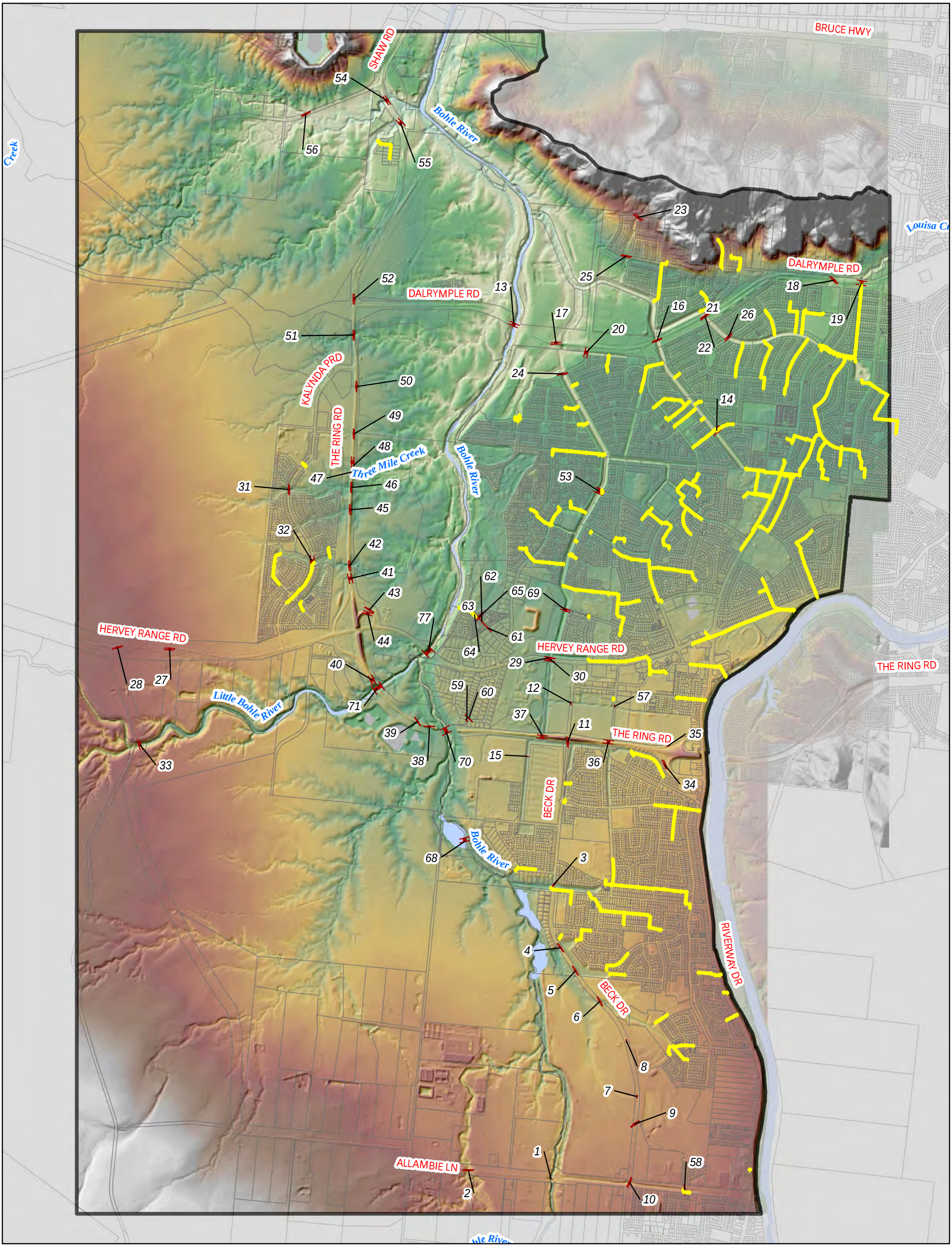

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MIKE URBAN Structures

MIKE 11 Structures

UPPER & MIDDLE BOHLE FLOOD STUDY
Middle Bohle: Model Geometry

Figure 3-3

3.3.2 Boundary Conditions

3.3.2.1 Upper Bohle

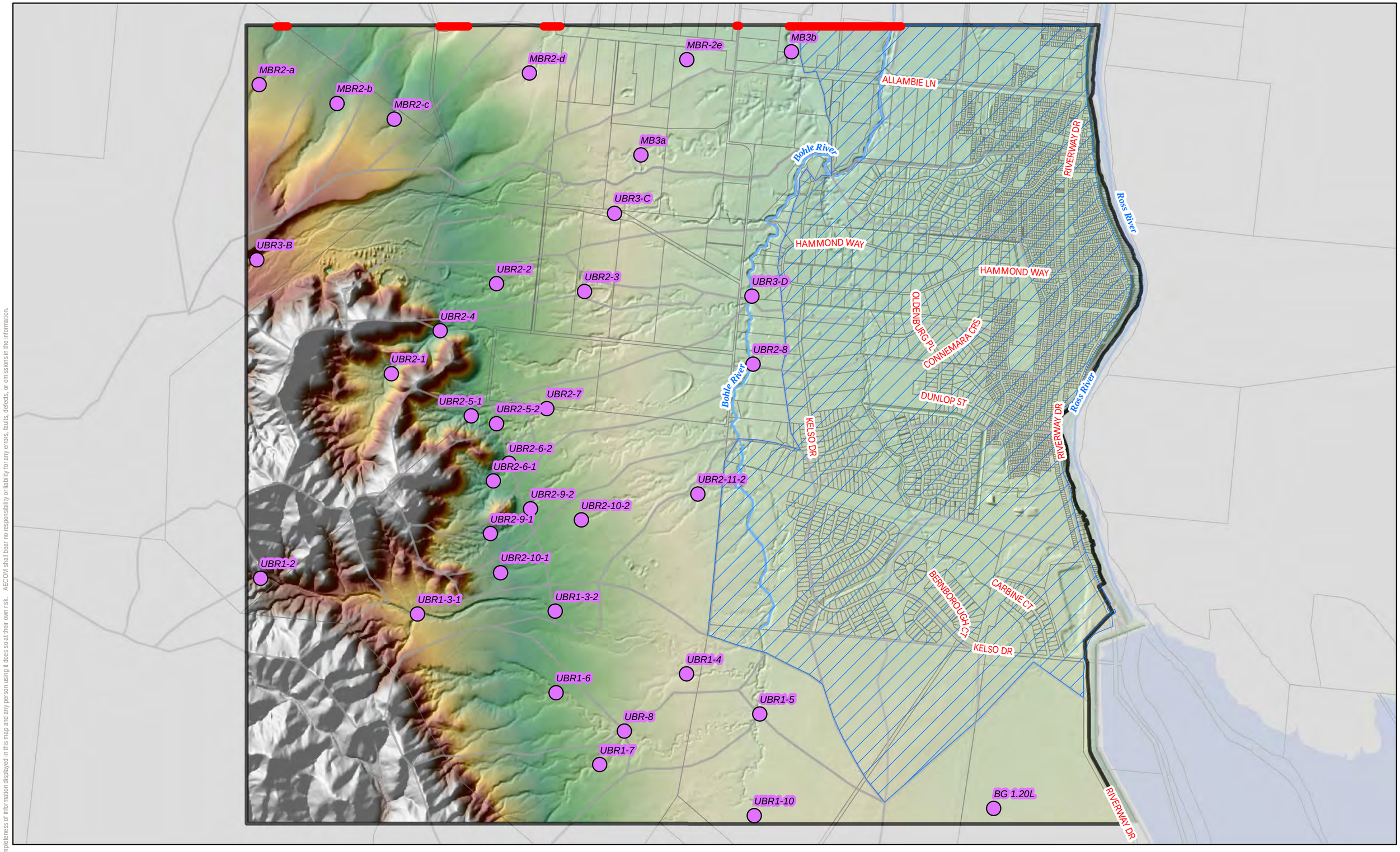
Upstream boundary conditions were derived from the inflow hydrographs, obtained from the XP RAFTS hydrologic model at specific catchments and applied as source points at appropriate locations throughout the hydraulic model for the Upper Bohle model. Rain-on-grid was applied across the more urban and relatively flat areas of the model extent.

Watercourses at the downstream extents of the MIKE 21 grid were extended using MIKE 11 sections to reduce sensitivity to downstream boundary conditions within the MIKE 21 grid. Boundary conditions at the downstream extents of the MIKE 11 sections were applied by using a discharge rating curve derived from a calculated slope at the downstream extent of the model (see Figure 3-4 for locations). Cross sections were derived from 1 m LiDAR data supplied for this project.

3.3.2.2 Middle Bohle

Inflow hydrographs at the upstream boundary were taken from discharge hydrographs from the Little Bohle River, Blacks Gully and Upper Bohle River XP-Rafts models. Rain-on-grid was applied across the more urban and relatively flat areas of the model extent. The locations of all boundary conditions for this model can be seen in Figure 3-5.

An ocean downstream boundary was applied as a fixed water level of 1.254 m AHD which represents the mean high water spring (MHWS) tide for the Townsville area as included in the Queensland Tide Tables (2011). This downstream boundary was extended down to the ocean through a MIKE 11 channel to account for any potential backwater effects from the downstream catchments of the Bohle River and the representation of a hydraulic gradient line profile for the entire length of the river. For the Louisa Creek downstream boundary of the model, a discharge rating curve derived from a calculated slope at the downstream extent of the model was applied (see Figure 3-5 for locations). Cross sections were derived from 1 m LiDAR data supplied for this project.



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Base Data:
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Source Locations

Outflow Boundaries

Rain on Grid Area Net Precipitation

UPPER & MIDDLE BOHLE FLOOD STUDY

Upper Bohle: Boundary Conditions

Figure 3-4

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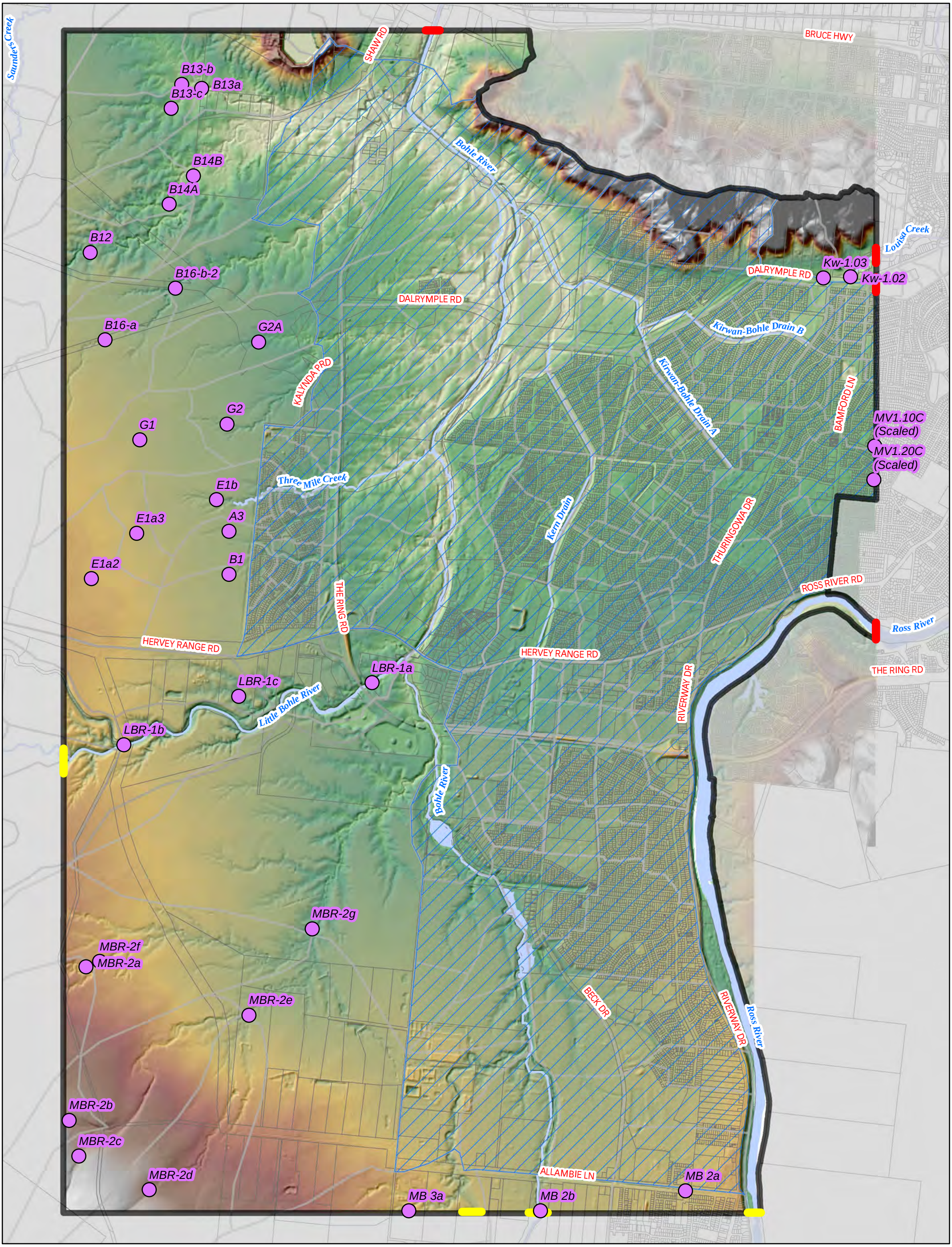

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Source Locations
Rain on Grid Area Net Precipitation
Inflow Boundaries
Outflow Boundaries

UPPER & MIDDLE BOHLE FLOOD STUDY
Middle Bohle: Boundary Conditions

Figure 3-5

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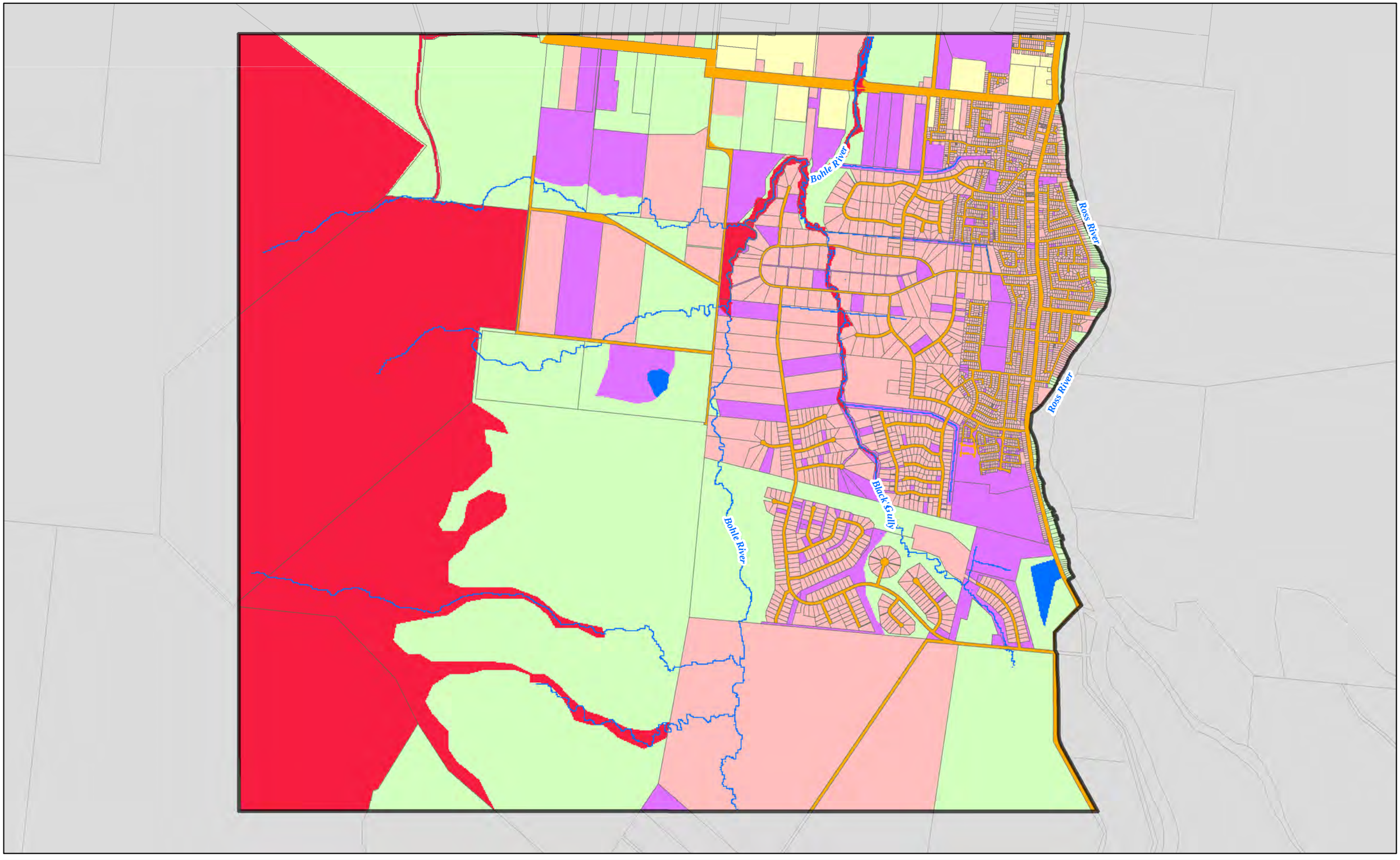
3.3.3 Roughness

Hydraulic roughness (Manning's n value) is a measure of the resistance to flow and is primarily dependent on land use. Values selected for each land use are provided in Table 3-4 and roughness maps are shown in Figure 3-6 and Figure 3-7. These values are consistent with previous flood study reports undertaken as part of the *City Wide Flood Constraints Project* in the Bohle Flood Plains area and have been confirmed through calibration both in the previously modelled Upper and Lower Bohle River models (*BPFPR 2010*) and as part of this study.

Table 3-4 Hydraulic Roughness Values

Land Use	Manning's n Value
Drainage Easements	0.02
Roads/Rail	0.025
River Channel	0.03
Open Grassland	0.04
Open Space/Sandy area	0.05
Rural Residential	0.055
Urban Areas	0.06
Dense Forest	0.08
Riparian Zone	0.1



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Base Data:
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Manning's (n)

0.02	0.03	0.05	0.06	0.1
0.025	0.04	0.055	0.08	

UPPER & MIDDLE BOHLE FLOOD STUDY
Upper Bohle: Roughness Map

Figure 3-6

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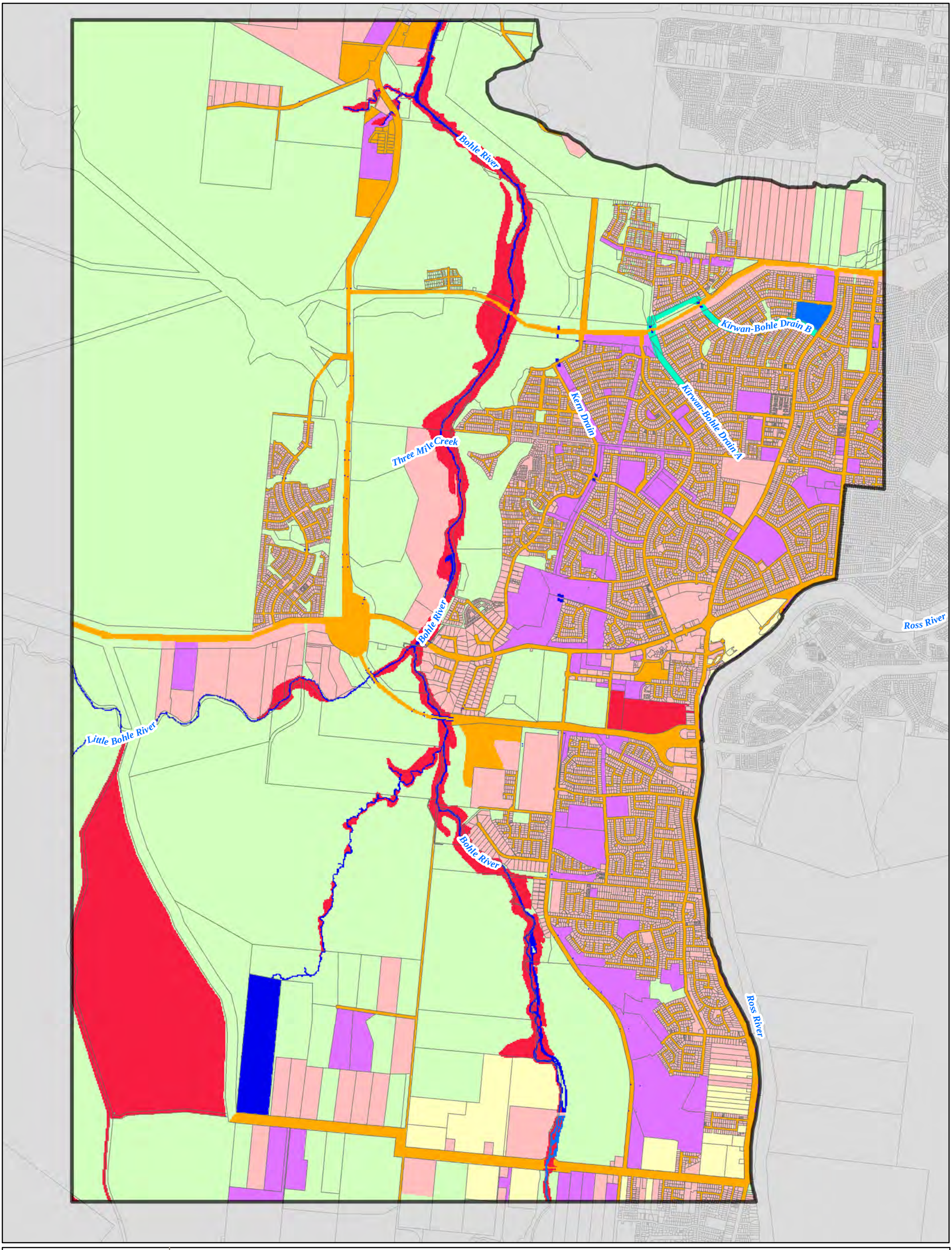

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Manning's (n)

0.02 | 0.03 | 0.05 | 0.06 | 0.1
0.025 | 0.04 | 0.055 | 0.08

UPPER & MIDDLE BOHLE FLOOD STUDY

Middle Bohle: Roughness Map

Figure 3-7

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3.4 Model Calibration

The Upper and Middle Bohle hydraulic models were each calibrated against recorded flood levels and flood gauge data for the January 2008 rainfall event. Water levels were recorded at various points across the Bohle River catchment. The flood event lasted from 13th-15th January 2008. During this rainfall event approximately 170 mm of rain fell on the catchment in 48 h. Rainfall data was obtained from the Department of Environment and Heritage Protection (DEHP) Water Monitoring Data Portal and applied to XP-RAFTS models at corresponding catchments. Details on the gauge from which rainfall data was extracted are included in Table 3-5.

Table 3-5 Rainfall Gauging Station used to obtain rainfall data for the January 2008 event

Catchment	Gauge Number	Site Name	Source	Latitude (°S)*	Longitude (°E)*
Bohle River	118003A	Hervey Range Road	DERM	-19.26833	146.70306

Note: * Coordinates in AGD84 coordinate system.

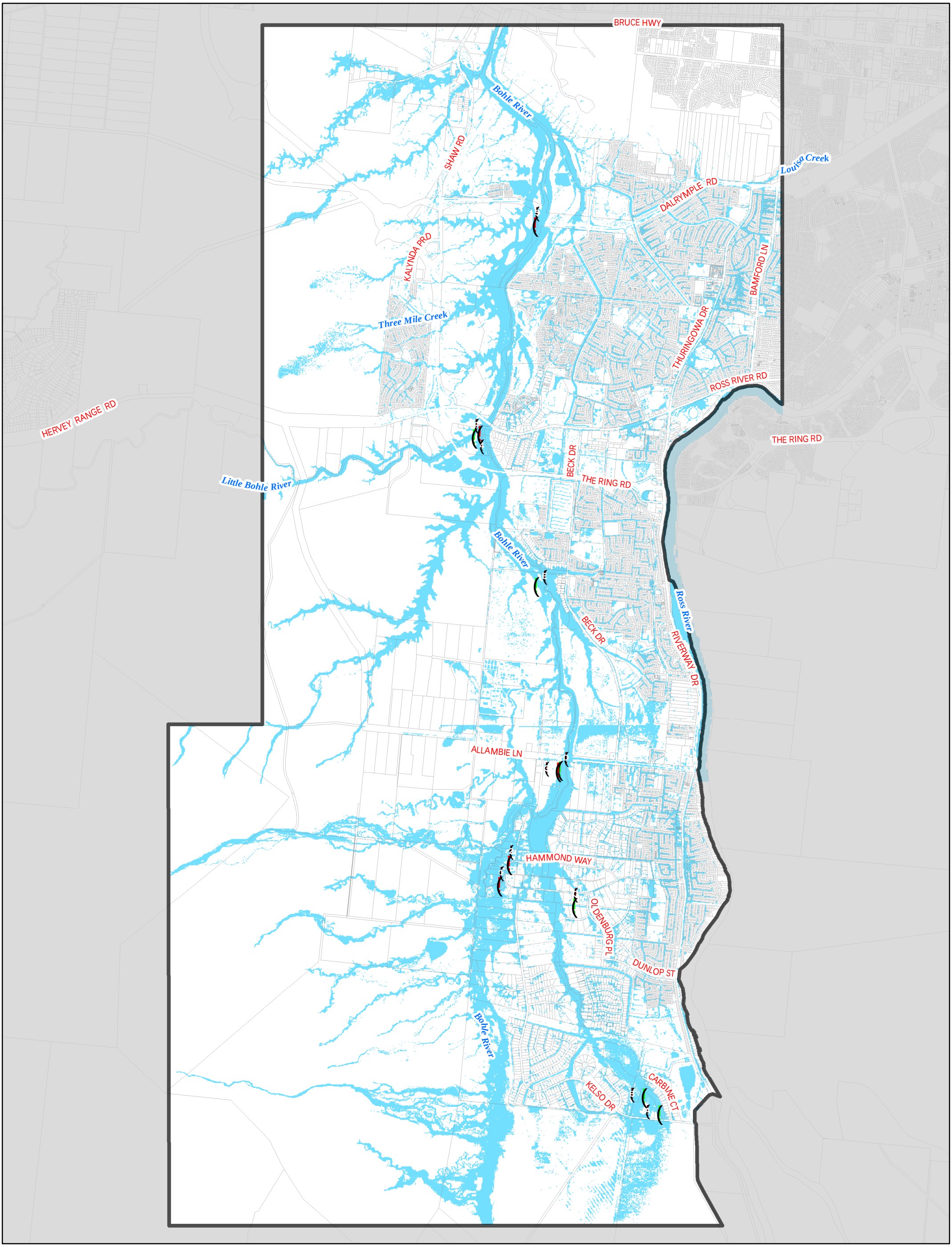
The results of the hydraulic modelling were reviewed and compared to recorded levels within both model extents as well as the previously completed Upper and Lower Bohle River models (*BPFPR, 2010*). A summary of the results across both models is provided in Table 3-6 with surveyed locations shown in Figure 3-8 and a comparison of recorded water level at the Hervey Range Road gauging station against modelled water levels for the calibration event are shown in Figure 3-9.

Table 3-6 Bohle River - January 2008 Flood Recorded Levels

Surveyed Location	Date	Location	Surveyed Flood Level (m AHD)	MIKE FLOOD Level (m AHD)	Difference (m)
1	15/1/2008	67 Hammond Way	23.34	23.3 [UB]	*-0.04*
2	15/1/2008	Hammond Way/Palamino Place	22.77	22.72 [UB]	*-0.05*
3	15/1/2008	Allambie Lane	19.82	19.81 [UB]	*-0.01*
4	15/1/2008	Hervey Range Road	13.37	13.39 [MB]	*0.02*
5	15/1/2008	Dalrymple Road	9.72	9.77 [MB]	*-0.05*
A	13/1/2008	23 Carbine Court	28.08	27.68 [UB]	*-0.4*
B	13/1/2008	25 Carbine Court	28.04	27.58 [UB]	*-0.46*
C	13/1/2008	48 Oldenburg Place	22.97	22.9 [UB]	*-0.07*
D	13/1/2008	Allambie Lane	20	20.06 [UB]	*0.06*
E	13/1/2008	43 Beck Road South	17.28	17.27 [MB]	*-0.01*
F	13/1/2008	Hervey Range Road	13.24	13.25 [MB]	*0.01*

Note:
[UB] = Flood level extracted from the Upper Bohle Model
[MB] = Flood level extracted from the Middle Bohle Model

From Table 3-6 it can be seen that the modelled results provide a generally good fit with the actual recorded flood levels from the event. The only modelled levels considerably different to the recorded levels are those around the two Carbine Court addresses. The modelled results are both around 400 mm lower than what was recorded by debris levels at two very close locations after the flood event. This could be due to a localised issue that has not been represented in the model. The rest of the points within both model extents calibrate well and are within ±100 mm which is considered acceptable in modelling terms.



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UPPER & MIDDLE BOHLE FLOOD STUDY

Location of Recorded Water Levels following the Jan 2008 Event

Figure 3-8

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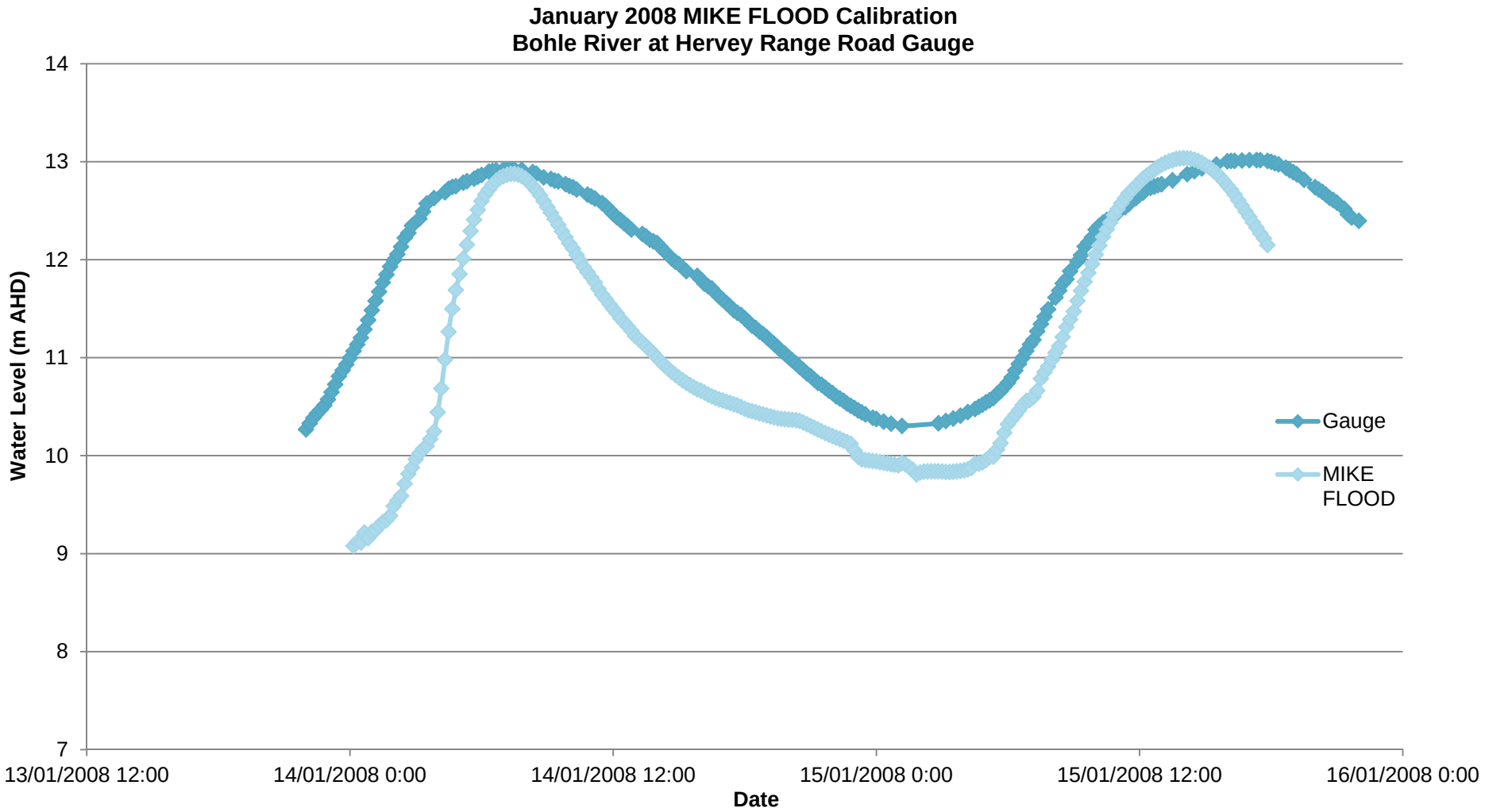


Figure 3-9 Bohle River at Hervey Range Road – January 2008 Flood Levels

The calibration results for water level from the MIKE FLOOD model were plotted against the recorded water levels at the gauge, as shown in Figure 3-9. The results show a generally good fit against the gauged results in that the first peak matches well in terms of water level and timing of the peak despite the discrepancy with timing on the rising and recession limbs. The second peak matches well in terms of water level with the timing slightly different.

A number of checks against the Upper and Lower Bohle River models (*BPFPR 2010*) were performed during the calibration process to gain confidence in the results. These checks, described in Section 4.3, provided enough confidence to conclude that the calibration was acceptable for the purposes of the study.

3.5 Design Flood Critical Duration Assessment

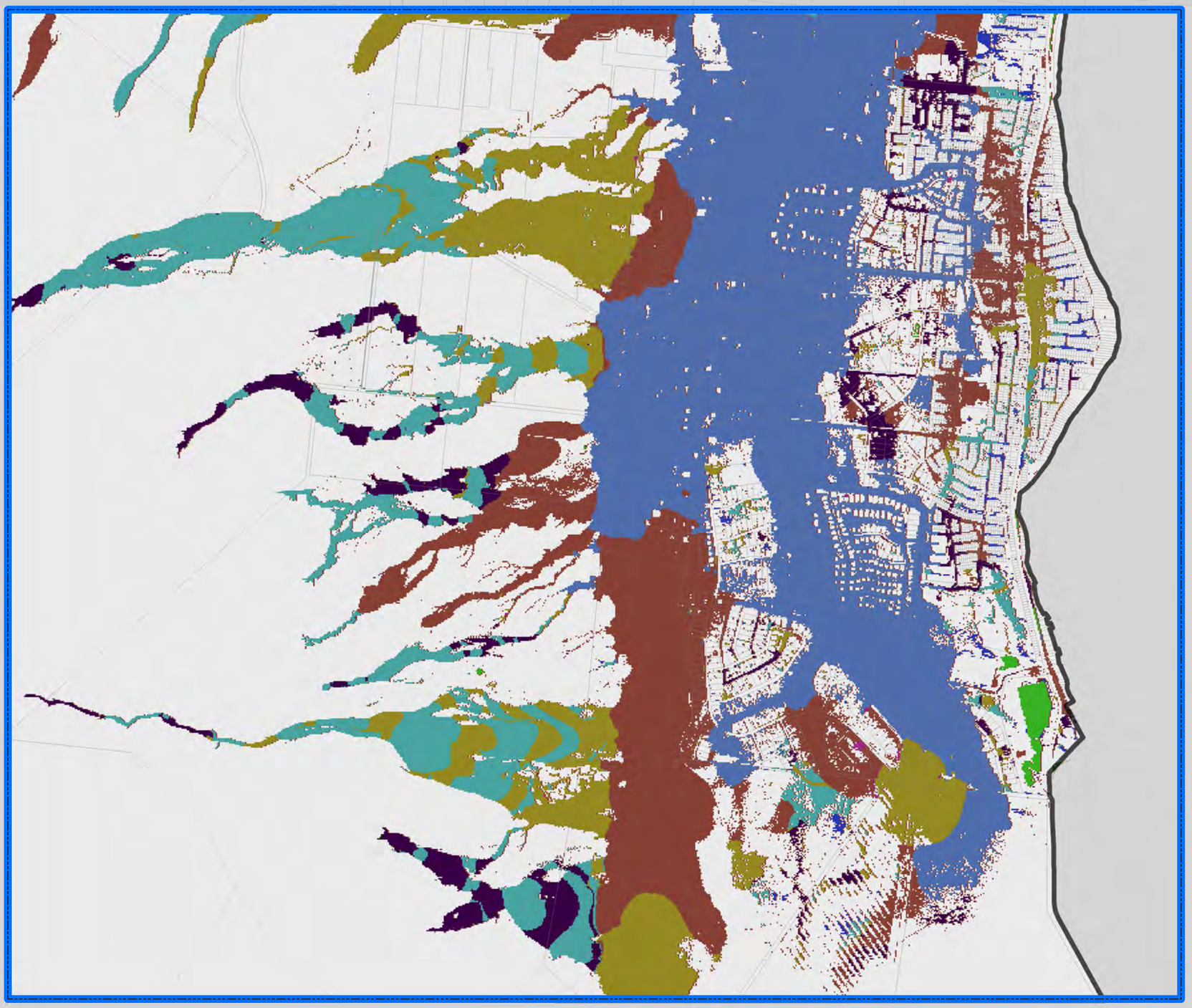
The critical duration for the 2, 5, 10, 20, 100, 200 and 500-yr ARI events were assessed by simulating the 1, 2, 3, 4.5, 6, 9, 12 and 18 h durations for the 100-yr ARI events. Figure 3-10 and Figure 3-11 show the 100-yr ARI critical durations for areas within the Upper Bohle and Middle Bohle flood models respectively. Within the Upper Bohle catchment, the critical durations adopted were 6 and 12 h whereas for the Middle Bohle model they were 2 and 12 h.

It must be noted that the predominant durations were found to be 6 and 12 h across the Middle Bohle section. However, across the urban parts of the model the 2 h duration was predominant and given the minor differences found in water levels between the 2 and the 6 h duration events across the areas where the 6 h was critical, the 2 h duration was used to represent flooding across the more developed/urban areas of the Middle Bohle section.

The adopted critical durations were applied to the 2, 5, 10, 20, 50, 200 and 500 year ARI events for both the Upper and Middle Bohle models.

For the 2000-yr ARI and PMF events the 1, 4.5 and 6 h storm durations were assessed for the Upper Bohle study area and 2, 12 and 72 h storm durations were assessed for the Middle Bohle study area. These critical durations were determined following review of the critical duration assessment for the 100-yr ARI event and taking into consideration the results of the Ross River Flood Study Report *(RRFSR 2013)*.

Graphical displays of maximum water depth, surface elevation and flow velocity magnitude for each event modelled are provided in Appendix A.



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Duration (hours)

1 2 3 4.5 6 9 12 18

UPPER & MIDDLE BOHLE FLOOD STUDY

Upper Bohle: 100-yr ARI - Critical Duration Assessment

Figure 3-10

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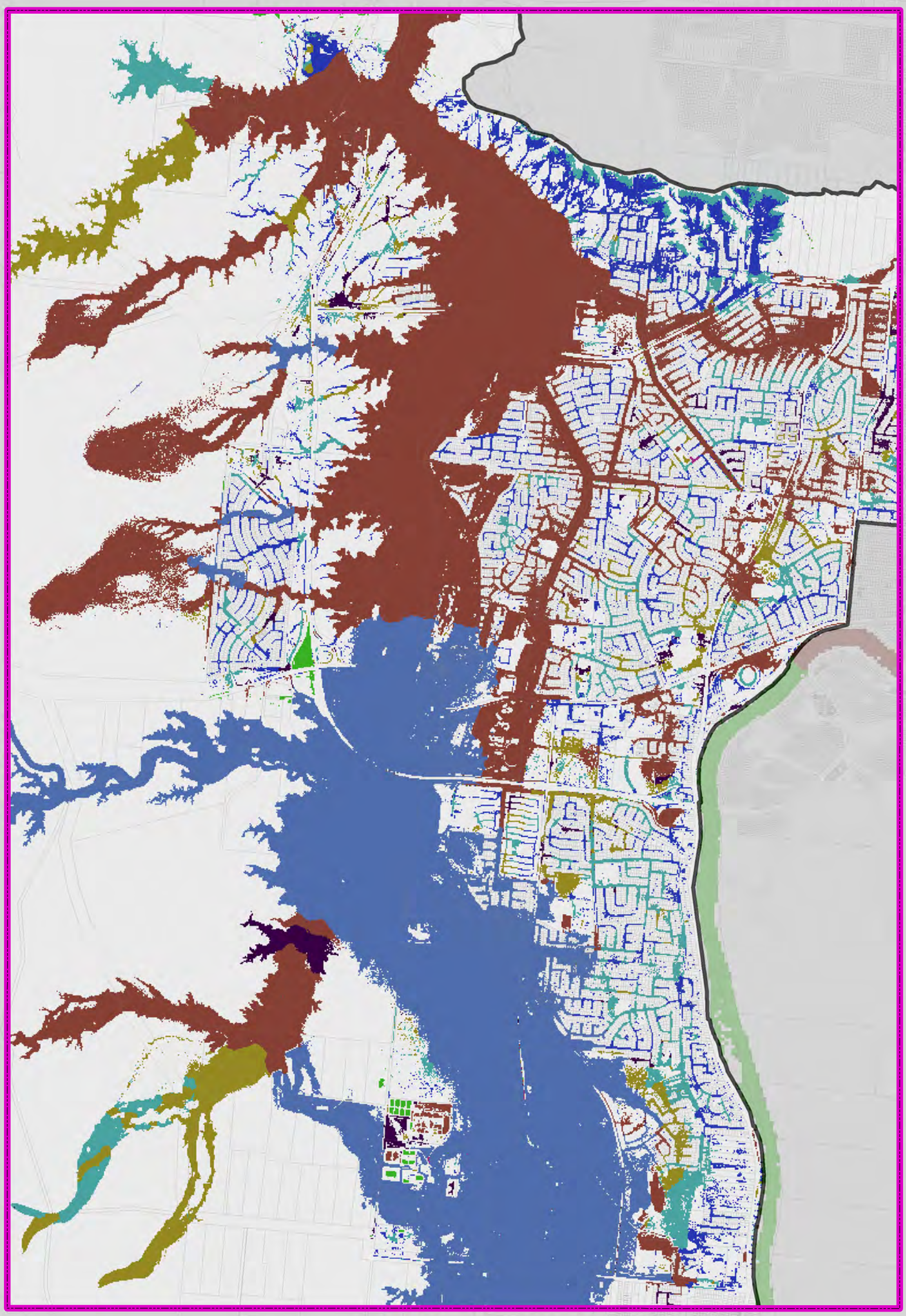

Duration (hours)

1 2 3 4.5 6 9 12 18

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UPPER & MIDDLE BOHLE FLOOD STUDY

Middle Bohle: 100-yr ARI - Critical Duration Assessment

Figure 3-11

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4.0 Flood Assessment

It is important to note that this study provides a high level assessment of the likely flooding that could be experienced within the model extents and it is therefore not intended to represent flooding at a property level. Further refinement of the models to account for site-specific features is required for this purpose.

With the Rain-on-Grid methodology adopted for this study and not all culverts included in the hydraulic models, localised flooding within the study area is common. As this project seeks to assess the major flow paths within the study area, this localised flooding may not represent the true localised drainage condition but can be used as a guide to identify potential inundation issues.

4.1 Flooding across the Study Areas - Summary

Base case flood maps for design ARI storms are provided in Appendix A. The maps show maximum water depth, water surface level and flow velocity magnitude produced for the following storms;

- 2 year ARI
- 5 year ARI
- 10 year ARI
- 20 year ARI
- 50 year ARI
- 100 year ARI
- 200 year ARI
- 500 year ARI
- 2000 year ARI
- Probable Maximum Flood

For mapping purposes the criteria adopted involves;

- Including water depths greater than or equal to 0.1 m; or
- Including water velocities greater than or equal to 0.3 m/s.

Therefore, only areas predicted to experience water depths lower than 0.1 m and water velocities lower than 0.3 m/s are shown as free from flooding in the mapping undertaken. This is in line with TCC's Flood Hazard Mapping Criteria.

To facilitate reading of flood modelling results, the majority of labels have been left out of the flood maps. The key areas mentioned in the assessment included in this section are shown in the locality map Figure 1-1 and therefore it is recommended that this is used as a reference when reviewing the flood maps.

Description of the flooding for the various design events are provided in Table 4-1. Assessment for out of bank flow, ponding across developed areas and high velocities within channels has been undertaken for each ARI being assessed.

4.1.1 Upper Bohle

Table 4-1 Upper Bohle – Flooding Assessment Summary

Event	Description	Map Ref
2 year ARI	- Flows contained mainly within the channel, with minor break outs predicted around the Hammond Way and Melrose Crescent areas (Bohle River and Black's Gully confluence). - Slight overflow from Bohle River into Spring Creek (around the Bohle River/Black's Gully confluence). - Localised areas of velocity higher than 1.25 m/s downstream of Allambie Lane. - Some rural residential properties inundated (water depth generally below 0.3 m).	A1, A11 and A21

Event	Description	Map Ref
5 year ARI	- Increased floodplain inundation around the Bohle River/Black's Gully confluence. - Increase in overflow from Bohle River into Spring Creek (around the Bohle River/Black's Gully confluence). - Significant increase in inundation in various areas (e.g. northern end of Kelso Drive (up to 0.75 m water depth)). - Slight increase in localised areas of velocity higher than 1.25 m/s downstream of Allambie Lane. - Inundation of residential area adjacent to Riverway Drive and Hammond Way intersection (less than 0.5 m water depth). - Residential areas in close proximity to Black's Gully affected.	A2, A12 and A22
10 year ARI	- Increased inundation around the Bohle River/Black's Gully confluence (up to 1.5 m water depth). - Increase in overflow from Bohle River into Spring Creek (water depth around 0.75 m). - Increased inundation in areas upstream of the Bohle River, adjacent to northern end of Kelso Drive (up to 0.75 m water depth). - Slight increase in localised areas of velocity higher than 1.25 m/s downstream of Allambie Lane. - Increased inundation of residential area adjacent to Riverway Drive and Hammond Way intersection (less than 0.5 m water depth). - Increase in inundation of residential areas around Black's Gully.	A3, A13 and A23
20 year ARI	- Increased floodplain inundation around the Bohle River/Black's Gully confluence. - Increase in overflow from Bohle River into Spring Creek (water depth around 1 m). - Velocity higher than 1.25 m/s now predicted to encroach upstream of Allambie Lane. - Increased inundation of residential area adjacent to Riverway Drive and Hammond Way intersection (less than 0.5 m water depth). - Inundation of residential area adjacent to Riverway Drive, Miles Avenue, Salina Drive and Pompeii Street (up to 0.75 m water depth). - Increase in inundation of residential areas around Black's Gully.	A4, A14 and A24
50 year ARI	- Increased floodplain inundation around the Bohle River/Black's Gully confluence, now up to 1.5 m across the floodplain. - Increase in floodplain inundation towards downstream boundary of the model (up to 0.75 m water depth). - Velocity of 1.75 m/s predicted across northern end of Kelso Drive near Hammond Way intersection.	A5, A15 and A25
100 year ARI	- Increased floodplain inundation around Black's Gully near Hammond Way/Melrose Crescent, up to 1.5 m water depth across extensive parts of the floodplain in this area. - Properties at the southern end of Tennessee Way inundated with water depths of up to 0.75 m.	A6, A16 and A26
200 year ARI	- Further increase in inundation around Black's Gully near Hammond Way/Melrose Crescent, water depth now up to 1.5 m across extensive parts of the floodplain in this area. - Out of channel flow being seen in the drains at the southern end of Kelso Drive (around Octagonal Crescent), water depths of up to 0.5 m in over bank area which encroaches on a number of properties in this area. - Increase in extent of flooding on properties along the roads of Riverway Drive (near Hammond Way intersection), Miles Avenue, Salina Drive and Pompeii Street. Water depths up to 0.75 m predicted. - Velocity higher than 1.75 m/s now predicted around Allambie Lane.	A7, A17 and A27
500 year ARI	- Further increase in inundation around Black's Gully near Hammond Way/Melrose Crescent, now up to 2 m across extensive parts of the floodplain in this area. - Increase in overflow from Bohle River into Spring Creek (water depth around 1.5 m).	A8, A18 and A28

Event	Description	Map Ref
	- Increase in floodplain inundation around the upstream reaches of Black's Gully adjacent to Carbine Court with properties showing inundation depths of between 0.75 and 1 m. - Increase in extent of flooding on properties along the roads of Riverway Drive (near Hammond Way intersection), Miles Avenue, Salina Drive and Pompeii Street. Water depths up to 1 m predicted. - Increase in properties at the southern end of Tennessee Way inundated with water depths of up to 1 m. - Velocity higher than 1.75 m/s now predicted around Allambie Lane.	
2000 year ARI	- Large amounts of inundation across Black's Gully and the Bohle River with water depths of 1.5 to 2 m across extensive parts of the floodplain. - Large flooding across residential areas with water depths of up to 0.75 m in places. - Velocities up to 1.25 m/s seen in Bohle River, adjacent to Melrose Crescent (Black's Gully/Bohle River confluence) and also Black's Gully adjacent to Tennessee Way.	A9, A19 and A29
PMF	- Significant inundation across the floodplain (both Black's Gully and Bohle River) with depths of up to 2 m encroaching on residential areas. - Increase in overflow from Bohle River into Spring Creek (water depth around 2 m). - Significant flooding extents across built up residential areas in the model, with water depths over 1 m in some areas. - Extensive areas of high velocities (1.25 m/s and higher) throughout both Bohle River and Black's Gully. - Areas of high velocities (1.75 m/s and higher) around roadways including Kelso Drive, Hammond Way and Allambie Lane.	A10, A20 and A30

4.1.2 Middle Bohle

Table 4-2 Middle Bohle – Flooding Assessment Summary

Event	Description	Map Ref
2 year ARI	- Flows contained mainly within the channel, no noticeable break out flows occurring. - Areas of high velocity downstream of the Hervey Range Road crossing (velocities in excess of 1 m/s predicted). - No significant impact predicted for residential areas (i.e. water depth generally below 0.3 m).	A31, A41 and A51
5 year ARI	- Flows contained mainly within the channel, no noticeable break out flows occurring. - Ponding seen in areas around Kirwan State High School, Tony Ireland Stadium/Weir State School and Beck Drive (southern end). - Areas of high velocity downstream of the Hervey Range Road crossing (velocities in excess of 1.5 m/s predicted). - Localised areas of high velocities near Mount Louisa and also in the Bohle River main channel adjacent to Beck Drive. - No significant impact predicted for residential areas (i.e. water depth generally below 0.3 m).	A32, A42 and A52
10 year ARI	- Flows contained mainly within the channel, some break out flow seen at the confluence of Kirwan-Bohle Drains A and B and Kern Drain (not impacting any residential areas). - Increase in ponding seen in areas around Kirwan State High School, Tony Ireland Stadium/Weir State School and Beck Drive (southern end). - Flooding noticed at the Willows Golf Course as a result of channel capacity locally exceeded at the Bohle River. - Areas of high velocity downstream of the Hervey Range Road crossing (velocities in excess of 1.5 m/s predicted). - Localised areas of high velocities near Mount Louisa and also in the Bohle River main channel adjacent to Beck Drive. - Areas of high velocity upstream of the Kern Drain crossing of Golf Links Drive (up to	A33, A43 and A53

Event	Description	Map Ref
	1.25 m/s). - No significant impact predicted for residential areas (i.e. water depth generally below 0.3 m).	
20 year ARI	- Flows contained mainly within the channel, some break out flow seen at the confluence of Kirwan-Bohle Drains A and B and Kern Drain (not impacting any residential areas) and also Kern Drain upstream of Hervey Range Road causing flooding around Shalom Christian College. - Increase in ponding seen in areas around Kirwan State High School, Tony Ireland Stadium/Weir State School, Beck Drive (southern end), Cannon Park and Shalom Christian College. - Increased flooding at the Willows Golf Course - Areas of high velocity downstream of the Hervey Range Road crossing (velocities in excess of 2 m/s predicted). - Localised areas of high velocities near Mount Louisa and also in the Bohle River main channel adjacent to Beck Drive. - Areas of high velocity upstream of the Kern Drain crossing of Golf Links Drive (in excess of 1.25 m/s). - Break out flows beginning to encroach on properties around Landel and Florentor Court.	A34, A44 and A54
50 year ARI	- Out of channel flow seen at the confluence of Kirwan-Bohle Drains A and B and Kern Drain and also at the upstream end of Kern Drain (downstream of Hervey Range Road crossing) (not encroaching on any residential areas). - Increase in ponding seen in areas around Kirwan State High School, Tony Ireland Stadium/Weir State School, Beck Drive (southern end), Cannon Park, Shalom Christian College and Greenwood Park adjacent to Kirwan-Bohle Drain B. - Increased flooding at the Willows Golf Course - Areas of high velocity downstream of the Hervey Range Road crossing (velocities in excess of 2 m/s predicted). - Areas of high velocity upstream of the Kern Drain crossing of Golf Links Drive (up to 1.5 m/s). - Localised areas of high velocities near Mount Louisa and also in the Bohle River main channel adjacent to Beck Drive. - Break out flows encroaching significantly on properties around Landel and Florentor Court as well as St. Andrew's Close. - Properties around Rivergum Court affected further by out of channel flows from the Bohle River.	A35, A45 and A55
100 year ARI	- Out of channel flow seen at the confluence of Kirwan-Bohle Drains A and B and Kern Drain, at the upstream end of Kern Drain (downstream of Hervey Range Road crossing) (encroaching on residential areas) and around Kern Drain upstream of the Golf Links Drive crossing. - Increase in ponding seen in areas around Kirwan State High School, Tony Ireland Stadium/Weir State School, Beck Drive (southern end), Cannon Park, Shalom Christian College and Greenwood Park adjacent to Kirwan-Bohle Drain B. - Increased flooding at the Willows Golf Course - Areas of high velocity downstream of the Hervey Range Road crossing (velocities in excess of 2 m/s predicted). - Localised areas of high velocities in residential areas in Mount Louisa and also in the Bohle River main channel adjacent to Beck Drive. - Areas of high velocity upstream of the Kern Drain crossing of Golf Links Drive (up to 1.5 m/s) as well as Dalrymple Road crossing of Kern Drain (in excess of 2 m/s). - Break out flows encroaching significantly on properties around Landel and Florentor Court as well as St. Andrew's Close, Fairway Close and Nineteenth Avenue. - Properties around Rivergum Court and through the suburb of Rasmussen affected by break out flows from the Bohle River.	A36, A46 and A56

Event	Description	Map Ref
200 year ARI	- Significant out of channel flow seen along Kern Drain, Kirwan-Bohle Drain B and Bohle River. - Increase in ponding seen in areas around Kirwan State High School, Tony Ireland Stadium/Weir State School and Cannon Park. - Significant inundation seen around the Willows Golf Course, Shalom Christian College and at the southern end of Beck Drive. - Areas of high velocity downstream of the Hervey Range Road crossing (velocities of in excess of 2 m/s predicted) encroaching further downstream. - Localised areas of high velocities in residential areas in Mount Louisa and also in the Bohle River main channel adjacent to Beck Drive. - Areas of high velocity upstream of the Kern Drain crossing of Golf Links Drive (in excess of 1.5 m/s) as well as Dalrymple Road crossing of Kern Drain (in excess of 2 m/s). - Break out flows encroaching significantly on properties around Landel and Florentor Court as well as St. Andrew's Close, Fairway Close, Nineteenth Avenue and Golf Links Drive. - Properties around Rivergum Court significantly affected by out of channel flows from the Bohle River as well as inundation of residential properties through the suburbs of Rasmussen, Condon, Kirwan, Thuringowa Central and Mount Louisa. - Properties within the Shaw and Mount Louisa areas beginning to see inundation to a depth of up to 0.5 m.	A37, A47 and A57
500 year ARI	- Significant out of channel flow seen along Kern Drain, Kirwan-Bohle Drain A and B and Bohle River and tributaries causing inundation of properties adjacent to these waterways including the suburbs of Rasmussen, Condon, Kirwan, Mount Louisa and Thuringowa Central. - Increase in ponding seen in areas around Kirwan State High School, Tony Ireland Stadium/Weir State School and Cannon Park. - Significant inundation seen around the Willows Golf Course, Shalom Christian College and the southern end of Beck Drive. - Areas of high velocity downstream of the Hervey Range Road crossing (velocities in excess of 2 m/s predicted) encroaching further downstream. - Localised areas of high velocities in residential areas in Mount Louisa and also in the Bohle River main channel adjacent to Beck Drive (extending further downstream). - Areas of high velocity upstream of the Kern Drain crossing of Golf Links Drive (up to 1.75 m/s) as well as Dalrymple Road crossing of Kern Drain (in excess of 2 m/s). - Break out flows encroaching significantly on properties around Landel and Florentor Court as well as St. Andrew's Close, Fairway Close, Nineteenth Avenue and Golf Links Drive. - Properties within the Bohle Plains area beginning to see some inundation (water depths up to 0.5 m). - Properties within the Shaw and Mount Louisa areas to experience inundation to a depth of up to 0.75 m. - Overflows to Louisa Creek are noticed during this large event.	A38, A48 and A58
2000 year ARI	- Significant out of channel flow seen along Kern Drain, Kirwan-Bohle Drain A and B and Bohle River and tributaries causing wide-spread inundation of properties adjacent to these waterways including the suburbs of Rasmussen, Condon, Kirwan, Mount Louisa and Thuringowa Central. - Large increases in ponding seen in areas around Kirwan State High School, Tony Ireland Stadium/Weir State School, Cannon Park and residential areas along Thuringowa Drive. - Significant inundation seen around the Willows Golf Course, Shalom Christian College and the southern end of Beck Drive - Wide-spread areas of high velocity downstream of the Hervey Range Road crossing (velocities in excess of 2 m/s predicted). - Localised areas of high velocities in residential areas in Mount Louisa - Areas of high velocities in the Bohle River main channel adjacent to Beck Drive now	A39, A49 and A59

Event	Description	Map Ref
	considered wide-spread. - Areas of high velocity extending along the length of the Kern Drain main channel (up to 1.5 m/s). - Break out flow upstream of Bohle River Hervey Range Road crossing causing wide spread inundation of properties north of Nineteenth Avenue.. - Properties within the Bohle Plains area seeing further inundation (water depths up to 0.75 m). - Properties within the Shaw and Mount Louisa areas to experience inundation to a depth of up to 1.5 m. - Increase in the overflows arriving to Louisa Creek is noticed during this extreme event.	
PMF	- Major break out flows experienced between the Bohle River overflowing into Kern Drain causing major inundation of all properties encompassed by the area between these two waterways (water depths in excess of 3 m in areas). - Significant out of channel flows seen in the Kirwan-Bohle Drain A and B causing wide spread inundation of in the area (waters depths in excess of 3 m in various locations). - Major break out flow from the Ross River during the 72 h duration event around the bend in the Ross River adjacent to Riverway Drive, Ross River Road intersection. This break out causes major flows to travel down Thuringowa Drive and link up with Kirwan-Bohle Drain A and B and the upper reaches of Louisa Creek. - Significant inundation through the residential areas of Kirwan, Condon, Rasmussen, Thuringowa Central and Mount Louisa. - Wide-spread areas of high velocity downstream of the Hervey Range Road crossing (velocities in excess of 2 m/s predicted). - Numerous areas of high velocities (in excess of 1.25 m/s) throughout various suburbs including Thuringowa Central, Kirwan, Shaw and Mount Louisa. - Areas of high velocities in the Bohle River main channel wide-spread throughout the length of the channel within the model (in excess of 2 m/s) - Areas of high velocity extending along the length of the Kern Drain main channel (up to 2 m/s). - Properties within the Bohle Plains area seeing further inundation (water depths up to 2 m). - Properties within the Shaw and Mount Louisa areas to experience inundation levels in excess of 3 m water depth. - Significant overflows to Louisa Creek expected during this extreme event.	A40, A50 and A60