Regional Floodplain Database:

Hydrologic and Hydraulic Modelling - Bribie Island (BRI)

Moreton Bay Regional Council
Emergency Management EMQ Queensland
Australian Government
Attorney-General's Department
Emergency Management Australia
Queensland Government

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Bribie Island (BRI)

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Contents

Appendices

Index of Figures

Index of Tables

1 Introduction

Moreton Bay Regional Council (MBRC) is delivering a Regional Floodplain Database (RFD) in support of their flood risk management, considering emergency response, development control, strategic landuse and infrastructure planning. The MBRC was recently formed under local government amalgamations and is responsible for Caboolture, Pine Rivers, Redcliffe and Bribie Island. The RFD project focuses on the northern sector as a key growth area for South-East Queensland.

The project is being funded by MBRC, Emergency Management Queensland (EMQ) and Emergency Management Australia (EMA) as part of the Disaster Resilience Program and will provide:

- A comprehensive and consistent description of flood behaviour across the region
- Strategies for management of any flooding problems identified
- A system/process to store and manage this information and keep it up-to-date

Stage 1 of the project was completed in July 2010 and involved a number of sub-projects. These projects delivered consistent processes and protocols for the detailed hydrologic and hydraulic model development. A key sub-project involved the development of broadscale hydrodynamic models for each minor basin to provide general understanding of flooding mechanisms and allow prioritisation of data capture.

Stage 2 (current stage) of the project involves the development of detailed hydrologic and hydraulic models for each minor basin.

Stage 3 will build on the detailed models and “add value” through assessment of flood damages and community resilience measures.

This report discusses the study data, methodology and results for the Stage 2 detailed modelling of the Bribie Island (BRI) minor basin for the RFD.

This basin covers an area approximately 46 km^2 and incorporates Bribie Gardens and Pacific Harbour estates, as well as Dux Creek, Wrights Creek and Freshwater Creek. There are residential developments on both the eastern and western beachfronts of Bribie Island, including White Patch, Banksia Beach, Bellara, Bongaree and Woorim. The remainder of the basin is largely undeveloped.

1.1 Scope

The detailed modelling of the Bribie Island minor basin will provide Council with an understanding of flood behaviour for the range of flood events between the 1 year Average Recurrence Interval (ARI) and the Probable Maximum Flood (PMF) event.

The detailed modelling converts broadscale hydrologic and hydraulic models developed as part of Stage 1 into detailed models. This conversion is done using the approaches and methodologies developed during Stage 1 and through inclusion of the latest topographic/bathymetric data and key hydraulic features, such as culverts, bridges and footbridges.

The detailed models are then used to undertake detailed catchment analysis, calibration (where possible) and flood scenario modelling. The scenario modelling includes sensitivity analysis to a range of catchment changes. The results provide detailed flood information such as levels, depths, velocities, hazard, flood extents and flood timing.

1.2 Objectives

Key objectives of this study are as follows:

- Convert the broadscale hydrologic and hydraulic models into detailed models
- Undertake detailed catchment analysis for the 1 year ARI to PMF events for current catchment conditions
- Assess a range of scenarios including climate change, land use change, vegetation change, culvert blockage and storm tide events
- Provide Council with flood mapping to be incorporated into their GIS system

1.3 General approach

The general approach for this study is summarised as follows:

- Familiarisation with background materials and models
- Review of floodplain infrastructure and bathymetric data and identification of additional data required
- Review of broadscale catchment and stream definition (hydrography) and recommendation of changes
- Review of historic flood studies, rainfall, stream gauge, flood mark and catchment data; assessment of calibration and validation feasibility; and recommendation of suitable calibration/validation events
- Review of broadscale land use and topographic data and recommendation of modifications
- Review and update of the WBNM hydrologic models for existing, historic and future scenarios
- Updating broadscale TUFLOW hydraulic models to include:
  - Boundary conditions reflective of changes in hydrography and/or downstream boundary
  - Smaller grid resolution and review of active model area
  - Existing, historic and future hydraulic landuse scenarios
  - Floodplain infrastructure and bathymetry
  - Topographic modifiers for stability and key floodplain features
- Calibration and validation of the models to a single calibration and a single validation event (if possible)
- Modelling of the 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000 and PMF design events for the existing catchment
- Assessment of the MBRC Design Storm (a 100 yr ARI 15 min in 270 min ‘Embedded Design Storm’)
- Undertaking sensitivity testing for:
  - Varied discharges, manning’s n, tailwater and culvert blockages
  - Climate change scenarios for rainfall intensity and sea level rise
  - Storm tide without any riverine flooding
  - Future landuse
- Checking of model quality for all model runs

- Preparation of a report to describe the model establishment, methodology, limitations and input data including mapping
- Collation of GIS data and model outputs for handover to Council

1.4 Related sub-projects (RFD Stage 1 and Stage 2 Pilot)

The following RFD sub-projects provide input data and/or methodologies for the Bribie Island Stage 2 models:

- 1D – Hydrologic and Hydraulic Modelling (Broadscale), sub-project 1D developed the broadscale TUFLOW models used as the basis for the detailed modelling (BMT WBM, 2010)
- 1E – Floodplain Topography (2009 LiDAR) including 1F, 2E, 2I, sub-project 1E provided the topographic information, such as model z-pts layer and digital elevation models (DEM) utilising a DEM tool developed specifically for the RFD (WorleyParsons, 2010)
- 1G – Hydrography (MBRC), sub-project 1G supplied the subcatchment delineation including streamlines and junctions (used in the WBNM model)
- 1H – Floodplain Landuse, sub-project 1H delivered the percentage impervious raster (utilised in the hydrologic model) and the roughness Manning's 'n' values and spatial definitions (utilised in the hydraulic model) (SKM, 2010)
- 1I – Rainfall and Stream Gauges Information Summary (MBRC), sub-project 1I summarised available rainfall and stream gauge information for the study area. Based on the assessment undertaken in this sub-project, the historical flood events (May 2009 and February 1999) were selected for model calibration and/or verification
- 2B – Hydrologic and Hydraulic Modelling (Detail), sub-project 2B defined model naming conventions and model protocols to be used in the detailed modelling (BMT WBM, 2010)
- 2C – Floodplain Structures (Culverts), sub-project 2C defined the process to be used for modelling of culverts on the floodplain (Aurecon, 2010)
- 2D – Floodplain Structures (Bridges), sub-project 2D defined the process to be used for modelling of bridges on the floodplain (Aurecon, 2010)
- 2F – Floodplain Structures (Trunk Underground Drainage), sub-project 2F defined the process to be used for modelling of trunk underground drainage on the floodplain (Aurecon, 2010)
- 2G - Floodplain Structures (Basins), sub-project 2G consolidated defined the process to be used for modelling of detention basins on the floodplain (Aurecon, 2010)
- 2J – Floodplain Landuse (Historic and Future), sub-project 2J defined the historic and future percentage impervious cover (utilised in the hydrologic model) and the roughness (Manning's 'n') values representing landuse for the February 1999 event (utilised in the hydraulic model) (SKM, 2010)
- 2K – Flood Information Historic Flooding, sub-project 2K collected flood levels for the historic May 2009 and February 1999 flood events (GHD, 2010)
- 2L – Design Rainfall and Infiltration Loss, sub-project 2L defined the rainfall parameters to be adopted in the WBNM modelling (WorleyParsons, 2010)
- 2M – Boundary Conditions, Joint Probability and Climate Risk Scenarios, sub-project 2M defined the boundary conditions and provided recommendations in regards to joint probability (ie occurrence of storm surge in combination with river flooding events, or river flooding in combination with local tributary flooding). This project also recommended certain sea level rise and rainfall intensity values to assess Climate Risk Scenarios (SKM, 2012)
- 2N – Floodplain Parameterisation, sub-project 2N provided recommendations for the floodplain parameters to adopt, such as a range of values for various impervious percentages for various landuse types (ie residential or rural landuse, dense vegetation), a range of values for various roughness types (ie long grass, dense vegetation) and structure losses (SKM, 2012)

2 Available data

The following list summarises the data available for the study:

- **Aerial imagery** – imagery across the entire catchment was supplied by MBRC
- **Hydrography** – delineation of major basins, minor basins, major catchments, minor sub-catchments, reaches and junctions were provided by MBRC
- **Floodplain Landuse** – polygons for buildings, footpaths, roads, urban blocks, vegetation and waterbodies were provided by MBRC. These were developed by SKM as part of RFD Stage 1
- **Floodplain Topography** – A 2.5 m DEM and model z-points (on a 5 m grid) were provided by Worley Parsons. The DEM Tool developed during Stage 1 was used to prepare these datasets based on LiDAR data collected in 2009, bathymetric data for the canal areas and modifiers (breaklines) developed by Aurecon. A copy of the thinned LiDAR data was also provided
- **Solander Drain Topography** – survey data of Solander Drain and the downstream end of Wrights Creek was provided by MBRC
- **Broadscale TUFLOW Model** – the broadscale BRI model was provided by MBRC. This model was developed by BMT WBM as part of RFD Stage 1
- **Detailed BUR Model** – the detailed model of the Burpengary (BUR) minor basin was provided by MBRC. This model was developed by BMT WBM as part of RFD Stage 1
- **WBNM Model** – the WBNM model of the minor basin was provided by MBRC
- **Materials values** – materials values for the Stage 2 models were provided by MBRC
- **Rainfall, Stream Gauge and Historic Flood Information** – rainfall and stream gauge data was provided by MBRC. Historical flood information was also provided by MBRC
- **Floodplain Structures** – floodplain structure information was provided from a range of sources including:
  - Details (plans) of a number of Council owned bridges from MBRC
  - Existing GIS database information for some existing culverts from MBRC
  - Detailed survey undertaken by MBRC surveyors as part of this study
  - Photos of various structures captured during site visits

- **Storm Tide Tool** – the storm tide hydrograph generator developed by Cardno Lawson Treloar as part of Council's storm tide study was provided by MBRC
- **Stage 1 Reports** – reports from the various consultants involved in Stage 1 of the RFD project were provided by MBRC
- **Example folder structure and run files** – these were provided by MBRC based on the outputs developed by BMT WBM for the RFD Stage 1
- **Mapping colour profiles** – these were developed by BMT WBM in Stage 1 of the RFD and provided by MBRC
- **Future landuse scenario** – hydrography (sub-catchments) files for the future landuse scenario were provided by MBRC
- **Impervious area raster files** – these were provided by MBRC and were developed by SKM during RFD Stage 1

3 Methodology

3.1 Data review

3.1.1 Infrastructure data assessment

At the outset of the project, the infrastructure and bathymetric data requirements for modelling of the Bribie Island minor basin were assessed. This included a data gap analysis for bridges, culverts, detention basins and trunk drainage infrastructure and also for below-water bathymetric details. Infrastructure and bathymetric details were then assigned a priority (A or B) based upon their likelihood of impacting upon the model predictions.

The infrastructure was prioritised according to the significance of location and potential impacts on the hydraulic model results. Key factors which were taken into account were proximity to broadscale flood extents, surrounding land use and whether the structure was beneath a major road or a railway. The creek bathymetry was prioritised according to the size (width) of the reach, the size of the contributing catchment and proximity to urban areas.

Table 1 presents a summary of the structures and bathymetric reaches which were identified and prioritised.

Table 1 | Infrastructure and bathymetric data

Data Item	Priority A	Priority B
Structures (culverts, bridges and trunk drains)	34	3
Bathymetric reaches	15.4m	1.0km

Following the gap analysis and the data prioritisation, a composite assessment of survey requirements was undertaken and provided to Council. A copy of the Data Infrastructure Assessment Report is included in Appendix A.

3.1.2 Calibration and validation

The feasibility of carrying out calibration and validation for the Bribie Island models was assessed. This was based on the availability of stream gauge, daily rainfall, pluviograph rainfall and historic flood mark data.

Stream gauge data (recorded water level with respect to time) is essential to calibrating a hydrologic model. Recorded water levels are converted to discharges and compared with hydrologic model predictions. Stream gauge data is also useful in calibrating a hydraulic model through comparisons of recorded and predicted water levels with time at the gauge location. No stream gauges exist in the Bribie Island minor basin.

When no stream gauge data is available and historic flood mark data available, it is possible to undertake a joint calibration process in which both hydrologic and hydraulic parameters are modified until calibration of the hydraulic model is achieved. Unfortunately, no historic flood mark data was available in the BRI minor basin.

Given that no stream gauge data and no historic flood mark data was available in the BRI minor basin it was recommended that calibration and validation of the models was not feasible. A copy of the Calibration and Validation Feasibility Report is included in Appendix C.

3.1.3 Hydrography

The hydrography provided by MBRC was reviewed to ensure the following two key objectives were supported:

- Catchments were sufficiently defined to ensure accurate representation of contributing areas at key points of interest (urbanised areas, drainage control points, areas marked for future development)
- Hydraulic model objectives were supported through appropriate flow reporting locations, noting the following:
  - The hydraulic model applies inflow distributed across the sub-catchment, effectively “filling” the sub-catchment from the lowest point
  - The hydraulic model will advise on flood immunity of major roads accessing key urban areas

A number of recommendations were made, including:

- Junctions be included at structures where no junction had previously been defined
- Sub-catchments which cover only a section of road should be modified so the inflow is not applied to the road surface in the hydraulic model, which would in turn show the road to be inundated

A copy of the Hydrography Review Report for Package 3: Pumicestone Passage and Bribie Island is included in Appendix B.

Upon receipt of the final updated hydrography from MBRC, the sub-catchment fraction impervious values were updated using the process defined by SKM (2010) in their *Existing, Historic and Future Floodplain Land Use* report. This final hydrographic dataset was used to develop the WBNM model.

3.2 Hydrologic model

The WBNM model supplied by MBRC was adopted for use in the hydrologic modelling. The hydrologic model setup process is described in Appendix G.

Hydrologic modelling was undertaken for the following events:

- **Design events**: 1, 2, 5, 10, 20, 50 and 100 year ARI
  The 0010, 0015, 0030, 0045, 0060, 0090, 0120, 0180, 0270, 0360, 0540, 0720, 1080, 1440, 1800, 2160, 2880, 4320 minute durations were run for each event
- **Embedded design storm (EDS)**: the 0015 minute burst in a 0270 minute duration event was run for the 1, 2, 5, 10, 20, 50 and 100 year ARI events
- **Extreme events**: 200, 500, 1000 and 2000 year ARI
  The 0015, 0030, 0045, 0060, 0090, 0120, 0180, 0360 0720, 1440, 2160, 2880 and 4320 minute durations were run for each event

- **PMP event**: The 0015, 0030, 0045, 0060, 0090, 0120, 0150, 0180, 0240, 0300, 0360, 0720, 1440, 2160, 2880 and 4320 minute durations were analysed
- **Climate change event** (S4): The EDS was run with IFD rainfall intensities increased by 12%
- **Future landuse scenario** (S11): The EDS was run with percentage impervious changed to represent the future landuse scenario

The local catchment flows derived from the hydrologic model were used as inputs to the hydraulic model. No total catchment flows were used as input to the hydraulic model.

3.3 Hydraulic model

3.3.1 Model software

The following text describes the TUFLOW modelling package. This text has been copied from Section 3.2.1 of the *Hydraulic Modelling (Detail) Regional Floodplain Database Sub-Project 2B Report* (BMT WBM, 2010).

"Because of the complex nature of floodplain flow patterns in urban and rural catchments, MBRC has adopted TUFLOW, a dynamically-linked 2D/1D hydrodynamic numerical model, to predict the flood behaviour of a catchment. TUFLOW has the ability to:

- *Accurately represent overland flow paths, including flow diversion and breakouts (2D modelling);*
- *Model the waterway structures of the entire catchment with a relatively high level of accuracy (1D or 2D modelling);*
- *Dynamically link components of the 1D models (i.e. culverts) to any point in the 2D model area; and*
- *Produce high quality flood map output (i.e. flood extent, flood levels, depths, velocities, hazard and stream power), which are fully compatible with Geographic Information Systems (GIS)."*

3.3.2 Model geometry

A 5 m grid TUFLOW model was prepared in accordance with the requirements of MBRC. The model topography was developed by Worley Parsons using the DEM tool (Worley Parsons, 2010) and provided for use in this study, in both DEM and z-point format. The following information was included in the DEM tool:

- 2009 ALS data used as the base information across the entire MBRC area
- Bathymetric data for Bribie Gardens and Pacific Harbour estates
- Stream breakline modifiers, as developed by Aurecon, were used to create continuous stream paths for the following stream lengths:
  - 2.1 km of Freshwater Creek through Woorim
  - 0.5 km of lagoon to the north of First Avenue at Woorim

In addition to the z-points provided by the DEM tool, a number of modifiers were incorporated directly into the model, including:

- Z-shapes for the road and rail embankments in a number of locations where these were not included in the 2009 ALS data
- Stability modifiers, primarily at culvert inlet and outlets

Figure 3-1 illustrates the Bribie Island model layout. Additional details on the model setup are provided in Appendix D.

3.3.3 Model structures

Structures were represented using three different approaches, as recommended in the Floodplain Structures report (Aurecon, 2010):

- Culverts were modelled as 1D structures using the 1d_nwk approach
- Trunk drains were modelled as 1D elements using the 1d_nwk approach
- Bridges were modelled as 2D structures using the 2d_flcsh approach

To solve stability issues, two culvert structures on the outlet channel to the Bellara detention basin and one culvert structure on South Esplanade (branch BON_21) were modelled using the 2D approach.

Table 2 | Number of modelled structures

Structure Type	Number of Modelled Structures
2D bridges	10
1D culverts	19
2D culverts	3
Trunk drains	1 system located at the outlet of the Bellara detention basin, consists of 2 sets of 2 pipes

Culvert exit and entry loss coefficients were applied as per the recommendations of the SKM Floodplain Parameterisation report (2012).

3.3.4 Landuse mapping

Landuse polygons were used to define the spatially varying hydraulic roughness within the hydraulic model. In total, eleven different types of landuse were mapped and provided by SKM as part of the Floodplain Parameterisation project (2012). These polygons were reviewed and modified in a number of locations (see Appendix H for more information). The final adopted landuse map is presented in Figure 3-2.

Manning's n roughness parameters were determined during the calibration and verification process. The adopted values are presented in Table 3.

Table 3 | Hydraulic model landuse categorisation

Landuse Type	Manning's n Roughness Coefficient
Dense vegetation	Depth varying: 0.090 – 0.180
Medium dense vegetation	Depth varying: 0.075 – 0.150
Low grass/grazing	Depth varying: 0.025 – 0.250
Reeds/swamp	0.080
Crops	0.040
Urban Blocks (> 2000 m^2)	0.300
Buildings	1.000
Roads	0.015
Footpaths	0.015
Waterbodies – Creeks	0.030
Waterbodies – Rivers	0.030

3.3.5 Model boundaries

The WBNM hydrologic model results were used to provide inflows to the hydraulic model for all design, extreme, PMF and sensitivity events, as discussed in Section 3.2. The inflows were applied to the 2D domain using a flow-time source boundary for each subcatchment. This technique applies the inflow at the lowest grid cell in a subcatchment initially and then subsequently to all wet cells in that subcatchment.

A static Mean High Water Springs (MHWS) oceanic condition was applied as the downstream boundary condition, based on recommendations from SKM's Boundary Conditions, Joint Probability & Climate Change Report (2012). MHWS values were sourced from the Maritime Safety Queensland (MSQ) semi-diurnal tidal planes (2010). Different values were applied for Bongaree and Woorim as shown in Table 4.

Table 4 | Downstream boundary water levels

Location	Mean High Water Springs Level (m AHD)
Bongaree	0.77
Woorim	0.78

3.4 Model calibration and verification

Calibration and verification of the BRI models was not undertaken due to the lack of available data. The calibration and verification process which was undertaken for other minor basins provided model parameters for adoption in the BRI model, including:

- WBNM C value = 1.6
- Manning's n values as described in Table 3

3.5 Design flood events

This section describes the design event conditions (including design, extreme and PMF events as identified in Section 3.2) which were analysed using the hydraulic models. Design storm events are hypothetical events that are used to estimate design flood conditions. They are based on a probability of occurrence, usually specified as an Average Recurrence Interval (ARI).

3.5.1 Critical storm duration assessment

A detailed assessment of the hydraulic model critical storm durations for the 10 year ARI, 100 year ARI and PMF events was undertaken using the following process:

- Hydrologic modelling of the 0010, 0015, 0030, 0045, 0060, 0090, 0120, 0180, 0270, 0360, 0540, 0720, 1080, 1440, 1800, 2160, 2880 and 4320 minute durations for the 10 and 100 year ARI events and the 0015, 0030, 0045, 0060, 0090, 0120, 0150, 0180, 0240, 0300, 0360, 0720, 1440, 2160, 2880 and 4320 minute durations for the PMP event
- Hydraulic modelling of the above events using the 5 m model for the 10 year ARI and the 10 m model for the 100 year ARI and PMF events
- Processing of the model results to create an overall peak water level envelope from all durations and a map showing the spatial extents of the critical durations
- Selection of durations (two or three) which cover the most widespread and developed areas
- Calculation of the peak water level from the selected durations
- Comparison and mapping of peak water level differences between the overall peak and the peak from the selected durations

- An iterative process covering the above three steps was undertaken to select the critical durations producing the least differences over the largest area
- The remainder of the events (ARIs) were then modelled for the selected critical durations

Table 5 presents the selected critical durations and the events to which they were applied. Figure 3-3, Figure 3-4 and Figure 3-5 show the comparisons between the overall peak water levels and the selected duration peak water levels for the 10 year ARI, 100 year ARI and PMF events respectively.

Table 5 | Critical duration selection

Assessment Event	Selected Critical Durations	Adopted Events
10 year ARI	0180, 1440	1, 2, 5, 10 and 20 year ARI
100 year ARI	0180, 1440	50 and 100 year ARI
Probable Maximum Flood	0120, 0180, 0300	200, 500, 1000, 2000 year ARI and PMF

3.5.2 Design event simulations

The Bribie Island model was simulated for the return periods, grid sizes and storm durations shown in Table 6.

Table 6 | Simulated design events

Return Period (years)	Model Grid Size (m)	Modelled Durations (mins)
1, 2, 5	5	0180, 1440
10	5	0010, 0015, 0030, 0045, 0060, 0090, 0120, 0180, 0270, 0360, 0540, 0720, 1080, 1440, 1800, 2160, 2880, 4320
20, 50	5	0180, 1440
100	5	0010, 0015, 0030, 0045, 0060, 0090, 0120, 0180, 0270, 0360, 0540, 0720, 1080, 1440, 1800, 2160, 2880, 4320
200, 500, 1000, 2000	5	0120, 0180, 0300
PMF	5	0015, 0030, 0045, 0060, 0120, 0150, 0180, 0240, 0300, 0360, 0720, 1440, 2160, 2880, 4320

3.6 Sensitivity analysis

Table 7 below provides a summary of the sensitivity runs which were undertaken based on specifications by MBRC. The methodology for each of these is described further in Sections 3.6.1 to 3.6.4.

Table 7 Sensitivity runs

ID	Title	Description	Methodology Section
S1	EDS	MBRC EDS	
S2	Increase n	Increase manning's n values by 20%	0
S3	Blockage	Model blockage of culverts	0
S4	Climate Change 1	Model impact of increased rainfall	3.6.4
S5	Climate Change 2	Model impact of increased downstream boundary	3.6.4
S6	Climate Change 3	Model impact of increased rainfall (S4) and sea level (S5)	3.6.4
S7	Storm Tide 1	Model dynamic storm tide boundary – 100 year ARI storm tide event, no rainfall	3.6.4
S8	Storm Tide 2	Model rainfall with static storm tide boundary – 100 year ARI	3.6.4
S9	Storm Tide 3	Increased Rainfall (S4) + Increase in Sea level (S5) + Static ST level (100yr GHG)	3.6.4
S10	Future Landuse 1	Model impact of increased vegetation in floodplains	3.6.1
S11	Future Landuse 2	Model impact of increased residential development – hydrology changes only	3.6.1
S12	Future Landuse 3	Model impact of increased residential development (S11) and increased vegetation in floodplains (S12)	3.6.1

The EDS was simulated for the BRI model. The EDS is a single storm event which approximates the flood levels and behaviour of the critical duration design events. The EDS is useful for initial investigations into changes in model parameters and catchment characteristics, as it reduces the number of model runs required. The adopted EDS event was utilised as a base case for the comparison to future landuse, sensitivity and climate change scenarios.

3.6.1 Future landuse analysis

Three future landuse scenarios were assessed:

- Increased vegetation (S10)
- Increased residential development (S11)
- A combination of the above two (S12)

For the increased vegetation case (S10), two modifications were made to the Manning's n values applied to the model. For the landuse types defined in Figure 3-2 and Table 3 the following changes were made:

- Medium Dense Vegetation was changed to Dense Vegetation
- Low Grass/Grazing was changed to Medium Dense Vegetation

For the increased residential development case (S11), the fraction impervious values in the WBNM model were increased. The sub-catchments in which development may occur were identified by MBRC and increased fraction impervious values were provided for these sub-catchments. The WBNM model was then run with these increased values for the EDS event and the resulting inflows were applied to the TUFLOW model.

3.6.2 Hydraulic roughness analysis

To test the sensitivity of the model to selection of landuse roughness values (S2), a scenario was run whereby Manning's n values were uniformly increased by 20%.

3.6.3 Structure blockage analysis

A blockage scenario (S3) was run to assess the effects of waterway crossings (culverts) becoming blocked during a flood event. The SKM Floodplain Parameterisation report (2012) provided recommendations for a moderate blockage scenario. The adopted blockage parameters were:

- Full blockage for culverts/pipes with width ≤ 2.4 m
- Partial (15%) blockage for culverts/pipes with width > 2.4 m

3.6.4 Climate change and downstream boundary condition analysis

Six scenarios were simulated to assess the potential impacts of climate change and storm tide in accordance with the SKM Boundary Conditions, Joint Probability & Climate Change (2012) recommendations. The horizon for climate change events was selected as 2050. Details of the changes made in each of these simulations are provided below.

- Increased rainfall (S4) – the IFD parameters for the WBNM model were increased by 12%, then the increased inflows were applied to the TUFLOW model
- Increased downstream boundary (S5) – the downstream boundary was increased to represent a sea level rise of 0.8 m to 2050. Base Case rainfall was applied
- Increased rainfall and downstream boundary (S6) – S4 and S5 were combined
- Dynamic storm tide (S7) – the Storm Tide Hydrograph Calculator (Cardno Lawson Treloar, 2010) was used to determine the dynamic storm tide conditions (no rainfall), for the 100 year ARI event with wave setup included. Two locations were adopted for application to the model boundary locations:
  - MBC-042 was applied to the Woorim boundaries
  - MBC-058 was applied to the Bongaree boundaries
- Static storm tide (S8) – the downstream boundaries were increased to 2.1 m AHD at the Woorim boundary location and 2.1 m AHD at the Bongaree boundary location as per information supplied by MBRC. The data used for the Woorim boundary was from a non-cyclonic storm tide condition, as there is no cyclonic storm tide data available for this location. Base Case rainfall was also applied
- Increased rainfall, sea level rise and static storm tide (S9) – Inflows from S4 were applied. Downstream boundary conditions were raised to 3.1 m AHD (2.3 + 0.8) at the Bongaree boundary and 2.8 m AHD (2.0 + 0.8) at the Woorim boundary in accordance with information supplied by MBRC

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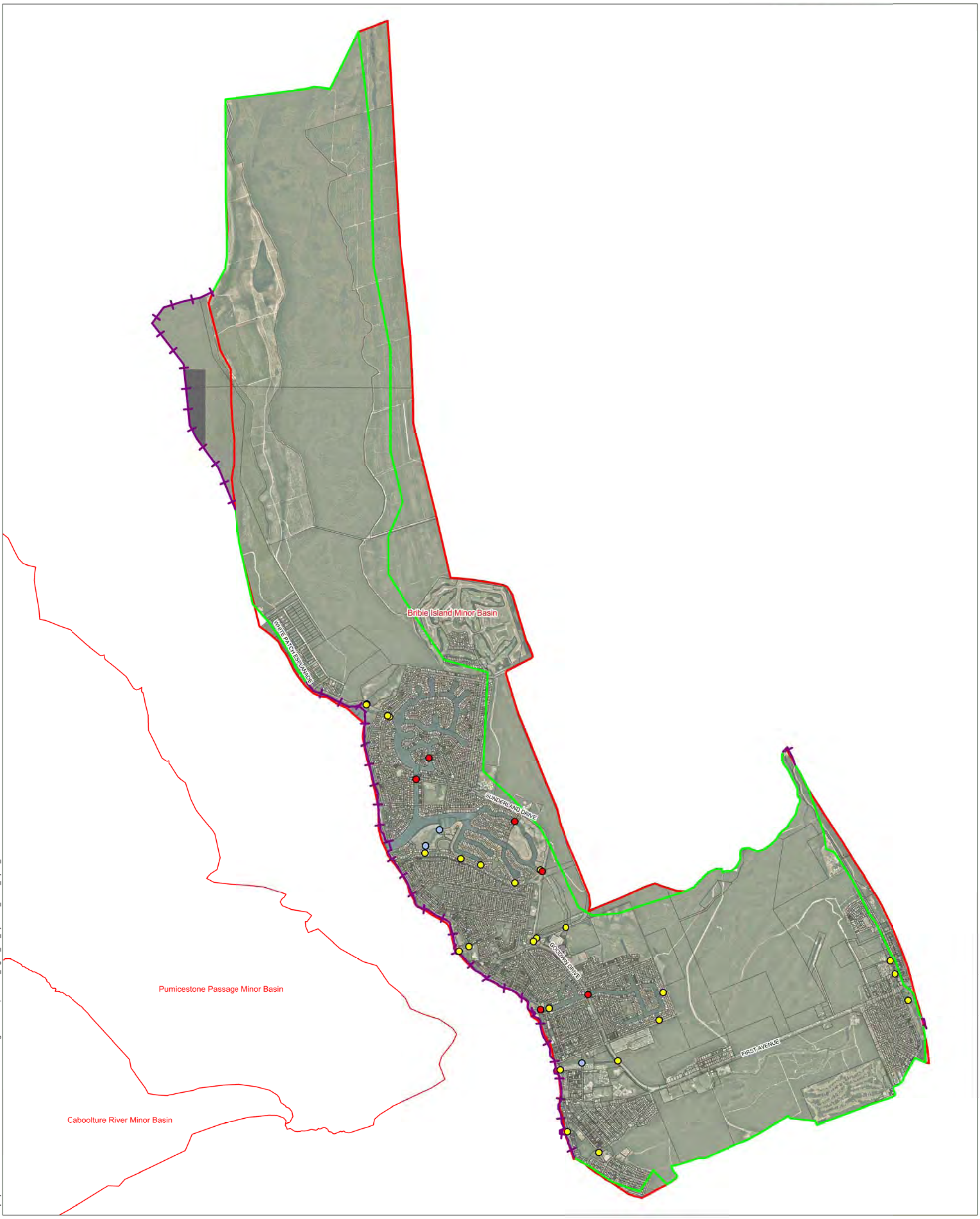

Notes:

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A3 scale 1:50,000

0 1,250 m 2,500 m

Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure 3-1:Hydraulic Model Layout

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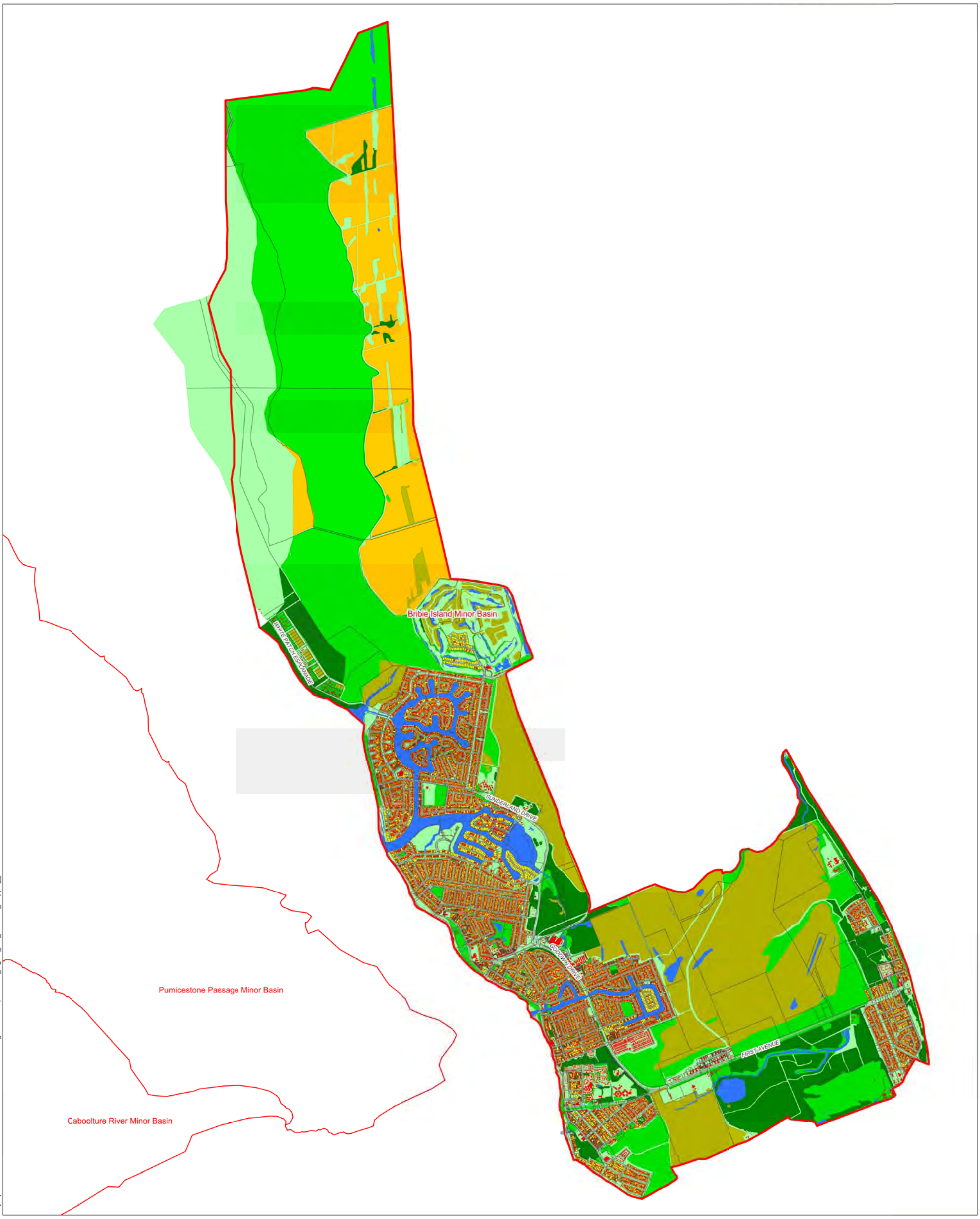

Map by: DJF P:\SWMP\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_3-2_Landuse_mapping_rev0.wor

Legend

Cadastre
Minor Basin Boundaries
Dense Vegetation
Low Grass/Grazing
Medium Vegetation
Crops
Buildings
Roads/Footpaths
Urban Blocks
Waterbodies

Notes:
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A3 scale 1:50,000
0 1,250 m 2,500 m

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Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure 3-2: Landuse Mapping - Existing Conditions

aurecon

Map by: DJF P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_3-3_CD_Assess_0010Y_WSL_Difference_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- -0.10 to -0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

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A3 scale 1:50,000

0 1,250 m 2,500 m

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RFD Detailed Modelling (BRI)

Figure 3-3: Critical Duration Assessment Peak Flood Difference 10 Year ARI

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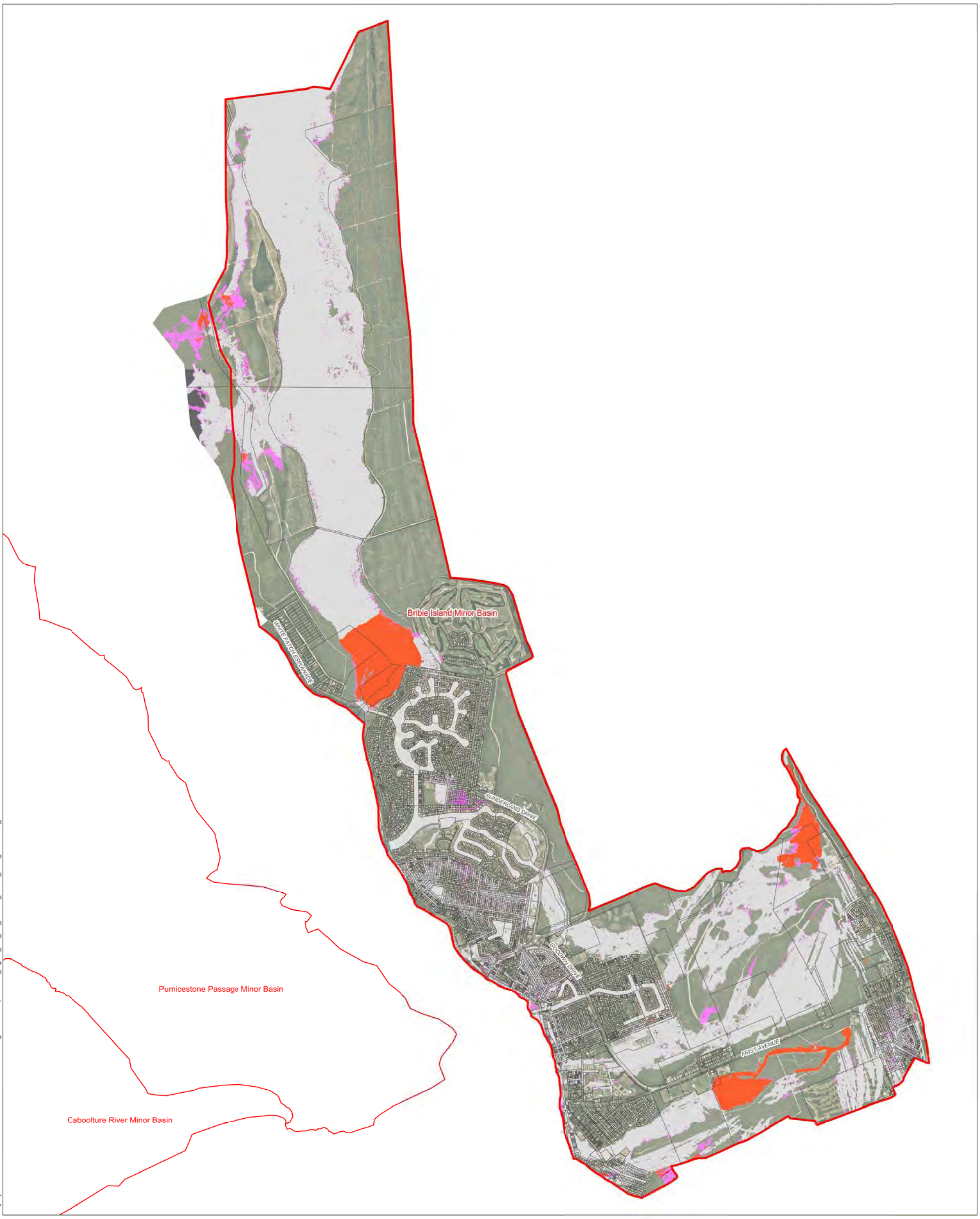

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Legend

Cadastre

Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- -0.10 to -0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

A3 scale 1:50,000

0 1,250 m 2,500 m

Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure 3-4: Critical Duration Assessment Peak Flood Difference 100 Year ARI

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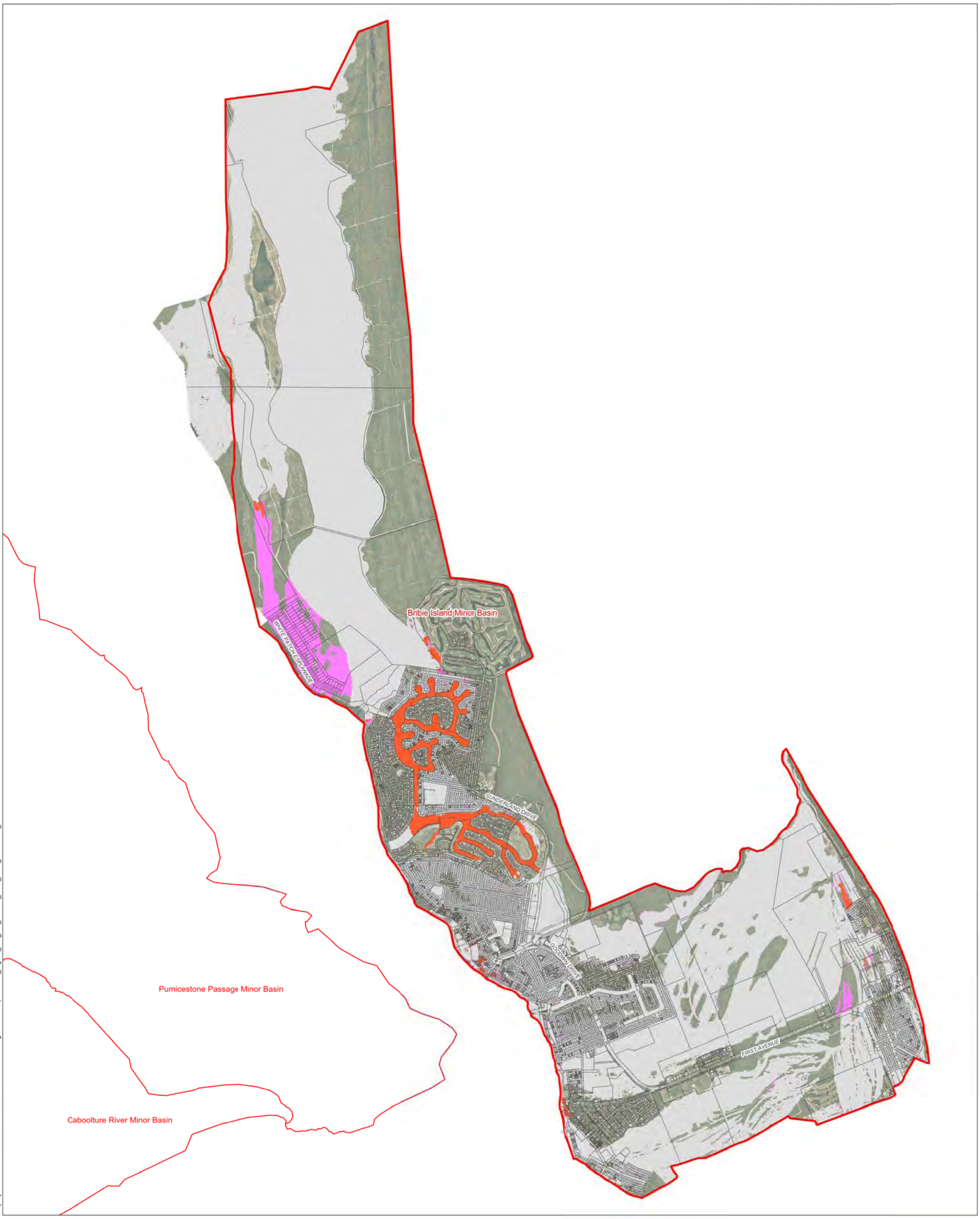

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Legend

Cadastre

Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- -0.10 to -0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

A3 scale 1:50,000

0 1,250 m 2,500 m

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Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure 3-5: Critical Duration Assessment Peak Flood Difference PMF

4 Results and outcomes

4.1 Calibration and verification

Calibration and verification of the BRI models was not undertaken due to the lack of available data. The calibration and verification process which was undertaken for other minor basins provided model parameters for adoption in the BRI model (refer to SKM's Floodplain Parameterisation report, 2012).

4.2 Design flood behaviour

The discussion in this section is copied from Sections 4.3.3 and 4.3.4 of BMT WBM's Hydraulic Modelling (Detail) Sub-Project 2B Report (2010). Very few changes have been made to the text from BMT WBM's report.

4.2.1 Model results

The model results were used to prepare a set of design flood maps, including inundation maps, peak flow velocity maps, hazard maps and stream power maps. The flood conditions presented in these maps were derived using the envelope (maximum) of all modelled storm durations. Flood maps are only provided for the 100 year ARI design event as the focus of this project is on digital data, rather than provision of flood maps. A description of the digital data provided to Council for incorporation into their RFD is summarised in Section 4.2.2. The flood maps for the 100 year ARI design storm event are presented in Appendix E.

4.2.2 Digital data provision

The Regional Floodplain Database is focused on structuring model input and output data in a *GIS database* held by MBRC. Therefore, all model input and output data is being provided upon completion of the study. The data includes all model files for the design events (for each duration), future scenarios, sensitivity analysis and climate change assessment.

In addition, post processing batch files have been provided. The batch files were used to:

- Derive the maximum envelope of the critical duration runs and combine these into one file; and
- Convert the envelope file into ESRI readable ascii grids (*.asc)

4.3 Sensitivity analysis

The 100 Year EDS (with a 15 minute burst in a 270 minute storm duration) was simulated. The results were compared to the 100 year ARI results and are provided in Figure F1 of Appendix F. This figure shows that, within the residential areas, the EDS model predictions are generally within ±0.1 m of the 100 year ARI results.

The 100 Year EDS was utilised for sensitivity, future landuse conditions and climate change scenarios and is therefore the Base Case for these sensitivity runs.

The use of SA boundaries for the application of rainfall to the model has impacted upon the location in which inflows are applied in some of the sensitivity runs. For this reason some of the runs show a reduction in flood levels and inundation extents in areas where this would not be expected to occur. Results in these areas should be treated with caution.

4.3.1 Future landuse analysis

For each of the future landuse cases, the peak flood levels were compared to those of the Base Case EDS. The results are presented in Figure F10, Figure F11 and Figure F12 in Appendix F. A summary of the model results are presented below.

- Increased vegetation (S10, Figure F10)
  - Increased vegetation density has very little impact upon the peak water levels (±0.1m) and minor changes in inundation extents occur across the basin
- Increased residential development (S11, Figure F11)
  - The impacts of increased residential development are minor as this only occurs in areas which are already developed; therefore the ultimate percentage impervious values are only slightly higher than the existing values. The most noticeable impact occurs in Marlin Court where water levels are increased by up to +0.25m and inundation extents are increased
- A combination of the above two (S12, Figure F12)
  - Impacts across the basin are minor
  - A localised increase in inundation extents occurs along the roadways of Endeavour Drive, Bowsprit Court and Marlin Court near Pacific Harbour Gold Club and peak water levels in Marlin Court increase by up to +0.37 m

4.3.2 Hydraulic roughness analysis

The increased roughness impacts are presented in Figure F2. This figure shows that increased roughness has very little impact upon the peak water levels, with the worst case impact (increase in water levels of +0.2 m) occurring on Oxley Way between Winnett Street and Hutchinson Street. Increase in peak water level of +0.12 m occurs in properties on the western side of Blaik Street. Across the remainder of the basin, water levels are within ±0.1 m and minor increases in inundation extents occur.

4.3.3 Structure blockage analysis

The impacts presented in Figure F3 show that structure blockage increases peak water levels in the Bellara detention basin by up to 0.5 m.

Blockage of the footpath crossing of Dux Creek immediately downstream of Sunderland Drive increases water levels upstream of the crossing by +0.8 m. Impacts of +0.2 to +0.3 m occur in the drain which runs along the northern boundary of Bellara. This increases inundation extents between Boronia Drive and the drain.

Other impacts which occur as a result of culvert blockage are:

- Increases in peak water levels of up to +0.15 m in Wrights Creek upstream of White Patch Esplanade
- Increases in peak water levels of approximately +0.25 m in Barklya Crescent, Alstonia Court, Tamala Court, Cotterill Avenue and Protea Court and a resultant increase in inundation extents

- Increases in peak water levels of approximately +0.8 m in Freshwater Creek in Lions Park and upstream to Second Avenue and increases of +0.15 to +0.28 m upstream of Second Avenue

4.3.4 Climate change and downstream boundary condition analysis

- Increased rainfall (S4, Figure F4)
  - No significant increase in peak water levels occurs as a result of increased rainfall. Minor increases in inundation extents occur throughout the basin, with impacts of up to +0.32 m on Oxley Way between Winnett Street and Hutchinson Street and in properties on the western side of Blaik Street and impacts of up to +0.11 m on Kangaroo Avenue, Partridge Street, Kingfisher Street and Cormorant Street
- Increased downstream boundary (S5, Figure F5)
  - Peak water levels in the Pacific Harbour canal systems are increased by +0.8 m, therefore peak water levels and inundation extents in the upstream areas which drain to these canals are also increased. This effect is most evident in the Cosmos Avenue and Cosmos Park area
  - Peak water levels in the Bellara detention basin and Bongaree canal system are increased by approximately +0.5 to +0.52 m. Similar to the Pacific Harbour area, peak water levels and inundation extents in the upstream areas which drain to these systems are also increased
  - The model shows a decrease in peak water levels and inundation extents to the south of the Bellara detention basin. This results from a redistribution of flows within the model and is not a real effect
- Increased rainfall and downstream boundary (S6, Figure F6)
  - The S6 results are a combination of S4 and S5 and show very similar impacts to these two scenarios
- Dynamic storm tide (S7, Figure F7)
  - The Bribie Island dynamic storm tide model shows a significant amplification of water levels into the Pacific Harbour canals. This effect is likely to result from the same momentum issues which affect the canals in the static downstream tailwater condition (see Appendix D for further discussion) and is not likely to occur in a real storm tide event, therefore the model results for the dynamic storm tide run should be treated with caution
- Static storm tide (S8, Figure F8)
  - The static storm tide tailwater condition causes an increase in peak water levels throughout the Pacific Harbour canals (approximately +1.3 m), Bongaree canals (approximately+0.95 m) and Bellara detention basin (approximately +0.65 m). Inundation extents are increased throughout the residential areas, with many of the roadways in Pacific Harbour becoming inundated, as well as properties on Hawaii Avenue. Much of Bellara becomes inundated as well as Oleander Drive in Bongaree
- Increased rainfall, sea level rise and static storm tide (S9, Figure F9)
  - S9 is predicted to have the most significant impacts upon peak water levels. In the undeveloped areas, impacts are similar to those in S4. Inundation from the combined storm tide and sea level rise occurs throughout most of Pacific Harbour, Bellara and Bongaree. Indicative increases in peak water levels are:
    - +2.3 m in the Pacific Harbour canals
    - +1.5 m in the Bellara detention basin
    - +1.9 m in the Bongaree canals
    - +1.1 m in Wrights Creek

4.4 Model limitations

This section is reproduced from Section 4.7 of BMT WBM's Hydraulic Modelling (Detail) Sub-Project 2B Report (2010) and revised to be specific to the Bribie Island minor basin. Given that the same approach has been used across all the Stage 2 hydraulic models, the limitations will be similar.

The topography of creeks in the non-urban areas of the Bribie Island basin is defined using LiDAR data due to the absence of surveyed cross-sections or bathymetry. LiDAR is unable to pick up ground levels below the water surface, and therefore the bed levels of creeks are not represented in detail. This approach means that the flood levels, particularly for small flood events where a greater proportion of the flow is typically conveyed in bank (eg the 1 to 10 year ARI), may be overestimated. This approach has been adopted by MBRC due to budget constraints and the consideration of cost versus benefit. The use of LiDAR data in the creeks will generally be conservative (ie overestimate flood levels).

Watercourses have also been represented in the 2D domain, for which the grid resolution is limited to 5 m. In addition, for the narrower upstream reaches, a waterway landuse layer has not been incorporated. This may not allow adequate representation of the channel conveyance, particularly for the narrower upper reaches. In some instances this limitation may lead to the model over or underestimating conveyance in the watercourses. The extent of this over or underestimation will vary according to local topographic factors.

5 Conclusions and recommendations

Hydrologic and hydraulic modelling has been undertaken to simulate the full range of design flood conditions in the Bribie Island minor basin, from the 1 year ARI event to the Probable Maximum Flood. This modelling was undertaken using the standards and approaches developed during Stage 1 of the Regional Floodplain Database project.

Assessment of a range of scenarios including climate change, land use change, vegetation change, culvert blockage and storm tide events was also undertaken.

A comprehensive set of GIS results has been prepared for incorporation into Council's GIS systems. This includes peak water surface levels, depths, velocities, stream power and hazard. Mapping of the 100 year ARI results has also been prepared.

We recommend that the outcomes of the Model Quality Report in Appendix D should be taken into account when using the models and/or their results.

6 References

Australian Water Engineering (September 1994), *Six Mile Creek Flood Study*

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WorleyParsons (June 2010), *Regional Floodplain Database Design Rainfall - Burpengary Pilot Project (Draft)*

Appendices

Appendix A
Infrastructure Data Assessment Report

Appendix A
Infrastructure Data Assessment Report

Project: Regional Floodplain Database Stage 2 Detailed Modelling – Package 3: Pumicestone Passage and Bribie Island

Data Infrastructure Assessment Report

Reference: 211090

Prepared for: Moreton Bay Regional Council

Revision: 1

31 May 2012

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Regional Floodplain Database Stage 2 Detailed Modelling – Package 3: Pumicestone Passage and Bribie Island

Date | 31 May 2012
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Contents

Appendices

1 Introduction

1.1 Study objective

Moreton Bay Regional Council (MBRC) is delivering a Regional Floodplain Database (RFD) in support of their flood risk management, considering emergency response, development control, strategic landuse and infrastructure planning. The MBRC was recently formed under local government amalgamations and is responsible for Caboolture, Pine Rivers, Redcliffe and Bribie Island. The RFD project is focusing on the northern sector as a key growth area for south east Queensland.

The project is being funded by MBRC, Emergency Management Queensland (EMQ) and Emergency Management Australia (EMA) as part of the Disaster Resilience Program and will provide:

- A comprehensive and consistent description of flood behaviour across the region
- Strategies for management of any flooding problems identified
- A system/process to store and manage this information and keep it up-to-date

Stage 1 of the project was completed in July 2010 and involved a number of sub-projects. These projects delivered consistent processes and protocols for the detailed hydrologic and hydraulic model development. A key sub-project involved the development of broadscale hydrodynamic models for each minor basin to provide general understanding of flooding mechanisms and allow prioritisation of data capture.

Stage 2 (current stage) of the project involves the development of detailed hydrologic and hydraulic models for each minor basin.

Stage 3 will build on the detailed models and "add value" through assessment of flood damages and community resilience measures.

1.2 Objective of data infrastructure assessment report

This report pertains to the data infrastructure assessment and gap analysis for Package 3, including:

- Bribie Island
- Pumicestone Passage (including Six Mile, Beerburrum, Elimbah, Ningi and Glass Mountain Creeks)

The Pumicestone Passage basin is mostly rural, with flood-prone lower reaches. There are a large number of structures in this basin, with the potential to impact upon flooding of urban areas. Additionally, accurate modelling of breakout flows travelling between the lower reaches of Ningi and Elimbah Creeks will be important.

The Bribie Island catchment has significant flooding through some urban areas and canal estates. Representation of urban flowpaths and structures will be important to the accurate modelling of this catchment.

This report assesses the infrastructure and bathymetric data requirements for modelling of the Bribie Island and Pumicestone Passage minor basins. It documents the results of the data gap analysis carried out for drainage infrastructure including bridges, culverts, detention basins and trunk drainage and also for below-water bathymetric details. The infrastructure has been prioritised according to the significance of location and potential impacts to the hydraulic model results. Following the gap analysis and the data prioritisation, a composite assessment of survey requirements has been undertaken.

2 Available data and gap analysis

2.1 Bridges

Bridge drawings received by the Department of Transport and Main Roads (DTMR), Moreton Bay Regional Council (MBRC) and Queensland Rail (QR) for road and rail crossings have been assessed to determine whether critical data is available. The critical information required for the hydraulic modelling of bridges includes:

- Deck location, surface/obvert levels and thickness
- Pier locations, dimensions, orientation to flow and pile arrangements
- Handrail location, height and extent
- Cross-section of channel beneath bridge

Appendix A provides a list of the available data for all bridges and identifies data gaps. With regards to the above, deck locations can be obtained from the aerial images where they are not available in drawings. We note that where no data is available regarding whether a particular crossing is a bridge or a culvert, we have assumed that the crossing is a culvert. This assumption may not be correct in all cases.

2.2 Culverts

Bribie Island and Pumicestone Passage stormwater trunk drainage network GIS data, DTMR drawings and QR drawings have been reviewed to determine whether critical data for culvert crossing locations is available. Culvert locations and lengths can be estimated from the aerial image where visible. The critical information required for the hydraulic modelling of culverts includes:

- Culvert shape
- Dimensions and number of barrels
- Culvert invert levels

Culvert locations identified in the data assessment exclude crossings of local dirt roads throughout the upper reaches of the Pumicestone Passage catchment. Appendix A provides a list of the available data for all culverts and identifies data gaps.

We understand that Council's surveyors have undertaken survey of many of the culverts within the Pumicestone Passage and Bribie Island minor basins and that the gap analysis provided in Appendix A will need to be revised once this survey data is provided to Aurecon.

2.3 Trunk underground drainage

The trunk drainage data standard specifies that trunk drainage refers to "extended underground drainage systems which have a large open channel or stream feeding into them (ie stormwater pipe networks which are intended to convey flows from a major storm event)". Whilst the only location in which we have identified that this definition applies is the outlet to the Bellara Detention Basin, we recommend that the drainage systems in Bellara be included in the modelling as this area is flood-prone and the stormwater networks have the potential to impact upon the flood modelling results throughout this area.

The critical areas in which we think modelling of the pipe network is required include:

- All pipe systems which drain into the Bellara Detention Basin
- All pipe systems which drain from Bellara into the Pacific Harbour canal

The critical information required for the hydraulic modelling of trunk drainage includes:

- Pipe location, shape, dimensions, invert levels, length and number of barrels
- Stormwater pit/junction locations, type, dimensions and invert levels

Stormwater pits and junctions include structures such as kerb inlet pits, manholes and field inlet pits. An assessment of the Bribie Island stormwater drainage network GIS data for the areas defined above established:

- Pipe location, shape, dimensions, invert levels and number of barrels are available
- Stormwater pit locations, invert levels and surface levels are available
- Stormwater pit/junctions types have been categorised into manholes, catch pits, gully pits, pipe outlets and inlet structures however details of the structures corresponding to these categories are not available

2.4 Detention basins

We have identified a single detention basin within Bellara on Bribie Island. The outlet of this basin consists of two culverts. The simple arrangement of the outlet allows it to be represented directly in the hydraulic model, excluding the requirement for a special relationship to be developed. Refer to Section 2.3 for the trunk drainage data relevant to the Bellara Detention Basin.

The culvert inlets on this basin are screened with wire mesh operating as trash racks and the culvert outlets consist of an attachment reducing the flow area of the culvert. These features have been identified through a site visit and no further information is required for the outlet structure.

The LiDAR data at the detention basin outlet is well defined and is free of dense vegetation, thick grass or any other obstructions which may affect the accuracy of the LiDAR survey; therefore the LiDAR representation of the outlet embankment should be sufficient for accurate modelling. No bathymetric data exists for the detention basin.

2.5 Terrain

LiDAR data has been provided by MBRC for the Pumicestone Passage and Bribie Island basins. In addition to the LiDAR data, to accurately model the waterways, bathymetric information will be required for significant perennial reaches. These reaches have been identified and prioritised in Appendix C.

Cross-section data, including bathymetric details, are available from the EXTRAN Model layout and cross-sections provided by MBRC for Six Mile Creek in the Pumicestone Passage Basin. A comparison of the surveyed cross-sections and the LiDAR data showed that there is minimal difference between the two and the inclusion of the invert details from the cross-sections is considered to have an insignificant impact on conveyance capacity through Six Mile Creek, therefore this information will not need to be included in the hydraulic model.

The WorleyParsons (2010) Floodplain Terrain report indicates that bathymetric data for Pacific Harbour and Bribie Gardens is available and is included in the terrain tool (and therefore the zpoints).

Survey data for the Solander Drain is also available. This survey has been compared to the LiDAR data and there is a difference in the bed elevation in the order of 1 m, therefore we recommend that the survey should be included in the hydraulic model.

No bathymetric data is available for the Bellara Detention Basin.

2.6 Prioritisation methodology

The structure data has been prioritised based on three main criteria:

- Broadscale model flood extents – Structures within or nearby the 100 year broadscale model flood extents were identified as structures to be included in the hydraulic model. Conversely structures outside of these extents were considered to be insignificant and were excluded
- Land use – Flood levels through urban areas are generally of greater significance than rural areas therefore structures located in urban areas were considered to be of higher priority
- Major crossings of highways and railway – Highways and railways present a large obstruction to flowpaths. The major crossings of the Bruce Highway, Beerburrum Road and the railway line were given higher priority

Prioritisation of the bathymetric data was determined from the aerial image and has been prioritised based on three major criteria:

- Larger reaches with greater widths and higher water depths were considered to be of higher priority as bathymetry in these reaches could have a substantial impact on channel capacity. Larger channels are typically located in the lower reaches of each waterway
- Reaches with large catchments are likely to have a greater impact in hydraulic model and are considered of higher priority. These are also typically located in the lower reaches of each waterway
- Reaches in urban areas are considered to be of greater significance

Prioritisation of the structures is listed in Appendix B and prioritisation of the bathymetry is listed in Appendix C. Note that all structures have been prioritised, then structures requiring survey have identified following the prioritisation.

2.7 Data prioritisation (A and B)

The structures and bathymetric data have been prioritised into A (high priority) and B (low priority). These structures are shown on Figure 1. Structures identified as Priority A include:

- Structures inside or nearby the 100 year broadscale model flood extents and in urban areas
- Crossings of Pumicestone Road
- Outlet structure from the Bellara Detention Basin
- Significant crossings of the railway and highways (Bruce Highway and Beerburrum Road)

Structures of Priority B include:

- Structures that are inside or nearby the 100 year ARI broadscale model flood extents, in rural areas and not part of a major crossing of the railway or highways

Bathymetric data of Priority A includes large (wide or deep) reaches (typically in the lower reaches) and reaches inside or nearby urban areas. Bathymetric data of Priority B includes smaller reaches, which are typically tributaries, or upper reaches in rural areas. Prioritised bathymetric data is shown on Figure 2.

2.7.1 Survey capture requirements

The survey capture requirements have been identified based upon a composite assessment of data gaps and data prioritisation. Discussions with Council have indicated that most culvert survey within the Pumicestone Passage and Bribie Island catchments has been undertaken; therefore culverts have not been included in the survey data requirements. The prioritised infrastructure and bathymetric survey requirements are included in Appendix D and a copy of the survey scope document is included in Appendix E.

2.7.2 Alternative data capture methods

We understand that there are limited budgets available for survey capture and that MBRC may determine that other catchments are more important with respect to survey data collection, therefore we have tried to identify where alternative methods may be used to provide the critical details required for modelling. These methods are outlined below.

Culverts

In the absence of survey data for modelling of culverts the invert levels could be set to match the LiDAR data surface levels and the culvert size, number of barrels and shape determined from the field with a site visit.

Bridges

Either the obvert levels or the thickness of bridge decks will need to be provided by drawings or survey due to difficulty in alternative determination techniques. The LiDAR data could be used as a less accurate method of determining the deck levels and of representing the cross section underneath the bridge. The aerial images could be used to determine the bridge deck location. Other critical data such pier locations, dimensions, orientation to flow, pile arrangements and handrail location, height and extent can be measured or estimated in the field with a site visit.

Trunk drainage

For the stormwater network data within Bellara, most critical data is available for the pipes. Data relating to pit types is unavailable. It would be possible to either:

- Adopt standard pit types and apply these standard types to all pits for which no data is available
- Undertake a site visit to determine as much information as possible, especially with regard to inlet pit types. The site visit would not provide manhole/junction pit details however standard assumptions could be made regarding these

Bathymetry

No alternative methods exist for capture of bathymetric data. If bathymetric survey is not available, 2d_zlines will need to be used to provide a continuous flowpath through modelled reaches.

3 Recommendations

Priority A culverts are located in areas considered to be critical, such as urban areas where accuracy of results is considered to be important or at major crossings of highways and railways where the structure has could have substantial influence on upstream and downstream conditions. Priority A infrastructure also includes major bridge crossing of highways and railways where inaccuracy in modelling could impact on results upstream and downstream.

Survey requirements for bridges have been identified based upon the gap analysis and the data prioritisation. No survey requirements have been identified for culverts as most of these have already been surveyed by Council.

Where bathymetric data is not available, there are no alternative methods for this data capture and the LiDAR survey will need to be applied, reducing the reliability of the hydraulic model. Reaches of Priority B are typically tributaries in rural areas where reducing the reliability of the hydraulic model may be considered acceptable. Priority B reaches are typically smaller with shallower depths; therefore the reduction in channel capacity may not be significant if the LiDAR data is applied. Priority A reaches are considered to be critical to the hydraulic model and the reduction in channel capacity in the absence of bathymetric data could have a significant impact on results.

It is recommended that survey information for Priority A structures and reaches requiring bathymetric data be sourced in order to maximise the reliability of the hydraulic model and obtain accurate results in critical areas. Alternate methods may be considered for Priority B structures where possible as lower reliability of the hydraulic model may be considered acceptable in these areas.

4 References

4.1 Documents

WorleyParsons (2010), Regional Floodplain Database – Floodplain Terrain, 9 September 2010

4.2 Other data

Aerial images

All MBRC roads GIS data, as provided by council

Bribie Island stormwater trunk drainage network GIS data, as provided by Council September 2010

Department of Transport and Main Roads (DTMR) drawings for bridges and culverts

LiDAR data from, as provided by Council

Moreton Bay Regional Council (MBRC) drawings for bridges

Pumicestone Passage stormwater trunk drainage network GIS data, as provided by Council September 2010

Queensland Rail (QR) drawings for bridges and culverts

Solander Drain survey 09 September 2008, as provided by council October 2010

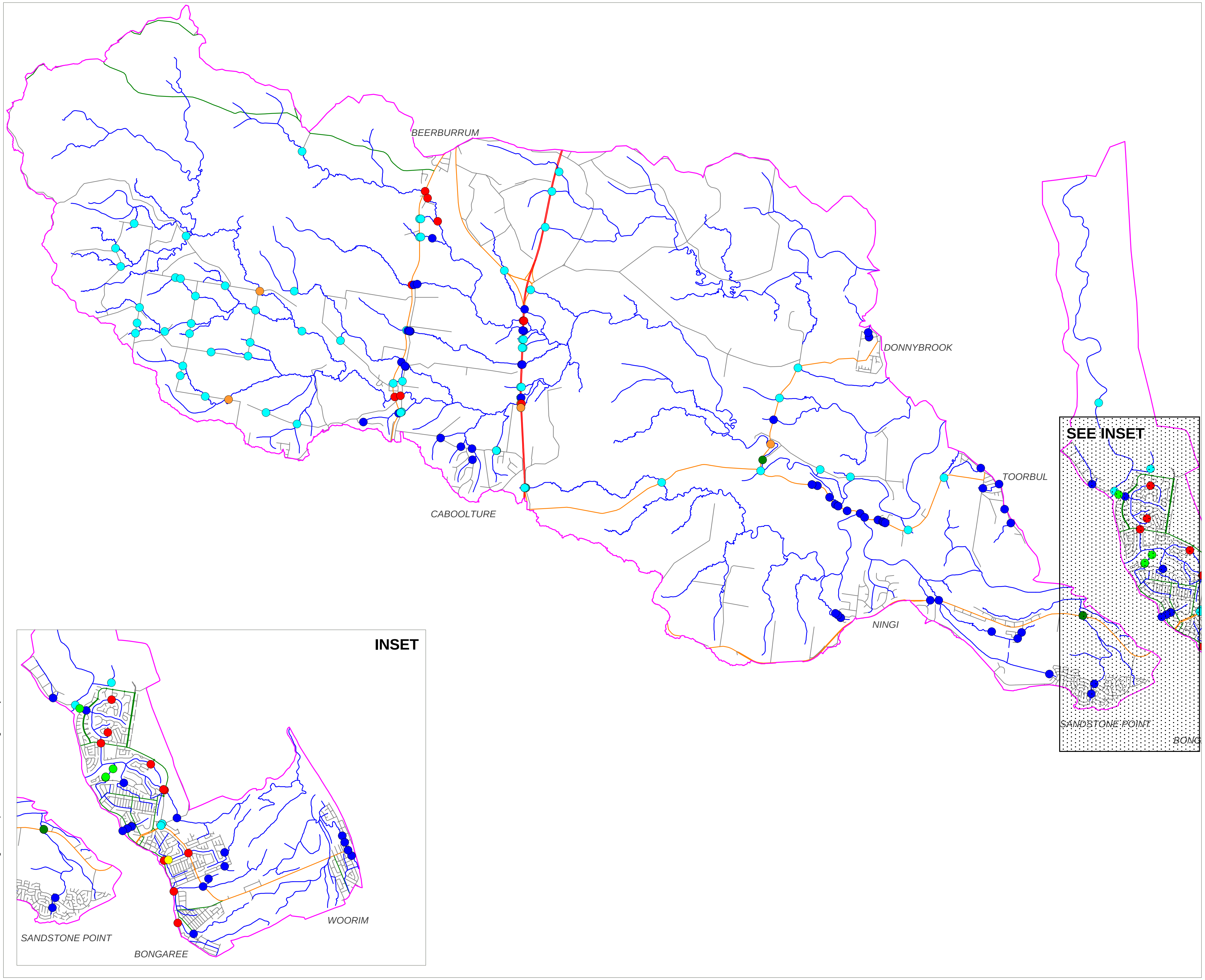
Tuflow Z points and loc files covering the Moreton Bay regional basins of Pumicestone Passage (PUM) and Bribie Island (BRI)

Six Mile Creek EXTRAN Model layout and cross sections, as provided by Council October 2010

Appendices

Appendix A
Figures

aurecon



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Legend

Roads by Heirarchy

- 1
- 2
- 3
- 4
- 5

Reaches

Bribie Island Structures

- Bridge Priority A
- Culvert Priority A
- Culvert Priority B
- Footbridge Priority A
- Lock Priority A

Pumicestone Passage Structures

- Bridge Priority A
- Bridge Priority B
- Culvert Priority A
- Culvert Priority B
- Footbridge Priority B

Notes:

Date: 20/10/2010 Version: 0

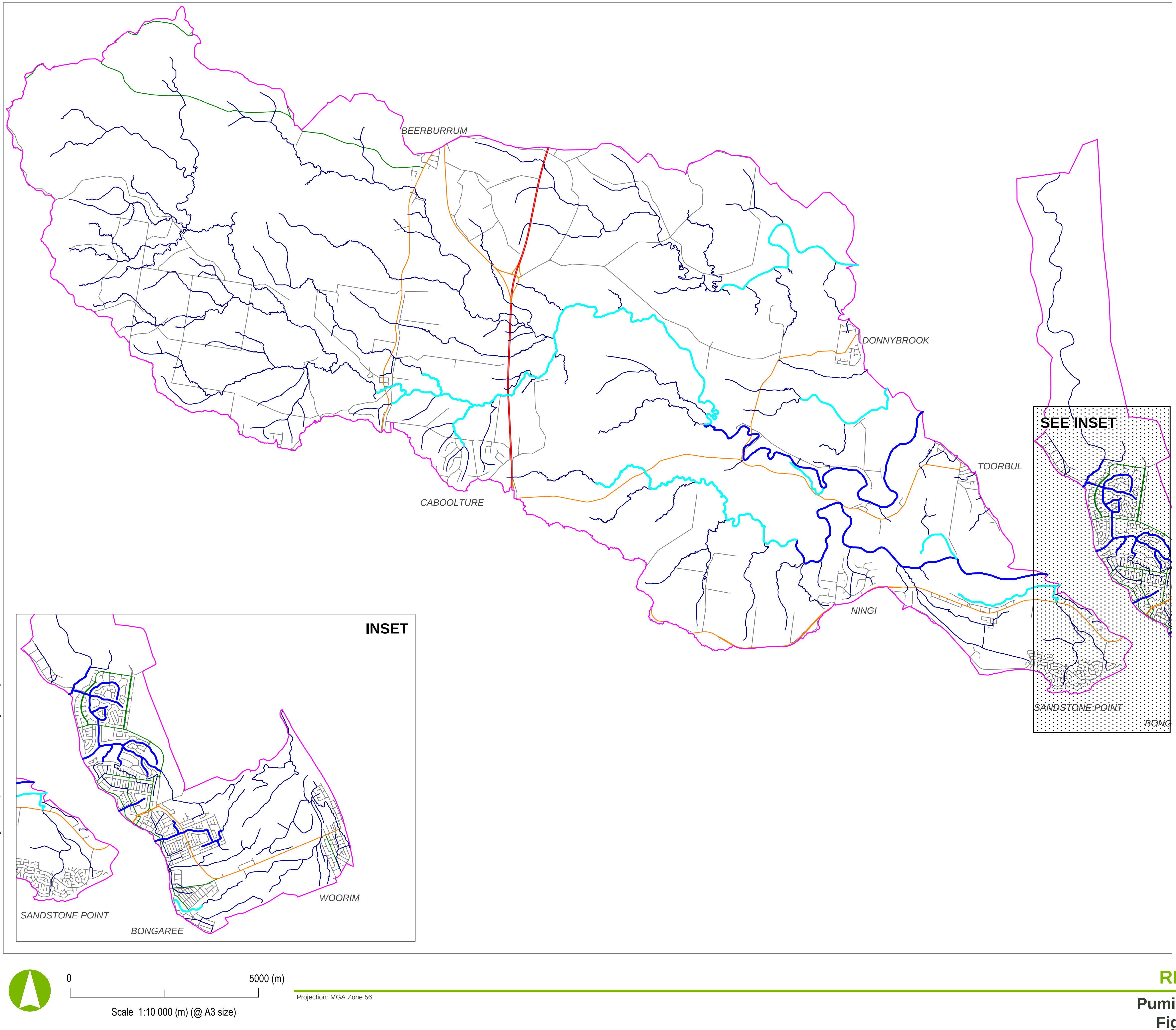
0 5000 (m)

Scale 1:10 000 (m) (@ A3 size)

Projection: MGA Zone 56

RFD Stage 2 Detailed Modelling

Pumicestone Passage and Bribie Island
Figure 1: Structure Locations



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aurecon

Legend

Roads by Heirarchy

- 1
- 2
- 3
- 4
- 5

- Non-Critical Reaches
- Priority A Reaches
- Priority B Reaches

Notes:

Date: 20/10/2010

Version: 0

RFD Stage 2 Detailed Modelling

Pumicestone Passage and Bribie Island

Figure 2: Bathymetric Data Locations

Appendix B
Data assessment and gap analysis

Appendix B – Data assessment and gap analysis

Pumicestone Passage – Bridges

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
BEE_01_01652	Bruce Highway	PUM	Bridge	No	Handrail	DTMR DWG
BEE_01_01675	Bruce Highway	PUM	Bridge	No	Handrail	DTMR DWG
BEE_01_06768	Railway	PUM	Bridge	No	Pier Data, Deck Elevation Data	QR DWG
BEE_01_07615	Railway	PUM	Bridge	No	All	None
BEE_01_07828	Beerburrum Road	PUM	Bridge	Yes	None	DTMR DWG
BEE_10_01778	Beerburrum Road	PUM	Bridge	No	All	None
ELI_01_09748	Donnybrook Road	PUM	Footbridge	No	All	None
ELI_01_10536	Donnybrook Road	PUM	Bridge	Yes	None	MBRC DWG
NIN_36_00225	Bribie Island Road	PUM	Footbridge	No	All	None
SMC_01_02645	Bruce Highway	PUM	Bridge	Yes	None	DTMR DWG
SMC_01_02671(A)	Bruce Highway	PUM	Bridge	Yes	None	DTMR DWG
SMC_01_05975	Railway	PUM	Bridge	No	Pier Data, Deck Vertical Data	QR DWG
SMC_01_06873	Beerburrum Road	PUM	Bridge	Yes	None	DTMR DWG
SMC_01_13518	Twin View Road	PUM	Bridge	Yes	None	MBRC DWG
SMC_34_03784	King Road	PUM	Bridge	No	All	None

[a] Where data source is not available the structure type has been taken from aerial images and will need to be confirmed once data is available

[b] Complete data set column refers to critical data as identified in Section 2 of the report

Pumicestone Passage – Culverts

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
BEE_01_11919	Old Gympie Road	PUM	Unknown	No	All	None
BEE_06_00530	Railway	PUM	Culvert	No	All	None
BEE_06_00568	Beerburrum Road	PUM	Unknown	No	All	None
BEE_08_00425	Railway	PUM	5/1800 RCP	No	Invert Levels	QR DWG
BEE_08_00755	Railway	PUM	Culvert	No	All	None
BEE_08_00787	Beerburrum Road	PUM	Unknown	No	All	None
BEE_09_01117	Bruce Highway	PUM	Unknown	No	All	None
BEE_09_01592	Steve Irwin Way	PUM	Culvert	No	Invert Levels	QR DWG
BEE_10_01633	Railway	PUM	6/2100 RCP	No	Invert Levels	QR DWG
BEE_10_01724	Railway	PUM	Culvert	No	All	None
BEE_12_00243	Bruce Highway	PUM	1/1800 RCP	Yes	None	DTMR DWG
BEE_12_00275	Bruce Highway	PUM	1/1800 RCP	Yes	None	DTMR DWG
BEE_14_00454	Bruce Highway	PUM	Unknown	No	All	None
BEE_14_00481	Bruce Highway	PUM	Unknown	No	All	None
BEE_16_00679	Bruce Highway	PUM	1/1200x450 RCBC	No	All	None
BEE_16_00703	Bruce Highway	PUM	2/750 RCP	Yes	None	DTMR DWG
BEE_18_01376	Bruce Highway	PUM	3/1800X450 RCBC	No	All	None
BEE_18_01396	Bruce Highway	PUM	6/1800 RCP	Yes	None	DTMR DWG
BEE_18_05085	Rose Creek Road	PUM	2/1800 RCP	No	Invert Levels	QR BWG
BEE_18_05085	Railway	PUM	Culvert	Yes	None	MBRC GIS
BEE_18_05151	Railway	PUM	Culvert	Yes	None	MBRC GIS

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
BEE_18_05190	Beerburrum Road	PUM	Culvert	No	All	None
ELI_03_01693	Bruce Highway	PUM	Culvert	No	All	None
ELI_07_00183	Meldale Road	PUM	1/450 RCP	Yes	None	MBRC GIS
ELI_09_00104	Meldale Road	PUM	2/450 RCP	Yes	None	MBRC GIS
ELI_10_00057	Pumicestone Road	PUM	Culvert	No	All	None
ELI_11_04807	Donnybrook Road	PUM	Culvert	No	All	None
Not on reach	Pumicestone Road	PUM	1/750x450 RCBC	Yes	None	DTMR DWG
Not on reach	Pumicestone Road	PUM	1/900x300 RCBC	Yes	None	DTMR DWG
Not on reach	Pumicestone Road	PUM	1/450 RCP	Yes	None	DTMR DWG
Not on reach	Pumicestone Road	PUM	2/600x300 RCBC	Yes	None	DTMR DWG
Not on reach	Pumicestone Road	PUM	2/600x300 RCBC	Yes	None	DTMR DWG
ELI_13_01616	Donnybrook Road	PUM	Culvert	No	All	None
ELI_14_00382	Pumicestone Road	PUM	Culvert	No	All	None
ELI_16_01136	Pumicestone Road	PUM	Culvert	No	All	None
ELI_18_00000	Esplanade	PUM	Unknown	No	All	None
ELI_20_00000	Esplanade	PUM	4/750 RCP	Yes	None	MBRC GIS
ELI_20_00617	Freeman Road	PUM	3/1200x600 RCBC	Yes	None	MBRC GIS
ELI_22_00038	Esplanade	PUM	Culvert	No	All	None
ELI_24_00122	Esplanade	PUM	Unknown	No	All	None
GMC_01_15669	Bruce Highway	PUM	Unknown	No	All	None
GMC_02_00459	Bruce Highway	PUM	Culvert	No	All	None
GMC_04_02236	Bruce Highway	PUM	1/750 RCP	No	All	None
GMC_24_00212	Esplanade North	PUM	Culvert	No	All	None

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
GMC_24_00331	Amy Street	PUM	3/750 RCP	Yes	None	MBRC GIS
GMC_26_00000	Amy Street	PUM	2/1200x450 RCBC	Yes	None	MBRC GIS
GMC_28_02630	Donnybrook Road	PUM	Unknown	No	All	None
Not on reach	Pumicestone Road	PUM	1/450x300 RCBC	No	Location	DTMR DWG
Not on reach	Pumicestone Road	PUM	1/450x300 RCBC	No	Location	DTMR DWG
Not on reach	Pumicestone Road	PUM	1/450x300 RCBC	No	Location	DTMR DWG
Not on reach	Pumicestone Road	PUM	1/450x300 RCBC	No	Location	DTMR DWG
Not on reach	Pumicestone Road	PUM	1/450x300 RCBC	Yes	None	DTMR DWG
Not on reach	Pumicestone Road	PUM	1/450x300 RCBC	Yes	None	DTMR DWG
Not on reach	Pumicestone Road	PUM	1/450x300 RCBC	Yes	None	DTMR DWG
NIN_01_18391	Pumicestone Road	PUM	Culvert	No	All	None
NIN_01_23388	Rutters Road	PUM	Culvert	No	All	None
NIN_01_23388	Bruce Highway	PUM	Culvert	No	All	None
NIN_01_23388	Bruce Highway	PUM	Culvert	No	All	None
NIN_14_00567	Minor Road	PUM	Unknown	No	All	None
NIN_14_01586	Wattle Grove Drive	PUM	1/750 RCP	Yes	None	MBRC GIS
NIN_14_01586	Wrenaus Way	PUM	3/750 RCP	Yes	None	MBRC GIS
NIN_22_00733	Bribie Island Road	PUM	Culvert	No	All	None
NIN_24_00716	Bribie Island Road	PUM	Culvert	No	All	None
NIN_24_03255	Sandstone Bvd	PUM	Culvert	No	All	None
NIN_28_00581	Sandheath Place	PUM	Culvert	No	All	None
NIN_28_02308	Sandheath Place	PUM	3/2400x1200 RCBC & 1/1200x1200 RCBC	No	All	MBRC GIS

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
NIN_28_02761	Redondo Street	PUM	1/1200x2100 RCBC	No	All	MBRC GIS
NIN_36_00585	Bribie Island Road	PUM	Culvert	No	All	None
NIN_36_03043	Bestmann Road East	PUM	3/1200X600 RCBC	Yes	None	MBRC GIS
NIN_36_03325	Carpenter Way	PUM	3/1200x600 RCBC	Yes	None	MBRC GIS
SMC_01_02671(B)	Bruce Highway	PUM	3360 CSPIP 2A DWG 197272	Yes	None	DTMR DWG
SMC_01_11575	Old Gympie Road	PUM	Unknown	Na	None	None
SMC_08_00499	Prosser Road	PUM	Unknown	No	All	None
SMC_09_02090	Rose Creek Road	PUM	Unknown	No	All	None
SMC_09_02136	Railway	PUM	4/3000x1800 RCBC	No	Invert Levels	QR DWG
SMC_09_02248	Beerburrum Road	PUM	Culvert	No	All	None
SMC_09_06807	Old Gympie Road	PUM	Unknown	No	All	None
SMC_12_00384	Twin View Road	PUM	Unknown	No	All	None
SMC_13_00311	Twin View Road	PUM	Unknown	No	All	None
SMC_14_01506	Woodlands Drive	PUM	Culvert	No	All	None
SMC_15_00438	Railway	PUM	2/1200x900 RCBC	No	Invert Levels	QR DWG
SMC_15_00665	Beerburrum Road	PUM	Culvert	No	All	None
SMC_17_01044	Bruce Highway	PUM	Unknown	No	All	None
SMC_17_01055	Bruce Highway	PUM	1/675RCP 2C DWG197272	Yes	None	DTMR DWG
SMC_18_00832	Woodlands Drive	PUM	Culvert	No	All	None
SMC_19_00348	Bruce Highway	PUM	Unknown	No	All	None
SMC_19_00373	Bruce Highway	PUM	4/825 RCP	Yes	None	DTMR DWG

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
SMC_20_01371	Williams Road	PUM	Unknown	No	All	None
SMC_20_03707	Powell Road	PUM	Culvert	No	All	None
SMC_20_03766	Hoffman Road	PUM	Unknown	No	All	None
SMC_20_05638	Minor Road	PUM	Unknown	No	All	None
SMC_22_00787	Newlands Road	PUM	Unknown	No	All	None
SMC_24_00261	Newlands Road	PUM	Unknown	No	All	None
SMC_26_00127	Powell Road	PUM	Culvert	No	All	None
SMC_28_00908	Powell Road	PUM	Culvert	No	All	None
SMC_28_01916	Scurr Road	PUM	Culvert	No	All	None
SMC_28_02077	Scurr Road	PUM	Unknown	No	All	None
SMC_30_00666	Scurr Road	PUM	4/900 RCP	Yes	None	MBRC DWG
SMC_36_00481	King Road	PUM	Unknown	No	All	None
SMC_36_01650	Powell Road	PUM	Unknown	No	All	None
SMC_40_00207	Powell Road	PUM	Unknown	No	All	None
SMC_42_00788	Williams Road	PUM	Unknown	No	All	None
SMC_42_01802	Pates Road	PUM	Culvert	No	All	None
SMC_44_00868	Williams Road	PUM	Culvert	No	All	None
SMC_46_01629	King Road	PUM	Unknown	No	All	None
SMC_48_01569	King Road	PUM	Culvert	No	All	None
SMC_58_00453	Hamilton Road	PUM	9/675 RCP	Yes	None	MBRC GIS
SMC_58_00504	Railway	PUM	2/1800 RCP	No	Invert Levels	QR DWG
SMC_58_00539	Beerburrum Road	PUM	Culvert	No	All	None
SMC_60_00679	Kirrang Drive	PUM	1/900 RCP	Yes	None	MBRC GIS

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
SMC_64_01396	Mansfield Road	PUM	1/1500x750 RCBC	Yes	None	MBRC GIS
SMC_66_00151	Bigmor Drive	PUM	1/450 RCP	Yes	None	MBRC GIS
SMC_68_00227	Mansfield Road	PUM	1/600 RCP	Yes	None	MBRC GIS
SMC_70_00654	Mansfield Road	PUM	3/900 RCP	Yes	None	MBRC GIS
SMC_72_01331(A)	Mansfield Road	PUM	2/450 RCP	Yes	None	MBRC GIS
SMC_72_01331(B)	Mansfield Road	PUM	1/450 RCP	Yes	None	MBRC GIS

[a] Where data source is not available the structure type has been taken from aerial images and will need to be confirmed once data is available

[b] Complete data set column refers to critical data as identified in Section 2 of the report

Bribie Island – Bridges

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
BON_01_00137	Welsby Parade	BRI	Bridge	No	All	None
BON_01_00212	Footpath	BRI	Lock	No	All	None
BON_01_00811	Goodwin Drive	BRI	Bridge	No	All	None
BON_09_00050	Welsby Parade	BRI	Bridge	No	All	None
BON_21_00037	South Esplanade	BRI	Bridge	No	All	None
DUX_01_02462	Sunderland Drive	BRI	Bridge	No	All	None
DUX_01_01826	Footpath	BRI	Footbridge	No	All	None
DUX_02_00701	Eagles Landing	BRI	Bridge	No	All	None
DUX_04_00568	Sunderland Drive	BRI	Bridge	No	All	None
DUX_04_02128	Quarterdeck Drive	BRI	Bridge	No	All	None
DUX_11_00000	Minor Road	BRI	Footbridge?	No	All	None

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
DUX_11_00000	Minor Road	BRI	Footbridge?	No	All	None
DUX_12_00000	Island Parade	BRI	Bridge	No	All	None
WRI_05_00000	Footpath	BRI	Footbridge	No	All	None

[a] Where data source is not available the structure type has been taken from aerial images and will need to be confirmed once data is available

[b] Complete data set column refers to critical data as identified in Section 2 of the report

Bribie Island – Culverts

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
BON_01_01940	Protea Drive	BRI	2/1200 RCP	Yes	None	MBRC GIS
BON_03_00000	Cotterill Avenue	BRI	1/1200 RCP	Yes	None	MBRC GIS
BON_09_00673	Goodwin Drive	BRI	4/450 RCP	Yes	None	MBRC GIS
BON_13_00238	Minor Road	BRI	Unknown	No	All	None
BON_21_00612	Toorbul Street	BRI	2/900x300 RCBC	Yes	None	MBRC GIS
Not on reach	Benabrow Avenue	BRI	1/450 RCP	Yes	None	MBRC GIS
Not on reach	Benabrow Avenue	BRI	1/1500X750 RCBC	Yes	None	MBRC GIS
DUX_01_03276	Hornsby Road	BRI	Culvert	No	All	None
DUX_06_00128	Endeavour Drive	BRI	5/1500 RCP	Yes	None	MBRC GIS
DUX_09_00546	Marina Boulevard	BRI	3/1200x450 RCBC	Yes	None	MBRC GIS
DUX_15_00000	Footpath	BRI	Unknown	No	All	None
DUX_15_00148	Eucalypt Street	BRI	1/900 RCP	Yes	None	MBRC GIS
DUX_15_00148	Eucalypt Street	BRI	1/900 RCP	Yes	None	MBRC GIS
DUX_15_00148	Sylvan Beach Esplanade	BRI	1/2400x1800 RCBC	Yes	None	MBRC GIS

WW_ID	Xing_Name	Domain	Structure type[a]	Data set complete[b]	Missing data	Data source
FRE_01_00429	Access Surf Club	BRI	4/2400x1200 RCBC	No	All	None
FRE_01_00623	First Avenue	BRI	3/450 RCP	Yes	None	MBRC GIS
FRE_01_00623	First Avenue	BRI	4/900 RCP	Yes	None	MBRC GIS
FRE_01_01047	Second Avenue	BRI	4/900 RCP	Yes	None	MBRC GIS
WRI_01_00227	White Patch Esplanade	BRI	3/1500 RCP	Yes	None	MBRC GIS
WRI_01_03180	Minor Road	BRI	Unknown	No	All	None
WRI_02_00042	White Patch Esplanade	BRI	Unknown	No	All	None
WRI_03_00554	Minor Road	BRI	Unknown	No	All	None

[a] Where data source is not available the structure type has been taken from aerial images and will need to be confirmed once data is available

[b] Complete data set column refers to critical data as identified in Section 2 of the report

Appendix C
Structure prioritisation

Appendix C – Structure prioritisation

Pumicestone Passage – Structure Prioritisation

WW_ID	Xing_Name	Domain	Land use	Priority
BEE_01_01652	Bruce Highway	PUM	Rural	A
BEE_01_01675	Bruce Highway	PUM	Rural	A
BEE_01_06768	Railway	PUM	Rural	A
BEE_01_07615	Railway	PUM	Rural	A
BEE_01_07828	Beerburrum Road	PUM	Rural	A
BEE_01_11919	Old Gympie Road	PUM	Rural	B
BEE_06_00530	Railway	PUM	Rural	B
BEE_06_00568	Beerburrum Road	PUM	Rural	B
BEE_08_00425	Railway	PUM	Rural	A
BEE_08_00755	Railway	PUM	Rural	B
BEE_08_00787	Beerburrum Road	PUM	Rural	B
BEE_09_01117	Bruce Highway	PUM	Rural	A
BEE_09_01592	Steve Irwin Way	PUM	Rural	B
BEE_10_01633	Railway	PUM	Rural	A
BEE_10_01724	Railway	PUM	Rural	A
BEE_10_01778	Beerburrum Road	PUM	Rural	A
BEE_12_00243	Bruce Highway	PUM	Rural	A
BEE_12_00275	Bruce Highway	PUM	Rural	A
BEE_14_00454	Bruce Highway	PUM	Rural	B
BEE_14_00481	Bruce Highway	PUM	Rural	B
BEE_16_00679	Bruce Highway	PUM	Rural	B
BEE_16_00703	Bruce Highway	PUM	Rural	B
BEE_18_01376	Bruce Highway	PUM	Rural	A
BEE_18_01396	Bruce Highway	PUM	Rural	A
BEE_18_05085	Rose Creek Road	PUM	Rural	B
BEE_18_05085	Railway	PUM	Rural	A
BEE_18_05151	Railway	PUM	Rural	A
BEE_18_05190	Beerburrum Road	PUM	Rural	B
ELI_01_09748	Donnybrook Road	PUM	Rural	B
ELI_01_10536	Donnybrook Road	PUM	Rural	B
ELI_03_01693	Bruce Highway	PUM	Rural	B
ELI_07_00183	Meldale Road	PUM	Rural	B
ELI_09_00104	Meldale Road	PUM	Rural	B
ELI_10_00057	Pumicestone Road	PUM	Rural	B
ELI_11_04807	Donnybrook Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B

WW_ID	Xing_Name	Domain	Land use	Priority
Not on reach	Pumicestone Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B
ELI_13_01616	Donnybrook Road	PUM	Rural	B
ELI_14_00382	Pumicestone Road	PUM	Rural	B
ELI_16_01136	Pumicestone Road	PUM	Rural	B
ELI_18_00000	Esplanade	PUM	Urban	A
ELI_20_00000	Esplanade	PUM	Urban	A
ELI_20_00617	Freeman Road	PUM	Urban	A
ELI_22_00038	Esplanade	PUM	Urban	A
ELI_24_00122	Esplanade	PUM	Urban	A
GMC_01_15669	Bruce Highway	PUM	Rural	B
GMC_02_00459	Bruce Highway	PUM	Rural	B
GMC_04_02236	Bruce Highway	PUM	Rural	B
GMC_24_00212	Esplanade North	PUM	Urban	A
GMC_24_00331	Amy Street	PUM	Urban	A
GMC_26_00000	Amy Street	PUM	Urban	A
GMC_28_02630	Donnybrook Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B
Not on reach	Pumicestone Road	PUM	Rural	B
NIN_01_18391	Pumicestone Road	PUM	Rural	B
NIN_01_23388	Rutters Road	PUM	Rural	B
NIN_01_23388	Bruce Highway	PUM	Rural	B
NIN_01_23388	Bruce Highway	PUM	Rural	B
NIN_14_00567	Minor Road	PUM	Urban	A
NIN_14_01586	Wattle Grove Drive	PUM	Urban	A
NIN_14_01586	Wrenaus Way	PUM	Urban	A
NIN_22_00733	Bribie Island Road	PUM	Urban	A
NIN_24_00716	Bribie Island Road	PUM	Urban	A
NIN_24_03255	Sandstone Bvd	PUM	Urban	A
NIN_28_00581	Sandheath Place	PUM	Urban	A
NIN_28_02308	Sandheath Place	PUM	Urban	A
NIN_28_02761	Redondo Street	PUM	Urban	A

WW_ID	Xing_Name	Domain	Land use	Priority
NIN_36_00225	Bribie Island Road	PUM	Rural	B
NIN_36_00585	Bribie Island Road	PUM	Rural	B
NIN_36_03043	Bestmann Road East	PUM	Urban	A
NIN_36_03325	Carpenter Way	PUM	Urban	A
SMC_01_02645	Bruce Highway	PUM	Rural	A
SMC_01_02671(A)	Bruce Highway	PUM	Rural	A
SMC_01_02671(B)	Bruce Highway	PUM	Rural	A
SMC_01_05975	Railway	PUM	Urban	A
SMC_01_06873	Beerburrum Road	PUM	Urban	A
SMC_01_11575	Old Gympie Road	PUM	Rural	B
SMC_01_13518	Twin View Road	PUM	Rural	B
SMC_08_00499	Prosser Road	PUM	Rural	B
SMC_09_02090	Rose Creek Road	PUM	Rural	B
SMC_09_02136	Railway	PUM	Rural	A
SMC_09_02248	Beerburrum Road	PUM	Rural	A
SMC_09_06807	Old Gympie Road	PUM	Rural	B
SMC_12_00384	Twin View Road	PUM	Rural	B
SMC_13_00311	Twin View Road	PUM	Rural	B
SMC_14_01506	Woodlands Drive	PUM	Rural	B
SMC_15_00438	Railway	PUM	Rural	B
SMC_15_00665	Beerburrum Road	PUM	Urban	A
SMC_17_01044	Bruce Highway	PUM	Rural	B
SMC_17_01055	Bruce Highway	PUM	Rural	B
SMC_18_00832	Woodlands Drive	PUM	Rural	B
SMC_19_00348	Bruce Highway	PUM	Rural	B
SMC_19_00373	Bruce Highway	PUM	Rural	B
SMC_20_01371	Williams Road	PUM	Rural	B
SMC_20_03707	Powell Road	PUM	Rural	B
SMC_20_03766	Hoffman Road	PUM	Rural	B
SMC_20_05638	Newlands Road	PUM	Rural	B
SMC_22_00787	Newlands Road	PUM	Rural	B
SMC_24_00261	Newlands Road	PUM	Rural	B
SMC_26_00127	Powell Road	PUM	Rural	B
SMC_28_00908	Powell Road	PUM	Rural	B
SMC_28_01916	Scurr Road	PUM	Rural	B
SMC_28_02077	Scurr Road	PUM	Rural	B
SMC_30_00666	Scurr Road	PUM	Rural	B
SMC_34_03784	King Road	PUM	Rural	B
SMC_36_00481	King Road	PUM	Rural	B

WW_ID	Xing_Name	Domain	Land use	Priority
SMC_36_01650	Powell Road	PUM	Rural	B
SMC_40_00207	Powell Road	PUM	Rural	B
SMC_42_00788	Williams Road	PUM	Rural	B
SMC_42_01802	Pates Road	PUM	Rural	B
SMC_44_00868	Williams Road	PUM	Rural	B
SMC_46_01629	King Road	PUM	Rural	B
SMC_48_01569	King Road	PUM	Rural	B
SMC_58_00453	Hamilton Road	PUM	Rural	B
SMC_58_00504	Railway	PUM	Rural	A
SMC_58_00539	Beerburrum Road	PUM	Rural	A
SMC_60_00679	Kirrang Drive	PUM	Urban	A
SMC_64_01396	Mansfield Road	PUM	Urban	A
SMC_66_00151	Bigmor Drive	PUM	Urban	A
SMC_68_00227	Mansfield Road	PUM	Urban	A
SMC_70_00654	Mansfield Road	PUM	Rural	B
SMC_72_01331(A)	Mansfield Road	PUM	Rural	B
SMC_72_01331(B)	Mansfield Road	PUM	Rural	B

Bribie Island – Structure Prioritisation

WW_ID	Xing_Name	Domain	Land use	Priority
BON_01_00137	Welsby Parade	BRI	Urban	A
BON_01_00212	Footpath	BRI	Urban	A
BON_01_00811	Goodwin Drive	BRI	Urban	A
BON_01_01940	Protea Drive	BRI	Urban	A
BON_03_00000	Cotterill Avenue	BRI	Urban	A
BON_09_00050	Welsby Parade	BRI	Urban	A
BON_09_00673	Goodwin Drive	BRI	Urban	A
BON_13_00238	Minor Road	BRI	Urban	A
BON_21_00037	South Esplanade	BRI	Urban	A
BON_21_00612	Toorbul Street	BRI	Urban	A
DUX_01_02462	Sunderland Drive	BRI	Urban	A
DUX_01_01826	Footpath	BRI	Urban	A
Not on reach	Benabrow Avenue	BRI	Urban	A
Not on reach	Benabrow Avenue	BRI	Urban	A
DUX_01_03276	Hornsby Road	BRI	Urban	A
DUX_02_00701	Eagles Landing	BRI	Urban	A
DUX_04_00568	Sunderland Drive	BRI	Urban	A
DUX_04_02128	Quarterdeck Drive	BRI	Urban	A
DUX_06_00128	Endeavour Drive	BRI	Urban	A

WW_ID	Xing_Name	Domain	Land use	Priority
DUX_09_00546	Marina Boulevard	BRI	Urban	A
DUX_11_00000	Minor Road	BRI	Urban	A
DUX_11_00000	Minor Road	BRI	Urban	A
DUX_11_00000	Minor Road	BRI	Urban	A
DUX_12_00000	Island Parade	BRI	Urban	A
DUX_15_00000	Footpath	BRI	Urban	A
DUX_15_00148	Eucalypt Street	BRI	Urban	A
DUX_15_00148	Eucalypt Street	BRI	Urban	A
DUX_15_00148	Sylvan Beach Esplanade	BRI	Urban	A
FRE_01_00429	Access Surf Club	BRI	Urban	A
FRE_01_00623	First Avenue	BRI	Urban	A
FRE_01_00623	First Avenue	BRI	Urban	A
FRE_01_01047	Second Avenue	BRI	Urban	A
WRI_01_00227	White Patch Esplanade	BRI	Rural	B
WRI_01_03180	Minor Road	BRI	Rural	B
WRI_02_00042	White Patch Esplanade	BRI	Urban	A
WRI_03_00554	Minor Road	BRI	Rural	B
WRI_05_00000	Footpath	BRI	Urban	A

Appendix D
Bathymetric data assessment and gap analysis

Appendix D – Bathymetric data assessment and gap analysis

Pumicestone Passage – Bathymetric data gap analysis and prioritization

Reach	Approximate Width	Priority	Data Available
ELI_01_00000	610	A	No
ELI_01_00477	420	A	No
ELI_01_01480	160	A	No
ELI_01_02483	120	A	No
ELI_01_03485	130	A	No
ELI_01_03717	95	A	No
ELI_01_04719	120	A	No
ELI_01_05721	50	A	No
ELI_01_06360	40	A	No
ELI_01_06450	55	A	No
ELI_01_07455	35	A	No
ELI_01_07492	45	A	No
ELI_01_08494	35	A	No
ELI_01_09496	35	A	No
ELI_01_09748	90	A	No
ELI_01_10536	40	A	No
ELI_01_11395	85	A	No
ELI_01_12398	150	B	No
ELI_01_12848	60	B	No
ELI_01_13527	40	B	No
ELI_01_14534	35	B	No
ELI_01_15341	35	B	No
ELI_01_15535	30	B	No
ELI_01_16541	45	B	No
ELI_01_17562	25	B	No
ELI_01_18208	45	B	No
ELI_01_18581	30	B	No
ELI_01_19599	45	B	No
ELI_01_20608	60	B	No
ELI_11_00000	410	B	No
ELI_11_00873	150	B	No
ELI_11_01875	180	B	No
ELI_11_02446	120	B	No
ELI_12_00000	70	B	No
ELI_15_00000	20	B	No
GMC_01_00000	190	B	No

Reach	Approximate Width	Priority	Data Available
GMC_01_00319	190	B	No
GMC_01_00604	140	B	No
GMC_01_01320	420	B	No
GMC_01_02323	490	B	No
GMC_01_02719	250	B	No
GMC_01_03325	280	B	No
GMC_01_04327	180	B	No
GMC_01_04695	160	B	No
GMC_01_05586	30	B	No
GMC_01_06379	20	B	No
GMC_01_06600	20	B	No
GMC_01_06792	25	B	No
GMC_01_06969	20	B	No
GMC_01_07726	10	B	No
GMC_01_08734	10	B	No
GMC_07_00000	5	B	No
NIN_01_00000	180	A	No
NIN_01_01000	180	A	No
NIN_01_02001	210	A	No
NIN_01_02695	90	A	No
NIN_01_03762	120	A	No
NIN_01_04195	120	A	No
NIN_01_04346	130	A	No
NIN_01_05009	150	A	No
NIN_01_05871	60	A	No
NIN_01_06010	60	A	No
NIN_01_07014	30	A	No
NIN_01_08016	30	A	No
NIN_01_09018	15	A	No
NIN_01_09575	15	A	No
NIN_01_10020	15	A	No
NIN_01_10052	15	A	No
NIN_01_10735	10	B	No
NIN_01_11367	10	B	No
NIN_01_11737	10	B	No
NIN_01_12891	10	B	No
NIN_01_13893	10	B	No
NIN_01_14016	10	B	No
NIN_01_15043	10	B	No

Reach	Approximate Width	Priority	Data Available
NIN_01_16067	10	B	No
NIN_01_16736	10	B	No
NIN_01_17759	20	B	No
NIN_01_18261	20	B	No
NIN_01_18391	20	B	No
NIN_01_19284	10	B	No
NIN_03_00000	70	B	No
NIN_03_01109	70	B	No
NIN_34_00000	80	B	No
NIN_34_00156	80	B	No
NIN_36_00000	80	B	No
NIN_36_00225	10	B	No
SMC_01_00000	30	B	Yes
SMC_01_00561	30	B	Yes
SMC_01_01454	35	B	Yes
SMC_01_01554	35	B	Yes
SMC_01_02462	90	B	Yes
SMC_01_02645	90	B	Yes
SMC_01_02671	80	B	Yes
SMC_01_03163	80	B	Yes
SMC_01_03785	50	B	Yes
SMC_01_04812	20	B	Yes
SMC_01_04961	15	B	Yes
SMC_01_05975	20	B	Yes
SMC_01_06731	20	B	Yes
SMC_01_06873	20	B	Yes
SMC_09_00000	30	B	Yes
SMC_09_00045	30	B	Yes
SMC_58_00000	30	B	Yes
SMC_64_00000	10	B	Yes
SMC_64_00746	10	B	Yes
SMC_64_00861	10	B	Yes
SMC_64_01057	5	B	Yes
SMC_64_01396	5	B	Yes

Bribie Island – Bathymetric data gap analysis and prioritisation

Reach	Approximate Width	Priority	Data Available
BON_01_00000	70	A	Yes
BON_01_00137	70	A	Yes
BON_01_00212	70	A	Yes
BON_01_00664	70	A	Yes
BON_01_00811	70	A	Yes
BON_01_01701	70	A	Yes
BON_01_01817	70	A	Yes
BON_01_01940	70	A	Yes
BON_02_00000	60	A	Yes
BON_03_00000	50	A	Yes
BON_05_00000	70	A	Yes
BON_21_00037	10	B	No
BON_21_00612	10	B	No
DUX_01_00000	150	A	Yes
DUX_01_00568	150	A	Yes
DUX_01_00860	150	A	Yes
DUX_01_01204	60	A	Yes
DUX_01_01826	60	A	Yes
DUX_02_00000	60	A	Yes
DUX_02_00701	60	A	Yes
DUX_04_00000	150	A	Yes
DUX_04_00568	150	A	Yes
DUX_04_00738	150	A	Yes
DUX_04_00994	150	A	Yes
DUX_04_01461	150	A	Yes
DUX_04_02128	150	A	Yes
DUX_06_00000	60	A	Yes
DUX_06_00128	60	A	Yes
DUX_07_00000	60	A	Yes
DUX_08_00000	60	A	Yes
DUX_09_00000	60	A	Yes
DUX_10_00000	60	A	Yes
DUX_11_00000	60	A	Yes
DUX_12_00000	60	A	Yes
DUX_15_00000	10	A	No
DUX_15_00148	20	A	No
FRE_06_01263	30	B	No
FRE_06_01416	30	B	No

Reach	Approximate Width	Priority	Data Available
FRE_06_01891	30	B	No
FRE_06_02350	30	B	No
FRE_06_02999	30	B	No
FRE_08_00000	15	B	No
FRE_08_00430	15	B	No
FRE_11_00000	20	B	No
FRE_11_00785	10	B	No
WRI_01_00000	70	A	No
WRI_01_00160	30	A	No
WRI_01_00227	30	A	No
WRI_05_00000	20	A	No

Appendix E
Survey requirements

Appendix E – Survey requirements

Bridge survey requirements

Priority A

WW_ID	Domain	Xing_Name	Priority A Survey Required
BEE_01_01652	PUM	Bruce Highway	Handrail
BEE_01_01675	PUM	Bruce Highway	Handrail
BEE_01_06768	PUM	Railway	Pier Data, Deck Elevation Data
BEE_01_07615	PUM	Railway	All
BEE_10_01778	PUM	Beerburrum Road	All
SMC_01_05975	PUM	Railway	Pier Data, Deck Vertical Data
BON_01_00137	BRI	Welsby Parade	All
BON_01_00811	BRI	Goodwin Drive	All
BON_09_00050	BRI	Welsby Parade	All
BON_21_00037	BRI	South Esplanade	All
DUX_01_02462	BRI	Sunderland Drive	All
DUX_01_01826	BRI	Footpath	All
DUX_02_00701	BRI	Eagles Landing	All
DUX_04_00568	BRI	Sunderland Drive	All
DUX_04_02128	BRI	Quarterdeck Drive	All
DUX_11_00000	BRI	Minor Road	All
DUX_11_00000	BRI	Minor Road	All
DUX_12_00000	BRI	Island Parade	All
WRI_05_00000	BRI	Footpath	All

Priority B

WW_ID	Domain	Xing_Name	Priority B Survey Required
ELI_01_09748	PUM	Footbridge	All
NIN_36_00225	PUM	Footbridge	All
SMC_34_03784	PUM	Bridge	All

Bathymetric survey requirements

Priority A Survey Required	Priority B Survey Required
ELI_01_00000 to ELI_11395	ELI_01_12398 to ELI_01_20608
NIN_01_00000 to NIN_01_10052	ELI_11_00000 to ELI_11_02446
DUX_15_00000 to DUX_15_00148	ELI_12_00000
WRI_01_00000 to WRI_01_00227	GMC_01_00000 to GMC_01_05586
	NIN_01_10735 to NIN_01_19284
	NIN_03_00000 to NIN_03_01109
	NIN_34_00000 to NIN_34_00156
	NIN_36_00000 to NIN_36_00225
	BON_21_00037 to BON_21_00612

Appendix F
Survey scope document

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Project: RFD Stage 2 Detailed Modelling	Reference: 211090-002

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Subject: Survey Scope - MBRC Infrastructure

Paul

As discussed, we are requesting a cost estimate to undertake survey of a number of different infrastructure types within the Moreton Bay Regional Council area. I've sought clarification from Council regarding which survey items are required and we would like quotes for the following two elements:

- The bridge, detention basin, trunk drainage and bathymetric components outlined in Sections 1 to 2 of this document
- A general cost per culvert and per bridge for other areas of Moreton Bay Regional Council, in particular the Stanley River and Mary River catchments shown in Figure 1

Can you please provide separate costs for the bridges and bathymetric components outlined below? Can you also provide separate costs for the Priority A and Priority B categories?

1. Bridges

Table 1 presents the general survey data requirements for the bridges. Table 2 and Figure 2 present the bridges for which survey is required.

Table 1 Survey Data Capture Requirements

Item	Description	Data Type	Width	Decimals	Domain/Remark
No of spans	Number of bridge spans	Integer	4	0	
Length of spans[1]	Distance between pier centres	Double	12	3	
Deck point 1	Coordinate at corner of bridge deck – upstream, left hand side of deck when looking downstream	Double	12	3	
Deck level 1	Level at deck point 1	Double	12	3	
Deck point 2	Coordinate at corner of bridge deck – upstream, right hand side of deck when looking downstream	Double	12	3	
Deck level 2	Level at deck point 2	Double	12	3	

Project: RFD Stage 2 Detailed Modelling	Reference: 211090-002

Item	Description	Data Type	Width	Decimals	Domain/Remark
Deck point 3	Coordinate at corner of bridge deck – downstream, left hand side of deck when looking downstream	Double	12	3	
Deck level 3	Level at deck point 3	Double	12	3	
Deck point 4	Coordinate at corner of bridge deck – downstream, right hand side of deck when looking downstream	Double	12	3	
Deck level 4	Level at deck point 4	Double	12	3	
Deck point 5	Coordinate at highest point on bridge deck	Double	12	3	
Deck level 5	Level at deck point 5	Double	12	3	
Deck thickness	Thickness of deck from top of deck to soffit (ie top of headstock)	Double	12	3	
No of piers	Number of piers	Integer	4	0	
No of piles per pier	Number of separate piles in each pier	Integer	4	0	
Pile shape[2]	Shape of each pile	Text	30	0	Round/Square/ H-I/Oblong/Other
Pile width	Width of pile in flow direction	Double	12	3	
Pier orientation[3]	Orientation of piers to bridge deck	Integer	4	0	
Handrail type[2]	Handrail material type	Text	30	0	None/Guardrail/ Galvanised Pipes/Galvanised Vertical Bars/Other
Handrail length	Length of handrail	Double	12	3	
Handrail elevation 1	Elevation at centre of upstream handrail if level, otherwise elevation at higher end	Double	12	3	
Handrail elevation 2	Elevation at lower end of upstream handrail	Double	12	3	
Bridge cross-section[4]	Cross section of channel below bridge from top of abutment to top of abutment	Double	12	3	
Photo georeference[5]	Coordinate of photo locations	Double	12	3	Minimum of 4

[1] If span lengths differ then additional details will be required (ie field notes)
[2] If "other" is specified then additional details will be required (ie field notes)
[3] Detailed survey of pier angle is not required – angle such as 10°, 45°, 60° etc is acceptable
[4] Points to be surveyed at locations in which the grade changes
[5] A minimum of 4 photographs is required. These are looking upstream and downstream from the bridge and looking at the upstream and downstream sides of the bridge. Other photographs which validate the above information may also be required (especially with regards to pier details, handrail details and where the Domain/Remark has been selected as "other")

Please note that:

- All data is to be delivered in MGA coordinates with the origin of coordinates (PM number), coordinate values and estimated accuracy provided. Accuracy is to be 4th order or better
- All heights are to be on AHD datum with origin datum supplied. Accuracy is to be 4th order or better
- The data is to be supplied in ESRI shape file format
- GPS (RTK) methods are acceptable and will achieve the desired accuracies. Ensure there are redundant checks to verify the accuracy

Table 2 Survey Data Locations

Bridge ID	Crossing Name	Crossing Type	Approx. Easting	Approx. Northing
Priority A				
BEE_01_01652	Bruce Highway	Vehicle	497805	7013974
BEE_01_01675	Bruce Highway	Vehicle	497782	7013975
BEE_01_06768	Railway	Vehicle	495565	7016544
BEE_01_07615	Railway	Vehicle	495302	7017144
BEE_10_01778	Beerburrum Road	Vehicle	494894	7014900
SMC_01_05975	Railway	Vehicle	494597	7012038
BON_01_00137	Welsby Parade	Vehicle	515421	7005547
BON_01_00811	Goodwin Drive	Vehicle	516056	7005739
BON_09_00050	Welsby Parade	Vehicle	515677	7004747
BON_21_00037	South Esplanade	Vehicle	515778	7003933
DUX_01_02462	Sunderland Drive	Vehicle	515374	7006499
DUX_01_01826	Footpath	Pedestrian	515439	7007366
DUX_02_00701	Eagles Landing	Vehicle	515082	7008036
DUX_04_00568	Sunderland Drive	Vehicle	513791	7008578
DUX_04_02128	Quarterdeck Drive	Vehicle	514065	7009704
DUX_11_00000	Footbridge	Pedestrian	513909	7007694
DUX_11_00000	Footbridge	Pedestrian	513909	7007694
DUX_12_00000	Island Parade	Vehicle	513968	7008859
WRI_05_00000	Footbridge	Pedestrian	513238	7009480
Priority B				
ELI_01_09748	Footbridge	Pedestrian	503998	7010381
NIN_36_00225	Footbridge	Pedestrian	512305	7006357
SMC_34_03784	Bridge	Vehicle	490139	7011934

2. Bathymetry

Cross-section survey of below-water bathymetry is required for the following creek reaches (as shown in Figure 3). Please provide a quote for surveying cross-sections at an average spacing of 500m on Elimbah Creek and Ningi Creek and at average spacings of 200m for the Bribie Island waterways. The length of each reach for survey of priority A is:

- Elimbah Creek – 12398m
- Ningi Creek – 10735m
- Bellara Detention Basin and Outlet Channel – 756m
- Solander Drain – 960m

We have not included the lengths for survey Priority B channels at this stage.

3. Culverts

For the general costs per culvert, please base these on the following survey requirements.

Table 3 Survey Data Capture Requirements

Item	Description	Data Type	Width	Decimals	Domain/Remark
Culvert type	Description of culvert type	Text	30	0	Pipe/Box/Slab-link box
Diameter or width	Diameter of pipe culvert or width of box or slab-link culvert	Double	12	3	
Height (box)	Internal height of box culvert	Double	12	3	
Height (slab)	Internal height under slab	Double	12	3	
No. barrels	Number of culvert barrels	Integer	4	0	
Inlet point	Coordinate of inlet point (centre of upstream headwall)	Double	12	3	
Outlet point	Coordinate of outlet point (centre of downstream headwall)	Double	12	3	
Length	Length of culvert	Double	12	3	
Upstream invert level	Upstream invert level	Double	12	3	
Downstream invert level	Downstream invert level	Double	12	3	
Material type[1]	Culvert material type	Text	20	0	Concrete/Corrugated iron/Other
Wingwall material type[1]	Headwall and wingwall material type	Text	20	0	Concrete/Block/Rock/None/Other
Wingwall angle[2]	Angle between headwall and wingwall	Integer	4	0	
Pipe inlet details[1]	Description of pipe inlet	Text	30	0	Rounded/Square-edged/Other

Project: RFD Stage 2 Detailed Modelling	Reference: 211090-002

Item	Description	Data Type	Width	Decimals	Domain/Remark
Road elevation 1	RL at centre of structure on road crown if road is level; otherwise RL at higher end of structure on road crown if road has super-elevation	Double	12	3	
Road elevation 2	RL at lower end of structure on road crown if road not level if road has super-elevation; ignore otherwise	Double	12	3	
Handrail type[1]	Handrail material type	Text	30	0	None/Guardrail/ Galvanised Pipes/Galvanised Vertical Bars/Other
Handrail length	Length of handrail	Double	12	3	
Handrail elevation 1	Elevation at centre of handrail if level, otherwise elevation at higher end	Double	12	3	
Handrail elevation 2	Elevation at lower end of handrail	Double	12	3	
Photo georeference[3]	Coordinate of photo locations	Double	12	3	Minimum of 4

[1] If "other" is specified then additional details will be required (ie field notes)

[2] Detailed survey of wingwall angle is not required – angle such as 100°, 135°, 150° etc is acceptable. Note angle should be 0° if no wingwalls are present (ie if headwall only)

[3] A minimum of 4 photographs is required. These are looking at the channel upstream and downstream of the culvert and looking at the upstream and downstream ends of culvert. Other photographs which validate the above information may also be required (especially with regards to headwall/wingwall setup, pipe inlet details, handrail details and where the Domain/Remark has been selected as "other")

Please note that:

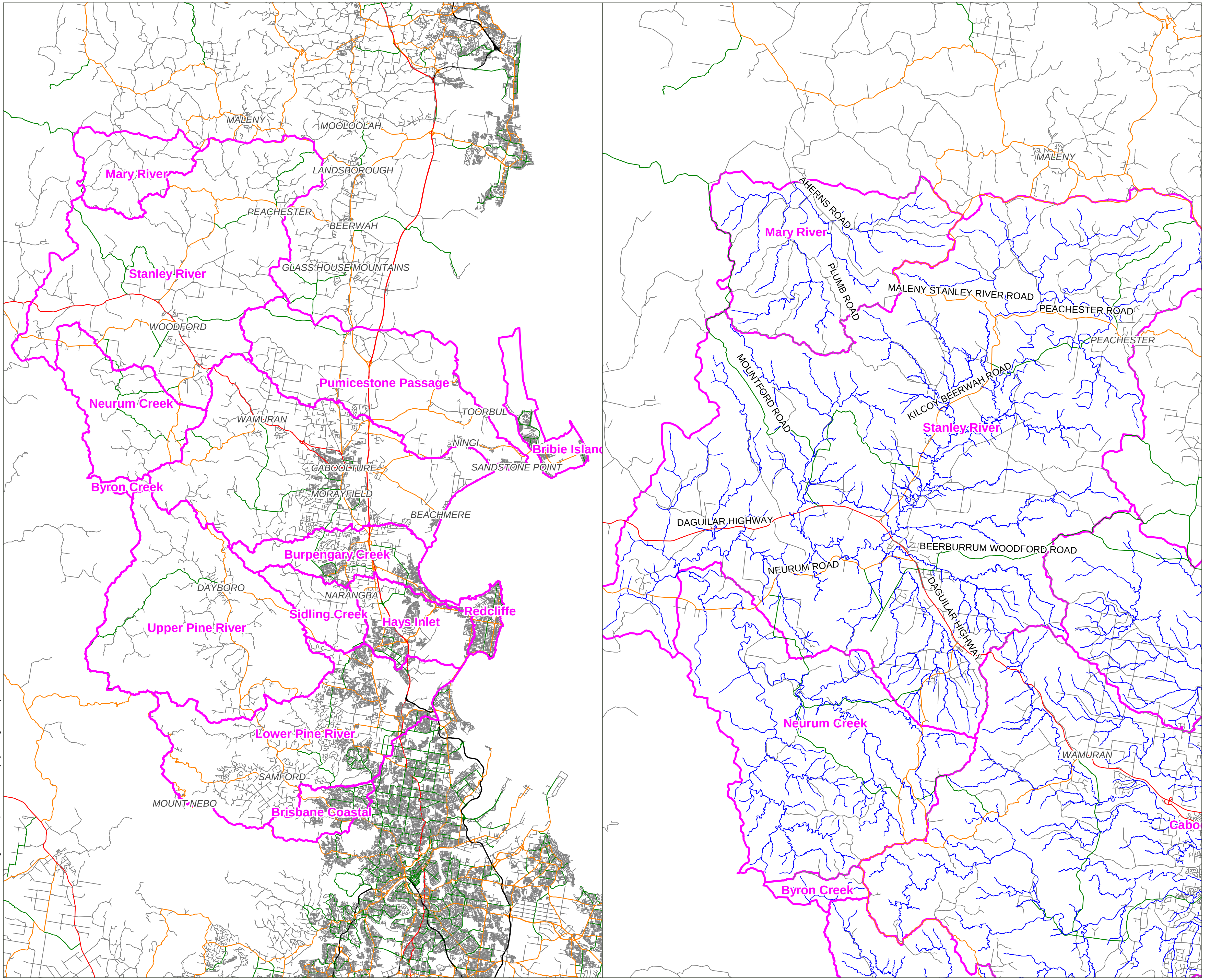
- All data is to be delivered in MGA coordinates with the origin of coordinates (PM number), coordinate values and estimated accuracy provided. Accuracy is to be 4th order or better
- All heights are to be on AHD datum with origin datum supplied. Accuracy is to be 4th order or better
- The data is to be supplied in ESRI shape file or csv format
- GPS (RTK) methods are acceptable and will achieve the desired accuracies. Ensure there are redundant checks to verify the accuracy

If you require any further information please let me know.

Regards

TCampbell

Talia Campbell
Senior Engineer
Water



Legend

Minor Basin

Streams

Roads by Heirarchy

- 1
- 2
- 3
- 4
- 5

Notes:

Date: 19/10/2010 Version: 0

0 150 (m)

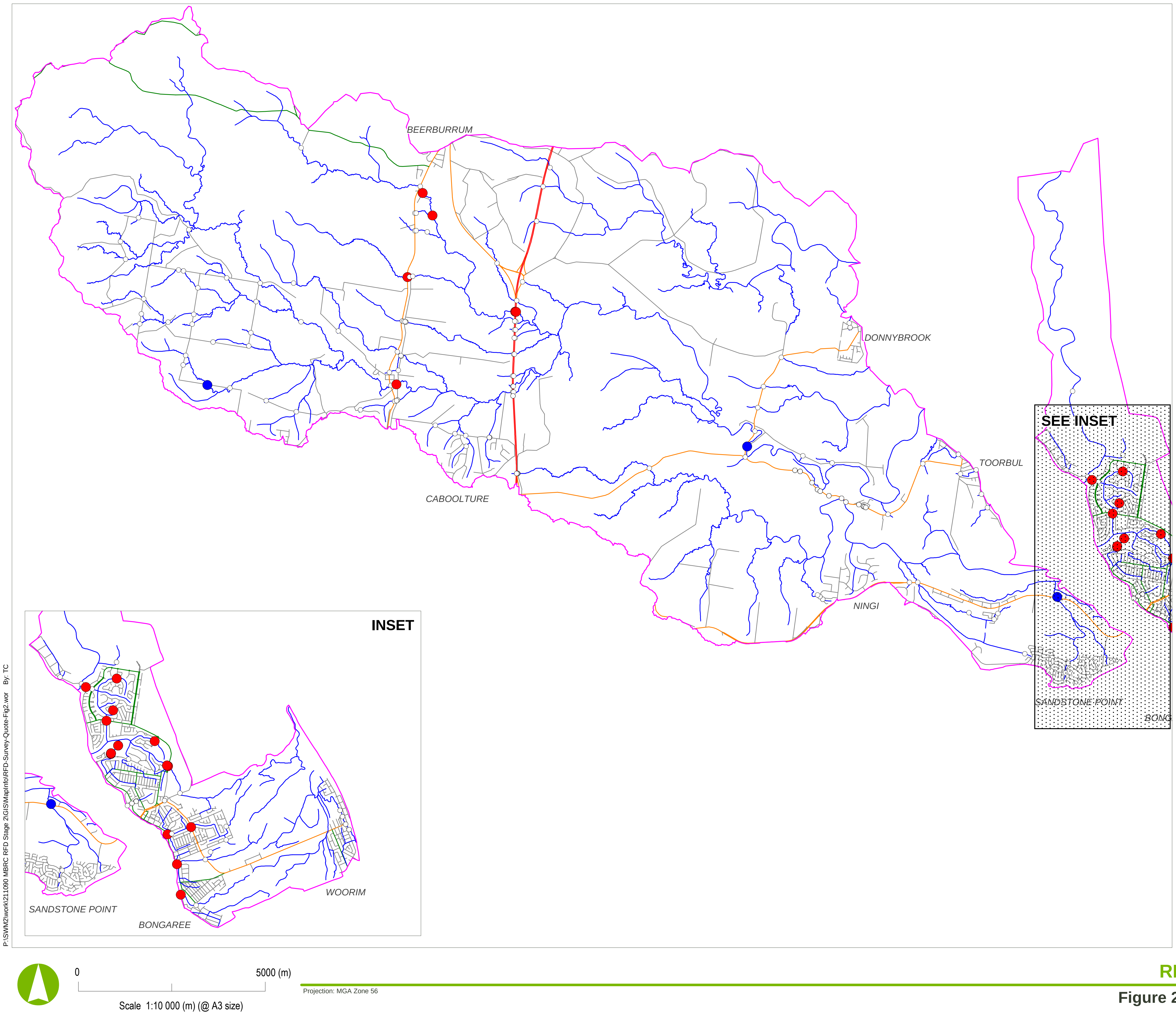
Scale 1:3 000 (m) (@ A3 size)

Projection: MGA Zone 56

P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\RFD-Survey-Quote-Fig1.wor By: TC

RFD Stage 2 Detailed Modelling

Figrue 1: Catchments for Survey Quote



Legend

Roads by Heirarchy

- 1
- 2
- 3
- 4
- 5

Reaches

Survey Requirements

- No Survey Required
- Priority A
- Priority B

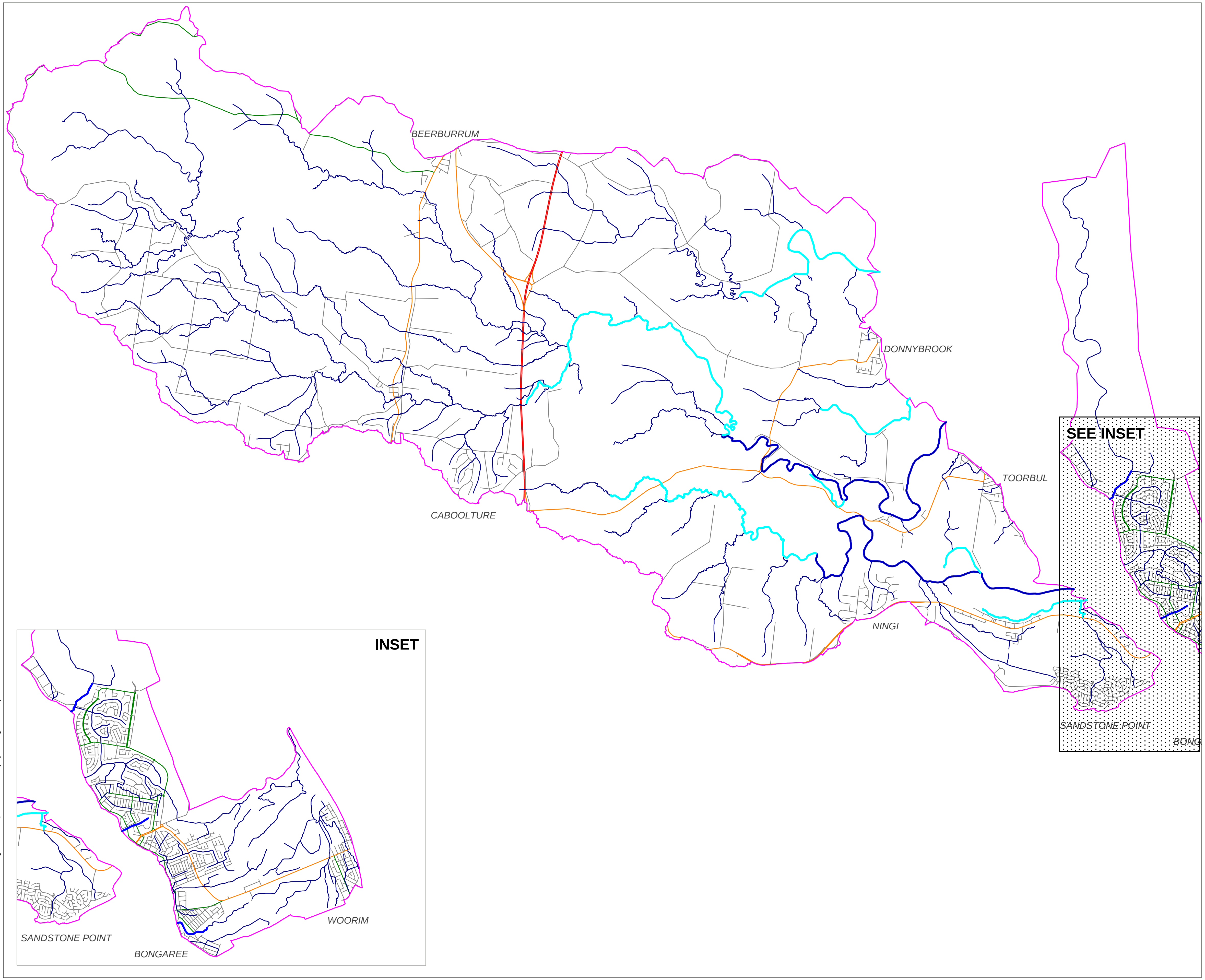
Notes:

Date: 20/10/2010

Version: 0

RFD Stage 2 Detailed Modelling

Figure 2: Structure Data Survey Locations



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aurecon

Legend

Roads by Heirarchy
- 1
- 2
- 3
- 4
- 5

- Non-Critical Reaches
- Priority A Survey Required
- Priority B Survey Required

Notes:

Date: 20/10/2010 Version: 0

0 5000 (m)

Scale 1:10 000 (m) (@ A3 size)

Projection: MGA Zone 56

RFD Stage 2 Detailed Modelling

Figure 3: Bathymetric Data Survey Locations

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Appendix B
Hydrography Review Report

Appendix B
Hydrography Review Report

Project: Regional Floodplain Database Stage 2 Detailed Modelling – Package 3 Pumicestone Passage and Bribie Island

Hydrography Review Report

Reference: 211090

Prepared for: Moreton Bay Regional Council

Revision: 1

31 May 2012

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Document Control Record

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Approval			
Author Signature		Approver Signature	Trinity Graham
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Title	Associate	Title	Technical Director

Regional Floodplain Database Stage 2 Detailed Modelling – Package 3 Pumicestone Passage and Bribie Island

Date | 31 May 2012
Reference | 211090
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Contents

Index of Figures

Index of Tables

1 Introduction

1.1 Study objective

Moreton Bay Regional Council (MBRC) is delivering a Regional Floodplain Database (RFD) in support of their flood risk management, considering emergency response, development control, strategic landuse and infrastructure planning. The MBRC was recently formed under local government amalgamations and is responsible for Caboolture, Pine Rivers, Redcliffe and Bribie Island. The RFD project is focusing on the northern sector as a key growth area for south east Queensland.

The project is being funded by MBRC, Emergency Management Queensland (EMQ) and Emergency Management Australia (EMA) as part of the Disaster Resilience Program and will provide:

- A comprehensive and consistent description of flood behaviour across the region
- Strategies for management of any flooding problems identified
- A system/process to store and manage this information and keep it up-to-date

Stage 1 of the project was completed in July 2010 and involved a number of sub-projects. These projects delivered consistent processes and protocols for the detailed hydrologic and hydraulic model development. A key sub-project involved the development of broadscale hydrodynamic models for each minor basin to provide general understanding of flooding mechanisms and allow prioritisation of data capture.

Stage 2 (current stage) of the project involves the development of detailed hydrologic and hydraulic models for each minor basin.

Stage 3 will build on the detailed models and “add value” through assessment of flood damages and community resilience measures.

1.2 Objective of hydrography review report

This report pertains to the hydrography review for Package 3, covering two minor basins:

- Bribie Island
- Pumicestone Passage (including Six Mile, Beerburrum, Elimbah, Ningi and Glass Mountain Creeks)

The term ‘hydrography’ describes the sub-catchment delineation, stream reach lines and junction locations and will form the basis of the hydrological model. The hydrography is required to support the following key objectives:

- Sufficiently define catchments to ensure accurate definition of contributing areas at key points of interest (urbanised areas, drainage control points, areas marked for future development)
- Support the hydraulic model objectives through appropriate flow reporting locations, noting the following:
  - The hydraulic model will apply inflow distributed across the sub-catchment, effectively “filling” the sub-catchment from the lowest point
  - The hydraulic model will advise on flood immunity of major roads accessing key urban areas

MBRC have provided initial sub-catchment boundaries, stream reaches and junctions. A review of the hydrography has been undertaken for each minor basin to ensure compliance with the above objectives.

2 Hydrography review

2.1 Package 3 minor basin appreciation

Bribie Island

Bribie Island is located east of Donnybrook, separated by the Pumicestone Passage. The northern two-thirds of the island is National Park. Urbanisation exists along the western shore in the lower third of the island and along the eastern shore in the south east corner. The southern tip is also heavily vegetated with no development.

The island formation is a low lying sand deposit, with minimal natural creeks and watercourses, however there are a number of canal developments on the island. As a result, flood risk is governed by tide/canal levels (including any tidal processes that occur within the Passage) and the stormwater network capacity for the minor storm events. Overflow in major events is generally conveyed via the road network and/or low-lying areas.

Comparison of the 2005 Caboolture Shire Plan with the aerial photography indicates that areas marked for residential development are already under construction. It is unknown whether further significant development is planned for the island.

Key areas of interest are:

- White Patch Esplanade bridge
- Banksia Beach canal estate
- Bellara
- Bongaree canal estate
- Woorim and Esplanade (northern tip)

Pumicestone Passage

The Pumicestone Passage minor basin extends from the D'Aguilar Ranges, incorporating the Glasshouse Mountains, to the Pumicestone Passage across from Bribie Island. The basin has low levels of urbanisation with National Park in the upper reaches and rural residential land use in the lower reaches. The basin is traversed by the Bruce Highway, the North Coast Railway and Beerburrum Road. The urban centres include Beerburrum and Elimbah upstream of the Bruce Highway. On the shoreline, Donnybrook and Toorbul are the main areas of urbanisation.

The southern boundary of the basin follows Bribie Island Rd and incorporates Ningi and Sandstone Point, at the entry bridge to Bribie Island. These areas are both subject to new housing developments. The northern fringes of Caboolture are also included in the basin.

As for Bribie Island, areas shown for development within the 2005 Caboolture Shire Plan either exist or are under construction.

Key areas of interest are:

- Toorbul and access roads
- Donnybrook and access roads
- Sandstone Point/Ningi (future development focus area)
- North Coast Railway and Bruce Highway

2.2 Issues identified during Stage 1

Common issues to both minor basins

There were a number of issues raised during the broadscale modelling development in Stage 1 that are relevant to the hydrography definition for both systems. These include:

- Where a major road reach has been delineated as a separate sub-catchment, the road will show as overtopping under all design events regardless of the deck level relative to flood levels
- Where junctions along the shoreline are located within the ocean/Passage, inflow for that sub-catchment will be applied to the water body, bypassing the downstream sub-catchment

Issues specific to each minor basin are discussed below.

Bribie Island

The broadscale modelling report discusses potential flow breakouts in the north-western area of the proposed modelling domain. Although this area is not of interest, it potentially affects the flow volume diverted south towards the White Patch Esplanade crossing. This could impact the estimated flood immunity of the crossing.

The northern and southern areas of the island are heavily vegetated which has impacted the LiDAR (aerial survey) capture. The broadscale report recommends further data capture in these areas if they are likely to be of interest. With reference to the 2005 Caboolture Shire Plan, it is not considered that these areas would be focus areas for future development on the island. It is therefore suggested that further data capture and refinement in these areas would not be warranted.

Pumicestone Passage

The broadscale modelling report discusses infilling of the Digital Elevation Model (DEM) in the upper reaches of the basin. It is understood that Council have subsequently obtained LiDAR for this area. Given the low level of development in this area, it is unlikely that the quality of the DEM in this area will have an impact on the project objectives.

During Stage 1 it was identified that the level of detail in the upper-most sub-catchments results in a reduced level of detail in the resultant hydraulic model output. Where these sub-catchments are large, the inflows to the hydraulic model are not located in the very upper reaches of the catchment and the predicted inundation extents may be truncated. This is only considered to be of concern where critical areas of interest are located within these upper catchments.

2.3 Stream connectivity

A review of the sub-catchment and reach network was undertaken with reference to the study objectives outlined in Section 1.2. For the Bribie Island basin, two main issues were noted:

- The north-western breakout, as discussed in the previous section
- Inconsistency with the stormwater network

Council provided the trunk drainage stormwater network for Bribie Island. In the Banksia Beach area, it is estimated that the contributing catchments may vary by up to 20% for the minor storm events, during which flow is conveyed via the piped network. Given that high flows will be conveyed along the streets and into the canals, the flow patterns will not generally change from what has been represented in the hydrography. As such, it is not anticipated that this would significantly affect the model output.

However, in the vicinity of Cassia Ave minor event flows would drain to Dux Creek in the south rather than the canal system to the north. The DEM indicates that surface flows would follow a similar path. This may have an impact on local flooding extent predictions.

Another area of concern is the Bellara Detention Pond where sub-catchments for minor storm events potentially differ by 50%. Again, surface flow is likely to follow the same path (given that the road network is a significant drainage component) and this may have an impact on local flooding extents predictions.

For the Pumicestone Passage basin, there have been no issues found in terms of catchment connectivity.

2.4 Inclusion of floodplain structures

The Package 3 Infrastructure Data Assessment Report has identified key structures that are recommended to be included in the hydraulic models. Table 1 below includes a list of the structures for which no junction currently exists in the hydrography. New junctions will be required at these structure locations to ensure the contributing upstream catchment is correct. Note that this table does not include structures for which there are no reaches in the hydrography but that we intend to include in the hydraulic modelling (eg beneath Pumicestone Road and at the Benabrow Avenue/Sunderland Drive roundabout).

Table 1 | Structures for which no junction exists in the hydrography

WW_ID	Domain	Xing_Name	Description
NIN_01_23388	PUM	Bruce Highway	No junctions included for separate carriageways of the highway (as has been done elsewhere)
NIN_14_00567	PUM	Wattle Grove Drive	
NIN_14_01586	PUM	Minor Road	Crossing of minor road looks significant in aerial image
NIN_24_03255	PUM	Sandstone Blvd	
SMC_28_00908	PUM	Powell Road	
SMC_42_00788	PUM	Williams Road	
BEE_18_05085	PUM	Railway	Railway culvert on upstream side of Rose Creek Road
BON_01_01940	BRI	Protea Drive	Lock at outlet to Bribie Gardens canal system
DUX_01_01826	BRI	Footpath	Footbridge on downstream side of Sunderland Drive
DUX_11_00000	BRI	Footpath (x2)?	Aerial image shows two structures across this reach – we are unsure of what these structures actually are and whether they need to be included
DUX_12_00000	BRI	Island Parade	
DUX_15_00148	BRI	Eucalypt Street	Bellara Detention Basin outlet
FRE_01_00623	BRI	Second Avenue	
WRI_05_00000	BRI	Footpath	

There is no junction at the Bellara Detention Pond outlet. Flow from the contributing sub-catchment may be applied downstream of the pond and prevent accurate modelling of water levels within the pond, which in turn affects stormwater network performance.

There is a drainage channel running parallel to Marina Blvd that has been omitted from the reaches layer. However, the two-dimensional method of hydraulic modelling will determine this flow path. Modification of the hydrography reach layer is not considered necessary.

2.5 Existing resolution/detail

Given the objectives of the RFD, the resolution of the defined hydrography is generally considered to be appropriate.

One of the primary issues to be considered is the application of the inflow hydrographs using 2d_sa tables within the hydraulic model. If the 2d_sa table is defined to match the sub-catchment boundary, the inflow will be applied to the lowest point within the sub-catchment, with the following impacts:

- For a given sub-catchment, the flow will likely be applied at the junction and from there routed downstream within the creek/channel. Where a sub-catchment has its primary area of interest in the upper reaches, the local inflows will bypass this area. Where residential areas are located on a ridge between the shore and canal, as for Bribie Island, the flow may be applied directly to the shoreline, again bypassing the residential areas
- For the upper-most sub-catchments, there will be no flow routed through them from upstream sub-catchments. Where they are not urbanised or not of concern, the hydrography need not be modified

2.5.1 Future development

In the case of large areas of land being proposed for development, it would be recommended that sub-catchment delineation align with future development to allow the hydrologic and hydraulic models to be easily updated for “future land use” scenarios. However, based on a review of the 2005 Caboolture Shire Plan it is not anticipated that land use and development areas will change significantly from what currently exists.

3 Proposed changes

Based on the issues discussed in the previous section, the hydrography changes in the following sections (3.1 to 3.3) are recommended. Following these sections, Table 2 and Table 3 summarise the issues and recommendations. These tables include a suggested order of priority for the recommended changes, with red being high priority, orange being medium priority and yellow being low priority.

3.1 Stream connectivity

The following recommendations are made with regard to the sub-catchment and reach network definition.

Bribie Island

- It is recommended that the hydrography be aligned with the stormwater – road network in the vicinity of the Banksia Beach Park and the Bellara Detention Pond. Although the stormwater network describes the minor flow system, it is considered to be indicative of the high flow paths in this area. Figure 1 and Figure 2 illustrate the recommended changes (note that the data shown in these Figures is available is GIS format if required)
- As discussed in Section 2.2, there is potential for flow breakout in the north-western area of the proposed model extent which could impact on the accuracy of flow estimates through the White Patch Esplanade crossing. Given that there is no interest in flooding extents in this north-western area, it is not recommended that the hydrography be modified in this area. Provided the hydraulic model active domain is extended further west to the natural ridgeline, the flow split will be sufficiently represented

Pumicestone Passage

- Where a junction is located within the Pumicestone Passage or ocean and there are areas of interest within that sub-catchment, we propose to modify the 2d_sa table within the hydraulic model. This will prevent the inflow for that sub-catchment being applied to the ocean or Passage and being lost from the system. For the Pumicestone basin, this is particularly important for Donnybrook and Toorbul. For the Bribie Island canal areas, modification of the hydrography is not required. Flood risk will be largely defined by the chosen tide level and consequent canal levels. The addition of inflows to the canals will meet the project objectives

3.2 Inclusion of floodplain structures

The following recommendations are made with regard to modifying the hydrography to accommodate floodplain structures.

- For both minor basins, it is recommended that a junction be included at each of the floodplain structures in Table 1, to ensure that the volume of flow calculated at each structure is accurate and to ensure consistency with the hydrography approach adopted for the detailed modelling
- It is recommended that a junction be placed at the Bribie Island Bellara Detention Pond outlet to ensure accurate levels within the pond are predicted and to ensure consistency with the hydrography approach adopted for the detailed modelling

3.3 Resolution/detail

The following recommendations are made with regard to the level of hydrographic detail provided.

Common recommendations for both minor basins

- It is recommended that road reaches which have been defined as separate sub-catchments are incorporated into the upstream catchments. Alternatively, the 2d_sa tables may be modified within the hydraulic model. This will prevent the road being "flooded" in situations where it has not actually been overtopped
- If a sub-catchment has its primary area of interest in the upper reaches, consideration should be given to further dividing the sub-catchment or alternatively, applying more than one 2d_sa table over the region (where flow would be distributed according to area)
- Where an upper-most sub-catchment is of interest, either the hydrography may be modified, or the 2d_sa table modified within the hydraulic model to ensure flow is routed through it

Figure 1 | Recommended hydrography changes in Banksia Beach, Bribie Island (pink = provided hydrography, green = proposed modification)

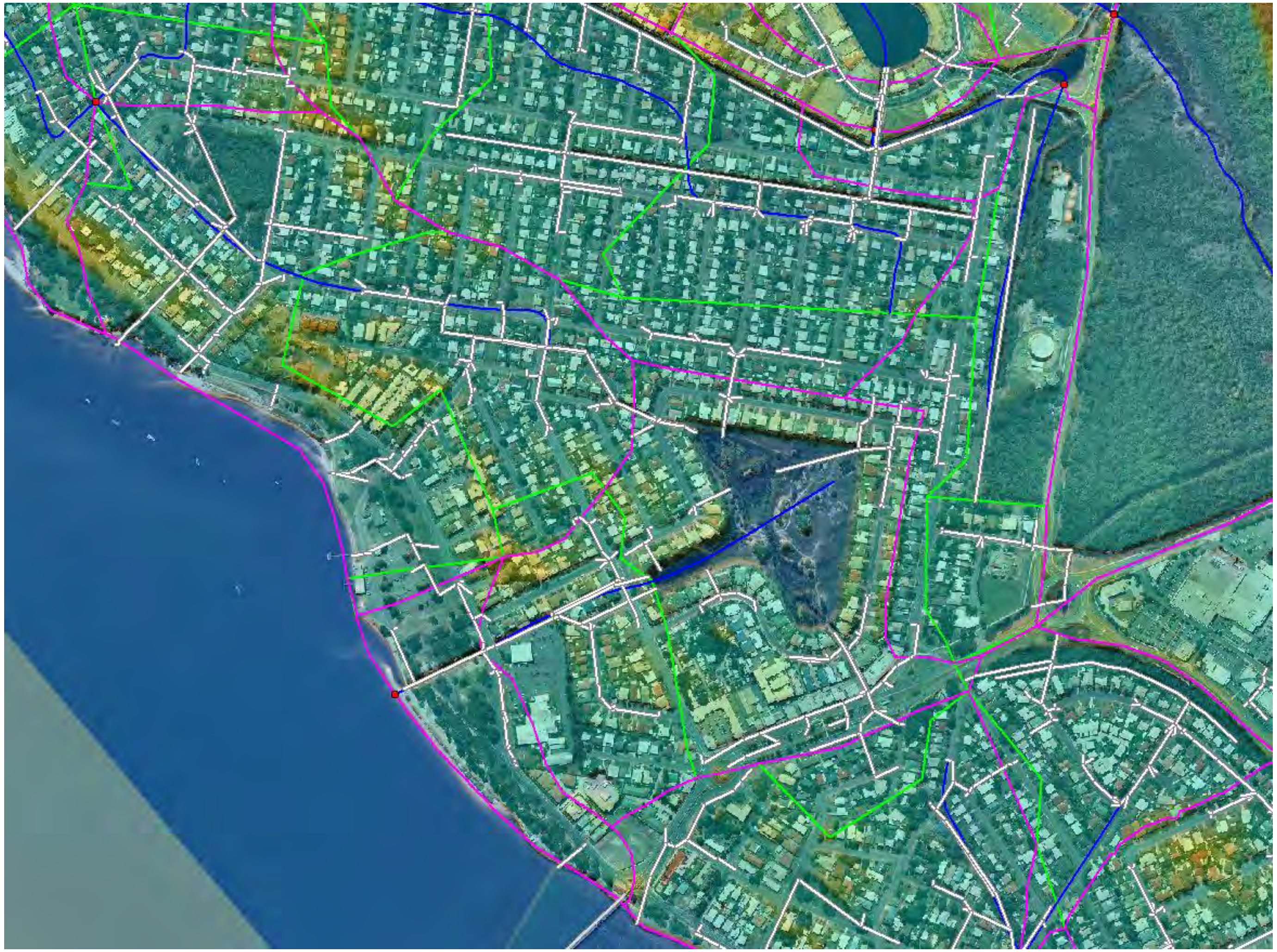

Figure 2 | Recommended hydrography changes in Bellara, Bribie Island (pink = provided hydrography, green = proposed modification)

Table 2 | Bribie Island – Summary of hydrography issues and recommended changes

Priority	Location	Issue	Recommended Change
●	Throughout	Where floodplain structures have been identified for inclusion (with reference to Table 1) a junction is required	Include new junctions at new floodplain structures
●	Throughout	Junctions should be placed in consistent locations throughout the catchment (ie either upstream/on/downstream of structures)	It is recommended that all floodplain structures have a junction placed in a consistent location with reference to the structure
●	Throughout	Where a sub-catchment has its primary area of interest in the upper reaches, local inflows may bypass the area of interest	Refine sub-catchment definition where a sub-catchment has its key area of interest in the upper reach or apply more than one 2d_sa table over the region
●	Endeavour Drive (at White Patch) Banksia Beach	Road surface has been defined as a catchment. Rainfall will be applied directly to road within hydraulic model indicating it is wet even if not overtopped	Include road sub-catchment in upstream sub-catchment or amend 2d_sa table in hydraulic model
●	Banksia Beach West along coast	Sub-catchments include all houses to western coast despite the ridge along Endeavour Drive This increases the size of contributing catchment and may cause flow to be applied along the shoreline only if it is lower ground	Refine sub-catchment delineation
●	Banksia Beach	Sub-catchment delineation is not consistent with the stormwater network provided. Sub-catchments for minor storm events potentially differ by 10-20%. Overland flow paths likely follow same path	Refine sub-catchment delineation
●	Banksia Beach Park	In the vicinity of Cassia Ave, Banksia Beach flow appears to drain to Dux Creek in the south rather than the canal system to the north	Refine sub-catchment delineation in the vicinity of Cassia Ave
●	Marina Boulevard	Road surface has been defined as a catchment. Rainfall will be applied directly to road within hydraulic model indicating it is wet even if not overtopped	Include road sub-catchment in upstream sub-catchment or amend 2d_sa table in hydraulic model
●	Bellara detention pond and surrounding sub-catchments	Sub-catchment delineation is not consistent with the stormwater network provided. Sub-catchments for minor storm events potentially differ by 50%	Modify sub-catchment delineation in the vicinity of Bellara Detention Pond

Priority	Location	Issue	Recommended Change
🔴	Bellara detention pond	There is no junction at the pond outlet. Flow from the contributing catchment may be applied downstream of the pond	Include a junction at the Bellara Detention Pond Outlet.

Table 3 | Bribie Island – Summary of hydrography issues and recommended changes

Priority	Location	Issue	Recommended Change
🔴	Throughout	Where floodplain structures have been identified for inclusion (with reference to Table 1) a junction is required	Include new junctions at new floodplain structures
🟡	Throughout	Junctions should be placed in consistent locations throughout the catchment (ie either upstream/on/downstream of structures)	It is recommended that all floodplain structures have a junction placed in a consistent location with reference to the structure
🟠	Throughout	Where a sub-catchment has its primary area of interest in the upper reaches, local inflows may bypass the area of interest	Refine sub-catchment definition where a sub-catchment has its key area of interest in the upper reach or apply more than one 2d_sa table over the region
🟠	Endeavour Drive (at White Patch) Banksia Beach	Road surface has been defined as a catchment. Rainfall will be applied directly to road within hydraulic model indicating it is wet even if not overtopped	Include road sub-catchment in upstream sub-catchment or amend 2d_sa table in hydraulic model
🟡	Banksia Beach West along coast	Sub-catchments include all houses to western coast despite the ridge along Endeavour Drive This increases the size of contributing catchment and may cause flow to be applied along the shoreline only if it is lower ground	Refine sub-catchment delineation
🟡	Banksia Beach	Sub-catchment delineation is not consistent with the stormwater network provided. Sub-catchments for minor storm events potentially differ by 10-20%. Overland flow paths likely follow same path	Refine sub-catchment delineation
🟠	Banksia Beach Park	In the vicinity of Cassia Ave, Banksia Beach flow appears to drain to Dux Creek in the south rather than the canal system to the north	Refine sub-catchment delineation in the vicinity of Cassia Ave

Priority	Location	Issue	Recommended Change
	Marina Boulevard	Road surface has been defined as a catchment. Rainfall will be applied directly to road within hydraulic model indicating it is wet even if not overtopped	Include road sub-catchment in upstream sub-catchment or amend 2d_sa table in hydraulic model
	Bellara detention pond and surrounding sub-catchments	Sub-catchment delineation is not consistent with the stormwater network provided. Sub-catchments for minor storm events potentially differ by 50%	Modify sub-catchment delineation in the vicinity of Bellara Detention Pond
	Bellara detention pond	There is no junction at the pond outlet. Flow from the contributing catchment may be applied downstream of the pond	Include a junction at the Bellara Detention Pond Outlet.

Table 4 | Pumicestone Passage – Summary of hydrography issues and recommended changes

Priority	Location	Issue	Recommended Change
	Throughout	Where floodplain structures have been identified for inclusion (with reference to Table 1) a junction is required	Include new junctions at new floodplain structures
	Throughout	Junctions should be placed in consistent locations throughout the catchment (ie upstream/on/downstream of structures)	It is recommended that all floodplain structures have a junction placed in a consistent location with reference to the structure
	Throughout	Where a junction is located within the Pumicestone Passage, flow will be applied to the water	No change to the hydrography is recommended. This will be addressed through modification of the 2d_sa tables
	Throughout	Where a sub-catchment has its primary area of interest in the upper reaches, local inflows may bypass the area of interest	Refine sub-catchment definition where a sub-catchment has its key area of interest in the upper reach or apply more than one 2d_sa table over the region

Priority	Location	Issue	Recommended Change
●	Beerburrum Road	Road surface has been defined as a catchment. Rainfall will be applied directly to road within hydraulic model indicating it is wet even if not overtopped	Include road sub-catchment in upstream sub-catchment or amend 2d_sa table in hydraulic model
●	Bruce Highway	Road surface has been defined as a catchment. Rainfall will be applied directly to road within hydraulic model indicating it is wet even if not overtopped	Include road sub-catchment in upstream sub-catchment or amend 2d_sa table in hydraulic model
●	Bribie Island Road Ningi	Road surface has been defined as a catchment. Rainfall will be applied directly to road within hydraulic model indicating it is wet even if not overtopped	Include road sub-catchment in upstream sub-catchment or amend 2d_sa table in hydraulic model

4 Recommendations

Generally, the defined hydrography is considered to be appropriate for the project objectives. Table 2 and Table 3 present recommended changes to the hydrography for the Bribie Island and Pumicestone Passage minor basins. The changes have been presented with a suggested order of priority. It is advised that Council modify the sub-catchments in line with the high priority recommendations (red). The medium (orange) recommendations should also be modified if resources and budget allow it. The low priority recommendations have been included for reference but are unlikely to impact the objectives of the study.

In a number of instances, the application of the flow within the hydraulic model may be modified instead of the hydrography. This has been noted in the summary tables and associated discussion.

It is also recommended that Council reference the latest available Local Plans for the region and consider if further sub-catchment delineation is required to support the "future development" scenarios. Based on the information available for this report, there are no areas of significant development within the Package 3 basins.

5 References

5.1 Documents

Cardno (2009), Bellara Drainage Investigation - Relief Drainage Options, 23 January 2009

Cardno (2008), Bellara Drainage Investigation - Park Lines Relief Drainage Options, 23 December 2008

BMT WBM (2010) Hydraulic Modelling (Broadscale) Regional Floodplain Database - Stage 1 Sub-Project 1D, July 2010

Caboolture Shire Council (2005) Caboolture Shire Plan, December 2005

5.2 Other data

Bribie Island stormwater trunk drainage network, as provided by Council September 2010

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Appendix C
Calibration and Validation Report(s)

Appendix C
Calibration and Validation Report(s)

aurecon

Project: Regional Floodplain Database Stage 2 Detailed Modelling – Package 3: Pumicestone Passage and Bribie Island

Calibration and Validation Feasibility Report

Reference: 211090

Prepared for: Moreton Bay Regional Council

Revision: 1

31 May 2012

Document Control Record

Document prepared by:

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Author Signature		Approver Signature	
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Title	Associate	Title	Technical Director

Regional Floodplain Database Stage 2 Detailed Modelling – Package 3: Pumicestone Passage and Bribie Island

Date | 31 May 2012
Reference | 211090
Revision | 1

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Contents

Appendices

Index of Figures

Index of Tables

1 Introduction

1.1 Study objective

Moreton Bay Regional Council (MBRC) is delivering a Regional Floodplain Database (RFD) in support of their flood risk management, considering emergency response, development control, strategic landuse and infrastructure planning. The MBRC was recently formed under local government amalgamations and is responsible for Caboolture, Pine Rivers, Redcliffe and Bribie Island. The RFD project is focusing on the northern sector as a key growth area for south east Queensland.

The project is being funded by MBRC, Emergency Management Queensland (EMQ) and Emergency Management Australia (EMA) as part of the Disaster Resilience Program and will provide:

- A comprehensive and consistent description of flood behaviour across the region
- Strategies for management of any flooding problems identified
- A system/process to store and manage this information and keep it up-to-date

Stage 1 of the project was completed in July 2010 and involved a number of sub-projects. These projects delivered consistent processes and protocols for the detailed hydrologic and hydraulic model development. A key sub-project involved the development of broadscale hydrodynamic models for each minor basin to provide general understanding of flooding mechanisms and allow prioritisation of data capture.

Stage 2 (current stage) of the project involves the development of detailed hydrologic and hydraulic models for each minor basin.

Stage 3 will build on the detailed models and “add value” through assessment of flood damages and community resilience measures.

1.2 Objective of calibration and validation feasibility report

This report pertains to the calibration and validation analysis for Package 3, including:

- Bribie Island
- Pumicestone Passage (including Six Mile, Beerburrum, Elimbah, Ningi and Glass Mountain Creeks)

The Pumicestone Passage basin is mostly rural, with flood-prone lower reaches. There are a large number of structures in this basin, with the potential to impact upon flooding of urban areas. Additionally, accurate modelling of breakout flows travelling between the lower reaches of Ningi and Elimbah Creeks will be important.

The Bribie Island catchment has significant flooding through some urban areas and canal estates. Representation of urban flowpaths and structures will be important to the accurate modelling of this catchment.

This report assesses the feasibility of carrying out calibration and validation for the hydrological and hydraulic modelling of the Pumicestone Passage and Bribie Island basins based on the current and prospective availability of data.

2 Available data

2.1 Stream gauge data

Stream gauge data (recorded water level with respect to time) is essential to calibrating a hydrologic model. Recorded water levels are converted to discharges and compared with hydrologic model predictions. Stream gauge data is also useful in calibrating a hydraulic model through comparisons of recorded and predicted water levels with time at the gauge location. Unfortunately, there are no stream gauges within either the Pumicestone Passage or Bribie Island basins.

2.2 Rainfall data

Rainfall data is used to provide input to a hydrologic model regarding the amount, location and timing of rainfall during a storm event.

Rainfall station locations have been sourced from Moreton Bay Regional Council (MBRC) and the Bureau of Meteorology's (BoM) Water Resources Station Catalogue (WRSC). The gauge locations obtained from these sources are shown in Figure 1 and Figure 2 respectively. There are two types of rainfall stations:

- Alert station (or pluviometer) – rainfall is recorded in short duration intervals (as short as 6 minutes) providing rainfall patterns through the course of a rainfall event
- Daily station – total rainfall during the course of a day is recorded

The alert stations and daily stations within the zone of influence to the Pumicestone Passage and Bribie Island Basins have been provided in Table 1 and Table 2 respectively. The rainfall data has not yet been sourced for these stations. In a number of locations the data sets have conflicting information in regards to gauge ownership, therefore the information from both sources has been provided in the tables below.

Table 1 | Alert/Pluviograph Stations

Gauge Name	Gauge Owner/Data Source	Operational Start Date	Operational Finish Date
Old Gympie Road	SCRC/BoM	7/5/2004	Still operational
Beerwah	SCRC/BoM	7/5/2004	Still operational
Woodford	SEQWC/BoM	15/5/2002	Still operational
Wamuran	MBRC/BoM	30/9/1998	Still operational
Round Mtn Reservoir	MBRC/BoM	7/1/1998	Still operational
Caboolture WTP	MBRC/BoM	7/1/1998	Still operational

Gauge Name	Gauge Owner/Data Source	Operational Start Date	Operational Finish Date
Upper Caboolture	MBRC/BoM	281/2004	Still operational
Bribie Island	MBRC	Not available	Still operational

Table 2 | Daily rainfall stations

Gauge Name	Gauge Owner/Data Source	Operational Start Date	Operational Finish Date
Glass House Mountains	BoM	01/01/1908	01/01/1946
Beerburrum Forest Station	BoM	29/9/1898	Still operational
Pumicestone Post Office	BoM	1/1/1958	1/1/1973
Godwin Beach	BoM	19/11/2005	Still operational
Beachmere Sands Retirement Resort	Private/BoM	10/12/2005	Still operational
Caboolture Post Office	BoM	01/01/1870	05/09/1999
Wamuran Post Office	BoM	30/05/1915	Still operational
Woodford BCC	BoM	06/06/1964	29/12/1995
Bongaree Bowls Club	BoM	29/11/1931	16/04/1991
Bribie Island Qld Uni	BoM	30/03/1978	02/11/1993
Bribie Island Bore	NRW	29/04/1993	Still operational

2.3 Historic flood marks

Historic flood marks are an important part of calibrating a hydraulic model as they provide information regarding the variation in water levels across a floodplain. At the current time, there is no historic flood mark data available. It is understood MBRC is advertising for community input into the provision of historic flood marks (peak water levels).

3 Flood events

3.1 Possible events for calibration/validation

It is possible to undertake an assessment of the available rainfall data to determine when rainfall events occurred. This data could be used to assess which rainfall events were likely to have led to flood events and therefore identify the historic periods in which MBRC should target sourcing of community data. We will undertake this rainfall assessment if MBRC feels it is required.

3.2 Feasibility of calibration/validation

Given the lack of recorded stream gauge data within either the Pumicestone Passage or Bribie Island basins, it will not be possible to calibrate the WBNM models. If a number of reliable historic flood marks are sourced from the community it may be possible to undertake a joint calibration process in which both hydrologic and hydraulic parameters are modified until calibration of the hydraulic model is achieved.

Historic flood mark data sourced from the community is less reliable than surveyed flood data as it relies on community recollection of peak water levels or remaining debris following a flood event. As a result, calibration would be limited in accuracy if this was the only source of historic data.

We recommend that the calibration and validation feasibility for Pumicestone Passage and Bribie Island be reviewed once flood mark data is obtained and the quality of the data is assessed.

4 Recommendations

In order to carry out calibration/validation of a hydrologic model, rainfall and stream gauge data needs to be available. No stream gauge data is available within the Pumicestone Passage or Bribie Island basins.

To calibrate/validate a hydraulic model, both rainfall and water level data needs to be available. At present only rainfall data is available within the Pumicestone Passage and Bribie Island catchments. No stream gauge or historic flood mark records exist within these basins which would provide water level data. The feasibility of model calibration and validation will therefore be dependant on the amount and quality of information obtained from the community in regards to historic flood water levels.

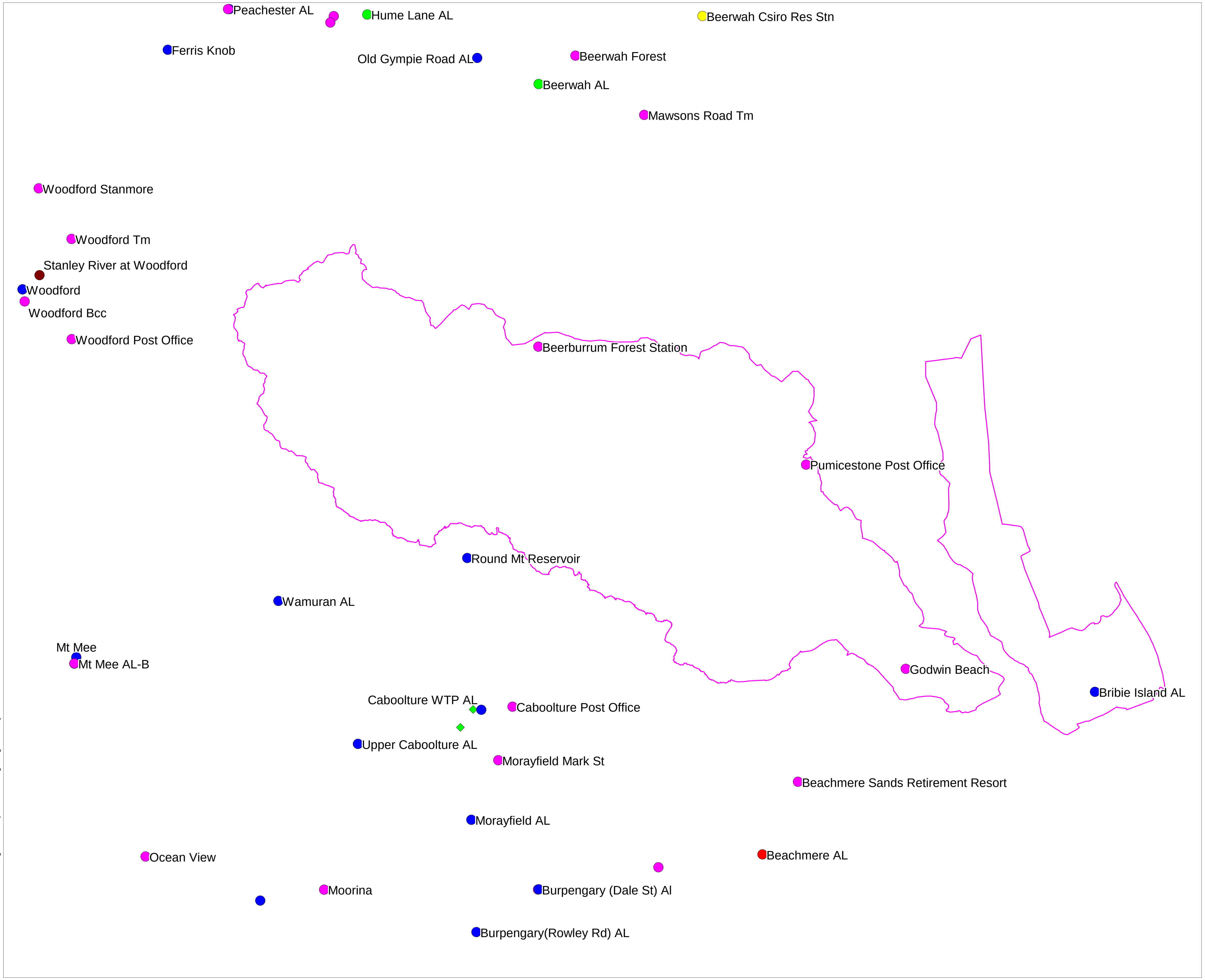
5 References

Bureau of Meteorology, Water Resources Station Catalogue [Online] Available: http://www.bom.gov.au/hydro/wrsc Accessed October 2010

Gauges GIS data, as provided by Council, September 2010

Appendices

Appendix A
Figures



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Legend

Gauge Types

- Battery
- Rainfall Alert
- Rainfall Daily
- Rainfall non-alert (pluviometer)
- Water Level
- Water Level Non-Alert

- Maximum Height Indicators
- WQ Event Monitoring Program

Notes:

Date: 25/10/2010 Version: 0

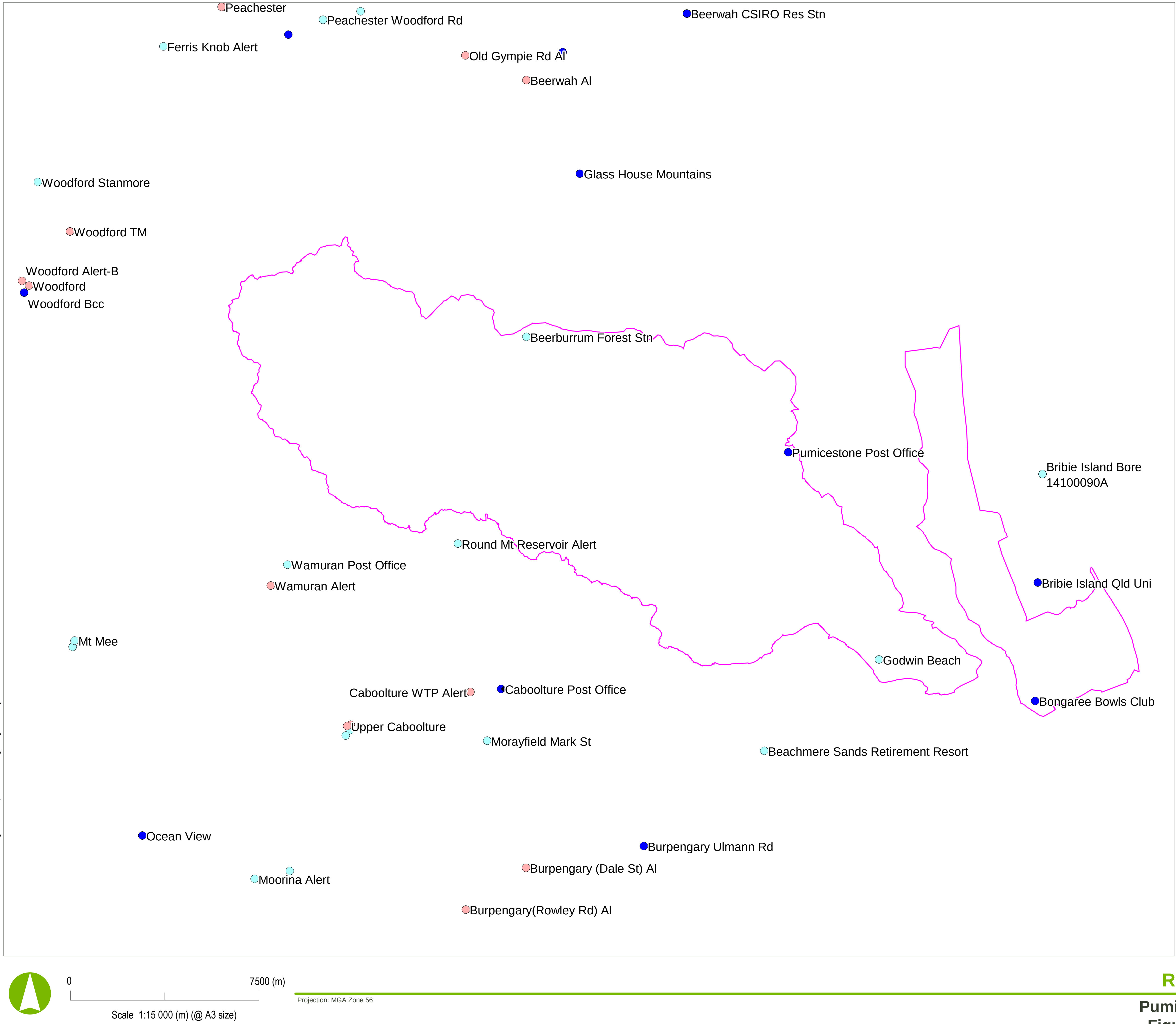
0 7500 (m)

Scale 1:15 000 (m) (@ A3 size)

Projection: MGA Zone 56

RFD Stage 2 Detailed Modelling

Pumicestone Passage and Bribie Island
Figure 1: MBRC Gauge Data Locations



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Legend

Water Resources Station Catalogue
- River Station - Operational
- River Station - Closed
- Rainfall Station - Operational
- Rainfall Station - Closed

Notes:

Date: 25/10/2010 Version: 0

Projection: MGA Zone 56

RFD Stage 2 Detailed Modelling

Pumicestone Passage and Bribie Island
Figure 2: WRSC Gauge Data Locations

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Appendix D
Modelling Quality Report

Appendix D
Modelling Quality Report

Project: Regional Floodplain Database
Model Quality Report
Bribie Island (BRI)

Reference: 211090

Prepared for: Moreton Bay Regional Council

Revision: 1

14 June 2012

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Regional Floodplain Database
Model Quality Report
Bribie Island (BRI)

Date | 14 June 2012
Reference | 211090
Revision | 1

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Contents

Appendices

Index of Figures

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Stage 2 (current stage) of the project involves the development of detailed hydrologic and hydraulic models for each minor basin.

Stage 3 will build on the detailed models and “add value” through assessment of flood damages and community resilience measures.

1.2 Objective of model quality report

This report describes the model setup process adopted for the detailed 5 m grid TUFLOW model of the Bribie Island (BRI) minor basin, including all the changes made to the broadscale model. It also describes the model quality and model issues for the hydrologic and hydraulic models.

2 TUFLOW model setup process

2.1 Code boundary

The code boundary was modified as per the following:

- In most areas the boundary was changed to run along the edge of the land near the land-water interface. This was done to increase stability in these areas
- In the north-western part of the model, adjacent to Wrights Creek, the boundary was changed to better match the topographic features and to reduce the modelled area in this location

In Figure 1 below, the red line shows the adopted code boundary and the blue line shows the broadscale model code boundary.

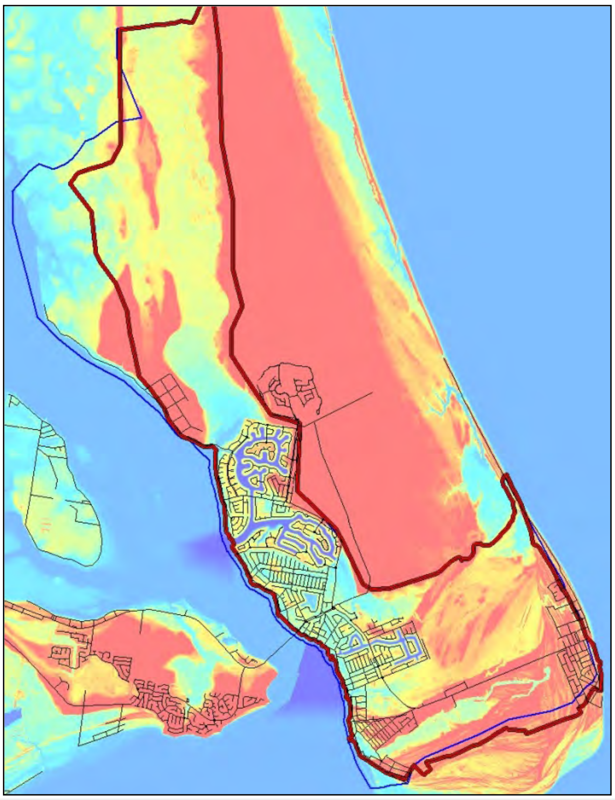


Figure 1 | Code boundary

2.2 Inflows and SA boundaries

SA boundaries were adopted based upon the final hydrography minor catchments layer provided to Aurecon on 24 February 2011. The following changes were made to this layer:

- Near the downstream boundary, the SA boundaries were modified so the most downstream catchment was not applied in the ocean
- At structures the SA boundaries were modified so they crossed the top of the structure and inflows were then applied upstream of the structure

Figure 2 below shows an example of how the SA boundaries were modified at structures. The black line represents the adopted SA boundary and the grey line represents the minor catchment definition. In this image, flow is from the bottom of the page towards the top of the page.

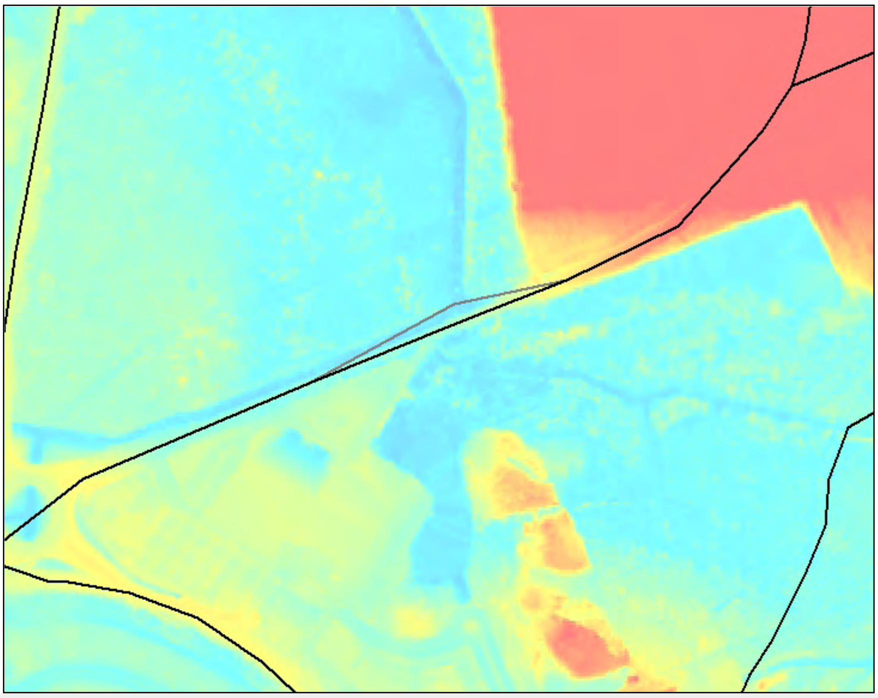


Figure 2 | SA Boundaries

2.2.1 Downstream boundaries

The downstream boundary location was modified to match the code boundary location.

Mean High Water Springs was adopted as the downstream boundary conditions. The values applied to the downstream boundaries were determined based upon the Maritime Safety Queensland Tidal Plane data. The following values were adopted:

- At Bongaree MHWS = 1.87 m and AHD = 1.10 m, therefore a MHWS value of 0.77 m AHD was adopted as the downstream boundary condition for the western model boundary (ie the Pumicestone Passage side of the model)
- At Woorim MHWS = 1.71 m and MSL = 0.93 m, therefore a MHWS value of 0.78 m AHD was adopted as the downstream boundary condition for the eastern model boundary (ie the open ocean side of the model)

2.2.2 Survey, topography and Zpoints

The Zpoints provided by WorleyParsons were used as the base Zpoints for the model. The following changes were made to the Zpoints:

- Zpoints in the area of the White Patch Esplanade crossing of Wrights Creek were based upon detailed Solander Drain survey provided by Council on 30 September 2010
- In locations where the lowest point within a SA boundary was a culvert inlet, a Zc upstream of the culvert was lowered such that this would become the initial location for SA inflow application
- It appeared that the Zpoints in some areas of Pacific Harbour were based upon a DEM in which the triangulation was not correct. In these areas Zshapes have been used to smooth out these inconsistencies
- Where required for model stability, Zlines and Zshapes have been used to lower the cells in the vicinity of culvert inlets and outlets

2.3 Materials

Materials files provided by MBRC at the outset of the project were reviewed and changes were made to these files as per Aurecon's memo to Council on 1 March 2011. Within the Bribie Island model extents, these changes were limited to revision of the footpaths layer such that these were defined over the footpath extents.

The Manning's n values associated with the materials files were also updated. The new values were those adopted during the model calibration process undertaken on a number of the other catchments within the MBRC region.

2.4 Structures

Hydraulic structures, including bridges, footbridges, culverts and trunk drains, were incorporated into the model. Appendix A presents details of all modelled structures and all other structures identified in the Data Assessment Report. Comments regarding specific structures are included in this table.

3 Quality assessment process

3.1 Hydrologic model quality

The hydrologic model quality was reviewed using the following process:

- For the 100yr 3hr and EDS runs, the peak outflow volumes and discharges and the time of peak discharge were mapped across the catchment. A visual inspection of these values was undertaken to ensure that peaks were sensible as flows moved through the system
- For the 100yr 3hr and EDS runs, a graphical review of the hydrographs throughout the system was undertaken to check that timing and volume was sensible as flows moved through the system
- It was assumed that if the 100yr 3hr and EDS runs were sensible, then the model would perform adequately for the remainder of the runs

3.2 Hydraulic model quality

The model quality was assessed using the following process:

- Review of model log to determine:
  - Whether the run was completed or unstable
  - Number of negative depths in the run
  - Whether final and peak cumulative mass error values were less than 1%
- Review of culvert discharges to determine:
  - Whether culverts were stable during the peak of the run
  - Extent of instabilities in low flows
  - Whether run duration was long enough to capture peak at all structures
- Review of water levels to determine:
  - Whether instabilities were evident (ie whether any “blow ups” existed)
  - Whether the water surface gradients were sensible throughout the system
- Where required, modifications to the models were made to reduce instabilities and the above process was repeated
  - For the culverts, it was not possible to get all culverts stable for all runs, therefore the focus was upon obtaining stability in the peak of the critical events

4 Quality assessment results

4.1 Hydrologic model quality

The hydrologic model was found to be performing well. The following Figure 3 and Figure 4 show examples of the model hydrographs within the Dux Creek part of the model. These figures show that:

- Between branches DUX_01_03276 and DUX_01_01204, the hydrograph shape stays the same, with the timing extended and the volume increased. This is the expected model response as there are no large tributaries entering the system between these two locations
- Between branch DUX_01_01204 and DUX_01_00568 there is a significant change in shape and volume which is expected as a result of the side tributary inflows
- As expected, discharges in DUX_01_00000 are approximately equal to the addition of discharges from branches DUX_01_00568 and DUX_04_00000, with a slight change in timing resulting from routing in this reach

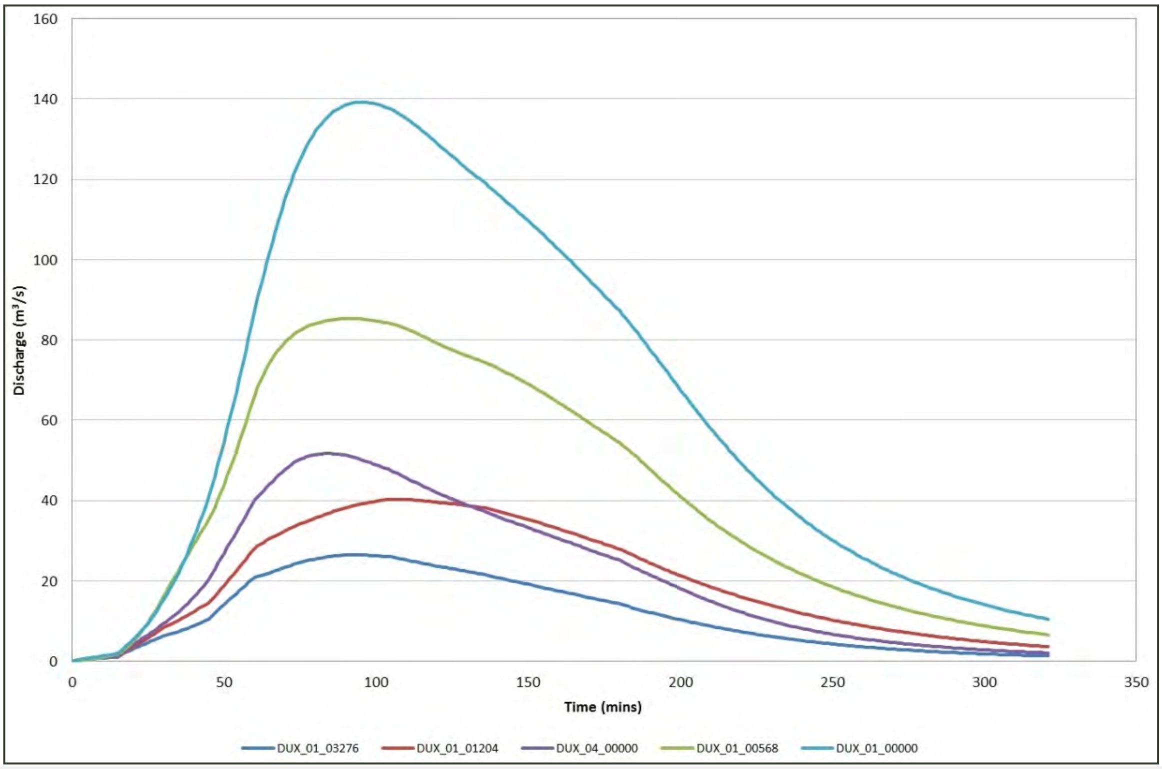


Figure 3 | WBNM 0180m Event Discharges – Dux Creek

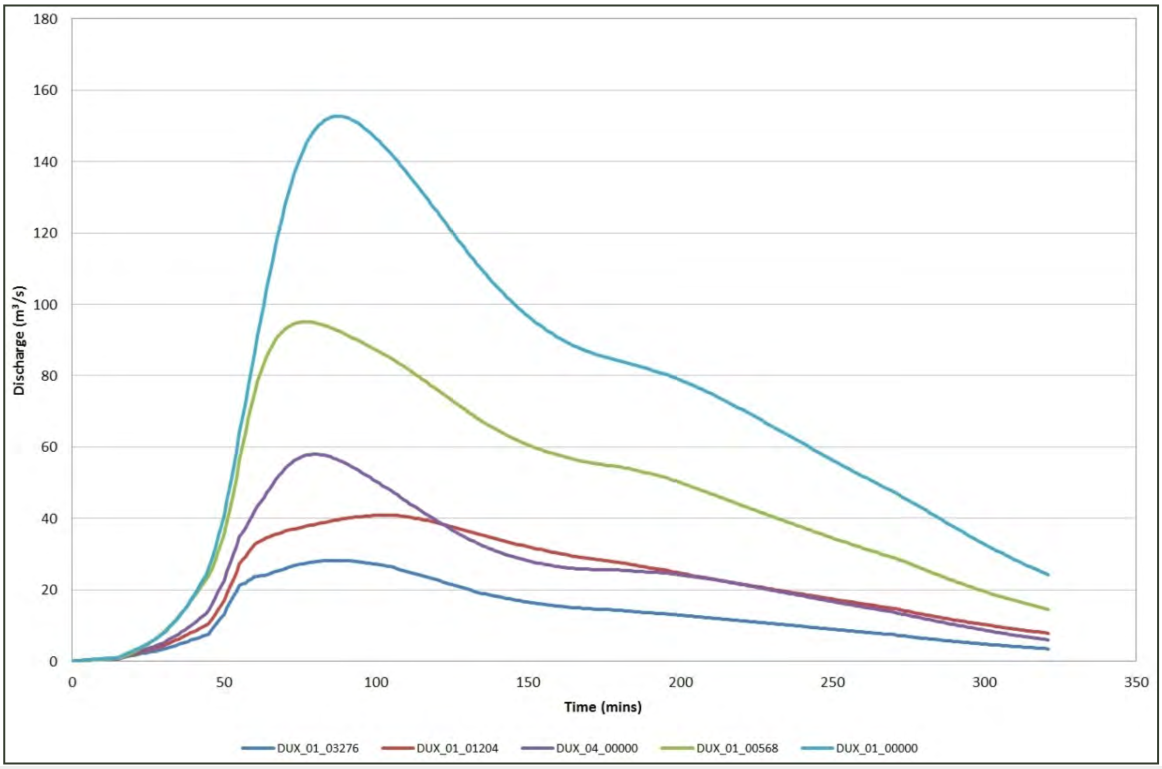


Figure 4 | WBNM EDS Event Discharges – Dux Creek

A similar process to that described in this report for Dux Creek was undertaken across the entire model area and for more frequent locations within each creek. No significant issues were found with model consistency, therefore the WBNM models were considered to be performing well.

4.2 Hydraulic model quality

Figure 6 shows areas where there are either concerns with the model results or in which future investigations and development to the models may improve the model outcomes. These are discussed further in the following sections.

4.2.1 Overall stability

The parameters which were used to assess the overall stability results are provided in the table in Appendix B. These results show that:

- No 1D negative depths occur in any of the runs
- Typically there are 0-3 2D negative depths occurring, except in the following two cases:
  - In the PMF event up to 190 2D negative depths occur, these negative depths nearly all occur at one location
  - In the S7 event (dynamic storm tide) 680 negative depths occur near the downstream boundary of the Pacific Harbour canal system
- Volume error is within ±0.1%
- Final cumulative mass error is within ±0.06% except for the 10y 4320 min event where it is -0.12%
- Peak cumulative mass error is within ±0.07% except for the 10y 4320 min event where it is -0.14%

The above parameters are all well within acceptable ranges and indicate that the model is generally performing well across all events. The biggest indicator of poor performance in the models are the negative depths in the storm tide and PMF events, however in both cases nearly all of these occur at one location and it was not considered critical that the models be rerun to fix this one issue, which has little effect on the overall model predictions.

4.2.2 Canal oscillations

Water level oscillations are evident in the Pacific Harbour canal system, as presented in Figure 5 for the EDS. These oscillations have been extensively investigated and whilst intuitively they do not seem correct, the model is performing correctly. These oscillations occur in the canal systems where there are large volumes of water connected to the ocean by comparatively small channels. Momentum builds up within the system which causes drawdown below the constant tailwater level, which in turn causes backflow into the model and this continues, decaying in amplitude. This is primarily due to the smooth Manning's n value (0.03) adopted in the canal systems.

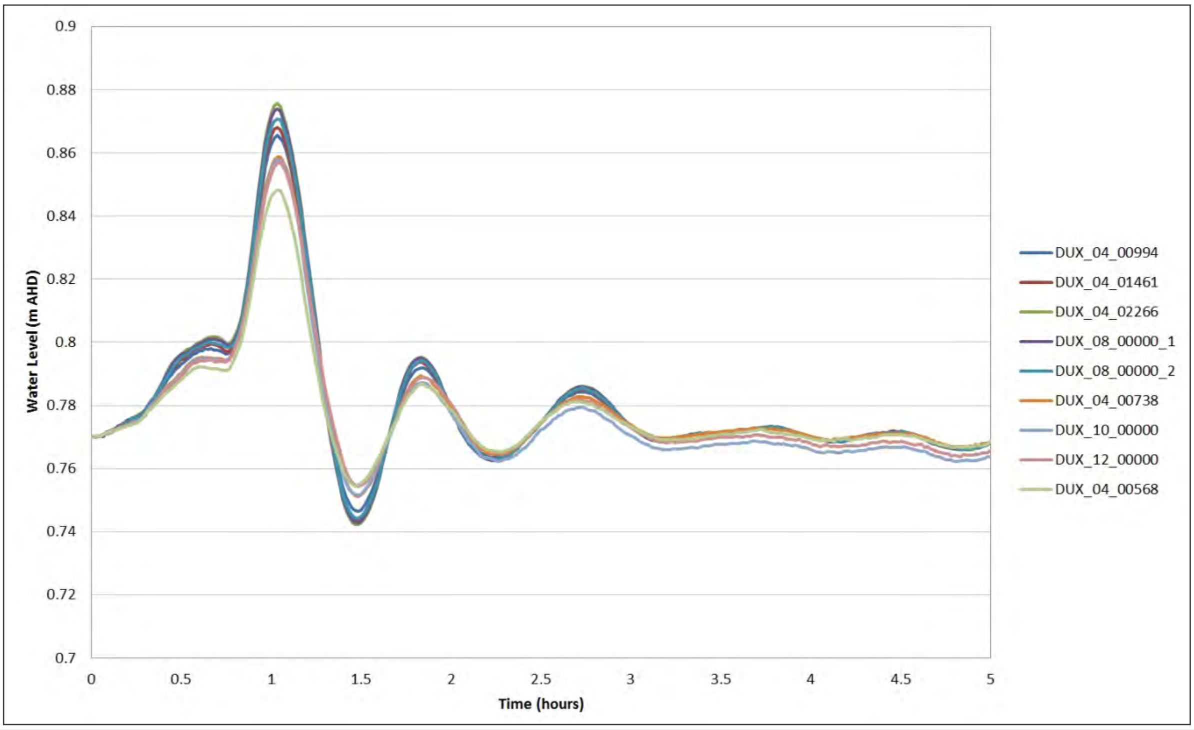


Figure 5 | Pacific Harbour canal water level oscillations

4.2.3 Structure stability

Stability of model structures was problematic and many configurations of inlet/outlet boundaries and topography were tested. The adopted configuration proved to be the most stable. There are a number of culverts in which stability was not able to be achieved for all runs and for the entire duration of the run. Through this process, the three most unstable 1D structures were converted to 2D structures to improve stability. The small channels that these structures are located in may be better represented using 1D branches.

The culvert discharge results for the EDS run are presented in Appendix C. A summary of the culvert results is as follows:

- Stability is generally increased with increased discharge, ie stability issues tend to occur with low flows
- Culvert BON_05_00000 is the most problematic culvert and is generally stable through the peak of the run but unstable in low flows. In the 1 year ARI event, this culvert is unstable throughout the entire event. The proximity of this culvert to the model boundary is most likely the cause of the instability
- Culvert BON_03_00141 is also a problematic culvert and performs similarly to BON_05_00000. On the upstream side a large inlet pit and grate direct flows into this culvert, therefore the upstream invert level is significantly lower than the surrounding topography. The instability is most likely a result of this detail
- There are a number of other culverts which are unstable in low flow conditions but which perform stably throughout the peak of the event
- Generally the culvert discharge and velocity instabilities have very little impact upon water levels both upstream and downstream of the culvert

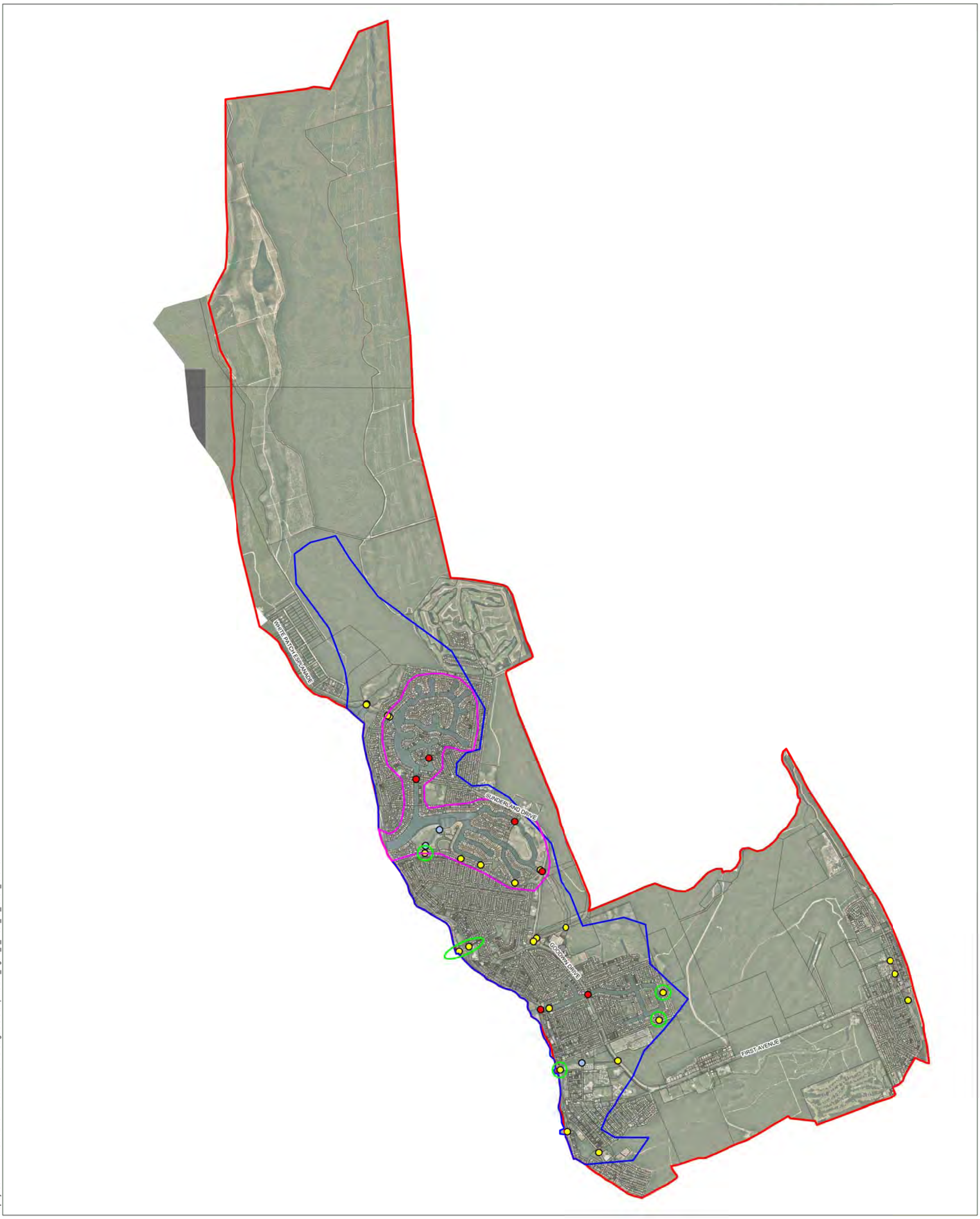
4.2.4 Sensitivity run inundation extents

The use of SA boundaries for the application of rainfall to the model has impacted upon the location in which inflows are applied in some of the sensitivity runs. For this reason some of the runs show a reduction in flood levels and inundation extents in areas where this would not be expected to occur. To remedy this it would be necessary to rerun all the models and this was not considered prudent given that it was only discovered at a very late stage of the project. Results in these areas should be treated with caution.

4.2.5 Dynamic storm tide in canals

The Bribie Island dynamic storm tide model shows a significant amplification of water levels into the Pacific Harbour canals. This effect is likely to result from the same momentum issues which affect the canals in the static downstream tailwater condition (as discussed in Section 4.2.2) and is not likely to occur in a real storm tide event, therefore the model results for the dynamic storm tide run should be treated with caution. Sensitivity testing of the model, with the Manning's n value for waterbodies changed to 0.06 (up from 0.03) shows that this amplification can be removed from the model and sensible results can be achieved. It is recommended that further testing and analysis of this issue in the canal system be undertaken.

aurecon



Map by: DJF P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_6_Areas_for_review_rev0.wor

Legend

	Cadastre		Minor Basin Boundaries
	Footbridge		Structure Stability
	Bridge		Water Level Oscillations
	Culvert		SA Boundary Application

Notes:
This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

A3 scale 1:50,000
0 1,250 m 2,500 m

Date: 31/05/2012 Version: 0 Job No: 211090
Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure 6: Areas of Concern for Future TUFLOW Model Review/Upgrades

5 Conclusions

The Bribie Island detailed modelling has upgraded the 10 m grid broadscale model to a 5 m grid detailed model. This model upgrade has followed the general model setup of the Burpengary Creek (BUR) detailed model.

Changes to the model include:

- Revision of boundary conditions and their locations
- Inclusion of 5 m grid Zpoints and some minor modifications to these
- Inclusion of materials layers and some minor modifications to these
- Inclusion of structures and associated boundary conditions

The model quality has been assessed through review of the model results for both the hydrologic and hydraulic model. Key findings of the quality assessment are:

- The hydrologic model is performing well
- The hydraulic model is generally performing well, with the following issues being of note
  - Water level oscillations occur in the Pacific Harbour canals – these intuitively do not seem correct, however the situation has been reviewed in detail and the model is performing correctly. It is recommended that sensitivity testing of Manning's n values in these canals be undertaken
  - Structure stability – the stability of the structures has been problematic and whilst stability has been significantly improved, minor instabilities are still occurring at some structures, particularly in low flow conditions
  - In the sensitivity runs, water levels and inundation extents are shown to reduce in some areas as a result of SA boundaries redistributing flows across the catchments. Results in these areas should be treated with caution
  - The dynamic storm tide model results in the Pacific Harbour canal systems are not representative of the conditions which would occur in these canals during a real storm tide event. It is recommended that further sensitivity testing of Manning's n values in these canals be undertaken

Appendices

Appendix A
Modelled Structures

Structure ID	Waterway ID	Structure Type	Crossing Name	Priority*	Is Structure Modelled?	Data Availability/ Source	Comments
BON_01_00137	BON_01_00137	Bridge	Welsby Parade	A	Yes	Aurecon Survey	
BON_01_00811	BON_01_00811	Bridge	Goodwin Drive	A	Yes	MBRC Plans	
BON_09_00409	BON_09_00409	Bridge	Footpath	Not identified	Yes	Aurecon Survey	
DUX01_01826a	DUX_01_01826	Bridge	Sunderland Drive	A	Yes	No	Dimensions based on site visit. Deck level based on LiDAR
DUX_02_00701	DUX_02_00701	Bridge	Eagles Landing	A	Yes	MBRC Plans	Arch bridge, modelled in 1d
DUX_04_00568	DUX_04_00568	Bridge	Sunderland Drive	A	Yes	MBRC Plans	
DUX_04_02128	DUX_04_02128	Bridge	Quarterdeck Drive	A	Yes	MBRC Plans	Arch bridge, modelled in 1d
DUX11_00000a	DUX_11_00000	Bridge	Footpath	A	Yes	MBRC Plans	
DUX11_00000b	DUX_11_00000	Bridge	Footpath-Weir	A	Yes	MBRC Plans	
DUX_12_00000	DUX_12_00000	Bridge	Island Parade	A	Yes	Aurecon Survey	Arch bridge, modelled in 1d
N/A	WRI_05_00000	Bridge	Footpath	B	No	No	
DUX_15_00000	DUX_15_00000	Culvert	Sylvan Beach Esplanade Seawall	A	Yes	MBRC Survey	Survey ID = DUX_15_00148 Modelled as a 2D structure
DUX_15_00148	DUX_15_00148	Culvert	Sylvan Beach Esplanade	A	Yes	MBRC Survey	Survey ID = DUX_15_00148 Modelled as a 2D structure
BON_21_00037	BON_21_00037	Culvert	South Esplanade	A	Yes	MBRC Survey	Modelled as a 2D structure
01_00212	BON_01_00212	Culvert	Lock	A	Yes	No	Assumed that lock is closed. Dimensions based on site visit. Levels based on LiDAR
01_02338	BON_01_02338	Culvert	Protea Drive	A	Yes	MBRC Survey	Survey ID = BON_01_0228
03_00141	BON_03_00141	Culvert	Cotterill Avenue	A	Yes	MBRC Survey	
05_00050	BON_05_00050	Culvert	Welsby Parade	Not identified	Yes	No	Bridge but modelled as culvert. Dimensions based on site visit. Deck level based on LiDAR

Structure ID	Waterway ID	Structure Type	Crossing Name	Priority*	Is Structure Modelled?	Data Availability/ Source	Comments
09_00859	BON_09_00859	Culvert	Goodwin Drive	A	Yes	MBRC Survey	
21_00612	BON_21_00612	Culvert	Toorbul Street	A	Yes	MBRC Survey	
01_01826b	DUX_01_01826	Culvert	Footpath	Not identified	Yes	Aurecon Survey	
01_02462a	DUX_01_02462	Culvert	Sunderland Drive	A	Yes	MBRC GIS	
01_02462b	DUX_01_02462	Culvert	Sunderland Drive	A	Yes	MBRC GIS	
01_03276	DUX_01_03276	Culvert	Hornsby Road	A	Yes	MBRC Survey	
06_00000	DUX_06_00000	Culvert	Endeavour Drive	A	Yes	MBRC Survey	Survey ID = DUX_06_00227
07_00593	DUX_07_00593	Culvert	Marina Boulevard	B	Yes	MBRC Survey	
09_00488a & 09_00488b	DUX_09_00488	Culvert	Marina Boulevard	A	Yes	No	Dimensions based on site visit. Invert level based on LiDAR
11_00597a & 11_00597b	DUX_11_00597	Culvert	Marina Boulevard	B	Yes	MBRC Survey	Survey ID = DUX_11_00541
17_00109a & 17_00109b	DUX_17_00109	Culvert	Marina Boulevard	Not identified	Yes	MBRC Survey	Survey ID = DUX_09_00546
01_00429d	FRE_01_00429	Culvert	Oxley Way	A	Yes	MBRC Survey	
01_00623	FRE_01_00623	Culvert	Second Avenue	A	Yes	MBRC GIS	
01_01047	FRE_01_01047	Culvert	Third Avenue	A	Yes	MBRC Survey	
01_00227	WRI_01_00227	Culvert	White Patch Esplanade	B	Yes	MBRC Survey	
N/A	BON_13_00238	Culvert	Minor Road	B	No	No	
N/A	WRI_01_03180	Culvert	Minor Road	B	No	No	
N/A	WRI_02_00042	Culvert	White Patch Esplanade	A	No	No culvert exists	
N/A	WRI_03_00554	Culvert	Minor Road	B	No	No	

Structure ID	Waterway ID	Structure Type	Crossing Name	Priority*	Is Structure Modelled?	Data Availability/ Source	Comments
DUX15_00434a	DUX_15_00434	Trunk Drain	Eucalypt Street	A	Yes	MBRC GIS	Dimensions based on GIS. ILs based on GIS but some assumptions made
DUX15_00434b	DUX_15_00434		Eucalypt Street	A	Yes	MBRC GIS	
DUX15_00434c	DUX_15_00434		Eucalypt Street	A	Yes	MBRC GIS	
DUX15_00434d	DUX_15_00434		Eucalypt Street	A	Yes	MBRC GIS	
FRE01_00429a	FRE_01_00429	Trunk Drain	First Avenue	A	Yes	MBRC GIS	Dimensions based on site visit. ILs assumed
FRE01_00429b	FRE_01_00429		First Avenue	A	Yes	MBRC GIS	
FRE01_00429c	FRE_01_00429		First Avenue	A	Yes	MBRC GIS	

** As identified in the Data Assessment Report*

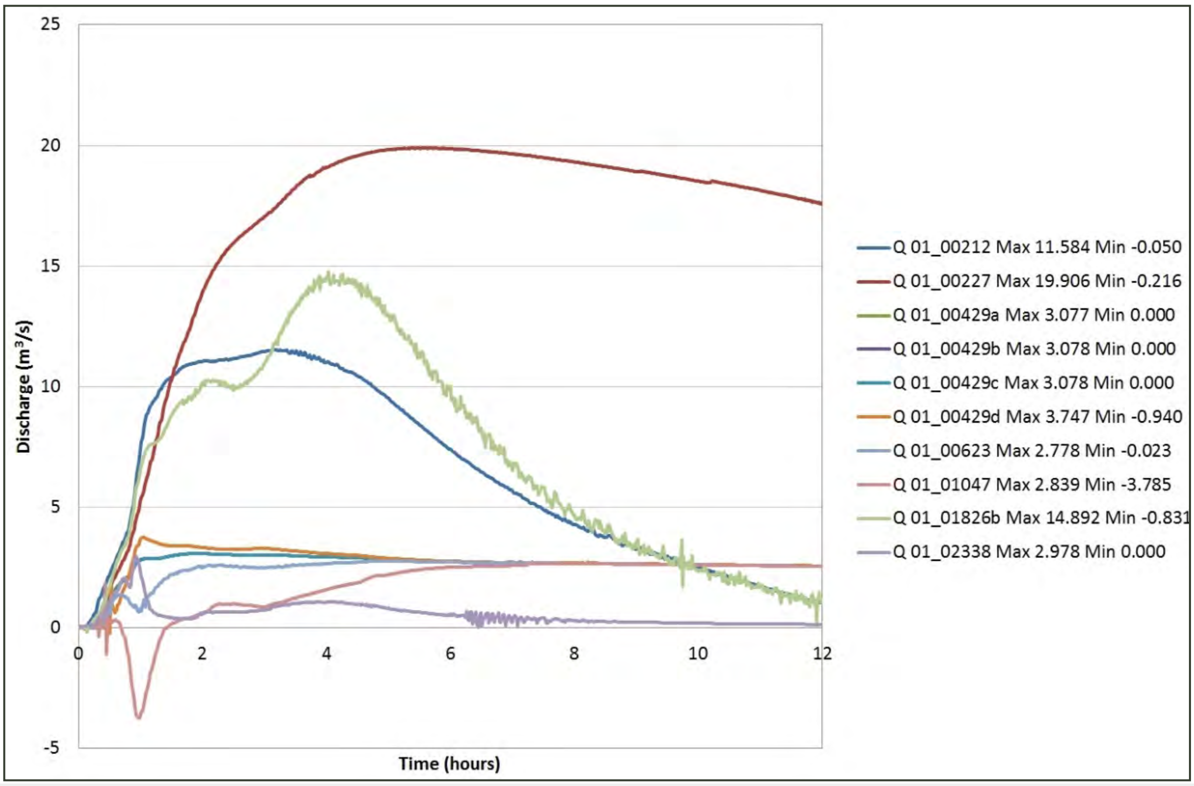
Appendix B
Overall Stability Results

Simulation	Total 1D Negative Depths	Total 2D Negative Depths	WARNINGs prior to simulation	WARNINGs during simulation	Volume Error (m3)	Final Cumulative ME	Whole Simulation Peak Cumulative ME
00001Y_0180m	0	0	9	0	-669 or 0.0%	-0.01%	-0.02% at 7.52h
00001Y_1440m	0	0	9	0	-3539 or -0.1%	-0.06%	-0.07% at 27.84h
00002Y_0180m	0	1	9	1	-1133 or 0.0%	-0.02%	-0.02% at 10.44h
00002Y_1440m	0	0	9	0	-1995 or 0.0%	-0.02%	-0.05% at 25.05h
00005Y_0180m	0	1	9	1	-1187 or 0.0%	-0.02%	-0.03% at 9.23h
00005Y_1440m	0	0	9	0	-6086 or -0.1%	-0.05%	-0.06% at 25.70h
00010Y_0010m	0	0	9	0	-642 or 0.0%	-0.02%	-0.02% at 4.85h
00010Y_0015m	0	0	9	0	-896 or 0.0%	-0.02%	-0.02% at 6.00h
00010Y_0030m	0	1	9	1	-660 or 0.0%	-0.01%	-0.02% at 6.93h
00010Y_0045m	0	0	9	0	-1011 or 0.0%	-0.02%	-0.02% at 3.86h
00010Y_0060m	0	1	9	1	-1402 or 0.0%	-0.03%	-0.03% at 7.13h
00010Y_0090m	0	0	9	0	609 or 0.0%	0.01%	0.01% at 8.63h
00010Y_0120m	0	0	8	0	-261 or 0.0%	0.00%	-0.01% at 1.59h
00010Y_0180m	0	1	9	1	229 or 0.0%	0.00%	-0.01% at 1.81h
00010Y_0270m	0	1	9	1	-601 or 0.0%	-0.01%	-0.02% at 2.98h
00010Y_0360m	0	1	9	1	782 or 0.0%	0.01%	-0.01% at 2.75h
00010Y_EDS	0	0	9	0	-7 or 0.0%	0.00%	-0.01% at 1.82h
00010Y_0540m	0	1	9	1	-2931 or 0.0%	-0.03%	-0.03% at 5.82h
00010Y_0720m	0	0	9	0	-1635 or 0.0%	-0.02%	-0.02% at 19.70h
00010Y_1080m	0	1	9	1	-1670 or 0.0%	-0.01%	-0.03% at 9.37h
00010Y_1440m	0	1	9	1	-2618 or 0.0%	-0.02%	-0.02% at 29.92h
00010Y_1800m	0	1	9	1	-5626 or 0.0%	-0.04%	-0.05% at 16.76h
00010Y_2160m	0	2	9	2	-6137 or 0.0%	-0.04%	-0.07% at 19.56h
00010Y_2880m	0	0	9	0	-11052 or -0.1%	-0.06%	-0.07% at 48.65h
00010Y_4320m	0	0	9	0	-27700 or -0.1%	-0.12%	-0.14% at 72.45h
00020Y_0180m	0	1	9	1	544 or 0.0%	0.01%	0.01% at 3.14h
00020Y_1440m	0	1	9	1	-2808 or 0.0%	-0.02%	-0.02% at 35.00h
00050Y_0180m	0	2	9	2	1666 or 0.0%	0.02%	0.02% at 4.55h
00050Y_1440m	0	0	9	0	-430 or 0.0%	0.00%	0.02% at 7.08h
00100Y_0010m	0	0	9	0	-969 or 0.0%	-0.02%	-0.02% at 5.97h
00100Y_0015m	0	1	9	1	-953 or 0.0%	-0.02%	-0.02% at 6.83h
00100Y_0030m	0	1	8	1	-346 or 0.0%	-0.01%	-0.01% at 5.40h
00100Y_0045m	0	1	9	1	-121 or 0.0%	0.00%	-0.01% at 0.77h
00100Y_0060m	0	2	9	2	498 or 0.0%	0.01%	-0.01% at 0.76h

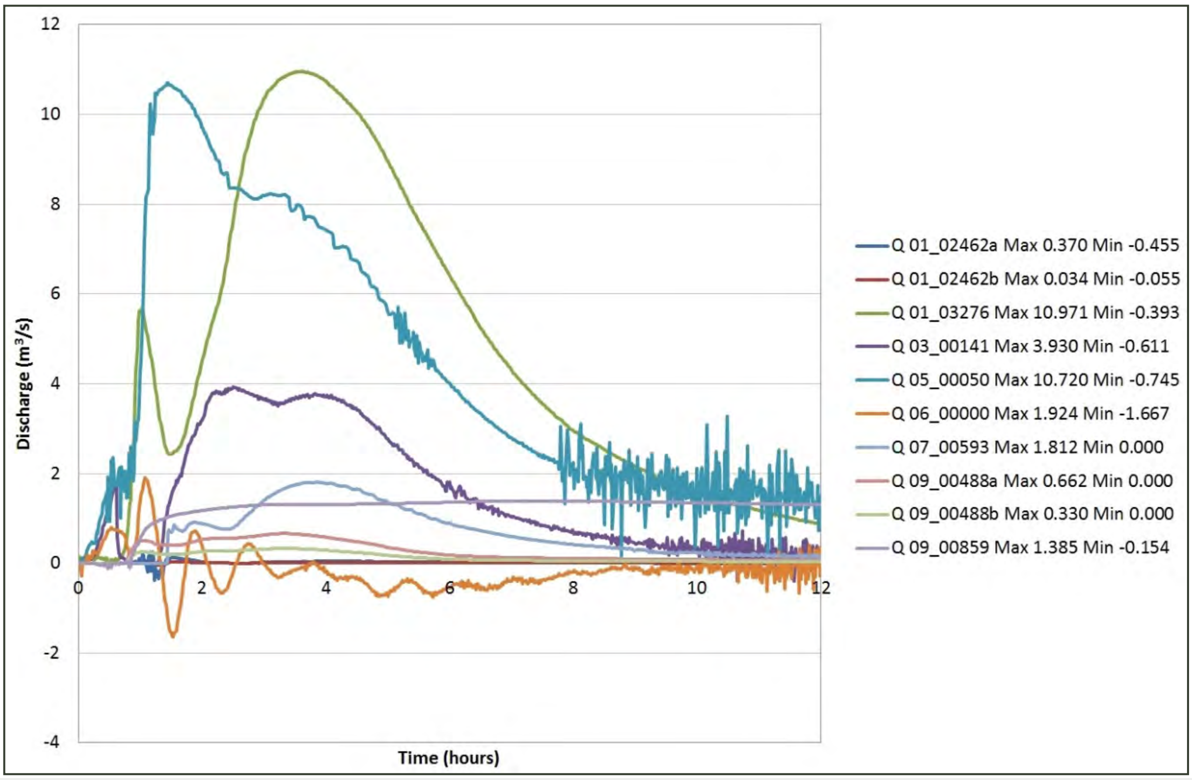
Simulation	Total 1D Negative Depths	Total 2D Negative Depths	WARNINGs prior to simulation	WARNINGs during simulation	Volume Error (m3)	Final Cumulative ME	Whole Simulation Peak Cumulative ME
00100Y_0090m	0	2	9	2	1440 or 0.0%	0.02%	0.02% at 6.63h
00100Y_0120m	0	1	9	1	1977 or 0.0%	0.02%	0.02% at 5.71h
00100Y_0180m	0	1	9	1	3106 or 0.0%	0.03%	0.03% at 5.35h
00100Y_0270m	0	2	9	2	3112 or 0.0%	0.03%	0.03% at 6.55h
00100Y_0360m	0	3	9	3	3603 or 0.0%	0.03%	0.03% at 6.55h
00100Y_0540m	0	0	9	0	3336 or 0.0%	0.02%	0.03% at 8.66h
00100Y_0720m	0	2	9	2	3507 or 0.0%	0.02%	0.03% at 8.46h
00100Y_1080m	0	2	9	2	3524 or 0.0%	0.02%	0.02% at 17.77h
00100Y_1440m	0	2	9	2	1785 or 0.0%	0.01%	0.03% at 6.65h
00100Y_01800m	0	1	9	1	1453 or 0.0%	0.01%	-0.02% at 3.82h
00100Y_2160m	0	1	9	1	-1860 or 0.0%	-0.01%	-0.03% at 25.88h
00100Y_02880m	0	1	9	1	-8865 or 0.0%	-0.03%	-0.03% at 60.00h
00100Y_4320m	0	1	9	1	-19531 or 0.0%	-0.05%	-0.05% at 78.14h
00200Y_0120m	0	2	9	2	5113 or 0.0%	0.04%	0.04% at 5.23h
00200Y_0180m	0	0	9	0	4605 or 0.0%	0.04%	0.04% at 5.99h
00200Y_0300m	0	2	9	2	7713 or 0.0%	0.05%	0.06% at 6.75h
00500Y_0120m	0	2	9	2	5643 or 0.0%	0.04%	0.04% at 5.20h
00500Y_0180m	0	2	9	2	5715 or 0.0%	0.04%	0.04% at 5.22h
00500Y_0300m	0	3	9	3	7471 or 0.0%	0.04%	0.05% at 7.11h
01000Y_0120m	0	2	9	2	3225 or 0.0%	0.02%	0.02% at 5.48h
01000Y_0180m	0	2	9	2	6989 or 0.0%	0.04%	0.05% at 5.60h
01000Y_0300m	0	2	9	2	9600 or 0.0%	0.04%	0.05% at 6.94h
02000Y_0120m	0	3	9	3	3036 or 0.0%	0.02%	0.02% at 5.97h
02000Y_0180m	0	2	9	2	4578 or 0.0%	0.02%	0.03% at 5.94h
02000Y_0300m	0	0	9	0	7562 or 0.0%	0.03%	0.04% at 7.32h
PMF_0015m	0	2	9	2	587 or 0.0%	0.00%	-0.02% at 0.93h
PMF_0030m	0	7	9	7	1126 or 0.0%	0.01%	-0.02% at 0.73h
PMF_0045m	0	10	9	10	1046 or 0.0%	0.00%	-0.02% at 0.66h
PMF_0060m	0	82	9	82	2172 or 0.0%	0.01%	-0.02% at 0.67h
PMF_0090m	0	67	9	67	-1393 or 0.0%	0.00%	-0.02% at 5.30h
PMF_0120m	0	90	9	90	-7415 or 0.0%	-0.01%	-0.03% at 6.63h
PMF_0150m	0	96	9	96	-11485 or 0.0%	-0.02%	-0.03% at 7.23h
PMF_0180m	0	122	9	122	-23100 or 0.0%	-0.04%	-0.04% at 8.27h
PMF_0240m	0	190	9	190	-37528 or -0.1%	-0.05%	-0.06% at 7.92h

Simulation	Total 1D Negative Depths	Total 2D Negative Depths	WARNINGs prior to simulation	WARNINGs during simulation	Volume Error (m3)	Final Cumulative ME	Whole Simulation Peak Cumulative ME
PMF_0300m	0	182	9	182	-47784 or -0.1%	-0.06%	-0.07% at 7.47h
PMF_0360m	0	175	9	175	-50028 or -0.1%	-0.06%	-0.06% at 8.15h
PMF_0720m_ GSDM	0	21	9	21	-15611 or 0.0%	-0.02%	-0.02% at 15.61h
PMF_1440m	0	21	9	21	11137 or 0.0%	0.01%	0.05% at 5.99h
PMF_2160m	0	19	9	19	22522 or 0.0%	0.02%	0.05% at 19.10h
PMF_2880m	0	20	9	20	25488 or 0.0%	0.02%	0.06% at 21.27h
PMF_4320m	0	19	9	19	-5943 or 0.0%	0.00%	0.05% at 8.43h
00100Y_EDS	0	3	9	3	2570 or 0.0%	0.02%	0.03% at 5.60h
00100Y_EDS_S2	0	1	9	1	1282 or 0.0%	0.01%	0.01% at 5.61h
00100Y_EDS_S3	0	0	9	0	1452 or 0.0%	0.01%	0.02% at 6.42h
00100Y_EDS_S4	0	1	9	1	4170 or 0.0%	0.03%	0.04% at 6.46h
00100Y_EDS_S5	0	0	9	0	-5037 or 0.0%	-0.04%	-0.04% at 12.00h
00100Y_EDS_S6	0	0	9	0	-6335 or 0.0%	-0.05%	-0.05% at 11.99h
00100Y_EDS_S7	0	679	9	679	-10984 or 0.0%	-0.02%	-0.07% at 22.18h
00100Y_EDS_S8	0	0	9	0	-940 or 0.0%	-0.01%	-0.01% at 6.22h
00100Y_EDS_S9	0	0	9	0	-3056 or 0.0%	-0.02%	-0.02% at 12.00h
00100Y_EDS_ S10	0	2	9	2	1865 or 0.0%	0.02%	0.02% at 11.75h
00100Y_EDS_ S11	0	3	9	3	2578 or 0.0%	0.02%	0.03% at 6.42h
00100Y_EDS_ S12	0	2	9	2	2070 or 0.0%	0.02%	0.02% at 11.63h

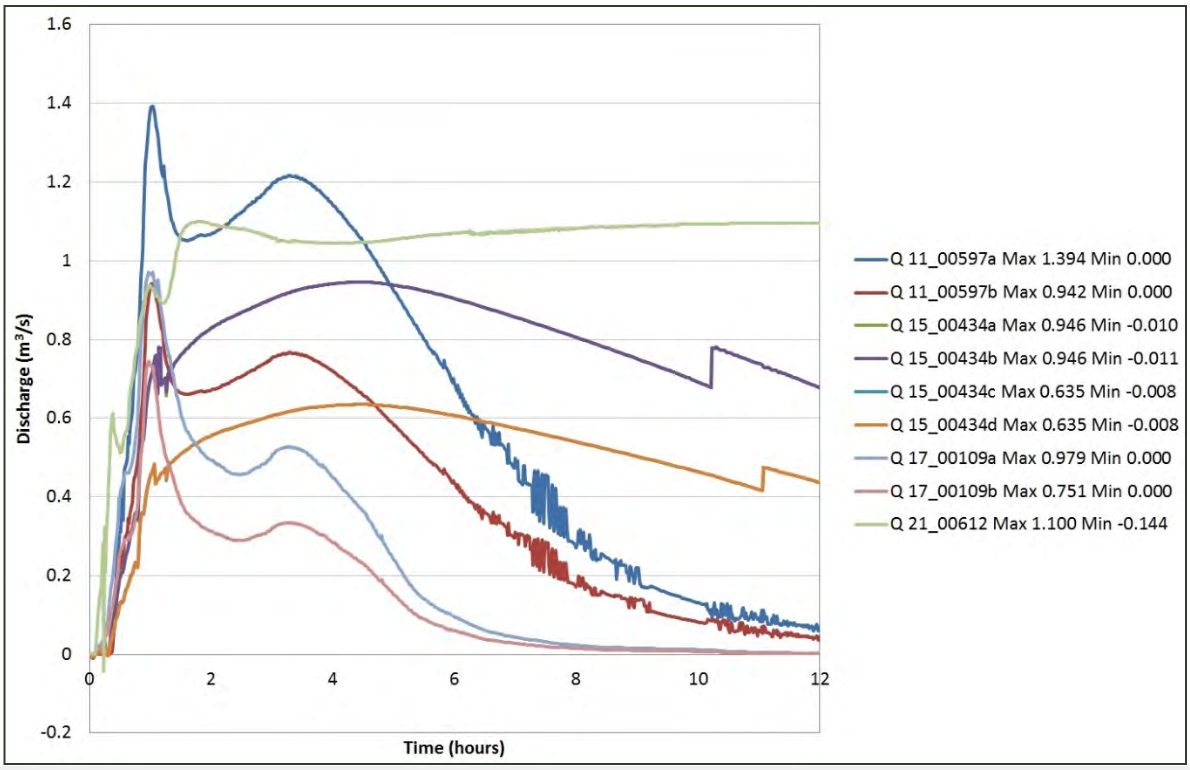
Appendix C
EDS Culvert Discharge Graphs



BRI Culvert Discharge Results



BRI Culvert Discharge Results



BRI Culvert Discharge Results

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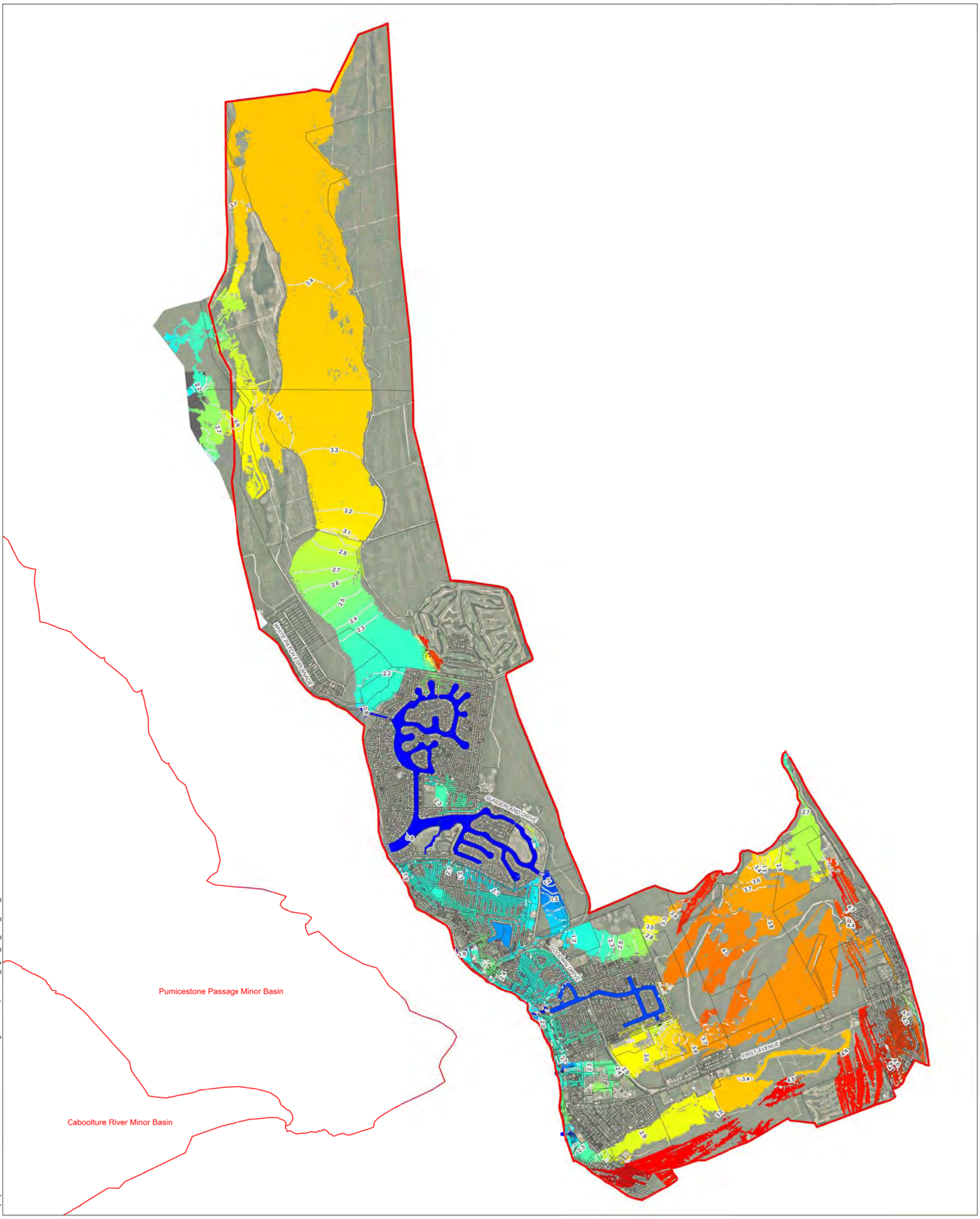
Appendix E
Flood Maps – 100 Year ARI

Appendix E
Flood Maps – 100 Year ARI

aurecon



Map by: DJF   P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_E1_WSL_100Y_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

Contour Lines (m AHD)

Flood Level (m AHD)

<1.0   2.0   3.0   4.0   >5.0

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

A3 scale 1:50,000

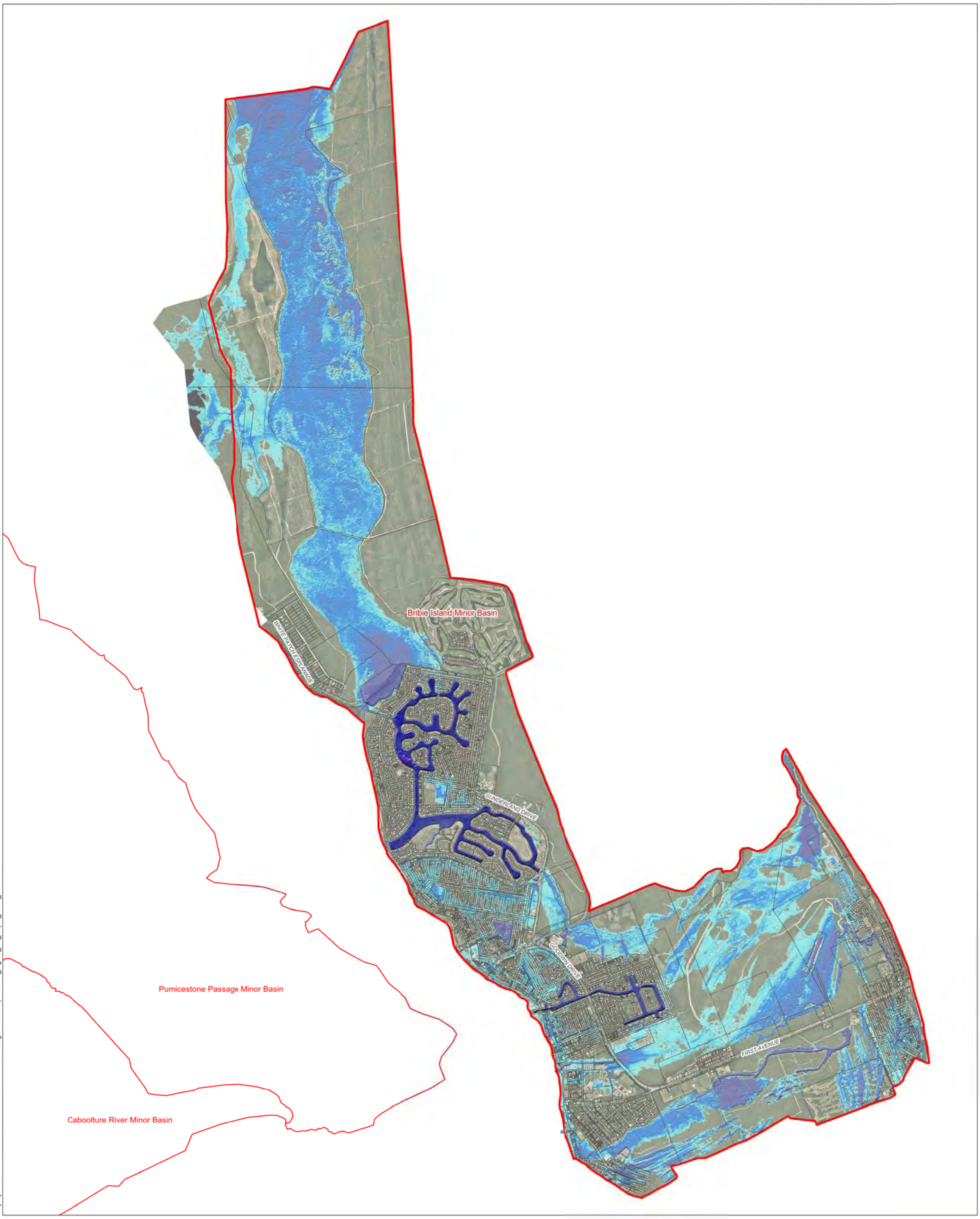
0   1,250 m   2,500 m

Date: 31/05/2012   Version: 0   Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure E1: Peak Flood Level Map - 100 Year ARI



Map by: DJF P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_E2_Depth_100Y_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

100 Year ARI Peak Flood Depth (m)

0.0 1.0 2.0 3.0 >4.0

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

A3 scale 1:50,000

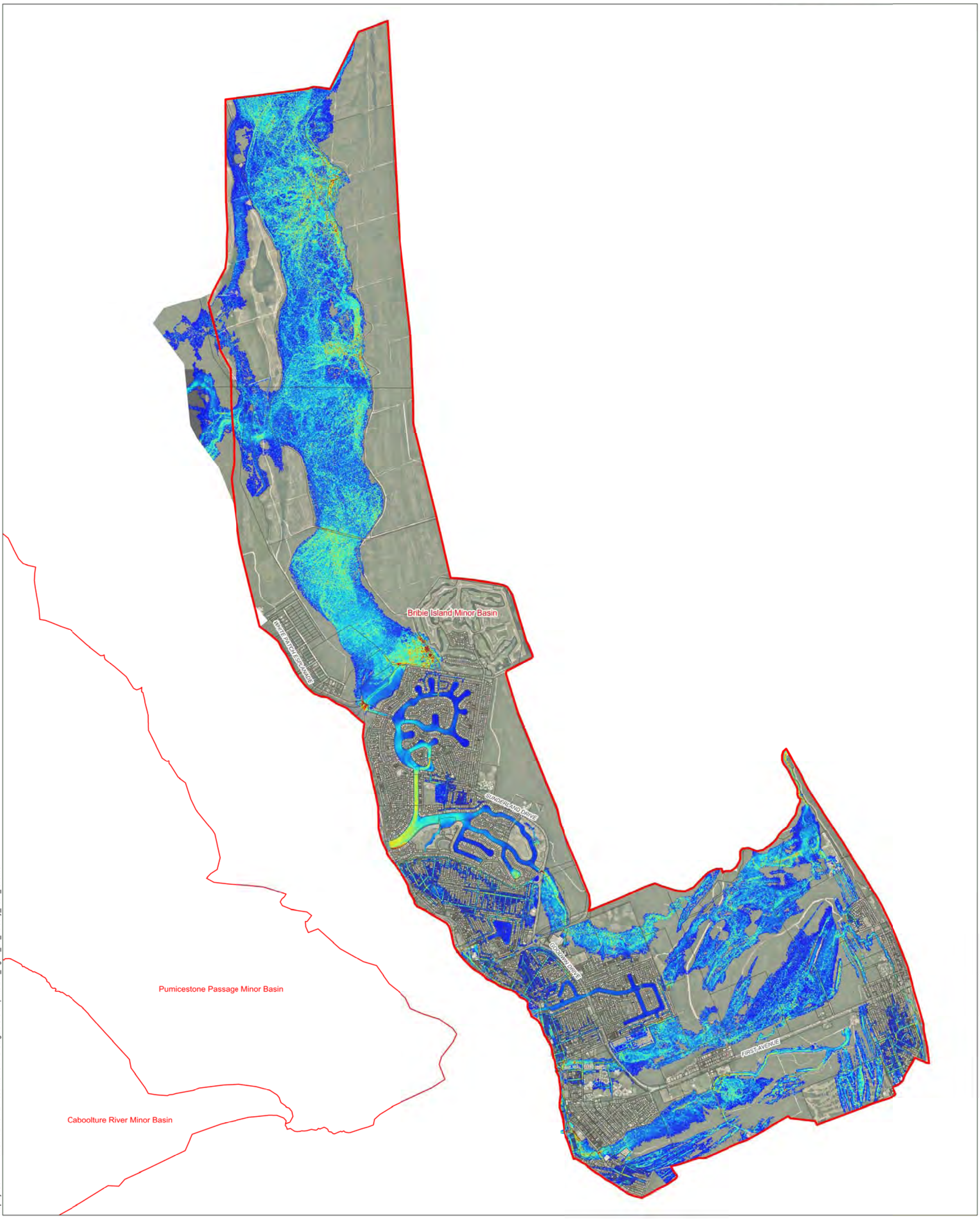
0 1,250 m 2,500 m

Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure E2: Peak Flood Depth Map - 100 Year ARI



Map by: DJF   P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_E3_Velocity_100Y_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

100 Year ARI Peak Flood Velocity (m/s)

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 >6.0

Notes:

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A3 scale 1:50,000

0   1,250 m   2,500 m

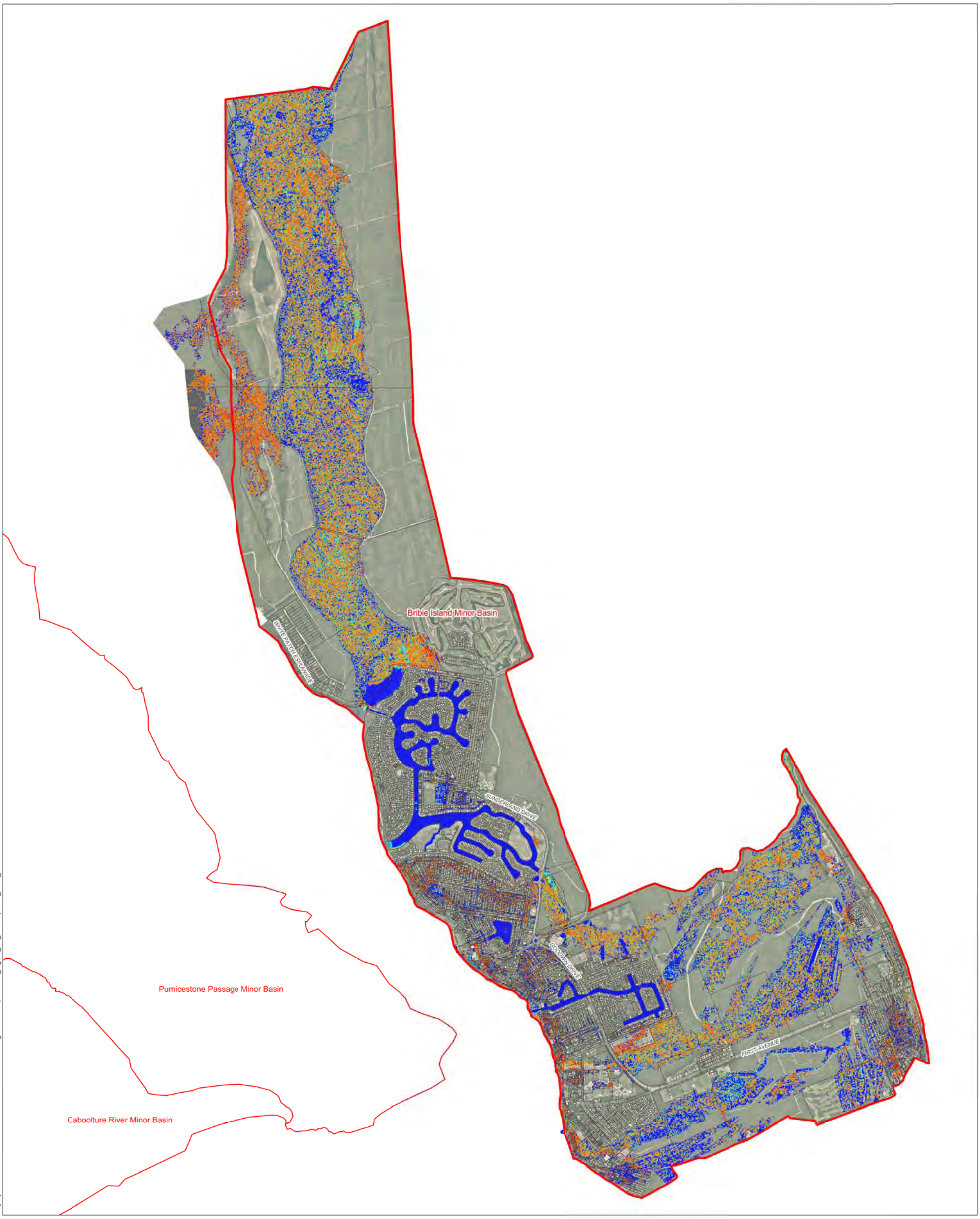
Date: 31/05/2012   Version: 0   Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure E3: Peak Flood Velocity Map - 100 Year ARI

aurecon



Map by: DJF   P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_E4_Streampower_100Y_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

100 Year ARI Peak Stream Power

0 3 5 10 >500

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

A3 scale 1:50,000

0 1,250 m 2,500 m

Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure E4: Peak Flood Stream Power Map 100 Year ARI

Map by: DJF   P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_E5_Hazard_100Y_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

New South Wales Floodplain Development
Manual Flood Hazard Category
100 Year ARI Event

Low Hazard
High Hazard

Notes:

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A3 scale 1:50,000

0   1,250 m   2,500 m

Date: 31/05/2012   Version: 0   Job No: 211090

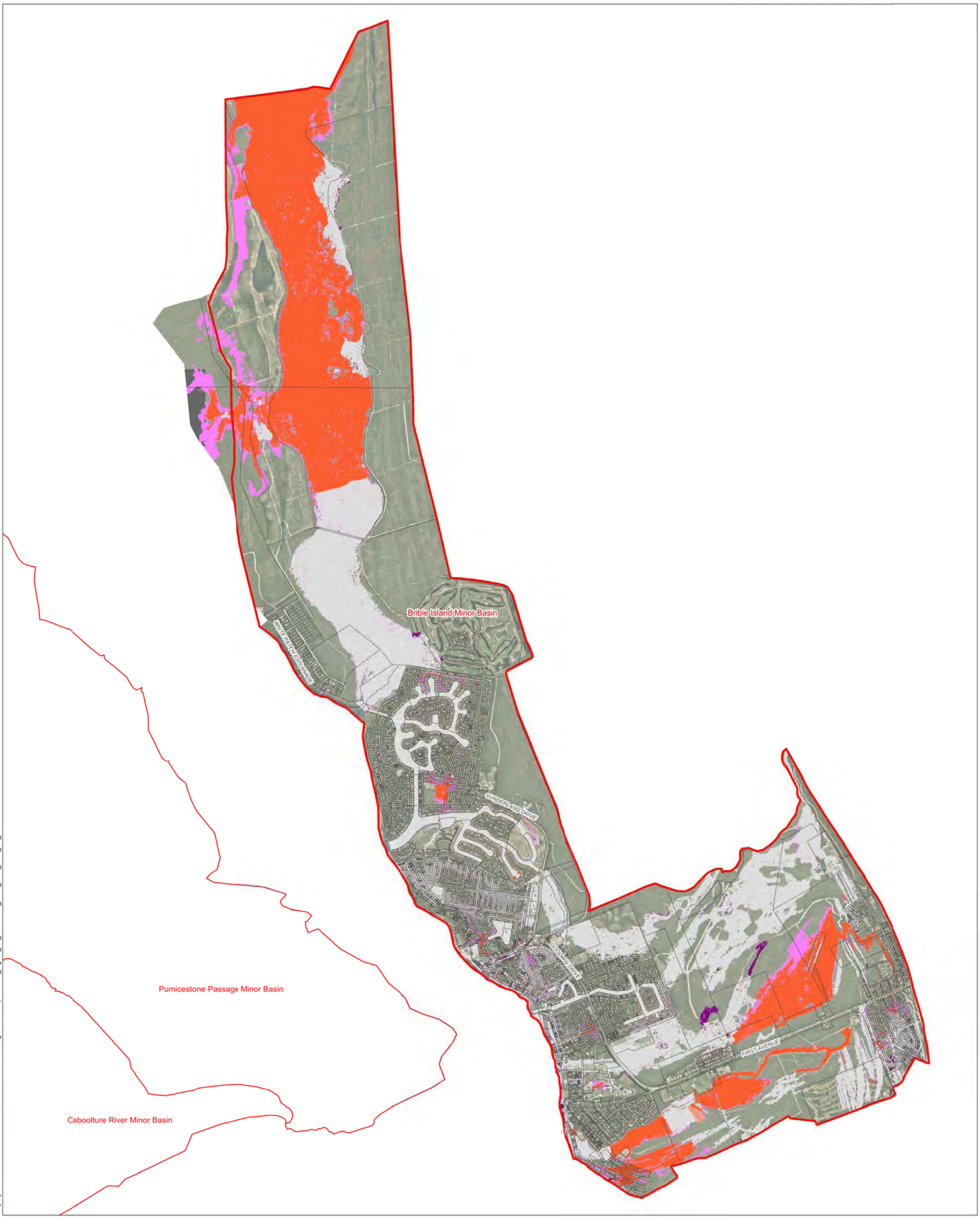
Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure E5: Peak Flood Hazard Map - 100 Year ARI

Appendix F
Model Sensitivity Analysis Maps

Appendix F
Model Sensitivity Analysis Maps



Map by: DJF P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_F1_Difference_100Y_EDS_SCD_S1_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows EDS peak water level minus selected critical durations peak water level

A3 scale 1:50,000

0 1,250 m 2,500 m

Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F1: Peak Flood Level Difference between EDS and Selected Critical Storm Durations - 100 Year ARI (S1)

Map by: DJF P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_F2_Increased_Roughness_Impact_100Y_EDS_S2_rev0.wor

Legend

- Cadastre
- Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in roughness peak water level minus EDS peak water level

A3 scale 1:50,000

0 1,250 m 2,500 m

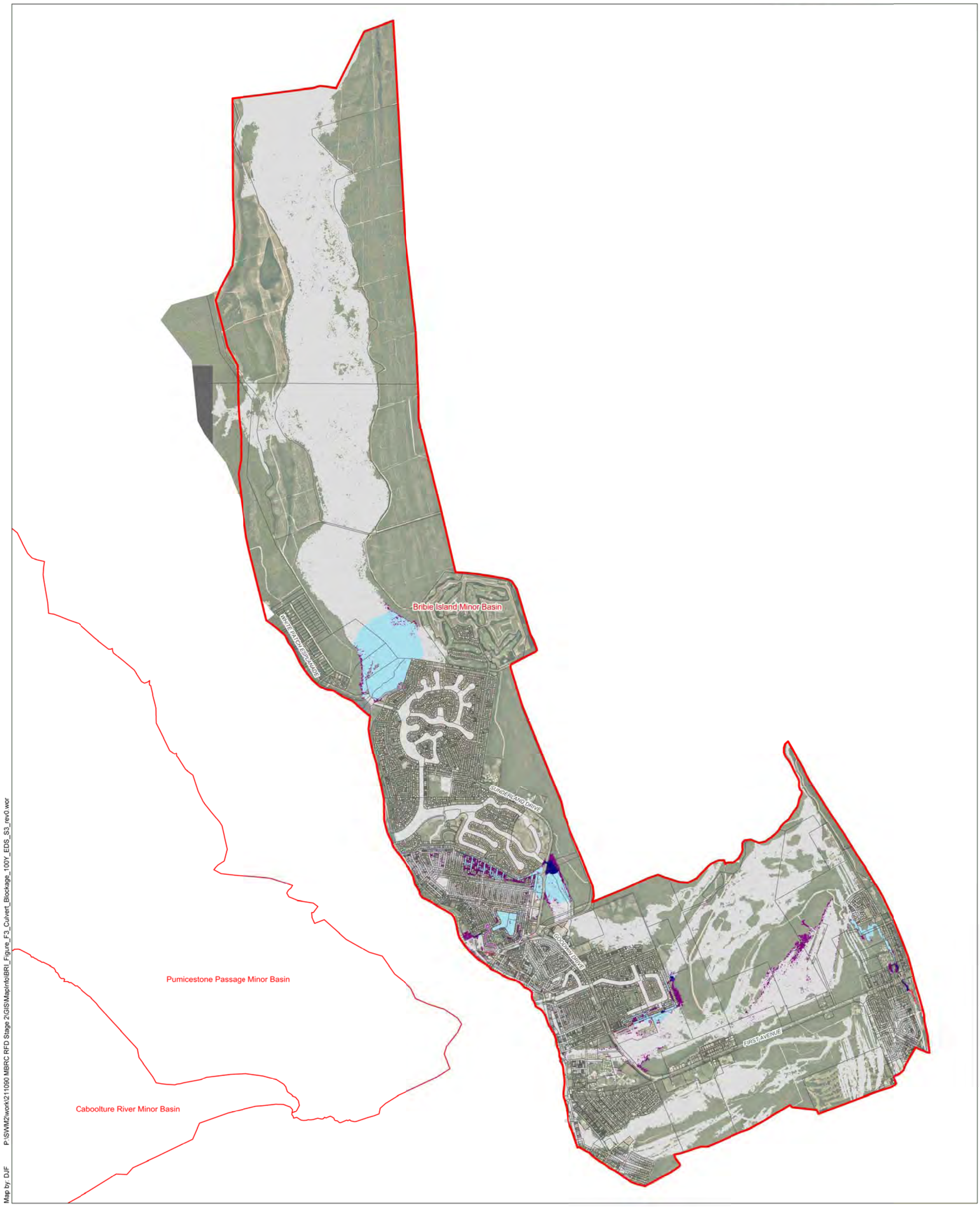
Date: 31/05/2012 Version: 0

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F2: Increase in Roughness Flood Level Impact 100 Year EDS (S2)

aurecon



Legend

Cadastre

Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows structure blockage peak water level minus EDS peak water level

A3 scale 1:50,000

0 1,250 m 2,500 m

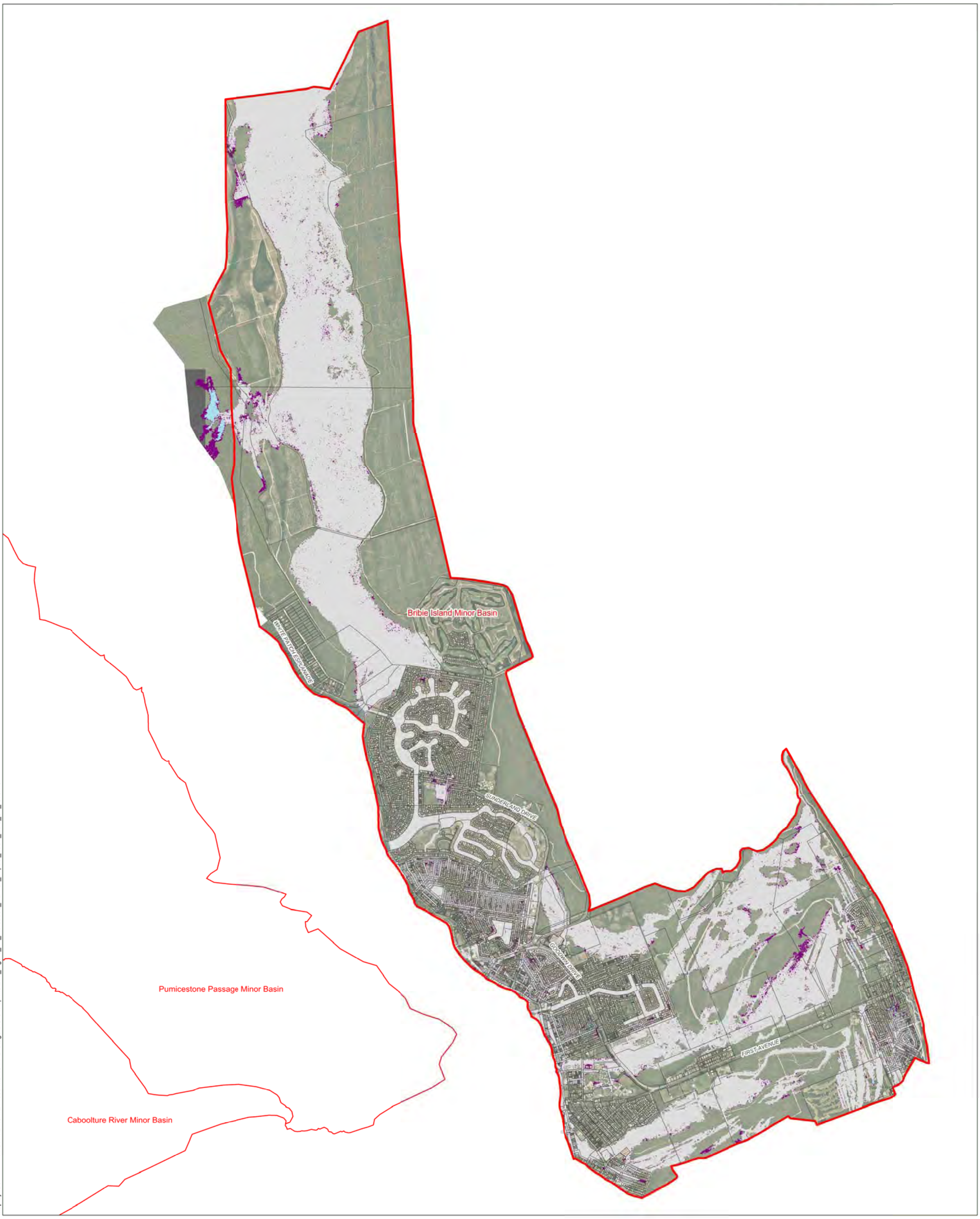
Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F3: Structure Blockage Flood Level Impact 100 Year EDS (S3)

aurecon



Map by: DJF P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_F4_Increased_Rainfall_Impact_100Y_EDS_S4_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in rainfall peak water level minus EDS peak water level

A3 scale 1:50,000

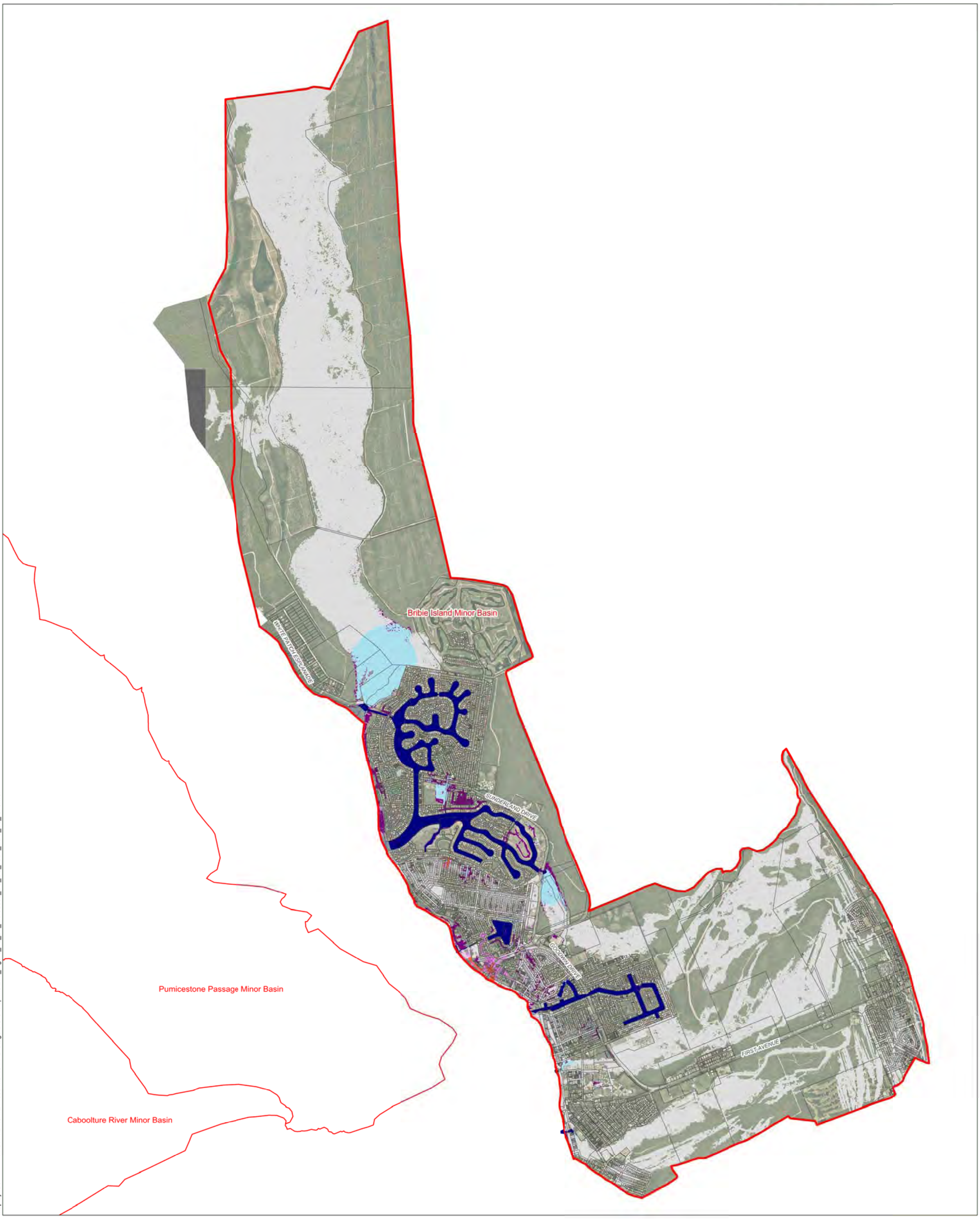
0 1,250 m 2,500 m

Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F4: Increase in Rainfall Flood Level Impact 100 Year EDS (S4)



Map by: DJF P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_F5_Dif_Increased_DS_BC_100Y_EDS_S5_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in downstream boundary peak water level minus EDS peak water level

A3 scale 1:50,000

0 1,250 m 2,500 m

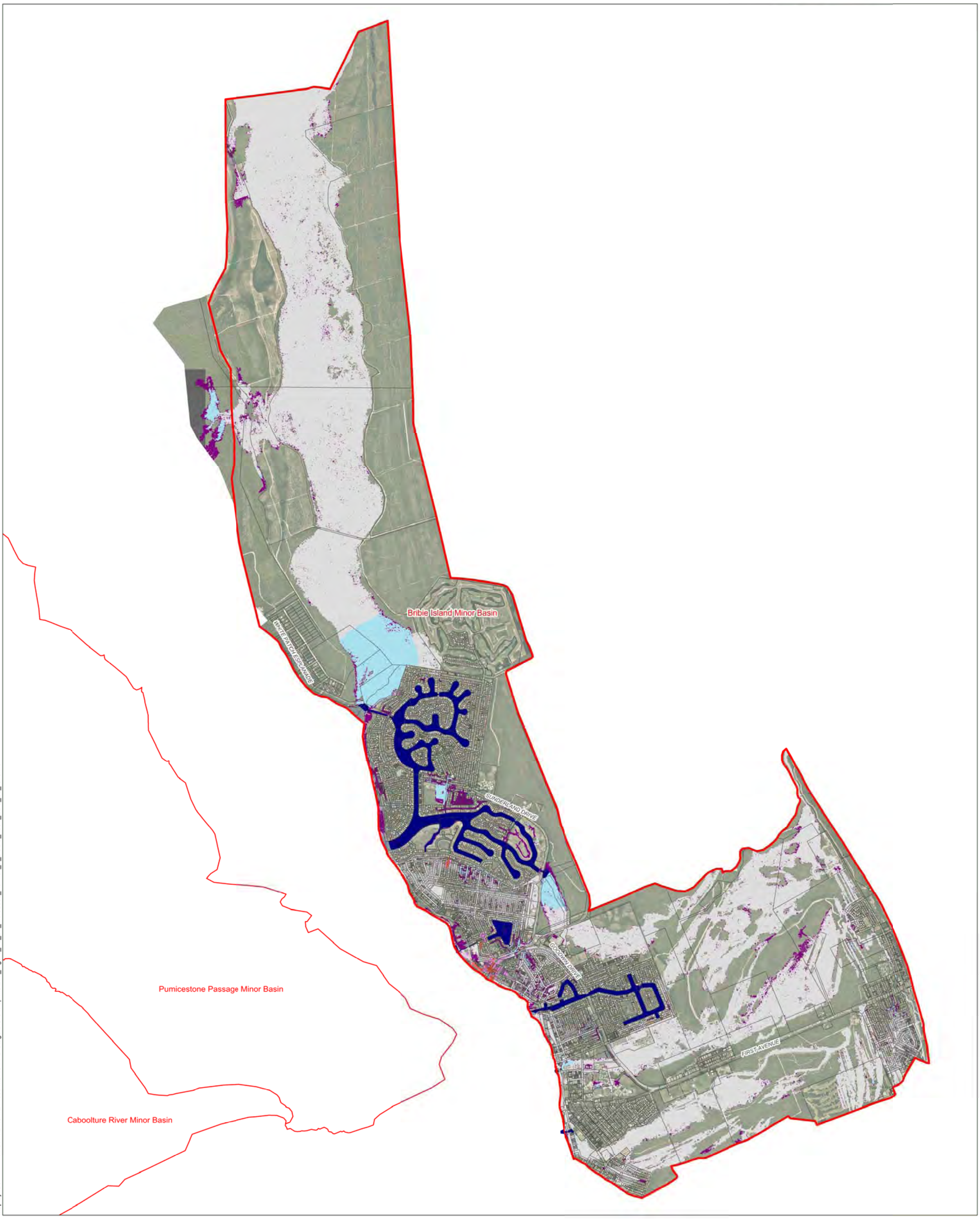
Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F5: Increase in Downstream Boundary Flood Level Impact 100 Year EDS (S5)

aurecon



Map by: DJF   P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_F6_Dif_Increased_Rainfall_&_DSBC_100Y_EDS_S6_rev0.wor

Legend

- Cadastre
- Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in rainfall and downstream boundary peak water level minus EDS peak water level

A3 scale 1:50,000

0 1,250 m 2,500 m

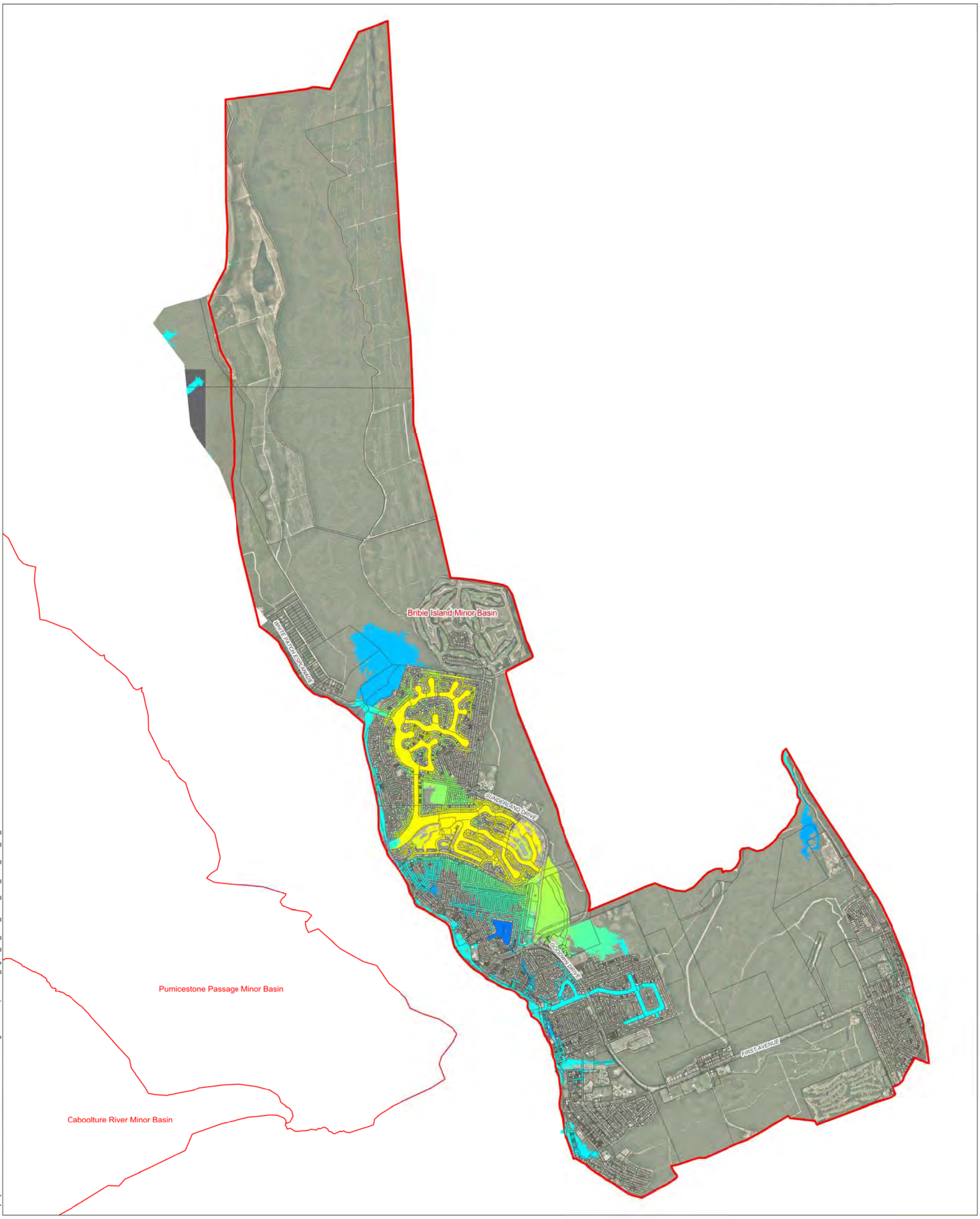
Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F6: Increase in Rainfall and Downstream Boundary Flood Level Impact 100 Year EDS (S6)

aurecon



Map by: DJF P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_F7_WSL_Storm_Tide_100Y_EDS_S7_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

Flood Level (m AHD)

<1.0 2.0 3.0 4.0 >5.0

Notes:
This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

A3 scale 1:50,000

0 1,250 m 2,500 m

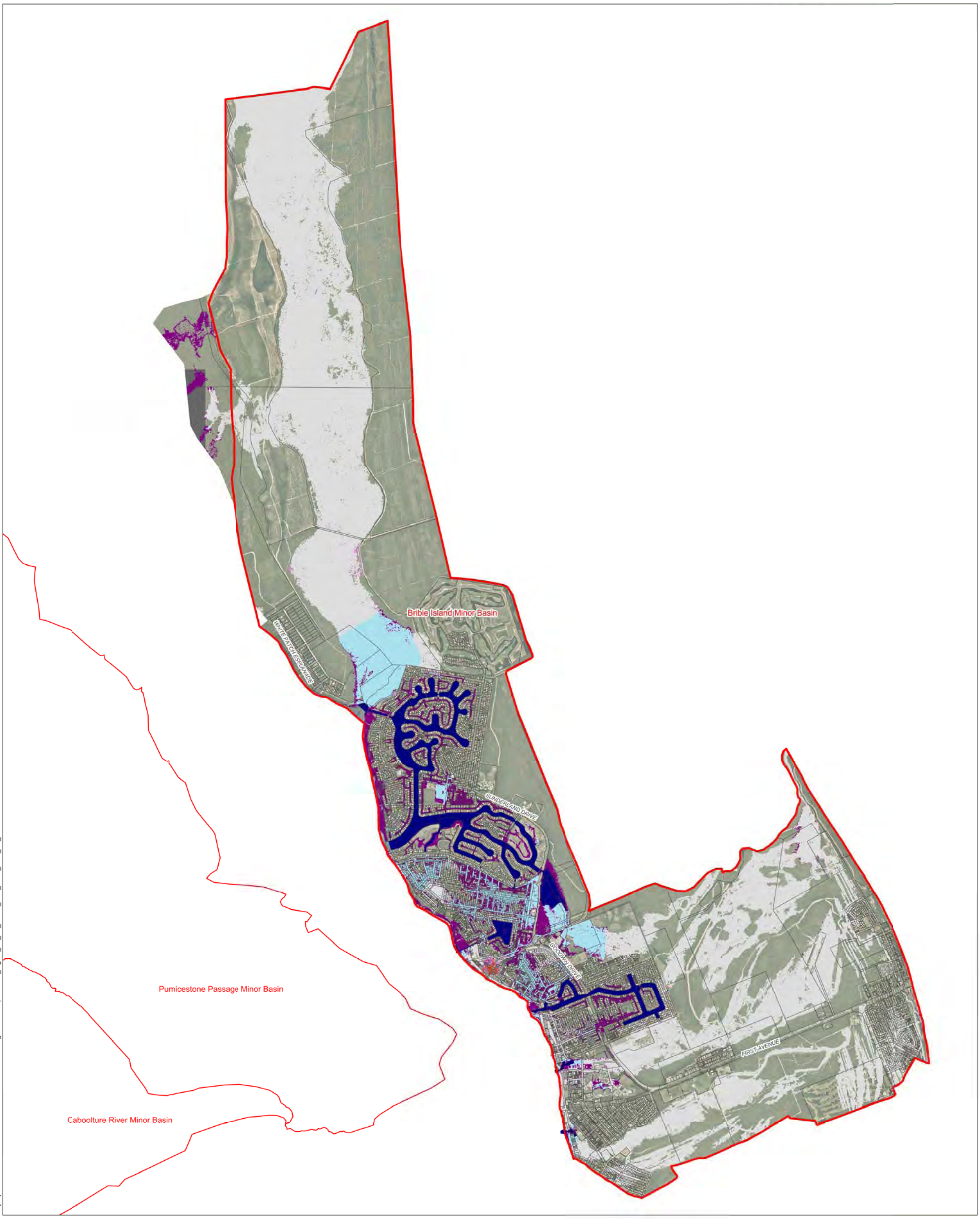
Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Stage 2 Detailed Modelling

Figure F7: Dynamic Storm Tide Peak Flood Level 100 Year ARI (S7)

aurecon



Map by: DJF P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_F8_Dif_Storm_Tide_100Y_EDS_S8_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows static storm tide peak water level minus EDS peak water level

A3 scale 1:50,000

0 1,250 m 2,500 m

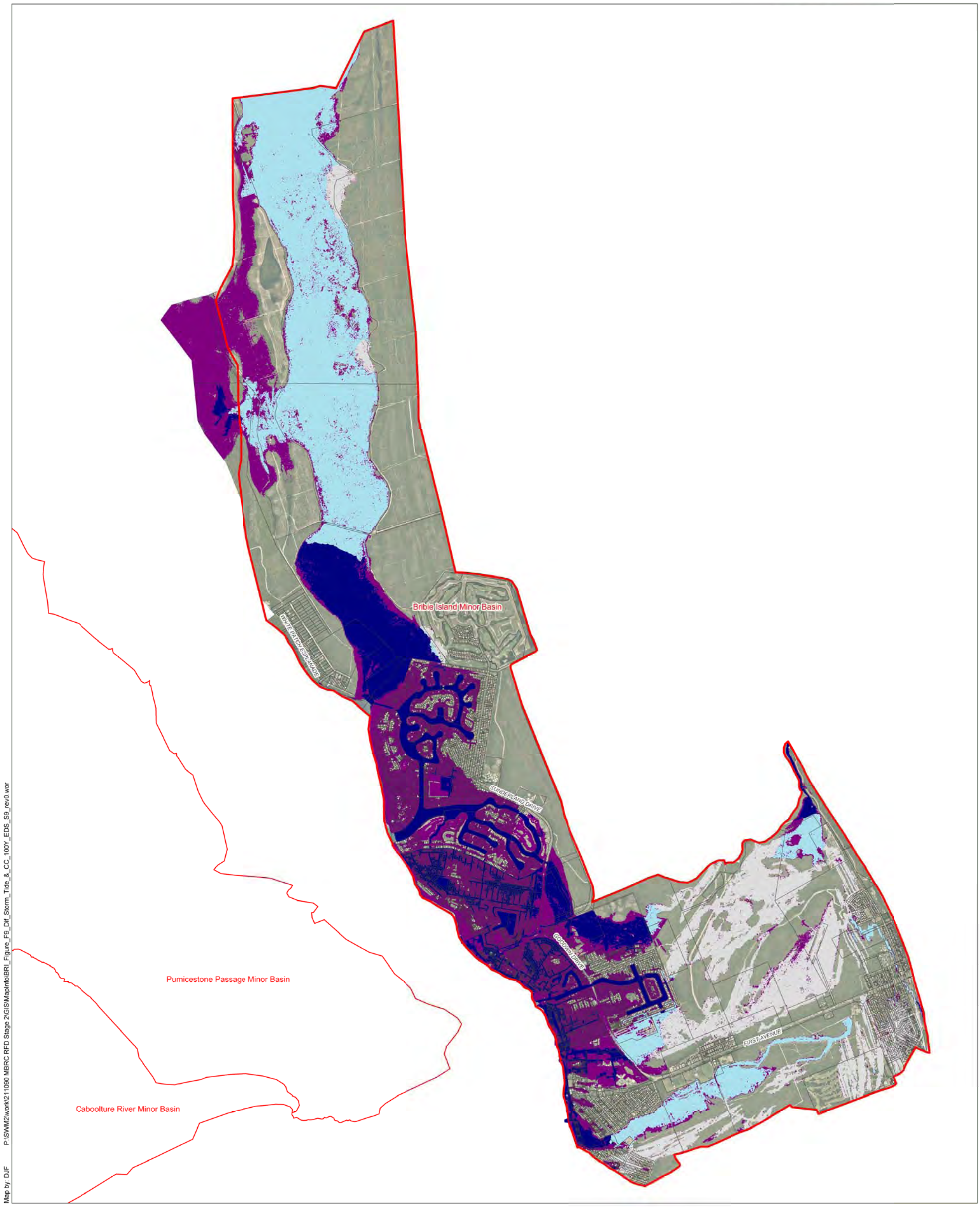
Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F8: Static Storm Tide Flood Level Impact - 100 Year EDS (S8)

aurecon



Legend

Cadastre

Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows static storm tide and climate change peak water level minus EDS peak water level

A3 scale 1:50,000

0 1,250 m 2,500 m

Date: 31/05/2012 Version: 0 Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F9: Static Storm Tide and Climate Change Flood Level Impact 100 Year EDS (S9)

aurecon

Map by: DJF   P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_F10_Dif_Increased_Vegetation_100Y_EDS_S10_rev0.wor

Legend

- Cadastre
- Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in vegetation peak water level minus EDS peak water level

A3 scale 1:50,000

0   1,250 m   2,500 m

Date: 31/05/2012   Version: 0   Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F10: Increase in Vegeation Flood Level Impact 100 Year EDS (S10)

aurecon

Map by: DJF   P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_F11_Dif_Increased_Development_100Y_EDS_S11_rev0.wor

Legend

Cadastre

Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in residential development peak water level minus EDS peak water level

A3 scale 1:50,000

0   1,250 m   2,500 m

Date: 31/05/2012   Version: 0   Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F11: Increase in Residential Development Flood Level Impact 100 Year EDS (S11)

aurecon

Map by: DJF   P:\SWM2\work\211090 MBRC RFD Stage 2\GIS\MapInfo\BRI_Figure_F12_Dif_Increased_Vegetation_&_Development_100Y_EDS_S12_rev0.wor

Legend

- Cadastre
- Minor Basin Boundaries

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in vegetation and residential development peak water level minus EDS peak water level

A3 scale 1:50,000

0   1,250 m   2,500 m

Date: 31/05/2012   Version: 0   Job No: 211090

Projection: MGA Zone 56

RFD Detailed Modelling (BRI)

Figure F12: Increase in Vegetation and Residential Development Flood Level Impact - 100 Year EDS (S12)

Appendix G
Hydrologic Modelling Details

Appendix G
Hydrologic Modelling Details

A separate report for hydrologic model establishment was not created as part of the study; therefore this section has been included to describe the process undertaken in the hydrologic modelling.

Available data

The following data was made available for the hydrologic modelling:

- Base WBNM model supplied by Andrew Wiersma on 30 March 2011. This model was supplied with notes that C-value = 1.6; ARF = 1.0 and IFD file location in all runfiles will need to be amended
- Design rain gauge locations were also supplied by Andrew Wiersma on 30 March 2011
- Guidance on how climate change modelling is to be undertaken ie IFD coefficients to be increased by 12% (as per email correspondence from Hester van Zijl on 10 April 2012)
- Future development impervious values as supplied by Hester van Zijl on 2 May 2012
- Guidance for rainfall data setup was provided in the Worley Parsons (2010) *Database Design Rainfall - Burpengary Pilot Project (Draft)* report

Methodology

Model version

WBNM version 2010_000 was used to undertake the analyses.

The TUFLOW convert_to_ts1 utility (v 2009-10-AB) was used to convert the results to TUFLOW format.

Design event modelling

A separate .wbn file was created for each duration for each event (ARI). This was done in order to create separate output files for each event, which could then be used as input to the TUFLOW hydraulic model.

Two (2) design event rain gauge locations were adopted for the BRI minor basin as per the IFD data supplied.

The model results were then converted to .ts1 files for input to TUFLOW. Zero flow values were added to the end of each hydrograph. This was done for all WBNM model results, including the extreme events, PMP events and climate change events. Only the .loc files were used as input to the TUFLOW models.

Extreme event modelling

CRC-Forge was used to provide rainfall intensities. These were calculated for each of the five rainfall gauge locations adopted for the design events. For the 0045, 0090 and 0120 minute durations, no values are provided by CRC-Forge, therefore these were linearly interpolated between the 0030, 0060 and 0180 intensities.

PMP temporal patterns were applied to the extreme events. For the 0015, 0030, 0045, 0060, 0090, 0120, 0180 and 0360 minute events the temporal pattern for the Generalised Short Duration Method (GSDM) (BoM, 2003) was adopted. For the 1440, 2160, 2880 and 4320 minute events the temporal patterns from the coastal_avm_100 storms were adopted (as per the Generalised Tropical Storm Method (GTSMR), BoM 2003).

For the 0720 minute duration, both the GSDM and GTSMR temporal patterns were analysed. For the GTSMR, the times applying to the 1440 minute duration pattern were halved to create a 0720 minute pattern.

PMP event modelling

For the PMP event, a single storm was used across the entire model extents. The temporal patterns used for the extreme events were also used for the PMP events.

The methods set out in the GSDM (BoM, 2003) were used to provide rainfall intensities for the 0015, 0030, 0045, 0060, 0120, 0150, 0180, 0240, 0300 and 0360 minute events. The GTSMR methods (BoM, 2003) were used to provide intensities for the 1440, 2160, 2880 and 4320 minute events. For the 0720 minute event, a line of best fit was applied between the short and long duration intensities and the rainfall intensity was calculated to provide the best R^2 value to this line.

Key parameters used in the PMP analysis are provided in Table G1.

Table G1 | Adopted PMP Parameters

Parameter/Method	Value
GSDM – initial depths	Rough surface for area = 1km^2
GSDM – EAF	1 as topography is below 1500m AHD
GSDM – MAF	0.85 (as per design events)
GTSMR – initial depths	Coastal summer values for area = 1km^2
GTSMR – TAF	1.505 – median value from region inspection
GTSMR – DAF	0.997 – median value from region inspection
GTSMR – EPW	88.525 – median value from region inspection

Climate change event analysis

For the climate change scenario (S4), the IFD data adopted for the design events was increased by 12%. No other changes were made to the EDS model setup.

Future landuse scenario analysis

For the future landuse scenario (S11), the revised fraction impervious values provided by MBRC were incorporated into the .wbn file. No other changes were made to the model setup.

Appendix H
Landuse Polygon Review

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Landuse Polygon Review

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Project: Moreton Bay Flood Modelling	Reference: 211090

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✔			Hester van Zijl	MBRC	Hester.vanzijl@moretonbay.qld.gov.au
	✔		Talia Campbell	Aurecon	campbellt@ap.aurecongroup.com
From: Brandon Breen				Date: 1 March 2011	Total pages: 6

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Subject: Land Use Polygon Review

Hester

We have undertaken a review of the land use polygons developed by SKM. As part of our land use review, the following land use polygon layers have been visually compared to the available aerial images:

- Roads - MBRC_DigitisedRoads_2009AerialsOnly_MGA56 and AllMBRC_Roads_Merged_MGA56
- Buildings - MBRC_Buildings_Updatedw2009Aerials_MGA56
- Footpaths - MBRC_Footpaths_Updatedw2009Aerials_MGA56
- Vegetation - MBRC_Vegetation_Existing_2009_MGA56
- Water bodies (creeks) - MBRC_Waterbodies_Creeks_2009Aerials_MGA56
- Water bodies (rivers) - MBRC_Waterbodies_Rivers_2009Aerials_MGA56
- Urban blocks - MBRC_UrbanBlock_2000SqmBlocks_MGA56

This review has shown that the above layers cover the MBRC region and have also been extended to cover the portion of the SCRC region which falls within the Pumicestone Passage minor basin.

This memo presents the findings of our review and our proposed approach in areas that discrepancies occur.

Project: Moreton Bay Flood Modelling	Reference: 211090

Roads Land Use Layer

The SKM land use polygons partially include dirt roads (as shown in Figure 1 below). If the digitised road at location 1 is to be included in the roads land use layer, then in order to provide consistency throughout the model other dirt roads such as that in location 2 should also be digitised.

We think the inclusion of the dirt tracks is not likely to make a large impact on the modelling and therefore propose to provide consistency by excluding dirt roads from the modelling, rather than digitising all remaining dirt roads in the Pumicestone domain. The railway line, which has similar properties to a dirt road, has not been included in roads land use layer which suggests the dirt roads are not required.

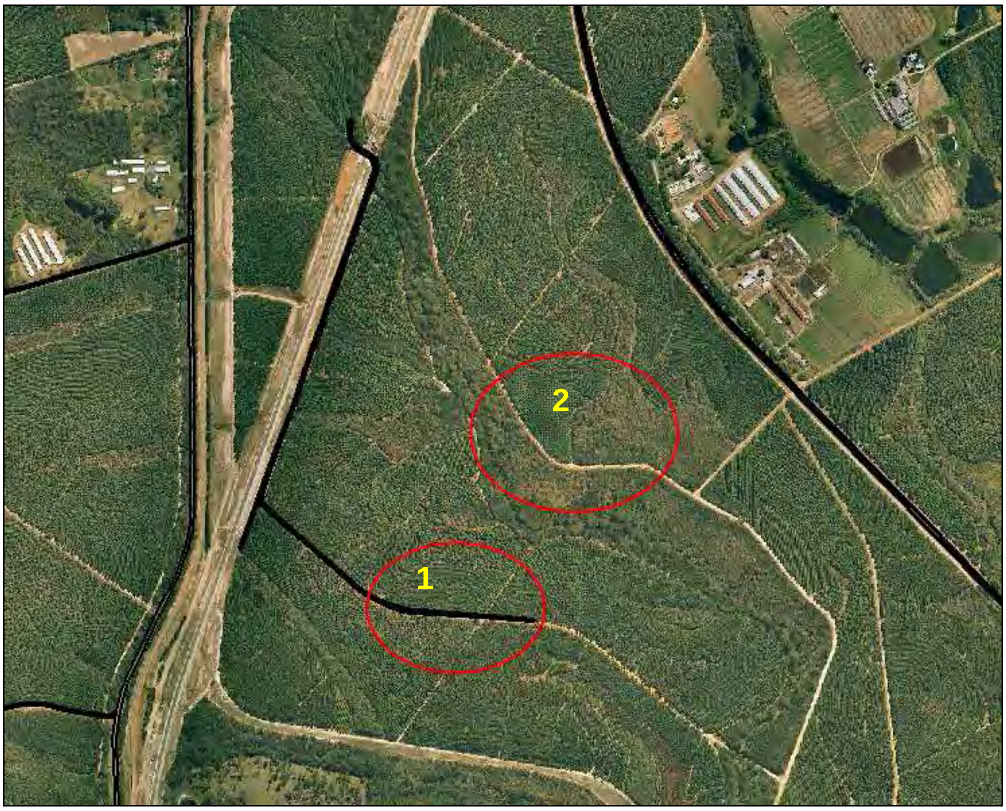

Figure 1 Example of Digitised Dirt Roads

Buildings Land Use Layer

Review of the SKM buildings land use layer shows that all buildings in the urban areas have been digitised; however there are some inconsistencies in the rural areas of the Pumicestone domain. The example in Figure 2 below shows a small cluster of buildings at location 1 have been included in the buildings layer and the larger buildings at location 2 have not been included.

We propose to add all large buildings and residential buildings into the buildings land use layer in order to provide consistency throughout the model.

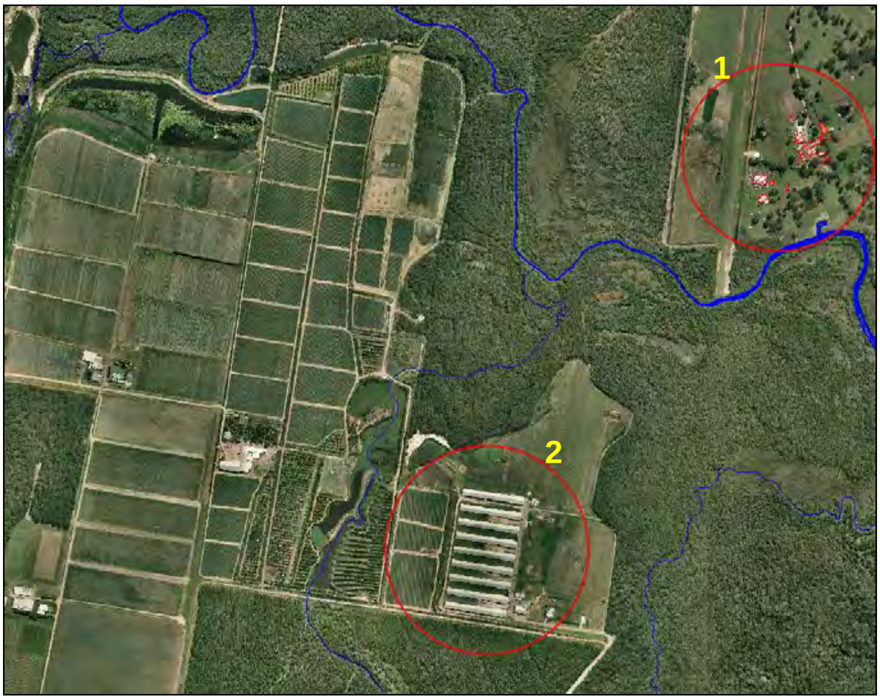

Figure 2 Example of Digitised buildings

Footpaths Land Use Layer

A review of the SKM footpaths layer has shown that they are generally well aligned and well defined. In a few locations, particularly on Bribie Island, some minor realignment, extension and addition of short sections to these polygons is proposed. We do not propose to make and any major changes to this layer. An example of minor adjustments is shown in Figure 3 with the proposed updated alignment in red.

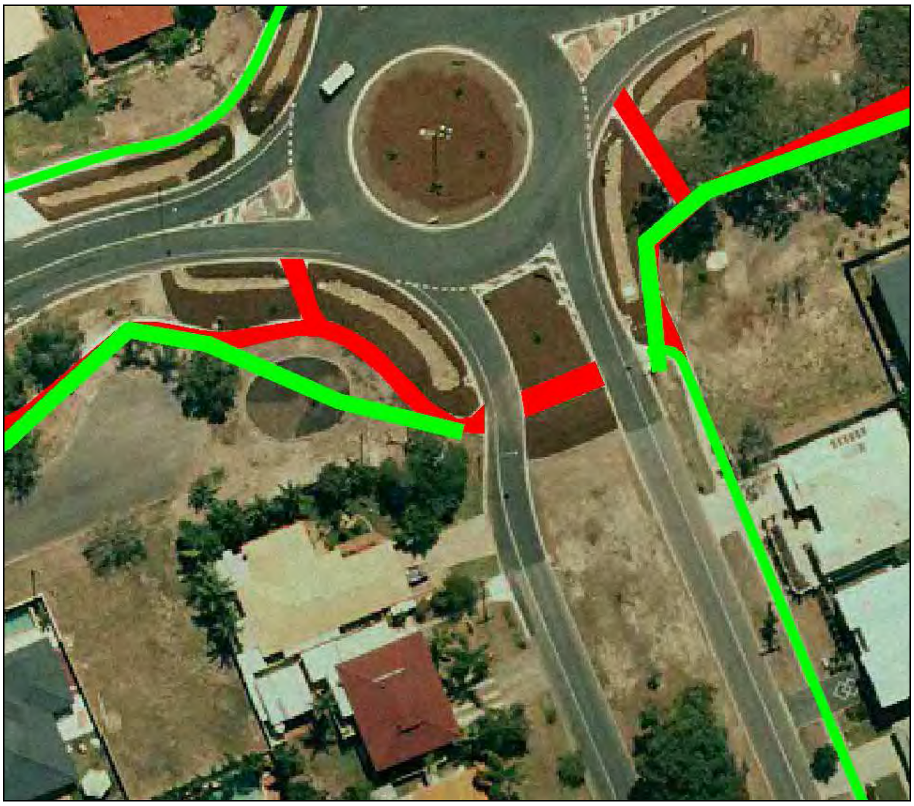

Figure 3 Example of Digitised Footpaths

Vegetation Land Use Layer

A review of the SKM land use layer found the polygons to be accurate within the MBRC region. The portion of these polygons which have been digitised in the SCRC region have not picked up all the vegetated land. We propose to maintain the existing SKM land use layer, with the additional definition of vegetation layers in the SCRC area as shown in Figure 4 below – this figure shows the areas defined by SKM (green) and the additional definition we are proposing (red).

Figure 4 Example of Digitised Vegetation

Waterbodies (Creeks)

The waterbodies (creeks) were well defined in the SKM land use layer. In the SCRC portion of the Pumicestone Passage catchment we found three waterbodies which were not included. We propose to maintain the existing SKM land use layer, with the addition of these three waterbodies in the SCRC area.

Waterbodies (Rivers)

The waterbodies (rivers) are well defined in the SKM land use layers. We do not propose to make any changes to this layer.

Project: Moreton Bay Flood Modelling	Reference: 211090

Urban Blocks

A review of the urban blocks layer showed that all blocks under 2000m^2 within the MBRC region were defined. The urban blocks in the Beerburrum area were not included in this layer. We propose to maintain the existing SKM urban blocks land use layer, with the addition of urban blocks in Beerburrum (based upon cadastral data sourced from DERM on 25th February) as shown in Figure 5.

Figure 5 Example of Urban Blocks to be Included

Could you please review this memo and provide your comments regarding our proposed changes to the land use polygons?

Regards

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Water

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