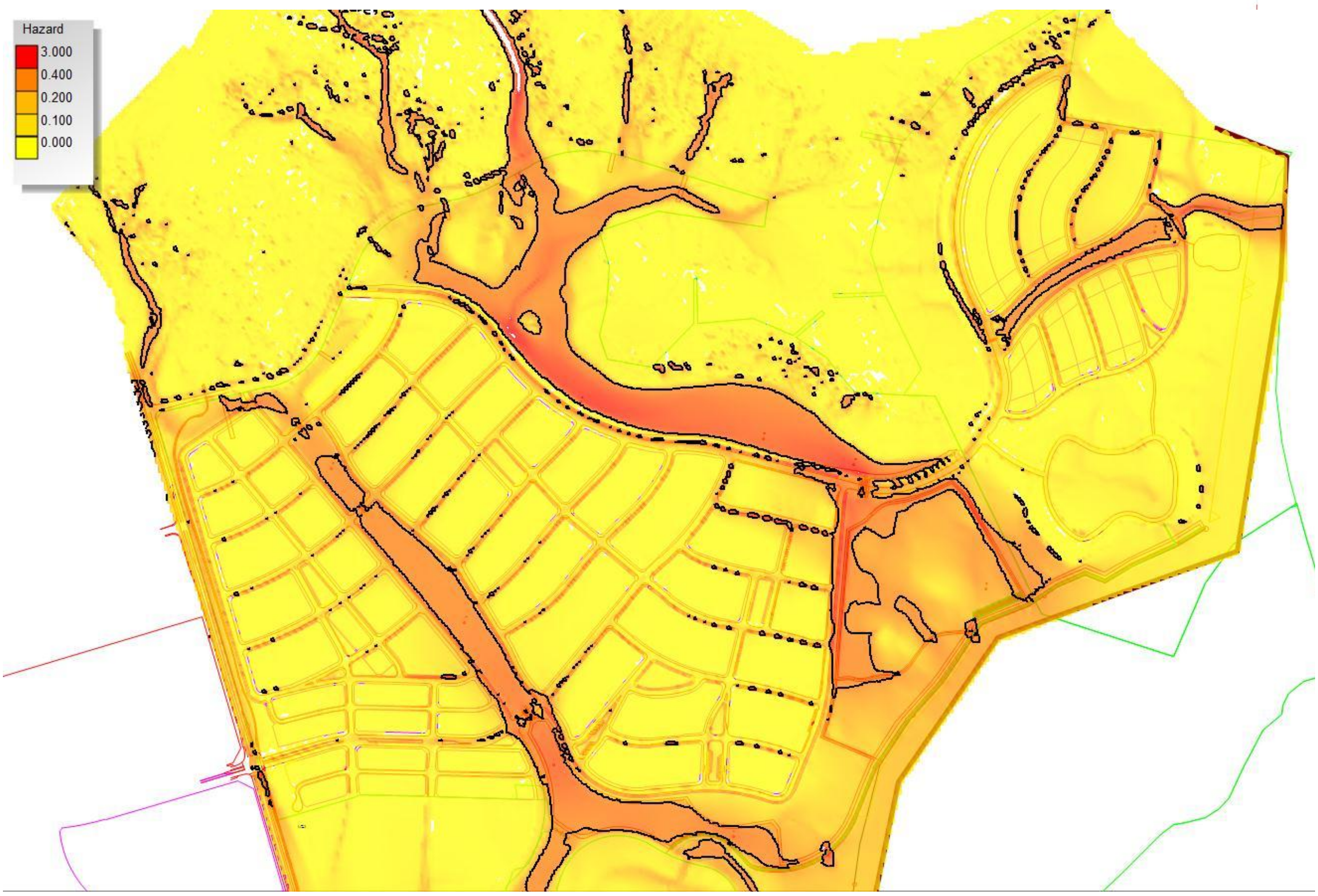


Figure 40 – Critical Flood Hazard Mapping Across the Developed Riverside Site – 1hr PMF Storm, 2100 100yr Tailwater (VxD=0.4 contour highlighted)

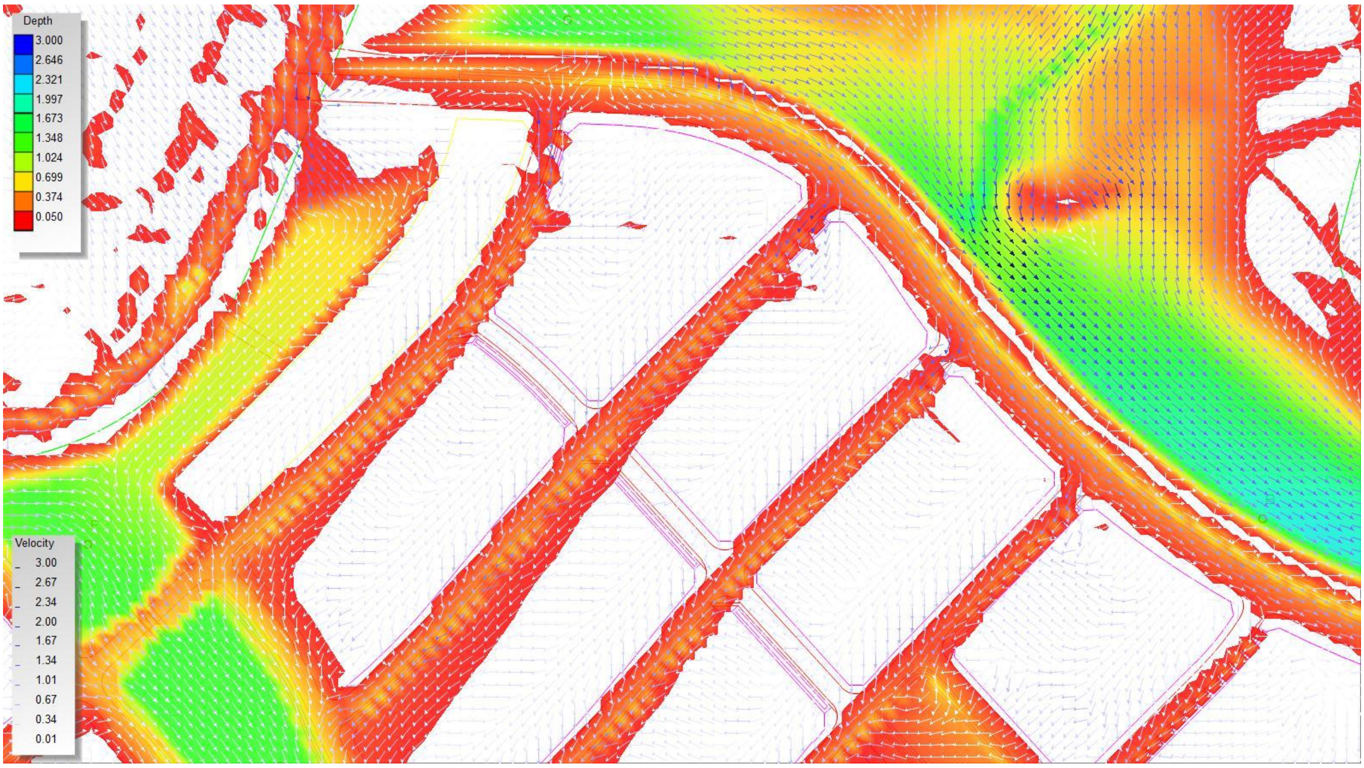


Figure 41 – Critical Flood Depth/Velocity Mapping Across the Developed Riverside Site – 1hr PMF Storm, 2100 100yr Tailwater

The following critical areas are worst affected by the PMF event, and require further discussion;

- **West Branch Floodway**

Some road crossings of the West Branch will become submerged and dangerous for pedestrians to cross in the 1hr, 2hr and 3hr PMF events, but as the proposed landform rises away from the floodway, there are safe evacuation routes available via other streets that will not require crossing of dangerous floodwaters. Furthermore, passage through these areas by vehicles and 'trained safety workers' would still be safe.

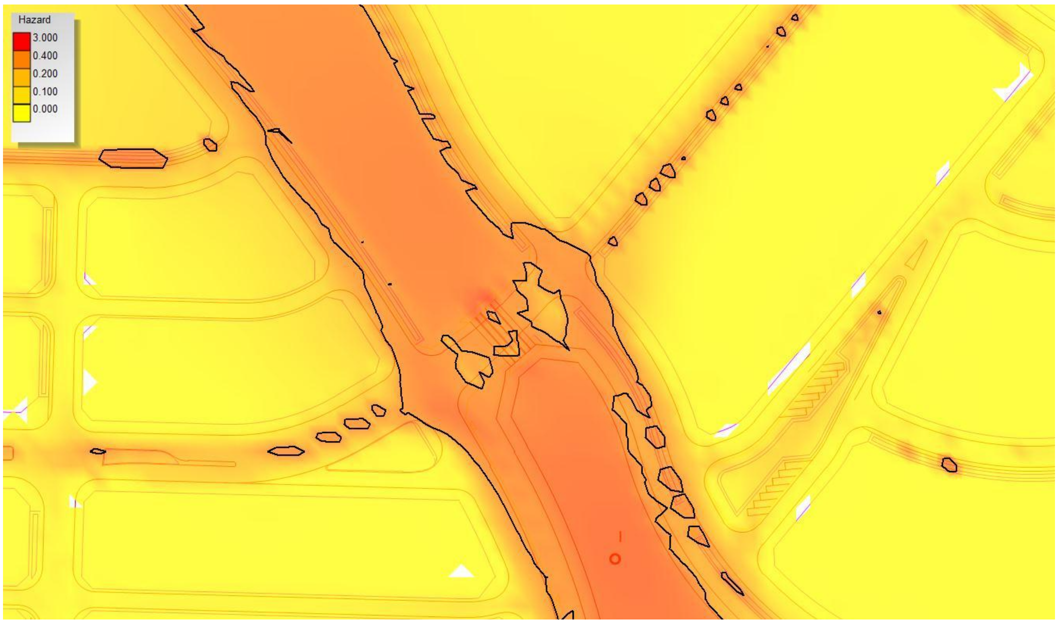


Figure 42 – Critical Flood Hazard Mapping Across the West Branch Crossing - 1hr PMF Storm, 2100 100yr Tailwater (VxD=0.4 contour highlighted)

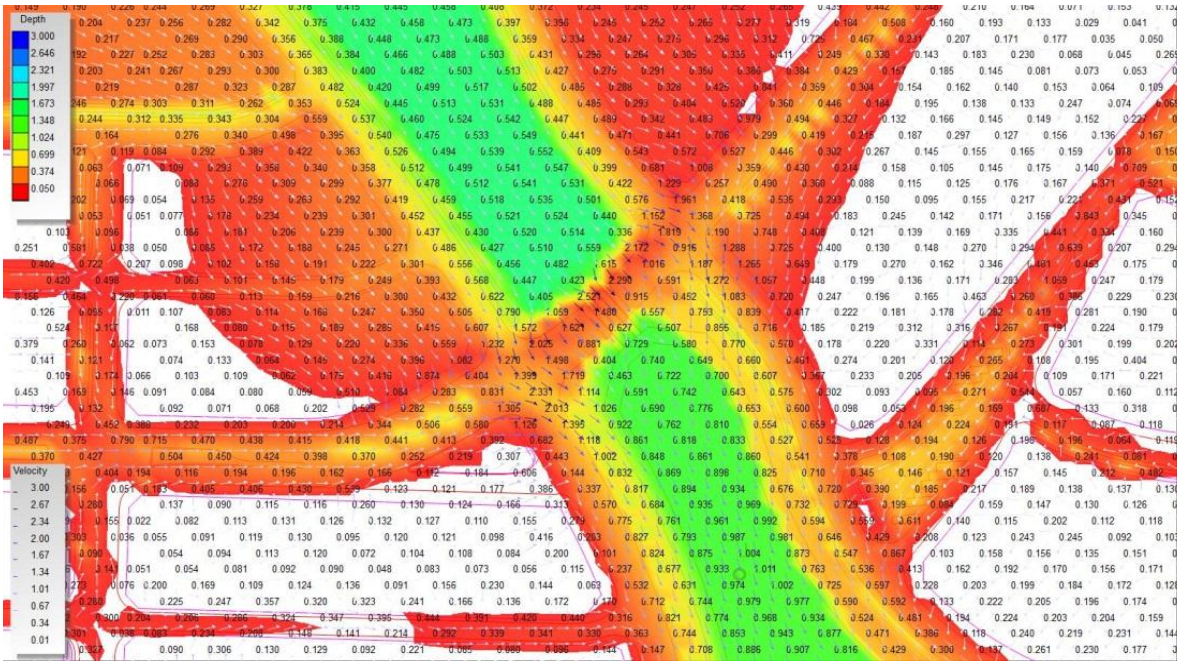


Figure 43 – Critical Flood Depths/Velocities (Velocity values displayed) Across the West Branch Crossing - 1hr PMF Storm, 2100 100yr Tailwater

- **East-West Branch Floodway**

The access road across the East-West Branch to the Monkey Jacket precinct will become a causeway in the 1hr, 2hr and 3hr PMF events. In the worst case (3hr PMF storm) the VxD product will be greater than 0.4 for up to 90min (t=30-120min). The absolute peak value witnessed in this location was 1.3 (Depth 0.73m, Velocity 1.8m/s). At this level the area would be impassable by trained rescue workers and vehicles alike.

Ultimately access to this precinct will also be available via the collector road connection to the proposed residential subdivision to the North, providing another safe evacuation route which will not require crossing the floodway. Existing public access corridors between existing lots linking to Toonang Drive and Petrel Place will also remain post-development and will provide additional safe emergency evacuation options.

Significant areas of highground (all residential lots) are available for refuge during the PMF event until flood water recedes to again provide safe access to the flooded sections of the street network.

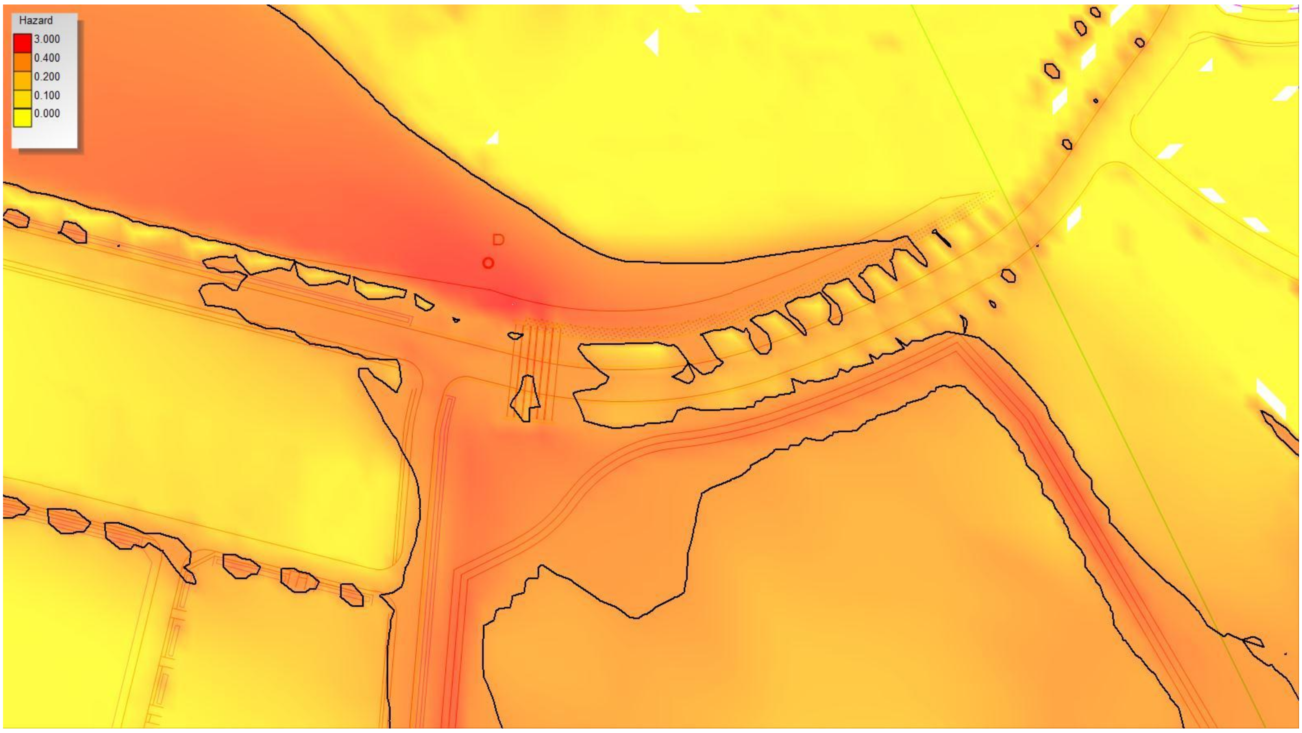


Figure 44 – Flood Hazard Mapping Across the East-West floodway linking to the Monkey Jacket Precinct - 1hr PMF Storm, 2100 100yr Tailwater (VxD=0.4 contour highlighted)

4.0 SUMMARY AND CONCLUSIONS

Through a comprehensive analysis using industry leading modelling techniques, a full range of storm recurrence intervals, durations, and tailwater conditions, it has been demonstrated that the proposed Riverside development will not have an adverse impact on the flood behaviour on or around the site, and developed areas will remain essentially flood free.

Specifically;

- The combination of the storage and low flow discharge structures ensure existing regular ‘environmental’ flows into the wetland buffer are maintained post-development,

- High flow discharge via the level spreader over the full downstream frontage of the site ensures the development will not result in any increase of potentially damaging 100yr peak flow velocities in the downstream wetland,

- Existing flood levels in surrounding areas are not adversely impacted post development,

- The proposed development includes sufficient lot filling/floodway capacities to allow all lots to remain flood free in the design 100yr event. Relevant “Flood Planning Levels” have been determined for the entire development. This includes an assessment of the possible impact of Climate Change induced rainfall intensity increases on the Flood Planning Level assessment,

- The ‘worst case’ Probable Maximum Flood assessment demonstrates the proposal sufficiently caters for the safety of all future residents.

5.0 REFERENCES

Brisbane City Council (2003) *Natural Channel Design*

Commonwealth Bureau of Meteorology (2003) *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short Duration Method*

The Department of Environment, Climate Change and Water (2010) *Flood Risk Management Guide*

Department of Public Works, NSW (1980) *Lower Myall River Flood Analysis*

Engineers Australia (1987) *Australian Rainfall and Runoff*

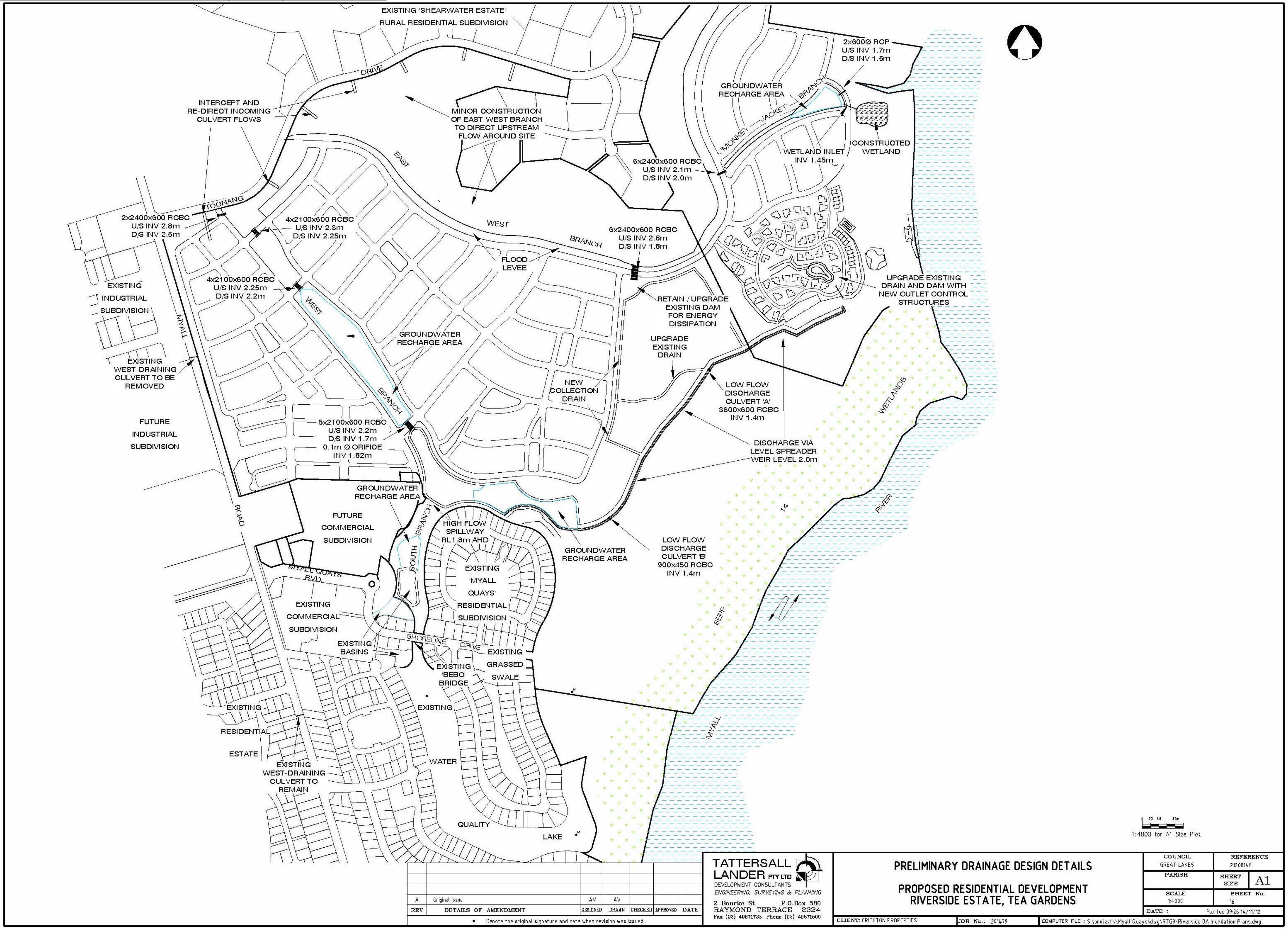
Engineers Australia (2010) *Australian Rainfall and Runoff, Revision Project 10: Appropriate Safety Criteria for People*

Great Lakes Council (1995) *Design Specifications*

NSW Government (2005) *Floodplain Management Manual*

WMA Water (2010) *Port Stephens Design Flood Levels – Climate Change Review*

APPENDIX A: Preliminary Drainage Design Details Plan



APPENDIX B: Great Lakes Council IFD Data

16-NOV-2000 THU 15:19 GLC ENGINEERING FAX NO. 0265910240 P. 02

" RARE " - Rainfall & Runoff Estimation Program

INTENSITY - FREQUENCY - DURATION TABLE

(Results in mm/hour)

FILE REFERENCE: HAWKS-NEST

Values Used:

```
2 year  I  1 hr : 37.00
        I 12 hr :  7.30
        I 72 hr :  2.20

50 year I  1 hr : 72.00
        I 12 hr : 14.50
        I 72 hr :  4.40

Co-efficient  G  : 0.00
             F2  : 4.32
             F50 : 16.10
```

TIME	AVERAGE RECURRENCE INTERVAL (ARI) years 1	2	5	10	20	50	100	200	500
5 mins	92.9	119	150	168	192	223	246	270	302
6 mins	87.1	111	141	158	180	210	232	254	284
7 mins	82.2	105	133	149	171	198	219	240	268
8 mins	78.0	99.9	127	142	162	189	208	229	256
9 mins	74.4	95.3	121	135	155	180	199	218	244
10 mins	71.2	91.3	116	130	148	173	191	210	234
12 mins	65.9	84.4	107	120	138	160	177	194	217
14 mins	61.5	78.8	100	112	129	150	166	182	204
15 mins	59.6	76.4	97.1	109	125	145	161	177	198
16 mins	57.8	74.1	94.3	106	121	141	156	172	192
18 mins	54.6	70.1	89.2	100	115	134	148	163	182
20 mins	51.9	66.6	84.8	95.3	109	127	141	155	173
25 mins	46.4	59.6	76.0	85.4	97.9	114	127	139	156
30 mins	42.2	54.2	69.2	77.8	89.3	104	116	127	142
40 mins	36.1	46.4	59.4	66.9	76.0	89.7	99.5	109	123
50 mins	31.9	41.0	52.6	59.3	68.1	79.6	88.3	97.2	109
1 hour	28.8	37.0	47.5	53.5	61.5	72.0	79.9	88.0	98.8
1.5 hours	22.2	28.6	36.7	41.5	47.7	55.8	62.0	68.2	76.7
2 hours	18.4	23.7	30.5	34.4	39.6	46.4	51.6	56.8	63.8
3 hours	14.1	18.2	23.4	26.4	30.4	35.7	39.7	43.7	49.1
4.5 hours	10.8	13.9	17.9	20.3	23.4	27.4	30.5	33.6	37.8
6 hours	8.9	11.5	14.9	16.8	19.4	22.7	25.3	27.9	31.4
9 hours	6.8	8.8	11.4	12.9	14.9	17.5	19.4	21.4	24.1
12 hours	5.7	7.3	9.4	10.7	12.3	14.5	16.1	17.8	20.1
15 hours	4.9	6.3	8.2	9.3	10.7	12.6	14.0	15.5	17.5
18 hours	4.4	5.7	7.3	8.3	9.6	11.3	12.5	13.8	15.6
24 hours	3.6	4.7	6.1	6.9	8.0	9.4	10.4	11.5	13.0
30 hours	3.2	4.1	5.3	6.0	6.9	8.1	9.0	10.0	11.2
36 hours	2.8	3.6	4.7	5.3	6.1	7.2	8.0	8.9	10.0
48 hours	2.3	3.0	3.8	4.4	5.0	5.9	6.6	7.3	8.2
72 hours	1.7	2.2	2.9	3.2	3.7	4.4	4.9	5.4	6.1

APPENDIX C: Great Lakes Council Correspondence re Flood Levels and Probability Combinations

Adrian

Subject: Riverside, Lower Myall River

From: Geoff Love [mailto:Geoff.Love@greatlakes.nsw.gov.au]
Sent: Friday, 7 September 2012 4:01 PM
To: Adrian; bob@tatland.com.au
Subject: Riverview, Lower Myall River

Adrian & Bob,

Riverside:
Further to my discussion with Bob and Adrian over the last couple of weeks I can confirm that the tailwater level (modelling of storm and flood flows) for Riverside is RL 2.8m AHD being the projected 2100 1% AEP flood level in the adjacent Lower Myall River. I assume you are taking a flood envelope approach to determining flood extents. That is the worst extent/conditions determined by:

- 100 year ARI local catchment conditions combined with 5 year ARI tailwater, ***and***
- 5 year ARI local catchment conditions combined with 100 year ARI tailwater (RL 2.8m AHD)

We do not have any recent data on the 5 year ARI tailwater in the Lower Myall but looking at old 1980 flood profiles it appears that RL 2.0m AHD might be a reasonable approximation for the 2100, 5 year ARI tailwater.

Regards,

Geoff Love
Investigations Engineer
Design & Investigation Branch
Engineering Services Division
Great Lakes Council
Phone: (02) 6591 7273
Fax: (02) 6591 7248
Email: geoff.love@greatlakes.nsw.gov.au

APPENDIX D: PMF Generalised Short-Duration Method Calculation Sheet

Appendix 1

GSDM CALCULATION SHEET

LOCATION INFORMATION

Catchment ...Riverside................ Area ....4.4.............. km²

State ....NSW.................................. Duration Limit ....6..................... hrs

Latitude .....32.......°.....39.....' S Longitude......152.......°.......9.......' E

Portion of Area Considered: within 20km of Tomaree Peninsula

Smooth , **S** = ...0............. (0.0 - 1.0) Rough , **R** = ...1.0............. (0.0 - 1.0)

ELEVATION ADJUSTMENT FACTOR (EAF)

Mean Elevation ....10...............m

Adjustment for Elevation (-0.05 per 300m above 1500m) ....–..........

EAF = .. 1.00 .... (0.85 - 1.00)

MOISTURE ADJUSTMENT FACTOR (MAF)

MAF = ...0.75..... (0.40 - 1.00)

PMP VALUES (mm)

Duration (hours)	Initial Depth - Smooth (D_S)	Initial Depth - Rough (D_R)	PMP Estimate = $(D_S \times S + D_R \times R) \times MAF \times EAF$	Rounded PMP Estimate (nearest 10 mm)
0.25	–	225	169	170
0.50	–	325	244	240
0.75	–	415	311	310
1.0	–	480	360	360
1.5	–	620	465	470
2.0	–	730	547	550
2.5	–	800	600	600
3.0	–	875	656	660
4.0	–	1005	754	750
5.0	–	1100	825	830
6.0	–	1170	877	880

Prepared by ....Adrian Varela.................... Date ..10../...9..../..12..

Checked by ....Dave Kopcsandy.................... Date ..12../...9..../..12..

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THE ESTIMATION OF PROBABLE MAXIMUM PRECIPITATION IN AUSTRALIA: GENERALISED SHORT-DURATION METHOD
JUNE 2003

APPENDIX E: PMF Flood Hazard and Flood Depth Mapping Results

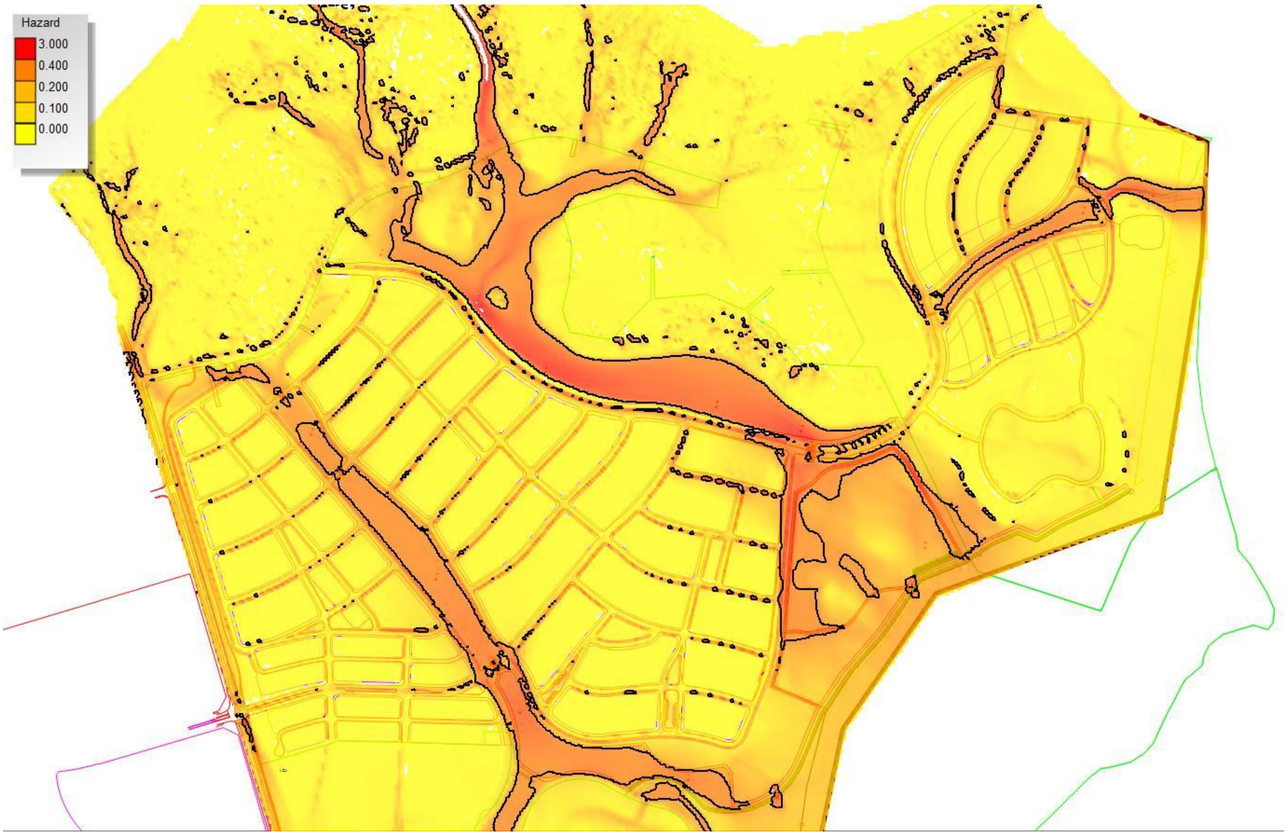

Figure E.1 – Flood Hazard Mapping Across the Developed Riverside Site – 1hr PMF Storm, 100yr Tailwater (VxD=0.4 contour highlighted)

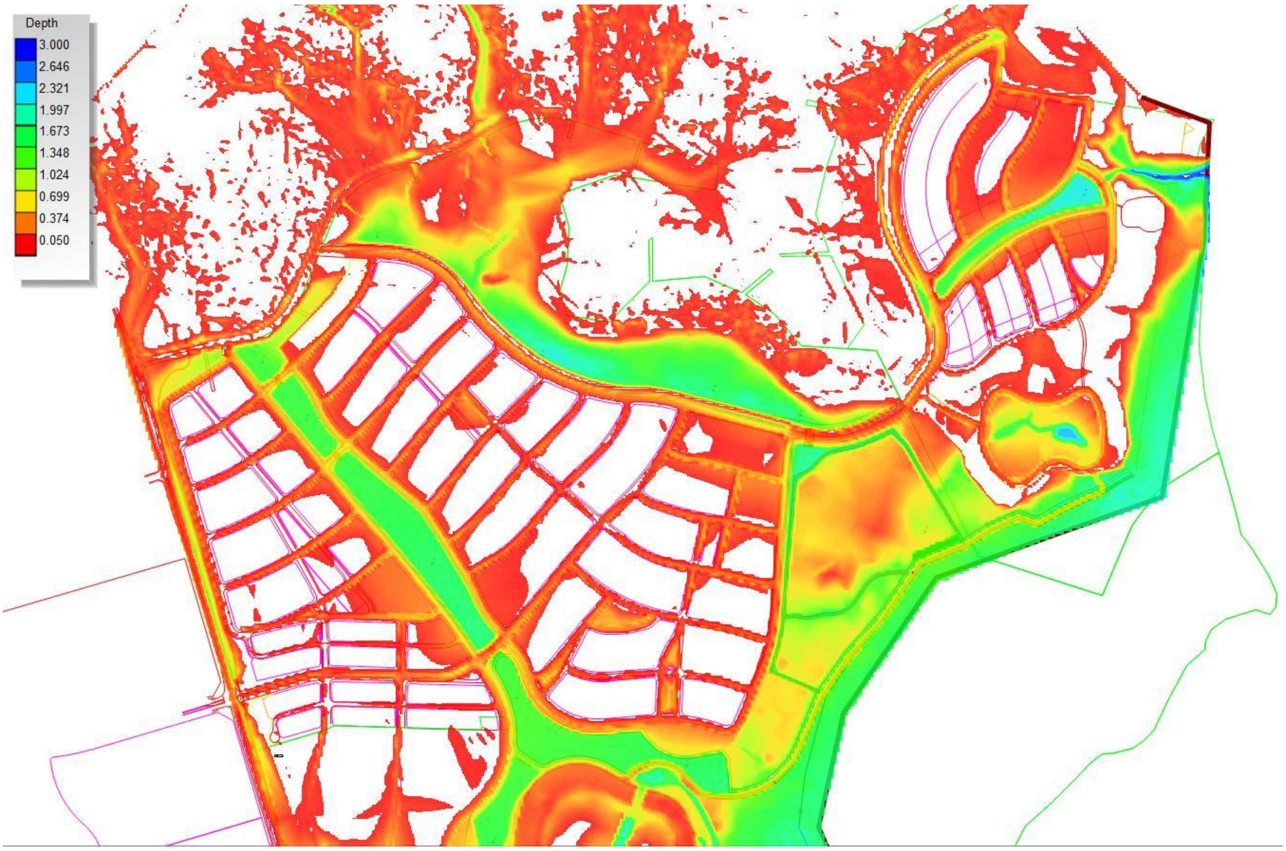

Figure E.2 – Flood Depth Mapping Across the Developed Riverside Site – 1hr PMF Storm, 100yr Tailwater (Depth<0.05m Filtered Out)

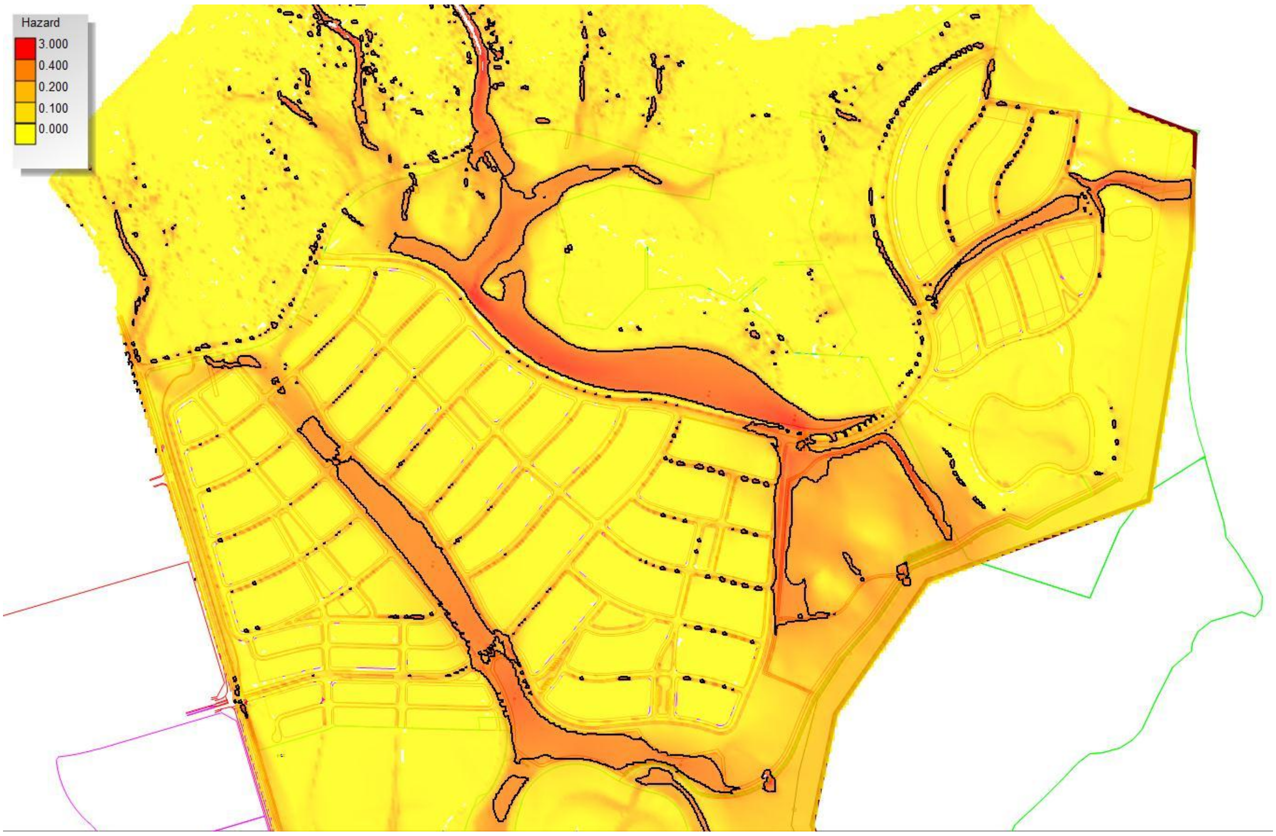

Figure E.3 – Flood Hazard Mapping Across the Developed Riverside Site – 2hr PMF Storm, 100yr Tailwater (VxD=0.4 contour highlighted)

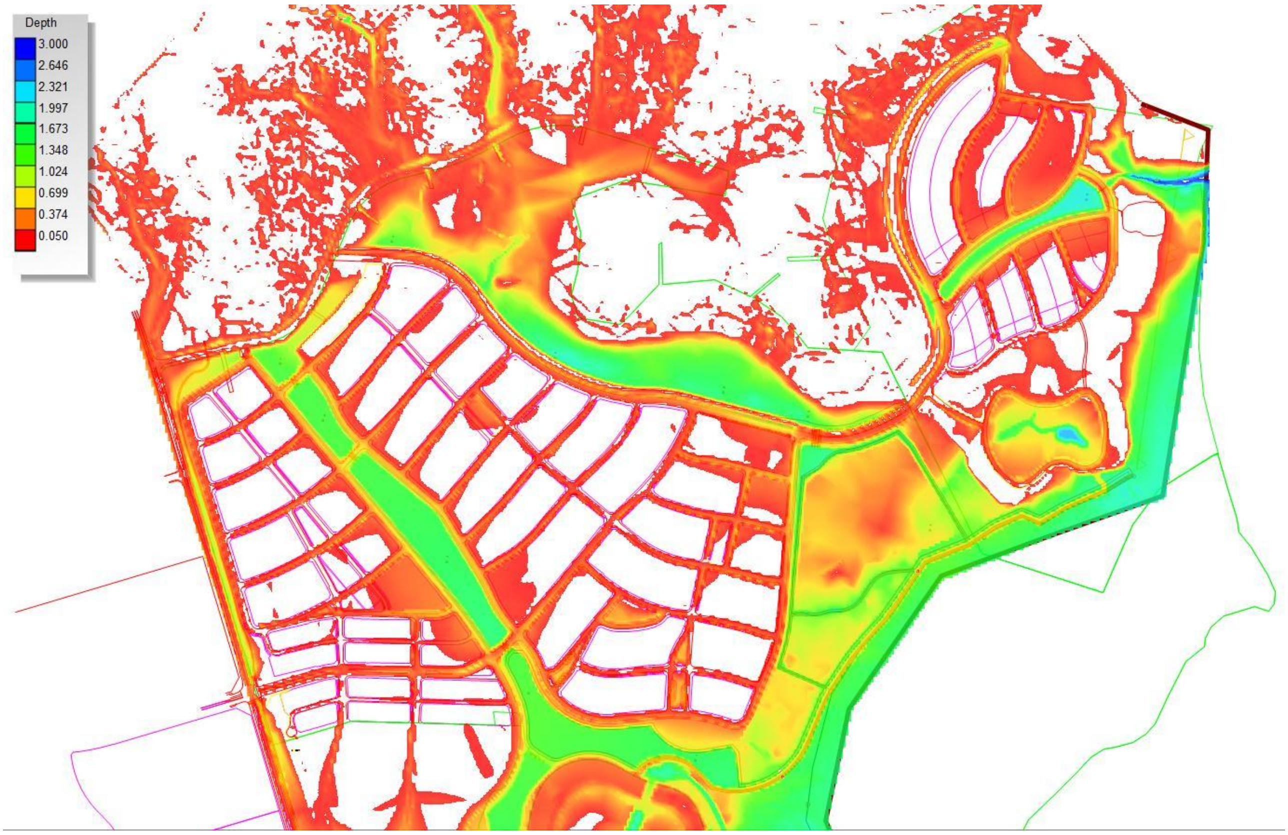

Figure E.4 – Flood Depth Mapping Across the Developed Riverside Site – 2hr PMF Storm, 100yr Tailwater (Depth<0.05m Filtered Out)

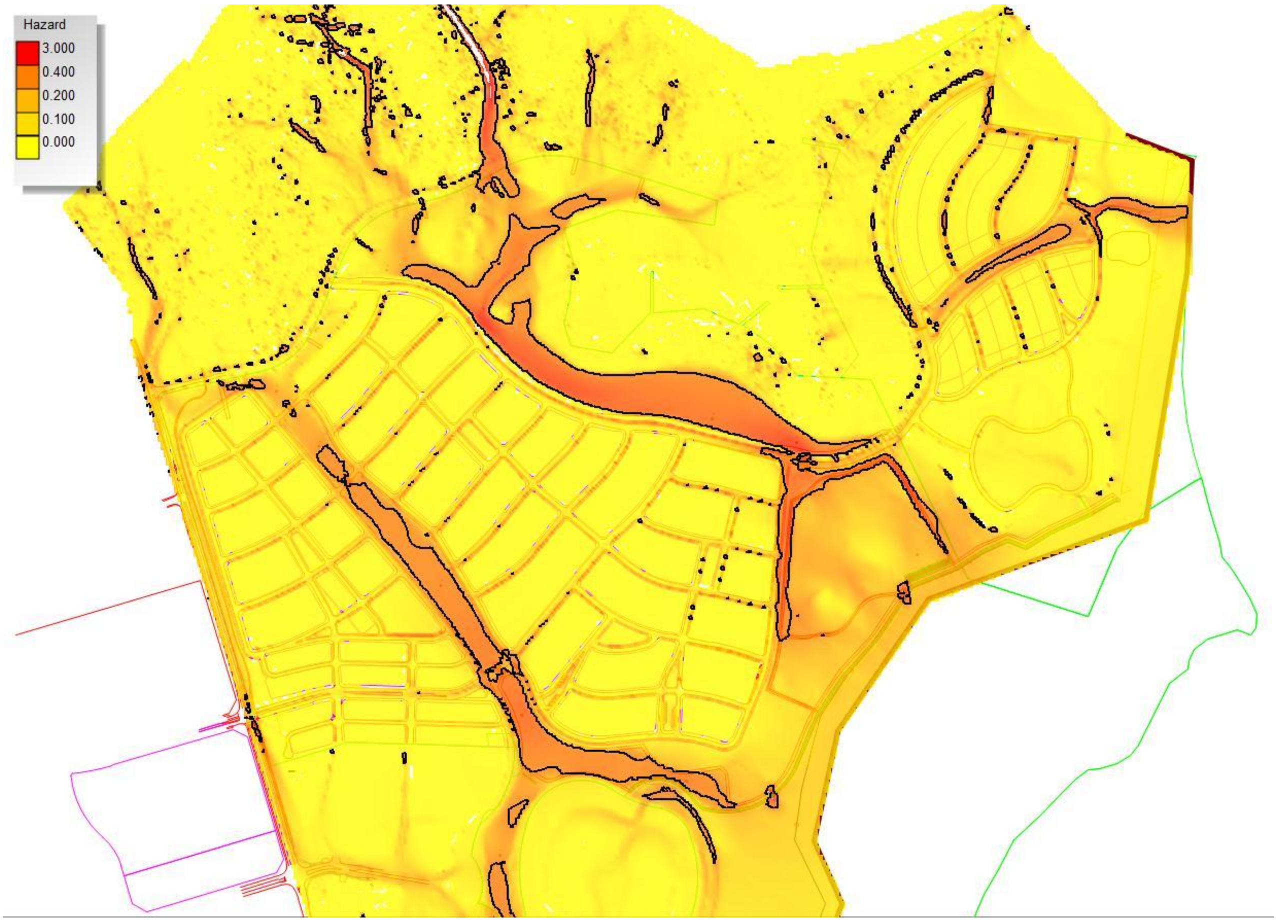

Figure E.5 – Flood Hazard Mapping Across the Developed Riverside Site – 3hr PMF Storm, 100yr Tailwater (VxD=0.4 contour highlighted)

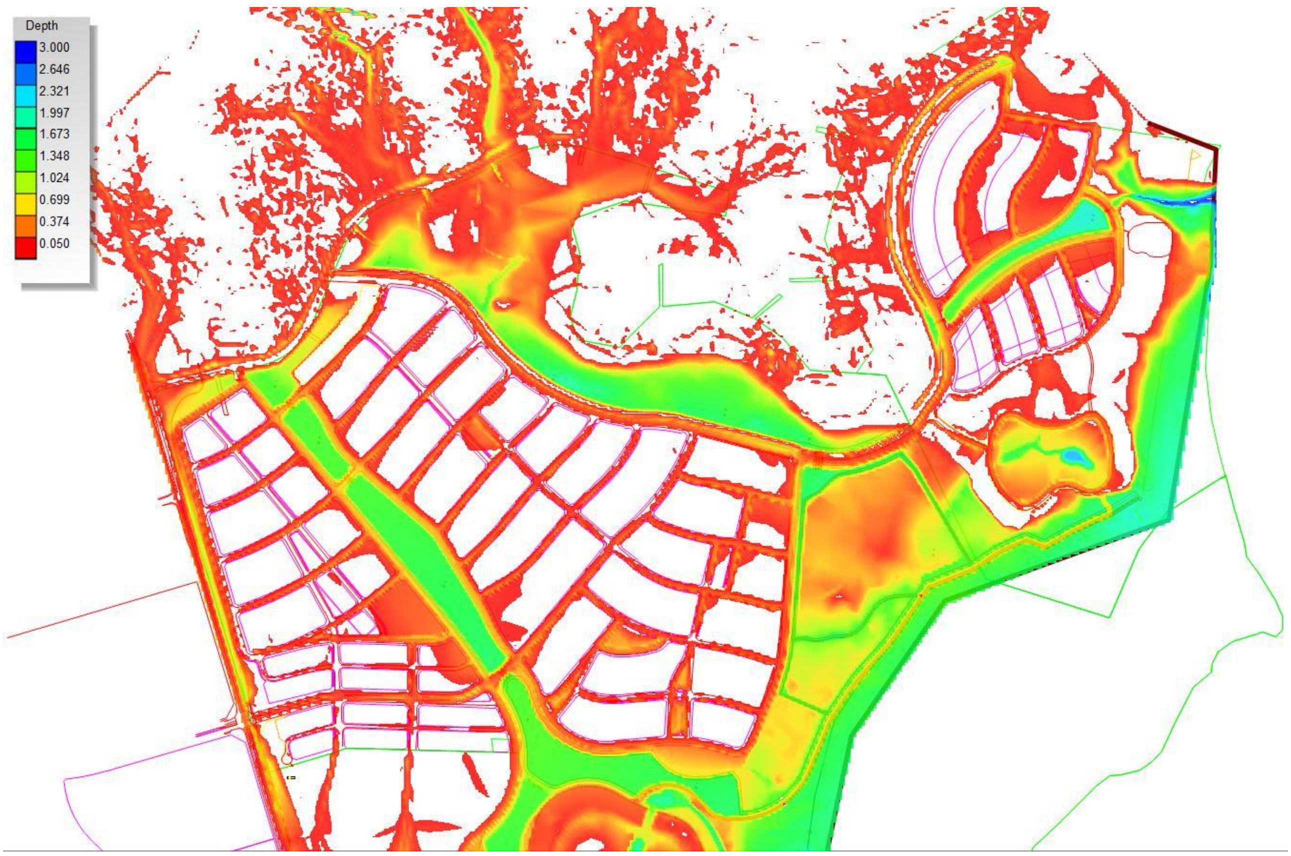

Figure E.6 – Flood Depth Mapping Across the Developed Riverside Site – 3hr PMF Storm, 100yr Tailwater (Depth<0.05m Filtered Out)

Figure E.7 – Flood Hazard Mapping Across the Developed Riverside Site – 6hr PMF Storm, 100yr Tailwater (VxD=0.4 contour highlighted)

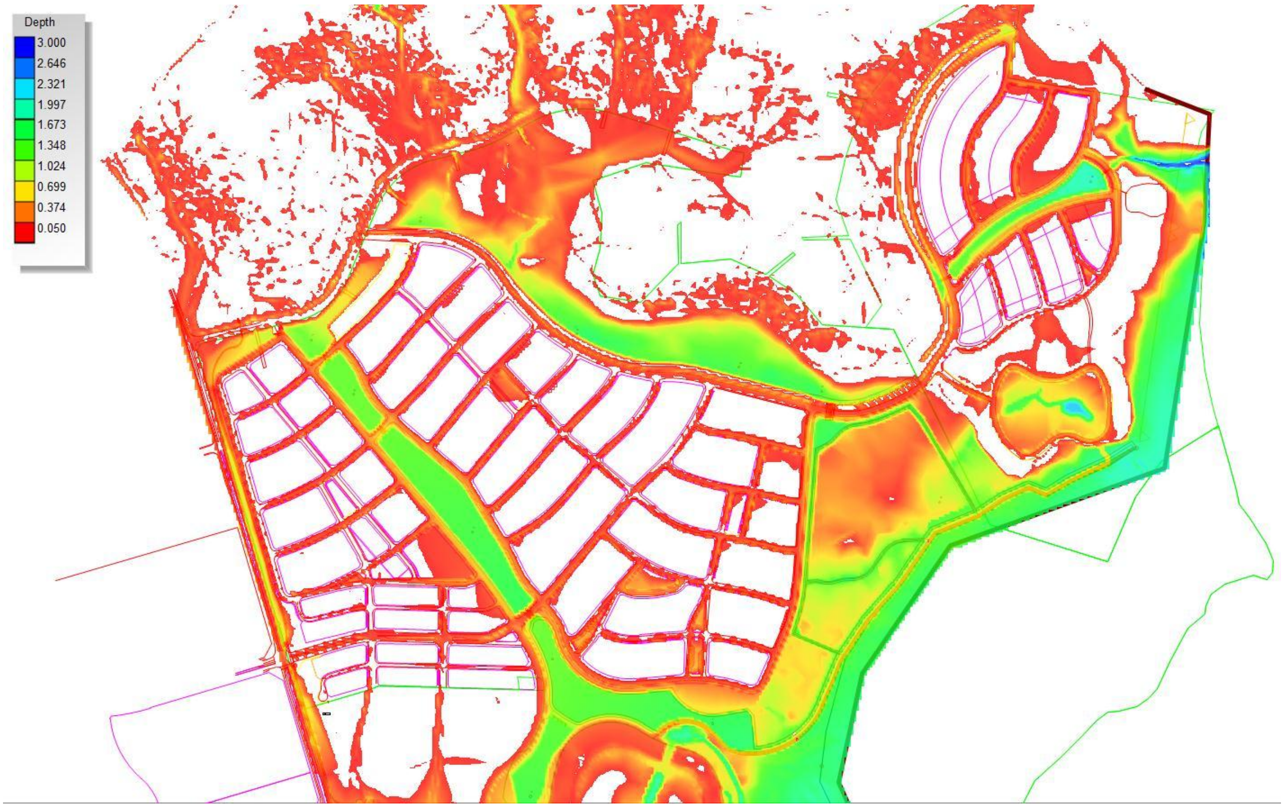

Figure E.8 – Flood Depth Mapping Across the Developed Riverside Site – 6hr PMF Storm, 100yr Tailwater (Depth<0.05m Filtered Out)

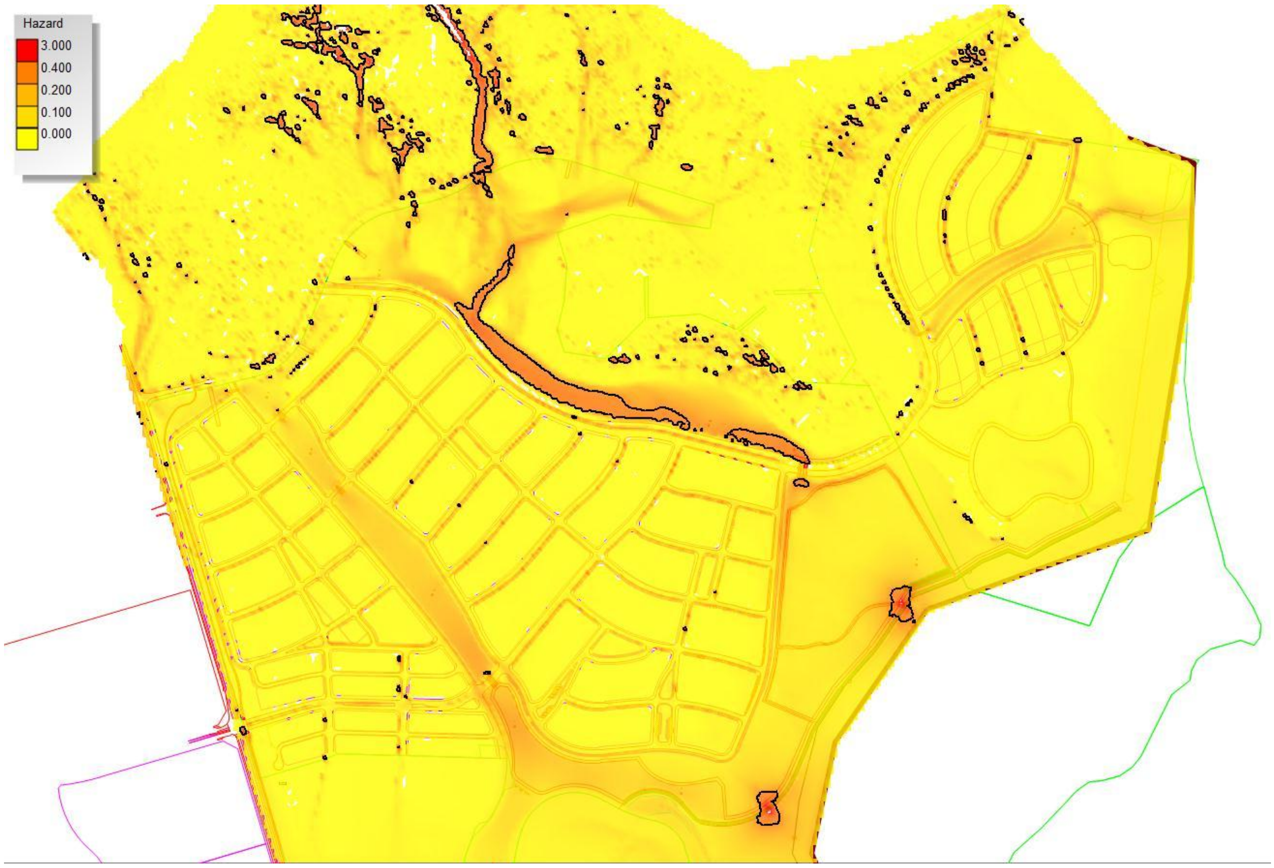

Figure E.9 – Flood Hazard Mapping Across the Developed Riverside Site – 1hr 100yr Storm, Extreme Tailwater (VxD=0.4 contour highlighted)

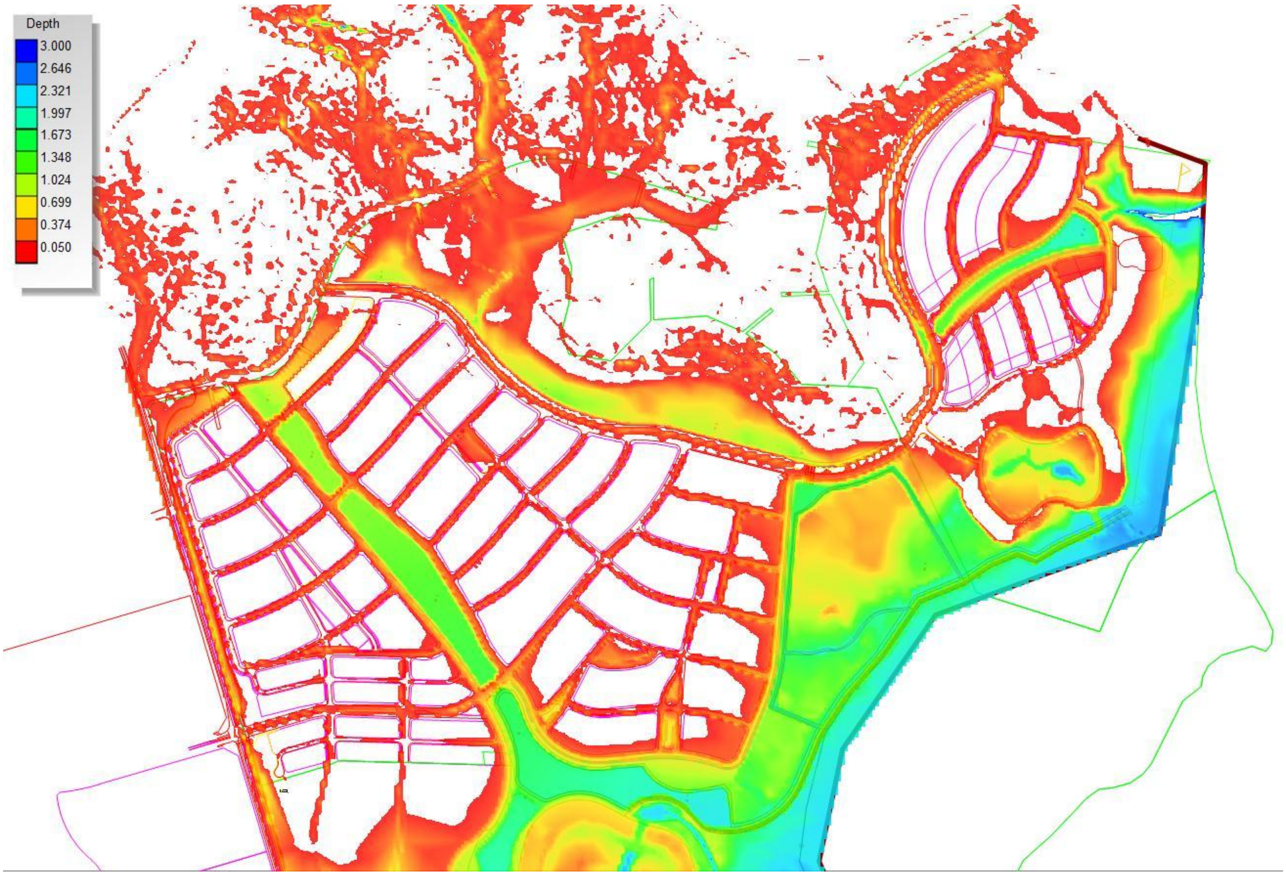

Figure E.10 – Flood Depth Mapping Across the Developed Riverside Site – 1hr 100yr Storm, Extreme Tailwater (Depth<0.05m Filtered Out)

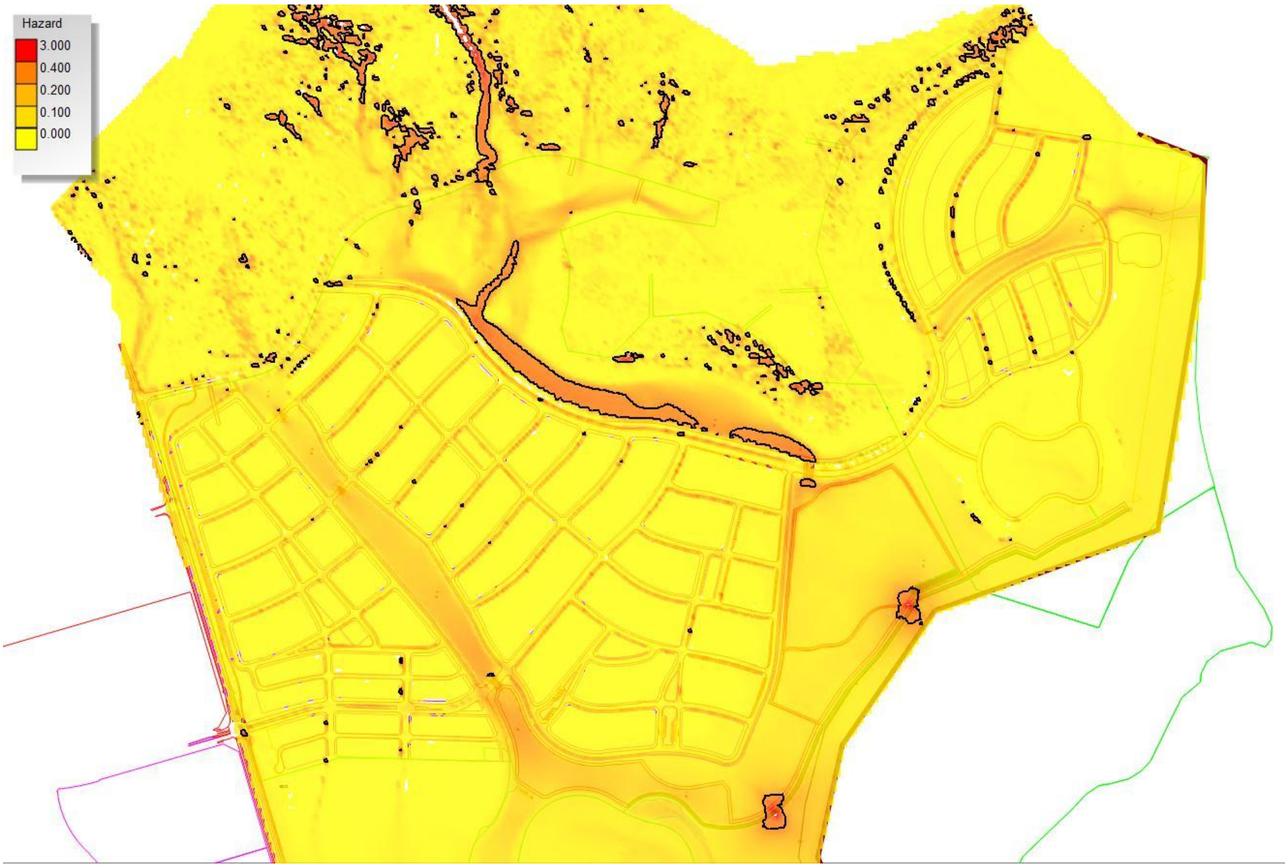

Figure E.11 – Flood Hazard Mapping Across the Developed Riverside Site – 2hr 100yr Storm, Extreme Tailwater (VxD=0.4 contour highlighted)

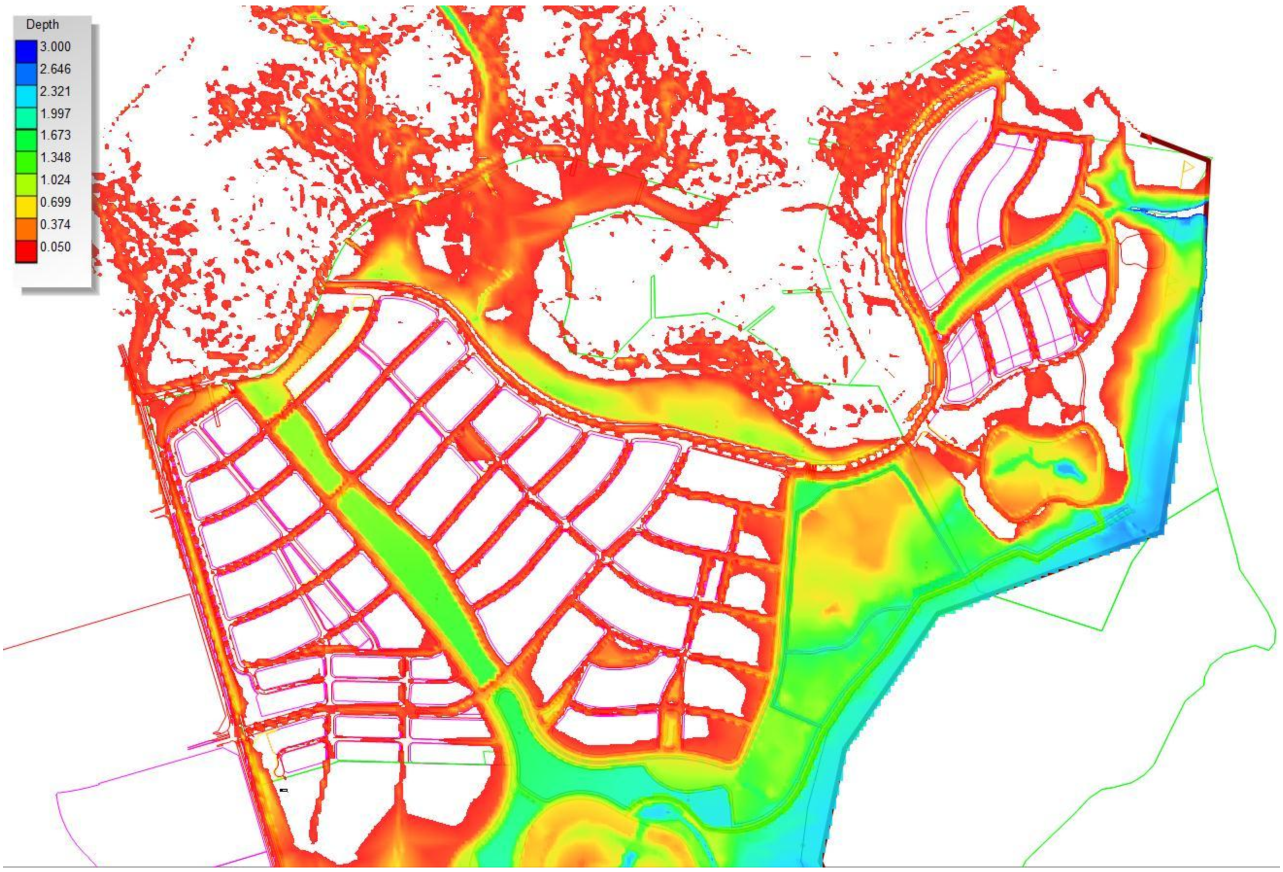

Figure E.12 – Flood Depth Mapping Across the Developed Riverside Site – 2hr 100yr Storm, Extreme Tailwater (Depth<0.05m Filtered Out)

Figure E.13 – Flood Hazard Mapping Across the Developed Riverside Site – 3hr 100yr Storm, Extreme Tailwater (VxD=0.4 contour highlighted)

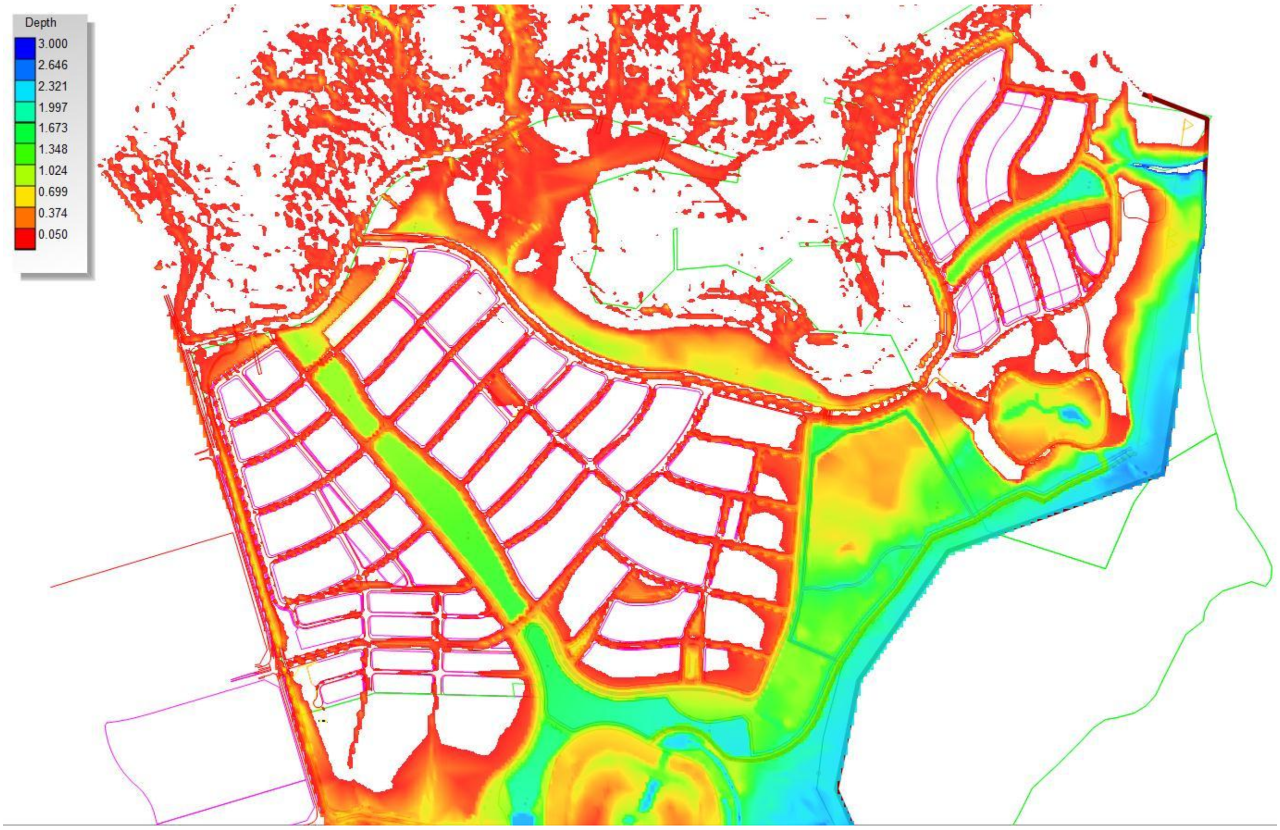

Figure E.14 – Flood Depth Mapping Across the Developed Riverside Site – 3hr 100yr Storm, Extreme Tailwater (Depth<0.05m Filtered Out)

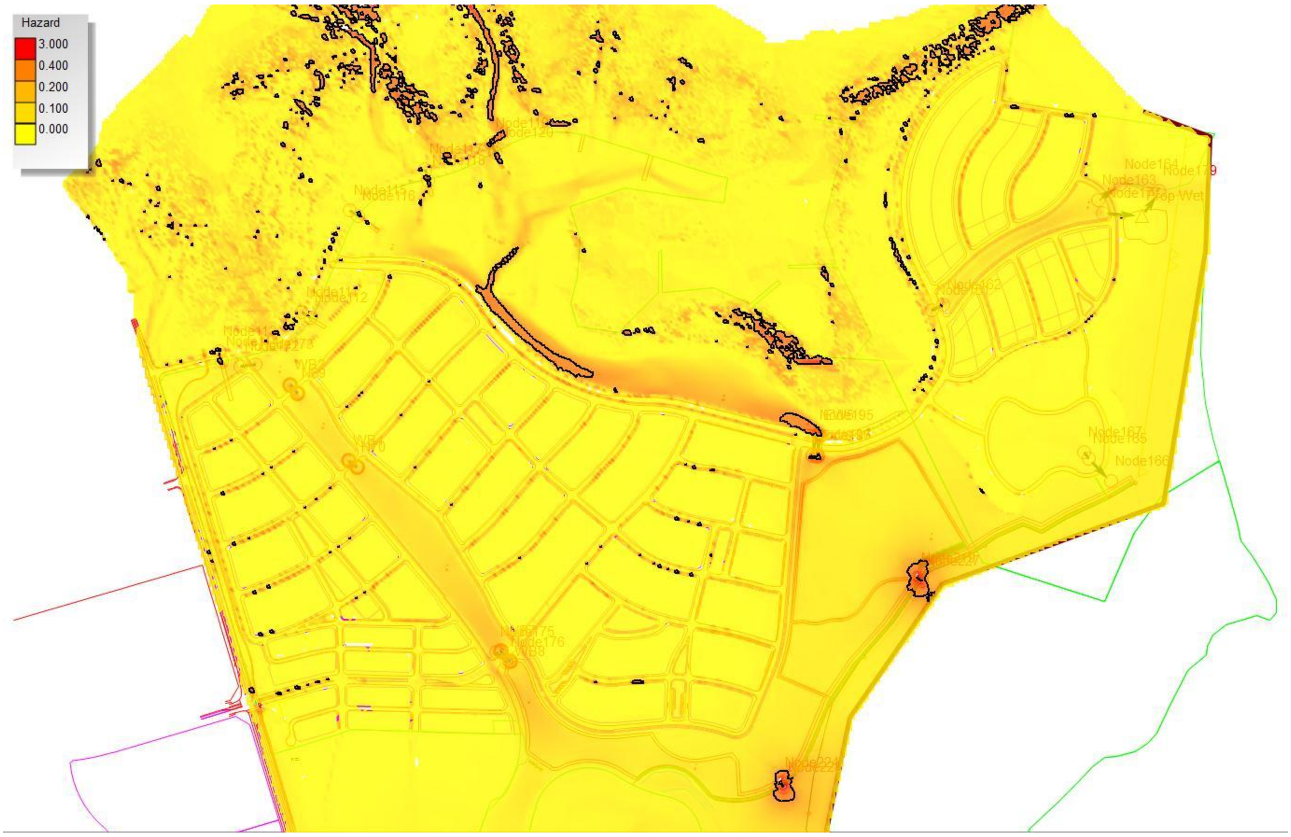

Figure E.15 – Flood Hazard Mapping Across the Developed Riverside Site – 6hr 100yr Storm, Extreme Tailwater (VxD=0.4 contour highlighted)

Figure E.16 – Flood Depth Mapping Across the Developed Riverside Site – 6hr 100yr Storm, Extreme Tailwater (Depth<0.05m Filtered Out)