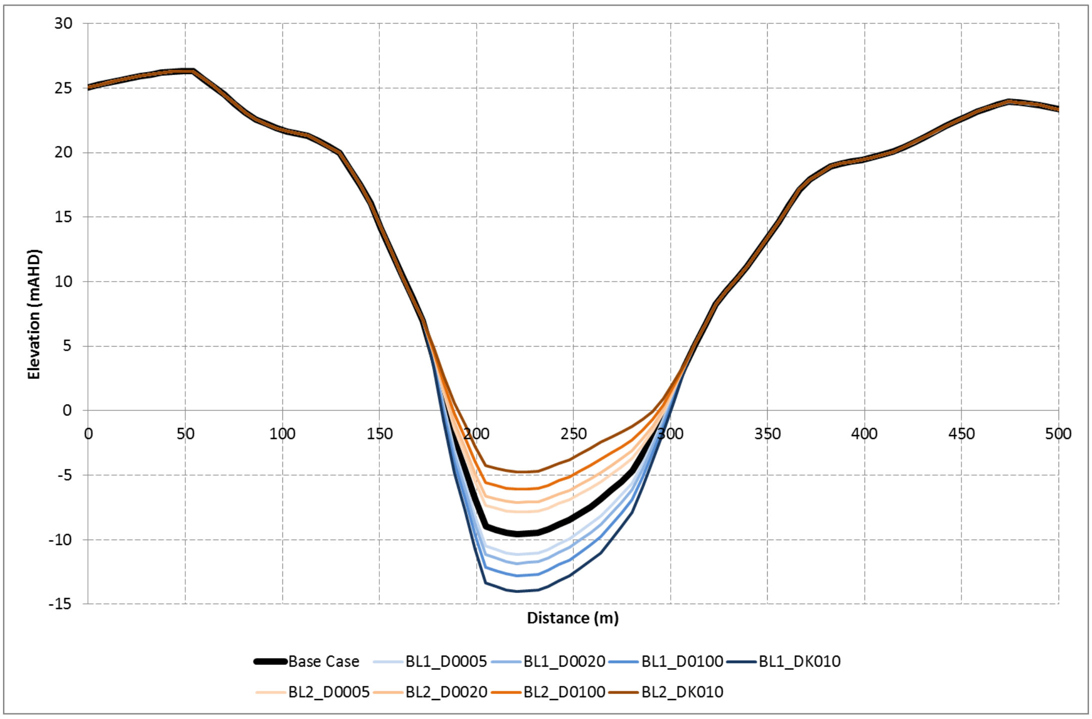


Figure 4-1 Bed Level Change at Moggill (BL1 and BL2)

Table 4-4 summarises the model runs undertaken for the bed level sensitivity.

Table 4-4 Simulations Required for Bed Level Sensitivity Assessment

AEP Event (from ITO)	# Events in AEP Ensemble	Conveyance Change Scenarios		# Model Runs
		BL1 Upper Bound (%)	BL2 Lower Bound (%)	
20%	6	+20%	-20%	12
5%	6	+20%	-20%	12
1%	5	+20%	-20%	10
0.01%	4	+20%	-20%	8
			Total	**42**

4.5 Dams Sensitivity Analysis for Calibration Events (CND, CWD)

The ITO referred to a 'no dam' scenario in which the major storages of Wivenhoe, Somerset, Cressbrook, Perseverence, Manchester and Moogerah Dams were removed from the hydrologic models as applicable. The revised hydrologic flows would then be applied to the Detailed Model and results compared to a 'with dams' scenario to ascertain the dams roles in reducing flood levels for events modelled. This sensitivity analysis was carried out for five calibration events[8], namely 1974, 1996, 1999, 2011 and 2013For all events other than 1974, the 'with dams' simulation is the same as that used in calibration i.e. all the dams listed above were in place at the time of the event. For the 1974 event an additional simulation was required in which Wivenhoe Dam was assumed present[9]. This allows for a 'like for like' comparison of the dams influences on the five calibration events. The flow at the Wivenhoe outlet for each of the five calibration events for with and without dams scenarios are shown in Figure 4-2 to Figure 4-6. For reasons discussed above, the 1974 Base Case event is different to the 'With Dams' case and so both are plotted.

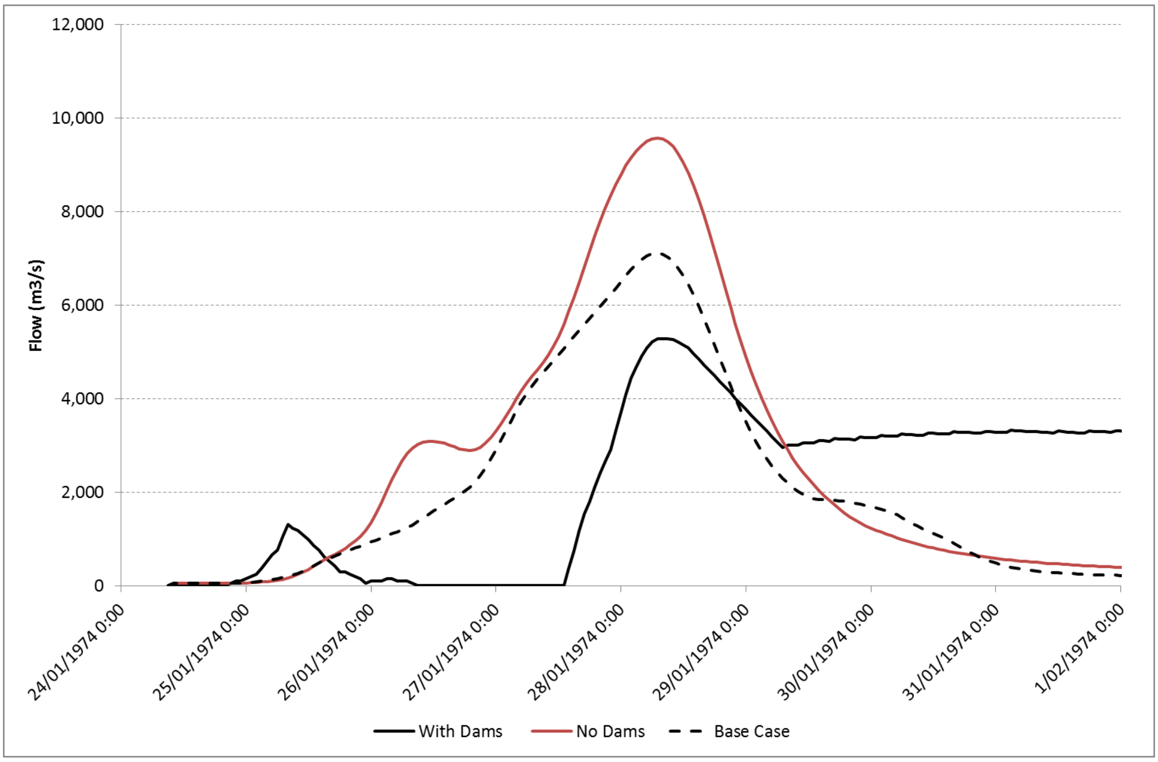


Figure 4-2 1974 Wivenhoe Outflows

[8] Use of the five calibration events instead of the design events is a departure from the ITO and was agreed with the TWG and IPE.
[9] The assumed management of the dam used simulated Wivenhoe Dam outflows from the Wivenhoe and Somerset Dams Optimisation Study (WSDOS) based on the 'Alternate Urban 3' assumed operation. Dam outflows were supplied by Seqwater.

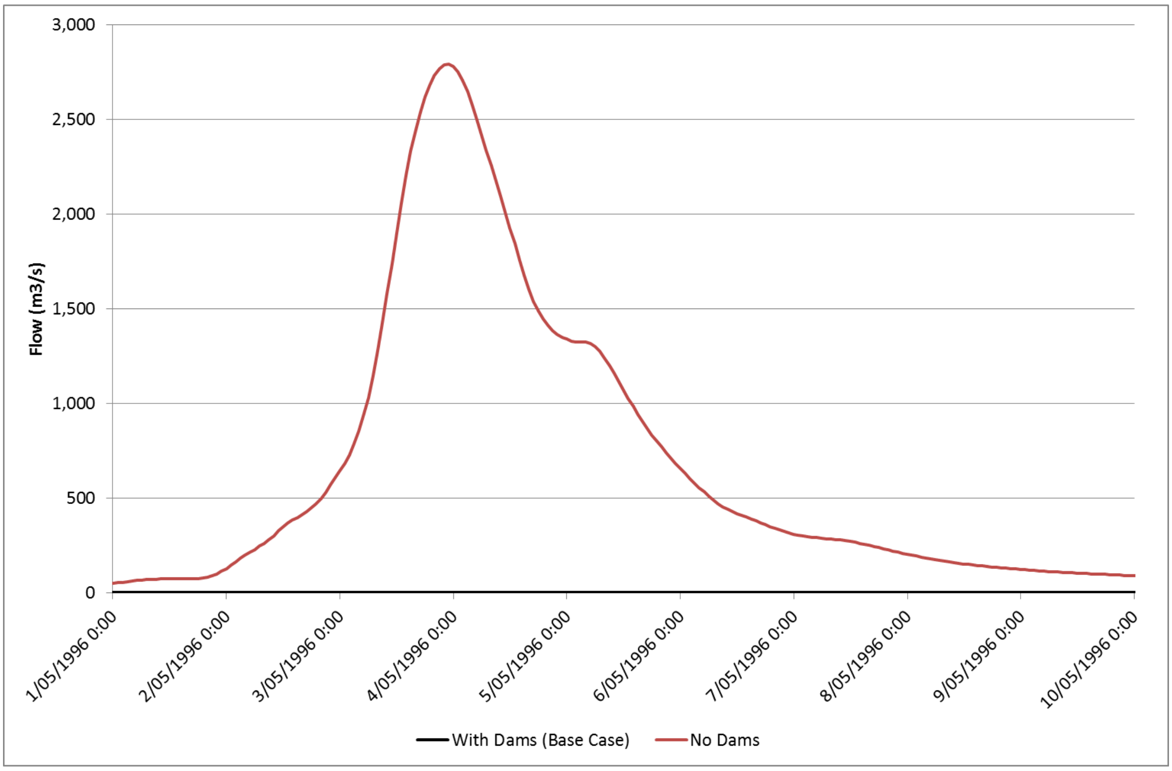


Figure 4-3 1996 Wivenhoe Outflows (no outflow for Base Case)

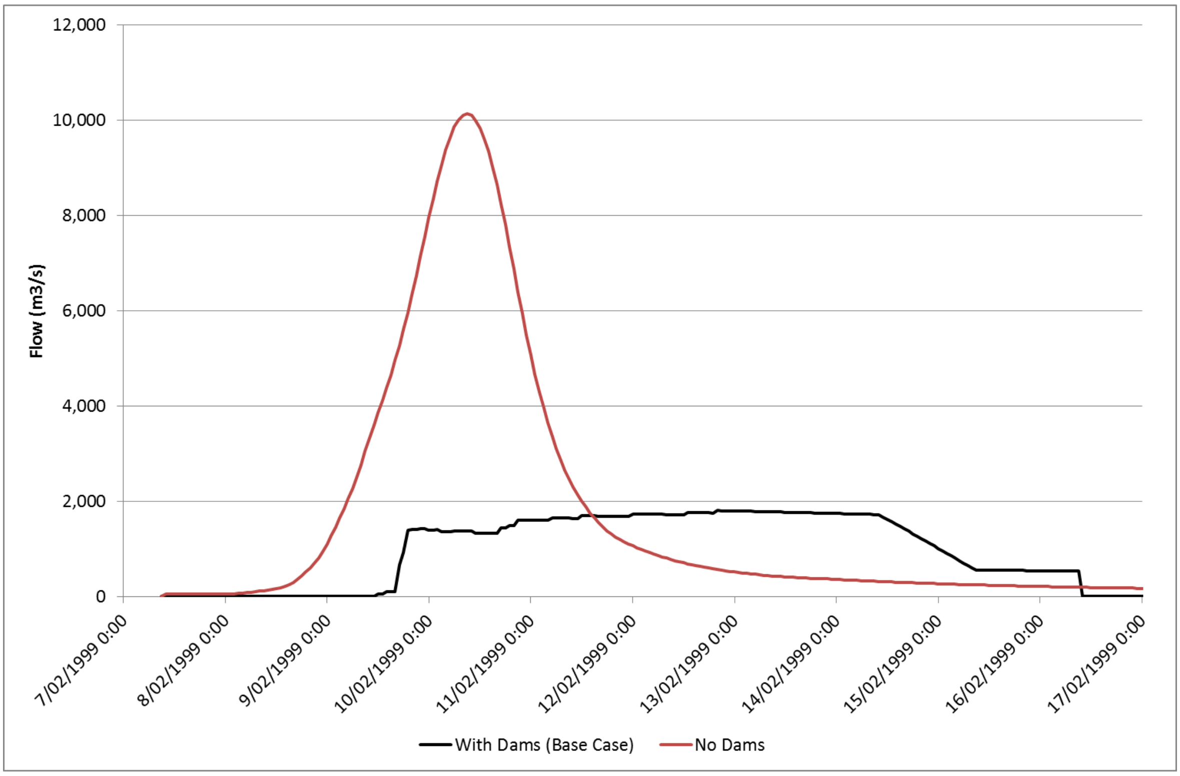


Figure 4-4 1999 Wivenhoe Outflows

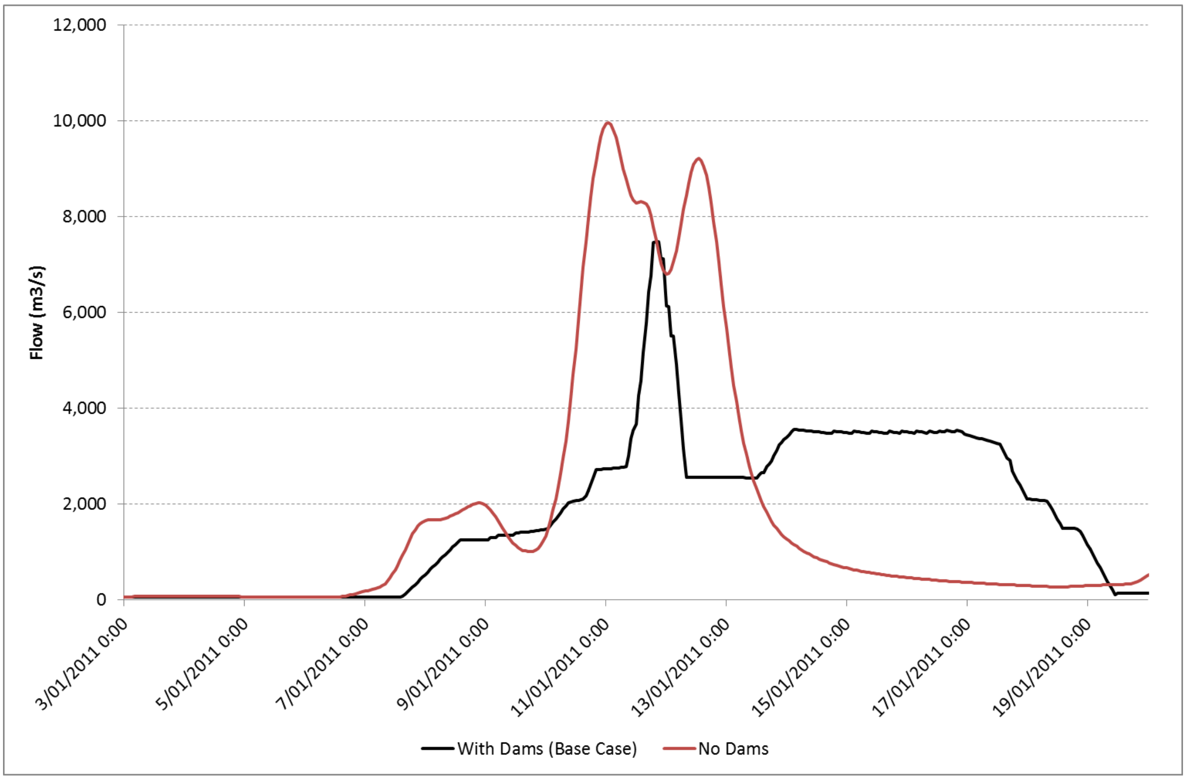


Figure 4-5 2011 Wivenhoe Outflows

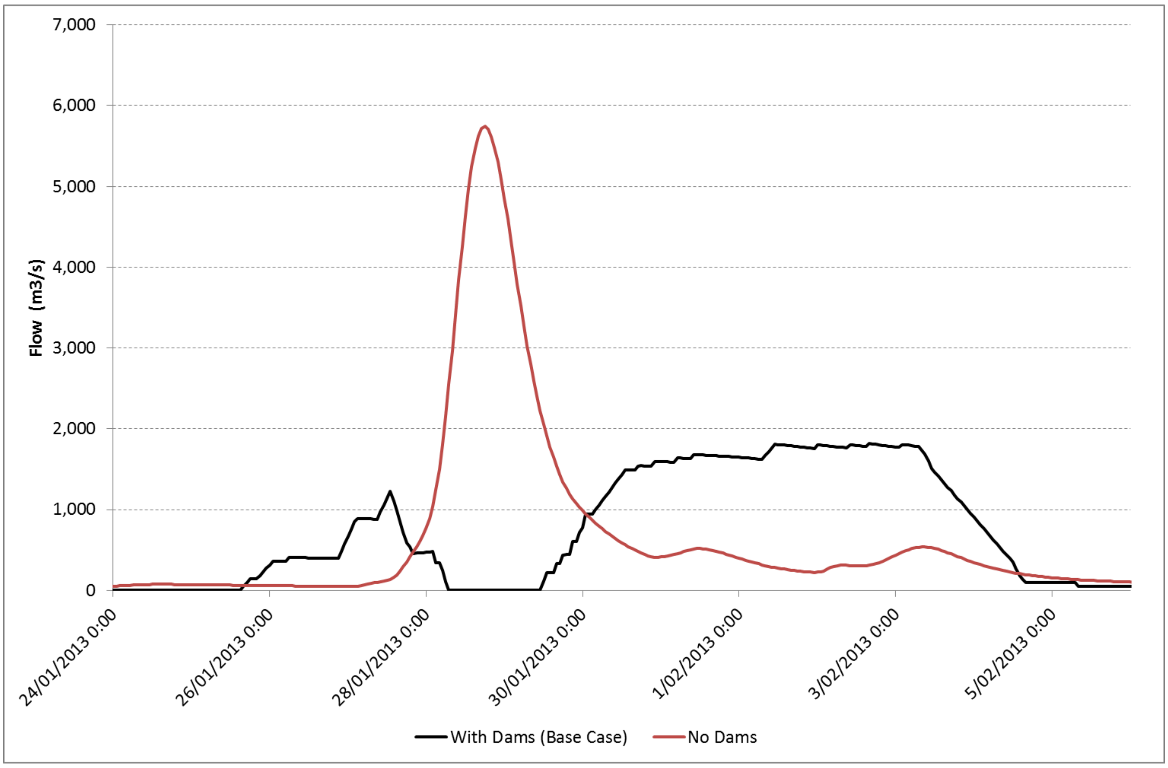


Figure 4-6 2013 Wivenhoe Outflows

4.5.1 Model Implementation – No Dams (CND)

No changes were required to the Detailed Model used for the calibration events other than to specify revised model inflows. Model inflows were derived from modified BRCFS URBS hydrologic models.

Dams are incorporated into the URBS model using different techniques depending on the size of the dam and its method of operation. Actions to remove the relevant dams influence are detailed in Table 4-5.

Table 4-5 Summary of Removing Key Dam Influence from Hydrologic Model

Dam	Year Completed	URBS Catchment	Storage (ML) to Full Supply Level	Method of Removal
Wivenhoe	1986	Upper	1,165,238	Remove input of recorded hydrograph for dam outflow in lower model Reinstate full reach lengths and floodplain storage across impounded area (based on those used in 1974 event model) Remove drowned reach factors Remove impervious area associated with impounded water surface
Somerset	1953	Stanley	379,849	Remove input of recorded hydrograph for dam outflow in upper model Remove drowned reach factors Remove impervious area associated with impounded water surface
Moogerah	1961	Warrill	83,765	Remove 'Dam Route' statement Remove impervious area associated with impounded water surface
Cressbrook	1983	Upper	81,842	Remove 'Dam Route' statement Remove drowned reach factors
Perseverance	1965	Upper	30,140	Remove 'Dam Route' statement
Manchester	1916	Lower	26,217	Remove 'Dam Route' statement

4.5.2 Model Implementation – With Dams (CWD)

All calibration events other than 1974 included the six dams listed in Table 4-5. In 1974 Wivenhoe Dam and Cressbrook Dam were not present. Cressbrook Dam is located upstream of Wivenhoe. As a fixed outflow has been supplied for use with Wivenhoe Dam for the 1974 event, then no modifications were required to reinstate Cressbrook Dam for the 1974 event.

5 Detailed Model Results

5.1 Introduction

Eleven AEP design flood ensembles have been simulated within the Detailed Model. For each AEP ensemble the peak (maximum) flood output at every model cell has been queried and the maximum value from that ensemble reported. This 'maximum of maximums' approach is used for all mapping output unless otherwise specified. In the case of the 1 in 2 AEP event, the map output is shown within the tidal limits only.

The key outputs from the study are as follows:

- **A series of drawings:** These present peak flood levels, depths, depth averaged velocities and hydraulic hazard[10] for each of the 11 design flood AEPs. The 1 in 100 AEP event drawings are provided in the accompanying Drawing Addendum and drawings for all other AEPs are supplied digitally.
- **A series of plots** in the accompanying Plot Addendum. The plots show design flood levels and flows for the duration of the model simulations. Long section plots and rating curves are also supplied in the plot addendum.
- **A set of Tables** giving Detailed Model AEP peak flood levels and flows at the 28 reporting locations are provided in an accompanying Table Addendum.

5.1.1 Provision of Digital Mapping

The Drawing Addendum contains a subset (the 1 in 100 AEP event) of the design flood mapping produced during this study. Mapping for all AEP events and sensitivity scenarios for which digital mapping was requested in the ITO (including the 1 in 100 AEP event) are provided as pdf files in a Digital Addendum (See Appendix B for list of files). The Digital Addendum is structured as shown in Figure 5-1. Note that the No Dams (CND) folder contains all five calibration events.

[10] Hydraulic hazard is the product of flood depth and the depth averaged velocity. The peak hydraulic hazard is tracked during the model simulation and occurs when the product of flood depth and velocity is greatest.

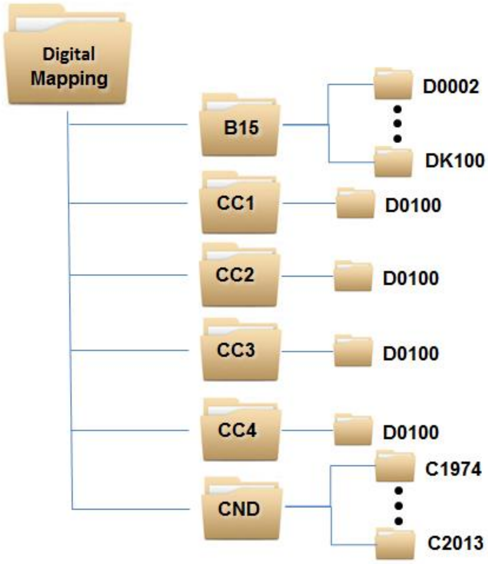


Figure 5-1 Structure of Mapping Files in Digital Addendum

5.2 Base Case Scenario (B15)

5.2.1 Drawings

Detailed Model peak outputs across the assessment area are provided digitally for all AEP events and are included in the accompanying Drawing Addendum for the 1 in 100 AEP event. These drawings are divided into AEP design events and then further divided into five regions with one A3 page per region. A key sheet identifying the regions is provided in Drawing 4.

Four model outputs are presented as follows:

- Peak Water Surface Levels – flood extent shown with 1m interval contours giving peak level to m AHD
- Peak Flood Depth Maps – colour shaded mapping indicating five intervals of flood depth
- Peak Flood Velocity Maps – colour shaded mapping with six intervals of depth averaged velocity
- Peak Depth x Velocity (Hydraulic Hazard) Maps – colour shaded mapping with five intervals of hydraulic hazard. Hydraulic hazard is the product of flood depth and the depth averaged velocity. The peak hydraulic hazard is tracked during the model simulation and occurs when the product of flood depth and velocity is greatest.

The mapping within the sections of the Detailed Model utilising 1D in-bank channels, for example Lockyer Creek and upstream of One Mile Bridge on the Bremer Catchment, provides estimates of variations in depth and velocity across the waterway despite not being a 2D solution. The mapping uses lines to form a triangulated surface. Along each line a parallel channel flow analysis is carried out to estimate how the velocity varies across the section according to variations in depth and roughness (Manning's n), from which an estimate of the velocity and DxV can be calculated.

Therefore, the V and DxV mapping within the 1D channels can be considered indicative and is useful information, although not a 2D solution. This feature is known as the WLL (Water Level Line) feature in the TUFLOW software, on which more information can be found in the TUFLOW User Manual.

All mapping also includes the following:

- A dotted line indicating the 'extreme flood' extent, nominally taken to be the 1 in 100,000 AEP flood
- Limit of mapping lines defining the upstream limits of where the design riverine flood mapping is valid
- A hatched area across flood extents shown in the Lockyer Valley Regional Council (LVRC) area and extending part way into Somerset Regional Council (SRC) area. This area is beyond the area specified in the ITO to be mapped and may be subject to higher localised creek flooding, therefore flood levels for design and planning purposes should be checked with the local council. The mapping is provided because it adds valuable insight into flood behaviour on the complex Lockyer Creek floodplain from the backwater interaction between Lockyer Creek and Brisbane River.

5.2.2 Plots

Time series plots of water levels and flows are provided in the accompanying Plot Addendum. The plots are designed so that when viewing them in digital format they can be readily zoomed into so that a much closer inspection of the results can be observed without losing image clarity.

The water level plots are grouped by the three main waterways of Lockyer Creek, Bremer River and the Brisbane River downstream of Wivenhoe Dam. Where possible/practical the plots' water level axis scale and range have been kept similar to other nearby gauges to allow ease of comparison between the gauges.

Modelled longitudinal profiles of all design events are also included in the Plot Addendum (similar to MR3). These plots provide an indication as to the relative magnitude of each design flood throughout modelled sections of Lockyer Creek, Bremer River and the Brisbane River.

5.2.3 Tables

Addendum Table 1 contains the peak flows and levels at reporting locations for all Base Case AEP design floods. The peak values are the maximum values from each AEP ensemble.

5.2.4 Discussion of Base Case (B15) Results

It can be seen from the mapping, plots and summary table of peak flood levels that, as expected, peak flood levels increase with increasing flood rarity.

Given the significance of the 1 in 100 AEP event as a traditional reference flood, some additional commentary has been provided for this event to aid understanding of the event magnitude in the context of historical events. Figure 5-2 to Figure 5-4 present design flood levels for the 1 in 50 to 1 in 500 AEP events along with the simulated 1974 and 2011 flood levels for Lowood, Ipswich and

Brisbane respectively to assist with interpretation. For brevity, the smaller and larger design events are not shown. The following points are noted:

- In the lower reaches of Lockyer Creek the 1 in 100 AEP flood level is typically higher than both the 1974 and 2011 floods but only moderately so by around 0.2m to 0.4m. However due to the complex nature of the lower Lockyer floodplain, in localised areas the historical events were higher.
- For much of the mid Brisbane River between Wivenhoe Dam and Moggill, including the lower reaches of the Bremer, the 1 in 100 AEP flood is lower than both the 2011 and the 1974 floods. For example near Lowood the 1 in 100 AEP flood is lower than both the 1974 and 2011 events by approximately 0.8m to 1.0m.
- Near Ipswich CBD the 1 in 100 AEP flood is around 1m higher than the 2011 flood but around 0.8m lower than the 1974 flood.
- The 1 in 100 AEP flood is higher than the 2011 flood in the lower reaches of the Brisbane River, downstream of Centenary Bridge. Typically it is between 0.1m and 0.3m higher and in the vicinity of Brisbane CBD the difference ranges from 0.1m to 0.15m.
- Near the estuary, downstream from the Gateway Motorway, the 1 in 100 AEP flood is similar to the peak level resulting from the storm surge experienced in the January 2013 event. This was higher than both the 2011 and 1974 flood levels.
- Backwater flooding from the Brisbane River occurs on numerous tributaries, most notably on the Bremer River and Oxley Creek but also on many local creeks on the lower Brisbane River such as Norman, Bulimba and Breakfast Creeks. Backwater flooding in the lower reaches of these creeks is likely to result in peak flood levels higher than that which would be experienced from a local 1 in 100 AEP flood event on the respective creeks.
- The rate of rise and duration of inundation of the 1 in 100 AEP flood will vary depending on the ensemble event considered. The individual ensemble event that results in the highest flood level at any given location may not be the event that exhibits the fastest rate of rise or longest duration of inundation at that location. This is because the ensemble events have been selected on the basis of satisfying peak flood level criteria only. For this reason, it is recommended that if rate of rise or duration of inundation is of specific interest in future studies, then consideration be given as to whether a suitable rate of rise at a particular location for a given AEP is given by: a) the critical event that provides the peak flood level AEP; or b) one of the AEP ensemble events; or c) one of the 11,340 Monte Carlo events. Whether or not a rate of rise estimated by one of these three options is suitable is dependent upon the accuracy required.

With regard to the 1 in 200 AEP flood, this is higher at all modelled locations than either of the two biggest floods of recent times: the 1974 and 2011 floods, noting that Wivenhoe Dam was not constructed at the time of the 1974 event. However, at Brisbane CBD the 1 in 200 AEP flood is only slightly higher by around 0.1m to 0.2m than the 1974 flood. The 1 in 200 AEP flood is comparable to the CC2 climate change event for the 1 in 100 AEP flood where a 0.3m sea level rise and 10% increase in rainfall are applied (see Section 0).

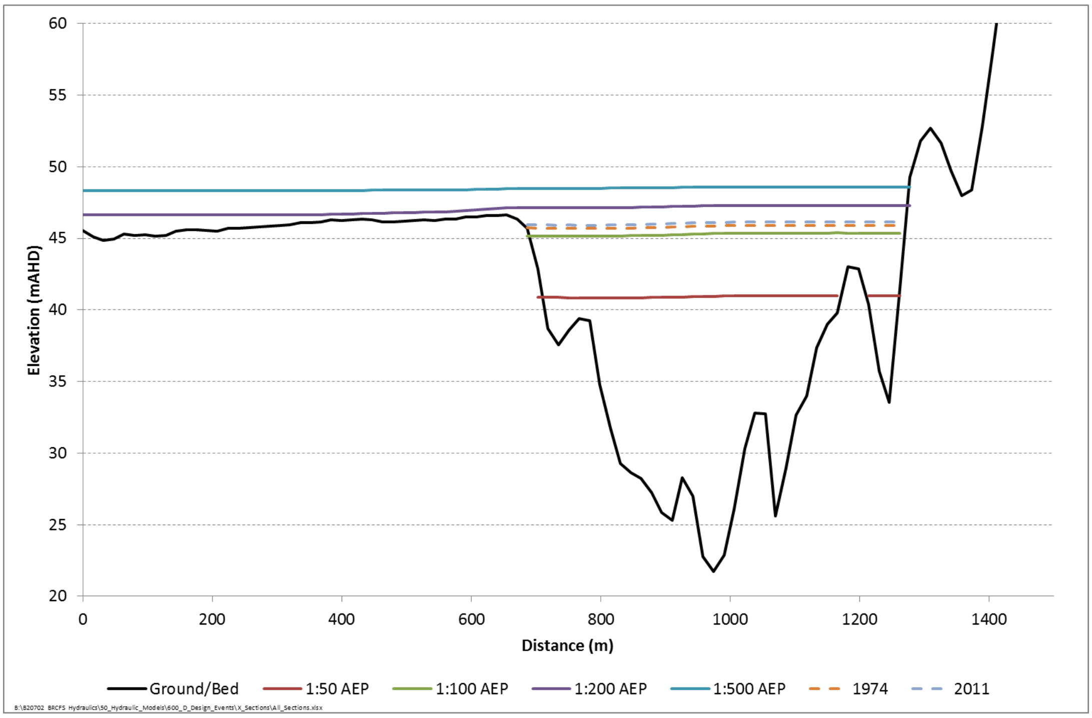


Figure 5-2 Lowood Design and Historic Flood Levels

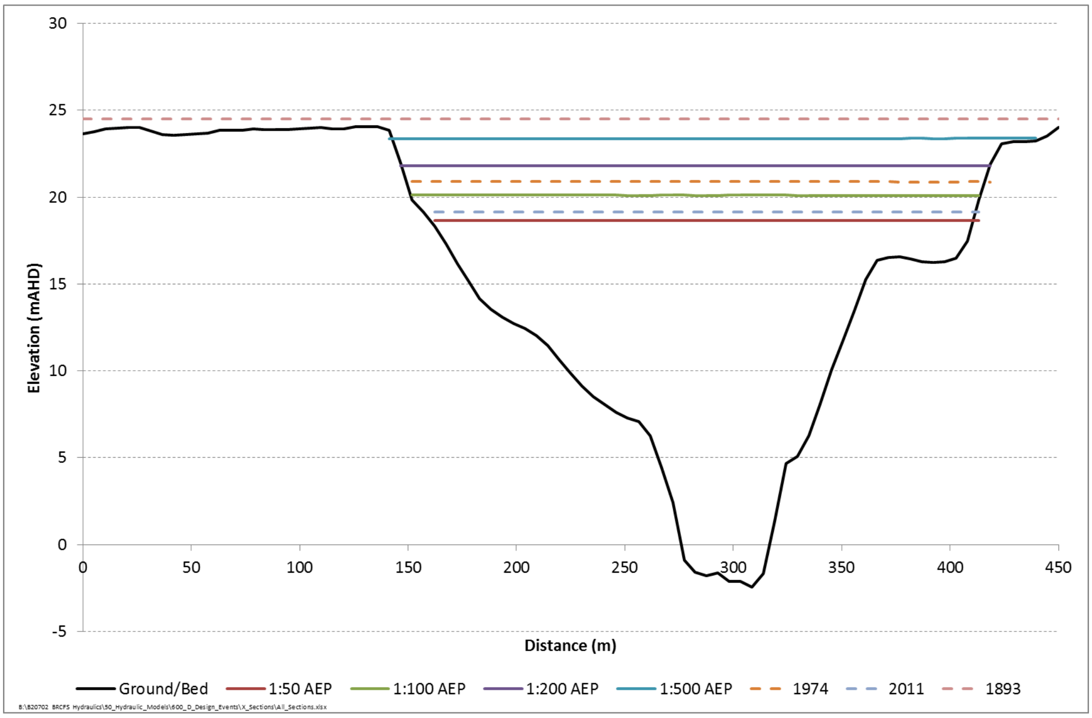


Figure 5-3 Ipswich CBD Design and Historic Flood Levels

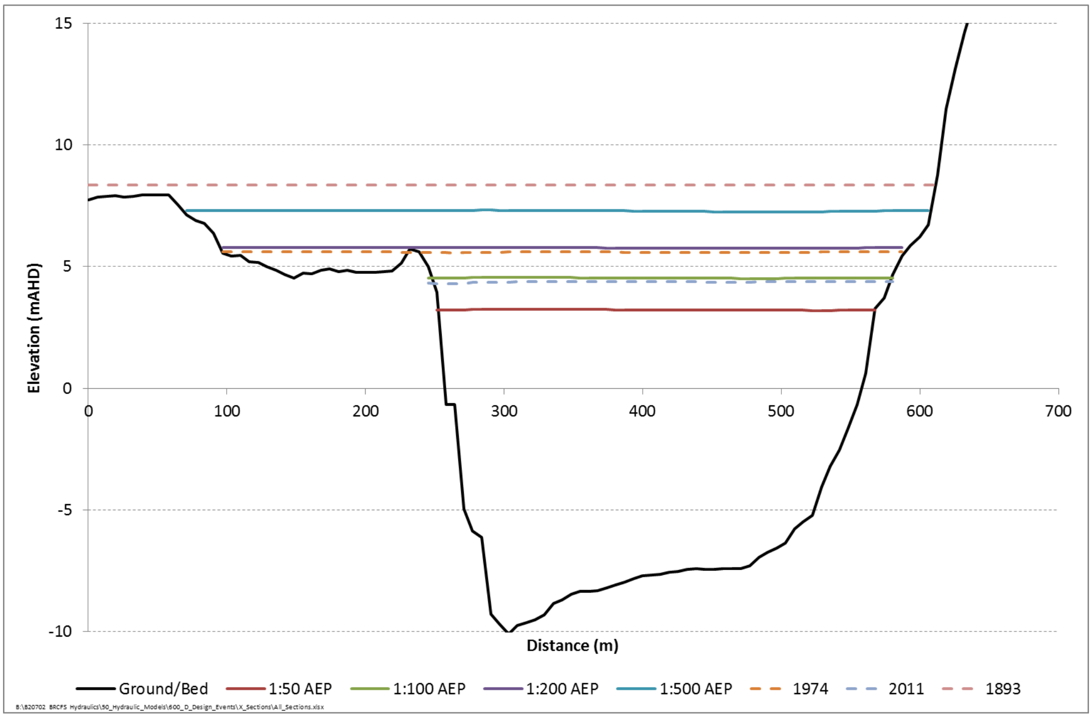


Figure 5-4 Brisbane CBD (City Gauge) Design and Historic Flood Levels

In addition to peak flood level, peak depth, velocity and hydraulic hazard are mapped. The hydraulic hazard is a combination (product) of depth and velocity. Therefore, areas of high hazard can be areas of deep water, fast flowing water, or both.

Typically areas with high hazard values (1.2 or greater) are within the main rivers as would be expected. Areas with high hazard values are also present in the floodplain where water may form deep overland flow routes such as some of those seen in the complex Lockyer Creek floodplain. High hazard is also apparent in many tributaries into which the backwater from the main river extends. This water would typically have a very low velocity but the depth can be significant, leading to high hazard values.

Within the Brisbane CBD minor inundation is shown for a 1 in 10 AEP flood in lower lying parts of Margaret Street. The extent of flooding increases significantly for the 1 in 100 AEP flood extending north along Albert Street and south into Alice Street and across into the Botanical Gardens. The floodwater originates from back up from the stormwater network (and potentially other underground conduits such as car parks) rather than overtopping of the river banks.

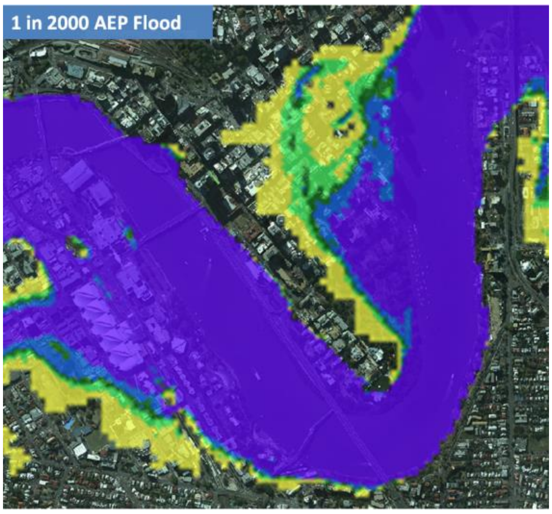
In the 1 in 100 AEP event the hazard in these Brisbane CBD areas remains low with a typical value of 0.02. The 1 in 200 AEP flood indicates that overtopping of the riverbank along the Eagle Street waterfront occurs and much of the south eastern part of the CBD is inundated. However, hydraulic hazard remains low as the water is ponding with minimal velocity.

As flood magnitudes increase further, flow routes begin to establish through the CBD. This is apparent for events of the 1 in 500 AEP magnitude and greater. Initially the flow route is through the south eastern portion of the Botanical Gardens and, as the magnitude increases to the 1 in

2,000 AEP flood, much of the south eastern part of the Brisbane CBD effectively becomes part of the river (see Figure 5-5).

A notable change in flood behaviour occurs in the 1 in 10,000 AEP flood when floodwaters start to short circuit the CBD river meander by breaking over the bank between the William Jolly Bridge and North Quay and flowing through the CBD along main thoroughfares like Adelaide and Queen Street to re-join the river near Kangaroo Point. Almost all of the CBD is inundated under this extreme event with the flooding having high hazard values (5.0 or greater) due to the depth and velocity of flow.

Short-circuiting of river meanders is widespread for the 1 in 10,000 AEP flood with other notable examples of established bypass flow routes in Brisbane, in addition to the CBD, at Fig Tree Pocket, Indooroopilly, Fairfield and St Lucia.



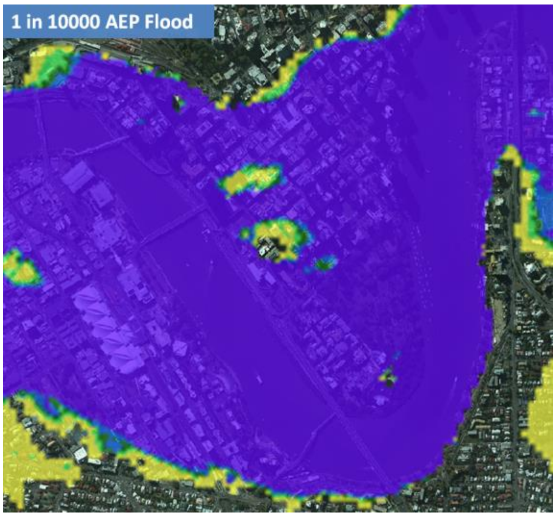


Figure 5-5 Brisbane CDB: Hydraulic Hazard and onset of Breakout Flowpaths

Ipswich CBD is subject to minor flooding in the 1 in 5 AEP flood with floodwaters backing up into the Marsden Parade area of the city. In the 1 in 10 and 1 in 20 AEP flood there is some inundation in parts of North Ipswich such as at the eastern ends of Lawrence and Canning Streets (see Figure 5-6).

In the 1 in 50 AEP flood there is an additional breakout near the CBD into Timothy Molony Park and into surrounding streets. The two breakouts into the CBD are more extensive in the 1 in 100 AEP event (Figure 5-6), but retain relatively low hazard values as the floodwater is predominately ponded backwater and not actively flowing.

For the 1 in 500 AEP flood, there is significant inundation of Ipswich CBD and North Ipswich along with other parts of the city.

The flood behaviour in the vicinity of the Ipswich CBD begins to change in the 1 in 10,000 AEP event as areas of backwater flooding begin to flow, effectively becoming part of the river. This results in high hazard values in northern parts of the Ipswich CBD close to the Bremer River.

The 1 in 100,000 AEP event shows extreme levels of inundation, with the Bremer River meander at the Ipswich CBD short circuited by flow passing from Brassall through to Tivoli across much of North Ipswich.

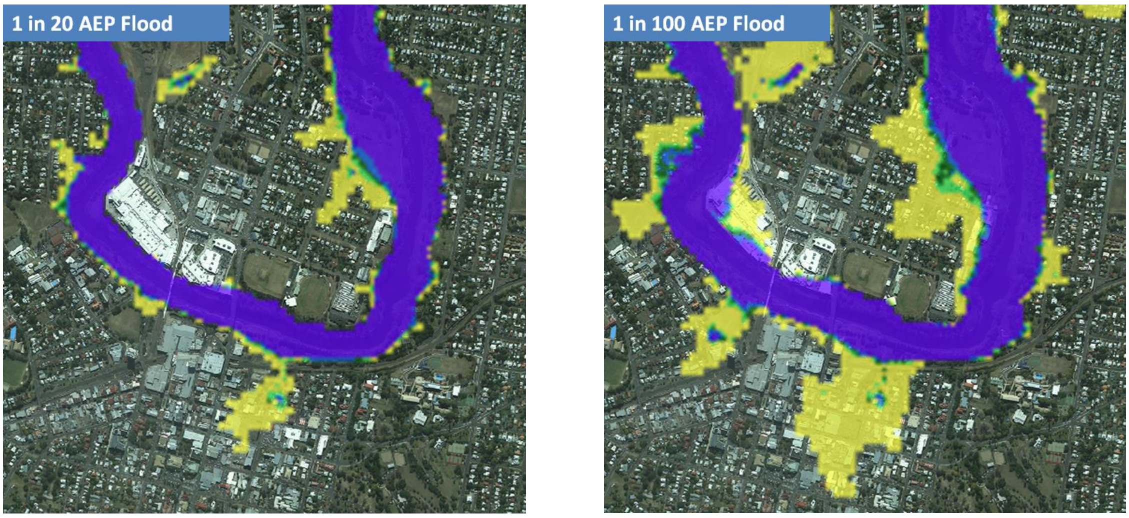


Figure 5-6 Ipswich CDB: Hydraulic Hazard Backwater Inundation

The town of Fernvale experienced flooding in the 2011 event via an overland flow route that bypassed the river bend upstream of the quarry. Design event modelling shows this flow route to become active in the 1 in 100 AEP flood with moderate hazard values as the depth of flow is typically shallow. In the larger 1 in 200 AEP flood this flow route is more established and hazardous as can be seen in Figure 5-7. Inundation within Fernvale is relatively extensive.

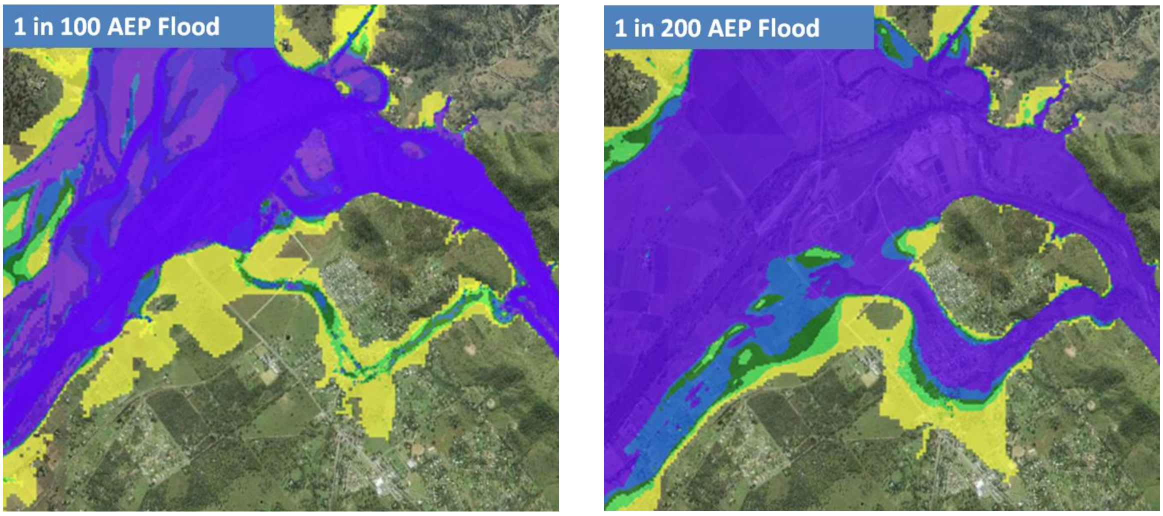


Figure 5-7 Fernvale: Hydraulic Hazard and Bypass Flow

5.2.5 Comparison to Fast Model Design Results

Peak flood levels from the Detailed Model for each AEP flood have been compared with those from the Fast Model. Addendum Table 2 gives the change in level from the Fast Model. A positive value is where the Detailed Model is higher than the Fast Model and vice versa. Due to the differences in modelling approach, differences are expected but overall the agreement is considered good with notable differences explainable. Some key points are summarised below:

- The models show good agreement for events ranging from the 1 in 20 to the 1 in 200 AEP flood. This is broadly within the range of the larger calibration events and encompasses the key design floods.
- The 1 in 100 AEP flood in particular typically showed very good agreement between the models with the differences being within ±0.1m for much of the lower Brisbane River.
- For more extreme floods there is good overall agreement but there are some notable differences eg. for the 1 in 100,000 AEP flood on the lower Brisbane where the Detailed Model predicts higher levels. This is consistent with the findings during the models' development and calibration phases (MR2 and MR3) when comparing the 5x1974 and 8x1974 events, and is an artefact for the different modelling approaches.
- There are some notable differences at Lyons Bridge (Lockyer Creek) with the Detailed Model generally predicting lower levels than the Fast Model (around 1m lower in the 1 in 100 AEP flood). Given the complexity of the floodplain and the difficulties of representing and simplifying this complexity within a 1D model schematisation, differences of this magnitude are not unexpected.

5.3 Sensitivity Analyses

As discussed in Section 4, sensitivity tests have been undertaken for the following scenarios:

- Floodplain Future Condition (FF1);
- Climate Change scenarios (CC1, CC2, CC3, CC4);
- Bed Level scenarios (BL1, BL2); and
- Calibration events No/With Dams (CND, CWD).

In accordance with the ITO and subsequent discussions at project workshops, results for sensitivity tests are presented in formats summarised in Table 5-1.

Table 5-1 Summary of Presentation Formats for Sensitivity Test Results

Event	Floodplain Future (FF1)	Climate Change (CC1 to CC4)	Bed Levels (BL1, BL2)	With/Without Dams CND, CWD
1974	-	-	-	RS, dh
1996	-	-	-	RS, dh
1999	-	-	-	RS, dh
2011	-	-	-	TS, dh

Event	Floodplain Future (FF1)	Climate Change (CC1 to CC4)	Bed Levels (BL1, BL2)	With/Without Dams CND, CWD
2013	-	-	-	RS, dh
20% AEP	-	RS	RS	-
5% AEP	-	RS	RS	-
1% AEP	RS	DM	RS	-
0.5% AEP	RS	-	-	-
0.2% AEP	RS	-	-	-
0.01% AEP	RS	RS	RS	-

RS = Summary of results (Peak flows and levels) at reporting locations

DM = Digital Mapping (d,h,V,z0) and full hydrographs at reporting locations

TS = Full hydrographs (water level and flows) at reporting locations

dh = Difference map (change in peak flood level from unmodified scenario)

Mapping outputs, plots and tables can be found in the respective addenda. To aid interpretation, the tables of peak flows and levels include the change in flow/level from the Base Case.

Please refer to Section 4 for details on the methodology developed and implemented for each of these scenarios. Also included in Section 4 is discussion on the limitations associated with the sensitivity scenario results.

5.3.1 Floodplain Future Condition (FF1) Discussion

The modelled increase in ground levels outside a nominated floodplain within both BCC and ICC administrative areas under the floodplain future scenario has resulted in a throttling of flows compared to the Base Case (existing) case. The extent of fill within BCC area is largely located outside of the 1 in 100 AEP flood extent and by itself would not have a significant effect on peak flood levels for this event. However, the ICC fill does encroach onto the 1 in 100 AEP flood extent and consequently this increases flood levels upstream of Ipswich with a corresponding decrease downstream. The downstream effects extend as far as Brisbane CBD where peak 1 in 100 AEP flood levels are reduced under this scenario by around 0.08m at the City Gauge.

For the 1 in 200 AEP flood there is a similar pattern as for the 1 in 100 AEP flood whereby flows are constrained upstream of Ipswich resulting in higher levels there and lower levels downstream. However peak levels on some tributaries increase due to the squeeze on floodplain storage under the fill scenario. Increases in flood level are noted for Oxley Creek and Breakfast Creek.

The 1 in 500 AEP flood has a mix of increasing and decreasing peak levels, increasing upstream of constrictions in the floodplain caused by the modelled increase in ground levels and decreasing downstream.

For the extreme flows of the 1 in 10,000 AEP flood, the floodplain is highly constrained compared to Base Case conditions and significant increases are observed upstream of Tennyson (near the outlet of Oxley Creek). These increases extend all the way up the modelled lengths of the Bremer catchment and extend up the Brisbane River to Wivenhoe Dam and into the lower reaches of Lockyer Creek. Downstream of Tennyson, the peak flood levels are reduced as a result of the throttling effect of flows. Peak levels are around 2m lower at the City Gauge in Brisbane CBD.

Please refer to Section 4 for details on the methodology developed and implemented for each of these scenarios. Also included in Section 4 is discussion on the limitations associated with the sensitivity scenario results.

5.3.2 Climate Change Sensitivity

Four climate change scenarios have been assessed as detailed in Section 4.3 and summarised as:

CC1 – 0.3m sea level rise

CC2 – 0.3m sea level rise and 10% increase in rainfall

CC3 – 0.8m sea level rise

CC4 – 0.8m sea level rise and 20% increase in rainfall

The scenarios have been applied to the 1 in 5, 20, 100 and 10,000 AEP events. Digital mapping is produced for the 1 in 100 AEP event only in accordance with the ITO. Peak level results at Brisbane and Ipswich CBD's are summarised in Table 5-2.

Table 5-2 Change in Peak Flood Level under Climate Change Sensitivity Scenarios

	Increase in Peak Flood Level from Base Case (m)			
AEP	Brisbane (City Gauge)		Ipswich (David Trumpy Bridge)	
1 in …	CC2	CC4	CC2	CC4
5	0.3	0.8	1.0	1.8
20	0.5	1.1	0.8	1.5
100	1.2	2.5	0.9	2.4
10,000	1.7	3.0	1.1	2.0

Mapping for the scenarios when applied to the 1 in 100 AEP event is as expected, with increases in peak flood levels for the sea level rise only scenarios (i.e. CC1 and CC3) confined to the lower Brisbane and Bremer Rivers. The scenarios CC2 and CC4, for which rainfall also increases, show rises in peak flood level at all locations.

For much of the Brisbane River the CC2 scenario (0.3m rise in sea level and 10% increase in rainfall intensity) produces similar peak levels to the Base Case (B15) 1 in 200 AEP flood levels. For the CC4 scenario (0.8m rise in sea level and 20% increase in rainfall intensity) produces peak levels around 2.5m above Base Case 1 in 100 AEP levels for Brisbane CBD and for parts of the lower Bremer peak levels for this scenario are around 3.75m higher than the Base Case.

It can be seen from Addendum Table 5 and Addendum Table 7 that typically the increases in flows are greater than either the 10% or 20% rainfall increase in each respective scenario. This is partially attributed to the non-linearity of the catchment rainfall-runoff response. For example, a

10% increase in rainfall intensity causes greater than 10% increase in runoff rate (or flow) as the losses are assumed to not change (note that the increase in rainfall intensity due to climate change is an increase to the total rainfall falling on the catchments). Furthermore, outflow from the dam may similarly increase non-linearly due to the way in which the dam operates when inflows increase and because dam outflows are also sensitive to inflow volume.

As discussed in Section 4.1, the climate change scenarios do not produce equivalent AEP peak flood levels for that scenario unless the selection of AEP flood event ensembles is repeated for each sensitivity test. The climate change sensitivity test results therefore need to be treated as indicative only and with an appropriate degree of caution as discussed in Section 4.1.

5.3.3 Bed Level Sensitivity

Two bed level sensitivity scenarios have been assessed; a decrease in bed level approximating a 20% increase in flow conveyance and an increase in bed level approximating a 20% decrease in flow conveyance. As discussed in Section 4.4 the changes have been applied only to the in-bank tidal zone on the Brisbane River. Results of the scenarios generally conform to expectations in that the decrease in bed level reduces levels along affected lengths and vice versa. Some exceptions to this are for the relatively low magnitude 1 in 5 AEP event where a lowering of bed level has resulted in marginal increases in peak flood level between Centenary Bridge and Brisbane CBD. This effect is attributed to the increased conveyance allowing greater penetration of the tide and any tidal storm surge into the model. For larger riverine events this effect becomes less pronounced as the flood peak dominates.

Figure 5-8 plots the 1 in 100 AEP peak flood levels at Brisbane CBD (City Gauge), for the BL1 and BL2 scenarios. To aid comparison, the Base Case (B15) peak level is also shown.

The decrease in bed level lowers peak 1 in 100 AEP flood levels at Brisbane CBD by around 0.7m. Although there are no changes to bed level along the Bremer River, the peak level at Ipswich CBD decreases by around 0.3m as a result of the increased conveyance on the Brisbane River.

The increase in bed level increases the 1 in 100 AEP peak flood level at Brisbane CBD by around 1m. An increase in peak flood level of 0.5m is also seen at Ipswich CBD despite no change in bed level along the Bremer River due to backwater effects from the higher Brisbane River.

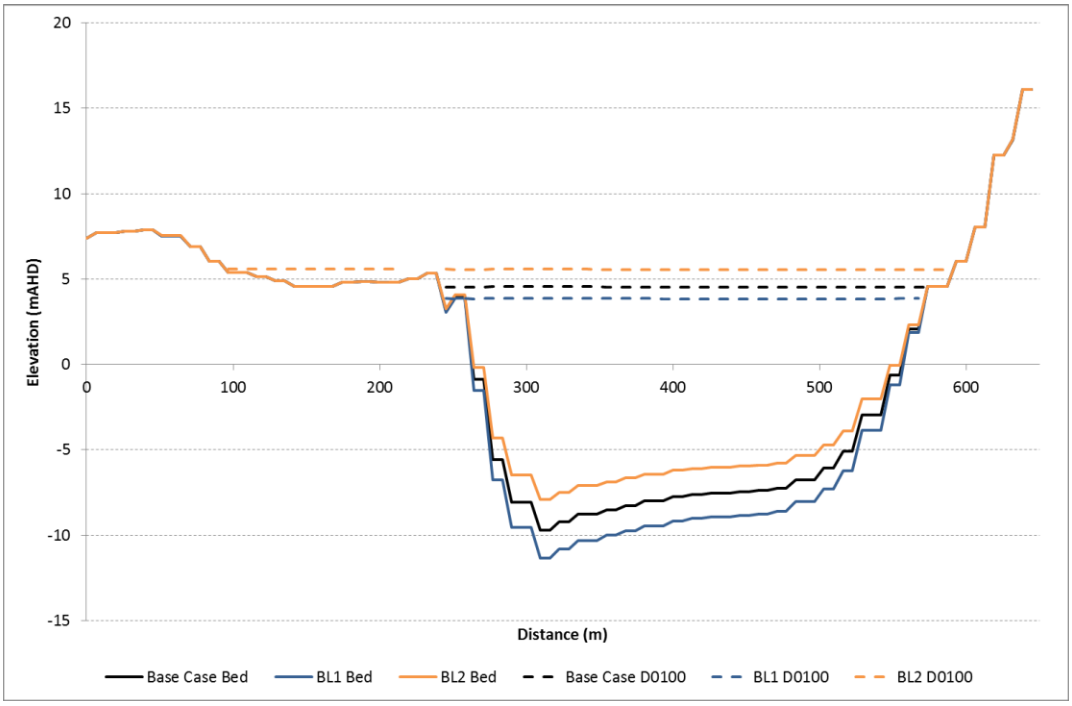


Figure 5-8 Brisbane CBD: Bed Level Sensitivity, D0100 AEP Event

5.3.4 No Dams Sensitivity

Table 5-3 and Table 5-4 present a summary of the peak levels for the 'no dams' and 'with dams' scenarios at Brisbane and Ipswich CBDs respectively. It can be seen that under the with dams scenarios i.e. with Wivenhoe and the other dams, all five simulated events show lower peak flood levels than would have otherwise occurred under a 'no dams' scenario.

For the 2011 event the dams reduced the flood peak by approximately 2.0m in Brisbane and 2.8m at Ipswich for the model conditions simulated.

Table 5-3 No Dams: Brisbane City Gauge

Event	No Dams (mAHD)	With Dams (mAHD)	Decrease with Dams (m)
1974	6.3	3.9	-2.4
1996	2.7	1.9	-0.8
1999	3.3	1.5	-1.8
2011	6.5	4.5	-2.0
2013	3.1	2.2	-0.9

Table 5-4 No Dams: Ipswich CBD

Event	No Dams (mAHD)	With Dams (mAHD)	Decrease with Dams (m)
1974	21.8	20.3	-1.5
1996	14.2	13.8	-0.4
1999	16.4	7.8	-8.6
2011	22.0	19.2	-2.8
2013	16.8	14.1	-2.7

6 Rating Curve Review

6.1 Introduction

6.1.1 Background

The primary purpose of the review of the rating curves at gauges focuses on the requirements for consistency between the Hydrologic and Hydraulic Assessments, as well as improving our understanding of the stage-discharge relationships at key stream gauging stations, particularly at those locations affected by backwater, with the aim of further refining the existing rating curves as appropriate. This chapter is similar to that produced for MR3, but updated with the addition of the results from the 60 design Monte Carlo events to allow for further understanding of the hydraulic behaviour from the larger events.

The background to the development of the rating curves is summarised as follows:

- Seqwater undertook initial development of the Hydrologic Assessment URBS models and completed a review of the rating curves as part of this work in 2013. The Seqwater investigations undertook extensive calibration to over 35 flood events and this was undertaken conjunctively with a review of the rating curves. This meant that the rating curves informed the calibration of the URBS models and the calibration results were also used to improve the curves. The Seqwater review investigated a broad range of data, however, the Seqwater review only had access to limited hydraulic modelling analyses.
- The Hydrologic Assessment (Aurecon) undertook a further extensive review of the rating curves in 2014 and 2015. The Aurecon review completed a range of further independent and localised hydraulic modelling to inform the review of the rating curves, however only limited calibration was carried out for some of this hydraulic modelling. The DMT modelling results were also used in the latter stages of the review. Some rating curves were revised as part of the Aurecon Review. Aurecon then recalibrated the URBS models, however, this recalibration was limited to the five historical flood events of 1974, 1996, 1999, 2011 and 2013. The key aspects of the rating curves for the Hydrologic Assessment, in order of importance are:
    - The rating curves were used to convert recorded peak gauge height to estimates of rated flow for use in the flood frequency analysis. The flood frequency analysis was then used to reconcile the design AEP peak flow and volume estimates from the Monte Carlo Simulation and Design Event Approach estimates. In this context the rating curves have significant importance for the flood frequency estimates arising from the BRCFS. If significant revision of the rating curves is identified as necessary, the flood frequency analysis may need to be revised and the design AEP peak flow and volume estimates may need to be updated.
    - The rating curves adopted in the Hydrologic Assessment were used to recalibrate the URBS models. The recalibration, performed by Aurecon, produced different estimates of historical flood flow hydrographs compared to the estimates derived in the Seqwater model calibration. Considering the different focus of the Seqwater and Aurecon work, these differences are generally of little consequence to the Hydrologic Assessment, but may be important for the Hydraulic Assessment Fast and Detailed Models calibration. The 'best fit' routing URBS

parameters were not significantly different to the Seqwater estimates for the URBS models where the catchment vector configuration was not changed.

  - Whilst the URBS model hydrologic calibration and flood frequency analysis are critically dependent upon the rating curves, the rating curves were also reviewed and adjusted by Aurecon as part of an iterative process in order to achieve consistency of the Hydrologic Assessment results between gauges in each model (representing each sub-catchment) as well as the whole system (catchment-wide).

- The Hydraulic Assessment modelling has relied upon estimates of the historical flood flow hydrographs produced by the Hydrologic Assessment URBS model recalibration for calibration of the Fast and Detailed Models. This means that to some extent the Fast and Detailed Models' calibration is dependent on the rating curves adopted by Aurecon to calibrate the Hydrologic Assessment URBS models. On this basis, it is important that the Fast and Detailed Model results are used to review the rating curves at key gauges in order to understand the consistency with the rating curves used in the Hydrologic Assessment and therefore to be able to deem whether the "combined" hydrology and hydraulics model calibrations are acceptably consistent. If significant differences are evident, outside the bounds of data inaccuracies and modelling assumptions and uncertainties, it may indicate a need to:
  - Revise the entire calibration processes to achieve acceptable closure of the differences; and
  - Revise the flood frequency analyses applied in the Hydrologic Assessment as this is important information to reconcile and "adjust" parameters used the design flood estimates arising from the Monte Carlo and design flood event simulations.

The extensive review of the existing rating curves generated by Seqwater, DNRM, BoM and other sources carried out as part of the Hydrologic Assessment are presented in the Data, Rating Curve and Historical Flood Review Report (Aurecon, 2015d) and summarised in the Draft Final Hydrology Report (Aurecon, 2015c). The Seqwater and Hydrologic Assessment (Aurecon) curves are shown on the rating curve plots discussed in this section.

The review of the Hydrologic Assessment (Aurecon) rating curves presented in MR3, and subsequently reviewed by the TWG and IPE, concluded the rating curves to be commensurate with the hydraulic modelling stage-discharge relationships within the bounds of data inaccuracies, modelling uncertainties, hysteresis effects, and variations in hydraulic behaviour of the different calibration events. On this basis it was agreed that there was no justifiable benefit in revising the hydrologic and hydraulic modelling calibrations.

6.1.2 Stage-Discharge Data from Hydraulic Models

The Fast and Detailed Models, as hydraulic models, produce data on how flow varies with water level (the stage-discharge relationship), from which the existing rating curves including those adopted for the Hydrologic Assessment can be compared and refined as appropriate.

Importantly, the stage-discharge relationship at a site can vary, sometimes significantly, resulting in different flows for a given water level. This variation known as hysteresis or looping in the curve occurs where the flood surface gradient and/or backwater effects vary during the flood. For example, flows are usually higher on the rising limb than the falling limb due to the steeper flood surface gradient on the flood rise. Where variable backwater effects occur, for example, the tide or the Brisbane River backing up the Bremer River, there can be considerable differences in flows resulting in substantial looping in the stage-discharge relationship. The greater the backwater effect the lower the flow. Of importance is that where there is little or no hysteresis in the relationship, a reliable rating curve can be derived. Where hysteresis does occur there is no single rating curve that can represent the stage-discharge relationship.

It is to be noted that different models (eg. URBS hydrologic model and the Fast and Detailed hydraulic models) have varying abilities to represent the complex and variable looping characteristics of rating curves. The hydraulic models with their ability to reproduce variations in hydraulic gradients as the flood rises and falls, and to take into account more accurately the effects of backwater, are considered significantly more accurate in this regard, however, there is always some degree of uncertainty associated with the input data and modelling approximations.

There will also be differences in rating curves apparent between the Fast and Detailed Models, particularly for extreme flows. For example, the higher peak flood levels in some locations in the Detailed Model under extreme flows compared with those in the Fast Model as shown in Addendum Table 2 and in the rating curves (Plot 61 to Plot 63) are a result of greater head losses in the Detailed Model at the major constrictions and bends such as at Breakfast Creek and Story Bridge. The differences between the Fast Model and the Detailed Model are primarily the consequence of the Fast Model's substantially more simplistic geometrical representation of the river and floodplains, as well as the more simplistic assumptions adopted in the 1D hydraulic equations used by the Fast Model. For the 1 in 100 AEP event the difference between the Fast Model and Detailed Model at Brisbane CBD is negligible at 0.1% of the depth. The maximum difference between the Fast Model and Detailed Model is less than 10% of the depth for the 1 in 100,000 AEP at the Brisbane CBD (ie. 3.1m difference in a depth of 34m). At the majority of locations the difference is a within a few percent or less, representing compatibility between the Fast and Detailed Models. Also of note is that the lack of calibration data for events greater than around the 1 in 500 AEP means that greater differences are likely between the Fast and Detailed Models for the more extreme events, as is apparent in the results.

The differences between the Fast and Detailed Models have negligible or no impact on the study outcomes and that the final results from the Detailed Models are acceptable for the purpose of the flood study. The IPE endorse this specifically. The Fast Model's role in the Hydraulic Assessment was to act as an alternative hydraulic model designed for simulating a large number of Monte Carlo events generated by the Hydrologic Assessment, as it was not practical to simulate all of the 11,340 Monte Carlo events through the Detailed Model; hence the need for a numerically faster model (ie. the Fast Model). The Fast Model Monte Carlo results were used to perform an AEP flood frequency analysis, from which a subset or ensembles of Monte Carlo events were selected to represent different AEP events Milestone Report 4 (BMT WBM, 2016). Differences between the Fast and Detailed Model do not affect the implementation of this process, provided the Fast and Detailed Models produce reasonably consistent results and similar hydraulic behaviour at the Reporting Locations, which is considered to be the case.

Importantly, comparison of the rating curves needs to take into account these influencing factors including, but not limited to: input data inaccuracies; modelling assumptions and uncertainties; the different hydraulic behaviour of different events; and variations in hydraulic behaviour causing hysteresis.

6.1.3 Rating Curve Plots

Plot 58 to Plot 63 present the results from the Fast and Detailed Models plotted against the existing rating curves developed by Seqwater (labelled as Operational) and the curves developed by the Hydrologic Assessment. Each site is discussed in detail in the following sections, with observations and recommendations provided.

Note: The data on Plot 58 to Plot 60 and from Plot 61 to Plot 63 are the same, but shown at different scales. The first set of plots are scaled in the range from minor to major flooding, while the second set of plots are scaled from minor to extreme flooding.

In interpreting the plots note that:

- Detailed Model stage-discharge results are shown using red symbols for calibration events and grey for the 60 design events.
- Fast Model stage-discharge results are shown using green symbols for calibration events and mauve for the 60 design events.
- Seqwater rating curves are shown using dark blue circles.
- Aurecon (Hydrologic Assessment) rating curves use cyan (light blue) circles.
- Available gauging information from any past floods, including ones other than the calibration events are shown as a yellow circle. Only a few of the sites have available gauging information.
- Where backwater or tidal effects occur, the Fast and Detailed Model results show a more pronounced hysteresis or looping, with the lower side of the loop (higher flows) occurring during the flood rise, and the higher side (lower flows) on the flood recession.
- The Brisbane City Gauge results show the strong effect of the ocean tide at lower levels.

6.1.4 General Observations

General observations are summarised as follows:

- The most noticeable differences occur during the in-bank stages of Glenore Grove and Rifle Range, and the higher stages of Loamside. For Glenore Grove and Rifle Range the in-bank differences could be due to the uncertainties associated with using LiDAR for in-bank areas and the inaccuracies associated with deriving the rating curves.
- There is some looping (hysteresis) effects at some gauges. Where this occurs the rating curves tend to match with the rising limb of the flood (ie. with the lower side of the hysteresis curve).
- As discussed in MR3, at gauges such as Mt Crosby and Moggill there is a noticeable difference between the major floods of 1974 and 2011, despite having similar peak flows at Mt Crosby. This is most likely due to the different flood shapes; the 2011 flood, due to the influence of Wivenhoe Dam, was a shorter, sharper shape with less volume than the 1974 event. The Bremer River flow entering at Moggill in 1974 was also greater than 2011 making 1974 larger

than 2011 downstream of the rivers' confluence. This is aptly illustrated at the lower Brisbane gauges where the flood level was above 10 mAHD for around 3 days in 1974, but less than 2 days in 2011.

- The inclusion of the 60 design event results for the 11 AEPs has value added to the understanding of the level of uncertainty associated with hysteresis caused by backwater effects and different shaped hydrographs. From the design event results, the rating curves in some instances could be refined as appropriate, and extended to include extreme events.

6.1.5 Rating Curve Interpretation

Whilst the Hydraulic Assessment ITO sought to achieve a consistent, robust and agreed set of rating curves at key gauge sites, after discussions and agreement with the TWG (comprising of senior technical officers from various agencies including Seqwater, Bureau of Meteorology, four catchment Councils and DNRM) and IPE, it was agreed that the results from the hydraulic modelling should be used to help inform agencies of the sensitivity and uncertainty of the rating curves, and provide commentary on the validity of the rating curves. Different organisations utilise the rating curves for different purposes, and may choose or not choose to adopt or refine rating curves based on the findings of the Hydraulic Assessment. Hence it was agreed not to produce a single rating curve that can satisfy all users.

Whilst the overall reliability and accuracy of the rating curves depend on various factors (including the site characteristics, data and modelling), the following sections emphasise uncertainties in the stage-discharge relationships due to hysteresis. Where hysteresis is evident, there is also the question over whether to follow the rising limb or the level at the peak flow, as these two approaches can yield different rating curves. The discussion in the following sections for uncertainty of rating relationships has not considered potential rating change over time due to geomorphological influences, vegetation changes, or topography changes such as development and levee banks etc, which are beyond the scope of the study. The rating curves at key gauge sites within the Hydraulic Assessment study area are also important to organisations such as Seqwater, DNRM, BoM, and Councils, for operation of Wivenhoe Dam, water resources planning and management and for flood forecasting and warnings. Rating relationships can often be used to provide estimates of (a) estimate of flow based on measured flood levels to inform real time flood modelling for forecasting and to support the operation of Wivenhoe Dam, and (b) to provide estimates of flood levels based on a flow scenario. Ultimately, it is the responsibility of each organisation to derive and utilise rating curve(s) that meet their particular objectives and ongoing operational needs.

The information and plots in this section may also provide some guidance to organisations and interested parties in terms of interpreting the uncertainties and degree of hysteresis at each gauge site to further refine the existing rating curves as appropriate for their needs. This information, together with the hydraulic modelling information from the 60 design event simulations, may assist to inform extrapolation of the rating curves to levels beyond historical records, gaugings and other flow estimates such as steady state dam releases.

6.2 Glenore Grove (Lockyer Creek)

The Seqwater and Aurecon rating curves for Glenore Grove on Lockyer Creek are presented in Plot 58 and Plot 61. The curves are plotted against the stage-discharge results from the Fast and Detailed Models for the calibration and design floods.

Aurecon *et al* (2015c) Commentary

Catchment:	Lockyer Creek to O'Reilly's Weir	Power-law fit of data up to 2.5m then hydraulic model results
Stream:	Lockyer Creek	Rating is considered to be good up to around 13m (900m³/s) with generally good fit of flows (translated from Lyons Bridge) and hydrologic model data. Generally good agreement above this level and rating is considered reasonable, but becomes very sensitive to changes in level
Site:	Glenore Grove	
Gauge No:	143807	
Owner:	BoM	

Observations

- For flows up to around 4,000 m^3/s, which covers all the calibration events, there are minor hysteresis effects in the model results indicating the site is a reasonable rating location for flows up to this magnitude.
- For larger events, little or no hysteresis effects occur as seen for the extreme events. In this regard Glenore Grove is suited as a rating site at all levels, and the presence of the large Lockyer Creek floodplains downstream seems to have little influence on the stage-discharge relationship.
- The Seqwater and Aurecon rating curves have a similar shape to the stage-discharge relationship from the Fast and Detailed Models, although there is a vertical shift of around 1.0m with the Aurecon curve. The Seqwater curve is a closer match to the model results.
- The adjoining floodplains have a pronounced influence on the shape of the stage-discharge relationship, with a major flattening of the curve at around 81 to 82 mAHD. The accuracy of the rating curve above this elevation is highly uncertain due to the flat-lining of the curve.
- Whilst the Seqwater and Aurecon curves are in closer agreement with the Fast Model at their limit of around 4,000 m^3/s, the results from the Detailed Model are considered more accurate.
- The stage-discharge accuracy of the Fast and Detailed Models for predominantly in-bank flows only, ie. less than around 1,000 m^3/s, would be influenced by the vertical inaccuracies associated with using LiDAR for the in-bank topography.

Conclusions and Recommendations

- Glenore Grove is a reliable rating curve location for all flows in that there is little or no hysteresis, however, it should be treated with considerable uncertainty once predominately overbank flows develop due to the flat-lining of the curve.
- The Seqwater curve matches best with the model results and is recommended as the preferred rating curve for Glenore Grove. Consideration should be given to fine-tuning the rating curve for flows in excess of 1,500 m^3/s based on the Detailed Model results. If the rating curve is extended beyond 4,000 m^3/s, it is recommended that the Detailed Model stage-discharge

relationship is used in preference to the Fast Model, however, as mentioned above, the extreme flat-lining of the relationship means that estimation of high flows should be treated with considerable uncertainty.

- As the Aurecon curve is not significantly different compared to the preferred rating curve, further consideration for any likely revision or refinement of associated Hydrologic Assessment work is not warranted.

6.3 Rifle Range Road (Lockyer Creek)

The Seqwater and Aurecon rating curves for Rifle Range Road on Lockyer Creek are presented in in Plot 58 and Plot 61. The curves are plotted against the stage-discharge results from the Fast and Detailed Models for the calibration and design events.

Aurecon *et al* (2015c) Commentary[11]

Catchment:	Lockyer Creek to O'Reilly's Weir	Power law best-fit of flow gauging and hydrologic model data Reasonable fit of flow gauging data up to 15.85m (830m^3/s). Perched channel in wide floodplain with unreliable and potentially inconsistent response above bank-full capacity. Rating should not be used above bank-full (15.5m approx.)
Stream:	Lockyer Creek	
Site:	Rifle Range Rd	
Gauge No:	143210B	
Owner:	DNRM	

Observations

- For flows up to around 5,000 m^3/s, which covers all the calibration events, there are minor hysteresis effects in the Detailed Model results indicating the site is a reasonable rating location in this regard for flows up to this magnitude. The Fast Model shows a greater spread in the relationship, but is considered less accurate than the Detailed Model.
- For larger events, significant hysteresis effects can occur as seen for extreme events once backwater effects from the Brisbane River take place. Rifle Range Road is, therefore, not well-suited as a rating site once backwater effects of the Brisbane River occur. The exception would be that flows on the rising limb prior to any backwater effects could be considered useable, but subject to high uncertainty due to the flat-lining of the curve caused by the large Lockyer Creek floodplains.
- The Seqwater and Aurecon rating curves have a similar shape to the stage-discharge relationship from the Fast and Detailed Models, although there is a significant vertical shift of up to 2m or more for predominately in-bank flows (up to 1,000 m^3/s) and 0.5 to 1.0 m for flows exceeding 1,000 m^3/s. As for Glenore Grove, the flat-lining of the relationship once overbank flows develop make flow estimates considerably uncertain once overbank flooding commences.

[11] Note that the Gauge No for Rifle Range Road is amended from the Aurecon report.

- The stage-discharge accuracy of the Fast and Detailed Models for predominantly in-bank flows only, ie. less than around 1,000 m^3/s, would be influenced by the vertical inaccuracies associated with using LiDAR for the in-bank topography.

Conclusions and Recommendations

- Rifle Range Road is potentially a reasonable rating curve location for in-bank flows with greater uncertainty once predominately overbank flows develop due to the flat-lining of the curve.
- If Rifle Range Road is to be used as a rating location, it would be beneficial to conduct a closer review of the differences between the rating curves and the stage-discharge relationship from the Fast and Detailed Models. However, there will always be considerable uncertainty in flow estimates once overbank flows develop, and for this reason, it is not recommended to use Rifle Range Road as a reliable rating location.

6.4 Walloon (Bremer River)

The Seqwater and Aurecon rating curves for Walloon on the Bremer River are presented in Plot 58 and Plot 61. The curves are plotted against the stage-discharge results from the Fast and Detailed Models for the calibration and design events.

Aurecon *et al* (2015c) Commentary

Catchment:	Bremer River to Walloon	DNRM rating up to 5m then hydraulic model results
Stream:	Bremer River	Generally good fit of flow gaugings and hydrologic model data up to about 9m. Rating becomes fairly sensitive at high flows and potentially affected by backwater from major Brisbane River/Warrill Creek floods due to 'choke point' that forms in the reach downstream of the Warrill Creek confluence.
Site:	Walloon	
Gauge No:	143107A	
Owner:	DNRM	

Observations

- For flows up to around 2,000 m^3/s, which covers all the calibration events, there are minor hysteresis effects in the model results indicating the site is a reasonable rating location for flows up to this magnitude.
- The Walloon rating is affected by backwater effects when there are high levels on the Brisbane River giving rise to significant hysteresis under such conditions. Use of a tail-water dependent rating would be recommended for operational use.
- The Seqwater and Aurecon rating curves have a similar shape to the rising limb of the stage-discharge relationships from the Fast and Detailed Models, with the Seqwater curve providing the best match.
- There is no evidence of the vertical shift between the rating curves and the models as occurs at Loamside. This is of interest in that the Fast and Detailed Models use the same LiDAR data for in-bank and overbank ground elevations at Loamside and Walloon.

Conclusions and Recommendations

- The stage-discharge relationship is reliable up to around 2,000 m^3/s assuming there are no backwater effects from the Brisbane River. The site is unsuitable for rating flows once Brisbane

River backwater effects occur. However, reliable flows can be estimated on the rising limb prior to any backwater effects.

- The Seqwater curve matches with the model results and is recommended as the preferred rating curve for Walloon. The curve could be further extended along the rising limb of floods exceeding 2,500 m^3/s, provided there are no backwater effects occurring.

- As the Aurecon curve is not significantly different compared to the preferred rating curve, further consideration for any likely revision or refinement of associated Hydrologic Assessment work is not warranted.

6.5 Amberley (Warrill Creek)

The Seqwater and Aurecon rating curves for Amberley on Warrill Creek are presented in Plot 58 and Plot 61. The curves are plotted against the stage-discharge results from the Fast and Detailed Models for the calibration and design events.

Aurecon *et al* (2015c) Commentary

Catchment:	Warrill Creek to Amberley	Power-law fit of data up to 5m then hydraulic model results
Stream:	Warrill Creek	Good fit of flow gaugings. Deviates significantly from Seqwater rating above 8m due to breakout of flows upstream of gauge location. Rating is considered to be good, but becomes very sensitive to changes in level above 10m (1200m^3/s)
Site:	Amberley	
Gauge No:	143108A	
Owner:	DNRM	

Observations

- For flows below 2,000 m^3/s, which covers all the calibration events, there is little or no hysteresis in the model results indicating the site is a suitable rating location for flows up to this magnitude.
- A significant hysteresis can develop, as seen for the extreme events, due to backwater effects from the Brisbane River. Amberley is, therefore, not well-suited as a rating site once backwater effects of the Brisbane River take place.
- The Seqwater and Aurecon rating curves have a similar shape to the stage-discharge relationship from the Fast and Detailed Models, with the Aurecon curve providing the best match.
- A number of streamflow gaugings are available for Amberley as shown by the yellow circles. The Fast and Detailed Model results, and the rating curves, align with the gaugings providing confidence in the rating curves and the models at Amberley.
- There is no evidence of the vertical shift between the rating curves and the models as occurred at Loamside. This is of interest in that the Fast and Detailed Models use the same LiDAR data for in-bank and overbank ground elevations at Loamside and Amberley.

Conclusions and Recommendations

- The stage-discharge relationship is reliable up to around 2,000 m^3/s depending on the presence of backwater effects from the Brisbane River. The site is unsuitable for rating flows once Brisbane River backwater effects occur. However, reliable flows can be estimated on the rising limb prior to any backwater effects.
- The Aurecon curve matches with the model results and is recommended as the preferred rating curve for Amberley. The curve could be further extended using the rising limb for floods exceeding 3,000 m^3/s, provided there are no backwater effects occurring.

6.6 Loamside (Purga Creek)

The Seqwater and Aurecon rating curves for Loamside on Purga Creek are presented in Plot 59 and Plot 62. The curves are plotted against the stage-discharge results from the Fast and Detailed Models for the calibration and design events.

Aurecon *et al* (2015c) Commentary

Catchment:	Purga Creek to Loamside	DNRM rating up to 6m then hydraulic model results
Stream:	Purga Creek	Generally good fit of flow gaugings and hydrologic model data. Rating is considered to be reasonable, but becomes very sensitive to changes in level above 7.5m (170m³/s)
Site:	Loamside	
Gauge No:	143113A	
Owner:	DNRM	

Observations

- For flows below 800 m^3/s, which covers all the calibration events, there is little or no hysteresis in the model results indicating the site is a suitable rating location for flows up to this magnitude.
- For flows above 800 m^3/s, a significant hysteresis can develop as seen for the extreme events. This would be due to backwater effects from the Brisbane River. Loamside is, therefore, not well-suited as a rating site once backwater effects of the Brisbane River take place. For the floods simulated, a consistent rating is seen on the rising limb (lower side of the curve) up to around 1,500 m^3/s.
- The Seqwater and Aurecon rating curves have a similar shape to the stage-discharge relationship from the Fast and Detailed Models, but sit lower by 0.5 to 0.8m, although there are events that concur well with the rating curves. The offset is most likely due to inaccuracies in vertical elevations of the LiDAR that was used for the modelling in this area, especially for heavily vegetated in-bank sections and/or associated with other uncertainties.

Conclusions and Recommendations

- The stage-discharge relationship is reliable up to around 800 m^3/s, and on the rising limb up to higher flows depending on the presence of backwater effects from the Brisbane River. The site is unsuitable for rating flows once Brisbane River backwater effects occur.
- Ground surveys in the vicinity of the rating curves is available from Seqwater that may assist in ascertaining the causes for the 0.5 to 0.8m discrepancy should further investigation be

warranted. Until such an investigation is undertaken, the Loamside rating curves should be preferred over those from the Detailed Model due to uncertainties over the vertical accuracies in the LiDAR used by the model, particularly for in-bank flows.

- The Aurecon and Seqwater curves are similar, with the Aurecon curve most likely preferred due to its more recent derivation.

6.7 Savages Crossing (Brisbane River)

The Seqwater and Aurecon rating curves for Savages Crossing on the Brisbane River are presented in Plot 59 and Plot 62. The curves are plotted against the stage-discharge results from the Fast and Detailed Models for the calibration and design events.

Aurecon *et al* (2015c) Commentary

Catchment:	Lower Brisbane River	Rating updated based on review of gaugings, steady-state release flows and DMT TUFLOW model results
Stream:	Brisbane River	Rating provides reasonable fit of flow gauging, steady flow release and hydrologic model data. Well contained site but believed to be subject to changes in rating. Available data displays some historical variation, most notably an abrupt change during/after the 2011 flood event. Gauge is considered to be reasonably rated but not particularly consistent
Site:	Savages Crossing	
Gauge No:	143001C	
Owner:	DNRM	

Observations

- For flows up to around 10,000 m^3/s, which covers all the calibration events, there are minor hysteresis effects in the model results indicating the site is a reasonable rating location for flows up to this magnitude.
- For larger events, minor hysteresis effects continue to occur as seen for the extreme events. Savages Crossing is, therefore, well suited as a rating site at all levels noting that there is some uncertainty associated with hysteresis.
- A number of streamflow gaugings are available for Savages Crossing as shown by the yellow circles. The Detailed Model matches the gaugings closer than the Fast Model, and is also in better agreement than the rating curves. It should be noted that many of the gaugings are probably taken on the receding limb or during post-flood, steady-state, discharges from Wivenhoe Dam, and are therefore not reflective of the rising limb of the stage-discharge relationship results (note that the rising limb is on the lower side of the hysteresis loop).
- The Seqwater and Aurecon rating curves are comparable and have a similar shape to the stage-discharge relationships from the Fast and Detailed Models. There is a particularly close match between the rating curves and the rising limb of the Detailed Model results.
- The design events show a greater spread of results, which would be reflective of their wider variation in hydrograph shapes.

Conclusions and Recommendations

- Savages Crossing is a good rating curve location for all flows with minor hysteresis evident.

- The Aurecon and Seqwater curves match with the model results up to 10,000 m^3/s. For flows above 10,000 m^3/s, adjusting and extending the curve to be in line with the rising limb of the Detailed Model stage-discharge relationship is recommended.
- As the Aurecon curve is not significantly different compared to the preferred rating curve, further consideration for any likely revision or refinement of associated Hydrologic Assessment work is not warranted.

6.8 Mt Crosby Weir (Brisbane River)

The Seqwater and Aurecon rating curves for Mt Crosby Weir on the Brisbane River are presented in Plot 59 and Plot 62. The curves are plotted against the stage-discharge results from the Fast and Detailed Models for the calibration and design events.

Aurecon *et al* (2015c) Commentary

Catchment:	Lower Brisbane River	Rating updated based on review of gaugings, steady-state release flows and DMT TUFLOW model results Gauge location is considered to be reasonable with well-defined weir crest and relatively confined channel. Rating provides generally good fit of flow gauging, steady flow release and most hydrologic data, although it is noted that a number of the hydrologic model results deviate significantly from the rating Importantly, the rating is considered relatively unreliable between around 1,200 and 2,000m³/s. Interference of the bridge is considered a likely cause
Stream:	Brisbane River	
Site:	Mt Crosby Weir	
Gauge No:	430003A	
Owner:	Seqwater	

Observations

- For flows between 1,500 m^3/s and 10,000 m^3/s, which covers all the calibration events, hysteresis effects in the model results are evident indicating the site, while a reasonable rating location for flows up to 10,000 m^3/s, is subject to greater uncertainty in flow estimates. There is also greater separation between different flood events (for example, between the 1974 and 2011 events as documented in MR3) than for Savages Crossing further upstream that further reduces the accuracy of using Mt Crosby as a rating site.
- For smaller flows (less than 1,500 m^3/s) the weir acts as a hydraulic control and is not affected by downstream tail-water levels.
- For larger events, the hysteresis effects evident in the calibration events diminishes as seen for the extreme events. Mt Crosby Weir is, therefore, suited as a rating site at all levels noting that there is uncertainty associated with hysteresis, especially for flows under 20,000 m^3/s.
- The Seqwater and Aurecon rating curves are comparable and match the rising limb of the stage-discharge relationship from the Detailed Model, although the Aurecon curve seems to over predict flows above 30mAHD. Of interest is that the Aurecon curve matches with the rising limb of the 2011 flood, while the Seqwater curve lies between the rising limbs of the 1974 and 2011 events as documented in MR3.

Conclusions and Preliminary Recommendations

- Mt Crosby Weir is a reasonable rating curve location for all flows with uncertainties associated with hysteresis effects, especially for flows below 20,000 m^3/s.
- The weir hydraulics is complex and by necessity, there is some approximation in its representation in the Detailed Model. To further improve the rating a full 3D computational fluid dynamics (CFD) model could be developed noting that this is outside the scope of the BRCFS Hydraulic Assessment.
- The Seqwater curve is more consistent with the Detailed Model results and perhaps should be preferred over the Aurecon curve, especially for flood levels above 30mAHD. For flows above 15,000 m^3/s, adjusting and extending the curve to be in line with the rising limb of the Detailed Model stage-discharge relationship is recommended.
- As the Aurecon curve is not significantly different compared to the preferred rating curve, further consideration for any likely revision or refinement of associated Hydrologic Assessment work is not warranted.

6.9 Moggill (Brisbane River)

The Seqwater and Aurecon rating curves for Moggill on the Brisbane River are presented in Plot 59 and Plot 62. The curves are plotted against the stage-discharge results from the Fast and Detailed Models for the calibration and design events.

Aurecon *et al* (2015c) Commentary

Catchment:	Lower Brisbane River	Rating updated based on review of gaugings, steady-state release flows and DMT TUFLOW model results Rating provides generally good fit of steady flow release and hydrologic data, but no flow gauging available for comparison. Rating is considered to be reasonable, with a fairly well contained site. Revised rating tends to predict higher flows than previously estimated due to dynamic effects and attenuation evident in the TUFLOW model but not properly represented in the hydrologic model
Stream:	Brisbane River	
Site:	Moggill	
Gauge No:	143951	
Owner:	BoM/Seqwater	

Observations

- Similar to Mt Crosby Weir, for flows up to around 12,000 m^3/s, which covers all the calibration events, hysteresis effects in the model results are evident indicating the site, while a reasonable rating location for flows up to this magnitude, is subject to greater uncertainty in flow estimates. There is also greater separation between different flood events than for Savages Crossing further upstream that adds to the uncertainty in flow estimates.
- For larger events, the hysteresis effects evident in the calibration events remains as seen for the extreme events. Moggill is, therefore, suited as a rating site at all levels noting that there is uncertainty associated with hysteresis.
- The Seqwater and Aurecon rating curves tend to match the rising limbs of the stage-discharge relationships from the Fast and Detailed Models. Of interest is that for flows above 4,500 m^3/s,

the Aurecon curve lies closer to the lower bound (higher flow) of the modelled events, while the Seqwater curve sits above the Aurecon curve yielding a significantly lower flow.

- The evidence of the tide for flows below 2,000 m^3/s is apparent in the Fast and Detailed Models' results.

Conclusions and Preliminary Recommendations

- Moggill is a reasonable rating curve location for flows above 2,000 m^3/s, noting that there are uncertainties associated with hysteresis effects. For flows below 2,000 m^3/s there is a significant influence from varying tide levels.
- For flows above 4,500 m^3/s, the Aurecon curve lies closer to the lower bound (rising limb) of events than the Seqwater curve and perhaps should be preferred. For flows above 12,000 m^3/s, the Aurecon curve continues to match the rising limb relationship from the modelling and should the curve be further extended the rising limb from the Detailed Model results should be utilised.

6.10 Centenary Bridge (Brisbane River)

The Seqwater and Aurecon rating curves for Moggill on the Brisbane River are presented in Plot **60** and Plot **63**. The curves are plotted against the stage-discharge results from the Fast and Detailed Models for the calibration and design events.

Aurecon *et al* (2015c) Commentary

Catchment:	Lower Brisbane River	Rating updated based on review of gaugings, steady-state release flows and DMT TUFLOW model results Rating provides generally good fit of flow gauging, steady flow release and hydrologic data. Rating is considered to be reasonable, with a fairly well contained site and flow gauging up to high flows (10,000m³/s). However, site is subject to significant dynamic effects, meaning that there is not a direct relationship between flow and level
Stream:	Brisbane River	
Site:	Centenary Bridge	
Gauge No:	43982	
Owner:	BoM	

Observations

- Similar to Moggill, for flows from around 2,000m^3/s up to around 12,000 m^3/s, which covers all the calibration events, hysteresis effects in the model results are evident indicating the site, while a reasonable rating location for flows up to this magnitude, is subject to greater uncertainty in flow estimates. There is also separation between different flood events that further increases the uncertainty in flow estimates.
- For larger events, the hysteresis effects evident in the calibration events increases as seen for the extreme events. Centenary Bridge is, therefore, suited as a rating site at all levels noting that there is uncertainty associated with hysteresis, and that this uncertainty increases with extreme events.
- A number of streamflow gaugings are available for Centenary Bridge as shown by the yellow circles. The gaugings, taken at different stages of different floods, demonstrate the variability due to rising and falling limbs. The three recordings from 1974 are all on the falling limb of the

event and these align with the falling limb of the Detailed Model results for 1974 as documented in MR3, but these falling limb flows are significantly different to the higher rising limb flows as predicted by the modelling.

- The Seqwater and Aurecon rating curves tend to match the rising limbs of the stage-discharge relationships from the Fast and Detailed Models. Of interest is that for flows above 5,000 m^3/s, the Aurecon curve lies between the rising limbs of the 1974 and 2011 floods, while the Seqwater curve matches the 1974 flood, but not the 2011 event as documented in MR3.
- The evidence of the tide for flows below 4,000 m^3/s is apparent in the Fast and Detailed Models' results.
- For flows above 12,000 m^3/s or 15 mAHD, the Seqwater and Aurecon curves diverge, with the Aurecon curve significantly more consistent with the hydraulic modelling.
- For flows below 2,000m^3/s there is a significant influence from varying tide levels.

Conclusions and Preliminary Recommendations

- Centenary Bridge is a reasonable rating curve location for all flows, noting that there are uncertainties associated with hysteresis effects that increases with extreme events.
- The Aurecon curve is more consistent overall with the hydraulic modelling, especially for flows above 12,000 m^3/s. Should the rating curves be further extended, the rising limb from the Detailed Model results should be utilised.

6.11 City Gauge (Brisbane River)

The Seqwater and Aurecon rating curves for City Gauge on the Brisbane River are presented in Plot 60 and Plot 63. The curves are plotted against the stage-discharge results from the Fast and Detailed Models for the calibration and design events.

Aurecon *et al* (2015c) Commentary

Catchment:	Lower Brisbane River	Rating updated based on review of gaugings, steady-state release flows and DMT TUFLOW model results Rating is highly tide dependent even up to high flow rates (>10,000m³/s). Site has also been subjected to dredging and other changes, the effects of which are unquantified Overall, the current rating appears to give a reasonable estimate of the flow order-of-magnitude and match of historical flood events for flows in the range 6,000 to 16,000 m³/s. The site/rating is complex and improving the rating would require significant work (hydraulic modelling) that is outside the scope the current study
Stream:	Brisbane River	
Site:	Brisbane City	
Gauge No:	143838	
Owner:	Seqwater	

Observations

- For flows up to around 12,000 m^3/s, which covers all the calibration events, hysteresis effects in the model results are evident, as are tidal effects, indicating the site, while a reasonable rating location for flows up to this magnitude, is subject to significant uncertainties at the lower end due to the tidal effects.

- For extreme events, the hysteresis effects and tidal effects evident in the calibration events disappears, and the degree of hysteresis is minimal due to the confined nature of the river at this location. City Gauge is, therefore, suited as a rating site at all levels noting that there is significant uncertainty associated with hysteresis and tidal effects for flows below 12,000 m^3/s. There is a significant differential between the Fast and Detailed Model results for extreme events at this location, with the Detailed Model results considered to be more accurate due to the complex flow processes that occur at these levels (see discussion in Section 6.1.2).
- The Seqwater and Aurecon rating curves have two bounds to accommodate the tidal effects. The curves match reasonably well with the range of flows with the Aurecon curves providing the best fit for flows below 7,000 m^3/s. For flows above 7,000 m^3/s there are mixed correlations between the Seqwater and Aurecon curves, with the Aurecon curve aligning well with the lower bound (rising limb) of the hydraulic modelling. For flows above 12,000 m^3/s, the Aurecon curve matches the rising limbs significantly more closely than the Seqwater curve, with the Detailed Model results indicating that the Aurecon flows may still be slightly overestimating in the 15,000 to 20,000 m^3/s range.

Conclusions and Preliminary Recommendations

- City Gauge is a reasonable rating curve location for extreme flood flows, and can be used for rating flows above 12,000 m^3/s. Below 12,000 m^3/s there are significant uncertainties associated with hysteresis and tidal effects.
- If the City Gauge rating curve is to be further improved, the results from the Detailed Model could be used, however, the uncertainties associated with particularly the tidal influences limits the value of the City Gauge rating curve for the majority of flood events.

7 Hydraulic Structures

7.1 Introduction

Structures were included in the Detailed Model if they had the potential to impact on flood behaviour along the main watercourses. This included all known structures crossing the main waterways and significant structures in backwater areas. Minor floodplain structures were included, such as culverts through railway embankments, where their omission would result in a constrained flood extent.

Hydraulic structures representing the bridges over the main rivers in the Detailed Model remain unchanged from those included in model development and calibration stage see Milestone Report 3 (BMT WBM, 2015b) for details.

7.2 Hydraulic Structure Reference Sheets

The Hydraulic Structure Reference Sheets (HSRS) presented in Milestone Report 3 (BMT WBM, 2015b) have been updated with results from the design flood modelling for the 1 in 100 and 1 in 2000 AEP events as per the ITO and are included in Appendix C. These events were selected as they are frequently required for hydraulic assessment of bridges.

As for MR3, details of the structure itself are included in the HSRS along with modelled output on discharges, flow area and flow velocity under and over the structure. Upstream and downstream peak water levels are also provided along with the resulting head drop. Preliminary guidance on whether or not to consider blockage in future assessments is also provided (see Section 7.3).

7.3 Blockage Analysis

An assessment of the potential impacts resulting from a partial or full blockage of the bridges does not form part of the project scope. However a significant amount of data and knowledge has been gained from undertaking the hydraulic modelling. Some preliminary guidance on whether or not to consider blockage in future assessments such as those that may be undertaken as part of the follow on Flood Management Study has been summarised in Addendum Table 11. This information has also been incorporated into the Hydraulic Structure Reference Sheets. Blockage considerations have been provided for the substructure i.e. below bridge obvert, and superstructure, principally blockage of bridge railings. Generally bridges with narrow spans are considered for sub-structure blockage and bridges with railings are considered for superstructure blockage. Bridges that have solid barriers are not considered for blockage as the barrier is modelled with a 100% blockage by default. Addendum Table 11 also includes some brief commentary on each structure including any comments on historical blockage received from local councils.

8 Limitations

The Detailed Model represents the most comprehensive hydraulic modelling assessment tool – and interfaces with the most comprehensive hydrologic assessment (Aurecon 2015) – of the Brisbane River undertaken to date. The modelling has: utilised the latest data to develop computer models; proofed these models by validating their results against five well documented historical floods; and employed industry leading techniques such as Monte Carlo statistical analysis to derive AEP design floods that encompass the effects on flood behaviour caused by the influence of Somerset and Wivenhoe Dams, along with the variable responses of the Brisbane River and its major tributaries of Lockyer Creek and Bremer River. As such, the AEP design flood results from the Detailed Model are significantly more reliable and robust than any previous regional scale hydraulic assessments undertaken.

The Detailed Model has been developed to quantify riverine flooding information for the Brisbane River downstream of Wivenhoe Dam for floods of different annual exceedance probability (AEP), ie. the design floods. The future of use of the Detailed Model needs to take into account the limitations and constraints outlined below to ensure that its application to flood management tasks, and the interpretation of the Detailed Model's outputs, are confined within the bounds and intent of the BRCFS and the model's design.

8.1 Riverine versus Local Flooding

Brisbane River riverine flooding is the inundation caused by flooding in the Brisbane River. As required by the ITO, to meet the objective of quantifying riverine flooding the modelling needs to include areas that experience inundation caused or exacerbated by elevated water levels in the Brisbane River; inundation of this nature is often referred to as flooding due to backwater effects. Notably, this includes the lower sections of Lockyer Creek and the Bremer River extending up into Warrill and Purga Creeks, but also includes all numerous smaller side tributaries.

Localised flooding, that is flooding caused by rainfall within a tributary's catchment, is a different flooding mechanism and may cause higher or lower flood levels, and different flood behaviour compared with backwater flooding from the Brisbane River. For example, a local creek may also be prone to flash flooding with little warning time and rapidly rising flood levels, which would contrast with backwater flooding that rises slowly and steadily as the Brisbane River rises.

Where the flood maps extend into the tributaries, the flood information provided is caused by Brisbane River backwater effects, and not that from local flooding. Note that all tributaries contribute runoff to the system for the flood events simulated, however, the rainfall onto the catchments of the local tributaries is typically not of the intensity and duration that would be representative of the critical storm event for simulating localised flooding of an equivalent AEP.

When information is sought on flood levels for local tributaries, both this assessment and that from local tributary modelling that may have been undertaken and in the ownership of local councils should be considered. Advice should be sought from the local council in such situations. Recommendations on integrating maximum flood surfaces derived from local studies with the riverine flooding surfaces from the BRCFS, for the same AEP, are:

- The higher of the two surfaces should be used (ie. take the maximum of the local and riverine surfaces).
- Review the tailwater (river) conditions used at the downstream riverine boundary of the local flood modelling for consistency with the riverine flood levels from the BRCFS. Joint probability considerations should be taken into account (ie. a 1 in 100 AEP local event peaking at the same time as a 1 in 100 AEP riverine flood has a much lower AEP of occurrence than a 1 in 100 AEP). If the original riverine boundary is deemed to be inconsistent, the local flood modelling should be reworked using a boundary consistent with the BRCFS.
- Due to joint probability considerations, the expectation is that riverine boundaries used for existing local flood modelling would be lower than the Brisbane River riverine levels from the BRCFS (for the same AEP). Therefore, taking the maximum of the two surfaces as recommended above will produce a seamless transition between local and riverine flooding. The exception maybe for the creek outlets where the riverine flood level is controlled by the ocean storm tide and a higher storm tide level was used for the local flood study compared with those adopted for the BRCFS. In this case, the riverine or storm tide boundary would need to be reviewed as recommended above.

8.2 Validity of AEP in Areas Distant from Reporting Locations

The derivation of design flood levels for each AEP was established using a Monte Carlo flood frequency analyses at each of the 28 reporting locations along the main rivers and creeks. For locations between reporting locations a small amount of uncertainty is introduced. Outside the area covered by the reporting locations, the assumptions that underpin the Monte Carlo assessment can become less valid, and therefore the assigned AEP less certain.

This issue is primarily confined to the mid-section of Lockyer Creek. The Detailed Model extends for a further 26km upstream from the most upstream reporting location at Lyons Bridge, therefore the AEP of the flood extents and levels may begin to deviate from the AEP at the reporting locations. A hatched area is indicated on the design flood mapping showing this area. The map output is still presented within the hatched area as it is considered of value for assisting with understanding the flood behaviour on a complex floodplain. Within this area, the advice of the relevant local council should be sought if seeking to establish design flood levels for an AEP.

Other areas that maybe influenced by this “edge” effect are the areas upstream of the reporting locations on the Bremer River, and Warrill and Purga Creeks. However, these areas are of a significantly smaller extent than that on Lockyer Creek.

8.3 Fast Model AEP Levels

The design flood AEP levels statistically derived from the 11,340 events at each of the 28 reporting locations as documented in MR4 are based on using the Fast Model. These Fast Model AEP levels are a “stepping stone” to quantifying indicative AEP levels and for selecting a sub-set of the 11,340 Monte Carlo events that are representative of reproducing these AEP levels. The selected 60 design events, as simulated through the Detailed Model and presented in this report, represent the final stage in producing reliable AEP flood levels, depths, velocities and hydraulic hazard caused by Brisbane River riverine flooding.

Whilst the absolute Fast Model AEP levels should not be used directly as they are a “stepping stone” to the final AEP levels, the Fast Model can still potentially be used for rapid assessment of, for example, a first pass selection process for estimating the shift or change in AEP levels for flood mitigation options. The Fast Model may also be adapted for operational purposes such as flood forecasting and warning, subject to comprehensive operational testing, and with capacity to maintain representativeness of current floodplain conditions.

8.4 Model Design

The Detailed Model is designed to provide accurate flood mapping from Brisbane River riverine flooding at a regional scale based on present day conditions. Other than for tidal regions, the model has had limited calibration for very small flood events with less than around a 2,000m^3/s peak flow. Furthermore, the model is not designed for quantifying flooding caused by localised flooding, as discussed above, or for flood impact assessments at an individual property scale. It is however suitable for determining riverine flood levels at the property scale noting the limitations on the mapping of extents. The model is designed for regional flood management planning and development control, and should only be used for modelling features that have a measureable influence on Brisbane River riverine flooding. Where detailed flood modelling is required at a local scale, information from the Detailed Model could be extracted to provide boundary information to the localised modelling.

8.5 Velocity and Hydraulic Hazard Results

Peak flood velocity and DxV (hydraulic hazard) maps, as with other maps, are presented at the regional scale and should be interpreted accordingly.

Mapping of velocity and DxV (hydraulic hazard) in 2D areas is based on a depth averaged velocity over a 30m grid. To quantify variations in velocity with depth and sub-grid features would require higher resolution modelling 2D or 3D modelling.

Mapping of velocity and DxV (hydraulic hazard) for 1D in-bank channel sections, for example Lockyer Creek and upstream of One Mile Bridge on the Bremer River, uses an estimate of velocity and depth based on parallel channel flow analysis and should be interpreted as such.

8.6 1 in 2 AEP Event

The Hydrologic Assessment reports 1 in 2 AEP peak flood flows which are generated from catchment runoff (Aurecon, 2015), however, the URBS hydrologic model does not account for tidal influences on flows in the tidal reaches of the river. The hydraulic modelling carried out for the Hydraulic Assessment simulates catchment runoff flows in combination with tides to determine probable flood levels. For the 1 in 2 AEP flood event the peak flows in the tidal reaches are dominated by tidal influence and these flows are higher than the catchment runoff flow. Reporting 1 in 2 AEP peak flood levels from the model simulations in the tidal zone is reasonable as they are caused by Moreton Bay storm tide conditions, however, it is not possible to report a meaningful peak catchment flow from the hydraulic model for the 1 in 2 AEP within the tidal influence.

For areas upstream of the tidal zone, the analysis to derive AEP levels at reporting locations for the 1 in 2 AEP in MR4 is considered to be influenced by the water level in Wivenhoe Dam and variable antecedent conditions in Lockyer Creek and the Brisbane and Bremer Rivers above the tidal limits[12]. There is therefore significant uncertainty associated with the 1 in 2 AEP levels outside of the areas influenced by the storm tide. It was agreed with the TWG and IPE that mapping for the 1 in 2 AEP should be confined to the tidal limits where there is greater confidence in the results. Use of the 1 in 2 AEP levels beyond the tidal limits is not recommended.

8.7 Limits of Mapping

The extent of flood mapping has been limited to the area of the Detailed Model's 2D representation, but excludes those areas in which the modelled flood behaviour is not considered to reasonably represent a design flood level as controlled by the effects of Brisbane River backwater. These limits are shown on the maps as a line denoted in the legend as "Limit of Detailed Modelling".

Mapping along the 1D in-bank channel sections, for example Lockyer Creek and upstream of One Mile Bridge on the Bremer River, uses a parallel channel flow analysis over a triangulated surface. Minor gaps or sudden transitions may occur in the transition from the triangulated surface 1D results to the 2D domain gridded surface along the 1D/2D interface.

8.8 Backflow Prevention Devices

The Detailed Model assumes that no backflow prevention devices were fitted to the stormwater pipes or trunk drainage systems, for the design case modelling. It is important to note that this will result in a conservative (worst case) modelled flood level and extent in those local areas that are typically protected by the backflow prevention devices. For those events for which the devices would otherwise provide protection, the apparent impact on peak flood levels and extent of inundation in the local areas can be significant (also see Section 8.1).

8.9 Structure Blockage

The Detailed Model assumes no blockage allowance to hydraulic structures other than that directly as a result of the structure itself such as a bridge deck. Application of blockage to structures may increase peak flood levels in some locations and decrease them in others. Preliminary guidance on the likelihood of structure blockage is provided in the Hydraulic Structure Reference Sheets presented in Appendix C.

8.10 Sensitivity Scenarios

As discussed in Section 4.1, the sensitivity scenarios, undertaken using the selected design events, represent the impacts on the flood modelling outputs only for those individual events. The scenarios do not necessarily produce equivalent AEP peak flood levels for that scenario, especially if the scenario represents a significant change to volume of flow and/or flood behaviour from, for example, major works. In order to derive equivalent AEP events under these scenarios, the scenario would need to be applied to all 11,340 Monte Carlo events using the Fast Model followed by a Total Probability Theorem analysis on the resulting peak flood levels at each reporting

[12] The tidal zone is considered to extend downstream from just below Mt Crosby Weir on the Brisbane River and downstream of Hancocks Bridge on the Bremer River.

location. The event selection process would then need to be undertaken with the selected events run through the Detailed Model to produce revised AEP ensembles. Sensitivity scenario results therefore need to be interpreted with caution.

8.11 Detailed Model Accuracy and Tolerances

In general all flood models contain limitations. Whilst the results from the Detailed Model have substantially improved the certainty of AEP flood levels, depths, velocities and hydraulic hazard, the accuracy of the results are subject to various sources of uncertainty inherent in a large and complex flood study such as the BRCFS. These uncertainties, which can give rise to residual uncertainty in the estimated flood levels and flows, are considered to be:

- Any uncertainties inherent in the Hydrologic Assessment that affect the inflows to the Detailed Model – these uncertainties have been minimised through calibration of hydrologic and hydraulic models to the same historical events, and through cross-checks and reviews of stage-discharge relationships (rating curves) at key locations covered by both the hydrologic and hydraulic modelling.
- Uncertainties in hydraulic modelling parameters and Detailed Model discretisation – these have been minimised through adopting industry standard parameter values proofed and fine-tuned through calibration and verification of the Detailed Model to observed tide and flood behaviour.
- Assumptions with regard to dam operations under these hypothetical events, including a no dam failure assumption.
- Statistical uncertainties associated with the Monte Carlo analyses carried out in both the Hydrologic and Hydraulic Assessments.
- The in-bank topographic data where the 2D bathymetry or 1D cross-sections are reliant on LiDAR. These areas are notably:
  - Lockyer Creek
  - Between Wivenhoe Dam and Kholo Bridge
  - Downstream of Mt Crosby Weir to the start of the bathymetric survey
  - Non-tidal reaches of Bremer, Warrill and Purga Creeks.
- Limited historical flood data for rare and extreme floods for the calibration and verification of the hydrologic and hydraulic models.
- The calibration of the hydraulic models to the 2011 flood highlighted unusually high energy losses in the vicinity of the Fernvale Quarry, therefore, any assessments in this area should take this into consideration.
- The influence of farm levees and other works either not well defined or captured by the available LiDAR surveys, or built subsequent to the LiDAR surveys, particularly on the flood levels in the Lockyer Creek floodplains.
- For the 1D sections of the Detailed Model, where there are high in-bank velocities causing a significant variation in water level across the river/creek at a sharp bend (ie. superelevation).

For the calibration of the Detailed Model, given that the significant majority of levels, including flood marks, fall within the desired tolerances for the model calibration and verification events, including tidal flows, and that these events represent a reasonably wide range in terms of flood magnitudes and behaviour, the tolerances are considered to be indicative of the confidence limits of the accuracy of the hydraulic modelling for these calibration events. The tolerances are:

- Brisbane River downstream of Oxley Creek ± 0.15 m
- Brisbane River between Goodna and Oxley Creek ± 0.30 m
- Ipswich urban area ± 0.30 m
- Brisbane River and tributaries upstream of Goodna (for non-urban areas), including Bremer River and Lockyer Creek ± 0.50 m.

For events outside the range of the calibration events, these tolerances, from a hydraulic modelling viewpoint, would increase due to lack of good quality calibration data, but by how much is difficult to quantify. However, the more extreme the event, the greater the uncertainties and therefore the appropriate tolerances. It should also be noted that for these extreme events, there is greater uncertainty in the hydrologic derivation of the flows.

It is important to note that due to the potential sources of errors and residual uncertainties discussed above, and the need to take into account the sensitivity of peak water levels to the local topography, parameter uncertainties, and other effects, it is not necessarily appropriate to simply apply these tolerances when setting planning levels and freeboards. The sensitivity of peak flood levels to residual uncertainties in the hydrologic and hydraulic modelling, future catchment conditions and development, climate change, and local topographic effects, need to be taken into account. For example, peak water levels along Lockyer Creek change little once the creek is overtopped due to the large floodplain, whereas many sections of the Brisbane River the flood levels increase significantly with a relatively small increase in flows due to the shortage of a large floodplain. A more appropriate approach to considering residual uncertainty in flood planning levels is to use a freeboard that incorporates the effects of a shift in AEP probability. For example, the freeboard could be based on the greater of the tolerances above (or some other minimum freeboard amount) and the difference in peak level between the 1 in 200 and 1 in 100 AEPs, noting that potential influences on AEP peak levels such as climate change may also need to be taken into account. A similar approach can be taken in assigning flood risk using hydraulic hazard (DxV) values and depth averaged velocities for structure design.

In terms of accurately predicting flood warning times, the Detailed Model calibration demonstrated a consistent and matched reproduction of the travel time and shape of the flood wave for all calibration floods after accounting for any bias carried through from the hydrologic modelling.

9 Conclusions

The Detailed Flood model developed and calibrated as documented in Milestone Report 3 (BMT WBM, 2015b) was updated to incorporate features as agreed for the Base Case for the design flood modelling. Of note, updated LiDAR data across the Brisbane and Ipswich City Council areas has been incorporated into the model.

The design flood modelling simulated the selected 60 critical Monte Carlo flood events as documented in MR4 through the Detailed Model representing 11 AEP ensembles from the 1 in 2 to 1 in 100,000 AEP.

Results from the design flood modelling are presented as a series of maps, plots and tables which together provide spatial and temporal information on the design floods. Maps for the 1 in 100 AEP event are provided in the accompanying Drawing Addendum whilst maps for all other AEP floods are provided digitally.

Table 9-1 provides a summary of peak flood levels in Lowood, Ipswich and Brisbane CBD.

Table 9-1 Summary of Peak Design Riverine Flood Levels and Flows at Lowood and Brisbane and Ipswich CBDs

AEP 1 in …	Peak Design Flood Levels and Flows					
	Lowood (Pump Station)		Ipswich (David Trumpy Bridge)		Brisbane (City Gauge)	
	Peak Level (mAHD)	Peak Flow (m3/s)†	Peak Level (mAHD)	Peak Flow (m3/s)†	Peak Level (mAHD)	Peak Flow (m3/s)†
2*	n/a	n/a	1.9	n/a	1.6	n/a
5	31.0	1,000	11.8	1,300	1.7	2,300
10	33.7	1,800	14.8	1,900	1.8	3,200
20	36.3	2,800	16.1	2,300	2.2	4,800
50	40.9	5,500	18.7	3,200	3.2	6,900
100	45.3	9,800	20.1	3,800	4.5	9,200
200	47.3	13,000	21.8	4,800	5.8	11,000
500	48.6	15,800	23.4	5,600	7.3	13,200
2,000	51.0	20,400	25.7	6,900	9.9	17,200
10,000	54.5	29,300	29.0	9,300	14.7	25,700
100,000	63.0	52,600	36.1	13,500	23.7	56,000
2011 event‡	*46.3*	*10,900*	*19.2*	*2,300*	*4.5*	*8,900*

*1 in 2 AEP event results provided for tidal zone only i.e results at Lowood not included

†Peak flood flows for the 1 in 2 AEP event simulations are not provided because the simulated peak flows are due to tidal influence rather than flood influence

‡ Peak levels and flows shown for the 2011 event are modelled results

The mapping provided in the Drawing Addendum and Digital Addendum can be examined to understand flood risk in any particular location of the study area. Some specific points that have been highlighted are:

- Brisbane CBD has an onset of flooding for the 1 in 10 AEP flood with floodwater backing up the stormwater network and affecting lower lying parts of Margaret Street. Bypass flow routes start to short circuit the CBD in the 1 in 10000 AEP flood at which point the majority of the CBD is inundated.
- Within Ipswich CBD inundation starts to affect lower lying parts of the CBD from the 1 in 5 AEP flood but the hydraulic hazard remains relatively low until the 1 in 10,000 AEP event when the northern part of the CBD becomes an area of active flow. Bypassing of the CBD by flow to the north occurs in the 1 in 100000 AEP flood.
- An overland bypass flow route causing flooding at Fernvale is activated in the 1 in 100 AEP flood and is fully established with high associated hazard values events of the 1 in 200 AEP flood and greater.

Sensitivity scenarios have also been simulated in accordance with the ITO and results are presented, primarily as tables of peak flood levels and flows along with the change from the peak baseline value except for the Climate Change sensitivity test where digital mapping for the 1 in 100 AEP flood applied under this scenario is presented. Key findings from the sensitivity testing are as follows:

- The floodplain future condition assessment showed that increasing ground levels across the nominated floodplain area generally increased peak levels everywhere for the more extreme events and resulted in a mix of increases and decreases in peak flood level for smaller events considered. The decreases were due to upstream constrictions in the floodplain throttling the flow resulting in lower peak downstream levels.
- Lowering the Brisbane River bed level within the tidal zone reduces flood levels, whilst raising the bed level increases flood levels. For a ±20% change in conveyance at the flood peak (approximately an average ±2m increase/decrease in bed level), the 1 in 100 AEP peak levels increased and decreased by around 1.0m and 0.7m respectively at Brisbane City Gauge under these two scenarios.
- The major dams (Wivenhoe, Somerset, Cressbrook, Perseverence, Manchester and Moogerah Dams) have a significant influence on peak flood levels. For example, if these dams were not present for the 2011 event, the peak level would have been around 2.1m and 2.8m higher in Brisbane and Ipswich CBDs respectively for the simulated conditions used.

The rating curve reconciliation discussion presented in MR3 has been included and extended in MR5 to include the results of the design flood simulations. The findings from MR3 on rating curves is consistent with the design flood events, and the addition of the design flood results from both the Fast and Detailed Models provides valuable further information on the accuracy of the rating curves under a wide range of flood magnitudes and shapes. In particular, the design floods provide valuable insight to the performance of the gauges under floods greater in size than historically recorded events.

Guidance is provided on the limitations of the modelling in terms of interpreting the flood information presented in this Milestone Report 5, and for appropriate future application of the Detailed Model. Of particular note is that the flood information provided is for Brisbane River riverine flooding downstream of Wivenhoe Dam, not for localised flooding.

The Detailed Model has been subject to a rigorous internal QA process including model reviews and checks for consistency on modelled volumes and mass error. All simulated events performed within acceptable criteria.

The hydraulic modelling carried out using the Detailed Model provides the most up-to-date and accurate predictions of Brisbane River riverine flooding for a wide range of probabilities of occurrence. The modelling forms the basis for future flood management and formulation of planning controls for the Brisbane River, tributaries and floodplains affected by flooding caused by the Brisbane River below Wivenhoe Dam.

10 References

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Appendix A Detailed Model Results QC Checks

A.1 Introduction

Quality Control (QC) of the Detailed Model was an ongoing process throughout the development and application of the model. This ensures a high quality deliverable and limits the potential for error. Furthermore, additional checks are undertaken on the models performance. These checks are documented below.

A.2 Model Review

The model used for the design flood assessment is based on the model developed and calibrated as documented in Milestone Report 3. This model was subject to periodic internal reviews as part of the model development process. Model reviews for the current design flood modelling stage of the assessment have focussed on ensuring that the model is consistently stable when simulating the range of events considered. Volume checks were also undertaken to ensure that all required inflows were accounted for. Further detail on some of the checks undertaken is provided in the following sections.

A.3 Volume Checks

To ensure consistency with both the Fast Model and the URBS model, total modelled event inflow volumes were compared. The check ensures that all inflows are accounted for in the model. To simplify the check, the tidal boundary was set to a constant value in both Fast and Detailed models. This ensured that the check was not subject to varying tidal inflows. Because URBS output for the 11,000 Monte Carlo events was simplified to contain only that used by the hydraulic models, no total volume is reported in the supplied URBS results. The sum of the URBS total and local flows output for use in the hydraulic models was therefore derived and used for the comparison.

The comparison check was undertaken on one of 1 in 100 AEP Monte Carlo events (096_0742) and results are summarised in Table A-1.

Table A-1 Volume Comparison Check – MC Event 096_0742

	Event Volume (ML)	% change from URBS
URBS outflows (total/local used by hydraulic models)	4,871,221	-
Total Volume Input to FM	4,861,602	-0.20%
Total Volume Input to DM	4,867,868	-0.07%

It can be seen from Table A-1 that inflows to both the Fast and Detailed Models correspond very closely to that supplied from the URBS model. This confirms that all supplied URBS inflows are accounted for in the modelling.

As a further check on volumes, the event flow hydrograph was plotted for the Brisbane City Gauge for the URBS[13], Fast and Detailed Models as shown in Figure A-1. It can be seen that all three hydrographs are similar, particularly the Fast and Detailed Models. Some difference would be expected, particularly for the URBS model, as this relies on hydrologic rather than hydraulic routing techniques. Table A-2 gives the event volumes at the Brisbane City Gauge. It can be seen total volumes are slightly lower for the Fast and Detailed Models than for the URBS model. This is expected due to hydraulic models usually having some residual (ponded) water remaining on the floodplains and unable to drain, or drain at a slower rate.

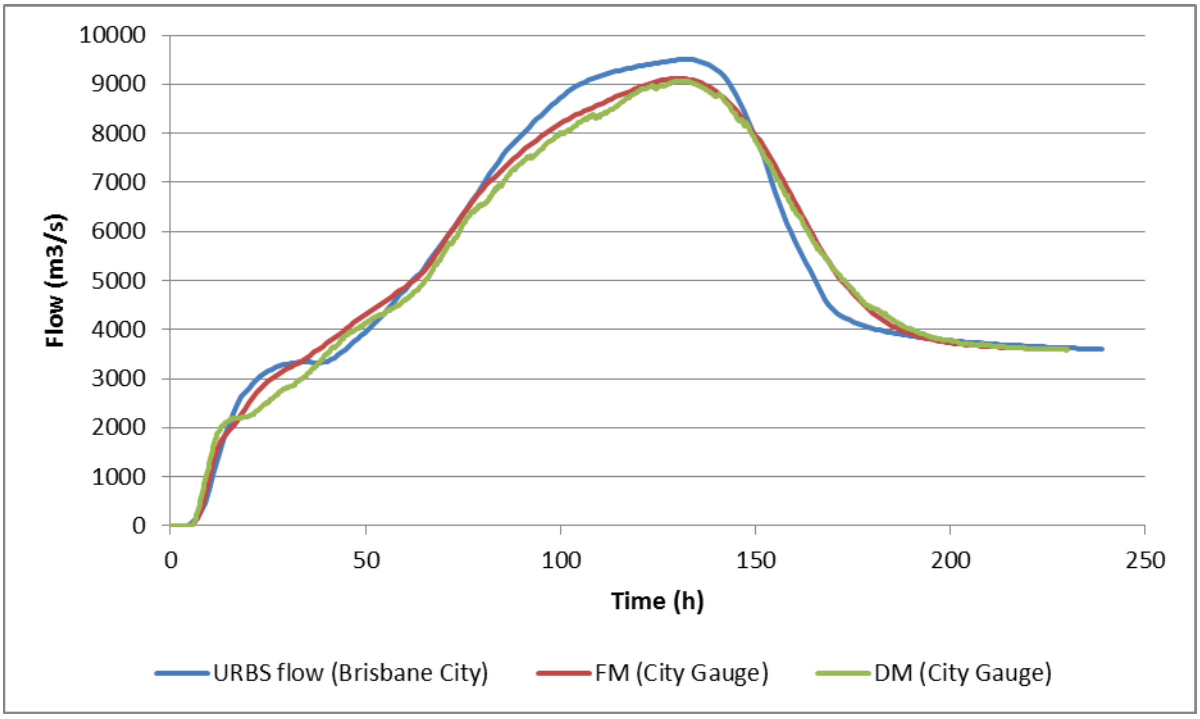


Figure A-1 Flows at Brisbane City Gauge for MC Event 096_0742

Table A-2 Volume Comparison Check – MC Event 096_0742

Model	Event Volume (ML)	% change from URBS
URBS	4,505,967	-
FM	4,472,892	-0.73%
DM	4,385,203	-1.96%

A.4 Mass Balance Checking

Mass conservation within the hydraulic model simulation for every Base Case model simulation is presented in Table A-3. In the case of the TUFLOW Classic computations being used for the Detailed Model, mass error is an indicator of solution convergence. TUFLOW Classic uses an implicit matrix based solution that relies on convergence after usually 2 iterations per timestep. Mass error exceeding 1 to 3% is a sign that convergence is not being achieved and the modeller

[13] The exact location of the URBS output location is unknown but is assumed to be Brisbane City Gauge

should be checking that the timestep is not too large, areas of the model are not experiencing instabilities, and cross-checking the model setup and boundary configurations.

The peak cumulative mass error did not exceed ±1.0% for all simulations with the majority of simulations not exceeding ±0.5%. This provides confidence that the computational solution is converging well and that the model is well configured. In addition, none of the design event simulations experienced a numerical instability, another sign the model is well configured.

Table A-3 Summary of Detailed Model Mass Conservation

Simulation	Peak Cumulative Mass Error (%)	Final Cumulative Mass Error (%)
D0002_012_0058	-0.08%	-0.08%
D0002_012_0232	-0.07%	-0.07%
D0002_018_0102	-0.07%	-0.07%
D0002_024_0008	-0.08%	-0.08%
D0002_048_0227	-0.09%	-0.09%
D0002_072_0054	-0.07%	-0.07%
D0002_120_0010	-0.09%	-0.07%
D0005_012_0693	-0.28%	-0.25%
D0005_024_0534	-0.27%	-0.22%
D0005_036_0346	-0.18%	-0.17%
D0005_096_0261	-0.07%	-0.07%
D0005_120_0264	-0.28%	-0.27%
D0005_168_0183	-0.22%	-0.22%
D0010_024_0518	-0.36%	-0.32%
D0010_036_0400	-0.43%	-0.32%
D0010_120_0404	-0.18%	-0.18%
D0010_168_0086	-0.19%	-0.19%
D0010_168_0481	-0.16%	-0.16%
D0020_018_0299	-0.45%	-0.42%
D0020_018_0462	-0.47%	-0.34%
D0020_024_0670	-0.38%	-0.33%
D0020_048_0611	-0.23%	-0.23%
D0020_096_0328	-0.37%	-0.33%
D0020_120_0479	-0.24%	-0.22%
D0050_048_0620	-0.68%	-0.56%
D0050_048_0663	-0.48%	-0.37%
D0050_048_0678	-0.39%	-0.29%
D0050_072_0653	-0.22%	-0.17%

Simulation	Peak Cumulative Mass Error (%)	Final Cumulative Mass Error (%)
D0050_120_0558	-0.34%	-0.22%
D0050_120_0625	-0.37%	-0.36%
D0100_012_0902	-0.63%	-0.40%
D0100_018_0789	-0.46%	-0.42%
D0100_048_0770	-0.39%	-0.30%
D0100_096_0742	-0.32%	-0.27%
D0100_120_0776	-0.35%	-0.30%
D0200_024_0859	-0.45%	-0.31%
D0200_048_0657	-0.61%	-0.45%
D0200_048_0808	-0.43%	-0.32%
D0200_096_0774	-0.52%	-0.37%
D0200_096_0786	-0.55%	-0.36%
D0200_096_0803	-0.57%	-0.32%
D0200_120_0762	-0.32%	-0.28%
D0500_024_0774	-0.61%	-0.61%
D0500_072_0783	-0.55%	-0.49%
D0500_072_0867	-0.48%	-0.44%
D0500_168_0725	-0.54%	-0.52%
D0500_168_0887	-0.44%	-0.43%
D2000_018_0991	-0.59%	-0.50%
D2000_036_0991	-0.59%	-0.50%
D2000_072_0914	-0.54%	-0.48%
D2000_096_0889	-0.49%	-0.45%
D2000_168_0952	-0.49%	-0.45%
DK010_036_1026	-0.43%	-0.41%
DK010_072_0899	-0.56%	-0.53%
DK010_072_0994	-0.45%	-0.42%
DK010_120_0988	-0.42%	-0.41%
DK100_012_1236	-0.34%	-0.34%
DK100_072_1114	-0.39%	-0.30%
DK100_072_1130	-0.37%	-0.29%
DK100_096_1142	-0.40%	-0.29%

A.5 Timestep Convergence

Timestep convergence is a term used to consider how model results change when the simulation timestep is increased or decreased. A converged model is not susceptible to significantly different results as a result of a change in model timestep. Generally the largest timestep for which a model is stable is used as this reduces the computational demand and gives improved run times.

Hydraulic model computations are subject to a Courant stability criterion. TUFLOW Classic's implicit solution approach allows the simulation to proceed at Courant numbers greater than 1.

The Detailed Model utilises a 30m grid cell size with a standard timestep of 12s and a reduced timestep of 6s for the larger events (1 in 500 AEP flood or greater). All calibration events were run on a 12s timestep. Given the significant depth of the Brisbane River and high velocities, these timesteps are at the higher end of that seen in the industry and are a sign of a well configured model that does not require the use smaller timesteps to remain stable. However, too large a timestep can also cause a distortion in results, although this is rare in flood simulations where timesteps are usually constrained to the lower end of the spectrum (much larger timesteps can often be used in coastal modelling due to the lower velocities and absence of hydraulic controls such as levees and structures).

A test was undertaken on the 1 in 100 AEP ensemble events by running these at the reduced timestep of 6s with results compared to those run on a 12s timestep. Figure A-2 presents a histogram of the differences in peak flood level between the 6 and 12 second timestep ensembles (6s minus 12s).

It can be seen from Figure A-2 that the majority of peak flood levels (around 95%) are within ± 0.03m regardless of the timestep used. Over 99.9% of peak levels are within ±0.10m. It is therefore considered that the use of a 12s timestep over a 6s one for the more frequent flood events is considered acceptable and well within the accuracy bounds of the modelling. Likewise, use of a 6s timestep will not give significantly different results and the model can still be considered calibrated with use of this lower timestep.

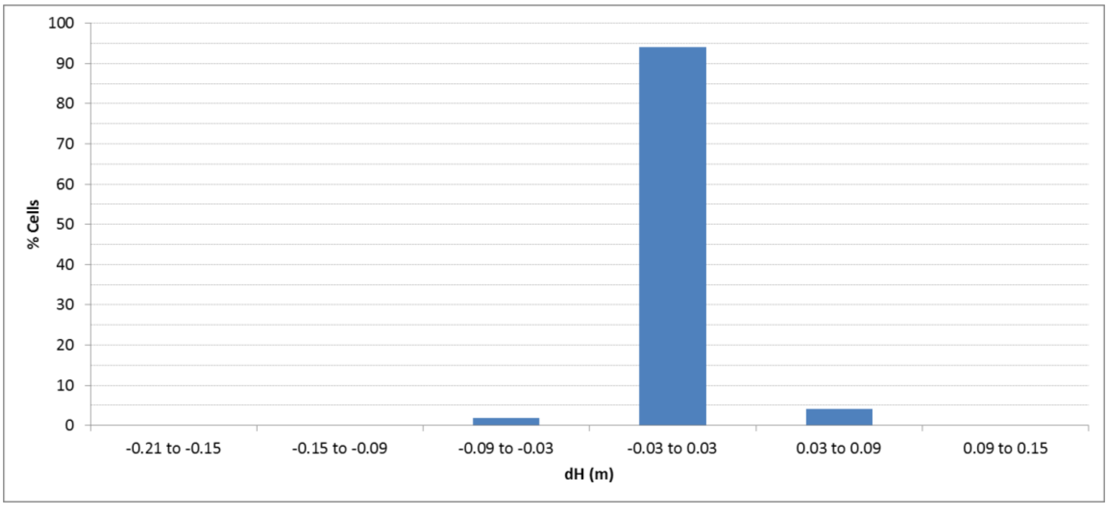


Figure A-2 Change in Peak Flood Level (6s vs 12s timestep) D0100 Ensemble

A.6 Model Run Times

Model run times, whilst not a measure of model stability or a criteria under this study, will be of interest to future practical users of the model. The run times will vary due to the event being modelled, the timestep used and the performance specifications of the machine upon which they are being simulated.

On a 64 bit machine with 32GB of RAM utilising an Intel® Core™ i7 4790K running at 4.0GHz , an indicative run time for a simulation of a 1 in 100 AEP event is around 28 hours. This run time decreases to around 21 hours for the smaller 1 in 2 AEP events. For those events of the 1 in 500 AEP magnitude or greater, the reduced timestep results in significantly increased run times (around 85 hours for the largest 1 in 100000 AEP events).

Appendix B Digital Map List

Figure Name	OutputMap
Peak Flood Depth Maps - 1 in 2 AEP Event for Riverine Flooding - Region A	B15-D0002-D-RegA.pdf
Peak Flood Depth Maps - 1 in 2 AEP Event for Riverine Flooding - Region B	B15-D0002-D-RegB.pdf
Peak Flood Depth Maps - 1 in 2 AEP Event for Riverine Flooding - Region C	B15-D0002-D-RegC.pdf
Peak Flood Depth Maps - 1 in 2 AEP Event for Riverine Flooding - Region D	B15-D0002-D-RegD.pdf
Peak Flood Depth Maps - 1 in 2 AEP Event for Riverine Flooding - Region E	B15-D0002-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 2 AEP Event for Riverine Flooding - Region A	B15-D0002-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 2 AEP Event for Riverine Flooding - Region B	B15-D0002-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 2 AEP Event for Riverine Flooding - Region C	B15-D0002-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 2 AEP Event for Riverine Flooding - Region D	B15-D0002-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 2 AEP Event for Riverine Flooding - Region E	B15-D0002-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 2 AEP Event for Riverine Flooding - Region A	B15-D0002-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 2 AEP Event for Riverine Flooding - Region B	B15-D0002-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 2 AEP Event for Riverine Flooding - Region C	B15-D0002-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 2 AEP Event for Riverine Flooding - Region D	B15-D0002-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 2 AEP Event for Riverine Flooding - Region E	B15-D0002-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 2 AEP Event for Riverine Flooding - Region A	B15-D0002-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 2 AEP Event for Riverine Flooding - Region B	B15-D0002-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 2 AEP Event for Riverine Flooding - Region C	B15-D0002-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 2 AEP Event for Riverine Flooding - Region D	B15-D0002-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 2 AEP Event for Riverine Flooding - Region E	B15-D0002-V-RegE.pdf
Peak Flood Depth Maps - 1 in 5 AEP Event for Riverine Flooding - Region A	B15-D0005-D-

Figure Name	OutputMap
	RegA.pdf
Peak Flood Depth Maps - 1 in 5 AEP Event for Riverine Flooding - Region B	B15-D0005-D-RegB.pdf
Peak Flood Depth Maps - 1 in 5 AEP Event for Riverine Flooding - Region C	B15-D0005-D-RegC.pdf
Peak Flood Depth Maps - 1 in 5 AEP Event for Riverine Flooding - Region D	B15-D0005-D-RegD.pdf
Peak Flood Depth Maps - 1 in 5 AEP Event for Riverine Flooding - Region E	B15-D0005-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 5 AEP Event for Riverine Flooding - Region A	B15-D0005-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 5 AEP Event for Riverine Flooding - Region B	B15-D0005-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 5 AEP Event for Riverine Flooding - Region C	B15-D0005-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 5 AEP Event for Riverine Flooding - Region D	B15-D0005-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 5 AEP Event for Riverine Flooding - Region E	B15-D0005-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 5 AEP Event for Riverine Flooding - Region A	B15-D0005-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 5 AEP Event for Riverine Flooding - Region B	B15-D0005-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 5 AEP Event for Riverine Flooding - Region C	B15-D0005-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 5 AEP Event for Riverine Flooding - Region D	B15-D0005-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 5 AEP Event for Riverine Flooding - Region E	B15-D0005-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 5 AEP Event for Riverine Flooding - Region A	B15-D0005-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 5 AEP Event for Riverine Flooding - Region B	B15-D0005-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 5 AEP Event for Riverine Flooding - Region C	B15-D0005-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 5 AEP Event for Riverine Flooding - Region D	B15-D0005-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 5 AEP Event for Riverine Flooding - Region E	B15-D0005-V-RegE.pdf
Peak Flood Depth Maps - 1 in 10 AEP Event for Riverine Flooding - Region A	B15-D0010-D-RegA.pdf
Peak Flood Depth Maps - 1 in 10 AEP Event for Riverine Flooding - Region B	B15-D0010-D-RegB.pdf

Figure Name	OutputMap
Peak Flood Depth Maps - 1 in 10 AEP Event for Riverine Flooding - Region C	B15-D0010-D-RegC.pdf
Peak Flood Depth Maps - 1 in 10 AEP Event for Riverine Flooding - Region D	B15-D0010-D-RegD.pdf
Peak Flood Depth Maps - 1 in 10 AEP Event for Riverine Flooding - Region E	B15-D0010-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 10 AEP Event for Riverine Flooding - Region A	B15-D0010-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 10 AEP Event for Riverine Flooding - Region B	B15-D0010-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 10 AEP Event for Riverine Flooding - Region C	B15-D0010-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 10 AEP Event for Riverine Flooding - Region D	B15-D0010-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 10 AEP Event for Riverine Flooding - Region E	B15-D0010-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 10 AEP Event for Riverine Flooding - Region A	B15-D0010-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 10 AEP Event for Riverine Flooding - Region B	B15-D0010-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 10 AEP Event for Riverine Flooding - Region C	B15-D0010-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 10 AEP Event for Riverine Flooding - Region D	B15-D0010-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 10 AEP Event for Riverine Flooding - Region E	B15-D0010-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 10 AEP Event for Riverine Flooding - Region A	B15-D0010-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 10 AEP Event for Riverine Flooding - Region B	B15-D0010-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 10 AEP Event for Riverine Flooding - Region C	B15-D0010-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 10 AEP Event for Riverine Flooding - Region D	B15-D0010-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 10 AEP Event for Riverine Flooding - Region E	B15-D0010-V-RegE.pdf
Peak Flood Depth Maps - 1 in 20 AEP Event for Riverine Flooding - Region A	B15-D0020-D-RegA.pdf
Peak Flood Depth Maps - 1 in 20 AEP Event for Riverine Flooding - Region B	B15-D0020-D-RegB.pdf
Peak Flood Depth Maps - 1 in 20 AEP Event for Riverine Flooding - Region C	B15-D0020-D-RegC.pdf
Peak Flood Depth Maps - 1 in 20 AEP Event for Riverine Flooding - Region D	B15-D0020-D-

Figure Name	OutputMap
	RegD.pdf
Peak Flood Depth Maps - 1 in 20 AEP Event for Riverine Flooding - Region E	B15-D0020-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 20 AEP Event for Riverine Flooding - Region A	B15-D0020-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 20 AEP Event for Riverine Flooding - Region B	B15-D0020-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 20 AEP Event for Riverine Flooding - Region C	B15-D0020-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 20 AEP Event for Riverine Flooding - Region D	B15-D0020-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 20 AEP Event for Riverine Flooding - Region E	B15-D0020-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 20 AEP Event for Riverine Flooding - Region A	B15-D0020-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 20 AEP Event for Riverine Flooding - Region B	B15-D0020-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 20 AEP Event for Riverine Flooding - Region C	B15-D0020-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 20 AEP Event for Riverine Flooding - Region D	B15-D0020-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 20 AEP Event for Riverine Flooding - Region E	B15-D0020-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 20 AEP Event for Riverine Flooding - Region A	B15-D0020-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 20 AEP Event for Riverine Flooding - Region B	B15-D0020-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 20 AEP Event for Riverine Flooding - Region C	B15-D0020-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 20 AEP Event for Riverine Flooding - Region D	B15-D0020-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 20 AEP Event for Riverine Flooding - Region E	B15-D0020-V-RegE.pdf
Peak Flood Depth Maps - 1 in 50 AEP Event for Riverine Flooding - Region A	B15-D0050-D-RegA.pdf
Peak Flood Depth Maps - 1 in 50 AEP Event for Riverine Flooding - Region B	B15-D0050-D-RegB.pdf
Peak Flood Depth Maps - 1 in 50 AEP Event for Riverine Flooding - Region C	B15-D0050-D-RegC.pdf
Peak Flood Depth Maps - 1 in 50 AEP Event for Riverine Flooding - Region D	B15-D0050-D-RegD.pdf
Peak Flood Depth Maps - 1 in 50 AEP Event for Riverine Flooding - Region E	B15-D0050-D-RegE.pdf

Figure Name	OutputMap
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 50 AEP Event for Riverine Flooding - Region A	B15-D0050-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 50 AEP Event for Riverine Flooding - Region B	B15-D0050-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 50 AEP Event for Riverine Flooding - Region C	B15-D0050-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 50 AEP Event for Riverine Flooding - Region D	B15-D0050-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 50 AEP Event for Riverine Flooding - Region E	B15-D0050-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 50 AEP Event for Riverine Flooding - Region A	B15-D0050-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 50 AEP Event for Riverine Flooding - Region B	B15-D0050-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 50 AEP Event for Riverine Flooding - Region C	B15-D0050-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 50 AEP Event for Riverine Flooding - Region D	B15-D0050-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 50 AEP Event for Riverine Flooding - Region E	B15-D0050-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 50 AEP Event for Riverine Flooding - Region A	B15-D0050-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 50 AEP Event for Riverine Flooding - Region B	B15-D0050-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 50 AEP Event for Riverine Flooding - Region C	B15-D0050-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 50 AEP Event for Riverine Flooding - Region D	B15-D0050-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 50 AEP Event for Riverine Flooding - Region E	B15-D0050-V-RegE.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event for Riverine Flooding - Region A	B15-D0100-D-RegA.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event for Riverine Flooding - Region B	B15-D0100-D-RegB.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event for Riverine Flooding - Region C	B15-D0100-D-RegC.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event for Riverine Flooding - Region D	B15-D0100-D-RegD.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event for Riverine Flooding - Region E	B15-D0100-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event for Riverine Flooding - Region A	B15-D0100-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event for Riverine	B15-D0100-H-

Figure Name	OutputMap
Flooding - Region B	RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event for Riverine Flooding - Region C	B15-D0100-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event for Riverine Flooding - Region D	B15-D0100-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event for Riverine Flooding - Region E	B15-D0100-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event for Riverine Flooding - Region A	B15-D0100-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event for Riverine Flooding - Region B	B15-D0100-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event for Riverine Flooding - Region C	B15-D0100-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event for Riverine Flooding - Region D	B15-D0100-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event for Riverine Flooding - Region E	B15-D0100-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event for Riverine Flooding - Region A	B15-D0100-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event for Riverine Flooding - Region B	B15-D0100-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event for Riverine Flooding - Region C	B15-D0100-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event for Riverine Flooding - Region D	B15-D0100-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event for Riverine Flooding - Region E	B15-D0100-V-RegE.pdf
Peak Flood Depth Maps - 1 in 200 AEP Event for Riverine Flooding - Region A	B15-D0200-D-RegA.pdf
Peak Flood Depth Maps - 1 in 200 AEP Event for Riverine Flooding - Region B	B15-D0200-D-RegB.pdf
Peak Flood Depth Maps - 1 in 200 AEP Event for Riverine Flooding - Region C	B15-D0200-D-RegC.pdf
Peak Flood Depth Maps - 1 in 200 AEP Event for Riverine Flooding - Region D	B15-D0200-D-RegD.pdf
Peak Flood Depth Maps - 1 in 200 AEP Event for Riverine Flooding - Region E	B15-D0200-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 200 AEP Event for Riverine Flooding - Region A	B15-D0200-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 200 AEP Event for Riverine Flooding - Region B	B15-D0200-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 200 AEP Event for Riverine Flooding - Region C	B15-D0200-H-RegC.pdf

Figure Name	OutputMap
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 200 AEP Event for Riverine Flooding - Region D	B15-D0200-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 200 AEP Event for Riverine Flooding - Region E	B15-D0200-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 200 AEP Event for Riverine Flooding - Region A	B15-D0200-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 200 AEP Event for Riverine Flooding - Region B	B15-D0200-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 200 AEP Event for Riverine Flooding - Region C	B15-D0200-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 200 AEP Event for Riverine Flooding - Region D	B15-D0200-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 200 AEP Event for Riverine Flooding - Region E	B15-D0200-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 200 AEP Event for Riverine Flooding - Region A	B15-D0200-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 200 AEP Event for Riverine Flooding - Region B	B15-D0200-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 200 AEP Event for Riverine Flooding - Region C	B15-D0200-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 200 AEP Event for Riverine Flooding - Region D	B15-D0200-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 200 AEP Event for Riverine Flooding - Region E	B15-D0200-V-RegE.pdf
Peak Flood Depth Maps - 1 in 500 AEP Event for Riverine Flooding - Region A	B15-D0500-D-RegA.pdf
Peak Flood Depth Maps - 1 in 500 AEP Event for Riverine Flooding - Region B	B15-D0500-D-RegB.pdf
Peak Flood Depth Maps - 1 in 500 AEP Event for Riverine Flooding - Region C	B15-D0500-D-RegC.pdf
Peak Flood Depth Maps - 1 in 500 AEP Event for Riverine Flooding - Region D	B15-D0500-D-RegD.pdf
Peak Flood Depth Maps - 1 in 500 AEP Event for Riverine Flooding - Region E	B15-D0500-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 500 AEP Event for Riverine Flooding - Region A	B15-D0500-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 500 AEP Event for Riverine Flooding - Region B	B15-D0500-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 500 AEP Event for Riverine Flooding - Region C	B15-D0500-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 500 AEP Event for Riverine Flooding - Region D	B15-D0500-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 500 AEP Event for Riverine	B15-D0500-H-

Figure Name	OutputMap
Flooding - Region E	RegE.pdf
Peak Water Surface Level Maps - 1 in 500 AEP Event for Riverine Flooding - Region A	B15-D0500-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 500 AEP Event for Riverine Flooding - Region B	B15-D0500-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 500 AEP Event for Riverine Flooding - Region C	B15-D0500-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 500 AEP Event for Riverine Flooding - Region D	B15-D0500-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 500 AEP Event for Riverine Flooding - Region E	B15-D0500-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 500 AEP Event for Riverine Flooding - Region A	B15-D0500-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 500 AEP Event for Riverine Flooding - Region B	B15-D0500-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 500 AEP Event for Riverine Flooding - Region C	B15-D0500-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 500 AEP Event for Riverine Flooding - Region D	B15-D0500-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 500 AEP Event for Riverine Flooding - Region E	B15-D0500-V-RegE.pdf
Peak Flood Depth Maps - 1 in 2000 AEP Event for Riverine Flooding - Region A	B15-D2000-D-RegA.pdf
Peak Flood Depth Maps - 1 in 2000 AEP Event for Riverine Flooding - Region B	B15-D2000-D-RegB.pdf
Peak Flood Depth Maps - 1 in 2000 AEP Event for Riverine Flooding - Region C	B15-D2000-D-RegC.pdf
Peak Flood Depth Maps - 1 in 2000 AEP Event for Riverine Flooding - Region D	B15-D2000-D-RegD.pdf
Peak Flood Depth Maps - 1 in 2000 AEP Event for Riverine Flooding - Region E	B15-D2000-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 2000 AEP Event for Riverine Flooding - Region A	B15-D2000-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 2000 AEP Event for Riverine Flooding - Region B	B15-D2000-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 2000 AEP Event for Riverine Flooding - Region C	B15-D2000-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 2000 AEP Event for Riverine Flooding - Region D	B15-D2000-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 2000 AEP Event for Riverine Flooding - Region E	B15-D2000-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 2000 AEP Event for Riverine Flooding - Region A	B15-D2000-L-RegA.pdf

Figure Name	OutputMap
Peak Water Surface Level Maps - 1 in 2000 AEP Event for Riverine Flooding - Region B	B15-D2000-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 2000 AEP Event for Riverine Flooding - Region C	B15-D2000-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 2000 AEP Event for Riverine Flooding - Region D	B15-D2000-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 2000 AEP Event for Riverine Flooding - Region E	B15-D2000-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 2000 AEP Event for Riverine Flooding - Region A	B15-D2000-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 2000 AEP Event for Riverine Flooding - Region B	B15-D2000-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 2000 AEP Event for Riverine Flooding - Region C	B15-D2000-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 2000 AEP Event for Riverine Flooding - Region D	B15-D2000-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 2000 AEP Event for Riverine Flooding - Region E	B15-D2000-V-RegE.pdf
Peak Flood Depth Maps - 1 in 10000 AEP Event for Riverine Flooding - Region A	B15-DK010-D-RegA.pdf
Peak Flood Depth Maps - 1 in 10000 AEP Event for Riverine Flooding - Region B	B15-DK010-D-RegB.pdf
Peak Flood Depth Maps - 1 in 10000 AEP Event for Riverine Flooding - Region C	B15-DK010-D-RegC.pdf
Peak Flood Depth Maps - 1 in 10000 AEP Event for Riverine Flooding - Region D	B15-DK010-D-RegD.pdf
Peak Flood Depth Maps - 1 in 10000 AEP Event for Riverine Flooding - Region E	B15-DK010-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 10000 AEP Event for Riverine Flooding - Region A	B15-DK010-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 10000 AEP Event for Riverine Flooding - Region B	B15-DK010-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 10000 AEP Event for Riverine Flooding - Region C	B15-DK010-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 10000 AEP Event for Riverine Flooding - Region D	B15-DK010-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 10000 AEP Event for Riverine Flooding - Region E	B15-DK010-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 10000 AEP Event for Riverine Flooding - Region A	B15-DK010-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 10000 AEP Event for Riverine Flooding - Region B	B15-DK010-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 10000 AEP Event for Riverine Flooding -	B15-DK010-L-

Figure Name	OutputMap
Region C	RegC.pdf
Peak Water Surface Level Maps - 1 in 10000 AEP Event for Riverine Flooding - Region D	B15-DK010-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 10000 AEP Event for Riverine Flooding - Region E	B15-DK010-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 10000 AEP Event for Riverine Flooding - Region A	B15-DK010-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 10000 AEP Event for Riverine Flooding - Region B	B15-DK010-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 10000 AEP Event for Riverine Flooding - Region C	B15-DK010-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 10000 AEP Event for Riverine Flooding - Region D	B15-DK010-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 10000 AEP Event for Riverine Flooding - Region E	B15-DK010-V-RegE.pdf
Peak Flood Depth Maps - 1 in 100000 AEP Event for Riverine Flooding - Region A	B15-DK100-D-RegA.pdf
Peak Flood Depth Maps - 1 in 100000 AEP Event for Riverine Flooding - Region B	B15-DK100-D-RegB.pdf
Peak Flood Depth Maps - 1 in 100000 AEP Event for Riverine Flooding - Region C	B15-DK100-D-RegC.pdf
Peak Flood Depth Maps - 1 in 100000 AEP Event for Riverine Flooding - Region D	B15-DK100-D-RegD.pdf
Peak Flood Depth Maps - 1 in 100000 AEP Event for Riverine Flooding - Region E	B15-DK100-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100000 AEP Event for Riverine Flooding - Region A	B15-DK100-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100000 AEP Event for Riverine Flooding - Region B	B15-DK100-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100000 AEP Event for Riverine Flooding - Region C	B15-DK100-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100000 AEP Event for Riverine Flooding - Region D	B15-DK100-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100000 AEP Event for Riverine Flooding - Region E	B15-DK100-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 100000 AEP Event for Riverine Flooding - Region A	B15-DK100-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 100000 AEP Event for Riverine Flooding - Region B	B15-DK100-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 100000 AEP Event for Riverine Flooding - Region C	B15-DK100-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 100000 AEP Event for Riverine Flooding - Region D	B15-DK100-L-RegD.pdf

Figure Name	OutputMap
Peak Water Surface Level Maps - 1 in 100000 AEP Event for Riverine Flooding - Region E	B15-DK100-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 100000 AEP Event for Riverine Flooding - Region A	B15-DK100-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 100000 AEP Event for Riverine Flooding - Region B	B15-DK100-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 100000 AEP Event for Riverine Flooding - Region C	B15-DK100-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 100000 AEP Event for Riverine Flooding - Region D	B15-DK100-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 100000 AEP Event for Riverine Flooding - Region E	B15-DK100-V-RegE.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region A	CC1-D0100-D-RegA.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region B	CC1-D0100-D-RegB.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region C	CC1-D0100-D-RegC.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region D	CC1-D0100-D-RegD.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region E	CC1-D0100-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region A	CC1-D0100-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region B	CC1-D0100-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region C	CC1-D0100-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region D	CC1-D0100-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region E	CC1-D0100-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region A	CC1-D0100-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region B	CC1-D0100-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region C	CC1-D0100-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region D	CC1-D0100-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region E	CC1-D0100-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 1 for	CC1-D0100-V-

Figure Name	OutputMap
Riverine Flooding - Region A	RegA.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region B	CC1-D0100-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region C	CC1-D0100-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region D	CC1-D0100-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 1 for Riverine Flooding - Region E	CC1-D0100-V-RegE.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region A	CC2-D0100-D-RegA.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region B	CC2-D0100-D-RegB.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region C	CC2-D0100-D-RegC.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region D	CC2-D0100-D-RegD.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region E	CC2-D0100-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region A	CC2-D0100-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region B	CC2-D0100-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region C	CC2-D0100-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region D	CC2-D0100-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region E	CC2-D0100-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region A	CC2-D0100-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region B	CC2-D0100-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region C	CC2-D0100-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region D	CC2-D0100-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region E	CC2-D0100-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region A	CC2-D0100-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region B	CC2-D0100-V-RegB.pdf

Figure Name	OutputMap
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region C	CC2-D0100-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region D	CC2-D0100-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 2 for Riverine Flooding - Region E	CC2-D0100-V-RegE.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region A	CC3-D0100-D-RegA.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region B	CC3-D0100-D-RegB.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region C	CC3-D0100-D-RegC.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region D	CC3-D0100-D-RegD.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region E	CC3-D0100-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region A	CC3-D0100-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region B	CC3-D0100-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region C	CC3-D0100-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region D	CC3-D0100-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region E	CC3-D0100-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region A	CC3-D0100-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region B	CC3-D0100-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region C	CC3-D0100-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region D	CC3-D0100-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region E	CC3-D0100-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region A	CC3-D0100-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region B	CC3-D0100-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region C	CC3-D0100-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 3 for	CC3-D0100-V-

Figure Name	OutputMap
Riverine Flooding - Region D	RegD.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 3 for Riverine Flooding - Region E	CC3-D0100-V-RegE.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region A	CC4-D0100-D-RegA.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region B	CC4-D0100-D-RegB.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region C	CC4-D0100-D-RegC.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region D	CC4-D0100-D-RegD.pdf
Peak Flood Depth Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region E	CC4-D0100-D-RegE.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region A	CC4-D0100-H-RegA.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region B	CC4-D0100-H-RegB.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region C	CC4-D0100-H-RegC.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region D	CC4-D0100-H-RegD.pdf
Peak Velocity x Depth (Hydraulic Hazard) Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region E	CC4-D0100-H-RegE.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region A	CC4-D0100-L-RegA.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region B	CC4-D0100-L-RegB.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region C	CC4-D0100-L-RegC.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region D	CC4-D0100-L-RegD.pdf
Peak Water Surface Level Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region E	CC4-D0100-L-RegE.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region A	CC4-D0100-V-RegA.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region B	CC4-D0100-V-RegB.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region C	CC4-D0100-V-RegC.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region D	CC4-D0100-V-RegD.pdf
Peak Flood Velocity Maps - 1 in 100 AEP Event Climate Change Scenario 4 for Riverine Flooding - Region E	CC4-D0100-V-RegE.pdf

Figure Name	OutputMap
Peak Change in Water Surface Level Maps - 1974 Historical EventNo Dams Scenario for Riverine Flooding - Region A	CND-C1974-dH-RegA.pdf
Peak Change in Water Surface Level Maps - 1974 Historical EventNo Dams Scenario for Riverine Flooding - Region B	CND-C1974-dH-RegB.pdf
Peak Change in Water Surface Level Maps - 1974 Historical EventNo Dams Scenario for Riverine Flooding - Region C	CND-C1974-dH-RegC.pdf
Peak Change in Water Surface Level Maps - 1974 Historical EventNo Dams Scenario for Riverine Flooding - Region D	CND-C1974-dH-RegD.pdf
Peak Change in Water Surface Level Maps - 1974 Historical EventNo Dams Scenario for Riverine Flooding - Region E	CND-C1974-dH-RegE.pdf
Peak Change in Water Surface Level Maps - 1996 Historical EventNo Dams Scenario for Riverine Flooding - Region A	CND-C1996-dH-RegA.pdf
Peak Change in Water Surface Level Maps - 1996 Historical EventNo Dams Scenario for Riverine Flooding - Region B	CND-C1996-dH-RegB.pdf
Peak Change in Water Surface Level Maps - 1996 Historical EventNo Dams Scenario for Riverine Flooding - Region C	CND-C1996-dH-RegC.pdf
Peak Change in Water Surface Level Maps - 1996 Historical EventNo Dams Scenario for Riverine Flooding - Region D	CND-C1996-dH-RegD.pdf
Peak Change in Water Surface Level Maps - 1996 Historical EventNo Dams Scenario for Riverine Flooding - Region E	CND-C1996-dH-RegE.pdf
Peak Change in Water Surface Level Maps - 1999 Historical EventNo Dams Scenario for Riverine Flooding - Region A	CND-C1999-dH-RegA.pdf
Peak Change in Water Surface Level Maps - 1999 Historical EventNo Dams Scenario for Riverine Flooding - Region B	CND-C1999-dH-RegB.pdf
Peak Change in Water Surface Level Maps - 1999 Historical EventNo Dams Scenario for Riverine Flooding - Region C	CND-C1999-dH-RegC.pdf
Peak Change in Water Surface Level Maps - 1999 Historical EventNo Dams Scenario for Riverine Flooding - Region D	CND-C1999-dH-RegD.pdf
Peak Change in Water Surface Level Maps - 1999 Historical EventNo Dams Scenario for Riverine Flooding - Region E	CND-C1999-dH-RegE.pdf
Peak Change in Water Surface Level Maps - 2011 Historical EventNo Dams Scenario for Riverine Flooding - Region A	CND-C2011-dH-RegA.pdf
Peak Change in Water Surface Level Maps - 2011 Historical EventNo Dams Scenario for Riverine Flooding - Region B	CND-C2011-dH-RegB.pdf
Peak Change in Water Surface Level Maps - 2011 Historical EventNo Dams Scenario for Riverine Flooding - Region C	CND-C2011-dH-RegC.pdf
Peak Change in Water Surface Level Maps - 2011 Historical EventNo Dams Scenario for Riverine Flooding - Region D	CND-C2011-dH-RegD.pdf
Peak Change in Water Surface Level Maps - 2011 Historical EventNo Dams Scenario for Riverine Flooding - Region E	CND-C2011-dH-RegE.pdf
Peak Change in Water Surface Level Maps - 2013 Historical EventNo Dams Scenario for Riverine Flooding - Region A	CND-C2013-dH-RegA.pdf
Peak Change in Water Surface Level Maps - 2013 Historical EventNo Dams Scenario	CND-C2013-dH-

Figure Name	OutputMap
for Riverine Flooding - Region B	RegB.pdf
Peak Change in Water Surface Level Maps - 2013 Historical EventNo Dams Scenario for Riverine Flooding - Region C	CND-C2013-dH-RegC.pdf
Peak Change in Water Surface Level Maps - 2013 Historical EventNo Dams Scenario for Riverine Flooding - Region D	CND-C2013-dH-RegD.pdf
Peak Change in Water Surface Level Maps - 2013 Historical EventNo Dams Scenario for Riverine Flooding - Region E	CND-C2013-dH-RegE.pdf

Appendix C Hydraulic Structure Reference Sheets

Sir Leo Hielscher Bridges (TMR_001) Structure

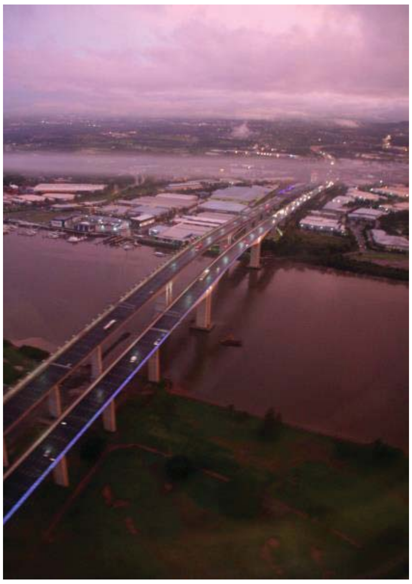
Structure Name	Sir Leo Hielscher Bridges		
Structure ID	TMR_001		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1986	**AMTD**	9940
Date of significant modification	2010	**Co-ordinates (GDA 56)**	509982.86E 6964316.4N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) As-Constructed Drawings (2010)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\TMR_001 New Gateway Bridge\		

Description	Concrete Arch Bridge.		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	11.22mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	19m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	15.22mAHD		
Rail height	-m		
Span Length	584m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Gateway Motorway and Sir Leo Hielscher Bridges, looking upstream
Image Reference	Guard, P. BMT WBM (2011*). The Sir Leo Hielscher Bridges.* [digital photography]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Gateway_Bridge_aerial4.JPG



Sir Leo Hielscher Bridges (TMR_001) Characteristics

Structure Name	Sir Leo Hielscher Bridges
Structure ID	TMR_001
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	3444	0	3444	3087	0	3087	1.1	0.0	1.1	1.46	1.44	0.02
1999	544	0	544	3054	0	3054	0.2	0.0	0.2	1.37	1.37	0.00
2011	9046	0	9046	3139	0	3139	2.9	0.0	2.9	1.65	1.55	0.10
2013	2416	0	2416	3317	0	3317	0.7	0.0	0.7	1.98	1.97	0.01
1 in 100 AEP	8236	0	8236	3336	0	3336	2.5	0.0	2.5	2.07	2.01	0.06
1 in 2000 AEP	16870	0	16870	3878	0	3878	4.4	0.0	4.4	3.30	3.14	0.17

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	3438	0	3438	2882	0	2882	1.2	0.0	1.2	1.43	1.41	0.02
1999	687	0	687	2863	0	2863	0.2	0.0	0.2	1.37	1.37	0.00
2011	8707	0	8707	2385	0	2385	3.7	0.0	3.7	1.65	1.47	0.18
2013	2167	0	2167	3129	0	3129	0.7	0.0	0.7	1.97	1.96	0.01
1 in 100 AEP	8072	0	8072	3096	0	3096	2.6	0.0	2.6	1.95	1.84	0.12
1 in 2000 AEP	16846	0	16846	3689	0	3689	4.6	0.0	4.6	3.34	2.99	0.35

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Deck is above extreme events so therefore no blockage consideration required. Opening width precludes debris blockage.*	No	No

*The original Gateway Bridge was opened in 1986 as single bridge. The bridge was duplicated and the second bridge was opened in 2010. The pair were renamed the Sir Leo Hielscher Bridges at that time.

BMT WBM

Story Bridge (BCC_006) Structure

Structure Name	Story Bridge		
Structure ID	BCC_006		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1940	**AMTD**	21740
Date of significant modification	-	**Co-ordinates (GDA 56)**	503498.12E 6962171.33N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1938)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_006 Storey Bridge\		

Description	Suspension Bridge, Steel truss superstructure		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	29.8mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	9.6m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	33.5mAHD		
Rail height	1.1*m		
Span Length	82-281m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Story Bridge, looking upstream
Image Reference	Macey, C.R. (2007*). Story Bridge* [digital photography]. Retrieved from below source
Image Source	http://de.wikipedia.org/wiki/Story_Bridge#mediaviewer/File:Story_Bridge_Panorama.jpg

Story Bridge (BCC_006) Characteristics

Structure Name	Story Bridge
Structure ID	BCC_006
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10775	0	10775	3089	0	3089	3.5	0.0	3.5	4.96	4.87	0.08
1996	3556	0	3556	2349	0	2349	1.5	0.0	1.5	1.96	1.94	0.02
1999	746	0	746	2233	0	2233	0.3	0.0	0.3	1.44	1.44	0.01
2011	8960	0	8960	2862	0	2862	3.1	0.0	3.1	4.10	4.03	0.07
2013	2726	0	2726	2432	0	2432	1.1	0.0	1.1	2.30	2.29	0.01
1 in 100 AEP	8757	0	8757	2884	0	2884	3.0	0.0	3.0	4.18	4.11	0.07
1 in 2000 AEP	16054	0	16054	4281	0	4281	3.8	0.0	3.8	8.38	8.27	0.11

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10710	0	10710	3711	0	3711	2.9	0.0	2.9	4.92	4.91	0.01
1996	3293	0	3293	2865	0	2865	1.1	0.0	1.1	1.86	1.86	0.00
1999	835	0	835	2745	0	2745	0.3	0.0	0.3	1.45	1.45	0.00
2011	8815	0	8815	3456	0	3456	2.6	0.0	2.6	4.09	4.06	0.02
2013	2348	0	2348	2960	0	2960	0.8	0.0	0.8	2.21	2.21	0.00
1 in 100 AEP	8742	0	8742	3371	0	3371	2.6	0.0	2.6	4.07	4.02	0.04
1 in 2000 AEP	16364	0	16364	5409	0	5409	3.0	0.0	3.0	9.08	9.07	0.01

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Deck is above extreme events so therefore no blockage consideration required. Opening width precludes debris blockage.	No	No

Captain Cook Bridge (TMR_038) Structure

Structure Name	Captain Cook Bridge		
Structure ID	TMR_038		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1972	**AMTD**	24090
Date of significant modification		**Co-ordinates (GDA 56)**	502861.51E 6960260.23N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1970)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\TMR_038 Capitain Cook Bridge\		

Description	Concrete Arch Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	10.4mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	6m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	9.8mAHD		
Rail height	1.5*m		
Span Length	73-183m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Captain Cook Bridge, looking downstream
Image Reference	BrisbanePom (2011*). The Captain Cook Bridge over the Brisbane River at Brisbane.* [digital photography]. Retrieved from below source
Image Source	https://en.wikipedia.org/wiki/Captain_Cook_Bridge,_Brisbane#/media/File:Captain_Cook_Bridge_at_dusk,_Brisbane.jpg

BMT WBM

Captain Cook Bridge (TMR_038) Characteristics

Structure Name	Captain Cook Bridge
Structure ID	TMR_038
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10790	0	10790	3432	0	3432	3.1	0.0	3.1	6.02	5.90	0.13
1996	3571	0	3571	2327	0	2327	1.5	0.0	1.5	2.18	2.15	0.03
1999	1295	0	1295	2152	0	2152	0.6	0.0	0.6	1.49	1.48	0.01
2011	8961	0	8961	3104	0	3104	2.9	0.0	2.9	4.97	4.86	0.11
2013	2759	0	2759	2398	0	2398	1.2	0.0	1.2	2.44	2.42	0.02
1 in 100 AEP	9061	0	9061	3122	0	3122	2.9	0.0	2.9	5.03	4.92	0.11
1 in 2000 AEP	17066	0	17066	4594	0	4594	3.7	0.0	3.7	9.89	9.70	0.19

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10363	0	10363	5854	0	5854	1.8	0.0	1.8	6.23	6.14	0.08
1996	3408	0	3408	3750	0	3750	0.9	0.0	0.9	2.06	2.05	0.01
1999	864	0	864	3538	0	3538	0.2	0.0	0.2	1.48	1.48	0.00
2011	8672	0	8672	5236	0	5236	1.7	0.0	1.7	4.97	4.90	0.08
2013	2422	0	2422	3849	0	3849	0.6	0.0	0.6	2.32	2.32	0.01
1 in 100 AEP	8569	0	8569	5270	0	5270	1.6	0.0	1.6	5.04	4.97	0.07
1 in 2000 AEP	15417	-7	15409	7338	17	7355	2.1	0.0	2.1	10.93	10.76	0.16

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage below obvert.	No	Yes

Goodwill Bridge (BCC_008) Structure

Structure Name	Goodwill Bridge		
Structure ID	BCC_008		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	2001	**AMTD**	24260
Date of significant modification		**Co-ordinates (GDA 56)**	502674.14E 6960341.25N
Source of Structure Information	Structural Design Drawings (1999)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_008 Goodwill Bridge\		

Description	Concrete and Steel Arch Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	6.1mAHD	**Number of Barrels**	-
Number of Piers in Waterway	8	**Dimensions**	-
Pier Width	23m, 0.8m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	7.3mAHD		
Rail height	1.6*m		
Span Length	19.7 - 112m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Goodwill Bridge, looking from South Bank
Image Reference	Department of Public Works (2012*). Goodwill bridge from South Bank* [Digital Photograph]. Retrieved from below source
Image Source	Department of Public Works, 2012

BMT WBM

Goodwill Bridge (BCC_008) Characteristics

Structure Name	Goodwill Bridge
Structure ID	BCC_008
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8960	0	8960	3773	0	3774	2.4	0.7	2.4	5.13	5.10	0.04
2013	2760	0	2760	2889	0	2889	1.0	0.0	1.0	2.47	2.46	0.02
1 in 100 AEP	9064	1	9065	3793	1	3794	2.4	0.8	2.4	5.19	5.16	0.03
1 in 2000 AEP	15733	1342	17075	5297	431	5727	3.0	3.1	3.0	10.37	10.10	0.27

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8816	7	8822	3649	5	3654	2.4	1.3	2.4	5.04	5.00	0.03
2013	2428	0	2428	2527	0	2527	1.0	0.0	1.0	2.33	2.27	0.06
1 in 100 AEP	8713	7	8721	3672	19	3691	2.4	0.4	2.4	5.11	5.07	0.04
1 in 2000 AEP	14977	1250	16227	5627	506	6133	2.7	2.5	2.6	11.03	10.93	0.10

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Shorter spans may require blockage consideration.	Yes	Yes

Victoria Bridge (BCC_009) Structure

Structure Name	Victoria Bridge		
Structure ID	BCC_009		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1865	**AMTD**	25305
Date of significant modification	1897, 1969	**Co-ordinates (GDA 56)**	502072.36E 6961236.33N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1966)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_009 Victoria Bridge\		

Description	Concrete Arch Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	8.2mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	4m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	9.2mAHD		
Rail height	1.5*m		
Span Length	136, 85.3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Victoria bridge, looking downstream
Image Reference	Figaro, I. (2009*). Fountain at Newstead House in Brisbane, Queensland, Australia* [digital photograph]. Retrieved from below source
Image Source	http://www.marysrosaries.com/collaboration/index.php?title=File:Victoria-Bridge_Brisbane.jpg

BMT WBM

Victoria Bridge (BCC_009) Characteristics

Structure Name	Victoria Bridge
Structure ID	BCC_009
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10797	0	10797	3226	0	3226	3.3	0.0	3.3	6.50	6.41	0.08
1996	3584	0	3584	2184	0	2184	1.6	0.0	1.6	2.32	2.29	0.03
1999	1317	0	1317	1996	0	1996	0.7	0.0	0.7	1.52	1.51	0.01
2011	8962	0	8962	2946	0	2946	3.0	0.0	3.0	5.41	5.33	0.08
2013	2822	0	2822	2239	0	2239	1.3	0.0	1.3	2.53	2.51	0.02
1 in 100 AEP	9074	0	9074	2962	0	2962	3.1	0.0	3.1	5.47	5.39	0.08
1 in 2000 AEP	15941	14	15956	3934	10	3944	4.1	1.5	4.0	11.02	10.61	0.41

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10748	0	10748	3764	0	3764	2.9	0.0	2.9	6.62	6.59	0.03
1996	3446	0	3446	2590	0	2590	1.3	0.0	1.3	2.14	2.14	0.00
1999	1415	0	1415	2441	0	2441	0.6	0.0	0.6	1.50	1.50	0.00
2011	8858	0	8858	3344	0	3344	2.6	0.0	2.6	5.37	5.34	0.04
2013	2545	0	2545	2644	0	2644	1.0	0.0	1.0	2.37	2.37	0.00
1 in 100 AEP	8763	0	8763	3360	0	3360	2.6	0.0	2.6	5.43	5.40	0.03
1 in 2000 AEP	15668	16	15683	4755	16	4771	3.3	1.0	3.3	11.37	11.30	0.07

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage.	No	Yes

Kurilpa Bridge (BCC_010) Structure

Structure Name	Kurilpa Bridge		
Structure ID	BCC_010		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	2009	**AMTD**	25705
Date of significant modification		**Co-ordinates (GDA 56)**	501765.75E 6961559.1N
Source of Structure Information	Structural Design Drawings (2007)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_010 Kurilpa Bridge\		

Description	Tensegrity Cable Stay Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	9.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	10*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	10.4mAHD		
Rail height	1.6*m		
Span Length	115m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Kurilpa Bridge, looking upstream
Image Reference	Guard, P. BMT WBM (2009*). Kurilpa Bridge.* [digital photograph]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:KurilpaBridge1.JPG

BMT WBM

Kurilpa Bridge (BCC_010) Characteristics

Structure Name	Kurilpa Bridge
Structure ID	BCC_010
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8951	0	8951	3514	0	3514	2.5	0.0	2.5	5.55	5.53	0.02
2013	2778	0	2778	2852	0	2852	1.0	0.0	1.0	2.56	2.55	0.01
1 in 100 AEP	9065	0	9065	3529	0	3529	2.6	0.0	2.6	5.62	5.60	0.02
1 in 2000 AEP	11964	49	12013	4804	32	4837	2.5	1.5	2.5	11.28	11.22	0.06

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8832	0	8832	2856	0	2856	3.1	0.0	3.1	5.33	5.30	0.03
2013	2557	0	2557	2290	0	2290	1.1	0.0	1.1	2.38	2.37	0.01
1 in 100 AEP	8723	0	8723	2868	0	2868	3.0	0.0	3.0	5.39	5.35	0.04
1 in 2000 AEP	13197	63	13260	4287	121	4408	3.1	0.5	3.0	11.79	11.64	0.16

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage below obvert.	No	Yes

William Jolly Bridge (BCC_011) Structure

Structure Name	William Jolly Bridge		
Structure ID	BCC_011		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1932	**AMTD**	26035
Date of significant modification		**Co-ordinates (GDA 56)**	501537.64E 6961628.46N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1927)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_011 William Jolly\		

Description	Concrete Arch Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	13.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	6.6m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	14.3mAHD		
Rail height	1.5*m		
Span Length	72.5m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	William Jolly Bridge, looking downstream
Image Reference	Allen, R. (2012*). William Jolly Bridge (looking upstream)* [digital photograph]. Retrieved from below source
Image Source	https://www.flickr.com/photos/raeallen/7173158786/in/photostream/

William Jolly Bridge (BCC_011) Characteristics

Structure Name	William Jolly Bridge
Structure ID	BCC_011
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10719	0	10719	3882	0	3882	2.8	0.0	2.8	6.85	6.81	0.04
1996	3582	0	3582	2864	0	2864	1.3	0.0	1.3	2.39	2.38	0.01
1999	1324	0	1324	2679	0	2679	0.5	0.0	0.5	1.54	1.53	0.01
2011	8952	0	8952	3621	0	3621	2.5	0.0	2.5	5.70	5.67	0.03
2013	2816	0	2816	2908	0	2908	1.0	0.0	1.0	2.59	2.58	0.01
1 in 100 AEP	9071	0	9071	3637	0	3637	2.5	0.0	2.5	5.76	5.74	0.03
1 in 2000 AEP	12021	0	12021	4926	0	4926	2.4	0.0	2.4	11.44	11.39	0.05

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10548	0	10548	3769	0	3769	2.8	0.0	2.8	6.94	6.91	0.04
1996	3463	0	3463	2636	0	2636	1.3	0.0	1.3	2.18	2.18	-0.01
1999	1408	0	1408	2515	0	2515	0.6	0.0	0.6	1.51	1.51	0.00
2011	8802	0	8802	3415	0	3415	2.6	0.0	2.6	5.64	5.62	0.03
2013	2565	0	2565	2696	0	2696	1.0	0.0	1.0	2.42	2.41	0.01
1 in 100 AEP	8695	0	8695	3457	0	3457	2.5	0.0	2.5	5.69	5.67	0.02
1 in 2000 AEP	13790	0	13790	5336	0	5336	2.6	0.0	2.6	12.10	12.04	0.06

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage.	No	Yes

Merivale St Bridge (QR_087) Structure

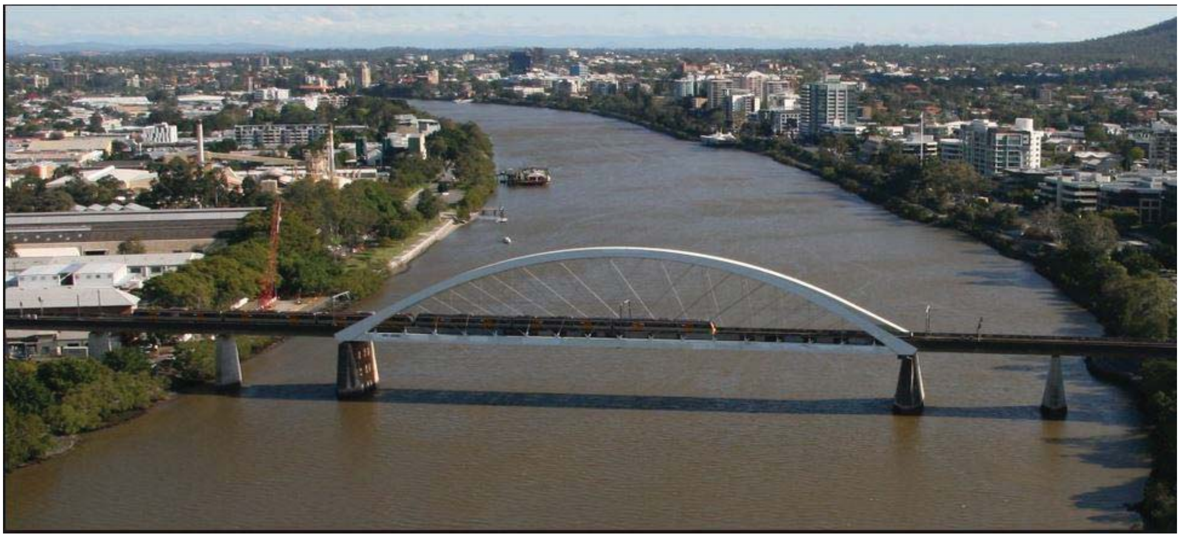
Structure Name	Merivale St Bridge		
Structure ID	QR_087		
Owner	QR	**Waterway**	Brisbane River
Date of Construction	1979	**AMTD**	26290
Date of significant modification		**Co-ordinates (GDA 56)**	501306.22E 6961566.52N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) As-Constructed Drawings (1974)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\QR_087 Merivale Street Rail\		

Description	Through Arch Bridge with Concrete Deck and Cable Stay Arch		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	14.1mAHD	**Number of Barrels**	-
Number of Piers in Waterway	4	**Dimensions**	-
Pier Width	max 13.4m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	15.1mAHD		
Rail height	-m		
Span Length	33.4-132.9m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Merivale St Bridge, looking upstream
Image Reference	Bilious. (2008). *Merivale Bridge, Brisbane taken from an oblique elevated vantage* [digital photograph]. Retrieved from below source
Image Source	http://commons.wikimedia.org/wiki/File:Merivale_Bridge.jpg



Merivale St Bridge (QR_087) Characteristics

Structure Name	Merivale St Bridge
Structure ID	QR_087
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	3598	0	3598	1691	0	1691	2.1	0.0	2.1	2.51	2.41	0.11
1999	1331	0	1331	1522	0	1522	0.9	0.0	0.9	1.56	1.54	0.02
2011	8956	0	8956	2434	0	2434	3.7	0.0	3.7	6.01	5.75	0.27
2013	2862	0	2862	1728	0	1728	1.7	0.0	1.7	2.66	2.60	0.07
1 in 100 AEP	9073	0	9073	2451	0	2451	3.7	0.0	3.7	6.08	5.82	0.27
1 in 2000 AEP	14308	0	14308	3707	0	3707	3.9	0.0	3.9	11.73	11.50	0.24

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	3454	0	3454	2390	0	2390	1.4	0.0	1.4	2.23	2.22	0.01
1999	1406	0	1406	2228	0	2228	0.6	0.0	0.6	1.52	1.51	0.00
2011	8814	0	8814	3344	0	3344	2.6	0.0	2.6	5.88	5.82	0.06
2013	2565	0	2565	2441	0	2441	1.1	0.0	1.1	2.45	2.44	0.01
1 in 100 AEP	8709	0	8709	3364	0	3364	2.6	0.0	2.6	5.92	5.85	0.06
1 in 2000 AEP	14311	0	14311	5524	0	5524	2.6	0.0	2.6	12.29	12.23	0.06

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage below obvert.	No	Yes

Go Between Bridge (BCC_012) Structure

Structure Name	Go Between Bridge		
Structure ID	BCC_012		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	2010	**AMTD**	29380
Date of significant modification		**Co-ordinates (GDA 56)**	501204.81E 6961523.39N
Source of Structure Information	As-Constructed Drawings (2010)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_012 Go Between Bridge\		

Description	Concrete Arch Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	6.7mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	8.9m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	7.5mAHD		
Rail height	1.3m		
Span Length	78.5-117 m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Go Between Bridge, looking upstream
Image Reference	Guard, P. BMT WBM (2010). *Go Between Bridge.* [digital photograph]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Go_between_bridge.jpg

Go Between Bridge (BCC_012) Characteristics

Structure Name	Go Between Bridge
Structure ID	BCC_012
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8956	0	8956	3397	0	3397	2.6	0.0	2.6	6.05	6.03	0.02
2013	2873	0	2873	2470	0	2470	1.2	0.0	1.2	2.68	2.66	0.01
1 in 100 AEP	9075	0	9075	3416	0	3416	2.7	0.0	2.7	6.12	6.10	0.02
1 in 2000 AEP	13875	445	14320	4638	173	4811	3.0	2.6	3.0	11.91	11.75	0.16

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8781	0	8781	3352	0	3352	2.6	0.0	2.6	5.97	5.93	0.05
2013	2570	0	2570	2346	0	2346	1.1	0.0	1.1	2.47	2.45	0.01
1 in 100 AEP	8808	0	8808	3362	0	3362	2.6	0.0	2.6	6.02	5.97	0.05
1 in 2000 AEP	13294	399	13693	4144	229	4373	3.2	1.7	3.1	12.36	12.25	0.10

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage below obvert.	No	Yes

BMT WBM

Eleanor Schonell (Green) Bridge (BCC_019) Structure

Structure Name	Eleanor Schonell (Green) Bridge		
Structure ID	BCC_019		
Owner	BCC	**Waterway**	Brisbane River
Date of Construction	2006	**AMTD**	35100
Date of significant modification		**Co-ordinates (GDA 56)**	502036.19E 6958442.67N
Source of Structure Information	As-Constructed Drawings (2005)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_019 Green Bridge\		

Description	Harp Cable Stay Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	11.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	6.2-9.5m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	12.4mAHD		
Rail height	1.17m		
Span Length	73-184.4m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Eleanor Schonell (Green) Bridge, looking upstream
Image Reference	Bilious. (2007*). The completed Eleanor Schonell Bridge taken on, from the City Cat.* [digital photography]. Retrieved from below source
Image Source	http://en.wikipedia.org/wiki/File:Eleanor_Schonell_Bridge,_Brisbane,_2007-01-31.jpg

Eleanor Schonell (Green) Bridge (BCC_019) Characteristics

Structure Name	Eleanor Schonell (Green) Bridge
Structure ID	BCC_019
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8972	0	8972	4894	0	4894	1.8	0.0	1.8	7.48	7.47	0.01
2013	2988	0	2988	3507	0	3507	0.9	0.0	0.9	3.00	3.00	0.01
1 in 100 AEP	9138	0	9138	4927	0	4927	1.9	0.0	1.9	7.58	7.57	0.01
1 in 2000 AEP	13647	23	13669	6992	19	7011	2.0	1.2	2.0	13.64	13.60	0.03

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8907	0	8907	5696	0	5696	1.6	0.0	1.6	7.79	7.77	0.02
2013	2734	0	2734	3915	0	3915	0.7	0.0	0.7	2.76	2.75	0.01
1 in 100 AEP	9067	0	9067	5831	0	5831	1.6	0.0	1.6	8.04	8.02	0.02
1 in 2000 AEP	16220	25	16245	8726	46	8772	1.9	0.5	1.9	14.39	14.37	0.03

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Deck is above extreme events and the opening width precludes debris blockage.	No	No

Jack Pesch Bridge (BCC_021) Structure

Structure Name	Jack Pesch Bridge		
Structure ID	BCC_021		
Owner	BCC	**Waterway**	Brisbane River
Date of Construction	1998	**AMTD**	41550
Date of significant modification		**Co-ordinates (GDA 56)**	497452.41E 6957523.98N
Source of Structure Information	As-Construcuted Drawings (1997)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_021 Walter Taylor Pedestrian Bridge\		

Description	Steel Cable Stay Bridge. NB: Jack Pesch, Indooroopilly Rail (2) and Walter Taylor Bridges modelled as one.		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	15.5*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	0	**Dimensions**	-
Pier Width	-m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	18.4mAHD		
Rail height	1.8*m		
Span Length	167.5m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	See BCC_020
Included in Detailed Model (DM)	Yes	**DM Representation**	See BCC_020

Image Description	Aerial image, looking upstream. Jack Pesch Bridge on right
Image Reference	Kgbo. (2014*). Jack Pesch Bridge and next to it Albert Bridge, Brisbane.* [digital photography]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Jack_Pesch_Bridge_05.JPG

Jack Pesch Bridge (BCC_021) Characteristics

Structure Name	Jack Pesch Bridge
Structure ID	BCC_021
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	1588	0	1588	1651	0	1651	1.0	0.0	1.0	1.94	1.93	0.01
2011	9173	0	9173	3029	0	3029	3.0	0.0	3.0	9.84	9.79	0.06
2013	3557	0	3557	1934	0	1934	1.8	0.0	1.8	3.79	3.76	0.03
1 in 100 AEP	9217	0	9217	3056	0	3056	3.0	0.0	3.0	9.98	9.93	0.05
1 in 2000 AEP	14867	0	14867	4087	0	4087	3.6	0.0	3.6	16.34	15.98	0.36

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	1587	0	1587	2002	0	2002	0.8	0.0	0.8	1.83	1.83	0.00
2011	9023	0	9023	3230	0	3230	2.8	0.0	2.8	9.48	9.47	0.01
2013	3357	0	3357	2211	0	2211	1.5	0.0	1.5	3.21	3.21	0.00
1 in 100 AEP	9160	0	9160	3280	0	3280	2.8	0.0	2.8	9.74	9.74	0.00
1 in 2000 AEP	16919	0	16919	4310	0	4310	3.9	0.0	3.9	15.97	15.87	0.10

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage.	No	Yes

Indooroopilly Railway Bridges (QR_083) Structure

Structure Name	Indooroopilly Railway Bridges		
Structure ID	QR_083		
Owner	QR	**Waterway**	Brisbane River
Date of Construction	1957	**AMTD**	41550
Date of significant modification		**Co-ordinates (GDA 56)**	497432.65E 6957535.32N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1951)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\QR_083 Indooroopilly Rail\		

Description	Two steel suspension bridges. Albert Bridge with arched superstructure. NB: Jack Pesch, Indooroopilly Rail (2) and Walter Taylor Bridges modelled as one.		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	15.5*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	1	**Dimensions**	-
Pier Width	7.3m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	16.5mAHD		
Rail height	-m		
Span Length	104.2m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	See BCC_020
Included in Detailed Model (DM)	Yes	**DM Representation**	See BCC_020

Image Description	Aerial image, looking upstream. Indooroopilly Rail Bridges in center
Image Reference	Guard, P. BMT WBM (2008). *Indooroopilly Rail Bridge.* [digital photograph]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Indooroopilly_Bridge.jpg

Indooroopilly Railway Bridges (QR_083) Characteristics

Structure Name	Indooroopilly Railway Bridges
Structure ID	QR_083
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10860	0	10860	3331	0	3331	3.3	0.0	3.3	11.38	11.32	0.06
1996	3663	0	3663	1960	0	1960	1.9	0.0	1.9	3.95	3.92	0.03
1999	1588	0	1588	1651	0	1651	1.0	0.0	1.0	1.94	1.93	0.01
2011	9173	0	9173	3029	0	3029	3.0	0.0	3.0	9.84	9.79	0.06
2013	3557	0	3557	1934	0	1934	1.8	0.0	1.8	3.79	3.76	0.03
1 in 100 AEP	9217	0	9217	3056	0	3056	3.0	0.0	3.0	9.98	9.93	0.05
1 in 2000 AEP	14867	0	14867	4087	0	4087	3.6	0.0	3.6	16.34	15.98	0.36

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10753	0	10753	3540	0	3540	3.0	0.0	3.0	11.12	11.11	0.01
1996	3506	0	3506	2234	0	2234	1.6	0.0	1.6	3.36	3.36	0.00
1999	1587	0	1587	2002	0	2002	0.8	0.0	0.8	1.83	1.83	0.00
2011	9023	0	9023	3230	0	3230	2.8	0.0	2.8	9.48	9.47	0.01
2013	3357	0	3357	2211	0	2211	1.5	0.0	1.5	3.21	3.21	0.00
1 in 100 AEP	9160	0	9160	3280	0	3280	2.8	0.0	2.8	9.74	9.74	0.00
1 in 2000 AEP	16919	0	16919	4310	0	4310	3.9	0.0	3.9	15.97	15.87	0.10

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events. Truss structure above deck will require blockage consideration. Opening width precludes debris blockage below obvert.	No	Yes

Walter Taylor Bridge (BCC_020) Structure

Structure Name	Walter Taylor Bridge		
Structure ID	BCC_020		
Owner	BCC	**Waterway**	Brisbane River
Date of Construction	1936	**AMTD**	41550
Date of significant modification		**Co-ordinates (GDA 56)**	497399.96E 6957559.5N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1934)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_020 Walter Taylor Bridge\		

Description	Concrete Bridge with Steel Suspension. NB: Jack Pesch, Indooroopilly Rail (2) and Walter Taylor Bridges modelled as one.		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	15.5*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	0	**Dimensions**	-
Pier Width	10.1*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	16.5mAHD		
Rail height	1.8*m		
Span Length	152.4m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Aerial image, looking upstream. Walter Taylor on left
Image Reference	Guard, P. BMT WBM (2008*). Walter Taylor Bridge.* [digital photograph. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Walter_Taylor_Bridge.jpg

Walter Taylor Bridge (BCC_020) Characteristics

Structure Name	Walter Taylor Bridge
Structure ID	BCC_020
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10860	0	10860	3331	0	3331	3.3	0.0	3.3	11.38	11.32	0.06
1996	3663	0	3663	1960	0	1960	1.9	0.0	1.9	3.95	3.92	0.03
1999	1588	0	1588	1651	0	1651	1.0	0.0	1.0	1.94	1.93	0.01
2011	9173	0	9173	3029	0	3029	3.0	0.0	3.0	9.84	9.79	0.06
2013	3557	0	3557	1934	0	1934	1.8	0.0	1.8	3.79	3.76	0.03
1 in 100 AEP	9217	0	9217	3056	0	3056	3.0	0.0	3.0	9.98	9.93	0.05
1 in 2000 AEP	14867	0	14867	4087	0	4087	3.6	0.0	3.6	16.34	15.98	0.36

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10753	0	10753	3540	0	3540	3.0	0.0	3.0	11.12	11.11	0.01
1996	3506	0	3506	2234	0	2234	1.6	0.0	1.6	3.36	3.36	0.00
1999	1587	0	1587	2002	0	2002	0.8	0.0	0.8	1.83	1.83	0.00
2011	9023	0	9023	3230	0	3230	2.8	0.0	2.8	9.48	9.47	0.01
2013	3357	0	3357	2211	0	2211	1.5	0.0	1.5	3.21	3.21	0.00
1 in 100 AEP	9160	0	9160	3280	0	3280	2.8	0.0	2.8	9.74	9.74	0.00
1 in 2000 AEP	16919	0	16919	4310	0	4310	3.9	0.0	3.9	15.97	15.87	0.10

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events. Truss structure above deck will require blockage consideration. Opening width precludes debris blockage below obvert.	No	Yes

Centenary Bridge (TMR_039) Structure

Structure Name	Centenary Bridge		
Structure ID	TMR_039		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1964	**AMTD**	49990
Date of significant modification	1985	**Co-ordinates (GDA 56)**	494771.63E 6955108.12N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings, Duplication of Bridge (1985)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\TMR_039 Centenary Bridge\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	13.2mAHD	**Number of Barrels**	-
Number of Piers in Waterway	4	**Dimensions**	-
Pier Width	0.7m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	11.1mAHD		
Rail height	1.3m		
Span Length	42.3-48.3 m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Centenary Bridge, seen from Jindalee looking downstream
Image Reference	Kgbo. (2014) *Centenary Bridge, seen from Jindalee, Queensland, 03.2014.* [digital photograph]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Centenary_Bridge_03.2014_03.JPG

Centenary Bridge (TMR_039) Characteristics

Structure Name	Centenary Bridge
Structure ID	TMR_039
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	9825	755	10580	3311	349	3660	3.0	2.2	2.9	13.92	13.80	0.12
1996	3714	0	3714	1722	0	1722	2.2	0.0	2.2	5.05	4.98	0.07
1999	2117	0	2117	1256	0	1256	1.7	0.0	1.7	2.33	2.28	0.05
2011	9241	136	9377	3143	79	3222	2.9	1.7	2.9	12.25	12.13	0.12
2013	3559	0	3559	1685	0	1685	2.1	0.0	2.1	4.84	4.77	0.07
1 in 100 AEP	9065	149	9214	3153	86	3239	2.9	1.7	2.8	12.30	12.19	0.12
1 in 2000 AEP	7724	5513	13237	3318	2098	5416	2.3	2.6	2.4	18.78	18.62	0.16

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10596	433	11029	4152	788	4940	2.6	0.6	2.2	14.09	14.02	0.07
1996	3569	0	3569	2055	0	2055	1.7	0.0	1.7	4.55	4.51	0.05
1999	1658	0	1658	1648	0	1648	1.0	0.0	1.0	2.27	2.25	0.02
2011	9385	85	9470	3772	344	4116	2.5	0.2	2.3	12.30	12.23	0.07
2013	3371	0	3371	2016	0	2016	1.7	0.0	1.7	4.34	4.29	0.04
1 in 100 AEP	9126	89	9215	3874	365	4239	2.4	0.2	2.2	12.40	12.33	0.07
1 in 2000 AEP	12097	4687	16785	4173	3118	7291	2.9	1.5	2.3	19.16	19.13	0.03

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, handrail will require consideration. Opening width precludes debris blockage below obvert.	No	Yes

BMT WBM

Colleges Crossing (TMR_078) Structure

Structure Name	Colleges Crossing		
Structure ID	TMR_078		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1894	**AMTD**	85890
Date of significant modification		**Co-ordinates (GDA 56)**	480670.33E 6951875.09N
Source of Structure Information	Structural Design Drawings (1981)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\TMR_078 Colleges\		

Description	Concrete Bridge. Note: Data for small culverts embedded in causeway were unavailable however this omission has negligible effect on results.		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	2.2mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	0.6m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	2.6mAHD		
Rail height	0.3m		
Span Length	14m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Colleges Crossing, looking upstream
Image Reference	BMT WBM (2014). *Colleges Crossing (looking upstream)* [digital photography].
Image Source	BMT WBM, 2014

BMT WBM

Colleges Crossing (TMR_078) Characteristics

Structure Name	Colleges Crossing
Structure ID	TMR_078
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	58	9531	9590	59	8063	8122	1.0	1.2	1.2	24.93	24.90	0.03
1996	53	2546	2599	59	2408	2467	0.9	1.1	1.1	11.81	11.79	0.02
1999	59	1874	1933	59	1587	1646	1.0	1.2	1.2	9.52	9.49	0.03
2011	61	9204	9266	59	7422	7481	1.0	1.2	1.2	23.54	23.51	0.03
2013	50	2191	2240	59	2192	2251	0.8	1.0	1.0	11.23	11.22	0.02
1 in 100 AEP	59	8489	8548	59	7144	7203	1.0	1.2	1.2	22.93	22.91	0.03
1 in 2000 AEP	74	17070	17143	59	11464	11523	1.2	1.5	1.5	32.17	32.14	0.04

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	84	9510	9594	97	8136	8234	0.9	1.2	1.2	24.58	24.54	0.03
1996	83	2489	2573	97	2637	2734	0.9	0.9	0.9	12.12	12.10	0.03
1999	90	1792	1882	97	1703	1800	0.9	1.1	1.0	9.81	9.77	0.04
2011	90	9367	9457	97	7587	7684	0.9	1.2	1.2	23.44	23.39	0.05
2013	83	1998	2082	97	2280	2377	0.9	0.9	0.9	11.16	11.13	0.03
1 in 100 AEP	89	8561	8650	97	7196	7293	0.9	1.2	1.2	22.80	22.76	0.04
1 in 2000 AEP	99	16730	16829	97	11311	11408	1.0	1.5	1.5	31.47	31.44	0.03

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtopped frequently, blockage below and above deck (handrail) requires consideration. *ICC: Very low immunity – naturally potential for blockage is higher.*	Yes	Yes

BMT WBM

Mt Crosby Weir (BCC_077) Structure

Structure Name	Mt Crosby Weir		
Structure ID	BCC_077		
Owner	Seqwater	**Waterway**	Brisbane River
Date of Construction	1894	**AMTD**	90320
Date of significant modification	1897, 1927	**Co-ordinates (GDA 56)**	480042.24E 6954038.38N
Source of Structure Information	Brief Archival Record (Converge 2013 for SEQwater)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_077 Mt Crosby Weir\		

Description	Multi-cell weir with concrete overbridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	11.2mAHD	**Number of Barrels**	-
Number of Piers in Waterway	21	**Dimensions**	-
Pier Width	0.91m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	12.5mAHD		
Rail height	1.5*m		
Span Length	7.6m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	18xRectangular culverts with overtop
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Culvert Channels, 2D Weir

Image Description	Mt Crosby Weir, looking upstream from west bank
Image Reference	BMT WBM (2014). *Mt Crosby Weir (looking upstream from west bank)* [digital photography]
Image Source	BMT WBM, 2014

Mt Crosby Weir (BCC_077) Characteristics

Structure Name	Mt Crosby Weir
Structure ID	BCC_077
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1741	7856	9598	509	3248	3756	3.4	2.4	2.6	27.40	27.28	0.11
1996	2008	605	2613	509	290	799	3.9	2.1	3.3	14.04	13.62	0.42
1999	1899	0	1899	473	0	473	4.0	0.0	4.0	12.18	11.33	0.85
2011	1812	7557	9369	509	2990	3498	3.6	2.5	2.7	26.25	26.13	0.12
2013	2011	231	2243	509	151	660	4.0	1.5	3.4	13.33	12.87	0.46
1 in 100 AEP	1733	6829	8562	509	2805	3314	3.4	2.4	2.6	25.43	25.32	0.11
1 in 2000 AEP	1977	14141	16119	509	5005	5513	3.9	2.8	2.9	35.19	35.04	0.15

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	664	8952	9615	509	3270	3779	1.3	2.7	2.5	26.61	26.46	0.15
1996	1803	845	2649	509	389	898	3.5	2.2	3.0	14.58	13.62	0.96
1999	1838	118	1956	509	175	683	3.6	0.7	2.9	12.93	12.28	0.65
2011	701	8819	9520	509	3024	3533	1.4	2.9	2.7	25.80	25.63	0.17
2013	1780	375	2155	509	273	782	3.5	1.4	2.8	13.69	12.93	0.77
1 in 100 AEP	659	7997	8656	509	2676	3184	1.3	3.0	2.7	25.04	24.86	0.18
1 in 2000 AEP	219	17351	17570	509	5905	6414	0.4	2.9	2.7	34.14	33.92	0.22

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtopped frequently, blockage below and above deck requires consideration.	Yes	Yes

Kholo Rd Bridge (BCC_076) Structure

Structure Name	Kholo Rd Bridge		
Structure ID	BCC_076		
Owner	BCC	**Waterway**	Brisbane River
Date of Construction	1970	**AMTD**	99090
Date of significant modification		**Co-ordinates (GDA 56)**	475036.12E 6950949.91N
Source of Structure Information	Structural Design Drawings (1969)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_076 Kholo Rd Bridge\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	11.2mAHD	**Number of Barrels**	-
Number of Piers in Waterway	8	**Dimensions**	-
Pier Width	0.8m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	11.7mAHD		
Rail height	0.6m		
Span Length	12.7m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Kholo Rd Bridge, looking downstream
Image Reference	BMT WBM (2015*). Kholo Road Bridge (looking downstream)* [digital photography].
Image Source	BMT WBM, 2015

BMT WBM

Kholo Rd Bridge (BCC_076) Characteristics

Structure Name	Kholo Rd Bridge
Structure ID	BCC_076
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	736	8100	8836	414	3872	4286	1.8	2.1	2.1	30.06	29.98	0.08
1996	716	1891	2607	414	977	1391	1.7	1.9	1.9	16.78	16.70	0.08
1999	768	1177	1945	414	580	993	1.9	2.0	2.0	14.95	14.84	0.11
2011	771	8042	8812	414	3685	4098	1.9	2.2	2.2	29.20	29.11	0.09
2013	719	1530	2249	414	791	1204	1.7	1.9	1.9	15.92	15.84	0.08
1 in 100 AEP	747	7351	8098	414	3473	3887	1.8	2.1	2.1	28.23	28.15	0.08
1 in 2000 AEP	619	10111	10730	414	5652	6065	1.5	1.8	1.8	38.23	38.17	0.06

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	623	6074	6698	402	4000	4402	1.6	1.5	1.5	29.83	29.77	0.06
1996	797	1794	2590	402	1102	1504	2.0	1.6	1.7	17.58	17.49	0.08
1999	757	1140	1897	402	696	1099	1.9	1.6	1.7	15.89	15.78	0.12
2011	670	6221	6891	402	3845	4248	1.7	1.6	1.6	29.17	29.11	0.06
2013	776	1327	2103	402	870	1272	1.9	1.5	1.7	16.49	16.40	0.09
1 in 100 AEP	656	5978	6635	402	3696	4098	1.6	1.6	1.6	28.30	28.24	0.06
1 in 2000 AEP	388	6354	6742	402	5892	6294	1.0	1.1	1.1	37.67	37.63	0.04

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck requires consideration. *ICC: No record. New bridge in place I recall. BCC?*	Yes	Yes

Burtons Bridge (SRC_075) Structure

Structure Name	Burtons Bridge		
Structure ID	SRC_075		
Owner	SRC	**Waterway**	Brisbane River
Date of Construction	?	**AMTD**	119090
Date of significant modification	2000	**Co-ordinates (GDA 56)**	469361.11E 6958199.51N
Source of Structure Information	Structural Design Drawings (2000)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\SRC_075 Burtons Bridge\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	18.1*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	5	**Dimensions**	-
Pier Width	1-1.2*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	19.8mAHD		
Rail height	1.1*m		
Span Length	14.3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Burtons Bridge, looking downstream
Image Reference	BMT WBM (2014*). Burtons Bridge (looking downstream)* [digital photography].
Image Source	BMT WBM, 2014

Burtons Bridge (SRC_075) Characteristics

Structure Name	Burtons Bridge
Structure ID	SRC_075
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	272	8000	8272	232	5628	5860	1.2	1.4	1.4	36.42	36.38	0.04
1996	369	2121	2490	232	1124	1356	1.6	1.9	1.8	25.37	25.30	0.07
1999	383	1556	1939	232	803	1036	1.6	1.9	1.9	24.08	23.99	0.09
2011	285	8192	8477	232	5501	5733	1.2	1.5	1.5	36.16	36.12	0.04
2013	379	1890	2268	232	987	1219	1.6	1.9	1.9	24.85	24.76	0.09
1 in 100 AEP	293	7612	7905	232	4985	5218	1.3	1.5	1.5	35.09	35.05	0.04
1 in 2000 AEP	154	7469	7623	232	9273	9506	0.7	0.8	0.8	43.76	43.74	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	671	8471	9142	369	5517	5886	1.8	1.5	1.6	36.27	36.26	0.01
1996	725	1765	2489	369	1019	1388	2.0	1.7	1.8	25.28	25.24	0.04
1999	739	1172	1911	369	682	1051	2.0	1.7	1.8	23.82	23.77	0.05
2011	688	8566	9254	369	5473	5842	1.9	1.6	1.6	36.18	36.17	0.01
2013	734	1406	2140	369	822	1191	2.0	1.7	1.8	24.43	24.38	0.05
1 in 100 AEP	668	7757	8425	369	5011	5380	1.8	1.5	1.6	35.23	35.23	0.01
1 in 2000 AEP	693	15665	16358	369	9024	9393	1.9	1.7	1.7	43.44	43.45	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck (handrail) requires consideration. *Rarely obstructed in the substructure. Some blockage of the guard rails, up to 50%.*	Yes	Yes

BMT WBM

Savages Crossing (SRC_074) Structure

Structure Name	Savages Crossing		
Structure ID	SRC_074		
Owner	SRC	**Waterway**	Brisbane River
Date of Construction	?	**AMTD**	85990
Date of significant modification		**Co-ordinates (GDA 56)**	467394.57E 6964416.65N
Source of Structure Information	Cottrell Cameron and Steen Survey (2008) for Esk-Lowood Flood Study		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\SRC_074 Savages Crossing\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	20.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	5	**Dimensions**	-
Pier Width	0.5-0.6m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	21.31mAHD		
Rail height	0.97m		
Span Length	12.3-12.6m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Savages Crossing, looking downstream
Image Reference	BMT WBM (2014). *Savages Crossing (looking downstream)* [digital photography].
Image Source	BMT WBM, 2014

Savages Crossing (SRC_074) Characteristics

Structure Name	Savages Crossing
Structure ID	SRC_074
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	88	9428	9515	64	5816	5880	1.4	1.6	1.6	42.35	42.30	0.05
1996	75	2333	2408	64	1692	1756	1.2	1.4	1.4	30.37	30.34	0.04
1999	74	1849	1923	64	1363	1427	1.2	1.4	1.3	28.97	28.93	0.03
2011	89	9704	9793	64	5868	5932	1.4	1.7	1.7	42.47	42.42	0.05
2013	76	2207	2283	64	1584	1648	1.2	1.4	1.4	29.92	29.88	0.04
1 in 100 AEP	90	8988	9078	64	5385	5449	1.4	1.7	1.7	41.32	41.27	0.05
1 in 2000 AEP	78	12637	12714	64	8742	8806	1.2	1.4	1.4	49.18	49.15	0.04

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	227	8925	9152	91	4876	4967	2.5	1.8	1.8	42.36	42.33	0.03
1996	165	2256	2421	91	1532	1623	1.8	1.5	1.5	30.63	30.56	0.08
1999	165	1722	1886	91	1236	1328	1.8	1.4	1.4	29.17	29.10	0.07
2011	230	9154	9384	91	4931	5023	2.5	1.9	1.9	42.53	42.50	0.03
2013	168	1987	2155	91	1365	1456	1.8	1.5	1.5	29.80	29.74	0.07
1 in 100 AEP	228	8555	8782	91	4619	4711	2.5	1.9	1.9	41.56	41.53	0.04
1 in 2000 AEP	208	13981	14188	91	7180	7272	2.3	1.9	2.0	49.55	49.50	0.05

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck (handrail) requires consideration. *Frequent need to clean debris from structure.* *Usually 50% or less of waterway obstructed.*	Yes	Yes

Brisbane Valley Highway (TMR_050) Structure

Structure Name	Brisbane Valley Highway		
Structure ID	TMR_050		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1993	**AMTD**	123290
Date of significant modification		**Co-ordinates (GDA 56)**	464368.59E 6965778.14N
Source of Structure Information	Structural Design Drawings (1993)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\TMR_050 Brisbane Valley Hway\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	31.1mAHD	**Number of Barrels**	-
Number of Piers in Waterway	6	**Dimensions**	-
Pier Width	2m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	33.6mAHD		
Rail height	0.8m		
Span Length	31m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Brisbane Valley Highway, looking downstream
Image Reference	BMT WBM (2014). *Brisbane Valley Highway (looking downstream)* [digital photography].
Image Source	BMT WBM, 2014

Brisbane Valley Highway (TMR_050) Characteristics

Structure Name	Brisbane Valley Highway
Structure ID	TMR_050
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	2349	0	2349	1438	0	1438	1.6	0.0	1.6	32.15	32.09	0.07
1999	1872	0	1872	1349	0	1349	1.4	0.0	1.4	30.78	30.77	0.01
2011	816	1703	2519	1438	2353	3791	0.6	0.7	0.7	43.48	43.47	0.01
2013	2286	0	2286	1438	0	1438	1.6	0.0	1.6	31.79	31.73	0.06
1 in 100 AEP	958	1669	2627	1438	2087	3525	0.7	0.8	0.7	42.39	42.38	0.01
1 in 2000 AEP	364	2166	2530	1438	3904	5342	0.3	0.6	0.5	49.87	49.86	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	2357	0	2357	1466	0	1466	1.6	0.0	1.6	32.93	32.84	0.09
1999	1835	0	1835	1465	0	1466	1.3	0.0	1.3	31.62	31.56	0.06
2011	957	1554	2511	1466	2386	3852	0.7	0.7	0.7	43.95	43.94	0.01
2013	2163	0	2163	1466	0	1466	1.5	0.0	1.5	32.36	32.29	0.08
1 in 100 AEP	1029	1507	2536	1466	2163	3629	0.7	0.7	0.7	43.02	43.01	0.01
1 in 2000 AEP	694	1873	2567	1466	3969	5435	0.5	0.5	0.5	50.54	50.54	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, blockage below and above deck (handrail) requires consideration. *SRC: Rarely any obstruction.*	Yes	Yes

Twin Bridges (SRC_073) Structure

Structure Name	Twin Bridges		
Structure ID	SRC_073		
Owner	SRC	**Waterway**	Brisbane River
Date of Construction	1900	**AMTD**	124390
Date of significant modification	?	**Co-ordinates (GDA 56)**	463779.36E 6965122.41N
Source of Structure Information	Cottrell Cameron and Steen Survey (2008) for Esk-Lowood Flood Study		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\SRC_073 Twin Bridges\		

Description	2 Concrete Causeways		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	23.3mAHD	**Number of Barrels**	-
Number of Piers in Waterway	14	**Dimensions**	-
Pier Width	0.4m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	23.7mAHD		
Rail height	-m		
Span Length	3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	2 banks of culverts
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Culvert Channels, 2D Weir

Image Description	Twin Bridges, looking downstream
Image Reference	BMT WBM (2014). *Twin Bridges (looking downstream)* [digital photography].
Image Source	BMT WBM, 2014

BMT WBM

Twin Bridges (SRC_073) Characteristics

Structure Name	Twin Bridges
Structure ID	SRC_073
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	69	5098	5167	58	7059	7117	1.2	0.7	0.7	43.35	43.34	0.01
1996	124	2226	2350	58	1965	2023	2.1	1.1	1.2	32.51	32.48	0.02
1999	122	1755	1877	58	1560	1618	2.1	1.1	1.2	31.19	31.16	0.02
2011	69	5149	5217	58	7137	7194	1.2	0.7	0.7	43.51	43.50	0.01
2013	127	2165	2292	58	1862	1919	2.2	1.2	1.2	32.18	32.15	0.03
1 in 100 AEP	79	5258	5337	58	6600	6658	1.4	0.8	0.8	42.42	42.41	0.01
1 in 2000 AEP	35	5484	5519	58	10288	10345	0.6	0.5	0.5	49.88	49.87	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-18	5720	5702	58	6351	6408	-0.3	0.9	0.9	43.78	43.78	0.00
1996	-26	2387	2361	58	1778	1836	-0.5	1.3	1.3	33.23	33.24	-0.01
1999	-26	1853	1827	58	1496	1553	-0.5	1.2	1.2	31.92	31.91	0.01
2011	-18	5804	5786	58	6434	6491	-0.3	0.9	0.9	43.96	43.97	0.00
2013	-26	2187	2161	58	1656	1713	-0.4	1.3	1.3	32.66	32.67	-0.01
1 in 100 AEP	-19	5746	5726	58	6022	6080	-0.3	1.0	0.9	43.04	43.04	-0.01
1 in 2000 AEP	-1	5717	5716	58	9366	9424	0.0	0.6	0.6	50.55	50.55	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtopped frequently, blockage below deck requires consideration. No handrail at structure. *SRC: Frequent need to clean debris from culverts.* *Usually 100% of culvert blocked.*	Yes	No

Warrego Hwy (TMR_037) Structure

Structure Name	Warrego Hwy		
Structure ID	TMR_037		
Owner	TMR	**Waterway**	Bremer River
Date of Construction	1953	**AMTD**	5310
Date of significant modification	1990	**Co-ordinates (GDA 56)**	481697.09E 6948960.68N
Source of Structure Information	Structural Design Drawings (1990)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\TMR_037 Bremer river Warrego Hwy 18A\		

Description	Dual Concrete Bridges with debris fender system, modelled as single structure		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	14.5*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	11	**Dimensions**	-
Pier Width	1.5*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	15.8mAHD		
Rail height	1.3*m		
Span Length	30-37m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Aerial Imagery of dual bridges, flow direction bottom to top
Image Reference	*Ipswich City Council. Bremer River, Warrego Highway [* digital photograph].
Image Source	Imagery provided by ICC

BMT WBM

Warrego Hwy (TMR_037) Characteristics

Structure Name	Warrego Hwy
Structure ID	TMR_037
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	69	374	443	1868	1275	3143	0.0	0.3	0.1	20.74	20.74	0.00
1996	1031	0	1031	937	0	937	1.1	0.0	1.1	9.03	9.02	0.01
1999	324	0	324	551	0	551	0.6	0.0	0.6	5.08	5.07	0.01
2011	233	345	578	1868	791	2659	0.1	0.4	0.2	18.89	18.89	0.00
2013	1626	0	1626	1001	0	1001	1.6	0.0	1.6	9.54	9.52	0.02
1 in 100 AEP	629	449	1077	1868	742	2610	0.3	0.6	0.4	18.70	18.69	0.01
1 in 2000 AEP	0	159	159	258	2678	2935	0.0	0.1	0.1	26.09	26.09	0.00

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	331	182	513	1748	981	2728	0.2	0.2	0.2	20.54	20.54	0.00
1996	1590	0	1590	953	0	953	1.7	0.0	1.7	9.57	9.52	0.05
1999	302	0	302	572	0	572	0.5	0.0	0.5	5.19	5.18	0.01
2011	458	149	607	1748	608	2355	0.3	0.2	0.3	18.83	18.83	0.00
2013	1558	0	1558	1021	0	1021	1.5	0.0	1.5	10.16	10.12	0.04
1 in 100 AEP	762	233	995	1755	582	2338	0.4	0.4	0.4	18.72	18.71	0.01
1 in 2000 AEP	173	220	393	1755	2098	3853	0.1	0.1	0.1	25.66	25.66	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtopped frequently, blockage below and above deck (handrail) requires consideration. *ICC: No record but bridge opening is quite large. TMR post flood records?*	Yes	Yes

David Trumpy Bridge (TMR_043) Structure

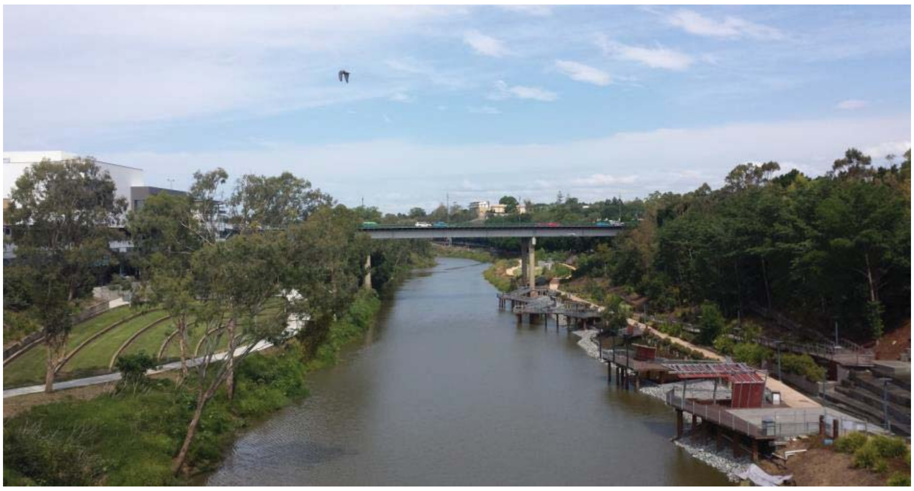
Structure Name	David Trumpy Bridge		
Structure ID	TMR_043		
Owner	TMR	**Waterway**	Bremer River
Date of Construction	1965	**AMTD**	16720
Date of significant modification		**Co-ordinates (GDA 56)**	476469.74E 6945831.92N
Source of Structure Information	Structural Design Drawings (1961)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\TMR_043 Bremer river Warrego connection\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	20.9mAHD	**Number of Barrels**	-
Number of Piers in Waterway	4	**Dimensions**	-
Pier Width	0.5m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	24.5*mAHD		
Rail height	1.6m		
Span Length	40.8-50.3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	David Trumpy Bridge 1974, looking upstream
Image Reference	Ipswich City Council (2015). *David Trumpy Bridge.* [digital photograph].
Image Source	Imagery provided by ICC



BMT WBM

David Trumpy Bridge (TMR_043) Characteristics

Structure Name	David Trumpy Bridge
Structure ID	TMR_043
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	2022	0	2022	2990	0	2990	0.7	0.0	0.7	21.01	21.01	0.01
1996	1662	0	1662	1132	0	1132	1.5	0.0	1.5	12.28	12.27	0.01
1999	687	0	687	465	0	465	1.5	0.0	1.5	6.57	6.56	0.01
2011	1361	0	1361	2520	0	2520	0.5	0.0	0.5	19.16	19.15	0.00
2013	1789	0	1789	1254	0	1254	1.4	0.0	1.4	13.06	13.06	0.01
1 in 100 AEP	3681	0	3681	2754	0	2754	1.3	0.0	1.3	20.10	20.09	0.01
1 in 2000 AEP	1307	326	1633	3536	526	4062	0.4	0.6	0.4	26.13	26.12	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	2203	0	2203	2819	0	2819	0.8	0.0	0.8	20.89	20.89	0.00
1996	1589	0	1589	1359	0	1359	1.2	0.0	1.2	13.83	13.80	0.03
1999	665	0	665	665	0	665	1.0	0.0	1.0	7.84	7.80	0.03
2011	1466	0	1466	2399	0	2399	0.6	0.0	0.6	19.16	19.15	0.00
2013	1667	0	1667	1408	0	1408	1.2	0.0	1.2	14.10	14.08	0.02
1 in 100 AEP	3533	0	3533	2608	0	2608	1.4	0.0	1.4	20.13	20.11	0.01
1 in 2000 AEP	2349	174	2523	3332	298	3630	0.7	0.6	0.7	25.74	25.73	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, Opening width precludes debris blockage. Handrail above deck will require blockage consideration. *ICC: No known record of notable blockage. Was above water in 1974, likely 1893 as well. Large waterway opening so likelihood of blockage is low.*	No	Yes

Railway Workshop Bridge (QR_025) Structure

Structure Name	Railway Workshop Bridge		
Structure ID	QR_025		
Owner	QR	**Waterway**	Bremer River
Date of Construction	1895	**AMTD**	17000
Date of significant modification	?	**Co-ordinates (GDA 56)**	476213.02E 6945933.83N
Source of Structure Information	Structural Design Drawings (1895)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\QR_025 Riverlink Shopping Centre Rail\		

Description	Steel Truss Supported Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	20.6*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	2.2*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	21.1mAHD		
Rail height	1.7*m		
Span Length	45.57m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Railway Bridge, Ipswich, looking usptream
Image Reference	Goodwin, C. (2009*). Rail bridge across the Bremer River, Ipswich, Queensland.* [digital imagery]. Retrieved from below source
Image Source	http://en.wikipedia.org/wiki/File:Bremer_R.JPG

BMT WBM

Railway Workshop Bridge (QR_025) Characteristics

Structure Name	Railway Workshop Bridge
Structure ID	QR_025
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	2099	0	2099	2331	0	2331	0.9	0.0	0.9	21.04	21.02	0.02
1996	1662	0	1662	1105	0	1105	1.5	0.0	1.5	12.33	12.32	0.01
1999	687	0	687	507	0	507	1.4	0.0	1.4	6.62	6.61	0.01
2011	1359	0	1359	2116	0	2116	0.6	0.0	0.6	19.17	19.16	0.01
2013	1789	0	1789	1203	0	1203	1.5	0.0	1.5	13.11	13.10	0.01
1 in 100 AEP	3685	0	3685	2271	0	2271	1.6	0.0	1.6	20.15	20.13	0.03
1 in 2000 AEP	1638	576	2214	2331	694	3025	0.7	0.8	0.7	26.14	26.13	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	3680	0	3680	2288	0	2288	1.6	0.0	1.6	20.99	20.92	0.07
1996	1607	0	1607	1210	0	1210	1.3	0.0	1.3	14.00	13.95	0.06
1999	661	0	661	376	0	376	1.8	0.0	1.8	8.00	7.93	0.07
2011	1470	0	1470	2015	0	2015	0.7	0.0	0.7	19.19	19.18	0.01
2013	1681	0	1681	1233	0	1233	1.4	0.0	1.4	14.22	14.19	0.03
1 in 100 AEP	3568	0	3568	2127	0	2127	1.7	0.0	1.7	20.30	20.20	0.09
1 in 2000 AEP	1879	627	2506	2171	936	3107	0.9	0.7	0.8	25.77	25.75	0.02

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events. Truss structure above deck will require blockage consideration. Opening width precludes debris blockage. *ICC: No known record. But very large opening. Expect low potential.*	No	Yes

Hancock Bridge (ICC_058) Structure

Structure Name	Hancock Bridge		
Structure ID	ICC_058		
Owner	ICC	**Waterway**	Bremer River
Date of Construction	1895	**AMTD**	20420
Date of significant modification	?	**Co-ordinates (GDA 56)**	474756.37E 6946775.98N
Source of Structure Information	Survey taken as part of Bremer River Flood Study, Reports 1 and 2		
Link to data source	K:\B20702.k.saw_Brisbane_River\10 Data Management\10-05_Structures\Structure_Details\BRI\BRM\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	11*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	0.8*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	14.8*mAHD		
Rail height	1.2*m		
Span Length	18.3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Hancock Bridge, Bremer River flow left to right
Image Reference	*Ipswich City Council. Hancock Bridge [* digital photograph].
Image Source	Imagery provided by ICC

Hancock Bridge (ICC_058) Characteristics

Structure Name	Hancock Bridge
Structure ID	ICC_058
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1301	2767	4068	750	1392	2142	1.7	2.0	1.9	22.65	22.57	0.08
1996	1669	0	1669	750	0	750	2.2	0.0	2.2	14.14	14.01	0.13
1999	690	0	690	362	0	362	1.9	0.0	1.9	8.05	8.04	0.01
2011	799	876	1674	750	705	1456	1.1	1.2	1.2	19.59	19.56	0.03
2013	1794	3	1797	750	6	757	2.4	0.4	2.4	14.92	14.77	0.15
1 in 100 AEP	1329	2505	3833	750	1242	1992	1.8	2.0	1.9	22.04	21.96	0.08
1 in 2000 AEP	1285	5037	6322	750	2526	3276	1.7	2.0	1.9	26.61	26.53	0.08

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1595	2196	3791	775	1723	2497	2.1	1.3	1.5	22.78	22.76	0.02
1996	1463	159	1622	775	112	886	1.9	1.4	1.8	15.69	15.60	0.09
1999	670	0	670	505	0	505	1.3	0.0	1.3	10.03	10.00	0.03
2011	1125	850	1975	775	1002	1776	1.5	0.8	1.1	19.79	19.77	0.02
2013	1471	206	1677	775	142	917	1.9	1.4	1.8	15.95	15.86	0.09
1 in 100 AEP	1609	1899	3508	788	1503	2291	2.0	1.3	1.5	22.12	22.09	0.03
1 in 2000 AEP	1550	3659	5209	788	2696	3484	2.0	1.4	1.5	26.61	26.60	0.01

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtopped frequently, blockage below and above deck (handrail) requires consideration. *ICC: Bridge went under in 1974 so immunity is not high, estimated 20yr ARI. Increased potential for blockage in larger events.*	Yes	Yes

BMT WBM

Wulkuraka Rail Bridge (QR_103) Structure

Structure Name	Wulkuraka Rail Bridge		
Structure ID	QR_103		
Owner	QR	**Waterway**	Bremer River
Date of Construction	1895	**AMTD**	22300
Date of significant modification	?	**Co-ordinates (GDA 56)**	474327.63E 6945513.17N
Source of Structure Information	Structural Design Drawings (1895)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\QR_103 DIxon St\		

Description	Steel Truss Supported Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	25.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	8	**Dimensions**	-
Pier Width	1.2m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	28.1*mAHD		
Rail height	2.2*m		
Span Length	46.5m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Wulkuraka Rail Bridge, Aerial Imagery
Image Reference	*Ipswich City Council. Wulkuraka Rail Bridge, Aerial Imagery [* digital photograph].
Image Source	Imagery provided by ICC

Wulkuraka Rail Bridge (QR_103) Characteristics

Structure Name	Wulkuraka Rail Bridge
Structure ID	QR_103
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	4143	0	4143	2147	0	2147	1.9	0.0	1.9	24.09	24.08	0.01
1996	1665	0	1665	901	0	901	1.8	0.0	1.8	16.02	16.01	0.01
1999	686	0	686	366	0	366	1.9	0.0	1.9	10.70	10.70	0.01
2011	2325	0	2325	1444	0	1444	1.6	0.0	1.6	20.46	20.46	0.01
2013	1801	0	1801	978	0	978	1.8	0.0	1.8	16.70	16.69	0.01
1 in 100 AEP	3898	0	3898	2015	0	2015	1.9	0.0	1.9	23.51	23.50	0.01
1 in 2000 AEP	6932	26	6958	2625	39	2664	2.6	0.7	2.6	28.26	28.05	0.21

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	4045	0	4045	2130	0	2130	1.9	0.0	1.9	24.00	23.89	0.11
1996	1616	0	1616	1054	0	1054	1.5	0.0	1.5	17.01	16.94	0.07
1999	670	0	670	580	0	580	1.2	0.0	1.2	11.72	11.61	0.11
2011	2308	0	2308	1526	0	1526	1.5	0.0	1.5	20.62	20.54	0.08
2013	1677	0	1677	1075	0	1075	1.6	0.0	1.6	17.24	17.17	0.07
1 in 100 AEP	3719	0	3719	2026	0	2026	1.8	0.0	1.8	23.34	23.24	0.09
1 in 2000 AEP	6423	0	6423	2751	0	2751	2.3	0.0	2.3	27.77	27.62	0.14

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events. Truss structure above deck will require blockage consideration. Opening width precludes debris blockage. At Dixon St end of bridge the opening widths reduce significantly which may require consideration. *ICC: No known record but reasonable opening size . QR may have records perhaps?*	Yes	Yes

One Mile Bridge (ICC_057) Structure

Structure Name	One Mile Bridge		
Structure ID	ICC_057		
Owner	ICC	**Waterway**	Bremer River
Date of Construction	1936	**AMTD**	24230
Date of significant modification	2004	**Co-ordinates (GDA 56)**	475079.71E 6944381.61N
Source of Structure Information	Structural Design Drawings, Upgrade (2004)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\ICC_057\		

Description	Concrete bridge on Bremer River downstream of Deebing Creek confluence		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	15.43mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	1.2m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	17.43mAHD		
Rail height	1.4m		
Span Length	29.7-30.0m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	One Mile Bridge, looking from downstream
Image Reference	BMT WBM (2014*). One Mile Bridge (looking downstream)* [digital photography]
Image Source	BMT WBM, 2015

BMT WBM

One Mile Bridge (ICC_057) Characteristics

Structure Name	One Mile Bridge
Structure ID	ICC_057
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1044	3105	4148	1095	2750	3846	1.0	1.1	1.1	25.28	25.25	0.02
1996	1597	74	1671	1095	52	1147	1.5	1.4	1.5	18.08	18.03	0.05
1999	685	0	685	709	0	709	1.0	0.0	1.0	13.45	13.44	0.01
2011	1089	1364	2453	1095	1179	2274	1.0	1.2	1.1	21.73	21.70	0.03
2013	1616	189	1805	1095	123	1218	1.5	1.5	1.5	18.67	18.61	0.06
1 in 100 AEP	1050	2881	3931	1095	2539	3635	1.0	1.1	1.1	24.80	24.78	0.02
1 in 2000 AEP	1069	5261	6331	1095	4532	5627	1.0	1.2	1.1	29.26	29.23	0.02

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	891	2787	3678	472	2320	2792	1.9	1.2	1.3	25.13	25.10	0.03
1996	1523	71	1594	472	60	531	3.2	1.2	3.0	18.27	18.05	0.22
1999	661	0	661	270	0	270	2.4	0.0	2.4	13.36	13.25	0.10
2011	1007	1311	2318	472	969	1441	2.1	1.4	1.6	21.56	21.50	0.05
2013	1537	125	1662	472	83	555	3.3	1.5	3.0	18.48	18.26	0.22
1 in 100 AEP	913	2590	3502	472	2060	2532	1.9	1.3	1.4	24.46	24.43	0.03
1 in 2000 AEP	950	4305	5255	472	3761	4232	2.0	1.1	1.2	28.94	28.92	0.02

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, may require blockage consideration below deck although unlikely. Concrete barrier above deck so therefore no further blockage required. *ICC: New bridge (Don Livingstone One Mile) has no records but it has low immunity (likely no more than 20r ARI if at all). The Old Mile Bridge(s) over Bremer/Deebing are of a much lower immunity, possibly as low as 1-2yr ARI. Increased potential for blockage in the older bridges causing local impacts and for larger events on the new bridge.*	Yes	No

BMT WBM

Three Mile Bridge (ICC_056) Structure

Structure Name	Three Mile Bridge		
Structure ID	ICC_056		
Owner	ICC	**Waterway**	Bremer River
Date of Construction	1970	**AMTD**	29310
Date of significant modification	2004	**Co-ordinates (GDA 56)**	473160.25E 6943533.27N
Source of Structure Information	Structural Design Drawings (2006)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\ICC_056\		

Description	Concrete bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	16.7mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	0.55m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	19.2mAHD		
Rail height	1.3*m		
Span Length	25m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Three Mile Bridge, looking form upstream
Image Reference	BMT WBM (2015*). Three Mile Bridge (looking from upstream)* [digital photography]
Image Source	BMT WBM, 2015

Three Mile Bridge (ICC_056) Characteristics

Structure Name	Three Mile Bridge
Structure ID	ICC_056
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	57	1026	1082	257	1941	2198	0.2	0.5	0.5	26.38	26.37	0.01
1996	349	685	1033	257	408	665	1.4	1.7	1.6	21.19	21.13	0.06
1999	465	0	465	257	0	257	1.8	0.0	1.8	17.45	17.33	0.12
2011	244	1346	1591	257	1123	1380	1.0	1.2	1.2	23.70	23.68	0.03
2013	249	596	845	257	485	742	1.0	1.2	1.1	21.50	21.46	0.04
1 in 100 AEP	59	993	1052	257	1850	2107	0.2	0.5	0.5	26.08	26.08	0.01
1 in 2000 AEP	14	984	998	257	2978	3235	0.1	0.3	0.3	29.77	29.77	0.00

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	12	633	645	257	2010	2267	0.0	0.3	0.3	26.61	26.60	0.00
1996	288	685	973	257	485	742	1.1	1.4	1.3	21.50	21.46	0.04
1999	460	0	460	257	0	257	1.8	0.0	1.8	17.63	17.51	0.12
2011	214	1195	1408	257	1216	1473	0.8	1.0	1.0	24.01	23.99	0.02
2013	247	633	880	257	525	782	1.0	1.2	1.1	21.65	21.62	0.03
1 in 100 AEP	15	656	671	257	1928	2185	0.1	0.3	0.3	26.34	26.33	0.00
1 in 2000 AEP	1	460	462	257	2941	3198	0.0	0.2	0.1	29.65	29.65	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, will require blockage consideration below deck. Concrete barrier rails so therefore no further blockage above deck *ICC: No known record of notable blockage. Large waterway opening but immunity understood to be low, no more than 20yr ARI at best.*	Yes	No

BMT WBM

Cunningham Hwy (TMR_048) Structure

Structure Name	Cunningham Hwy		
Structure ID	TMR_048		
Owner	TMR	**Waterway**	Warrill Ck
Date of Construction	1991	**AMTD**	7630
Date of significant modification		**Co-ordinates (GDA 56)**	470262.48E 6940695.99N
Source of Structure Information	Structural Design Drawings (1991)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\WAR\TMR_048 Cunningham Hwy\		

Description	Flat Deck Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	25.6mAHD	**Number of Barrels**	-
Number of Piers in Waterway	6	**Dimensions**	-
Pier Width	0.7m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	27mAHD		
Rail height	0.75m		
Span Length	14m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Cunningham hwy over Warrill Creek
Image Reference	BMT WBM (2015*). Cunningham Highway over Warrill Creek* [digital photography].
Image Source	BMT WBM, 2015

Cunningham Hwy (TMR_048) Characteristics

Structure Name	Cunningham Hwy
Structure ID	TMR_048
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	266	0	266	268	0	268	1.0	0.0	1.0	23.45	23.44	0.02
1999	68	0	68	110	0	110	0.6	0.0	0.6	20.88	20.87	0.01
2011	106	0	106	302	0	302	0.4	0.0	0.4	23.94	23.94	0.01
2013	95	0	95	238	0	238	0.4	0.0	0.4	22.98	22.98	0.01
1 in 100 AEP	447	0	447	513	0	513	0.9	0.0	0.9	26.69	26.65	0.04
1 in 2000 AEP	108	455	562	513	878	1391	0.2	0.5	0.4	29.84	29.84	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	296	0	296	281	0	281	1.1	0.0	1.1	23.65	23.63	0.02
1999	67	0	67	109	0	109	0.6	0.0	0.6	20.85	20.85	0.01
2011	156	0	156	329	0	329	0.5	0.0	0.5	24.33	24.32	0.01
2013	153	0	153	255	0	255	0.6	0.0	0.6	23.24	23.23	0.01
1 in 100 AEP	749	102	851	513	91	603	1.5	1.1	1.4	27.25	27.10	0.15
1 in 2000 AEP	210	589	799	513	856	1369	0.4	0.7	0.6	29.78	29.77	0.01

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, blockage below and above deck (handrail) requires consideration. *ICC: No information available – state owned bridge. Being a bridge on a highway there is the expectation of a lower risk of blockage. This will however depend on the immunity of the bridge itself. TMR may have records post flood events for this structure perhaps.*	Yes	Yes

Cunningham Hwy (TMR_049) Structure

Structure Name	Cunningham Hwy		
Structure ID	TMR_049		
Owner	TMR	**Waterway**	Purga Ck
Date of Construction	1991	**AMTD**	2290
Date of significant modification		**Co-ordinates (GDA 56)**	472413.14E 6940314.45N
Source of Structure Information	Structural Design Drawings (1991)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\PRG\TMR_049 Cunningham Hwy\		

Description	Flat Deck Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	25.3mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	0.7m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	26.8mAHD		
Rail height	0.75m		
Span Length	16m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Cunningham hwy over Purga Creek
Image Reference	*Ipswich City Council. Cunningham Highway over Purga Creek [* digital photography].
Image Source	Imagery provided by ICC

Cunningham Hwy (TMR_049) Characteristics

Structure Name	Cunningham Hwy
Structure ID	TMR_049
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	408	0	408	297	0	297	1.4	0.0	1.4	24.56	24.55	0.01
1999	187	0	187	150	0	150	1.3	0.0	1.3	22.86	22.85	0.01
2011	771	0	771	471	0	471	1.6	0.0	1.6	26.31	26.25	0.06
2013	1063	19	1082	544	32	576	2.0	0.6	1.9	27.13	26.99	0.14
1 in 100 AEP	908	588	1496	544	366	909	1.7	1.6	1.6	28.08	27.98	0.10
1 in 2000 AEP	325	839	1164	544	1140	1684	0.6	0.7	0.7	29.89	29.88	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	403	0	403	298	0	298	1.4	0.0	1.4	24.57	24.56	0.01
1999	187	0	187	149	0	149	1.3	0.0	1.3	22.85	22.84	0.01
2011	737	0	737	463	0	463	1.6	0.0	1.6	26.22	26.18	0.04
2013	990	0	990	531	0	531	1.9	0.0	1.9	26.89	26.78	0.12
1 in 100 AEP	825	487	1311	544	321	865	1.5	1.5	1.5	27.97	27.88	0.09
1 in 2000 AEP	108	559	667	544	1099	1643	0.2	0.5	0.4	29.79	29.79	0.01

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, blockage below and above deck (handrail) requires consideration. *ICC: See above*	Yes	Yes

O'Reilly's Weir (SRC_071) Structure

Structure Name	O'Reilly's Weir		
Structure ID	SRC_071		
Owner	SEQw	**Waterway**	Lockyer Ck
Date of Construction	1951	**AMTD**	1480
Date of significant modification		**Co-ordinates (GDA 56)**	459557.06E 6967166.25N
Source of Structure Information	Various As-Constructed and Maintenance Plans (1951)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\LKY\SRC_071\		

Description	Concrete single-cell weir		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	-mAHD	**Number of Barrels**	-
Number of Piers in Waterway	-	**Dimensions**	-
Pier Width	-m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	31.1mAHD		
Rail height	-m		
Span Length	27.6m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	Weir Channel
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Weir Channel

Image Description	O'Reilly's Weir, looking upstream
Image Reference	BMT WBM (2014*). O'Reilly's Weir (looking upstream)* [digital photography].
Image Source	BMT WBM, 2014

BMT WBM

O'Reilly's Weir (SRC_071) Characteristics

Structure Name	O'Reilly's Weir
Structure ID	SRC_071
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	0	-1123	-1123	0	2071	2071	0.0	0.0	-0.5	47.38	47.39	-0.01
1996	0	2334	2334	0	746	746	0.0	3.1	3.1	39.73	39.51	0.22
1999	0	519	519	0	267	267	0.0	1.9	1.9	35.52	35.44	0.08
2011	0	-595	-595	0	2150	2150	0.0	0.0	-0.3	47.73	47.74	0.00
2013	0	2377	2377	0	746	746	0.0	3.2	3.2	39.73	39.50	0.23
1 in 100 AEP	0	-976	-976	0	1986	1986	0.0	0.0	-0.5	47.01	47.01	0.00
1 in 2000 AEP	0	-1580	-1580	0	2780	2780	0.0	0.0	-0.6	50.51	50.52	-0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	0	-997	-997	0	2280	2280	0.0	0.0	-0.4	48.31	48.31	0.00
1996	0	2345	2345	0	799	799	0.0	2.9	2.9	40.13	39.94	0.19
1999	0	478	478	0	321	321	0.0	1.5	1.5	36.05	36.01	0.04
2011	0	-951	-951	0	2353	2353	0.0	0.0	-0.4	48.63	48.63	0.00
2013	0	2253	2253	0	743	743	0.0	3.0	3.0	39.71	39.51	0.20
1 in 100 AEP	0	-835	-835	0	2227	2227	0.0	0.0	-0.4	48.07	48.08	0.00
1 in 2000 AEP	0	-1296	-1296	0	3084	3084	0.0	0.0	-0.4	51.86	51.86	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
No blockage potential. *SRC: Seqwater maintain this structure.*	No	No

Pointings Bridge (SRC_070) Structure

Structure Name	Pointings Bridge		
Structure ID	SRC_070		
Owner	SRC	**Waterway**	Lockyer Ck
Date of Construction	?	**AMTD**	3930
Date of significant modification	2010	**Co-ordinates (GDA 56)**	457621.09E 6964188.17N
Source of Structure Information	As-Constructed Drawings (2009)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\LKY\SRC_070\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	38.7mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	1.05m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	40.2mAHD		
Rail height	1.2*m		
Span Length	29.9, 30m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Pointings Bridge, looking downstream
Image Reference	BMT WBM (2014). *Pointings Bridge (looking downstream)* [digital photography].
Image Source	BMT WBM, 2014

Pointings Bridge (SRC_070) Characteristics

Structure Name	Pointings Bridge
Structure ID	SRC_070
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	666	931	1597	407	418	825	1.6	2.2	1.9	48.55	48.46	0.10
2013	946	563	1509	407	217	623	2.3	2.6	2.4	44.53	44.36	0.17
1 in 100 AEP	667	824	1490	407	387	794	1.6	2.1	1.9	47.94	47.85	0.09
1 in 2000 AEP	292	589	880	407	518	925	0.7	1.1	1.0	50.56	50.54	0.02

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	530	786	1316	407	441	848	1.3	1.8	1.6	49.02	48.96	0.06
2013	883	460	1343	407	191	597	2.2	2.4	2.2	44.01	43.87	0.15
1 in 100 AEP	504	688	1192	407	416	823	1.2	1.7	1.4	48.52	48.47	0.05
1 in 2000 AEP	16	193	209	407	583	990	0.0	0.3	0.2	51.86	51.86	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck (handrail) requires consideration. *SRC: 30% obstructions common after large events.*	Yes	Yes

BMT WBM

Brisbane Valley Rail Trail, Mahons Rd (QR_065) Structure

Structure Name	Brisbane Valley Rail Trail, Mahons Rd		
Structure ID	QR_065		
Owner	QR	**Waterway**	Lockyer Ck
Date of Construction	1926	**AMTD**	13510
Date of significant modification		**Co-ordinates (GDA 56)**	453580.13E 6966961.39N
Source of Structure Information			
Link to data source			

Description	Wooden Railway Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	51.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	1	**Dimensions**	-
Pier Width	0.85m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	52.5mAHD		
Rail height	-m		
Span Length	6.7m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Brisbane Valley Rail Trail bridge
Image Reference	BMT WBM (2014). *Brisbane Valley Rail Trail Bridge* [digital photography].
Image Source	BMT WBM, 2014

Brisbane Valley Rail Trail, Mahons Rd (QR_065) Characteristics

Structure Name	Brisbane Valley Rail Trail, Mahons Rd
Structure ID	QR_065
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1716	230	1946	825	125	951	2.1	1.8	2.0	53.75	53.58	0.18
1996	1304	106	1410	825	75	900	1.6	1.4	1.6	53.25	53.13	0.11
1999	547	0	547	522	0	522	1.0	0.0	1.0	47.75	47.74	0.01
2011	1729	234	1962	825	127	952	2.1	1.8	2.1	53.77	53.59	0.18
2013	1317	112	1429	825	77	903	1.6	1.5	1.6	53.27	53.16	0.12
1 in 100 AEP	1797	250	2047	825	132	958	2.2	1.9	2.1	53.82	53.63	0.19
1 in 2000 AEP	2767	768	3534	825	277	1103	3.4	2.8	3.2	55.27	54.78	0.49

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1253	83	1336	825	66	891	1.5	1.3	1.5	53.16	53.10	0.06
1996	1118	7	1126	825	13	838	1.4	0.6	1.3	52.63	52.58	0.05
1999	504	0	504	491	0	491	1.0	0.0	1.0	47.34	47.34	0.01
2011	1271	93	1364	825	72	897	1.5	1.3	1.5	53.22	53.16	0.06
2013	1116	8	1124	825	13	838	1.4	0.6	1.3	52.63	52.58	0.05
1 in 100 AEP	1309	113	1422	825	83	908	1.6	1.4	1.6	53.33	53.26	0.06
1 in 2000 AEP	1871	452	2323	825	216	1042	2.3	2.1	2.2	54.66	54.53	0.13

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, blockage below and above deck (handrail) requires consideration. *SRC: Could find no record of clearing of obstructions.*	Yes	Yes

Watsons Bridge (SRC_064) Structure

Structure Name	Watsons Bridge		
Structure ID	SRC_064		
Owner	SRC	**Waterway**	Lockyer Ck
Date of Construction	?	**AMTD**	18460
Date of significant modification	1982	**Co-ordinates (GDA 56)**	454415.25E 6964784.8N
Source of Structure Information	Structural Design Drawings (1982)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\LKY\SRC_064\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	52.3mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	0.5m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	53mAHD		
Rail height	0.3m		
Span Length	18m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Watsons Bridge, looking upstream
Image Reference	BMT WBM (2014). *Watsons Bridge (looking upstream)* [digital photography]
Image Source	BMT WBM, 2014

Watsons Bridge (SRC_064) Characteristics

Structure Name	Watsons Bridge
Structure ID	SRC_064
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	713	388	1101	575	275	850	1.2	1.4	1.3	56.56	56.52	0.04
1999	367	0	367	493	0	493	0.7	0.0	0.7	51.08	51.07	0.01
2011	826	483	1309	575	299	874	1.4	1.6	1.5	56.86	56.81	0.05
2013	727	401	1128	575	279	854	1.3	1.4	1.3	56.61	56.57	0.04
1 in 100 AEP	842	497	1338	575	302	877	1.5	1.6	1.5	56.90	56.84	0.06
1 in 2000 AEP	1307	908	2215	575	378	953	2.3	2.4	2.3	57.84	57.71	0.13

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	830	460	1290	575	284	859	1.4	1.6	1.5	56.68	56.62	0.05
1999	368	0	368	487	0	487	0.8	0.0	0.8	51.01	51.00	0.01
2011	961	549	1511	575	299	874	1.7	1.8	1.7	56.86	56.79	0.07
2013	870	487	1357	575	289	864	1.5	1.7	1.6	56.74	56.68	0.06
1 in 100 AEP	940	535	1475	575	297	871	1.6	1.8	1.7	56.83	56.76	0.07
1 in 2000 AEP	1008	588	1595	575	307	882	1.8	1.9	1.8	56.96	56.88	0.08

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck (handrail) requires consideration. *SRC: 30% obstructions common after large events.*	Yes	Yes

Lyons Bridge (SRC_063) Structure

Structure Name	Lyons Bridge		
Structure ID	SRC_063		
Owner	SRC	**Waterway**	Lockyer Ck
Date of Construction	1955	**AMTD**	27480
Date of significant modification	?	**Co-ordinates (GDA 56)**	453585.31E 6961344.89N
Source of Structure Information	Site photographs		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\LKY\SRC_063\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	60.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	4	**Dimensions**	-
Pier Width	0.8m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	61mAHD		
Rail height	0.5m		
Span Length	30m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Lyons Bridge, looking upstream
Image Reference	BMT WBM (2014). *Lyons Bridge (looking upstream)* [digital photography].
Image Source	BMT WBM, 2014

Lyons Bridge (SRC_063) Characteristics

Structure Name	Lyons Bridge
Structure ID	SRC_063
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1218	797	2016	734	364	1098	1.7	2.2	1.8	65.14	65.03	0.11
1996	974	474	1448	734	283	1017	1.3	1.7	1.4	64.33	64.27	0.06
1999	372	0	372	501	0	501	0.7	0.0	0.7	58.32	58.32	0.01
2011	1272	877	2149	734	382	1115	1.7	2.3	1.9	65.32	65.19	0.13
2013	1017	541	1558	734	303	1037	1.4	1.8	1.5	64.53	64.46	0.07
1 in 100 AEP	1301	914	2215	734	391	1124	1.8	2.3	2.0	65.41	65.28	0.13
1 in 2000 AEP	1482	1412	2894	734	502	1235	2.0	2.8	2.3	66.52	66.32	0.20

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	490	226	715	734	277	1011	0.7	0.8	0.7	64.27	64.26	0.02
1996	540	209	749	734	243	976	0.7	0.9	0.8	63.93	63.91	0.02
1999	373	0	373	503	0	503	0.7	0.0	0.7	58.34	58.33	0.01
2011	443	228	670	734	290	1024	0.6	0.8	0.7	64.40	64.39	0.01
2013	535	220	754	734	256	990	0.7	0.9	0.8	64.06	64.05	0.02
1 in 100 AEP	476	229	705	734	282	1015	0.6	0.8	0.7	64.32	64.30	0.02
1 in 2000 AEP	245	211	456	734	326	1059	0.3	0.6	0.4	64.76	64.75	0.01

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck (handrail) requires consideration. *SRC: 30% obstructions common after large events.*	Yes	Yes

Pamphlet Bridge (BCC_023) Structure

Structure Name	Pamphlet Bridge		
Structure ID	BCC_023		
Owner	BCC	**Waterway**	Oxley Ck
Date of Construction	1964	**AMTD**	150
Date of significant modification		**Co-ordinates (GDA 56)**	499513.94E 6955446.4N
Source of Structure Information	Hydraulic Structure Reference Sheet (Aurecon 2013)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\OXL\BCC_023 Pamphlet Bridge\		

Description	Flat Deck Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	7.1mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	0.7m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	8.1mAHD		
Rail height	0.8*m		
Span Length	16.7m - 21.3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Pamphlet Bridge, looking from downstream
Image Reference	BMT WBM (2015*). Pamphlet Bridge (looking from downstream)* [digital photography].
Image Source	BMT WBM, 2015

Pamphlet Bridge (BCC_023) Characteristics

Structure Name	Pamphlet Bridge
Structure ID	BCC_023
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	401	213	615	506	206	712	0.8	1.0	0.9	10.77	10.75	0.02
1996	34	0	34	279	0	279	0.1	0.0	0.1	3.68	3.68	0.00
1999	-29	0	-29	170	0	170	-0.2	0.0	-0.2	1.85	1.85	0.00
2011	262	64	326	506	91	597	0.5	0.7	0.5	9.28	9.27	0.01
2013	218	0	218	269	0	269	0.8	0.0	0.8	3.52	3.51	0.01
1 in 100 AEP	285	74	358	506	102	607	0.6	0.7	0.6	9.42	9.41	0.01
1 in 2000 AEP	397	651	1048	506	567	1073	0.8	1.1	1.0	15.46	15.44	0.02

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	3	3	6	505	323	828	0.0	0.0	0.0	11.06	11.06	0.00
1996	108	0	108	198	0	198	0.5	0.0	0.5	3.23	3.22	0.00
1999	-45	0	-45	154	0	154	-0.3	0.0	-0.3	1.76	1.76	0.00
2011	-33	-6	-39	505	97	602	-0.1	0.0	-0.1	9.37	9.37	0.00
2013	271	0	271	197	0	197	1.4	0.0	1.4	3.18	3.18	0.01
1 in 100 AEP	7	2	9	505	122	627	0.0	0.0	0.0	9.65	9.65	0.00
1 in 2000 AEP	-373	-576	-949	505	888	1393	-0.7	0.0	-0.7	15.81	15.81	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and the coarse 1D FM discretisation of the floodplain. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure or where the 1D FM discretisation includes some overbank floodplain flows in the structure representation.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, blockage below and above deck (handrail) requires consideration.	Yes	Yes

Sir Leo Hielscher Bridges (TMR_001) Structure

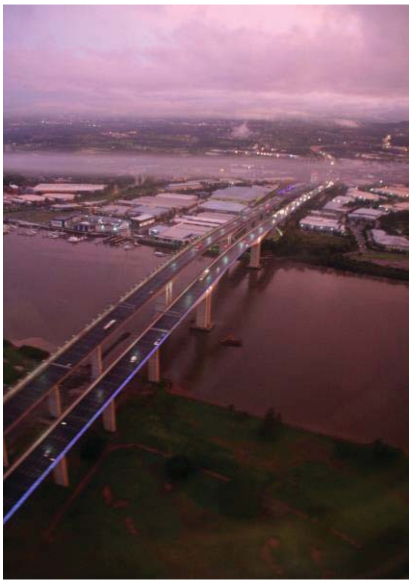
Structure Name	Sir Leo Hielscher Bridges		
Structure ID	TMR_001		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1986	**AMTD**	9940
Date of significant modification	2010	**Co-ordinates (GDA 56)**	509982.86E 6964316.4N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) As-Constructed Drawings (2010)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\TMR_001 New Gateway Bridge\		

Description	Concrete Arch Bridge.		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	11.22mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	19m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	15.22mAHD		
Rail height	-m		
Span Length	584m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Gateway Motorway and Sir Leo Hielscher Bridges, looking upstream
Image Reference	Guard, P. BMT WBM (2011*). The Sir Leo Hielscher Bridges.* [digital photography]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Gateway_Bridge_aerial4.JPG



Sir Leo Hielscher Bridges (TMR_001) Characteristics

Structure Name	Sir Leo Hielscher Bridges
Structure ID	TMR_001
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	3444	0	3444	3087	0	3087	1.1	0.0	1.1	1.46	1.44	0.02
1999	544	0	544	3054	0	3054	0.2	0.0	0.2	1.37	1.37	0.00
2011	9046	0	9046	3139	0	3139	2.9	0.0	2.9	1.65	1.55	0.10
2013	2416	0	2416	3317	0	3317	0.7	0.0	0.7	1.98	1.97	0.01
1 in 100 AEP	8236	0	8236	3336	0	3336	2.5	0.0	2.5	2.07	2.01	0.06
1 in 2000 AEP	16870	0	16870	3878	0	3878	4.4	0.0	4.4	3.30	3.14	0.17

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	3438	0	3438	2882	0	2882	1.2	0.0	1.2	1.43	1.41	0.02
1999	687	0	687	2863	0	2863	0.2	0.0	0.2	1.37	1.37	0.00
2011	8707	0	8707	2385	0	2385	3.7	0.0	3.7	1.65	1.47	0.18
2013	2167	0	2167	3129	0	3129	0.7	0.0	0.7	1.97	1.96	0.01
1 in 100 AEP	8072	0	8072	3096	0	3096	2.6	0.0	2.6	1.95	1.84	0.12
1 in 2000 AEP	16846	0	16846	3689	0	3689	4.6	0.0	4.6	3.34	2.99	0.35

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Deck is above extreme events so therefore no blockage consideration required. Opening width precludes debris blockage.*	No	No

*The original Gateway Bridge was opened in 1986 as single bridge. The bridge was duplicated and the second bridge was opened in 2010. The pair were renamed the Sir Leo Hielscher Bridges at that time.

BMT WBM

Story Bridge (BCC_006) Structure

Structure Name	Story Bridge		
Structure ID	BCC_006		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1940	**AMTD**	21740
Date of significant modification	-	**Co-ordinates (GDA 56)**	503498.12E 6962171.33N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1938)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_006 Storey Bridge\		

Description	Suspension Bridge, Steel truss superstructure		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	29.8mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	9.6m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	33.5mAHD		
Rail height	1.1*m		
Span Length	82-281m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Story Bridge, looking upstream
Image Reference	Macey, C.R. (2007*). Story Bridge* [digital photography]. Retrieved from below source
Image Source	http://de.wikipedia.org/wiki/Story_Bridge#mediaviewer/File:Story_Bridge_Panorama.jpg

Story Bridge (BCC_006) Characteristics

Structure Name	Story Bridge
Structure ID	BCC_006
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10775	0	10775	3089	0	3089	3.5	0.0	3.5	4.96	4.87	0.08
1996	3556	0	3556	2349	0	2349	1.5	0.0	1.5	1.96	1.94	0.02
1999	746	0	746	2233	0	2233	0.3	0.0	0.3	1.44	1.44	0.01
2011	8960	0	8960	2862	0	2862	3.1	0.0	3.1	4.10	4.03	0.07
2013	2726	0	2726	2432	0	2432	1.1	0.0	1.1	2.30	2.29	0.01
1 in 100 AEP	8757	0	8757	2884	0	2884	3.0	0.0	3.0	4.18	4.11	0.07
1 in 2000 AEP	16054	0	16054	4281	0	4281	3.8	0.0	3.8	8.38	8.27	0.11

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10710	0	10710	3711	0	3711	2.9	0.0	2.9	4.92	4.91	0.01
1996	3293	0	3293	2865	0	2865	1.1	0.0	1.1	1.86	1.86	0.00
1999	835	0	835	2745	0	2745	0.3	0.0	0.3	1.45	1.45	0.00
2011	8815	0	8815	3456	0	3456	2.6	0.0	2.6	4.09	4.06	0.02
2013	2348	0	2348	2960	0	2960	0.8	0.0	0.8	2.21	2.21	0.00
1 in 100 AEP	8742	0	8742	3371	0	3371	2.6	0.0	2.6	4.07	4.02	0.04
1 in 2000 AEP	16364	0	16364	5409	0	5409	3.0	0.0	3.0	9.08	9.07	0.01

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Deck is above extreme events so therefore no blockage consideration required. Opening width precludes debris blockage.	No	No

BMT WBM

Captain Cook Bridge (TMR_038) Structure

Structure Name	Captain Cook Bridge		
Structure ID	TMR_038		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1972	**AMTD**	24090
Date of significant modification		**Co-ordinates (GDA 56)**	502861.51E 6960260.23N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1970)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\TMR_038 Capitain Cook Bridge\		

Description	Concrete Arch Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	10.4mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	6m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	9.8mAHD		
Rail height	1.5*m		
Span Length	73-183m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Captain Cook Bridge, looking downstream
Image Reference	BrisbanePom (2011*). The Captain Cook Bridge over the Brisbane River at Brisbane.* [digital photography]. Retrieved from below source
Image Source	https://en.wikipedia.org/wiki/Captain_Cook_Bridge,_Brisbane#/media/File:Captain_Cook_Bridge_at_dusk,_Brisbane.jpg

Captain Cook Bridge (TMR_038) Characteristics

Structure Name	Captain Cook Bridge
Structure ID	TMR_038
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10790	0	10790	3432	0	3432	3.1	0.0	3.1	6.02	5.90	0.13
1996	3571	0	3571	2327	0	2327	1.5	0.0	1.5	2.18	2.15	0.03
1999	1295	0	1295	2152	0	2152	0.6	0.0	0.6	1.49	1.48	0.01
2011	8961	0	8961	3104	0	3104	2.9	0.0	2.9	4.97	4.86	0.11
2013	2759	0	2759	2398	0	2398	1.2	0.0	1.2	2.44	2.42	0.02
1 in 100 AEP	9061	0	9061	3122	0	3122	2.9	0.0	2.9	5.03	4.92	0.11
1 in 2000 AEP	17066	0	17066	4594	0	4594	3.7	0.0	3.7	9.89	9.70	0.19

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10363	0	10363	5854	0	5854	1.8	0.0	1.8	6.23	6.14	0.08
1996	3408	0	3408	3750	0	3750	0.9	0.0	0.9	2.06	2.05	0.01
1999	864	0	864	3538	0	3538	0.2	0.0	0.2	1.48	1.48	0.00
2011	8672	0	8672	5236	0	5236	1.7	0.0	1.7	4.97	4.90	0.08
2013	2422	0	2422	3849	0	3849	0.6	0.0	0.6	2.32	2.32	0.01
1 in 100 AEP	8569	0	8569	5270	0	5270	1.6	0.0	1.6	5.04	4.97	0.07
1 in 2000 AEP	15417	-7	15409	7338	17	7355	2.1	0.0	2.1	10.93	10.76	0.16

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage below obvert.	No	Yes

Goodwill Bridge (BCC_008) Structure

Structure Name	Goodwill Bridge		
Structure ID	BCC_008		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	2001	**AMTD**	24260
Date of significant modification		**Co-ordinates (GDA 56)**	502674.14E 6960341.25N
Source of Structure Information	Structural Design Drawings (1999)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_008 Goodwill Bridge\		

Description	Concrete and Steel Arch Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	6.1mAHD	**Number of Barrels**	-
Number of Piers in Waterway	8	**Dimensions**	-
Pier Width	23m, 0.8m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	7.3mAHD		
Rail height	1.6*m		
Span Length	19.7 - 112m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Goodwill Bridge, looking from South Bank
Image Reference	Department of Public Works (2012). *Goodwill bridge from South Bank* [Digital Photograph]. Retrieved from below source
Image Source	Department of Public Works, 2012

Goodwill Bridge (BCC_008) Characteristics

Structure Name	Goodwill Bridge
Structure ID	BCC_008
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8960	0	8960	3773	0	3774	2.4	0.7	2.4	5.13	5.10	0.04
2013	2760	0	2760	2889	0	2889	1.0	0.0	1.0	2.47	2.46	0.02
1 in 100 AEP	9064	1	9065	3793	1	3794	2.4	0.8	2.4	5.19	5.16	0.03
1 in 2000 AEP	15733	1342	17075	5297	431	5727	3.0	3.1	3.0	10.37	10.10	0.27

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8816	7	8822	3649	5	3654	2.4	1.3	2.4	5.04	5.00	0.03
2013	2428	0	2428	2527	0	2527	1.0	0.0	1.0	2.33	2.27	0.06
1 in 100 AEP	8713	7	8721	3672	19	3691	2.4	0.4	2.4	5.11	5.07	0.04
1 in 2000 AEP	14977	1250	16227	5627	506	6133	2.7	2.5	2.6	11.03	10.93	0.10

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Shorter spans may require blockage consideration.	Yes	Yes

Victoria Bridge (BCC_009) Structure

Structure Name	Victoria Bridge		
Structure ID	BCC_009		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1865	**AMTD**	25305
Date of significant modification	1897, 1969	**Co-ordinates (GDA 56)**	502072.36E 6961236.33N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1966)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_009 Victoria Bridge\		

Description	Concrete Arch Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	8.2mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	4m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	9.2mAHD		
Rail height	1.5*m		
Span Length	136, 85.3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Victoria bridge, looking downstream
Image Reference	Figaro, I. (2009). *Fountain at Newstead House in Brisbane, Queensland, Australia* [digital photograph]. Retrieved from below source
Image Source	http://www.marysrosaries.com/collaboration/index.php?title=File:Victoria-Bridge_Brisbane.jpg

BMT WBM

Victoria Bridge (BCC_009) Characteristics

Structure Name	Victoria Bridge
Structure ID	BCC_009
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m³/s)*			Area (m²)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10797	0	10797	3226	0	3226	3.3	0.0	3.3	6.50	6.41	0.08
1996	3584	0	3584	2184	0	2184	1.6	0.0	1.6	2.32	2.29	0.03
1999	1317	0	1317	1996	0	1996	0.7	0.0	0.7	1.52	1.51	0.01
2011	8962	0	8962	2946	0	2946	3.0	0.0	3.0	5.41	5.33	0.08
2013	2822	0	2822	2239	0	2239	1.3	0.0	1.3	2.53	2.51	0.02
1 in 100 AEP	9074	0	9074	2962	0	2962	3.1	0.0	3.1	5.47	5.39	0.08
1 in 2000 AEP	15941	14	15956	3934	10	3944	4.1	1.5	4.0	11.02	10.61	0.41

DETAILED MODEL^

Event	Discharge (m³/s)*			Area (m²)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10748	0	10748	3764	0	3764	2.9	0.0	2.9	6.62	6.59	0.03
1996	3446	0	3446	2590	0	2590	1.3	0.0	1.3	2.14	2.14	0.00
1999	1415	0	1415	2441	0	2441	0.6	0.0	0.6	1.50	1.50	0.00
2011	8858	0	8858	3344	0	3344	2.6	0.0	2.6	5.37	5.34	0.04
2013	2545	0	2545	2644	0	2644	1.0	0.0	1.0	2.37	2.37	0.00
1 in 100 AEP	8763	0	8763	3360	0	3360	2.6	0.0	2.6	5.43	5.40	0.03
1 in 2000 AEP	15668	16	15683	4755	16	4771	3.3	1.0	3.3	11.37	11.30	0.07

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage.	No	Yes

Kurilpa Bridge (BCC_010) Structure

Structure Name	Kurilpa Bridge		
Structure ID	BCC_010		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	2009	**AMTD**	25705
Date of significant modification		**Co-ordinates (GDA 56)**	501765.75E 6961559.1N
Source of Structure Information	Structural Design Drawings (2007)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_010 Kurilpa Bridge\		

Description	Tensegrity Cable Stay Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	9.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	10*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	10.4mAHD		
Rail height	1.6*m		
Span Length	115m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Kurilpa Bridge, looking upstream
Image Reference	Guard, P. BMT WBM (2009*). Kurilpa Bridge.* [digital photograph]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:KurilpaBridge1.JPG

Kurilpa Bridge (BCC_010) Characteristics

Structure Name	Kurilpa Bridge
Structure ID	BCC_010
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8951	0	8951	3514	0	3514	2.5	0.0	2.5	5.55	5.53	0.02
2013	2778	0	2778	2852	0	2852	1.0	0.0	1.0	2.56	2.55	0.01
1 in 100 AEP	9065	0	9065	3529	0	3529	2.6	0.0	2.6	5.62	5.60	0.02
1 in 2000 AEP	11964	49	12013	4804	32	4837	2.5	1.5	2.5	11.28	11.22	0.06

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8832	0	8832	2856	0	2856	3.1	0.0	3.1	5.33	5.30	0.03
2013	2557	0	2557	2290	0	2290	1.1	0.0	1.1	2.38	2.37	0.01
1 in 100 AEP	8723	0	8723	2868	0	2868	3.0	0.0	3.0	5.39	5.35	0.04
1 in 2000 AEP	13197	63	13260	4287	121	4408	3.1	0.5	3.0	11.79	11.64	0.16

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage below obvert.	No	Yes

William Jolly Bridge (BCC_011) Structure

Structure Name	William Jolly Bridge		
Structure ID	BCC_011		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1932	**AMTD**	26035
Date of significant modification		**Co-ordinates (GDA 56)**	501537.64E 6961628.46N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1927)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_011 William Jolly\		

Description	Concrete Arch Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	13.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	6.6m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	14.3mAHD		
Rail height	1.5*m		
Span Length	72.5m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	William Jolly Bridge, looking downstream
Image Reference	Allen, R. (2012*). William Jolly Bridge (looking upstream)* [digital photograph]. Retrieved from below source
Image Source	https://www.flickr.com/photos/raeallen/7173158786/in/photostream/

William Jolly Bridge (BCC_011) Characteristics

Structure Name	William Jolly Bridge
Structure ID	BCC_011
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10719	0	10719	3882	0	3882	2.8	0.0	2.8	6.85	6.81	0.04
1996	3582	0	3582	2864	0	2864	1.3	0.0	1.3	2.39	2.38	0.01
1999	1324	0	1324	2679	0	2679	0.5	0.0	0.5	1.54	1.53	0.01
2011	8952	0	8952	3621	0	3621	2.5	0.0	2.5	5.70	5.67	0.03
2013	2816	0	2816	2908	0	2908	1.0	0.0	1.0	2.59	2.58	0.01
1 in 100 AEP	9071	0	9071	3637	0	3637	2.5	0.0	2.5	5.76	5.74	0.03
1 in 2000 AEP	12021	0	12021	4926	0	4926	2.4	0.0	2.4	11.44	11.39	0.05

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10548	0	10548	3769	0	3769	2.8	0.0	2.8	6.94	6.91	0.04
1996	3463	0	3463	2636	0	2636	1.3	0.0	1.3	2.18	2.18	-0.01
1999	1408	0	1408	2515	0	2515	0.6	0.0	0.6	1.51	1.51	0.00
2011	8802	0	8802	3415	0	3415	2.6	0.0	2.6	5.64	5.62	0.03
2013	2565	0	2565	2696	0	2696	1.0	0.0	1.0	2.42	2.41	0.01
1 in 100 AEP	8695	0	8695	3457	0	3457	2.5	0.0	2.5	5.69	5.67	0.02
1 in 2000 AEP	13790	0	13790	5336	0	5336	2.6	0.0	2.6	12.10	12.04	0.06

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage.	No	Yes

Merivale St Bridge (QR_087) Structure

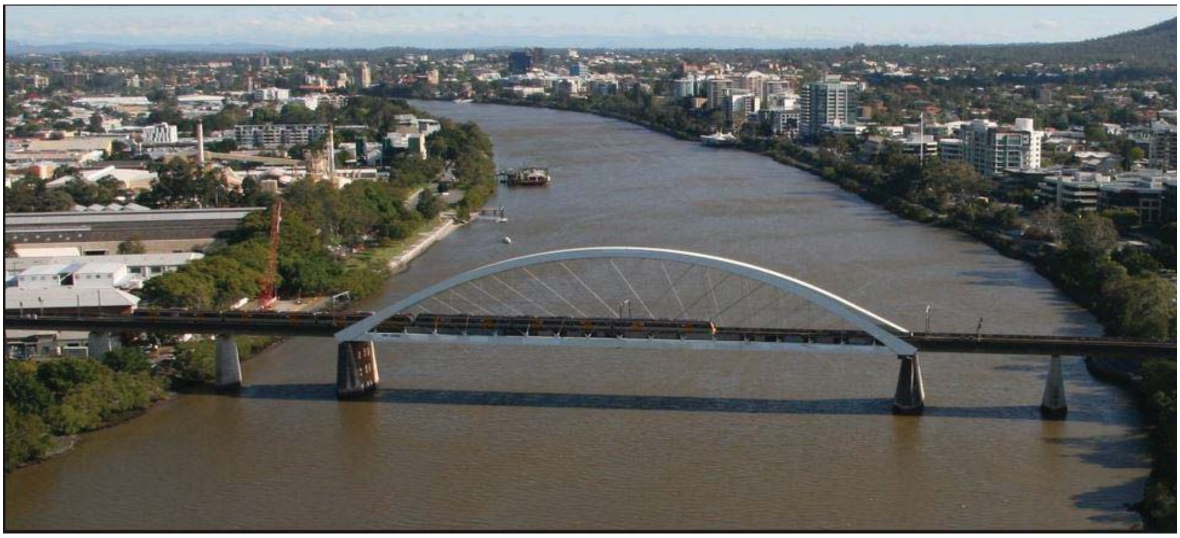
Structure Name	Merivale St Bridge		
Structure ID	QR_087		
Owner	QR	**Waterway**	Brisbane River
Date of Construction	1979	**AMTD**	26290
Date of significant modification		**Co-ordinates (GDA 56)**	501306.22E 6961566.52N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) As-Constructed Drawings (1974)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\QR_087 Merivale Street Rail\		

Description	Through Arch Bridge with Concrete Deck and Cable Stay Arch		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	14.1mAHD	**Number of Barrels**	-
Number of Piers in Waterway	4	**Dimensions**	-
Pier Width	max 13.4m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	15.1mAHD		
Rail height	-m		
Span Length	33.4-132.9m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Merivale St Bridge, looking upstream
Image Reference	Bilious. (2008*). Merivale Bridge, Brisbane taken from an oblique elevated vantage* [digital photograph]. Retrieved from below source
Image Source	http://commons.wikimedia.org/wiki/File:Merivale_Bridge.jpg



BMT WBM

Merivale St Bridge (QR_087) Characteristics

Structure Name	Merivale St Bridge
Structure ID	QR_087
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	3598	0	3598	1691	0	1691	2.1	0.0	2.1	2.51	2.41	0.11
1999	1331	0	1331	1522	0	1522	0.9	0.0	0.9	1.56	1.54	0.02
2011	8956	0	8956	2434	0	2434	3.7	0.0	3.7	6.01	5.75	0.27
2013	2862	0	2862	1728	0	1728	1.7	0.0	1.7	2.66	2.60	0.07
1 in 100 AEP	9073	0	9073	2451	0	2451	3.7	0.0	3.7	6.08	5.82	0.27
1 in 2000 AEP	14308	0	14308	3707	0	3707	3.9	0.0	3.9	11.73	11.50	0.24

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	3454	0	3454	2390	0	2390	1.4	0.0	1.4	2.23	2.22	0.01
1999	1406	0	1406	2228	0	2228	0.6	0.0	0.6	1.52	1.51	0.00
2011	8814	0	8814	3344	0	3344	2.6	0.0	2.6	5.88	5.82	0.06
2013	2565	0	2565	2441	0	2441	1.1	0.0	1.1	2.45	2.44	0.01
1 in 100 AEP	8709	0	8709	3364	0	3364	2.6	0.0	2.6	5.92	5.85	0.06
1 in 2000 AEP	14311	0	14311	5524	0	5524	2.6	0.0	2.6	12.29	12.23	0.06

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage below obvert.	No	Yes

Go Between Bridge (BCC_012) Structure

Structure Name	Go Between Bridge		
Structure ID	BCC_012		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	2010	**AMTD**	29380
Date of significant modification		**Co-ordinates (GDA 56)**	501204.81E 6961523.39N
Source of Structure Information	As-Constructed Drawings (2010)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_012 Go Between Bridge\		

Description	Concrete Arch Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	6.7mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	8.9m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	7.5mAHD		
Rail height	1.3m		
Span Length	78.5-117 m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Go Between Bridge, looking upstream
Image Reference	Guard, P. BMT WBM (2010). *Go Between Bridge.* [digital photograph]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Go_between_bridge.jpg

Go Between Bridge (BCC_012) Characteristics

Structure Name	Go Between Bridge
Structure ID	BCC_012
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8956	0	8956	3397	0	3397	2.6	0.0	2.6	6.05	6.03	0.02
2013	2873	0	2873	2470	0	2470	1.2	0.0	1.2	2.68	2.66	0.01
1 in 100 AEP	9075	0	9075	3416	0	3416	2.7	0.0	2.7	6.12	6.10	0.02
1 in 2000 AEP	13875	445	14320	4638	173	4811	3.0	2.6	3.0	11.91	11.75	0.16

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8781	0	8781	3352	0	3352	2.6	0.0	2.6	5.97	5.93	0.05
2013	2570	0	2570	2346	0	2346	1.1	0.0	1.1	2.47	2.45	0.01
1 in 100 AEP	8808	0	8808	3362	0	3362	2.6	0.0	2.6	6.02	5.97	0.05
1 in 2000 AEP	13294	399	13693	4144	229	4373	3.2	1.7	3.1	12.36	12.25	0.10

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage below obvert.	No	Yes

BMT WBM

Eleanor Schonell (Green) Bridge (BCC_019) Structure

Structure Name	Eleanor Schonell (Green) Bridge		
Structure ID	BCC_019		
Owner	BCC	**Waterway**	Brisbane River
Date of Construction	2006	**AMTD**	35100
Date of significant modification		**Co-ordinates (GDA 56)**	502036.19E 6958442.67N
Source of Structure Information	As-Constructed Drawings (2005)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_019 Green Bridge\		

Description	Harp Cable Stay Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	11.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	6.2-9.5m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	12.4mAHD		
Rail height	1.17m		
Span Length	73-184.4m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Eleanor Schonell (Green) Bridge, looking upstream
Image Reference	Bilious. (2007*). The completed Eleanor Schonell Bridge taken on, from the City Cat.* [digital photography]. Retrieved from below source
Image Source	http://en.wikipedia.org/wiki/File:Eleanor_Schonell_Bridge,_Brisbane,_2007-01-31.jpg

Eleanor Schonell (Green) Bridge (BCC_019) Characteristics

Structure Name	Eleanor Schonell (Green) Bridge
Structure ID	BCC_019
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8972	0	8972	4894	0	4894	1.8	0.0	1.8	7.48	7.47	0.01
2013	2988	0	2988	3507	0	3507	0.9	0.0	0.9	3.00	3.00	0.01
1 in 100 AEP	9138	0	9138	4927	0	4927	1.9	0.0	1.9	7.58	7.57	0.01
1 in 2000 AEP	13647	23	13669	6992	19	7011	2.0	1.2	2.0	13.64	13.60	0.03

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	8907	0	8907	5696	0	5696	1.6	0.0	1.6	7.79	7.77	0.02
2013	2734	0	2734	3915	0	3915	0.7	0.0	0.7	2.76	2.75	0.01
1 in 100 AEP	9067	0	9067	5831	0	5831	1.6	0.0	1.6	8.04	8.02	0.02
1 in 2000 AEP	16220	25	16245	8726	46	8772	1.9	0.5	1.9	14.39	14.37	0.03

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Deck is above extreme events and the opening width precludes debris blockage.	No	No

Jack Pesch Bridge (BCC_021) Structure

Structure Name	Jack Pesch Bridge		
Structure ID	BCC_021		
Owner	BCC	**Waterway**	Brisbane River
Date of Construction	1998	**AMTD**	41550
Date of significant modification		**Co-ordinates (GDA 56)**	497452.41E 6957523.98N
Source of Structure Information	As-Constructed Drawings (1997)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_021 Walter Taylor Pedestrian Bridge\		

Description	Steel Cable Stay Bridge. NB: Jack Pesch, Indooroopilly Rail (2) and Walter Taylor Bridges modelled as one.		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	15.5*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	0	**Dimensions**	-
Pier Width	-m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	18.4mAHD		
Rail height	1.8*m		
Span Length	167.5m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	See BCC_020
Included in Detailed Model (DM)	Yes	**DM Representation**	See BCC_020

Image Description	Aerial image, looking upstream. Jack Pesch Bridge on right
Image Reference	Kgbo. (2014). *Jack Pesch Bridge and next to it Albert Bridge, Brisbane.* [digital photography]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Jack_Pesch_Bridge_05.JPG

Jack Pesch Bridge (BCC_021) Characteristics

Structure Name	Jack Pesch Bridge
Structure ID	BCC_021
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	1588	0	1588	1651	0	1651	1.0	0.0	1.0	1.94	1.93	0.01
2011	9173	0	9173	3029	0	3029	3.0	0.0	3.0	9.84	9.79	0.06
2013	3557	0	3557	1934	0	1934	1.8	0.0	1.8	3.79	3.76	0.03
1 in 100 AEP	9217	0	9217	3056	0	3056	3.0	0.0	3.0	9.98	9.93	0.05
1 in 2000 AEP	14867	0	14867	4087	0	4087	3.6	0.0	3.6	16.34	15.98	0.36

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	1587	0	1587	2002	0	2002	0.8	0.0	0.8	1.83	1.83	0.00
2011	9023	0	9023	3230	0	3230	2.8	0.0	2.8	9.48	9.47	0.01
2013	3357	0	3357	2211	0	2211	1.5	0.0	1.5	3.21	3.21	0.00
1 in 100 AEP	9160	0	9160	3280	0	3280	2.8	0.0	2.8	9.74	9.74	0.00
1 in 2000 AEP	16919	0	16919	4310	0	4310	3.9	0.0	3.9	15.97	15.87	0.10

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, handrail will require consideration. Opening width precludes debris blockage.	No	Yes

Indooroopilly Railway Bridges (QR_083) Structure

Structure Name	Indooroopilly Railway Bridges		
Structure ID	QR_083		
Owner	QR	**Waterway**	Brisbane River
Date of Construction	1957	**AMTD**	41550
Date of significant modification		**Co-ordinates (GDA 56)**	497432.65E 6957535.32N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1951)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\QR_083 Indooroopilly Rail\		

Description	Two steel suspension bridges. Albert Bridge with arched superstructure. NB: Jack Pesch, Indooroopilly Rail (2) and Walter Taylor Bridges modelled as one.		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	15.5*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	1	**Dimensions**	-
Pier Width	7.3m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	16.5mAHD		
Rail height	-m		
Span Length	104.2m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	See BCC_020
Included in Detailed Model (DM)	Yes	**DM Representation**	See BCC_020

Image Description	Aerial image, looking upstream. Indooroopilly Rail Bridges in center
Image Reference	Guard, P. BMT WBM (2008*). Indooroopilly Rail Bridge.* [digital photograph]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Indooroopilly_Bridge.jpg

BMT WBM

Indooroopilly Railway Bridges (QR_083) Characteristics

Structure Name	Indooroopilly Railway Bridges
Structure ID	QR_083
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10860	0	10860	3331	0	3331	3.3	0.0	3.3	11.38	11.32	0.06
1996	3663	0	3663	1960	0	1960	1.9	0.0	1.9	3.95	3.92	0.03
1999	1588	0	1588	1651	0	1651	1.0	0.0	1.0	1.94	1.93	0.01
2011	9173	0	9173	3029	0	3029	3.0	0.0	3.0	9.84	9.79	0.06
2013	3557	0	3557	1934	0	1934	1.8	0.0	1.8	3.79	3.76	0.03
1 in 100 AEP	9217	0	9217	3056	0	3056	3.0	0.0	3.0	9.98	9.93	0.05
1 in 2000 AEP	14867	0	14867	4087	0	4087	3.6	0.0	3.6	16.34	15.98	0.36

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10753	0	10753	3540	0	3540	3.0	0.0	3.0	11.12	11.11	0.01
1996	3506	0	3506	2234	0	2234	1.6	0.0	1.6	3.36	3.36	0.00
1999	1587	0	1587	2002	0	2002	0.8	0.0	0.8	1.83	1.83	0.00
2011	9023	0	9023	3230	0	3230	2.8	0.0	2.8	9.48	9.47	0.01
2013	3357	0	3357	2211	0	2211	1.5	0.0	1.5	3.21	3.21	0.00
1 in 100 AEP	9160	0	9160	3280	0	3280	2.8	0.0	2.8	9.74	9.74	0.00
1 in 2000 AEP	16919	0	16919	4310	0	4310	3.9	0.0	3.9	15.97	15.87	0.10

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events. Truss structure above deck will require blockage consideration. Opening width precludes debris blockage below obvert.	No	Yes

BMT WBM

Walter Taylor Bridge (BCC_020) Structure

Structure Name	Walter Taylor Bridge		
Structure ID	BCC_020		
Owner	BCC	**Waterway**	Brisbane River
Date of Construction	1936	**AMTD**	41550
Date of significant modification		**Co-ordinates (GDA 56)**	497399.96E 6957559.5N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings (1934)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_020 Walter Taylor Bridge\		

Description	Concrete Bridge with Steel Suspension. NB: Jack Pesch, Indooroopilly Rail (2) and Walter Taylor Bridges modelled as one.		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	15.5*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	0	**Dimensions**	-
Pier Width	10.1*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	16.5mAHD		
Rail height	1.8*m		
Span Length	152.4m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Aerial image, looking upstream. Walter Taylor on left
Image Reference	Guard, P. BMT WBM (2008). *Walter Taylor Bridge.* [digital photograph. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Walter_Taylor_Bridge.jpg

Walter Taylor Bridge (BCC_020) Characteristics

Structure Name	Walter Taylor Bridge
Structure ID	BCC_020
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10860	0	10860	3331	0	3331	3.3	0.0	3.3	11.38	11.32	0.06
1996	3663	0	3663	1960	0	1960	1.9	0.0	1.9	3.95	3.92	0.03
1999	1588	0	1588	1651	0	1651	1.0	0.0	1.0	1.94	1.93	0.01
2011	9173	0	9173	3029	0	3029	3.0	0.0	3.0	9.84	9.79	0.06
2013	3557	0	3557	1934	0	1934	1.8	0.0	1.8	3.79	3.76	0.03
1 in 100 AEP	9217	0	9217	3056	0	3056	3.0	0.0	3.0	9.98	9.93	0.05
1 in 2000 AEP	14867	0	14867	4087	0	4087	3.6	0.0	3.6	16.34	15.98	0.36

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10753	0	10753	3540	0	3540	3.0	0.0	3.0	11.12	11.11	0.01
1996	3506	0	3506	2234	0	2234	1.6	0.0	1.6	3.36	3.36	0.00
1999	1587	0	1587	2002	0	2002	0.8	0.0	0.8	1.83	1.83	0.00
2011	9023	0	9023	3230	0	3230	2.8	0.0	2.8	9.48	9.47	0.01
2013	3357	0	3357	2211	0	2211	1.5	0.0	1.5	3.21	3.21	0.00
1 in 100 AEP	9160	0	9160	3280	0	3280	2.8	0.0	2.8	9.74	9.74	0.00
1 in 2000 AEP	16919	0	16919	4310	0	4310	3.9	0.0	3.9	15.97	15.87	0.10

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events. Truss structure above deck will require blockage consideration. Opening width precludes debris blockage below obvert.	No	Yes

BMT WBM

Centenary Bridge (TMR_039) Structure

Structure Name	Centenary Bridge		
Structure ID	TMR_039		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1964	**AMTD**	49990
Date of significant modification	1985	**Co-ordinates (GDA 56)**	494771.63E 6955108.12N
Source of Structure Information	Hydraulic Structure Reference Sheet (SKM 1999) Structural Design Drawings, Duplication of Bridge (1985)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\TMR_039 Centenary Bridge\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	13.2mAHD	**Number of Barrels**	-
Number of Piers in Waterway	4	**Dimensions**	-
Pier Width	0.7m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	11.1mAHD		
Rail height	1.3m		
Span Length	42.3-48.3 m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Centenary Bridge, seen from Jindalee looking downstream
Image Reference	Kgbo. (2014*) Centenary Bridge, seen from Jindalee, Queensland, 03.2014.* [digital photograph]. Retrieved from below source
Image Source	https://commons.wikimedia.org/wiki/File:Centenary_Bridge_03.2014_03.JPG

Centenary Bridge (TMR_039) Characteristics

Structure Name	Centenary Bridge
Structure ID	TMR_039
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	9825	755	10580	3311	349	3660	3.0	2.2	2.9	13.92	13.80	0.12
1996	3714	0	3714	1722	0	1722	2.2	0.0	2.2	5.05	4.98	0.07
1999	2117	0	2117	1256	0	1256	1.7	0.0	1.7	2.33	2.28	0.05
2011	9241	136	9377	3143	79	3222	2.9	1.7	2.9	12.25	12.13	0.12
2013	3559	0	3559	1685	0	1685	2.1	0.0	2.1	4.84	4.77	0.07
1 in 100 AEP	9065	149	9214	3153	86	3239	2.9	1.7	2.8	12.30	12.19	0.12
1 in 2000 AEP	7724	5513	13237	3318	2098	5416	2.3	2.6	2.4	18.78	18.62	0.16

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	10596	433	11029	4152	788	4940	2.6	0.6	2.2	14.09	14.02	0.07
1996	3569	0	3569	2055	0	2055	1.7	0.0	1.7	4.55	4.51	0.05
1999	1658	0	1658	1648	0	1648	1.0	0.0	1.0	2.27	2.25	0.02
2011	9385	85	9470	3772	344	4116	2.5	0.2	2.3	12.30	12.23	0.07
2013	3371	0	3371	2016	0	2016	1.7	0.0	1.7	4.34	4.29	0.04
1 in 100 AEP	9126	89	9215	3874	365	4239	2.4	0.2	2.2	12.40	12.33	0.07
1 in 2000 AEP	12097	4687	16785	4173	3118	7291	2.9	1.5	2.3	19.16	19.13	0.03

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, handrail will require consideration. Opening width precludes debris blockage below obvert.	No	Yes

BMT WBM

Colleges Crossing (TMR_078) Structure

Structure Name	Colleges Crossing		
Structure ID	TMR_078		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1894	**AMTD**	85890
Date of significant modification		**Co-ordinates (GDA 56)**	480670.33E 6951875.09N
Source of Structure Information	Structural Design Drawings (1981)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\TMR_078 Colleges\		

Description	Concrete Bridge. Note: Data for small culverts embedded in causeway were unavailable however this omission has negligible effect on results.		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	2.2mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	0.6m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	2.6mAHD		
Rail height	0.3m		
Span Length	14m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Colleges Crossing, looking upstream
Image Reference	BMT WBM (2014). *Colleges Crossing (looking upstream)* [digital photography].
Image Source	BMT WBM, 2014

Colleges Crossing (TMR_078) Characteristics

Structure Name	Colleges Crossing
Structure ID	TMR_078
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	58	9531	9590	59	8063	8122	1.0	1.2	1.2	24.93	24.90	0.03
1996	53	2546	2599	59	2408	2467	0.9	1.1	1.1	11.81	11.79	0.02
1999	59	1874	1933	59	1587	1646	1.0	1.2	1.2	9.52	9.49	0.03
2011	61	9204	9266	59	7422	7481	1.0	1.2	1.2	23.54	23.51	0.03
2013	50	2191	2240	59	2192	2251	0.8	1.0	1.0	11.23	11.22	0.02
1 in 100 AEP	59	8489	8548	59	7144	7203	1.0	1.2	1.2	22.93	22.91	0.03
1 in 2000 AEP	74	17070	17143	59	11464	11523	1.2	1.5	1.5	32.17	32.14	0.04

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	84	9510	9594	97	8136	8234	0.9	1.2	1.2	24.58	24.54	0.03
1996	83	2489	2573	97	2637	2734	0.9	0.9	0.9	12.12	12.10	0.03
1999	90	1792	1882	97	1703	1800	0.9	1.1	1.0	9.81	9.77	0.04
2011	90	9367	9457	97	7587	7684	0.9	1.2	1.2	23.44	23.39	0.05
2013	83	1998	2082	97	2280	2377	0.9	0.9	0.9	11.16	11.13	0.03
1 in 100 AEP	89	8561	8650	97	7196	7293	0.9	1.2	1.2	22.80	22.76	0.04
1 in 2000 AEP	99	16730	16829	97	11311	11408	1.0	1.5	1.5	31.47	31.44	0.03

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtopped frequently, blockage below and above deck (handrail) requires consideration. *ICC: Very low immunity – naturally potential for blockage is higher.*	Yes	Yes

BMT WBM

Mt Crosby Weir (BCC_077) Structure

Structure Name	Mt Crosby Weir		
Structure ID	BCC_077		
Owner	Seqwater	**Waterway**	Brisbane River
Date of Construction	1894	**AMTD**	90320
Date of significant modification	1897, 1927	**Co-ordinates (GDA 56)**	480042.24E 6954038.38N
Source of Structure Information	Brief Archival Record (Converge 2013 for SEQwater)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_077 Mt Crosby Weir\		

Description	Multi-cell weir with concrete overbridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	11.2mAHD	**Number of Barrels**	-
Number of Piers in Waterway	21	**Dimensions**	-
Pier Width	0.91m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	12.5mAHD		
Rail height	1.5*m		
Span Length	7.6m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	18xRectangular culverts with overtop
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Culvert Channels, 2D Weir

Image Description	Mt Crosby Weir, looking upstream from west bank
Image Reference	BMT WBM (2014). *Mt Crosby Weir (looking upstream from west bank)* [digital photography]
Image Source	BMT WBM, 2014

Mt Crosby Weir (BCC_077) Characteristics

Structure Name	Mt Crosby Weir
Structure ID	BCC_077
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1741	7856	9598	509	3248	3756	3.4	2.4	2.6	27.40	27.28	0.11
1996	2008	605	2613	509	290	799	3.9	2.1	3.3	14.04	13.62	0.42
1999	1899	0	1899	473	0	473	4.0	0.0	4.0	12.18	11.33	0.85
2011	1812	7557	9369	509	2990	3498	3.6	2.5	2.7	26.25	26.13	0.12
2013	2011	231	2243	509	151	660	4.0	1.5	3.4	13.33	12.87	0.46
1 in 100 AEP	1733	6829	8562	509	2805	3314	3.4	2.4	2.6	25.43	25.32	0.11
1 in 2000 AEP	1977	14141	16119	509	5005	5513	3.9	2.8	2.9	35.19	35.04	0.15

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	664	8952	9615	509	3270	3779	1.3	2.7	2.5	26.61	26.46	0.15
1996	1803	845	2649	509	389	898	3.5	2.2	3.0	14.58	13.62	0.96
1999	1838	118	1956	509	175	683	3.6	0.7	2.9	12.93	12.28	0.65
2011	701	8819	9520	509	3024	3533	1.4	2.9	2.7	25.80	25.63	0.17
2013	1780	375	2155	509	273	782	3.5	1.4	2.8	13.69	12.93	0.77
1 in 100 AEP	659	7997	8656	509	2676	3184	1.3	3.0	2.7	25.04	24.86	0.18
1 in 2000 AEP	-219	17788	17570	509	5905	6414	-0.4	3.0	2.7	34.14	33.92	0.22

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtopped frequently, blockage below and above deck requires consideration.	Yes	Yes

Kholo Rd Bridge (BCC_076) Structure

Structure Name	Kholo Rd Bridge		
Structure ID	BCC_076		
Owner	BCC	**Waterway**	Brisbane River
Date of Construction	1970	**AMTD**	99090
Date of significant modification		**Co-ordinates (GDA 56)**	475036.12E 6950949.91N
Source of Structure Information	Structural Design Drawings (1969)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\BCC_076 Kholo Rd Bridge\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	11.2mAHD	**Number of Barrels**	-
Number of Piers in Waterway	8	**Dimensions**	-
Pier Width	0.8m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	11.7mAHD		
Rail height	0.6m		
Span Length	12.7m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Kholo Rd Bridge, looking downstream
Image Reference	BMT WBM (2015). *Kholo Road Bridge (looking downstream)* [digital photography].
Image Source	BMT WBM, 2015

Kholo Rd Bridge (BCC_076) Characteristics

Structure Name	Kholo Rd Bridge
Structure ID	BCC_076
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	736	8100	8836	414	3872	4286	1.8	2.1	2.1	30.06	29.98	0.08
1996	716	1891	2607	414	977	1391	1.7	1.9	1.9	16.78	16.70	0.08
1999	768	1177	1945	414	580	993	1.9	2.0	2.0	14.95	14.84	0.11
2011	771	8042	8812	414	3685	4098	1.9	2.2	2.2	29.20	29.11	0.09
2013	719	1530	2249	414	791	1204	1.7	1.9	1.9	15.92	15.84	0.08
1 in 100 AEP	747	7351	8098	414	3473	3887	1.8	2.1	2.1	28.23	28.15	0.08
1 in 2000 AEP	619	10111	10730	414	5652	6065	1.5	1.8	1.8	38.23	38.17	0.06

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	623	6074	6698	402	4000	4402	1.6	1.5	1.5	29.83	29.77	0.06
1996	797	1794	2590	402	1102	1504	2.0	1.6	1.7	17.58	17.49	0.08
1999	757	1140	1897	402	696	1099	1.9	1.6	1.7	15.89	15.78	0.12
2011	670	6221	6891	402	3845	4248	1.7	1.6	1.6	29.17	29.11	0.06
2013	776	1327	2103	402	870	1272	1.9	1.5	1.7	16.49	16.40	0.09
1 in 100 AEP	656	5978	6635	402	3696	4098	1.6	1.6	1.6	28.30	28.24	0.06
1 in 2000 AEP	388	6354	6742	402	5892	6294	1.0	1.1	1.1	37.67	37.63	0.04

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck requires consideration. *ICC: No record. New bridge in place I recall. BCC?*	Yes	Yes

Burtons Bridge (SRC_075) Structure

Structure Name	Burtons Bridge		
Structure ID	SRC_075		
Owner	SRC	**Waterway**	Brisbane River
Date of Construction	?	**AMTD**	119090
Date of significant modification	2000	**Co-ordinates (GDA 56)**	469361.11E 6958199.51N
Source of Structure Information	Structural Design Drawings (2000)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\SRC_075 Burtons Bridge\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	18.1*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	5	**Dimensions**	-
Pier Width	1-1.2*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	19.8mAHD		
Rail height	1.1*m		
Span Length	14.3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Burtons Bridge, looking downstream
Image Reference	BMT WBM (2014). *Burtons Bridge (looking downstream)* [digital photography].
Image Source	BMT WBM, 2014

Burtons Bridge (SRC_075) Characteristics

Structure Name	Burtons Bridge
Structure ID	SRC_075
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	272	8000	8272	232	5628	5860	1.2	1.4	1.4	36.42	36.38	0.04
1996	369	2121	2490	232	1124	1356	1.6	1.9	1.8	25.37	25.30	0.07
1999	383	1556	1939	232	803	1036	1.6	1.9	1.9	24.08	23.99	0.09
2011	285	8192	8477	232	5501	5733	1.2	1.5	1.5	36.16	36.12	0.04
2013	379	1890	2268	232	987	1219	1.6	1.9	1.9	24.85	24.76	0.09
1 in 100 AEP	293	7612	7905	232	4985	5218	1.3	1.5	1.5	35.09	35.05	0.04
1 in 2000 AEP	154	7469	7623	232	9273	9506	0.7	0.8	0.8	43.76	43.74	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	671	8471	9142	369	5517	5886	1.8	1.5	1.6	36.27	36.26	0.01
1996	725	1765	2489	369	1019	1388	2.0	1.7	1.8	25.28	25.24	0.04
1999	739	1172	1911	369	682	1051	2.0	1.7	1.8	23.82	23.77	0.05
2011	688	8566	9254	369	5473	5842	1.9	1.6	1.6	36.18	36.17	0.01
2013	734	1406	2140	369	822	1191	2.0	1.7	1.8	24.43	24.38	0.05
1 in 100 AEP	668	7757	8425	369	5011	5380	1.8	1.5	1.6	35.23	35.23	0.01
1 in 2000 AEP	693	15665	16358	369	9024	9393	1.9	1.7	1.7	43.44	43.45	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck (handrail) requires consideration. *Rarely obstructed in the substructure. Some blockage of the guard rails, up to 50%.*	Yes	Yes

Savages Crossing (SRC_074) Structure

Structure Name	Savages Crossing		
Structure ID	SRC_074		
Owner	SRC	**Waterway**	Brisbane River
Date of Construction	?	**AMTD**	85990
Date of significant modification		**Co-ordinates (GDA 56)**	467394.57E 6964416.65N
Source of Structure Information	Cottrell Cameron and Steen Survey (2008) for Esk-Lowood Flood Study		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\SRC_074 Savages Crossing\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	20.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	5	**Dimensions**	-
Pier Width	0.5-0.6m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	21.31mAHD		
Rail height	0.97m		
Span Length	12.3-12.6m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Savages Crossing, looking downstream
Image Reference	BMT WBM (2014*). Savages Crossing (looking downstream)* [digital photography].
Image Source	BMT WBM, 2014

Savages Crossing (SRC_074) Characteristics

Structure Name	Savages Crossing
Structure ID	SRC_074
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	88	9428	9515	64	5816	5880	1.4	1.6	1.6	42.35	42.30	0.05
1996	75	2333	2408	64	1692	1756	1.2	1.4	1.4	30.37	30.34	0.04
1999	74	1849	1923	64	1363	1427	1.2	1.4	1.3	28.97	28.93	0.03
2011	89	9704	9793	64	5868	5932	1.4	1.7	1.7	42.47	42.42	0.05
2013	76	2207	2283	64	1584	1648	1.2	1.4	1.4	29.92	29.88	0.04
1 in 100 AEP	90	8988	9078	64	5385	5449	1.4	1.7	1.7	41.32	41.27	0.05
1 in 2000 AEP	78	12637	12714	64	8742	8806	1.2	1.4	1.4	49.18	49.15	0.04

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	227	8925	9152	91	4876	4967	2.5	1.8	1.8	42.36	42.33	0.03
1996	165	2256	2421	91	1532	1623	1.8	1.5	1.5	30.63	30.56	0.08
1999	165	1722	1886	91	1236	1328	1.8	1.4	1.4	29.17	29.10	0.07
2011	230	9154	9384	91	4931	5023	2.5	1.9	1.9	42.53	42.50	0.03
2013	168	1987	2155	91	1365	1456	1.8	1.5	1.5	29.80	29.74	0.07
1 in 100 AEP	228	8555	8782	91	4619	4711	2.5	1.9	1.9	41.56	41.53	0.04
1 in 2000 AEP	208	13981	14188	91	7180	7272	2.3	1.9	2.0	49.55	49.50	0.05

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck (handrail) requires consideration. *Frequent need to clean debris from structure.* *Usually 50% or less of waterway obstructed.*	Yes	Yes

Brisbane Valley Highway (TMR_050) Structure

Structure Name	Brisbane Valley Highway		
Structure ID	TMR_050		
Owner	TMR	**Waterway**	Brisbane River
Date of Construction	1993	**AMTD**	123290
Date of significant modification		**Co-ordinates (GDA 56)**	464368.59E 6965778.14N
Source of Structure Information	Structural Design Drawings (1993)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\TMR_050 Brisbane Valley Hway\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	31.1mAHD	**Number of Barrels**	-
Number of Piers in Waterway	6	**Dimensions**	-
Pier Width	2m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	33.6mAHD		
Rail height	0.8m		
Span Length	31m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Brisbane Valley Highway, looking downstream
Image Reference	BMT WBM (2014*). Brisbane Valley Highway (looking downstream)* [digital photography].
Image Source	BMT WBM, 2014

Brisbane Valley Highway (TMR_050) Characteristics

Structure Name	Brisbane Valley Highway
Structure ID	TMR_050
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	2349	0	2349	1438	0	1438	1.6	0.0	1.6	32.15	32.09	0.07
1999	1872	0	1872	1349	0	1349	1.4	0.0	1.4	30.78	30.77	0.01
2011	816	1703	2519	1438	2353	3791	0.6	0.7	0.7	43.48	43.47	0.01
2013	2286	0	2286	1438	0	1438	1.6	0.0	1.6	31.79	31.73	0.06
1 in 100 AEP	958	1669	2627	1438	2087	3525	0.7	0.8	0.7	42.39	42.38	0.01
1 in 2000 AEP	364	2166	2530	1438	3904	5342	0.3	0.6	0.5	49.87	49.86	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	2357	0	2357	1466	0	1466	1.6	0.0	1.6	32.93	32.84	0.09
1999	1835	0	1835	1465	0	1466	1.3	0.0	1.3	31.62	31.56	0.06
2011	957	1554	2511	1466	2386	3852	0.7	0.7	0.7	43.95	43.94	0.01
2013	2163	0	2163	1466	0	1466	1.5	0.0	1.5	32.36	32.29	0.08
1 in 100 AEP	1029	1507	2536	1466	2163	3629	0.7	0.7	0.7	43.02	43.01	0.01
1 in 2000 AEP	694	1873	2567	1466	3969	5435	0.5	0.5	0.5	50.54	50.54	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, blockage below and above deck (handrail) requires consideration. *SRC: Rarely any obstruction.*	Yes	Yes

BMT WBM

Twin Bridges (SRC_073) Structure

Structure Name	Twin Bridges		
Structure ID	SRC_073		
Owner	SRC	**Waterway**	Brisbane River
Date of Construction	1900	**AMTD**	124390
Date of significant modification	?	**Co-ordinates (GDA 56)**	463779.36E 6965122.41N
Source of Structure Information	Cottrell Cameron and Steen Survey (2008) for Esk-Lowood Flood Study		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRI\SRC_073 Twin Bridges\		

Description	2 Concrete Causeways		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	23.3mAHD	**Number of Barrels**	-
Number of Piers in Waterway	14	**Dimensions**	-
Pier Width	0.4m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	23.7mAHD		
Rail height	-m		
Span Length	3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	2 banks of culverts
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Culvert Channels, 2D Weir

Image Description	Twin Bridges, looking downstream
Image Reference	BMT WBM (2014). *Twin Bridges (looking downstream)* [digital photography].
Image Source	BMT WBM, 2014

Twin Bridges (SRC_073) Characteristics

Structure Name	Twin Bridges
Structure ID	SRC_073
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	69	5098	5167	58	7059	7117	1.2	0.7	0.7	43.35	43.34	0.01
1996	124	2226	2350	58	1965	2023	2.1	1.1	1.2	32.51	32.48	0.02
1999	122	1755	1877	58	1560	1618	2.1	1.1	1.2	31.19	31.16	0.02
2011	69	5149	5217	58	7137	7194	1.2	0.7	0.7	43.51	43.50	0.01
2013	127	2165	2292	58	1862	1919	2.2	1.2	1.2	32.18	32.15	0.03
1 in 100 AEP	79	5258	5337	58	6600	6658	1.4	0.8	0.8	42.42	42.41	0.01
1 in 2000 AEP	35	5484	5519	58	10288	10345	0.6	0.5	0.5	49.88	49.87	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-18	5720	5702	58	6351	6408	-0.3	0.9	0.9	43.78	43.78	0.00
1996	-26	2387	2361	58	1778	1836	-0.5	1.3	1.3	33.23	33.24	-0.01
1999	-26	1853	1827	58	1496	1553	-0.5	1.2	1.2	31.92	31.91	0.01
2011	-18	5804	5786	58	6434	6491	-0.3	0.9	0.9	43.96	43.97	0.00
2013	-26	2187	2161	58	1656	1713	-0.4	1.3	1.3	32.66	32.67	-0.01
1 in 100 AEP	-19	5746	5726	58	6022	6080	-0.3	1.0	0.9	43.04	43.04	-0.01
1 in 2000 AEP	-1	5717	5716	58	9366	9424	0.0	0.6	0.6	50.55	50.55	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtopped frequently, blockage below deck requires consideration. No handrail at structure. *SRC: Frequent need to clean debris from culverts.* *Usually 100% of culvert blocked.*	Yes	No

Warrego Hwy (TMR_037) Structure

Structure Name	Warrego Hwy		
Structure ID	TMR_037		
Owner	TMR	**Waterway**	Bremer River
Date of Construction	1953	**AMTD**	5310
Date of significant modification	1990	**Co-ordinates (GDA 56)**	481697.09E 6948960.68N
Source of Structure Information	Structural Design Drawings (1990)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\TMR_037 Bremer river Warrego Hwy 18A\		

Description	Dual Concrete Bridges with debris fender system, modelled as single structure		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	14.5*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	11	**Dimensions**	-
Pier Width	1.5*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	15.8mAHD		
Rail height	1.3*m		
Span Length	30-37m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Aerial Imagery of dual bridges, flow direction bottom to top
Image Reference	*Ipswich City Council. Bremer River, Warrego Highway [* digital photograph].
Image Source	Imagery provided by ICC

Warrego Hwy (TMR_037) Characteristics

Structure Name	Warrego Hwy
Structure ID	TMR_037
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	69	374	443	1868	1275	3143	0.0	0.3	0.1	20.74	20.74	0.00
1996	1031	0	1031	937	0	937	1.1	0.0	1.1	9.03	9.02	0.01
1999	324	0	324	551	0	551	0.6	0.0	0.6	5.08	5.07	0.01
2011	233	345	578	1868	791	2659	0.1	0.4	0.2	18.89	18.89	0.00
2013	1626	0	1626	1001	0	1001	1.6	0.0	1.6	9.54	9.52	0.02
1 in 100 AEP	629	449	1077	1868	742	2610	0.3	0.6	0.4	18.70	18.69	0.01
1 in 2000 AEP	0	159	159	258	2678	2935	0.0	0.1	0.1	26.09	26.09	0.00

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	331	182	513	1748	981	2728	0.2	0.2	0.2	20.54	20.54	0.00
1996	1590	0	1590	953	0	953	1.7	0.0	1.7	9.57	9.52	0.05
1999	302	0	302	572	0	572	0.5	0.0	0.5	5.19	5.18	0.01
2011	458	149	607	1748	608	2355	0.3	0.2	0.3	18.83	18.83	0.00
2013	1558	0	1558	1021	0	1021	1.5	0.0	1.5	10.16	10.12	0.04
1 in 100 AEP	762	233	995	1755	582	2338	0.4	0.4	0.4	18.72	18.71	0.01
1 in 2000 AEP	173	220	393	1755	2098	3853	0.1	0.1	0.1	25.66	25.66	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtopped frequently, blockage below and above deck (handrail) requires consideration. *ICC: No record but bridge opening is quite large. TMR post flood records?*	Yes	Yes

David Trumpy Bridge (TMR_043) Structure

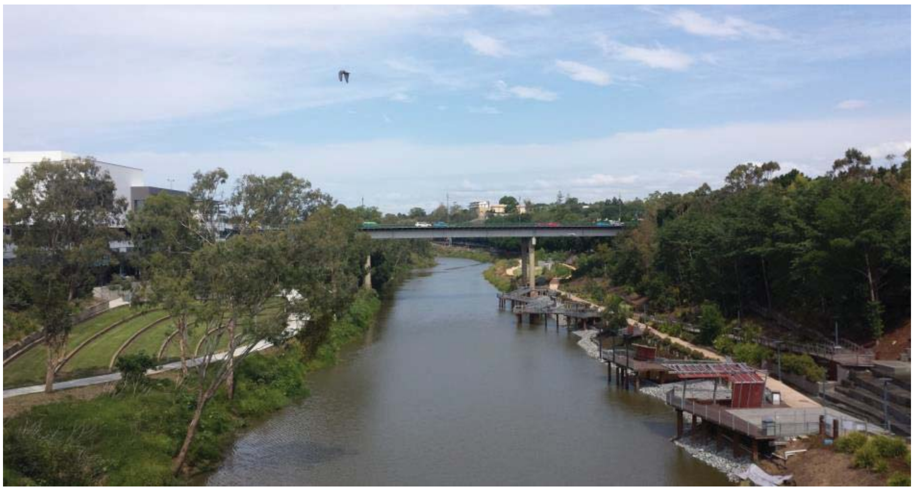
Structure Name	David Trumpy Bridge		
Structure ID	TMR_043		
Owner	TMR	**Waterway**	Bremer River
Date of Construction	1965	**AMTD**	16720
Date of significant modification		**Co-ordinates (GDA 56)**	476469.74E 6945831.92N
Source of Structure Information	Structural Design Drawings (1961)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\TMR_043 Bremer river Warrego connection\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	20.9mAHD	**Number of Barrels**	-
Number of Piers in Waterway	4	**Dimensions**	-
Pier Width	0.5m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	24.5*mAHD		
Rail height	1.6m		
Span Length	40.8-50.3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	David Trumpy Bridge 1974, looking upstream
Image Reference	Ipswich City Council (2015). *David Trumpy Bridge.* [digital photograph].
Image Source	Imagery provided by ICC



David Trumpy Bridge (TMR_043) Characteristics

Structure Name	David Trumpy Bridge
Structure ID	TMR_043
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	2022	0	2022	2990	0	2990	0.7	0.0	0.7	21.01	21.01	0.01
1996	1662	0	1662	1132	0	1132	1.5	0.0	1.5	12.28	12.27	0.01
1999	687	0	687	465	0	465	1.5	0.0	1.5	6.57	6.56	0.01
2011	1361	0	1361	2520	0	2520	0.5	0.0	0.5	19.16	19.15	0.00
2013	1789	0	1789	1254	0	1254	1.4	0.0	1.4	13.06	13.06	0.01
1 in 100 AEP	3681	0	3681	2754	0	2754	1.3	0.0	1.3	20.10	20.09	0.01
1 in 2000 AEP	1307	326	1633	3536	526	4062	0.4	0.6	0.4	26.13	26.12	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	2203	0	2203	2819	0	2819	0.8	0.0	0.8	20.89	20.89	0.00
1996	1589	0	1589	1359	0	1359	1.2	0.0	1.2	13.83	13.80	0.03
1999	665	0	665	665	0	665	1.0	0.0	1.0	7.84	7.80	0.03
2011	1466	0	1466	2399	0	2399	0.6	0.0	0.6	19.16	19.15	0.00
2013	1667	0	1667	1408	0	1408	1.2	0.0	1.2	14.10	14.08	0.02
1 in 100 AEP	3533	0	3533	2608	0	2608	1.4	0.0	1.4	20.13	20.11	0.01
1 in 2000 AEP	2349	174	2523	3332	298	3630	0.7	0.6	0.7	25.74	25.73	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, Opening width precludes debris blockage. Handrail above deck will require blockage consideration. *ICC: No known record of notable blockage. Was above water in 1974, likely 1893 as well. Large waterway opening so likelihood of blockage is low.*	No	Yes

Railway Workshop Bridge (QR_025) Structure

Structure Name	Railway Workshop Bridge		
Structure ID	QR_025		
Owner	QR	**Waterway**	Bremer River
Date of Construction	1895	**AMTD**	17000
Date of significant modification	?	**Co-ordinates (GDA 56)**	476213.02E 6945933.83N
Source of Structure Information	Structural Design Drawings (1895)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\QR_025 Riverlink Shopping Centre Rail\		

Description	Steel Truss Supported Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	20.6*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	2.2*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	21.1mAHD		
Rail height	1.7*m		
Span Length	45.57m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Railway Bridge, Ipswich, looking usptream
Image Reference	Goodwin, C. (2009*). Rail bridge across the Bremer River, Ipswich, Queensland.* [digital imagery]. Retrieved from below source
Image Source	http://en.wikipedia.org/wiki/File:Bremer_R.JPG

Railway Workshop Bridge (QR_025) Characteristics

Structure Name	Railway Workshop Bridge
Structure ID	QR_025
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	2099	0	2099	2331	0	2331	0.9	0.0	0.9	21.04	21.02	0.02
1996	1662	0	1662	1105	0	1105	1.5	0.0	1.5	12.33	12.32	0.01
1999	687	0	687	507	0	507	1.4	0.0	1.4	6.62	6.61	0.01
2011	1359	0	1359	2116	0	2116	0.6	0.0	0.6	19.17	19.16	0.01
2013	1789	0	1789	1203	0	1203	1.5	0.0	1.5	13.11	13.10	0.01
1 in 100 AEP	3685	0	3685	2271	0	2271	1.6	0.0	1.6	20.15	20.13	0.03
1 in 2000 AEP	1638	576	2214	2331	694	3025	0.7	0.8	0.7	26.14	26.13	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	3680	0	3680	2288	0	2288	1.6	0.0	1.6	20.99	20.92	0.07
1996	1607	0	1607	1210	0	1210	1.3	0.0	1.3	14.00	13.95	0.06
1999	661	0	661	376	0	376	1.8	0.0	1.8	8.00	7.93	0.07
2011	1470	0	1470	2015	0	2015	0.7	0.0	0.7	19.19	19.18	0.01
2013	1681	0	1681	1233	0	1233	1.4	0.0	1.4	14.22	14.19	0.03
1 in 100 AEP	3568	0	3568	2127	0	2127	1.7	0.0	1.7	20.30	20.20	0.09
1 in 2000 AEP	1879	627	2506	2171	936	3107	0.9	0.7	0.8	25.77	25.75	0.02

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events. Truss structure above deck will require blockage consideration. Opening width precludes debris blockage. *ICC: No known record. But very large opening. Expect low potential.*	No	Yes

BMT WBM

Hancock Bridge (ICC_058) Structure

Structure Name	Hancock Bridge		
Structure ID	ICC_058		
Owner	ICC	**Waterway**	Bremer River
Date of Construction	1895	**AMTD**	20420
Date of significant modification	?	**Co-ordinates (GDA 56)**	474756.37E 6946775.98N
Source of Structure Information	Survey taken as part of Bremer River Flood Study, Reports 1 and 2		
Link to data source	K:\B20702.k.saw_Brisbane_River\10 Data Management\10-05_Structures\Structure_Details\BRI\BRM\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	11*mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	0.8*m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	14.8*mAHD		
Rail height	1.2*m		
Span Length	18.3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	HW and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Hancock Bridge, Bremer River flow left to right
Image Reference	*Ipswich City Council. Hancock Bridge [* digital photograph].
Image Source	Imagery provided by ICC

BMT WBM

Hancock Bridge (ICC_058) Characteristics

Structure Name	Hancock Bridge
Structure ID	ICC_058
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1301	2767	4068	750	1392	2142	1.7	2.0	1.9	22.65	22.57	0.08
1996	1669	0	1669	750	0	750	2.2	0.0	2.2	14.14	14.01	0.13
1999	690	0	690	362	0	362	1.9	0.0	1.9	8.05	8.04	0.01
2011	799	876	1674	750	705	1456	1.1	1.2	1.2	19.59	19.56	0.03
2013	1794	3	1797	750	6	757	2.4	0.4	2.4	14.92	14.77	0.15
1 in 100 AEP	1329	2505	3833	750	1242	1992	1.8	2.0	1.9	22.04	21.96	0.08
1 in 2000 AEP	1285	5037	6322	750	2526	3276	1.7	2.0	1.9	26.61	26.53	0.08

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1595	2196	3791	775	1723	2497	2.1	1.3	1.5	22.78	22.76	0.02
1996	1463	159	1622	775	112	886	1.9	1.4	1.8	15.69	15.60	0.09
1999	670	0	670	505	0	505	1.3	0.0	1.3	10.03	10.00	0.03
2011	1125	850	1975	775	1002	1776	1.5	0.8	1.1	19.79	19.77	0.02
2013	1471	206	1677	775	142	917	1.9	1.4	1.8	15.95	15.86	0.09
1 in 100 AEP	1609	1899	3508	788	1503	2291	2.0	1.3	1.5	22.12	22.09	0.03
1 in 2000 AEP	1550	3659	5209	788	2696	3484	2.0	1.4	1.5	26.61	26.60	0.01

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtopped frequently, blockage below and above deck (handrail) requires consideration. *ICC: Bridge went under in 1974 so immunity is not high, estimated 20yr ARI. Increased potential for blockage in larger events.*	Yes	Yes

BMT WBM

Wulkuraka Rail Bridge (QR_103) Structure

Structure Name	Wulkuraka Rail Bridge		
Structure ID	QR_103		
Owner	QR	**Waterway**	Bremer River
Date of Construction	1895	**AMTD**	22300
Date of significant modification	?	**Co-ordinates (GDA 56)**	474327.63E 6945513.17N
Source of Structure Information	Structural Design Drawings (1895)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\QR_103 DIxon St\		

Description	Steel Truss Supported Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	25.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	8	**Dimensions**	-
Pier Width	1.2m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	28.1*mAHD		
Rail height	2.2*m		
Span Length	46.5m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Wulkuraka Rail Bridge, Aerial Imagery
Image Reference	*Ipswich City Council. Wulkuraka Rail Bridge, Aerial Imagery [* digital photograph].
Image Source	Imagery provided by ICC

BMT WBM

Wulkuraka Rail Bridge (QR_103) Characteristics

Structure Name	Wulkuraka Rail Bridge
Structure ID	QR_103
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	4143	0	4143	2147	0	2147	1.9	0.0	1.9	24.09	24.08	0.01
1996	1665	0	1665	901	0	901	1.8	0.0	1.8	16.02	16.01	0.01
1999	686	0	686	366	0	366	1.9	0.0	1.9	10.70	10.70	0.01
2011	2325	0	2325	1444	0	1444	1.6	0.0	1.6	20.46	20.46	0.01
2013	1801	0	1801	978	0	978	1.8	0.0	1.8	16.70	16.69	0.01
1 in 100 AEP	3898	0	3898	2015	0	2015	1.9	0.0	1.9	23.51	23.50	0.01
1 in 2000 AEP	6932	26	6958	2625	39	2664	2.6	0.7	2.6	28.26	28.05	0.21

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	4045	0	4045	2130	0	2130	1.9	0.0	1.9	24.00	23.89	0.11
1996	1616	0	1616	1054	0	1054	1.5	0.0	1.5	17.01	16.94	0.07
1999	670	0	670	580	0	580	1.2	0.0	1.2	11.72	11.61	0.11
2011	2308	0	2308	1526	0	1526	1.5	0.0	1.5	20.62	20.54	0.08
2013	1677	0	1677	1075	0	1075	1.6	0.0	1.6	17.24	17.17	0.07
1 in 100 AEP	3719	0	3719	2026	0	2026	1.8	0.0	1.8	23.34	23.24	0.09
1 in 2000 AEP	6423	0	6423	2751	0	2751	2.3	0.0	2.3	27.77	27.62	0.14

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events. Truss structure above deck will require blockage consideration. Opening width precludes debris blockage. At Dixon St end of bridge the opening widths reduce significantly which may require consideration. *ICC: No known record but reasonable opening size . QR may have records perhaps?*	Yes	Yes

BMT WBM

One Mile Bridge (ICC_057) Structure

Structure Name	One Mile Bridge		
Structure ID	ICC_057		
Owner	ICC	**Waterway**	Bremer River
Date of Construction	1936	**AMTD**	24230
Date of significant modification	2004	**Co-ordinates (GDA 56)**	475079.71E 6944381.61N
Source of Structure Information	Structural Design Drawings, Upgrade (2004)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\ICC_057\		

Description	Concrete bridge on Bremer River downstream of Deebing Creek confluence		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	15.43mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	1.2m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	17.43mAHD		
Rail height	1.4m		
Span Length	29.7-30.0m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	One Mile Bridge, looking from downstream
Image Reference	BMT WBM (2014*). One Mile Bridge (looking downstream)* [digital photography]
Image Source	BMT WBM, 2015

One Mile Bridge (ICC_057) Characteristics

Structure Name	One Mile Bridge
Structure ID	ICC_057
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1044	3105	4148	1095	2750	3846	1.0	1.1	1.1	25.28	25.25	0.02
1996	1597	74	1671	1095	52	1147	1.5	1.4	1.5	18.08	18.03	0.05
1999	685	0	685	709	0	709	1.0	0.0	1.0	13.45	13.44	0.01
2011	1089	1364	2453	1095	1179	2274	1.0	1.2	1.1	21.73	21.70	0.03
2013	1616	189	1805	1095	123	1218	1.5	1.5	1.5	18.67	18.61	0.06
1 in 100 AEP	1050	2881	3931	1095	2539	3635	1.0	1.1	1.1	24.80	24.78	0.02
1 in 2000 AEP	1069	5261	6331	1095	4532	5627	1.0	1.2	1.1	29.26	29.23	0.02

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	891	2787	3678	472	2320	2792	1.9	1.2	1.3	25.13	25.10	0.03
1996	1523	71	1594	472	60	531	3.2	1.2	3.0	18.27	18.05	0.22
1999	661	0	661	270	0	270	2.4	0.0	2.4	13.36	13.25	0.10
2011	1007	1311	2318	472	969	1441	2.1	1.4	1.6	21.56	21.50	0.05
2013	1537	125	1662	472	83	555	3.3	1.5	3.0	18.48	18.26	0.22
1 in 100 AEP	913	2590	3502	472	2060	2532	1.9	1.3	1.4	24.46	24.43	0.03
1 in 2000 AEP	950	4305	5255	472	3761	4232	2.0	1.1	1.2	28.94	28.92	0.02

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, may require blockage consideration below deck although unlikely. Concrete barrier above deck so therefore no further blockage required. *ICC: New bridge (Don Livingstone One Mile) has no records but it has low immunity (likely no more than 20r ARI if at all). The Old Mile Bridge(s) over Bremer/Deebing are of a much lower immunity, possibly as low as 1-2yr ARI. Increased potential for blockage in the older bridges causing local impacts and for larger events on the new bridge.*	Yes	No

Three Mile Bridge (ICC_056) Structure

Structure Name	Three Mile Bridge		
Structure ID	ICC_056		
Owner	ICC	**Waterway**	Bremer River
Date of Construction	1970	**AMTD**	29310
Date of significant modification	2004	**Co-ordinates (GDA 56)**	473160.25E 6943533.27N
Source of Structure Information	Structural Design Drawings (2006)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\BRM\ICC_056\		

Description	Concrete bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	16.7mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	0.55m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	19.2mAHD		
Rail height	1.3*m		
Span Length	25m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Three Mile Bridge, looking form upstream
Image Reference	BMT WBM (2015*). Three Mile Bridge (looking from upstream)* [digital photography]
Image Source	BMT WBM, 2015

Three Mile Bridge (ICC_056) Characteristics

Structure Name	Three Mile Bridge
Structure ID	ICC_056
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	57	1026	1082	257	1941	2198	0.2	0.5	0.5	26.38	26.37	0.01
1996	349	685	1033	257	408	665	1.4	1.7	1.6	21.19	21.13	0.06
1999	465	0	465	257	0	257	1.8	0.0	1.8	17.45	17.33	0.12
2011	244	1346	1591	257	1123	1380	1.0	1.2	1.2	23.70	23.68	0.03
2013	249	596	845	257	485	742	1.0	1.2	1.1	21.50	21.46	0.04
1 in 100 AEP	59	993	1052	257	1850	2107	0.2	0.5	0.5	26.08	26.08	0.01
1 in 2000 AEP	14	984	998	257	2978	3235	0.1	0.3	0.3	29.77	29.77	0.00

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	12	633	645	257	2010	2267	0.0	0.3	0.3	26.61	26.60	0.00
1996	288	685	973	257	485	742	1.1	1.4	1.3	21.50	21.46	0.04
1999	460	0	460	257	0	257	1.8	0.0	1.8	17.63	17.51	0.12
2011	214	1195	1408	257	1216	1473	0.8	1.0	1.0	24.01	23.99	0.02
2013	247	633	880	257	525	782	1.0	1.2	1.1	21.65	21.62	0.03
1 in 100 AEP	15	656	671	257	1928	2185	0.1	0.3	0.3	26.34	26.33	0.00
1 in 2000 AEP	1	460	462	257	2941	3198	0.0	0.2	0.1	29.65	29.65	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, will require blockage consideration below deck. Concrete barrier rails so therefore no further blockage above deck *ICC: No known record of notable blockage. Large waterway opening but immunity understood to be low, no more than 20yr ARI at best.*	Yes	No

Cunningham Hwy (TMR_048) Structure

Structure Name	Cunningham Hwy		
Structure ID	TMR_048		
Owner	TMR	**Waterway**	Warrill Ck
Date of Construction	1991	**AMTD**	7630
Date of significant modification		**Co-ordinates (GDA 56)**	470262.48E 6940695.99N
Source of Structure Information	Structural Design Drawings (1991)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\WAR\TMR_048 Cunningham Hwy\		

Description	Flat Deck Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	25.6mAHD	**Number of Barrels**	-
Number of Piers in Waterway	6	**Dimensions**	-
Pier Width	0.7m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	27mAHD		
Rail height	0.75m		
Span Length	14m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Cunningham hwy over Warrill Creek
Image Reference	BMT WBM (2015). *Cunningham Highway over Warrill Creek* [digital photography].
Image Source	BMT WBM, 2015

Cunningham Hwy (TMR_048) Characteristics

Structure Name	Cunningham Hwy
Structure ID	TMR_048
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	266	0	266	268	0	268	1.0	0.0	1.0	23.45	23.44	0.02
1999	68	0	68	110	0	110	0.6	0.0	0.6	20.88	20.87	0.01
2011	106	0	106	302	0	302	0.4	0.0	0.4	23.94	23.94	0.01
2013	95	0	95	238	0	238	0.4	0.0	0.4	22.98	22.98	0.01
1 in 100 AEP	447	0	447	513	0	513	0.9	0.0	0.9	26.69	26.65	0.04
1 in 2000 AEP	108	455	562	513	878	1391	0.2	0.5	0.4	29.84	29.84	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	296	0	296	281	0	281	1.1	0.0	1.1	23.65	23.63	0.02
1999	67	0	67	109	0	109	0.6	0.0	0.6	20.85	20.85	0.01
2011	156	0	156	329	0	329	0.5	0.0	0.5	24.33	24.32	0.01
2013	153	0	153	255	0	255	0.6	0.0	0.6	23.24	23.23	0.01
1 in 100 AEP	749	102	851	513	91	603	1.5	1.1	1.4	27.25	27.10	0.15
1 in 2000 AEP	210	589	799	513	856	1369	0.4	0.7	0.6	29.78	29.77	0.01

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in very large events, blockage below and above deck (handrail) requires consideration. *ICC: No information available – state owned bridge. Being a bridge on a highway there is the expectation of a lower risk of blockage. This will however depend on the immunity of the bridge itself. TMR may have records post flood events for this structure perhaps.*	Yes	Yes

BMT WBM

Cunningham Hwy (TMR_049) Structure

Structure Name	Cunningham Hwy		
Structure ID	TMR_049		
Owner	TMR	**Waterway**	Purga Ck
Date of Construction	1991	**AMTD**	2290
Date of significant modification		**Co-ordinates (GDA 56)**	472413.14E 6940314.45N
Source of Structure Information	Structural Design Drawings (1991)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\PRG\TMR_049 Cunningham Hwy\		

Description	Flat Deck Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	25.3mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	0.7m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	26.8mAHD		
Rail height	0.75m		
Span Length	16m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Cunningham hwy over Purga Creek
Image Reference	*Ipswich City Council. Cunningham Highway over Purga Creek [* digital photography].
Image Source	Imagery provided by ICC

BMT WBM

Cunningham Hwy (TMR_049) Characteristics

Structure Name	Cunningham Hwy
Structure ID	TMR_049
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	408	0	408	297	0	297	1.4	0.0	1.4	24.56	24.55	0.01
1999	187	0	187	150	0	150	1.3	0.0	1.3	22.86	22.85	0.01
2011	771	0	771	471	0	471	1.6	0.0	1.6	26.31	26.25	0.06
2013	1063	19	1082	544	32	576	2.0	0.6	1.9	27.13	26.99	0.14
1 in 100 AEP	908	588	1496	544	366	909	1.7	1.6	1.6	28.08	27.98	0.10
1 in 2000 AEP	325	839	1164	544	1140	1684	0.6	0.7	0.7	29.89	29.88	0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	403	0	403	298	0	298	1.4	0.0	1.4	24.57	24.56	0.01
1999	187	0	187	149	0	149	1.3	0.0	1.3	22.85	22.84	0.01
2011	737	0	737	463	0	463	1.6	0.0	1.6	26.22	26.18	0.04
2013	990	0	990	531	0	531	1.9	0.0	1.9	26.89	26.78	0.12
1 in 100 AEP	825	487	1311	544	321	865	1.5	1.5	1.5	27.97	27.88	0.09
1 in 2000 AEP	108	559	667	544	1099	1643	0.2	0.5	0.4	29.79	29.79	0.01

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, blockage below and above deck (handrail) requires consideration. *ICC: See above*	Yes	Yes

BMT WBM

O'Reilly's Weir (SRC_071) Structure

Structure Name	O'Reilly's Weir		
Structure ID	SRC_071		
Owner	SEQw	**Waterway**	Lockyer Ck
Date of Construction	1951	**AMTD**	1480
Date of significant modification		**Co-ordinates (GDA 56)**	459557.06E 6967166.25N
Source of Structure Information	Various As-Constructed and Maintenance Plans (1951)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\LKY\SRC_071\		

Description	Concrete single-cell weir		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	-mAHD	**Number of Barrels**	-
Number of Piers in Waterway	-	**Dimensions**	-
Pier Width	-m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	31.1mAHD		
Rail height	-m		
Span Length	27.6m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	Weir Channel
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Weir Channel

Image Description	O'Reilly's Weir, looking upstream
Image Reference	BMT WBM (2014). *O'Reilly's Weir (looking upstream)* [digital photography].
Image Source	BMT WBM, 2014

BMT WBM

O'Reilly's Weir (SRC_071) Characteristics

Structure Name	O'Reilly's Weir
Structure ID	SRC_071
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	0	-1123	-1123	0	2071	2071	0.0	0.0	-0.5	47.38	47.39	-0.01
1996	0	2334	2334	0	746	746	0.0	3.1	3.1	39.73	39.51	0.22
1999	0	519	519	0	267	267	0.0	1.9	1.9	35.52	35.44	0.08
2011	0	-595	-595	0	2150	2150	0.0	0.0	-0.3	47.73	47.74	0.00
2013	0	2377	2377	0	746	746	0.0	3.2	3.2	39.73	39.50	0.23
1 in 100 AEP	0	-976	-976	0	1986	1986	0.0	0.0	-0.5	47.01	47.01	0.00
1 in 2000 AEP	0	-1580	-1580	0	2780	2780	0.0	0.0	-0.6	50.51	50.52	-0.01

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	0	-997	-997	0	2280	2280	0.0	0.0	-0.4	48.31	48.31	0.00
1996	0	2345	2345	0	799	799	0.0	2.9	2.9	40.13	39.94	0.19
1999	0	478	478	0	321	321	0.0	1.5	1.5	36.05	36.01	0.04
2011	0	-951	-951	0	2353	2353	0.0	0.0	-0.4	48.63	48.63	0.00
2013	0	2253	2253	0	743	743	0.0	3.0	3.0	39.71	39.51	0.20
1 in 100 AEP	0	-835	-835	0	2227	2227	0.0	0.0	-0.4	48.07	48.08	0.00
1 in 2000 AEP	0	-1296	-1296	0	3084	3084	0.0	0.0	-0.4	51.86	51.86	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
No blockage potential. *SRC: Seqwater maintain this structure.*	No	No

Pointings Bridge (SRC_070) Structure

Structure Name	Pointings Bridge		
Structure ID	SRC_070		
Owner	SRC	**Waterway**	Lockyer Ck
Date of Construction	?	**AMTD**	3930
Date of significant modification	2010	**Co-ordinates (GDA 56)**	457621.09E 6964188.17N
Source of Structure Information	As-Constructed Drawings (2009)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\LKY\SRC_070\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	38.7mAHD	**Number of Barrels**	-
Number of Piers in Waterway	2	**Dimensions**	-
Pier Width	1.05m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	40.2mAHD		
Rail height	1.2*m		
Span Length	29.9, 30m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Pointings Bridge, looking downstream
Image Reference	BMT WBM (2014). *Pointings Bridge (looking downstream)* [digital photography].
Image Source	BMT WBM, 2014

Pointings Bridge (SRC_070) Characteristics

Structure Name	Pointings Bridge
Structure ID	SRC_070
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	666	931	1597	407	418	825	1.6	2.2	1.9	48.55	48.46	0.10
2013	946	563	1509	407	217	623	2.3	2.6	2.4	44.53	44.36	0.17
1 in 100 AEP	667	824	1490	407	387	794	1.6	2.1	1.9	47.94	47.85	0.09
1 in 2000 AEP	292	589	880	407	518	925	0.7	1.1	1.0	50.56	50.54	0.02

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2011	530	786	1316	407	441	848	1.3	1.8	1.6	49.02	48.96	0.06
2013	883	460	1343	407	191	597	2.2	2.4	2.2	44.01	43.87	0.15
1 in 100 AEP	504	688	1192	407	416	823	1.2	1.7	1.4	48.52	48.47	0.05
1 in 2000 AEP	16	193	209	407	583	990	0.0	0.3	0.2	51.86	51.86	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck (handrail) requires consideration. *SRC: 30% obstructions common after large events.*	Yes	Yes

BMT WBM

Brisbane Valley Rail Trail, Mahons Rd (QR_065) Structure

Structure Name	Brisbane Valley Rail Trail, Mahons Rd		
Structure ID	QR_065		
Owner	QR	**Waterway**	Lockyer Ck
Date of Construction	1926	**AMTD**	13510
Date of significant modification		**Co-ordinates (GDA 56)**	453580.13E 6966961.39N
Source of Structure Information			
Link to data source			

Description	Wooden Railway Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	51.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	1	**Dimensions**	-
Pier Width	0.85m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	52.5mAHD		
Rail height	-m		
Span Length	6.7m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Brisbane Valley Rail Trail bridge
Image Reference	BMT WBM (2014). *Brisbane Valley Rail Trail Bridge* [digital photography].
Image Source	BMT WBM, 2014

BMT WBM

Brisbane Valley Rail Trail, Mahons Rd (QR_065) Characteristics

Structure Name	Brisbane Valley Rail Trail, Mahons Rd
Structure ID	QR_065
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1716	230	1946	825	125	951	2.1	1.8	2.0	53.75	53.58	0.18
1996	1304	106	1410	825	75	900	1.6	1.4	1.6	53.25	53.13	0.11
1999	547	0	547	522	0	522	1.0	0.0	1.0	47.75	47.74	0.01
2011	1729	234	1962	825	127	952	2.1	1.8	2.1	53.77	53.59	0.18
2013	1317	112	1429	825	77	903	1.6	1.5	1.6	53.27	53.16	0.12
1 in 100 AEP	1797	250	2047	825	132	958	2.2	1.9	2.1	53.82	53.63	0.19
1 in 2000 AEP	2767	768	3534	825	277	1103	3.4	2.8	3.2	55.27	54.78	0.49

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1253	83	1336	825	66	891	1.5	1.3	1.5	53.16	53.10	0.06
1996	1118	7	1126	825	13	838	1.4	0.6	1.3	52.63	52.58	0.05
1999	504	0	504	491	0	491	1.0	0.0	1.0	47.34	47.34	0.01
2011	1271	93	1364	825	72	897	1.5	1.3	1.5	53.22	53.16	0.06
2013	1116	8	1124	825	13	838	1.4	0.6	1.3	52.63	52.58	0.05
1 in 100 AEP	1309	113	1422	825	83	908	1.6	1.4	1.6	53.33	53.26	0.06
1 in 2000 AEP	1871	452	2323	825	216	1042	2.3	2.1	2.2	54.66	54.53	0.13

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, blockage below and above deck (handrail) requires consideration. *SRC: Could find no record of clearing of obstructions.*	Yes	Yes

BMT WBM

Watsons Bridge (SRC_064) Structure

Structure Name	Watsons Bridge		
Structure ID	SRC_064		
Owner	SRC	**Waterway**	Lockyer Ck
Date of Construction	?	**AMTD**	18460
Date of significant modification	1982	**Co-ordinates (GDA 56)**	454415.25E 6964784.8N
Source of Structure Information	Structural Design Drawings (1982)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\LKY\SRC_064\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	52.3mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	0.5m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	53mAHD		
Rail height	0.3m		
Span Length	18m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Watsons Bridge, looking upstream
Image Reference	BMT WBM (2014). *Watsons Bridge (looking upstream)* [digital photography]
Image Source	BMT WBM, 2014

Watsons Bridge (SRC_064) Characteristics

Structure Name	Watsons Bridge
Structure ID	SRC_064
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	713	388	1101	575	275	850	1.2	1.4	1.3	56.56	56.52	0.04
1999	367	0	367	493	0	493	0.7	0.0	0.7	51.08	51.07	0.01
2011	826	483	1309	575	299	874	1.4	1.6	1.5	56.86	56.81	0.05
2013	727	401	1128	575	279	854	1.3	1.4	1.3	56.61	56.57	0.04
1 in 100 AEP	842	497	1338	575	302	877	1.5	1.6	1.5	56.90	56.84	0.06
1 in 2000 AEP	1307	908	2215	575	378	953	2.3	2.4	2.3	57.84	57.71	0.13

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	-	-	-	-	-	-	-	-	-	-	-	-
1996	830	460	1290	575	284	859	1.4	1.6	1.5	56.68	56.62	0.05
1999	368	0	368	487	0	487	0.8	0.0	0.8	51.01	51.00	0.01
2011	961	549	1511	575	299	874	1.7	1.8	1.7	56.86	56.79	0.07
2013	870	487	1357	575	289	864	1.5	1.7	1.6	56.74	56.68	0.06
1 in 100 AEP	940	535	1475	575	297	871	1.6	1.8	1.7	56.83	56.76	0.07
1 in 2000 AEP	1008	588	1595	575	307	882	1.8	1.9	1.8	56.96	56.88	0.08

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck (handrail) requires consideration. *SRC: 30% obstructions common after large events.*	Yes	Yes

BMT WBM

Lyons Bridge (SRC_063) Structure

Structure Name	Lyons Bridge		
Structure ID	SRC_063		
Owner	SRC	**Waterway**	Lockyer Ck
Date of Construction	1955	**AMTD**	27480
Date of significant modification	?	**Co-ordinates (GDA 56)**	453585.31E 6961344.89N
Source of Structure Information	Site photographs		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\LKY\SRC_063\		

Description	Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	60.5mAHD	**Number of Barrels**	-
Number of Piers in Waterway	4	**Dimensions**	-
Pier Width	0.8m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	61mAHD		
Rail height	0.5m		
Span Length	30m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	1D Bridge and Weir Channels

Image Description	Lyons Bridge, looking upstream
Image Reference	BMT WBM (2014). *Lyons Bridge (looking upstream)* [digital photography].
Image Source	BMT WBM, 2014

Lyons Bridge (SRC_063) Characteristics

Structure Name	Lyons Bridge
Structure ID	SRC_063
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	1218	797	2016	734	364	1098	1.7	2.2	1.8	65.14	65.03	0.11
1996	974	474	1448	734	283	1017	1.3	1.7	1.4	64.33	64.27	0.06
1999	372	0	372	501	0	501	0.7	0.0	0.7	58.32	58.32	0.01
2011	1272	877	2149	734	382	1115	1.7	2.3	1.9	65.32	65.19	0.13
2013	1017	541	1558	734	303	1037	1.4	1.8	1.5	64.53	64.46	0.07
1 in 100 AEP	1301	914	2215	734	391	1124	1.8	2.3	2.0	65.41	65.28	0.13
1 in 2000 AEP	1482	1412	2894	734	502	1235	2.0	2.8	2.3	66.52	66.32	0.20

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	490	226	715	734	277	1011	0.7	0.8	0.7	64.27	64.26	0.02
1996	540	209	749	734	243	976	0.7	0.9	0.8	63.93	63.91	0.02
1999	373	0	373	503	0	503	0.7	0.0	0.7	58.34	58.33	0.01
2011	443	228	670	734	290	1024	0.6	0.8	0.7	64.40	64.39	0.01
2013	535	220	754	734	256	990	0.7	0.9	0.8	64.06	64.05	0.02
1 in 100 AEP	476	229	705	734	282	1015	0.6	0.8	0.7	64.32	64.30	0.02
1 in 2000 AEP	245	211	456	734	326	1059	0.3	0.6	0.4	64.76	64.75	0.01

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops frequently, blockage below and above deck (handrail) requires consideration. *SRC: 30% obstructions common after large events.*	Yes	Yes

Pamphlet Bridge (BCC_023) Structure

Structure Name	Pamphlet Bridge		
Structure ID	BCC_023		
Owner	BCC	**Waterway**	Oxley Ck
Date of Construction	1964	**AMTD**	150
Date of significant modification		**Co-ordinates (GDA 56)**	499513.94E 6955446.4N
Source of Structure Information	Hydraulic Structure Reference Sheet (Aurecon 2013)		
Link to data source	B:\B20702 BRCFS Hydraulics\10_Data Management\10_03_Structures\Structure_Details\OXL\BCC_023 Pamphlet Bridge\		

Description	Flat Deck Concrete Bridge		
BRIDGES		**CULVERTS**	
Lowest Point of Deck Soffit	7.1mAHD	**Number of Barrels**	-
Number of Piers in Waterway	3	**Dimensions**	-
Pier Width	0.7m	**Length**	-
		Upstream invert	-
		Downstream Invert	-
Lowest point of Deck/Embankment	8.1mAHD		
Rail height	0.8*m		
Span Length	16.7m - 21.3m		

*estimated

Included in Fast Model (FM)	Yes	**FM Representation**	XZ and LC table
Included in Detailed Model (DM)	Yes	**DM Representation**	2D Layered Flow Constriction

Image Description	Pamphlet Bridge, looking from downstream
Image Reference	BMT WBM (2015). *Pamphlet Bridge (looking from downstream)* [digital photography].
Image Source	BMT WBM, 2015

Pamphlet Bridge (BCC_023) Characteristics

Structure Name	Pamphlet Bridge
Structure ID	BCC_023
Link to model data	B:\B20702 BRCFS Hydraulics\50_Hydraulic_Models\200_Calibration_S2\TUFLOW\F\model\bg\CSV

FAST MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	401	213	615	506	206	712	0.8	1.0	0.9	10.77	10.75	0.02
1996	34	0	34	279	0	279	0.1	0.0	0.1	3.68	3.68	0.00
1999	-29	0	-29	170	0	170	-0.2	0.0	-0.2	1.85	1.85	0.00
2011	262	64	326	506	91	597	0.5	0.7	0.5	9.28	9.27	0.01
2013	218	0	218	269	0	269	0.8	0.0	0.8	3.52	3.51	0.01
1 in 100 AEP	285	74	358	506	102	607	0.6	0.7	0.6	9.42	9.41	0.01
1 in 2000 AEP	397	651	1048	506	567	1073	0.8	1.1	1.0	15.46	15.44	0.02

DETAILED MODEL^

Event	Discharge (m^3/s)*			Area (m^2)*			Velocity (m/s)*			Peak Water Surface Level (mAHD)		Max Head Drop (m)*
	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	Under Structure	Over Structure	Total	US	DS*	
1974	3	3	6	505	323	828	0.0	0.0	0.0	11.06	11.06	0.00
1996	108	0	108	198	0	198	0.5	0.0	0.5	3.23	3.22	0.00
1999	-45	0	-45	154	0	154	-0.3	0.0	-0.3	1.76	1.76	0.00
2011	-33	-6	-39	505	97	602	-0.1	0.0	-0.1	9.37	9.37	0.00
2013	271	0	271	197	0	197	1.4	0.0	1.4	3.18	3.18	0.01
1 in 100 AEP	7	2	9	505	122	627	0.0	0.0	0.0	9.65	9.65	0.00
1 in 2000 AEP	-373	-576	-949	505	888	1393	-0.7	0.0	-0.7	15.81	15.81	0.00

* At time of peak water level on upstream side. Discharges can be significantly below peak flow values where significant backwater effects occur.

^ Consistent values may not occur between the Fast and Detailed Models due to dissimilarities between the models' solution schemes (1D vs 2D) and domain discretisation. These differences tend to be emphasised where rapidly varying flow and high velocities occur in the vicinity of the structure.

Fast Model Version Number for Calibration Events: 285

Fast Model Version Number Design Events: 360

Detailed Model Version Number for Calibration Events: 605

Detailed Model Version Number for Design Events: 605

BLOCKAGE CONSIDERATION

Commentary	Recommendation to consider in future blockage assessment?	
	Blockage Below Obvert	Blockage Above Deck
Overtops in large events, blockage below and above deck (handrail) requires consideration.	Yes	Yes

Appendix D IPE Comments on Draft Report and Endorsement

Milestone Report 5: Detailed Model Results - Comprehensive Hydraulic Assessment - June 2016

Introduction

Milestone report 5 discusses the design results from the detailed hydraulic model that is reported in earlier milestone reports. The report details the design events, various sensitive assessments, rating curve review and the waterway structures used in the detailed model. Design flood behaviour for the 11 selected Annual Exceedance Probability (AEP) events is defined using the 60 events described in Milestone report 4. Comments provided at the workshop have not been repeated here unless they are significant. The report also detailed the naming conventions used for all the runs that will help futures users.

Overall the IPE is satisfied with the quality of the work and most of our comments are focused on clarifying how the design work is presented.

Sensitivity assessment

The detailed model is for selected design events to investigate the sensitivity of the Brisbane river floodplain to:

- floodplain filling,
- Climate change, and
- Bed level changes.

The model is also used to assess how 5 historical events would occur under no dams conditions.

While sensitive assessments are very broad brush they demonstrate that parts of the floodplain are very sensitive changes. The climate change assessment assumed that changes in flood levels from climate change induced increases in flood producing rainfall could be assessed by assessing by testing of design events that contribute to key AEP change. A more robust approach would be to assess how design rainfall change AEP.

Specific comments

Some minor issues have been noted in the MR5 Draft Report. All of these are listed in the TWG Template below. Those that require some elaboration are discussed here.

Matters that have been noted for action in the BMT WBM Memorandum on Workshop 5 Summary of Outcomes/Actions are not repeated here.

Much of the following material is discussion that does not require action.

Section 5.3.2 *Climate Change* page 36 and **Table Addendum**

Table 4 *Climate Change Scenario CC1^; SLR +0.30m*
- The maximum change in level is at Gateway diminishing upstream as to be expected
- The very small change at Gateway for AEP 1 in 100000 is only 0.03m. Perhaps a typo of 0.30?

Table 5 *Climate Change Scenario CC2^; SLR +0.30m and +10% change in rainfall*
- The location of the maximum change in level moves downstream from Wivenhoe TW to Port Office as AEP becomes rarer
- The magnitude of the maximum change in level increases progressively as AEP becomes rarer to AEP 1 in 100 but reduces for AEP 1 in 10000 to about the same as for AEP 1 in 20
- However, the magnitude of the change in level at the Port Office increases progressively as AEP becomes rarer

Table 6 *Climate Change Scenario CC3^; SLR +0.80m*
The contents are identical with those of Table 4 Scenario CC1^ - requires correction.

Table 7 *Climate Change Scenario CC4^; SLR +0.80m and +20% change in rainfall*
- All the patterns of change in level are similar those detailed for CC2^ but the magnitudes are larger in each case.

Summary of three 'Climate Change' Scenarios - all water level changes are +ve

	Scenario CC1^ SLR +0.30m		
AEP	Location Maximum dh Change (m)	Magnitude of dh Change (m)	dh Change at Port Office (m)
1in5	Gateway	0.30	0.29
1in20	Gateway	0.30	0.25
1in100	Gateway	0.30	0.13
1in10K	Gateway	0.03	0.01
	Scenario CC2^ SLR +0.30m & +10% rain		
1in5	Wivenhoe TW	1.26	0.31
1in20	Wivenhoe TW	1.72	0.46
1in100	Bris R U/S Mt C W	2.87	1.26
1in10K	Port Office	1.74	1.74
	Scenario CC4^ SLR +0.80m & +20% rain		
1in5	Wivenhoe TW	2.46	0.82
1in20	Wivenhoe TW	3.32	1.05
1in100	Bris R U/S Mt C W	5.12	2.54
1in10K	Port Office	3.05	3.05

Section 5.3.3 *Bed Level Sensitivity* page 37 and **Table Addendum**

Table 8 *Scenario BL1^* bed level lowered to increase conveyance by 20%

The effects of bed level lowering increase in magnitude with increasing flood magnitude, as to be expected.

- Lowering of the bed reduces the water levels in all cases except for a small number of small positives for AEP 1 in 5 and AEP 1 in 20
- The changes all follow a 'reasonable' sequence except for Oxley Creek at Rocklea at AEP 1 in 100 when it is noticeably different at -0.05m from Tennyson at -0.46m. In the other AEP cases it is fairly close to the change at the Brisbane River at Tennyson.
- As the AEP becomes rarer, the maximum reduction in water level in the Brisbane River increases and its location moves downstream
- In the Bremer River the changes in water levels follow a consistent sequence, decreasing in magnitude with distance upstream.

Table 9 *Scenario BL2^* bed level raised to reduce conveyance by 20%
The effects of bed level raising increase the water levels in all cases except for one small negative of 0.01m at Gateway Bridge.

Summary of both Bed Level Sensitivity Scenarios - changes in water levels (m)

	BL1^ 20% increase in conveyance			BL2^ 20% reduction in conveyance			
AEP	Locn Max Change	Mag of Change	Change at Port Office	Locn Max Change	Mag of Change	Change at Port Office	Thalweg bed level change at Moggill
1in5	Moggill	-0.53	+0.02	Moggill	0.81	0.01	± 1.6
1in20	Moggill	-1.07	-0.16	Moggill	1.16	0.30	± 2.2
1in100	Tennyson	-1.26	-0.68	Jindalee	1.20	1.03	± 3.1
1in10K	Port Office	-1.79	-1.79	Port Office	1.73	1.73	±4.4

Section 6.10 *Centenary Bridge (Brisbane River)* page 53

Fourth dot point
'Centenary Bridge is a reasonable rating curve location for all flows, noting that there are uncertainties associated with hysteresis effects that increases with extreme events.'

This statement is difficult to justify in the light of the large uncertainties that apply for a wide range of flows. At 10,000 m^3/s the uncertainty in flow rate for a given level is in excess of 30% and at 20,000 m^3/s it is in excess of 35%. The corresponding uncertainty in level at a given flow rate is of order half these percentages.

Section 6.11 *City Gauge (Brisbane River)* Page 54

First paragraph

'There is significant differential between the Fast and Detailed Model results for extreme events at this location, with the Detailed model results considered to be more accurate due to the complex flow processes that occur at these levels.'

The separation between the DM and FM results is much greater here than elsewhere for extreme events. The DM 'loop' lies well above the FM curve for flows greater than about 20,000 m^3/s. More discussion than that given is necessary to elaborate on the complex flow processes and to justify the use of the DM rating curve.

Section 6.11 *City Gauge (Brisbane River)* Page 54

Second dot point
'City Gauge is a reasonable rating curve location for extreme flood flows, and can be used for rating flows for all floods , noting that below 12,000m^3/s there are significant uncertainties associated with hysteresis and tidal effects.'

This can be accepted only if a sufficient discussion has been provided in response to the comment above for the first paragraph of page 54.

Section 9 Conclusions Page 59

For completeness, the bullet points providing an outline of sensitivity conclusions should include reference to Climate Change sensitivities, and in particular those associated with Wivenhoe Dam interaction.

Detailed Model Results Plot Addendum

In the MR5 Draft Report, **Section 8.5** *1 in 2 AEP Event* page 57

The first paragraph includes the disclaimer
"it was agreed with the TWG and IPE that mapping for the 1 in 2 AEP should be confined to the tidal limits where there is greater confidence in the results. Use of the 1 in 2 AEP levels beyond the tidal limits is not recommended. "

- It would be consistent with this statement to delete those parts of the Plots of the AEP 1 in 2 profiles from the Figures in the Plot Addendum as recommended here and in the Template. In Plot 34 *1 in 2 AEP Mid Brisbane* and Plot 45 *All AEPs Mid Brisbane*, the AEP 1 in 2 profiles are meaningless between 0 -15000 m Chainage. It is recommended all AEP 1 in 2 profiles be deleted from both Plots 34 and 45 in this upstream reach.

- In Plot 46 *1 in 2 AEP Lockyer* and Plot 57 *All AEPs Lockyer*, the AEP 1 in 2 profiles are meaningless everywhere.

It is recommended all AEP 1 in 2 profiles be deleted from both Plots 46 and 57 from the full length of Lockyer.

Appendix A Detailed Model Results QC Checks

The quality control described in Appendix A is excellent and the outcomes are excellent. Two examples are given below.

Section A.4 *Mass Balance Checking* page A-3

60 runs are listed in Table A-3. The final cumulative mass error is less the 0.5% in all except a very few cases.

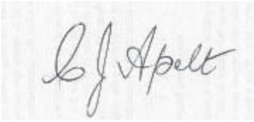
Section A.5 *Timestep Convergence* page A-5

The change in peak flood level due to halving the time step from 12 sec to 6 sec as shown in Fig A-2 is small; within ±0.03m in about 95% and within ±0.10m in more than 99.9% of cases.

Conclusions

The IPE endorses Milestone Report 5 dated 17 June 2016.

14 July 2016



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Appendix

Item No.	Page No.	Section	Para/Line/Dot Point/Table etc	Issue/Comments	Suggestion
1	iii	Executive Summary	Line 1	‘*target AEP peak flood levels’*	What is meant by ‘target’ here?
2	4	1.2.1	Second dot point, last line	‘*Calibration events No/With (CND and CWD)*”	‘Dams’ missing
3	7	1.2.2	Table 1	No-dams scenario	Add footnote about agreed change from ITO No-dams scenario
4	22	4.5	First paragraph		Include comment that change from ITO No-dams scenario agreed by TWG &IPE

5	53	6.10	Fourth dot point	*'Centenary Bridge is a reasonable rating curve location for all flows etc'*	This is hard to justify in light of the large uncertainties for a wide range of flows
6	54	6.11	First paragraph	*'Detailed model results considered to be more accurate due to the complex flow processes etc'*	The separation between the DM and FM results is much greater here than elsewhere. The DM 'loop' lies well above the FM curve for flows greater than about 20,000. More discussion than that given is necessary.
7	54	6.11	Second dot point	*'City Gauge is a reasonable rating curve location for extreme flood flows etc'*	This statement can be defended only if sufficient discussion has been provided in response to Item 6
8	56	8.1	Last line	Some text is missing from the sentence.	Complete the sentence
9	Plots 34 1in2 AEP and 45 All AEPs	D M Results Plot Addendum	Mid Brisbane	AEP 1in2 profile meaningless between 0 -15000 m Chainage	Delete AEP 1in2 profiles in this upstream reach from Plot 34 and Plot 45
10	Plots 46 1in2 AEP and 57 All AEPs	D M Results Plot Addendum	Lockyer	AEP 1in2 profile meaningless everywhere	Delete AEP 1in2 profiles from full length of Lockyer from Plot 46 and Plot 57
11		Table Addendum	Table 4 CC1^	Very small change at Gateway for AEP 1in100000 - only 0.03m	Check if this should be 0.30m
12		Table Addendum	Table 6 CC3^	Table 6 Scenario CC3^ contents are identical with those of Table 4 Scenario CC1^	Provide correct contents for Table 6

Response to changes to MR5 proposed by BMT WBM

The IPE are satisfied that BMT WBM have addressed all the IPE's comments. For item 6 it is worth noting that the primary purpose of the Fast Model was not to produce accurate absolute level estimates but to select events for input into the detailed model, as BMT WBM have stated. Further, it was always expected that the two models would diverge at extreme flows. While the IPE are satisfied with the proposed revisions we have the following suggestions for further fine tuning:

- IPE Item 6 Page 54, Section 6.11

The IPE are satisfied with the BMT WBM proposed additional commentary.
However, we suggest consideration be given to rearranging the following part of the extra text:
"The maximum difference, between the Fast Model and Detailed Model, is less than 10% of the depth for the 1 in 100,000 AEP at the Brisbane CBD (ie. 3.1m difference in a depth of 34m). For the 1 in 100 AEP event the difference at Brisbane CBD is negligible at 0.1% of the depth. "

to read:
"For the 1 in 100 AEP event the difference between the Fast Model and Detailed Model at Brisbane CBD is negligible at 0.1% of the depth. The maximum difference between the Fast Model and Detailed Model is less than 10% of the depth for the 1 in 100,000 AEP at the Brisbane CBD (ie. 3.1m difference in a depth of 34m)."

- IPE Item 7 Page 54, Section 6:11

The IPE are satisfied with the BMT WBM proposed additional commentary.

- IPE Item 5 (Section 6.10), and Items 6 and 7 (Section 6.11)

The comments in these Items all relate to Sections on rating curves.
It would be helpful if a comment was added, somewhere, that for extreme events where the results from the Detailed Model and those from the Fast Model differ the results from the Detailed Model are to be used.
Perhaps this could be added in Section 6.1.2 *Stage Discharge Data from Hydraulic Models*

- the differences between the Fast and Detailed Models will have no impacts on the study outcomes and that the final results from the Detailed Model are acceptable for the purpose of the flood study. The IPE endorse this specifically.

Conclusions

The IPE endorses proposed changes to Milestone Report 5, Detailed Model Results.

19 September 2016

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