

APPENDIX A

Existing Flood Behaviour

Lower and Upper Narara Creek

Lower Narara Creek

Modelling indicates Lower Narara Creek remains within its banks at the Racecourse up to the 5% AEP design event. In the 2% AEP design event and above, there is significant out-of-bank flow through the Racecourse.

Local watercourses within the Golf Course are backfilled by Narara Creek in each design event.

Commercial premises along Manns Road at West Gosford become flood affected by out-of-bank flow in the 20% AEP design event and above.

Peak flood height in Lower Narara Creek occurs associated with the 9 h design flood event in all AEPs. The maximum flood height in the PMF is associated with the 3 h design flood event.

Flood levels above 10% AEP in this area are primarily impacted by the constriction caused by the Main Northern Railway across Fagans Bay.

At Showground Road, Narara Creek is out-of-bank in the 50% AEP design event and above, with the Railway and Maliwa/Rowena Road acting as channel confines.

Showground Road bridge is overtopped in the 20% AEP and above. Modelling indicates a significant proportion of flow is out-of-bank in the vicinity of this bridge, with less 'in bank' compared to above and below. This suggests the creek may be silted up at this location.

Commercial premises on Showground Road adjacent Narara Creek within the Glennie Street West industrial area are impacted in the 50% AEP design event and above.

Backyards of properties at Showground Road near the Manns Road bridge are flood affected in the 50% AEP and above, as is the Model Railway.

Peak flood height at this location on Narara Creek is associated with the 9 hr design flood event for all AEPs, except the PMF. The critical duration of the PMF at this location is 2 h. The time of peak in the 9 h 1% AEP is 6 to 6.5 h.

In contrast, peak flow from Bradys Gully, above Akora Road, is associated with the 2 h design flood event for all AEP except the PMF. The time of peak in the 2 h 1% AEP, as an example, is 50 min.

For Wingello Creek, peak flow at the confluence with Narara Creek occurs associated with the 9 h design event at time 6.25 h. The flood peak is 9 h due to the Pecan Close detention basin.

For Wyoming Creek, above the Pacific Highway, peak flow occurs associated with 2 h design event for AEP > 10%. The time of peak flood height at the outlet of Wyoming Creek is 45 min.

In summary, peak flows from Bradys Gully and Wingello Creek at the confluence with Narara Creek occur prior to peak flow of Narara Creek itself thereby allowing these tributaries to discharge. For Wyoming Creek, the critical duration is 9 h due to the Pecan Close detention basin; however, there is still significant discharge in the 2 h design flood event from this catchment.

In the vicinity of Carrington Street and Deane St, the Carrington Street bridge is overtopped in the 20% AEP event and above. The Deane St bridge is overtopped in the 50% AEP event and above. Similarly, modelling indicates the bridge at Manns Road is also overtopped in the 20% AEP and above.

Commercial premises on Manns Road, on the north side of Narara Creek, are flood affected above 10% AEP and floodplain is active in the 50% AEP and above. Similarly, the out-of-bank flood path west of Hanlan Street is active in the 50% AEP and above. In this area, peak flood height in Narara Creek is associated with the 9 h design flood event in up to 1% AEP, except 2% AEP where it is 6 h. In the 0.5% and 0.2% AEP, the critical duration design flood event is 6 h.

Peak inflow from West Narara Creek is associated with the 2 h design flood event in the 1% AEP and above and is 6 h in lower AEPs. Fountain Creek peak inflow and flood height is associated with the 2 h design flood event for all AEPs except the PMF.

Tabulated results for the 1% AEP design event at major hydraulic structures along Lower Narara Creek are presented in Table 1.

Table 1: Bridge and Culvert Hydraulics - 1% AEP (Lower Narara Creek)

Description	Central Coast Highway	Manns Road (West Gosford)	Showground Road	Manns Road	Carrington Street	Deane Street
Dimension	Bridge, Soffit 2.35 mAHD	Bridge, Soffit 2.17 mAHD	Bridge, Soffit 1.8 mAHD	Bridge, Soffit 2.92 mAHD	Bridge, Soffit 3.70 mAHD	Bridge, Soffit 6.04 mAHD
Upstream Invert (mAHD)	-3.40	-0.23	-2.58	-1.00	0.45	4.60
Downstream Invert (mAHD)	-3.40	-0.23	-2.58	-1.00	0.45	4.60
Headwater Level (mAHD)	1.88	2.42	3.75	4.65	4.89	7.96
Tailwater Level (mAHD)	1.84	2.39	3.74	4.51	4.87	7.35
Weir Level (mAHD)	4.07	2.80	2.75	3.65	4.25	6.99
Q Culvert (m ³ /s) ¹	362.1	11.4	3.8	75.8	9.8	39.
Q Weir (m ³ /s)	0	0	1.6	21.2	4.1	17.5
Q Total (m ³ /s) ¹	362.1	11.4	5.4	97.0	14.0	56.5
V Culvert (m/s) ¹	1.6	0.5	0.1	1.3	0.4	2.8
Length of Culvert	32	8.5	11.74	12.3	12.2	19
Culvert Regime at Peak	Bridge	Bridge	Bridge	Bridge	Bridge	Bridge
US_Node	CH26.2	CH67.2	CH146.2	CH280B.2	CH269.2	CH506.2
DS_Node	CH27.1	CH64.1	CH147.1	CH156.1	CH272.1	CH493.1
Critical duration (h)	9	9	9	9	9	2
Time of Peak Height (h)	7.1	6.9	6.4	6.15	6.1	1.3

¹ Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q may not occur concurrently with peak flood height.

Upper Narara Creek

Narara Valley Drive is overtopped in the 50% AEP design event and above and Upper Narara Creek is out-of-bank at the lower end of Koninderie Parade.

Significant out-of-bank flow occurs along Koninderie Parade in the 10% AEP design event and above and the overland flood path behind Koninderie Parade is active in the 10% AEP and above.

The critical duration at this location occurs associated with the 9 h design flood event for AEP up to 10% event and is 2 h in the 5% AEP event and above. The critical duration of the PMF at Koninderie Parade is 60 min.

Flood level at the Railway bridge, upstream of Koninderie Parade, is below the soffit up to the 0.5% AEP and the railway itself is just overtopped in the PMF.

Backyards of properties at Kathleen Morreau Road are flood affected in the 50% AEP and above, however, house floor levels appear to be adequate up to the 1% AEP. Kathleen Morreau Road bridge is overtopped in the 50% AEP and above.

At the intersection of Perratt Close and Railway Crescent, modelling indicates the primary culvert is overtopped in the 0.2% AEP event and above. There is ponded stormwater, however, at this location in the 20% AEP event and above.

Above Railway Crescent to Alan Street, Upper Narara Creek is confined in-bank due to steep channel sides.

At Alan Street, at the intersection with Siletta Road, the structure is overtopped in the 10% AEP event and above.

Table 2 presents model results and details of main structures that occur along Upper Narara Creek.

Table 2: Bridge and Culvert Hydraulics - 1% AEP (Upper Narara Creek)

Description	Narara Valley Drive	Railway Bridge	Kathleen Morreau Road	Railway Bridge	Railway Crescent	Alan Street
Dimension	RCBC, 4*2700X1800	Bridge, Soffit 13.68 mAHD	Bridge, Soffit 13.46 mAHD	Bridge, Soffit 15.79 mAHD; RCP 750 dia; RCP 2*900 dia	RCP, 3*3050 dia	RCP, 1*2000 dia
Upstream Invert (mAHD)	5.40	9.97	10.55	14.00, 12.91, 12.80	12.67	18.20
Downstream Invert (mAHD)	5.05	9.97	10.55	14.00, 12.71, 12.77	12.36	18.10
Headwater Level (mAHD)	8.99	13.52	15.13	15.87	16.15	23.43
Tailwater Level (mAHD)	8.70	13.50	15.00	15.77	15.90	20.80
Weir Level (mAHD)	7.53	15.20	14.13	17.19	17.02	22.90
Q Culvert (m ³ /s) ¹	55.2	99.6	25.3	49.2, 0.6, 1.9	51.7	18.2
Q Weir (m ³ /s) ¹	48.9	0	10.2	0	0	22.1
Q Total (m ³ /s)	104.1	99.6	35.5	51.6	51.7	40.4
V Culvert (m/s) ¹	2.8	1.2	1.3	2.2, 1.4, 1.5	2.4	5.8
Length of Culvert	28.7	12.9	8.7	15	22.7	31.5
Culvert Regime at Peak	Outlet Control	Bridge	Bridge	Outlet Control	Outlet Control	Outlet Control
US_Node	CH545.2	CH563.2	CH582.2	CH22.2	CH894.2	S51.1
DS_Node	CH508.1	CH559.1	CH572.1	CH585.1	CH22.1	CH876.1
Critical duration (h)	2	2	2	2	2	2
Time of Peak Height (h)	1.3	1.1	0.95	1.13	1.17	1

¹ Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q may not occur concurrently with peak flood height.

Bradys Gully

Lower Reach

Modelling indicates that Bradys Gully is in-bank up to the 2% AEP event below Henry Parry Drive to the Pacific Highway. Bradys Gully at the Pacific Highway is not overtopped until the 5% AEP event.

For design events greater than the 5% AEP, the constriction due to the Railway bridge, as well as tailwater effects of Narara Creek, lead to ponding immediately east of the railway line.

There is surface overland flow at the roundabout of Pacific Highway, Henry Parry Drive and Pemell Street in the 50% AEP event, however, is generally less than 10 to 20 cm until the 10% AEP event. There is ponding in Pemell St in all AEP events > 50%. This is due to the low hydraulic gradient between this location and the outlet at the Railway.

Table 3 presents tabulated results of main hydraulic structures in the lower reach of Bradys Gully.

Table 3: Bridge and Culvert Hydraulics - 1% AEP (Bradys Gully – Lower Reach)

Description	Showground Road	Railway Bridge	Akora Road	Pacific Highway	Driveway Access Bridge	Henry Parry Drive	Halycon Street
Dimension	Bridge, Soffit 2.86 mAHD	Bridge, Soffit 3.65 mAHD	Bridge, Soffit 2.30 mAHD	RCBC, 2*2100X2050	Bridge, Soffit 5.07 mAHD	RCBC, 2*2450X1500; RCBC 2*2450X1500	RCP, 2*1200 dia
Upstream Invert (mAHD)	-0.08	0.55	0.13	0.86	1.15	3.55, 3.73	5.90
Downstream Invert (mAHD)	-0.08	0.55	0.13	0.85	1.15	3.31, 3.33	5.80
Headwater Level (mAHD)	3.74	3.83	3.85	4.45	4.55	5.91	7.17
Tailwater Level (mAHD)	3.69	3.75	3.82	3.74	4.52	5.06	7.01
Weir Level (mAHD)	3.96	5.15	3.00	4.13	5.74	6.00	7.55
Q Culvert (m ³ /s) ¹	15.4 ²	23.0	6.6	31.8	46.5	23.6, 22.1	3.7
Q Weir (m ³ /s) ¹	0	0	2.0	3.5	0	0	9.3
Q Total (m ³ /s)	15.4	23.0	8.6	35.3	46.5	45.7	13.0
V Culvert (m/s) ¹	0.8	1.0	0.7	3.7	1.7	5.4, 5.0	1.7
Length of Culvert	13.6	10.5	5.8	28.9	11.4	30	19.2
Culvert Regime at Peak	Bridge	Bridge	Bridge	Outlet Control	Bridge	Inlet Control	Outlet Control
US_Node	B6.1	CH383.2	CH139.2	CH391.2	B4.1	C1-3a.1	S1.1
DS_Node	B6.2	CH137.1	CH383.1	CH6.1	B4.2	C1-3a.2	CH991.1
Critical duration (h)	9	9	9	2	2	2	90 min
Time of Peak Height (h)	6.4	6.4	6.3	0.87	0.83	0.83	0.53

¹ Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q (documented in flood study report) may not occur concurrently with peak flood height; ² Bridge swamped by floodplain cross-flow at maximum flood height.

Upper Reach

The capacity of the Catholic School culvert is less than the 50% AEP event, however, the overland flow path between Glennie Street and Cary Street appears sufficient up to the 1% AEP. Floor levels will need to be confirmed.

Bradys Gully between Glennie Street and Bradys Gully Road is contained in-bank for all AEPs events up to PMF.

Above Glennie Street to Dwyer Street, the natural creek has been piped. The capacity of that system appears to be less than the 50% AEP event, with surface overland flow occurring through the multi-unit housing complex down to Glennie Street.

There is overland flow through North Gosford Hospital; however, it is quite shallow up to the 10% AEP event.

There is a minor tributary of Bradys Gully that runs parallel to Bradys Gully Road which is now piped from below an earthen dam through to Blanche St and Jarrett St. This trunk line has recently been upgraded. Due to the shallow hydraulic gradient at the downstream end, that trunk line is subject to outlet control. Modelling suggests the capacity of the new drainage line is ~20% AEP event.

A tributary of Bradys Gully through Kirkness Avenue has capacity up to the 2% AEP event. Surface overland flow along Kirkness Avenue (where the natural watercourse has been piped) is generally less than 10 to 20 cm.

Upstream of Bradys Gully Road, Bradys Gully is confined in-bank up to Stachon Street to about the 1% AEP event. The level of service of the pipe running parallel to Stachon Street is less than the 50% AEP event and residents report regular issues with standing water due to overland flow.

Table 4 presents tabulated results for main structures in the upper reaches of Bradys Gully.

Table 4: Bridge and Culvert Hydraulics - 1% AEP (Bradys Gully – Upper Reach)

Description	Catholic School Culvert	Bradys Gully Road	Stachon Street	Kirkness Avenue	Above Blanch St to Jarrett St	Jarrett St below Halycon	Halycon Street
Dimension	RCP, 3*1500 dia; RCBC, 2*1.5*2.4	RCP, 2*1800 dia	RCP, 1*1200 dia	RCBC, 1*3300X1200	RCP, 2*1200 dia; RCBC, 1*2.7*1.2; RCBC, 1*3.6*0.9	RCP, 2*1200 dia	RCP, 2*1200 dia
Upstream Invert (mAHD)	4.86	8.36	15.20	12.35	13.48	5.05	5.90
Downstream Invert (mAHD)	4.00 ²	7.50	12.70	12.02	9.02	4.7	5.80
Headwater Level (mAHD)	8.00	11.27	18.27	14.15	16.11	6.50	7.17
Tailwater Level (mAHD)	6.40	9.14	14.23	13.33	9.18	6.09	7.01
Weir Level (mAHD)	7.00 ⁴	11.00 ⁵	17.00	13.99	N/A ⁶	6.30	7.55
Q Culvert (m ³ /s) ¹	13.4	20.3	2.3	10.9	4.3	4.9	3.7
Q Weir (m ³ /s) ¹	31.8	2.7	15.9	1.4	2.2	17.0	9.3
Q Total (m ³ /s)	45.2	23.0	18.2	12.4	6.5	21.9	13.0
V Culvert (m/s) ¹	2.5	4.0	2.0	4.6	2.3	2.2	1.7
Length of Culvert	155 ³	63	250	19.1	224	13.8	19.2
Culvert Regime at Peak	Outlet Control	Outlet Control	Outlet Control	Inlet Control	Outlet Control	Outlet Control	Outlet Control
US_Node	CH402.2	CH404.2	P4.1	c1-1.1	Blanch120a.1	CH993.2	S1.1
DS_Node	CH397.1	Blanch117.2	CH427.1	c1-1.2	Blanch117.2	S2.2	CH991.1
Critical duration (h)	2	12	2	2	90 min	90 min	90 min

Time of Peak Height (h)	0.8	7.07	0.9	0.73	0.53	0.53	0.53
-------------------------	-----	------	-----	------	------	------	------

¹ Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q may not occur concurrently with peak flood height; ² at outlet of Cary St culvert; ³ combined; ⁴ in playground above 3*1500 pipeline; ⁵ road crest; ⁶ overflow flow path from above Blanche St as well as from Blanche St to Jarrett St.

Wingello Creek

Lower Reach

Wingello Creek between the confluence with Narara Creek and Jarrett Street remains in-bank for all AEP events, except for the PMF

Wingello Creek at Pacific Highway has a level of service of greater than the 1% AEP event.

Table 5 presents tabulated model results for the 1% AEP event with respect to the main hydraulic structures in the lower reach of Wingello Creek.

Below Warawilla Road as well as below Jarrett Street, the currently available floodplain appears sufficient to confine up to the 0.2% AEP event. An exception is Roselands Avenue, where there is localised ponding. This is due to the hydraulic gradient being such that the trunk drainage line at outlet from that sub-catchment is under outlet control. Outlet control reduces the effective conveyance capacity of the pipe network.

The culvert at Jarrett Street has a level of service of up to 0.2% AEP event. It is noted that the hydraulic regime at this structure is inlet control rather than outlet control.

The culvert at Warawilla Road has a level of serviceability of 20% AEP.

Table 5: Bridge and Culvert Hydraulics – 1% AEP (Wingello Creek – Lower Reach)

Description	Railway Bridge	Pedestrian Bridge	Willow Motel Driveway	Pacific Highway	Jarrett Street	Warawilla Road
Dimension	Bridge, Soffit 3.56 mAH	Bridge, Soffit 4.85 mAH	RCBC 1*3000*3650; RCBC 2*3000X2800	RCBC 1*3000*3600; 2*3000*3200	RCP 2*1740 dia; RCP 3*2100 dia	RCBC 6*1400*1830
Upstream Invert (mAH)	0.00	0.88	1.04, 1.85	1.26, 1.26	3.45, 3.61	7.15
Downstream Invert (mAH)	0.00	0.88	1.02, 1.84	1.26, 1.26	3.37, 3.38	7.20
Headwater Level (mAH)	3.88	3.96	4.04	4.14	5.85	9.77
Tailwater Level (mAH)	3.77	3.94	4.01	4.11	5.42	9.58
Weir Level (mAH)	4.99	4.97	5.18	5.46	6.25	9.61
Q Culvert (m ³ /s) ¹	20.2	34.5	15.8, 22.4	14.0, 28.1	15.8, 27.9	29.0
Q Weir (m ³ /s) ¹	0.0	0.0	0.0	0.0	0.0	1.1
Q Total (m ³ /s)	20.2	34.5	38.2	42.1	43.7	30.0
V Culvert (m/s) ¹	1.0	1.0	1.9	1.7	3.3, 2.9	1.9
Length of Culvert	11.6	6.8	7.3	32.1	12.9	10.0
Culvert Regime at Peak	Bridge	Bridge	Outlet Control	Outlet Control	Inlet Control	Outlet Control
US_Node	CH152.2	CH1011.2	CH1039.2	CH1021.2	CH1037.2	CH1098.2
DS_Node	CH150.1	CH1012.1	CH1019.1	CH1039.1	CH1034.1	CH1093.1
Critical duration (h)	9	9	9	9	9	9

Description	Railway Bridge	Pedestrian Bridge	Willow Motel Driveway	Pacific Highway	Jarrett Street	Warrawilla Road
Time of Peak Height (h)	6.35	6.3	6.05	5.85	5.65	5.5

¹ Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q may not occur concurrently with peak flood height.

Upper Reaches

Modelling indicates the Pecan Close detention basin is overtopped in the 0.2% AEP event and above. As illustrated in Figure 33, this structure is critical in reducing the flood height below Warrawilla Road. The culvert at Maidens Brush Road has a level of service of 5% AEP.

Table 6 presents tabulated model results at main hydraulic structures in the upper reaches of Wingello Creek.

Table 6: Bridge and Culvert Hydraulics – 1% AEP (Wingello Creek – Upper Reaches)

Description	Pecan Close	Rainforest Road	Driveway Paperbark Close	Maidens Brush Road
Dimension	RCP 2*1200 dia	RCBC 1*1550X2100	RCP 1*1100 dia	RCP 3*1500 dia
Upstream Invert (mAHD)	9.40	10.29	25.80	10.35
Downstream Invert (mAHD)	9.00	10.29	25.10	10.13
Headwater Level (mAHD)	13.50	13.54	28.71	12.56
Tailwater Level (mAHD)	10.37	13.51	25.66	12.08
Weir Level (mAHD)	14.10	14.40	30.00	12.25
Q Culvert (m ³ /s) ¹	8.5	2.0	4.3	17.5
Q Weir (m ³ /s) ¹	0.0	0.0	0.0	2.8
Q Total (m ³ /s)	8.5	2.0	4.3	20.4
V Culvert (m/s) ¹	3.8	0.6	4.5	3.3
Length of Culvert	95.0	35.8	28.8	15.6
Culvert Regime at Peak	Outlet Control	Outlet Control	Outlet Control	Outlet Control
US_Node	P1.1	S57.1	CH1139.2	CH1165.2
DS_Node	P1.2	S57.2	CH1140.1	CH1157.1
Critical duration (h)	9	9	2	9
Time of Peak Height (h)	6.15	6.05	0.8	5.35

¹ Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q may not occur concurrently with peak flood height.

Wyoming Creek

Wyoming Creek between Pacific Highway and Alan Davison Park is confined in-bank up to the 2% AEP event. The culvert at Pacific Highway has a level of service of greater than the 0.2% AEP. There are some residential properties adjacent to Wyoming Creek that may be flood affected in the 1% AEP event and above.

The levee of the detention basin at Brookes Avenue is not exceeded until the 1% AEP design event. Floor levels within the basin will need to be confirmed to determine whether commercial premises are flood affected in that event.

Wyoming Creek is out-of-bank within Alan Davison Park in the 20% AEP event, however, is confined within the floodplain for all AEP events.

The Day Street channel has a level of service of about 2% AEP. 50% AEP levels are above the concrete-lined portion of this channel; however, the available easement appears sufficient up to the 2% AEP.

The Day Street culvert is overtopped in the 5% AEP event and above.

Above the Day Street culvert, Wyoming Creek is out-of-bank in the 50% AEP event and above, however, is confined within the available floodplain for essentially all AEP events except the PMF. Upstream of Chamberlain Road, Wyoming Creek is confined within the available floodplain up to the 0.2% AEP event. The Chamberlain Road culvert is overtopped in the 10% AEP design event and above. At Pangari Close, there is surface overland flow in events > 50% AEP; however, this results in localised ponding and may not lead to flood affectation of surrounding properties. Floor levels will need to be confirmed.

The access bridge to the Aged Care Facility on Chamberlain Road is above the PMF.

The culvert on Chamberlain Road at the intersection with Maya Street is overtopped in the 50% AEP event and above.

Table 7 presents tabulated results at the main hydraulic structures within Wyoming Creek.

Table 7: Bridge and Culvert Hydraulics – 1% AEP (Wyoming Creek)

Description	Railway Bridge	Pacific Highway	Day Street	Chamberlain Road	Chamberlain Road/Maya Street	Pangari Close
Dimension	Bridge, Soffit 3.07 mAHD	RCBC 3*3000X2000	RCBC 2*3000X1300	RCBC 2*3050X1500	RCP 1*1500 dia	RCP 1*1200 dia
Upstream Invert (mAHD)	-0.02	0.96	7.60	10.67	14.90	13.50
Downstream Invert (mAHD)	-0.02	0.90	7.32	10.64	14.90	13.20
Headwater Level (mAHD)	3.88	3.93	9.92	13.41	17.11	17.54
Tailwater Level (mAHD)	3.84	3.89	8.93	12.99	16.28	14.51
Weir Level (mAHD)	5.00	4.75	9.41	12.66	16.49	16.00
Q Culvert (m ³ /s) ¹	26.3	15.4	25.4	24.1	4.4	3.9
Q Weir (m ³ /s) ¹	0	0	4.3	1.7	15.1	10.0
Q Total (m ³ /s)	26.3	15.4	29.7	25.8	19.5	13.9
V Culvert (m/s) ¹	0.7	0.9	5.4	2.6	2.5	3.4
Length of Culvert	10.8	50.5	19.4	29.2	37.4	115
Culvert Regime at Peak	Bridge	Outlet Control	Inlet Control	Outlet Control	Outlet Control	Outlet Control
US_Node	C8.2	CH187.2	CH199.2	CH248.2	CH12.2	P433.1
DS_Node	CH160.1	CH170.1	CH197.1	CH209.1	CH225.1	CH245.2
Critical duration (h)	9	9	2	2	90	2
Time of Peak Height (h)	6.35	6.3	0.77	0.73	0.53	0.83

¹ Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q may not occur concurrently with peak flood height.

West Narara Creek

Modelling indicates West Narara Creek is out-of-bank in the 50% AEP event and above. There is currently limited development within the floodplain of West Narara Creek. There are, however, a couple of residential buildings at the upper end of Deane Street, however, ground levels imply these are above the 0.2% AEP flood level.

Table 8 presents tabulated model results for the Hanlan Street culvert, which is the only hydraulic structure in this creek.

The Hanlan Street culvert is overtopped in less than the 50% AEP event.

Table 8: Bridge and Culvert Hydraulics – 1% AEP (West Narara Creek)

Description	Hanlan St
Dimension	RCBC, 1*3150X2350; RCBC 2*2750X1950
Upstream Invert (mAHD)	1.79
Downstream Invert (mAHD)	1.79
Headwater Level (mAHD)	6.25
Tailwater Level (mAHD)	6.19
Weir Level (mAHD)	4.95
Q Culvert (m ³ /s) ¹	21.4
Q Weir (m ³ /s) ¹	8.7
Q Total (m ³ /s)	39.7
V Culvert (m/s) ¹	1.2, 1.2
Length of Culvert	30.3
Culvert Regime at Peak	Outlet Control
US_Node	CH1269.2
DS_Node	CH259.1
Critical duration (h)	9
Time of Peak Height (h)	5.95

¹ Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q may not occur concurrently with peak flood height.

Fountain Creek

The Carrington Street culvert is overtopped in less than the 50% AEP design event with the Narara High School overland flow path active in the 50% AEP event and above.

Fountain Creek above Carrington Street culvert is confined in-bank in less than the 50% AEP design event, however, the available floodplain appears sufficient up to the 0.2% AEP event.

The causeway at Reeves Street is overtopped in less than the 50% AEP event and is reported by residents to be regularly impassable to vehicular traffic.

There do not appear to be residential buildings along Fountain Creek that are flood affected.

Table 9 presents tabulated model results for main hydraulic structures along Fountain Creek.

Table 9: Bridge and Culvert Hydraulics – 1% AEP (Fountain Creek)

Description	Carrington Street	Carrington Street	Driveway Access Bridge	Reeves Road Causeway	Reeves Road near Pildara Street
Dimension	Bridge, Soffit 4.25 mAHD	RCBC 2*2970*1100	Bridge, Soffit 6.68 mAHD	RCP, 2*900 dia	RCBC 1*2730X930
Upstream Invert (mAHD)	1.81	4.81	5.54	7.56	9.75
Downstream Invert (mAHD)	1.81	4.79	5.54	6.42	9.30
Headwater Level (mAHD)	5.28	6.90	7.68	9.21	10.87
Tailwater Level (mAHD)	4.97	6.82	7.61	9.14	9.80
Weir Level (mAHD)	4.73	6.45	6.88	8.15	10.86
Q Culvert (m ³ /s) ¹	33.4	11.7	7.1	1.2	5.0
Q Weir (m ³ /s) ₁	13.7	24.1	16.3	11.6	0.0
Q Total (m ³ /s)	47.1	35.7	23.3	12.7	5.0
V Culvert (m/s) ¹	2.0	1.8	0.9	0.9	2.7
Length of Culvert	22.6	13.8	6.5	22.0	16.0
Culvert Regime at Peak	Bridge	Outlet Control	Bridge	Outlet Control	Inlet Control
US_Node	CROSS7.1	CHF_14.2	Carr01.1	CH314.2	CH379.2
DS_Node	CH1258.1	CROSS9.2	Carr01.2	CH1309.1	CH381.1
Critical duration (h)	9	2	2	2	2
Time of Peak Height (h)	6	0.8	0.83	0.93	0.8

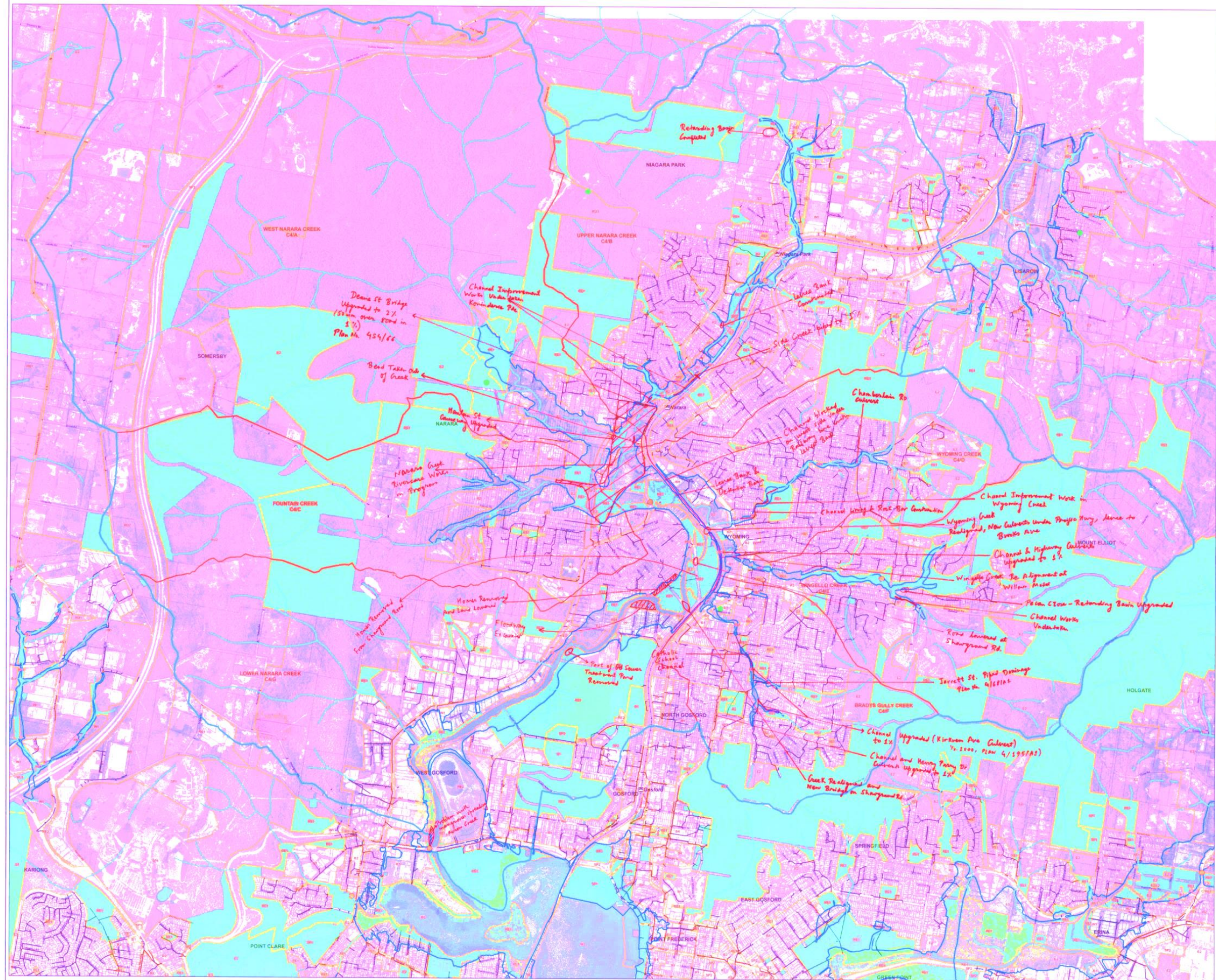
¹ Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q may not occur concurrently with peak flood height.

The western tributary of Fountain Creek, accessed from Carrington Street and Reeves Road/Cross Street, is out-of-bank above the 50% AEP; however, model results indicate there are no residential properties flood affected in any modelled AEP design flood event.

Upstream of the end of Cross Street, the natural floodplain has been in-filled and there is a myriad of driveway access bridges in that area. Although the level of service of these access points is quite low, less than 50% AEP, they do not appear to result in flood affectation of surrounding residential properties in any modelled AEP event.

APPENDIX B

**Flood Management Works Carried Out After
the 1992 Flood Event**



FINAL DRAFT

APPENDIX C

Hazard Definition

Floodplain Development Manual

The following hazard definition is provided in the NSW Floodplain Development Manual (2005)

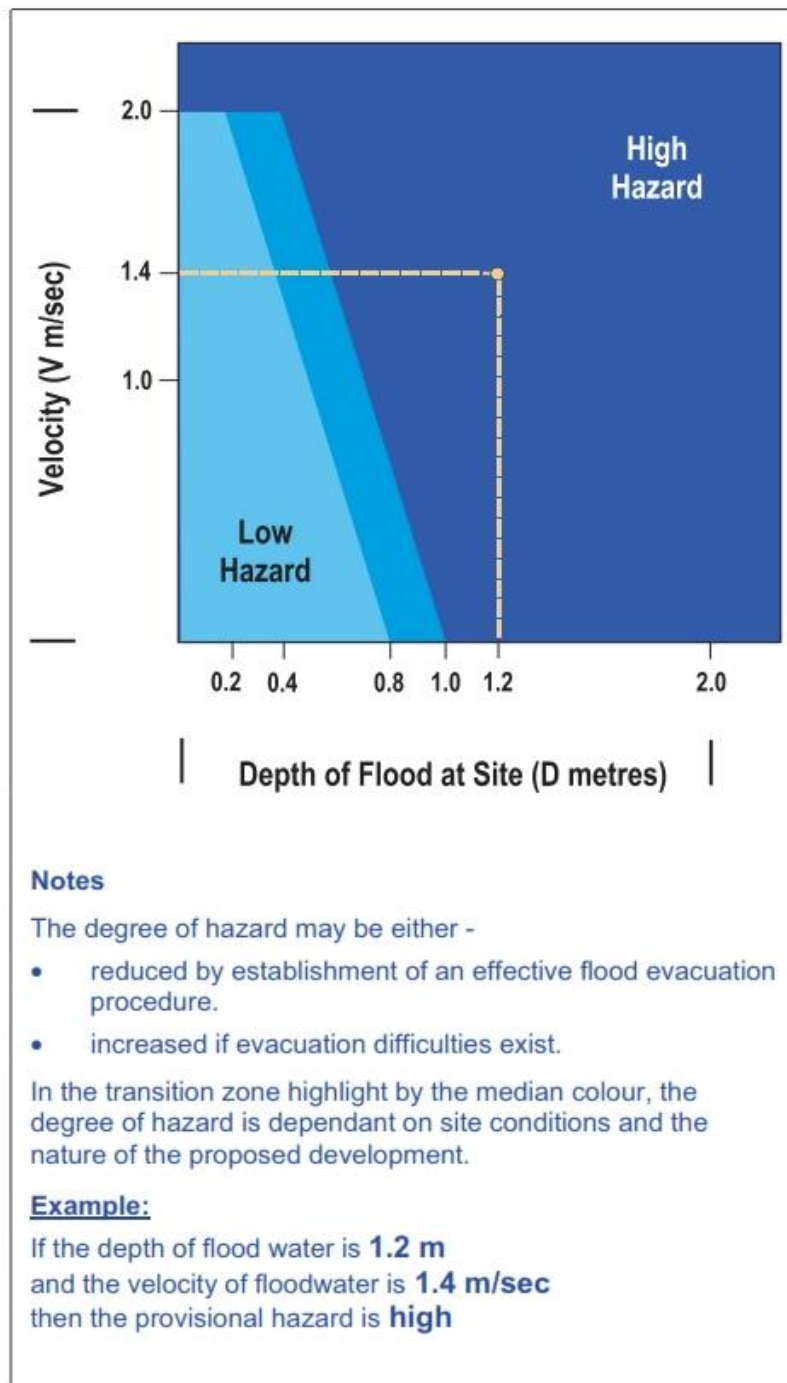
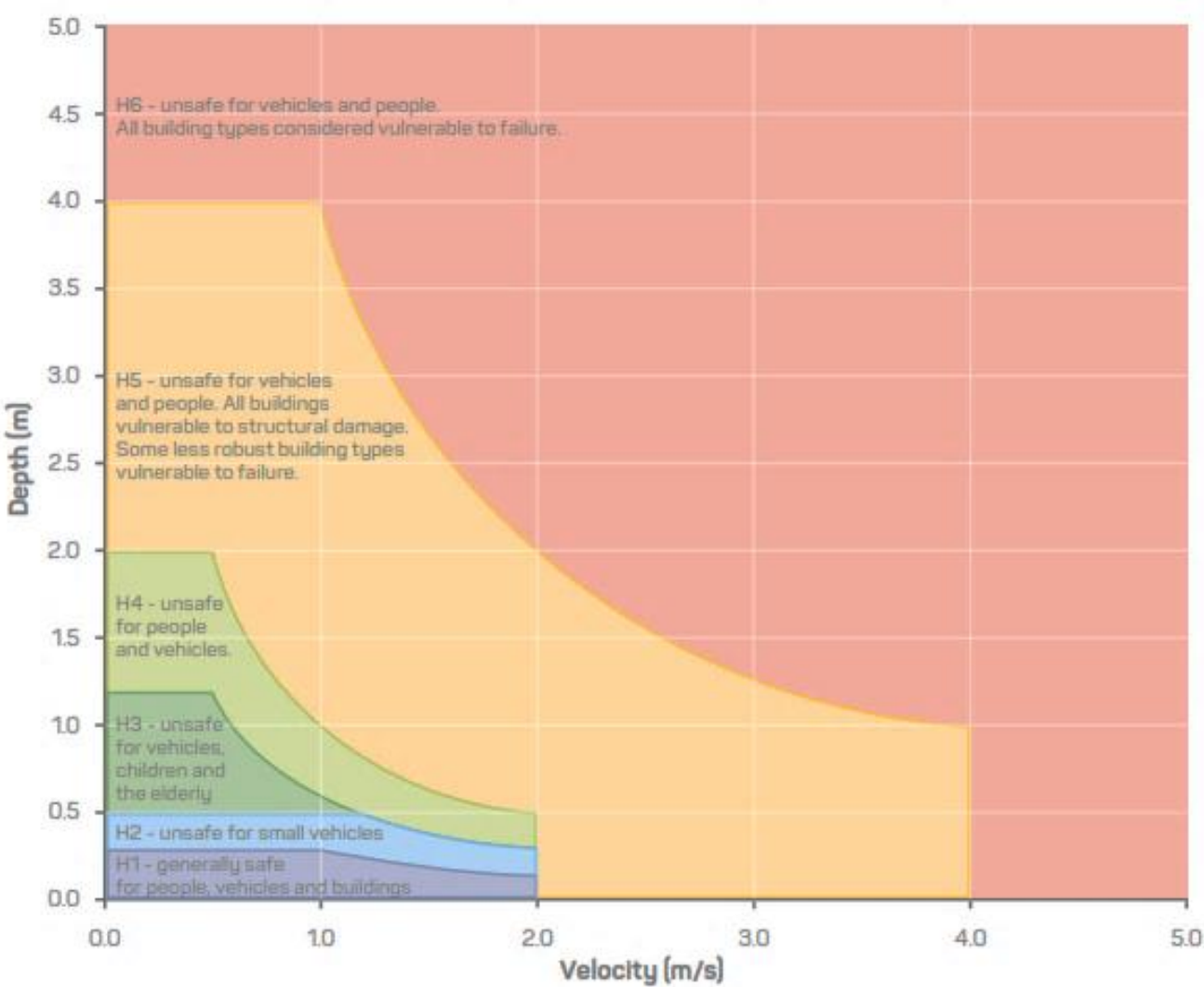


FIGURE L2 - Provisional Hydraulic Hazard Categories

Australian Rainfall and Runoff

Australian Institute of Disaster Reduction

The following hazard definition is provided in Chapter 6 of Australian Rainfall and Runoff 2019 and Handbook 7 “Managing the Floodplain” by Australian Institute of Disaster Reduction.



APPENDIX D
Property Survey
(Confidential)

APPENDIX E

Flood Management Options Identified in Previous Studies

FINAL DRAFT

Lower Narara Creek FRMS and FRMP (Kinhill, 1991)

Flood Modification Options

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
NC1	Narara Creek Floodway	Restore floodway along Narara Creek at various locations	Recommended as part of other options		
NC2	West Gosford Foreshore and residential flood area	The proposal is to establish building floor levels and to prevent future significant filling of land within the West Gosford foreshore and residential flood area	No works recommended		see below
NC3	West Gosford industrial flood area	Affected by Narara Ck and local drainage flooding	Excessive filling of the area to be avoided		Excessive filling has occurred over the years
NC4	Racecourse and golf course flood storage areas	It is proposed that no development in this area should proceed unless it is flood compatible. The flood storage area should be retained. Future developments should not hinder the passage of water from the Narara Creek floodway on the flood storage area.	Flood storage areas to be retained		There has been no development as yet
NC5	Dwyer Street West - old sewage treatment works floodway area	The proposed works in this location comprise the removal of the constriction by land shaping. The shaping would consist essentially of refilling the oxidation pond and the general construction of a low-level berm of approximately 1.1 m AHD as shown in Figure NC.2. The construction of this berm may facilitate more water spreading on to the golf course, but this is not seen as detrimental as the area that may be affected by water flow is part of the flood storage area.	Formation of floodway/berm	4	Yes

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
NC6	Glennie Street West industrial area	The proposal is to construct a berm on the southern side of Narara Creek at this location, beyond the line designated in Figure NC.3. Construction of the berm would necessitate the removal of some existing creek bank vegetation, although this is not expected to include the mangroves at the downstream end of the floodway.	Rowena Road Levee + Glennie Street floodway/berm (levee cannot be built without floodway)	2	Floodway constructed, Rowena Road (VP)
NC7	Showground Road acquisition area	The proposal is to voluntary purchase the houses and land shown in figure NC.4. It is intended that future development would be prevented by means of appropriate zoning of the land so that the area would be kept as a high hazard area, forming part of a park or open space area for the conveyance of floodwaters.	Acquisition of houses north of and including No. 140 Showground Road	1	Yes
NC7	Showground Road acquisition area		Flood proofing of 77 Showground Rd	7	No
NC7	Showground Road acquisition area		VP of houses south of 140 and 9 Showground Rd	8	Yes

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
NC8	Rowena Road protection area	An earth levee could be constructed at the rear of the properties on the eastern side of Rowena Road. Some of the houses in this area are located very close to the banks of Narara Creek, particularly houses Nos 10,12,14, and 16 Rowena Road, as well as 103 and 105 Maliwa Road, and these houses have been excluded from the levee. Houses that have been specifically excluded from the earth levee in Rowena Road could be protected by either a different form of levee, such as a concrete wall, or could be considered for acquisition. It is deemed appropriate that acquisition of houses in Maliwa Road may be a more viable option due to the potential for erosion of the creek bank in the area where Narara Creek takes a significant bend (see Section NC7.2). Houses in Rowena Road should be protected by the levee.	Rowena Road Levee + Glennie Street floodway/berm (levee cannot be built without floodway)	2	VP occurred along Rowena Road. No. 25 Rowena Road requested to be added to VP in recent community survey.
NC9	Wyoming and Wingello Creeks flood storage area	The proposed works in this area would include creek realignment and straightening of Wingello and Wyoming Creeks downstream of the Pacific Highway. This would increase the conveyance of the creeks so that water from the Pacific Highway could discharge to Narara Creek more efficiently. The work is shown in Figure NC.5.	Channel works to improve conveyance	6	Yes (along with Brooks Ave Levee)

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
NC10	Brooks Avenue flood storage area	The proposed works in this area would involve closure of the northern railway underpass. Should it be desired that the existing creek between the two railway underpasses and on the eastern side of the railway line, be realigned or that significant filling of the floodplain be undertaken, a more detailed study of this area would be required to precisely quantify local flooding impacts in the area. Any development proposed within the area prior to closure of the underpass should not include filling beyond the building floor plan area. Any proposal requiring filling for any other purpose would require detailed assessment to ensure it has no effects on local flooding.	Block Railway underpass	3	Yes (along with Brooks Ave Levee)
NC11	Showground Road protection and flood proofing area	The proposed works in this area involve the realignment of Narara Creek to improve its flow conveyance, and also to reduce flood levels. Scour protection would be provided in areas where scouring of banks had occurred, and where it was expected to occur in the future. Some houses in this area are flood-affected above the lower ground floor level.	Scour protection and reforming of Narara Creek	3	VP of all houses along Showground Road occurred except No. 162. Channel scour protection not yet done.
NC12	Manns Road - Deane Street floodway area	The proposal for this area includes the acquisition of the one flood affected house at Carrington Street; the other house is already owned by the Council. The proposed works also includes the formalisation of two floodways; one for Narara Creek and one for Niagara Park Branch (Figure NC.6). A minor levee is proposed at Mans Road to direct flows from the Niagara Parch Branch into Narara Creek so that water does not flow on to Narara Valley Nursery. Stream stabilisation works will be undertaken for the area shown on Figure NC.6 with waterway enlargement at Carrington Street.	Construct Levee, Manns Rd and Deane St floodways, channel improvement/stabilisation between Carrington St and Manns Rd, VP 25 Manns Rd	5	No aspects implemented.

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
NC13	Upstream development areas	Conditions imposed upon future development upstream of Deane and Hanlan Streets should restrict any future development on the floodplain and flows in Narara Creek so that existing flooding problems are not exacerbated.			Yes, in part. Redevelopment of Agricultural Research Station assumed to be net neutral change on flooding.

Review of Lower Narara Creek Floodplain Management Study – Final Report (Kinhill 1993)

Table NC.1 Priority of Works (pg. 68)

Priority	Item	Cost (\$1000s)	Benefit/Cost	Notes	Implemented?
1	Acquisition of houses north of and including 140 Showground Road in Showground Road acquisition area		Completed 1992	one house outstanding	Yes
2	Voluntary purchase of houses south of 140 and 9 Showground Road		Completed 1992		Yes
3	Voluntary purchase and demolish 9 houses in Rowena Rad		Completed 1993		Yes
4	Acquisition of land in Glennie Street industrial area		Completed 1992		Yes
5	Voluntary purchase and resell for development 6 houses in Rowena Road	395	0.22		Partial, 25 & 13 Rowena Rd not yet purchased under VP program, go ahead given in 2002 Amendment
6	Floodproof 3 houses in Rowena Road including sewer modification	131	0.38		
7	Floodproofing of 77 Showground Road and 105 Maliwa Road	105	0.27	Council has acquired 77 Showground Road	Yes
8	Improved access to 77 and 79 Showground Road	31.5	n/a		No
9	Undertake rock protection works in Showground Road scour protection area	18.9	n/a		No
10	Undertake channel works for Wingello Creek downstream of the railway line	65	0.32	Benefit/cost ratio averaged over items 10 and 11	No

Priority	Item	Cost (\$1000s)	Benefit/Cost	Notes	Implemented?
11	Undertake channel works for Wingello Creek upstream of the railway line	383	0.3	Benefit/cost ratio averaged over items 10 and 11 Not before priority 10	No
12	Floodway construction, channel enlargement, formalisation of overflow path in Narara Creek in Showground Road	328.6	0.08	Benefit only really noticed when levee constructed Not before priority 5.	No
13	Undertake channel works for Wyoming Creek	172	0.08	Benefit only really noticed when levee constructed Not before priority 12.	No
14	Construct levee adjacent to Brooks Avenue estate and block railway underpass	300	0.08	Benefit only really noticed when levee constructed Not before priority 13.	No
15	Channel works for Bradys Gully Creek, voluntary purchase of 130 Showground Road and selective tree removal around Gavenlock Oval	240	0.21	Not before priority 6.	No
16	Formation of Dwyer Street berm	203	n/a		No
17	Construct Manns Road levee, Manns Road and Deane Street floodways and undertake channel improvement/stabilisation works between Carrington Street and Manns Road. Voluntary purchase of 25 Manns Road	740	0.23	Not before priority 9.	No

Brady Gully Creek FDMP (Kinhill, 1993)

Flood Modification Options

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
BG1	Laycock St lining area - Pacific Hwy to Henry Parry Dr	It is recommended that in order to improve the flow conditions and prevent erosion, to fully line the creek from Henry Parry Drive to the Pacific Highway. Upstream of the access bridge on Lot 33, Laycock Street, a concrete lined channel is proposed which is considered more appropriate in order to reduce the required channel width. Downstream of the access bridge, stacked rock lining may be more acceptable as there is less restriction of available land.		2	1A) No, upstream of access bridge; 1B) Yes, downstream of access bridge.
BG2	Carry St reach - Henry Parry Dr to Cary St	- Line channel from Cary Street to Henry Parry Drive. - Increase culvert size under Henry Parry Drive.		3, 4	No, no lining but channel works now overgrown.
BG3	Catholic School Pipeline - Cary ST to Glennie St	As a result of the works recommended downstream, the water level at Cary Street is lowered, resulting in an increased capacity of the pipelines. Overland flow still occurs, and the recommended works are to make the carpark and fences flood compatible with minimal resistance to flows. In addition, at the inlet to the pipes, a stacked rock transition section should be constructed between the pipe inlets and the existing formalized channel.		5	3A) Yes, culvert upgraded; 3B) Yes, channel works above Catholic School pipeline.

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
BG4	Jarrett St channel - Glennie St to Bradys Gully Road	• Continue and complete channel work up to Bradys Gully Road. • Keep channel clear of undergrowth and silt. • Avoid costly diversions of services during new channel work.		1	Yes, but now overgrown
BG5	Kirkness Ave Creek - Tributary 1	The recommended works are to upgrade the 1,200 mm diameter culvert to three 1,200. mm pipes. These pipes will reduce the frequency of inundation of Kirkness A venue, but as this flooding problem is only localized the works are considered low priority.		6	Yes
BG6	Bradys Gully Creek Floodway	Regular maintenance program			No

Wyoming Creek FDMP (Kinhill, 1993)**Flood Modification Options**

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
WY1	Renwick St and Glencoe Ave floodway and channel improvement area	In order to reduce the flooding problem, it is recommended that the capacity of the Pacific Highway culverts is doubled, and the creek be lined from the Pacific Highway to Chainage 280, just upstream of Glencoe Avenue. Works identified under the Lower Narara Creek Floodplain Management Plan for the downstream creek must be completed prior to the works at the Pacific Highway.		3 (lined channel), 2 (Hwy Culvert)	1A) Yes, culverts upgraded; 1B) Yes, Rivercare works.
WY2	Alan Davidson Park floodway and dissipator area	Wyoming Creek passes through Alan Davidson Park between Day Street and Glencoe Avenue. The park is a large passive and active recreation area with short, well maintained grass cover. The grassed banks form a natural floodplain and therefore no channel formalization is required. However, sections of the creek are eroding on the outside of the bends and bank protection works would be required there. The recommended proposal is to provide gabion or sandstone rock protection works at eroding areas and to construct an energy dissipation structure at the discharge point of the existing concrete channel. This work should be undertaken as erosion becomes severe.		6, 5	Yes, Rivercare works.

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
WY3	Bourbon St and Day St floodway and channel	Upstream of Alan Davidson Park and downstream of Day Street, Wyoming Creek is contained in a concrete channel. Several footbridges and an access bridge span the channel which is sometimes used for skateboarding. • Remove skateboard ramp. • Raise footbridges and access bridges. • No future obstructions such as service crossings are to be allowed in the flow area unless detailed analysis has been done to assess their impact on the flow regime.	Completed 1992		Yes
WY4	Chamberlain Rd floodway and channel improvement area	Upstream of Day Street, Wyoming Creek meanders through a public reserve up to Chainage 1077 before passing through the frontage of some properties on Chamberlain Road. Between Chainage 885 and Chainage 1077 the creek is overgrow and ill defined, and there are some sections where bank erosion is undermining the property boundaries. As no houses are flood liable, only localised bank protection works with an estimated cost of \$59,000 are recommended. These are required just upstream of the Day Street culvert.		4	No, still significantly overgrown

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
WY5	Giselle Ave floodway and channel improvement area	The recommended works for this section of the creek are to improve the inlet conditions of the Chamberlain Road culvert and upgrade the culvert. At the inlet to the culverts, the creek would need to be widened and the obstructing tree removed. In addition, the vehicular guard rail and mesh railing above the culvert should be replaced with railings that offer minimal obstruction to flows. It is also proposed to upgrade the existing pipe culverts under Chamberlain Road to twin cell 3.6 m x 1.5 m box culverts. As a result of these works and the channel works recommended downstream, the house at No. 1 Giselle A venue becomes flood free for the 1 % AEP event.		1	Yes, but there's a wooden fence there above Culvert that probably needs to be removed.

Wingello Creek FDMP (Kinhill, 1993)**Flood Modification Options**

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
WG1	Reptile Park Reach - Pacific Highway to Jarrett Street	The proposed works for this section of the creek are to remove the low level access bridge in the creek and to lower the concrete weir from the present level of RL 3.7 m AHD to RL 2.7 m AHD. The low level access bridge could be replaced by a similar structure that would cause minimal obstruction to flow.	Completed 1992		Yes
WG2	Jarrett Street to Rainforest Reserve lining area - Jarrett St to Roselands Ave	It is recommended that the section of creek between Jarrett Street and Halycon Street be straightened and lined. This channel has been assumed to be concrete lined, but a channel of stacked rock of an equivalent conveyance may be considered more acceptable. At present, several houses in Roselands Avenue have only 50 to 100 mm freeboard above the 1 % AEP flood level. In order to increase this freeboard and reduce the amount of scour and bank erosion, it is also proposed to line the channel from Halycon Street to Roselands Avenue.		1	2A) No, no channel straightening and lining; 2B) No (Wyoming Creek), no channel lining.

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
WG3	Roselands Ave to Warrawilla Rd grassed waterway area	The main problem along this section of the creek is channel erosion. After the completion of the recommended works downstream, the design flood levels will be reduced and thus the free board for the houses along Roselands Avenue will be increased. However, between Chainage 593 and Chainage 835 it is recommended that a low flow channel (3.0 m by 0.6 m deep) be constructed to improve the flow condition and to control erosion. This low flow channel could be either lined with concrete or stacked rock. Upstream of the Roselands Avenue subdivision, it is proposed, that as a long term option, the grassed waterway between Chainage 593 and Chainage 837 be extended up to Warrawilla Road between Chainage 835 and Chainage 1381. A typical cross-section is shown in Figure WG4. As a short term option, additional rock protection should be provided where the tributary joins the main creek flow to reduce the bank erosion.		2, 4	3A) Yes; 3B) Yes
WG4	Existing Pecan Close Detention Basin	The recommended works are to lower a 40 m section of the embankment to RL13.75 and make it into an emergency weir with a spillway and energy dissipation structure. However, a more specific and detailed study should be undertaken prior to the final design.		3	Yes
WG5	Tributary 1 Area - Warrawilla Rd	• Realign and line creek bank upstream of Warrawilla Road. • Rock lining should be placed to prevent further undermining		5	Yes, but now overgrown

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
WG6	Tributary 1 Area - Maidens Brush Rd	• Line northern bank of creek downstream of Maidens Bush Road. • Rock lining should be placed to prevent further undermining	Completed 1992		Yes

Upper Narara Creek FRMS and FRMP (Patterson Britton, 1995)

Flood Modification Options

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
1	Deane Street Bridge lengthening	The proposed crossing upgrade involves lengthening the bridge, to increase the opening from 8.7 m wide to 10 m wide, as shown in Figure UNCL.1.	Medium priority		Yes
2	Narara Valley Drive bridge	The existing four cell culvert is to be replaced with a concrete bridge as shown in Figure UNC2.1. The proposed bridge spans the creek channel and has a deck invert level just above the predicted 1 % AEP flood level of 8.5 m AHO.	High Priority		No
3	Koninderie Parade channel improvement	There is considerable accretion of sediments in the Niagara Park Branch of Narara Creek, in the section of channel running parallel to Koninderie Parade (refer Figure 4). The sediment shoaling reduces the available flow area and has a significant impact on raising flood levels in this vicinity. Clearing and widening of the channel would increase the flow area and significantly reduce the incidence of flooding in the Koninderie Parade area.	High Priority		Yes

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
4	Formalise flood flow across Narara Valley Drive at Yurunga Ave	An overland flow path is to be constructed which includes a swale at existing ground level with impermeable brick walls either side to channel the overflows. The wall is to extend from Yurunga Ave northwards and turn east along the southern boundaries of 17 Koninderie and 83 Narara Valley Drive. The brick wall is to be about 1.2 m high. This option requires the purchase of 17 Koninderie Parade and 83 Narara Valley Drive but would alleviate inundation of the adjacent residences from the overflows. Vehicular access to 2 Yurunga Ave is to be relocated from Narara Valley Drive to Yurunga Ave and the driveway of 85 Narara Valley Drive requires realignment.	High Priority		No
5	Flood free access	• Option SA - One Lane Bridge Over Tributary A at Hanlan Street An alternative access route for residents west of the Deane Street crossing would be via a new road bridge across Tributary A to join south and north Hanlan Street. This could be a one lane timber bridge for use only in emergencies. The estimated cost of this 30 m long • Option SB - Low Key Road Access Between Haggerty Close and Willari Avenue It is preferable that an alternative vehicular access is provided from Willari Avenue, Apra Close and Woorin Close to Narara Valley Drive during severe floods. One option	Low		5A) No; 5B) Yes. VP of houses in vicinity of Apra Close; 5C) Yes

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
		is to provide of a low key vehicle access through the public reserve between Willari Avenue and Haggerty Close which would cater for residents in Willari Avenue and Aparra Close. It would be necessary to bridge or pipe the small channel towards the northern end of the reserve. The estimated cost of the road and drainage works to provide the low key • Option 5D - Minor Levee to Reduce Secondary Flows The construction of a levee at the northern end of the reserve near Haggerty Close would reduce the secondary flows which occur in the reserve when the creek banks are overtopped further upstream. This levee would reduce the flood flows through the reserve but would have to be incorporated with other downstream improvements in the main channel to alleviate any potential adverse effects associated with increased flows.			
6	Raising floor levels	Not considered			N/A

Identifier	Assessed	Short Description	Recommendation	Ranking	Implemented?
7	Bank stabilisation	<u>OPTION 7 BANK STABILISATION</u> Sedimentation within the creek gradually reduces the waterway area available to convey flood flows and can lead to increased flood levels and the need for more maintenance works. A major source of this sediment is from the erosion of the creek channel banks. Two specific areas were identified in which channel bank stabilisation could reduce the supply of sediment to the creek. These were: • Option 7A Between Deane Street bridge and Narara Valley Drive culverts, a creek length of approximately 250 metres, or 500 metres of bank to be stabilised, and • Option 7B Upstream of Koninderie Parade to Niagara Park Primary School, a creek length of approximately 750 metres, or 1500 metres of bank to be stabilised.	Medium priority		7A) Yes; 7B) Yes

Creeks West of Hanlan Street - FPMS and FPMP (Kinhill 1997)

Flood Modification Options

	Option	Details	Comments	Costs (\$1000's)	Flood mitigation impact	Recommendations	Priority Raking	Implemented
NA1	Hanlan Street Culvert	Raise road to RL 5.0m AHD. Upgrade existing culvert to 3 No. 1.8 x 2.7 rcbc's. Channel clearance upstream and downstream	Designed for approx. 6-9 month flow-minor channel widening for transitions	274	Minimal as levels dictated by Lower Narara levels. Reduction in period of flooding, and hazards for minor events.	Long-term recommendation	2	Yes
NA2	Fountain Road upgrade	Raise road or build embankment to a +6.0 mAHD; embankment could tie in with existing house @ junction	Designed for 1% AEP flows, embankment the cheaper alternative	181	Prevents Fountains Road overtopping and flood extent for Fountain Creek. Raises flood levels by approximately 0.78m.	Not recommended		No
NA3	Hanlan Street Wet Basin (1)			552	Minimal as small storage.	Long-term recommendation	9	No
NA4	Hanlan Street to Deane Street floodway	Formalise and straighten channel between cross-section 20 and 22. Floodway bed width 25-35m	Need embankment along norther side to prevent flooding of low lying land		Negligible flood mitigation impact, destructive to natural creek therefore not justified.	Not recommended		No
NA5	Nursery Street flood proofing	Raise road adjacent to house to 9.50 mAHD so flood free access.	Road would need raising 1.2m in sections and would create impedance		Raises flood levels	Not recommended		No

	Option	Details	Comments	Costs (\$1000's)	Flood mitigation impact	Recommendations	Priority Raking	Implemented
			to flow unless culverts put in.					
NA5	Nursery Street flood proofing	Straighten channel and channel clearance upstream of house, possible bank protection and levee on northern side	Would prevent flow breakout upstream of house and localised flow path between house and stables	363	Would prevent local drainage path around house.	Long-term recommendation	5	No
NA6	Narara Agricultural Research Station	Create detention basin upstream of cross-section 25. Embankment to +12.0 m AHD.	4.0m high embankment required with only nominal storage unless a lot of additional excavation.		Minimal, insufficient storage available to cause significant detention,	Not recommended		No
NA6	Narara Agricultural Research Station	Construct sediment trap upstream of cross-section 23. Embankment to +10.0 m AHD with 2.1 m pipe for low flows	Low flow sand will pass through. High flow will settle out upstream of embankment and could be mined.	53	Minimal	Long-term recommendation	7	No
NA7	Property Acquisition	Lot B DP 393508 to be acquired	House is flood prone for the 1% AEP event.	150	Would prevent flooding of this property.	Immediate implementation recommended	1	No
FR1	East Hanlan Street channels	Form grassed floodways 20m bed width for Fountain Cr, 5m bed width for Reeves CR. Combine channels before	Continuation of channel work in Lower Narara FPMS.	216	No impact on flood level. No reduction in flood extent if no fill as all land low lying.	Long-term recommendation	8	No

	Option	Details	Comments	Costs (\$1000's)	Flood mitigation impact	Recommendations	Priority Raking	Implemented
		discharging into Narara Cr.						
FR2	Hanlan Street Wet Basin (2)	At confluence of Fountain Creek and Reeves Creek		1030	Minimal as small storage.	Long-term recommendation	10	No
FR3	Carrington Street Floodway	Form grassed channel parallel to road or along old alignment 15, bed width. Upgrade culvert under Pandala Rd to 5. No. 0.9 x 2.7 rcbc's	Channel adjacent to road will require access to lots. Channel along old alignment will maximise lots but longer flow path. Culvert under Pandala Road will only take 3 year ARI flows. No good without FR4 due to backwater		Minimal	Not recommended		Yes, as part of Rivercare works.
FR4	Carrington Street Bridges	Upgrade 2 bridge crossings to accommodate a 20% AEP event. 3 No. 2.1 x 2.7 and 5 No. 1.2 x 2.7 rcbc's required respectively.	Culvert will only take 20% AEP flows; marginal justification to renew			Not recommended		Yes, 2 x 3 m x 1.2 m high RCBCs.
FR4	Carrington Street Bridges	Replace bridge u/s by 5 No. 1.2 x 2.7 rcbc's.	Culvert will only take 20% AEP flows			Not recommended		Yes, 2 x 3 m x 1.2 m high RCBCs
FR5	Carrington Street culvert	Remove pipe culvert at cross-section 6	Old accessway; no longer used and possible privately owned	1.4		Recommended to be done immediately as funds permit	6	Yes

	Option	Details	Comments	Costs (\$1000's)	Flood mitigation impact	Recommendations	Priority Raking	Implemented
FR6	Fountain Creek tributaries	New 3 No. 0.9 x 3.3m RCBC on alignment of Carrington Street.	Will be required for future expansion. Only designed for 20% AEP flow. Dependent on final road levels.	94	Minimal	No further consideration. Not identified in DCP works	3	No
FR6	Fountain Creek tributaries	New 3 No. 1.2 x 2.0, RCBC on alignment of Cross Street	Will be required for future expansion. Designed for 5% AEP flows. Well defined channel, so bridge may be more acceptable.	88	Minimal	No further consideration. Not identified in DCP works	3	No
FR7	Reeves Street Causeway	Replace existing pipe culverts by elevated causeway or bridge	Road top level will be above 1% AEP level.	2,595	Minimal	Long-term recommendation	4	No, but might be worth considering. Extensively requested during Community Survey.
FR8	Reeves Street Detention Basin	Raise road level along Reeves St +13.00 mAHD with 1 No. 2.4 ϕ pipe. Clear away all area below +13.0 contour-use natural basin	No houses affected by very dense bush to be cleared- also 6 ha flooded for 1% AEP event.		Minimal	Not recommended		No
FR9	Reeves Street Culvert	Replace existing pipe culvert by 3 No. 1.2 ϕ RCP	Culverts will make Reeves Street flood-free for 2% AEP events.	35	Minimal	Completed 1994.	N/A	N/A

NARARA CREEK MANNS ROAD TO DEANE STREET RIVERCARE MANAGEMENT STUDY (2003)

6.10 SUMMARY OF PREFERRED WORKS (pg. 57)

Type	Works	Estimated Cost (\$)	Priority	Implemented?
Bed Control Structures	Niagara Park Branch Small Control Structures at Chainages:	20,000	H	No
	148 m			No
	214 m			No
	284 m			No
	614 m			No
	Hanlan Street Reach	10,000	H	No
	63m			No
	646 m (Narara Creek)			No
	Side Drain (18 Narara Valley Drive)	5,000	H	No
	High bed control structure at chainage 560 m with localised lowering of bed in Old Narara Creek	35,000	H	No
				No
Bank Stabilisation	<i>Niagara Park Branch</i>			No
	mechanical reform + revegetate (ch 0 to 300 m)	80,000	H	No
	<i>Niagara Park Branch - chainage 500 m to confluence</i>			No
	natural slumping/replanting at top of stable slope	15,000	M	No
	<i>Niagara Creek - chainage 830 m to Carrington Street</i>			No
	natural slumping/replanting at top of stable slope	15,000	M	No

Type	Works	Estimated Cost (\$)	Priority	Implemented?
	<i>Old Narara Creek - between Areas 1 and 3</i>			No
	natural slumping/replanting at top of stable slope	5,000	L	No
	<i>Carrington Street to Manns Road</i>			No
	regularly remove sand from point bars	10,000/yr	H	No
	natural slumping/replanting at top of stable slope	20,000	M	No
	<i>Agriculture Research Station</i>			No
	bed control structure	5,000	H	No
	regularly remove sand	1,000/yr		No
Protection of House (16 Narara Valley Drive)	major channel realignment and bed control structure at chainage 312 m	90,000	H	No

APPENDIX F

Pacific Highway Upgrade Details



Pacific Highway and Manns Road upgrade between Narara and Lisarow

September 2016

The NSW Government is providing \$2 million in 2016/17 to plan for a future staged upgrade of the Pacific Highway and Manns Road between Narara Creek Road, Narara and Parsons Road, Lisarow. The proposed staged upgrade would improve road user safety, travel times and reduce congestion. This project update provides information on the updated proposed design for this section of road.

Comments on the proposed design are invited by **28 October 2016** and will be considered in developing and finalising the design.

Background

Roads and Maritime Services is planning for the future upgrade of a 4.7 kilometre section of road along the Pacific Highway and Manns Road, which will be delivered in stages.

Roads and Maritime displayed the strategic design for the section of road between Narara Creek Road, Narara and Parsons Road, Lisarow in March 2012. The preferred option was developed further and this section of road was displayed for community comment in May 2014.

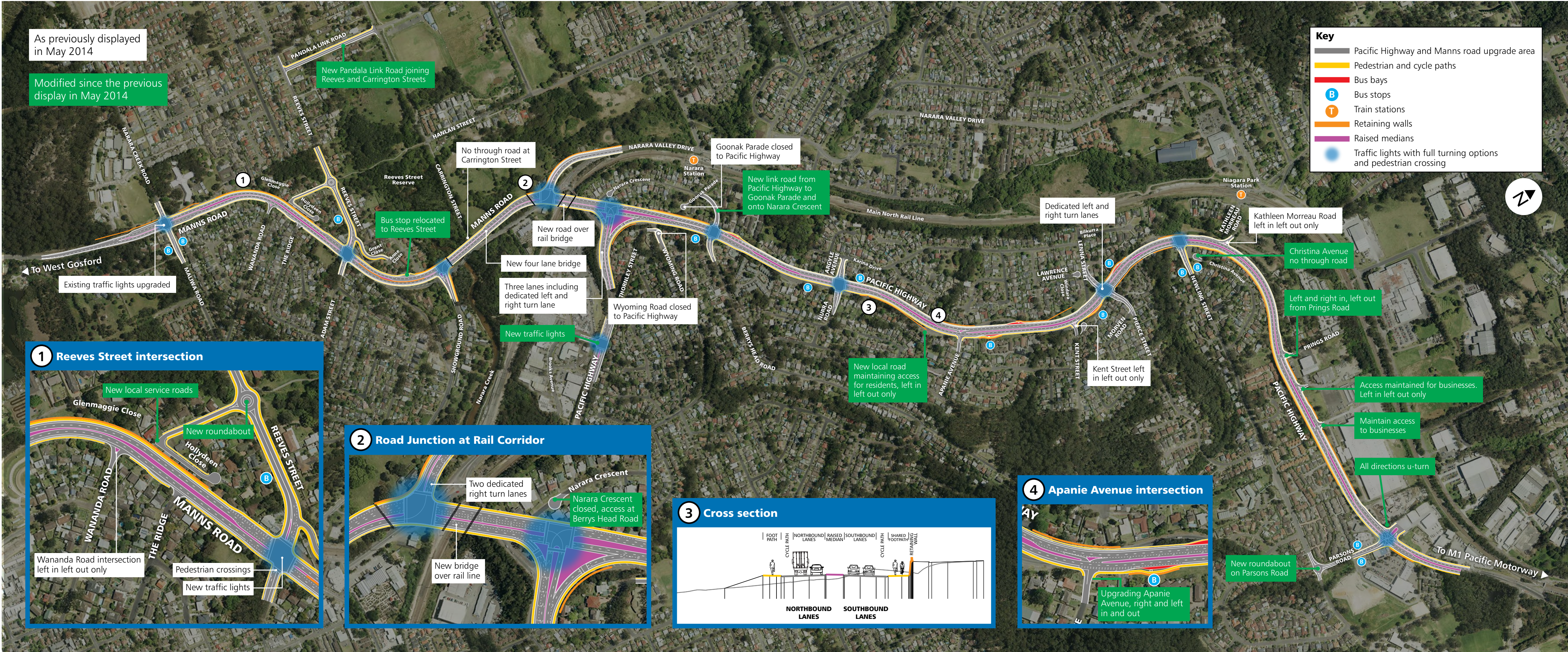
Following this consultation we have carried out extensive investigations to develop a concept design for the proposed upgrade of the Pacific Highway and Manns Road between Narara and Lisarow.

This community update provides information on the concept design, including changes to the design since the last public display in 2014.

Roads and Maritime is seeking community feedback to help finalise the design and provide input into the environmental assessment.

More information is available at
rms.nsw.gov.au/nararatolisarow

Proposed Pacific Highway and Manns Road upgrade



Features

- Two lanes in each direction on the Pacific Highway and Manns Road
- New bridges along Manns Road over Narara Creek and the railway line
- Traffic lights to replace the roundabouts at:
 - Manns Road and Pacific Highway intersection
 - Manns Road and Narara Valley Drive intersection
- New traffic lights on the Pacific Highway at:
 - Berrys Head Road
 - Parsons Road
 - Newling Street
 - Lenna Street and Pierce Street
 - Nurra Road and Argyle Avenue
 - Brooks Avenue
- New traffic lights on Manns Road at:
 - Adam Street and Reeves Street
 - Showground Road
- Upgrading existing traffic lights at Manns Road, Narara Creek Road and Maliwa Road
- Provision of pedestrian and cycle paths along and across the Pacific Highway and Manns Road
- Providing new pedestrian and cycle paths and crossings at traffic lights along both sides of the Pacific Highway and Manns Road.

These features are largely unchanged from the 2014 public display.

What has changed since the 2014 public display?

There have been several changes made to the design since the 2014 public display. These changes improve access for local roads, maximise traffic flow and improve safety along the Pacific Highway and Manns Road.

The changes consider community feedback and further investigation, including:

- New roundabout in Reeves Street at the new Glenmaggie Close intersection
- Removing the originally proposed local road connecting Carrington and Reeves Streets
- New local street from Reeves Street to connect to Pandala Road
- New intersection at Apanie Avenue to provide left and right turns in and out
- New bridge south of Newling Street
- Revised intersection at Prings Road to provide left turns in and out, and a right turn in

- Removing the originally proposed roundabout outside the Lisarow Heights Business Park to access Prings Road
- New northbound and southbound u-turn intersection at Pacific Highway and Parsons Road
- New roundabout at Parsons Road and Newling Street
- Rural Fire Station in Manns Road to be relocated
- Carrington Street to be closed and become a no through road
- Bus stops and indented bus bays provided along the length of the proposed upgrade to help the flow of traffic and improve safety
- Improving drainage along the Pacific Highway and Manns Road.

Local properties

Some properties along the Pacific Highway will be affected by the upgrade. We will be in contact with these property owners during the community consultation process.

If you have any concerns about your property please contact us. Potentially affected property owners will be invited to make an appointment for a property information meeting.

Please see the back page for contact details or to provide your feedback.

You can also visit rms.nsw.gov.au/acquisition



New pathways
for active transport



Better and more
reliable trips
for people, business
and freight



11 intersection
improvements

Next steps

The community are invited to comment on the design by **28 October 2016**.

Feedback received will be considered when finalising the design. This upgrade is part of the NSW Government's commitment to planning for important road infrastructure on the Central Coast.

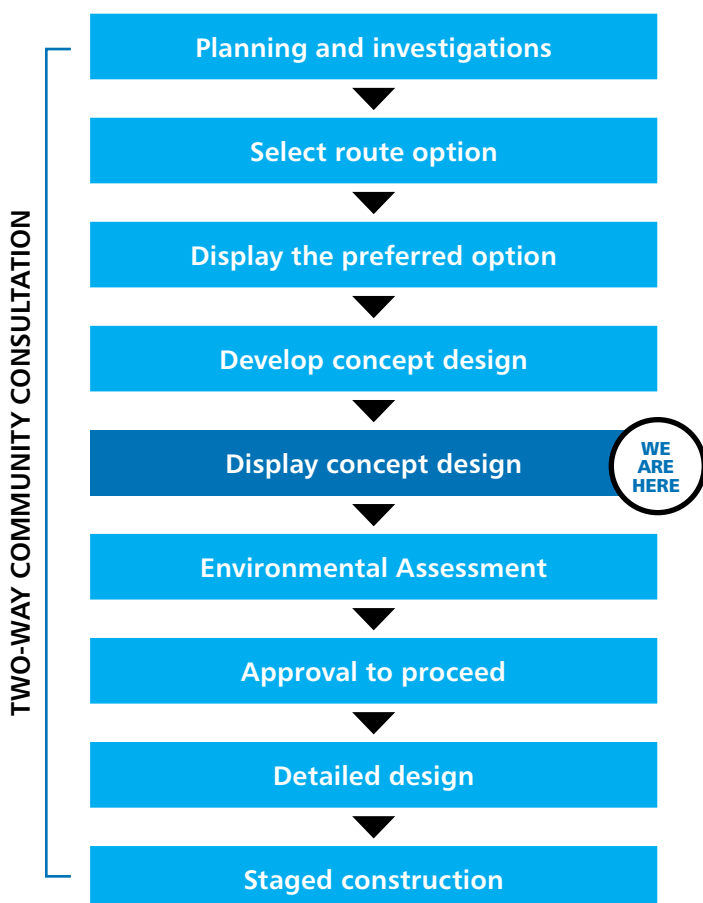
Community information sessions

Roads and Maritime is committed to working with the community and stakeholders during the planning process to understand issues and minimise potential impacts.

The community is invited to view the plans and find out more at a drop in staffed display at

Niagara Park Stadium, 16 Washington Avenue, Niagara Park NSW 2250, on:

- Thursday 13 October: 4pm to 7pm
- Tuesday 18 October: 4pm to 7pm
- Thursday 20 October: 4pm to 7pm



Your feedback and more information

Phone: 1800 814 968 during business hours

Email: central.coast.office@rms.nsw.gov.au

Mail: Pacific Highway and Manns Road Upgrade
Roads and Maritime Central Coast Office
Locked Bag 2030
Newcastle NSW 2300

Website: rms.nsw.gov.au/nararatolisarow



This document contains important information about road projects in your area. If you require the services of an interpreter, please contact the Translating and Interpreting Service on **131 450** and ask them to call the project team on **1800 814 968**. The interpreter will then assist you with translation.

Please send us your comments by 28 October 2016.

Visit rms.nsw.gov.au/nararatolisarow for more information and to provide your comments on the proposed future upgrade.



September 2016
RMS 16.399



Privacy Roads and Maritime Services ("RMS") is subject to the Privacy and Personal Information Protection Act 1998 ("PPIP Act") which requires that we comply with the Information Privacy Principles set out in the PPIP Act. All information in correspondence is collected for the sole purpose of delivering this project. The information received, including names and addresses of respondents, may be published in subsequent documents unless a clear indication is given in the correspondence that all or part of that information is not to be published. Otherwise RMS will only disclose your personal information, without your consent, if authorised by the law. Your personal information will be held by RMS at Level 1, 29–37 George Street, Woy Woy NSW 2256. You have the right to access and correct the information if you believe that it is incorrect.

APPENDIX G

Proposed Planning Matrix

	FPCC 4 – Development outside the Flood Planning Area to the PMF extent							Development within the Flood Planning Area																						
								FPCC3							FPCC2							FPCC1								
								H1	Including Hazards Categories H2-H4 within Defined Flood Event (1% AEP)						H5 Hazard Category							H6 Hazard Category								
Land use Categories	Sensitive uses / Tourist/ Critical Infrastructure Accommodation (LEP cl. 7.3)	Subdivision	Residential (Single Dwellings)	Commercial & Industrial	Med – High Density Residential	Recreational & Non-Urban/Ancillary	Concessional Development	Residential (Single Dwellings)	Sensitive uses / Tourist/ Critical Infrastructure Accommodation (LEP cl. 7.3)	Subdivision	Residential (Single Dwellings)	Commercial & Industrial	Med – High Density Residential	Recreation & Non-urban/Ancillary	Concessional Development	Sensitive uses / Tourist/ Critical Infrastructure Accommodation (LEP cl. 7.3)	Subdivision	Residential (Single Dwellings)	Commercial & Industrial	Med – High Density Residential	Recreation & Non-urban/Ancillary	Concessional Development	ALL Land Use Categories							
New development/ Re development	4	4						2	4	4	2	2	2	2	5			4	4		2	4	4							
Floor Level	2	NA						1		1	1	1	5															5,6		
Building Components	2	NA						1		1	1	1																1		
Structural Soundness	2	NA						1,3		1,3	1,3	1,3	1															4		
Flood Affection	4,5	4,5						2,5		2,5	2,5	2,5	2															1		
Emergency Management/Evacuation	1,2, 3	2,7						6		6	6	3,6	2															3		
Car Parking	4	NA						1,3		1,3	3	1,2,3																4		
Management & Design	5,6,8	1,2a						6		6	3,6,10	7,8																5,6		
Wave Impacts	1,2	NA																										1,2		
Fencing	1	1						1		1	1	1	1	1														1		
	Suitable Land Use with controls			Unsuitable Land Use								Suitable Land Use No Restriction																		

New Development/Redevelopment	
1	New developments not suitable.
2	New developments may be suitable provided it is <u>not in a floodway or flood storage</u> hydraulic category as defined in a flood study in accordance with the Floodplain Development Manual (2005) or consistent with an adopted Floodplain Risk Management Study or Plan.
3	Where redevelopment may extend the design life of the structure / facility, development may be considered on a merits-based approach. However, relocation to an area outside of the floodplain should be considered as a priority.
4	New developments may be approved by Council on merits based approach, provided any proposed mitigation measures are identified in a floodplain risk management plan and evacuation and “shelter in place” can be achieved <u>without traversing through flood waters</u> with a hazard category of greater than H1 as defined in Australian Rainfall & Runoff Chapter Book 6 Flood Hydraulics Chapter 7 Safety Design Criteria. Development would need to address the objectives of the Council DCP and meet the performance criteria as specified in the DCP Any proposed mitigation measures would need to be supported by a hydraulic engineers report or support by Council.
5	New developments may be suitable provided it is <u>not in a floodway or flood storage</u> hydraulic category as defined in a flood study in accordance with the Floodplain Development Manual (2005) or consistent with an adopted Floodplain Risk Management Study or Plan.
Floor Level	
1	Habitable floor levels to be equal to or greater than the FPL or 300mm <u>whichever is greater</u> above the finished ground level at the upstream side of the development.
2	Habitable floor levels to be equal to or greater than the PMF or FPL (whichever is higher).
3	Habitable floor levels to be as close to FPL as practical & no lower than existing floor level.
4	All habitable floor levels (proposed and existing) to be raised above the FPL.
5	Floor levels to be 300mm above the finished ground level or equal to or greater than the 20 Year ARI flood level (whichever is higher)
6	Floor levels of boatsheds are recommended to be equal to or greater than the FPL. Unless it can be demonstrated through a Flood Management Report that the boat shed is structurally designed to withstand inundation up to the FPL and wave impacts.
7	No planning levels apply to jetties, bridging ramps or pontoons located on the seaward side of the foreshore edge. Development should comply with AS4997-2005 Guidelines for the Design of Maritime Structures and be compatible with foreshore edge treatment.

8	(i) 40m² if the existing residential floor is at or above the FPL less the applicable freeboard; (ii) 20m² if the existing residential floor below the FPL less the applicable freeboard; 10% increase in floor area for commercial or industrial additions
Building Components & Method	
1	All structures to have flood compatible building components below or at the FPL.
2	All structures to have flood compatible building components below or at the PMF or FPL (whichever is higher).
3	Where possible, flood compatible building components are to be incorporated into the existing structure below or at the FPL.
4	Where possible, flood compatible building components are to be incorporated into the existing structure below or at the PMF or FPL (whichever is higher).
Structural Soundness	
1	All structures must be designed and constructed to ensure structural integrity for immersion and impact of velocity and debris up to the FPL (including wave run up and over topping where appropriate i.e. Brisbane Water Estuary).
2	All structures must be designed and constructed to ensure structural integrity for immersion and impact of velocity and debris up to the level of the PMF (including wave run up and over topping).
3	If the structure is to be relied upon for 'shelter-in-place' evacuation then structural integrity must be ensured up to the level of the Probable Maximum Flood (including wave run up and overtopping) or the FPL (whichever is higher).
Flood Affection	
1	
2	The impact of the development on flooding elsewhere to be considered. In particular secondary flow paths need careful consideration up to and including the PMF.
3	Filling that impact on active flow areas in the stream networks feeding Brisbane Water is not permitted. Filling operations must include adequate provision for drainage of surface water erosion and siltation control and be so placed and graded as to prevent the shedding of surface water direct to adjoining properties.
4	For Minor Development a Hydraulic Engineers report required to certify that the development will not increase flood affection elsewhere. For Major Development a report (prepared in accordance with the NSW Floodplain Development Manual) certified by a suitably qualified practicing civil engineer who is eligible for Membership to the Institution of Engineers Australia and which is acceptable to Council has determined that the cumulative effect of the development will not increase flood affection in a 1% AEP event by more than 10mm.
5	Where a development is proposed within the area of an existing Floodplain Risk Management Plan as adopted by the Council, then the development must comply with specific conditions of the plan.
Emergency Management - Evacuation	

1	Pedestrian access is required at or above the PMF or FPL (whichever is higher) from habitable floors to a suitable area of refuge above the PMF level or FPL (whichever is higher), either on site (e.g. second storey) or off site. On-site refuges are designed to cater for the number of people reasonably expected on the development site and are provided with emergency lighting. On-site refuges are of a construction type able to withstand the effects of flooding. Design certification by a practicing structural engineer that the building is able to withstand the hydraulic loading due to flooding (at the PMF). Councils and SES must consider <i>“the time available to complete evacuation before inundation occurs or evacuation routes are lost”</i>.
2	All access roads and driveways, and external parking areas to be above the PMF to provide the ability to safely receive and evacuate occupants or contents without having to cross floodwaters with a Safety Design Criteria Flood Hazard Threshold greater than H1, assuming 50% blockage of any pipes, culverts or bridges of any size.
3	A site emergency response plan (approved by Council) is required for multi-unit residential or commercial development. An evacuation response plan does not negate compliance with all planning and building regulations.
4	In order to provide safe and reliable access, all roads and driveways, and external parking areas to be at or above the 1 % AEP Flood Event (assuming 50% blockage of any pipes, culverts or bridges), continually rising to flood free land above the PMF.
5	Reliable safe access for pedestrians and vehicles from the development, at a minimum level equal to the lowest habitable floor level of the development, continually rising to flood free land above the PMF. Meets the Safety Design Criteria Flood Hazard Threshold H1 and an
Car Parking	
1	Enclosed garage and enclosed car park: floor levels are recommended to be at or above 'FPL (i.e. Min Habitable Floor Level) minus 150mm'. Where this is not feasible, floor levels will be considered at or above the 100 Year ARI level or 300mm above the ground level, whichever is higher.
2	Covered basement car parking: all possible water entry points (e.g. access and ventilation) shall be above the FPL or PMF (whichever is higher). Pedestrian access (separate to vehicle access) shall be provided via a low flood hazard area to a 'safe haven' above the FPL.
3	Open car park areas (including covered car park areas) and carports: floor levels to be at the 20 Year ARI level or 300mm above the ground level, whichever is higher.
Management and Design	
1	Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with DCP.
2	The subdivision of land requires the building platforms for each additional allotment created to be at or above the: a) DFE (Defined Flood Event) b) FPL or PMF (whichever is higher).
3	Applicant to demonstrate that area is available to store goods above the FPL.
4	Applicant to demonstrate that area is available to store goods above the FPL or PMF level (whichever is higher).
5	No external storage of materials below the design floor level which may cause pollution or be hazardous during any flood.

6	All electrical equipment, wiring, fuel lines or any other service pipes and connections must be waterproofed to the FPL
7	All electrical equipment, wiring, fuel lines or any other service pipes and connections must be waterproofed to the FPL or PMF (whichever is higher)
8	Sewer and water services within the site should be designed to have continued function up to the FPL. If the development is being used as flood refuge, design should function up to the FPL or PMF (whichever is higher).
9	Sewer and water services within the site should be designed to have continued function up to the FPL or PMF (whichever is higher).
10	Internal storage of materials that may cause pollution or be hazardous during any flood to be waterproofed to the FPL or PMF or located above the FPL or PMF (whichever is the higher).
11	Sea walls adjacent to the Brisbane Water Estuary are to be designed and built with consideration wave run impacts discussed in Brisbane Water Floodplain Risk Management Study & Plan (2015) and the Brisbane Water Estuary Management Plan.
Wave Impacts	
1	Wave run-up (as calculated in the Flood Study, Cardno 2013) should be managed in development is within 20m of the foreshore for most locations and within 40m of the foreshore for some locations near the entrance to Brisbane Water. This may be done through foreshore management (i.e. wave dissipation devices) or construction management (i.e. floor levels, structural soundness). All designs should be prepared in accordance with Council's relevant guidelines.
2	Applicable only to areas subject to Coastal Inundation as a result of elevated sea levels, refer individual specific flood control matrix.
Fences	
1	Fencing within a floodway will not be permissible except for security/ permeable/ open type/ safety fences of a type approved by Council. Fencing in certain areas may also be restricted by current Floodplain Risk Management Plans. Council will require a Development Application for all new solid (nonporous) and continuous fences above 0.6m high, within the 100 year ARI storm event extents unless otherwise stated by exempt and complying development provisions which may be incorporated in State Environmental Planning Policies or Councils Environmental Planning Instruments from time to time. An applicant will need to demonstrate that the fence would create no significant impediment to the flow of floodwaters. Appropriate fences must satisfy the following:- An open collapsible hinged fence structure, or flow through fencing (pool type fencing) is to be provided in the bottom part of the fencing to a height required to pass the flow. The width and height of flow-through fencing shall make allowance for 50% blockage.

APPENDIX H

**List of Vulnerable Facilities and
Infrastructure**

Vulnerable Developments/Facilities in the Study Area		
#	Type	Name
1	Shopping Centre	West Gosford Shopping Centre
2	Aged Care	Leisure Living Retirement Village
3	School	Gosford Primary School
4	School	Henry Kendall High School
5	Hospital	Gosford Public
6	School	Gosford High School
7	School	Our Lady of the Rosary Primary School
8	School	Wyoming Primary School
9	Caravan Park	Wyoming Caravan Park
10	Shopping Centre	Wyoming Shopping Centre
11	Hospital	North Gosford Private Hospital
12	Aged Care	Adelene Retirement Village
13	Aged Care	Henry Kendall Retirement Village
14	School	Valley View Primary School
15	Nursing Home	Brisbane Water Legacy Nursing Home
16	School	Narara Primary School
17	Shopping Centre	Lisarow Plaza
18	School	Lisarow High School
19	School	Niagara Park Primary School
20	Shopping Centre	Niagara Park Shopping Centre
21	School	Narara Valley High School
22	School	Glenvale School
23	School	St Philips Christian School
24	Substation	Substation
25	Substation	Substation

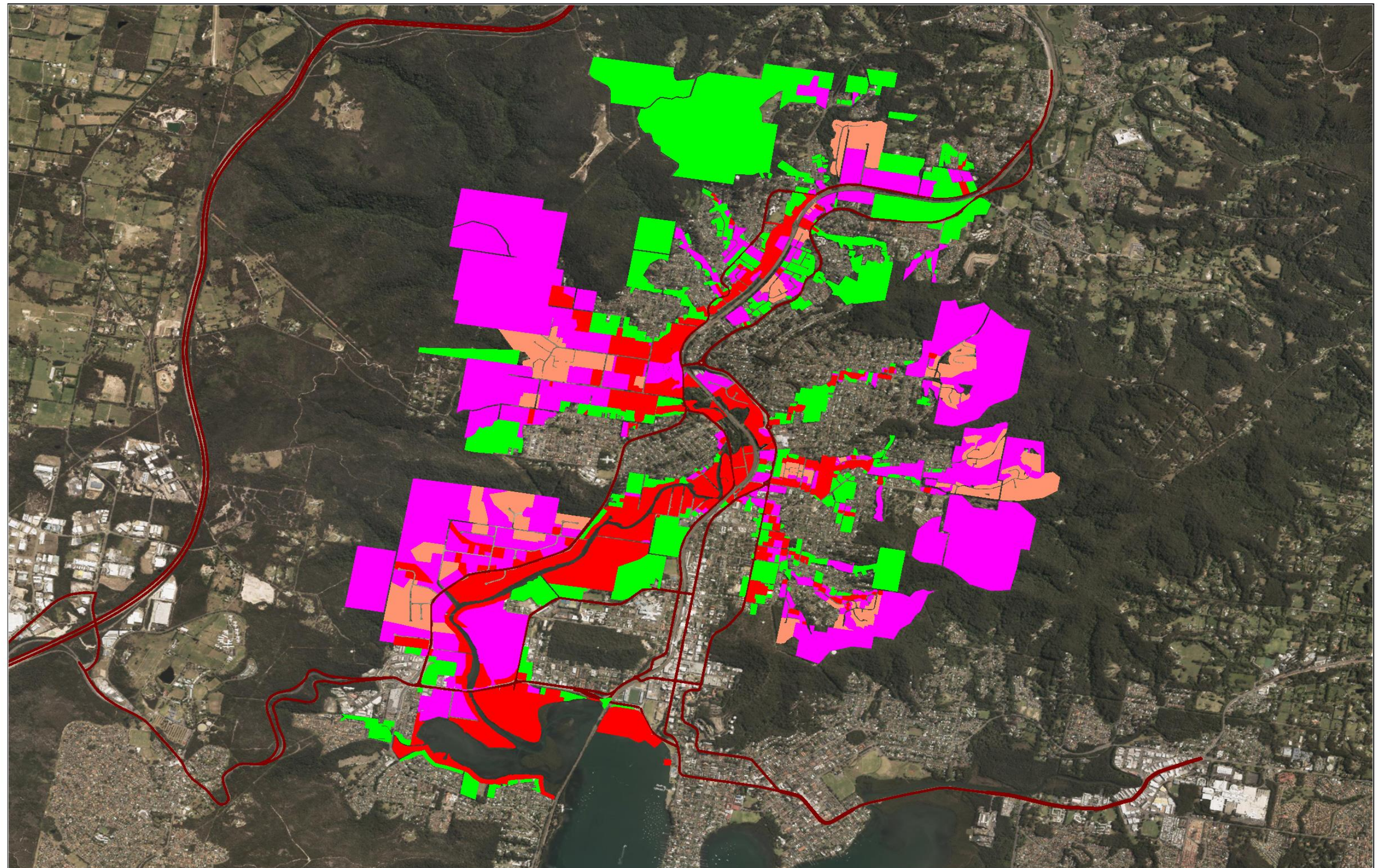
Vulnerable Developments/Facilities in the Study Area		
#	Type	Name
28	Club	Gosford RSL Club
29	Aged Care	Chamberlain Gardens Aged Care
30	Club	Central Coast Leagues Club
31	Aged Care	Legacy Brisbane Water Retirement Village
32	Aged Care	Matuta Lodge Hostel
33	Aged Care	The Orchards Retirement Village
34	Club	Gosford City Bowling Club
35	Cemetery	Lisarow Cemetery
36	Cemetery	Bradys Gully Cemetery
37	Cemetery	Point Clare Cemetery
38	Aged Care	Orana Nursing Home & Village
39	Disability Services	Fairhaven Services
40	Ambulance Station	Point Clare Ambulance Station
42	Place of Worship	Gosford Christian Centre
43	Place of Worship	Central Coast Community of Christ
44	Place of Worship	Narara Wyoming Uniting
45	Place of Worship	Gosford Christ Church
46	Place of Worship	Wyoming Holy Family
47	Place of Worship	Narara Valley Baptist
48	Place of Worship	Our Lady of the Rosary
49	Place of Worship	Narara Gospel Chapel
50	Place of Worship	Gosford Church of Christ
51	Place of Worship	Lisarow Church of Christ
52	Place of Worship	Church of Jesus Christ of Latter Day Saints
53	Place of Worship	Narara Jehovahs Witnesses

Vulnerable Developments/Facilities in the Study Area

#	Type	Name
54	Place of Worship	St Matthews Lutheran
55	Place of Worship	West Gosford Presbyterian
56	Place of Worship	Ourimbah Lisarow Seventh-Day Adventist
57	Fire Station	Wyoming Fire Station
58	Fire Station	Narara Rural Fire Service
59	Accommodation	Bermuda Motor Inn
60	Accommodation	The Ashwood Motor Inn
61	Accommodation	Gosford Motor Inn
62	Accommodation	Gosford Palms Motor Inn
63	Accommodation	Hotel Formule 1
64	Accommodation	Quality Inn The Willows
65	Accommodation	Terranova Park Motel
66	Accommodation	Grange Hotel/Motel
67	Accommodation	Galaxy Motel
68	Library	Niagara Park Library
69	Library	Wyoming Library
70	Stadium	Bluetongue Stadium
71	Racecourse	Gosford Racecourse
72	Showground	Gosford Showground

APPENDIX I

Flood Emergency Response Classification of Communities



Legend FIS (Flooded, Isolated, Submerged) FIE (Flooded, Isolated, Elevated) FER (Flooded, Exit Route, Rising Road) NIC-Evacuation (Not flooded, Indirect Consequences)	Central Coast Council HydroStorm Consulting	0 1,000 metres N	Flood Emergency Response Classification of Communities (1% AEP Event)	
		Narara Creek Floodplain Risk Management Study and Plan		
		31/08/2023	J1004	

